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COMMENTS

U.S. CONSUMER PRODUCT SAFETY COMMISSION
WASHINGTON, D.C. 20207

May 13, 1997

Dear Colleague:

Enclosed is a draft of a revised CPSC Handbook for Public Playground Safety. The draft proposes revisions to the 1991 Handbook that was republished with minor revisions in 1994. CPSC staff is asking for your comments and suggestions on the proposed revisions as noted in the enclosure. Please be aware that the revisions are being proposed by the staff and have not been reviewed or approved by the Commission.

Many of the Figures (graphics) in the enclosed draft are the same as those in the 1991 and 1994 publications. However, because the sections in the revised Handbook have been reordered, the Figure numbers have changed. A list of the Figures in the order they will appear in the revised Handbook is included in the draft (see page 50), with a cross reference to the Figure numbers as they appeared in the 1991 and 1994 versions of the Handbook. There are some new figures, and these are so noted.

If you do not have a copy of the 1994 Handbook, you may request a copy from the CPSC Office of Public Affairs (301/504-0850). Alternatively, the 1994 Handbook, in its entirety (pdf file format) or in text only format is available for downloading/printing at CPSC's World Wide Web site on the Internet. The CPSC Web address is: **http://www.cpsc.gov**

Some of the more significant proposed changes to the Handbook are as follows:

1. Since falls from an elevation continue to be the most common cause of injuries requiring hospital emergency room treatment, recommendations for the maximum height of playground equipment have been added (see Sections 4.3.1 & 12.1.5). A paper published in 1996 was based on a study in New Zealand to evaluate the effectiveness of height and surfacing requirements in a standard for playground equipment (NZS 5828). An observation in the study was an increased risk of injury in falls from heights above those recommended in that standard (2.5 meters or 8.2 feet).

2. For the most part, the current Handbook recommends a 12-foot spacing between individual pieces of playground equipment. A number of requests have been received by staff for opinions on the safety of playgrounds that do not meet the spacing recommendations. Many of the requests were from operators of child care facilities having limited space for their playgrounds. Playground incident data has not identified that insufficient spacing is a common cause of injury. Therefore, some reductions in the spacing recommendations are proposed (see Section 5.1.1).

3. Sand boxes and activity walls require a child to be at ground level. It is proposed that such ground level activities be excluded from the recommendations for protective surfacing under and around playground equipment (see Section 4.4).

4. Protrusions on playground equipment, especially on slides, have resulted in entanglement with clothing and, in some cases, strangulation fatalities. For protrusions that are inclined upwards, and those on slides, a more stringent recommendation is proposed (see Section 9.4).

One goal in revising the Handbook was to attempt to harmonize its recommendations with provisions in the ASTM Standard Consumer Safety Performance Specification for Playground Equipment for Public Use, ASTM F1487, which, in turn, is being harmonized with a Canadian standard for playground equipment. However, the enclosed proposed revised draft still contains some recommendations that differ with provisions in the ASTM standard. For example, the maximum recommended slope for stairways in Table 2 of the enclosed draft Handbook continues to differ from that in Table 2 of the ASTM standard. Stairway slope in the Handbook ($\leq 35^{\circ}$) is based on the slope required by building codes for stairways in private homes. The ASTM standard permits stairway slopes up to 50°. The staff does not believe that stairways on playground equipment should be steeper than those found in a child's own home. Therefore, no change to this recommendation is contemplated at this time. We are especially interested in receiving your views on this and other differences between the enclosed draft revision of the Handbook and the ASTM F1487 standard. We request that any suggestions for changes to the recommendations in the enclosed draft revised Handbook be accompanied by rationale.

Please forward any comments on the enclosed draft to my attention by **June 30, 1997**. Depending on the nature and volume of comments received, a public meeting may be scheduled where interested parties may express their views .

Sincerely,

John D. Preston, P.E.
Directorate for Engineering Sciences

Enclosure

CPSA 6 (b)(1) Cleared
No Mfrs/Private Labs or
Products Identified
Excepted by
Firms Notified,
Comments Processed.

HANDBOOK FOR PUBLIC PLAYGROUND SAFETY

DRAFT

Revised May 1997

NOTE: Revisions to this Handbook are identified as follows. Additions are double underlined and deletions are ~~struck out~~.

U.S. Consumer Product Safety Commission
Washington, D.C. 20207

DRAFT DRAFT

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1. INTRODUCTION

This handbook presents playground equipment safety information in the form of guidelines. Because many factors may affect playground safety, the U.S. Consumer Product Safety Commission (CPSC) believes that guidelines, rather than a mandatory rule, are appropriate. The safety guidelines for equipment are based on recommendations provided to the CPSC by COMSIS Corporation in a March 1990, report [1]*, inputs from interested parties received during and after a playground safety roundtable meeting held in October 1996, and a staff review of recent changes to playground equipment voluntary standards.

The handbook is intended for use by parks and recreation personnel, school officials, equipment purchasers and installers, and any other members of the general public concerned with public playground safety such as parents and school groups. A voluntary standard for public playground equipment, ASTM F1487, was published in 1993 [2]. It contains more technical requirements than this handbook and is primarily intended ~~as a guide to~~ for use by equipment manufacturers.

"Public" playground equipment refers to equipment intended for use in the play areas of parks, schools, child care facilities, institutions, multiple family dwellings, restaurants, resorts and recreational developments, and other areas of public use. The guidelines are not intended to apply to amusement park equipment, equipment normally intended for sports use, soft contained play equipment, equipment found in water play facilities, or to home playground equipment. A voluntary standard for home playground equipment, ASTM F1148 [3], contains a number of provisions that are similar to the recommendations in this handbook. The guidelines also are not intended to apply to fitness trail exercise equipment intended for adult use, provided that these are not located on or adjacent to a children's playground. Equipment components intended solely for the handicapped and modified to accommodate such users are also not covered by these guidelines.

