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Standard Guide for Use of High Solids Content, Cold Liquid-Applied Elastomeric Waterproofing Membrane with an Integral Wearing Surface[1]

This standard is issued under the fixed designation C 1127; the number immediately following the designation indicates the year of original adoption or, in the case of revision, the year of last revision. A number in parentheses indicates the year of last reapproval. A superscript epsilon (ε) indicates an editorial change since the last revision or reapproval.

1. Scope

1.1 This guide describes the design and installation of cold liquid-applied elastomeric waterproofing membrane systems that have an integral wearing surface. The cold liquid-applied elastomeric waterproofing membrane (membrane) to which this guide refers is specified in Specification C 957.

1.2 *Concrete Slab-on-Grade*—Waterproofing the upper surface of a concrete slab on grade presents special problems due to the possibility of negative hydrostatic pressure causing loss of bond to the substrate. Consideration of these problems is beyond the scope of this guide. Consult the membrane manufacturer for recommendations when this situation exists.

1.3 The values stated in SI units are to be regarded as the standard. The values given in parentheses are for information only.

1.4 *This standard does not purport to address all of the safety concerns, if any, associated with its use. It is the responsibility of the user of this standard to establish appropriate safety and health practices and determine the applicability of regulatory limitations prior to use.* For specific hazard statements see Note in 15.4.

2. Referenced Documents

2.1 *ASTM Standards:*

C 33 Specification for Concrete Aggregates[2]

C 150 Specification for Portland Cement[3]

C 330 Specification for Lightweight Aggregates for Structural Concrete[2]

C 332 Specification for Lightweight Aggregates for Insulating Concrete[2]

C 717 Terminology of Building Seals and Sealants[4]

C 755 Practice for Selection of Vapor Retarders for Thermal Insulation[5]

C 920 Specification for Elastomeric Joint Sealants[4]

C 957 Specification for High-Solids Content, Cold Liquid-Applied Elastomeric Waterproofing Membrane with Integral Wearing Surface[4]

C 962 Guide for Use of Elastomeric Joint Sealants[6]

C 1193 Guide for Use of Joint Sealants[4]

D 653 Terminology Relating to Soil, Rock, and Contained Fluids[7]

D 1752 Specification for Preformed Sponge Rubber and Cork Expansion Joint Fillers for Concrete Paving and Structural Construction[8]

D 2628 Specification for Preformed Polychloroprene Elastomeric Joint Seals for Concrete Pavements[8]

2.2 *U.S. Department of Commerce Standard:*

Product Standard PS 1-74 Construction and Industrial Plywood[9]

2.3 *American Concrete Institute (ACI) Standard:*

301-84 (1985) Specification for Structural Concrete for Buildings[10]

2.4 *Steel Structures Painting Council (SSPC) Standards:*

Steel Structures Painting Manual, Systems and Specifications:

Specification SSPC SP-2 Wire Brush Cleaning[11]

Specification SSPC SP-6 Commercial Blast Cleaning[11]

2.5 *American Plywood Association (APA) Standard:*

APA Plywood Construction Guide[12]

3. Terminology

3.1 *Definitions*—Refer to Terminology C 717 for the following terms used in this guide: *bond breaker; cellular; cold joint; compatibility; compound; construction joint; control joint; creep; dry film thickness; elastomer; expansion joint;*

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[2] *Annual Book of ASTM Standards*, Vol 04.02.

[3] *Annual Book of ASTM Standards*, Vol 04.01.

[4] *Annual Book of ASTM Standards*, Vol 04.07.

[5] *Annual Book of ASTM Standards*, Vol 04.06.

[6] Discontinued. See 1992 *Annual Book of ASTM Standards*, Vol 04.07. Replaced by C1193.

[7] *Annual Book of ASTM Standards*, Vol 04.08.

[8] *Annual Book of ASTM Standards*, Vol 04.03.

[9] Available from National Institute of Standards and Technology, Gaithersburg, MD 20899.

[10] Available from the American Concrete Institute, P.O. Box 19150, Detroit, MI 48219.

[11] Available from Steel Structures Painting Council, 4400 Fifth Ave., Pittsburgh, PA 15213.

[12] Available from American Plywood Assoc. (Forest Industries), P.O. Box 11700, Tacoma, WA 98411.

gasket; isolation joint; joint; laitance; primer; reglet; reinforced joint; sealant; spalling.

3.2 *Description of Terms Specific to This Standard:*

3.2.1 *cold-applied*—capable of being applied without heating as contrasted to hot-applied.

3.2.1.1 *Discussion*—Cold-applied products are furnished in a liquid state, whereas hot-applied products are furnished as solids that must be heated to liquefy them.

3.2.2 *curing time*—the period between application and the time when the material attains its intended physical properties.

3.2.3 *deck*—the horizontal structural substrate supporting the plaza deck system.

3.2.4 *deflection*—the deviation of a structural element from its original shape or plane due to physical loading, temperature gradients, or rotation of its support.

3.2.5 *finish*—the exposed top surface of the plaza deck system, or traffic or wearing surface.

3.2.6 *flashing*—a generic term describing the transitional area between the waterproofing membrane and surfaces above the wearing surface of the plaza; a terminal closure or barrier to prevent ingress of water into the system.

3.2.7 *floated finish*—a concrete finish provided by consolidating and leveling the concrete with only a power driven or hand float, or both.

3.2.7.1 *Discussion*—A floated finish is more coarse than a troweled finish. For specifications, see ACI Specification 301.

3.2.8 *freeze-thaw cycle*—the freezing and subsequent thawing of a material.

3.2.9 *grout*—concrete containing no coarse aggregate; a thin mortar.

3.2.10 *preparatory coat*—an initial coat of the liquid-applied membrane which is applied at cracks, joints, or terminal points to provide reinforcement to the membrane at these critical areas.

3.2.11 *structural slab*—a horizontal, supporting, cast-in-place concrete building deck.

3.2.12 *traffic surface*—a surface exposed to traffic, either pedestrian or vehicular.

3.2.13 *troweled finish*—a concrete finish provided by smoothing the surface with power-driven or hand trowels, or both, after the float finishing operation.

3.2.13.1 *Discussion*—A troweled finish is smoother than the floated finish. For specifications, see ACI Specification 301.

3.2.14 *wearing surface*—see *traffic surface.*

3.2.15 *wet-film thickness*—the thickness of a liquid coating as it is applied.

3.2.16 *wet-film gauge*—a gauge for measuring the thickness of a wet film.

4. Significance and Use

4.1 This guide is divided into two sections which provide design and specification guidelines for the use of a cold liquid-applied elastomeric membrane with integral wearing surface for waterproofing building decks in building areas to be occupied by personnel, vehicles, or equipment.

4.2 The intent of Sections 5-11, Design Considerations, is to provide information and design guidelines where a waterproofing membrane with integral wearing surface is to be used. The intent of the remaining sections is to provide minimum guide specifications for the use of the purchaser and the seller in contract documents.

4.3 Where the state of the art is such that criteria for a particular condition is not as yet firmly established or has numerous variables that require consideration, reference is made to the applicable portion of Sections 5-11 that covers the particular area of concern. Section 16 describes the repair, rehabilitation, and replacement of the membrane.

DESIGN CONSIDERATIONS

5. General

5.1 *Major Components, Subsystems, and Features*—Design of plaza deck waterproofing includes consideration of several subsystems, with their material components and interrelationships. The specific project requirements, types of substrates exposed to weather, difference in climatic conditions to which the deck is exposed, and interior environmental requirements of the occupied space, are major determinants in the selection of components. Information needed to design the deck subsystems includes temperature extremes of the inner and outer surfaces, precipitation rates, solar exposure, prevailing wind direction, the pattern and reflectivity of adjacent structures, anticipated amount and intensity of vibration resulting from function or adjacent occupancies, and design live loads.

5.2 *Major Subsystems*—The major subsystems to be considered in waterproofing a building deck are the structural building deck or substrate to be waterproofed, deck supports, traffic-bearing waterproofing membrane, drainage, membrane terminations, and joint systems (see Fig. 1). The design guidelines, as well as the details, components, and drawings which follow, illustrate a principle but are not necessarily the only solutions for a diversity of environments.

