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AMERICAN NATIONAL STANDARD SPECIFICATIONS FOR THE INSTALLATION OF CERAMIC TILE

ANSI A108, A118, & A136 — 1999

American National Standard

for Installation of Ceramic Tile

Secretariat

Tile Council of America, Incorporated

Approved October 27, 1999

American National Standards Institute, Inc.

Abstract

This publication is a compilation of voluntary standards for the installation of ceramic tile. American national standard specifications A108.1A, .1B, .1C, .4, .5, .6, .8, .9, .10, .11, .12, and .13 define the installation of ceramic tile. American national standard specifications A118.1, .3, .4, .5, .6, .7, .8, .9, .10, and .11 and A136.1 define the test methods and physical properties for ceramic tile installation materials. These standards are intended to be referenced or included in the ceramic tile sections of project specifications.

American National Standard

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Foreword (This foreword is not part of American National Standard A108, 118, or 136—1999.)

These voluntary standards define the installation of ceramic tile as well as the test methods and physical properties for ceramic tile installation materials. They are intended to serve as a guide to the general public, manufacturers, distributors, specifiers, architects, tile contractors, testing laboratories, and other businesses and professionals in the tile industry.

While the existence of these standards does not in any respect preclude anyone, including those who have accepted them, from manufacturing, marketing, purchasing, or using products, processes, or procedures not conforming to this standard, producers of ceramic tile installation materials made in conformance with these standards are encouraged individually to indicate such conformance in advertising, promotion, and labeling.

These standards were processed and approved for submittal to ANSI by the Accredited Standards Committee on Ceramic Tile A108. Committee approval of a standard does not necessarily imply that all committee members voted for its approval. The A108 Committee had the following members at the time it approved these standards:

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*Joe A. Tarver, Acting Chairman
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Foreword

Explanation and notes

AN-1 Introduction

AN-1.1 The applicable ANSI specifications for ceramic tile installed with portland cement mortar, dry-set or latex-portland cement mortar, organic adhesive, epoxy adhesive, chemical resistant water cleanable tile-setting and -grouting epoxy, chemical resistant furan mortar and grout, modified epoxy emulsion mortar, and the ANSI specifications for the installation of ceramic tile grouts should be made a part of a project specification by reference or by copying the applicable parts of the ANSI specification and including into the ceramic tile sections of a project specification. In either case, augment the ANSI specifications and modify the specific project conditions.

NOTE – If ceramic tiles irregular in size and/or thickness (not conforming to ANSI A137.1) are specified and specialized methods are required for installation, labor and material costs will be increased.

AN-1.2 American national standard specifications A118.1, .3, .4, .5, .6, .7, .8, .9, .10, and .11, and A136.1 for ceramic tile installation materials are included with these ANSI specifications as separate documents and should also be referenced or included in project specifications.

AN-1.3 The term "thin-set" is not specific. "Thin-set" describes a family of products manufactured to be used as setting and/or bonding coats. When a thin-set method is desired for which there is a specification, the appropriate ANSI specification should be referenced by both number and title.

AN-1.4 American National Standard Specification A10.20 Safety Requirements for Ceramic Tile, Terrazzo and Marble Work is protocol for job site safety for the tile industry. It should be treated as a separate document and should be referenced or included in project specifications.

AN-2 General requirements for subsurfaces

AN-2.1 General

The quality and cost of ceramic tile installations are influenced by the stability, permanence, and precision of installation of the backing or base material. Make the materials and recommendations included under "Related Work Specified in Other Sections," part of the appropriate section of the project specifications by inclusion or reference.

AN-2.1.1 Specific operations that may be performed by one or more trades are clearly assigned to one trade in these standard specifications to permit uniform bidding. When the tile contractor is to perform any of the work included in "Related Work Specified in Other Sections" indicate this in the scope and include the appropriate specifications from "related" sections in the tile section of the project specification.

AN-2.2 Floor drains

Specify floor drains to comply with ANSI A112.21.1M-1980 (R1990). Slope in subfloor shall be specified in sections such as concrete or carpentry and not with the mortar setting bed. Mortar bed to be of uniform thickness.

AN-2.3 Deflection

Floor areas over which tile is directly bonded to subfloor shall not have a deflection greater than 1/360 of the span when tested per ASTM C627. Make allowance for live load and impact as well as all dead load, including weight of tile and setting bed.

NOTE – Stone tile installations may require a more rigid substrate. Refer to Marble Institute of America recommendations.

AN-2.4 Backing surfaces

Ceramic tile can be installed over horizontal and vertical building surfaces by one or more methods described in these documents. Tile can be installed directly over sound, clean, and dimensionally stable

surfaces with one of the thin-set methods, or with a mortar bed method.

AN-2.4.1 Some backing materials are subject to deterioration when subjected to moisture. When a tile installation is subjected to frequent wetting, backing materials of concrete, portland cement mortar, cementitious backer units, or masonry are recommended.

AN-2.4.2 Where the backing surface can be damaged by water, is not continuous, is cracked, or is dimensionally unstable, a membrane is required to separate the backing surface from the mortar setting bed and tile. The membrane, or cleavage membrane as it is generally called on a horizontal surface, is always a material that is not damaged by water. It does not form an impermeable membrane that will hold water, but is intended to protect backings from water damage. When waterproofing is desired, a waterproofing membrane will also serve as a cleavage membrane for a full mortar bed installation. (See Paragraph A-2.1.8.)

AN-2.4.3 **CAUTION** – Wood-based panels such as particle board, composite panels (veneer faces bonded to reconstituted wood cores), non-veneer panels (wafer board, oriented strand board, and other similar boards), lauan plywood, and softwood plywood expand and contract with changes in moisture content and are not recommended as backing materials for ceramic tile. Plywood, however, manufactured with fully waterproof adhesive and with an exposure durability rating of Exposure 1 or Exterior may be used on residential horizontal surfaces when installed in accordance to Paragraph AN-3.4.

AN-2.5 Backing materials for walls and ceilings

Requirements of backing materials for walls and ceilings for methods of tile installation are covered by these ANSI specifications: portland cement mortar, dry-set or latex-portland cement mortar, and organic adhesive or epoxy adhesive.

CAUTION – Wood-based panels such as particle board, composite panels (veneer faces bonded to reconstituted wood cores), non-veneer panels (wafer board, oriented strand board, and other similar boards), lauan plywood, and softwood plywood expand and contract with changes in moisture content content and are not recommended as backing materials for ceramic tile. (See Paragraph A-2.4.3)

AN-2.5.1 Ceramic tile installed with portland cement mortar

AN-2.5.1.1 Gypsum backing: When the specified method of setting tile is in portland cement mortar and the backing is gypsum plaster, gypsum block, or gypsum board, specify the application of a membrane and metal lath to cover the backing.

AN-2.5.1.2 Concrete and masonry walls

AN-2.5.1.2.1 Where tile is applied directly to concrete or concrete masonry walls, provide properly located control joints or other effective measures to prevent cracking.

AN-2.5.1.2.2 Sound, crack-free concrete and masonry walls which are smooth, dusty, coated with form-release compounds, painted, effloresced, or have loose surface material may be prepared for direct application of mortar and tile (no membrane or metal lath) by mechanically scarifying to completely expose uncontaminated backing surface. Specify the preparation work in the ceramic tile section of the project specifications or in the appropriate section for related work. As an alternate to mechanically scarifying, specify metal lath, with or without membrane, in the project specifications.

AN-2.5.1.2.3 The architect or specifier shall design exterior walls that are to receive tile on exterior or interior face to prevent moisture from collecting behind the tilework. This may include flashing, copings, membranes, vapor barriers, and weep holes as required.

AN-2.5.2 Ceramic tile installed with dry-set or latex-portland cement mortar

AN-2.5.2.1 Suitable backings: Prepared suitable backings include plumb and true masonry, concrete, lean portland cement mortar and cured portland cement mortar (cured conventional setting beds), cementitious backer units, brick, ceramic tile, marble and dimension stone, and, in dry areas only, gypsum board.

AN-2.5.2.2 Other backings: On all other solid backing surfaces for walls and ceilings, specify membrane, metal lath, and a portland cement mortar

bed or cementitious backer units. Solid wall surfaces in dry locations may be covered with gypsum board.

AN-2.5.3 Ceramic tile installed with organic adhesive or epoxy adhesive

AN-2.5.3.1 The surfaces hereinafter listed are used for wall and ceiling surfaces to receive ceramic tile applied with organic adhesives or epoxy adhesives. In every case the backing surface must be clean, dry and, if portland cement mortar or concrete, fully cured with a maximum variation of ¼-inch in 10 feet (6 mm in 3 m) from the required plane; nor more than 1/16 inch in 12 inches (2 mm in 305 mm) when measured from the high points in the surface. For materials not listed consult the adhesive manufacturer.

AN-2.5.3.2 Suitable backings: Suitable prepared backings for dry areas include gypsum board, cementitious backer units or gypsum plaster, portland cement mortar, formed concrete, and masonry. Suitable prepared backings for wet areas include portland cement mortar, formed concrete, masonry, cementitious backer units, or water-resistant gypsum backing board for walls only. (See Paragraph AN-4.15.)

AN-2.5.3.3 CAUTION – Gypsum wallboard (ASTM C36) or gypsum plaster shall not be used in wet areas. (See Paragraph AN-4.15)

AN-2.6 Backing materials for floors

Following are requirements of backing materials for floors for methods of tile installation covered by these ANSI specifications: portland cement mortar, dry-set or latex-portland cement mortar, organic or epoxy adhesive, chemical resistant water cleanable tile-setting and -grouting epoxy, modified epoxy emulsion mortar, and chemical resistant furan mortar.

CAUTION – Wood-based panels such as particle board, composite panels (veneer faces bonded to reconstituted wood cores), non-veneer panels (wafer board, oriented strand board, and other similar boards), lauan plywood, and softwood plywood expand and contract with changes in moisture content and are not recommended as backing materials for ceramic tile. Plywood, however, manufactured with fully waterproof adhesive and with an exposure durability rating of Exposure 1 or Exterior may be used on residential horizontal surfaces when installed in accordance to Paragraph AN-3.4.

AN-2.6.1 Ceramic tile floors installed with portland cement mortar

AN-2.6.1.1 Slab-on-grade construction where no bending stresses occur may have mortar and tile bonded directly to them. Specify such floor surfaces to have a steel trowel and fine broom finish, wood float finish, or mechanical scarification.

AN-2.6.1.2 All other concrete floors, including all precast concrete floor systems, require a cleavage membrane between the concrete and mortar surfaces. Require such floor surfaces to have a steel trowelled finish. In these cases specify a cleavage membrane and reinforcing mesh in the mortar bed in the ceramic tile section of the project specifications.

AN-2.6.1.3 Where tile is installed over wood subfloors, specify a membrane and a wire reinforced portland cement mortar setting bed of uniform thickness.

AN-2.6.1.4 Where a wire reinforced mortar bed for floors is installed over cleavage membrane, specify reinforcing and thickness as follows:

	Extra Heavy/Heavy	Moderate	Residential
Thickness of bed	2-1/2 inch minimum; 3-1/2 inch maximum	1-1/4 inch minimum; 2-1/2 inch maximum	3/4 inch minimum; 1-1/4 inch maximum
Reinforcing Fabric	(Reference paragraph A-2.1.7)	(Reference paragraph A-2.1.7)	Expanded Metal Lath (See Paragraph A-2.1.6)
Placement of Reinforcing	Suspend reinforcing wire in the mortar bed.	Suspend reinforcing wire in the mortar bed.	Fasten expanded metal lath to substrate.

AN-2.6.1.5 Mortar beds in excess of 3-½" in thickness may require heavier reinforcing, larger aggregate, richer mix, greater compaction, and must be detailed by appropriate authority.

AN-2.6.2 Ceramic tile floors installed with dry-set, latex-, or EGP (Exterior glue plywood) latex-portland cement mortar

AN-2.6.2.1 Install floor tile over a portland cement mortar bed of uniform thickness that is placed by the tile contractor in accordance with ANSI A-108.1A, .1B, or .1C. Identify areas in drawings and in the proper sections of the project specifications and include instructions for proper elevations of the substrate to accommodate the thickness of mortar bed and tile.

AN-2.6.2.2 Other suitable substrates to receive ceramic floor tile are structural concrete slabs of limited area and slab-on-grade construction where no bending stresses occur; also, if expressly approved by the mortar manufacturer, surfaces such as portland cement terrazzo and existing ceramic tile. Surfaces must be clean, free of wax, curing compounds, and other coatings. They shall be dry, stable, and well cured with a maximum permissible variation of ¼-inch in 10 feet (6 mm in 3 m) from the required plane; nor more than 1/16 inch in 12 inches (2 mm in 305 mm) when measured from the high points in the surface.

AN-2.6.2.3 Alternate

Cementitious backer units installed over subfloor with dry-set portland cement mortar and fastened to subfloor with galvanized nails, screw type nails, or other corrosion-resistant fasteners. This method does not allow leveling the floor.

AN-2.6.2.4 Plywood

Limit plywood surfaces to dry, interior floor, counter, and vanity top applications only. These areas shall be limited to dry or limited water exposure areas such as residential kitchens, toilet rooms, commercial dry area interiors, and decoration or similar areas with like service requirements. Surfaces must be structurally sound, dry, and free of contaminants such as sealers, cleaning compounds, coatings, oil, dust, dirt, etc. Special construction is required to leave an 1/8 inch (3mm) wide space between panels and 1/4 inch (6mm) wide space between panel and any restraining surface which it abuts, such as columns or perimeter walls, *for expansion*. Plywood substrates shall have a maximum permissible variation of ¼-inch in 10 feet (3 mm in 3m) from the required plane; nor more than 1/16 inch in 12 inches (2 mm in 305 mm) when measured from the high points in the surface. *Floor surfaces along adjacent edges of panels shall not be more than 1/32 inch (1 mm) above or below each other.* (See Paragraph AN-3.4.3.)

NOTE – Only EGP latex-portland cement mortars which are approved by the manufacturer for bonding to wood underlayments covered in Paragraph AN-3.4.3 may be used for plywood applications.

AN-2.6.3 Ceramic tile floors installed with organic adhesive or epoxy adhesive

AN-2.6.3.1 Surfaces hereinafter listed are commonly used as backing for floor surfaces to receive ceramic tile applied with organic adhesive or epoxy adhesive. In every case the backing surface must be sound, clean, and dry. Additional precautions, if any, are listed for the individual material. For materials not listed, consult adhesive manufacturer. Ceramic tile floors set with organic adhesives are suitable for residential traffic only.

AN-2.6.3.2 Concrete slabs, existing ceramic tile, and terrazzo

Floor surface shall be dry, structurally sound, and free of wax, curing compounds, or other coatings. Slabs-on-grade subject to moisture transmission are not suitable for ceramic tile set with organic adhesive.

AN-2.6.3.3 Wood subfloors

Concentrated live load and dead load deflection shall not exceed 1/360 of span when tested per ASTM C627. For installation methods, refer to Paragraph AN-3.4. See cautionary note in Paragraph AN-2.6.

NOTE – Stone tile installations may require a more rigid substrate. Refer to Marble Institute of America recommendations.

AN-2.6.4 Ceramic tile floors installed with chemical resistant, water cleanable tile-setting and -grouting epoxy and modified epoxy emulsion mortar

AN-2.6.4.1 The surfaces hereinafter listed are used as backings to receive ceramic tile set and grouted with chemical resistant, water cleanable epoxy or modified epoxy emulsion mortar. In every case the backing must be free of ridges and depressions, sound, clean, and dry. Additional precautions are listed for the individual backing materials.

AN-2.6.4.2 Concrete slabs, existing ceramic tile, and terrazzo

Floor surface shall be dry, structurally sound, and free of wax, curing compounds, or other coatings. Sound, crack-free concrete which is smooth, dusty, coated with form-release compounds, painted, efflouresced, or has loose surface material may be prepared for direct application of tile by mechanically scarifying to completely expose uncontaminated backing surface. Specify the preparation work in the ceramic tile section of the project specifications or in the appropriate section for related work.

AN-2.6.4.3 Steel plate

Consult the tile-setting epoxy manufacturer for specific recommendations. Steel plate shall be flat, clean, dry, and fastened to prevent movement at abutting plate edges.

AN-2.6.4.4 Wood subfloor

Limit to interior floor applications only. Surfaces must be structurally sound, dry, and free of contaminants such as sealers, cleaning compounds, oil, dirt, dust, etc. Special construction is required to leave ¼-inch gaps between plywood sheets, which will be filled with tile-setting epoxy or modified epoxy emulsion mortar during the setting operation. (See Paragraph AN-3.4.2.5.)

AN-2.6.4.5 Cured portland cement mortar bed for floors

Specify the placement of portland cement mortar bed in accordance with the requirements of ANSI A108.1A. Suggest it to be damp cured under cover for 96 hours at 70°F (21°C) or above and then allowed to dry before tile are set. For lower temperatures, longer cure times may be necessary. Consult tile-setting epoxy manufacturer for specific recommendations.

AN-2.6.4.6 For backing information when tile are only to be grouted with epoxy (set with other than chemical resistant epoxy), consult the applicable American national standard specifications for other installation methods. Use of cement or sand spacing mix is not permitted.

AN-2.6.4.7 For backing materials not listed, consult the tile-setting epoxy manufacturer.

AN-2.6.4.8 Service temperature

Where installations will be exposed to repeated thermal shock or temperatures above 140°F (60°C) or below 32°F (0°C) during use, consult the epoxy manufacturer for information regarding temperature limitations.

AN-2.6.5 Ceramic tile floors installed with chemical resistant furan mortar

AN-2.6.5.1 Furan mortar bond coats utilize catalysts to make them cure. Alkaline or portland cement based substrates may require special preparation. Consult furan manufacturer.

AN-2.7 Waterproofing

Specify and detail on drawings, location and depth of depression in floor to accommodate wire reinforced mortar bed, waterproof membrane, and tile. See Paragraphs AN-2.6.1.4 and AN-2.6.1.5 for mortar bed thickness. Refer to membrane and tile manufacturer data for thickness to be included in depression.

AN-2.7.1. Thin-bed

When the substrate cannot be depressed, specify a load bearing, bonded, waterproof membrane designed for this purpose and meeting the requirements of American National Standard A118.10.

AN-3 Related work specified in other sections

AN-3.1 General

Where preparatory work is done by other trades, include tolerances, finishing, and other requirements in applicable sections of project specification. The following materials are recommended for inclusion in appropriate sections of project specification.

AN-3.2 Requirements for concrete masonry: preparations by other trades

AN-3.2.1 Concrete slabs

AN-3.2.1.1 Where the mortar bed for the tile floors is to be bonded to concrete slabs, include the following paragraph in the concrete section:

"Screed finish concrete slabs that are to receive ceramic tile. Maximum permissible variation in the plane or slope ¼-inch in 10 feet (6 mm in 3 m) from the required plane when measured with a straight edge. Depress slabs that are to receive tile. Properly cure slabs without using liquid curing compounds or other coatings."

If mortar bed is to be applied over a cleavage membrane, substitute "steel trowel" for "screed" in the first sentence.

AN-3.2.1.2 Where tile is to be bonded directly to concrete slabs with one of the thin-set methods (See Paragraph AN-1.3) include the following in the concrete section:

"Steel trowel and fine-broom finish concrete slabs that are to receive ceramic tile. Maximum permissible variation ¼-inch in 10 feet (6 mm in 3 m) from the required plane. Cure concrete slabs that are to receive tile before tile application. Do not use liquid curing compounds or other coatings that may prevent bonding of tile setting materials to slabs. Slab shall be dry at time of tile installation. Since any cracking of the concrete slabs will be transmitted to the finished surface, take all precautions to prevent cracks in the concrete. Use control joints through the slab and tile finish as specified or where cracks are anticipated."

AN-3.2.1.3 Exterior slabs shall be supported so that there will be no settlement, excessive deflection, or heaving from frost action. Exterior slabs-on-grade require a porous base with adequate drainage; edges of exterior slabs exposed to moisture either directly or from contact with soils require a vapor barrier at these edges.

AN-3.2.1.4 Interior slabs-on-grade require vapor barriers at underside of slab and at edges of slab.

AN-3.2.2 Depressed slabs

Where finished tile floors are to be flush with adjacent floors, depress concrete slabs the thickness of the mortar bed, bond coat, and tile, allowing additionally for membranes and concrete fill, if applicable. Note the dimension for depression as well as the areas to be depressed on project drawings and designate in project specification.

AN-3.2.3 Changes in level

Specify thresholds to adjust between adjacent finish floor levels when substrate cannot be depressed. Changes in level up to ¼-inch may be vertical and without edge treatment, however, protection of exposed tile edges is advisable. Changes in level between ¼-inch and ½-inch shall be beveled with a slope no greater than 1:2.

AN-3.2.3.1 Changes in level greater than ½-inch shall be accomplished by means of a ramp. The least possible slope shall be used for any ramp. The maximum slope of a ramp in new construction shall be 1:12.

AN-3.2.3.2 Curb ramps and interior or exterior ramps to be constructed on sites or in existing buildings or facilities where space limitations prohibit the use of a 1:12 slope or less may have slopes and rises as follows:

AN-3.2.3.2.1 A slope between 1:10 and 1:12 is allowed for a maximum rise of 6 inches.

AN-3.2.3.2.2 A slope between 1:8 and 1:10 is allowed for a maximum rise of 3 inches. A slope steeper than 1:8 is not allowed.

AN-3.2.3.2.3 If existing thresholds at doors are 3/4 inches in height or less and have (or are modified to have) a beveled edge on each side, they may remain.

AN-3.2.4 Concrete or mortar fill

If fill is required to receive floor tile and mortar bed, or to provide necessary slope, specify and show it to be a least 1-½ inches (38 mm) thick plus the dimension for slope. Specify reinforced concrete fill and show dimensions and location on project drawings. When floors require fill or slope, specify in the tile section. Tile contractor shall provide and install fill to conform with current industry recommendations (see Paragraph A-4.1a.2.3), local building code, or project specification and drawings. Cure fill without using curing compounds or other coatings.

AN-3.2.5 Vertical surfaces

AN-3.2.5.1 Specify the plane of wall surfaces to receive ceramic tile, set with a mortar bed, to have square corners and to be plumb and true, with variations not exceeding ¼-inch in 10 feet (6 mm in 3 m) from the required plane.

AN-3.2.6 Bonding to concrete or masonry surfaces

Specify a bondable surface, free of all contaminants such as sealers, cleaning compounds, coatings, oil, and dust. Surface preparation may be necessary to provide a bondable surface.

AN-3.2.7 Flashing and drainage

Design exterior walls, that are to receive tile on exterior or interior face, to prevent moisture from collecting behind the tilework. This may require flashing, copings, membranes, vapor barriers, and weep holes as required.

AN-3.2.8 Testing

Waterproofing shall be tested by the waterproofing contractor just prior to commencing the tile installation.

AN-3.3 Requirements for lathing and portland cement plastering

AN-3.3.1 General

The portland cement plaster scratch coat, including metal lath is normally included in the lathing and plastering section of the project specification except in a few geographical locations where it is customary to include the scratch coat in the tile section. When the lath and scratch coat is to be part of the tilework, so state in the tile section of the project specification.

AN-3.3.2 Metal lath

All lathing used as backing for tile applied on interior walls and ceilings shall be metal complying with ASTM C-847, except steel need not be copper bearing and may be painted. Metal lath on exterior walls shall comply with ASTM C-847 and be galvanized. Lath shall be flat-expanded type and weigh not less than 2.5 pounds per square yard (1.4 kg/m^2). Membrane material may be preassembled to metal lath provided it is capable of being lapped metal to metal and membrane to membrane. Neither flat rib metal lath nor 3/8 inch (10 mm) rib metal lath shall be used for tile backing.

AN-3.3.3 Application of lath

Before applying metal lath to wood studs, wood furring, or to steel studs, first secure membrane over studs or furring, with joints lapped. The method of securing lath to wall or stud surfaces shall conform to building codes.

AN-3.3.3.1 Install a membrane of 15-lb. (730 g/m^2) roofing felt or 4-mil (100 microns) polyethylene film, free from holes or breaks and lapped shingle fashion a minimum of 2 inches (50 mm), in back of all tilework unless otherwise noted.

AN-3.3.3.2 Extend lath in showers to within 2 inches (50 mm) of floor and lap over shower pan.

Nails in lath shall not be placed below top of shower pan.

AN-3.3.3.3 Lap metal lath a minimum of 2 inches (50 mm) at sides and ends where sheets are joined. Lap preassembled membrane and metal lath metal to metal and membrane to membrane. Lap wire fabric one full mesh, wire to wire, where joined.

AN-3.3.4 Scratch and leveling coat mix for walls and ceilings

The mix for scratch and leveling coats for application to metal lath, concrete, and masonry surfaces shall be as follows:

AN-3.3.4.1 1-part portland cement, ½-part hydrated lime, and 4-parts dry sand or 5-parts damp sand by volume; or 1-part portland cement and 3-parts dry sand or 4-parts damp sand by volume.

AN-3.3.4.2 When hand mixing, thoroughly mix dry mortar ingredients before adding water to obtain proper consistency. When machine mixing, add water first. Discard mortar when it has reached its initial set.

AN-3.3.4.3 Over clean interior concrete block walls, scratch coat may be omitted and the tile setter's mortar bed, not to exceed 3/4 inch (19 mm) thick, may be used directly over the properly dampened block surface.

AN-3.3.5 Application of scratch coat

Apply scratch coat to lath or to prepared, clean masonry. Bushhammer or heavy sandblast concrete surfaces for a degree of roughness to provide mechanical bond.

AN-3.3.5.1 Cure scratch coat for a least 24 hours before applying leveling coat:

AN-3.3.5.2 Apply leveling coat over scratch coat when its surface varies more than ¼-inch in 8 feet (6 mm in 2.4m) from the required plane, or when mortar bed thickness of more than 3/4 inch (19 mm) is required to build out to finished tile surface. Scratch and cure leveling coat.

AN-3.4 Wood subfloors

PLYWOOD FLOORS UNDER CERAMIC TILE				
		Minimum Plywood Thickness (in.)		
Use	**Joist Spacing (in.)**	**Subfloor[1]**	**Under-layment[2]**	**Tile Installation**
Residential	16	19/32"	—	Cement Mortar (1-1/4" minimum)
	16	19/32"	11/32"	Organic or Epoxy Adhesive[3]
	16	19/32"	15/32"	Epoxy Mortar[3]
	16	19/32"	7/16" CBU	Dry-Set or Latex-Portland Cement Mortar
	16	19/32"	15/32"	EGP (Exterior Glue Plywood) latex-portland cement mortar
Commercial	16	19/32"	—	Cement Mortar (1-1/4" minimum)
	16	19/32"	19/32"	EGP (E xterior Glue Plywood)
	16	19/32"	19/32"	Epoxy Mortar[3]
(1) APA-Rated Sheathing or APA Rated Sturd-I-Floor with floor span rating of 20" or more except as noted.				
(2) APA-underlayment or sanded grade, except as noted.				
(3) Special construction requires leaving gaps between plywood (underlayment) sheet when epoxy or epoxy adhesive is used. See Paragraphs AN-3.4.2.4 and AN-3.4.1.4.				

AN-3.4.1 Requirements for carpentry for organic adhesive or epoxy adhesive ANSI A108.4

Where ceramic tile is to be bonded directly to plywood floors with organic adhesive include the following requirements in the carpentry section of the project specification. (See Paragraph AN-2.6.3.)

AN-3.4.1.1 Floor framing

Maximum spacing of 16 inches (406 mm) on center with framing size and span in accordance with applicable building code provisions for floors and floor loading.

AN-3.4.1.2 Subfloor

Exposure 1 or Exterior plywood conforming to provisions of Voluntary Product Standard PS 1-95 for Construction and Industrial plywood, or plywood APA Rated Sheathing, or plywood APA Rated Sturd-I-Floor conforming to provisions of APA PRP-108, Performance Standards and Policies for Structural-Use Panels or PS 2-92, Performance Standards for Wood-based Structural-Use Panels, or 1" nominal boards.

Underlayment — Plywood Underlayment, Exposure 1 or C-C plugged Exterior, or sanded plywood grades with special innerply construction conforming to underlayment provisions of Voluntary Product Standard PS 1-95 for Construction and Industrial plywood, or plywood APA Rated Sturd-I-Floor conforming to provisions of APA PRP-108, Performance Standards and Policies for Structural-Use Panels or PS 2-92, Performance Standards for Wood-based Structural-Use Panels. Each panel of subfloor and underlayment shall be identified with a trademark of the recognized quality assurance agency.

AN-3.4.1.3 Over 19/32 inch (15 mm) thick structural subflooring, 1-by-6 inch (19 x 140 mm) tongue and grooved boards, or other structural subflooring, secure 11/32 inch (9 mm) thick underlayment with adhesive or 3d ring shank nails; locate nails at 6 inch (152 mm) centers along panel edges and 8 inch (203 mm) centers each way throughout the panel; offset joints of subfloor and underlayment. Fasteners should not penetrate framing below.

AN-3.4.1.4 Leave an 1/8 inch (3 mm) wide space between panels and ¼-inch (6 mm) wide space between panel and any restraining surface which it abuts, such as columns or perimeter walls, *for expansion*. Floor surfaces along adjacent edges of sheets shall not be more than 1/32 inch (1 mm) above or below each other.

AN-3.4.2 Requirements for carpentry for chemical resistant epoxy mortar ANSI A108.6

Where plywood floors are used as a backing for bonding ceramic tile on floors with epoxy, include the following requirements in the carpentry section of project specifications.

AN-3.4.2.1 Floor framing

Maximum spacing of 16 inch (406 mm) on center with framing size and span in accordance with applicable building code provisions for floors and floor loading.

AN-3.4.2.2 Subfloor

Exposure 1 or Exterior plywood conforming to provisions of Voluntary Product Standard PS 1-95 for Construction and Industrial plywood, or plywood APA Rated Sheathing, or APA Rated Sturd-I-Floor conforming to provisions of APA PRP-108, Performance Standards and Policies for Structural-Use Panels or PS 2-92, Performance Standards for Wood-based Structural-Use Panels, or 1" nominal boards.

Underlayment — Plywood Underlayment, Exposure 1 or C-C plugged Exterior, or sanded plywood grades with special innerply construction conforming to underlayment provisions of Voluntary Product Standard PS 1-95, Construction and Industrial plywood, or plywood APA Rated Sturd-I-Floor conforming to provisions of APA PRP-108, Performance Standards and Policies for Structural-Use Panels or PS 2-92, Performance Standards for Wood-based Structural-Use Panels. Each panel of subfloor and underlayment shall be identified with a trademark of the recognized quality assurance agency.

AN-3.4.2.3 Over 19/32 inch (15 mm) thick structural subflooring, 1-by-6 inch (19 x 140 mm) tongue and grooved boards, or other structural subflooring, secure 15/32 inch (12 mm) underlayment for residential use, or 19/32 inch (15 mm) underlayment for commercial and light institutional use, with adhesive or with 4d ring shank nails; locate nails at 6 inch (152 mm) centers along panel edges and 8 inch (203 mm) centers each way throughout the panel; offset joints of subfloor and underlayment. Fasteners should not penetrate framing below.

AN-3.4.2.4 Deleted 1999

AN-3.4.2.5 Leave a ¼-inch (6 mm) wide space between underlayment panel edges and between all materials which they abut, such as walls, drains, and posts. When underlayment is installed over a subfloor, space 4d ring shank nails in underlayment at 6 inch (152 mm) centers along panel edges and 8 inch (203 mm) centers each way throughout the panels, or use an adhesive specifically approved for this purpose. Floor surfaces along adjacent edges of panels shall not be more than 1/32 inch (1 mm) above or below each other. Cover the ground in crawl spaces beneath such floors with a vapor barrier equivalent to 6-mil (150 microns) polyethylene.

AN-3.4.3 Requirements for carpentry for EGP (Exterior glue plywood) latex-portland cement mortars A108.12

Where plywood underlayment is required as a backing for bonding ceramic tile on floors with EGP latex-portland cement mortar, include the following requirements in the carpentry section of project specifications.

AN-3.4.3.1 Floor framing

Maximum spacing of 16 inches (406 mm) on center with framing size and span in accordance with applicable building code provisions for floors and floor loading.

AN-3.4.3.2 Subfloor

Exterior or Exposure 1 plywood conforming to provisions of Voluntary Product Standard PS 1-95, Construction and Industrial, or plywood APA Rated Sheathing, or plywood APA Rated Sturd-I-Floor conforming to provisions of APA PRP-108, Performance Standards and Policies for Structural-Use Panels or plywood conforming to the provisions of Voluntary Standard PS 2-92, Performance Standards for Wood-based Structural-Use Panels, or 1 inch nominal boards.

Underlayment — Plywood Underlayment, C-C plugged Exterior, or sanded plywood grades with special innerply construction conforming to underlayment provisions of Voluntary Product Standard PS 1-95, Construction and Industrial plywood, or exterior glue plywood APA Rated Sturd-I-Floor conforming to provisions of manufacturing and Performance Standards for APA rated Sturd-I-Floor panels. Each panel of subfloor and underlayment shall be identified with a trademark of the approved quality-assurance agency.

AN-3.4.3.3 Over 19/32 inch (15 mm) thick plywood subflooring, or 1-by-6 inch (19 x 140 mm) tongue and grooved boards, or other subflooring, secure 15/32 inch (12 mm) underlayment for residential use, or 19/32 inch (15 mm) underlayment with plugged crossbands under face for commercial and light institutional use, with adhesive and with 4d ring shank nails; locate nails at 6 inch (152 mm) centers along panel edges and 8 inch (203 mm) centers each way throughout the panel; offset joints of subfloor and underlayment. Fasteners should not penetrate framing below.

AN-3.4.3.4 Leave a 1/8 inch (3 mm) wide space between panels and ¼-inch (6 mm) wide space between panel and any restraining surface which it abuts, such as columns or perimeter walls, *for expansion.* When underlayment is installed over a subfloor, space 4d ring shank nails in underlayment at 6 inch (152 mm) centers along panel edges and 8 inch (203 mm) centers each way throughout the panels and use an adhesive specifically approved for this purpose. Floor surfaces along adjacent edges of panels shall not be more than 1/32 inch (1mm) above or below each other. Cover the ground in crawl spaces beneath such floors with a vapor barrier equivalent to 6-mil (150 microns) polyethylene.

AN-3.5 Requirements for gypsum board: preparations by other trades

AN-3.5.1 Dry areas

Install gypsum wallboard (ASTM C-36) in accordance with GA-216. Treat all joints with tape and one coat of joint compound. Cover heads of all fasteners with two coats of joint compound.

AN-3.5.1.1 CAUTION — Gypsum wallboard (ASTM C-36) and water-resistant gypsum backing board shall not be used on ceilings or in critical exposure areas such as exteriors, showers, saunas, or steam rooms. (See Paragraph AN-4.15).

AN-3.5.2 Wet areas

Install water-resistant gypsum backing board, complying with ASTM C630, in accordance with GA-216. All joints and interior corners shall be finished flush with the surface of the gypsum board with setting-type joint compound and tape.

AN-3.5.2.1 CAUTION — Gypsum wallboard (ASTM C36) or gypsum plaster shall not be used in wet areas. (See Paragraph AN-4.15.)

AN-3.5.3 Water-resistant gypsum backing board used in wet areas shall be installed over framing not to exceed 16 inches (406 mm) on center. A ¼-inch (6 mm) gap shall be left between the paper

edge and tub. The gap shall be caulked with a flexible sealant.

AN-3.5.3.1 CAUTION — Gypsum wallboard (ASTM C-36) and water-resistant gypsum backing board shall not be used on ceilings or in critical exposure areas such as exteriors, showers, saunas, or steam rooms. (See Paragraph AN-4.15.)

AN-3.5.4 Reinforce interior angles with supports to provide rigid corners.

AN-3.6 Requirements for plumbing: preparations by other trades

AN-3.6.1 Where the receptor portions of ceramic tile shower floors, roman bathtubs, and similar areas, are on-site, built-up plumbing fixtures, they are to comply with the plumbing code and standards adopted by the municipality where the structure is being built. Plumbing codes in the United States include the Uniform Plumbing Codes, sponsored by International Association of Plumbing and Mechanical Officials; The Basic Plumbing Code, sponsored by Building Officials and Code Administrators International, Inc.; and the Standard Plumbing Code, sponsored by the Southern Building Code Congress.

