
USACE / NAVFAC / AFCEA / NASA UFGS-32 18 16.13 (April 2008)

Preparing Activity: USACE Superseding
UFGS-32 18 16.13 (April 2006)

UNIFIED FACILITIES GUIDE SPECIFICATIONS

References are in agreement with UMLR dated January 2009

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SECTION 32 18 16.13

PLAYGROUND PROTECTIVE SURFACING

04/08

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SECTION 32 18 16.13

PLAYGROUND PROTECTIVE SURFACING 04/08

NOTE: This guide specification covers the requirements for furnishing and installing protective surfacing in children's outdoor play areas.

Edit this guide specification for project specific requirements by adding, deleting, or revising text. For bracketed items, choose applicable items(s) or insert appropriate information.

Remove information and requirements not required in respective project, whether or not brackets are present.

Comments and suggestions on this guide specification are welcome and should be directed to the technical proponent of the specification. A listing of technical proponents, including their organization designation and telephone number, is on the Internet.

Recommended changes to a UFGS should be submitted as a Criteria Change Request (CCR).

PART 1 GENERAL

NOTE: Designer should require materials, products, and innovative construction methods and techniques which are environmentally sensitive, take advantage of recycling and conserve natural resources.

1.1 REFERENCES

NOTE: This paragraph is used to list the publications cited in the text of the guide specification. The publications are referred to in the text by basic designation only and listed in this paragraph by organization, designation, date,

and title.

Use the Reference Wizard's Check Reference feature when you add a RID outside of the Section's Reference Article to automatically place the reference in the Reference Article. Also use the Reference Wizard's Check Reference feature to update the issue dates.

References not used in the text will automatically be deleted from this section of the project specification when you choose to reconcile references in the publish print process.

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

ASTM INTERNATIONAL (ASTM)

ASTM C 136	(2006) Standard Test Method for Sieve Analysis of Fine and Coarse Aggregates
ASTM D 1557	(2007) Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Modified Effort (56,000 ft-lbf/ft ³) (2700 kN-m/m ³)
ASTM D 2047	(2004) Static Coefficient of Friction of Polish-Coated Floor Surfaces as Measured by the James Machine
ASTM D 2261	(2007a) Tearing Strength of Fabrics by the Tongue (Single Rip) Procedure (Constant Rate-of-Extension Tensile Testing Machine)
ASTM D 412	(2006ae1e2) Standard Test Methods for Vulcanized Rubber and Thermoplastic Elastomers - Tension
ASTM D 6112	(1997; R 2005) Compressive and Flexural Creep and Creep-Rupture of Plastic Lumber and Shapes
ASTM D 648	(2007) Deflection Temperature of Plastics Under Flexural Load in the Edgewise Position
ASTM E 1912	(1998; R 2004) Accelerated Site Characterization for Confirmed or Suspected Petroleum Releases
ASTM F 1015	(2003) Relative Abrasiveness of Synthetic Turf Playing Surfaces
ASTM F 1292	(2004) Impact Attenuation of Surface Systems Under and Around Playground Equipment

ASTM F 1487

(2007ae1) Playground Equipment for Public Use

CONSUMER PRODUCT SAFETY COMMISSION (CPSC)

CPSC Pub No 325

(1997) Handbook for Public Playground Safety

1.2 DEFINITIONS

1.2.1 Critical Height

The fall height at which the protective surfacing meets the requirements of ASTM F 1292.

1.2.2 Designated Play Surface

Any elevated surface for standing, walking, sitting, or climbing; or a flat surface a minimum 50 mm 2 inches wide having up to a maximum 30 degree angle from horizontal. In some play events the platform surface will be the same as the designated play surface. However, the terms should not be interchanged as they do not define the same point of measurement according to ASTM F 1487.

1.2.3 Head Injury Criteria (HIC)

A measure of impact severity that considers the duration over which the most critical section of the deceleration pulse persists as well as the peak level of that deceleration. Head impact injuries are not believed to be life threatening if the HIC does not exceed a value of 1,000.

1.2.4 Impact Attenuation

The ability of protective surfacing to reduce and dissipate the energy of an impacting body.

1.2.5 Loose Fill

Consisting of small independent movable components such as sand, gravel, or wood chip. The percent of fine material in the loose fill affects its compression properties from rainfall.

1.2.6 Maximum Equipment Height

The highest point on the equipment (i.e.: roof ridge, top of support pole).

1.2.7 Play Event

A piece of manufactured playground equipment that supports one or more play activities.

1.3 SYSTEM DESCRIPTION

NOTE: Drawings will indicate the perimeters of the play event use zone defining fall height, platform height, and maximum equipment height; spot elevations; and details as required to install

protective surfacing to meet child safety requirements.

Accessibility: Drawings will indicate spot elevations; dimensions; ramp slope and rise; transfer platform height and transfer space; transfer step and height; and maneuvering space as required to install protective surfacing to meet child accessibility requirements.

Measure the perimeters of the play event use zone in accordance with the requirements of Section 11 68 13 PLAYGROUND EQUIPMENT.

1.3.1 Child Safety

Meet or exceed the impact attenuating performance requirements of synthetic surfacing and loose-fill surfacing systems, installed in the use zones, as follows. The surfacing critical height value shall yield up to both a maximum 200 G's peak deceleration, and a maximum 1,000 Head Injury Criteria (HIC) value for a head-first fall from the play event in accordance with CPSC Pub No 325 and ASTM F 1292. The protective surfacing should have a minimum critical height value equal to the height of the highest designated play surface. Measuring fall heights for play events is defined in paragraph FALL HEIGHT. Sand, gravel, and wood products shall not be installed over a concrete or bituminous subsurface in accordance with CPSC Pub No 325.

