



**Corrosion
Engineering™**

AN ERGONARMOR COMPANY

TECHNICAL INFORMATION

CES-309

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CORROSION ENGINEERING SPECIFICATION FOR INSTALLATION

CORROSION-RESISTANT TILE/BRICK FLOORING USING THE TILE SETTER'S METHOD OF CONSTRUCTION

1. SCOPE

- 1.1 The following specification governs materials, preparation and installation of a direct bond corrosion-resistant floor, employing the Tile Setter's method of application.

NOTE: For continuously wet conditions or severe chemical attack, consideration of a chemically resistant membrane under the mortar and tile/brick should be given. Consult CES-307, Corrosion Engineering Standard for Acid-Proof Brick Floors or CES-302 - Direct Bond Floor - Bricklayers Method.

- 1.2 Corrosion-resistant Brick/Tile Flooring is broadly used in the Food and Beverage Processing Industries as a durable and aesthetically pleasing floor to provide protection to concrete from organic and inorganic acids, salts, detergents, alkali cleaning agents, oils, solvents and a variety of organic foodstuffs. The brick or tile flooring functions as a mechanical and thermal barrier, the grout functions as a corrosion-resistant joint barrier. Depending on the degree of protection required, three types of setting beds are used.
- 1.3 The corrosion-resistant brick/tile flooring system utilizes either quarry/ ceramic tiles or red shale acid brick set by one of the following methods:
- A. Directly bonded to a pre-sloped concrete slab, using a 100% epoxy setting bed at 1/8" thick.
 - B. Set in sand/cement mixture or latex-modified cement mixture. Minimum thickness 3/4", maximum thickness 3". Slope may be designed and constructed with setting bed.

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- C. Set in a 1/8" latex modified mortar over a pre-sloped concrete slab.
- 1.4 Corrosion-resistant grout (furan, epoxy, vinyl ester) is then grouted into the side joints to form the complete protection system. The epoxy setting bed acts as a corrosion-resistant membrane that provides for a longer-lasting floor. Sand/cement or latex setting beds offer an alternative for less severe conditions. Sand/cement materials can be used as a sloping bed as well as a setting bed.

2. MATERIALS OF CONSTRUCTION

2.1 Ceramic Units

Quarry tile shall meet ASTM Specification C-242 and C-57, and should also meet ANSI A-137.1 for ceramic tile. Tile should conform to the dimensional tolerances specified by the Tile Council of America.

Brick pavers shall meet ASTM designations C-279 and C-410. Surfaces may have the following texture:

- A. Standard Smooth
- B. Smooth with diamond tread
- C. Wire-cut surface
- D. Slip-resistant abrasive finish

Ceramic units should have bonding surfaces suitable for adhesion to resinous cements. The manufacture of the tile shall be accurately controlled, and the tile shall not be warped, twisted, cracked or spalled.

NOTE: If furan grout or vinyl ester mortar is used, top surfaces of tile or pavers must be coated with wax. Care must be taken so that wax does not run onto edges, sides or bottoms of ceramic units.

2.2 Setting Beds

2.2.1 Epoxy Bed

The setting bed material shall be a 100% reactive epoxy adhesive composed of an epoxy resin, chemically curing hardener and silica filler. The adhesion of the epoxy setting bed shall be greater than the tensile strength of the concrete slab and also the brick and/or tile.

The epoxy setting bed shall have a minimum tensile strength of 2500 psi (ASTM C-307). Water absorption of the setting bed material shall not be greater than 0.28% (ASTM C-413).

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NOTE: To insure maximum protection and sealing of concrete, priming the concrete with an epoxy primer should be considered.

2.2.2 Sand-Cement Bed

This material shall meet the standards set by the American National Standard Specifications for Dry-Set Portland cement mortar, A118.1.

2.2.3 Latex Underlayment Bed

This material shall meet the standards set by the American National Standard Specifications for Latex-Portland Cement Mortar, A118.4.

2.3 Grouts

2.3.1 Furan Grout

The chemically-resistant furan grout shall consist of two components, a polyfurfuryl alcohol resin and carbon-filled powder. The furan grout shall be resistant to organic and non-oxidizing inorganic acids, most cleaning agents and detergents, oils, solvents and mineral salts. The furan grout shall be dense - 95 lbs/cu.ft., have minimum tensile strength of 700 psi (ASTM C-307); compressive strength 6000 psi (ASTM C-579); flexural strength 1000 psi (ASTM C-453); have excellent adhesion to wire-cut and matte brick, 500 psi (ASTM C-321); a low coefficient of thermal expansion, 20×10^{-6} (ASTM C-531); and low absorption 0.5% or less.

