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Sadlerstone Technical Bulletins & Trouble Shooting Guide

The technical bulletins contained within this document are to be used as a guide to the installation and care of Sadlerstone under normal conditions. Always consult with your local Sadlerstone agent or project engineer to confirm the information container within is suitable to your projects needs.

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Technical Bulletin – Cladding

- Sadlerstone smooth and textured tiles have been used in a variety of cladding applications, both internal and external. They provide a beautiful, durable, natural looking surface suitable for cladding architectural features or for whole buildings. The large range of colours and sizes can complement various aesthetic and structural requirements. When properly sealed Sadlerstone tiles have excellent freeze/thaw characteristics.

- As each cladding job has its own special considerations for wind loading, type and bonding strength of the substrate, movement and settling etc, Sadlerstone do not retain any drawings detailing fixing methods for cladding tiles. There are numerous proprietary-fixing systems that could be suitable and fixing system manufacturers could assist project architects and engineers to develop a system for each application. Installation fixing systems and methods will need to meet appropriate local standards and regulations. If the wall height is under the locally recognised height where mechanical fixing is required and/or the tile is under a certain weight, an adhesive fix is often suitable.

- Subject to the engineer's requirements, Sadlerstone can supply material 3/8” (10mm), 5/8" (15mm), 3/4" (20mm) or 1" (25mm) thick cut from full size slabs 8’ x 4’ (2460 x 1240mm) intended for cutting into standard tile sizes. Very large pieces cut from these slabs may be too thin for mechanical fixing. Material thicker than 1” (25mm) can be produced in special moulds at significantly higher cost. Many mechanical fixing systems require stone material to be a minimum of 1 1/4" to 1 1/2" (30 to 40mm) thick, however it may be possible to use simple brackets with 1/10” (3mm) diameter pins or channels in the edges of 3/4” (20mm) and 1” (25mm) thick tiles. The drilling of holes or cutting of slots in the edge of the tiles will need to be done on the construction site (or by third parties), as Sadlerstone are not able to do these in the factory.

- In addition to standard size tiles, special sizes such as 48” x 32” (1220 x 811mm), 48” x 24” (1220 x 608mm), 32” x 24” (811 x 608mm), 16” x 12” (405 x 303mm) etc can be cut from full size panels 8’ x 4’ (2460 x 1240mm), without wastage. Note that material up to 405mm should be a minimum of 3/8” (10mm) thick, up to 608mm a minimum of 5/8” (15mm) thick and over 608mm should be 3/4” (20mm) or 1” (25mm) thick.

- The project’s structural engineer could be informed that 3/4” (20mm) thick material weighs 10.2 lb/ft2 (50 kg/m2) and 1½” (40mm) thick material weighs 20 lb/ft2 (100 kg/m2), has a compressive strength of 8,702 psi (about 60mpa) and a flexural strength of 1,401 psi (about 9mpa). Refer your engineer to the Tile Testing pages in our Product Information guide for information on strength, weight etc.

- In many cases, standard size tiles up to 1” (25mm) thick could be suitable for adhesive fixing. Consult the manufacturer of the substrate for suitable systems. (For example, for heavy tiles, one manufacturer of compressed fibre cement sheets recommends a system incorporating a continuous aluminium bracket supporting every second row of tiles, in conjunction with adhesive.)

    - External cladding with smooth tiles: Over time the weather can tend to dull the surface of most polished natural stones used externally. Surface blooming (micro-efflorescence), water spotting and streaking may also occur. While not very noticeable on light coloured surfaces, darker coloured Sadlerstone tiles may show some of these characteristics. Sadlerstone material will age attractively (not unlike natural copper or zinc cladding as it ages) and weathering early in its life should be regarded as an attractive characteristic. A quality penetrating sealer (such as Dry-Treat Stain-Proof) can minimise weathering and icing. A surface sealer can prevent dulling and surface bloom. The material is suited to anti-graffiti sealers.

Technical Bulletin – Hot Weather Installations

- Provide your specifier with details of the technical characteristics of Sadlerstone tiles and tile dimensions. It is the specifiers' responsibility to determine the suitability of Sadlerstone for your particular installation and draw up a specification.

During hot weather, the following recommendations apply:

- Do not allow pallets or crates of tiles to sit in hot sun. Tiles should be carefully stacked on their bottom edges and (subject to advice on specific local conditions) allowed to acclimatise to the hotter conditions prior to installation. Do not stack pallets on top of each other. Fully enclosed crates can be stacked two high. Protect from rain. Follow the general storage recommendations in "Recommendations for the Installation, Finishing and Care of Sadlerstone Tiles", which can be downloaded from our website.

- Do not install tiles:
  – on very hot days.
  – when direct sun will fall on the tiles.
  – when hot winds will blow over the installation.
  – when hot weather is predicted immediately following the installation.

- Use a rapid setting Mapei adhesive with a low water content. The Granirapid system is often specified, however the correct adhesive should be chosen according to the size and thickness of the tile, the installation conditions and the final usage of the installation. Contact your Mapei adhesive specialist and seek advice on the most suitable adhesive, grout joint widths and expansion/control joints to use to fulfil the engineer's requirements. Install the tiles according to procedures outlined in Sadlerstone technical literature, in combination with the additional procedures recommended by the engineer and adhesive specialist.

- Avoid extremes of temperature, direct sun and wind early after tiles are installed.

- Do not flood new installations with water.

For cleaning, sealing and maintenance procedures, follow the Sadlerstone technical literature that can be downloaded from our website.

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Technical Bulletin - Maintaining Smooth Tiles: Professional Protocol

For initial preparation of a new Sadlerstone smooth floor, refer to our 4-page Installation and Finishing guide. Engage a Sadlerstone recommended finishing contractor to set up a regular floor maintenance schedule and demonstrate procedures. The use of properly sized walk-off mats and sweeping or dust mopping daily reduces the rate of wear and protects the finish of the tile by eliminating most of the abrasive grit that is tracked in from outside. The use of protectors on chair and table legs is also recommended. For maintaining floors finished with a surface sealer, refer to the sealer manufacturer's procedures.

Low Maintenance Routine – Smooth Tiles with Penetrating Sealer

- Dust/mop or sweep daily or more frequently. Vacuum the walk off mats daily. Spot clean with a neutral detergent.
- Damp mop as required using a neutral cleaner diluted to manufacturer's dilution recommendation (eg Johnson's Stride) with a clean cotton mop and bucket with squeezing rollers. (Do not use plain water).
- Periodic buffing with a red pad on a floor-buffing machine can be used to increase the level of the sheen or remove streaks from mopping.