1.3.2 Child Accessibility

NOTE: Facilities will be accessible in accordance with TI 800-01 and 36 CFR 1191, Americans with Disabilities Act (ADA) Accessibility Guidelines for Buildings and Facilities.

Ensure one access and egress point for a furnished play event meets accessibility. Ensure all children are accommodated on the playground in a 'play for all' socialization skill development environment. When children with disabilities are allowed to choose play events, they are more eager to learn the skills necessary to participate.

The accessibility requirement in accordance with ASTM F 1487 includes the following: When the play event use zone consists of a protective surfacing rated as inaccessible, at least one accessible route shall be provided from the use zone perimeter to the play event. When there is more than one of the same play activity provided, only one shall meet accessibility requirements (i.e.: one swing seat or one spring rocking play event). When the access and egress points are not the same for a play event, an accessible route shall be provided to both. The accessible route shall access all accessible play events and elements. The protective surfacings that meet accessibility are synthetic surfacing and engineered wood fiber in accordance with ASTM E 1912. When the accessible surface is within the use zone, it shall meet the requirements of paragraph CHILD SAFETY

1.3.3 Play Areas at CDC

The technical representative for outdoor play areas at CDC shall be the installation Child Development Services (CDS) Coordinator. The design of the CDC outdoor play area shall be based on the developmental play program for the age groups accommodated at the CDC. The play area is designed to support the CDC program and to provide a stage set for creative play. Developmental activities are selected which promote the intellectual, social, emotional and physical growth of the children. The developmental play program is developed by the MACOM CDS Director, installation CDS Coordinator and CDC Director. They are responsible for the developmental play program, child safety and accessibility to meet that program.

1.3.4 Sites Other than CDC

The technical representative for outdoor play areas on sites other than CDCs shall be the Director of Public Works or designated representative. The design of these outdoor play areas shall be based on the play program and the age groups to be accommodated as determined by the play area committee.

1.4 SUBMITTALS

NOTE: Review submittal description (SD) definitions in Section 01 33 00 SUBMITTAL PROCEDURES and edit the following list to reflect only the submittals required for the project. Submittals should be kept to the minimum required for adequate quality control.

A "G" following a submittal item indicates that the submittal requires Government approval. Some submittals are already marked with a "G". Only delete an existing "G" if the submittal item is not complex and can be reviewed through the Contractor's Quality Control system. Only add a "G" if the submittal is sufficiently important or complex in context of the project.

For submittals requiring Government approval on Army projects, a code of up to three characters within the submittal tags may be used following the "G" designation to indicate the approving authority. Codes for Army projects using the Resident Management System (RMS) are: "AE" for Architect-Engineer; "DO" for District Office (Engineering Division or other organization in the District Office); "AO" for Area Office; "RO" for Resident Office; and "PO" for Project Office. Codes following the "G" typically are not used for Navy, Air Force, and NASA projects.

Choose the first bracketed item for Navy, Air Force and NASA projects, or choose the second bracketed item for Army projects.

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for [Contractor Quality Control

approval.][information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government.] Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-02 Shop Drawings

Shop Drawings.

Scale drawings defining the revised use zone configuration.

Finished Grade and Underground Utilities

Finished grade, underground utilities, storm-drainage system and irrigation system status; and location of underground utilities and facilities.

SD-03 Product Data

Synthetic Surfacing Loose Fill Surfacing Geotextile Fabric

Manufacturer's descriptive data; catalogue cuts; and the latest edition of ASTM F 1487 and CPSC Pub No 325.

Manufacturer's specifications, handling and storage requirements, installation procedures, and safety data sheets to include warnings and critical height performance standards for synthetic surfacing and loose fill surfacing.

A list to include part numbers of furnished protective surfacing materials and components for synthetic surfacing and loose fill surfacing

Delivery schedule and manufacturer name for synthetic surfacing and loose fill surfacing plus delivery, storage and handling information.

Impact attenuation and critical height performance for each thickness of synthetic surfacing and loose fill surfacing provided.

Manufacturer's Qualification

Name of the owner or user; service or preventive maintenance provider; date of the installation; point of contact and telephone number; and address for 10 sites.

Wood

Wood components obtained from managed forests.

Site Preparation

Playground equipment and site furnishings installed.

Temperature Limitation

Temperature limitation for applying adhesive.

Wood By-Products

Composition, source; particle size; free from toxic chemicals; poisonous plant material; protrusions; or hazardous material.

Wood Treatment

Wood treatment chemical content, toxicity level, and life-cycle durability.

Adhesive

EPA registered uses, toxicity levels, and application hazards.

Color

[Two] [_____] color charts displaying surfacing colors, color granule percentages and finishes.

SD-04 Samples

Synthetic Surfacing

Loose Fill Surfacing

- a. Synthetic Surfacing: A minimum 50 by 50 mm 2 by 2 inch sample.
- b. Loose Fill Surfacing: A minimum 0.003 cu. m 0.125 cu. ft sample.

SD-06 Test Reports

Percolation Test

A certified report of inspection, test method used and compliance with recognized test standard shall be described.

Recycled Plastic

Individual component and assembled unit structural integrity test; creep tolerance; deflection tolerance; and vertical load test results. The estimated percentage of recovered material content in the material and components. Life-cycle durability.

Synthetic Surfacing

Chemical composition, color granule percentage, and test results to which material has been subjected; identifying each material and component containing recycled materials and showing the estimated percentage of recovered material content. Freezing temperature life-cycle durability.