AN-3.6.2 Prior to applying waterproof membranes, most plumbing codes require that floors of showers and roman tubs be sloped, by means of a smooth and solidly-formed sloping sub-base, to weep holes located in clamp style drains.

AN-3.6.2.1 Codes contain exacting requirements for installation of waterproof membranes, such as height above curbs, reinforcing at corners, mopping, and other requirements. Waterproofing membranes include:

AN-3.6.2.1.1 Three layers of hot-mopped roofing felt.

AN-3.6.2.1.2 Factory manufactured, sheet membranes.

AN-3.6.2.1.3 Lead or copper, which require insulation by coatings of asphaltic or coal tar pitch products between lead or copper and concrete, mortar, or dissimilar metals.

AN-3.6.2.1.4 Trowel applied membranes.

AN-3.6.3 Height of finished curbs above drain determines whether or not units are classified as showers or tubs. Curbs up to 9 inches (229 mm) are considered a shower unit. Curbs over 9 inches (229 mm) are considered a tub unit.

AN-3.6.4 Bathtubs require a secure and adequate support because of the combined weight of the tub, plus person plus the water. Specify as follows:

"Secure bathtubs on metal hangers or on end grain wood blocks secured to wall structure. Set tubs close enough to wall so that ceramic tile covers the lip of the tub."

AN-3.6.5 Prefabricated shower receptors must be solidly set in mortar to prevent any movement or flexing of the unit from the weight of a person using the shower. Specify as follows:

"Install prefabricated shower receptors in such a manner that they will not move or flex from the weight of persons using the shower unit."

AN-3.6.6 Before installation, place a bead of caulking or sealant between rim on sinks or lavatories and ceramic tile counter tops or vanities.

AN-3.7 Requirements for movement joints: preparations by other trades

NOTE – The American Concrete Institute has defined the following joints:

Construction: The surface where two successive placements of concrete meet, across which it may be desirable to achieve bond and through which reinforcement may be continuous.

Contraction joint: Formed, sawed, or tooled groove in a concrete structure to create a weakened plane and regulate the location of cracking resulting from the dimensional change of different parts of the structure.

Control joint: See contraction joint.

Expansion joint: (1) A separation provided between adjoining parts of a structure to allow move-

ment where expansion is likely to exceed contraction; (2) a separation between pavement slabs-on-grade, filled with a compressible filler material; (3) an isolation joint intended to allow independent movement between adjoining parts.

Isolation joint: A separation between adjoining parts of a concrete structure, usually a vertical plane, at a designated location such as to interfere least with performance of the structure, yet such as to allow relative movement in three directions and avoid formation of cracks elsewhere in the concrete and through which all or part of the bonded reinforcement is interrupted.

AN-3.7.1 It is not the intent of these specifications to make movement joint recommendations for specific projects. Specifier shall specify and detail movement joints and show locations.

AN-3.7.1.1 Openings for movement joints shall extend completely through tilework down to structural backing (membranes may remain continuous). Movement joints shall be kept free of all surface preparation materials, reinforcing, and construction debris.

AN-3.7.2 Exteriors

For temperature changes up to 100 degrees F: Locate movement joints in exterior tile work on walls and floors not more than 16 feet on center based on a ½-inch wide movement joint. For temperature changes greater than 100 degrees F: add 1/16 inch for every 15 degrees F increment. Movement joints are also required over all construction, control, or expansion joints in the backing and where backing materials change or change directions, including terminations of tilework where it would abut restraining or dissimilar surfaces.

AN-3.7.3 Interiors

For environmentally controlled interiors not subjected to temperature variations greater than 20 degrees F or exposed to moisture, place field movement joints twice the distance as required for exteriors (24 to 32 feet on center) and at all other locations as required in Paragraph AN-3.7.2.

AN-3.7.3.1 Interior areas exposed to direct sunlight shall have expansion joints spaced at 8 feet to 12 feet (2.4 m to 3.5 m).

AN-3.7.4 Requirements for sealing expansion joints in tilework

AN-3.7.4.1 The installation of back-up strip and sealant is to be done by the caulking and sealant contractor. Include the following in the caulking and sealant section of the project specifications:

AN-3.7.4.1.1 "Unless otherwise specified, use sealants complying with ASTM C920, which designates sealants according to type, grade, class and uses. The following are suitable for use in tilework.

Type S: single-component sealant.

Type M: multi-component sealant.

Grade P: pourable or self-leveling sealants for joints on horizontal surfaces.

Grade NS: non-sagging sealants for joints in vertical surfaces.

Class 25 or 12-½ identifies sealants which can withstand an increase and decrease of ±25% or ±12-½% of joint width.

Use T: use in joints subjected to pedestrian and vehicle traffic.

Use NT: sealants for nontraffic exposures.

Uses M and G: sealants that will remain adhered to mortar (M) and glass (G) are suitable for use with tilework.

Suitable sealants include silicone, urethane, and polysulfide. Generally, urethane sealants are recommended for exterior vertical tile surfaces and both exterior and interior horizontal tile surfaces, including tiled traffic areas. Cured sealants in traffic areas require a Shore A Hardness of 35 or greater.

Back-up strip shall be a flexible and compressible type of closed-cell foam polyethylene, butyl rubber, or open cell and closed cell polyurethane, rounded at surface to contact sealant, and as recommended by sealant manufacturers. It must fit neatly into the joint without compacting and to such a height to

allow a sealant depth of ½ the width of the joint. Sealant must not bond to the back-up material."

AN-3.7.4.1.2 "Tile edges to which the sealant will bond shall be clean and dry. Primer on tile edges is mandatory when recommended by sealant manufacturer. Keep primer off tile faces."

AN-3.7.4.1.3 "Install sealant after tilework and grout are dry. Follow sealant manufacturer's recommendations."

AN-3.7.5 Saw-tooth joints

Saw-tooth joints affect the performance of sealant and caulking materials and are not recommended.

AN-3.8 Damage to tilework

After completion and cleaning, the obligation of the tile contractor ceases as to damage or injury which may be done to the tilework by others.

AN-3.9 Maintenance

All tile installations and especially exterior installations require periodic inspection and maintenance. All exterior installations require inspection and routine maintenance including the application of hydrophobic sealers, repair of movement joints, and replacement of cracked or missing tiles and grout. It is the owner's responsibility to provide for routine inspection and appropriate maintenance. Consult material manufacturers and maintenance products manufacturers for recommended procedures.

AN-4 Notes for tile material, accessories, and definitions

AN-4.1 Include a full description of each type of tile to be used in project specification. Refer to Paragraph A-2.1.1 of the standard specifications herein in addition to grade markings on tile containers. When specified by the architect, Master Grade Certificates will be issued at the time of shipment. The covering order is required to show the names of the architect and owner and the name and location of the project. Specimens of the Master Grade Certificate and applicable labels are shown in ANSI A137.1.

AN-4.2 Exteriors

On exteriors, use only tile recommended by the manufacturer as suitable for the climatic conditions of the locality.

AN-4.3 Interiors

Use only tile types recommended by the manufacturer as suitable for walls and/or floors (traffic areas).

AN-4.3.1 CAUTION — Although organic adhesives provide a good bond for floor tile to substrate, they may provide insufficient support under non-residential loads, resulting in the cracking of tile. ANSI A118.1 dry-set portland cement mortars, ANSI A118.4 latex-portland cement mortars, ANSI A118.3 epoxy mortars, and ANSI A118.11 EGP (Exterior glue plywood) latex-portland cement mortars are preferable setting systems for floor tile installations.

AN-4.4 Inspection

If desired, specify inspection or approval of the tile as in Paragraph A-2.1.1 of the standard specifications herein and the procedure that is to be followed to inspect and approve tile before installation.

AN-4.5 Tile accessories

Show location of accessories such as towel bars, paper, soap and tumbler holders and grab rail on drawings and specify types in project specifications.

AN-4.6 Specifying organic adhesive

Specify type of adhesive in accordance with ANSI A136.1 Standard Specifications for organic adhesives for installation of ceramic tile Type I or Type II. This American National Standard is included herein.

AN-4.7 Specifying dry-set mortar

Specify dry-set mortar in accordance with ANSI A118.1 Standard Specifications for dry-set portland cement mortar. This American National Standard is included herein.

AN-4.7.1 Specialized mortars covered by ANSI A118.1 include the following types:
1) Fast setting dry-set mortar
2) Non-sagging dry-set mortar
If a specialized mortar is required, specify dry-set mortar in accordance with ANSI A118.1 Standard Specifications for dry-set portland cement mortar and type of specialized mortar to be used. This American National Standard is included herein.

AN-4.8 Specifying latex-portland cement mortar

Specify latex-portland cement mortar in accordance with ANSI A118.4 Standard Specifications for latex-portland cement mortar. This American National Standard is included herein.

AN-4.8.1 Specialized mortars covered by ANSI A118.4 include the following types:
1) Fast setting latex-portland cement mortar
2) Non-sagging latex-portland cement mortar
If a specialized mortar is required, specify latex-portland cement mortar in accordance with ANSI A118.4 Standard Specifications for latex-portland cement mortar and type of specialized mortar to be used. This American National Standard is included herein.

AN-4.8.2 Specifying EGP (Exterior glue plywood) latex-portland cement mortar

Specifying EGP latex-portland cement mortar in accordance with ANSI A118.11 Standard Specifications for EGP (Exterior glue plywood) latex-portland cement mortar. This American National Standard is included herein.

AN-4.9 Specifying tile-setting and -grouting epoxy and epoxy adhesive

Specify chemical resistant, water cleanable tile-setting and -grouting epoxy or epoxy adhesive in accordance with ANSI A118.3 Standard Specifications for chemical resistant, water cleanable tile-setting and-grouting epoxy and water cleanable tile-setting epoxy adhesive. This American National Standard is included herein.

AN-4.9.1 Where chemical exposure is not critical, chemical resistant epoxy grout may be sufficient. In such case, specify particular setting method desired and refer to appropriate ANSI Standard Specifications.

AN-4.10 Specifying chemical resistant furan mortars and grout

Specify chemical resistant furan mortars and grouts in accordance with ANSI A118.5 Standard Specifications for chemical resistant furan mortars and grouts. This American National Standard is included herein.

AN-4.11 Specifying modified epoxy emulsion mortar and grout

Specify modified epoxy emulsion mortar and grout in accordance with ANSI A118.8 Standard Specifications for modified epoxy emulsion mortar and grout. They are not designed for chemical resistance. This American National Standard is included herein.

AN-4.12 Specifying grouts

Specify grouts not covered in Paragraphs AN-4.9 through AN-4.11 in accordance with ANSI A118.6 or ANSI A118.7. This American National Standard is included herein.

AN-4.12.1 CAUTION — Exterior vertical surfaces in climates involving freeze-thaw conditions and high annual precipitation may require silicone rubber grout as joint filler between tiles, in lieu of cementitious grout.

AN-4.13 Specifying cementitious backer units

Cementitous backer units are fiber glass mesh-reinforced concrete construction units usually 7/16 inch minimum (11 mm) thickness. Follow manufacturers directions. Specify in accordance to ANSI A118.9. This American National Standard is included herein.

AN-4.14 Install and cure grout in accordance with appropriate ANSI Standard Specifications

A108.6 Chemical resistant epoxy grout. A108.8 Chemical resistant furan grout. A108.8 Modified epoxy emulsion grout, or A108.10 Installation of grout.

AN-4.15 Wet areas

Tile surfaces that are either soaked, saturated or subjected to moisture or liquids (usually water) such as in gang showers, tub enclosures, showers, laundries, saunas, steamrooms, swimming pools, or exterior areas.

AN-5 Guide for referencing American national standard specifications for installation of ceramic tile

Description of Method	Reference Method
I. Portland Cement Mortar Bed Installations:	
A. Ceramic tile set on a mortar bed which is still workable (Wet-Set Method). See Note.	ANSI A108.1A-Installation of Ceramic Tile in the Wet-Set Method with Portland Cement Mortar.
B. Ceramic tile set on a cured mortar bed with dry-set or latex- portland cement mortar.	ANSI A108.1B-Installation of Ceramic Tile on a Cured Portland Cement Mortar Setting Bed with Dry-Set or Latex-Portland Cement Mortar.
C. Ceramic tile set on a mortar bed by either of the above methods. Industry practice has resulted in a large majority of mortar bed installations being installed according to ANSI A108.1B. It is reasonable and economical to give the tile contractor the option to choose either method, which are recognized in the industry as equivalent methods for walls, ceilings, and floors.	ANSI A108.1C-Contractors Option: Installation of Ceramic Tile in the Wet-Set Method with Portland Cement Mortar -or-Installation of Ceramic Tile on a Cured Portland Cement Mortar Setting Bed with Dry-Set or Latex Portland Cement Mortar.
II. Thin-Set Installations:	
D. Tile set with dry-set portland cement mortar or latex-portland cement mortar on prepared concrete, masonry, cementitious backer units, or other cementitious underlayment and backer units certified by the manufacturer as suitable for intended use.	ANSI A108.5-Ceramic tile installed with dry-set or latex-portland cement mortar.
E. Tile set with organic adhesive or epoxy adhesive on smooth, sound interior surfaces.	ANSI A108.4-Ceramic tile installed with organic or epoxy adhesives.
G. Tile set with modified epoxy emulsion mortar.	ANSI A108.9-Ceramic tile installed with modified epoxy emulsion mortar/grout.
H. Tile set on prepared Exterior or Exposure 1 plywood with EGP (Exterior Glue Plywood) latex-portland cement mortar certified by the manufacturer as suitable for intended use.	ANSI A108.12-Ceramic tile installed with EGP (exterior glue plywood) latex-portland cement mortar.
III. Chemical Resistant Installations:	
I. Tile set and grouted with water cleanable, chemical-resistant tile-setting epoxy mortar.	ANSI A108.6-Ceramic tile installed with chemical epoxy mortar and grout.
J. Tile set and grouted with chemical-resistant furan.	ANSI A108.8-Ceramic tile installed with chemical-resistant furan resin mortar and grout.

NOTE – Wet-Set Method — The practice of setting ceramic tile in a thin bond coat on a portland cement mortar bed that is still workable.

End of Foreword — Explanation and Notes — 1999

American national standard specifications for installation of ceramic tile ANSI A108.1A, .1B, .1C, .4, .5, .6, .8, .9, .10, .11, .12, AND .13 — 1999

A-1 General

A-1.1 Scope

These ANSI specifications are intended to describe the minimum requirements of materials and workmanship for installation of ceramic tile. STORAGE OF MATERIALS AT PROJECT SITE, SAMPLES, ENVIRONMENTAL CONDITIONS AND PROTECTION, MATERIALS, AND GENERAL REQUIREMENTS FOR TILE INSTALLATION are part of each installation method in this standard. INSTALLATION OF TILE is specified separately for each installation method. Section A-4.1a, A-4.1b, A-4.1c, A-4.2, A-4.3, A-4.4, A-4.5, A-4.6, A-4.7, A-4.9.

A-1.2 Standards

The following standards and standard specifications, referred to thereafter by designation only, form a part of these standard specifications as modified and specified herein. Current edition of these standards and specifications should be utilized at all times.

American National Standards Institute, Inc. (ANSI)

A108.1A — 1999 Ceramic tile installed in the wet-set method with portland cement mortar.

A108.1B — 1999 Ceramic tile installed on a cured portland cement mortar setting bed with dry-set or latex-portland cement mortar.

A108.1C — 1999 Ceramic tile installed by contractors' option.

A108.4 — 1999 Ceramic tile installed with organic adhesive and epoxy adhesives and water cleanable tile-setting epoxy adhesive.

A108.5 — 1999 Ceramic tile installed with dry-set portland cement mortar or latex-portland cement mortar.

A108.6 — 1999 Ceramic tile installed with chemical resistant, water cleanable tile-setting and -grouting epoxy.

A108.8 — 1999 Ceramic tile installed with chemical resistant furan mortar and grout.

A108.9 — 1999 Ceramic tile installed with modified epoxy emulsion mortar/grout.

A108.10 — 1999 Installation of grout in tilework.

A108.11 — 1999 Interior installation of cementitious backer units.

A108.12 — 1999 Installation of ceramic tile with EGP (Exterior glue plywood) latex-portland cement mortar.

A108.13 — 1999 Installation of load bearing, bonded, waterproof membranes for thin-set ceramic tile and dimension stone.

A118.1 — 1999 Dry-set portland cement mortar.

A118.3 — 1999 Chemical resistant, water cleanable tile-setting and-grouting epoxy and water cleanable tile-setting epoxy adhesive.

A118.4 — 1999 Latex-portland cement mortar.

A118.5 — 1999 Chemical resistant furan mortars and grouts.

A118.6 — 1999 Standard ceramic tile grouts for tile installation.

A118.7 — 1999 Polymer modified cement grouts for tile installation.

A118.8 — 1999 Modified epoxy emulsion mortar/grout.

A118.9 — 1999 Cementitious backer units.

A118.10 — 1999 Load bearing, bonded, waterproof membranes for thin-set ceramic tile and dimension stone installation.

A118.11 — 1999 EGP (Exterior glue plywood) latex-portland cement mortar.

A136.1 — 1999 Organic adhesives for installation of ceramic tile.

A137.1 — 1988 Ceramic tile.

American Society for Testing and Materials (ASTM)

A82-97 Steel wire, plain, for concrete reinforcement.

A185-97 Steel welded wire fabric, plain, for reinforcing.

A653/A653M-99 Specification for steel sheet, zinc-coated (galvanized) or zinc alloy-coated (galvannealed) by the hot-dip process.

C36-97 Gypsum wallboard.

C91-98 Specification for masonry cement.

C144-97 Aggregate for masonry mortar.

C150-99a Portland cement.

C171-97a Sheet materials for curing concrete.

C206-84 (1997) Finishing hydrated lime.

C207-91 (1997) Hydrated lime for masonry purposes.

C627-93 Test method for evaluating ceramic floor tile installation systems using the Robinson-type floor tester.

C630/C630M-96a Water-resistant gypsum backing board.

C645-99 Nonstructural steel framing members.

C836-95 High solids content, cold liquid applied elastometric waterproofing membrane for use with separate wearing course.

C847-95 Metal lath.

C933-96a Welded wire lath.

C955-98 Load bearing (transverse and axial) steel studs, runner (track), and bracing or bridging, for screw application of gypsum panel products and metal plaster bases.

C1328-98 Specification for plastic (stucco) cement.

D226-97a Asphalt-saturated organic felt used in roofing and waterproofing.

D227-97a Coal-tar saturated organic felt used in roofing and waterproofing.

D4068-96 Chlorinated polyetheylene (CPE) sheeting for concealed water-containment membrane.

D4397-96 Polyetheylene Sheeting for construction, industrial, and agricultural applications.

D4551-96 Poly(vinyl chloride) (PVC) Plastic flexible concealed water-containment membrane.

Gypsum Association

GA-216-96 Application and Finishing of gypsum board.

A-1.3 Delivery, storage, and handling of materials at project site

Deliver and store packaged materials in original unopened containers with labels intact until time of use. Store and handle materials in a manner to prevent damage or contamination by water, freezing, or foreign matter.

A-1.4 Samples

Submit samples of materials, as they are designated in the project specification, for approval before de-

livery of material to the project site. Installed materials shall match approved samples within normal industry standards.

A-1.5 Environmental conditions and protection

A-1.5.1 Close spaces, in which tile is being set, to traffic and other work. Keep closed until tile is firmly set.

A-1.5.2 Do not walk on, nor work on, newly tiled floors without using kneeling boards or equivalent protection of the tiled surface.

A-1.5.2.1 Keep traffic off horizontal portland cement mortar installations for at least 72 hours.

A-1.5.2.2 Keep all traffic off epoxy and furan installed floors for at least 40 hours after grouting, and heavy traffic off for at least 7 days, unless otherwise specifically authorized by manufacturer.

A-1.5.3 Do not apply tile setting materials to surfaces that contain frost. Do not install tile in areas where the temperature is not maintained above 50°F (10°C) or the temperature of the backing is above 100°F (38°C).

A-1.5.3.1 Temperature of substrate shall be 60°F (16°C) and rising for application of epoxy and furan unless otherwise specifically authorized by its manufacturer.

A-1.5.3.2 Maintain epoxy and furan at a stable temperature between 60°F (16°C) and 90°F (32°C) during the curing period.

A-2 Materials

A-2.1 Materials shall conform with requirements of referenced standard specifications and requirements specified herein

A-2.1.1 Ceramic tile: ANSI A137.1.

A-2.1.1.1 Tile shall be Standard Grade unless Seconds or specially designed products are specified in the project specifications.

A-2.1.1.2 Tile shall be graded and containers grade-marked in accordance with requirements and minimum grade specifications established in ANSI A137.1. If Master Grade Certificates have been requested by the architects, the covering order for tile shall request Master Grade Certificates and show the names of architect and owner and the name and location of the project.

A-2.1.1.3 Tile types, sizes, colors and patterns: Types, sizes, colors, patterns, trim shapes, finishes, and required characteristics of all tile shall be as designated in the project specifications.

A-2.1.1.3.1 When installing tile with epoxy, surface-waxed tile may be used in areas where quality and appearance of installation may be enhanced.

A-2.1.1.4 Tile accessories: Types, sizes, shapes, colors, and finishes of glazed ceramic accessories such as towel bars and, paper, soap, and tumbler holders shall be as designated in the project specifications.

A-2.1.2 Cement

Cement shall be one of the following:

A-2.1.2.1 Portland cement: ASTM C150, Type I, gray or white as designated.

A-2.1.2.2 Masonry cement: ASTM C91, Type S or M as designated.

A-2.1.2.3 Plastic cement: ASTM C1328, Type S or M as designated.

A-2.1.3 Aggregate

Sand in accordance with ASTM C144 for mortar and for grout. Fine sand shall be clean, graded, and pass a 16-mesh screen.

A-2.1.4 Hydrated lime

ASTM C206, Type S or ASTM C207, Type S.

A-2.1.5 Water

Clean and potable.

A-2.1.6 Metal lath

Flat expanded type, weighing not less than 2.5 pounds per square yard (1.4 kg/m²). Metal lath for interiors shall comply with ASTM C847, except steel need not be copper bearing and may be painted. Metal lath for exteriors shall comply with ASTM C847.

A-2.1.7 Reinforcing wire fabric

Reinforcing shall be one of the following welded wire fabrics conforming to ASTM A82 and ASTM A185.

A-2.1.7.1 2 by 2 inch (50 by 50 mm) mesh. 16/16 wire.

A-2.1.7.2 3 by 3 inch (76 by 76 mm) mesh. 13/13 wire.

A-2.1.7.3 1-½ by 2 inch (38 by 50 mm) mesh. 16/13 wire.

A-2.1.7.4 2 by 4 inch (50 by 100 mm) mesh, 16/16 wire.

A-2.1.8 Membrane or cleavage membrane

Membrane material shall be one of following:

A-2.1.8.1 Roofing felt: ASTM D226 (15 lb. [730g/m²] asphalt-saturated) or ASTM D227 (13 lb. [635g/m²] coal-tar-saturated).

A-2.1.8.2 Reinforced asphalt paper, duplex type: ASTM C171.

A-2.1.8.3 Polyethylene sheeting, at least nominal thickness of 4-mil (100 microns): ASTM C171 or D4397.

A-2.1.8.4 High solids, cold liquid applied membrane: ASTM C836.

A-2.1.8.5 Chlorinated polyetheylene sheeting: ASTM D4068.

A-2.1.8.6 Polyvinyl chloride membrane: ASTM D4551.

A-2.1.9 Organic adhesives

ANSI A136.1 (Type I or Type II). Adhesives shall be certified by their manufacturer as proper for the intended application.

A-2.1.10 Dry-set portland cement mortar

ANSI A118.1. Dry-set mortars which are labeled for use with particular types of tile, such as wall tile, ceramic tile, mosaic tile, paver tile, or quarry tile are required by A118.1 to pass only the requirements for those types and shall be used to set only the types of tile for which they are intended.

A-2.1.11 Latex-portland cement mortars

A-2.1.11.1 Latex-portland cement mortar: ANSI A118.4.

A-2.1.11.2 EGP (Exterior glue plywood) latex-portland cement mortar: ANSI A118.11.

A-2.1.12 Primers

As required by the mortar or adhesive manufacturer.

A-2.1.13 Chemical resistant water cleanable tile-setting and -grouting epoxy: ANSI A118.3.

A-2.1.13.1 When ceramic mosaic tile, quarry tile, paver tile, and packing house tile are set with epoxy, grout shall be epoxy. For mild chemical resistance, tile shall be installed by other methods and grouted with epoxy when so specified in project specifications.

A-2.1.14 Water cleanable tile-setting epoxy adhesive: ANSI A118.3.

A-2.1.15 Chemical resistant furan resin mortar and grout: ANSI A118.5.

A-2.1.15.1 When quarry tile, paver tile, and packing house tile are set with furan, grout shall be furan. For mild chemical resistance, tile may be installed by other methods and grouted with furan when so specified in project specifications.

A-2.1.16 Ceramic tile grouts: ANSI A118.6 or ANSI A118.7 as designated.

A-2.1.17 Modified epoxy emulsion mortar and grout: ANSI A118.8.

A-2.1.18 Cementitous backer units: ANSI A118.9.

A-2.1.19 Divider strips

As designated in project specifications and shown on project drawings.

A-2.1.20 Thresholds

Ceramic tile, marble, slate, or stone, as designated in project specifications and shown on the project drawings.

A-2.1.21 Proprietary and trade-marked materials

Mix and use in strict accordance with manufacturer's directions unless otherwise specified in the project specifications.

A-3 General requirements for tile installations

A-3.1 Inspection of surfaces and conditions

Prior to commencing ceramic tilework, the tile contractor shall inspect surfaces to receive tile and accessories,and shall notify the architect, general contractor, or other designated authority in writing of any visually obvious defects or conditions that will prevent a satisfactory tile installation. Installation work shall not proceed until satisfactory conditions are provided.

A-3.1.1 All surfaces shall be structurally sound, clean, dry, and free of oily or waxy films and all foreign matter. Concrete surfaces shall be free of form oil, curing compounds, and laitance.

A-3.1.2 Concrete floors shall be screed-finished for application of bonded portland cement mortar bed, but steel-trowel finished if a cleavage membrane is used under the mortar bed. If tile is to be bonded directly to concrete floor with one of the thin-set methods, the slab shall have a steel trowel and fine broom finish, wood float finish, or mechanical scarification.

A-3.1.3 Grounds, anchors, plugs, hangers, door frames, electrical, mechanical, and other work in or behind tile shall be installed before tile work is started.

A-3.1.4 Surfaces to receive tile shall be plumb, level, and true with square corners. Floors in wet areas shall be sloped with cementitious fill under membrane. Maximum variation from required plane shall be:

A-3.1.4.1 Portland cement mortar bed (A108.1A Section A-4.1a)

A-3.1.4.1.1 Sub-floor surfaces: ¼-inch in 10 feet (6 mm in 3 m).

A-3.1.4.1.2 Wall and ceiling surfaces: ¼-inch in 10 feet (6 mm in 3 m).

A-3.1.4.2 Organic adhesive or epoxy adhesive (A108.4 Section A-4.2).

A-3.1.4.2.1 Sub-floor surfaces: 1/16 inch in 3 feet (2 mm in 1 m). Abrupt irregularities of more than 1/32 inch (1 mm) will not be acceptable.

A-3.1.4.2.2 Wall and ceiling surfaces: ¼-inch in 10 feet (6 mm in 3 m).

A-3.1.4.2.3 Gypsum board shall be installed and prepared in accordance with GA-216.

A-3.1.4.3 Dry-set portland cement mortar or latex-portland cement mortar: A108.5 (Section A-4.3), **Chemical resistant water cleanable tile-setting and-grouting epoxy:** A108.6 (Section A-4.4), **Furan:** A108.8 (Section A-4.5), **Modified epoxy emulsion mortar:** A108.9 (Section A-4.6.), and **EGP (Exterior glue plywood) latex-portland cement mortar:** A108.12 (Section A-4.9).

A-3.1.4.3.1 Sub-floor surfaces: ¼-inch in 10 feet (6 mm in 3 m).

A-3.1.4.3.2 Vertical surfaces: ¼-inch in 10 feet (6 mm in 3 m).

A-3.1.4.3.3 Tile shall not be installed on plywood underlayment with epoxy or modified epoxy emulsion mortar unless plywood is installed with ¼-inch (6 mm) wide gaps between sheets. If plywood underlayment has been installed without a ¼-inch (6 mm) gap between sheets, the joints shall be opened by cutting the underlayment to its full depth. Tile shall not be installed on plywood underlayment with EGP latex-portland cement mortar unless plywood is installed with 1/8 inch (3 mm) wide gaps between sheets. In conformance to the setting material manufacturers recommendations, the gap shall be filled with setting materials as it is spread or be left void. Plywood substrates shall be properly vented beneath the substrate to prevent accumulation of moisture. Plywood substrates shall be certified by the installer of the substrate that it is suitable for the installation of ceramic tile and has been installed in accordance with the specifications in Section AN-3.4. (Plywood underlayment with contaminated surface shall be cleaned by sanding to expose raw wood.)

A-3.2 Portland cement mortar bed as a backing when specified

A-3.2.1 Wet-set method (workable mortar bed)

A-3.2.1.1 Dry-set mortars and latex-portland cement mortars can be used as a 1/16" thick bond coat as is customary when a neat (pure) portland cement bond coat is used as in ANSI A108.1A.

A-3.2.2 Cured (pre-floated) portland cement mortar bed

A-3.2.2.1 Dry-set and latex-portland cement mortars can also be used on a cured (pre-floated) portland cement mortar bed according to ANSI A108.1B. Under normal job conditions, a minimum of 20 hours cure at 70°F (21°C) is adequate, but longer mortar bed cures up to 10 days are desirable.

A-3.2.2.2 Where tile is to be set in epoxy in accordance with ANSI A108.6, the mortar bed shall be damp cured under cover for 96 hours at a temperature of at least 70°F (21°C) or above and then shall be allowed to dry before tiles are set. Lower temperatures may necessitate longer curing times. Consult epoxy manufacturer for specific recommendations.

A-3.2.2.3 Where tile is to be set in organic adhesive in accordance with ANSI A108.4, the mortar bed shall be damp cured for 24 hours at a temperature of at least 70°F (21°C) or above and then shall be allowed to dry thoroughly before tiles are set.

A-3.2.3 Cementitous backer units (CBU)

A-3.2.3.1 Dry-set mortars and latex-portland cement mortars shall be used as a 3/32 inch minimum thick bond coat in accordance with ANSI A108.11.

NOTE – Cementitous backer units may be used as an alternate for a mortar bed as a backing where light weight construction or the need to eliminate recessing the sub-floor is a factor on interior installations.

A-3.3 Workmanship, cutting, and fitting

A-3.3.1 Center and balance areas of tile, if possible.

A-3.3.2 An excessive amount of cuts shall not be made. Usually, no cuts smaller than half size should be made. Make all cuts on the outer edges of the field.

A-3.3.3 Smooth cut edges. Install tile without jagged or flaked edges.

A-3.3.4 Fit tile closely where edges will be covered by trim, escutcheons, or other similar devices.

A-3.3.5 The splitting of tile is expressly prohibited except where no alternative is possible.

A-3.3.6 Maintain the heights of tilework in full courses to the nearest obtainable dimension where the heights are given in feet and inches and are not required to fill vertical spaces exactly.

A-3.3.7 Lippage: guidelines, explanation, and caution

Lippage refers to differences in elevation between edges of adjacent tile modules. These differences or perception thereof are influenced by many factors such as:

A) The allowable thickness variation of the tile modules when judged in accordance with manufacturing standards.

B) The allowable warpage of the tile modules.

C) The spacing or separation of each tile module, which would influence a gradual or abrupt change in elevation.

D) Angle of natural or manufactured light accentuating otherwise acceptable variance in modules.

E) Highly reflective surfaces of tile modules accentuating otherwise acceptable variance in modules.

The following chart is a guideline for identifying acceptable lippage — in addition to the inherent warpage of tile manufactured in accordance with ANSI A137.1 — for typical installations of tile :

Tile Type	Tile Size	Joint Width	Allowable Lippage
Glazed Wall/ Mosaics	1" x 1" to 6" x 6"	1/8" or less	1/32"
Quarry	6" x 6" to 8" x 8"	1/4" or greater	1/16"
Paver	All	1/8" to 1/4"	1/32"
Paver	All	1/4" or greater	1/16"

A-3.3.8 Nominal centerline of all joints should be straight and of even width with due allowances for hand-molded or rustic tiles.

A-3.3.9 Back-up all thin-set trim units and molded or shaped pieces and secure firmly in place.

A-3.3.9.1 Back-up all thick-bed nosings, coves, curbing, gutters, flat tile, and trim units and molded or shaped pieces.

A-3.3.9.2 Bond coat mix shall not be used to back-up thick-bed trim and angles.

A-3.3.10 Finish floor and wall areas level and plumb with no variations exceeding ¼-inch in 10 feet (6 mm in 3 m) from the required plane.

A-3.3.11 Install accessories in tilework to be evenly spaced, properly centered with tile joints, and level, plumb, and true to the correct projection. Install accessories at locations and heights designated.

A-3.3.12 Completed tilework shall be cleaned after all defective tile is replaced and the responsible party shall accept end use maintenance at that time.

A-3.3.13 Deleted 1999

A-3.4 Movement joints

It is not the intent of these specifications to make movement joint recommendations for specific projects. Specifier shall specify and detail movement joints and show locations.

A-3.4.1 Movement joints are required over all construction, control, and expansion joints in the backing and where backing materials change or change direction including terminations of tilework where it abuts restraining or dissimilar surfaces.

A-3.4.2 Movement joints are a requirement for tilework. (See Paragraph AN-3.7)

A-3.4.3 Movement joints shall be kept free and clear of all setting and grouting materials.

A-3.4.4 Tile edges to which the sealant will bond shall be clean and dry. Primer on the tile edges is mandatory when recommended by sealant manufacturer. Keep primer off tile faces.

A-3.4.5 Install sealant after tilework and grout are dry. Follow sealant manufacturer's recommendations.

A-3.5 Cleaning tile

A-3.5.1 See appropriate grout specification and/or manufacturer's recommendation for cleaning of tile after grouting.

A-3.5.2 Upon completion of setting and grouting, clean tile.

A-3.5.3 Acid or acid cleaners shall not be used to clean glazed tile.

A-3.5.4 When applicable, acid cleaning of unglazed tile shall not be done before 10 days after grouting. Tile and grout shall be soaked with water before cleaning. In the absence of recommendation from the grout manufacturer and/or tile manufacturer, acid cleaning may be done with a saturated solution of sulfamic acid in room-temperature water (approximately one pound of sulfamic acid crystals to five gallons of water).

All metal and enamel surfaces shall be protected with grease or petroleum jelly, or other protective coating to be removed after cleaning. Tile and grout shall be thoroughly flushed with water after acid cleaning.

A-3.5.4.1 **CAUTION –** Hydrochloric acid is not recommended.

End of general requirements — 1999

A-4 Installation of ceramic tile

Applicable portions of Section A-1 through A-3 are a part of these A108.1A installation specifications.

