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LOG OF MEETING

SUBJECT: **Playground Surfacing - ASTM F08-63 Subcommittee Meeting**

DATE OF MEETING: **May 21, 1999**

DATE OF LOG ENTRY: **June 1, 1999**

PERSON SUBMITTING LOG: **George F. Sushinsky**

LOCATION: Sheraton Hotel
Seattle, WA

CPSC ATTENDEE(S): George F. Sushinsky

NON-CPSC ATTENDEE(S): Members and Guests of ASTM F 08.63
An attendance list is not yet available but is being mailed to attendees. It will be attached to this log when available

SUMMARY OF MEETING:

The meeting was called to order by subcommittee chairman Robert Heath (Fibar). After introductions, it was requested that a membership list be included in the next mailing with the minutes of the current meeting. A proposed agenda was available but the chairman announced that he knew of changes to the agenda to accommodate the scheduled ASTM break. (See attachment 1.) The time for discussion of each item was controlled and may have in some cases limited discussion. Procedural issues were addressed with regard to proxy representation. Only one proxy is allowed per ASTM rules and that proxy must be assigned to a particular individual. Mr. Heath indicated that he wished the members of the subcommittee to play by the rules.

(2) Review of Main Committee Ballot Results of F 1292

Mr. Heath announced that the main committee ballot upholding the subcommittee's negatives had passed. This means that the revised standard was approved for publication and would be issued about September 1999. Donna Thompson, Director of the National Program for Playground Safety (NPPS) asked if activities at the current meeting could suspend publication of the revised standard. George Luciw, the subcommittee's ASTM liaison, said that current discussions could not affect the business conducted 6 months previously. New business conducted at the current meeting could result in changes to the standard. A discussion of the "fair play" aspects of lobbying a position ensued. Roger Schmidt, subcommittee chairman of F08.52 on Playing Surfaces, suggested that the standards process move forward to new issues that contribute to the improvement of the standard.

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(3) Report on Reference Pad Task Group

Roger Amorosi initiated a discussion of the Reference Pad Task Group. He outlined activities in the headgear subcommittees for ice hockey helmets and bicycle helmets concerning a system check procedure for impact attenuation measurement systems. A handout containing recommended changes to ASTM F1045-95 "Standard Performance Specification for Ice Hockey Helmets" and a letter from CPSC staff outlining a similar recommendation for playground surfacing systems was distributed. (See attachment 2.) Mr. Amorosi then asked George Sushinsky (CPSC) to describe the system check procedure recommended in the CPSC letter. Mr. Sushinsky explained the use of the procedure, the CPSC and bicycle industry experience in using the procedure to verify the operational performance of the impact attenuation equipment used at various laboratories, and the results of a 1997 round robin between seven test laboratories. The reproducibility variability between laboratories was estimated to be less than 10 percent which is substantially better than that measured in a round robin using playground surfacing laboratories in 1988. The systems check procedure uses a spherical impactor of specified shape and mass dropped at a specified velocity onto a specified Modular Elastomer Programmer (MEP). The resulting Peak G response is expected to be within a narrow target value range if the measurement system is operating correctly.

Representatives from the testing laboratories suggested that changes to equipment at CPSC between 1988 and 1998 could explain some of the differences found in internal CPSC testing. Richard Schefsky (Northwest Laboratories) stated that some of the measurement variability in the past were related to the differences in the operational characteristics of equipment used by testing laboratories. It was decided, however, that the proposal was with merit. A round robin to evaluate the current reproducibility within the playground surfacing test industry was proposed as the next step. A motion was drafted and approved to conduct a round robin using the CPSC MEP as a reference surface. Because of the possibility that a spherical impactor may not be compatible with some laboratories equipment, the use of the spherical impactor was left as an option. In addition several laboratories, requested that the Procedure B missile (a hemispherically shaped mass with a 3.25 inch radius weighing 15 lb.) be included in the round robin protocol. Mr. Sushinsky was asked to draft up the test protocol and send it through Robert Heath for distribution to interested testing laboratories. Mr. Martyn Shorten was suggested as the statistician to analyze the data. All participating laboratories were to remain anonymous in whatever reports are published.

(4) Report on Engineered Wood Fiber task Group

Ted Illjes passed out a current draft of the engineered wood fiber standard. (Attachment 3) There was a discussion of the purpose of this standard and its relationship to other forms of wood chips used as surfacing materials. There were discussions about why the specified hazardous materials were included in the standard (they are found in ASTM F 963), and the need for a test to determine metal content. It was recognized that this document is not specific enough to prevent some claims that non-engineered wood chips might be able to pass these tests and claim to be "Engineered." The frequency of testing materials was also a concern for some subcommittee members. The critical height table in the CPSC Playground Safety Handbook was stated to provide a level of endorsement for the materials included in the table. Mr. Sushinsky was asked how would non-engineered wood products be viewed in light of the standard for engineered wood fiber. His response indicated that as long as wood chips remain a choice for surfacing medium, they would probably remain listed in the Handbook.

(5) Review editorial changes to F-1951-99 - "Determination of Accessibility of Surface Systems Under and Around Playground Equipment

The new standard was published and then withdrawn for editorial corrections. Questions arose about the effect on product certified under the interim (PS 83) standard. Would they need to be recertified? Retested? Issued new certification reports? Mr. Amorosi (DTL) said that they would issue a statement of equivalence for the two standards. In addition, a footnote explaining the relationship of PS 83 to F1951 was to be added to the F1951 document while it was undergoing its other editorial changes.

(6) Report on ASTM F 1292 Repeatability Testing

Mr. Shorten presented data showing the effect of more impacts on the repeatability of impact data from one loose-fill and three unitary materials. Four laboratories participated in the tests, each doing one material. Ten impacts each day for five consecutive days were done. Mr. Shorten analyzed the data separately for the loose-fill and unitary materials. He developed precision and bias statements for each material category. He concluded that the data produced by following the current standard, with one conditioning impact and calculating the average of the second and third impacts, could be made less variable by three conditioning impacts and averaging the third and fourth impacts. There did not appear to be a large enough benefit to justify more than three conditioning drops. He also speculated that the variability in the loose-fill data may ultmately lead to the need for a test protocol different than that used for unitary surfaces. (Mr. Shorten and I had discussed such a possibility prior to the meeting.) Mr. Shorten noted that another (extensive) round robin would be necessary to look at such changes to the standard.

(7) Review editorial changes to F 1292

After a lunch break, Mike Hayward suggested delaying publishing of the standard until the needed changes could be made. Because this in an ongoing process this delay was not seen as beneficial. Changes would be added at the next opportunity. Mr. Schefsky (Northwest Laboratories) thought that editorial corrections were necessary. He pointed out what appeared to be a typographical error in the frequency specification for the equipment characteristics. Mr. Luciw said that if it were balloted with that error that ballot would stand. If it could be shown that the alleged mistake was typographical then a change could be made. A call was placed to Paul Bamburak, the author of the disputed section. He said that the balloted standard was correct as drafted and that no changes were necessary.

Comments from Fran Wallach (attachment 5) were deemed not editorial and would be considered when the standard was reballoted.

Items requiring attention were listed to focus the subcommittee's attention on what had been discussed and decided so far. They included:

- Consideration of amending the standard to include more preconditioning impacts
- A round robin with the CPSC MEP
- Possible change in the missile
- Fran Wallach's comments
- A second round robin to address changes to the testing protocols for unitary and loose-fill materials.

A letter from Jeffrey Sacks, from the Center for Disease Control (attachment 6) was discussed briefly. Mr. Sushinsky noted that one issue addressed in the letter - changes to the F 1292 standard - was consistent with the CPSC request to add a system check procedure to the standard. He stated that the reproducibility between laboratories was a concern as well as the variability in loose-material data. Mr. Heath thought that the issue of loose-fill material testing may be decreasing in importance because the provision in the disability legislation (ADA) was eliminating materials such as sand and gravel as a surfacing option. Mr. Sushinsky replied that the ADA did not require access to the entire play equipment, that parts of the surfacing could be sand or gravel, sand and gravel surfacing still exists in communities, and that the variability issues in testing extend to the wood fiber products as well. There was a lot of disagreement about this interpretation of the ADA requirements and the practicality of different surfacing in different parts of the playground. These issues were later rejoined when Donna Thompson returned to the meeting. Dr. Thompson agreed that sand and gravel continue to be used as surfaces in play areas and needed the continued consideration of the subcommittee.

Other Business

Walter Henderson reported on IPEMA certification. IPEMA appears to be an industry group that lists certified providers of surfacing materials. It is not a testing laboratory. There was a discussion of developing a consumer guide to the standard for the user community. Some other standards do this to bring the technical requirements to a more understandable level for the consumer. Mr. Heath enlisted a task group to determine the desirability of this undertaking. Donna Thompson passed copies of "Monkey Bar Injuries: Complications of Play" (Pediatrics Vol. 103 No. 5 May 1999 (attachment 6). She said that NPPS is responding to the report.

The meeting was adjourned at 3:00 p.m.

Attachment 1

Committee F-8 on SPORTS EQUIPMENT AND FACILITIES

Chairman:	Richard D. Breland, Breland Consultant & Service Co., Box 1403, Dalton, GA 30722-1403
First Vice-Chairman:	Roger G. Schmidt, Rubatex Corp., 5223 Valley Pk Dr., Roanoke, VA 24019-3074 (800-348-3428 / Fax 540-561-6085)
Second Vice-Chairman:	Dean Fisher, Bell Sports, Inc., 8464 Charloma Drive, Downey, CA 90240 (562-869-2164 / Fax 562-869-2934)
Secretary:	Martyn R. Shorten, 2835 SE Tolman, Portland, OR 97202-8752 (503-774-7855/Fax 7868)
Membership Secretary:	Robert P. Anderson, Andradco, Inc., P.O. Box 255, Dalton, GA 30722 (706-226-4233 / Fax 4233)
Chairman - F08.63 Playground Surfacing	Robert G. Heath, Suite 300, 80 Business Park Drive, Armonk, NY 10504 800-342-2721 / Fax (914) 273-8659 E-mail: robert@fibar.com
Staff Manager:	George Luciw (610-832-9710) e-mail: gluciw@astm.org

TO: **ASTM F08.63 Playground Surfacing Systems Sub-Committee Members**

DATE: May 21, 1999

Agenda (Revised 5/18/99)

8:00 - 8:10	Opening welcome, identification of attendees	10 mins.
8:10 - 8:15	Appoint a Timekeeper and Align on the Agenda	5 mins.
8:15 - 8:30	(1) Review of minutes of December 8, 1998 F08.63 meeting, Nashville, TN	15 mins.
8:30 - 9:00	(2) Review of Main Committee (98-02) Ballot results of F1292	30 mins.
~~9:00 - 9:10~~	~~Break~~	10 mins.
9:10 - 9:40	(3) Report on Reference Pad Task Group - *Roger Amorosi*	30 mins.
9:40 - 10:10	~~Other Business~~ BREAK ~~Report on Operator Qualifications Task Group - *Paul Bamburak*~~	30 mins.
10:10 - 10:20	~~Break~~ OTHER BUSINESS	10 mins.
10:20 - 10:50	(4) Report on Engineered Wood Fibre Task Group - Ted Ilgen	30 mins.
10:50 - 11:20	(5) Review Editorial Changes to ~~PS 83~~ - 1951-97	30 mins.
11:20 - 11:30	Break	10 mins.
11:30 - 12:00	(6) Report on ASTM F 1292 Repeatability Testing - *Martyn Shorten*	30 mins.
12:00 - 1:00	Lunch	60 mins.
1:00 - 1:30	(7) Review Editorial changes to F 1292 - *Martyn Shorten, Fran Wallach, CPSC, CDC, Biokinetics*	30 mins.
1:30 - 1:50	Update on IPEMA Certification Process - *Walt Henderson*	20 mins.
1:50 - 2:00	Break	10 mins.
2:00 - 2:30	Other Business	30 mins.
2:30 - 3:00	Agreements	30 mins.
3:00	Adjourn	

These time allotments are subject to change.