Sand

Gravel

Sieve test results. Sand shall be uniformly graded.

SD-07 Certificates

Materials

Prior to the delivery of materials, certificates of compliance attesting that materials meet the specified requirements. Certified copies of the material certificates shall include composition and tests to which the material has been subjected.

Manufacturer's Qualification

Certificate of Insurance AA rated for a minimum one million dollars.

Manufacturer's Representative

The individual's name, company name and address, and playground safety training certificate.

Installer's Qualification

The installer's company name and address, and training and experience certification.

Substitution

Technical representative's written approval.

Protective Surfacing Acceptance

Record of measurements and findings by the certified playground safety inspector. Verification that installed protective surfacing meets manufacturer's recommendations and paragraphs CHILD SAFETY and CHILD ACCESSIBILITY.

SD-10 Operation and Maintenance Data

Maintenance Instructions

[Two] [_____] bound copies of manufacturer's operation and maintenance manuals. Include manufacturer supplied spare parts.

1.5 QUALITY ASSURANCE

1.5.1 Manufacturer's Qualification

Protective surfacing should have been installed in a minimum 10 sites and been in successful service for a minimum 5 year calendar period. The manufacturer shall provide a Certificate of Insurance AA rated for a minimum one million dollars covering both product and general liability.

1.5.2 Manufacturer's Representative

The manufacturer's certified playground safety inspector or the manufacturer's designated certified playground safety representative shall supervise the installation and adjustment of the protective surfacing to verify the installation meets the requirements of the manufacturer, this specification, and paragraphs CHILD SAFETY and CHILD ACCESSIBILITY.

1.5.3 Installer's Qualification

The installer shall be certified by the manufacturer for training and experience installing the protective surfacing.

1.5.4 Shop Drawings

When the use zone perimeter and play event configuration conflict with the requirements and paragraphS CHILD SAFETY and CHILD ACCESSIBILITY, submit shop drawings defining corrective measures to include the following: Adjustment to the play event with the use zone perimeter; use zone perimeter overlaps; fall height and critical height value.

1.6 DELIVERY, STORAGE, AND HANDLING

Provide a delivery schedule at least 10 calendar days prior to the first day of delivery. Deliver, handle, and store protective surfacing material in accordance with the manufacturer's recommendations. The storage area shall be as designated. Store the materials in a dry, covered area until installed. Inspect protective surfacing material, upon arrival at the job site, for meeting specified quality. Unacceptable materials shall be removed from the job site.

1.7 WARRANTY

Furnish protective surfacing with a minimum 1 year calendar period warranty.

1.8 MAINTENANCE INSTRUCTIONS

Furnish the manufacturer's operation and maintenance manual describing the recommended preventive maintenance, inspection frequency and techniques, periodic adjustments, lubricants, and cleaning requirements. Furnish protective surfacing spare parts provided by the manufacturer.

PART 2 PRODUCTS

2.1 MATERIALS

NOTE: Before selecting a protective surfacing system, evaluate the different types of protective surfacing systems to determine the most appropriate surfacing for the climate, accessibility, play value, and cost. Consider life cycle maintenance cost.

Synthetic Surfacing System: Synthetic surfacing systems, either unified or combined, meet accessibility requirements and have less daily maintenance requirements than loose-fill surfacing systems. Synthetic surfacing systems have limited play value. These systems may be used to add color patterns to the playground to be used for play activities.

Loose Fill Surfacing System: The only loose fill surfacing that meets accessibility is engineered wood fiber. To maintain accessibility there needs to be a commitment to replenishing the material

every month with the same engineered material. Some loose-fill materials such as sand, not only provide a good impact attenuation surface, but have excellent play value. Loose fill surfacing systems require daily maintenance to maintain impact attenuation performance due to material displacement, decomposition, and compression.

Depth of Material: Depth of the protective surfacing is determined by both the fall height and the type of protective surfacing system selected.

Provide materials which are the standard products of a manufacturer regularly engaged in the manufacture of protective surfacing and that are similar to surfacing in satisfactory use a minimum 5 year calendar period. Protective surfacing consists of two systems; synthetic surfacing and loose fill surfacing.

2.2 SYNTHETIC SURFACING

Synthetic surfacing includes the following: poured-in-place system; tile system; and combination system. The synthetic surfacing consists of either impact attenuating substrate covered by a wear surface bonded to produce a unified system; a shredded rubber or aggregate substrate covered by a polyethylene plastic woven sheet wear surface; or a uniform material manufactured in such a way that the top portion meets the requirements specified for wear surface.

2.2.1 Subbase

The subbase for synthetic surfacing may be either concrete, aggregate, or bituminous material.

2.2.1.1 Concrete Subbase

Provide concrete material conforming to Section 32 13 13.03 AIRFIELDS AND HEAVY-DUTY CONCRETE PAVEMENT LESS THAN 10000 CUBIC YARDS.

2.2.1.2 Bituminous Subbase

Provide bituminous material conforming to Section 32 12 11 BITUMINOUS SURFACE TREATMENT.

2.2.1.3 Aggregate Subbase

Provide aggregate material conforming to Section 32 11 24 AGGREGATE AND/OR GRADED-CRUSHED AGGREGATE BASE COURSE.

2.2.2 Impact Attenuating Substrate

Provide a substrate compatible with the wear surface, and consisting of modular units; poured-in-place; or loose fill. Recycled materials shall conform to EPA requirements in accordance with Section 01 62 35 RECYCLED / RECOVERED MATERIALS.