Machine Maintenance Routine – Smooth Surface with Penetrating Sealer

- Clean the floor using an auto-scrubber fitted with a red pad or nylon brush using a mild neutral detergent diluted to manufacturer's dilution recommendation. For particularly dirty floors, use a blue pad. Use a clean, damp cotton mop to clean edges and corners and to pick up excess detergent slurry.
- As an alternative to the auto-scrubber, use a floor machine fitted with a 40cm red pad. Apply liberal quantities of neutral detergent and warm water (mixed to detergent manufacturer's dilution recommendation) and agitate with the floor machine fitted with the red pad.
- Do in manageable sections and do not allow the floor to become dry during this process. Work slowly and steadily, passing in both east/west and north/south directions. Immediately remove the slurry with a squeegee and a clean damp mop.
- For particularly dirty floors, use a blue pad. Follow with a dry buff with a red pad (or, occasionally with a blue pad if the red pad is not producing an even sheen).
- For a higher level of sheen, use a red pad with a spray buff liquid such as Johnson's 'Snapback' or (if the floor has been sealed with a Dry-Treat penetrating sealer) with a little of Dry-Treat's Stain-Proof.

Some red pads transfer red colour to high spots – remove this by hand with a green 'Scotch Brite' pad.

As wear and buffing reduces slip resistance, consider using slip resistant finishes in areas where slip resistance standards are mandatory.

Stain Removal

Most stains can be removed with an all-purpose neutral cleaner. For more difficult stains use a neutral spot cleaner (following manufacturer's instructions). Minor water spots or light acid etching will be diminished with buffing. For stronger spotting, try using a hand disk sander/polisher (e.g. Hitachi SAT180) fitted with a couple of green Scotch Brite pads. Experiment first on a spare tile as some skill is required to avoid leaving swirl marks or shiny spots. A Scotch Brite Surface Conditioning Disk will do a similar job, but will make the buffed area quite shiny. Acid aggression on smooth tiles (e.g. from lemon juice, vinegar etc) may require specialised procedures.

Notes:

- The floor machine must be operated by an experienced user.
- A white pad is too soft to clean Sadlerstone, but can be used to buff a polishing wax to a high shine.
- Pads stronger than a blue pad should only be used by a contractor experienced with Sadlerstone.
- Use only neutral detergents – no other chemicals are suitable.
- Increase concentration of detergent for very dirty floors.

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Technical Bulletin - Maintaining Textured Tiles: Professional Protocol

Engage a Sadlerstone recommended finishing contractor to set up a regular floor maintenance schedule and demonstrate procedures. Daily sweeping reduces the rate of wear and protects the finish of the tile by eliminating the tracking of abrasive grit. The use of protectors on chair and table legs is also recommended. Sadlerstone recommend that all textured tile installations be sealed with a penetrating sealer. Refer to our guide "Preparing a New Sadlerstone Floor – Textured Tiles" for recommended procedures.

Surface sealers are not usually recommended for textured tiles as they can diminish the high slip resistance of the surface. For maintaining floors finished with a surface sealer, refer to the sealer manufacturer's procedures.

Low Maintenance Routine – Textured Tiles with Penetrating Sealer

- Sweep daily or more frequently. Spot clean with a neutral detergent (such as Johnson's Stride) diluted to manufacturer's recommendation.
- Scrub with a stiff garden broom as required using a neutral detergent. (Do not use plain water.) Use a squeegee and mop to remove the detergent slurry.
- If there is dirt build-up, scrub periodically with a floor machine fitted with a bassine or nylon brush using a neutral detergent (see below).

Machine Maintenance Routine – Textured Tiles with Penetrating Sealer

Clean the floor using an auto-scrubber fitted with a nylon brush using a mild neutral detergent diluted to manufacturer's recommendation. For particularly dirty floors, use a more concentrated detergent mix. Use a clean, damp cotton mop to clean edges and corners and to pick up excess detergent slurry.

As an alternative to the auto-scrubber, use a floor machine fitted with a bassine or nylon brush. Apply liberal quantities of neutral detergent and warm water (mixed to detergent manufacturer's dilution recommendation) and agitate with the floor machine fitted with the nylon brush. Do in manageable sections and do not allow the floor to become dry during this process. Work slowly and steadily, passing in both east/west and north/south directions. Remove the slurry with a squeegee and a clean damp mop. For particularly dirty floors, use a more concentrated detergent mix.

If the floor has been sealed with Dry-Treat's Stain-Proof, it should not need resealing. Other types of sealers may require occasional replenishment – follow manufacturer's directions.

Stain Removal

Most stains can be removed with an all-purpose neutral cleaner and a scrubbing brush. For more difficult stains use a neutral spot cleaner (following manufacturer's instructions).

Minor water spots or light acid etching will be diminished by scrubbing with a neutral detergent. For stronger spotting, seek the help of a stone care professional. Do not use acids or chemicals on the tiles – only neutral detergents. Acid aggression on tiles (e.g. from pool acid concentrate, lemon juice, vinegar etc) may require specialised procedures.

Notes:

- The floor machine must be operated by an experienced user.
- A carbon-graphite brush should only be used by a contractor experienced with Sadlerstone.
- Use only neutral detergents – no other chemicals are suitable.
- Increase concentration of detergent for very dirty floors.

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A method for applying Nitoflor Lithurin to Sadlerstone tiles – professional protocol

[Note Nitoflor Lithurin toxicity issues – refer MSDS. Protect surrounding materials from possible corrosive effect of material]

Test a spare tile first to ensure that you are happy with the level of sheen.

1 Clean the floor: Using a cotton mop, apply liberal quantities of neutral detergent (e.g. Johnson's Stride) and warm water (mixed to detergent manufacturer's dilution recommendation) and agitate using a floor machine fitted with a 40cm blue pad.

2 Do in manageable sections and do not allow the floor to become dry during this process. Work slowly and steadily, passing in both east/west and north/south directions. Use a clean, damp cotton mop to clean edges and corners.

3 When complete, immediately remove the detergent slurry with a squeegee and a clean damp mop.

4 When dry, follow with a dry buff with a dry red pad (or, with a dry blue or green pad if the red pad is not producing an even sheen). Work slowly and steadily, passing in both east/west and north/south directions. Make sure that the floor is completely clean and has an even sheen before proceeding with the next step.