The safety of each individual piece of playground equipment as well as the layout of the entire play area should be considered when evaluating a playground for safety. The installation of protective surfacing under and around all equipment is crucial.

Because all playgrounds present some challenge and because children can be expected to use equipment in unintended and unanticipated ways, adult supervision is recommended. However, it is recognized that this may not be possible for some playgrounds. Equipment design, layout, and maintenance, as discussed in this handbook, are essential for increasing public playground safety.

A playground should allow children to develop progressively and test their skills by providing a series of graduated challenges. The challenges presented should be appropriate for age-related abilities and should be ones that children can perceive and choose to undertake.

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* - Numbers in brackets indicate references that are listed at the end of this handbook.

Preschool and school-age children differ dramatically, not only in physical size and ability, but also in their cognitive and social skills. Therefore, age-appropriate playground designs should accommodate these differences with regard to the type, scale, and the layout of equipment. Recommendations throughout this handbook address the different needs of preschool and school-age children; "preschool" refers to children from 2 up to 5 years old, and "school-age" refers to children over 5 up to 12 years old. ~~The overlap between these groups is realistic in terms of playground equipment use, and provides for a margin of safety.~~
The recommendations in this handbook are based on the assumption that the minimum user will be a 2 year-old-child. Therefore, playground equipment fabricated in accordance with these recommendations may not be appropriate for children under 2 years of age.

These guidelines are not a CPSC standard and are not mandatory requirements. Therefore, the Commission is not endorsing them as the sole method to minimize injuries associated with playground equipment. The Commission believes, however, that the safety features in many of the recommendations in this handbook will contribute to greater equipment safety. Publication of the handbook is expected to promote greater safety awareness among those who purchase, install, and maintain public playground equipment.

2. PLAYGROUND INJURIES

The Consumer Product Safety Commission has long recognized the potential hazards that exist with the use of public playground equipment. A Commission study [4] of playground equipment-related injuries treated in U.S. hospital emergency rooms indicated that the majority resulted from falls from equipment. These were primarily falls to the ground surface below the equipment rather than falls from one part of the equipment to another part.

Other hazard patterns involved impact by swings and other moving equipment, colliding with stationary equipment, and contact with such hazards as protrusions, pinch points, sharp edges, hot surfaces, and playground debris. Fatal injuries reported to the Commission involved falls, entanglement of clothing or other items on equipment such as slides, entanglement in ropes tied to or caught on equipment, head entrapment in openings, impact from equipment tipover or structural failure, and impact by moving swings.

The recommendations in this handbook have been developed to address the hazards that resulted in these playground-related injuries and deaths. The recommendations include those which address the potential for falls from and impact with equipment, the need for protective surfacing under and around equipment, openings with the potential for head entrapment, the scale of equipment and other design features related to user age, layout of equipment on a playground, installation and maintenance procedures, and general hazards presented by protrusions, sharp edges, and pinch points.

3. DEFINITIONS

Composite Structure - Two or more play structures, attached or directly adjacent, to create one integral unit that provides more than one play activity (e.g. combination climber, slide, and horizontal ladder).

Critical Height - The maximum fall height from which a life-threatening head injury would not be expected to occur.

Entrapment - Any condition that impedes withdrawal of a body or body part that has penetrated an opening.

Fall Zone - The surface under and around a piece of equipment onto which a child falling from or exiting from the equipment would be expected to land.

Footing - A means for anchoring playground equipment to the ground.

Guardrail - An enclosing device around an elevated platform that is intended to prevent inadvertent falls from the platform.

Infill - Material(s) used in a protective barrier to prevent a user from passing through the barrier.

Loose-Fill Surfacing Material - A material used for protective surfacing in the fall zone that consists of loose particles such as sand, gravel, wood fibers, or shredded rubber.

Non-Rigid Component - A component of playground equipment that significantly deforms or deflects during the normal use of the equipment.

Preschool Age Children - Children from 2 years of age to not more than 5 years of age.

Protective Barrier - An enclosing device around an elevated platform that is intended to prevent both inadvertent and deliberate attempts to pass through the barrier.

Protective Surfacing - Surfacing material in the fall zone that conforms to the recommendations in Section 10.2 of this handbook.

Roller Slide - A slide that has a ~~bed~~ chute consisting of a series of individual rollers over which the user travels.

School-Age Children - Children over 5 years of age but not over 12 years of age.

Slide Chute - The inclined sliding surface of a slide.

Stationary play equipment - Any play structure which does not move or does not have components that move during its intended use.

Tot Swings - A swing intended for children under 4 years of age that provides support on all sides of the occupant.

Tube Slide - A slide in which the ~~sliding section~~ chute consists of a totally enclosed tube or tunnel.

Unitary Surfacing Material - A manufactured material used for protective surfacing in the fall zone that may be rubber tiles or a combination of rubber-like materials held in place by a binder that may be poured in place at the playground site and cures to form a unitary shock absorbing surface.

Upper Body Equipment - A device designed to support a child by the hands only (e.g. horizontal ladder, overhead swinging rings).

4. SURFACING

The surface under and around playground equipment can be a major factor in determining the injury-causing potential of a fall. It is self evident that a fall onto a shock absorbing surface is less likely to cause a serious injury than a fall onto a hard surface. Because head impact injuries from a fall have the potential for being life threatening, the more shock absorbing a surface can be made, the more is the likelihood that the severity of the injury will be reduced. However, it should be recognized that ~~all~~ some injuries ~~due to~~ from falls ~~cannot be prevented~~ will occur no matter what playground surfacing material is used.

4.1 Determining Shock Absorbency of a Surfacing Material

No data are available to predict precisely the threshold tolerance of the human head to an impact injury. However, biomedical researchers have established two methods that may be used to determine when such an injury may be life threatening.