2.2.2.1 Poured-In-Place Substrate

Poured-in-place substrate shall consist of a [100] [_____] percent

recycled, shredded, styrene butadiene rubber (SBR) adhered with a 100 percent solid polyurethane binder to form a resilient, porous material or shredded rubber. Strands of SBR may vary from a minimum 0.5 mm 1/50 inch to a maximum 2 mm 2/25 inch thickness; by a minimum 3 mm 1/8 inch to a maximum 20 mm 4/5 inch length. Binder shall be between a minimum 12 percent and a maximum 16 percent of the total weight of the mixture of rubber and urethane; and shall provide 100 percent coating of the particles. Foam rubber will not be accepted in the substrate.

2.2.2.2 Loose Fill Substrate

The loose fill substrate shall consist of [100] [_____] percent recycled shredded rubber produced from recycled vehicle tires without non-steel belts. Loose-fill strands may vary from a minimum 3 mm 1/8 inch to a maximum 6 mm 1/4 inch thickness; a minimum 3 mm 1/8 inch to a maximum 13 mm 1/2 inch width; and a minimum 13 mm 1/2 inch to a maximum 50 mm 2 inch length.

2.2.3 Wear Surface

Wear surfaces consist of the following: a poured-in-place durable, weather-resistant, ultraviolet stable, water permeable material top-coat; an integral component of a tile system; synthetic turf wear surface; rubber sheet wear surface; or a polyethylene woven plastic sheet wear surface. The wear surface shall meet requirements of ASTM D 2047 for a minimum 0.8 coefficient of friction.

2.2.3.1 Poured-in-Place Wear Surface

Poured-in-place wear surface consists of ethylene propylene diene monomer (EPDM) particles adhered with a polyurethane binder formulated to produce an even, uniform surface. Particles of EPDM shall meet ASTM D 412 for tensile strength and elongation, and contain a minimum 25 percent of rubber hydrocarbons. Particles of EPDM shall be peroxide or sulfur cured in accordance with the manufacturer. Size of rubber particles shall be between a minimum 1 mm 1/32 inch, and a maximum 3 mm 1/8 inch diameter. Binder shall be between a minimum 16 percent and a maximum 21 percent total weight of rubber used in the wear surface, and shall provide 100 percent coating of the particles. Wear surface shall be a minimum 10 mm 3/8 inch thick. The wear surface shall be porous.

2.2.3.2 Synthetic Turf Wear Surface

Synthetic turf wear surface shall consist of nylon fibers a minimum 500 denier, or heavy face weight polypropylene fiber a minimum 5,000 denier; and tufted construction conforming to ASTM F 1015. Fibers in each roll shall be from the same dye lot.

2.2.3.3 Rubber Sheet Wear Surface

Rubber sheet wear surface shall consist of a smooth, uniform formulation of EPDM rubber granules bonded under pressure in the factory with polyurethane to form a continuous sheet, and shall be a minimum 10 mm 3/8 inch thick. Up to a maximum 80 percent of the rubber may consist of SBR particles. Particle size shall vary from a minimum 1 mm 1/32 inch to a maximum 5 mm 3/16 inch diameter.

2.2.3.4 Polyethylene Plastic Woven Sheet Wear Surface

Polyethylene plastic woven sheet wear surface shall be lockstitched and meet the tear resistance test, [ASTM D 2261](#) and shall have an accelerated ultra-violet degradation protection feature.

2.2.4 Synthetic Tile

Synthetic tile shall be sized [as indicated] [_____]. Synthetic tile shall be a factory-molded unit consisting of the following: combining impact attenuating substrate and wear surface meeting requirements specified for substrate and wear surface; or a dual-density, uniform material, the top portion of which shall conform to wear surface requirements specified.

2.2.5 Color

NOTE: Specify the percentage of each color granule for a unified poured-in-place system. Recommend the overall color of the surfacing be light colors to reduce contact burn risk from solar heat buildup. An EPDM wear surface is preferred for color retention.

The color shall be [as shown in Section [09 06 90](#) COLOR SCHEDULE] [as indicated] [_____]. An EPDM wear surface is preferred for color retention. Black or the following dark colored SBR wear surfaces retain heat and are not acceptable: color combinations containing more than 10 percent black; or color combinations averaging more than 10 percent dark colors.

2.2.6 Sealant

Sealant for tile or combined protective surface systems shall be compatible with the protective surfacing, and shall match the color of the wear surface.

2.2.7 Hardware

Hardware, anchors or fasteners shall be corrosion resistant stainless steel or galvanized steel to anchor the surfacing system securely, in accordance with manufacturer's instructions. Hardware shall provide or be recessed to provide a flat surface and shall be covered by the required depth of protective surfacing.

2.2.8 Binder

Binder for synthetic surfacing shall be nontoxic, weather-resistant, ultraviolet stable, non-hardening, and retaining impact-attenuating performance. It shall be 100 percent solids containing polyurethane, methylene diphenyl isocyanate (MDI), or as recommended by the manufacturer. A maximum 2 percent of toluene diphenyl isocyanate (TDI) shall be used. Weight of polyurethane shall be between a minimum [1.02 kg/L](#) [8.5 lbs/gal](#) and a maximum [1.14 kg/L](#) [9.5 lbs/gal](#). Coloring pigments shall be inorganic oxides.

2.2.9 Adhesive

Adhesive shall be a two component polyurethane providing extremely high impact resistant bond and shall be installed as recommended by the manufacturer. The adhesive shall be non-toxic, resistant to ultraviolet light, and safe for children.