5 Prepare the area by protecting metal, wood and paint from contact with the Nitoflor Lithurin.

6 Thoroughly wet the floor with neat Nitoflor Lithurin using a soft broom - ensure complete coverage. Coverage approx 4 to 6m2 per litre per coat.

7 Leave for 10 minutes then agitate with the floor machine* fitted with the red pad. Work slowly and steadily, passing in both east/west and north/south directions. Keep the floor wet during this process by brooming on extra Nitoflor Lithurin if needed.

8 Wait another 10 minutes, squeegee off excess liquid, then repeat steps 6 and 7.

9 Wait 10 minutes then squeegee off excess liquid, and then rinse the floor with plain water. Immediately remove the rinsing water with a squeegee and a clean damp mop.

10 When dry, immediately buff the floor with a dry red pad to produce an even sheen.

11 Apply Dry Treat Stain Proof (or equivalent) following manufacturer's instructions. Do not wet the floor for 48 hours after applying sealer. (If the floor was already sealed with Stain Proof, omit this step.)

- The above process will build resilience in the tile and may give an initial higher level of sheen.
- Maintain the floor by damp mopping with a neutral detergent. Do not use plain water to clean the floor. From time to time, scrub with neutral detergent and buff with a dry red pad to increase sheen.
- The penetrating sealer should be a type that will provide resistance to oil-based stains, for example, Dry Treat's Stain Proof.
- In confined spaces, hand scrubbing with a scrubbing brush can be substituted for the floor machine.

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Technical Bulletin - Preparing a Textured Tile Floor: Professional Protocol

Each installation will have different requirements for cleaning and maintenance. The following recommendations may need to be varied according to the specific requirements of the job. Engaging a Sadlerstone preferred contractor for preparing and sealing Sadlerstone tiles is recommended. Where a preferred contractor is not available, as a general rule, follow the instructions in Sadlerstone "Recommendations for the Installation, Finishing and Care of Sadlerstone Tiles" or the procedures below. Please consult Sadlerstone or one of Sadlerstone's preferred contractors for advice prior to commencement of work not described below.

Sadlerstone is a mixture of natural materials using cement as the binder. Like most natural stone, the tiles are acid-sensitive.

1. After installation and grouting, all adhesive and grout smears must be removed from the surface of the tiles with a damp sponge while they are still fresh. Once dry, they cannot be removed. The floor should be covered (or effectively cordoned off) and kept dry immediately after installation to avoid paint, silicon and food stains etc. before initial cleaning and sealing. Do not use duct tape, gaffer tape or other tapes on the tile, as these can permanently damage the surface.

2. Clean and scrub the floor using a bassine or nylon bristle brush with an autoscrubber or Polyvac 40cm (16") floor machine (or a 150 to 200 rpm machine) to agitate detergent. Do in manageable sections, working steadily, passing in both north/south and east/west directions. Use a pH neutral detergent such as Johnson Stride, following manufacturer's dilution recommendation and do not allow the section being scrubbed with the detergent slurry to dry out. For very dirty areas, use Johnson Peneclean.

3. Remove detergent slurry with a wet vacuum or squeegee and mop. Rinse and immediately remove rinsing water with a wet vacuum or squeegee and mop. Allow to dry thoroughly. If floor is completely clean, proceed to seal the floor (step 7 overleaf).

4 For adhesive and grout-smeared tiles consider using Dry-Treats X-Duty and a carbon graphite brush, but do an inconspicuous test area first as these bristles are very strong. A carbon-graphite brush is for professional use only.

5 For areas showing an efflorescent bloom where the surface has a low pH level (below 8), scrub with a slightly alkaline detergent such as Peneclean diluted to manufacturer's recommendation. If the surface has a high pH (over 10), scrub with a neutral detergent such as Stride. (Pool shops sell pH test kits.)

6 If the surface of the textured tile is showing a white bloom (micro-efflorescence) and the above procedures do not remove this, it may be necessary to clean the tile with a very mild acid wash. It is recommended that acid washing be carried out in dry weather and after the floor has weathered for at least six months.

The following procedure is for textured tiles only – never use acid, no matter how dilute, on smooth tiles. Do the following under the direction of a contractor experienced with Sadlerstone. Experiment on a spare tile or inconspicuous area first. Use only a sulfamic or phosphoric acid-based concrete wash.

Thoroughly wet a small section of tiles with plain water and then apply the concrete wash diluted at the rate of 20 to 1 (or 15 to 1 where the bloom is more difficult to remove) and agitate with the bristle scrubber or stiff broom. Immediately rinse thoroughly with the scrubber and neutral detergent diluted to manufacturer's recommendation, followed by a hose at full pressure. Rinsing must be very thorough, as acid residues can create a permanent white bloom. NEVER USE VINEGAR OR HYDROCHLORIC ACID ON THE TILES.

7 Sadlerstone tiles come with a factory applied solvent-based impregnating primer seal. For a higher level of protection, after tiles have been thoroughly cleaned, allow tiles to dry completely, then apply two coats of Dry-Treat Stain-Proof (www.drytreat.com) impregnator (penetrating sealer) following manufacturer's directions, or use the following method:

- Test the sealer on a small area first and allow 24-hour cure time to determine appropriate application method and desired result. Using a low-pressure hand spray, brush or roller, evenly apply one coat of Dry-Treat Stain-Proof at a rate of 20 to 25 m2 per litre (200 to 250 ft2 per quart).
- Allow 5 to 10 minutes to penetrate.
- Apply another coat of sealer and allow 5 to 10 minutes to penetrate.
  With a clean white cloth, rub off excess sealer until no sealer remains visible on the surface.
- After sealing, do not wet or wash the floor for 48 hours. As the sealer reaches maximum performance after 30 days, special care should be taken during this time.

8 For regular maintenance, use a pH neutral detergent such as Dry-Treat S-P Cleaner (or Johnson's Stride) following manufacturer's dilution recommendations. Refer to the guide "Maintaining Sadlerstone Textured Tiles – Professional Protocol".

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Rejection Criteria – Smooth Tiles

General

Sadlerstone Smooth tiles compete in the up-market against, primarily, ceramics, marbles and limestone along with other floors that can even include coloured concrete.