5.3 *Compatibility*—Components and contiguous elements should be compatible and coordinated to form a totally integrated waterproofing system.

5.4 *Waterproofing Membrane*—The waterproofing membrane may be composed of several components, such as substrate primer(s), base coat(s), top coat(s), and antiskid aggregate(s), and each material may be single or multicomponent. The thickness of each coat, the use of primers, as well as the type and amount of aggregates needed for each particular application, vary according to the exposure conditions. Areas of high stress and wear, such as sharp turn radii and areas with heavy acceleration and braking from vehicular traffic, require a greater application thickness of the membrane and aggregate than do areas of lower stress. The membrane system must be applied at a thickness great enough to withstand the conditions of use. The actual thickness of each

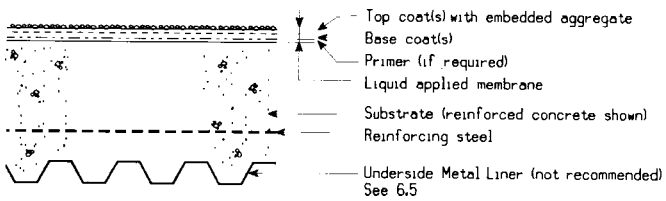


FIG. 1 Basic Components of Cold-Applied Elastomeric Waterproofing Membrane with Integral Wearing Course (see 5.2 and 5.4)

coat required for a particular application and the use of aggregate in topcoats should be established between the purchaser and the seller. The purchaser should specify that the minimum membrane or film thickness meets or exceeds the requirements for the particular application and substrate.

5.5 *Membrane Wear*—The liquid-applied elastomeric membrane forms the wearing surface of the building deck and therefore can be expected to show wear and deterioration. The installed membrane system requires maintenance to provide maximum life and waterproofing protection. A program of regularly scheduled inspections (that is, annual, semi-annual, or quarterly) shall be established to detect problems before major damage occurs to the membrane. Small areas of high wear (such as a sharp turn in a parking deck) or areas subjected to abuse can and should be repaired. If the top coat or wearing surface has begun to deteriorate, the wearing surface (including aggregate) can be rehabilitated. Should the membrane system become worn to the point where large areas of the deck substrate are visible, the membrane system probably will have to be completely replaced and structural repairs may be required. Loss of watertight integrity should not be permitted as corrosion of reinforcing steel can occur, causing spalling and thereby jeopardizing the structural integrity of the deck.

6. Cast-In-Place Concrete

6.1 *General*—The concrete substrate or building deck referred to in this guide is reinforced, cast-in-place structural concrete, which should conform to all requirements of ACI Specification 301.

6.2 *Strength*—The strength of concrete is an important factor since liquid-applied elastomeric membranes have a much higher modulus and tensile strength than a typical building sealant or a waterproofing membrane normally used with a separate wearing course. (For example, the 100 % (tensile) modulus value may range up to 34.47 MPa (5000 psi).) The concrete must have sufficient strength to avoid rupture at the bond line of the membrane when the membrane is under tensile or shear stress. The strength of concrete is also a factor to be considered insofar as it relates to finish, bond strength, and continuing integrity (absence of cracks and other defects that could affect the integrity of the membrane after installation). Thus, the concrete should have a minimum compressive strength of 20.68 MPa (3000 psi) when the membrane is applied.

6.3 *Aggregates and Moisture Content*—Concrete is a complex mixture of portland cement, water, aggregates and, optionally, admixtures. The portland cement used should be in conformance with Specification C 150, Type I or III. (Types II, IV, and V are rarely, if ever, used in building deck construction.) Aggregates generally available for use in concrete are in conformance with Specifications C 33, C 330, and C 332. The moisture content of the cured concrete, which is related to the type of aggregate used, can affect the adhesion of the waterproofing membrane to the substrate. With an excessively high moisture content, moisture may condense at the interface of the membrane and concrete, and cause membrane delamination. This is particularly so if the top surface is cooler than the concrete below. Lower moisture contents are achieved with the use of dense stone aggregates conforming to Specification C 33, which generally provides structural concrete with a 3 to 5 % moisture content when cured. Aggregates conforming to Specification C 330 will provide lightweight structural concrete generally having a 5 to 20 % moisture content when cured. Aggregates conforming to Specification C 332 provide lightweight insulating concrete, generally having a relatively low compressive strength and capable of having over 20 % moisture content when cured. The concrete used for the deck substrate should have a maximum moisture content of 8 % when cured and a minimum density of 1760 kg/m^3 (110 lb/ft^3). Hence, a limited number of lightweight aggregates (Specification C 330) may be used, and no lightweight insulating aggregates (Specification C 332) shall be used.

6.4 *Admixtures, Additives, and Cement/Concrete Modifiers*—Admixtures, additives, and modifiers serve many functions in mixing, forming, and curing concrete, such as to retard or accelerate the cure rate; reduce the water content required; entrain air; increase strength; create or improve the ability of the concrete to bond to existing, cured concrete; permit thin topping overlayers; and improve workability. Some admixtures and modifiers (particularly polymeric, latex or other organic/chemical based materials) may coat the concrete particles and reduce the ability of the waterproofing membrane to bond to the concrete. The membrane manufacturer should be consulted if the concrete used for the deck contains any admixtures, additives, or modifiers in order to determine the compatibility of the membrane with the concrete.

6.5 *Underside Metal Liner and Coating*—The underside of the concrete deck should not be impervious to water, but rather should permit the free evaporation of water from the concrete. If an underside metal liner, used as a form or composite structural component, does not permit moisture to evaporate, water vapor may be trapped between the membrane and the support and condense at the membrane-concrete interface. The condensate can destroy or prevent the adhesive bond of the membrane to the concrete. Adequate drying of residual moisture in concrete poured over permanent metal liners requires a much longer period (possibly years) to achieve similar moisture content as is achieved with slabs stripped of forming. Uniformly spaced perforations in permanent metal liners may provide a solution to the vapor barrier problem but as yet there are no definite data on the requirements for the size and spacing of the perforations. Subsequent coating which might inhibit moisture vapor transmission through the vents should be avoided. Coating the underside of a stripped concrete deck with a coating that inhibits vapor transmissions should also be avoided. The minimum perm rating permissible for such a coating to be acceptable is 1 metric perm (1.52 U.S. perms).

6.5.1 *Perforations*—Perforated metal liners have different structural characteristics and properties than nonperforated material. These differences must be recognized and accommodated in the design and use of these materials.

6.6 *Slope for Drainage*—Drainage at the membrane level is important. Since the waterproofing membrane is placed directly on the concrete slab, a monolithic concrete substrate slope of a minimum 11 mm/m (⅛ in/ft) should be maintained. Slope is best achieved with a monolithic pour, as compared with a separate concrete fill. The fill presents the potential of

additional cracks and provides a cleavage plane between the fill and the structural slab. The cleavage plane complicates the detection of leakage in the event that water penetrates the membrane at a crack in the fill and travels along the separation until reaching a crack in the structural slab.

6.7 *Finish*—The structural slab should have a finish that facilitates proper application of the liquid-applied membrane. The surface should be of sufficiently rough texture to provide a mechanical bond for the membrane, but not so rough as to preclude achieving continuity of the membrane of the specified thickness across the surface. As a minimum, ACI Specification 301 floated finish is required with ACI Specification 301 troweled finish preferred, deleting the final trowelling. Follow the requirements of the membrane manufacturer as to the required finish.

6.7.1 *Vertical Substrate*—The vertical surface to which the waterproofing membrane is adhered should have a sound, smooth finish, dry and free from cracks and loose materials, as stated for the horizontal or deck substrate.

6.8 *Curing*—Curing of the structural slab is necessary to provide a sound concrete surface and obtain the quality of concrete required. Curing is a chemical reaction accomplished with moisture and should not be misconstrued as drying. The concrete should be cured a minimum of 7 days and aged a minimum of 28 days, including curing time, before applying the liquid-applied membrane. The more commonly known curing methods are moist curing, impermeable sheet curing, and chemical curing.