2.2.10 Containment Curbs

Containment curbs include the following: treated wood, concrete, recycled plastic, or recycled plastic molded as lumber. Containment curbs shall provide a smooth and hazard-free transition from the protective surfacing to the adjacent surface. Curbs shall be free of sharp vertical edges, protruding elements and trip hazards. Curbs shall be as recommended by the manufacturer. All edges should be provided with a minimum 13 mm 1/2 inch radius.

2.2.11 Transition Edge

The transition edge shall be designed to maintain the protective surfacing performance, support the surfacing between changes of material, and shall be concrete in accordance with paragraph CONCRETE CURB. The face of the edge to the subgrade shall be covered with the impact attenuating surface and meet the requirements of paragraph CHILD SAFETY.

2.2.12 Combination System

Combination systems shall consist of combined protective surfacing materials specified. Each component is a part of a manufactured surfacing system. Wear surface shall be of the materials specified.

2.3 LOOSE-FILL SURFACING

Loose-fill surfacing installed in the use zone shall consist of sand, gravel or wood by-products.

2.3.1 Sand

NOTE: Sand provides both a protective surface when installed to the recommended depth and play value as in deep digging. When selecting sand, the composition of fine to coarse particles becomes a factor as sand compresses from rainfall. Compressed sand no longer meets impact attenuation for the fall height specified. Also, sand is displaced from running, digging or dragging activities, requiring replenishment on a daily basis to maintain impact attenuation performance. "Uniformly graded" sand is to be specified as it has less tendency to compact than "well graded" sand. The specified sieve sizes provide a range of passing percentages that meet paragraph CHILD SAFETY requirements. The range of sieve sizes provided give a sand composition that is locally available and reduce custom mixing.

In accordance with the US Army Community and Family Support Center (CFSC-FSCY) requirements for the Army developmental play program, sand is a required play

element and shall not be eliminated from the play area.

Sand shall be uniformly graded, washed, free of dust, clay, dirt, hazardous substances, or foreign objects. Sand particles shall be rounded naturally or by mechanical means and sieved in accordance with [ASTM C 136](#) to be in the following gradation range.

SIEVE SIZE	PERCENT PASSING
2.36 mm	100 percent
1.18 mm	80-100 percent
0.6 mm	40-75 percent
0.3 mm	0-25 percent
0.15 mm	less than 2 percent

SIEVE SIZE	PERCENT PASSING
#8	100 percent
#16	80-100 percent
#30	40 - 75 percent
#50	0-25 percent
#100	less than 2 percent

2.3.2 Gravel

Gravel shall be washed, free of dust, clay, dirt, hazardous substances or foreign objects. Gravel particles shall be rounded naturally or by mechanical means and sieved in accordance with [ASTM C 136](#) to be in the following gradation range.

SIEVE SIZE	PERCENT PASSING
12.5 mm	100 percent
9.5 mm	75-85 percent

SIEVE SIZE	PERCENT PASSING
1/2 inch	100 percent
3/8 inch	75-85 percent

2.3.3 Wood By-Products

Wood by-products include wood mulch and engineered wood fiber. Wood by-products shall be free of sharp or foreign objects or toxic chemicals. Wood by-products manufactured from recycled pallets or lumber containing nails or metal fasteners shall be rejected.

2.3.3.1 Wood Mulch

Wood mulch shall be untreated chipped bark and/or untreated chipped tree prunings a maximum 40 mm 1-1/2 inches long and shall be free of twigs, leaves, branches, thorns, dirt, grass, yard clippings, soil, or poisonous plants.

2.3.3.2 Engineered Wood Fiber

Engineered wood fiber manufactured for the purpose of protective surfacing shall consist of particles varying from a minimum 3 mm 1/8 inch wide to a maximum 13 mm 1/2 inch thick; and a minimum 25 mm 1 inch wide to a maximum 75 mm 3 inches long.

2.4 GEOTEXTILE FABRIC

Geotextile fabric consists of the following: nonwoven polypropylene sheet; nonwoven 100 percent polyester sheet; or nonwoven needle punched polyester sheet composed of recycled polyester resins.

2.5 RECYCLED PLASTIC

Recycled plastic shall contain a minimum [85] [____] percent of recycled post-consumer product and shall conform to EPA requirements in accordance with Section 01 62 35 RECYCLED / RECOVERED MATERIALS.

2.5.1 High Density Polyethylene

NOTE: Ensure manufacturers supply quality plastic products made from post-consumer recycled high density polyethylene that is equal to the performance of metal or wood by providing tight performance standards. High density polyethylene can be manufactured using post-consumer recycled plastic resins from products such as milk containers. Recommend products using high density polyethylene.

The material shall be molded of ultraviolet (UV) and color stabilized polyethylene; and consist of a minimum 75% plastic profile of high-density polyethylene, low-density polyethylene, and polypropylene raw material. The material shall be non-toxic and have no discernible contaminants such as paper, foil, or wood. The material shall contain a maximum 3 percent air voids. The material shall be free of splinters, chips, peels, buckling, and cracks. Material shall be resistant to deformation from solar heat gain. Material shall have factory-drilled holes. Components with extra holes not filled by hardware or covered by other components shall be rejected. The material shall not be painted.

2.5.2 Structural Component

Recycled plastic materials will not be used as load bearing structural members.

2.5.3 Recycled Plastic Molded As Lumber

NOTE: Recycled plastic molded as lumber and wood-polymer lumber are susceptible to both creep and deflection; therefore, it cannot be used for a load bearing structural member of protective surfacing systems. To overcome creep and deflection, the product is increased in volume of material and dimension.

