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An American National Standard

Standard Guide for Specification, Purchase, Installation and Maintenance of Poured-In-Place Playground Surfacing[1]

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1. Scope

1.1 This guide covers information with regard to the design, manufacture, installation, and maintenance of poured-in-place playground surfaces.

NOTE 1—This document is a guide and not intended to be used as a specification; it should be used for educational purposes.

1.2 This guide outlines the issues of compliance with existing standards, durability, and functional longevity.

1.3 This guide reviews issues such as edge treatment, abutting surfaces, and combinations with other surfaces designed for circulation or protective surfaces.

1.4 This guide presents maintenance considerations and general procedures that should be followed by the owner/operator.

1.5 This guide outlines aging considerations such as loss of impact absorption, cracking, shrinkage, heaving, and how to prevent, accommodate, or rectify those issues.

1.6 This guide presents warranty considerations.

1.7 This guide does not imply that an injury cannot be incurred when the surface system is compliant with the standards referred to in this guide.

1.8 The values stated in inch-pound units are to be regarded as standard. The values given in parentheses are mathematical conversions to SI units that are provided for information only and are not considered standard.

1.9 *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.*

1.10 *This international standard was developed in accordance with internationally recognized principles on standardization established in the Decision on Principles for the Development of International Standards, Guides and Recommendations issued by the World Trade Organization Technical Barriers to Trade (TBT) Committee.*

2. Referenced Documents

2.1 *ASTM Standards:*[2]

F1292 Specification for Impact Attenuation of Surfacing Materials Within the Use Zone of Playground Equipment

F1951 Specification for Determination of Accessibility of Surface Systems Under and Around Playground Equipment

2.2 *CSA Standard:*[3]

CSA Z614 Children's Playspaces and Equipment

3. Terminology

3.1 *Definitions:*

3.1.1 *aliphatic prepolymer*—prepolymer which does not contain any 1,3,5-cyclohexatrien group.

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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] Available from Canadian Standards Association (CSA), 5060 Spectrum Way, Mississauga, ON L4W 5N6, Canada, http://www.csa.ca.

3.1.1.1 *Discussion—*

Generally highly color stable when exposed to UV radiation, no yellowing.

3.1.2 *ambient grinding*—process that takes raw rubber products and processes it to rubber crumb, chips, buffings, and so forth that is at the temperature generated by the grinding equipment or in the location of production.

3.1.3 *aromatic prepolymer*—hydrocarbons that are made from only hydrogen and carbon and contain a prepolymer which contains one or more 1,3,5-cyclohexatriene group.

3.1.3.1 *Discussion—*

Aromatic prepolymer are generally susceptible to change when exposed to UV and moisture. These changes can be seen as a yellowish shading or "ambering" of the top surface, especially when encapsulating rubber crumb that is grey, light blue, blue, eggshell, teal, and so forth.

3.1.4 *asphalt, adjacent*—bituminous bound material that is used as a curb or walkway and comes into contact with the poured-in-place surface.

3.1.4.1 *Discussion—*

The materials and compaction shall conform to local engineering practices and have a mechanical compaction of no less than 98 % standard proctor density. The edge of the asphalt at the junction with the poured-in-place surface shall be vertical to 30° from horizontal. Consideration should be given to the use of an appropriate primer as recommended by the manufacturer to ensure adhesion of the poured-in-place surface to the asphalt.

3.1.5 *asphalt, base*—hard, bituminous bound surface that is under the poured-in-place surface.

3.1.5.1 *Discussion—*

New asphalt should cure at least 14 days, have no residual surface oils, and be pressure washed or have at least two thorough rainfalls prior to receiving poured-in-place surface. When the surface is flooded with as much as 0.2 in. (5.1 mm) of water, there should be no evidence (rainbow effect) of oils on the surface of the water. A properly prepared asphalt base will be able to effectively remove any water which penetrates the poured-in-place surface. This may be accomplished by sloping the asphalt, installing drainage, or using porous asphalt.

3.1.6 *concrete, base*—concrete surface that is under the poured-in-place surface.

3.1.6.1 *Discussion—*

The concrete base should be 4 in. (100 mm) minimum thickness. All new concrete slabs should cure for a minimum of seven days prior to receiving poured-in-place surface. Concrete base should have a medium broom finish. A properly prepared concrete base will be able to effectively remove any water which penetrates the poured-in-place surface. This may be accomplished by sloping the concrete, installing drainage, or using a porous concrete.