Our technical and sales literature states:

- Precision-made hard surface finishes <Context>
- Shading (colour variation) of individual pieces due to natural variations <TM>
- Colour variation between samples and/or printed illustrations and actual product <TM>
- To have a uniform range of colour, surface finish, pattern and texture variations, ensure that the distribution of tiles is such that local concentrations of one type or similarity do not occur <TM>
- Product as supplied is subject to pitting and edge fraying <Quotation>
- Sadlerstone tiles are a natural stone product and will vary in tone and shade from run to run and within each production run. Variations in tone and shade are not considered defects <Quotation>

Smooth tiles are almost exclusively for interior use and, therefore, reflect light differently to rough exterior Sadlerstone tiles. This means factory rejection criteria that applies to rough exterior tiles should not be applied to smooths. Items such as colour match, mottling and pitting are more stringent.

No International Standards exist for Engineered Stone Concrete Tiles, therefore, for Dimension and Surface Quality sampling and acceptance, ISO 10545-1 (AS4459.1) for ceramic tiles it is the generally recognized Industry Standard. This standard partners ISO 13006, which defines the Dimension and Surface Quality criteria. Under these criteria (reference Table 1) up to 5% of tiles may lie outside dimensional and, a further 5% outside surface quality criteria.

It is important, therefore, for either ceramic or Colorstone Concrete Tiles that installers (tilers) grade tiles before laying and utilize those affected tiles to cut for edges and surrounds such that they achieve an installation standard that conforms to the likes of AS3958.1. Generally installers order an additional 10% of their take-off quantity in smaller (less than 100m2) and 5% extra in larger projects. In addition some 10% of tiles are normally cut.

Specifically

REJECT

CRACKS / BROKEN	Definite rejection criteria at all times.
CHIPPING	Not acceptable, however filled minor edge fraying up to 1.5mm OK. No need to fill edge fraying less than 1mm.
LIP	This is caused by a mould crack – reject.
SPECKLING	Not acceptable as this leads to in-use surface failure and pitting.
CRAZING	Definite rejection criteria at all times as this indicates plastic shrinkage.
DRY MIX	This shows as a colour contrast or degraded surface. Reject unless this is very feint.

ACCEPT MAX 5%

BOWING	Tolerance marginally less than rough. For tiles less than 405mm in any dimension, use .75mm spacer. Use the 5c coin clearance test for tiles 405mm and up to 608mm. Use 10c coin clearance test for tiles over 608mm in both dimensions.
DIMENSIONAL	Size +/- 0.5mm (measured diagonally). Thickness +/- 1.0mm over 90% or more of the tile.

ACCEPT MAX 5%

COLOUR MATCH	Tolerance less than rough; marginal colour sweeps not OK; a reasonable match to the control sample; reject milkiness on dark colours.
MOTTLING	Only minor acceptable; “leopard” tiles definitely not OK. Blotches of contrasting shade not OK.
PITTING	Much more rigid than with rough tiles. Use the tap test on suspect holes and reject if any hole is greater than 2mm diameter (no larger than the thickness of a 20c coin). Repair (fill) holes, or if greater than 5 pinholes, reject.
SCRATCHES	Only light hairline scratches to less than 10% of tile acceptable. Scratches that cannot be greatly reduced by buffing are not acceptable.
WATER MARKS	Permanent obvious water marks generally not OK.

THIS MEANS THAT UP TO 10% OF TILES PER CRATE CAN HAVE DIMENSIONAL AND SURFACE DEFECTS

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Rejection Criteria – Textured Tiles

General

Sadlerstone Textured tiles compete in the up-market against, primarily, ceramics, marbles and limestone along with other floors that can even include coloured concrete.

Our technical and sales literature states:

- Precision-made hard surface finishes <Context>
- Shading (colour variation) of individual pieces due to natural variations <TM>
- Colour variation between samples and/or printed illustrations and actual product <TM>
- To have a uniform range of colour, surface finish, pattern and texture variations, ensure that the distribution of tiles is such that local concentrations of one type or similarity do not occur <TM>
- Product as supplied is subject to pitting and edge fraying <Quotation>
- Sadlerstone tiles are a natural stone product and will vary in tone and shade from run to run and within each production run. Variations in tone and shade are not considered defects <Quotation>

Textured tiles are almost exclusively for external use and, therefore, reflect light differently to smooth interior Sadlerstone tiles. This means factory rejection criteria that applies to smooth interior tiles should not be applied to textured tiles. Items such as colour match, mottling and pitting are less stringent.

No International Standards exist for Engineered Stone Concrete Tiles, therefore, for Dimension and Surface Quality sampling and acceptance, ISO 10545-1 (AS4459.1) for ceramic tiles it is the generally recognized Industry Standard. This standard partners ISO 13006, which defines the Dimension and Surface Quality criteria. Under these criteria (reference Table 1) up to 5% of tiles may lie outside dimensional and, a further 5% outside surface quality criteria.

It is important, therefore, for either ceramic or Colorstone Concrete Tiles that installers (tilers) grade tiles before laying and utilize those affected tiles to cut for edges and surrounds such that they achieve an installation standard that conforms to the likes of AS3958.1. Generally installers order an additional 10% of their take-off quantity in smaller (less than 100m2) and 5% extra in larger projects. In addition some 10% of tiles are normally cut.

Specifically

REJECT	
CRACKS / BROKEN	Definite rejection criteria at all times.
CHIPPING	Not acceptable, however filled minor edge fraying up to 1.5mm OK. No need to fill edge fraying less than 1mm.
LIP	This is caused by a mould crack – reject.
SPECKLING	Not usually noticeable on textured tiles.
CRAZING	Not usually noticeable on textured tiles.
DRY MIX	Not usually noticeable on rough tiles. Reject if surface is degraded.
ACCEPT MAX 5%	
BOWING	Tolerance marginally less than rough. For tiles less than 405mm in any dimension, use .75mm spacer. Use the 5c coin clearance test for tiles 405mm and up to 608mm. Use 10c coin clearance test for tiles over 608mm in both dimensions.
DIMENSIONAL	Size +/- 0.5mm (measured diagonally). Thickness +/- 1.0mm over 90% or more of the tile.
ACCEPT MAX 5%	
COLOUR MATCH	Again tolerance greater than smooth, marginal colour sweeps OK although distinct two-tone is not, a reasonable match to the control sample.
MOTTLING	Generally acceptable if not severe.
PITTING	Again much more relaxed than with smooth tiles, no holes greater than 3mm, no more than 15 “pinholes” per tile (use the tap test on suspect holes).
SCRATCHES	Not usually noticeable on rough tiles.
WATER MARKS	Water marks generally OK.