6.8.1 *Moist Curing*—Moist curing is achieved by keeping the surfaces continuously wet by covering them with burlap saturated with water and kept wet by spraying or hosing. The covering material should be placed in a manner that provides complete surface coverage, with joints lapped a minimum of 75 mm (3 in.).

6.8.2 *Sheet Curing*—Sheet curing is accomplished with a sheet vapor barrier, which reduces the loss of water from the concrete and moistens the surface of the concrete by condensation, thus preventing the surface from drying while curing. Laps of sheets covering the slab should not be less than 5 cm (2 in.) and should be sealed or weighted. (See Practice C 755.)

6.8.3 *Chemical Curing*—Liquid or chemical curing compounds should not be used unless approved by the manufacturer of the liquid-applied membrane, as the material may interfere with the bond of the membrane to the structural slab.

6.9 *Dryness*—Membrane manufacturer's requirements for substrate dryness vary from being visibly dry to having a specific maximum moisture content as measured by a moisture meter. Since there is a lack of unanimity in this regard, it is necessary to meet the manufacturer's requirements for the particular membrane being applied.

6.10 *Joints*—Joints in a structural concrete slab are herein referred to as reinforced joints, nonreinforced joints, and expansion joints, as follows:

6.10.1 *Reinforced Joints*—Reinforced joints consist of hairline cracks, cold joints, construction joints, and control joints held together with reinforcing steel bars or wire fabric. These are considered static joints with little or no movement anticipated because the slab reinforcement is continuous across the joint.

6.10.2 *Nonreinforced Joints*—Nonreinforced joints consist of cracks or butted construction joints and isolation joints not held together with reinforcing steel bars or wire fabric. These joints are generally considered by the designer of the structural system as nonmoving or static joints. However, they should be considered as capable of having some movement, the magnitude of which is difficult to predict.

6.10.3 *Expansion and Seismic Joints*:

6.10.3.1 Expansion joints, as differentiated from control joints, are designed to accommodate movement in more than one direction; are an integral part of the building structural system; and are to be carried through the entire structure. Expansion joints are incorporated in the structural frame to reduce internal stresses caused by wide temperature ranges, or differential movement, or both, between structural elements, as might be the case in large adjoining heated and unheated spaces; where there are different foundation settlement conditions between adjacent elements; or where movements between high and low attached structures are anticipated.

6.10.3.2 Seismic joints are a special case in which the joints are generally quite large and are designed to limit damage to the structural frame during earthquakes.

6.10.3.3 Expansion and seismic joints are best located at the high points of contoured substrates to deflect water away from the joint. For expansion joints designed for thermal movement only, the movement is expected to be only in the horizontal plane. Seismic joints are designed to accommodate both vertical and horizontal movement. In detailing expansion joints to achieve water-tightness, the amount of movement anticipated should be carefully determined using a reasonable factor of safety. The opening size and configuration should then be related to the capability of the joint seal materials so as to accommodate the anticipated movement.

6.10.4 *Joint Design Using Cold, Liquid-Applied Elastomeric Joint Sealants*—The guidelines provided in Guide C 962 should be followed for the joint size and configuration needed to accommodate the anticipated joint movement. Joint preparation, back up material requirements, and sealant type should also conform to the requirements detailed in Guide C 962.

6.10.5 *Joint Design Using Compression Seals*—Compression seals are designed to be continuously under compression through the entire joint movement range. There are two main types of joint designs: (*1*) those which use a steel angle cap at the face and surface of the joint and (*2*) those which use a curve or bevel in the concrete at the top edge of the joint face. The use of a beveled or curved face on the concrete is not recommended because of the difficulty of maintaining a uniform coating of the liquid-applied membrane on a curved or beveled surface, the possible compatibility problems between the membrane and the compression seal and its lubricant/adhesive, and water ponding in the recessed surface of the compression seal. Since there is no uniform recommended practice for the design and installation of compression seal expansion joints, the compression seal manufacturer should be contacted for joint design and installation guidelines. All compression seal materials used should meet the requirements

of Specification D 2628.

7. Precast Concrete Decks

7.1 *General*—The application of liquid-applied elastomeric membranes directly to structural precast concrete decks is not recommended. Such decks, which consist of numerous individual units or panels, can have problems in many areas. Among these problems are unsuitable surface finish of the individual panels, maintenance of uniformity in level and proper slope during installation, uniform joint spacing, and installation, coverage, and protection of the shear connectors. The individual planks are subject to differential movement (vertically and horizontally) at the panel joint, which could overstress a membrane and lead to premature failure if the membrane was carried across the joint. A poured-in-place, reinforced concrete topping slab applied over a precast concrete deck may be a suitable substrate for the liquid-applied membrane under certain conditions. It can provide the finish and slope uniformity necessary for proper drainage and geometry at control joints. Shear connectors should be used to limit movement at joints (except at expansion joints). The topping slab should be bonded to the precast units and the control joints centered over the precast unit joints.

7.2 *Topping Slab*—The topping slab should be of a minimum thickness to meet the design requirements and should conform to the requirements of 6.1-6.4.

7.2.1 *Topping Slab Reinforcement*—The topping slab should be reinforced with metal mesh or bars to reduce the possibility of crack growth and to control the differential movement (horizontal and vertical shear) in the control joints.

7.3 *Control Joints*—A control joint should be placed above each junction where two precast units are butted together. The joint should be a minimum of 13 mm (½ in.) wide and 25 mm (1 in.) deep.

7.4 *Topping Slab Treatment*—The topping slab should conform to the requirements of Section 6 in all respects of slope, drainage, finish, curing, dryness, and joint design.

8. Plywood Substrate

8.1 *General*—Plywood decks are normally used only in pedestrian applications, such as walkways and balconies where light to moderate loads are expected.

8.2 *Grade*—All plywood should be identified as conforming to PS 1 for construction and industrial plywood by the grade, trademarks of the American Plywood Association, or equivalent. For maximum smoothness, EXT Type APA, Grade A-C should be used. The “A” side should be positioned to receive the coating.

8.3 *Placement*—Select plywood thickness and attachment methods as indicated in the APA Plywood Construction Guide and other APA literature, using only nonrusting screw, spiral, or coated-nail type fasteners. An option would be to recess or counter sink fasteners ⅛ to ¼ in. and seal with a compatible sealant. Suitable edge support to prevent differential deflection between panels should be provided. Panel edges should be tongue and groove or supported on solid blocking. Space panels 3 to 5 mm (⅛ to 3⁄16 in.) at panel ends. The space directly below the plywood should be vented to the exterior and below the vented space should be a vapor barrier over occupied space or damp areas to maintain as dry a condition as possible for the plywood and its supports.

8.4 *Finish*—The finish of the plywood should be consistent with the grade according to PS 1.

8.5 *Joint Treatment*:

8.5.1 *Panel Spacing Joints*—Joints between plywood panels should be filled flush with a sealant compatible with the coating system, as recommended by the coating manufacturer. Prior to installing the sealant, the joints should be dry and swept or blown clean of dust, dirt, and debris.

8.5.2 *Expansion Joints*—Expansion joints are not necessary in plywood decks unless required because of other factors in the building construction. If such joints exist in the building structure, the membrane should be terminated on either side of the joint, but in such a manner as to provide a watertight seal at the joint interface.

9. Incidental Substrates

9.1 *General*—All incidental substrates such as metal, plastic, and coated materials should be cast-in-place or otherwise firmly anchored to prevent any horizontal shear of the membrane. Joints at edges of any substrate that is not firmly anchored should be treated as expansion joints terminating on the deck substrate.

9.2 *Patching, Leveling, and Topping Compounds*—Patching, leveling, and topping compounds are used to repair concrete decks and provide proper slope and finish to the deck. Some compounds, particularly those containing polymeric, latex, or other organic chemical materials, may have poor adhesion with the membrane. The membrane manufacturer should be consulted to determine the compatibility of these compounds with the membrane. Patching, leveling, and topping compounds, when used, must be well cured and meet the dryness tests in 6.3 and 6.9.

10. Membrane

10.1 *General*—A liquid-applied waterproofing membrane has the capability of adhering to the substrate and should be applied so as to take optimum advantage of this inherent characteristic. Without this adhesion, a waterproofing membrane with integral wearing surface could be torn loose with even the lightest traffic, leading rapidly to complete membrane failure. Water vapor that condenses at the membrane/concrete interface, or water diffusing through the membrane, can act at the interface to destroy the adhesion of the membrane to the concrete.

