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Standard Guide for Use of High Solids Content, Cold Liquid-Applied Elastomeric Waterproofing Membrane with an Integral Wearing Surface¹

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 committee having jurisdiction for this guide is not aware of any similar ISO standard.

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

1.5 *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:*²

C 33 Specification for Concrete Aggregates

C 150 Specification for Portland Cement

C 330 Specification for Lightweight Aggregates for Structural Concrete

C 332 Specification for Lightweight Aggregates for Insulating Concrete

C 717 Terminology of Building Seals and Sealants

C 755 Practice for Selection of Water Vapor Retarders for Thermal Insulation

C 920 Specification for Elastomeric Joint Sealants

C 957 Specification for High-Solids Content, Cold Liquid-Applied Elastomeric Waterproofing Membrane With Integral Wearing Surface

C 962 Guide for Use of Elastomeric Joint Sealants³

C 1193 Guide for Use of Joint Sealants

D 653 Terminology Relating to Soil, Rock, and Contained Fluids

D 1752 Specification for Preformed Sponge Rubber Cork and Recycled PVC Expansion Joint Fillers for Concrete Paving and Structural Construction

D 2628 Specification for Preformed Polychloroprene Elastomeric Joint Seals for Concrete Pavements

2.2 *U.S. Department of Commerce Standard:*
Product Standard PS 1-74 Construction and Industrial Plywood⁴

2.3 *American Concrete Institute (ACI) Standard:*
301-84 (1985) Specification for Structural Concrete for Buildings⁵

2.4 *Steel Structures Painting Council (SSPC) Standards:*
Steel Structures Painting Manual, Systems and Specifications:

Specification SSPC SP-2 Wire Brush Cleaning⁶

Specification SSPC SP-6 Commercial Blast Cleaning⁶

2.5 *American Plywood Association (APA) Standard:*
APA Plywood Construction Guide⁷

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*

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² For referenced ASTM standards, visit the ASTM website, www.astm.org, or contact ASTM Customer Service at service@astm.org. For *Annual Book of ASTM Standards* volume information, refer to the standard's Document Summary page on the ASTM website.

³ Withdrawn.

⁴ Available from National Institute of Standards and Technology, Gaithersburg, MD 20899.

⁵ Available from the American Concrete Institute, P.O. Box 19150, Detroit, MI 48219.

⁶ Available from Steel Structures Painting Council, 4400 Fifth Ave., Pittsburgh, PA 15213.

⁷ Available from American Plywood Assoc. (Forest Industries), P.O. Box 11700, Tacoma, WA 98411.

joint; creep; dry film thickness; elastomer; expansion joint; 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 multi-component. 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

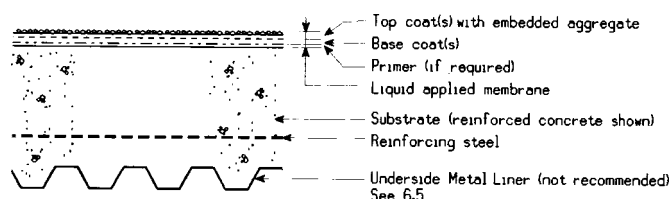


FIG. 1 Basic Components of Cold-Applied Elastomeric Waterproofing Membrane with Integral Wearing Course (see 5.2 and 5.4)

withstand the conditions of use. The actual thickness of each 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/m³ (110 lb/ft³). 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 overlays; 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 (1/8 in/ft) should be maintained. Slope is best achieved with a monolithic concrete substrate.

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 hair-line 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 instructions.