The next meeting of this Committee will take place on Friday, December 10, 1999 at the Hyatt Regency, New Orleans, Louisiana.

Note: Book of Standards Vol. 15.07 - 1999 Edition
Cut-off Date for all Materials - May 30, 1999
Publication Date - November 1999

Attachment 2

Detroit Testing Laboratory, Inc.
Memorandum

TO: Robert Heath, F08.63 Chairman

FROM: Roger J. Amorosi

DATE: May 17, 1999

SUBJECT: Report on Reference Pad Task Group
F08.63 Seattle 5/21/99 Agenda Item

This request was originally assigned at the May 1998 meeting to Bamburak, Shefsky and Amorosi, but not pursued.

My recent review has involved the following related approaches:

1. Hockey Helmets (F1045)
   Item 2 of recent F8 ballot proposes an MEP pad, a spherical aluminum impactor to be used for Instrument System Check. See attached pages 1A, 1B, and 1C which are pages 17, 20 and 23 of the F8 ballot.

2. Bicycle Helmets (F1447 & F1446)
   ASTM F1447 refers to Paragraph 17 and Paragraph 3.1.17 of ASTM F1446 which are essentially identical to the Hockey Helmet procedure above. Dean Fisher and Dennis Piper have indicated successful use of this procedure for bicycle helmet testing.

3. CPSC Letter Recommendation
   The 4/19/99 CPSC letter (attachment 3A, 3B, and 3C) from George Sushinsky to you recommends essentially the same procedures as above, with an alternative using the ANSI C headform, with appropriate adjustments.

4. CADEX Recommendation
   See attached.

RJA/ld

cc: George Sushinsky
Serge Dextraze (CADEX)
Alfredo Apolloni
Michael Krygier
John Diggs

1A

ITEM #2

F8 BALLOT

ASTM SUBCOMMITTEE F08.15 - ICE HOCKEY EQUIPMENT

DATE: February 1999

TO: ASTM Committee F8

FROM: John Sabelli, Chair, Subcommittee F8.15 on Ice Hockey Equipment JS

SUBJECT: Revisions to **F1045-95 Standard Performance Specification for Ice Hockey Helmets** for concurrent F 8.15 subcommittee and F8 main committee ballot.

This standard is in serious need of updating. Obsolete headforms and impact pads are specified, and the standard is not current with best published practices for headgear testing as detailed in ASTM Method F 1446, and international standards for the same product, such as those of the International Standards Organization

After extensive task group work on comprehensive revisions to F 1045, recommendations were presented to the F8.15 subcommittee at the May 1998 meeting. The revisions were sent out for subcommittee ballot in the fall, and ballot results were discussed at the December 1998 F8 meeting.

The initial subcommittee ballot brought forth a number of comments which were found by the subcommittee to be persuasive. Revisions for these comments, along with editorial corrections, have been incorporated into the present draft.

Specific revisions for area of coverage and allowable damage due to impact testing are balloted separately.

On the following pages, the subject of the revision and the rationale (where not self-evident) for each revision is noted above each change. Existing and proposed new figures are included at the end of the text.

This item is being balloted concurrently by the subcommittee and main committee and will be included in *Standardization News* (SN) for Society Review. It will proceed to publication upon successful balloting and positive resolution of any negative votes or comments received.

1B

(3.1.9 No change)

3.1.10 *modular elastomer programmer (MEP)*– a cylindrical-shaped pad used as the impact surface for the spherical impactor. The MEP is 152 mm (6.0 in.) in diameter, and 25.4 mm (1.0 in.) thick. It is affixed to the top surface of a flat, 6.35 mm (0.25 in.) thick aluminum plate. The durometer of the MEP is 60 ± 2 Shore A.

3.1.11 *spherical impactor*– a 146 mm (5.75 in.) diameter aluminum sphere, weighing 4005 ± 5 g, specifically machined for mounting onto the ball-arm connector of the drop test assembly. The impactor is used for systems check of the electronic equipment.

REVISION: Change reference to temperature range to reflect changes in conditioned impact tests.

4.1.1 All materials used in the fabrication of helmets shall be known to be suitable for the intended application. For example, shell materials shall remain strong, semirigid, and firm, and shall not permanently distort during an exposure of at least 4 h to any temperature in the range ~~from 0 ± 3.6 to 122 ± 3.6°F (-18 ± 2 to 50 ± 2°C),~~ **-25 ± 2°C to 30 ± 2°C (-13 ± 3.6 to 86 ± 3.6°F)**, nor shall the material be significantly affected by exposure to ultraviolet radiation, water, dirt, or vibration. All materials shall be rot-resistant. In addition, paints, glues, and finishes used in manufacture shall be compatible with the helmet shell and shock absorption system materials.

REVISION: Include neck strap language; SI unit dominance.

4.7.3 The minimum width of the chin strap exclusive of the cup,**or neck strap**, shall be ~~0.5 in. (13 mm).~~ **13 mm (0.5 in).**

REVISION: Change reference to temperature range to reflect changes in conditioned impact tests.

5.1 General-Helmets shall be capable of meeting the requirements in this performance specification throughout their full range of adjustment. They shall be capable of meeting the requirements in Sections 11 and 12 at any temperature between ~~0 and 122°F (-18 and 50°C).~~ **-25 and 30°C (-13 and 86°F).**

1C

~~%. This should produce a g_{max} of 375 ± 25 g with a time duration of 3.1 ± 0.3 ms~~
~~line.~~

~~10.2 Record at least three impacts as described in 12.2 and 12.3 immediately prior t~~
~~following each series of tests and record on the report form.~~

~~10.3 If the maximum g or acceleration time history, or both, are not within the tolerance limits prior to test; adjust or repair the system as necessary.~~

~~10.4 If the means of the three peak acceleration values following the test series differ by more than 40 g from the mean of the initial calibration series, discard the entire test series.~~

10. Instrument system check

10.1 The instrumentation of the system shall be checked before and after each series of tests by dropping the spherical impactor (see 3.1.11) onto the MEP pad (see 3.1.10) at an impact velocity of 5.44 m/s (±2%). The peak acceleration obtained during this impact should be 389 ± 8 g. Three such impacts, at intervals of 75 ± 15 s, shall be performed before and after each series of tests. If the peak acceleration obtained in the pre-test impacts differs by more than 5% from the peak acceleration obtained in the post-test impacts, recalibration of the instruments and transducers is required, and all data obtained during that series of helmet tests should be discarded.

REVISION: Change temperature range for materials used and for pre-impact conditioning. Change conditioning environments (tighten acceptable temperature range for ambient condition, colder low temperature condition, lower high temperature condition). Add aging test which evaluates susceptibility of helmet to storage (but not use) at high temperature conditions and exposure to ultraviolet light. Change number of samples required due to addition of this test. State SI units as standard.

RATIONALE: Research conducted to measure temperatures in the helmet liner in actual playing conditions shows that liner temperatures do not exceed 30C (86F). Designing materials for impact protection at higher temperatures involves a trade-off which sacrifices impact attenuation characteristics at normal playing conditions. However damage to helmet from reasonably expected storage conditions is a concern.

11. Conditioning

11.1 Prior to testing, condition each helmet in one of the following ways:

11.1.1 *Ambient Temperature* - Condition one helmet for a period of not less than 4 h at laboratory conditions which shall be at a temperature of ~~70 ± 9°F (21 ± 5°C)~~ **20±2°C (68±3.6°F)** and a relative humidity of 50 ± 15 %. Record the temperature to the nearest degree

3A

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

April 19, 1999

Mr. Robert G. Heath
Chairman, ASTM F08.63
Fiber Inc.
80 Business Park Drive, Suite 300
Armonk, NY 10504-1705

Dear Mr. Heath:

Staff of the U.S. Consumer Product Safety Commission (CPSC) conducted tests on loose-fill playground surfacing materials. It is apparent from the test results that there is a need to revise ASTM F1292, "Consumer Safety Specification for Impact Attenuating Materials Under and Around Playground Equipment." A suggested revision is enclosed.

By way of background, the CPSC staff conducted impact attenuation tests in 1989 on seven loose-fill materials that, at the time, were commonly used for surfacing under and around playground equipment. The results of these tests were published in a 1990 CPSC report titled "Impact Attenuation Performance of Playground Surfacing Materials." In 1991, after calculating the Head Injury Criterion (HIC) values from the impact attenuation curves, CPSC published the Critical Heights for the materials tested (Table 2 in the 1991 "Handbook for Public Playground Safety," publication #325). In the handbook, Critical Height is defined as the maximum height that, when a C-size headform is dropped onto the surfacing materials, the recorded G_{max} and HIC do not exceed the values stated in ASTM F1292.

In 1997, tests were conducted by an independent testing laboratory for a university using loose-fill materials similar to those tested by CPSC in 1989. The university test results generally had lower G_{max} values than the 1989 CPSC test results. This resulted in higher Critical Heights than reported by 1989 CPSC data.

CPSC staff conducted additional tests on selected playground surfacing materials during 1998 to determine the reasons for these differences. The 1998 CPSC results were generally lower in G_{max} values than either the 1989 CPSC or the 1997 university test results. A report, in preparation, attributes the difference between the 1998 and 1989 CPSC tests principally to the differences in the G_{max} instrumentation sensitivity as shown by data generated during calibration (systems check) procedures at CPSC. The differences in instrumentation sensitivity levels resulted in data differences of about 30 percent. In the 1989 CPSC tests, the instrumentation was set to record a G_{max} of 400 when a C-size headform was dropped from 1 meter on its crown onto a pad known as a Modular Elastomer Programmer (MEP). This appears to be the procedure established in a 1988 ASTM round robin conducted by the ASTM F 08.63 subcommittee. The 1998 CPSC procedure dropped a spherical impactor with an impact velocity of 5.44 ± 0.11 m/s (from a height of about 1.5 meters) onto the MEP to achieve a G_{max} of 389 ± 8 G. These same instrument settings produced a G_{max} of 305 when a C-size headform was dropped from 1 meter onto the MEP

(3 B)

— about 25 percent less than the comparable 1989 test. The 1998 CPSC procedure is used in ASTM F1446-97, "Standard Test Method for Equipment and Procedures Used in Evaluating the Performance Characteristics of Protective Headgear."

Failure to uniformly control the instrumentation settings can explain differences noted in the round robin testing conducted by the subcommittee in 1988. The result is a wider than necessary spread in the data (± 17.6 percent) reported for tests of the MEP used to "calibrate" the participating laboratories' equipment. From the round robin data of 1988, it appears that all of the participating laboratories did not use the same calibration criteria when setting up their measurement systems.