THIS MEANS THAT UP TO 10% OF TILES PER CRATE CAN HAVE DIMENSIONAL AND SURFACE DEFECTS

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Technical Bulletin – Slip Resistance, Australia

The Australian Standard AS/NZS 4586:2004, *Slip resistance classification of new pedestrian surface materials*, exists "to provide users and specifiers of pedestrian surface materials (architects, engineers, facility managers, manufacturers and the like) with means for classifying such surfaces according to their pedestrian slip resistance for use in the selection of surfaces." "These classifications are based on an assessment of the contribution of a pedestrian surface to the risk of slipping and they will assist in the specification of a surface material suitable for most pedestrian applications. Factors such as usage, cleaning systems, applied coatings and patterns of wear may affect the characteristics of the surface after classification."

The Standard states that HB 197, *an introductory guide to the slip resistance of pedestrian surface materials*, "provides guidelines for the selection of slip resistant pedestrian surfaces classified in accordance with the Standard."

Further the "Standard provides a means of demonstrating compliance for the acceptance and rejection of new surfaces for the nominated criteria." Compliance with AS/NZS 4586:2004, requires that one of the three wet slip resistance methods detailed be used for all external pedestrian surfaces and those internal pedestrian surfaces that have a reasonably foreseeable risk of the presence of wet substances such as water, grease and oil. Sadlerstone has, in fact, been fully tested to two of these methodologies. Historically, a third test method for dry testing shows Sadlerstone with the highest rating, F, making them suitable for all dry environments. AS/NZS 4586:2004 – HB 197 wet slip resistance ratings for Sadlerstone smooth, textured and terrazzo tiles are summarised in this table:

AS/NZS 4586 Test Method	Appendix A **Wet Pendulum***	Appendix B Dry Floor Friction	Appendix C Wet/Barefoot Ramp	HB197 Table 3 Equivalent Appendix D Oil-Wet Ramp
Sadlerstone	**X**	F	N.A.	R10
Textured	**V** (highest)	F	**C** (highest)	R11 (**R12** actual)
Terrazzo	**V** (highest)	F	**C** (highest)	R11 (**R12** actual)

*Copies of wet slip test results tested in accordance with Appendices (those marked in bold) are available on request.

HB 197 Table 3 "gives some recommendations for pedestrian surface materials in some specific locations."

Pendulum	Locations
V	External ramps; Swimming pool ramps and stairs leading into water
W	External colonnade, walkways and pedestrian crossings; Swimming pool surrounds and communal shower rooms; Accessible internal stair nosings (wet) – handrails present; external stair nosings
X	Shopping centre – food court; Internal ramps, slopes (greater than 2 degrees) – dry; Other shops with external entrances – entry area; Fast food outlets, buffet food servery areas; Shop and supermarket fresh fruit and vegetable areas; Communal changing rooms; Toilet facilities in offices, hotels, shopping centres; Undercover concourse areas of sports stadium; Accessible internal stair nosings (dry) – handrails present
Y	
Z	Entry foyers hotel, office, public buildings – dry; Shopping centre excluding food court; Lift lobbies above external entry level; Other separate shops inside a shopping centre; Hospitals and aged care facilities – dry areas; Supermarket aisles except fresh food areas

- HB 197 also includes details of the German R rating system in its Table 5
- There is further classification that covers public wet barefoot areas – the barefoot ramp test has three ratings: A (e.g. changing rooms), B (e.g. pool surrounds, shower rooms) and C (e.g. sloping pool edges). See Table 4 of HB 197-1999.
- Sadlerstone always recommends the use of walk off mats for minimising water and grit that might diminish slip resistance.

Sadlerstone is a unique material that responds to varying maintenance and usage over time and we appreciate and reinforce the Australian Standard philosophy that "factors such as usage, cleaning systems, applied coatings and patterns of wear may affect the characteristics of the surface after classification". The applicable Standard for *existing* floors is AS/NZS 4663, *Slip resistance measurement of existing pedestrian surfaces*.

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Technical Bulletin – Sub-floor Heating Installations

Follow these procedures when installing Sadlerstone tiles over sub-floor heating:

1 Provide your project engineer (or heating engineer) with details of the technical characteristics of Sadlerstone tiles and tile dimensions. It is the responsibility of the project engineer to determine the suitability of our tile for your particular installation and draw up a specification. The engineer may, for example, recommend extensive conditioning of the substrate prior to the tile installation – this may include activating the heating several times over an extended period.

2 In cases where sub-floor heating may continue to cause significant expansion or other movement in the substrate it may be necessary to use systems which allow some degree of independent movement between the tiles and the substrate.

3 Only install heating systems with in-floor thermostats (not air sensors). Heating output should not exceed 170 watts per square metre. Set points should be between 20 to 27 degrees Celsius (approx 70 to 80 degrees Fahrenheit), with a 5 degree Celsius (approx 9F) maximum fluctuation.

4 Ensure that the substrate is adequately prepared, clean, dry and flat. The correct adhesive should be chosen according to the size and thickness of the tile, the installation conditions and the final usage of the installation. Contact your Mapei adhesive specialist and seek advice on the most suitable adhesive, grout joint widths and expansion/control joints to use to fulfill the engineer's requirements. Install the tiles according to procedures outlined in Sadlerstone technical literature, in combination with the additional procedures recommended by the engineer and adhesive specialist.

   Depending on type of heating system, allow a minimum of 4 to 8 weeks after installation before activating heating for the first time.

5 After tiles are installed, follow the engineer's specification for activating sub-floor heating. By way of example, the following recommendation was taken from a recent specification: "Allow 4 weeks or longer from completion of tile installation before activating heating for the first time. When turning on heating for the first time (or after a period when the heating has been turned off), set the heater's thermostat to two degrees above the overnight lowest floor temperature. Repeat this every day, increasing the thermostat temperature by two degrees Celsius until the optimum temperature is reached. Optimum temperature should not exceed 27 degrees Celsius (approx 80F).

   As an example, if the initial low was 10 degrees Celsius (50F), then it would take 6 days to reach a temperature of 22 degrees (approx 72F)."

6 Do not expose the installation to fluctuations in temperature from the sub-floor heating. Protect new installations from full sun and fluctuations in ambient temperatures from hot air and wind etc.

7 Never allow water to pond on the surface of the tiles. Do not flood the floor with water when cleaning – use only a slightly damp mop.

For cleaning, sealing and maintenance procedures, please refer to the guide: "Recommendations for the Installation, Finishing & Care of Sadlerstone Tiles". This is available upon request or can be downloaded from our website.