Ceramic tile installation methods are divided into twelve sections:

Installation of ceramic tile in the wet-set method, with portland cement mortar ANSI A108.1A (Section A-4.1a)

Installation of ceramic tile on a cured portland cement mortar setting bed with dry-set or latex-portland cement mortar ANSI A108.1B (Section A-4.1b)

Installation of ceramic tile with contractor's option: wet-set method with portland cement mortar OR on a cured portland cement mortar setting bed with dry-set or latex-portland cement mortar ANSI A108.1C (Section A-4.1c)

Installation of ceramic tile with organic adhesives or water cleanable tile-setting epoxy adhesive ANSI A108.4 (Section A-4.2)

Installation of ceramic tile with dry-set portland cement mortar or latex-portland cement mortar ANSI A108.5 (Section: A-4.3)

Installation of ceramic tile with chemical resistant, water cleanable tile-setting and -grouting epoxy ANSI A108.6 (Section A-4.4)

Installation of ceramic tile with chemical resistant furan resin mortars and grouts ANSI A108.8 (Section A-4.5)

Installation of ceramic tile with modified epoxy emulsion mortar/grout ANSI A108.9 (Section A-4.6)

Installation of grout in tilework ANSI A108.10 (Section A-4.7)

Interior installation of cementitious backer units ANSI A108.11 (Section A-4.8)

Installation of ceramic tile with EGP (Exterior glue plywood) latex-portland cement mortar ANSI A108.12 (Section A-4.9)

Installation of load bearing, bonded, waterproof membranes for thin-set ceramic tile and dimension stone ANSI A108.13 (Section A-4.10)

A-4.1a Installation of ceramic tile in the wet-set method, with portland cement mortar ANSI A108.1A — 1999

A-4.1a.1 Application of metal lath and scratch-coat to walls and ceilings

When it is specifically stated in the tile or plastering section of the project specifications that the metal lath and/or scratch coat is part of the tilework, preparation and installation of the metal lath and/or scratch coat shall be as follows:

A-4.1a.1.1 Metal lath: All lathing used as backing for tile applied on interior walls and ceilings shall be metal lath complying with ASTM C847, except steel need not be copper bearing and may be painted. Metal lath on exterior walls shall comply with ASTM C847 and be galvanized. Lath shall be flat expanded type and weigh not less than 2.5 pounds per square yard (1.4 kg/m^2). Preassembled membrane material shall be capable of being lapped metal to metal and membrane to membrane. Neither flat rib metal lath nor 3/8-inch (10 mm) rib metal shall be used for tile backing.

A-4.1a.1.2 Application of lath: Before applying metal lath to wood studs, wood furring, steel studs, or a solid backing, secure membrane over studs or furring, with joints lapped. The method of securing membrane and lath to wall or stud surfaces shall conform to building codes.

Install a membrane free from holes or breaks and lapped shingle-fashion a minimum of 2 inch (50 mm) in back of all tilework unless otherwise noted. Membrane may be 15-lb. roofing felt or 4 mil polyethylene film.

A-4.1a.1.2.1 Extend lath in showers to within 2 inches (50 mm) of floor and lap over the shower pan. Nails in lath shall not be placed below top of shower pan.

A-4.1a.1.2.2 Lap metal lath a minimum of 2 inches (50 mm) at sides and end where sheets are joined.

Lap preassembled membrane and metal lath, metal to metal and membrane to membrane. Lap wire fabric one full mesh, wire to wire, where joined.

A-4.1a.1.3 Scratch and leveling coat mix for walls and ceilings: The mix for scratch and leveling coats for application to metal lath, concrete, and masonry surfaces shall be as follows:

A-4.1a.1.3.1 1-part portland cement, ½-part hydrated lime, and 4-parts dry sand or 5-parts damp sand by volume; 1-part portland cement and 3-parts dry sand or 4-parts damp sand by volume; 1-part Type S or M masonry cement and 3-parts damp sand by volume; or 1- part Type S or M plastic cement and 3-parts damp sand by volume. Mix ratios can vary depending on local materials.

A-4.1a.1.3.2 When hand mixing, thoroughly mix dry mortar ingredients before adding water to obtain proper consistency. When machine mixing, add water first. Discard mortar when it has reached its initial set.

A-4.1a.1.4 Application of scratch coat: Apply scratch coat to lath or to prepared clean masonry.

A-4.1a.1.4.1 Cure scratch coat for at least 24 hours before applying the mortar bed.

A-4.1a.1.4.2 When a leveling coat (plumb scratch) over the scratch coat is specified, scratch and cure it at least 24 hours dependent upon climate conditions.

A-4.1a.2 Mortar mixes

A-4.1a.2.1 Mortar for walls and ceilings

A-4.1a.2.1.1 Mortar bed mix (also called float coat): from 1-part portland cement, ½-part hydrated lime and 5-parts damp sand to 1-part portland cement, 1-part hydrated lime and 7- parts damp sand, by volume; or 1-part Type S or M masonry cement and 3-parts damp sand by volume; or 1-part Type S or M plastic cement and 3-parts damp sand by volume. Mix ratios can vary depending on local materials.

A-4.1a.2.2 Mortar for floors

A-4.1a.2.2.1 Mortar bed mix: 1-part cement, 5-parts damp sand, and optionally, up to 1/10-part hydrated lime by volume. Mix ratios can vary depending on local materials.

A-4.1a.2.2.2 When mixed with water, the mortar shall be of such a consistency and workability that will allow maximum compaction during tamping of the mortar bed.

A-4.1a.2.3 Mortar and special requirements for shower receptors

A-4.1a.2.3.1 Mortar bed mix: 1-part portland cement and 4-parts damp sand, by volume.

A-4.1a.2.3.2 Make the mortar bed water-resistant by using an admixture. Mix and use this material in strict accordance with the manufacturers directions.

A-4.1a.2.3.3 After mixing with water, the mortar shall be of such a consistency and workability that will allow maximum compaction during tamping of the mortar bed.

A-4.1a.2.3.4 The shower drain shall be installed by the plumber. The waterproof membrane shall be installed over a slope of ¼-inch per foot (20 mm/m) to the drain weep holes.

A-4.1a.2.3.5 Reinforcing shall be suspended in mortar bed. Reinforcement shall not butt against vertical surfaces.

A-4.1a.2.3.6 Minimum thickness of mortar bed: 1-½ inches (38 mm) at any point or consistent with local plumbing code.

A-4.1a.2.3.7 High point of floor and pitch toward drain: The high point to the floor shall be not less than 2 inches (50 mm) or more than 9 inches (225 mm) below the top of the finished dam and the mortar fill, waterproof membrane and finished floor shall have a minimum of ¼-inch pitch toward the drain per foot (20 mm/m).

A-4.1a.2.4 Mixing mortar: When hand mixing, thoroughly mix dry mortar ingredients before add-

ing water to obtain proper consistency. When machine mixing, add water first. Discard mortar when it has reached its initial set.

A-4.1a.3 Bond coat mixes

A-4.1a.3.1 Bond coat for walls, ceilings, floors and shower receptors: Bond coat mix (also called skim coat, pure coat, or neat cement coat) shall be as follows:

A-4.1a.3.1.1 For walls and ceilings: Gray or white portland cement mixed with water to a creamy consistency. Rework from time to time. Additional water or cement shall not be added after initial mixing. Discard unused bond coat after initial set is reached.

A-4.1a.3.1.2 Alternate bond coat for walls and ceilings: Gray or white dry-set portland cement mortar or latex-portland cement mortar mixed with water to a creamy consistency in strict accordance with the manufacturer's directions.

A-4.1a.3.1.3 For floors, decks, and countertops: Gray or white portland cement mixed with water to a creamy consistency or a gray or white portland cement dust coat.

A-4.1a.4 Spacing mix (for maintaining spacing of ceramic mosaic tile, quarry tile, and paver tile during setting). Spacing mix shall be as follows:

A-4.1a.4.1 For narrow joints less than 1/8 inch (3 mm) wide, 1-part portland cement and 1-part fine sand, by volume.

A-4.1a.4.2 For joints wider than 1/8 inch (3 mm), 1-part portland cement and 2-parts fine sand, by volume.

A-4.1a.4.3 When spacing mix is used, a depth of approximately 25% of the tile thickness is recommended.

A-4.1a.5 Mortar application

A-4.1a.5.1 Application of mortar to walls and ceilings

A-4.1a.5.1.1 Cure scratch coat or leveling coat (plumb scratch) before the mortar bed is applied (length of cure dependent upon climatic conditions).

A-4.1a.5.1.2 Immediately prior to applying the mortar bed, evenly dampen preceding surface coat or the clean concrete block surface with water as required.

A-4.1a.5.1.3 Apply mortar bed to provide a plumb and true surface the proper distance back from the finished wall or ceiling line. Maximum thickness of mortar bed: 3/4 inch (19 mm).

A-4.1a.5.1.4 When the one-coat method using a mortar setting bed is specified in the project specifications, comply with the following: Install a membrane. Securely attach metal lath through the membrane to the backing. Apply a mortar bed, 3/8 to 3/4 inch (10 to 19 mm) thick, and set tile while the mortar bed is still workable.

A-4.1a.5.2 Application of mortar to concrete floors and deck: Unless otherwise specified, place and bond the mortar bed to concrete slab as follows:

A-4.1a.5.2.1 Dampen clean, properly prepared concrete surface with water immediately prior to placing the bonded mortar bed. Concrete surface to be completely free of standing water.

A-4.1a.5.2.2 Before placing mortar bed, spread a very thin continuous coating of pure portland cement slurry on the concrete surface or dust a thin layer of dry portland cement on the concrete and wet it. Broom the pure portland cement slurry or the wetted portland cement dust to completely coat the concrete surface with a thin and uniform coating.

A-4.1a.5.2.3 Immediately apply mortar bed over the pure cement coating. Firmly tamp and screed mortar bed. Mortar bed thickness shall be a nominal 1-¼ inches (32 mm).

A-4.1a.5.3 Application of mortar for floors, decks, and countertops over a cleavage membrane and for shower receptors: On wood subfloors, countertops, coated concrete, waterproof membranes, and when a cleavage membrane over concrete is specified in tile section of the project specifications, place the mortar bed as follows:

A-4.1a.5.3.1 Place a cleavage membrane over the substructure, lapped at least 4 inches (102 mm) at joints, except when a waterproof membrane installed by others is already in place (as in a shower receptor or roofdeck.)

A-4.1a.5.3.2 Place mortar bed with wire reinforcing over the membrane. Lap reinforcing at least one full mesh and support so that reinforcing shall be suspended in the mortar bed. Reinforcing shall not butt against vertical surfaces.

A-4.1a.5.3.3 Place, tamp firmly, and screed the mortar bed. Mortar bed thickness shall conform to Paragraph AN-2.6.1.4 except for countertop and shower receptors. (For special requirements for shower receptors refer to Paragraph A-4.1a.2.3.)

A-4.1a.6 Installation of ceramic tile on walls, ceilings, floors, decks, and countertops

A-4.1a.6.1 General

A-4.1a.6.1.1 Installation of tile includes base, wainscots, window stools, reveals, and accessories where specified.

A-4.1a.6.2 Installation of tile

A-4.1a.6.2.1 Soak tile in clean water for at least ½ hour and drain excess water before setting. Immerse each tile completely during the soaking period. Resoak and drain tiles that exhibit drying along the edges before setting. Free moisture shall not remain on the backs of the tile when they are being set. (Vitreous tile, glazed or unglazed, need not be soaked.)

A-4.1a.6.2.2 When a bond coat of dry-set mortar or latex-portland cement mortar is used, the tile should not be soaked.

A-4.1a.6.2.3 Before setting sheets of face-mounted tile on vertical surfaces, fill the joints with spacing mix.

A-4.1a.6.2.4 Apply a 1/32 to 1/16 inch (1 to 2 mm) thick bond coat over the mortar bed while still workable. If white joints are required, a white bond coat shall be used.

A-4.1a.6.2.4.1 Alternate for tile on floors, decks, or countertops: Immediately preceding the setting of tile, dust a thin layer of dry portland cement 1/32 to 1/16 inch (1 to 2 mm) thick over the mortar bed; assure sufficient moisture to dampen the dust coat.

A-4.1a.6.2.5 If 95% coverage is specified in the project specifications, back butter each tile with bond coat; or select a notched trowel sized to facilitate the proper coverage, key the mortar into the substrate with the flat side of the trowel, and comb with the notched side of the trowel in one direction. Embed the tile in the mortar by beating-in, pushing in a direction perpendicular to the combed ridges, or other means to achieve specified coverage. The method used should produce maximum coverage with the corners and edges fully supported. Periodically remove and check a tile to assure that proper coverage is being attained.

A-4.1a.6.2.6 Set tile firmly on the mortar bed. Lugs on tile determine the joint width between tile. Spacers, string, or rope shall be used to space tile that have no lugs. Bring all surfaces to a true plane at the proper position or elevation. Set all tile while the mortar bed is still workable. The beat-in shall fill the entire space between ribs of tile with mortar.

A-4.1a.6.2.7 Deleted 1999

A-4.1a.6.2.8 Make adjustment of tile before initial set of the mortar takes place.

A-4.1a.7 Grouting of tile

A-4.1a.7.1 Install and cure in accordance with appropriate ANSI installation standard: A108.6 Chemical resistant epoxy grout. A108.8; Chemical resistant furan grout. A108.9 Modified epoxy emulsion grout; or A108.10 Installation of grout.

A-4.1a.8 Curing

A-4.1a.8.1 Damp cure all non-latex/polymer modified tile installations.

End of ANSI A108.1A — 1999

A-4.1b Installation of ceramic tile on a cured portland cement mortar setting bed with dry-set or latex-portland cement mortar ANSI A108.1B — 1999

Applicable portions of Section A-1 through A-3 are a part of these A108.1B installation specifications.

A-4.1b.1 Installation of mortar setting beds on vertical and horizontal surfaces

The mortar bed shall be installed in accordance with Sections A-4.1a.1, A-4.1a.2, and A-4.1a.5 of ANSI A108.1A.

A-4.1b.1.1 All mortar bed surfaces shall be plumb, level and true with square corners. Maximum variation from required plane shall be: Vertical surfaces — ¼ inch in 10 feet (6 mm in 3 m). Horizontal surfaces — ¼ inch in 10 feet (6 mm in 3 m).

A-4.1b.2 Installation and grouting of tile

In accordance with applicable sections of ANSI A108.5.

End of ANSI A108.1B — 1999

A-4.1c Contractor's Option: installation of ceramic tile in the wet-set method with portland cement mortar or installation of ceramic tile on a cured portland cement mortar setting bed with dry-set or latex-portland cement mortar ANSI A108.1C — 1999

Applicable portions of Section A-1 through A-3 are a part of these A108.1C installation specifications.

NOTE – Two equivalent methods for installing ceramic tile on portland cement mortar beds are recognized by the industry. They are the methods covered by ANSI A108.1A which requires the tile to be set in the wet-set method and the method covered by ANSI A108.1B which requires the tile to be set on a cured portland cement bed with dry-set or latex-portland cement mortar. Unless there are specific reasons to specify tile installed according to either of these specifications, it is reasonable for the specifier to allow the tile contractor the option of choosing either method by specifying tile installed by ANSI A108.1C. See paragraph AN-5 of the Foreword.

End of ANSI A108.1C — 1999

A-4.2 Installation of ceramic tile with organic adhesives or water cleanable tile-setting epoxy adhesive ANSI A108.4 — 1999

Applicable portions of Section A-1 through A-3 are a part of these A108.4 installation specifications.

NOTE – Although organic adhesives and epoxy adhesives are installed the same way, their working and physical properties differ. For example: epoxy must be mixed while organic adhesives are used directly from the container without mixing. Therefore, more skill on the part of the installer is required when epoxy adhesive is specified.

A-4.2.1 Installation of ceramic tile for walls and ceilings

A-4.2.1.1 General

A-4.2.1.1.1 Installation of tile for walls and ceilings includes base, wainscots, window stools, reveals, wall-breaks, and accessories where required. Application shall be over gypsum board and gypsum plaster (dry-areas only), cementitious backer units, portland cement mortar, or smooth, dry concrete.

A-4.2.1.2 Preparation of surfaces

A-4.2.1.2.1 Preparation in wet areas: (Wet areas are tub enclosures or other similar areas with like service requirements. Reference Paragraph AN-4.15). Inspect water-resistant gypsum board surfaces to assure that surfaces are installed and prepared by other trades in accordance with GA-216 (joints filled with a water-resistant joint compound and tape). Tiles shall not be applied to surfaces that are not properly installed.

A-4.2.1.2.2 CAUTION – Gypsum wallboard (ASTM C36) and water-resistant gypsum backing board shall not be used on ceilings or in critical exposure areas such as exteriors, showers, saunas, or steam rooms. (See Paragraph AN-4.15)

A-4.2.1.3 Adhesive application

A-4.2.1.3.1 Apply adhesive with flat side of trowel to obtain mechanical bond and coverage. Using the notched side of trowel, comb adhesive to obtain even setting bed without scraping backing material. Cover surface uniformly without bare spots, with sufficient adhesive to insure a minimum wet film thickness of 1/32 inch between tile and backing after tile has been beat into place. Apply adhesive only in areas that can be covered with tile before the adhesive films over. Remove any adhesive that films over and apply fresh adhesive.

A-4.2.1.4 Setting tile on walls and ceilings

A-4.2.1.4.1 Press tile into adhesive, insuring adhesive contact with tile while maintaining accurate joint alignment and spacing. Keep a minimum of 2/3 of joint depth open for grouting.

A-4.2.1.4.2 Thoroughly beat all tile or tile assemblies into place with a beating block to obtain maximum contact of adhesive on the back of each tile, or back of each tile and back mounting material. Average contact shall be not less than 80% except on shower installations where contact area shall be 95% when no less than three tiles or tile assemblies are removed for inspection.

A-4.2.1.4.3 Remove paper from paper-mounted ceramic mosaics before the adhesive is firmly set and align individual tile.

A-4.2.2 Installation of tile for floors and countertops

A-4.2.2.1 General

A-4.2.2.1.1 Installation of tile for floors and countertops shall be over concrete, plywood, or cementitious backer units and include curbs, gutters, and saddles.

A-4.2.2.2 Preparation of surfaces

A-4.2.2.2.1 Provide patching and underlayment on surfaces to receive tile when so specified in the project specifications. Type of underlayment material and application shall be as recommended by

the adhesive manufacturer unless otherwise specified.

A-4.2.2.2.2 Leave space for movement joints as shown or specified.

A-4.2.2.3 Adhesive application

A-4.2.2.3.1 Apply adhesive with flat side of trowel to obtain mechanical bond and coverage. Using the notched side of trowel, comb adhesive to obtain even setting bed without scraping backing material. Cover surface uniformly without bare spots, with sufficient adhesive to insure a minimum wet film thickness of 1/32 inch (1 mm) between tile and backing after tile has been beat into place.

A-4.2.2.3.2 Apply organic adhesive only in areas that can be covered with tile before the adhesive films over. Remove any adhesive that films over and apply fresh adhesive.

A-4.2.2.3.3 During application of epoxy adhesive to plywood underlayment, force epoxy between edges of plywood sheets to completely fill gaps when required by the setting material manufacturers recommendations. (See Paragraph A-3.1.4.3.3)

A-4.2.2.4 Setting tile floors and countertops

A-4.2.2.4.1 Press tile into adhesive, insuring adhesive contact with tile while maintaining accurate joint alignment and spacing. Keep a minimum of 2/3 of joint depth open for grouting.

A-4.2.2.4.2 Thoroughly beat all tile or tile assemblies into place with a beating block to obtain maximum contact of adhesive on the back of each tile, or back of each tile and back mounting material, and not less than an average contact area of 80% except on shower installations where contact area shall be 95% when no less than three tiles or tile assemblies are removed for inspection.

A-4.2.2.4.3 If the tile is face mounted, remove paper before initial set occurs and adjust all tiles that are out of line or level. Use no more water than necessary in removing paper.

A-4.2.3 Grouting of tile

A-4.2.3.1 Remove all adhesive from face and edges of tile.

A-4.2.3.2 Allow a minimum of 24 hours for evaporation of solvent before grouting unless otherwise recommended by adhesive manufacturer. When the tile and substrate are such that the adhesive does not cure in 24 hours, allow additional time prior to grouting.

A-4.2.3.3 Install and cure grout in accordance with appropriate ANSI installation standard or A108.10 Installation of grout.

End of ANSI A108.4 — 1999

A-4.3 Installation of ceramic tile with dry-set portland cement mortar or latex-portland cement mortar ANSI A108.5 — 1999

Applicable portions of Section A-1 through A-3 are a part of these A108.5 installation specifications.

NOTE – Dry-set mortars and latex-portland cement mortars can be used as a 1/16 inch (2 mm) thick bond coat to bond tile to a portland cement mortar bed that is still workable, as is customary when a neat cement bond coat is used. They can also be used on a cured (pre-floated) portland cement mortar bed or cementitious backer units. Under normal conditions, a minimum of 20 hours cure at 70°F (21°C) is adequate but longer mortar bed cures up to 10 days are desirable.

A-4.3.1 Mixing mortars

A-4.3.1.1 Mixing dry-set portland cement mortars: Mix dry-set mortars in accordance with the following directions, unless mortar manufacturer's instructions differ.

A-4.3.1.1.1 Add dry ingredients to recommended amount of water. Mix slowly and thoroughly and let mortar stand for 15 minutes, then remix. Do not speed mix. Do not add water, additional mortar, or other ingredients after slaking period.

A-4.3.1.1.2 Mortar consistency shall be such that when applied with the recommended notched trowel to the backing, the ridges formed in the mortar shall not flow or slump.

A-4.3.1.1.3 During use, remix mortar occasionally. Additional water or fresh materials shall not be added after initial mixing. Mortar shall not be used after initial set.

A-4.3.1.2 Mixing latex-portland cement mortars: Mix latex-portland cement mortars in accordance with latex manufacturer's instructions or as modified herein.

A-4.3.1.2.1 Use the brand of prepacked dry mortar mix specified by the latex manufacturer.

A-4.3.1.2.2 Add dry mortar mix to amount of latex or water specified by manufacturer and mix thoroughly to obtain complete and visually uniform wetting of the dry mortar mix. Slake for 15 minutes and remix before using.

A-4.3.1.2.3 Latex-portland cement thin-set mortars are available in two forms. Both are dry mixes with one requiring the addition of liquid latex when mixing. In this instance, follow the liquid latex manufacturer's instructions. The second form is a factory blend of dry powder and dry polymers that requires that only water be added when mixing. In this case, follow the mortar manufacturer's instructions.

A-4.3.1.2.4 The proper mortar consistency is such that when applied with the recommended notched trowel to the backing, the ridges formed in the mortar will not flow or slump.

A-4.3.1.2.5 During use, remix mortar occasionally. Additional water or fresh materials shall not be added after initial mixing. Mortar shall not be used after initial set.

A-4.3.2 Installation of tile for walls and ceilings

A-4.3.2.1 General

A-4.3.2.1.1 Installation of tile for walls and ceilings includes base, wainscot, window stools, reveals, wall breaks, and accessories where required.

A-4.3.2.1.2 Refer to Section A-3 "General requirements for tile installations" for specifications applicable to wall and ceiling installations.

A-4.3.2.2 Applying dry-set portland cement or latex-portland cement mortar

A-4.3.2.2.1 Clean surface thoroughly. Dampen if very dry, but do not saturate.

A-4.3.2.2.2 Apply mortar with flat side of trowel over an area no greater than can be covered with tile before the mortar skins over. Using a notched trowel of type recommended by mortar manufacturer, comb mortar to obtain even setting bed without scraping backing material. Cover surface uniformly with no bare spots and with sufficient mortar to insure a minimum mortar thickness of 3/32 inch (2 mm) between tile and backing after tile has been beaten into place. Tile shall not be applied to skinned-over mortar.

A-4.3.2.3 Setting glazed wall tile (Semi-vitreous and Non-vitreous)

A-4.3.2.3.1 Refer to mortar and latex manufacturer's directions.

A-4.3.2.3.2 Tile shall not be soaked.

A-4.3.2.3.3 Press tile into freshly combed mortar, insuring mortar contact with tile while maintaining joint alignment and spacing. Keep an adequate joint depth open for grouting.

A-4.3.2.3.4 Average contact area shall be not less than 80% except on exterior or shower installations where contact area shall be 95% when not less than three tiles or tile assemblies are removed for inspection. The 80% or 95% coverage shall be sufficiently distributed to give full support of the tile.

A-4.3.2.3.5 If 95% coverage is specified in the project specifications, back butter each tile with bond coat; or select a notched trowel sized to facilitate the proper coverage, key the mortar into the substrate with the flat side of the trowel, and comb with the notched side of the trowel in one direction. Embed the tile in the mortar by beating-in, pushing in a direction perpendicular to the combed ridges, or other means to achieve specified coverage. The method used should produce maximum coverage with the corners and edges fully supported. Periodically remove and check a tile to assure that proper coverage is being attained.

A-4.3.2.4 Setting ceramic mosaic tile

A-4.3.2.4.1 Refer to mortar and latex manufacturer's directions.

A-4.3.2.4.2 Press tile into freshly combed mortar, insuring mortar contact with tile. Maintain joint alignment and spacing. Keep an adequate joint depth open for grouting.

A-4.3.2.4.3 Thoroughly beat all tile or tile assemblies into place with a beating block to obtain maximum contact of bonding mortar on the back of each tile, or back of each tile and back mounting material. Average contact area shall be not less than 80% except on exterior or shower installations where contact area shall be 95% when no less than three tiles or tile assemblies are removed for inspection.

A-4.3.2.4.4 Deleted 1999

A-4.3.2.4.5 If tile is face mounted, remove paper before initial set of mortar occurs and adjust all tiles that are out of line or level. Use no more water than necessary in removing paper.

A-4.3.2.5 Setting quarry tile, paver tile, and other unmounted vitreous and impervious tile

A-4.3.2.5.1 Refer to mortar and latex manufacturer's directions.

A-4.3.2.5.2 Press tile into freshly combed mortar, insuring mortar contact with tile. Maintain joint alignment and spacing. Keep an adequate joint depth open for grouting.

A-4.3.2.5.3 Average contact area shall be not less than 80% except on exterior or shower installations where contact area shall be 95% when not less than three tiles or tile assemblies are removed for inspection. The 80% or 95% coverage shall be sufficiently distributed to give full support of the tile.

A-4.3.2.5.4 If 95% coverage is specified in the project specifications, back butter each tile with bond coat; or select a notched trowel sized to facilitate the proper coverage, key the mortar into the substrate with the flat side of the trowel, and comb with the notched side of the trowel in one direction. Embed the tile in the mortar by beating-in, pushing in a direction perpendicular to the combed ridges, or other means to achieve specified coverage. The method used should produce maximum coverage with the corners and edges fully supported. Periodically remove and check a tile to assure that proper coverage is being attained.

A-4.3.3 Installation of tile for floors

A-4.3.3.1 General

A-4.3.3.1.1 Installation of floor tile shall be over a cement mortar bed, properly prepared concrete slabs, or properly prepared cementitious backer units.

A-4.3.3.2 Applying dry-set portland cement mortar or latex-portland cement mortar

A-4.3.3.2.1 Clean surface thoroughly. Dampen if very dry, but do not saturate.

A-4.3.3.2.2 Apply mortar with flat side of trowel over an area no greater than can be covered with tile before the mortar skins over. Using a notched trowel of type recommended by mortar manufacturer, comb mortar to obtain even setting bed without scraping backing material. Cover surface uni-

formly with no bare spots with sufficient mortar to insure a minimum mortar thickness of 3/32 inch (2 mm) between tile and backing after tile has been beaten into place. Tile shall not be applied to skinned over mortar.

A-4.3.3.2.3 Insert filler in movement joints.

A-4.3.3.3 Setting floor tile

A-4.3.3.3.1 Press tile into freshly combed mortar, insuring mortar contact with tile. Maintain joint alignment and spacing. Keep an adequate joint depth open for grouting.

A-4.3.3.3.2 Average uniform contact area shall be not less than 80% except on exterior or shower installations where contact area shall be 95% when no less than three tiles or tile assemblies are removed for inspection. The 80% or 95% coverage shall be sufficiently distributed to give full support to the tile with particular attention to this support under all corners of the tile.

A-4.3.3.3.3 If 95% coverage is specified in the project specifications, back butter each tile with bond coat; or select a notched trowel sized to facilitate the proper coverage, key the mortar into the substrate with the flat side of the trowel, and comb with the notched side of the trowel in one direction. Embed the tile in the mortar by beating-in, pushing in a direction perpendicular to the combed ridges, or other means to achieve specified coverage. The method used should produce maximum coverage with the corners and edges fully supported. Periodically remove and check a tile to assure that proper coverage is being attained.

A-4.3.4 Grouting of tile

A-4.3.4.1 Before grouting, all tiles must be firmly set, all paper and glue removed from face of mounted tile, and all spacers, strings, ropes, and pegs removed.

A-4.3.4.2 Consult mortar manufacturer's recommendations prior to grouting.

A-4.3.4.3 Install and cure grout in accordance with appropriate ANSI installation standard: A108.6 Chemical resistant epoxy grout; A108.8 Chemical resistant furan grout; A108.9 Modified epoxy emulsion grout; or A108.10 Installation of grout.

End of ANSI A108.5 — 1999

A-4.4 Installation of ceramic tile with chemical resistant, water cleanable tile-setting and -grouting epoxy ANSI A108.6 — 1999

Applicable portions of Sections A-1 through A-3 are a part of these A108.6 installation specifications.

NOTE – This installation method for use with ANSI A118.3, 100% solids epoxy material only.

A-4.4.1 Mixing chemical resistant water cleanable tile-setting and -grouting epoxy.

A-4.4.1.1 Store epoxy materials at a temperature of 60 to 90°F (20 to 32°C) for a period of 48 hours prior to use.

A-4.4.1.2 Epoxies are supplied as two or more separate parts that shall be mixed together on the job at the time of use. Separate parts shall be proportioned exactly and mixed thoroughly.

A-4.4.1.3 Follow the manufacturer's directions for proportioning and mixing of the epoxy, including pre-mixing of separate parts before combination, when required.

A-4.4.2 Installation of tile

A-4.4.2.1 General

A-4.4.2.1.1 Installation of tile for floors shall include base, cove, saddles, gutters, etc. where required.

A-4.4.2.1.2 Tile shall not be set in epoxy on wet surface unless specifically authorized by the epoxy manufacturer.

A-4.4.2.1.3 Apply epoxy with flat side of trowel to completely cover substrate. Using a notched trowel of type recommended by epoxy manufacturer, comb epoxy to obtain an even setting bed without scraping substrate. After beating in, achieve an average thickness of 1/16 inch (1.6 mm) for ceramic mosaic tile and 3/32 inch (2 mm) for quarry tile, paver tile, and packing house tile.

A-4.4.2.1.4 Apply only amount of epoxy that can be covered with tile before initial set. Temperature affects set times. Test sections should be tried before tiling large areas.

A-4.4.2.1.5 In conformance to the setting material manufacturer's recommendations, the gaps between plywood sheets shall be filled with setting material as it is spread or be left void.

A-4.4.2.1.6 Spacing mix shall not be used between tiles.

A-4.4.2.2 Setting quarry tile, paver tile, and packing house tile with epoxy

A-4.4.2.2.1 Refer to epoxy manufacturer's directions.

A-4.4.2.2.2 Average uniform contact area shall not be less than 80%.

A-4.4.2.2.3 If 95% coverage is specified in the project specifications, back butter each tile with bond coat; or select a notched trowel sized to facilitate the proper coverage, key the mortar into the substrate with the flat side of the trowel, and comb with the notched side of the trowel in one direction. Embed the tile in the mortar by beating-in, pushing in a direction perpendicular to the combed ridges, or other means to achieve specified coverage. The method used should produce maximum coverage with the corners and edges fully supported. Periodically remove and check a tile to assure that proper coverage is being attained.

A-4.4.2.2.4 Use spacers when necessary on vertical backings to maintain even joint width.

A-4.4.2.2.5 Remove epoxy that has taken an initial set from the substrate and replace with fresh epoxy prior to installing tile.

A-4.4.2.2.6 Immediately remove any epoxy that gets on the face of tile.

A-4.4.2.3 Setting ceramic mosaic tile with epoxy

A-4.4.2.3.1 Refer to epoxy manufacturer's directions.

A-4.4.2.3.2 Install mounted tile sheets into epoxy to assure a smooth surface and to obtain at least 80% contact between tile and epoxy.

A-4.4.2.3.3 Use spacers when necessary on vertical backings to maintain even joint width.

A-4.4.2.3.4 If tile is face mounted, remove paper and glue within one hour after tiles are set and adjust all tiles that are out of line or level. Use no more water than necessary in removing paper.

A-4.4.2.3.5 Remove epoxy that has taken an initial set from the substrate and replace with fresh epoxy prior to installing tile.

A-4.4.2.3.6 Immediately remove any epoxy that gets on the face of tile.

A-4.4.2.4 Setting tile with dry-set portland cement mortar or latex-portland cement mortar: When tiles are specified in project specifications to be set with dry-set portland cement mortar or latex-portland cement mortar, install in accordance with ANSI A108.5 (Section A-4.3).

A-4.4.2.5 Setting tile with portland cement mortar: When tile is specified in project specifications to be set with portland cement mortar, install in accordance with ANSI A108.1A (Section A-4.1a) or ANSI A108.1B (Section A-4.1b.).

A-4.4.3 Grouting of tile with epoxy

A-4.4.3.1 Before grouting, all tiles must be firmly set, all paper and glue removed from face of mounted tiles, and all spacers, strings, ropes, or pegs removed.

A-4.4.3.2 Grouting shall be done in accordance with the manufacturer's instructions.

A-4.4.3.3 Refer to epoxy manufacturer for how soon grouting can be performed.

A-4.4.3.4 Force epoxy into joints using a hard rubber grouting trowel or other suitable tool recommended by epoxy manufacturer. Use sufficient pressure and flow epoxy into joints progressively to avoid air pockets or voids. Keep an adequate joint depth open for grouting. Spacing mixes are not permitted. Tiles thicker than ½-inch are recommended when using methods described in Paragraphs A-4.4.2.4 and A-4.4.2.5.

A-4.4.3.5 Remove all excess epoxy from surface of tile with a squeegee or rubber trowel before it loses its plasticity or begins to set. Immediately perform final clean-up in accordance with epoxy manufacturer's directions.

A-4.4.3.6 Epoxy shall not be allowed to harden on face of tile.

A-4.4.3.7 Joints grouted with epoxy shall be filled to provide a contoured depression no deeper than 3/64 inch (1 mm) for a ¼-inch (6 mm) wide joint, and 1/16 inch (2 mm) for a 3/8 inch (10 mm) wide joint.

A-4.4.4 Curing

A-4.4.4.1 Keep installation at a temperature of 65 to 85°F (18 to 29°C) during the first 8 hours of cure. Shade area completely from sun during this period. Before, during, and after grouting, the area must be kept clean, dry, and free from foreign materials such as construction dirt, portland cement, plaster, and other contaminants which could interfere with the setting and curing of the epoxy.

End of ANSI A108.6 — 1999

A-4.5 Installation of ceramic tile with chemical resistant furan resin mortar and grout ANSI A108.8 — 1999

Applicable portions of Section A-1 through A-3 are a part of these A108.8 installation specifications.

This specification describes the minimum requirements for the installation of ceramic tile with chemical resistant furan resin mortar and grout.

A-4.5.1 Mixing chemical resistant furan resin mortar and grout

A-4.5.1.1 Store furan materials in a clean, dry place under cover, out of direct sunlight, at a temperature of 65 to 85°F (18 to 29°C) for a period of 48 hours minimum prior to use. If lower or higher substrate temperatures are expected, consult mortar or grout manufacturer.

A-4.5.1.2 Furans are supplied as two-component materials that are mixed together on the job at the time of use. Stir liquid resins before using. Mortars and grouts are prepared by combining and mixing thoroughly the appropriate ratio of powder into the liquid resin to form a workable mix.

A-4.5.1.3 Mixing ratios may vary slightly depending on temperature and working conditions. Follow the manufacturer's recommendations for permissible variances in ratios of components to insure proper cure and performance of the mortar or grout.

A-4.5.2 Installation of tile

A-4.5.2.1 General

A-4.5.2.1.1 Installation of quarry, paver, and packing house tile for floors and walls shall include base, cove, saddles, gutters, trim etc. where required.

A-4.5.2.1.2 Furan mortar bond coats utilize acid catalysts to make them cure; consequently, they cannot be applied as a bond coat directly to an alkaline substrate or one containing portland cement without special preparation. Alkalinity in the substrate will neutralize the acid catalyst resulting in an incomplete cure of the furan bond coat. Use manufacturers special preparation procedure directly over concrete substrate to secure proper bond of furan mortar.

A-4.5.2.1.3 Follow manufacturer's directions for mixing, handling, and installing of furan materials.

A-4.5.2.2 Packing house tile and corrosion resistant membrane construction

A-4.5.2.2.1 This method of construction generally requires the use of 1-3/16 inch (30.2 mm) minimum thickness of tile.