3.1.7 *concrete, adjacent*—concrete material that is used as a curb or walkway and comes into contact with the poured-in-place surface

3.1.7.1 *Discussion—*

The materials and compaction shall conform to local engineering practices and have a moisture content less than 5 % at the time the poured-in-place surface is installed. The edge of the concrete at the junction with the poured-in-place surface shall be vertical. Consideration should be given to the use of an appropriate primer as recommended by the manufacturer to ensure adhesion of the poured-in-place surface to the concrete. Other strategies to avoid sinking of the final poured-in-place surface would be to provide a "key" or "step" in the vertical face of the concrete to support the poured-in-place surface.

3.1.8 *cryogenic grinding*—process that takes a raw rubber product and processes it to rubber crumb, chips, and so forth, a process that freezes the raw product and the frozen product is ground to the specification.

3.1.9 *gravel, base* —mixture of crushed stone, sand, or both that is compacted to not less than 95 % standard proctor density.

3.1.9.1 *Discussion—*

A geotextile may be required between the granular base and poured-in-place surface to ensure that the particles of the granular base do not contaminate the poured-in-place surface. If fine particles from the base migrate into the poured-in-place system the void content of the system is reduced and the ability to attenuate force is reduced.

3.1.10 *drainage, sub-surface*—provision of a method of removing water below the poured-in-place surface.

3.1.10.1 *Discussion*—

This can be achieved by sloping the sub-base material where it has a high clay content, using drainage channels or pipes, installing a granular drainage layer for percolation.

3.1.11 *drainage, surface*—sloping of the surface to allow water to travel across the surface to a drain.

3.1.11.1 *Discussion*—

The porosity of the poured-in-place surface allows water to pass through more quickly than across it unless it is fully saturated.

3.1.12 *EPDM rubber product*—product comprised of organic and inorganic materials with a minimum of 20 % and a maximum of 26 % of ethylene propylene-diene-saturated polymethylene main chain along with other organic and inorganic components. The rubber can be either peroxide or sulphur cured.

3.1.13 *functional longevity*—ability of the poured in place surface to continue to comply with relevant ASTM standards and not require replacement.

3.1.13.1 *Discussion*—

There are circumstances where the poured-in-place surface is physically in place however because of failures with regard to the stated performance criteria, the surface needs to be replaced. The functional longevity can be stated in years or by comparison to the functional life of the play structure as stated in writing by the play structure manufacturer.

3.1.14 *gravel, drainage layer*—open course of granular material that is installed as a layer or in channels to promote removal of water from a location.

3.1.14.1 *Discussion*—

The layer should have a slope that promotes the removal of water.

3.1.15 *humidity/moisture effects*—changes in the poured-in-place system caused by fluctuations in absolute humidity or exposure to moisture during the storage of materials, installation, and cure.

3.1.15.1 *Discussion*—

Polyurethane binders are reactive to moisture in varying degrees, depending upon formulation. All one-component polyurethane binders will require some degree of moisture to affect a cure of the product. Dramatic changes in moisture or absolute humidity can cause variable finishes in the surface if they are not accounted for. During installation, some poured-in-place surfaces require dry conditions, while others can be installed during a light rain and others can have water applied directly to the surface. Exposure to water may cause the binder to foam and which may reduce the effectiveness of the bond. Moisture in the rubber that is mixed with the binder may also have an effect on the outcome of the project if not accounted for. One strategy to eliminate this problem is to have the rubber stored in a dry place and if this is not possible, the rubber should be covered with tarps or other methods employed to prevent moisture from entering the materials.

3.1.16 *lacquers*—polyurethane-based product that contains solvents applied as a top coat in a spray or roller application.

3.1.16.1 *Discussion*—

This product is used to provide color through the addition of a pigment, protection, or both from exposure to ultraviolet light.

3.1.17 *latex binders*—polymer binder that is water-based that has thermoplastic properties.

3.1.17.1 *Discussion*—

Generally, the flexibility performance is within a narrow range of temperature. Latex has also been associated with allergic

reactions once it has cured. There is a concern for children with exposed skin coming into contact with this binder, as well persons with disabilities who have a propensity to allergic reactions to latex.

3.1.18 *polymer binders*—synthetic binders used in the manufacture of the poured-in-place surface that coat the individual rubber chips, crumb, or buffings.

3.1.18.1 *Discussion*—

These binders are to provide flexibility to allow the rubber particles to move in relation to one another and have the strength to stop the bond from breaking at maximum elongation. These binders are man-made from petrochemicals and some of these demonstrate flexibility at a range of temperatures that children are expecting to use the playground and specifically to allow compliance with Specification F1292. Polymer binders with a glass transition temperature above –22°F (–30°C) and with high sensitivity to damage by submersion in water are to be avoided.