One method holds that if the peak deceleration of the head during impact does not exceed 200 times the acceleration due to gravity (200 G's), a life threatening head injury is not likely to occur. The second method holds that both the deceleration of the head during impact and the time duration over which the head decelerates to a halt are significant in assessing head impact injury. This latter method uses a mathematical formula to derive a value known as Head Injury Criteria (HIC) [5]. Head impact injuries are not believed to be life threatening if the HIC does not exceed a value of 1,000.

The most widely used test method for evaluating the shock absorbing properties of a playground surfacing material is to drop an instrumented metal headform onto a sample of the material and record the acceleration/time pulse during the impact. Such a method is described in an ASTM Standard Specification for Impact Attenuation of Surface Systems Under and Around Playground Equipment, ASTM F1292 [6].

4.2 Critical Height -- is a term originating from Europe and is used to describe the shock absorbing performance of a surfacing material. As ~~it is~~ used in this publication, the Critical Height for a surfacing material is defined as **the maximum height from which the instrumented metal headform, upon impact, yields both a peak deceleration of no more than 200 G's and a HIC of no more than 1,000 when tested in accordance with the procedure described in ASTM F1292.** Critical Height, therefore, can be considered as an approximation of the maximum fall height from which a life-threatening head injury would not be expected to occur.

The surfacing material used under and around a particular piece of playground equipment should have a Critical Height value of at least the height of the highest accessible part of the equipment.

4.3 Highest Accessible Part of Equipment

Recommendations for the "highest accessible part" for various pieces of playground equipment are as follows.

Climbers and Horizontal Ladders - For structures that are intended to be climbed upon, the highest accessible part is the maximum height of the structure.

Elevated Platforms Including Slide Platforms - Since children may climb onto or over guardrails, the highest accessible part of a platform surrounded by guardrails is the height above the playing surface of the top of the guardrail. Since protective barriers are designed to minimize the likelihood of climbing, the highest accessible part of a platform surrounded by protective barriers is the height of the platform surface above the ground.

Merry-Go-Rounds - The highest accessible part is the height above the ground of any part at the perimeter on which a child may sit or stand.

See-Saws - The highest accessible part is the maximum height attainable by any part of the see-saw.

Spring Rockers - The highest accessible part is the maximum height above the ground of the seat or designated play surface.

Swings - Since children may fall from a swing seat at its maximum attainable angle (assumed to be 90° from the "at rest" position), the highest accessible part of a swing structure is the height of the pivot point where the swing's suspending elements connect to the supporting structure.

4.3.1 Recommended Maximum Accessible Heights

Preschool-Age Children - With the exception of swings and horizontal ladders, it is recommended that the highest accessible part of the equipment be no more than 4 feet above the protective surfacing. The recommended maximum height for swing hangers is 8 feet and for horizontal ladders is 5 feet.

School-Age Children - It is recommended that the highest accessible part of all equipment be no more than 8 feet.

Note: These maximum height recommendations do not apply to playground equipment that is totally enclosed (i.e. includes a roof over platforms and protective barriers with no openings large enough for the small torso template (see Figure B-3) to freely pass through).

4.4 Equipment to Which Protective Surfacing Recommendations Do Not Apply

Equipment that requires a child to be standing or sitting at ground level during play is not expected to follow the recommendations for resilient surfacing. Examples of such equipment are sand boxes, activity walls or any other equipment that has no elevated playing surface.

4.5 Acceptability of Various Surfacing Materials

Hard surfacing materials, such as asphalt or concrete, are unsuitable for use under and around playground equipment of any height unless they are required as a base for a shock absorbing unitary material such as a rubber mat. Earth surfaces such as soils and hard packed dirt are also not recommended because their shock absorbing properties can vary considerably depending on geologic and climatic conditions, such as moisture and temperature. Similarly, grass and turf are not recommended because their effectiveness in absorbing shock during a fall can be reduced considerably due to wear and environmental conditions.

Acceptable playground surfacing materials are available in two basic types, **unitary** or **loose-fill.**

Unitary Materials - are generally rubber mats or a combination of rubber-like materials held in place by a binder that may be poured in place at the playground site and cures to form a unitary shock absorbing surface. Unitary materials are available from a number of different manufacturers, many of whom have a range of materials with differing shock absorbing properties. Persons wishing to install a unitary material as a playground surface should request test data from the manufacturer ~~that should~~ identifying the Critical Height of the desired material. In addition, site requirements should be obtained from the manufacturer because, as stated above, some unitary materials require installation over a hard surface while ~~for others this is not required~~ some do not.

Loose-Fill Materials - can also have acceptable shock absorbing properties when installed and maintained at a sufficient depth. These materials include, but are not confined to, sand, gravel, ~~and~~ shredded wood products and shredded tires. Loose-fill materials should not be installed over hard surfaces such as asphalt or concrete unless daily inspection can be guaranteed to insure that the materials have not become displaced.

Because loose-fill materials are generally sold for purposes other than playground surfacing, many vendors are unlikely to be able to provide information on their shock absorbing performance. For that reason, CPSC staff has conducted tests to determine the relative shock absorbing properties of some loose-fill materials commonly used as surfaces under and

around playground equipment. Appendix D contains a description of the tested materials. The tests were conducted in accordance with the procedure in the voluntary standard for playground surfacing systems, ASTM F1292. Table 1, below, lists the critical height (expressed in feet) for each of seven materials when tested in an uncompressed state at depths of 6, 9, and 12 inches. The table also reports the critical height when a 9 inch depth of each material was tested in a compressed state.

~~The~~ Table 1 should be read as follows: If, for example, uncompressed wood mulch is used at a minimum depth of 6 inches, the Critical Height is 7 feet. If 9 inches of uncompressed wood mulch is used, the Critical height is 10 feet. It should be noted that, for some materials, the Critical Height decreases when the material is compressed.