A-4.5.2.2.2 Corrosion resistant membrane construction is utilized when jobsite conditions require imperviousness and/or resistance to aggressive chemical environments. Consult manufacturers for assistance in proper selection of membranes.

A-4.5.2.2.3 Properly sloped substrates onto which membranes are applied shall be clean and dry unless otherwise specified by the manufacturer.

A-4.5.2.2.4 Apply furan bond coat to completely cover the membrane. After setting and beating-in the tile, the furan bond coat thickness, when measured from the top of membrane to bottom of flat tile or tile rib, shall be minimum 3/32 inch (2.4 mm), in an applied position. If furan partially sets, remove and replace with fresh furan prior to setting tile.

A-4.5.2.2.5 Spacing mix shall not be used between tile.

A-4.5.2.2.6 If 95% coverage is specified in the project specifications, back butter each tile with bond coat; or select a notched trowel sized to facilitate the proper coverage, key the mortar into the substrate with the flat side of the trowel, and comb with the notched side of the trowel in one direction. Embed the tile in the mortar by beating-in, pushing in a direction perpendicular to the combed ridges, or other means to achieve specified coverage. The method used should produce maximum coverage with the corners and edges fully supported. Periodically remove and check a tile to assure that proper coverage is being attained.

A-4.5.2.2.7 Predicated on job requirements, the bond coat can be eliminated and tile set directly on

the membrane and joints only grouted with furan grout. If grooved-back tile are used, the grooves shall be filled with furan mortar in order to eliminate trapped air and prevent grooves from being filled with corrosive and unsanitary materials that might penetrate the tile or joints.

A-4.5.2.3 Setting quarry tile, paver tile, and packing house tile in epoxy and grouting with furan

A-4.5.2.3.1 Follow manufacturer's directions for mixing, handling, and installing epoxy and furan materials.

A-4.5.2.3.2 Unless otherwise specified, press tile firmly into position to obtain at least 80% coverage of epoxy on the back of each tile.

A-4.5.2.3.3 Apply epoxy bond coat to completely cover the substrate. After setting and beating-in the tile, the epoxy bond coat thickness, when measured from top of substrate to bottom of flat tile or tile rib shall be minimum 3/32 inch (2.4 mm), in an applied position.

A-4.5.2.3.4 If 95% coverage is specified in the project specifications, back butter each tile with bond coat; or select a notched trowel sized to facilitate the proper coverage, key the mortar into the substrate with the flat side of the trowel, and comb with the notched side of the trowel in one direction. Embed the tile in the mortar by beating-in, pushing in a direction perpendicular to the combed ridges, or other means to achieve specified coverage. The method used should produce maximum coverage with the corners and edges fully supported. Periodically remove and check a tile to assure that proper coverage is being attained.

A-4.5.2.3.5 Use spacers when necessary on vertical applications in order to maintain even joint widths. Remove spacers prior to grouting.

A-4.5.2.3.6 If epoxy has partially set, remove and replace with fresh epoxy prior to bedding the tile.

A-4.5.2.3.7 If tile is not waxed, immediately remove any epoxy that gets on face of the tile according to manufacturer's instructions.

A-4.5.2.4 Setting tile with dry-set portland cement mortar or latex-portland cement mortar: When tile for floors and walls are specified in project specifications to be set with dry-set mortar or latex-portland cement mortar, install in accordance with ANSI A108.5 (Section A-4.3).

A-4.5.2.5 Setting tile with portland cement mortar: When tile for floors and walls are specified in project specifications to be set with portland cement mortar, install in accordance with ANSI A108.1A (Section A-4.1a) or ANSI A108.1B (Section A-4.1b).

A-4.5.2.6 Grouting of tile with furan grout

A-4.5.2.6.1 When setting tile in accordance with Paragraphs A-4.5.2.4 and A-4.5.2.5 of this standard, it is generally required that the joints be acid washed, rinsed with water, and dried prior to grouting with furan grout. Phosphoric, hydrochloric, or sulfamic acid in 10 to 15% concentration are acceptable for the acid washing procedure. Acid washing provides a clean, vertical tile edge for optimizing bond while minimizing potential grout contamination, thus insuring proper cure of the furan grout joint. Consult furan grout manufacturer for confirmation of joint preparation recommendations.

A-4.5.2.6.2 Follow manufacturer's instructions for required setting time and temperature limitations before grouting.

A-4.5.2.6.3 When grouting with furans, it is required that the face of the tile be given a coat of paraffin wax prior to installation in order to prevent staining of the tile. (See Paragraph A-2.1.15.1.)

NOTE – When abrasive surface tile is used, additional coats of paraffin wax may be required.

A-4.5.2.6.4 Rake joints as required to insure joints are grouted to at least 75% of the joint depth. Spacing mixes are not permitted. Force furan into joints using a rubber grouting trowel or other suitable tool recommended by the grout manufacturer. Use sufficient pressure and flow furan into joints progressively to avoid air pockets or voids. Quarry, paver, or packing house tile with a nominal minimum thickness of ½-inch (12 mm) and conforming to ANSI A137.1 are recommended when using the setting methods described in Paragraphs A-4.5.2.4 and A-4.5.2.5.

A-4.5.2.6.5 Prior to the furan beginning to set, remove all excess furan from the surface of tile with a squeegee or rubber trowel by pulling trowel diagonally across the tile. For final clean-up, follow grout manufacturer's directions.

A-4.5.2.7 Curing

A-4.5.2.7.1 Keep installation surface at 65 to 85°F (18 to 29°C) during the first 8 hours of cure. Before, during, and after grouting, the area must be kept clean and dry and free from foreign materials such as construction dirt, portland cement, plaster, and other contaminants, which could interfere with the setting and curing of the furan grout. Shade area completely from sun during the curing period. As soon as the material has hardened sufficiently, as evidenced by no staining when rubbing a cloth over the surface of the joints, steam cleaning to remove protective wax coating may commence.

End of ANSI A108.8 — 1999

A-4.6 Installation of ceramic tile with modified epoxy emulsion mortar/grout ANSI A108.9 — 1999

Applicable portions of Section A-1 through A-3 are a part of these A108.9 installation specifications.

This specification describes the minimum requirements for the installation of ceramic tile with modified epoxy emulsion mortar/grout. This type of installation is not designed for chemical resistance.

A-4.6.1 Mixing modified epoxy emulsion mortar/grout

A-4.6.1.1 Store modified epoxy emulsion materials at a temperature of 60 F to 90°F (20 to 32°C) for a period of 48 hours prior to use.

A-4.6.1.2 Modified epoxy emulsions are supplied as three separate parts that shall be mixed together on the job at the time of use. Separate parts shall be proportioned exactly and mixed thoroughly.

A-4.6.1.3 Follow the manufacturer's directions for proportioning and mixing of the modified epoxy emulsion, including pre-mixing of separate parts before combination, when required.

A-4.6.2 Installation of tile

A-4.6.2.1 General

A-4.6.2.1.1 Installation of tile for floors shall also include base, cove, saddles, gutters, etc. where required.

A-4.6.2.1.2 Tile shall not be set in modified epoxy emulsion on any surface unless specifically recommended by the manufacturer.

A-4.6.2.1.3 Apply modified epoxy emulsion with flat side of trowel over an area no greater than can be covered with tile while modified epoxy emulsion remains workable. Using a notched trowel of type recommended by modified epoxy emulsion manufacturer, comb material to obtain even setting bed. Cover surface uniformly with sufficient material to insure a minimum thickness of 3/32 inch (2 mm) between tile and backing after tile has been beat into place. Tile shall not be applied to skinned-over material.

A-4.6.2.1.4 Apply only amount of modified epoxy emulsion that can be covered with tile before initial set. Temperature affects set time. Test sections shall be tried before tiling large areas.

A-4.6.2.1.5 Spacing mix shall not be used between tiles.

A-4.6.2.2 Setting quarry tile, paver tile, and packing house tile

A-4.6.2.2.1 Follow modified epoxy emulsion manufacturer's directions for mixing, handling, and installation of materials.

A-4.6.2.2.2 Remove modified epoxy emulsion that has set from the substrate and replace with fresh material prior to installing tile.

A-4.6.2.2.3 Unless otherwise specified, press tile firmly into position to obtain at least 80% coverage of modified epoxy emulsion on the back of each tile.

A-4.6.2.2.4 If 95% coverage is specified in the project specifications, back butter each tile with bond coat; or select a notched trowel sized to facilitate the proper coverage, key the mortar into the substrate with the flat side of the trowel, and comb with the notched side of the trowel in one direction. Embed the tile in the mortar by beating-in, pushing in a direction perpendicular to the combed ridges, or other means to achieve specified coverage. The method used should produce maximum coverage with the corners and edges fully supported. Periodically remove and check a tile to assure that proper coverage is being attained.

A-4.6.2.2.5 Immediately remove any mortar that gets on the face of tile.

A-4.6.2.3 Setting ceramic mosaic tile

A-4.6.2.3.1 Refer to mortar manufacturer's directions.

A-4.6.2.3.2 Remove modified epoxy emulsion that has set from the substrate and replace with fresh material prior to installing tile.

A-4.6.2.3.3 Install mounted tile sheets into mortar to assure a smooth surface and to obtain essentially 100% contact between tile and epoxy.

A-4.6.2.3.4 If tile is face mounted, remove paper within one hour after tile is set and adjust all tiles that are out of line or level. Use no more water than necessary in removing paper and glue.

A-4.6.2.3.5 Immediately remove any mortar that accidentally gets on the face of the tile.

A-4.6.3 Grouting of tile with modified epoxy emulsion

A-4.6.3.1 Refer to modified epoxy emulsion manufacturer's specific directions for grouting.

A-4.6.3.2 Allow 48 hours to elapse before grouting tile set in epoxy.

A-4.6.3.3 Force modified epoxy emulsion into joints using a hard rubber grouting trowel or other suitable tool recommended by manufacturer. Fill all joints full and even with surface of tile or to depth of cushion with cushion-edge tile. Use sufficient pressure and flow modified epoxy emulsion into joints progressively to avoid air pockets or voids.

A-4.6.3.4 Remove all excess grout from surface of tile with a squeegee or rubber trowel before it loses its plasticity or begins to set. For final clean-up, follow manufacturer's directions.

A-4.6.3.5 Modified epoxy emulsion shall not be allowed to harden on face of tile.

A-4.6.4 Curing

A-4.6.4.1 Keep installation at a temperature of 65 to 85°F (18 to 29°C) during the first 8 hours of cure. Shade area completely from sun during this period. Before, during, and after grouting, the area must be kept clean, dry, and free from foreign materials such as construction dirt, portland cement, plaster, and other contaminants which will interfere with the setting and curing of the epoxy.

End of ANSI A108.9 — 1999

A-4.7 Installation of grout in tilework ANSI A108.10 — 1999

Applicable portions of Section A-1 through A-3 are a part of this ANSI A108.10 installation specification.

A-4.7.1 Scope

A-4.7.1.1 This specification describes the minimum requirements for grouting ceramic tile with sand-portland cement grout, standard sanded cement grout, standard unsanded cement grout, polymer modified sanded tile grout, and polymer modified unsanded tile grout.

A-4.7.2 Environmental conditions

A-4.7.2.1 Grouting and curing shall be performed at temperatures between 50 and 100°F (10 to 38°C).

A-4.7.2.2 Uniform curing conditions shall be provided or maintained at the job-site.

A-4.7.3 Materials

A-4.7.3.1 **Aggregate**. Sand in accordance with ASTM C144. Fine sand shall be clean, graded, and pass a 16-mesh screen.

A-4.7.3.2 **Portland cement**: ASTM C150, Type I or III, gray or white as specified.

A-4.7.3.3 **Water**: Clean and potable, for mixing with grout and for clean up.

A-4.7.3.4 **Hydrated lime**: ASTM C206 Type S or ASTM C207 Types.

A-4.7.3.5 Grout

A-4.7.3.5.1 Sand-portland cement grout

An on-the-job mixture of 1-part portland cement to 1-part fine graded sand is used for joints up to 1/8 inch (3 mm) wide, 1:2 for joints up to ½-inch (12.5 mm) wide, and 1:3 for joints over ½-inch (12.5 mm) wide. Up to 1/5-part lime may be added.

A-4.7.3.5.2 Standard cement grouts

Standard sanded cement grout: A factory prepared mixture of cement, graded sand, and other ingredients to produce a water-resistant, dense, uniformly colored material, meant for joints of 1/8 inch width or greater.

Standard unsanded cement grout: A factory prepared mixture of cement and additives that provide water retentivity, meant for joints of 1/8 inch width or less.

A-4.7.3.5.3 Deleted 1999.

A-4.7.3.5.4 Polymer modified tile grout

Polymer modified unsanded tile grout: A factory prepared mixture of cement and other ingredients incorporating a polymer in the form of a redispersable powder (to which only water is added at the jobsite) or a liquid latex admixture. When added in a latex form it is added as a replacement for part or all the mixing water. These grouts are designed for installation in joints of 1/8 inch width or less.

Polymer modified sanded tile grout: A factory prepared mixture of cement, sand, and other ingredients incorporating a polymer in the form of a redispersable powder (to which only water is added at the jobsite) or a liquid latex admixture. When added in a latex form it is added as a replacement for part or all of the mixing water. These grouts are designed for installation in joints of 1/8 inch width or greater. The maximum allowable joint width is designated by the grout manufacturer

A-4.7.4 Site conditions and preparation

A-4.7.4.1 Before grouting, all tiles must be firmly set, all paper and glue removed from face of mounted tiles, and all spacers, strings, ropes, or pegs removed.

A-4.7.4.2 Insure that all foreign material and job site debris are removed from the open joints before grouting.

A-4.7.4.3 Remove any excessive setting material present in the open grout joints.

A-4.7.5 Mixing grout

A-4.7.5.1 General

A-4.7.5.1.1 Machine mixing of grout is preferred to assure a uniform blend. To prevent trapping air bubbles into the prepared grout, use a slow speed mixer.

A-4.7.5.1.2 Slake for 15 minutes.

A-4.7.5.1.3 The water or latex additives used for mixing with the dry grout shall be measured accurately.

A-4.7.5.2 Mixing standard sanded cement grout, standard unsanded cement grout, polymer modified sanded tile grout, and polymer modified unsanded tile grout

A-4.7.5.2.1 Mix grout in accordance with manufacturer's printed instructions.

A-4.7.5.2.2 Deleted 1999. (See Paragraph A-4.7.5.2.1.)

A-4.7.5.3. Deleted 1999. (See Paragraph A-4.7.5.2.1.)

A-4.7.6 Installing grout

A-4.7.6.1 Use caution, when grouting glazed ceramic tiles to prevent scratching or damaging the surface of the tile.

A-4.7.6.2 Dampen dry joints prior to grouting with sand-portland cement grout, standard sanded cement grout, standard unsanded cement grout, polymer modified sanded tile grout, and polymer modified unsanded tile grout. Do not leave puddles of water in the joints before grouting.

A-4.7.6.3 Keep an adequate joint depth open for grouting. Force a maximum amount of grout into the joints.

A-4.7.6.4 All grout joints shall be uniformly finished. Cushion edge tile shall be finished evenly to the depth of the cushion.

A-4.7.7 Cleaning

A-4.7.7.1 See appropriate grout specification and/or manufacturer's recommendations for cleaning of tile after grouting. Final clean-up shall be done by finishing or polishing with a terry cloth or similar pad.

A-4.7.8 Curing

A-4.7.8.1 It is recommended that sand-portland cement grout be damp cured to sufficiently hydrate cement. For standard sanded cement grout, standard unsanded cement grout, polymer modified sanded tile grout, and polymer modified unsanded tile grout, follow the manufacturer's instructions. (See Paragraph A-1.5)

End of ANSI A108.10 — 1999

A-4.8 Interior installation of cementitious backer units ANSI A108.11 — 1999

These voluntary standards define the interior installation, test methods, and physical properties of cementitious backer units (CBU's) as a substrate for the installation of ceramic tile. They are intended to serve as a guide to the general public, manufacturers, architects, installing mechanics, testing laboratories, and other businesses and professionals in producing, specifying, installing, and testing cementitious backer units.

While the existence of these standards do not in any respect preclude anyone, including those who have accepted them, from manufacturing, marketing, purchasing, or using products, processes, or procedures not conforming to these standards, producers of CBU's made in conformance with these standards are encouraged individually to indicate such conformance in advertising, promotion, and labeling.

It is recognized that ceramic tile is installed over a variety of substrates each of which possesses its own performance characteristics. In critical performance areas such as those exposed to moisture or impact, materials which are unaffected by moisture and have high compressive strengths are more suitable.

The quality and performance of CBU's is determined by a number of factors, but most importantly the ability to remain unaffected by moisture while maintaining structural integrity. These standards promote long-term performance of CBU's as a substrate for ceramic tile installations.

A-4.8.1 General

A-4.8.1.1 Scope

This standard covers cementitious backer units (CBU's) when used as a substrate for the installation of ceramic tile in interior applications.

A-4.8.1.2 Purpose

This standard is for the use of manufacturers of CBU's, architects, installing mechanics, and testing laboratories in producing, specifying, installing, and testing CBU's as a substrate for the installation of ceramic tile. It provides a basis for promoting proper installation of CBU's as specified herein.

A-4.8.1.3 Standards

The following standards and specifications are referred to in the body of these standards by designations only and form a part of these standards as modified and specified herein. Current edition of these standards and specifications should be utilized at all times.

American Society for Testing and Materials (ASTM):

A 653-96 Specification for steel sheet, zinc-coated (galvanized) or zinc iron alloy-coated (galvannealed) by the hot-dip process

C 645-96a Specification for non-load (axial) bearing steel studs, runners (track), and rigid furring channels for screw applications of gypsum board

C 955-94 Specification for load bearing (transverse and axial) steel studs, runners (track), and bracing or bridging, for screw application of gypsum board and metal plaster bases.

A-4.8.2 General installation requirements

A-4.8.2.1 Delivery, storage, and handling of materials at project site

A-4.8.2.1.2 Materials shall be delivered in unopened packages and stored in an enclosed shelter providing protection from damage and exposure to the elements. Damaged materials shall be removed from the premises.

A-4.8.2.2 Environmental conditions

A-4.8.2.2.1 During CBU and tile installation, ambient room temperatures shall be maintained within the range of 50 to 100°F (10 to 38°C). Ventilation shall be provided.

A-4.8.3 Materials

A-4.8.3.1 Cementitous backer units shall conform to ANSI A118.9.

A-4.8.3.2 Fasteners

A-4.8.3.2.1 For wood framing, use corrosion resistant roofing nails (11ga x 3/8 inch HD) such as hot-dipped galvanized, or equal, of sufficient length to penetrate the wood framing a minimum of 3/4 inch (19 mm) or corrosion resistant wood screws (minimum No. 8-18 x 3/8 inch HD ribbed wafer). Screw length must provide a minimum of 3/4 inch (19 mm) thread engagement.

A-4.8.3.2.2 For steel framing, use corrosion resistant screws (minimum No. 8-18 x 3/8 inch HD ribbed wafer). Screw length must provide a minimum ¼-inch (6mm) thread engagement.

A-4.8.3.3 Miscellaneous

A-4.8.3.3.1 Tape: Coated glass fiber mesh tape as required for joint treatment by CBU manufacturer.

A-4.8.3.3.2 Bonding materials:

A-4.8.3.3.2.1 Organic adhesive manufactured in conformance with ANSI A-136.1, Type 1.

A-4.8.3.3.2.2 Dry-set portland cement mortar manufactured in conformance with ANSI A-118.1.

A-4.8.3.3.2.3 Latex-portland cement mortar manufactured in conformance with ANSI A-118.4.

A-4.8.4 General Framing requirement

A-4.8.4.1 Framework shall meet the minimum requirements of Paragraph A-3.

A-4.8.4.1.1 Framing members shall be straight, plumb or level, of uniform dimension, and aligned to provide square corners. Maximum variation from required plane shall be 1/4 inch in 10 feet (6 mm in 3 m) for floor joists, wall studs, and ceiling joists.

A-4.8.4.1.2 Support framing shall be designed for a maximum allowable assembly deflection of L/360 under all intended live loads.

A-4.8.4.1.3 Framing members shall be spaced a maximum of 16 inch (406 mm) on center.

A-4.8.4.2 Wood framing requirements

A-4.8.4.2.1 Wood framing shall meet the following minimum requirements for proper performance of CBU's.

A-4.8.4.2.2 Wall framing lumber shall be of a grade suitable for its intended use, and shall be a minimum 2 x 4 inch, nominal (38 x 89 mm, actual), and shall bear the grade mark of a recognized inspection agency.

A-4.8.4.2.3 All framing lumber shall have a moisture content not in excess of 19% at time of CBU application.

A-4.8.4.3 Steel framing requirements

A-4.8.4.3.1 Steel framing shall meet ASTM C955 "Load bearing (transverse and axial) steel studs, runners (track), and bracing or bridging for screw application of gypsum board and metal plaster bases," or ASTM C645 "Specification for non-load (axial) bearing steel studs, runners (track), and rigid furring channels for screw application of gypsum board" including the requirements specified in Sections A-4.8.4.3.1.1 and A-4.8.4.3.1.2.

A-4.8.4.3.1.1 Steel framing shall meet the design criteria for the intended use, with the additional requirement that the minimum base metal thickness, individual measurement, shall be not less than 20 gauge (0.033") (0.84 mm).

A-4.8.4.3.1.2 Steel shall have a minimum G60 galvanized coating per ASTM A653.

A-4.8.4.4 Walls

A-4.8.4.4.1 Studs shall be furred out flush with face of receptors and heavy gauge anchor plates. Install required blocking or headers to support all plumbing fixtures, soap dishes, grab bars, towel racks, and other accessories.

A-4.8.4.5 Subfloor

A-4.8.4.5.1 Place 19/32 (16 mm) or thicker plywood, with Exposure 1 or Exterior durability classification and meeting the minimum requirements of local building codes and Paragraph AN-3.4.1.2 — with the long dimension across the wood or steel joists spaced a maximum 16 inch (406 mm) on center. A ¼-inch (6 mm) bead of construction adhesive shall be applied to the center of the top of the joists.

A-4.8.4.5.2 Position plywood and fasten to steel joists with screws as specified by steel joist manufacturer. Locate screws not more than 6 inches (152 mm) on center along panel edges and 12 inches (305 mm) on center at intermediate supports.

A-4.8.4.5.3 Fasten to wood joists with 6 d ring shank nails located not more than 6 inches (152 mm) on center along panel edges and 12 inches (305 mm) on center at intermediate supports.

A-4.8.4.6 Ceilings

A-4.8.4.6.1 Steel ceiling joists or furring channels 20 gauge (0.033 inch [0.84 mm]) or heavier shall be spaced a maximum 16 inches (406 mm) on center.

A-4.8.4.6.2 Framing shall be capable of supporting the total ceiling system dead load, including insulation, ceramic tile, bonding materials, and CBUs, with a deflection not exceeding L/360.

A-4.8.5 General applications

A-4.8.5.1 Walls

A-4.8.5.1.1 In tub and shower areas after the installation of the tub, shower pan, or receptor, precut CBU to proper size and make necessary cut-outs.

A-4.8.5.1.2 Install moisture retarding membrane if required by local building code. Place and fasten CBU's on studs according to manufacturer's requirements. For steel framing, begin fastening at the bottom or edge nearest to the runner or track and continue fastening.

A-4.8.5.1.3 Drill holes in CBU for relief around protruding bolts and screwheads. Fill holes with the tile setting material.

A-4.8.5.1.4 Apply CBU's to framing with long dimension across framing. Center end or edge joints on framing and stagger joints in adjacent rows. Space ends and edges in accordance with manufacturer's recommendations.

A-4.8.5.1.5 Select fastener to be used as specified in Paragraph A-4.8.3.2 herein and fasten to wood or steel framing placing nails or screws a maximum of 8 inch (203 mm) on center. Alternative fasteners and fastener spacing are permitted where equivalent CBU structural performance can be documented.

A-4.8.5.1.6 Provide additional blocking where required to permit proper attachment. Edges or ends of unit parallel to framing shall be continuously supported.

A-4.8.5.1.7 Hold CBU firmly in contact with framing while driving fasteners. Do not overdrive screws and replace any screws that are stripped. Where CBU joints meet on steel framing members, attach CBU to web side of flange first.

A-4.8.5.2 Floors

A-4.8.5.2.1 Install CBU over plywood subfloor as described in Paragraph A-4.8.4.5 after application of a coat of mortar or adhesive to the subfloor for a minimum thickness of 3/32 inch (2 mm) coverage to provide for uniform support between the cementitious backer unit and the subfloor. If CBU manufacturer recommends use of organic adhesive, follow adhesive manufacturer's instructions. CBU shall be placed and secured before setting material films over.

A-4.8.5.2.2 Stagger CBU joints so as not to coincide with joints in subfloor. CBU must be fastened with screws or nails 8 inches (20 cm) on center in the field and around all edges.

A-4.8.5.3 Countertops

A-4.8.5.3.1 Sawcut dot and dash cuts 6 to 8 inches (150 to 203 mm) on center through the thickness of 23/32 inch (17 mm) or thicker plywood with Exposure 1 or Exterior durability classification.

A-4.8.5.3.2 Position ends and edges of properly sized plywood sheets over cabinet supports. Glue and nail or screw sheets to the supports. Locate fasteners not more than 6 inches (152 mm) on center over the supports.

A-4.8.5.3.3 Apply a waterproof membrane to plywood face and edges in areas subject to high moisture or steam.

A-4.8.5.3.4 Install CBU over plywood using bonding material described in Paragraph A-4.8.3.3.2 herein and as required by CBU manufacturer. Apply a coat of the material to the plywood for a minimum thickness of 3/32 inch (2 mm) coverage to provide for uniform support between the CBU and the plywood. If CBU manufacturer recommends the use of organic adhesive, follow adhesive manufacturer's instructions.

A-4.8.5.3.5 Place and secure CBU's before bonding material films over. Fasten CBU with screws or nails 8 inches (203 mm) on center in the field and around all edges.

A-4.8.5.4 Ceilings

A-4.8.5.4.1 Apply CBU to framing with long dimension across framing spaced a maximum of 16 inches (406 mm) on center. Center end joints on framing and stagger joints in adjacent rows. Fit ends and edges according to manufacturer's requirements. Fasten unit to steel with 1-¼ inch (31.8 mm) screws and wood framing with a 1-5/8 inch (41 mm) screws or 1-½ (38 mm) nails spaced a maximum of 6 inches (152mm) on center. For type of fastener see Paragraph 4.8.3.2.1.

A-4.8.5.5 Joint treatment: floors, walls, and ceilings

A-4.8.5.5.1 Fill all joints of CBU's with tile setting material and tape according to manufacturer's requirements.

End of ANSI A108.11 — 1999

Appendix — limitations and explanations

[This Appendix is not part of American National Standard A108.11]

1. CBU's cannot be used as structural load-bearing members unless approved by manufacturer and recognized for use by local building codes.

2. Do not use paper tape for joint treatment. Do not apply ceramic tile to a CBU where the joints have been filled with gypsum board joint compound and/or paper tape.

3. CBU's cannot be used on floors that are sloped to a drain.

4. Do not use dry wall nails to install CBU's.

5. When CBU's are used on countertops, be sure cabinet is level prior to CBU installation.

6. All references to plywood conform to recommendations and terminology of APA - The Engineered Wood Association.

7. Special materials: There are certain items required for the proper installation of cementitious backer units. Follow manufacturers recommendation for use of these materials:

   -Carbide-tipped scoring tools used to score the boards.

   -Coated glass fiber mesh tape used to cover the joints.

A-4.9 Installation of ceramic tile with EGP (Exterior glue plywood) latex-portland cement mortar ANSI A108.12 — 1999.

Applicable portions of Sections A-1 through A-3 are a part of these A108.12 installation specifications.

NOTE – This specification covers installation of ceramic tile over Exterior or Exposure 1 plywood in interior, dry or limited water exposure areas only with EGP latex-portland cement mortar. Plywood is not a recommended substrate for ceramic tile on walls, ceilings, or in wet areas.

A-4.9.1 Installation of tile for floors

A-4.9.1.1 General

A-4.9.1.1.1 Only those cementitious materials which have been specifically designed and approved by the manufacturer for bonding to wood substrates in accordance with Paragraph AN-3.4.3 may be used for bonding to Exterior or Exposure 1 plywood which has been properly installed in accordance with Paragraph AN-3.4.3.

A-4.9.1.2 Preparation of surface

A-4.9.1.2.1 Clean surface of plywood and 1/8 inch (6mm) gaps between sheets of plywood thoroughly.

A-4.9.1.3 Mixing EGP latex-portland cement mortar

A-4.9.1.3.1 Mix EGP latex-portland cement mortar in accordance with the following directions, unless mortar manufacturer's instructions differ.

A-4.9.1.3.2 Add dry ingredients to proper amount of water or liquid latex recommended by the manufacturer.

Mix and slake according to the manufacturer's instructions. In the absence of manufacturer's instructions, mix slowly and thoroughly and let mortar stand for 15 minutes; then remix. Do not mix with high speed mechanical mixer. Mechanical mixers must be 300 RPM or lower. Do not add water, latex, additional mortar, or other ingredients after slaking period.

A-4.9.1.3.3 Mortar consistency shall be such that when applied with the recommended notched trowel to the plywood, the ridges formed in the mortar shall not flow or slump.

A-4.9.1.3.4 During use, remix mortar occasionally. Additional liquid or fresh materials shall not be added after initial mixing. Mortar shall not be used after initial set.

A-4.9.1.4 Applying EGP latex-portland cement mortar

A-4.9.1.4.1 Insert temporary filler in movement joints.

A-4.9.1.4.2 Clean surface thoroughly.

A-4.9.1.4.3 Follow the manufacturer's directions for treatment of gaps between adjacent sheets of plywood. Key the setting material into the plywood by applying mortar with flat side of trowel over an area no greater than can be covered with tile before the mortar skins over. Using a notched trowel of type recommended by mortar manufacturer, comb mortar to obtain even setting bed. Cover surface uniformly with no bare spots, and with sufficient mortar to insure a minimum mortar thickness of 3/32 inch (2mm) between tile and plywood after tile has been embedded. Tile shall not be applied to skinned-over mortar.

A-4.9.1.5 Setting tile

A-4.9.1.5.1 Press tile into freshly combed mortar, insuring mortar contact with tile while maintaining accurate joint alignment and spacing. Keep an adequate joint depth open for grouting.

A-4.9.1.5.2 Thoroughly embed all tile or tile assemblies to obtain maximum contact and penetration of mortar into the back of each tile, or back of each tile and back mounting material. Average contact area shall not be less than 80% when no less than three tiles or tile assemblies are removed for inspection.

A-4.9.1.5.3 Certain rib-backed or button-backed tile may require trowelling a layer of mortar on the back of each tile prior to placing on the combed mortar bed.

A-4.9.2 Grouting of tile

A-4.9.2.1 Tile shall be firmly set before grouting. Follow the setting material manufacturer's recommendations.

A-4.9.2.2 Before grouting all paper and glue shall be removed from face of mounted tile and all spacers, strings, ropes, and pegs removed.

A-4-9.2.3 Install and cure grout in accordance with appropriate American National Standard: A108.6 Chemical resistant epoxy grout; A108.9 Modified epoxy emulsion grout; or A108.10 Installation of grout.

End of ANSI A108.12 — 1999

A-4.10 Installation of load bearing, bonded, waterproof membranes for thin-set ceramic tile and dimension stone ANSI A108.13 — 1999

Applicable portions of Section A-1 through A-3 are a part of this ANSI A108.13 installation specification.

A-4.10.1 Scope

A-4.10.1.1 This specification is a guideline for installing waterproof membranes that comply with ANSI A118.10. Use of such a membrane does not change industry requirements for the installation of tile, including proper movement joint placement.

A-4.10.2 Application of membrane to substrate

A-4.10.2.1 There are many types of waterproof membrane systems available that comply with ANSI A118.10**.** Application methods differ widely.

A-4.10.2.1.1 Sheet membranes: Use manufacturer's recommended bonding material to attach the membrane to the substrate. Follow the manufacturer's written instructions for application of membrane and bonding material.

A-4.10.2.1.2 Liquid applied membranes: These are generally applied directly to the substrate without a separate bonding material. Follow the manufacturer's written instructions for application and gauging of the membrane.

A-4.10.3 Curing of membrane and/or bonding material

A-4.10.3.1 Follow manufacturer's instructions for curing time and conditions after application of the membrane. Consult membrane manufacturer for recommended testing of waterproofing.

A-4.10.4 Installation of ceramic tile over cured membrane

A-4.10.4.1 Tile installation materials must be specified by the membrane manufacturer for proper bonding to their individual membranes. Latex-portland cement mortars (ANSI A118.4), Organic adhesives (ANSI A136.1), or water cleanable tile-setting epoxy adhesives (ANSI A118.3) should be applied to the cured membrane in accordance with the appropriate ANSI A108 specification.

A-4.10.5 Grouting of tile

A-4.10.5.1 Before grouting, all tiles must be firmly set, all paper and glue removed from face mounted tile and all spacers, strings, ropes, and pegs removed.

A-4.10.5.2 Consult grouting material manufacturer prior to grouting.

A-4.10.5.3 Install and cure grout in accordance with appropriate American National Standard: A108.6 Chemical resistant epoxy grout; A108.9 Modified epoxy emulsion grout; or A108.10 Installation of grout.

End of ANSI A108.13 — 1999

American national standard specifications for dry-set portland cement mortar A118.1 — 1999

Foreword

Explanation and Notes

This foreward is not part of American national standard specifications for dry-set portland cement mortar, A118.1.

Formerly this standard included dry-set mortar types to which sand and sometimes also cement (concentrate type) were added by the mechanic at the job site. These particular types are no longer covered. However, mortars which require only the addition of water at the job site — mortars which may be labeled for one or more of the following types of tile: glazed wall tile, ceramic mosaics, pavers, and quarry tile — are covered by this standard. These mortars need only be tested for shear strength with respect to the particular types of tile for which they are intended. Mortars which are not restricted by their labeling to particular types of tile must pass all of the shear tests.

The specialized mortars covered in this specification (fast setting dry-set mortar and non-sagging dry-set mortar) shall only be exempt from those tests specifically stated plus some modifications to the normal testing procedures may be required where indicated.

End of Foreword — Explanation and Notes

C-1 Scope

This specification describes the test methods and minimum requirements for dry-set portland cement mortar.

C-2 Definitions

C-2.1 Dry-set mortar

A water-retentive portland cement mortar, which eliminates the necessity of soaking either the tile or backing surfaces before installation.

C-2.1.1 Fast-setting dry-set mortar: A dry-set mortar specifically designed to obtain the minimum required shear bond strengths at a much faster rate than normal dry-set mortar. The accelerated hydration may be accomplished by the use of liquid accelerators in combination with normal dry-set mortars or by the use of special cements in powdered form.

C-2.1.2 Non-sagging dry-set mortar: A dry-set mortar specifically formulated to reduce slippage of tile on vertical installations.

C-2.2 Ceramic tile: As described in ANSI A137.1.

C-2.2.1 Tile for tests: All tiles for tests in this standard are to be dry and clean as obtained from manufacturer's undamaged cartons. Mortar contact is always on the unglazed face of glazed wall tile. Water absorption of tiles is determined by ASTM C373. Tiles for tests in this standard include the following:

Designation	Description
A	*Glazed wall tile, 4-¼ x 4-¼ inches (108 x 108 mm), having a nominal thickness of 5/16 inch (8 mm), water absorption of 13-15 percent.
A-1	Same as A but cut to form pieces 4-¼ x 2-1/8 inches (108 x 54 mm) with the back pattern ribs parallel to the 2-1/8 inch dimension. Tile must be dry at time of use. Dry to constant weight in an oven at 302°F (150°C) followed by a 24-hour equilibrium period at 70-77°F (21-25°C), 50 percent relative humidity before use.
B	4 x 4 x 3/8 inch (102 x 102 x 10 mm) nominal unglazed paver tile weighing from 190 to 210 grams and having a water absorption of 3 percent or less.
C	2 x 2 x ¼ inch (50 x 50 x 6 mm) modular unglazed ceramic mosaic tile with a water absorption of 0 to 0.5 percent. Always use the tile face that is free of paper or glue as the

bonding surface [actual size is approximately 1-15/16 by 1-15/16 inches (50 by 50 mm)].

