NPPAS
NATIONAL PROGRAM FOR PLAY AREA SAFETY

Selecting Playground Surfaces

Guidelines for decisions to the best surface for play areas for children

Why is surfacing at public play areas for children so important?

Play areas are fun — and they're great for learning and community togetherness — but they must be safe and appropriate for children. Each year, over 200,000 children require emergency room care due to playground injuries (Hanway 2016; Tuckel et al. 2017). Playgrounds often present some of the highest surface temperatures with an urban area, amplifying heat extremes - and most playgrounds lack shade (Bloch, 2019, Vanos, et al., 2016; & Olsen et al. 2019).

There's a lot to uncover. Here's what the latest research and safety guidance reveal:

PREVENTING PLAYGROUND INJURIES

Falls account for over 70% of playground injuries and information on thermal hazards are increasingly alarming. To address safety risks, the Consumer Product Safety Commission (CPSC) published its first Handbook for Public Playground Safety in 1981. ASTM International introduced ASTM F1292 in 1995 as a standardized laboratory test used to evaluate how effectively surfacing materials cushion falls to reduce the risk of a life-threatening head injury.

In collaboration with the CPSC, researchers affiliated with NPPAS in 2017 conducted the first field-based study to evaluate surfacing materials installed at play sites.

To learn more, go to
PlaygroundSafety.org/Research

This pioneering effort marked a critical shift toward real-world testing, revealing how surfacing performs under everyday conditions.

In response, ASTM introduced F3313 in 2018, a standard to assess impact attenuation within the use zones at play sites. Unlike lab tests, it accounts for wear, weather, and site-specific variables that influence safety over time.

ENVIRONMENTAL CONDITIONS

Play areas for children are exposed to a wide range of seasonal extremes that accelerate wear and maintenance. It is important to factor in your local environmental conditions when making decisions.

- **Freeze-thaw cycles and Freezing Temperatures:** Weakens trees, ground coverage, and plant life. This reduces shade, biodiversity, and thermal comfort. Cold weather causes materials to contract and become brittle.
- **Heat and Sun Exposure:** Many play areas are located in heat-prone zones, where the built material may trap and amplify warmth. When ground surfaces are exposed to direct sunlight for just 30 minutes, they can radiate high temperatures, posing risks to children's health. UV rays can cause fading, cracking, and brittleness.
- **Rain, Flooding, Snow, and Humidity:** These conditions can dramatically alter the ground surface — both in appearance and behavior. Moisture leads to rust, mold, and wood rot. These conditions can weaken structural integrity of surface materials and some conditions can increase slip hazards.

As environmental conditions intensifies — it is no longer sufficient to maintain and build children's play areas as we always have. Choose materials built for your climate — resilient, safe, appropriate, and toxin-free.

What are factors to consider when selecting play area surfacing for children?

NPPAS researchers have studied playground surfacing for over 30 years, creating the *S.A.F.E. Surfacing Decision-Making Model* in 1999 (Hudson & Thompson) — a framework that continues to evolve with new research and emerging insights. There are four factors to make concerning the surface of play areas for children. If any factor is a no, the surfacing is not the best decision for the play area.