TABLE 1 - CRITICAL HEIGHTS (in feet) OF TESTED MATERIALS				
MATERIAL	UNCOMPRESSED DEPTH			COMPRESSED DEPTH
	6 inch	9 inch	12 inch	9 inch
Wood Mulch	7	10	11	10
Double Shredded Bark Mulch	6	10	11	10
Uniform Wood Chips	6	7	>12	6
Fine Sand	5	5	9	5
Coarse Sand	5	5	6	4
Fine Gravel	6	7	10	6
Medium Gravel	5	5	6	5

The Critical Heights shown in the above table may be used as a guide in selecting the type and depth of loose-fill materials that will provide the necessary safety for equipment of various heights. There may be other loose-fill materials such as bark nuggets or shredded tires that have shock absorbing properties equivalent to those in the above table. However, no tests have been conducted on these materials by CPSC staff.

The depth of any loose fill material could be reduced during use resulting in different shock-absorbing properties. For this reason, a margin of safety should be considered in selecting a type and depth of material for a specific use. When loose-fill materials are used, it is recommended that there be a means of containment around the perimeter of the fall zone. Also, depending on playground location, weather conditions and frequency of use, frequent maintenance may be necessary to insure adequate depth and to loosen the materials which may have become packed (see additional maintenance discussion in Section 7.2).

4.6 Accessibility to the Disabled

The Americans with Disabilities Act of 1990 (ADA) prohibits discrimination on the basis of disability in employment, public services, transportation, public accommodations (including many services operated by private entities) and telecommunications. Title III of the legislation includes within the definition of public accommodation: "a park, zoo, amusement park, or other place of recreation; a school, including nursery schools; a day care center; and a gymnasium, health spa, or other places of exercise or recreation." Specific Federal requirements for accessibility to playgrounds by the disabled are expected to be published in 1998 and may prohibit the use of many loose-fill materials.

~~The Department of Parks and Recreation in the State of California has advised that after January 1, 1991, regulations requiring that all types of play activity in new and redone play areas must be accessible to the disabled. Other states may similarly issue accessibility requirements.~~ Playground designers, installers and operators are reminded that they should determine what Federal and State requirements for accessibility are in effect. These requirements could necessitate changes to existing playgrounds as well as when new playgrounds are planned or existing playgrounds refurbished.

4.7 Other Characteristics of Surfacing Materials

Selection of a surfacing material for a specific location may be governed by the environmental conditions at that location. Appendix C lists some characteristics of surfacing materials that may influence the choice for a particular playground.

5. ~~USE~~ FALL ZONES FOR EQUIPMENT

~~The use zone for each piece of equipment is made up of two parts:~~

The Fall Zone is an area under and around the equipment where protective surfacing is required. ~~and,~~

~~(2) the No-Encroachment Zone: an additional area beyond the fall zone where children using the equipment can be expected to move about and should have no encroaching obstacles.~~

~~With the exception of spring rocking equipment, equipment under 24 inches in height, and the zone between adjacent swings (see below), the fall zones of adjacent pieces of equipment should not overlap. However, adjacent pieces of equipment may share a single no-encroachment zone.~~

Regardless of the type of equipment, the ~~use~~ fall zone should be free of obstacles that children could run into or fall on top of and thus be injured. For example, there should not be any vertical posts or other objects protruding from the ground onto which a child may fall.

5.1 Recommendations for Fall Zones for Different Types of Playground Equipment

5.1.1 Stationary Equipment (excluding slides)

The fall zone should extend a minimum of 6 feet in all directions from the perimeter of the equipment.

The fall zones of two stationary pieces of playground equipment that are positioned adjacent to one another may overlap if the adjacent play events of each structure are no more than 30 inches above the protective surface. If adjacent play events on either structure exceed a height of 30 inches, the minimum distance between the structures should be 9 feet.

5.1.2 Slides -- The fall zone in front of the access and to the sides of a slide ~~shall~~ should extend a minimum of 6 feet from the perimeter of the equipment. Note: This does not apply to embankment slides.

The fall zone in front of the exit of a slide ~~shall~~ should extend a minimum distance of 6 feet from the end of the slide chute or for a distance of H + 4 feet whichever is the greater. H is the height of the slide platform and the H + 4 foot measurement is made from a point on the slide chute where the gradient has been reduced to 5° from the horizontal (see Figure 1).

5.1.3 Single-Axis Swings -- Because children may deliberately attempt to exit from a single axis swing while it is in motion, the fall zone in front of and behind the swing should be greater than to the sides of such a swing. It is recommended that the fall zone extend to the front and rear of a single axis swing a minimum distance of ~~2 times~~ twice the height of the pivot point above the surfacing material measured from a point directly beneath the pivot on the supporting structure (see Figure 2). The fall zone to the sides of a single axis swing should follow the general recommendation and extend a minimum of 6 feet from the perimeter of the swing structure in accordance with the general recommendation for fall zones. This 6 foot zone may overlap that of an adjacent swing structure.

The fall zone to the front and rear of tot swings should extend a minimum distance of twice the height of the pivot point measured from the lowest point on the occupant seating surface when the swing is unoccupied.

5.1.4 Multi-Axis Swings -- The fall zone should extend in any direction from a point directly beneath the pivot point for a minimum distance of 6 feet + the length of the suspending members (see Figure 18). In addition, the fall zone ~~shall~~ should extend a minimum of 6 feet from the perimeter of the supporting structure. This 6 foot zone may overlap that of an adjacent swing structure.