3.1.19 *polyurethane*—polymer binder that demonstrates flexibility and strength over a wide range of temperatures.

3.1.19.1 *Discussion*—

Polyurethane is manufactured in both one-component (moisture cured) and two-component (mixing part A and part B in a specified ratio). Binders used in poured-in-place surfaces are almost always of the one-component type. Certain polyurethane binders can be damaged through exposure to ultraviolet light and immersion in water. UV-resistant polyurethane lacquers may be applied to the surface following installation of the poured-in-place surface. These lacquers are typically two-component. Once cured, polyurethane produces no known allergic reactions.

3.1.20 *recycled black EPDM rubber*—crumb manufactured through ambient or cryogenic grinding or crushing of post industrial scrap, containing a mixture of types of rubber including EPDM rubber product and varying in size. This rubber must have a minimum of 4 % actual EPDM content.

3.1.20.1 *Discussion*—

The actual percentage of EPDM content will be significantly less than new EPDM rubber product due to the inclusion of other industrial scrap rubber that is sourced in the recycling process.

3.1.21 *recycled post consumer or industrial rubber* —rubber crumb that is the result of granulating in an ambient or cryogenic process from a variety of scrap rubber produced as a part of an industrial process or at the end of an industrial or consumer good made of rubber.

3.1.21.1 *Discussion*—

This is manufactured into rubber crumb as the feedstock and is often of limited dimension. The variety of rubber can be very large in that this can include any waste rubber from a manufacturing process or post consumer use.

3.1.22 *recycled tire rubber*—rubber crumb, chips, or buffings made from post manufacturing of tires or post consumer tires.

3.1.22.1 *Discussion*—

This rubber can vary in its content as a result of the type of tire (automobile, truck, off road, and so forth) that is ground.

3.1.23 *release agents*—materials that prevent the bonding of the polyurethane to other surfaces.

3.1.23.1 *Discussion*—

These can be waxes, silicone, or petroleum jelly.

3.1.24 *rubber buffings*—strands of rubber that are product shavings of rubber feedstock, typically tires, ranging in size from 0.079 to 0.87 in. (2 to 20 mm) in length and 0.039 to 0.157 in. (1 to 4 mm) in width.

3.1.25 *rubber chips*—particles of rubber that have been produced by ambient or cryogenic grinding of rubber feedstock to a size of 0.197 to 0.59 in. (5 to 15 mm).

3.1.26 *rubber crumb*—particles of rubber that have been produced by ambient or cryogenic grinding of rubber feedstock to a size of between 0.02 and 0.197 in. (0. 5 and 5 mm).

3.1.26.1 *Discussion*—

Rubber crumb shall contain less than 2 % rubber dust, fine rubber passing a 0.85 mm screen, as this can consume binder and affect the performance and longevity of the surface. The supplier of the rubber crumb shall be able to supply a sieve curve analysis that stipulates the components and their percentages to the poured-in-place supplier.

3.1.27 *SBR rubber*—styrene butadiene rubber or a rubber compound consisting mainly of styrene butadiene rubber such as tire rubber.

3.1.27.1 *Discussion*—

This rubber is generally a major component of the tire manufacturing processes.

3.1.28 *screed*—straight-edged device that is used to provide an even thickness of material.

3.1.28.1 *Discussion*—

Screed is generally used to ensure the evenness and thickness of the lower layer of the poured-in-place system.

3.1.29 *solvents*—hydrocarbons and other chemical substances which are normally non-reactive to polyurethanes and can wash off or dilute polymer binders. Cured binders might be swollen by contact with certain solvents that will destroy the chemical structure of the binder.

3.1.29.1 *Discussion*—

Solvents are used for the cleaning of tools, equipment and other areas. These materials should be used carefully in conjunction with the polymer binder as inappropriate use can detrimentally affect the performance and longevity of the surface. They are sometimes also used to slow the reaction time of the polyurethane binder or extend the wetting action of the polyurethane.

3.1.30 *storage*—method of holding the various components utilized in the poured-in-place surface.

3.1.30.1 *Discussion*—

It is important that the materials be stored both prior to the installation and at the installation site in such a manner as to protect them from damage, especially moisture. The binders will have to be stored in a manner that is consistent with the recommendations of the manufacturer.

3.1.31 *sub-base*—material that is installed under the poured-in-place surface.

3.1.31.1 *Discussion*—

This can be concrete, asphalt, or compacted crushed granular stone. The base can be of a single plane or can be shaped to accommodate changes in thickness required to accommodate varying thickness of the installed surface. Sub-base should exhibit positive drainage.

3.1.32 *temperature effects*—changes in the poured-in-place system caused by fluctuations in temperature during the installation process.