D 4 x 8 x ½ inch (102 x 208 x 13 mm) nominal unglazed quarry tile with water absorption not exceeding 5 percent, cut into pieces approximately 4 x 4 x ½ inch. The smooth face is used as the bonding surface.

*In order to obtain comparable test results, the tile selected shall be standard grade, of one glaze color, obtained from one manufacturer. Bonding surface must be cleaned of dust produced by cutting. Brush wet and flush with plain water.

C-3 Sampling and testing procedures

C-3.1 Sample

Obtain not less than 20 pounds (9 kg) of the particular brand of dry-set mortar to be tested from a commercial shipment of recent manufacture to conduct tests described in this standard.

C-3.2 Temperature

Unless otherwise stated in a particular test, all tests are to be run at a normal room temperature of 70-77°F (21-25°C) and relative humidity of approximately 45-55 percent. Components (water, mortar, tile, etc.) used in performing all tests shall be stored at the temperature specified for each test for a minimum of 12 hours prior to use.

C-3.3 Recording test values

In any of the following tests requiring more than one specimen, record each individual test value and determine the mean of the multiple values for comparison with the test requirements.

Values which do not reflect a normal distribution of shear strengths shall be discarded when they satisfy the Dixon test for extreme value as follows:

If $\frac{X_2-X_1}{X_4-X_1} \geq 0.765$, then the lowest value shall be discarded

If $\frac{X_4-X_3}{X_4-X_1} \geq 0.765$, then the highest value shall be discarded

where X_1, X_2, X_3, X_4, are the observed shear strength values from lowest to highest.

C-4 Tests for application properties of dry-set mortars

C-4.1 Mortar preparations

C-4.1.1 Water ratio: The water ratio used in mortar preparation shall follow the manufacturer's recommended water to powder ratio.

C-4.1.2 Mixing mortar: Slowly hand mix the mortar and water until uniform mixing has been achieved, and then vigorously mix for proper air entrainment and consistency. The mixing operation shall be performed in five to six minutes of the initial water addition. Slake for 15 minutes and remix before using unless otherwise stated in the subsequent test. The resulting mortar shall be trowelable, but stiff enough so that when it is troweled on a horizontal surface with a ¼-inch (6 mm) square-notched trowel, the ridges retain their original shape without sagging or spreading. This mix ratio shall be used in all tests.

C-4.2 Initial set

By Gilmore Needles (ASTM C266) using mortar as prepared in C-4.1.2 with a 15-minute slake and a ½-inch (13 mm) thickness of prepared material.

Requirement: Initial set greater than 6 hours after mortar sample is prepared.

C-4.2.1 Initial set at 100°F: By Gilmore Needles (ASTM C266) using mortar as prepared in C-4.1.2 with a 15-minute slake and ½-inch (13 mm) thickness of prepared material.

Requirement: Initial set greater than 1.0 hour after mortar sample is prepared.

C-4.2.2 Initial set of fast -setting dry-set mortars: By Gilmore Needles, (ASTM C-266) using mortar mixed and slaked according to manufacturer's instructions with a ½-inch (13 mm) thickness of prepared material.

Requirement: Initial set greater than or equal to 1.0 hour after mortar sample is prepared.

NOTE – Testing for initial set at 100°F is not required for fast-setting dry-set mortars.

C-4.3 Final set

By Gilmore Needles (ASTM C266) using mortar as prepared in C-4.1.2 with a 15-minute slake and a ½-inch (13 mm) thickness of prepared material.

Requirement: Final set greater than 9 but less than 15 hours after the mortar sample is prepared.

C-4.3.1 Final set at 100°F: By Gilmore Needles (ASTM C266) using mortars prepared in C-4.1.2 with a 15-minute slake and a ½-inch (13 mm) thickness of prepared material.

Requirement: Final set greater than 1.5 hours after the mortar specimen is prepared.

C-4.3.2 Final set of fast-setting dry-set mortars: By Gilmore Needles, (ASTM C-266) using mortar mixed and slaked according to manufacturer's instructions with a ½-inch (13 mm) thickness of prepared material.

Requirement: Final set less than 3 hours after the mortar sample is prepared.

NOTE – Testing for final set at 100°F is not required for fast-setting dry-set mortars.

C-4.4 Open time

Prepare at least 1,000 grams of mortar powder as specified in C-4.1.2. Trowel onto a vertical, rigidly supported gypsum wallboard (½-inch thickness) surface using a ¼-inch square-notched trowel with ¼-inch flats, so as to obtain an average mortar thickness of 1/8 inch (3 mm). After an initial period of 45 minutes for room temperature and 15 minutes for high temperature, one tile (Type A) shall be pressed onto this mortar surface with the open time tool so that the space between the tile (exclusive of the back pattern) and wallboard is 3/23 inch (2.4 mm) and then twisted to a 90 degree angle. At 5 minute intervals, additional tile shall be set and twisted in the same manner. Designate as the Open time, the longest time after application of the mortar that the tile is retained on the surface when applied in the above fashion. Make two such tests, one at room temperature and one at high temperature.

The open time tool shall consist of a ¼-inch (6 mm) thick, flat brass plate 5-½ x 3-3/4 inches (140 by 95 mm) with 4 studs threaded into it, one at each corner. The studs shall be adjusted so that they will protrude from the bottom side of the plate 3/32 inch (2.4 mm) more than the thickness (exclusive of the back pattern) of the Type A wall tile used for the test and the brass nuts used to lock the studs at this position.

NOTE – Condition wallboard at 100°F (38°C) for 12 hours before high temperature testing.

Requirement:

Room temperature open time: 50 minutes or more at 70-77°F (21-25°C) and a relative humidity of 45-55 percent.

High temperature open time: 20 minutes or more at 100-110°F (38-45°C) and a relative humidity of 45-55 percent.

C-4.4.1 Open time of fast-setting dry-set mortars: Follow testing procedures as described in C-4.4 using mortar mixed and slaked according to manufacturer's instructions.

Requirement: Room temperature open time: 20 minutes or more at 70-77°F (21-25°C) and a relative humidity of 45-55 percent.

NOTE – Testing for Open time at high temperature is not required for fast-setting dry-set mortars.

C-4.5 Adjustability

Prepare mortar as specified in C-4.4 but slake for one additional hour at room temperature after the 15-minute remixing. Trowel mortar onto a vertical,

rigidly supported gypsum wallboard (½-inch thickness) surface using a ¼-inch (6mm) square notched trowel with ¼-inch flats, so as to obtain an average mortar thickness of 3/32 inch (2.4 mm). Immediately upon troweling mortar for each test, using the open time tool described in C-4.4, press 10 tiles (Type A) onto the mortar surface, so that the space between tile (exclusive of the back pattern) and wallboard is 3/32 inch (2.4 mm). Allow a 3 inch (76 mm) space between the tile. Using the open time tool, twist each tile through an angle of 90 degrees and back to the original position at 5-minute intervals. Allow 25 minutes initial time before twisting the first tile for the 70°F (21°C) test and 5 minutes for the 100°F (38°C) test.

Twisting the tiles shall be performed using one hand only. Designate as the Adjustability, the longest time after application of the tiles that a tile remains affixed to the surface when so tested. Make separate tests at 100°F (38°C) and at 70°F (21°C), both at a relative humidity of approximately 50 percent.

NOTE – Condition wallboard at 100°F (38°C) for 12 hours before high temperature testing.

Requirement:

Room temperature adjustability: 30 minutes or more at 70-77°F (21-25°C) and a relative humidity of 45-55 percent.

High temperature adjustability: 10 minutes or more at 100-110°F (38-45°C) and a relative humidity of 45-55 percent.

C-4.5.1 Adjustability of fast-setting dry-set mortars: Follow testing procedures as described in C-4.5 using mortar mixed and slaked according to manufacturer's instructions. Additional slaking period of one hour is not required.

Requirement: Room temperature adjustability: 20 minutes or more at 70-77°F (21-25°C) and a relative humidity of 45-55 percent.

NOTE – Testing for adjustability at high temperature is not required for fast-setting dry-set mortars.

C-4.6 Sag on vertical surfaces (required for mortars designated for vertical applications)

Screed mortar onto a 2 x 7-½ x 15-½ inch (51 x 190 x 394 mm) concrete block of density of 2.35 gm/cm^3, using a 7-½ inch square, 1/8 inch thick, plexiglass template with a 5-½ inch square hole. The mortar shall be screeded using 10 cuts in a right to left direction and 30 cuts in a left to right direction (±2 cuts). One cut shall consist of a complete up and down motion. Cut the plexiglass form free from the mortar and remove it. Gently center the tile (Type B) on the mortar pad with the ribs in a vertical position and place the tile-application jig (Fig. II) onto the tile. Following the application pattern (Fig. III), raise the 130 gm (±5 gm) weight up the shaft of the jig and drop once from a height of 4 inches in each of the four positions. Remove the tile-application jig and place the sag-measuring jig (Fig. IV) onto the block with the tile and mortar pad between the metal struts. Secure the sag-measuring jig to the block using the set-screws at the top of the jig. Then screw the center-measuring shaft inward until the bottom of the plexiglass beam lightly touches the top surface of the tile. Record the measurement in 64ths of an inch. This shall be achieved by reading the bottom edge of the beam on each strut and the average of the two readings taken. This value is termed the initial sag measurement. Readings shall be taken on the bottom of the beam using the inner scales of each strut. Remove the sag-measuring jig and reposition the assembly so the tile and mortar layer is in a vertical plane. After one hour, return the block to its initial position and replace the sag-measuring jig. Record the tile position with the measuring beam as specified above. This value is termed the final sag measurement. Subtract the initial sag measurement from the final sag measurement. This number is to be called the "sag value."

Requirement: Sag less than 1/16 inch (2 mm).

C-4.6.1 Sag on vertical surfaces of non-sagging dry-set mortars: Assemble the test specimen as indicated in C-4.6 except use Type D tile.

Requirement: Tile must not sag from its original position.

C-4.7 Cohesion immediately after application

Apply a ¼-inch (6 mm) layer of mortar (per C-5.1.1) between two tiles (Type A). Offset end of the tiles 1

inch (25 mm) and clamp top tile in a horizontal position so that lower tile is supported only by the cohesion of the mortar. Note position of lower tile after 24 hours.

Requirement: Assembly to be intact.

C-5 Shear strength of mortars to ceramic tile

C-5.1 Shear strength of mortars to glazed wall tile

C-5.1.1 Preparation of specimens: Prepare 500 grams of mortar as specified in C-4.1.2. Assemble 16 shear specimens from 32 pieces of Type A-1 tile, with a 3/32 inch (2.4 mm) mortar layer by bonding two pieces of tile together for each specimen. The 3/32 inch mortar bonding layer shall be established by placing 1/8 inch (3 mm) thick T-bar spacers (Figure V) on the smallest tile edge; be sure to rub all of the mortar off the underside of the spacers by sliding them back and forth along the edge. The top tile shall be placed with the cut edge opposite to that of the bottom tile's cut edge and squeezed until a 3/32 inch thickness of mortar is obtained. The specimen shall be constructed so that the cut edge will be loaded. The tile shall then be slid back and forth along the stainless steel spacers to ensure proper thickness of the mortar. The tiles shall then be slid to ensure a 1/8 inch (3 mm) offset. Care shall be taken in removing the stainless steel spacers so as not to cant or slide the tiles in relation to each other or to alter the offset distance. Specimens should not be individually handled for 24 hours and shall be treated with care until broken. Cure all specimens for seven days at 70-77°F (21-25°C), 45-55 percent relative humidity and further cure or treat as directed in tests C-5.1.2 through C-5.1.5. Assume an area of bond of 8.0 square inches (51.6 cm^2) in calculating the strength value in psi.

C-5.1.2 7-day shear strength: Remove 4 specimens assembled as directed in C-5.1.1 and individually test as in C-5.4 with compression loading at a rate of 2400 pounds (1088.6 kg) per minute so that the mortar is stressed in shear to failure. Record these values as the 7-day shear strength.

Requirement: Shear strength greater than 200 psi (14 kg/cm^2).

C-5.1.3 7-day water immersion shear strength: Immerse 4 specimens prepared in C-5.1.1 in water for 7 days. Test in shear (per C-5.1.2) and record the values as 7-day water immersion shear strength.

Requirement: Shear strength greater than 150 psi (10.5 kg/cm^2).

C-5.1.4 4-week shear strength: Cure 4 specimens prepared in C-5.1.1 for an additional 3 weeks at the temperature and relative humidity specified in C-5.1.1. Test in shear (per C-5.1.2) and record the values as 4-week shear strength.

Requirement: Shear strength greater than 250 psi (17.4 kg/cm^2).

C-5.1.5 12-week shear strength: Cure 4 specimens prepared in C-5.1.1 for an additional 11 weeks at the temperature and relative humidity specified in C-5.1.1. Test in shear (per C-5.1.2) and record the values as 12-week shear strength.

Requirement: Shear strength greater than 250 psi (17.4 kg/cm^2).

C-5.2 Shear strength of mortars to impervious ceramic mosaic tile

C-5.2.1 Preparation of specimens: Prepare 500 grams of mortar as specified in C-4.1.2. Assemble 16 shear specimens from 32 Type C tiles, with a 1/8 inch (3 mm) mortar layer by bonding the two tiles together for each specimen. The 1/8 inch mortar bonding layer shall be established by placing 1/8 inch thick T-bar spacer (Figure V) on the tile edge; be sure to rub all mortar off the under side of the spacers by sliding them back and forth along the edge. The top tile shall be placed on top of the mortar layer and squeezed until a 1/8 inch thickness of mortar is obtained. The tile shall then be slid back and forth along the stainless steel spacers to ensure proper thickness of the mortar. The tile shall then be slid to ensure a 1/8 inch (3 mm) offset. Care shall be taken in removing the stainless steel spacers so as not to cant or slide the tiles in relation to each other or to alter the offset distance. Specimens shall not be individually handled for 24 hours and shall be treated with care until broken. Cure all specimens for seven days at 70-77°F (21-25°C), 45-55 percent relative humidity and further cure or treat as directed in tests C-5.2.2 through C-5.2.5. Assume an area of bond of 2.9 square

inches (18.7 cm^2) in calculating the strength value in psi.

C-5.2.2 7-day shear strength: Remove specimens assembled as directed in C-5.2.1 and individually test as in C-5.4 with compression loading at a rate of 360 pounds (163.4 kg) per minute, so that the mortar is stressed to failure. Record these values as the 7-day shear strength.

Requirement: Shear strength greater than 150 psi (10.5 kg/cm^2).

C-5.2.3 7-day water immersion shear strength: Immerse 4 specimens prepared in C-5.2.1 in water for seven days. Test in shear (per C-5.2.2) and record the values as 7-day water immersion shear strength.

Requirement: Shear strength greater than 100 psi (7.0 kg/cm^2).

C-5.2.4 4-week shear strength: Cure 4 specimens prepared in C-5.2.1 for an additional three weeks at the temperature and relative humidity specified in C-5.2.1. Test in shear (per C-5.2.2) and record the values as 4-week shear strength.

Requirement: Shear strength greater than 150 psi (10.5 kg/cm^2).

C-5.2.5 12-week shear strength: Cure 4 specimens prepared in C-5.2.1 for an additional eleven weeks at the temperature and relative humidity specified in C-5.2.1. Test in shear (per C-5.2.2) and record the values as 12-week shear strength.

Requirement: Shear strength greater than 150 psi (10.5 kg/cm^2).

C-5.3 Shear strength of mortars to quarry tile

C-5.3.1 Preparation of specimens: Prepare 1000 grams mortar as specified in C-5.1.2. Assemble 12 shear specimens from 24 pieces of Type D tile with a 1/8 inch (3 mm) mortar layer by bonding the two pieces of tile together. The 1/8 inch mortar bonding layer shall be established by placing 1/8 inch thick T-bar spacers (Figure V) on the tile edge; be sure to rub all mortar off the under side of the spacers by sliding them back and forth along the edge. The top tile shall be placed on top of the mortar layer and squeezed until a 1/8-inch thickness of mortar is obtained. The tile shall then be slid back and forth along the stainless steel spacers to ensure proper thickness of mortar. The specimen shall be constructed so that the uncut, manufactured edge will be loaded. The tile shall then be slid to ensure an 1/8 inch (3 mm) offset. Care shall be taken in removing the stainless steel spacers so as not to cant or slide the tiles in relation to each other or to alter the offset distance. Specimens shall not be individually handled for 24 hours and shall be treated with care until broken. Cure all specimens for seven days at 70-77°F (21-25°C), 45-55 percent relative humidity and further cure or treat as directed in tests C-5.3.2 through C-5.3.4. Use measured area of bond or assume an area of bond of 14.4 square inches (92.9 cm^2) in calculating the strength value in psi.

C-5.3.2 7-day shear strength: Remove 4 specimens assembled as directed in C-5.3.1 and individually test as in C-5.4 with compression loading at a rate of 1340 pounds (609.09 kg) per minute, so that the mortar is stressed in shear to failure. Record these values as the 7-day shear strength.

Requirement: Shear strength greater than 50 psi (3.5 kg/cm^2).

C-5.3.3 4-week shear strength: Cure 4 specimens prepared in C-5.3.1 for an additional three weeks at the temperature and relative humidity specified in C-5.3.1. Test in shear (per C-5.3.2) and record the values as 4-week shear strength.

Requirement: Shear strength greater than 100 psi (7.0 kg/cm^2).

C-5.3.4 12-week shear strength: Cure 4 specimens prepared in C-5.3.1 for an additional eleven weeks at the temperature and relative humidity specified in C-5.3.1. Test in shear (per C-5.3.2) and record the values as 12-week shear strength.

Requirement: Shear strength greater than 100 psi (7.0 kg/cm^2).

C-5.4 Support for shear specimens

Support all shear bond specimens in the shear bond test jig (Figure VI). Be sure to place the tile whose edge is to be loaded against the non-movable support.

C-5.5 Shear strength of fast-setting mortars

Test as described in Section C-5 except fast-setting mortars shall be mixed and slaked according to manufacturer's instructions. Also, assemble 8 additional shear specimens (4 impervious ceramic mosaic tile and 4 quarry tile specimens). These specimens shall be dry cured at 70-77ºF (21-25ºC), 45-55 percent relative humidity. Shear these specimens after curing 4 hours.

Requirements: In addition to the shear bond strengths required in sections C-5.2 and C-5.3, fast-setting mortars are required to meet the following:

4-hour shear strength of mortar to impervious ceramic mosaic tile: Equal to or greater than 50 psi.

4-hour shear strength of mortar to quarry tile: Equal to or greater then 50 psi.

C-6 Additional requirements for comparison with portland cement

While no specific tests are given for the following items, dry-set mortar performance is expected to be at least equal to Type I portland cement.

C-6.1 Non-etching of glazes

C-6.2 Non-toxicity

C-6.3 Non-allergenicity

C-6.4 Resistance to mold growth

C-6.5 Stability in storage

C-6.6 Practical handling on the job

C-6.7 Non-flammability of dry powder

C-7 Additional properties of dry-set mortar

No tests or requirements are given for the following properties. However, good performance in these properties is expected of dry-set mortars.

C-7.1 Freedom from objectionable odor

C-7.2 Non-lumping

C-7.3 Water retentivity

C-7.4 Inedibility by vermin

C-7.5 Homogeneity

C-8 Package labeling

C-8.1 Application

The container shall be clearly labeled. The directions for application and the general instructions required below shall appear on the container.

C-8.1.1 Instructions for storage: Instructions for proper storage of the dry-set mortar and any liquid additive required shall be given including any cautions against damage by freezing that are required.

C-8.1.2 Use: Instructions for proper use with kinds of tile, recommended tools, and procedures for application shall be given. If temperature range or use is different from the temperature range stated in A-1.5.3, it must be stated on the container.

C-8.1.3 Shelf life: Each container shall be labeled with the date of manufacture and the age after which the product cannot be safely used.

End of ANSI A118.1 — 1999

American national standard specifications for chemical resistant, water cleanable tile-setting and -grouting epoxy and water cleanable tile-setting epoxy adhesive A118.3 — 1999

E-1 Scope

This specification describes the test methods and minimum requirements for chemical resistant, water cleanable tile-setting and -grouting epoxy and water cleanable tile-setting epoxy adhesive.

Materials meeting A118.3 are not resistant to all chemicals and exposure conditions.

These systems shall not be confused with modified epoxy emulsion mortar/grout, which is covered by ANSI A118.8.

Architect/specifier shall submit to the epoxy manufacturer the known chemical agents, concentrations, and exposure conditions to which the epoxy will be subjected for verification of the chemical resistance (see Paragraph E-5.9).

E-2 Definitions

E-2.1 Chemical resistant, water cleanable tile-setting and -grouting epoxy

An epoxy composition, essentially a 100 percent solid system, that is supplied in two or more parts to be mixed immediately before use as a setting adhesive and joint filling grout for ceramic tile, and that is partially emulsified by water, after mixing, in order to expedite cleaning from tile surfaces during application before the epoxy hardens.

E-2.2 Water cleanable tile-setting epoxy adhesive

An epoxy composition, essentially a 100 percent solid system, that is supplied in two or more parts to be mixed immediately before use as a setting adhesive, and that is partially emulsified by water, after mixing, in order to expedite cleaning from tile surfaces during application before the epoxy hardens.

E-2.3 Ceramic tile: As described in ANSI A137.1.

E-2.3.1 The tile for tests in this standard are to be dry and clean as obtained from manufacturer's undamaged cartons. Quarry tile shall be 6 x 6 x ½ inch (152 x 152 x 12 mm) nominal unglazed quarry tile with a maximum water absorption of 5.0 percent cut into pieces approximately 3 x 6 x ½ inch (76 x 152 x 12 mm). The smooth face is used as the bonding surface, except as noted.

E-3 Sampling and testing procedures

E-3.1 Sample

Obtain not less than 13 lbs. (5.8 kg), or 1 gallon (4 liters), of the brand to be tested from a commercial lot of recent manufacture to conduct the tests described in this standard. When the weight and ratio of parts is given or can be accurately determined, the epoxy may be mixed in small batches for the individual tests.

E-3.2 Temperature

Unless otherwise stated in a particular test, all preparation, curing, and testing shall be done at 70-77°F (21-25°C) and at a relative humidity of 45-55 percent.

E-3.3 Recording test values

In any of the following tests requiring more than one specimen, record each individual test value and determine the mean of the multiple values for comparison with the test requirements.

Values which do not reflect a normal distribution of shear strengths shall be discarded when they satisfy the Dixon test for extreme value as follows:

If $\frac{X_2-X_1}{X_4-X_1} \geq 0.765$, then the lowest value shall be discarded

If $\frac{X_4-X_3}{X_4-X_1} \geq 0.765$, then the highest value shall be discarded

where X_1, X_2, X_3, X_4, are the observed shear strength values from lowest to highest.

E-4 Preparation of epoxy

E-4.1 Mixing

Read thoroughly the manufacturer's directions for mixing. Blend the parts supplied using a suitable hand tool or machine mixer, making sure any dry ingredients are thoroughly and uniformly wetted.

E-5 Tests for application properties

E-5.1 Water cleanability

Immediately after mixing the batch, remove between 250 ml and 300 ml from the container and spread it evenly over the bottom of an 8 inch ±½ inch (203 mm ±13 mm) diameter enameled or stainless steel, flat-bottomed pan. At 65 minutes, 80 minutes, and 95 minutes after mixing is complete, apply the material to the smooth face of a clean, dry quarry tile with a 6 inch (152 mm) wide putty knife. The material shall be spread in a thin layer and stick to the tile. After scraping the excess material from the tile with the putty knife, use a clean cellulose sponge and water at 70-77°F (21-25°C) to clean the remaining material from the tile. Water cleanability is indicated when the wet sponge removes the remaining epoxy leaving no lumps, color, or streaks. With some epoxies the cleaning water may turn milky during the first stages of clean up.

Requirement: The mixed material shall be spreadable and water cleanable at 80 minutes.

E-5.2 Initial setting time, service strength setting time

Equipment and procedure as defined in ASTM C308, except intervals of test may be lengthened.

Requirement: Service strength setting time 7 days or less. Initial setting time greater than 2 hours.

E-5.3 Shrinkage of the mixed components during cure

Equipment and procedures as defined in ASTM C531 to measure shrinkage after 7-day cure at 70-77°F (21-25°C).

Requirement: Average shrinkage shall not be greater than 0.25 percent after 7 days.

E-5.4 Sag in vertical joints

(Only for epoxy compositions not labeled specifically for use on floors or horizontal surfaces.)

E-5.4.1 Preparation: At least two days before test, set two ½-inch (13 mm) thick quarry tiles on the smooth 8 x 16 inch (203 x 406 mm) side of a cinder block or concrete block with the epoxy so that a 3/8 ±1/32 inch (10 ±1 mm) wide joint 6 inches (152 mm) long is formed between the tile across the width of the block.

E-5.4.2 Procedure: With the cinder block set so that the tiles are in a horizontal position, grout the 3/8 inch (10 mm) wide joint between them with the recently mixed material. Screed the joint flush with the tile and clean the excess material from the face of the tile with a wet sponge. Turn the block to put grouted joint in a vertical position. Observe the joint 24 hours later.

Requirement: No change in shape of the joint shall be noticeable.

E-5.5 Bond strength to quarry tile

E-5.5.1 Equipment: Compression testing machine, of the universal type, capable of loading from zero to 20,000 lbs. minimum (9075 kg) at a rate of 2400 lbs. (1088.6 kg) per minute.

E-5.5.2 Procedure: Using ¼-inch (6 mm) diameter and 2 inch (50 mm) long spacers or an appropriate jig, prepare 4 shear bond specimens by bonding two 6 x 3 x ½ inch (152 x 76 x 13 mm) quarry tiles face to face with the 6 inch (152 mm) sides overlapped so a bond area of approximately 15 sq. in. (96.8 cm^2) is obtained between each tile and the mixed material. Apply an excess of bonding epoxy material to one tile face, peaking the layer slightly at the center. Press the second tile face into the epoxy material until the thickness of the epoxy is ¼-inch (6 mm) as directed by the jig or the two spacers previously inserted between the tiles near and parallel to the ends of the specimen. The spacers remain in the specimen. Cure the 4 specimens for 14 days and then test in shear by applying load to the 6 inch (152 mm) long edges at a rate of 2400 lbs. (1088.6 kg) per minute until the specimen will not support load. The specimen must be supported so that the bonded planes remain vertical during testing using a support jig similar to that shown in Figure E-1.

Record the maximum load during the test and express it in pounds per square inch over the actual bonded area measured to the nearest ½ square inch.

If tile failure occurs before bond failure, record that load and note it as "tile failure."

Requirement: Average shear bond strength to quarry tile shall be greater than 1000 psi (69.8 kg/cm^2).

E-5.6 Compressive strength of the cured material

E-5.6.1 As per test method ASTM C579.

Requirement: Average compressive strength after 7 days shall be not less than 3500 psi (244 kg/cm^2).

E-5.7 Tensile strength of the cured material

E-5.7.1 As per test method C307 (three samples only).

Requirement: Average tensile strength after 7 days shall be not less than 1000 psi (69.8 kg/cm^2).

E-5.8 Thermal shock test

E-5.8.1 Equipment: Compression testing machine, of the universal type, capable of loading from zero to 20,000 lbs. minimum (9072 kg) at a rate of 2400 lbs. (1088.6 kg) per minute.

Non-absorbent spacers that are 1/8 inch (3 mm) in diameter and 2 inches (50 mm) long.

E-5.8.2 Preparation: Prepare 4 shear bond specimens by bonding two 3 x 6 x ½ inch (76 x 152 x 13 mm) quarry tiles back to back with the 6 inch (152 mm) sides overlapped so a projected bonded area of approximately 15 sq. in. (96.8 cm^2) is obtained between each tile and the mixed epoxy material. The ribs on the tile backs shall run parallel to the direction of shear. Apply an excess of epoxy to both tile backs peaking the layers slightly at the centers, and press the tiles together until the space between the crests of the ribs on the tiles is 1/8 inch (3 mm) as indicated by two spacers previously inserted between the tiles near and parallel to the ends of the specimen.

The spacers remain in the specimen. Cure the 4 specimens for 14 days.

E-5.8.3 Test procedure: The 4 specimens shall be cycled between water baths maintained at 72 ±5°F (22.2 ±2.8°C) and 205 ±5°F (96.1 ±2.8°C). Place them in the 72°F (22.2°C) bath first for ½ hour and then in the 205°F (96.1°C) bath for ½ hour. Repeat the cycle three additional times, and then place the specimens in the 72°F (22.2°C) bath again for at least ½ hour for final cooling.

Adjust the bath temperatures before and, if required, during each immersion. Remove the specimens one at a time from the 72°F (22.2°C) bath, dry them of excess water, and test them in shear as described in E-5.5.2.

Requirement: Average wet shear bond strength after thermal shock shall be greater than 500 psi (34.9 kg/cm^2).

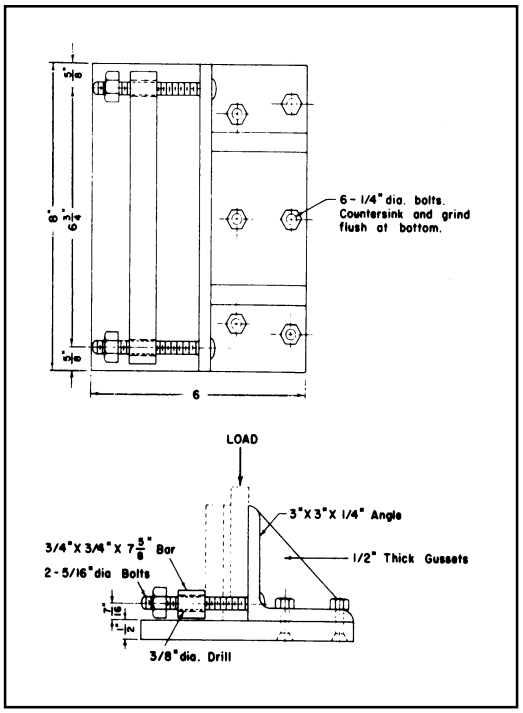
E-5.9 Chemical resistance

NOTE – Applicable only to chemical resistant epoxy mortar and grout, not to epoxy adhesive.

E-5.9.1 When specific chemical resistance data are required for the project, testing shall conform to ASTM C267, with chemical concentrations and immersion temperatures chosen to simulate exposure conditions.

End of ANSI A118.3— 1999

Fig. E-1—SUPPORT JIG FOR BOND STRENGTH TEST



METRIC CONVERSION TABLE FOR FIGURE E-1

inches	mm
1/8	3.2
5/16	7.9
3/8	9.5
7/16	11.1
1/2	12/7
3	76.2
6	152.4
6-3/4	171.4
8	203.2

American national standard specifications for latex-portland cement mortar A118.4 — 1999

Foreword

Explanation and Notes

This foreword is not a part of American national standard specifications for latex-portland cement mortar, A118.4.

FN-1 Introduction

FN-1.1 Latex additives and redispersable polymers in dry-set portland cement tile-setting mortars are designed to improve adhesion, reduce water absorption, and provide greater bond strength and resistance to shock and impact. These additives allow some latitude in working time, working conditions, and temperatures.

Latex-portland cement mortars vary in composition depending on their designed application and performance characteristics. Consult with the manufacturer to determine the suitability of specific products for desired applications.

FN-1.2 Basically, the latex additives are water emulsions which are added to portland cement mortars in place of water or replacing part of the water. The dry components — portland cement, dry additives, and graded sand — must be preblended and must be specified by the latex manufacturer for use with the particular latex additive.

Redispersable polymers are spray dried latex polymers which are pre-blended with portland cement, dry additives, and graded sand by the manufacturer. These mortars require only the addition of water for use.

FN-1.3 The specialized mortars covered in this specification (fast-setting latex-portland cement mortar and non-sagging latex-portland cement mortar) shall only be exempt from those tests specifically stated, plus some modification to the normal testing procedures may be required where indicated.

FN-2 Installation specifications

The ceramic tile section of the project specification should contain the following:

"Latex-portland cement mortar shall comply with requirements of American national standard specifications for latex-portland cement mortar, A118.4-1999."

"Installation and workmanship of ceramic tile with latex-portland cement mortar shall comply with the applicable requirements of the American National Standard Specification for installation of ceramic tile with dry-set portland cement mortar or latex-portland cement mortar A108.5 and manufacturer's installation directions."

End of Foreword — Explanation and Notes

F-1 Scope

This specification describes the test methods and the minimum requirements for latex-portland cement mortar.

NOTE – A latex sold separately shall meet the requirement of this specification only in combination with a particular brand of prepackaged dry mortar mix specified by the latex manufacturer or supplied by the latex manufacturer. A latex alone or intended for combination with job mixed cement and sand is not eligible for compliance with this specification.

F-2 Definitions

F-2.1 Latex-portland cement mortar

A modified dry-set portland cement mortar for the bonding of ceramic tile to which a polymer has been incorporated in latex form or as a redispersable powder. When added in latex form it is added as a replacement for part or all of the gauging water.

F-2.1.1 Fast-setting latex-portland cement mortar: A latex-portland cement mortar specifically designed to obtain the minimum required shear bond strengths at a much faster rate than normal latex-portland cement mortar.

F-2.1.2 Non-sagging latex-portland cement mortar: A latex-portland cement mortar specifically formulated to reduce slippage of tile on vertical installations.

F-2.2 Ceramic tile: As defined in ANSI A137.1.

F-2.2.1 All tile for tests in this standard are to be dry and clean as obtained from manufacturer's undamaged cartons. Mortar contact is always on the unglazed face of glazed wall tile. Water absorption of tile is determined by ASTM C373. Tile for tests in this standard include the following:

Designation	Description
A	*Glazed wall tile, 4-¼ x 4-¼ inches (108 x 108 mm), having a nominal thickness of 5/16 inch (8 mm), water absorption of 13-15 percent.
A-1	Same as A but cut to form pieces 4-¼ x 2-1/8 inches (108 x 54 mm) with the back pattern ribs parallel to the 2-1/8 inch dimension. Tile must be dry at time of use. Dry to constant weight in an oven at 302°F (150°C) followed by a 24-hour equilibrium period at 70-77°F (21-25°C), 50% relative humidity before use.
B	4 x 4 x 3/8 inch (102 x 102 x 10 mm) nominal unglazed paver tile weighing from 190 to 210 grams and having a water absorption of 3 percent or less.
C	2 x 2 x ¼ inch (50 x 50 x 6 mm) modular unglazed ceramic mosaic tile with a water absorption of 0 to 0.5 percent. Always use the tile face that is free of paper or glue as the bonding surface [actual size is approximately 1-15/16 by 1-15/16 inches (50 by 50 mm)].
D	4 x 8 x ½ inch (102 x 208 x 13 mm) nominal unglazed quarry tile with water absorption not exceeding 5 percent, cut into pieces approximately 4 x 4 x ½ inch. The smooth face is used as the bonding surface.

*In order to obtain comparable test results, the tile selected shall be standard grade, of one glaze color, obtained from one manufacturer. Bonding surface must be cleaned of dust produced by cutting. Brush wet and flush with plain water.

F-3 Sampling and testing procedures

F-3.1 Sampling

Obtain not less than one gallon of the brand of latex to be tested and a sufficient quantity of the prepared dry mortar mix specified by the latex manufacturer from commercial lots of recent manufacture. For mortars containing redispersable polymers, obtain not less than 20 lbs. (9 kg) of the brand to be tested from a commercial lot of recent manufacture.

F-3.2 Temperature

Unless otherwise stated in a particular test, all tests are to be run at normal room temperatures of 70-77°F (21-25°C) and relative humidity of approximately 45-55%. Components (water, mortar, tile, etc.) used in performing all tests shall be stored at that temperature specified for each test for a minimum of 12 hours prior to use.

F-3.3 Recording test values

In any of the following tests requiring more than one specimen, record each individual test value and determine the mean of the multiple values for comparison with the test requirements.

Values which do not reflect a normal distribution of shear strengths shall be discarded when they satisfy the Dixon test for extreme values as follows:

If $\frac{X_2-X_1}{X_4-X_1} \geq 0.765$, then the lowest value shall be discarded

If $\frac{X_4-X_3}{X_4-X_1} \geq 0.765$, then the highest value shall be discarded

where X_1, X_2, X_3, X_4, are the observed shear strength values from lowest to highest.