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Technical Bulletin – Surface Residues

- Calcium compounds are present in cementitious materials (including substrates, screeds and adhesives) and are a result of the chemical reaction between water and cement. As these compounds are white or light grey, cementitious products with dark pigments often appear lighter in tone where these compounds are concentrated nearer the surface of the material. This accounts for some of the attractive tonal variations in Sadlerstone. These variations are not surface residues and are permanent.

- The manufacturing, cutting and installation processes for cementitious products involve typical quantities of water. Sadlerstone smooth tiles may show varying degrees of surface bloom caused by evaporating water pulling some of the soluble materials to the top, causing differences in levels of surface sheen. This can occur even when tiles have been sealed with an impregnator (penetrating sealer). If an even sheen is preferred, cleaning and buffing the tiles after installation will remove most of these residues and also bring up the natural low-sheen finish. As there are a finite amount of soluble deposits in the material, any recurrence in the bloom will further fade over time with regular cleaning. Surface residues may recur on outside installations subject to rain, however deposits coming up from the substrate, screed or adhesive usually cause these.

- Do not allow water to pond on the tiles (especially when installations are young and where substrates, screeds and adhesives are the likely source of soluble materials) as this can reactivate the process of drawing soluble deposits to the surface. Areas subject to rain or run-off water should have sufficient fall to prevent water ponding on the surface of the tiles.

- Smooth tiles: Residue blemishes can be treated with a neutral detergent wet scrubbed with a rotary polisher with a blue pad (or a green pad for more persistent residues). Remove the slurry with a wet vacuum (or very clean mop), rinse and dry, then dry buff with a dry green or tan pad, followed by a red pad. If necessary, repeat this procedure. Refer to “Recommendations for the Installation, Finishing and Care of Sadlerstone Tiles” for detailed cleaning, sealing and ongoing maintenance procedures.

- Textured tiles: Refer to “Recommendations for the Installation, Finishing and Care of Sadlerstone Tiles” and the “Technical Bulletin Maintaining Textured Tiles” downloadable from the Technical Information page on our website.

- Water spotting: Regular use and cleaning will assist in diminishing shadows from evaporated water. Smooth tiles may show superficial water shadowing early after installation, however the implementation of an ongoing maintenance routine will address this as the tiles build resilience and residual shadowing fades from the surface. If desired, accelerate this process by buffing more frequently, especially during the first month after installation. Do not allow water to pond on the tiles, especially in young installations. In areas where water spotting may be frequent (e.g. bathrooms), apply a barrier sealer or, if a more natural look is preferred, Dry-Treat Marble and Porcelain Sealer should be applied over Dry-Treat Stain-Proof impregnator (penetrating sealer), following manufacturer’s instructions.

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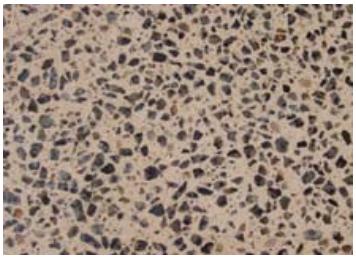
Technical Bulletin - Sadlerstone Terrazzo Tiles

Sizes: Sadlerstone terrazzo tiles are available in the same dimensions as our other tiles, however the thicknesses are slightly different. Standard sizes are:

Size	13mm	18mm	23mm
303 x 303	✓	✓	✓
405 x 405	✓	✓	✓
608 x 608	✗	✓	✓
608 x 303	✗	✓	✓
608 x 405	✗	✓	✓
811 x 405	✗	✗	✓



Appearance and sealing: Sadlerstone terrazzo tile is a chic and unique "sawn" finish that is best described as natural, simply beautiful. It is available in either granite or marble chip in the Sadlerstone colour range. It can be finished with a penetrating sealer for long-term protection against penetrating stains. To enhance the contrasts, an enhancing or "wet look" sealer is generally used, however topical sealers need to be renewed periodically. We recommend Rockstar Stone Shield, a citrus based sealer that is easy to apply, is economic and has good wear resistance. It penetrates and deep seals like a solvent-based sealer without the obnoxious solvent odours. See the manufacturer's guidelines for application www.rockstarsealing.com.au, although 2-3 coats with a lambswool applicator 2-3 hours apart is sufficient.

Installation: Refer to our 'Recommendations for the Installation, Finishing & Care of Sadlerstone Tiles'. As terrazzo are quite porous we recommend one coat of All Stone Pre-Seal before grouting.

Butt joints: Tiles are normally installed with grout joints at 0.5% of the long side of the tile, or more. For example, a 405 x 405mm tile will have a 2mm grout joint. Terrazzo tiles are sometimes butt-jointed. The Australian Standard for butt-jointing is 1.5mm, however, depending on the condition and age of the substrate, the configuration of the area to be tiled and the introduction of expansion joints, it may be possible to vary the width of the grout joints.

Care and maintenance: Terrazzo tiles installed as supplied (and with a penetrating sealer applied) can be cleaned with a bristle scrubber and neutral detergent. A scrubbing pad can also be used, but may tend to polish the surface and reduce the slip resistance of the tiles over time. Tiles sealed with a top sealer should be maintained according to the directions of the top sealer manufacturer.

Slip resistance: As supplied, Sadlerstone terrazzo tiles have excellent slip resistance (R12) and are suited to most wet environments (BPN 59). Honing the tile will reduce the slip resistance. As honing is carried out by third parties, they should be consulted about the likely slip resistance characteristics they will be able to achieve. Surface sealers can also reduce slip resistance.

Honing: Honing is a process whereby the surface of the tile is worked with stones of progressively finer grit until the desired level of smoothness and sheen is achieved. Honing of an in situ installation will enhance the contrasts and provide a very flat installation, however it can be expensive and can add considerably to supply and installation costs.

Tiles and bench tops etc can also be honed prior to installation. As Sadlerstone is not able to do honing or cut-outs for sinks etc in the factory, there will be costs from third parties and longer lead times for this. As terrazzo bench tops cannot be thicker than 23mm, they should be laminated to a solid backing material prior to cut-outs or installation.

Edge profiles: As the terrazzo surface is produced by grinding large slabs that are then cut to size, it is not possible to produce the off-mould edges available with our smooth and textured finishes. Cut to size terrazzo pieces can be supplied for others to apply the profile detail. Sadlerstone can arrange for an outside stone processor to apply the edge, however this can add considerably to the cost. Accordingly, it is preferable for installers to create simple edges (e.g. pencil round) on site.