The systems check procedure in ASTM F1446-97 prescribes that instrumentation, including electrical and mechanical systems, operate within prescribed limits. This check insures that all laboratories will have instrumentation that yields essentially the same test results. The CPSC laboratory is able to maintain the system response requirements established in ASTM F-1446 of ± 2 percent using a spherical impactor; system response is better than ± 4 percent when a C-size headform is used. CPSC staff suggests that the ASTM F1292 standard be revised to add a similar instrumentation check. Enclosed is a proposed revision to verify the operating conditions of the impact measurement system for both the guided C-size headform with a uniaxial accelerometer and the free-fall device using a triaxial accelerometer. The recommendation is based on the ASTM test method for protective headgear.

I request that the CPSC staff suggested revision of the ASTM F1292 standard be placed on the agenda for discussion at the May 21, 1999 meeting of ASTM Subcommittee F08.63 in Seattle. Please be aware that the suggested revision is from the CPSC staff and has not been reviewed or approved by the Commission.

Sincerely

George P. Sushinsky

George P. Sushinsky
Directorate for Laboratory Sciences

Enclosure

Cc:
Preston, John, Directorate for Engineering Sciences
Church, Colin, Office of Hazard Identification and Reduction
LS File

3C

Proposed Revision of ASTM F 1292 – "Consumer Safety Specification for Impact Attenuating Materials Under and Around Playground Equipment."

Terminology

Spherical Impactor – A 5.75-in (146-mm) diameter aluminum sphere, weighing 4005 ± 5 gm, specifically machined for mounting onto the ball-arm connector of the drop test assembly.[1] The impactor is used for systems check of the equipment.

MEP (modular elastomer programmer) – a cylindrical-shaped pad used as the impact surface for the spherical impactor. The MEP is 6.0 in. (152 mm) in diameter and 1.0 in. (25 mm) thick. It is affixed to the top surface of a flat, 0.25-in. (6.35-mm) thick aluminum plate. The durometer of the MEP is 60 ± 2 Shore A.

Instrument System Check (based on ASTM F 1446, Section 17)

The system instrumentation shall be checked before and after each series of tests by dropping the spherical impactor[2] (see terminology) onto the MEP (see terminology) at an impact velocity of 5.44 m/s (± 2 %)[3]. The peak acceleration obtained during this impact should be 389 ± 8 g. Three such impacts at 75 ± 15 s, shall be performed before and after each series of tests. If the peak acceleration obtained in the pretest impacts differs by more than 5% from the peak acceleration obtained in the posttest impacts, recalibration of the instruments and transducers is required, and all data obtained during the series of surfacing tests should be discarded.

[1] The total mass of the spherical impactor drop assembly shall be 5.0 ± 0.1 kg (11.0 ± 0.22 lb).

[2] As an alternative impactor, the subcommittee could consider use of the C-size headform used in the tests of surfacing materials. Adjustment of the peak G criterion would be necessary to adopt this change. The peak G (average of three impacts) obtained at the CPSC laboratory for crown impacts on a MEP range from 424 to 438 Gs.

[3] Theoretical drop height to achieve this velocity is 1.51 m (4.95 ft). The actual drop height for guided systems will be slightly higher to account for friction losses.

Attachment 3

May 3, 1999

DRAFT

ASTM DESIGNATION F._______

STANDARD SPECIFICATION FOR ENGINEERED WOOD FIBER FOR USE AS A PLAYGROUND SAFETY SURFACE UNDER AND AROUND PLAYGROUND EQUIPMENT

INTRODUCTION

The need for a systematic means of evaluating engineered wood fiber for use as a playground safety surface from the standpoint of particle size, consistency, purity, and ability to drain, has become a growing concern of the designers, operators, and manufacturers of engineered wood fiber systems. There has been no qualitative method to assess these parameters of engineered wood fiber (i.e., particle size, consistency, purity, and ability to drain) to insure its quality. Therefore, the goal of this specification is to establish a uniform means to measure the characteristics of engineered wood fiber in order to provide the potential buyer with performance specifications to select an engineered wood fiber suitable to meet the needs of playground designers, operators and manufacturers.

1. SCOPE

1.1 This specification establishes minimum characteristics for those factors that determine particle size, consistency, purity, and ability to drain.

1.2 The material that meets the requirements of this specification may be designated engineered wood fiber and must comply with specification ASTM F1292, Standard Specification for Impact Attenuation of Surface Systems Under and Around Playground Equipment if the surface is in the use zone as defined in ASTM F1487 Standard Consumer Safety Performance Specification for Playground Equipment for Public Use of the playground surface.

1.3 The material that meets the requirements of this specification may be designated engineered wood fiber, and the material must comply with ASTM F1951 (formerly ASTM PS 83) Standard Specification for Determination of Accessibility of Surface Systems Under and Around Playground Equipment.

1.4 This specification does not imply that an injury can not be incurred if the engineered wood fiber complies with this specification.

1.5 The following precautionary statement pertains to the test method portions only, in Section 8, of this specification: *This standard does not purport to address all of the safety concerns, if any, associated with its use. It is the responsibility of the user of this standard to establish appropriate safety and health practices and determine the applicability of regulatory limitations prior to use.*

1.6 To meet the requirements of the Standard for Engineered Wood Fiber Used Under and Around playground Equipment, the material shall meet particle size requirements, and be below concentrations of heavy metals considered hazardous to children and meet the requirements of ASTM F 1292 Standard Specification for Impact Attenuation of Surface Systems Under and Around Playground Equipment and ASTM F1951 (formerly ASTM PS 83) Standard Specification for Determination of Accessibility of Surface Systems Under and Around Playground Equipment.

2. REFERENCED DOCUMENTS

2.1 ASTM STANDARDS

2.1.1 ASTM F.1292 - Standard Specification for Impact Attenuation of Surface Systems Under and Around Playground Equipment

2.1.2 ASTM 1487 - Standard Consumer Safety Performance Specification for Playground Equipment for Public Use

2.1.3 ASTM F 1951 (formerly ASTM PS 83) Standard Specification for Determination of Accessibility of Surface Systems Under and Around Playground Equipment

2.1.4 ASTM F 963 - Consumer Safety Specification on Toy Safety. (Check test results of heavy metal/what procedure)

2.1.5 ASTM C136- Standard Sieve Analysis of Fine and Coarse Aggregates
ASTM E11 Specification For Wire Cloth and Sieves For Testing Purposes
ASTM D2217 Practice For Wet Preparation of Soil Samples for Particle-Size Analysis and Determination of Soil Constants

2.2 OTHER STANDARDS AND TEST METHODS

2.2.1 Method 7471A mercury in solid or semisolid waste (manual cold-vapor technique) as found in the Solid Waste Manual - SW 846

2.2.2 Method 6010B inductively coupled plasma-atomic emission spectrometry (for the determination of heavy metal concentrations) as found in the Solid Waste Manual - SW846

3. TERMINOLOGY/DEFINITIONS

3.1 Descriptions of terms specific to this standard

3.1.1 *Engineered Wood Fiber*: processed wood that is ground to a fibrous consistency, randomly sized, approximately ten times longer than wide with a maximum length of 2 inches, free of hazardous substances, and meets the criteria of this standard.

3.1.2 *around playground equipment* - The area under and surrounding playground equipment established as protection from falls from equipment.

3.1.3 *Hazard* - Any characteristic of a playground surface that presents an unreasonable risk of injury or illness during normal use, or as a result of reasonable foreseeable abuse.

3.1.4 *Normal use* - play modes that conform to the instruction accompanying the playground surface that have been established by tradition, custom, or that are evident from an examination of the playground.

3.1.5 *loose fill system* - a surface system consisting of small independent, movable components; that is, Engineered Wood Fiber, sand, gravel, wood chips, etc.

3.1.6 *maximum size* - (of Engineered Wood Fiber), n - in specifications for, or description of the smallest sieve opening through which the entire amount of Engineered Wood Fiber is required to pass.

3.1.7 *nominal maximum size* (of Engineered Wood Fiber), n - in specifications for, or description of the smallest sieve opening through which the entire amount of Engineered Wood Fiber is permitted to pass.

3.2. Definitions of terms specific to playground equipment

3.2.1 *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.

3.2.2 *impact attenuation* - the ability of a surface system to reduce and dissipate the energy of an impacting body.

4.0 GENERAL REQUIREMENTS

4.1 Playground surfaces represented as complying with this specification shall meet all applicable requirements specified herein. Anyone representing compliance with this specification shall keep such essential records as are necessary to document any claim that the requirements within this specification have been met.

4.2 For the surface within the fall zone of the surrounding playground equipment, the surface must meet U.S. Consumer Product Safety Commission guidelines minimum requirements of 200 G-max and 1000 HIC at its critical height when tested in accordance with Specification ASTM F1292.Standard Specification for Impact Attenuation of Surface Systems Under and Around Playground Equipment.

4.3 Standard Specification for Engineered Wood Fiber Used Under and Around Playground Equipment certification compliance shall be conducted by an independent accredited testing laboratory.

4.4 Standard Specification for Engineered Wood Fiber Used Under and Around Playground Equipment shall comply with ADA Regulation for Play Facilities, which requires compliance with ASTM F-1951 (formerly ASTM PS83) Standard Specification for Determination of Accessibility of Surface Systems Under and Around Playground Equipment.

5. SUMMARY OF METHODS

5.1 Samples of representative playground surface system; i.e., engineered wood fiber, are tested in accordance with: ASTM C136, ASTM F963, Section 4.3.5, 8.3

5.1.1 ASTM C 136 test method for Standard Sieve Analysis of fine and coarse aggregates. This standard provices a test method for determination of particle size distribution by passing a sample of dry Engineered Wood Fiber of known mass through a series of sieves of progressively smaller openings.

5.1.2 ASTM F963, Section 4.3 and Section 8.3 soluble elements are extracted from Engineered Wood Fiber under conditions that simulate the situation in which the Engineered Wood Fiber stays 4 hours in the alimentary tract after swallowing. The content of the soluble elements in the extract is determined for Antimony (Sb), Arsenic (As), Barium (Ba), Cadmium (Cd), Chromium (Cr), Lead (Pb), Mercury (Hg), and Selenium (Se).

5.1.2.1 Method 7471A Mercury in Solid or Semisolid Waste (manual cold vapor technique) as found in the solid waste manual SW846. This test will determine the levels of mercury in the engineered wood fiber.

5.1.2.2 Method 6010B Inductively Coupled Plasma-Atomic Emission Spectrometry (for the determination of heavy metal concentrations) as found in the solid waste manual SW846. This test will determine the levels of heavy metals.

6.0 SIGNIFICANCE AND USE

6.1 Sieve Analysis - this test method is used to determine grading of Engineered Wood Fiber-type material for proposed use as a playground safety surface. The results are used to determine compliance of the particle size distribution with applicable specification requirements and to provide necessary data that will indicate sufficient porosity for drainage, and larger particle size to limit compaction and maintain resilience and limit over-size pieces which could cause injury.

6.2 Heavy Metal Limits - This test method uses the section of ASTM F963 Standard Consumer Safety Specification on Toy Safety that deals specifically with toxic heavy metals. Since it is possible for children on a playground to handle and place Engineered Wood Fiber particles in the mouth, it is necessary to measure for toxic levels of heavy metals because of the use of recycled pallets, waste wood, and demolition wood as raw materials used in Engineered Wood Fiber. Limit for toxic levels of heavy metals are taken from Standard Consumer Safety Specification on Toy Safety ASTM F963, Section 4.3.5.2 and are adjusted with a statistical error correction factor taken from Section 8.3 of the Standard Consumer Safety Specification on Toy Safety, ASTM F963.