F-4 Tests for application properties

F-4.1 Mortar preparation

F-4.1.1 Dry mortar mix: Use the brand of prepackaged dry mortar mix specified by the latex manufacturer.

F-4.1.2 Mixing mortar: Add dry mortar mix to correct amount of latex, as specified by manufacturer, and stir manually to obtain complete and visually uniform wetting of dry mortar mix. When directions require dilution of latex with water, this shall be done with adequate mixing before dry mortar mix is added. For mortars containing redispersable polymers, add dry mortar mix to correct amount of water as specified by manufacturer and stir manually to obtain complete and visually uniform wetting of the dry mortar mix. Slake per manufacturers' directions and remix before using unless otherwise specified in subsequent test methods. The resulting mortar shall be trowelable, but stiff enough so that when troweled on a horizontal surface with a ¼-inch (5 mm) square notched trowel, the ridges retain their original shape without sagging or spreading. This mix ratio shall be used for all tests.

F-4.2 Initial set

By Gilmore Needles (ASTM C266) using mortar as prepared in F-4.1.2 with a 15 minute slake and a ½-inch (13 mm) thickness of prepared material.

Requirement: Initial set greater than 6 hours after mortar sample is prepared.

F-4.2.1 Initial set at 100°F: By Gilmore Needles (ASTM C266) using mortar as prepared in F-4.1.2 with a 15 minute slake and a ½-inch (13 mm) thickness of prepared material.

Requirement: Initial set greater than 1 hour after mortar sample is prepared.

F-4.2.2 Initial set of fast-setting latex-portland cement mortars: By Gilmore Needles (ASTM C-266) using mortar mixed and slaked according to manufacturer's instructions with a ½-inch (13 mm) thickness of prepared material.

Requirement: Initial set greater than 1 hour after mortar sample is prepared.

NOTE – Testing for initial set at 100°F is not required for fast-setting latex-portland cement mortars.

F-4.3 Final set

By Gilmore Needles (ASTM C266) using mortar as prepared in F-4.1.2 with a 15 minute slake and a ½-inch (13 mm) thickness of prepared material.

Requirement: Final set greater than 9 but less than 15 hours after the mortar specimen is prepared.

F-4.3.1 Final set at 100°F: By Gilmore Needles (ASTM C266) using mortars prepared in F-4.1.2 with a 15 minute slake and a ½-inch (13 mm) thickness of prepared material.

Requirement: Final set greater than 1.5 hours after the mortar specimen is prepared.

F-4.3.2 Final set of fast-setting latex-portland cement mortars: By Gilmore Needles, (ASTM C266) using mortar mixed and slaked according to manufacturer's instructions with a ½-inch (13 mm) thickness of prepared material.

Requirement: Final set less than 3 hours after the mortar sample is prepared.

NOTE – Testing for final set at 100°F is not required for fast-setting latex-portland cement mortars.

F-4.4 Open time

Prepare at least 1,000 grams of mortar as specified in F-4.1.2. Trowel onto a vertical, rigidly supported gypsum wallboard (½-inch thickness) surface using a ¼-inch (6 mm) square notched trowel with ¼-inch flats, so as to obtain an average mortar thickness of 3/32 inch (2.4mm). After an initial period of 45 minutes for the room temperature test, or 15 minutes for the high temperature test, one tile (Type A) shall be pressed onto this mortar surface

with the open time tool so that the space between the tile (exclusive of the back pattern) and wallboard is 3/32 inch (2.4mm) and then twisted to a 90 degree angle. At 5 minutes intervals, additional tile shall be set and twisted in the same manner. Designate as the Open time, the longest time after application of the mortar that the tile is retained on the surface when applied in the above fashion. Make two such tests, one at room temperature 70-77°F (21-25°C) and one at high temperature 100-110°F (38-45°C).

The open time tool shall consist of a ¼-inch (6 mm) thick, flat brass plate 5-½ x 3-3/4 inches (140 by 95 mm) with 4 studs threaded into it, one at each corner. The studs shall be adjusted so that they will protrude from the bottom side of the plate 3/32 inch (2.4mm) more than the thickness (exclusive of the ribs) of the Type A wall tile used for the test and the brass nuts used to lock the studs at this position.

Requirement:

Room temperature open time: 50 minutes or more at 70-77°F (21-25°C) and a relative humidity of 45-55 percent.

High temperature open time: 20 minutes or more at 100-110°F (38-45°C), and a relative humidity of 45-55 percent.

F-4.4.1 Open time of fast-setting latex-portland cement mortars: Follow testing procedures as described in F-4.4 using mortar mixed and slaked according to manufacturer's instructions.

Requirement: Room temperature open time: 20 minutes or more at 70-77°F (21-25°C) and a relative humidity of 45-55 percent.

NOTE – Testing for open time at high temperature is not required for fast-setting latex-portland cement mortars.

F-4.5 Adjustability

Prepare mortar as specified in F-4.1.2, but slake for one additional hour at room temperature after the 15-minute remixing. Trowel onto a vertical, rigidly supported gypsum wallboard (½-inch thickness) surface using a ¼-inch (6mm) square notched trowel with ¼-inch flats, so as to obtain an average mortar thickness of 3/32 inch (2.4mm). Immediately upon troweling mortar for each test, using the open time tool described in F-4.4, press 10 tile (Type A) on the mortar surface, so that the space between tile (exclusive of ribs) and wallboard is 3/32 inch (2.4 mm). Allow a 3 inch (76 mm) space between tile. Using the open time tool, twist each tile through an angle of 90 degrees and back to the original position at 5 minute intervals. Allow 25 minutes initial time before twisting the first tile for the 70°F (21°C) test and 5 minutes for the 100°F (38°C) test.

Twisting of tiles shall be performed using one hand only. Designate as adjustability of the mortar, the longest time that a tile remains affixed to the mortar when so tested. Make separate tests at 100°F (38°C) and at 70°F (21°C), both at a relative humidity of 45-50 percent.

NOTE – Condition wallboard at 100°F (38°C) for 12 hours before high temperature testing.

Requirement:

Room temperature adjustability: 30 minutes or more at 70-77°F (21-25°C) and a relative humidity of 45-55 percent.

High temperature adjustability: 10 minutes or more at 100-110°F (38-45°C) and a relative humidity of 45-55 percent.

F-4.5.1 Adjustability of fast-setting latex-portland cement mortars: Follow testing procedures as described in F-4.5 using mortar mixed and slaked according to manufacturers' instructions. Additional slaking period of one hour is not required.

Requirement: Room temperature adjustability: 20 minutes or more at 70-77°F (21-25°C) and a relative humidity of 45-55 percent.

NOTE – Testing for adjustability at high temperature is not required for fast-setting latex-portland cement mortars.

F-4.6 Sag on vertical surfaces (required for mortars designated for vertical applications)

Screed mortar prepared as specified in F-4.1.2 onto a 2 x 7-½ x 15-½ inch concrete block of density 2.35 gm/cm^3, using a 7-½ inch square, 1/8 inch thick, plexiglass template with a 5-½ inch square hole. The mortar shall be screeded using 10 cuts in a right to left direction and 30 cuts in a left to right direction (±2 cuts). One cut shall consist of a complete up and down motion. Cut the plexiglass form free from the mortar and remove it. Gently center the tile (Type B) on the mortar pad with the ribs in a vertical position and place the tile-application jig (Fig. II) onto the tile. Following the application pattern (Fig. III), raise the 130 g (±5 g) weight up the shaft of the jig and drop once from a height of 4 inches in each of the four positions. Remove the tile application jig and place the sag-measuring jig (Fig. IV) onto the block with the tile and mortar pad between the metal struts. Secure the sag-measuring jig to the block using the set-screws at the top of the jig. Then screw the center-measuring shaft inward till the bottom of the plexiglass beam lightly touches the top surface of the tile. Record the measurement in 64ths of an inch. This shall be achieved by reading the bottom edge of the beam on each strut and averaging the two readings taken. This value is termed the initial sag measurement. Readings shall be taken on the bottom of the beam using the inner scales of each strut. Remove the sag-measuring jig and reposition the assembly so the tile and mortar layer is in a vertical plane. After one hour, return the block to its initial position and replace the sag-measuring jig. Record the tile position with the measuring beam as specified above. This value is termed the final sag measurement. Subtract the initial sag measurement from the final sag measurement. This number is to be called the "sag value."

Requirement: Sag less than 1/16 inch (2 mm).

F-4.6.1 Sag on vertical surfaces of non-sagging latex-portland cement mortars: Assemble the test specimen as indicated in F-4.6 except use Type D tile.

Requirement: Tile must not sag from its original position.

F-5 Shear strength to ceramic tile

F-5.1 Shear strength of mortars to glazed wall tile

F-5.1.1 Preparation of specimens: Prepare 500 grams of mortar as specified in F-4.1.2. Assemble 20 shear specimens from 40 pieces of Type A-1 tile, with an 3/32 inch (2.4 mm) mortar layer by bonding the two pieces of tile together for each specimen. The 3/32 inch mortar bonding layer shall be established by placing 1/8 inch (3 mm) thick T-bar spacers (Figure V) on the smallest tile edge; be sure to rub all of the mortar off the underside of the spacers by sliding them back and forth along the edge. The top tile shall be placed with the cut edge opposite to that of the bottom tile's cut edge and squeezed until an 3/32 inch thickness of mortar is obtained. The specimen shall be constructed so that the cut edge will be loaded. The tile shall then be slid back and forth along the stainless steel spacers to ensure proper thickness of the mortar. The tile shall then be slid to ensure an 1/8 inch (3 mm) offset. Care shall be taken in removing the stainless steel spacer so as not to cant or slide the tiles in relation to each other or to alter the offset distance. Specimens shall not be individually handled for 24 hours and shall be treated with care until broken. Unless specified otherwise, cure all specimens for seven days at 70-77°F (21-25°C), 45-55 percent relative humidity and further cure or treat as directed in tests F-5.1.3 through F-5.1.6. Assume an area of bond of 8.0 square inches in calculating the strength value in psi.

F-5.1.2 48-hour shear strength: After 48 hours dry cure, remove 4 specimens assembled as directed in F-5.1.1 and individually test as in F-5.4 with a compression loading rate of 2400 pounds (1088.6 kg) per minute so that the mortar is stressed in shear failure. Record these values as the 48-hour shear strength.

Requirement: Shear strength greater than 100 psi (7.0 kg/cm^2).

F-5.1.3 7-day shear strength: Remove 4 specimens assembled as directed in F-5.1.1 and individually test as in F-5.4 with a compression loading rate of 2400 pounds (1088.6 kg) per minute so that the mortar is stressed in shear to failure. Record these values as the 7-day shear strength.

Requirement: Shear strength greater than 300 psi (20.9 kg/cm^2).

F-5.1.4 7-day water immersion shear strength: Immerse 4 specimens prepared in F-5.1.1 in water for seven days. Test in shear (per F-5.1.3) and record the values as 7-day water immersion shear strength.

Requirement: Shear strength greater than 200 psi (14 kg/cm^2).

F-5.1.5 4-week shear strength: Cure 4 specimens prepared in F-5.1.1 for an additional three weeks at the temperature and relative humidity specified in F-5.1.1. Test in shear (per F-5.1.3) and record the values as 4-week shear strength.

Requirement: Shear strength greater than 300 psi (20.9 kg/cm^2).

F-5.1.6 12-week shear strength: Cure 4 specimens prepared in F-5.1.1 for an additional eleven weeks at the temperature and relative humidity specified in F-5.1.1. Test in shear (per F-5.1.3) and record the values as 12-week shear strength.

Requirement: Shear strength greater than 300 psi (20.9 kg/cm^2).

F-5.2 Shear strength of mortars to impervious ceramic mosaic tile

F-5.2.1 Preparation of specimens: Prepare 500 grams mortar as specified in F-4.1.2. Assemble 20 shear specimens from 40 Type C tiles, with an 1/8 inch (3 mm) mortar layer by bonding two tiles together for each specimen. The 1/8 inch mortar bonding layer shall be established by placing 1/8 inch thick T-bar spacers (Figure V) on the tile edge; be sure to rub all mortar off the underside of the spacers by sliding them back and forth along the edge. The top tile shall be placed on top of the mortar layer and squeezed until an 1/8 inch thickness of mortar is obtained. The tile shall then be slid back and forth along the stainless steel spacer to ensure proper thickness of the mortar. The tile shall then be slid to ensure an 1/8 inch (3 mm) offset. Care shall be taken in removing the stainless steel spacer so as not to cant or slide the tiles in relation to each other or to alter offset distance. Specimens shall not be individually handled for 24 hours and shall be treated with care until broken. Cure all specimens for seven days at 70-77°F (21-25°C), 45-55 percent relative humidity and further cure or treat as directed F-5.2.2 through F-5.2.6. Assume an area of bond of 2.9 square inches (18.7 cm^2) in calculating the strength value in psi.

F-5.2.2 7-day shear strength: Remove 4 specimens assembled as directed in F-5.2.1 and individually test as in F-5.4 with compression loading at a rate of 360 pounds (163.4 kg) per minute, so that the mortar is stressed to failure. Record these values as the 7-day shear strength.

Requirement: Shear strength greater than 200 psi (14 kg/cm^2).

F-5.2.3 7-day water immersion shear strength: Immerse 4 specimens prepared in F-5.2.1 in water for seven days. Test in shear (per F-5.2.2) and record the values as 7-day water immersion shear strength.

Requirement: Shear strength greater than 150 psi (10.5 kg/cm^2).

F-5.2.4 4-week shear strength: Cure 4 specimens prepared in F-5.2.1 for an additional three weeks at the temperature and relative humidity specified in F-5.2.1. Test in shear (per F-5.2.2) and record the values as 4-week shear strength.

Requirement: Shear strength greater than 200 psi (14 kg/cm^2).

F-5.2.5 12-week shear strength: Cure 4 specimens prepared in F-5.2.1 for an additional eleven weeks at the temperature and relative humidity specified in F-5.2.1. Test in shear (per F-5.2.2) and record the values as 12-week shear strength.

Requirement: Shear strength greater than 200 psi (14 kg/cm^2).

F-5.2.6 4-week freeze-thaw shear strength: Dry cure 4 specimens prepared in F-5.2.1 for four weeks at the temperature and relative humidity specified in F-5.2.1. Immerse the specimens in room temperature [72 ±2°F (22 ±1°C)] water for 6 to 8 hours. Remove them and allow them to drip dry for a few minutes. Place them in a freezer at 1±5°F (-18 ±3°C) for a minimum of 12 hours, remove them, and repeat cycle, beginning with water immersion

of the now frozen specimen, for a total of 20 cycles. Allow specimens to reach room temperature in air after the last freeze cycle, test in shear (per F-5.2.1) and record the values as 4-week freeze-thaw shear strength.

Requirement: Shear strength of greater than 175 psi (12.2 kg/cm^2).

F-5.3 Shear strength of mortars to quarry tile

F-5.3.1 Preparation of specimens: Prepare 1000 grams of mortar as specified in F-4.1.2. Assemble 16 shear specimens from 32 pieces of Type D tile with a 1/8 inch (3 mm) mortar layer by bonding two pieces of tile together for each specimen. The 1/8 inch mortar bonding layer shall be established by placing 1/8 inch thick T-bar spacers (Figure V) on the tile edge; be sure to rub all mortar off the under side of the spacers by sliding them back and forth along the edge. The top tile shall be placed on top of the mortar layer and squeezed until a 1/8 inch thickness of mortar is obtained. The tile shall then be slid back and forth along the stainless steel spacers to ensure proper thickness of mortar. The specimen shall be constructed so that the uncut, manufactured edge will be loaded. The tile shall then be slid to ensure 1/8 inch (3 mm) offset. Care shall be taken in removing the stainless steel spacers so as not to cant or slide the tiles in relation to each other or to alter the offset distance. Specimens shall not be individually handled for 24 hours and shall be treated with care until broken. Cure all specimens for seven days at 70-77°F (21-25°C), 45-55 percent relative humidity and further cure or treat as directed F-5.3.2 through F-5.3.5. Use measured area of bond or assume an area of bond of 14.4 square inches (93 cm^2) in calculating the strength value in psi.

F-5.3.2 7-day shear strength: Remove 4 specimens assembled as directed in F-5.3.1 and individually test as in F-5.4 with compression loading at a rate of 1340 pounds (609.09 kg) per minute, so that the mortar is stressed to failure. Record these values as 7-day shear strength.

Requirement: Shear strength greater than 100 psi (7.0 kg/cm^2).

F-5.3.3 4-week shear strength: Cure 4 specimens prepared in F-5.3.1 for an additional three weeks at the temperature and relative humidity specified in F-5.3.1. Test in shear (per F-5.3.2) and record the values as 4-week shear strength.

Requirement: Shear strength greater than 150 psi (10.5 kg/cm^2).

F-5.3.4 12-week shear strength: Cure 4 specimens prepared in F-5.3.1 for an additional eleven weeks at the temperature and relative humidity specified in F-5.3.1. Test in shear (per F-5.3.2) and record the values as 12-week shear strength.

Requirement: Shear strength greater than 150 psi (10.5 kg/cm^2).

F-5.3.5 4-week freeze-thaw shear strength: Follow procedure of F-5.2.6 and test in shear as specified in F-5.3.1 and record the values as 4-week freeze-thaw cycle shear strength.

Requirement: Shear strength greater than 100 psi (7.0 kg/cm^2).

F-5.4 Support for shear specimens

Support all shear bond specimens in the shear bond test jig (Figure VI). Be sure to place the tile whose edge is to be loaded against the non-movable support.

F-5.5 Shear strength of fast-setting mortars

Test as described in Section F-5 except fast setting mortars shall be mixed and slaked according to manufacturer's instructions. Also assemble 8 additional shear specimens (4 impervious ceramic mosaic tile and 4 quarry tile specimens). These specimens shall be dry cured at 70-77ºF (21-25ºC), 45-55 percent relative humidity. Shear these specimens after curing 4 hours.

Requirement: In addition to the shear bond strengths required in sections F-5.2 and F-5.3, fast-setting mortars are required to meet the following:

4-hour shear strength of mortar to impervious ceramic mosaic tile: equal to or greater than 50 psi.

4-hour shear strength of mortar to quarry tile: equal to or greater than 50 psi.

F-6 Compressive strength

F-6.1 Preparation of specimens

Using mortar freshly prepared as specified in F-4.1.2, fill three 2-inch (50 mm) cube molds and cover with polyethylene film for 24 hours. Remove the polyethylene film and cure an additional 48 hours in the cube molds. At the end of 72 hours, remove cubes from the molds and store at 70-77°F (21-25°C), 45 to 55 percent humidity for an additional 25 days. On the 28th day after casting, obtain compressive strength on the cubes, generally following the procedure of Paragraph 10.6, ASTM Test Method C-109. Calculate the average.

Requirement: Average compressive strength not less than 2500 psi (175.8 kg/cm^2).

F-7 Package labeling

F-7.1 Application

The container shall be clearly labeled. The necessary directions for application including identification of acceptable pre-packaged dry mortar to be used and the general instructions required below shall appear on the container.

F-7.1.2 Instructions for storage: Instructions for proper storage of the latex shall be given, including any cautions against damage by freezing that are required.

F-7.1.3 Use: Instructions for proper use with kinds of tile, recommended tools, and procedures for application shall be given. If temperature range for use is different from the temperature range stated in A-1.5.3, it must be stated on the container.

F-7.1.4 Shelf life: Each container of latex shall be labeled with date of manufacture and the age after which the latex cannot be safely used.

End of ANSI A118.4 — 1999

American national standard specifications for chemical resistant furan mortars and grouts for tile installation A118.5 — 1999

G-1 Scope

This specification covers the requirements for chemical resistant furan resin mortars and grouts for the installation of ceramic units when tested in accordance with the methods designated herein.

G-2 Definitions

G-2.1 Chemical resistant furan mortars and grouts

An intimate mixture of a furan resin, a powder filler, and an acid catalyst. Filler materials are generally of a carbonaceous or siliceous nature, or combination thereof. The acid catalyst or setting agent shall be incorporated alone or into the filler component.

NOTE – The resin and powder fillers are mixed at ambient temperature to form a trowelable or groutable mix that subsequently hardens to a permanent infusible mass. The thicker mortar materials may be water cleanable. The thinner groutable materials necessitate prewaxed or similarly protected surfaces for cleaning after completion of the grouting process.

G-2.2 Ceramic units

G-2.2.1 The chemical resistant floor brick, 1 inch (25.4 mm) or 1-1/16 inch (27.0 mm) thick, used for testing furan mortars and grouts in this standard are to be dry and clean as obtained from the manufacturer's undamaged cartons. Sizes and surfaces shall be in accordance with the requirements of the specified test method.

G-3 Sampling and testing procedures

G-3.1 Sampling

Obtain not less than 5 lb. (2.3 kg) of resin and 10 lb. (4.5 kg) of the powder filler of the brand to be tested from a commercial lot of recent manufacturer to conduct the tests described in this standard.

G-3.2 Test environment

Unless otherwise specified for a particular test, the storage, preparation, cure, and testing of all samples shall be done at 70-77°F (21-25°C) and a relative humidity of 45-55 percent.

G-3.3 Test values

In any of the following tests requiring more than one specimen, record each individual test value and compute the average of these values for comparison with the test requirements.

G-4 Preparation of furan mortar and grout

G-4.1 In accordance with the manufacturer's recommendations, combine the weight ratios of resin and powder filler and properly mix in small batches for the individual test.

G-5 Tests for application properties

G-5.1 Workability

Mortars, when prepared in accordance with the manufacturer's instructions, shall be capable of being applied with minimum slump. Thorough wetting of the tile or paver surface must be achieved in order to optimize bond. Mortar must be capable of attaining a height of 6 inches minimum without slump when applied to a ¼-inch (6 mm) wide by 1 inch (25 mm) deep joint on a vertical surface.

Grouting materials, when prepared in accordance with the manufacturer's instructions, must yield a homogenous material capable of being fully grouted into a joint ¼-inch (6 mm) wide by 1-3/16 inch (30 mm) deep on a horizontal surface.

G-5.2 Physical property requirements

In accordance with Table I.

G-5.3 Fillers

Fillers influence the chemical resistance and chemical properties of furan mortars and grouts. Optimum

chemical resistance is achieved when 100% carbon fillers are utilized, exclusive of the acid catalyst. Other fillers such as silica, barytes, fiberglass, and combinations thereof may be used to attain specific desired properties. Consult the furan manufacturer for assistance in selecting the appropriate fillers to accomplish these requirements.

G-5.4 Chemical resistance

In accordance with ASTM C267. Architect/specifier shall submit to the furan manufacturer the known chemical agents, concentrations, and exposure conditions to which the furan will be subjected for verification of the chemical resistance.

G-5.4.1 When specific chemical resistance data are required for the project, testing shall conform to ASTM C267 with chemical concentrations and immersion temperatures chosen to simulate exposure conditions.

G-6 General requirements

The mortar and grout resins shall have a viscosity that will permit them to be readily mixed with the respective powders by manual methods. The filler materials shall have properly graded particles that will permit the preparation of a minimum joint thickness of 1/16 inch (1.6 mm) for mortars and 1/8 inch (3.2 mm) for grouts.

TABLE I: PHYSICAL PROPERTY REQUIREMENTS; MINIMUM VALUES, PSI. (MPa)

	Test	Mortar		Grout	
Property	Method	Carbon	Silica	Carbon	Silica
Compressive Strength	ASTM C579	5,000 (35)	5,000 (35)	3,000 (21)	3,000 (21)
Tensile Strength	ASTM C307	700 (5)	400 (3)	700 (5)	400 (3)
Absorption	ASTM C413	Max. 1%	Max. 1%	Max. 1%	Max. 1%
Modulus of Rupture	ASTM C580	1,600 (11)	1,200 (8)	700 (5)	600 (4)
Initial Set, Hrs.	ASTM 308	6	6	5	5
Final Set, Days	ASTM 308	7	7	7	7
Linear Shrinkage	ASTM 531	Max. 1%	Max. 1%	Max. 1%	Max. 1%
Coefficient of Expansion, (in/in/°F)	ASTM C531	2.1×10^{-5}	2.0×10^{-5}	2.3×10^{-5}	2.2×10^{-5}
Working Time, Mins.	ASTM C308	10	10	10	10
*Density, (lbs./cu. ft.)	ASTM D792	Max. 100	Max. 120	Max. 95	Max. 110
Bond Strength	ASTM C321	150 (1.0)	150 (1.0)	150 (1.0)	150 (1.0)

*Silica-free, partially carbon-filled materials may exhibit mortar densities up to 120 lbs/ft3 and grout densities up to 118 lbs/ft^3.

End of ANSI A118.5 — 1999

American national standard specifications for standard cement grouts for tile installation A118.6 — 1999

H-1 Scope

This specification describes the test methods and minimum requirements for standard cementitious grouts. Grouts meeting this specification may or may not contain polymers.

An on-the-job grout mixture of portland cement and fine graded sand is an acceptable grouting material. However, due to its non-controllable quality and mixing conditions of the raw materials, it is not applicable to this specification. Please reference A108.10, Section A-4.7.3.5.1 for proper mixing ratios and application.

H-2 Definitions

H-2.1 Standard sanded cement grout

A factory prepared mixture of cement, graded sand, and other ingredients to produce a water-resistant, dense, uniformly colored material, meant for joints of 1/8" width or greater.

H-2.2 Sand-portland cement grout

See Paragraph H-1.

H-2.3 Standard unsanded cement grout

A factory prepared mixture of cement and additives that provide water retentivity, meant for joints of 1/8" width or less.

H-3 Property requirements for standard sanded and unsanded cement grouts

Property	Standard Sanded Cement Grout	Standard Unsanded Cement Grout
Linear Shrinkage:		
1 day	less than 0.03%	less than 0.03%
7 days	less than 0.10%	less than 0.10%
Water Absorption:		
50% relative humidity to immersion	less than 10%	less than 18%
Immersion to dry	less than 12%	less than 20%
Compressive strength:		
28 days	3,500 psi min.	3,000 psi min.
Tensile strength:		
7 days	325 psi min.	250 psi min.
28 days	350 psi min.	350 psi min.
Flexural strength:		
7 days	350 psi min.	400 psi min.

H-4 Tests for properties of standard sanded and unsanded cement grouts

H-4.1 Sampling and testing procedures

H-4.1.1 Sample: Obtain at least 20 pounds of the particular brand of grout to be tested from a commercial shipment of recent manufacture.

H-4.1.2 Temperature: Unless otherwise stated in a particular test, all tests are to be run at normal room temperatures of 70-77°F (21-25°C) and a relative humidity of approximately 45-55 percent.

H-4.1.3 Recording test values: In any of the following tests requiring more than one specimen, record each individual test value and determine the mean of the multiple values for comparison with the test requirements.

Values which do not reflect a normal distribution of strengths shall be discarded when they satisfy the Dixon test for extreme value as follows:

If $\frac{X_2-X_1}{X_4-X_1} \geq 0.765$, then the lowest value shall be discarded

If $\frac{X_4-X_3}{X_4-X_1} \geq 0.765$, then the highest value shall be discarded

where X_1, X_2, X_3, X_4, are the observed values from lowest to highest.

H-4.2 Grout preparation

H-4.2.1 Water ratio: Use water to powder ratio designated by the grout manufacturer. Maintain this ratio for all subsequent tests requiring grout in this standard. Water must be potable and maintained at 70-77°F (21-25°C).

H-4.2.2 Mixing grout: Add grout powder to correct amount of water (see H-4.2.1) and stir manually to obtain a workable mix with complete and visually uniform wetting of the grout powder. Slake for 15 minutes, remix, and use immediately unless otherwise stated in the subsequent tests. Mixed grout shall not be used after 1 hour unless otherwise stated in a particular test.

Requirement: The resulting grout shall be workable and free of lumps, but possess enough consistency so that, when taken from the container, it will hang on a margin trowel.

H-4.3 Linear shrinkage

ASTM C531 procedure shall be followed, using equipment specified.

H-4.3.1 Prepare 2400 grams of grout powder as specified in H-4.2.

H-4.3.2 Fill a minimum of 4 molds as described in ASTM C531 with grout, taking care to eliminate air pockets or voids by working the grout with a spatula or thin trowel. Level the top surface with the spatula and strike off the excess evenly. After casting the specimens, remove the machine screws, holding the end blocks to permit free movement of the blocks. Store the specimens in the molds in a moist room that shall be so constructed as to provide storage facilities for test specimens at a relative humidity of not less than 95 percent and a temperature of 70-77°F (21-25°C) for 72 hours. Then, carefully disassemble the molds remove the bars, and remove the blocks from the measuring studs. Determine the length of the specimen bars after the 3 days cure (initial), 24 hours later, and 7 days after the initial reading.

H-4.4 Water absorption

H-4.4.1 When specific water absorption data are required for a project, testing shall conform to the following:

Preparation of specimens: Using freshly prepared mortar, prepared as specified in H-4.2, fill two 1 x 1 inch (25 x 25 mm) uncoated cylindrical molds (sections of 1 inch diameter polyethylene tubing). Cure the specimens in the molds for 72 hours, then remove the specimens from the molds and continue to cure for 25 days under conditions per H-4.1.2. When specimens are 28 days old, weigh them each to the nearest 0.01 grams (W_i) and then place them in 600 ml of 140°F (60°C) water in a glass beaker. Let the water cool normally with the specimens submerged in it for 22 hours. Then, remove the specimens, pat them dry with a paper towel, and weigh them each to the nearest 0.01 grams (W_s). Reweigh the specimens after oven drying to a constant weight (W_d) at 120 $\pm$5°F (48.9 $\pm$2.8°C).

Calculate the water absorption, (50 percent relative humidity to immersion) using the formula:

$$(W_s - W_i)/(W_i) \times 100$$

Calculate the water absorption, (immersion to dry) using the formula:

$$(W_s - W_d)/(W_d) \times 100$$

Where: W_i = initial weight (after cure at 50 per cent relative humidity)

W_s = saturated weight

W_d = dried weight

H-4.5 Compressive strength

H-4.5.1 Preparation of specimens: Using grout freshly prepared as specified in H-4.2, fill a minimum of three 2-inch (50 mm) cube molds, tak-

ing care to eliminate all voids or air pockets. Strike or level molds with spatula. At the end of 72 hours of moist cure (95 percent relative humidity or greater), remove the specimens from the molds and store at 70-77°F (21-25°C) and 45-55 percent relative humidity for 25 additional days. On the 28th day after casting, obtain the compressive strength of the specimen cubes, following the procedure of Paragraph 10.6, ASTM Test Method C109. Calculate the average.

H-4.6 Tensile strength

H-4.6.1 ASTM C307 shall be followed as modified herein, substituting grout for mortar.

H-4.6.2 Procedure

H-4.6.2.1 Prepare not less than 1000 grams or more than 1200 grams for making six briquets and not less than 1800 grams for making nine briquets.

H-4.6.2.2 Molding test specimens: Before filling, thinly cover the molds with a film of mineral oil or petroleum jelly. Immediately following completion of mixing the grout, and with the molds resting on unoiled glass or metal plates, fill the molds heaping full with a spatula. Work and pack the grout into the molds with the spatula. Cover the mold with a glass or metal plate, oiled with mineral oil, and turn over the mold and plate (held together with the hands) rotating the mold about its longitudinal axis. Remove the top plate and repeat the operation of packing and working the grout and level off.

H-4.6.2.3 Storage of test specimens: Keep all test specimens, immediately after molding the molds on the base plates, under moist cure (95 percent relative humidity or greater) for 72 hours with their upper surfaces exposed to the moist air but protected from dripping water.

H-4.6.2.4 Determination of tensile strength: Remove test specimens from molds.

H-4.6.2.4.1 Store the 7 day and 28 day specimens at 70-77°F (21-25°C) and a relative humidity of 45 - 55 percent, so that all surfaces have at least 1 inch free space for air circulation. Break all test specimens for a given test age within the permissible tolerance prescribed in the following table:

Test Age	Permissible Tolerance
7 days	± 3 hours
28 days	± 12 hours

H-4.6.2.4.2 Wipe each briquet to remove any loose sand grains or incrustations from the surfaces that will be in contact with the clips of the testing machine. The bearing surfaces of the clips shall be free of sand and the roller bearings shall be well-oiled and maintained so as to ensure freedom of turning. Keep the stirrups supporting the clips free of accumulations and keep the pivots in proper adjustment so that the clips may swing freely on the pivots without binding in the stirrups. Carefully center the briquets in the clips and apply the load continuously at the rate of 0.2 - 0.25 inch per minute.

H-4.6.3 Faulty briquets and retests

H-4.6.3.1 Briquets that are manifestly faulty, or that give strengths differing by more than 15% from the average value of all test briquets made from the same sample and tested at the same period, shall not be considered in determining the tensile strength*. After discarding briquets or strength values, if less than two strength values are left for determining the tensile strength at any given period, a retest shall be made.

*Reliable strength results depend upon careful observation of all the specified requirements and procedures. Erratic results at a given test period indicate that some of the requirements and procedures have not been carefully observed; for example, those covering the testing of the briquets, as prescribed in H-4.6.2.4.2.

H-4.6.4 Calculation: Record the total maximum load indicated by the testing machine and calculate the tensile strength in pounds-force per square inch (kilograms-force per square centimeter). If the cross-sectional area of a briquet varies more than 2.0% from the nominal, use the actual area for the calculation of the tensile strength. The tensile strength of all acceptable test briquets (see H-4.6.3) made from the same sample and tested at the same period shall be averaged and rounded to the nearest 5 psi (0.35 kg/cm^2).

H-4.7 Flexural strength

ASTM C580 procedures shall generally be followed, using equipment specified.

H-4.7.1 Prepare, mold, and cure a minimum of 4 test bar specimens following the procedure outlined in H-4.3.

NOTE – The same test bars may be used in both linear shrinkage and flexural strength tests. Be sure to take the shrinkage measurements prior to performing the flexural testing.

H-4.7.2 Seven days after removing the specimens from the molds, test the specimens and report results as outlined in ASTM C580.

H-5 General requirements for all grouts

H-5.1 Package labeling

H-5.1.1 Application

The container shall be clearly labeled regarding its type and specifications met. The directions for application and the instructions required below shall appear on the container.

H-5.1.1.1 Instructions for storage: Instructions for proper storage shall be given, including any cautions against damage by freezing that are required.

H-5.1.1.2 Instructions for use: Instructions for proper use with kinds of tile, recommended tools, and procedures for applications shall be given.

H-5.1.1.3 Shelf life: Each container shall be labeled with the date of manufacture and the age after which the material shall not be used.

End of ANSI A118.6 — 1999

American national standard specifications for polymer modified cement grouts for tile installation A118.7 — 1999

N-1 Scope

This specification describes the test methods and minimum requirements for polymer modified cement grouts. Grouts in this category provide improved characteristics such as increased color stability, stain resistance, bond strengths, flexural strengths, and lower water absorption to resist frost damage.

An on-the-job grout mixture of portland cement and fine graded sand is an acceptable grouting material. However, due to its non-controllable quality and mixing conditions of the raw materials, it is not applicable to this specification. Please reference A108.10, Section A-4.7.3.5.1 for proper mixing ratios and application.

N-2 Definitions

N-2.1 Sand-portland cement grout

See paragraph N-1.

N-2.2 Polymer modified unsanded tile grout

A factory prepared mixture of cement and other ingredients, including a redispersable, latex/polymer power (to which only water is added at the jobsite) or a liquid latex admixture. When added in a latex form it is added as a replacement for part or all of the mixing water. These grouts are designed for installation in joints of 1/8" wide or less.

N-2.3 Polymer modified sanded tile grout

A factory prepared mixture of cement, sand, and other ingredients, including a redispersable, latex/polymer powder (to which only water is added at the jobsite) or a liquid latex admixture. When added in a latex form it is added as a replacement for part or all of the mixing water. These grouts are designed for installation in joints of 1/8" wide or greater. The maximum allowable joint width is designated by the grout manufacturer.