2.3.2 Water-Cleanable Epoxy Grout

The chemically resistant grout shall be a 100% solids, epoxy composition, consisting of three components. The components, when mixed, must be partially soluble by water, to aid in cleaning from tile surfaces.

The adhesion of the epoxy grout shall be greater than the tensile strength of concrete and also brick or tile. The grout shall be dense, 100 lbs/cu.ft. minimum; have minimum compressive strength of 9000 psi (ASTM C-579); minimum tensile strength of 9000 psi (ASTM C-307); flexural strength of 3750 psi (ASTM C-580); and low water absorption - 0.4% maximum (ASTM C-413).

2.3.3. Grout - Vinyl Ester

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Where resistance to bleaching agents, chlorine and strong oxidizing inorganic acids, a vinyl ester grout shall be used as a side joint material. The vinyl ester grout shall have a compressive strength minimum 10,000 psi (ASTM C-759); tensile strength minimum 1300 psi (ASTM C-307), shrinkage <0.80 %; thermal expansion 17.7×10^{-6} (ASTM C-531), and low absorption 0.28% (ASTM C-413). Grout shall not contain asbestos fibers.

2.4 Expansion Joint Materials

Expansion Joints are required to accommodate mechanical or thermal stresses in the flooring. Expansion joints are placed in intervals of 20 to 40 feet along the brick flooring, and around fixed points of construction. A 2-component epoxy joint filler shall be used in traffic-bearing areas, having Shore A hardness of 70-80. A polysulfide joint filler is used in all other areas, having Shore A hardness of 20-30. A 100% closed cell foam rod should be installed, such that the foam rod completely covers the joint bottom.

3. MATERIALS OF CONSTRUCTION TRADE NAMES

- 3.1 Epoxy setting bed - THINSET® Adhesive (Product Data Sheet CE-158) from Corrosion Engineering meets the requirements listed in the previous section. Epoxy Primer - PENNTROWEL® Epoxy Primer (Product Data Sheet CE-139).
- 3.2 Furan Grout - FURALAC® Red Panel Mortar (Product Data Sheet CE-130) from Corrosion Engineering meets the requirements listed in the previous section.
- 3.3 Epoxy Grout - PENNTROWEL® Water-Cleanable Epoxy Grout (Product Data Sheet CE-234) from Corrosion Engineering meets the requirements listed in the previous section
- 3.4 Vinyl Ester Grout - PENNTROWEL Vinyl Ester Mortar (Product Data Sheet CE-231) from Corrosion Engineering meets the requirements listed in the previous section.
- 3.5 Epoxy Expansion Joint/Sealant - FLEXJOINT® Joint Filler (Product Data Sheet CE-133) from Corrosion Engineering meets the requirements listed in the previous section.
- 3.6 Polysulfide Joint/Sealant - FLEXJOINT® Polysulfide Joint Sealant (Product Data Sheet CE-241) from Corrosion Engineering meets the requirements listed in the previous section.

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- 3.7 Expansion joint backer rod - Dow Chemical Co. "Ethafoam" or equivalent.

4. CONCRETE PREPARATION

- 4.1 New concrete shall be structurally sound, homogeneously poured, clean, free of dirt or contamination, and dry. It shall have been moist-cured for a minimum of 28 days (see ASTM D-4263). The base slab shall be wood float finished, with no low spots where puddles can form when slab is flooded with water. Concrete should have smooth surface and be sloped to drain at 1/4"per foot.

Prior to commencement of any work, the flooring contractor shall thoroughly examine all new floor surfaces, and report any conditions which will adversely affect proper floor installation.

- 4.2 Existing concrete which is clean, dry, structurally sound, and can safely support the superimposed load shall be considered satisfactory. Contaminated concrete which otherwise meets these requirements shall be thoroughly cleaned and left clean and dry. Eroded, broken, chipped and cracked concrete shall be repaired and cured prior to installation of tile or brick. If not provided in the existing slab, a slope of 1/4"/ft. to the drains shall be established.

5. SELECTION OF SETTING BED MATERIALS

Tile or brick ceramic units can be set in one of three standard materials and methods. Choose one of the following based on performance, cost and installation time requirements.

- 5.1 Epoxy Setting Bed - 1/8" continuous layer, 100% solids epoxy

Concrete base slab is pre-sloped to drains. For use where maximum protection from chemical exposure, thermal shock and constant wet conditions is required.

For application, see section 6.1-"Application of Epoxy Setting Bed".

- 5.2. Sand-cement, setting/sloping bed -

3/4" to 3" of sand/cement which is used to create slope to drain as well as providing setting bed for brick or tile, Primarily for use where time and cost are factors. This technique provides excellent protection against physical abuse. Should not be used where thermal shock or constant wet conditions are expected.

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For application see section 6.2 -"Application of Setting/ Sloping Bed - Portland Sand/ Cement".