7.0 TEST APPARATUS

7.1 Sieve Analysis Test Apparatus

7.1.1 Balances - Balances or scales used in testing fine and coarse aggregate shall have readability and accuracy as follows:

7.1.1.1 Readable and accurate to 0.5 g or 0.1% of the test load, whichever is greater, at any point within the range of use.

7.1.2 Sieves - The sieve cloth shall be mounted on substantial frames constructed in a manner that will prevent loss of material during sieving. The sieve cloth and standard sieve frames shall conform to the requirements of Specification E 11. Nonstandard sieve frames shall conform to the requirements of Specification E 11 as applicable.

7.1.2.1 Sieve sizes required: 3/4 inch (19.05 mm), 3/8 inch (9.53 mm) and No.16 mounted on standard frame 8 inch (203.20 mm)diameter 2 inch (50.8 mm) height.

7.1.3 Sieve Shaker - a mechanical sieving device, if used, shall create motion of the sieves to cause the particles to bounce, tumble, or otherwise turn so as to present different orientations to the sieving surface. The sieving action shall be such that the criterion for adequacy of sieving described in test procedure is met in a reasonable time period.

7.1.4 Oven - an oven of appropriate size capable of maintaining a uniform temperature of 110 ± 5° C (230 ±9° F).

7.2 Hazardous Substance Test Apparatus

7.2.1 Normal laboratory apparatus

7.2.2 Metal Sieve, plain weave wire mesh stainless steel metal sieve with a nominal opening of 0.5 mm (No. 35 sieve) and the following specifications:

(a) Nominal wire diameter: 0.315 mm
(b) Maximum size deviation for an individual opening: +0.090 mm,
(c) Tolerance for average opening: +0.018 mm, and
(d) 6% or less of the openings to exceed the nominal plus: +0.054mm

7.2.3 pH, a means of measuring pH with a minimum accuracy of 0.2 pH units

7.2.4 Membrane Filter, with a pore size of 0.45 μm

7.2.5 Reagents - Use only reagents of recognized analytical grade during the analysis

7.2.5.1 Hydrochloric acid solution, 0.07 mol/L

7.2.5.2 Hydrochloric acid solution, approximately 2.0 mol/L (7.3% m/m).

7.2.5.3 Type 3 water in accordance with Specification D 1193 or Grade 3 water in accordance with ISO 3696

7.2.6 Centrifuge, capable of achieving 5000 ± 500 g

7.2.7 Container, of gross volume between 1.6 and 5.0 times that of the volume of HCL extractant

8.0 SAMPLING, TEST SPECIMENS

8.1 The following procedure will be used to collect the gross Engineered Wood Fiber sample from which the sieve test and the hazardous substance (heavy metal) sample will be taken

8.1.1 The gross sample of Engineered Wood Fiber shall represent a stockpile in excess of 50 cubic yards

8.1.1.2 Eight one gallon samples shall be taken. They shall be taken from four different quadrants of the stockpile 2 feet to 4 feet above the base and four different quadrants 4 feet - 6 feet above the base. Dig 1 foot to 2 feet into pile at each sample point. Combine and thoroughly mix the 8 gallon sample to achieve a homogeneous blend.

8.1.1.3 The thoroughly mixed 8 gallon sample will be known as the gross sample

8.2 SIEVE TEST SAMPLE

8.2.1 From the gross sample of Engineered Wood Fiber, measure a one gallon sample for drying

8.2.2 Dry the sieve test sample in accordance with the following method: (a constant moisture level is necessary to prevent weight changes due to changing moisture levels in the sample)

8.2.2.1 Engineered Wood Fiber specimens were reduced in overall size to facilitate testing using a standard 2-inch deep 8-inch diameter sieve. (Because of the light weight of wood, the oven dried sample weight of individual samples to be tested should not generally exceed 0.40 lbs.) Sieve screens, sieve frames, and wire cloth should conform to the requirements of ASTM E-11. Samples should be oven dried to a constant weight in general accordance with ASTM D2217 for oven drying of samples following reduction of the mass [Oven temperature of 230 degrees Farenheight and accuracy to ± 9 degrees (110 ± 5° C)].

8.3 HAZARDOUS SUBSTANCE SAMPLE (heavy metal toxicity)

8.3.1 Prepare the sample as follows:

8.3.1.1 From the gross sample of Engineered Wood Fiber, measure a one gallon sample and air dry sufficiently to eliminate particles sticking together due to moisture.

8.3.1.2 Using a No.35 sieve, mechanically agitate sufficient air dried Engineered Wood Fiber through the sieve to obtain 100 mg of screened Engineered Wood Fiber particles.

8.3.1.2.1 The dried Engineered Wood Fiber may be ground through the No. 35 sieve, if necessary

8.3.1.3 The screened Engineered Wood Fiber sample will be analyzed for toxic heavy metal content

9.0 TEST PROCEDURES & METHODS

9.1 Sieve Test Procedure

9.1.1 Because of the irregular shapes of the wood particles, hand manipulation of the sample through the sieve screens may be necessary.

9.1.2 Nest the three sieves (3/4 inch (19.05 mm), 3/8 inch (9.53 mm), and No.16) in order of decreasing size of opening from top to bottom and place the sample on the top sieve.

9.1.3 Agitate the sieves by hand or by mechanical apparatus for a sufficient period, established by trial or checked by measurement on the actual test sample, to meet the criterion for adequacy or sieving described in 9.1.5.3.

9.1.4 Limit the quantity of material on a given sieve so that all particles have opportunity to reach sieve openings a number of times during the sieving operation.

9.1.5 Prevent an overload of material on an individual sieve by one of the following methods: Insert an additional sieve with opening size intermediate between the sieve that may be overloaded and the sieve immediately above that sieve in the original set of sieves.

9.1.5.1 Insert an additional sieve with opening size intermediate between the sieve that may be overloaded and the sieve immediately above that sieve in the original set of sieves.

9.1.5.2 Split the sample into two or more portions, sieving each portion individually. Combine the masses of the several portions retained on a specific sieve before calculating the percentage of the sample on the sieve.

9.1.5.3 Continue sieving for a sufficient period and in such manner that, after completion, not more than 1 mass % of the residue on any individual sieve will pass that sieve during 1 minute of continuous hand sieving performed as follows: Hold the individual sieve, provided with a snug-fitting pan and cover, in a slightly inclined position in one hand. Strike the side of the sieve sharply and with an upward motion against the heel of the other hand at the rate of about 150 times per minute, turn the sieve about one sixth of a revolution at intervals of about 25 strokes. In determining sufficiency of sieving for sizes larger than the 4.75-mm (No. 4) sieve, limit the material on the sieve to a single layer of particles. If the size of the mounted testing sieves makes the described sieving motion impractical, use 8 inch (203-mm) diameter sieves to verify the sufficiency of sieving.

9.1.5.4 Hand sieve larger particles by determining the smallest sieve opening through which each particle will pass. Start the test on the smallest sieve to be used. Rotate the particles, if necessary, in order to determine whether they will pass through a particular opening; however, do not force particles to pass through an opening. Hand manipulation should not include grinding of the particles; however, natural breakdown through this practice is not necessarily detrimental.

9.1.5.5 Determine the mass of each size increment on a scale or balance conforming to the requirements specified in 6.1 to the nearest 0.1% of the total original dry sample mass. The total mass of the material after sieving should check closely with original mass of sample placed on the sieves. If the amounts differ by more than 0.3%, based on the original dry sample mass, the results should not be used for acceptance purposes.

9.2 Preparation and Analysis of Heavy Metal Sample.

9.2.1 Prepare a test portion in accordance with 8.3.3.

9.2.2 Mix the test portion so prepared with 50 times its mass of an aqueous solution of 0.08 mol/L hydrochloric acid at 37 + 2°C. In case of a test portion of less than 100 mg, mix the test portion with 5.0 mL of this solution at the given temperature. Shake for 1 minute.

9.2.3 Check the acidity of the mixture. If the pH is greater than 1.5, add dropwise while shaking an aqueous solution of 2 mol/L (7.3% m/m) hydrochloric acid until the pH is between 1.0 and 1.5. Protect the mixture from light. Shake the mixture efficiently for 1 hour continuously, and then allow the mixture to stand for 1 hour at 37 + 2°C.

Note: It has been shown that the extraction of soluble cadmium can reveal a two-fold to five-fold increase when extraction is conducted in the light rather than the dark.

9.2.4 Without delay, separate the solids from the mixture by filtration through a membrane filter with a pore size of 0.45 μm If necessary, centrifuge at 5000 g for no longer than 10 min. Analyze the solution to determine the presence of the elements identified in 5.1.2. If it is not possible to analyze the sample within one working day, stabilize by the addition of hydrochloric acid so that the resulting solution is approximately 1 mol/L of HCL.

9.2.5 If necessary, centrifuge the mixture and separate the solids from the mixture by filtration through a membrane filter with a pore size of 0.45μm and analyze the resulting solution to determine the presence and quantity of the elements identified in 5.1.2. Take care to ensure the stability of the solution if it is not possible to analyze within one working day.

9.2.6 The analytical results as determined in 9.2.4 or 9.2.5 shall be adjusted by subtracting the analytical correction factor in Table I using the following method. This is necessary to make statistical correction for interlaboratory error.

TABLE I ANALYTICAL CORRECTION								
Element	Sb	As	Ba	Cd	Cr	Pb	Hg	Se
Analytical Correction	60	60	30	30	30	30	50	60

Note 6 - Example of Calculations Using the Table:

Example 1:
The analytical result for lead is 120 mg/kg; the correction factor from the table is 30% (0.30).
Adjusted analytical results = 120 - (120 x 0.30) = 120 - 36 = 84 mg/kg
The result does not exceed the allowed value for lead in the table and is, therefore, acceptable.

Example 2:
The analytical result for chromium is 90 mg/kg; the correction factor from the table is 30% (0.30).
Adjusted analytical results = 90 - (90 x 0.30) = 90 - 27 = 63 mg/kg.
The result exceeds the allowed value for chromium in the table and is, therefore, not acceptable.

10.0 CALCULATIONS

10.1 Sieve Test

10.1.1 Calculate percentages passing in various size fractions to the nearest 0.1% on the basis of the total mass of the initial dry sample

11.0 REPORT

11.1 Sieve Test

11.1.1 Total percentage of material passing each sieve.

11.1.2 Total percentage of material that did not pass the 3/4 inch (19.05 mm) sieve (top) after hand manipulation

12.0 PRECISION & BIAS

to be determined

13.0 PERFORMANCE REQUIREMENTS

13.1 Sieve analysis test results requirements

13.1.1 When Engineered Wood Fiber is tested, in accordance with Section 9.1 of this Standard, it shall meet the following criteria to be considered acceptable.

13.1.1.1 The minimum and maximum percent (%) by weight passing through the three sieves shall be as follows in Table II:

TABLE II		
SIEVE SIZE	**MINIMUM %**	**MAXIMUM%**
3/4 INCH	99%	100%
3/8 INCH	86%	100%
No. 16	0%	15s%

13.2 Hazardous Substance Analysis Test Results Requirements

13.2.1 The analytical results obtained shall be adjusted in accordance with the test method in Section 9.2.6 prior to comparing them◆ the maximum permissible values of Table III to determine conformance to this standard.