N-3 Tests for properties of polymer modified cement grouts

N-3.1 Sampling and testing procedures

N-3.1.1 Sampling: For grouts containing redispersable polymers, obtain at least 20 pounds from a commercial shipment of recent manufacture. For grouts incorporating a latex admixture, obtain not less than one gallon of the brand of latex additive to be tested from a commercial lot of recent manufacture. Also obtain at least 20 pounds of the prepared dry grout mix specified by the latex manufacturer.

N-3.1.2 Temperature: Unless otherwise stated in a particular test, all tests are to be run at normal room temperatures of 70-77°F (21-25°C) and a relative humidity of approximately 45-55 percent.

N-3.1.3 Recording test values: In any of the following tests requiring more than one specimen, record each individual test value and determine the mean of the multiple values for comparison with the test requirements.

Values which do not reflect a normal distribution of strengths shall be discarded when they satisfy the Dixon test for extreme value as follows:

If $\frac{X_2-X_1}{X_4-X_1} \geq 0.765$, then the lowest value shall be discarded

If $\frac{X_4-X_3}{X_4-X_1} \geq 0.765$, then the highest value shall be discarded

where X_1, X_2, X_3, X_4, are the observed shear strength values from lowest to highest.

N-3.2 Grout preparation

N-3.2.1 Mixing grout: Add grout powder to correct amount of water or latex additive, as specified by manufacturer, and stir manually to obtain a workable mix with complete and visually uniform wetting of the grout powder. When directions require dilution of latex with water, this shall be done with adequate mixing before dry powder is added. Slake for 15 minutes and remix before using unless otherwise specified in subsequent test methods. Mixed grout shall not be used after 1 hour unless otherwise stated in a particular test.

Requirement: The resulting grout shall be workable and free of lumps, but possess enough consistency so that, when taken from the container, it will hang on a margin trowel.

N-3.3 Linear shrinkage

ASTM C531 procedure shall be followed, using equipment specified.

N-3.3.1 Prepare 2400 grams of grout powder as specified in N-3.2.

N-3.3.2 Fill a minimum of 4 molds as described in ASTM C531 with grout, taking care to eliminate air pockets or voids by working the grout with a spatula or thin trowel. Level the top surface with the spatula and strike off the excess evenly. After casting the specimens, remove the machine screws, holding the end blocks to permit free movement of the blocks. Store the specimens in the molds at a temperature of 70-77°F (21-25°C) and 45-55 percent relative humidity for 72 hours. Then, carefully disassemble the molds after 3 days, remove the bars, and remove the blocks from the measuring studs. Determine the length of the specimen bars after the 3 days cure (initial), 24 hours later, and 7 days after the initial reading.

Requirement: 1 day:less than 0.1 percent

7 day:less than 0.2 percent

N-3.4 Water absorption

N-3.4.1 When specific water absorption data are required for a project, testing shall conform to the following:

Preparation of specimens: Using freshly prepared mortar, prepared as specified in N-3.2, fill two 1x1 inch (25 x 25 mm) uncoated cylindrical molds (sections of 1 inch diameter polyethylene tubing). Cure the specimens in the molds for 72 hours, then remove the specimens from the molds and continue to cure for 25 days under conditions per N-3.1.2. When specimens are 28 days old, weigh them each to the nearest 0.01 grams (W_i) and then place them in 600 ml of 140°F (60°C) water in a glass beaker. Let the water cool normally with the specimens submerged in it for 22 hours. Then, remove the specimens, pat them dry with a paper towel, and weigh them each to the nearest 0.01 grams (W_s). Reweigh the specimens after oven drying to a constant weight (W_d) at 120 $\pm$5°F (48.9 $\pm$2.8°C).

Calculate the water absorption, (50 percent relative humidity to immersion) using the formula:

$$(W_s - W_i)/(W_i) \times 100$$

Calculate the water absorption, (immersion to dry) using the formula:

$$(W_s - W_d)/ (W_d) \times 100$$

Where: W_i = initial weight (after cure at 50 per cent relative humidity)

W_s = saturated weight

W_d = dried weight

Requirement: 50 percent relative humidity to immersion: less than 5.0 percent

Immersion to dry: less than 7.0 per cent

N-3.5 Compressive strength

N-3.5.1 Preparation of specimens: Using grout freshly prepared as specified in N-3.2, fill a minimum of three 2-inch (50 mm) cube molds, taking care to eliminate all voids or air pockets. Strike or level molds with spatula. After 72 hours cure, remove the specimens from the molds and store at 70-77°F (21-25°C) and 45-55 percent relative humidity for 25 additional days. On the 28th day after casting, obtain the compressive strength of the specimen cubes, following the procedure of Paragraph 10.6, ASTM Test Method C109. Calculate the average.

Requirement: 28 day compressive strength not less than 3000 psi (209.4 kg/cm^2)

N-3.6 Tensile strength

N-3.6.1 ASTM C307 shall be followed as modified herein, substituting grout for mortar.

N-3.6.2 Procedure

N-3.6.3 Prepare not less than 1000 grams or more than 1200 grams for making six briquets and not less than 1800 grams for making nine briquets.

N-3.6.4 Molding test specimens

Before filling, thinly cover the molds with a film of mineral oil or petroleum jelly. Immediately following the completion of the mixing of the grout, and with the molds resting on unoiled glass or metal plates, fill the molds heaping full with a spatula. Work and pack the grout into the molds with the spatula. Cover the mold with a glass or metal plate oiled with mineral oil, and turn over the mold and plate (held together with the hands) rotating the mold about its longitudinal axis. Remove the top plate and repeat the operation of packing and working the grout and level off.

N-3.6.5 Storage of test specimens

Keep all test specimens in the molds on the base plates for 72 hours with their upper surfaces exposed to 70-77°F (21-25°C) and 45-55 percent relative humidity.

N-3.6.6 Determination of tensile strength

Remove test specimens from molds. Store the 7 day and 28 day specimens at 70-77°F (21-25°C) and a relative humidity of 45-55 percent, so that all surfaces have at least 1 inch free space for air circulation. Break all test specimen for a given test age within the permissible tolerance prescribed in the following table:

Test Age	Permissible Tolerance
7 days	± 3 hours
28 days	± 12 hours

N-3.6.6.1 Wipe each briquet to remove any loose sand grains or incrustations from the surfaces that will be in contact with the clips of the testing machine. The bearing surfaces of the clips shall be free of sand and the roller bearings shall be well-oiled and maintained so as to ensure freedom of turning. Keep the stirrups supporting the clips free of accumulations and keep the pivots in proper adjustment so that the clips may swing freely on the pivots without binding in the stirrups. Carefully center the briquets in the clips and apply the load continuously at the rate of 0.2 - 0.25 inch per minute.

N-3.6.7 Faulty briquets and retests

N-3.6.7.1 Briquets that are manifestly faulty, or that give strengths differing by more than 15% from the average value of all test briquets made from the same sample and tested at the same period, shall not be considered in determining the tensile strength*. After discarding briquets or strength values, if less than two strength values are left for determining the tensile strength at any given period, a retest shall be made.

*Reliable strength results depend upon careful observation of all the specified requirements and procedures. Erratic results at a given test period indicate that some of the requirements and procedures have not been carefully observed; for example, those covering the testing of the briquets, as prescribed in N-3.6.6.1.

N-3.6.8 Calculation

Record the total maximum load indicated by the testing machine and calculate the tensile strength in pounds-force per square inch (kilograms-force per square centimeter). If the cross-sectional area of a briquet varies more than 2.0% from the nominal, use the actual area for the calculation of the tensile strength. The tensile strength of all acceptable test briquets (see N-3.6.7) made from the same sample and tested at the same period shall be averaged and rounded to the nearest 5 psi (0.35 kgf/cm^2).

Requirement: 7 days: 400psi (28.2 kgf/cm^2)

28 days: 500psi (35.2 kgf/cm^2)

N-3.7 Flexural strength

ASTM C580 procedures shall generally be followed, using equipment specified.

N-3.7.1 Prepare, mold, and cure a minimum of 4 test bar specimens following the procedure outlined in N-3.3.

NOTE – The same test bars may be used in both linear shrinkage and flexural strength tests. Be sure to take the shrinkage measurements prior to performing the flexural testing.

N-3.7.2 At the end of seven days of curing out of the molds, test the specimens and report results as outlined in ASTM C580.

Requirement: 7 day test : 1000 psi (70.5 kgf/cm^2)

N-4 General requirements for all grouts

N-4.1 Package labeling

N-4.1.1 Application: The container shall be clearly labeled regarding its type and specifications met. The directions for application and the instructions required below shall appear on the container.

N-4.1.1.1 Instructions for storage: Instructions for proper storage shall be given, including any cautions against damage by freezing that are required.

N-4.1.1.2 Instructions for use: Instructions for proper use with kinds of tile, recommended tools, and procedures for applications shall be given.

N-4.1.1.3 Shelf life: Each container shall be labeled with the date of manufacture and the age after which the material shall not be used.

End of ANSI A118.7 — 1999

American national standard specifications for modified epoxy emulsion mortar/grout A118.8 — 1999

J-1 Scope

This specification describes the test methods and the minimum requirements for modified epoxy emulsion mortar/grout. The chemical and solvent resistance of these mortars/grouts tends to be better than for organic adhesives, on a par with latex-portland cement mortars, but not designed to meet the requirements for ANSI A108.6 and ANSI A118.3.

J-2 Definitions

J-2.1 Modified epoxy emulsion mortars/grouts

Essentially include emulsified epoxy resins and hardeners, preblended portland cement, and silica sand. They are used as a tile setting mortar or grout. They can be cleaned from wall and floor surfaces using a wet sponge prior to initial set.

NOTE – Not all manufacturers recommend that this material be used for grouting.

J-2.2 Ceramic tile: As defined in ANSI A137.1.

J-2.2.1 All tile for testing in this standard are to be dry and clean as obtained from manufacturer's undamaged cartons. Mortar contact is always on the unglazed face of glazed wall tile. Water absorption of tile is determined by ASTM C373. Tile for test in this standard include the following:

Designation	Description
A	*Glazed wall tile, 4-¼ x 4-¼ inches (108 x 108 mm), having a nominal thickness of 5/16 inch (8 mm), water absorption of 13 to 15 percent.
A-1	Same as A but cut to form pieces 4-¼ x 2-1/8 inches (108 x54 mm) with the back pattern ribs parallel to the 2-1/8 inch dimension. Tile must be dry at time of use. Dry to a constant weight in an oven at 302°F (150°C) followed by a 24-hour equilibrium period at 70-77°F (21-25°C) and 50 percent relative humidity before use.
C	2 x 2 x ¼ inch (50 x 50 x 6 mm) modular unglazed ceramic mosaic tile with a water absorption of 0 to 0.5 percent. Always use the tile face that is free of paper or glue as the bonding surface [actual size is approximately 1-15/16 by 1-15/16 inches (50 by 50 mm)].
D	4 x 8 x ½ inch (102 x 204 x 12 mm) nominal unglazed quarry tile with water absorption not exceeding 5 percent, cut into pieces approximately 4 x 4 x ½ inch. The smooth face is used as the bonding surface.

J-3 Sampling and testing procedures

J-3.1 Sample

Obtain not less than one unopened, 1-gallon unit or larger of the brand to be tested from commercial lot of recent manufacture to conduct the tests described in this standard. When the weight ratio of parts is given, or can be accurately determined, the modified epoxy emulsion mortar grout may be mixed in small batches for the individual tests.

J-3.2 Test environment

Unless otherwise stated in a particular test, all tests are to be run at normal room temperatures of 70-77°F (21-25°C) and a relative humidity of 45-55 percent. Components (water, mortar, tile, etc.) used in performing all tests shall be stored at the temperature specified for each test for a minimum of 12 hours prior to use.

J-3.3 Test value

In any of the following tests requiring more than one sample or specimen, record each individual test

value and compute the average of these values for comparison with the test requirement.

J-4 Preparation of modified epoxy emulsion mortar/grout

J-4.1 Mixing

Thoroughly read and follow the manufacturer's directions for mixing. Blend the parts supplied using a suitable hand tool or slow speed (200 rpm) machine mixer, making sure any dry ingredients are thoroughly and uniformly wetted.

J-5 Tests for application properties

J-5.1 Water cleanability

Immediately after thoroughly mixing the batch, remove between 250 and 300 ml from the container and spread it evenly over the bottom of an 8 $\pm$ 0.5 inch (200 $\pm$13 mm) diameter enameled or stainless steel, flat-bottomed pan. Within one minute of 30 minutes, 40 minutes, and 50 minutes after mixing is complete, apply the material to the smooth face of a clean, dry quarry tile with a 6 inch (152 mm) wide putty knife. The material shall spread in a thin layer and stick to the tile. After scraping the material from the tile with the putty knife, use a clean cellulose sponge and water to clean the remaining material from the tile. Water cleanability is indicated when the wet sponge removes the remaining epoxy, leaving no lumps, color, or streaks. With some epoxies the cleaning water may turn milky during the first stages of clean-up.

Requirement: Not less than 40 minutes.

J-5.2 Initial set

By Gilmore Needles (ASTM C266) using mortar as prepared in J-4.1.

Requirement: Not less than 3 hours nor more than 7 hours.

J-5.3 Final set

By Gilmore Needles (ASTM C266) using mortar as prepared in J-4.1.

Requirement: Not less than 9 hours nor more than 16 hours.

J-5.4 Bond strength to quarry tile

J-5.4.1 Equipment: Compression testing machine, of the universal type, capable of loading from zero to 20,000 lbs. minimum (9075 kg) at a rate of 2,400 lbs. (1088.6 kg) per minute.

J-5.4.2 Procedure: Using ¼-inch (6 mm) diameter and 2 inch (50 mm) long spacers or an appropriate jig, prepare 4 shear bond specimens by bonding two 4 x 4 x ½ inch (102 x 102 x 3 mm) quarry tiles face to face with the sides overlapped so a bond area of approximately 15 sq. in. (96.8 cm^2) is obtained between each tile and the mixed material. Apply an excess of bonding epoxy material to one tile face, peaking the layer slightly at the center. Press the second tile face into the epoxy material until the thickness of the epoxy is ¼-inch (6 mm) as indicated by the jig or the two spacers previously inserted between the tiles near and parallel to the ends of the specimen. Cure the four specimens for seven days at 70-77°F (21-25°C) and then test in shear by applying load to overlapped edge at a rate of 2,400 lbs. (1088.6 kg) per minute until the specimen will not support the load. The specimen must be supported so that the bonded planes remain vertical during testing using a support jig similar to that shown in Figure E-1.

Record the maximum load during each test and express it in pounds per square inch over the actual bonded area measured to the nearest ½ square inch. Compute the average of the four test results.If tile failure occurs before bond failure, record that load and note it as "tile failure."

Requirement: Average shear bond strength to quarry tile shall be greater than 300 psi (21 kg/cm^2)

J-5.5 Shear strength of mortars to glazed wall tile

J-5.5.1 Preparation of specimens: Prepare 500 grams mortar as specified in J-4.1. Assemble

16 shear specimens from 32 pieces of Type A-1 tile, with a 3/32 inch (2.4 mm) mortar layer by bonding two pieces of tile together for each specimen. The 3/32 inch mortar bonding layer shall be established by placing 1/8 inch thick T-bar spacers (Figure V) on the smallest tile edge; be sure to rub all of the mortar off the underside of the spacers by sliding them back and forth along the edge. The top tile shall be placed with the cut edge opposite to that of the bottom tile's cut edge and squeezed until a 3/32 inch thickness of mortar is obtained. The specimen shall be constructed so that the cut edge will be loaded. The tile shall then be slid back and forth along the stainless steel spacers to ensure proper thickness of the mortar. The tiles shall then be slid to ensure a 1/8 inch (3 mm) offset. Care shall be taken in removing the stainless steel spacers so as not to cant or slide the tiles in relation to each other or to alter the offset distance. Specimens shall not be individually handled for 24 hours and shall be treated with care until broken. Cure all specimens for seven days at 70-77°F (21-25°C), 45-55 percent relative humidity and further cure or treat as directed in tests J-5.5.2 through J-5.5.5. Assume an area of bond of 8.0 square inches (51.6 cm^2) in calculating the strength value in psi.

J-5.5.2 7-day shear strength: Remove 4 specimens assembled as directed in J-5.5.1 and individually test as in J-5.7 with compression loading at a rate of 2400 pounds (1088.6 kg) per minute so that the mortar is stressed in shear to failure. Record these values as the 7-day shear strength.

Requirement: Shear strength greater than 200 psi (14 kg/cm^2).

J-5.5.3 7-day water immersion shear strength: Immerse 4 specimens prepared in J-5.5.1 in water for seven days. Test in shear (per J-5.5.2) and record the values as 7-day water immersion shear strength.

Requirement: Shear strength greater than 150 psi (10.5 kg/cm^2).

J-5.5.4 4-week shear strength: Cure 4 specimens prepared in J-5.5.1 for an additional three weeks at the temperature and relative humidity specified in J-5.5.1. Test in shear (per J-5.5.2) and record the values as 4-week shear strength.

Requirement: Shear strength greater than 250 psi (17.4 kg/cm^2).

J-5.5.5 12-week shear strength: Cure 4 specimens prepared in J-5.5.1 for an additional eleven weeks at the temperature and relative humidity specified in J-5.5.1. Test in shear (per J-5.5.2) and record the values as 12-week shear strength.

Requirement: Shear strength greater than 250 psi (17.4 kg/cm^2).

J-5.6 Shear strength of mortars to impervious ceramic mosaic tile

J-5.6.1 Preparation of specimens: Prepare 500 grams mortar as specified in J-4.1. Assemble 16 shear specimens from 32 type C tiles, with a 1/8 inch (3 mm) mortar layer by bonding the two tiles together for each specimen. The 1/8 inch mortar bonding shall be established by placing 1/8 inch thick T-bar spacer (Figure V) on the tile edge; be sure to rub all mortar off the underside of the spacers by sliding them back and forth along the edge. The top tile shall be placed on top of the mortar layer and squeezed until a 1/8-inch thickness of mortar is obtained. The tile shall then be slid back and forth along the stainless steel spacer to ensure proper thickness of the mortar. The tile shall then be slid to ensure a 1/8 inch (3 mm) offset. Care shall be taken in removing the stainless steel spacer so as not to cant or slide the tiles in relation to each other or to alter the offset distance. Specimens shall not be individually handled for 24 hours and shall be treated with care until broken. Cure all specimens for 7 days at 70-77°F (21-25°C), 45-55 percent relative humidity and further cure or treat as directed in tests J-5.6.2 through J-5.6.5. Assume an area of bond of 2.9 square inches (18.7 cm^2) in calculating the strength value in psi.

J-5.6.2 7-day shear strength: Remove specimens assembled as directed in J-5.6.1 and individually test as in J-5.7 with compression loading at a rate of 360 pounds (163.4 kg) per minute, so that the mortar is stressed to failure. Record these values as the 7-day shear strength.

Requirement: Shear strength greater than 150 psi (10.5 kg/cm^2).

J-5.6.3 7-day water immersion shear strength: Immerse 4 specimens prepared in J-5.6.1 in water for seven days. Test in shear (per J-5.6.2) and record values as 7-day water immersion shear strength.

Requirement: Shear strength greater than 100 psi (7.0 kg/cm^2).

J-5.6.4 4-week shear strength: Cure 4 specimens prepared in J-5.6.1 for an additional three weeks at the temperature and relative humidity specified in J-5.6.1. Test in shear (per J-5.6.2) and record values as 4-week shear strength.

Requirement: Shear strength greater than 150 psi (10.5 kg/cm^2).

J-5.6.5 12-week shear strength: Cure 4 specimens prepared in J-5.6.1 for an additional eleven weeks at the temperature and relative humidity specified in J-5.6.1. Test in shear (per J-5.6.2) and record value as 12-week shear strength.

Requirement: Shear strength greater than 150 psi (10.5 kg/cm^2).

J-5.7 Support for Shear Specimens

Support all shear bond specimens in the shear bond test jig (Figure VI). Be sure to place the tile whose edge is to be loaded against the movable support.

J-5.8 Comprehensive strength of the cured material

J-5.8.1 As per test method ASTM C579 except that cast specimens shall remain in the molds for 72 hours and testing shall take place seven days after removal from the molds.

Requirement: Greater than 2600 psi (183 kg/cm^2).

J-5.9 Tensile strength of the cured material

J-5.9.1 As per test method ASTM C307 except that cast specimens shall cure in the molds for 72 hours and testing shall take place seven days after removal from the molds.

Requirement: Greater than 300 psi (21 kg/cm^2).

J-5.10 Flexural strength

J-5.10.1 As per ASTM C580, except that cast specimens shall cure in the molds for 72 hours and testing shall take place seven days after removal from the mold. No acid treatment is required.

Requirement: Modulus of rupture greater than 850 psi (60 kg/cm^2). Modulus of elasticity not greater than 1.5 x 10^6 psi (1.1 x 10^5 kg/cm^2).

J-5.11 Deleted 1999.

J-5.12 Water absorption

J-5.12.1 Using freshly prepared mortar, prepared as specified in J-4.1, fill two 1 x 1 inch (25 x 25 mm) uncoated cylinder molds (sections of 1 inch diameter polyethylene tubing). Cure the specimens in the molds for 72 hours, then remove the specimens from the molds and continue the cure for 25 days under conditions per J-3.2. When specimens are 28 days old, weigh them each to the nearest 0.01 grams (W_i) and then place them in 600 milliliters of 140°F (60°C) water in a glass beaker. Let the water cool normally with the specimens submerged in it for 22 hours. Then, remove the specimens, pat them dry with a paper towel, and weigh them each to the nearest 0.01 grams (W_s). Reweigh the specimens after oven drying to constant weight (W_d) at 120 ±5°F (48.9 ±2.8°C).

Calculate the water absorption, (50 percent relative humidity to immersion) using the formula:

$$(W_s - W_i)/(W_i) \times 100$$

Calculate the water absorption, (immersion to dry) using the formula:

$$(W_s - W_d)/(W_d) \times 100$$

Where: W_i = initial weight (after cure at 50 per cent relative humidity)

W_s = saturated weight

W_d = dried weight

Requirement: 50 percent relative humidity to im mersion – less than 5.0 percent

Immersion to dry – less than 7.0 percent

End of ANSI A118.8 — 1999

American national standards for test methods and specifications for cementitious backer units A118.9 — 1999

Foreword

Explanation and notes

L-1 Scope

This specification describes the test methods and the minimum requirements and values for cementitious backer units.

L-2 Definitions

L-2.1 Cementitious backer unit (CBU) — A nailable/screwable backerboard or underlayment panel which is composed of stable portland cement, aggregates, and reinforcements that have a significant ability to remain unaffected by prolonged exposure to moisture.

L-3 Sampling and testing procedures

L-3.1 **Sampling:** Obtain 5 samples of the particular cementitious backer unit brand to be tested from a commercial lot of recent manufacture to conduct the tests described in this standard.

L-3.2 **Test Environment:** Unless otherwise specified for a particular test, the storage, preparation, curing, and testing of all samples shall be done at 70 to 77°F (21 to 25°C) and a relative humidity of 45 to 55 percent.

L-3.3 **Test values:** Record test values for each specimen and compute the average of these values for comparison with the specification requirements.

L-4 Test for physical properties

L-4.1 **Physical property requirements:** In accordance with Table 1.

L-5 General requirements

Component elements of cementitious backer units shall be of a type and grade that are capable of achieving the values stated in Table 1.

L-5.1 **Freeze-Thaw Cycling:** Test as described in ASTM C666 (Procedure B).

End of ANSI A118.9 — 1999

Table 1
Physical property requirements

PROPERTY	TEST METHOD	MINIMUM AVERAGE VALUE
1) Shear Bond Strength (7 day cure) [CBU to CBU—saturated]	ANSI A118.1 Dry-Set Portland cement Mortar	>50 psi (344 kPa)
	ANSI A118.4 Latex-Portland Cement Mortar	>50 psi (344 kPa)
	ANSI A136.1 Organic Adhesive (Type I)	>50 psi (344 kPa)
2) Compression Indentation	ASTM D2394 (Type of Substrate must be specified)	>1250 psi (8619 kPa) ≤0.050 inches (≤1.3 mm)
3) Facial Dimensions (length and width)	ASTM C473	±1/8 inch (3 mm)
4) Falling Ball Impact	ASTM D1037	No damage to top or bottom surface at 12 inch (305 mm) drop
5) Fastener Holding (saturated)	ASTM D1037 (roofing nail: 0.121 inches (3 mm) shank diameter x 0.375 inches (10 mm) head diameter	90 lbs. (400 N)
6) Flame Spread/Smoke Developed Indices	ASTM E84	10/10
7) Flexural Strength (saturated)	ASTM C947 (test sample shall not be less than 4 inches wide x 12 inches long)	>750 psi (5171 kPa)
8) Linear Variation or Moisture Movement (due to change in moisture content)	ASTM D1037	≤0.07 percent
9) Bacteria Resistance	ASTM G22	≤ 1
10) Fungus Resistance	ASTM C21	≤ 1
11) Squareness	ASTM C473	Square
12) Thickness	ASTM C473	±1/32 inch (0.75 mm)

American national standard specifications for load bearing, bonded, waterproof membranes for thin-set ceramic tile and dimension stone installation A118.10 — 1999

Foreword

Explanation and Notes

This foreword is not a part of American national standard specifications for load bearing, bonded, waterproof membranes for thin-set ceramic tile and dimension stone installations A118.10 — 1999.

MN-1 Introduction

MN-1.1 Waterproof membranes for thin-set ceramic tile and dimension stone installations function as barriers to positive liquid water migration. Membranes covered by this specification are bonded to a variety of manufacturer approved substrates covered by ANSI specifications and in some cases can be used as the adhesive for the ceramic tile and dimension stone as well. Others within the scope of this specification are allowed to cure and are then used as the substrate for the application of ceramic tiles and dimension stone by traditional methods and materials

MN-1.2 This standard applies to trowel applied, liquid, and sheet membranes.

MN-1.3 These membranes provide the lowest profile (elevation) of the tile installation incorporating a waterproof membrane.

MN-1.4 Consult individual manufacturers for specific instructions, application, performance levels, and limitations concerning their materials. Follow the individual manufacturer's written instructions precisely.

MN-1.5 This standard was developed to provide specifiers and installers with the minimum criteria necessary for a material to function as a barrier to positive liquid water migration in a load bearing, bonded, thin-set installation of ceramic tile and dimension stone.

End of Foreword — Explanation and Notes

M-1 Scope

This specification describes the test methods and minimum requirements for load bearing, bonded, waterproof membranes for thin-set ceramic tile and dimension stone installation.

M-2. Definitions

M-2.1 Latex-portland cement mortar

A modified dry-set portland cement mortar for the bonding of ceramic tile to which a polymer has been incorporated in latex form or as a redispersable powder. When added in latex form it is added as a replacement for part or all of the gauging water.

M-2.2 Ceramic tile: As defined in ANSI A137.1

M-2.2.1 The tile for tests in this standard are to be dry and clean as obtained from manufacturer's undamaged cartons. Water absorption of tile is determined by ASTM C373. Tile for tests in this standard include the following:

Designation	Description
A	*Glazed wall tile, 4-¼ x 4-¼ inches (108 x 108 mm), having a nominal thickness of 5/16 inch (8 mm), water absorption of 13-15 percent.
X	4 x 4 x 5/16 inch (102 x 102 x 8 mm) nominal unglazed paver tile with a water absorption of 0.0 to 0.5 percent. The smooth face is used as the bonding surface.

*In order to obtain comparable results, the tile selected shall be standard grade, of one glaze color, obtained from one manufacturer. Bonding surface must be cleaned of dust produced by cutting. Brush wet and flush with plain water.

M-3. Sampling and testing procedures

M-3.1 Sampling: Obtain a sufficient quantity of membrane, setting materials, and admixtures for a minimum 100 square foot installation based on the manufacturer's recommended coverage. All materials shall be in the manufacturer's sealed packaging and from commercial lots of recent manufacture.

M-3.1.1 Membrane sample preparation: Prepare trowel applied, liquid, or sheet membrane samples according to the manufacture's recommended application procedures. For some tests, an unbonded sample of membrane is required. In these tests, liquid applied materials shall be applied to a non-bondable material (such as polyethylene film or Teflon), cured according to the manufacturer's instructions, peeled, and cut if necessary to obtain a suitable sample.

M-3.2 Temperature: Unless otherwise stated in a particular test, all tests are to be run at room temperatures of 70-77°F (21-25°C) and a relative humidity of 45-55 percent.

Components (latex, mortar, tile, etc.) used in performing all tests should be stored at that temperature specified for each test for a minimum of 12 hours prior to use.

M-3.3 Recording test values: In any of the following tests requiring more than one specimen, record each individual test value and determine the mean of the multiple values for comparison with the test requirements.

Values which do not reflect a normal distribution of shear strengths shall be discarded when they satisfy the Dixon test for extreme values as follows:

If $\frac{X_2-X_1}{X_4-X_1} \geq 0.765$, then the lowest value shall be discarded

If $\frac{X_4-X_3}{X_4-X_1} \geq 0.765$, then the highest value shall be discarded

where X1, X2, X3, X4, are the observed values from lowest to highest.

M-4. Tests for material properties

M-4.1 Fungus and micro-organism Resistance: Test for Mold Growth: The organism used for this test shall be Aspergillus Niger. The stock cultures may be kept for not more than 4 months in a refrigerator at approximately 37.4 to 50°F (3 to 10°C). The culture medium shall be potato dextrose agar from Difco Products, Inc.; Detroit, Michigan-or its equivalent.

Dissolve 39 grams of the agar in 1 liter of water, using heat. Autoclave the medium and two 1 inch (25mm) square pieces of Type A tile at 15psi (1.1kg/cm^2) for 15 minutes. Apply a section of membrane to the tile following the manufacturer's recommended installation procedures at the minimum required thickness. Place the coated tile with the membrane side up in a sterile petri dish and pour sterile agar into the dish until the surface of the agar is level with the edge of the membrane. Inoculate with the organism.

For control purposes, one petri dish containing only the agar medium and the other piece of tile shall be inoculated with the test organism to determine the viability of the inoculum.

Place the petri dishes in an incubator at 82.4-86.0 °F (28-30°C) and at a relative humidity of 85-95 percent. After 14 days of incubation, examine to ascertain whether the membrane supports mold growth. (At the end of inoculation period, the control shall demonstrate visible evidence of mold growth.)

Requirement: The membrane shall not support mold growth.

M-4.2 Seam strength: By ASTM D751 at the test conditions specified in M-3.2. Seams in liquid applied membranes shall be prepared according to the manufacturer's instructions for joining one day's work to that placed the previous day.

Requirement: 8 pounds per inch width (16 lb/2 in) minimum.

M-4.3 Breaking strength: By ASTM D751; Procedure B at the test conditions specified in M-3.2. Liquid applied membrane sample thickness shall be the minimum specified by the manufacturer for a waterproofing application. Both transverse and lon-

gitudinal strengths shall be tested for materials having a sheet structure.

Requirement: 170 psi minimum.

M-4.4 Dimensional stability: Test in accordance with ASTM D1204 at temperature of +158°F and -15°F (±2°F variation).

Requirement: 0.7% maximum length change (expansion or shrinkage)

M-4.5 Waterproofness: Test in accordance with ASTM D4068; Annex A2: Hydrostatic Pressure Test, modified as follows:

M-4.5.1 Specimens: Obtain three 3"x3" specimens of membrane as described in M-3.1.1 of this document.

M-4.5.2 Apparatus: As described in Section A2.1 of ASTM D4068; Annex 2.

M-4.5.3 Procedure: Follow the procedure outlined in Section A2.3 of ASTM D4068; Annex 2, however, it is not necessary to make observation until the sample has been under hydrostatic pressure for 48 hours.

M-4.5.4 Performance criteria: The specimen shall be left under hydrostatic pressure for 48 hours and examined for evidence of moisture penetration.

Requirement: Evidence of wetness on top of the material, or the formation of a droplet, are both considered as visible water penetration and require rejection of the material.

M-5 Shear strength to ceramic tile and cement mortar

M-5.1 Preparation of mortar blocks: Prepare 20 mortar blocks as specified in ASTM C482; Section 9.1.2. Blocks may be used in testing after 25 additional days of storage at the conditions specified in M-3.2.

M-5.2 Preparation of shear bond assemblies: Follow the manufacture's instructions and apply the membrane to the entire face of the mortar blocks molded in Section 5.1. Apply type X tile to the membrane, offset ¼-inch, using the manufacturer's recommended adhesive system(s) and application rate including bonding material thickness after beat in of the tile. Use spacers, as described in applicable ANSI A118 and A136 sections for the bonding material to establish a consistent thickness. Allow the bonded assemblies to cure for 7 days at 70-77°F (21-25°C), 45-55 percent relative humidity. Measure the bond area to the nearest ½ square inch.

M-5.3 7-day shear strength: Shear 4 specimens to failure immediately after the 7-day cure in section 5.2 using the method described in ASTM C482; Section 9.8.

Requirement: Average shear strength greater than 50 psi.

M-5.4 7-day water immersion shear strength: Immerse 4 specimens prepared in M-5.2 in water immediately after the 7-day cure in M-5.2. Shear the specimens to failure (per M-5.3) seven days after immersion.

Requirement: Average shear strength greater the 50 psi.

M-5.5 4-week shear strength: Cure 4 specimens prepared in M-5.2 for an additional three weeks at the temperature and relative humidity specified in M-5.2. Shear the specimens to failure (per M-5.3).

Requirement: Average shear strength greater the 50 psi.

M-5.6 12-week shear strength: Cure 4 specimens prepared in M-5.2 for an additional eleven weeks at the temperature and relative humidity specified in M-5.2. Shear the specimens to failure (per M-5.3).

Requirement: Average shear strength greater the 50 psi.

M-5.7 100-day water immersion shear strength: Immerse 4 specimens prepared in M-5.2 in water immediately after the 7 day cure in M-5.2. Periodically check the water level to ensure that full immersion is maintained. Shear the speci-

mens to failure (per M-5.3) 100 days after immersion.

Requirement: Average shear strength greater the 50 psi.

M-6 System performance

NOTE: Due to the wide range of membranes, substrates, and tiles available, it is not possible to write a single test which is applicable to all materials.

When performance data is required for a particular substrate and tile, the procedures in ASTM C-627 shall be followed. The membrane, bonding material, and grout shall be installed in accordance with the manufacturer's instructions. The manufacturer must disclose all of the components used in the test.

End of ANSI A118.10 — 1999

American national standard specifications for EGP (Exterior glue plywood) latex-portland cement mortar A118.11 — 1999

Foreword

Explanation and Notes

This foreword is not a part of American national standard specifications for EGP (Exterior glue plywood) latex-portland cement mortar A118.11.

PN-1 Introduction

PN-1.1 Latex/polymer additives for use in dry-set portland cement tile-setting mortars are designed to improve adhesion, reduce water absorption, and provide greater bond strength and resistance to shock and impact. These additives allow some latitude in working time, working conditions, and temperatures.

PN-1.2 Liquid latex additives are water emulsions which are added to dry-set portland cement mortars in place of water or replacing part of the water. The dry components—portland cement, dry additives, graded sand—must be preblended and must be specified by the latex manufacturer for use with the particular latex additive.

PN-1.3 Polymers in a powder form are normally supplied as an integral portion of a latex-portland cement mortar formulation. These mortars are usually mixed with water only.

PN-1.4 EGP latex-portland cement mortars may be supplied in liquid latex or powder form but must be specifically designed for bonding to exterior glue plywood in interior dry or limited water exposure areas only.

PN-2 Installation specifications

The ceramic tile section of the project specification should contain the following:

"EGP latex-portland cement mortar shall comply with the requirements of American national standard specifications for EGP (Exterior glue plywood) latex-portland cement mortar, A118.11-1999."

"Installation and workmanship of ceramic tile with EGP latex-portland cement mortar shall comply with the applicable requirements of American national standard specifications for installation of ceramic tile with EGP latex-portland cement mortar, A108.12-1999 and manufacturer's installation directions."

End of Foreword — Explanation and Notes

P-1 Scope

This specification describes the test methods and the minimum requirements for EGP latex-portland cement mortar.

NOTE – A latex supplied separately can meet the requirement of this specification only in combination with a particular brand of prepackaged dry mortar mix specified by the latex manufacturer or supplied by the latex manufacturer. A latex alone or intended for combination with job mixed cement and sand is not eligible for compliance with this specification.