5.3 Latex Setting Bed - 1/8" continuous layer latex mixture.

Concrete base slab is pre-sloped to drains. Latex setting bed material has medium compressive strength (5000 psi). Faster cure time and mild chemical resistance to acids and alkalis.

For application see section 6.3 -"Application of Latex Setting Bed".

6. INSTALLATION

6.1 Application Of Epoxy Setting Bed

6.1.1 Mix epoxy setting bed material in accordance with manufacturers recommendations. (Read Product Data Sheet CE-158 and product container labels for additional mix instructions).

6.1.2 Mix until resin, hardener and filler are blended uniformly. Setting bed material which begins to cure cannot be recovered by adding more resin. Do not add water, Portland cement or any additives or adulterants to any components or the mixed setting bed.

6.1.3 Apply the setting bed material in a continuous layer to a thickness of 1/8" directly on the concrete slab by trowel, ensuring that there are no voids.

6.1.4 To improve bond strength and to ensure that concrete is sealed (prevents moisture from inhibiting cure), concrete may first be coated with epoxy primer. Epoxy setting bed should be placed while primer is tacky.

6.1.5 After placement of tile, allow for a minimum 24 hour cure at 70°F for initial set of setting bed before grouting side joints.

6.1.6 If temperature is below 50°F, see Section 7 - "Installation Temperatures".

6.2 Application Of Setting/Sloping Bed - Portland Cement/Sand

6.2.1 A standard sand/cement mix may consist of: 1 part cement, 6 parts sand, and up to 1/10th part hydrated lime by volume. Mix with only sufficient water to yield a nearly dry mix.

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- 6.2.2 Prior to applying the sand/cement mortar bed, spread a thin continuous coating of pure Portland cement slurry. This will serve as a thin uniform bonding coat.
- 6.2.3 Spread mixed material on base slab a minimum of 3/4" and not more than 3" thick. As work progresses, the bed should be leveled to slope smoothly and suitably to all drains.
- 6.2.4 Surface may be sprinkled with dry Portland cement, to a maximum depth of 1/32" Surface should be sprinkled with water; tiles are then set in this nearly dry mixture.
- 6.2.5 Let setting bed cure for at least 48 hours at 70°F before grouting. If using a furan grout, remove all traces of Portland cement with 10% muriatic acid, wash with clean hot water and allow to dry. An alkaline base will inhibit the cure of furan grout.

6.3 Application Of Latex Setting Bed

- 6.3.1 Mix latex setting bed material in strict accordance with manufacturer's written instructions.
- 6.3.2. Place a small amount of the liquid latex on the base slab and scrub into the surface with a stiff brush. The rest of the material is placed and spread to a total minimum thickness of 3/16". Use a screed or trowel, being careful to follow contours and to avoid leaving hollows or low spots. After placement of the tile, a minimum of 24 hours at 70°F must be allowed for initial set of the bed before side joints are grouted. At lower temperatures, allow for greater set time. If using a furan grout, remove all traces of Portland cement with 10% muriatic acid, and wash with clean hot water.
- 6.3.3 Let latex setting bed cure for at least 24 hours at 70°F before grouting. If using a furan grout, remove all traces of Portland cement with 10% muriatic acid, wash with clean hot water and allow to dry. An alkaline base will inhibit the cure of furan grout.

6.4 Placement of Tile and Pavers

- 6.4.1 Before initial hardening has taken place in the setting bed material, place the tile or paver onto bed and place a straight edge over tile and tap until true surfaces of tile are attained. Nominal 1/4" side joints should be maintained unless otherwise specified. The slope shall be properly maintained to prevent any puddling. High points of

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a sloped floor shall be a rolled surface so as not to expose the corners of the tile to the potential of cracking or chipping.

- 6.4.2 If Portland cement and/ or latex modified concrete is used, rake excess mortar from joints to remove all setting bed material to the full depth of the tile or paver. If using a furan grout, after the bed is cured, wash joints with muriatic acid to remove all traces of Portland cement from the sides of tile and brick pavers, and to also neutralize the bottom of the joint. Wash with hot water and allow to dry.

Optional: Brick shall be laid in a running or stack bond pattern - stretcher coursing may be installed around piers, perimeter of room, at high points, and at drains.

- 6.4.3 Brick or tile must be clean and dry, and temperature of brick or tile should be as close to 70°F as possible.

Note: Use separate trowels to apply epoxy, latex or Portland cement setting bed materials and furan or vinyl ester mortar. Do not mix epoxy setting bed material and furan mortar together. Take care in avoiding contamination of air setting bed material with grouting material in side joints.