5.1.5 Merry-Go-Rounds -- The fall zone should extend 6 feet beyond the perimeter of the platform.

5.1.6 Spring ~~Rocking Equipment~~ Rockers The fall zone should extend a minimum of 6 feet from the "at rest" perimeter of the equipment, but adjacent spring rockers with a maximum height of ~~24~~ 30 inches may share the same fall zone.

5.1.7 Composite ~~Equipment~~ Play Structures -- The above recommendations for individual pieces of equipment should be used as a guide in establishing the fall zones around ~~pieces of~~ the perimeter of a composite play~~ground~~ ~~equipment~~ structure. Note that in Sections 12.6.2 and 12.6.4 it is recommended that ~~single-axis~~ swings not be ~~a part of~~ attached to a composite structure.

~~5.2 Recommendations for No-Encroachment Zone~~

~~No specific dimensions can be recommended for the no-encroachment zone around individual pieces of playground equipment. These dimensions will vary according to the types of adjacent pieces of equipment and their orientation with respect to one another.~~

~~For example, the recommended fall zone at the side of both a slide and a swing is 6 feet. Since fall zones should not overlap (with the exception of certain adjacent spring rockers), a slide could be placed with its side no closer than 12 feet to the side of a swing. Therefore, there may be no need to add an additional no encroachment zone. Conversely, it would not be desirable to have a slide exit facing the front or rear of single axis swing.~~

~~No encroachment zones extending beyond the fall zones are recommended for moving equipment or equipment from which the child is in motion as he or she exits. This allows more space for children to regain their balance upon exiting the equipment and also provides added protection against other children running into a moving part.~~

~~For a single axis swing, it is recommended that there be a barrier beyond the fall zone in front of the swing if it is located in a playground facing other pieces of equipment.~~

6. LAYOUT AND DESIGN OF PLAYGROUNDS

6.1 Choosing a Site

When planning a new playground, it is important to consider hazards or obstacles to children traveling to or from the playground. A barrier, surrounding the playground, is recommended to prevent children from inadvertently running into a street. Such a barrier should not preclude supervision. It is recommended that such barriers have a minimum height of 5 feet and conform to the opening size recommendations in CPSC publication No. 362, Safety Barrier Guidelines for Home Pools [7].

When selecting a site, consideration should be given to slope and drainage, especially if loose-fill surfacing materials are going to be installed. While a gentle slope may aid in drainage, steep slopes could result in loose fill materials becoming washed away during periods of heavy rain. Such sites may require re-grading.

6.2 Locating Equipment

The playground should be organized into different areas to prevent injuries caused by conflicting activities and children running between activities. Active, physical activities should be separate from more passive or quiet activities. Areas for play equipment, open fields, and sand boxes should be located in different sections of the playground.

In addition, popular, heavy-use pieces of equipment or activities should be dispersed to avoid crowding in any one area. The layout of equipment and activity areas should be without visual barriers so that there are clear sight lines everywhere on the playground to facilitate supervision.

Moving equipment, such as swings and merry-go-rounds should be located toward a corner, side or edge of the play area. Slides exits should also be located in an uncongested area of the playground. Fall zones for moving equipment and at slide exits should never overlap the fall zone of other equipment, regardless of height.

Composite ~~equipment has~~ play structures have become increasingly popular on public playgrounds. Care should be taken to ensure that the play and traffic patterns of children using adjacent components on composite structures ~~equipment~~ are complementary.

6.3 Age Separation of Equipment

It is recommended that playgrounds have separate areas for younger children with appropriately sized equipment and materials to serve their less advanced developmental levels. The following items of playground equipment are not recommended for pre-school age children (2 to 5 years):

Chain or Cable Walks
Free Standing Arch Climbers
Free Standing Climbing Events with Flexible Components
Fulcrum Seesaws
Log Rolls
Long Spiral Slides
Overhead Rings
Parallel Bars
Swinging Gates
Track Rides
Vertical Sliding Poles

It is also important to recognize that preschoolers require more attentive supervision on playgrounds. ~~Throughout~~ In this handbook, ~~consideration is given to~~ there are several specific recommendations for equipment designed for preschool-age children ~~(2 to 5 years)~~. Following is a list of these recommendations together with references to the sections in which they are discussed:

Highest Accessible Part of Equipment (4.3)
Rung Ladders, Stepladders, Stairways and Ramps (Table 2)
Handrail Height (10.3.1)
Guardrails and Protective Barriers (11.3,11.4,11.5 and 11.7)
Stepped Platforms (11.7)
Climbers (12.1.2)
Horizontal Ladders (12.1.5)
Merry-Go-Rounds (12.2)
Spring Rockers (12.5)
Tot Swings (12.6.3)
Swings (12.6.2 & 12.6.3)

The design and scale of equipment should make the intended user group obvious. Some playgrounds, often referred to as "tot lots," are designed only for ~~younger~~ preschool-age children, so separation is not an issue.

In playgrounds intended to serve children of all ages the layout of pathways and the landscaping of the playground should show the ~~two~~ distinct areas for the two age groups. The areas should be separated at least by a buffer zone, ~~of ample physical space~~ which could be an area with shrubs or benches for supervisors. Signs posted in the playground area can be used to give some guidance to adults as to the age appropriateness of the equipment.

7. INSTALLATION AND MAINTENANCE OF EQUIPMENT

7.1 Assembly and Installation

Proper assembly and installation of playground equipment are crucial for structural integrity, stability, and overall safety. The people who assemble and install playground equipment should not deviate from the manufacturer's instructions. After assembly, equipment should be thoroughly inspected before its first use by a person qualified to inspect playgrounds for safety.

As a precaution, the manufacturer's assembly and installation instructions, and all other materials collected concerning the equipment should be kept in a permanent file.