P-1.1 Standards

The American national standard specifications for latex-portland cement mortar A118.4 shall be part of A118.11. The test methods and the minimum requirements for latex-portland cement mortars as described in A118.4, subject to the modifications contained in this specification, shall be complied with for materials to meet the American National Standard Specification for EGP (Exterior glue plywood) latex-portland cement mortar A118.11.

P-2 Definitions

P-2.1 EGP (Exterior glue plywood) latex-portland cement mortar: A modified portland cement dry-set mortar to which a polymer has been incorporated in latex form or in a powder form for the bonding of ceramic tile to exterior glue plywood in interior dry or limited water exposure areas only. When added in latex form it is added as a replacement for part or all of the gauging water in accordance with the manufacturer's instructions.

P-2.2 Ceramic tile: Ceramic tile referred to in this standard are as defined in ANSI A118.4; Section F-2.2.

P-2.3 Plywood: Nominal 23/32 inch Underlayment with exterior glue (Exposure 1), or C-C Plugged (Exterior) or better Group 1 Douglas fir, with at least one "C-Plugged" side, conforming to provisions of Voluntary Product Standard PS 1, construction and industrial plywood. Each panel of Underlayment shall be identified with the trademark of an approved testing agency. Plywood for tests in this standard include the following:

Designation	Description
P	Cut underlayment (plywood) to form pieces 4 x 4 x 23/32 inch (102 x 102 x 19 mm). The bonding surfaces shall be on the "C-Plugged" side with no visible flaws. The shear specimens shall be assembled so that the shear force is perpendicular to the direction of the face grain of the plywood.

P-3 Sampling and testing procedures

P-3.1 Sampling and testing procedures shall be in accordance with ANSI A118.4; sections F-3 through F-6. The following modifications and additions to the test in A118.4 shall be complied with.

P-3.1.1 Assemble only 16 shear specimens instead of the 20 shear specimens required in F-5.2.1.

P-3.1.2 Eliminate Section F-5.2.6 — 4-week Freeze-Thaw shear strength.

P-3.1.3 Assemble only 12 shear specimens instead of the 16 shear specimens required in F-5.3.1.

P-3.1.4 Eliminate section F-5.3.5 — 4-week Freeze-Thaw shear strength.

P-4 Shear strength to quarry tile

P-4.1 Preparation of specimens: In addition to the testing required in ANSI A118.4; Section F-5.3, prepare an additional 600 grams of mortar as specified in Section F-5.3.1. Assemble 12 shear specimens from 12 pieces of Type D tile and 12 pieces of Type P plywood. The 12 specimens of Type D tile to Type P plywood shall be assembled with a 1/8 inch (3mm) mortar layer by bonding one piece of tile and one piece of plywood together for each specimen. The 1/8 inch mortar bonding layer shall be established by placing 1/8 inch thick T-bar spacers (Figure V) on two parallel edges of the plywood piece; be sure to rub all mortar off the under side of the spacers by sliding them back and forth along the edge. The tile piece shall be placed on top of the mortar and squeezed until a 1/8 inch thickness of mortar is obtained. The tile shall then be slid back and forth along the stainless steel spacers to ensure proper thickness of the mortar. The tile shall then be slid to ensure 1/8 inch (3mm) offset. Care shall be taken in removing the stainless steel spacers so as not to cant or slide the tile in relation to the plywood or to alter the offset distance. Specimens shall not be individually handled for 24 hours and should be treated with care until broken. Cure all specimens for seven days at 70-77°F (21-25°C), 45-55 percent relative humidity and further cure or treat as directed in P-4.1.1 through P-4.1.3. Use measured area of bond or assume an area of 14.4 square inches (93 cm^2) in calculating the strength value in psi.

P-4.1.1 7-day shear strength of Type D tile To Type P plywood: After 7 days of dry cure, remove 4 specimens assembled as directed in P-4.1 and individually test as in P-4.3 with compression loading at a rate of 2400 pounds (1088.6 kg) per minute so that the mortar is stressed in shear to failure. Record these values as the 7-day shear strength of Type D tile to Type P plywood.

Requirement: Average shear strength greater than 100 psi (7 kg/cm^2).

P-4.1.2 4-week shear strength of Type D tile To Type P plywood: Dry cure 4 specimens prepared in P-4.1 for 4 weeks. Test in shear as specified in P-4.1.1 and record the values as 4-week shear strength.

Requirement: Average shear strength greater that 150 psi (10.5 kg/cm^2) or destruction of plywood above 150 psi (10.5 kg/cm^2).

P-4.1.3 12-week shear strength of Type D tile To Type P plywood: Dry cure 4 specimens prepared in P-4.1 for 12 weeks. Test in shear as specified in P-4.1.1 and record the values as 12-week shear strength.

Requirement: Average shear strength greater than 150 psi (10.5 kg/cm^2) or destruction of plywood above 150 psi (10.5 kg/cm^2).

P-4.2 Shear strength of fast-setting EGP (Exterior glue plywood) mortars: In addition to the testing required in ANSI A118.4; Section F-5.5, also assemble 12 specimens of Type D tile to Type P plywood as stated in P-4.1. Dry cure specimens at 70-77°F (21-25°C), 45-55 percent relative humidity.

P-4.2.1 4 -hour shear strength of Type D tile To Type P plywood: After 4 hours dry cure, remove 6 specimens assembled as directed in P-4.2 and individually test as in P-4.1.1 and record the values as 4-hour shear strength.

Requirements: Average shear strength greater than 50 psi (3.5 kg/cm^2).

P-4.2.2 24-hour shear strength of Type D tile to Type P plywood: After 24 hours dry cure, remove 6 specimens assembled as directed in P-4.2 and individually test as in P-4.1.1 and record the values as 24 hour shear strength.

Requirements: Average shear strength greater than 100 psi (7 kg/cm^2).

P-4.3 Support for shear specimens: Support all shear bond specimens in the shear bond test jig (Figure VI). Be sure to place the tile whose edge is to be loaded against the non-movable support.

P-5 Packaging labeling

P-5.1 Application: The container shall be clearly labeled. The necessary directions for application including identification of acceptable prepackaged dry mortar to be used and the general instructions required below shall appear on the container.

P-5.1.1 Instructions for storage: Instructions for proper storage of the latex and/or the powder shall be given, including any cautions against damage by freezing that are necessary.

P-5.1.2 Use: Instructions for proper use including types of tile, recommended tools, and procedures for application shall be given.

P-5.1.3 Shelf Life: Each container of latex and/or powder shall be labeled with date of manufacture and the age after which the latex and/or powder cannot be safely used.

End of ANSI A118.11 — 1999

American national standard specifications for organic adhesives for installation of ceramic tile A136.1 — 1999

K-1 Purpose

This standard is for the use of manufacturers of organic adhesives, tile producers, architects, installing mechanics, and testing laboratories in producing, specifying, and testing organic adhesives for the installation of ceramic tile. It provides a basis for promoting the quality of organic adhesives to be used under appropriate installation procedures specified in the current ANSI A108.4.

K-2 Scope

K-2.1 It is recognized that there are varying degrees of water resistance required in ceramic tile installations. Applications involving continuous water immersion, chemical resistance, and similar conditions may not be satisfied by products meeting this standard and therefore such applications should be referred to the manufacturer and considered upon an individual basis.

K-2.2 This standard covers organic adhesives for the installation of ceramic tile in interior areas requiring Type I and Type II water resistance and specified minimum requirements and methods of test for stability in storage, shear strength at intervals of time and water soaking, shear strength under accelerated aging, heat resistance, impact, requirements for manufacturer's instructions for installation, and labeling.

K-2.3 The quality of ceramic tile adhesives is determined by both strength and durability. This standard promotes improved flexibility and aging characteristics while maintaining more than adequate bond strength.

K-2.4 The methods used to prepare test specimens for the various strength requirements of this standard result in a bonded area of 50 ±5 percent of the tile surface. This factor is considered in evaluating the strength of adhesives tested under this standard.

K-2.5 This standard covers only organic adhesives in single package units ready for use.

K-3 Classification

K-3.1 Type I - Organic adhesives for installation of ceramic tile in interior areas.

A. On walls and ceilings having —

1. Commercial construction; dry or limited water exposure requirements.
2. Light construction; dry or limited water exposure requirements.
3. Light construction; wet requirements

B. On floors and countertops having —

1. Residential construction requirements

K-3.2 Type II - Organic adhesives for installation of ceramic tile in interior areas on walls and ceilings having Light construction; dry or limited water exposure.

K-3.3 All sections of ANSI A136.1 requirements pertain to both Type I and Type II specifications with the exception of Section K-5.2.2.1 which pertains only to Type I.

K-4 Definitions

K-4.1 **Ceramic tile**: for purposes of testing under this standard, shall be ceramic tile as described under K-6.2.1.1.

K-4.2 **Organic adhesive:** For the purposes of this standard, shall be an adhesive in which organic material is used as the principal bonding component.

K-4.3 **Commercial construction; dry or limited water exposure walls:** dairies, breweries, commercial kitchens, laundries, or other similar areas with like service requirements.

K-4.4 **Light construction; dry or limited water exposure walls:** residential kitchens and toilet rooms, commercial dry area interiors and deco-

ration, or similar areas with like service requirements.

K-4.5 Light construction; wet walls: tub enclosures and showers or other similar areas with like service requirements.

K-4.6 Residential construction floors: residential floors.

K-5 Requirements

K-5.1 Stability in storage: After 4 weeks storage under accelerated conditions as specified in K-6.1, the adhesive shall not change appreciably in volume or viscosity, shall not segregate in such a manner that it cannot be readily restored by hand-mixing with a paddle for not more than 10 minutes, and shall have substantially the same working qualities as another sample of recent manufacture, as obtained from the manufacturer at that time, strictly for the purpose of comparison.

K-5.2 Shear strength: When the adhesive is tested in accordance with K-6.2, it shall comply with the following requirements of shear strength.

K-5.2.1 Shear strength, conditioned, dry: Not less than 50 psi (3.5 kg/cm^2) when tested at a temperature of 73.4 ±6°F (23 ±2°C)* in accordance with the method described in K-6.2.3.1.

***NOTE –** This standard atmospheric temperature is specified by ASTM Committee D-14 on adhesives.

K-5.2.2 Shear strength, conditioned, after water immersion:

K-5.2.2.1 TYPE I - Not less than 50 psi (3.5 kg/cm^2) when tested at a temperature of 73.4 ±3.6°F (23 ±2°C) immediately after immersion in water for seven (7) days in accordance with the method described in K-6.2.3.2.

K-5.2.2.2 TYPE II - Not less than 20 psi (1.9 kg/cm^2) when tested at a temperature of 73.4 ±3.6°F (23 ±2°C) twenty (20) hours after final immersion in water of the last cycle in accordance with the method described in K-6.2.3.2.

K-5.2.3 Shear strength, room temperature, after 28 days air drying: Not less than 50 psi (3.5 kg/cm^2) when tested at a temperature of 73.4 ±3.6°F (23 ±2°C) in accordance with the method described in K-6.2.3.3.

K-5.2.4 Shear strength after accelerated aging: Not less than 75 percent of the actual shear strength, conditioned, dry computed and reported under K-5.2.1 when tested at a temperature of 73.4 ±3.6°F (23 ±2°C) in accordance with the method described in K-6.2.3.4 (e.g. if 100 psi (7.0 kg/cm^2) average is obtained under K-5.2.1, an average of at least 75 psi (5.2 kg/cm^2) must be obtained under K-6.2.3.4). However, in no case shall the shear strength after completion of the accelerated aging test be lower than 50 psi (3.5 kg/cm^2).

K-5.3 Heat resistance: Not less than 10 lbs. (4.5 kg) per tile assembly when tested at 120 ±2°F (48.8 ±1.1°C) in accordance with the method described in K-6.2.3.5.

K-5.4 Impact test: All tiles must remain bonded after impact when tested in accordance with the method described in K-6.2.3.6.

K-5.5 Stain test: Staining shall not exceed 70 percent penetration of the thickness of the tile when tested in accordance with the method described in K-6.3.

K-5.6 Resistance to mold growth: Tile adhesive shall not support mold growth when tested in accordance with the method described in K-6.4.

K-6 Sampling and testing procedures

K-6.1 Stability in storage: Two containers of at least 1-gallon each of the bonding adhesive, obtained at the same time and having the same lot or batch number, shall be tested as follows:

The two, 1-gallon containers shall be stirred until homogeneous and quickly repacked into eight, 1-quart, triple-tight cans to avoid loss of volatiles. Four quarts shall be stored for a four week period— two weeks at a temperature of 120 ±2°F (48.8 ±1.1°C), and two weeks at a temperature of 35 ±2°F (1.7 ±1.1°C). Any significant evidence of change in volume or viscosity shall be observed.

At the end of the last storage period, after the containers have attained room temperature, if there is any evidence of separation, the bonding adhesive shall be hand-mixed with a paddle for not longer than 10 minutes. The bonding adhesive, in the containers inspected at the end of the four week period after mixing, shall be compared with a sample of recent manufacture.

The remaining four quarts shall be used as in K-6.2 through K-6.4.

K-6.2 Shear strength

K-6.2.1 Materials: Materials used for testing methods specified herein shall be as follows:

K-6.2.1.1 The ceramic tiles shall be glazed wall tile, 4-¼ x 4-¼ inches (108 x 108 mm) having a nominal thickness of 5/16 inch (8 mm), water absorption of 13-15 percent according to ASTM C373.

In order to obtain comparable test results, the tile selected shall be standard grade, of one glaze color, obtained from one manufacturer.

K-6.2.1.2 The bonding material shall be the commercial product transferred into 1-quart cans, as outlined under K-6.1. Lids shall be kept tightly closed at all times when not in use.

K-6.2.1.3 The template used in applying the bonding adhesive shall be made of polytetrafluoroethylene* of .0625 ±0.002 inch (1.59 mm ±50 microns) thickness and shall conform to the exact measurements as shown in Figure K-1.

*Such as “Teflon”, a product of Dupont.

K-6.2.1.4 The oven used throughout this specification shall be a mechanical convection type such as the Thelco Model 18, or equivalent provided with lattice-type shelves. The heating element shall be external to the oven chamber with air circulation dependent upon the movement of warm air provided by a turbo blower and directed and circulated through diffuser. See Figure K-3.

K-6.2.1.5 Spacers: Spacer rods shall be made from straight high-carbon steel drill rod. They shall have a diameter of 1/32 inch (0.8 mm) and shall be 2 inches in length.

K-6.2.1.6 Storage prior to test: All materials mentioned herein for the purpose of conducting the following tests, shall be stored at a temperature of 73.4 ±3.6°F (23 ±2°C) and a relative humidity of 50 ±5 percent for a minimum of 24 hours prior to test.

K-6.2.2 Preparation of bonded tile assemblies

K-6.2.2.1 Bonded tile assemblies for all tests specified shall be prepared as follows:

All bonded tile assemblies shall be made at a temperature of 73.4 ±3.6°F (23 ±2°C), 50 ±5 percent relative humidity, free of drafts or direct sunlight. The porous, unglazed back of each tile shall be wiped or brushed to remove any loose particles.

With a T-square, or carpenter square, draw a pencil line on the porous side of the tile ¼-inch (6 mm) in from the tile edge and perpendicular to the back pattern ribs. See Figure K-2. (This line will serve as a guide in the overlapping of tile, as explained below.)

The template is placed over the porous side of a test tile. Sufficient adhesive is troweled across the template and screeded clean so as to neatly and completely fill the holes in the template. The template is then carefully removed vertically.

Spacer rods are then inserted diagonally in each of the four corners of the tile, 1 inch into the specimen to provide easy removal. See Figure K-2.

Exactly 2 minutes after the adhesive has been applied, the porous side of an uncoated tile shall be brought into contact with the coated tile with the back pattern ribs parallel and the tiles offset by exactly ¼-inch (6 mm), using the previously scribed pencil line as a guide, so that the edges of the tiles exactly parallel and a total overlap area of 17 square inches (109.8 cm^2) is obtained.

Having placed the bonded tile assembly on a level surface, the assembly shall then be immediately subjected to a total load of 15 lbs. (6.8 kg) (e.g. a 1 quart can filled with #3 lead shot), for a period of exactly 3 minutes. After exactly 1 hour remove spacer rods carefully.

Tiles bonded in this manner are considered bonded tile assemblies.

K-6.2.2.2 Drying: After the bonded tile assemblies have been prepared, they shall be stored at a temperature of 73.4 ±3.6°F (23 ±2°C) and a relative humidity of 50 ±5 percent for a period of 72 hours. After the drying period is complete, any excess adhesive shall be removed from the assemblies. They shall also be checked to assure correct parallelism. Any assemblies found to be not parallel shall not be used for these tests.

K-6.2.2.3 Conditioning of bonded tile assemblies: When specified in subsequent test methods the term "conditioned" shall refer to tile assemblies which have been prepared according to this procedure. Immediately following drying, the assemblies shall be aged in a horizontal position for 21 days in an air circulating oven, as described in K-6.2.1.4, at 120 ±2°F. Tile assemblies shall be placed in the oven such that a minimum of 1 inch is allowed between each assembly in all directions.

Remove assemblies after 21 days and further condition for a period of 24 hours at a temperature of 73.4 ±3.6°F (23 ±2°C) and a relative humidity of 50 ±5 percent immediately prior to testing.

K-6.2.3 Procedure

K-6.2.3.1 Shear strength at room temperature: Five bonded tile assemblies prepared, dried and conditioned in accordance with K-6.2.2 shall be tested in a vertical position by compression loading at a rate of 0.50 inch (13 mm) per minute so that the adhesive is stressed in shear to failure. Jigs, fixtures, or devices* must be employed to exert the compression load directly parallel and in line with the layer of adhesive in the test assembly. Failure of the material shall occur when the bond breaks suddenly, or when the stress causing deformation of the adhesive has reached a maximum value. If a tile breaks, the stress producing this failure shall not be used in computing the shear strength of the bonding material. Shear strength shall be calculated in accordance with the method described in K-6.2.4.

*Tinius Olsen, Dillon or equivalent machines have been found to be satisfactory for these purposes.

K-6.2.3.2 Shear strength wet, Type I: Five bonded tile assemblies prepared, dried, and conditioned in accordance with the method outlined in K-6.2.2 shall be immersed in distilled or deionized water at 73.4 ±3.6°F (23 ±2°C) for a period of 7 days. Assemblies shall then be removed, wiped with a cloth and, within 2 minutes, tested in shear to failure in accordance with the method described in K-6.2.3.1. Shear strength shall be calculated in accordance with the method described in K-6.2.4.

Shear strength wet, Type II: Five bonded tile assemblies prepared, dried, and conditioned in accordance with the method outlined in K-6.2.2 shall be immersed in distilled or deionized water at 73.4 ±3.6°F (23 ±2°C) for a period of 4 hours. Assemblies shall be removed and wiped with a cloth. Allow tile assemblies to recover for a period of 20 hours at 73.4 ±3.6°F (23 ±2°C), 50 ±5 percent relative humidity. Repeat for a total of 4 cycles. After fourth cycle, assemblies are to be tested in shear to failure in accordance with K-6.2.3.1. Shear strength shall be calculated in accordance with the method described in K-6.2.4.

K-6.2.3.3 Shear strength 28 days: Five bonded tile assemblies shall be prepared in accordance with the method described in K-6.2.2.1 and shall be aged for a period of 28 days at a temperature of 73.4 ±3.6(F (23 ±2(C) and a relative humidity of 50 (5 percent. The assemblies shall then be tested in shear to failure in accordance with the method described in K-6.2.3.1. Shear strength shall be calculated in accordance with the method described in K-6.2.4.

K-6.2.3.4 Accelerated aging: Five bonded tile assemblies shall be prepared in accordance with the method described in K-6.2.2.1 and shall be dried according to K-6.2.2.2.

At the end of this period, the assemblies shall be immediately transferred to an air circulating oven at 140 ±2°F (60 ±1.1°C) for a period of 28 days.

At the end of the 28 day period of accelerated aging, the assemblies shall be further conditioned for a period of 24 hours at a temperature of 73.4 ±3.6°F (23 ±2°C) and a relative humidity of 50 ±5 percent. The assemblies shall then be tested in shear to failure in accordance with the method outlined in K-6.2.3.1.

K-6.2.3.5 Heat Resistance: Two bonded tile assemblies prepared, dried, and conditioned in accordance with K-6.2.2 shall be suspended vertically in an air-circulating oven at 120 ±2°F (48.8 ±1.1°C). The top tile shall be held in a mechanical clamp to ensure vertical alignment. A load of 10 lbs. (4.5 kg) shall be suspended from the bottom tile and allowed to hang freely. (This load shall be applied by running a steel wire over the top edge of the bottom tile and hanging a 5 lb. (2.3 kg) weight from each end of the wire.)

The bonded tile assembly shall maintain a 10 lb. (4.5 kg) static load in shear without failure for 24 hours.

K-6.2.3.6 Impact test: Prepare two impact test assemblies as follows:

Using a good contact bond cement, laminate the reverse or backside of a 3/8 x 12 x 12 inch (10 x 305 x 305 mm) piece of gypsum wallboard (complying with ASTM C36) to a 1/8 x 12 x 12 inch (3 x 305 x 305 mm) steel plate.

Rule the face side of the gypsum wallboard into four adjacent 4-¼ x 4-¼-inch (108 x 108 mm) square areas laid out in a square geometrically centered so that the edges of the square are parallel to the edges of the wallboard. Apply the adhesive under test to the back of four individual tiles in accordance with K-6.2.2.1. Immediately place the coated tiles in the pattern laid out on the gypsum wallboard without the use of spacer rods, making sure tiles are butted to each other.

Place a 3/4 x 12 x 12 inch (19 x 305 x 305 mm) plywood board on the four tiles and then place a 15 lb. (6.8 kg.) total load on the center of the plywood for a total period of 3 minutes.

Condition the assembly at a temperature of 73.4 ±3.6°F (23 ±2°C) and a relative humidity of 50 ±5 percent for 72 hours. At the end of this period, remove excess adhesive from edges of tile and then place the assemblies in an air-circulating oven at 120 ±2°F (48 ±1.1°C) for an additional 72 hours. The assembly shall then be further conditioned at 140 ±2°F (60 ±1.1°C) for a period of 28 days. At the end of this period remove the assembly from the oven and further condition it at a temperature of 73.4 ±3.6°F (23 ±2°C) and a relative humidity of 50 ±5 percent for a period of 24 hours.

Support the impact assembly on a square frame of 2 x 4's (40 x 90 mm), the inside dimensions of which are 10 x 10 inch (254 x 254 mm), so that the edges of the tiles will be 3/4 inch (19 mm) from the frame on all sides.

A 2-lb. (0.9 kg) steel ball, with a screw eye attached shall be supported by a thin cord, or string, and secured to a laboratory ring stand, or other suitable holding device. The ball shall be suspended above the center of the test panel so that the distance between the bottom of the ball and the surface of the steel plate is exactly 48 inches (1.2 m). The string will then be burned to enable the ball to fall free. Any other suitable method which produces a 48 inch vertical free fall of the 2-lb. steel ball may be substituted for the above.

This impact test is performed only once to each panel.

K-6.2.4 Calculation of shear strength

In calculating shear strength, the load at failure of each of the five assemblies subjected to a test shall be recorded and the average of the five values calculated for determining the shear strength in pounds per square inch of bonded area. Divide the average of the five values by 8.5 square inches (54.8 cm^2). The average actual bonded area produced by the template method of assembly is 8.5 square inches (54.8 cm^2). Any individual value which varies from the average by more than 15 percent, plus or minus, shall be discarded and not used for determining the shear strength. If less than 3 values remain for averaging, the test shall be rerun using ten bonded tile assemblies. The average of these 10 tile values shall be taken as the shear strength and none shall be discarded.

K-6.3 Stain test: Apply adhesive to the back of four test tiles so that a continuous film 1/8 inch (3 mm) thick covers the entire back of the tiles. Cover the adhesive with a 5 x 5 inch (127 x 127 mm) piece of aluminum foil, folding excess foil over the edges of each tile so that solvent penetration is directed into the tile. Allow test specimens to be conditioned at a temperature of 73.4 ±3.6°F (23 ±2°C) and a relative humidity of 50 ±5 percent for a 7 days in a vertical position to simulate an actual wall application.

At the end of the 7 day period, crack the tile through the center by striking with a blunt instrument on the

face of the tile. The depth of adhesive stain penetration into the tile is made visible by exposing the broken tile edge to a "black light," such as a GE 20 watt 24 inch black light tube F 20 T 12/BLB . . . or other lamp of equal spectral characteristics. For visual comparison, repeat the examination using an uncoated test tile.

The maximum depth of stain for each tile shall be expressed as a percentage of the tile thickness. The maximum penetration for test tiles shall be reported.

K-6.4 Test for mold growth: The organism used for this test shall be Aspergillus Niger. The stock cultures shall be kept for not more than 4 months in a refrigerator at approximately 37.4-50°F (3-10°C). The culture medium shall be potato dextrose agar from Difco Products, Inc.; Detroit, Michigan or its equivalent.

Dissolve 39 grams of the agar in 1 liter of water, using heat. Autoclave the medium and two 1 inch (25 mm) square pieces of tile at 15 psi (1.1 kg/cm^2) for 15 minutes. Cover the unglazed side of one piece of sterile tile with an 1/8 inch (3 mm) layer of adhesive. Place the coated tile with the adhesive side up in a sterile petri dish and pour sterile agar into the dish until the surface of the agar is level with the edge of the adhesive. Inoculate with the organism.

For control purposes, one petri dish containing only the agar medium and the other piece of tile shall be inoculated with the test organism to determine the viability of the inoculum.

Place the petri dishes in an incubator at 82.4-86°F (28-30°C) and at a relative humidity of 85 to 95 percent. After 14 days of incubation, examine to ascertain whether the adhesive supports mold growth. (At the end of the inoculation period the control shall be well covered with a mold growth.)

K-7 Manufacturer's instructions

K-7.1 Application: The container shall be clearly labeled. The necessary directions for application and the general instructions shown below shall appear on the container.

Use installation procedures set forth in ANSI A108.4.

Type of adhesive shall be specified prominently on label to indicate it meets or surpasses requirements of ANSI A.136.1 TYPE I or TYPE II, for interiors only.

Instructions for storage, including any provisions for freezable type materials.

Instructions for practical handling on the job in reference to surface skinning time.

Types of tools to be used, and approximate coverage.

Solvent and methods of cleaning the tools and work.

If solvents are suggested for thinning or cleaning tools or work, the necessary precautions shall be stated on the label to eliminate any hazard from their use.

K-7.2 Storage: The manufacturer shall certify that the adhesive will meet the requirements of this specification for a minimum period of not less than one year of storage in accordance with the manufacturer's instructions.

K-8 Toxicity and flammability

K-8.1 Labels: The labels on the containers shall state plainly: tendencies of the material to be toxic or irritating to the workman under normal application conditions; tendencies toward flammability; and shall set forth precautions to be observed for protection of the workman.

End of ANSI A136.1-1999

FIG. K-1 Ceramic tile test assembly plate

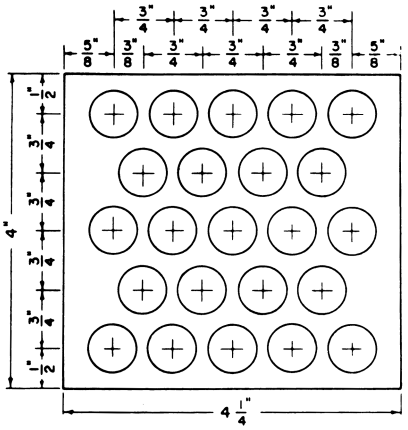


FIG. K-2 Ceramic tile test assembly lower portion

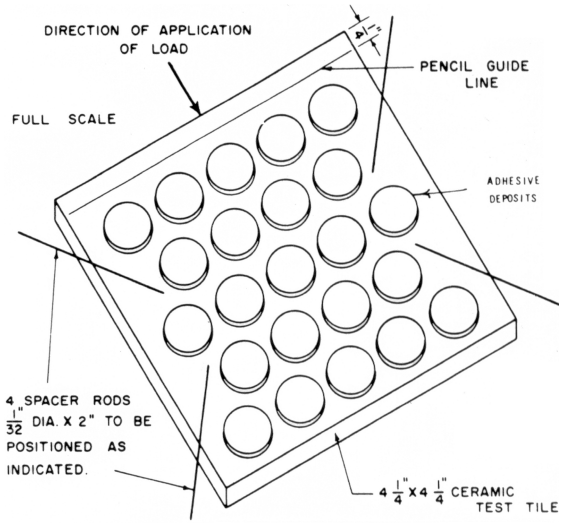
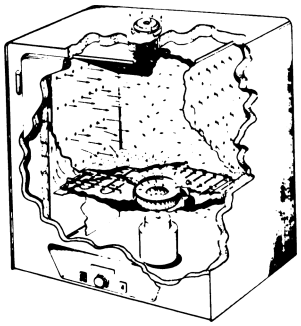


FIG. K-3 OVEN



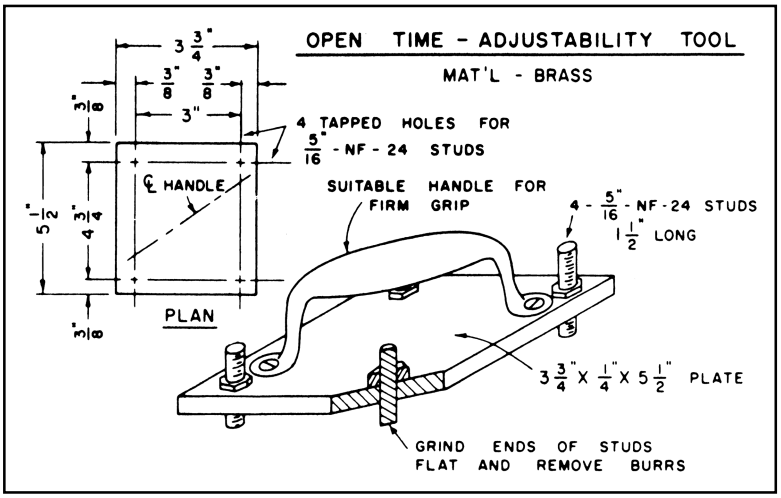


FIG. I OPEN TIME — ADJUSTABILITY TOOL

METRIC CONVERSION TABLE

FIGURES I THROUGH VI

inches	mm
1/8	3.2
3/16	4.8
¼	6.4
5/16	7.9
3/8	9.5
½	12.7
1	25.4
1-1/8	28.6
1/14	31.8
1-5/16	33.3
1-½	38.1
1-3/4	44.5
2	50.8
2-1/8	51.1
3	76.2
3-3/4	95.3
3-15/16	100.0
4	101.6
4-½	114.3
4-3/4	120.6
5	127.0
5-½	139.7

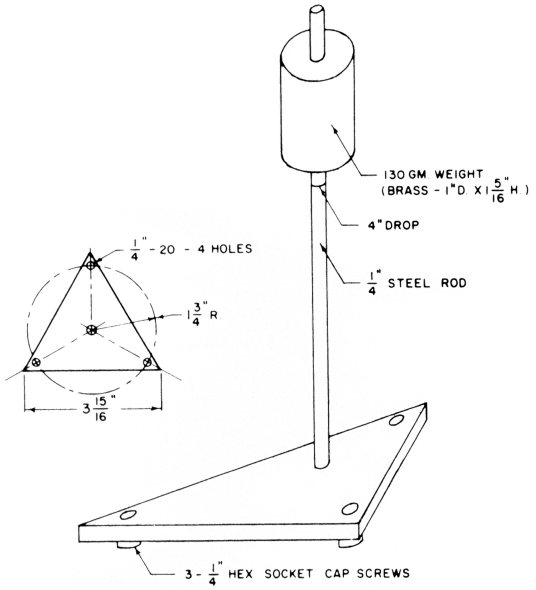


FIG. II TILE APPLICATION JIG

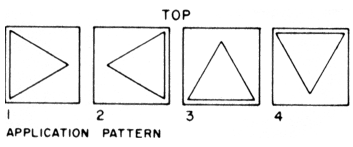


FIG. III APPLICATION PATTERN

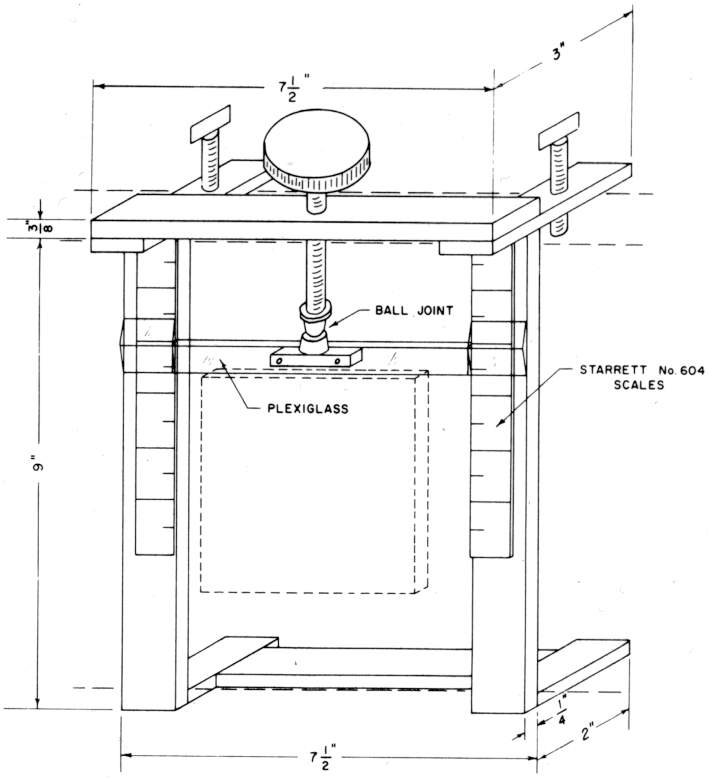


FIG. IV SAG MEASURING JIG

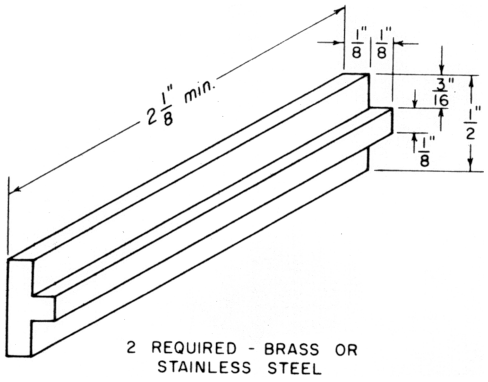


FIG. V T-BAR SPACER

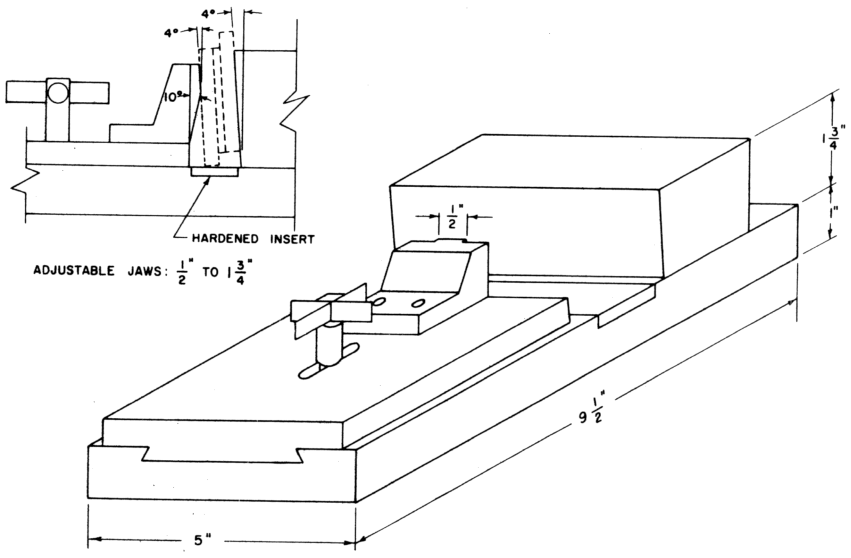


FIG. VI SHEAR BOND TEST JIG