



UNITED STATES
 CONSUMER PRODUCT SAFETY COMMISSION
 BETHESDA, MD 20814

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BALLOT VOTE SHEET

DATE: April 6, 2011

TO: The Commission
 Todd A. Stevenson, Secretary

THROUGH: Cheryl A. Falvey, General Counsel
 Kenneth R. Hinson, Executive Director

FROM: Philip L. Chao, Assistant General Counsel
 Mary A. House, Attorney, OGC

SUBJECT: Petition for Change to the Bunk Bed Standard (Petition CP 10-2 & HP 10-1)

Ballot Vote Due: April 12, 2011

CPSC staff is forwarding to the Commission a briefing package discussing a petition submitted by Carol Pollack-Nelson, Ph.D., of Independent Safety Consulting, dated April 16, 2010, requesting that the U.S. Consumer Product Safety Commission (“Commission” or “CPSC”) initiate a rulemaking to revise the regulations related to bunk beds, codified at 16 CFR parts 1213, 1500, and 1513 (“Bunk Bed Standard”). The petition seeks to revise the Bunk Bed Standard to incorporate requirements for head and neck entrapment testing in spaces created by side structures that are provided with a bunk bed, including ladders. Staff recommends that the Commission defer its decision on the petition for six months and direct staff to work with the ASTM F15.30 Bunk Bed Subcommittee on the ASTM F 1427 voluntary standard, *Standard Consumer Safety Specification for Bunk Beds*, to develop requirements to address head and neck entrapment in spaces created by side structures. (Option II – Defer the petition). If the Commission votes to defer its decision for six months, at the end of the 6-month period, staff will provide the Commission with an update on the progress of developing requirements for addressing entrapment in side structures. At that time, the Commission could make a determination to continue to defer its decision on the petition and proceed with the voluntary standards process or to pursue other Commission action.

Please indicate your vote on the following options.

I. Grant the petition.

 (Signature)

 (Date)

(a) Direct staff to draft an Advance Notice of Proposed Rulemaking.

(Signature)

(Date)

(b) Direct staff to draft a Notice of Proposed Rulemaking.

(Signature)

(Date)

II. Defer the petition.

(Signature)

(Date)

III. Deny the petition.

(Signature)

(Date)

IV. Take other action (Please specify).

(Signature)

(Date)

Attachment:

Briefing Package: Petition CP 10-2 & HP10-1 Petition for Change to the Bunk Bed Standard, dated April 6, 2011, from Timothy P. Smith, Project Manager, Division of Human Factors, Directorate for Engineering Sciences.

BRIEFING PACKAGE

PETITION CP 10-2 & HP 10-1:
PETITION FOR CHANGE TO THE BUNK BED STANDARD



April 6, 2011

For additional information contact:

Timothy P. Smith, Project Manager
Division of Human Factors
Directorate for Engineering Sciences
U.S. Consumer Product Safety Commission
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Bethesda, MD 20814
301-504-7691, tsmith@cpsc.gov

The contents of this package have not been reviewed or approved by the Commission and do not necessarily represent its views.

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Tab A: Petition CP 10-2 & HP 10-1, Petition for Change to the Bunk Bed Standard, submitted by Carol Pollack-Nelson, Ph.D., of Independent Safety Consulting, April 16, 2010.

Tab B: Memorandum from Mark Eilbert, Directorate for Laboratory Sciences, Mechanical Engineering Division, “Review of Entrapment Requirements in Bunk Bed Standards,” February 9, 2011.

Tab C: Memorandum from Craig O’Brien, Directorate for Epidemiology, Hazard Analysis Division, “Entrapment in Side Structures of Bunk Beds, 1993–2009,” February 9, 2011.

Tab D: Memorandum from Hope E. J. Nesteruk, Directorate for Engineering Sciences, Division of Human Factors, “Human Factors Analysis for Petition CP 10-2 & HP 10-1, Petition for Change to the Bunk Bed Standard,” February 9, 2011.

Tab E: Memorandum from John W. Peternel, Directorate for Economic Analysis, “Petition Requesting Revision of Bunk Bed Standard: Economic Considerations,” January 19, 2011.

Tab F: Public comments in response to Petition CP 10-2 & HP 10-1.

EXECUTIVE SUMMARY

In correspondence dated April 16, 2010, Carol Pollack-Nelson, Ph.D., of Independent Safety Consulting, requested that the U.S. Consumer Product Safety Commission (CPSC) initiate rulemaking to revise current regulations for bunk beds, referred to collectively as the “Bunk Bed Standard,” so that they incorporate requirements for head and neck entrapment testing in spaces created by side structures, such as ladders, that are provided with the bunk bed. The petitioner states that although the risk of injury caused by head and neck entrapment in the end structures of bunk beds is quite low in products that comply with the Bunk Bed Standard, this risk of injury persists in and around certain side structures, such as the space between a ladder and the side of the bed. On June 24, 2010, the CPSC’s Office of the General Counsel docketed the request for rulemaking as Petition CP 10-2 under provisions of the Consumer Product Safety Act (CPSA) and as Petition HP 10-1 under provisions of the Federal Hazardous Substances Act (FHSA).