7.1.1 Stability

When properly installed as directed by the manufacturer's instructions and specifications, equipment should withstand the maximum anticipated forces generated by active use which

might cause it to overturn, tip, slide, or move in any way. Secure anchoring is a key factor to stable installation, and because the required footing sizes and depths may vary according to equipment type, the anchoring process should be completed in strict accordance with the manufacturer's specifications. Local building codes may also have specific requirements for footings and anchoring of equipment together with a requirement for inspection by a licensed inspector.

7.2 Maintenance

Inadequate maintenance of equipment ~~can lead to~~ has resulted in injuries on ~~the~~ playgrounds. Because the safety of playground equipment and its suitability for use depend on good inspection and maintenance, the manufacturer's maintenance instructions and recommended inspection schedules should be strictly followed.

A comprehensive maintenance program should be developed for each playground ~~as a whole~~. ~~Generally,~~ All equipment should be inspected frequently for any potential hazards, for corrosion or deterioration from rot, insects, or weathering. The playground area should also be checked frequently for broken glass or other dangerous debris. Any damage or hazards detected during inspections should be repaired immediately, in accordance with the manufacturer's instructions for repair and replacement of parts.

For each piece of equipment, the frequency of thorough inspections will depend on the type of equipment, the amount of use, and the local climate. Based on the manufacturer's recommendations regarding maintenance schedules for each piece of equipment, a maintenance schedule for the entire playground can be created. The detailed inspections should give special attention to moving parts and other components which can be expected to wear. Inspections should be carried out in a systematic manner by trained personnel.

One possible procedure is the use of checklists. Some manufacturers supply checklists for general or detailed inspections with their maintenance instructions. These can be used to ensure that inspections are in compliance with the manufacturer's specifications. Inspections alone do not constitute a comprehensive maintenance program. All hazards or defects identified during inspections should be repaired promptly. All repairs and replacements of equipment parts should be completed in accordance with the manufacturer's instructions. A general checklist that may be used as a guide for frequent routine inspections of public playgrounds is included at Appendix A. ~~The checklist at Appendix A~~ This is intended to address only general maintenance concerns. It does not provide a complete safety evaluation of equipment design and layout. For example, it does not address the risk of falls from equipment, moving impact incidents, or head entrapment. Therefore, it is essential to use this checklist only for general maintenance purposes. The detailed design recommendations contained in this Handbook ~~should~~ can be used to evaluate the safety of each piece of equipment and the playground as a whole.

~~In addition to this general maintenance inspection, more detailed inspections should be conducted on a regular basis. The procedures and schedules for these detailed inspections will depend on the types and amount of equipment on the playground, the level of use, and the local climate, as well as the maintenance instructions provided by equipment manufacturers. Therefore, this checklist is only one of many elements which should be considered in the development of a comprehensive inspection schedule and system of maintenance.~~

~~Complete documentation~~ Records of all maintenance inspections and repairs should be retained, including the manufacturer's maintenance instructions and any checklists used. When an inspection is performed, the person performing it should sign and date whatever form is used. A record of any accident and injury reported to have occurred on the playground should also be ~~collected~~ retained. This will help identify potential hazards or dangerous design features ~~which warrant attention~~ that should be corrected.

8. MATERIALS OF MANUFACTURE AND CONSTRUCTION

8.1 Durability and finish

Purchasers should be sure that the equipment is manufactured and constructed only of materials that have a demonstrated record of durability in the playground or similar outdoor setting. Any new materials ~~shall~~ should be documented or tested accordingly for durability by the playground equipment manufacturer.

A major concern for playground equipment materials is corrosion or deterioration. Metals should be painted, galvanized, or otherwise treated to prevent rust.

All paints and other similar finishes must meet the current CPSC regulation for lead in paint ~~[3]~~ [8] (0.06% [600 ppm] maximum lead by dry weight). The ~~Regardless of the material or treatment process, the~~ manufacturer should ensure that the users of playground equipment cannot ingest, inhale, or absorb potentially hazardous amounts of ~~substances~~ preservative chemicals or other treatments applied to the equipment as a result of contact with equipment. Purchasers and installers of playground equipment should obtain documentation from the manufacturer that the preservatives or other treatments that have been used ~~applied to the equipment would~~ do not present a hazard to the consumer. The type of finish and treatment selected should not decrease the slip resistance of the playground equipment components the children normally contact.

Testing by CPSC and various state and local agencies revealed that some older playground equipment in schools, parks, and communities across the U.S. has leaded paint that over time has deteriorated. When playground equipment paint deteriorates, the resulting chips and dust may be ingested by young children who regularly touch the equipment while playing and then transfer the paint chips or dust from their hands to their mouths. The amount of paint that may be ingested can contribute to a hazardous and unnecessarily high lead exposure.

A strategy for identifying and controlling leaded paint on playground equipment is available from CPSC. A case-by-case approach is recommended since there are many factors to consider when developing a hazard assessment and plans for appropriate controls. Playground managers should consult an October 1996 report, CPSC Staff Recommendations for Identifying and Controlling Lead Paint on Public Playground Equipment [9].

Wood should either be naturally rot and insect-resistant or treated to avoid such deterioration. The most common wood treatments used in playground equipment are the inorganic arsenicals. Chromated copper arsenate (CCA) is acceptable for use as a treatment of playground equipment wood, if the dislodgeable arsenic on the surface of the wood is minimized. Inorganic arsenicals should be applied by the manufacturer or wood preserver in accordance with the specifications of the American Wood Preservers Association C17 standard. This standard states that the treated wood should be visibly free of residues which may contain high levels of arsenic (the greenish coloration of CCA treated wood is acceptable). Wood preservers and playground equipment manufacturers should practice technologies and procedures that minimize the level of dislodgeable arsenic (arsenic that might be removable from the wood surface by skin contact or wiping with testing materials). CPSC staff has found that technology and practices exist to treat playground equipment wood with CCA so that dislodgeable arsenic is below detectable levels [10].