10.1.1 The detection of leakage in a building deck waterproofing system could be a significant problem when the waterproofing membrane is not bonded to the structural slab. Water penetrating an unbonded membrane could migrate laterally under the membrane until reaching a crack or defect in the structural slab and then leak through to the space below. Leakage through the slab, therefore, would not necessarily indicate the location of the water entry in the membrane above.

10.1.2 Systems that meet the requirements of Specification C 957 could be expected to bridge reinforced hairline cracks that develop after the undersurface is laid. The systems are not designed to bridge dynamic, unreinforced cracks that develop under the membrane.

10.2 *Surface Preparation*:

10.2.1 *Concrete Surface Preparation*—Concrete surfaces should be prepared according to the membrane manufacturer's recommendations to remove laitance and other unwanted matter. Such preparation may include either an acid etch or mechanical abrasion (such as sand blast, water blast, scarifying, or grinding) or a combination of mechanical abrasion followed by an acid etch. Note that the chloride ions that result when muratic (hydrochloric) acid is used as the acid may contribute to chloride-ion induced corrosion of the reinforcing steel. The concrete must be thoroughly rinsed and allowed to dry before starting any preparatory work.

10.2.2 *Plywood Surface Preparation*—The wood surface should be cleaned of all dirt, dust, and debris by sweeping or by an air blast. All contaminants should be removed. Washing the plywood surface with detergent and water is not recommended. The absorbed moisture can cause poor adhesion and form bubbles and blisters if the membrane is applied to a moist deck, and any detergent film remaining on the deck may cause poor adhesion of the membrane.

10.2.3 *Metal Surface Preparation*—Remove any weld slag, flux, and burrs and grind welds smooth. Clean to a bright metal finish with power wire brush in accordance with SSPC SP 2, or preferably sand blast to an SSPC SP-6 finish. Do not burnish the substrate. Coat with a primer or an anticorrosion finish followed by a primer as soon as possible. The metal should be coated before any rust bloom forms.

10.2.4 *Plastics, Paints, and Other Coatings*—Wipe the substrate with the solvent or cleaning solution specified by the membrane manufacturer until all contamination has been removed. Apply the primer according to the manufacturer's requirements.

10.2.5 *Cleaning Substrates*—All dust, dirt, and any type of contamination should be removed by air blast, vacuuming, or sweeping. Contamination from oil or similar materials should be removed from the substrate. If an air blast is used, caution should be taken to prevent oil or water from the air compressor from getting into the air line and contaminating the substrates.

10.2.6 *Primers*—When required by the membrane manufacturer, each substrate should be primed with the primer specified by the membrane manufacturer for that substrate (steel, iron, brass, aluminum, metal, wood, concrete, plastic, coating, etc.) and allowed to dry as specified.

10.3 *Application*—The membrane should be applied under dry, frost-free conditions. The frost-free condition should exist throughout the depth of the concrete slab, and not simply on the surface. Membrane manufacturers' requirements for substrate dryness are described in 6.9. Excessive moisture in the substrate (see 6.3 and 6.5), or moisture on the surface (see 6.9) (as from frost or rain), may result in a membrane that has an improper cure with excessive gas pockets being formed, has little or no adhesion to the substrate, and may give poor service. In case rain or snow interrupts the application after at least one coat of material has been applied, the membrane manufacturer's directions should be followed pertaining to any necessary treatment of the cured, already applied material before continuing the application process.

10.4 *Terminal Conditions*—Four locations where a liquid-applied membrane is normally terminated or interrupted are on walls, at drains, at penetrations, and at expansion joints. The important consideration at terminal conditions is to prevent water from penetrating the substrate or behind the membrane at its edge.

10.4.1 *Termination on Walls or Other Vertical Surfaces*—The membrane should be turned up at vertical surfaces to eliminate the possibility of ponded surface water penetrating the wall above the membrane and running down behind it into the building. The minimum safe height of such a termination is dictated by the opportunity for conditions such as ponding and drifting snow that may be presented by the building's geometry and environment. The membrane may be continued farther up the wall for aesthetic reasons. The aggregate is rarely continued up the wall. The possibility of water entering through joints or cracks in the surface of the wall behind the coated surface must be examined. Water entering behind the coated surface is held by the membrane and consequently acts to destroy the adhesive bond between the membrane and the wall. Where this possibility exists (as determined by the building's geometry and environment), waterproof the opposite surface or devise a way for the water to get out without getting under the deck coating membrane.

10.4.1.1 *Deck to Vertical Surface Dynamic Joints*—Any junction of the horizontal deck and a vertical surface that is capable of movement greater than 3.2 mm (0.125 in.) in any direction should be treated as an expansion joint, in accordance with 6.10.3. Junctions that move less than 3.2 mm (0.125 in.) should be treated in accordance with 14.6.1.

10.4.2 *Termination at Drains*—Drains should be designed with a 50-mm (2-in.) wide (minimum) flange as an integral part. The drain should be cast in the slab when the deck is placed with the top of the flange set flush with or slightly below the surface of the slab. The wide flange provides a termination point for the liquid-applied membrane without endangering the function of the membrane or the drain.

10.4.3 *Termination at Penetrations*—Penetrations or protrusions into or through the surface by such items as conduits or service pipes create critical problems and should be avoided wherever possible. Such critical locations are best treated by casting a pipe sleeve into the structural slab (see Fig. 2). Such a sleeve may be cast in the deck during the main pour, or may be boxed out and cast at a later date.

10.4.3.1 A second method involves cutting a core hole in the deck and putting a sleeve having a wide flange into the hole. It is more difficult to maintain a waterproof seal using this second

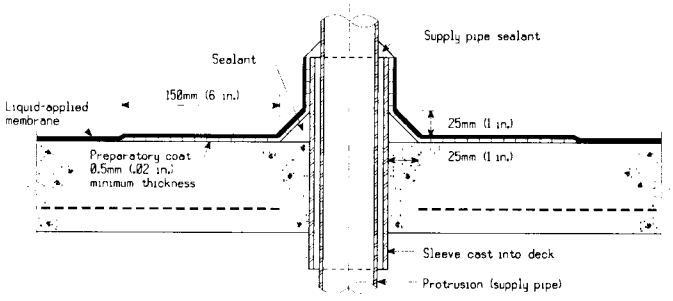


FIG. 2 Termination at Cast-in-Place Sleeve (Protrusion Installed) (see 10.4.3, 14.6.3.1, 14.6.3.2, and 14.6.3.4)

type of sleeve and is the least preferred method (see Fig. 3).

10.4.4 *Treatment at Joints*—Joints in the structural slab should be treated as follows, depending on whether they are reinforced joints, nonreinforced joints, or expansion joints:

10.4.4.1 *Treatment of Reinforced Joints or Cracks*—Fig. 4 indicates one recommended treatment of reinforced concrete joints in the structural slab. The designer should realize that the elongation capacity of this type of detail is quite limited and implicitly relies on the membrane's crack-bridging ability to withstand the strains imposed by the opening of cracks and reinforced joints. Alternatively, prevent the membrane from adhering to the substrate for a finite width centered on the joint or crack by employing a properly designed compatible bond-breaker tape.

10.4.4.2 *Treatment at Nonreinforced Joints*—Nonreinforced joints that are in reality nonmoving could be treated in the same manner as reinforced joints. However, since the joints are not held together with reinforcing steel, some movement, however slight, should be anticipated and provided for since the liquid-applied membrane has limited ability to take movement. Nonreinforced joints could open due to such factors as shrinkage, creep, and thermal contraction. Fig. 5 shows a nonreinforced butted joint that is capable of expanding 3.2 mm (⅛ in.), the minimum that should be provided for when using a sealant capable of ±25 % movement. The minimum sealant width should be correspondingly wider with a sealant having lesser movement capability. If the designer of the structural system feels that greater movement than 3.2 mm (⅛ in.) could occur in such joints, they should be treated as expansion joints.