Maximum thickness for terrazzo edge profiles is 23mm, with a recommended maximum length to width ratio of 2 to 1.

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Technical Bulletin - Treating Stains on Textured Tiles

For initial cleaning and sealing, follow the recommendations in the Technical Bulletin “Preparing a Textured Tile Floor: Professional Protocol”. Please consult Sadlerstone or one of Sadlerstone’s preferred contractors for advice prior to commencement of work not described below.

When tiles are properly sealed, most types of stains will fade over time with the action of the sun and the rain. Some suggestions for hastening this process are given below. Always test an inconspicuous area first.

Leaf Stains
Note that leaf stains usually fade and wash away with spring rains and UV light, as their dyes only survive for a limited time. If desired, try the following:

1 Wet tiles with a 3 to 1 mixture of water and liquid chlorine (available from pool and hardware shops) and leave on for 5 minutes.
2 Agitate with a broom or brush
3 Rinse with clean water

Timber Stains

1 Wet tiles
2 Apply Oxalic Acid (available from paint shops)
3 Agitate with brush or broom
4 Rinse with clean water

Rust Stains

1 Wet tiles
2 Apply CLR (available from hardware stores)
3 Agitate with brush or broom
4 Rinse with clean water

Fat Stains (from barbeques etc)

1 Dilute a pH neutral cleaner (such as Johnson's Stride) with hot water according to manufacturer’s instructions
2 Apply the diluted mixture and mop or agitate with broom or brush
3 Repeat if necessary
4 Rinse with clean water

General Cleaning

- Use a pH neutral detergent and a stiff broom (or bristle scrubber). Rinse.
- Never use vinegar, hydrochloric (or other) acid to clean tiles.
- Refer to the Technical Bulletin “Maintaining Textured Tiles: Professional Protocol”.

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Trouble Shooting Guide

These are examples of key field problem areas. Within each problem category there are common causes and remedies. See appropriate installation and maintenance recommendations and product characteristics summary for additional information.

Problem	Possible Causes Include	Suggested Remedies
Loose, drummy or broken tile	- Substrate/screed not cured - Poor setting technique - Using excessive water - No back-butter - Malleting tiles - Carrying out work in hot weather / full sun - Accelerated sub-floor heating - Wrong adhesive or trowel - Insufficient expansion joints	- Clean out setting bed and reset following recommended procedures. - Install additional expansion joints if necessary.
Lipping tiles (Can lead to trip hazards and chipped edges)	- Poor setting technique or as above - Sub-floor tolerance - Low amount of setting bed, small joint width - No back-butter	- Same as above
Grout film	- Poor clean-up	- Strip, re-clean then normal maintenance
Dirty tile / Marked tile	- Poor clean-up or maintenance	- Wash with neutral detergent then proceed with proper maintenance routine. Spot clean.
Dull tile	- Improper, or insufficient maintenance	- Clean and maintain according to tile type. Increase frequency of buffing.
Water spotting	As above	As above (Spots fade over time)
Uneven lustre	- Improper maintenance or misapplication of sealer	As above
Tile too glossy	- Improper maintenance or sealer	- Bristle scrub to reduce sheen or strip sealer and apply appropriate product.
Acid etching (vinegar, lemon juice etc), adhesive tape burns	- Spillages - Applying tape to tile surface	- Etching is permanent, but may diminish with buffing - Replace tile
Efflorescence	- Inappropriate or insufficient penetrating sealer	- Scrub with neutral detergent and apply Dry-Treat Stain Proof.

Grout failure/fading/lightening/ marking	- Inappropriate grout or cleaning method - Excessive salts in substrate	- Remove and replace with high-performance grout and seal with Natural Finish
Scratches	- Insufficient maintenance or protection - Using wire brushes etc for clean up	- As above. Install walk-off mats and soft tips to furniture. Sweep often. Buff with “Snapback” to fill hairline scratches
Slippery tile	- Surface dust, spillages, buffing, wear	- Dust mop. Wipe up spillages promptly. Install walk-off mats. Apply slip resistant coating.
Chips	- Impact damage, stones underfoot	- Install walk-off mats and soft tips to furniture. Sweep often.
Cracks	- Environmental and installation conditions (See also loose or broken tile above)	- Hairline cracks: thoroughly seal with Natural Finish. Larger cracks can be filled
Pitting Mottling Picture framing	- Natural to product	- No action, but fill holes if pitting severe. Picture framing fades with time
Tonal variation concentrated in one area	- Failure to blend tiles	- Blend tiles from different crates/pallets before installing. - Tonal variation diminishes over time.

A-Z Product Characteristics, Issues, Installation

Sadlerstone tiles are a mixture of natural materials and have performance characteristics similar to some carbonate-based natural stones. The following characteristics summary is not all-inclusive. Our warranty assumes that the following information is understood and recommended procedures are followed:

Issue	Explanation
Acids, abrasives: Do not use wire brushes, acids etc during cleanup.	Harsh abrasives can scratch the surface of the tile and acids and strong alkalies can etch the surface. Follow recommended procedures only.
Adhesive tapes, duct tape, gaffer tape not to be adhered to the tile surface.	These tapes can permanently etch the tile surface.
Adhesives 1: Consult your Mapei specialist for recommendations.	Each project is different and may require an adhesive chosen especially for the site conditions.
Adhesives 2: Do not add water to the adhesive mix.	Cementitious two-part adhesives have a controlled water content. Excess water in the mix may compromise bonding strength and cause tiles to curl/delaminate.
Chipping	Tiles as supplied may show minor edge fraying (up to 1.5mm). Mishandling, poor cutting techniques or blunt saws will chip edges. Lipping will expose edges of tiles to impact damage.
Cladding specification	Refer to local regulations. Mechanical fixing systems should be developed by an engineer using test results from this Manual.
Cleaning materials: Do not use supermarket cleaners, polysolvents or acidic cleaners.	Household cleaners sold in supermarkets usually have a very high pH level, making them too alkaline for use with Sadlerstone tiles. Use recommended neutral detergents.
Colour matching	Over time the natural materials used in manufacturing Sadlerstone tiles change and tiles mature in situ. Exact colour matches with older samples or installations are not always possible.
Countertops, kitchen: wipe up spillages promptly.	Even with an impregnator applied, acidic foods and drinks may dull or etch the surface of kitchen countertops. Expect kitchen countertops to “show some history” unless impervious surface sealers are used.
Cracking, crazing	Cementitious products can develop hairline cracks or crazing as a result of inappropriate installation methods, site conditions etc. If adhesive and substrate are sound, cracks should not open up and these tiles should last as long as the rest of the installation.