Installers, builders, and consumers who perform woodworking operations such as sanding, sawing, or sawdust disposal on pressure treated wood should read the consumer information sheet often available at the point of sale [11]. The sheet contains important health precautions and disposal information. Creosote, pentachlorophenol, and tributyl tin oxide are too toxic or irritating and should not be used as preservatives for playground equipment wood. Pesticide-containing finishes should also not be used. Other preservatives that have low toxicity and may be suitable for playground equipment wood are copper or zinc naphthenates, and borates.

8.2 Hardware

When installed and tightened in accordance with the manufacturer's instructions, all fasteners, connecting, and covering devices should not loosen or be removable without the use of tools. Lock washers, self-locking nuts, or other locking means should be provided for all nuts and bolts to protect them from detachment. Hardware in moving joints should also be secured against unintentional or unauthorized loosening. In addition, all fasteners should be corrosion resistant and be selected to minimize ~~the likelihood of~~ corrosion ~~to~~ of the materials they connect. Bearings used in moving joints should be easy to lubricate or be self-lubricating. All hooks, including S hooks, should be closed as tightly as possible (see also Section 12.6.1).

8.3 Metal Surfaces

To avoid the risk of contact burn injury ~~in geographical regions where intense sunlight can be expected~~, bare or painted metal surfaces on platforms and slide beds should be avoided unless they can be located out of the direct ~~rays of the~~ sun. As an alternative to bare or painted metal, platforms may be ~~fabricated from~~ wood, plastic or vinyl coated metal and slide beds may be fabricated from plastic (see also Slides in Section 12.4.4).

9. GENERAL HAZARDS

There are a variety of general hazards common to many types of playground equipment. The guidelines in this section apply to all elements of the playground.

9.1 Sharp Points, Corners, and Edges

There should be no sharp points, corners, or edges on any components of playground equipment that could cut or puncture children's skin. Frequent inspections are important ~~in order~~ to prevent injuries caused by ~~the exposure of~~ sharp points, corners, or edges due to wear and tear on the equipment. The exposed open ends of all tubing not resting on the ground or otherwise covered ~~shall~~ should be ~~provided with~~ covered by caps or plugs that cannot be removed without the use of tools.

Wood parts should be smooth and free from splinters. All corners, metal and wood, should be rounded. All metal edges should be rolled or have rounded capping. ~~Special attention to~~ There should be no sharp edges on slides. ~~especially~~ Metal edges on ~~is warranted.~~ the exit end and the sides along a slide bed can be particularly dangerous if protective measures are not taken (see also Section 12.4.5).

9.2 Protrusions and Projections

> ! WARNING: Children have died when hood or neck drawstrings on their jackets or sweatshirts caught on slides or other playground equipment. Parents are advised to remove hood or neck drawstrings from clothing to prevent entanglement and strangulation.

Protrusions or projections on playground equipment should not be capable of entangling children's clothing, because such entanglement can cause serious injuries or death by strangulation. ~~In~~ Particular attention should be given to avoid ~~eliminating~~ protrusions or projections ~~at the top of~~ on slides to minimize the risk of entanglement with clothing. Jackets and sweatshirts with hoods and/or drawstrings have been implicated in such entanglement/strangulation incidents. The diameter of a protrusion should not increase in the direction away from the surrounding surface towards the exposed end (see Figure 4).

When tested in accordance with the procedure in Paragraph 9.2.1, no protrusion should extend beyond the face of any of the three gauges having dimensions shown in Figure 5. These gauges may be purchased from the National Recreation and Park Association (NRPA) [12].

9.2.1 Protrusion Test Procedure

Successively place each gauge (see Figure 5) over any protrusion or projection and determine if it projects beyond the face of the gauge (see Figure 6).

9.3 Protrusions on Suspended Members of Swing Assemblies

~~These form a special case~~ Because protrusions on swings ~~they~~ can be extremely hazardous, given the potential for impact incidents, ~~therefore,~~ a special test gauge (see Figure 7) and procedure are recommended. No ~~surface~~ bolts or components in the potential impact region on suspended members should protrude through the hole beyond the face of the specified gauge, when tested in accordance with the following method.

Conduct the test with the suspended member in its rest position. Place the gauge over any protrusion on the front or rear surface of the suspended member such that the axis of the hole in the gauge is parallel to both the intended path of the suspended member and a horizontal plane. Visually determine if the protrusion penetrates through the hole and beyond the face of the gauge.

9.4 Protrusions that Project Upwards and Protrusions on Slides

To minimize the likelihood of clothing entanglement, protrusions that fit within any one of the three gauges shown in Figure 5 and also have a major axis that projects upwards from a horizontal plane should not have projections perpendicular to the plane of the surrounding surface that are greater than 1/8 inch (see Figure 8). This recommendation also applies to protrusions on slides no matter what their orientation if the protrusions fall within the area depicted in Figure 9.

9.5 Pinch, Crush, and Shearing Points

There should be no accessible pinch, crush, or shearing points on playground equipment that could injure children or catch their clothing. Such points can be caused by components moving relative to each other or to a fixed component when the equipment moves through its anticipated use cycle. To determine if there is a possible pinch, crush or shear point, consider the likelihood of entrapping a body part and the configuration and closing force of the components. Additional information on pinch, crush, and shear points is provided in the recommendations addressing specific pieces of equipment in Section 9.

9.6 Entrapment

9.6.1 Head entrapment

A component or a group of components should not form openings that could trap a child's head. A child's head may become entrapped if the child ~~attempts to~~ enters an opening either feet first or head first. Head entrapment by head-first entry generally occurs when children place their heads through an opening in one orientation, ~~then, after~~ turn~~ing~~ their heads to a different orientation, ~~they~~ and then are unable to withdraw from the opening. Head entrapment by feet-first entry involves children who ~~are~~ generally sit~~ting~~ or ~~lying~~ lie down and slide their feet into an opening that is large enough to permit passage of their bodies but is not large enough to permit passage of their heads ~~which then become entrapped~~.