10.4.4.3 *Treatment of Expansion Joints*—Expansion joints are designed to accommodate a predetermined amount of movement. Such movement could be due to thermal change, shrinkage, creep, deflection, or other factors and combinations of factors. Because waterproofing membranes with integral wearing surfaces generally have limited elongation capacity, they should not be continued over an expansion joint. Rather, the membrane should terminate on either side of the expansion joint. Thus, the design of the expansion joint can be made separate from the design of the waterproofing membrane except that the base coat or top coat of the membrane must be applied over any metal flashing or flanges used in the design of the expansion joint. A gutter system may be provided under the expansion joint for a secondary line of defense against leakage.

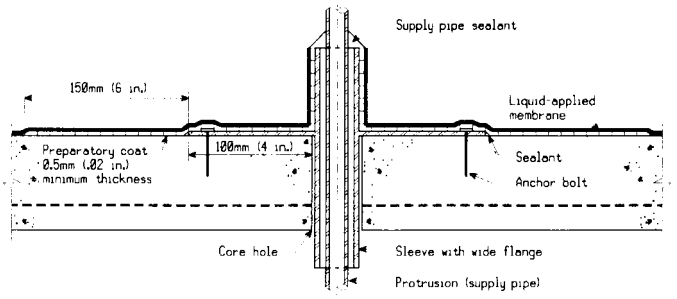


FIG. 3 Termination at a Core-Drilled Sleeve Having a Wide Flange (see 10.4.3, 14.6.3.3, and 14.6.3.4)

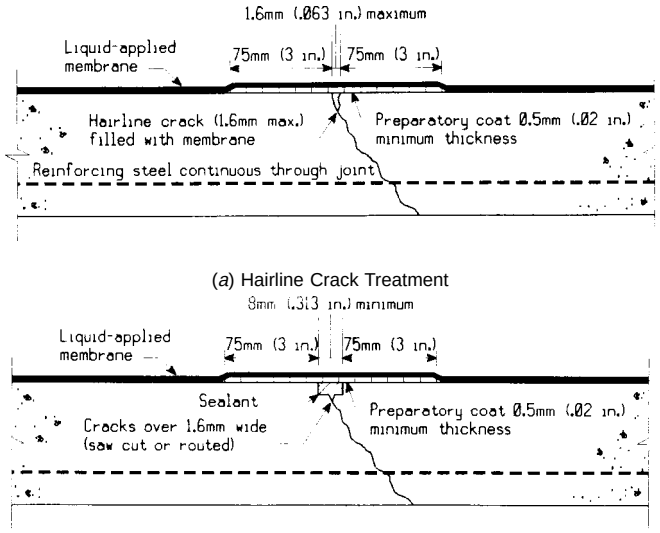


FIG. 4 Treatment of Reinforced Cracks and Joints (see 10.4.4.1, 14.5.1, and 14.5.2)

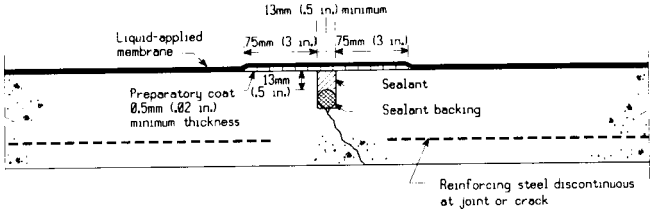


FIG. 5 Treatment of Nonreinforced Cracks and Joints (see 10.4.4.2 and 14.5.3)

11. Drainage System

11.1 *General*—Drainage should be considered as a total system with particular emphasis on the rate of flow into the drain.

11.2 *Requirements for Drainage at Membrane Level*—It is essential that water be removed from the membrane level for the following reasons:

11.2.1 To avoid building up a pressure head against the membrane and particularly against the more vulnerable splices and joints in the system.

11.2.2 To avoid freeze-thaw cycling of trapped water, which could disrupt the wearing course.

11.2.3 To minimize the deleterious effect prolonged, undrained water could have on the membrane, and particularly on the adhesion of the membrane to the substrate.

11.3 *Recommendations for Drainage of Membrane Level*:

11.3.1 Slope the substrate under the membrane a minimum of 11 mm/m (⅛ in./ft).

11.3.2 Slope the substrate under the membrane so as to drain away from expansion joints and walls.

11.3.3 Drains should have an integral flange at least 5 mm (2 in.) wide for adherence and bonding with the concrete slab and also for termination of the liquid-applied membrane, with sufficient room for an adhesive bond. The flange should be set level with or just slightly below the substrate surface.

MINIMUM GUIDE SPECIFICATIONS

12. Certification, Marking, Shipping, Preservation, and Safety

12.1 *Certification*:

12.1.1 When requested, manufacturer's laboratory certification attesting that the materials conform to Specification C 957 requirements shall be made available to the purchaser before delivery of materials to the project site. Complete documentation, including a referenced method, the material specification limits, and typical test results, shall be made available on request. Such certification shall be current with results obtained from tests performed no earlier than three years from the award of the contract. A separate certification shall be attached indicating quality control results on the shipped material compared to typical values or the range of values of quality control results, and identified by batch or lot numbers.

12.1.2 Independent laboratory certification shall contain complete documentation, including a referenced test method, the material specification limits, and test results. Such certification shall be made available before delivery of materials to the project site, attesting that the materials conform to the specification requirements. Such certifications shall be current with results obtained from tests performed no earlier than three years from the award of contract. If a purchaser desires independent certification on any lot of material delivered or a current certification of the material, this cost shall be negotiated between the manufacturer and the party requesting certification.

12.2 *Marking and Shipping*—The liquid applied membrane materials shall be delivered undamaged to the project site in original, sealed containers, clearly identified as to contents, the manufacturer's name, shelf life, and precautions on flammability and toxicity. The manufacturer's written instructions for application procedures shall be available. Dented pails are acceptable as long as the seal is unbroken and the membrane material within is not damaged.

12.3 *Handling and Storage*—Proper handling, storage, and protection of waterproofing materials are essential. Since some waterproofing materials are susceptible to moisture damage and absorption, optimum storage and protection is in a watertight enclosure. When job conditions make this unrealistic, materials shall, as a minimum, be stored off the ground or deck on pallets and covered above and on all sides and ends with breathable-type canvas tarpaulins. Plastic sheets shall not be used as they permit condensation build-up under them. Materials shall be stored and used in accordance with the manufacturer's specifications.

12.4 *Safety*—Where hazardous materials are involved, rigid adherence to the special precautions of the manufacturer, as modified by local, state, and federal authorities, shall be followed.

13. Materials

13.1 *Drains*—See analysis in 10.4.2.

13.2 *Pipe Sleeves*—See analysis in 10.4.3.

13.3 *Membrane*—The liquid-applied membrane shall be in conformance with Specification C 957.

13.4 *Membrane Primer*—Primers, when required or recommended by the manufacturer of the liquid-applied membrane for optimum performance, shall be as recommended and supplied by the manufacturer of the liquid-applied membrane.

13.5 *Aggregate*—Aggregate shall be clean and dry, and sieve graded. The sieve size range, type, hardness, and quantity used shall be in accordance with the manufacturer's requirements for the particular application.

13.6 *Top (Color) Coat*—The top coat shall be compatible with the base coat and aggregate and as recommended or supplied by the manufacturer of the liquid-applied base coat. The top coat color shall contrast in color or hue with the base coat or aggregate, or both, to assure application completeness and in-service residual.

13.7 *Flashing Compound*—Flashing compounds, when required or recommended by the manufacturer of the liquid-applied membrane for optimum performance, shall be as recommended or supplied by the manufacturer of the liquid-applied membrane.

13.8 *Sealant*—Sealant for use in nonreinforced butted joints in a structural concrete slab shall be an elastomeric sealant compatible with the liquid membrane as recommended or supplied by the manufacturer of the liquid-applied membrane, and conforming to Specification C 920. The compatibility between the liquid-applied membrane and the sealant shall be approved by the manufacturer of the liquid-applied membrane. The sealant shall be cured as recommended by the membrane manufacturer before application of any coat of the membrane.

13.9 *Sealant Primer*—A primer, when required or recommended by the manufacturer of the sealant for optimum adhesion of the sealant to the joint interface, shall be as recommended by or supplied by sealant manufacturer and shall be compatible with the liquid-applied membrane. The compatibility of the sealant primer with the liquid-applied membrane shall be determined by the manufacturer of the liquid-applied membrane.