CPSC staff analyzed potentially relevant bunk bed-related incidents during a 17-year period and identified eight incidents that appear to be within the scope of the petition, in that they involved head or neck entrapment in a bunk bed side structure that currently is not required by the Bunk Bed Standard to be tested for entrapment. These eight incidents resulted in four fatalities and one minor injury. Staff review of the incidents suggests that two fatalities, one injury, and two of the incidents without injury most likely would have been prevented had the provisions proposed in the petition been in the Bunk Bed Standard. The remaining incidents involved children younger than 2 years old, which is the lower end of the age range for which the entrapment probes in the Bunk Bed Standard are designed. Because the current entrapment probes are designed based on the anthropometric dimensions of the *smallest* 2-year-olds, however, staff believes that some of the incidents involving these younger children also might have been prevented if entrapment provisions for side structures had been in the Standard.

The ASTM International (ASTM) F15.30 Bunk Bed Subcommittee has formed a task group charged with recommending revisions to the voluntary standard for bunk beds, ASTM F 1427, *Standard Consumer Safety Specification for Bunk Beds*, to address the concerns raised by the petition. Provided that ASTM F 1427 is revised to incorporate entrapment provisions for side structures that are essentially identical to what the petitioner requests, the revised ASTM standard may address the same fatalities and injuries that would be addressable through the requested rulemaking.

CPSC staff recommends that the Commission defer its decision on the petition for six months and direct staff to work with the ASTM F15.30 Bunk Bed Subcommittee on the ASTM F 1427 voluntary standard to develop requirements that would address head and neck entrapments in side structures. If the Commission votes to defer its decision for six months, at the end of the 6-month period, staff will provide the Commission with an update on the progress of the voluntary standard. At that time, the Commission could make a determination to continue to defer its decision on the petition and proceed with the voluntary standards process or pursue other Commission action.



UNITED STATES
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MEMORANDUM

DATE: April 6, 2011

TO: The Commission
Todd A. Stevenson, Secretary

THROUGH: Cheryl A. Falvey, General Counsel
Kenneth R. Hinson, Executive Director

FROM: Robert J. Howell, Assistant Executive Director,
Office of Hazard Identification and Reduction

Timothy P. Smith, Project Manager,
Division of Human Factors, Directorate for Engineering Sciences

SUBJECT: Petition CP 10-2 & HP 10-1, Petition for Change to the Bunk Bed Standard

Staff of the U.S. Consumer Product Safety Commission (CPSC) has prepared this briefing package in response to a petition requesting that the Commission revise existing bunk bed regulations to address the potential for head and neck entrapment in spaces created by ladders and other side structures.

I. BACKGROUND

A typical bunk bed is a sleep structure consisting of two or more beds stacked directly over one another; the Commission defines a bunk bed as any bed with a mattress foundation whose underside is more than 30 inches above the floor. Bunk beds generally are composed of two uprights, or end structures, at the head and foot of the bed, joined by side elements that include support rails for each bed and upper-bunk guardrails intended to prevent falls. Mattress foundation supports span between the side rails. Often, a ladder is secured to the upper and lower bunks, leaned onto the upper bunk, or integrated into a side or end structure to provide access to the upper bunk.

The Commission regulates bunk beds under both the Federal Hazardous Substances Act (FHSA), for bunk beds intended for use by children, and the Consumer Product Safety Act (CPSA), for bunk beds not intended specifically for children. The regulations under both statutes are virtually identical and are codified at 16 CFR parts 1213, 1500, and 1513 (referred to collectively as the "Bunk Bed Standard"). The Bunk Bed Standard is intended to reduce or eliminate the risk that children will die or be injured from entrapment between the upper bunk and the wall, in openings within and below the guardrails, or in openings in the end structures of bunk beds.

A. PETITION INFORMATION

In correspondence dated April 16, 2010, Carol Pollack-Nelson, Ph.D., of Independent Safety Consulting (the “petitioner”), requested that the Commission initiate rulemaking to revise the Bunk Bed Standard to incorporate requirements for head and neck entrapment testing in spaces created by side structures, such as ladders, that are provided with the bunk bed. On June 24, 2010, the CPSC’s Office of the General Counsel docketed the request for rulemaking as Petition CP 10-2 under provisions of the CPSA and as Petition HP 10-1 under provisions of the FHSA. A copy of the petition can be found in Tab A.