TABLE III
Maximum Soluble Migrated Element in ppm (mg/kg)
Toy Material

Antimony (Sb)	Arsenic (As)	Barium (Ba)	Cadmium (Cd)	Chromium (Cr)	Lead (Pb)	Mercury (Hg)	Selenium (Se)
60	25	1000	75	60	90	60	500

Attachment 4

BIOMECHANICA

May 13, 1999

Dick Schefsky,	Northwest Laboratories
George Sushinsky,	CPSC
Roger Amorosi,	DTL
Paul Bamburek,	Alpha Automation
Kathleen Smith,	USSL

Dear Colleagues,

I have attached a summary and some analysis of our study of effects of the number of pre-conditioning drops and test drops on the repeatability of ASTM F-1292 g-max and HIC scores.

If you could let me have any comments or suggestions by 5/17, I will try to incorporate them into a revised report before the subcommittee meeting on 5/21.

Thank you again for agreeing to participate in this project.

With best regards,

Martyn R. Shorten, Ph.D.

cc: Robert Heath, Chairman F08.52
George Luciw, F08 Staff Manager.

Suite D, 6342 SW Macadam Ave. Portland, OR 97201, USA
TEL: +1 (503) 452-0350 . FAX: +1 (503) 452-0345 . email: admin@biomechanica.com

D: 12" Wood fiber surface

G-MAX

	Day				
Drop	1	2	3	4	5
1	74	76	89	103	95
2	92	94	93	109	104
3	89	101	107	121	109
4	98	100	102	111	108
5	100	102	102	108	113
6	100	100	104	116	120
7	103	101	106	125	122
8	115	107	110	112	120
9	104	100	110	123	106
10	96	102	110	119	108

HIC

	Day				
Drop	1	2	3	4	5
1	272	281	373	494	417
2	386	390	392	506	475
3	367	448	487	634	513
4	448	450	434	529	509
5	436	454	453	500	547
6	450	418	458	568	591
7	462	469	498	640	625
8	581	513	530	532	596
9	540	426	545	619	483
10	415	459	505	576	508

E: 2" PIP surface

G-MAX

	Day				
Drop	1	2	3	4	5
1	196	188	194	193	196
2	207	205	206	206	206
3	208	207	205	205	206
4	208	207	206	206	207
5	209	207	204	206	206
6	209	208	203	206	206
7	210	208	202	206	207
8	210	208	203	207	206
9	210	209	203	206	206
10	211	209	203	206	206

HIC

	Day				
Drop	1	2	3	4	5
1	1193	1136	1180	1187	1214
2	1279	1263	1287	1274	1292
3	1287	1283	1282	1265	1292
4	1291	1284	1280	1280	1290
5	1295	1288	1262	1279	1290
6	1295	1290	1262	1283	1291
7	1297	1293	1256	1285	1292
8	1311	1297	1249	1289	1291
9	1304	1300	1255	1285	1290
10	1309	1301	1247	1286	1296

Appendix 2: Raw Data

A: 3" PIP Surface

G·MAX

	Day				
Drop	1	2	3	4	5
1	149	147	145	145	144
2	148	149	148	147	148
3	150	148	149	147	148
4	150	148	148	148	148
5	151	147	145	148	149
6	151	148	145	149	147
7	151	147	149	149	148
8	152	147	149	149	148
9	152	148	149	149	146
10	152	149	148	149	146

HIC

	Day				
Drop	1	2	3	4	5
1	833	823	799	804	787
2	818	816	806	808	818
3	838	815	819	787	815
4	831	834	810	816	818
5	848	821	790	815	826
6	846	836	791	822	813
7	844	823	826	822	828
8	864	818	825	820	821
9	852	834	830	829	798
10	865	831	811	826	802

B: 3¾" Rubber tile surface

G·MAX

	Day				
Drop	1	2	3	4	5
1	146.8	140.3	141.0	138.9	140.3
2	155.3	145.1	145.8	144.1	142.7
3	153.0	144.7	145.1	143.7	143.4
4	151.6	142.3	143.7	143.0	145.1
5	148.5	144.4	145.1	144.1	141.7
6	147.5	144.4	145.8	144.1	142.0
7	147.8	142.7	143.7	143.0	143.7
8	146.5	142.7	143.7	144.4	143.4
9	142.7	140.3	142.3	144.1	144.7
10	147.5	143.7	144.4	145.1	143.4

HIC

	Day				
Drop	1	2	3	4	5
1	1190	1111	1178	1146	1169
2	1255	1156	1224	1198	1177
3	1332	1146	1217	1188	1187
4	1216	1107	1197	1191	1199
5	1177	1145	1218	1193	1161
6	1170	1146	1219	1204	1174
7	1184	1129	1202	1182	1182
8	1201	1125	1200	1209	1184
9	1105	1101	1173	1194	1196
10	1177	1197	1202	1201	1188

Appendix 1: Participating Laboratories

Northwest Laboratories Dick Schefsky	1 (206) 763 6252
US Consumer Product Safety Commission George Sushinsky	1 (301) 413 0172
Detroit Testing Laboratories Roger Amorosi	1 (540) 972 4324
Alpha Automation, Inc. Paul Bamburek	1 (609) 882 0366
US Sports Surfacing Laboratory, Inc. Kathleen Smith	1 (804) 541 7212

Project Coordination:

BioMechanica, LLC. Martyn Shorten	1 (503) 452-0350

Example of an alternative specific protocols

Table 2 compares the repeatability of the existing F-1292 protocol with two examples of alternative protocols. The first alternative (3-3) employs two additional pre-conditioning drops. The second (3-7) employs both two additional pre-conditioning drops and five additional test drops. The additional pre-conditioning drops of the 3-2 protocol improved repeatability on both the unitary and loose-fill surfaces. Improvements were less significant on the unitary surfaces that demonstrated acceptably repeatable results. The additional test drops of the 3-7 protocol did not produce meaningful improvements in repeatability.

Table 2: *Repeatability of two test protocols on different surface types.*

Protocol	Drops		Unitary		Loose-Fill	
	Pre-	Test	g-max	HIC	g-max	HIC
F-1292	1	2	3.7%	6.1%	25.5%	45.5%
3-2	3	2	3.4%	4.8%	14.0%	24.6%
3-7	3	7	3.2%	4.9%	17.3%	26.7%

These examples further illustrate the greater efficacy of increasing the number of pre-conditioning drops compare with that of increasing the number of test drops.

Recommendations

1. Consider increasing the number of pre-conditioning drops specified by F-1292 from one to three.
2. In any future inter-laboratory studies or revised precision and bias statements, consider reporting precision and bias for unitary and loose-fill surfaces separately.

loose-fill surfaces, unlike most unitary surfaces, do not recover elastically from each impact.

It was also be noted that the inter-day repeatability of scores for the unitary surfaces were better than those previously determined by an inter-laboratory study. Repeatability of test results from the loose-fill surface were consistent with those of the ILS. Assuming the F-1292 standard protocol, g-max repeatability averaged 3.7% on the unitary surfaces compared with 25.5% on the loose-fill surface. HIC repeatability differed similarly, averaging 6.1% on the unitary surfaces and 45.5% on the loose-fill surface.

Given the different responses of the two surface types, it is appropriate to consider different test protocols for each. Certainly, a precision and bias statement in which unitary and loose-fill surfaces were treated separately would be a more accurate reflection of reality.

Practical constraints

An ideal test protocol would employ a large numbers of pre-conditioning and test drops in order to maximize the repeatability of the test. Practically, however, the number of drops must be limited. F-1292 certification requires tests at a number of drop heights to be performed at three different temperatures. With a one-minute interval between drops, tests could be unreasonably prolonged and expensive to perform if an arbitrarily large number of drops were used. Therefore, when considering alternative protocols, it is important to balance gains in repeatability against the increased cost of performing the test.

Pre-conditioning trials are an effective investment

In this regard, increasing the number of pre-conditioning drops, up to three, is a more efficient way of improving repeatability than increasing the number of test drops by the same amount. After three pre-conditioning drops, the surfaces in this study were relatively stable and additional pre-conditioning did not produce further improvements in test repeatability. Any increase in the number of test drops appears to improve the repeatability of test results.

Discussion

Effects of test protocol on test results

The compliant materials of many playground surfaces are compacted slightly by an impact. If the deformation is permanent or if the time between impacts is not sufficient to allow full recovery, repeated impacts result in progressively higher g-max and HIC scores until the surface reaches a stable, compacted state.

The results of this study on five different surfaces tested using the F-1292 protocol suggest that compaction is most severe over the first 3 drops of a series (Figures 1 and 2). Also, the increases in scores were greater for the loose-fill surface than for the unitary surfaces (Figures 3 and 4).

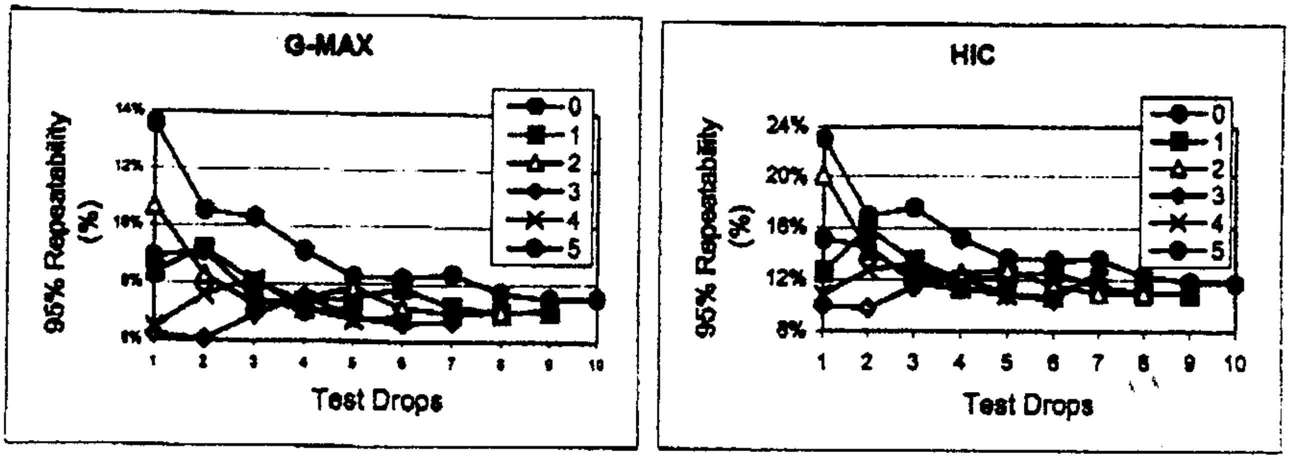
In the current F-1292 test protocol, reported results are the mean g-max and HIC scores of the 2nd and 3rd drops of a series. Typically, these scores will be recorded before the surface has reached a stable state. The instability of the surface at this stage undoubtedly contributes to the variability of reported results.