The component shall deflect a maximum 1/360 of the span of the frame when exposed to a uniform live load of 585 N/m 40 lbs/ft, ASTM D 648. The product shall meet the structural integrity test requirements set forth in ASTM F 1487 and ASTM D 6112.

2.6 CURBS

2.6.1 Concrete Curb

Concrete curbs shall conform to Section 32 16 13 CONCRETE SIDEWALKS AND CURBS AND GUTTERS

2.6.2 Wood

2.6.2.1 Wood Components

Wood components shall be exterior premium grade and free of knots. Identify wood components obtained from managed forests. Wood components shall have factory-drilled holes. Components with extra holes not filled by hardware or covered by other components shall be rejected.

2.6.2.2 Wood Treatment

Wood components that are not naturally rot and insect resistant shall be treated to resist rot and insect attack by using standard treatment procedures. Any wood placed up to a maximum 150 mm 6 inches above, or any portion below the top elevation of the protective surfacing, shall be treated after fabrication. Creosote, pentachlorophenol, and tributyl tin oxide are prohibited according to ASTM F 1487.

PART 3 EXECUTION

3.1 SITE PREPARATION

NOTE: Provide positive drainage for the proper functioning of protective surfacing. Ensure a minimum 2 percent slope is provided for the protective surfacing subgrade. Ensure ponding at the perimeter does not occur. To ensure proper drainage, provide a percolation test to establish the requirement for a subdrainage system.

Prior to installing the protective surfacing, verify the playground equipment and site furnishings are installed in accordance with Section 11 68 13 PLAYGROUND EQUIPMENT, and Section 12 93 00 SITE FURNISHINGS.

3.1.1 Finished Grade and Underground Utilities

Verify that finished grades are as indicated; the smooth grading has been completed in accordance with Section 31 00 00 EARTHWORK; installation of the underground utilities through the area has been completed in accordance with Section 31 00 00 EARTHWORK; installation of the storm-drainage system through the area has been completed in accordance with Section 33 40 00 STORM DRAINAGE; and the installation of underground sprinklers through the area has been completed in accordance with Section 32 84 24 UNDERGROUND SPRINKLER SYSTEMS. The location of underground utilities and facilities in the area of the operation shall be verified. Damage to underground utilities and facilities shall be repaired at the Contractor's expense.

3.1.2 Layout

The layout of the entire use zone perimeter shall be staked before excavation begins. The location of all elements shall be staked to include the following: All play event configuration access and egress points; and use zone perimeters. The use zone is defined as the area beneath and immediately adjacent to a play structure or equipment that is designated for unrestricted circulation around equipment; and on whose surface it is predicted that a user would land when falling from or exiting the equipment. Also, the use zone is associated with the following terms; "Clear Area," and "Fall Zone". The use zone shall be free of hard surfaces, objects or obstacles that a child could run into or fall on top of and be injured. Use zone perimeters shall not overlap hard surfaces. The use zone perimeter shall meet or exceed the requirements of paragraphs CHILD SAFETY and CHILD ACCESSIBILITY. Use zone perimeters shall not overlap except for certain play events as defined in ASTM F 1487.

3.1.3 Obstructions Below Ground

When obstructions below ground affect the work, shop drawings showing proposed adjustments shall be provided.

3.1.4 Percolation Test

A test for percolation shall be done to determine positive drainage, to include the lowest elevation of the subgrade in the areas containing the following: sand; gravel; wood by-products; or synthetic surfacing installed over a pervious base. A positive percolation shall consist of a minimum 25 mm 1 inch per 3 hour period. When a negative percolation test occurs, a shop drawing shall be provided to indicate the corrective measures.

3.1.5 Substitution

Under no circumstances are substitutions to be allowed or protective surfacing to be selected without written approval from the technical representative. Evaluate manufacturer substitutions for the critical height value with meeting the site conditions and paragraph FALL HEIGHT.

3.1.6 Subgrade

Correct subgrade irregularities to ensure the required depth of protective surfacing is provided. The subgrade elevation shall be as required by the manufacturer.

3.1.7 Subsurface

Install the subsurface in a true, even plane, and sloped to provide positive drainage as indicated.

3.1.8 Subbase

Tolerance of the concrete or bituminous subbase shall be within a maximum 6 mm in 3 m 1/4 inch in 10 feet. Tolerance of aggregate subbase shall be within a maximum similar to 6 mm in 3 m 1/4 inch in 10 feet. Compact aggregate subbase to a maximum 95 percent, ASTM D 1557. The compaction shall be completed in accordance with Section 31 00 00 EARTHWORK. Sand, gravel, and wood products shall not be installed over a concrete, aggregate, or bituminous subbase, in accordance with paragraph CHILD SAFETY.

3.1.9 Concrete or Bituminous Curing

Bituminous or concrete subbase shall be cured [a minimum of 7 days] [in accordance with the manufacturer's requirements]. Curing compounds and other deleterious substances that adversely affect adhesion shall be removed. Surface shall be clean and dry.

3.1.10 Fall Height

NOTE: To determine the required depth of protective surfacing, the fall height; maximum equipment height dimensions; and spot elevations for each play event shall be shown on the drawings.

3.1.10.1 General Requirements

The fall height is defined as the vertical distance between the finished elevation of the designated play surface and the finished elevation of the protective surfacing beneath it. For some play events the fall height and platform height are the same, while for other play events the fall height and maximum equipment height are the same, Section 11 68 13 PLAYGROUND EQUIPMENT. When the furnished play event fall height varies from the play event shown, shop drawings shall be provided defining the revised depth or type of protective surfacing to meet or exceed the requirements of paragraphs CHILD SAFETY and CHILD ACCESSIBILITY.