The petitioner identified three primary ways in which children become entrapped in the openings of products: head-first, feet-first, and neck-first. In head-first entrapment, the child inserts the head into a fully bounded opening but is physically or cognitively incapable of extricating the head. In feet-first entrapment, the child enters a fully bounded opening that is large enough to admit the torso, but is not large enough for the head to pass through. In neck-first entrapment, the child inserts the neck into a partially bounded opening at the top of the product but cannot extricate the head. The petitioner noted that children have strangled from head entrapments even with their feet and knees on the ground.

The petitioner remarked that the risk of injury caused by head and neck entrapment in the end structures of bunk beds is quite low in products that comply with the Bunk Bed Standard; but she argued that this risk of injury persists in and around certain side structures, such as the space between a ladder and the side of the bed. The petitioner identified three fatalities and four nonfatal incidents involving children whose head or neck became entrapped between the side of the bed and a bunk bed ladder. The petitioner described the hazard specific to ladders as arising from the child’s head passing through the space created by the top of the mattress and a horizontal ladder rung, and the neck dropping into the gap between the vertical ladder post and the side of the mattress.

The petitioner stated that assessing the entrapment hazard requires the use of a neck probe that simulates the dimensions of the smallest user’s neck. Based on child anthropometric data and the compressibility of the neck, the petitioner argued that any space greater than 1.9 inches (4.8 cm) can pose a risk of neck entrapment in bunk bed side structures. The petitioner argued that deaths have occurred and will continue to occur unless the Bunk Bed Standard is revised to include testing for head and neck entrapment in spaces created by side structures.

B. RELEVANT STANDARDS AND ACTIVITIES

1. MANDATORY BUNK BED STANDARD

As noted earlier, the Commission regulates children’s bunk beds under the FHSA and other bunk beds under the CPSA. The Bunk Bed Standard is codified at 16 CFR parts 1213, 1500, and 1513 and is intended to reduce or eliminate the risk that children will die or be injured from entrapment between the upper bunk and the wall, in openings within and below the guardrails, or in openings in the end structures of bunk beds. A bunk bed without proper guardrails and safe dimensions for openings in the bed’s structure may allow children to become entrapped and can cause these children to strangle or suffocate. This can occur when children become wedged

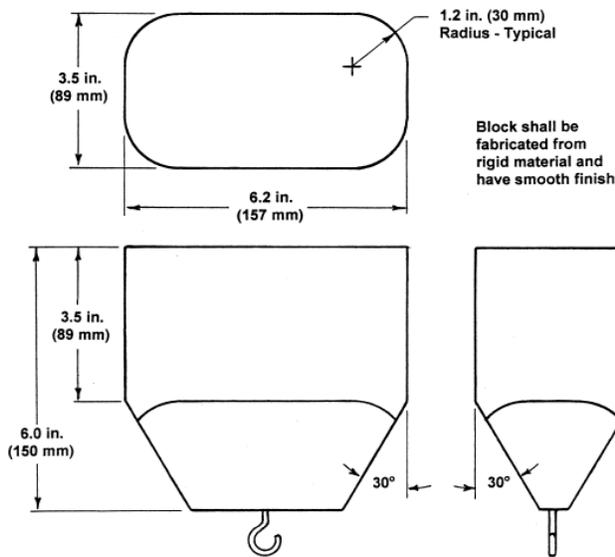


FIGURE 1. Torso entrapment probe (wedge block).
From 16 CFR parts 1213 and 1513.

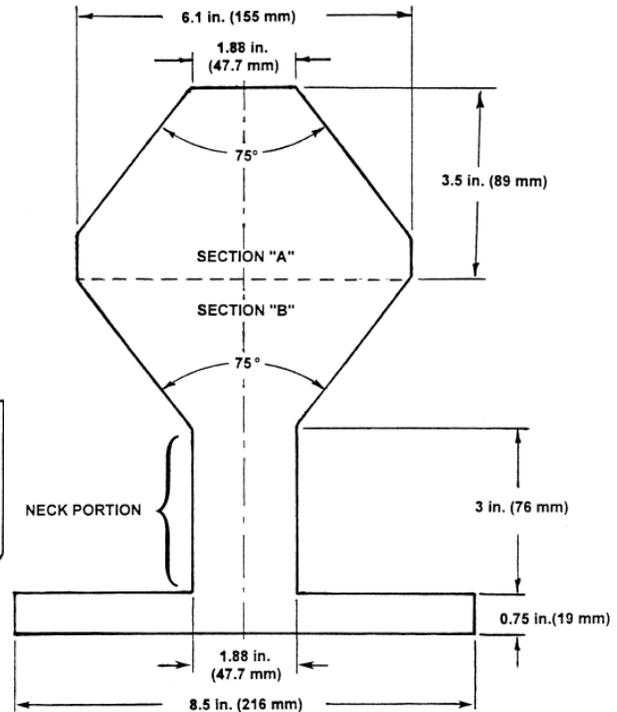


FIGURE 2. Neck entrapment probe.
From 16 CFR parts 1213 and 1513.

between the bed and the wall, when children slip their torso through an opening in the bed that is too small for their heads to pass through (feet-first entrapment), or when children place their heads into an opening, move to a narrower area of the opening where the head cannot be pulled out, and then fall or lose their footing (head-first entrapment). The Bunk Bed Standard became effective on June 19, 2000, and applies to all bunk beds manufactured in the United States or imported on or after that date.