Pre-conditioning the surface with a number of impacts before recording data appears to improve the repeatability of the final results. Since most of the compaction of the test surfaces occurred over the first three drops, the use of three or more pre-conditioning drops improved repeatability. Three pre-conditioning drops produced results that were approximately 29 % more repeatable than a test protocol with no pre-conditioning and 14% more repeatable than the standard protocol which specifies one pre-conditioning drop.

Increasing the number of test drops used to compute a test result also increased repeatability; each additional drop improving repeatability by an average of 4.5%. Five test drops produce test results that are 10% more repeatable than protocols using only two test drops and ten test drops produced a 41% improvement over the current protocol.

Unitary and loose-fill surfaces

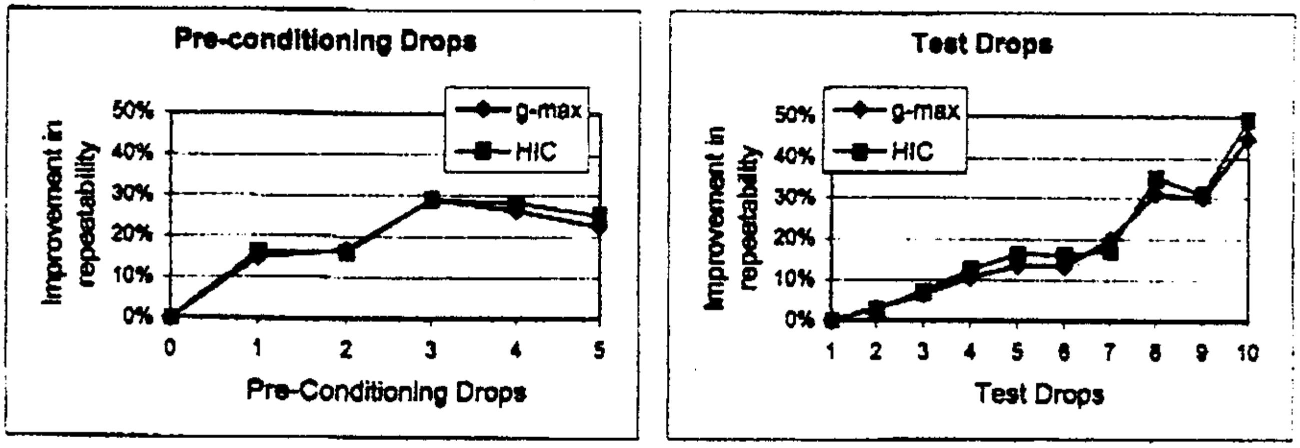
The single loose-fill surface used in this study produced less repeatable results that the unitary surfaces. Compaction of the loose-fill surface was more dramatic and the results generally more variable. These differences may be attributed to the fact that



(a)

(b)

Figure 5 : *Effect of test protocol on repeatability of (a) g-max and (b) HIC scores. Each line represents a different number of pre-conditioning drops*



(a)

(b)

Figure 6 : *Effect of increasing the numbers of (a) pre-conditioning drops and (b) test drops on the repeatability of g-max and HIC scores.*

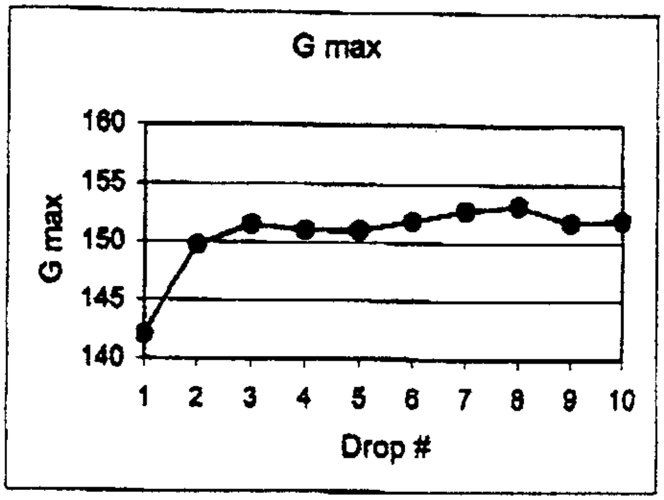


Figure 1:
Average G-max scores by drop number

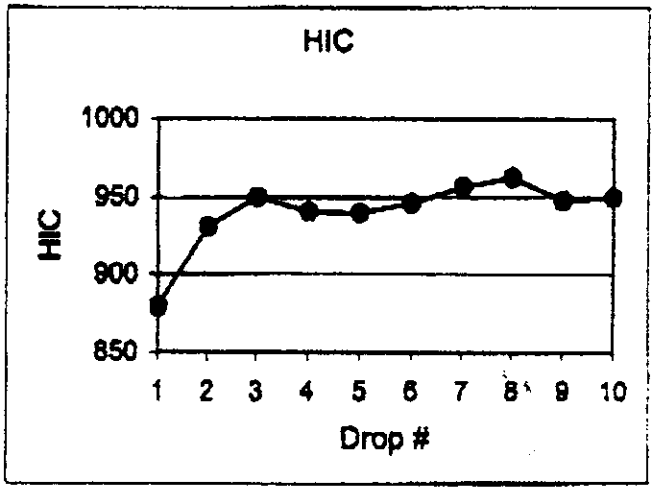


Figure 2
Average HIC scores by drop number

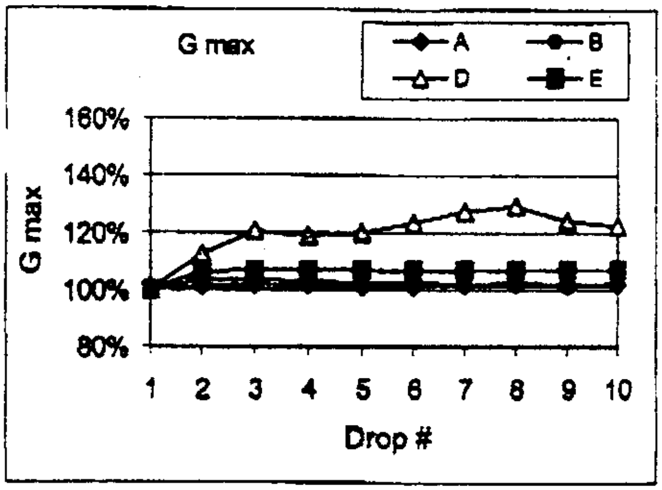


Figure 3:
Relative g-max scores by surface & drop number

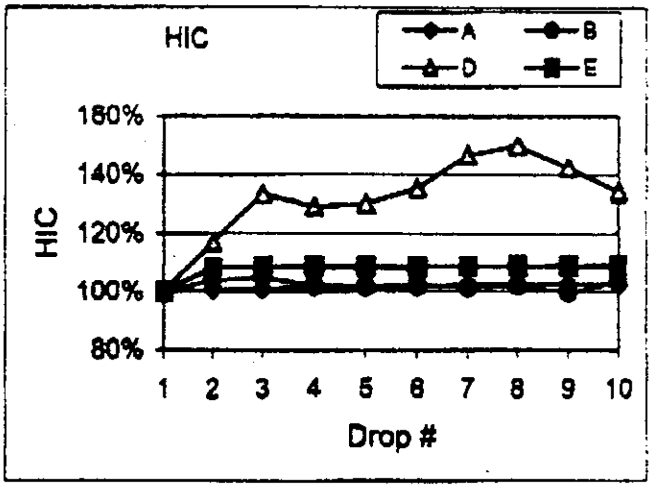


Figure 4:
Relative HIC scores by surface & drop number

Results

Raw data from all the participating laboratories are listed in Appendix 2. At the time of writing, no results had been received for surface C.

Effect of multiple drops on g-max and HIC scores

Figures 1 and 2 show the variation of g·max and HIC scores with successive drops, averaged over all surfaces and all days. Both scores show a tendency to increase over the course of three drops while drops 3-10 appear to be more consistent.

In figures 3 and 4, scores from successive drops are expressed relative to those from the first drop, as a percentage, and means from each surface are plotted separately. The tendency for scores to increase over a series of drops is particularly evident in surface D, a wood-fiber product. After five drops, g-max and HIC increased by an average of 3% and 4% respectively on the unitary surfaces. On the wood fiber surface, scores increased by 20% and 30%, respectively, after five drops.

Effects of sampling protocol on g-max and HIC scores

Figures 5 (a) and 5 (b) show the effects of different combinations of pre-conditioning drops and test drops on intra-laboratory, inter-day repeatability. For convenience, the 95 % repeatability confidence interval is represented as a percentage of the mean test score. These graphs show a general trend for improved repeatability with increasing numbers of pre-conditioning drops and test drops.

These trends are more clearly shown in Figures 6 (a) and 6 (b), which depict the average improvement in repeatability with increasing numbers of pre-conditioning and test drops, compared with the repeatability of a one-drop protocol. The use of 1, 2, and 3 pre-conditioning drops improved repeatability by up to 30%. Additional conditioning drops beyond 3 did not produce further improvements. At three pre-conditioning drops, repeatability was 30% better than a hypothetical test with no pre-conditioning and 15% better than a test protocol with a single pre-conditioning drop. Increasing the number of test drops systematically improved the repeatability of g-max and HIC scores, but at a lesser rate than increasing the number of pre-conditioning drops.

On days 2-6 of the experiment the surface samples were subjected to 10 consecutive drops, using the F-1292 protocol. G-max and HIC scores were recorded for each drop.

Analysis

The raw data provided by each laboratory were re-sampled to simulate various test protocols, each with a different combination of pre-conditioning drops and test drops. Intra-laboratory, inter-day repeatability statistics for each laboratory's data set were determined as follows:

1. For each combination of pre-conditioning drops, *m*, and test drops, *n*, test scores for each day, *d*, were determined as follows:

$$x_d = \frac{\sum_{i=m+1}^{m+n} x_i}{m} \qquad (1)$$

2. The intra-laboratory, inter-day standard deviation, *s*, for *D* days is given by

$$s = \sqrt{\frac{\sum_{d=1}^{d} x_d^2 - \frac{\left(\sum_{d=1}^{D} x_d\right)^2}{D}}{(D-1)}} \qquad (2)$$

3. Across *L* laboratories, inter-day, 95% repeatability for each combination of *m* and *n* was estimated as:

$$S_r = 2.8 * \sqrt{\frac{\sum_{l=1}^{L} S_l}{L}} \qquad (3)$$

EFFECTS OF THE NUMBER OF PRE-CONDITIONING DROPS AND TEST DROPS ON THE REPEATABILITY OF ASTM F-1292 G-MAX AND HIC SCORES.

Introduction

A previous inter-laboratory study of the F-1292[1] test method determined that the repeatability and reproducibility standard deviations of g-max and HIC scores were greater than optimal. While accepting the ILS results, ASTM Subcommittee F08.52 on Playground Surfacing agreed to explore ways of improving repeatability and reproducibility.

This report summarizes the results of a study in which the effects of sampling procedures on repeatability were examined. The current revision of F-1292 specifies that g-max and HIC results be determined by averaging scores from the second and third of three test drops. Scores from the first, pre-conditioning, drop are ignored. The purpose of this study was to determine whether increasing the number of pre-conditioning drops and/or test drops could improve the repeatability of reported g-max and HIC scores.