3.1.10.2 Measuring Fall Height

EQUIPMENT	MEASURING FALL HEIGHT
Composite Equipment Structure:	For a platform surrounded by protective barriers, measure from the platform finished elevation. For a platform surrounded by guardrails, measure from the guardrail top elevation.
Infant Crawl Area:	A maximum 600 mm height, measured from the crawl wall or barrier finished elevation.

EQUIPMENT	MEASURING FALL HEIGHT
Playhouse, Nonclimbable:	Measure from the designated play surface finished elevation.
Spring Rocking Equipment:	Measure from the seat top elevation.
Stationary Equipment, Climbable:	Measure from the maximum equipment height finished elevation.
Stationary Equipment, Nonclimbable:	Measure from the designated play surface finished elevation.
Swing:	Measure from the bottom of the pivot point.

EQUIPMENT	MEASURING FALL HEIGHT
Composite Equipment Structure:	For a platform surrounded by protective barriers, measure from the platform finished elevation. For a platform surrounded by guardrails, measure from the guardrail top elevation.
Infant Crawl Area:	A maximum 24 inch height, measured from the crawl wall or barrier finished elevation.
Playhouse, Nonclimbable:	Measure from the designated play surface finished elevation.
Spring Rocking Equipment:	Measure from the seat top elevation.
Stationary Equipment, Climbable:	Measure from the maximum equipment height finished elevation.
Stationary Equipment, Nonclimbable:	Measure from the designated play surface finished elevation.
Swing:	Measure from the bottom of the pivot point.

3.2 INSTALLING SYNTHETIC SURFACING SYSTEM

Surfacing edges shall fully adhere to the subsurface. Fully cover the subsurface to ensure no hard surfaces are exposed through displacement of loose fill. Rolled or beveled containment curb or transition edges shall maintain the full thickness required to meet paragraphs CHILD SAFETY and CHILD ACCESSIBILITY. Material shall cover foundation and cutouts around elements penetrating the surface. Seams shall be the minimum necessary and shall be tight.

3.2.1 Temperature Limitation

Provide temperature limitation for applying adhesive.

3.2.2 Poured-in-Place System

Components of the poured-in-place system shall be mixed mechanically on site in accordance with manufacturer's recommendations. Hand-mixing is prohibited. Installation of poured-in-place surfacing shall be seamless and completely bonded to subsurface. Material shall cover foundations and shall be tight around elements penetrating the surface. Add a minimum 2 mm 1/16 inch depth to the required surfacing depth to ensure the full depth of material is installed to meet paragraph CHILD SAFETY.

3.2.2.1 Geotextile Fabric for Poured-In-Place

Install geotextile fabric over a compacted aggregate base as indicated. Fabric shall cover the entire area and shall be lapped a minimum 100 mm 4 inch width at the seams. Seams shall be adhered in accordance with manufacturer's recommendations. The aggregate base shall be free of ruts or protruding objects. The fabric shall be installed smooth; and free of tensile stresses, folds, and wrinkles. The fabric shall be protected from clogging, tears, or other damage. Damaged fabric shall be repaired or replaced as directed.

3.2.2.2 Poured-in-Place Substrate

The substrate layer of the poured-in-place system shall be installed in one continuous pour on the same day. When a second pour is required, the edge of the previous work shall be fully coated with polyurethane binder to ensure 100 percent bond with new work. Adhesive shall be applied in small quantities so that new substrate can be placed before the adhesive dries.

3.2.2.3 Poured-in-Place Wear Surface

Wear surface shall be bonded to substrate. Adhesive shall be applied to substrate in small quantities so that wear surface can be applied before adhesive dries. Surface shall be hand troweled to a smooth, even finish. When wear surface is composed of different color patterns, pour shall be continuous and seamless. When seams are required due to color change or field conditions, the adjacent wear surface shall be placed as soon as possible, before initial pour has cured. The edge of initial pour shall be coated with adhesive and wear surface mixture shall be immediately applied.

3.2.3 Tile System

Tile shall be laid out to ensure that end cuts are equal. Tile shall be installed in accordance with manufacturer's instructions. Hardware shall be as recommended by the manufacturer. Tile shall be bonded to the subsurface with an adhesive approved by the manufacturer. Cutouts shall be filled with sealant according to manufacturer's instructions to eliminate voids at equipment. Sealant shall be the minimum amount necessary, shall not exceed a maximum 10 mm 3/8 inch width. Where excessive voids occur at cutouts, tile shall be removed and refitted. The tile system shall be installed throughout the play equipment use zone with the proper thickness.

3.2.4 Combination System

The combination system shall consist of [modular impact attenuating substrate units, adhered to form a unified system], [shredded rubber tires over a gravel substrate] [_____]. The substrate shall be covered with a wear surface as specified. Cutouts around equipment shall be properly filled and sealed according to manufacturer's instructions to eliminate voids. Sealant shall be the minimum amount necessary, shall not exceed a maximum 10 mm 3/8 inch width. Where excessive voids occur at cutouts, the modular substrate shall be removed and refitted. Construction methods shall be employed to ensure full depth installation of specified surfacing material and the finished wear surface.

3.2.4.1 Geotextile Fabric

Geotextile fabric shall be installed where a modular or shredded rubber substrate is installed over an aggregate base. It should be installed with poured-in-place wear surface or polyethylene plastic woven sheet wear surface installed over substrate. Fabric shall cover the entire area to receive the tile system and shall be lapped a minimum 100 mm 4 inch width at the seams. Seams shall be adhered in accordance with manufacturer's recommendations.