The Bunk Bed Standard requires that bunk beds be tested for entrapment hazards using a wedge block that simulates the torso of a small 2-year-old child. This wedge block, shown in Figure 1, is used to probe spaces in the upper bunk guardrails, between the guardrails and the upper bunk mattress foundation, and in the end structures of the bunk bed to identify openings that could allow feet-first torso entry, which could lead to head or neck entrapment. During testing, the wedge block must not pass freely through any opening in the upper-bunk end structure or in any space between the uppermost member of the upper-bunk guardrail and the underside of the upper bunk's foundation. If any opening in the lower-bunk end structure permits passage of the wedge block, that opening also must permit passage of a 9-inch diameter rigid sphere, which represents access for a 5-year-old child's head. If the sphere passes freely, the opening then is tested for neck entrapment using a specially designed probe that simulates a child's head and neck; this probe is shown in Figure 2. These tests are performed first with no mattress on the bed and again with the manufacturer's recommended maximum-thickness mattress in place. The Bunk Bed Standard does not require entrapment testing of side structures other than the aforementioned upper-bunk guardrails.

2. VOLUNTARY STANDARD FOR BUNK BEDS

The ASTM International¹ (ASTM) voluntary standard, ASTM F 1427, *Standard Consumer Safety Specification for Bunk Beds*, contains additional requirements for the design and performance of bunk beds. The current version of the standard is 2007 (ASTM F 1427 – 07). In 2001, ASTM F 1427 adopted the performance requirements specified in the Bunk Bed Standard for head entrapments in guardrails and end structures; however, the ASTM standard does not have a neck probe test. As in the case of the mandatory Bunk Bed Standard, the ASTM standard does not include any performance requirements intended to address entrapments in side structures, other than upper-bunk guardrails. Section 4.8 of the Standard specifies ladder requirements, but these requirements do not include testing for entrapment hazards.

CPSC staff attended a meeting of the ASTM F15.30 Bunk Bed Subcommittee on November 9, 2010, and briefly summarized the petition for the Subcommittee. Staff also participated in a conference call with the Bunk Bed Subcommittee on March 17, 2011, in which the Subcommittee discussed the petition and possible revisions to ASTM F 1427 that might address the hazard identified in the petition. At the conclusion of the meeting, the Subcommittee formed a task group charged with examining the ASTM standard, recommending revisions to the standard to address the concerns raised by the petition, and reporting these proposed revisions to the Subcommittee during the next Bunk Bed Subcommittee meeting, currently scheduled for the first week in May 2011.

3. OTHER STANDARDS WITH ENTRAPMENT REQUIREMENTS

Staff of the CPSC's Directorate for Laboratory Sciences, Division of Mechanical Engineering (LSM) identified other standards with potentially relevant entrapment requirements (see Tab B). The Australian/New Zealand voluntary standard, AS/NZS 4220, *Bunk Beds and Other Elevated Beds*, includes performance requirements for head entrapment hazards. Specifically, all openings greater than 600 mm (23.6 inches) above the floor cannot have dimensions between 95 and 230 mm (3.7 and 9.0 inches).

Although not specific to bunk beds, the ASTM voluntary standard, ASTM F 1148, *Standard Consumer Safety Performance Specification for Home Playground Equipment*, requires that accessible openings—except those between the ground and the bottom edge of the equipment—meet performance requirements intended to reduce the risk of accidental head or neck entrapment by head- or feet-first entry. An accessible opening is any completely bounded opening in which a torso test probe may be inserted into the opening to a depth of 4 inches. If the opening admits the torso test probe, it also must admit a head probe. All non-inverted angles, including those with accessible openings, also must conform to neck entrapment requirements, which place a lower bound on the interior angle formed by “V” shapes. The torso and head probes are similar in dimension and test methods to the probes in 16 CFR parts 1213 and 1513. ASTM F 1148 tests for neck entrapment by precluding the use of acute angles less than 55 degrees, unless the angle is inverted, which is defined as having the lowest leg horizontal or sloping downward. The ASTM voluntary standard, ASTM F 1487, *Standard Consumer Safety Performance Specification for Playground Equipment for Public Use*, has entrapment

¹ ASTM International was known formerly as the American Society for Testing and Materials.

requirements similar to the Standard for Bunk Beds, including the use of a neck entrapment probe similar in shape and use to the probe shown in Figure 2. The ASTM voluntary standard, ASTM F 2373, *Standard Consumer Safety Performance Specification for Public Use Play Equipment for Children 6 Months through 23 Months*, also uses entrapment test probes and methods similar to the Bunk Bed Standard and ASTM F 1487.