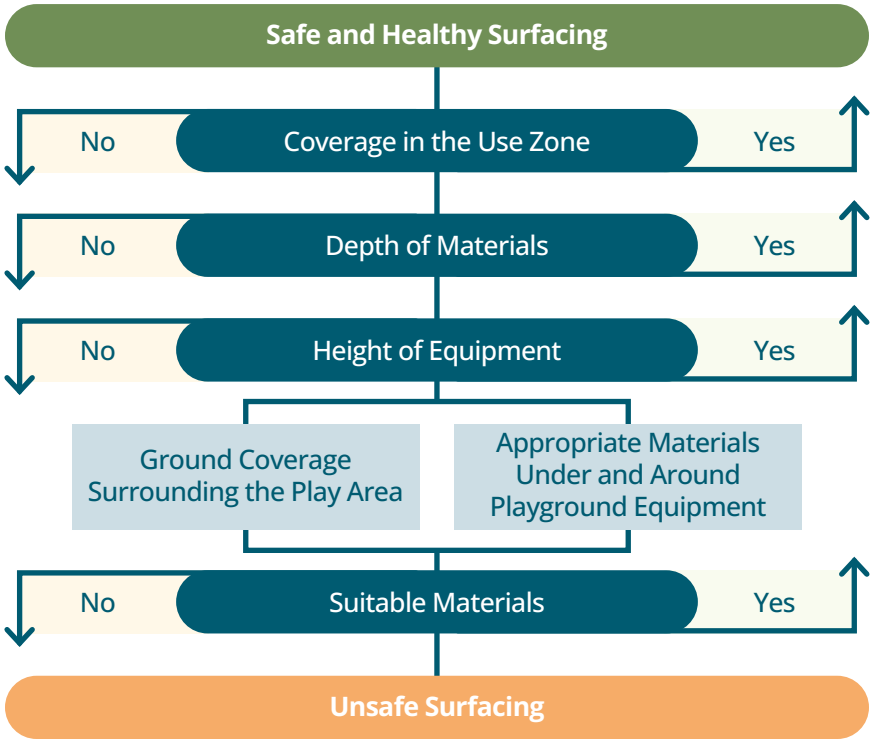


Figure 1. The *S.A.F.E. Surfacing Decision-Making Model*

Suitable Materials

Ground Coverage

The type of ground coverage surrounding a play area is a vital role in cooling and maintaining the space. Materials like asphalt, concrete, tar and chip, gravel, and native grass each have distinct thermal properties that influence surface temperature. Natural surfaces such as grass, wood fiber, and soil absorb far less heat than paved surfaces, helping to keep play areas cooler and more comfortable.

Native trees and plants are especially valuable in children's play environments. Through evapotranspiration, they release moisture into the air, creating a natural cooling effect. Open, vegetated ground also promotes better airflow, enhancing comfort and usability.

When surrounded by pavement or buildings, play areas with high vegetative ground coverage can serve as cooling islands—offering relief from urban heat and creating more inviting spaces.

The land coverage of the entire grounds covered with native grass, vegetation and plantings, and previous surface types tend to retain less heat, creating a cooler, more usable play area for children. Photo courtesy of Playmate Play Area Wood Chips

Selecting Appropriate Materials

Falls are the most common way children get hurt on playgrounds. That's why it's important to have soft, shock-absorbing ground under and around climbing equipment. If a child's feet leave the ground while playing, the surface below should cushion a fall.

Unsafe surface materials under elevated play structures. Asphalt, concrete dirt, soil, and grass are not safe.

Safe surface materials provide reliable fall protection, maintain performance over time, free from chemicals and unsafe toxins, and resist local environmental wear.

Acceptable Surfacing Materials

→ ***Loose-fill material*** are particles such as wood, synthetic rubber, sand, or pea gravel.

→ ***Unitary material*** is a smooth surface – artificial turf, poured-in-place, or rubber tiles

What is Reliable Fall Protection?

CPSC suggests to use safety-tested materials that meet standards. Standards, such as currently ASTM F1292, involve a laboratory test to measure how well a surface cushion falls. Acceptable scores for playground surfacing — HIC below 1000 and a G-max below 200.

What Else to Consider?	✔ What it Tests	✗ What it Does Not Test
F2075 Engineered Wood Fiber	Particle size distribution, heavy metal testing (such as CCA, mercury, etc); screens for sharp or metal fragments	Impact attenuation, installation quality, and organic chemical release
F2479 Guide for Poured-in-Place	This is a guide for poured-in-place material manufacturers on topics of installation, maintenance, and warranty	UV degradation, long-term performance, VOC, PAHs, organic chemical release, and impact attenuation
F1951 Accessibility of Surface Systems	Accessibility of surface systems, handling mobility testing	UV degradation, long-term performance, VOC, PAHs, and organic chemical release, and impact attenuation
F3012 Loose-fill rubber and turf infill	Particle size distribution, heavy metal testing (such as CCA mercury, etc)	VOC, PAHs, and other toxin substances, organic chemical release, and impact attenuation
D2859 Flammability of finished turf	Surface flammability, resists ignition and flame spread	Wear resistance, VOC, PAHs, and organic chemical release

Children Face Greater Risk

Children are especially vulnerable to health complications from unsafe exposure to chemicals, toxins, and pesticides. Their developing bodies, frequent hand-to-mouth behaviors, and close contact with surfaces make them more susceptible. These substances can enter a child's body in three ways:

Inhalation (Breathing)

Ingestion (Eating)

Contact with the Skin

The volume and physical properties of chemicals can interfere with hormones, trigger asthma, allergies, and headaches, and disrupt a young child's normal development and growth.