Cuts outs for vanities, sinks, taps etc are not recommended or warranted	Sadlerstone material contains no reinforcement. Cut outs close to edges can weaken the material leading to cracks.
Efflorescence: Smooth tiles in dark colours used outside may show water spotting, streaking and surface bloom.	Cementitious products contain calcium compounds that are white or light grey and may cause a bloom on the surface (micro-efflorescence). The bloom can be limited with impregnators or removed with buffing.
Grouting: Do not use liquid colours.	Liquid colours can stain the edges of tiles.
Hot weather tiling: Do not install tiles during hot weather or in full sun.	Hot tiles and/or substrates can dry adhesive before bonding causing possible drumminess, delamination, curling, or cracks. Refer Technical Bulletin “Hot Weather” on the website.
Impregnators 1: (penetrating sealers) are preferred as they do not detract from the natural appearance of the tile.	Impregnators limit penetrating stains but do not prevent superficial stains or water spotting. Quality sealers professionally applied and good maintenance practices will minimise surface staining.
Impregnators 2: Do not walk on newly sealed floors for up to 24 hours.	Impregnators need time to combine with tile material before providing protection. Note manufacturer’s instructions.
Loading, impact, stress. Note flexural strength before ordering sizes over 2:1 length/width ratio.	Long, narrow pieces of unreinforced cementitious agglomerates can crack if stressed by loading or impact or site conditions.
Malleting: Do not beat tiles; press in by hand.	Cementitious agglomerates can absorb high impact without breaking, but may develop stress cracks that may not be immediately visible.
Mitre cuts, birdsmouth cuts.	These can lead to unacceptable edge fraying and angles formed are subject to impact chips. Have a prototype approved before proceeding.
Mottling	Cementitious products may show mottling. This is not a defect, but a natural part of the product.
Pitting	Cementitious products may show light pitting. This is not a defect, but a natural part of the product.
Pool surrounds	Sadlerstone textured and terrazzo tiles demonstrate excellent slip resistance, colour-fastness and resistance to chlorine, making them ideal for pool areas.
Protect the floor and keep it dry at each stage of installation.	Other trades, liquids, impact etc can damage uncovered tiles. Damp coverings or water under the coverings can damage tiles.

Prototype area: Construct a prototype before commencing full installation.	Prototypes can identify early issues to do with substrate conditions, setting methods and materials, grout joints, blending, appearance etc.
Saddle supports: seek advice before specifying	Can be used with small, thick, square tiles. As tiles are intended for full adhesive fix, use with saddle supports may not be warranted.
Sandblasting: Smooth edge profiles may require sandblasting to achieve a textured finish for non-slip environments.	This process creates a different finish from textured off-mould tiles and may expose sub-surface aggregates of a different colour from the body tiles. Have a sample approved.
Scratches: Use walk-off mats to limit scratching. Use soft tips on furniture legs etc. Do not drag objects over tiles.	The product is warranted against wear, however the surface will show light scratching from everyday foot traffic as part of the long-term build up of an attractive surface patina. Buffing diminishes the appearance of surface scratches.
Screeds over substrates	A screed is usually required to ensure a level surface for installation. Screeds can require 7 days per centimetre to dry. (See “Substrates”)
Season or acclimatise tiles in their final environment.	Rapid changes in environmental conditions can cause expansion or shrinkage that can crack cementitious products. (See also “Sub-floor”)
Shower recesses: use extra sealer in wet areas to limit surface bloom and dull spots.	Dark colours may initially show surface blooming (micro-efflorescence). Water ponding on the tiles may dull the surface. Use a recommended contractor for on-site sealing. Refer to website for further comments.
Slip characteristics. Tiles used as treads may require application of non-slip or colour-contrasting materials.	Specify smooth, textured, or terrazzo tiles only according to slip standards that apply to the area in question. As use and buffing diminish slip resistance, apply slip-resistant coatings in areas where slip requirements are mandatory. Sadlerstone edge profile pieces are not supplied with non-slip or colour-contrasting materials applied.
Staining, etching, water spotting: Wipe up spillages promptly and avoid acidic foods (eg vinegar, lemon juice), chemicals etc spilling on the floor.	The product does not have a glazed surface, thus even with an impregnator applied, tiles may be subject to etching, water spotting and superficial staining. Quality impregnating sealers professionally applied can minimise staining and etching.
Storage: Store tiles indoors in a dry place and release strapping.	Tiles can be damaged by damp conditions or water when still in crates or on pallets. Tight strapping can bend or crack tiles if not released during storage. Season tiles to be used in air-conditioned environments.
Sub-floor heating used with Sadlerstone tiles: Obtain written specification from heating engineer.	Expansion and contraction of substrates can crack hard surface finishes. Conditioning of substrate/tiles may be required. Refer Technical Bulletin on website.

Substrates must be dry (below 5.5% moisture).	Damp substrates may cause delamination, window-framing. Screeds over damp substrates may not dry at the usual rate. (see “Screeds”)
Surface sealers	Surface sealers are incompatible with most penetrating sealers and will peel off them. Consult a sealing expert before proceeding. Glossy surface sealers can offer a high level of protection but can detract from the natural look of the tiles. Some tend to absorb stains.
Tonal variation: blend tiles from different pallets or crates to avoid a concentration of tone.	Tonal variation is an attractive feature of the product. Random blending will provide a pleasing mix of varying tones. Do not attempt to diminish tonal variation with chemicals without seeking advice.
Underside: Do not install the material upside down.	The underside has not been tested for surface characteristics and is therefore not warranted against wear.
Water: Do not allow water to pond, spot or ring on the surface - wipe up promptly.	Spots or ponds of water and other liquids on the surface can cause dull spots or shadows, especially prior to the final buff and seal. These marks usually diminish with ongoing use and maintenance.
Wear	The product has a Mohs hardness of 6 and is rated “Heavy Commercial” for the Robinson Floor Test (USA). Surface scratching is not an indication of excessive wear (see “Scratches”).
Window framing (or “picture framing”) is a condition where the perimeter of the tile shows a different tone from the centre.	Mild window framing is a natural feature of the product, adding interest to the floor. During periods of storage closely packed tiles may dry more quickly at the edges than the centre. Wet or variable storage conditions and damp substrates can cause or exacerbate window framing. (See “Storage”.)