II. HAZARD INFORMATION

A. INCIDENT DATA

As discussed in Tab C, staff of the CPSC's Directorate for Epidemiology, Division of Hazard Analysis (EPHA), searched CPSC data sources for bunk bed-related incidents that were reported to the CPSC from 1993 through 2009 (17 years)² and filtered the results to identify incidents that might have involved a head or neck entrapment in a side structure on the bunk bed. The CPSC's multidisciplinary Bunk Bed Petition team then completed a more thorough review of these incidents. For the purposes of this review, staff considered in-scope incidents to be those involving head or neck entrapment in a bunk-bed side structure that currently is not required to be tested for entrapment as specified in the Bunk Bed Standard. For example, upper-bunk guardrails already are required to be tested for entrapment in the Bunk Bed Standard, so entrapment incidents in these guardrails would be considered out of scope. However, entrapment incidents in side-mounted ladders or lower-bunk guardrails would be considered in scope.

As a result of the review, staff identified eight in-scope incidents. Four of these incidents resulted in fatalities; one resulted in minor injury (bruising); and three did not result in any injury to the child. The ages of the children involved ranged from 17 months to 6 years. In seven of the eight in-scope incidents, the side structure involved in the entrapment was a ladder; in five of these cases, the child was trapped between the mattress and a ladder; and in the other two cases, the child was trapped between two rungs of a ladder. In the remaining in-scope incident, the child was trapped between the mattress and a guardrail on the lower bunk.³ No in-scope incidents were found in the National Electronic Injury Surveillance System (NEISS) database; therefore, staff cannot provide annual estimates regarding the number of relevant entrapment injuries treated in hospital emergency rooms.

Staff identified 20 additional incidents that lacked sufficient details to determine whether they were within the scope of the petition. For example, some of these incidents reportedly involved a guardrail, but the incident description did not specify whether the guardrail was located in the upper or lower bunk. Some incidents reportedly involved entrapment in a ladder, but the incident description did not specify whether the ladder was located on an end or side structure. Of these 20 incidents, 10 resulted in fatalities; 2 resulted in injuries; and 8 did not result in any injury to the child. The ages of the children involved in these incidents ranged from 7 months to 11 years.

² This 17-year timeframe was based on the estimated expected useful life of a bunk bed (see Tab E).

³ The incident description refers to entrapment between a "bottom side rail" and mattress, and the team consensus was that this should be considered in scope. Upper-bunk guardrails commonly consist of two horizontal rails stacked vertically, however; so it is possible that this incident involved entrapment between an upper-bunk mattress and the lower rail of an upper-bunk guardrail. If that were the case, this incident would be considered out of scope.

B. FORESEEABLE CHILDREN'S BEHAVIOR

In Tab D, staff of the CPSC's Directorate for Engineering Sciences, Division of Human Factors (ESHF), notes that a 1990 study of bunk bed injuries by Selbst and colleagues found three primary hazard patterns: (1) playing in or near the bed; (2) sleeping; and (3) getting in or out of bed. Of the eight in-scope incidents identified by CPSC staff, three occurred while the child was playing in or near the bunk bed, and three occurred while the child was sleeping. The reports of the other two incidents did not contain enough information to determine what the child was doing at the time of entrapment.

According to ESHF staff, head and neck entrapments that occur during play typically affect children under 5 years because children at this age have neither the reasoning abilities to reverse the motions that lead to their entrapment nor the strength to lift themselves from a hanging situation. Children are known to play on bunk beds, for example, by using them as climbing structures. Some bunk bed manufacturers even include a slide as an egress method from the top bunk, virtually ensuring that the bed will be viewed not only as a sleeping structure, but also as a play structure. Three of the incidents analyzed by staff occurred when children were playing on the bunk bed. Behaviorally, there is nothing to suggest that play patterns involving end structures and side structures of a bunk bed will differ, especially because ladders on some models have been moved from the end structure to the sides, and new features, such as slides, have been added.

Settling problems and nighttime waking are common in young children (Ramchandani et al., 2000) and still affect up to 6.5 percent of children over age 5 (Blader et al., 1997). Selbst and colleagues' (1990) bunk bed study noted that about two-thirds of the children who were injured during sleep were under 6 years old; and it is well documented that children under age 6 still fall out of bed with some frequency while sleeping (*e.g.*, Lyons et al., 1993; Nimityongskul et al., 1987; Selbst et al., 1990). Young children do not possess the cognition to navigate a bunk bed safely. This cognitive deficit is amplified when a child is drowsy during a nighttime awakening and further compounded by the low-light condition likely present during the night. Older children also are subject to diminished cognition during nighttime awakenings and low-light visibility issues when navigating a bunk bed at night. Thus, children, especially younger children, may encounter any portion of the bunk bed during nighttime behaviors because they may not be fully aware of their surroundings.