5 CONSIDERATIONS

1 **Protection from Toxins**: Children deserve play environments free from harmful chemicals and toxins. Yet materials like PVC (polyvinyl chloride), BPA (bisphenol-A), and CCA (chromium, copper, arsenic) may still be used to enhance color or preserve products.

Pesticides, often applied to control weeds or pests, can seep into the ground and contaminate soil, creating long-term exposure risks in play areas.

Safety isn't static — It's situational. We must move beyond generic compliance and embrace surfacing strategies that reflect the health of children and the local environment.

- ✔ Check out CPSC and EPA's Federal Research Action Plan
- ✔ Chemical and toxin concerns not fully covered
- ✔ EPA has a guidance portal for best practices

2 **Age Appropriateness**: Avoid loose materials like pea gravel or rubber chips for infants and toddlers, who are prone to mouthing objects. These surfaces pose choking hazards and may contain chemicals.

3 **Local Microclimate Conditions**: Affect how playgrounds function and age over time.

- ***Soil health and microbial activity:*** Bacteria, fungi, and algae thrive differently depending on moisture and temperature. These organisms play a role in decomposition, nutrient cycling, and surface stability.
- ***Vegetation growth:*** Plants depend on light, moisture, and temperature. Shaded, moist areas may support lush growth, while dry, exposed zones can struggle to sustain greenery.
- ***Moisture retention:*** Shaded or humid areas tend to hold moisture longer, which can reduce dust and improve thermal comfort. Dry, sunny zones may experience cracking, surface degradation, or increased airborne dust.

4 **ADA and Accessibility**: In the United States, newly built or altered public play areas must meet accessibility guidelines. There are a number of solutions for meeting these requirements without covering the entire area with a hard surface. For example, a firm, stable, and slip resistant pathway to the play structures allows visitors to access the play experience.

5 **Thermal behavior**: Some surfaces may retain heat depending on sun exposure. Vegetated surfaces — like grass, clover, or low-growing native plants — act as natural insulators and can improve soil structure and nutrient cycling.

✔ Safe Wood Material for Children	Unsafe Wood Material for Children
Known for their strength and resilience, hardwoods stand up to heavy use while maintaining safety and structural integrity. For optimal performance and child safety, ensure the material consists of:	***Unsafe wood materials*** *for children involve chemical treatments. Wood mulch containing chromated copper arsenate (CCA) — treated wood product should not be used. Painted or stained wood with lead or high volatile organic compounds (VOC) should not be used.*
✔ Processed clean, de-barked chip from a reputable sawmill and lumber supplier	✗ Never use CRD (construction, renovation, and demolition)
✔ Hardwood is more durable and resistant to damage from pests and environmental conditions	✗ Retain moisture
✔ Product installed has reputation of performing well over a period of time (5 or more years)	✗ Has a slow runoff and washes away
✔ Meets ASTM International F3313; F2075; F1292	✗ Mulch absorbs moisture and clumps together
	✗ Recycled pallets often contain unsafe chemicals and oils

✗

Height of Equipment

The second factor in the *S.A.F.E. Surfacing Decision-Making Model* is the height of play structures. Height is associated with play structures and its relationship with injury. Height correlates with both higher injury rates and greater injury severity (Chalmers, 1996; Mott, 1997; Macarthur, 2000; Laforest, 2001; Fiissel, 2005; Clapperton & Cassell, 2005).

The higher a child falls from, the greater the chance they'll get hurt. That's why height is a key factor in decisions.

Equipment height directly affects the selection and performance of shock-absorbing surfacing in three key ways:

1. **Material limitations**: Each surface type has a maximum fall height it can safely support. For example, pea gravel is only rated for falls up to six feet, making it unsuitable beneath taller structures.
2. **Field vs. lab differences**: Some materials perform well in lab tests but show reduced impact attenuation in field conditions, due to factors like compaction, moisture, microclimatic conditions, or installation variability.
3. **Testing constraints**: ASTM F3313 field testing is questionable above 12 feet, making it unsuitable for evaluating surfacing under extreme-height structures. Testing at such heights would require specialized protocols and may not yield results comparable to F1292.