13.10 *Sealant Backing, Type A*—Sealant backing shall be a cellular rod, compatible with the sealant, having a diameter 25 % larger than the joint width or, if greater, shall be in accordance with the manufacturer's recommendations.

13.11 *Sealant Backing, Type B*—Sealant backing shall be a closed-cell polyethylene strip of the depth indicated and 25 % wider than the joint at the time of installation.

13.12 *Sealant Backing, Type C*—Sealant backing shall be a premolded strip in conformance with Specification D 1752.

13.13 *Bond Breaker*—Bond breakers shall be compatible types as recommended by the manufacturer of the liquid applied membrane. The bond breaker shall not interfere with the curing process or other performance properties of the liquid applied membrane.

13.14 *Compression Seals*—Compression seals shall conform to the most recent revision of Specification D 2628. The compatibility between the liquid-applied membrane and the

compression sealant and its lubricant/adhesive shall be determined by the membrane manufacturer.

14. Substrate Preparation

14.1 *General*—In order for the substrate to provide for the greatest adhesion by the membrane, prepare the surface of the substrate as required for the particular material. The surface preparation of plywood substrates is described in 10.2.2, and for other incidental substrates in 10.2.3 and 10.2.4. The finish for concrete substrates, either cast-in-place deck or a topping slab over a precast deck, is described in 6.7.

14.1.1 *Concrete Surface Preparation*—Prepare the concrete surface according to the membrane manufacturer's recommendations as described in 10.2.1. Lack of vigorous foaming during an acid etch is an indication that a concrete curing agent, which could interfere with adhesion of the membrane to the concrete, may be present on the surface. Use mechanical abrasion or chemical removal to remove this surface coat until vigorous foaming occurs with acid. Thoroughly rinse after the acid etch. Continue mechanical abrasion or chemical removal until the concrete foams vigorously when tested with acid on several places throughout the deck, indicating the absence of an interfering surface coating. Remove all dust and other residue due to mechanical abrasion from the surface with an air blast or by vacuuming.

14.2 *Substrates*—Concrete surfaces shall be free of laitance, and all surfaces shall be free of loose aggregate, sharp projections, grease, oil, dirt, curing compounds, paint or other coatings (primers excepted), or other contaminants that could affect the complete bonding of the liquid-applied membrane to the concrete surface. Do not proceed with the application until all protrusions and projections through the structural slab are in place, or until placing sleeves through the slab, and making provision to secure their watertightness. See 14.6.3. All substrates shall be visibly dry and pass any additional dryness tests recommended by the liquid-applied membrane manufacturer prior to application.

14.3 *Examination*—Inspect the substrate, including all penetrations and terminal conditions, to determine the suitability for application of the liquid-applied membrane waterproofing. Do not proceed with the installation without making corrections of any adverse conditions. Notify all parties concerned of any unacceptable conditions for resolution prior to proceeding. Any patching compounds used to repair unacceptable concrete surface conditions shall meet the requirements of 9.2.

14.4 *Environmental Conditions*—Do not begin waterproofing work at ambient temperatures below 5°C (40°F) or when there is any threat of inclement weather (rain or snow) without taking precautions to eliminate frost from the substrate or to prevent its formation during the application. See analysis in 10.3. Do not apply sealant, primers, or membrane materials until adequate ventilation is available to prevent any build-up of solvent or other vapors.

14.5 *Preparation of Cracks and Joints*:

14.5.1 *Narrow Reinforced Cracks or Joints*—Treat all reinforced cracks or joints which are not more than 1.6 mm (1⁄16 in.) wide with a preparatory coat as follows (see Fig. 2). Prime the reinforced joints area as required by the membrane manufacturer. Fill the joint with the waterproofing membrane and extend the waterproofing membrane 75 mm (3 in.) to each side of the joint at a minimum thickness of 0.5 mm (0.02 in.) or greater, as specified by the membrane manufacturer.

14.5.2 *Wide Reinforced Cracks and Joints*—Saw cut or route all reinforced cracks or joints which are greater than 1.6 mm (1⁄16 in.). Clean the cracks and joints and insert a bond-breaker tape or sealant. Fill the joint flush with a compatible sealant. After the sealant has cured, prime the joint area as recommended by the membrane manufacturer and then coat the area with the membrane at a minimum thickness of 0.5 mm (0.02 in.) or greater, as specified by the membrane manufacturer, extending 75 mm (3 in.) to each side with the joint (see Fig. 2).

14.5.3 *Nonreinforced Joints and All Control Joints*—Saw cut or route the nonreinforced joints to a width of 13 to 19 mm (0.5 to 0.75 in.) and a minimum depth of 13 mm (0.5 in.), and clean them of all dirt, dust, and loose concrete. Insert sealant backing or bond-breaker tape to control the sealant depth as required by the sealant manufacturer and the joint primed, if required. Fill the joint flush with a compatible sealant. After the sealant has cured, prime the joint area and then coat with the waterproofing membrane at a minimum thickness of 0.5 mm (0.02 in.) or greater, as specified by the membrane manufacturer, extended 75 mm (3 in.) to each side of the joint (see Fig. 5). Apply a bond-breaker tape between the sealant and the preparatory coat of the membrane if recommended by the manufacturer.

14.5.4 *Plywood Panel Joints*—If recommended by the manufacturer, install sealant backing or bond-breaker tape and prime the joint. Fill the joint flush with a compatible sealant and allow to cure. Coat the sealant with the membrane at a minimum thickness of 0.5 mm (0.02 in.) or greater, as specified by the membrane manufacturer, extending 75 mm (3 in.) to each side of the joint (see Fig. 6).

14.5.5 *Control Joint in Topping Slab*—As analyzed in 7.1 and 7.3, center a control joint over each junction of the precast units. Route the joint to a minimum width of 13 mm (0.5 in.) and a depth of 25 mm (1 in.). Clean the joint and insert a sealant backing to control the depth of the sealant. Prime the joint as required, and fill with a compatible sealant, which shall be allowed to cure. Coat the joint with the membrane at a minimum thickness of 0.5 mm (0.02 in.) or greater, as specified by the membrane manufacturer, extending 75 mm (3 in.) to each side of the joint (see Fig. 7).

14.5.6 *Expansion Joints*—A preparatory coat of the membrane shall extend a minimum of 150 mm (6 in.) on the deck from the expansion joint at a minimum thickness of 0.5 mm (0.2 in.) or greater, as specified by the membrane manufacturer. As analyzed in 10.4.4.3, the membrane shall terminate at the joint. See Fig. 8 for a typical expansion joint configuration.

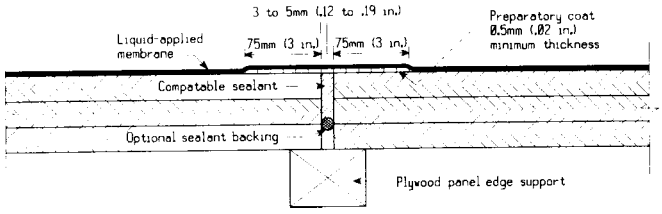


FIG. 6 Treatment of Plywood Panel Joints (see 8.5.1 and 14.5.4)

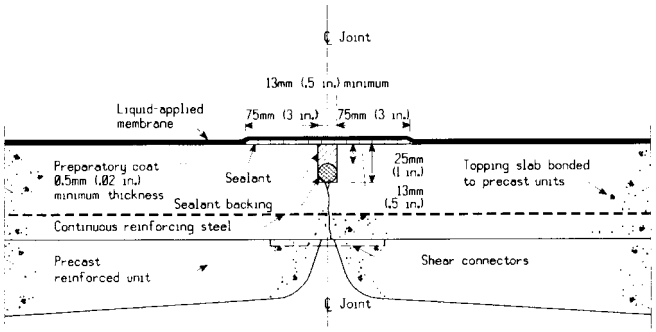


FIG. 7 Treatment of Control Joints in a Topping Slab (see 7.1, 7.2, 7.3, and 14.5.5)