Hypotheses

Pre-conditioning drops

Some types of playground surface, especially loose-fill surfaces and those with foam substrates, have cushioning characteristics that change as the surface is repeatedly impacted. Successive impacts compress the surface, increasing its stiffness, typically causing g-max and HIC scores to increase slightly. It is common therefore to condition surfaces with one or more impacts before recording useable data. Hypothetically, in surfaces subject to such effects, increasing the number of pre-conditioning drops will lead to more stable results.

Test Drops

In many experimental situations where test scores are variable or noisy, repeatability can be improved by using the average a number of test results as the final score. Averaging multiple samples tends to smooth out noise, reducing variability. It is hypothesised, therefore, that increasing the number of drops used to determine recorded results will improve repeatability.

Attachment 5

Editorial change from Fran Wallach - to ballot

SUMMARY OF TEST METHOD

Change section 4.1 to read as follows:

4.1 Representative playground surface systems or surfacing material samples, or both, are tested according to either Test Method F 355 ~~Procedure C (metal headform)~~ or the Free Fall Test Method described in Annex A1.

4.1.1 Conduct laboratory tests at various drop heights and test temperatures. The laboratory test method will determine the maximum drop heights at which the g-max does not exceed 200 or the HIC does not exceed 1000 at the test temperatures.

4.1.2 Conduct the field tests at the drop height specified and at the ambient temperature of the site within a specified range. The field test method will determine the g-max and the HIC from the drop heights specified by the initial owner/operator at the ambient temperature of the test.

PERFORMANCE REQUIREMENTS

Delete Existing Section 6.2 and replace with the following:

6.2 When tested in the laboratory at temperatures of 30, 72, or 120° F (-1, 23 or 49° C) in accordance with Test Method F 355, or the Free Fall Test Method Annex A1 using an average of the last 2 of 3 drops, no value shall exceed 200 g-max or 1000 HIC.

Attachment C

DEPARTMENT OF HEALTH & HUMAN SERVICES

Public Health Service

Centers for Disease Control
and Prevention (CDC)
Atlanta GA 30341-3724

May 13, 1999

Mr. Robert Heath
Fibar Systems
80 Business Park Drive
Suite 300
Armonk, NY 10504-1705

Dear Mr. Heath:

The National Center for Injury Prevention and Control of the Centers for Disease Control and Prevention has been working on the problem of playground injuries for the past ten years. One aspect of this work has been to fund the creation of a National Program for Playground Safety at the University of Northern Iowa (UNI). A portion of this funding was directed to study the impact attenuation characteristics of a variety of playground surfaces over a range of temperatures, compressions, heights, and depths.

We have carefully reviewed the results of that work and considered the subsequent testing work conducted by the Consumer Product Safety Commission (CPSC) in response to the findings of the UNI work. Our conclusion is that we find the UNI and CPSC work credible and sufficiently compelling to strongly indicate that ASTM standard 1292 needs to be changed.

Should you have any questions about our position in this regard, please contact me at 770-488-4652.

Sincerely yours,

Jeffrey Sacks

Jeffrey J. Sacks, M.D., M.P.H.
Division of Unintentional
Injury Prevention
National Center for Injury
Prevention and Control

cc:
Dr. Christine M. Branche
Ms. Sarah Olson
Dr. Julie Gilchrist
Mr. Tim Groza
Dr. Donna Thompson

Attachment 7

Monkeybar Injuries: Complications of Play

Mark L. Waltzman, MD; Michael Shannon, MD, MPH; Anne P. Bowen, MS, RN; and
Mary Christine Bailey, MD

ABSTRACT. *Background.* Playground equipment resulted in >200 000 injuries from 1990 to 1994, according to the Consumer Product Safety Commission; 88% were attributable to climbers (monkeybars/jungle gyms [MB/JGs]), swings, and slides. Equipment-specific injury requiring emergency department (ED) evaluation has not been reported previously.

Objective. To describe the spectrum of significant MB/JG-related injuries.

Methods. A 2-year retrospective chart review was performed using the computerized charting system at a large urban Children's Hospital/Regional Pediatric Trauma Center with 50 000 ED visits per year. A telephone survey also was conducted after the chart review to obtain additional information concerning the injury location, the surface type below the equipment, and the presence of adult supervision.

Results. A total of 204 patients were identified. Mean age was 6.2 years (range, 20 months to 12 years); 114 (56%) were male. A seasonal variation was noted with June to August accounting for 43% of visits. Injuries included fractures in 124 (61%), contusions in 20 (10%), neck and back strains in 17 (8%), lacerations in 16 (8%), closed head injuries in 10 (5%), abdominal trauma in 5 (3%), genitourinary injuries in 5 (3%), and miscellaneous injuries in the remainder. Among fractures, 90% were fractures of the upper extremity; 48 (40%) were supracondylar fractures. One child sustained a C7 compression fracture. Abdominal injuries included 1 child who sustained a splenic laceration. All genitourinary injuries (2 vaginal hematomas, 1 vaginal contusion, 1 penile laceration, and 1 urethral injury) were from straddle-type injuries. Fifty-one (25%) patients were admitted to the hospital. Of these, 47 (92%) required an operative procedure (orthopedic reduction or vaginal examination under anesthesia).

Analysis of the telephone data revealed that the surface did not influence the injury type. Of the 79 fractures, 30 occurred on "soft surfaces." Injury type was associated significantly with chronologic age. Younger children (1 to 4 years of age) sustained more long-bone fractures than did older children. The presence of adult (at least 18 years of age) supervision, did not influence the occurrence of fractures.

Conclusions. These data suggest that 1) a significant proportion (25%) of MB/JG-related injuries that are evaluated in the ED require hospitalization; 2) most of the injuries resulting in admission will require operative intervention (92%); 3) the surface below the equipment has no influence on the type or severity of the injury; 4) younger children are more likely to sustain long-bone fractures than are older children; and 5) adult supervision does not influence the injury pattern. These data identify the need for additional investigation of means of making MB/JGs safer for child use. *Pediatrics* 1999;103(5). URL: http://www.pediatrics.org/cgi/content/full/103/5/e58; *monkeybar, jungle gym, playground equipment, injury.*

ABBREVIATIONS. ED, emergency department; MB/JG, monkeybars/jungle gym; ICU, intensive care unit.

Childhood play takes on many forms, from organized interactions to independent activities. Unfortunately all types of play can place children at risk for injury. In the United States, >15 million children are seen in emergency departments (EDs), and ~600 000 children are hospitalized each year as a result of injuries.[1] Many of these injuries are equipment related; the Consumer Product Safety Commission estimates that 200 000 injuries occurred from playground equipment. Among these injuries 88% involved the use of climbers (monkeybars/jungle gyms [MB/JGs]), swings, and slides.

Several studies have reported the spectrum of injuries sustained during activities on playgrounds. These studies have focused on general playground equipment, the types of surfaces below the equipment, and the injuries sustained.[2–4] To date, however, there have been no systematic studies examining the specific injury patterns associated with individual pieces of equipment. The goal of this study was to gain an understanding of the specific injuries that occur as a result of play on MB/JGs.

METHODS

The computerized database of a large urban children's hospital ED/pediatric trauma center was searched using the text words "monkeybar" and "jungle gym." The ED has ~50 000 visits annually and 12 000 injury visits per year. The ED database was searched for the 2-year period ending October 31, 1997. Demographic, epidemiologic, and injury data were abstracted from each visit meeting the inclusion criteria.

A telephone survey was conducted after the chart review to obtain additional information about the injury. An attempt to contact all parents/guardians was made. The interval for telephone contact ranged from 1 week to 2 years after the initial injury. Parents or guardians were asked to recall three details: 1) the injury location (eg, school playground, public playground, day care, or home), 2) the type of surface below the equipment (eg, sand, wood chips, grass, or concrete), and 3) the presence of adult supervision. Data analysis consisted of simple descriptives and measures of central tendency. Intergroup analyses were performed using the χ^2 statistic and logistic regression. $P \leq .05$ was

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From Children's Hospital, Boston, Division of Emergency Medicine, Harvard Medical School, Boston, Massachusetts.

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Reprint requests to (M.L.W.) Children's Hospital, Boston, Division of Emergency Medicine, 300 Longwood Ave, Boston, MA 02115. E-mail: waltzman_m@a1.tch.harvard.edu

PEDIATRICS (ISSN 0031 4005).

considered significant. The study was approved by the Institutional Review Board.

RESULTS

There were 204 patients identified during the study period. Median age was 6 years, with an age range of 20 months to 12 years (Fig 1). There was a bimodal age distribution, with peaks at 4 and 6 years. Males accounted for 56%. Seasonal variability was noted, with the majority of injuries occurring between June and August.

Table 1 summarizes the injury pattern observed. The most common injuries sustained were long-bone fractures that occurred in 59% of children (Fig 2). These fractures were supracondylar in 48 (40%), radius/ulnar in 40 (33%), isolated radius in 17 (14%), humerus in 7 (6%), tibia in 4 (3.5%), fibular in 3 (2.5%), and femur in 2 (1%). Nonlong-bone fractures included 1 metatarsal, 1 clavicular, and 1 C7 compression fracture.

There were 10 (5%) closed head injuries; of these, 6 were complicated by the appearance of neurologic disturbances ($n = 5$), and the occurrence in 1 child with a preexisting clotting factor deficiency. Head computed tomography evaluation was performed on these 6 patients; all were negative for fracture or intracranial injury.

Blunt abdominal trauma resulted in one renal contusion and one splenic laceration. Genitourinary trauma resulting from straddle injury occurred in 5 children. These injuries included three vaginal contusions (1 requiring an examination under general anesthesia), 1 penile laceration, and 1 urethral injury.

Fifty-three injuries (26%) were classified as minor, consisting of lacerations, sprains, and contusions. Other miscellaneous injuries included 1 dental fracture, 1 ocular foreign body, 1 digital foreign body, 1 corneal abrasion, 1 case of toxic synovitis, and 2 radial head subluxations.

Fifty-two patients (25%) were admitted to the hospital as a result of their injuries (Fig 3). Of these, 47 (90%) were taken to the operating room. Of the operative procedures, 98% were orthopedic interventions. These included open reduction and internal fixation in 5/46 (11%), closed reduction and percutaneous pinning in 38 (83%), and closed reduction in 3 (6%). Twenty-seven children (57%) were taken directly to the operating room from the ED; the remaining 26 patients underwent surgery the next day. One child was discharged from the ED, returning the next day for orthopedic intervention.

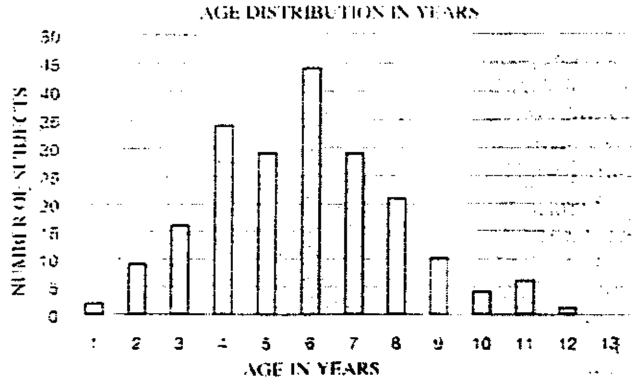

Fig 1. Age distribution in years.