~~In general,~~ Generally, an opening ~~may~~ presents an entrapment hazard if the distance between any interior opposing surfaces is greater than 3.5 inches and less than 9 inches. When one dimension of an opening is within this ~~potentially hazardous~~ range, all dimensions of the opening ~~must~~ should be considered together to ~~fully~~ evaluate the possibility of entrapment. This recommendation applies to all completely-bounded openings (see Figure B-1 in Appendix B) except where the ground serves as an opening's lower boundary. Further, it applies to all openings regardless of their height above the ground (see Figure B-1). Even ~~those~~ openings that are low enough ~~to permit~~ for children's feet to touch the ground ~~with their feet~~ can present a risk of strangulation for an entrapped child, because younger children may not have the necessary cognitive ability ~~and~~ or motor skills to extricate their heads especially if scared or panicked.

~~The most appropriate way~~ To determine whether an opening is hazardous ~~is to~~ use the recommended test fixtures, ~~Recommended test fixtures,~~ performance ~~requirements~~ recommendations, and test methods, ~~are~~ described in Appendix B. These recommendations apply to all playground equipment for both ~~for~~ preschool-age and school-age children. Fixed equipment as well as moving equipment (in its stationary position) should be tested for entrapment hazards. There are two special cases for which separate procedures are given: completely bounded openings where depth of penetration is a critical issue, and openings formed by non-rigid climbing components.

9.6.2 Angles

The angle of any vertex formed by adjacent components should not be less than 55 degrees, unless the lower leg is horizontal or projects downwards (see Figure 10). An exception to this recommendation can be made if a rigid shield is attached to the vertex between adjacent components and the shield is of sufficient size to prevent a 9 inch diameter circular template from simultaneously touching components on either side of the vertex (see Figure 11).

9.7 Tripping Hazards

All anchoring devices for playground equipment, such as concrete footings or horizontal bars at the bottom of flexible climbers, should be installed below the ~~playing~~ protective surfacing

material to eliminate the hazard of tripping. This will also prevent children who may fall from sustaining additional injuries due to exposed footings. In addition, ~~attention should be given to~~ environmental obstacles in the play area, including rocks, roots, fallen tree branches and other protrusions from the ground that may cause children to trip should be removed.

Retaining walls are commonly used to help contain loose surfacing materials. In order to minimize the trip hazard, retaining walls should be highly visible and any change of elevation should be obvious. The use of bright colors can contribute to better visibility.

9.8 Suspended Hazards

Cables, wires, ropes, or similar flexible components suspended between play units or from the ground to a play unit within 45 degrees of horizontal should not be located in areas of high traffic because they may cause injuries to a running child. It is recommended that these suspended members be either brightly colored or contrast with surrounding equipment to add to their visibility. This recommendation does not apply to suspended members that are located 7 feet or more above the playground surface.

10. ~~ACCESS AND PLATFORMS~~ STAIRWAYS, LADDERS AND HANDRAILS

10.1 General

Access to playground equipment can take many forms, such as conventional ramps, stairways with steps, and ladders with steps or rungs. Access may also be by means of climbing components, such as climbing nets, arch climbers, and tire climbers (see Figure 12). Such climbing components are generally intended to be more challenging than stairways and stepladders, and so require better balance and coordination of the children. Rung ladders are generally considered to present a level of challenge intermediate between stairways or stepladders and climbing components.

Rung ladders and climbing components such as climbing nets, arch climbers, and tire climbers, should not be used as the sole means of access to equipment intended for ~~preschoolers~~ preschool-age children.

Platforms over 6 feet in height (with the exception of free-standing slides) should provide an intermediate standing surface where a decision can be made to halt the ascent and to pursue an alternative means of descent.

10.2 Stairways and Ladders

Stairways, stepladders, and rung ladders are distinguished by the range of slopes permitted for each of these types of access. However, in all cases the steps or rungs should be evenly spaced, including the spacing between the top step or rung and the surface of the platform. Table 2 contains recommended dimensions for: access slope, tread or rung width, tread

depth, rung diameter, and vertical rise for rung ladders, stepladders, and stairways. Table 2 also contains slope and width recommendations for ramps. However, these recommendations are not intended to address ramps designed for access by wheelchairs.

Openings between ~~adjacent~~ steps or rungs and between the top step or rung and underside of a platform should ~~preclude~~ prevent the possibility of entrapment. Risers on stairways and stepladders should be closed if the distance between opposing interior surfaces of consecutive steps is between 3.5 and 9 inches (see Section 9.6). Since the design of rung ladders does not permit risers to be closed, the space between ~~consecutive~~ rungs should not be between 3.5 and 9 inches.

When risers are closed, treads of stairways and ladders should prevent the accumulation of sand, water, or other materials on or between steps.

10.2.1 Rungs and Other Handgripping Components

Whereas the steps of stairways and stepladders are used only for foot support, the rungs of rung ladders are used for both foot support and for hand support by a climbing child since rung ladders generally do not have handrails.

Rungs are generally round in cross section and should have a diameter or maximum cross sectional dimension between ~~1~~ 0.95 and ~~1.67~~ 1.55 inches. Other components intended to be grasped by the hands such as the bars of climbers should also have a diameter or maximum cross sectional dimension between ~~1~~ 0.95 and ~~1.67~~ 1.55 inches.

~~Rungs or other handgripping components that are intended to be grasped in a manner such that users will support their entire body weight by their hands should be generally round in cross section with a diameter between 1 and 1.55 inches.~~ To benefit the weakest child in each age group, a diameter of 1.25 inches is preferred. All rungs should be secured in a manner that prevents them from turning.