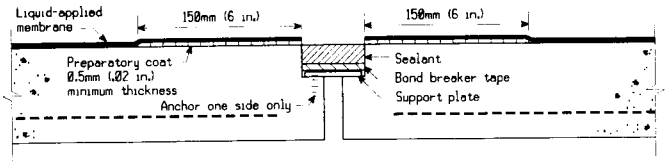
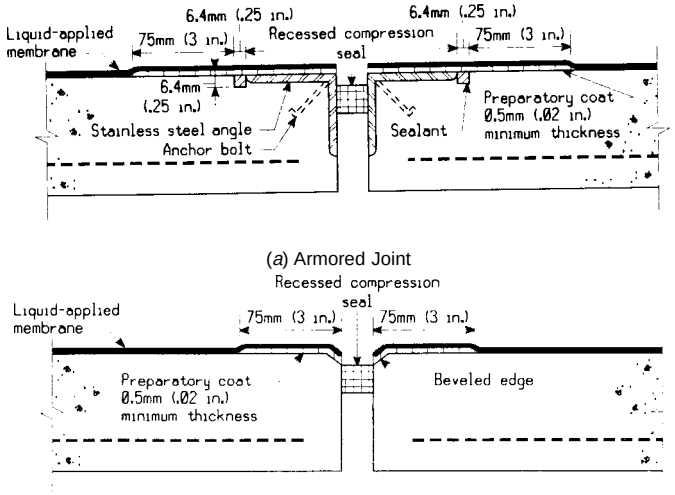


FIG. 8 Typical Expansion Joint (see 10.4.4.3 and 14.5.6)

14.5.7 *Expansion Joints Using Compression Seals*—Compression seal joints have either an armored (steel angle) edge or a beveled edge.

14.5.7.1 *Armored (Steel Angle) Edge*—Cast the steel angle into the concrete. Cut or route a 6.4 by 6.4-mm (0.25 by 0.25-in.) joint at the edge of the angle. Clean, prime and fill the joint flush with a compatible sealant. After the sealant has cured, prime the steel and concrete substrates as required by the membrane manufacturer. Apply a preparatory coat of the membrane at a minimum thickness of 0.5 mm (0.2 in.) or greater, as specified by the membrane manufacturer, extending a minimum of 75 mm (3 in.) onto the deck and terminating on the steel angle (see Fig. 9(*a*)).

14.5.7.2 *Beveled Edge*—Install the compression seal and allow any lubricant/adhesive to cure before installing the membrane. Prime the joint area as required by the membrane manufacturer. Apply a preparation coat of a non-sag grade of the membrane at a minimum thickness of 0.5 mm (0.02 in.) or greater, as specified by the membrane manufacturer, extending onto the deck a minimum of 75 mm (3 in.) to each side of the joint, and carried down to contact the edge of the compression seal. The additional coats of the membrane applied to this type of joint shall also be a non-sag grade. The membrane shall terminate at the compression seal and shall not extend across the seal (see Fig. 9(*b*)). As discussed in 6.10.5, this is not a recommended joint design.



(*a*) Armored Joint

(*b*) Beveled Concrete Edge

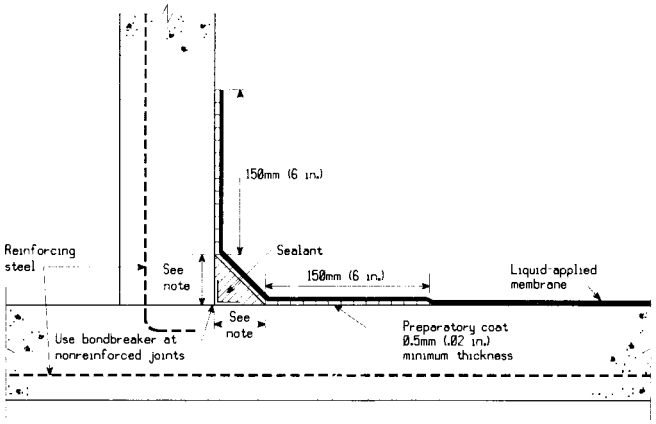
FIG. 9 Typical Compression Seal Joint (see 10.4.4.3 and 14.5.7)

14.6 *Preparation at Terminations*:

14.6.1 *Preparation at Walls or Other Vertical Surfaces*—Prepare all vertical surfaces which do not need to be treated as expansion joints, as analyzed in 10.4.1.1, as follows:

14.6.1.1 On any concrete walls which are poured onto the deck without reinforcement, cement block walls, brick walls, plywood, or metal walls, vertical-to-horizontal or any other junctions which have a potential movement between 1.6 mm (0.063 in.) and 3.2 mm (0.125 in.), use a bond breaker tape or sealant backing, extending 13 mm (0.5 in.) to each side of the junction, as shown in Fig. 10, to cover the junction. Then build a minimum 25 by 25-mm (1 by 1-in.) cant in a triangular shape over the bond breaker using an approved compatible sealant capable of meeting Specification C 920, Class 25, Grade NS. Allow the sealant to cure in accordance with the manufacturer's instructions. Prime the horizontal and vertical substrates as required by the manufacturer. Apply a preparatory coat of the membrane over the sealant at a minimum thickness of 0.5 mm (0.02 in.) or greater, as specified by the membrane manufacturer, extending 150 mm (6 in.) out on the horizontal surface and a minimum of 150 mm (6 in.) up the vertical wall (see Fig. 8). The preparatory coat and the full membrane shall extend up to the safe height of the wall, as analyzed in 10.4.1.

14.6.1.2 Any concrete walls or columns which are tied into the deck with reinforcement, curbs which are cast in with the main deck pour, vertical metal surface well anchored to the deck, vertical wood surface well fastened to a plywood deck or any other vertical-to-horizontal junction which will not move



NOTE 1—Dimension shall be 25 mm (1 in.) for a nonreinforced butt joint (movement between 1.6 mm (0.063 in.) and 3.2 mm (0.125 in.)) or 13 mm (0.5 in.) for a reinforced joint as shown (movement less than 1.6 mm (0.063 in.)).

FIG. 10 Termination at a Vertical Surface (see 10.4.1.1 and 14.6.1)

more than 1.6 mm (0.063 in.) in any direction shall have a minimum 12 by 12-mm (0.5 by 0.5-in.) cant built of an approved compatible sealant. After the sealant has cured, apply the preparatory coat as in 14.6.1.1.

14.6.2 *Preparation at Drains*—Clean and prime the metal surface of the flange as analyzed in 10.2.3 and 10.2.6. Fill any shrinkage cracks or gaps between the slab and the drain with the waterproofing membrane or a compatible sealant, in accordance with the manufacturer's instructions, as described in 14.5. Treat the flange with a preparatory coat of the membrane at a minimum thickness of 0.50 mm (0.02 in.) or greater, as specified by the membrane manufacturer, extending 150 mm (6 in.) out onto the surface of the deck (see Fig. 11). Use a second method of termination when it is necessary to use a drain which does not have the recommended wide flange on the top. Place an unsaturated, inert sealant backing about 19 mm (0.75 in.) wide and 12 mm (0.5 in.) high around the top outside surface of the drain before pouring the deck. The top of the drain shall be flush with or slightly below the surface of the deck. Remove the sealant backing and clean the exposed concrete and metal surfaces by sand blasting. Clean the metal to a bright finish, and remove all laitance from the concrete. Prime the metal and concrete surfaces as recommended by the manufacturer, and use a compatible sealant to fill the gap and then tool the sealant to provide a surface level with the slab. Allow curing time and then clean and prime the sealant in accordance with the manufacturer's instructions before applying the membrane. Apply the preparatory coat of the membrane at a minimum thickness of 0.5 mm (0.02 in.) or greater, as specified by the membrane manufacturer, carrying down into the drain and extending it 75 mm (3 in.) onto the deck (see Fig. 12).