TABLE 1. Injury Patterns Occurring With MB/JG

Long-bone fractures	121 (59%)
Contusion/abrasions	20 (10%)
Strains	17 (8%)
Lacerations	16 (8%)
Closed head injury	10 (5%)
Other fractures	3 (1%)
Abdominal injury	5 (3%)
Genitourinary injury	5 (3%)
Other	7 (3%)
Total	204

Five patients were admitted to the hospital but did not require operative intervention; 1 patient was admitted to the intensive care unit (ICU) for management of a splenic laceration; the remaining 4 were admitted for non-ICU observation (1 C7 compression, 1 closed head injury, 1 renal contusion, and 1 straddle injury).

Parents/guardians of 132/204 patients (65%) were reached and completed the telephone questionnaire. In an analysis of the telephone data, there was no significant association between the surface below the equipment and the type of injury. Of the 79 fractures, 30 occurred on soft surfaces (woodchips or mats) ($P = .12$). Using logistic regression for analysis between the individual surfaces (sand, dirt, woodchips, and grass) and the occurrence of fractures, there was no statistical difference noted in either the occurrence of fractures or the protective benefit of individual surfaces. In specifically examining the association between supracondylar fracture, having a soft surface did not result in a significantly lower rate ($P = .26$). However, in comparing the age of the child and the type of injury, children 1 to 4 years of age sustained more long-bone fractures than did older children ($P < .05$). The presence of an adult supervisor also was not significantly associated with a lower rate of fracture ($P = .87$).

DISCUSSION

Injuries sustained during play are common and variable. Epidemiologic data indicate that playground-related injuries most often are equipment-related. Bond and Peck reported in 1993 that 34% of playground injuries were related to climbers, 30% from slides, and 22% from swings.[2] Mott and associates found that among 178 children, 125 sustained injuries related to the surface beneath the equipment.[3] These authors, however, did not delineate the specific injury patterns seen with equipment type. In 1997, Lillis and Jaffe reported their observations of the general injuries sustained by children from climbing apparatus. They found that climbing apparatus accounted for 29% of playground-related injuries in children younger than 5 years and 47% of those older than 5 years; the most common injuries found in this series were fractures (28%), lacerations (24%), and hematomas (14%).[4]

This study describes the specific injuries associated with MB/JGs. The most common type of injury iden-

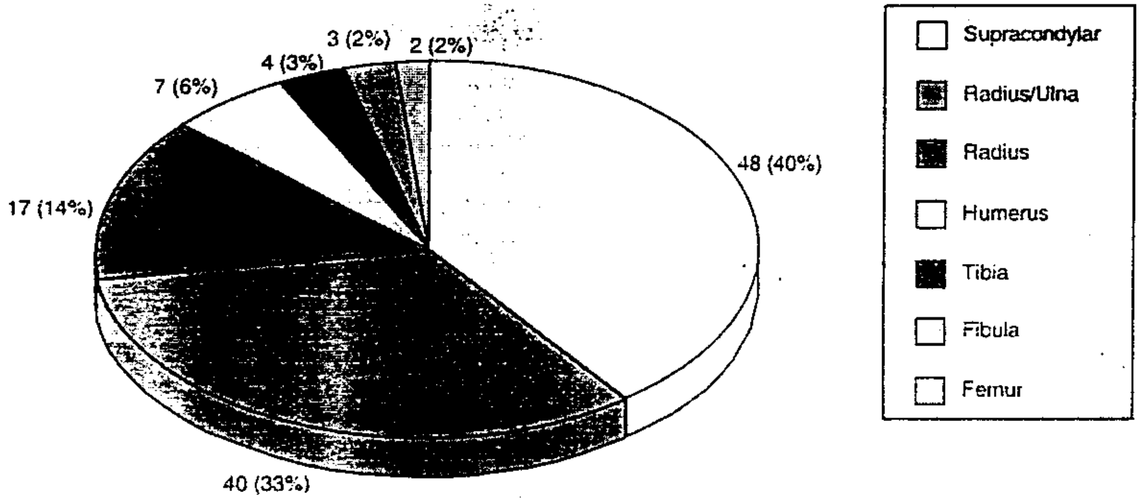

Fig 2. Long bone fracture after MB/JG injury (n = 121).

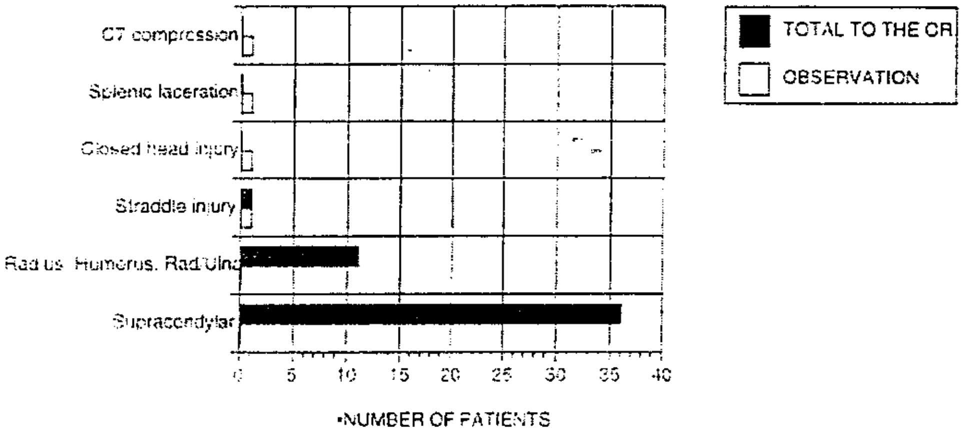

Fig 3. Final diagnosis of admitted patients.

tified was fracture, primarily of the long bones. Fractures of the distal humerus were the most common of these, accounting for 40% of long-bone fractures. Farnsworth and colleagues described the etiology of supracondylar fractures over an 8-year period, noting that 29% of these fractures occurred on playgrounds with 61% of all playground supracondylar fractures as a result of MBs. However, they observed that the incidence of supracondylar fractures increased with age ≥4 years.[5] The high incidence of long-bone fractures, specifically supracondylar fractures found in this study, most likely is related to the design and height of the MB/JGs. This equipment is designed to permit children to climb on top or hang from crossbars. Consequently, injuries occur most commonly as a result of falls and direct injury to the extremity. Younger children may be at higher risk for long-bone fractures because their balance has not developed fully. Also, because the center of gravity of children is centered more cephalad, they tend to land more on the upper portion of their body, sustaining injuries to the upper extremities, torso, and head. Chalmers and Langley found in 1990 that the incidence of fractures increased with falls from equipment >1.5 meters.[6]

Our data indicate that the injuries from this equipment often are serious; 36 (75%) of the supracondylar fractures required admission to the hospital and operative intervention. Isolated radius, radius/ulnar, and nonsupracondylar humerus fractures also were common, requiring surgery in many cases.

There are several laboratory studies that have resulted in the recommendation for use of impact-absorbing surfaces below climbing equipment to minimize fall-associated injuries. These recommendation come from such public health agencies as the Centers for Disease Control[7] and the United States Consumer Product Safety Commission.[8,9] Mott and associates found that certain materials provide protective surfaces for playgrounds. However, they also stressed that impact-absorbing surfaces alone are insufficient to prevent all injuries.[10] Sosin and co-workers could not identify any impact-absorbing surface as clearly superior in regards to the incidence of equipment-related fall injuries[11] Our study indicates that injury pattern is independent of the surface below the equipment.

There are several limitations to this study that deserve mention. The data are almost certainly skewed toward more serious injuries, because minor trauma (contusions, abrasions, etc) often are likely to be treated at home without medical intervention. In addition, because these are data from a single hospital, the overall frequency of these injuries on a population basis is likely to be underestimated. Selection bias is likely to be present in the study population because our ED is a level 1 trauma center that receives referrals from surrounding hospitals. However, although influencing frequency, we would not expect this factor to alter significantly the distribution of the fracture types or the pattern of other injuries identified. Finally, this study is retrospective and therefore has the inherent limitations in data collection. Medical record data were supplemented by the telephone survey in an attempt to circumvent this shortcoming. However, there may have been recall bias on the part of the parent, given the time span between the initial injury and the telephone survey. We feel that recall bias in minimal in that the equipment is located in areas that are frequented by the families and they were able to answer questions easily about the surfaces below the equipment. Despite these limitations, this study offers the first glimpse of the injuries associated with a particular type of equipment, finding an alarming incidence of serious upper extremity injury as well as significant injuries to the head, abdominal organs, and genitalia.

In summary, these data indicate that play on MB/JGs is responsible for a large number of serious childhood injuries. Most common among these are long-bone fractures, particularly supracondylar fractures.

Despite current recommendation that soft surfaces be placed below playground equipment, this study did not find any difference in frequency of supracondylar fractures associated with the surface type. Adult supervision, although always recommended, also did not seem to influence the occurrence of the most common injury, long-bone fractures.

We also found that a significant proportion of children who are injured while playing on MB/JGs require hospitalization, with the majority of these children requiring orthopedic surgical interventions.

Should MB/JGs be banned from playgrounds and backyards? Although our study indicates that there are a significant number of potential serious injuries as a result of this type of equipment, we do not feel these preliminary data warrant an end to the use of this type of recreation. Rather, additional study of the efficacy of soft surfaces placed below the equipment is needed. Increasingly, communities are making significant financial expenditures to place soft surfaces below playground equipment; our data suggest that this investment does not significantly alter the injury pattern.

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^Monkey bar injuries common, often
serious@
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NEW YORK, May 03 (Reuters Health) -- Playground injuries sustained by children in falls from monkey bars or jungle gyms are common and often serious, regardless of whether the structure stands over soft or hard surfaces, say Boston researchers.

In the first study of playground injuries related to a single apparatus, researchers from Children's Hospital in Boston and Harvard Medical School in Boston, Massachusetts, found that one in four injuries sustained in falls from monkey bars or jungle gyms evaluated by emergency room doctors required hospitalization. Most of the children hospitalized (92%) required operations, and most of these surgeries were to treat fractures or joint injuries.

In the study, published in the May electronic version of the journal Pediatrics (www.pediatrics.org), researchers examined records of 24,000 injury visits logged over a 2-year period by the Children's Hospital emergency department.

They identified 204 children ages 20 months to 12 years who sustained injuries linked to monkey bars or jungle gyms.

The most common injury was long-bone fractures, seen in 121 (59%) cases, and most of those (40%) involved broken upper arms. Other injuries included bruises, scrapes, muscle strains, head injury, and abdominal and genitourinary trauma.

The investigators also telephoned 132 parents and guardians of the patients to obtain specific information about the accidents. They found that of the 79 children who suffered fractures, 30 landed on soft-impact surfaces such as wood chips and sand.

The research team, led by Drs. Mark Waltzman and Mary Christine Bailey, concluded that such impact-absorbing surfaces were not effective in reducing injury.

``Increasingly, communities are making significant financial expenditures to place soft surfaces below playground equipment,'' they write. ``Our data suggest that this investment does not significantly alter the injury pattern.``

The Consumer Product Safety Commission says 50,000 children per year injured themselves on playground equipment between 1990 and 1994. The commission linked 88% of those injuries to monkey bars, jungle gyms, slides and swings.

The researchers noted several limitations to the study, chief among them is that examining injuries from the emergency department of a single hospital probably skew the data toward serious injuries. Such data also fails to take into account that most playground injuries are likely to be treated at home.

Despite finding that 25% of the injuries required hospitalization, the Boston researchers emphasize that their data are preliminary and do not recommend banning the equipment.