Research shows equipment exceeding six feet in height is linked to twice the injury rate compared to lower structures. To mitigate this risk, NPPAS recommends height limits of eight feet for school-aged children and six feet for preschoolers. It is essential to look closely at climbable areas and flagging potential fall hazards, especially when equipment exceeds eight feet and may expose children to unsafe impact surfaces.

Depth of Materials

The third decision is how deep or thick the surfacing is installed and maintained. Loose materials like wood chips need enough depth, and solid surfaces like rubber need enough thickness — especially under tall play equipment. If the surface isn't deep or thick enough, it increases the risk of serious head injuries.

RECOMMENDED ACTIONS

Before selecting a playground surface, it's important to discuss the depth and thickness—both when new and after years of use. Start by asking:

- **Thickness Requirements**: Does the manufacturer's testing confirm that the material meets safety standards for the tallest play structure on site?
- **Long-Term Durability**: How does the surface hold up after two, five years of regular use, weather exposure, and temperature changes?
- **Impact Attenuation Over Time**: Does the material still absorb impact effectively after aging, compaction, or wear?
- **Environmental Resilience**: How does it respond to moisture, UV exposure, freeze-thaw cycles, or heavy foot traffic?
- **Maintenance Needs**: What upkeep is required to maintain safety and performance — ask about drainage properties and servicing at the local site. How can boundaries and borders help operations?
- **Pests**: Are there documented cases of pest attraction or infestation? How often the material needs to be turned, replaced, or cleaned to avoid mold, mildew, or pest harborage.

First of Its Kind

Research affiliated with NPPAS visited playgrounds to assess impact attenuation of surface materials. A key insight revealed play structure height and surface depth directly affect safety.

- HIC scores increased by 36% when play structures were at heights above 9 feet.
- Unitary surfacing materials exhibited significant deterioration in safety at heights above 6 feet.

Use Zone

The final element that helps decide if the appropriate surface is present is the placement of surfacing under and around the play equipment. The CPSC *Handbook for Public Playground Safety* defines these areas as use zone. The basic use zone is six feet. However, because children move off swings and slides in different ways than other equipment, the use zone is expanded to provide a longer safety zone.

Stationary equipment	6 feet on all sides of the equipment
Slides	6 feet on all sides **Slide Exit Region Guidance** For slides taller than 6 feet, the exit region (use zone) in front of the slide should be equal to the slide's height, up to a maximum of 8 feet.
Swings	6 feet on each side. Plus, twice the height of the swing beam in front and back of the swing.

Children move off swings in different ways, the use zone is expanded to provide a longer safety zone. For instance, if a swing beam is 8 feet high, then the use zone extends 16 feet in front and 16 feet in back of the swing beam to accommodate children who might jump out of the swing seat while in motion.

What Questions Should You Be Asking?

These questions are a starting point for thoughtful planning, conducting an assessment, writing a request for proposal, and preparing for maintenance.

QUESTIONS

Has the surfacing material been safely processed?

Is the material safe and appropriate for the age of children using the play area?

What is the height of the tallest play structure?

What depth is needed for the height of the equipment?

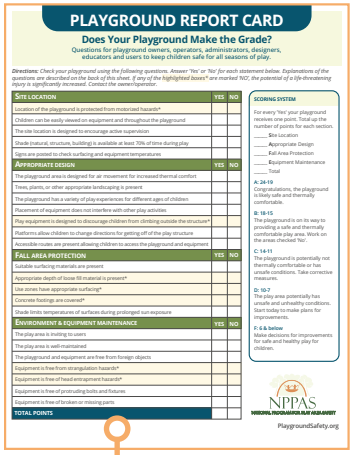
Is the material resistant to withstand the local microclimate and operational conditions without degradation or loss of performance over a year, 3 years, 5 years or more?

What vegetation and landscaping strategies can positively respond to the topography, drainage patterns, soil stability, site's slope gradients, etc?

Have the ground cover and impact attenuating surface been discussed for compatibility with the site's maintenance?