3.2.4.2 Modular Substrate

Modular substrate shall be laid out to minimize small end pieces. The substrate shall be installed in accordance with manufacturer's instructions.

3.2.4.3 Poured-in-Place Substrate

Same as paragraph POURED-IN-PLACE SYSTEM.

3.2.4.4 Synthetic Turf Wear Surface

Wear surface shall be bonded to substrate with 100 percent solids polyurethane adhesive. Surface irregularities and wrinkles shall be corrected. Seams shall be secured in accordance with manufacturer's recommendations. Wear surface roll width shall be as wide as practical for the installation.

3.2.4.5 Rubber Sheet Wear Surface

Wear surface shall be bonded to substrate with 100 percent solids polyurethane adhesive. Surface irregularities and wrinkles shall be corrected. Seams shall be secured in accordance with manufacturer's recommendations. Wear surface roll width shall be as wide as practical for the installation.

3.2.4.6 Poured-in-Place Wear Surface

Same as paragraph POURED-IN-PLACE SYSTEM.

3.2.4.7 Polyethylene Plastic Woven Sheet Wear Surface

Wear surface shall be securely anchored to a perimeter containment material with hardware in accordance with the manufacturer's instructions. Hardware shall be appropriate for the type of system and secured to eliminate protrusions.

3.3 INSTALLING LOOSE FILL SURFACING SYTEM

3.3.1 Sand Surfacing System

Sand shall be installed over a compacted subgrade at a minimum 450 mm 18 inches depth throughout the use zone. The finished elevation of sand shall be determined after sand has been settled by saturating with water and percolating. The sand depth in high play activity areas shall be as indicated. Sand shall meet the requirements of paragraph CHILD SAFETY.

3.3.2 Gravel Surfacing System

Gravel shall be installed over a compacted subgrade at a minimum 300 mm 12 inch depth throughout the use zone. The depth of gravel in high play activity areas shall be as indicated. Gravel shall meet the requirements of paragraph CHILD SAFETY.

3.3.3 Wood By-Product Surfacing System

Engineered wood fiber protective surfacing shall be installed according to manufacturer's instructions. Wood products shall meet the requirements of paragraph CHILD SAFETY.

3.3.3.1 Wood Mulch Surfacing System

Wood mulch shall be installed over a compacted subgrade covered with geotextile fabric. Wood mulch shall meet the requirements of paragraph CHILD SAFETY

3.3.3.2 Engineered Wood Fiber Surfacing System

Engineered wood fiber protective surfacing shall be installed according to manufacturer's instructions. The surfacing shall meet the requirements of paragraphs CHILD SAFETY and CHILD ACCESSIBILITY.

3.3.3.3 Geotextile Fabric for Wood By-Product

Geotextile fabric shall cover the entire area and shall be lapped a minimum 100 mm 4 inch width at the seams. Seams shall be adhered in accordance with manufacturer's recommendations. Folds, wrinkles, or loose fabric shall be smoothed. Fabric shall be protected from damage during wood product placement.

3.3.3.4 Minimum Depth for Wood By-Product

Wood by-product shall be installed at a minimum 300 mm 12 inch depth throughout the use zone. The depth of wood products in high play activity areas shall be as indicated.

3.4 RESTORATION AND CLEAN UP

When the operation has been completed, clean up and protect the site. Existing areas that have been damaged from the operation shall be restored to original condition at the Contractor's expense.

3.4.1 Clean Up

The site and play events shall be cleaned of all materials associated with the operation. Play events and surfaces shall be cleaned of dirt, stains,

filings, and other blemishes occurring from shipment and installation. Cleaning methods and agents shall be as recommended by the manufacturer.

3.4.2 Protection

The area shall be protected as required or directed by providing barricades and signage. Signage shall be in accordance with Section 10 14 01 EXTERIOR SIGNAGE

3.4.3 Disposal of Materials

Excess and waste material shall be removed and disposed of off Government property.

3.5 PROTECTIVE SURFACING ACCEPTANCE

a. When the protective surfacing is installed, the play events and protective surfacing shall be thoroughly inspected and measured to verify the playground meets manufacturer's recommendations, paragraphs CHILD SAFETY and CHILD ACCESSIBILITY, and paragraph FALL HEIGHT as follows: 1) secure anchoring; 2) all hardware and connectors are tight and below the wear surface; 3) sharp points, edges, and protrusions; 4) entanglement; and 5) pinch, crush, and shear points.

b. Measure use zone distances to determine the area is free of hard surfaces, objects or obstacles. Determine exceptions to use zone overlaps occur in accordance with ASTM F 1487. Measure play event fall height and compare to critical height value for the thickness of installed synthetic surfacing. Measure play event fall height and depth of loose fill protective surfacing.

c. Ensure installed chopped tire material is free from steel belts. Ensure the slide exit region has the required clear zone. Swing seat clearances are measured while occupied by a maximum user for the age group using the equipment.

d. The finished installation shall have the appearance of a single covering. Protective surfacing that does not comply shall be reinstalled. Hardware that does not comply shall be replaced. Ensure positive drainage for the area and the lowest elevation of protective surfacing subgrade has been provided.

e. A written report describing the results of the evaluation shall be provided.

3.6 RE-INSTALLATION

When re-installation is required, the following shall be accomplished. Re-install the product as specified. Provide new replacement materials supplied by the manufacturer (material acquisition of replacement parts is the responsibility of the Contractor). Damage caused by the failed installation shall be repaired at the Contractor's expense.

-- End of Section --