C. INCIDENT ADDRESSABILITY

As discussed by ESHF staff in Tab D, the testing requirements currently prescribed in the Bunk Bed Standard include the use of several anthropometrically developed probes to test various partially and completely bound openings in the bunk bed structure—namely the end structures and upper-bunk guardrails—for entrapment potential. The probes used for this testing were developed based on anthropometric dimensions of the children at risk of entrapment. The wedge block probe, which tests for torso-first entry and entrapment, was based on hip and buttocks dimensions of a small 2-year-old child. The neck entrapment probe also was based on the anthropometric dimensions of a 2-year-old child, specifically a 25- to 30-month-old, with 25 percent subtracted as a safety factor (Deppa, 1989).

Of the four fatalities, one injury, and three incidents without injury that CPSC staff determined to be within the scope of the petition, all but two fatalities and one incident without injury involved a child at least 2 years old. Thus, the provisions proposed in the petition most likely would have prevented these five incidents. It is unclear whether the proposed provisions would affect the two fatalities and one incident without injury that involved children younger than 2 years old. However, because the current entrapment probes are designed based on the anthropometric dimensions of the *smallest* 2-year-olds, some children younger than 2 years old, but of average or larger size, most likely are protected by these probes as well. This suggests that some of the incidents involving these younger children, especially those involving children very close to 2 years old,⁴ also might have been prevented if entrapment provisions for side structures had been in the standard.

Additionally, staff of the CPSC's Directorate for Laboratory Sciences, Division of Mechanical Engineering (LSM), found that five of the six in-scope incidents that have been investigated by CPSC staff involved an entrapping space of at least 3½ inches but not larger than about 6 inches (see Tab B). Comparing these spaces with the dimensions of the test probes in 16 CFR parts 1213 and 1513 suggests that these spaces would have permitted passage of the wedge block probe, which measures 3 ½ inches wide, but would not have permitted passage of the 9-inch head probe. Therefore, these spaces would be considered an entrapment hazard and would not have passed if entrapment provisions for side structures were included in the Bunk Bed Standard. The remaining investigated incident for which the entrapping dimensions could be determined involved an entrapment space that was estimated to be 3¼ inches wide, which is smaller than the 3½-inch width of the wedge block probe. This incident also involved a child younger than 2 years old, which, as discussed above, is younger than the age range for which the entrapment probes are designed. Thus, although this incident might have been prevented by entrapment provisions for side structures, it is possible that it would not have been prevented unless entrapment testing for these spaces was made more stringent.⁵

D. OTHER FORESEEABLE ENTRAPMENT HAZARD PATTERNS

ESHF staff identified other side-structure configurations that, although not represented in the available incident data, also could lead to head and neck entrapment (see Tab D). For example, staff identified several bunk beds on the market with guardrails that consist of a pair of horizontal slats without vertical members at the ends. An example of such a configuration is shown in Figure 3. Based on knowledge gained in other product areas,⁶ CPSC staff believes that the open areas at the ends of such structures could present an entrapment

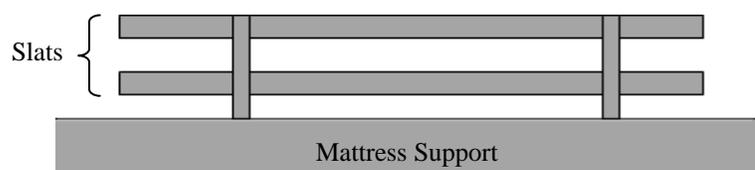


FIGURE 3. Example of open-ended guardrail. Adapted from Figure 1 in ESHF memorandum.

⁴ The two in-scope fatalities that involved children younger than 2 years old involved a 17-month-old and a 22-month-old. One in-scope incident without injury involved an 18-month-old.

⁵ For example, by using a wedge block of smaller size to represent a younger and smaller child.

⁶ The ASTM standard for public playgrounds (ASTM F 1487) and the CPSC Public Playground Safety Handbook (Publication #325), for example, use a similar partially bound opening probe and test. The lack of fatal neck entrapment incidents on playgrounds suggests the test is adequate.

hazard. Current requirements for bunk beds would test these structures for feet-first entrapment using a wedge block only. A guardrail matching this configuration, however, could prevent passage of the wedge block and still allow children to slip their necks into the open ends formed by the slats, perhaps while entering or exiting the bed using the ladder. Although the risk of neck entrapment in a partially bound opening such as this declines by the time children reach age two (Deppa, 1989), this type of structure could present an entrapment hazard.