14.6.3 *Preparation at Penetrations*—As analyzed in 10.4.3, all penetrations shall go through a sleeve. Treatment of the three types of sleeves is as follows:

14.6.3.1 *Treatment of Cast-in-Place Sleeve*—Clean and prime the metal surface as described in 10.2.3 and 10.2.6. Build a minimum 13 by 13-mm (0.5 by 0.5-in.) cant in a triangular shape using a sealant which meets Specification C 920, Grade NS, Type 25. Allow the sealant to cure in accordance with the manufacturer's instructions. Give the sleeve a preparatory coat of the membrane at a minimum thickness of 0.5 mm (0.02 in.) or greater, as specified by the membrane manufacturer, extending 150 mm (6 in.) onto the horizontal surface and 75 mm (3 in.) above the cant on the vertical surface or above the expected water line, whichever is higher (see Fig. 2).

14.6.3.2 *Treatment of Case-in-a-Box Sleeve*—Treat the sleeve projection as in 14.6.3.1. Treat the concrete joint as a construction joint, as described in 14.5.1 (see Fig. 11).

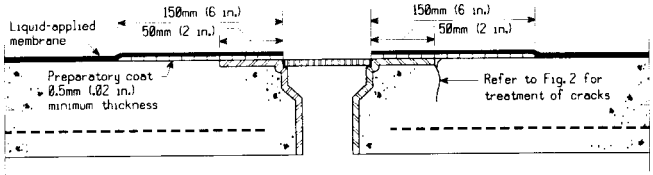


FIG. 11 Termination at Drain with a Wide Flange (see 10.4.2 and 14.6.2)

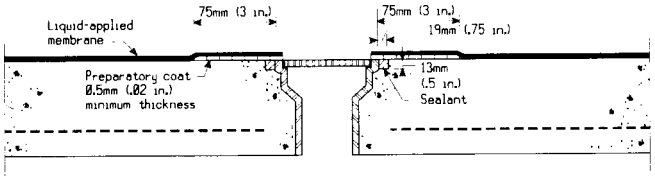


FIG. 12 Termination at Drain with a Narrow Flange (see 10.4.2 and 14.6.2)

14.6.3.3 *Treatment of Core Drilled Sleeve*—See analysis in 10.4.3. Clean and prime the metal surface as described in 10.2.3 and 10.2.6. Apply a bead of an approved compatible sealant capable of meeting Specification C 920, Grade NS, Type 25, at the edge of the sleeve's flange, extending 25 mm (1 in.) out onto the concrete surface and allow to cure. Apply a preparatory coat of the membrane at a minimum thickness of 0.5 mm (0.02 in.) or greater, as specified by the membrane manufacturer, to extend 150 mm (6 in.) on the horizontal surface; completely cover the horizontal surface of the flange, including the heads of the anchor bolts; and extend 75 mm (3 in.) up the vertical surface of the sleeve. The membrane shall terminate above the expected water line on the vertical surface of the sleeve (see Fig. 3).

14.6.3.4 *Sealing the Sleeve*—When a conduit or other protrusion is installed in the sleeve, a gap will exist between that protrusion and the sleeve. Seal this gap when the protrusion is installed.

14.7 *Curing*—Allow all preparatory coats to cure a minimum of 24 h. Clean and prime the preparatory coats as required by the membrane manufacturer before beginning the application of the full membrane. The full membrane shall completely overlap the preparatory coats.

15. Membrane Installation

15.1 *Surface Preparation*—Complete all preparation of surfaces, cracks or joints, and termination points, including all required priming, before applying the monolithic liquid-applied membrane. If required, prime not more than 24 h before beginning application of the membrane.

15.2 *Primer*—Prime the overall substrate if required by the membrane manufacturer. Apply the primer and allow it to cure in strict accordance with the membrane manufacturer's printed instructions.

15.3 *Membrane Preparation*—Do not open the membrane containers until immediately before use. Inspect the surface of the liquid for possible skin formation. Remove any skin or other gelled particles. Mix the multi-part systems according to the manufacturer's instructions, taking care to obtain a homogeneous blend free of entrapped air bubbles.

15.4 *Membrane Application*—Apply the membrane directly to the deck by a spray gun or by spreading with a notched squeegee or roller. Follow the instructions of the manufacturer in all respects with regard to method of application; rate of application (thickness of the membrane layer); number of coats applied and thickness of each coat; cure intervals between successive applications; method, type, and timing of application of aggregate (when used); and cure time necessary before usage of the deck. Avoid entrapping air bubbles during membrane application. Check wet film thickness every 9 m^2

(100 ft^2) by the applicator, using a wet-film gage. Maintain the wet film thickness greater than the minimum wet film thickness specified by the membrane manufacturer. Where possible, mark off the surface to be coated in even units to facilitate proper coverage. When the membrane is applied by spray, the concentration of vapor shall not exceed the manufacturer's requirement.

NOTE 1—**Precaution:** In addition to other precautions, the applicators shall wear masks when necessary to avoid inhaling and ingesting the materials. Do not allow the membrane materials to get onto or remain on the skin. Assure adequate ventilation before applying the membrane materials.

15.5 *Membrane Termination and Restart*—When it is necessary to stop work for more than a short period of time (1 to 2 h), terminate the membrane in a straight line. When the membrane application is ready to be resumed, clean the previously applied membrane (and prime if required by the manufacturer) 150 mm (6 in.) back from the edge of the membrane. The freshly applied membrane shall overlap the previous membrane 150 mm (6 in.) and then shall continue out onto the deck.

16. Membrane Repair, Rehabilitation, and Replacement

16.1 *Membrane Repair*:

16.1.1 *Cleaning*:

16.1.1.1 Use a power broom or light wire brushing over the affected area to remove all loose material and also material not well adhered to the substrate (the deck surface or a lower coat of membrane).

16.1.1.2 Clean the area of all loose material with a broom, vacuum, or air blast.

16.1.1.3 Clean the existing membrane with a solvent or other cleaner, as recommended by the membrane manufacturer, to provide for a minimum of 150-mm (6-in.) overlap onto the existing good membrane.

16.1.2 *Priming*:

16.1.2.1 *Deck*—Prime any exposed deck surface, if required by the manufacturer, using the primer and application procedure recommended by the manufacturer.

16.1.2.2 *Membrane*—Prime the membrane surface under the area to be repaired (that is, the base coat), if required by the manufacturer, using the primer and application procedure recommended by the manufacturer. The primer should extend a minimum of 150 mm (6 in.) onto the existing good membrane.

16.1.3 *Membrane Application*—Apply the membrane in the number of coats and in the manner specified by the membrane manufacturer. The membrane shall extend onto the existing good membrane a minimum of 150 mm (6 in.).

16.2 *Rehabilitation of Wearing Course*:

16.2.1 *Cleaning*—Clean the existing membrane, as outlined in 16.1.1, in order to provide a prepared surface for repairs and rehabilitation.

16.2.2 *Repair of Damaged Areas*—Repair any areas where the membrane has been damaged or worn below the surface coating, as detailed in 16.3.

16.2.3 *Final Surface Coating*—Prior to actual coating, prime the existing membrane and repair areas, if required and as recommended by the membrane manufacturer. When the primer(s) has dried, apply the final wearing course as recommended by the membrane manufacturer. Broadcast aggregate into the wet membrane and cross-roll. Lock the aggregate into the membrane with an additional coat of the same material or another material as recommended by the membrane manufacturer. Prior to performing this application, sweep or vacuum all loose aggregate from the deck. Then install a top coat and permit it to cure as recommended by the membrane manufacturer before exposing the membrane to traffic.

16.3 *Total Membrane Replacement*:

16.3.1 *Cleaning*:

16.3.1.1 Remove all of the old membrane from the deck using mechanical abrasion or chemical removal methods as recommended by the membrane manufacturer. Continue cleaning until all of the old membrane has been removed and a clean deck surface is available, as specified in 14.1.

16.3.1.2 Remove all loose material from the deck by sweeping, washing or, preferably, by vacuum. Allow all wet areas to thoroughly dry, as analyzed in 6.9.

16.3.2 *Preparatory Work*—Inspect and redo all penetrations and termination areas, as required, using the procedures specified in Section 14.

16.3.3 *Primer*—Prime the clean, dry deck, if required by the membrane manufacturer, using the primer and procedures as recommended by the membrane manufacturer.

16.3.4 *Membrane Application*—Apply the membrane as described in Section 15, and as recommended by the membrane manufacturer.

17. Keywords

17.1 design; installation; membrane; waterproofing