Do the products have specification and testing certifications (such as EPA's Safer Choice, EPA's Design for the Environment, GreenSeal, or EcoLogo)?

Additional Resources


PLAYGROUND REPORT CARD

Does Your Playground Make the Grade?

Questions for playground owners, operators, administrators, designers, educators and users to keep children safe for all seasons of play.

Directions: Check your playground using the following questions. Answer 'Yes' or 'No' for each statement below. Explanations of the questions are described on the back of this sheet. If any of the highlighted boxes* are marked 'NO', the potential of a life-threatening injury is significantly increased. Contact the owner/operator.

SITE LOCATION	YES	NO
Location of the playground is protected from motorized hazards*		
Children can be easily viewed on equipment and throughout the playground		
The site location is designed to encourage active supervision		
Shade (natural, structure, building) is available at least 70% of time during play		
Signs are posted to check surfacing and equipment temperatures		
APPROPRIATE DESIGN	**YES**	**NO**
The playground area is designed for air movement for increased thermal comfort		
Trees, plants, or other appropriate landscaping is present		
The playground has a variety of play experiences for different ages of children		
Placement of equipment does not interfere with other play activities		
Play equipment is designed to discourage children from climbing outside the structure*		
Platforms allow children to change directions for getting off of the play structure		
Accessible routes are present allowing children to access the playground and equipment		
FALL AREA PROTECTION	**YES**	**NO**
Suitable surfacing materials are present		
Appropriate depth of loose fill material is present*		
Use zones have appropriate surfacing*		
Concrete footings are covered*		
Shade limits temperatures of surfaces during prolonged sun exposure		
ENVIRONMENT & EQUIPMENT MAINTENANCE	**YES**	**NO**
The play area is inviting to users		
The play area is well-maintained		
The playground and equipment are free from foreign objects		
Equipment is free from strangulation hazards*		
Equipment is free of head entrapment hazards*		
Equipment is free of protruding bolts and fixtures		
Equipment is free of broken or missing parts		
TOTAL POINTS		

SCORING SYSTEM

For every 'Yes' your playground receives one point. Total up the number of points for each section.

_____ Site Location
_____ Appropriate Design
_____ Fall Area Protection
_____ Equipment Maintenance
_____ Total

A: 24-19
Congratulations, the playground is likely safe and thermally comfortable.

B: 18-15
The playground is on its way to providing a safe and thermally comfortable play area. Work on the areas checked 'No'.

C: 14-11
The playground is potentially not thermally comfortable or has unsafe conditions. Take corrective measures.

D: 10-7
The play area potentially has unsafe and unhealthy conditions. Start today to make plans for improvements.

F: 6 & below
Make decisions for improvements for safe and healthy play for children.

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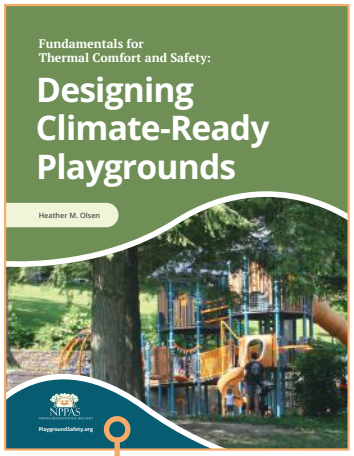
DOES YOUR PLAYGROUND MAKE THE GRADE?

NPPAS's *Playground Report Card* is a structured evaluation tool that can be used to assess various aspects of the health and safety of a play area. It helps identify possible playground risks and hazards to **keep children safe, protect them from the sun, and prevent injuries during all seasons of play.**

Learn more at ***playgroundsafety.org/report-card***



EVERY SAFE, COMFORTABLE PLAYGROUND STARTS WITH A PLAN.

When shade disappears and surfaces overheat, play stops and safety suffers. *Designing Climate-Ready Playgrounds* delivers 60 pages of expert strategies to help community members, child care and school managers, municipalities and parks, planners, designers, **build play spaces for children that stay cool, safe, and ready for action.**

Learn more at ***playgroundsafety.org/thermalcomfort***

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NPPAS is a nonprofit 501(c)3 organization raising awareness about safe play areas for children. ***Partner with us*** *to help ensure every child has access to a safe and healthy place to play.*

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