ESHF staff also is aware of some bunk beds that have rounded corners that meet in a V-shape, identified in Figure 4 by an arrow. This V-shape, a form of a partially bounded opening, has been identified as a possible neck entrapment hazard on several other products, such as baby gates and crib headboard cutouts (Deppa, 1989). Acute angles also have been recognized as a hazard on playground equipment for more than 30 years (Mahajan et al., 1978). The neck entrapment probe was designed to identify angles and other partially bound openings that may entrap a child's neck. It is unclear whether this corner angle would be considered a side structure and, therefore, whether it would be tested.

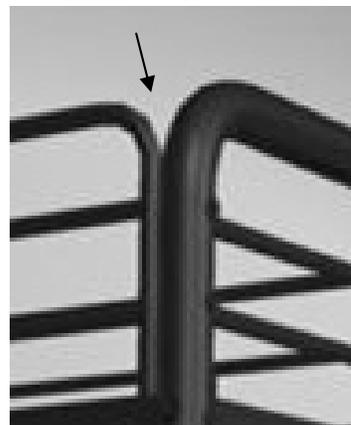


FIGURE 4. Example of V-shape at corner. Adapted from Figure 2 in ESHF staff memorandum.

III. ECONOMIC CONSIDERATIONS

As discussed by staff of the CPSC's Directorate for Economic Analysis (EC) in Tab E, there are more than 700 entities that either manufacture domestically or import bunk beds. Consumers can acquire bunk beds through several channels, including specialty stores, furniture stores, department stores, mail-order, or the Internet. Consumers also may acquire used bunk beds in secondary markets.

Based on available information, about 500,000 new bunk beds are sold annually. The average retail price of a new bunk bed is about \$350, with most prices ranging from \$150 to \$1,400. Therefore, the annual retail value of bunk beds sold for residential use is about \$175 million. Trade sources estimate that the expected useful life of a bunk bed is between 13 years and 17 years. Given sales estimates and information on the average product life of bunk beds, EC staff estimates that there may be about 9 million bunk beds currently in use.

No data is readily available on the percentage of firms that produce bunk beds with side structures, such as ladders or lower guardrails, or the numbers of bunk beds sold that have side structures that would fail the additional testing requirements of the standard proposed in the petition. However, if the bunk bed standard is amended as the petitioner requests, manufacturers may incur additional costs associated with the production and testing of bunk beds. While the percentage of bunk beds that would require modification to comply with a revised standard is unknown, all bunk bed manufacturers would be subject to additional testing requirements. However, because bunk beds already undergo significant testing pursuant to the Bunk Bed Standard and the testing requirements under the Consumer Product Safety Improvement Act (CPSIA), the increase in testing costs likely would be small.

Since 1994, and as described earlier, CPSC staff is aware of a total of eight bunk bed incidents, including four deaths and one minor injury that are within the scope of the petition. Given that these incidents have occurred over a 17-year period and there are about 9 million bunk beds in use, the bunk bed deaths that might have been addressed appear to be quite rare: about 1 death for every 38 million bunk beds in use per year.

As noted in the *Incident Data* section, CPSC staff identified 20 additional incidents, including 10 deaths that lacked sufficient detail to determine whether they would have been addressed by the proposed standard. For the most part, staff believes that it is unlikely that these deaths would have been addressed by the proposed standard. For example, several of the deaths reportedly involved a guard rail but the report did not specify whether the guard rail was on the upper bunk or the lower bunk. However, side guardrails on lower bunk beds appear to be uncommon; consequently, these deaths most likely involved the top bunk rail, which the current standard addresses. Nevertheless, if we assume that half of the deaths within this group of 20 incidents would have been addressed by the proposed standard, the total number of potentially addressable deaths would amount to 9,⁷ or about 1 death for every 17 million bunk beds in use per year.

IV. PUBLIC COMMENTS

On June 29, 2010, the Commission voted unanimously (5–0) to approve publication of a notice in the *Federal Register* to solicit public comments on the petition. The notice was published on July 12, 2010 (75 FR 39666), and the comment period ended on September 10, 2010. The Commission received four comments in response to the *Federal Register* notice. All four comments supported the petition and can be found in Tab F.

One commenter, CPSC-2010-0071-0002, stated that the petition would be raised at the next ASTM F15.30 Bunk Bed Subcommittee meeting. As noted earlier in the discussion of the *Voluntary Bunk Bed Standard*, this meeting took place on November 9, 2010 and a follow-up meeting of the Subcommittee took place on March 17, 2011. During these meetings, the Subcommittee discussed the petition and possible revisions to the voluntary standard, ASTM F 1427, that might address the hazard identified in the petition. The Subcommittee formed a task group in response to the petition and stated that it intends to address the concerns raised by the petition in the voluntary standard.