3.1.32.1 *Discussion*—

During installation the ambient temperature should not be less than or greater than those suggested by the binder manufacturer. High or low temperatures at the time of installation can affect the viscosity of the polyurethane binder causing it to drain down into the surface prior to final cure resulting in a minimal amount of binder directly at the surface. Poured-in-place surfaces are generally stable over a wide range of temperatures after they have been installed. This can be confirmed through the examination of the laboratory test performed in Specification F1292.

3.1.33 *thermoplastic vulcanizate (TPV)*—a thermoplastic elastomeric polymer consisting of two or more polymer systems at least one of which is rubbery (that is, an elastomer) and crosslinked and at least one of which is thermoplastic, with each system having its own phase.

3.1.33.1 *Discussion*—

The TPV polymer compositions may contain fillers, reinforcing agents, plasticizers, resins, antidegradants, colorants and other beneficial constituents. TPV materials are used in some poured-in-place systems as an alternative to EPDM rubber to provide long-term color for the surface.

3.1.34 *thinners*—another common name in the poured-in-place industry for solvents. See solvents (above) for the definition.

3.1.35 *trowel*—tool used in the spreading of the poured-in-place mixture.

3.1.35.1 *Discussion*—

The trowel is traditionally the method of application of the top layer of the poured-in-place system.

3.1.36 *ultraviolet light effects*—effect of the sun on the poured-in-place surface during installation and once the surface is in use.

3.1.36.1 *Discussion*—

Changes in direct sunlight during installation can result in variable finishes to the poured-in-place surface. Exposure to ultraviolet light over time can cause the poured-in-place surface to lose flexibility and impact absorbing properties, crack, or shrink. Exposure to ultraviolet light may also cause a change in the color of the surface.

4. Significance and Use

4.1 Every elevated play structure is required to have a protective surface installed and poured-in-place surfaces are one of the many choices. These surfaces are highly technical in structure, component selection, percentages of components and installation procedures. This guide is intended to assist the playground owner/operator, specification writer, designer, and so forth in determining the properties that can be considered with regard to the poured-in-place surface and set out considerations that the user of this guide should make to ensure a successful installation. This document is a guide and should not be used directly as a performance specification for poured-in-place surfacing.

5. Description

5.1 Poured-in-place is the combination of rubber crumb, chips, or rubber buffing, or all three, with a polymer binder in specific percentages determined by the manufacturer/installer that is mixed proximate to the playground and poured in one or more layers on a prepared base to provide a smooth and seamless surface.

5.2 Surfaces that are greater than 2000 ft^2 (186 m^2) or have distinct changes in color could have a seam or seams. Where seams occur, it is important that the bonding between sections be durable.

5.3 The poured-in-place surface is generally installed in two layers, with the lower layer being a cushioning layer and the top being a wearing course.

5.4 Color may be provided through pigmentation of the polymer binder, use of colored rubber crumb (EPDM) or the application of a lacquer. A black surface is considered to have no color as this is the black recycled rubber crumb with a non pigmented binder.

6. Standards Compliance

6.1 To comply with Specification F1292, the poured-in-place surfacing system shall be tested. Specification F1292 consists of a mandatory laboratory procedure and ~~the~~ a recommended field test procedure. The laboratory procedure determines the critical height which is the next full foot below which either the g-max exceeded 200 or the HIC (Head Injury Criterion) exceeded 1000 at any of the three temperatures. The critical height of the surface must always exceed the fall height for the play structure as outlined in the relevant play structure standard. It is recommended that field testing be performed periodically to a minimum of a 3-year cycle. It is recommended that a field test be performed within days after installation and prior to use.

6.2 The field testing in accordance with the field test procedure of Specification F1292 of a surface determines the g-max and HIC values at the drop height stipulated by the owner/operator prior to purchase. As long as the playground is in use the g-max must not exceed 200 or the HIC must not exceed 1000 from the drop height stipulated by the owner/operator prior to purchase.

6.3 The surfacing supplier should provide the owner/operator a copy of the laboratory testing results for the test required in Specification F1292.

6.4 Consideration by the owner/operator to test the surfacing system in the field after installation and periodic testing thereafter will determine whether the surfacing system is in compliance with Specification F1292. The owner/operator is required to stipulate the drop height(s) for the test prior to purchase of the surface. The owner operator may stipulate a higher drop height for testing than the fall height stipulated in the applicable equipment standards.

6.5 Field testing in accordance with the procedures set forth in Specification F1292 should take place following the total cure of the surface system to provide values that are reflective of the surface as intended. A strategy to ensure the testing of the surface