6.5 Grouting Side Joints

- 6.5.1 Allow setting bed to cure for minimum specified time depending upon setting bed material used, before grouting. Mix grout in accordance with manufacturer's written instructions. Pour the mixed grout on the floor and fill side joints by spreading with a squeegee or metal trowel. Use two grout passes with thicker tile to allow out gassing of grout. After side joints are entirely full, remove excess with trowel or squeegee, using diagonal strokes. After the grout has achieved full cure, clean the tile by washing with hot water joints that have settled or receded shall be repointed. Joints shall be smooth, free of lumps, or entrapped air. A chemical-resistant grout that has begun to set cannot be re-used or re-tempered.

6.6 Cleaning Ceramic Units

- 6.6.1 If using a furan grout, material should achieve full cure before being cleaned with hot water. Joints that have settled or receded shall be repointed.

- 6.6.2 If using a Water-Cleanable Epoxy Grout, clean-up should begin 20

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minutes after grouting, using cold water and mops. If a film remains, scrub using a mixture of muriatic acid and water. Grout should not be allowed to cure on paver or tile face. Consult manufacturer for further details.

6.7 Expansion Joints

6.7.1 Expansion and control joints may be installed in widths from 1/4" to 1", although in most facilities, a 1/2" wide joint is the norm. When installing material, apply surface primers to clean and dry joints.

6.7.2 Expansion Joint Locations

- A. Expansion joints shall be installed around all fixed objects except drains.
- B. Expansion joints shall be installed around the periphery of all rooms.
- C. Expansion joints shall be installed over all points of movement in concrete slab and over concrete control joints at a maximum distance of 20 feet apart.
- D. Expansion Joints shall be located near the crown of a sloped floor.
- E. Drains should be located as nearly as possible to the midpoint between expansion joints.

6.7.3 Horizontal expansion joints should be filled with a pouring viscosity joint sealant. Cove base and vertical joints should be filled with a caulking viscosity.

6.7.4 A cross-linked 100% closed cell polyethylene foam shall be installed as a backer rod in the construction of the expansion joint. The backer rod shall have a compressibility of 25% at a stress of 4.7 psi in accordance with ASTM D-1621. The uncompressed diameter of the backer rod shall be 50% greater than the width of the joint. The depth of the expansion joint material shall be twice the width of the joint.

6.7.5 An epoxy expansion joint sealant of suitable hardness should be used in areas of frequent and heavy traffic to prevent chipping and spalling of brick. A polysulfide expansion joint sealant should be used around the peripheries of rooms and in areas of light traffic.

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- 6.7.6 Concrete Joint Preparation - Brick/tile/concrete joint surfaces shall be clean, latence and all loose particles shall be removed by brushing or with air blast.
- 6.7.7 Joint Installation - place polyethylene foam in clean and dry joint.
- 6.7.8 Prime joint surfaces with mortar manufacturers' suitable primer. Avoid priming polyethylene foam. Fill primed joint within 4 hours after priming, and while primer exhibits a tacky condition. Re-prime if primer has cured beyond tack-free condition.
- 6.7.9 Fill horizontal joints in two pours, waiting 15 to 30 minutes between pours to allow for settling and air in joints to escape. Caulk vertical joints by knife or caulking gun in one application.
- 6.7.10 Do not apply expansion joint sealant when brick/ tile flooring is less than 50°F, or when joint surfaces are wet.

7. INSTALLATION TEMPERATURES

- 7.1 Epoxy setting bed material, furan and vinyl ester mortar, epoxy and polysulfide expansion joint material are formulated for installation between 50°F and 80°F.
- 7.2 If installation temperatures are below 50°F, substitute cold room hardeners or additives.
 - A. Substitute a cold room hardener for the epoxy setting bed material.
 - B. Use a cold room accelerator for the furan mortar.
 - C. Store product components as close to 75°F as possible. Store brick/ tile at 75°F for at least 48 hours. Avoid frost or moisture by keeping brick or tile under cover.
- 7.3 If installation temperatures are above 85°F:
 - A. Mix smaller batches of epoxy setting bed material and furan mortar.
 - B. Keep product components and brick/tile as close to 70°F as possible. Refrigerate resinous components 48 hours prior to use.
 - C. Set mixing pan for mortar and/ or setting bed material in cool water or

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ice bath. Avoid contaminating mortar mix or setting bed mix with water.

8. CLEANING - (Furan and vinyl Ester Grout Joints)

- 8.1 Steam cleaning shall be performed as soon as possible after all excess grout is struck from the surface of the tile, stains are removed and cement has fully cured and hardened. Remove all wax and excess material. Where necessary, repoint joints for a full sealed, smooth and proper installation. Note: Under no circumstances shall any acid be used in the cleanup work without the engineer's prior approval.

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- 9.2 Please contact Corrosion Engineering for specific recommendations at +1-610-833-4000 or fax +1-610-833-3040.

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