V. COMMISSION OPTIONS

Options for Commission action to address the petition include:

1. Grant the Petition

If, based on the information contained in this briefing package, the Commission concludes that bunk-beds side structures may present an unreasonable risk of injury or death and it finds that provisions in the Bunk Bed Standard may be reasonably necessary to eliminate or adequately reduce that risk, the Commission may grant the petition and direct staff to develop an advance notice of proposed rulemaking (ANPR) or a notice of proposed rulemaking (NPR) under the

⁷ Four in-scope fatalities, plus five questionable fatalities.

authority of the Consumer Product Safety Act (CPSA) and the Federal Hazardous Substances Act (FHSA).

2. Deny the Petition

If the Commission concludes that the available information does not support a finding that bunk-bed side structures present an unreasonable risk of injury or death and that provisions in the Bunk Bed Standard are necessary to address the hazard, the Commission may deny the petition.

3. Defer Decision on the Petition

If the Commission concludes that there is insufficient information to make a decision on the petition and that staff could obtain such information, or concludes that voluntary standards requirements could be developed that would address the issue under consideration, the Commission could defer its decision and direct staff to obtain the additional information or continue to work on the voluntary standards.

VI. STAFF CONCLUSIONS AND RECOMMENDATION

CPSC staff identified eight incidents from 1993 through 2009 that appear to be within the scope of the petition. These incidents resulted in four fatalities and one minor injury; three incidents did not result in injury. Staff review of the incidents suggests that two fatalities, one injury, and two of the incidents without injury most likely could have been prevented had the provisions proposed in the petition been in the Bunk Bed Standard. The remaining incidents involved children younger than 2 years old, which is the lower end of the age range for which the entrapment probes in the Bunk Bed Standard are designed. However, because the current entrapment probes are designed based upon the anthropometric dimensions of the *smallest* 2-year-olds, staff believes that some of the incidents involving these younger children also could have been prevented if entrapment provisions for side structures had been in the Standard.

Staff identified 20 additional incidents, including 10 fatalities and 2 injuries, that are possibly within the scope of the petition but lack sufficient details to allow staff to make a firm determination. The details that were available, however, suggest that many of these incidents are actually out of scope. Thus, although amending the Bunk Bed Standard could address as many as 14 of the observed fatalities and 3 of the injuries that occurred over the past 17 years, the number of fatalities and injuries that could have been prevented by the provisions proposed by the petition is likely to be closer to the 4 fatalities and 1 injury staff identified as within the petition's scope.

As noted earlier, the ASTM F15.30 Bunk Bed Subcommittee has formed a task group charged with recommending revisions to the ASTM F 1427 voluntary standard for bunk beds to address the concerns raised by the petition. Provided that ASTM F 1427 is revised to incorporate entrapment provisions for side structures that are identical to what the petitioner requests, the revised ASTM standard may address the same fatalities and injuries that may be addressable through the requested rulemaking.

Based on the information contained in this briefing package, CPSC staff recommends that the Commission defer its decision on the petition for six months and direct staff to work with the

ASTM F15.30 Bunk Bed Subcommittee on the ASTM F 1427 voluntary standard to develop requirements that would address head and neck entrapments in side structures. If the Commission votes to defer its decision for six months, at the end of the 6-month period staff will provide the Commission with an update on the progress of the voluntary standard. At that time, the Commission could make a determination to continue to defer its decision on the petition and proceed with the voluntary standards process or pursue other Commission action.

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TAB A

Petition CP 10-2 & HP 10-1,
Petition for Change to the Bunk Bed Standard

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April 16, 2010

Mr. Todd Stevenson, Director
Office of the Secretary
U.S. Consumer Product Safety Commission
4330 East-West Highway
Bethesda, MD 20814

Re: Petition for Change to the Bunk Bed Standard

Dear Mr. Stevenson:

I am writing this petition to request the Consumer Product Safety Commission (CPSC) initiate rulemaking to revise the Bunk Bed Standard (16 CFR Parts 1213, 1500, and 1513, FR Vol 64, No. 245) such that it incorporates requirements for head and neck entrapment testing in spaces created by side structures that are provided with a bunk bed, including ladders. I am a Human Factors Psychologist, having worked in the field of consumer product safety since 1982. From 1988 through 1993, I was employed by the CPSC in the Human Factors Division. Since 1994, I have been working independently as a human factors consultant. I have published in the field of Human Factors, including papers on product hazards, child supervision, warning label design, and voluntary standards. I have presented my findings at professional and industry conferences.

This past year, I was retained as an expert, in a case involving the fatal neck entrapment and strangulation of a child between a side ladder and the lower mattress platform of a bunk bed. Presently, the bunk bed standard limits head and neck entrapment testing to the end structure. It does not require testing of integral structures positioned on the side of the bed, such as a side-mounted ladder.

Today, the risk of head and neck entrapment in end structures is quite low in complying bunk beds. However, the risk of head and neck entrapment in the space between the ladder and side of the bed persists. Children have died as a result of this omission in the standard and they will continue to die until the mandatory standard is amended to address this issue.

Sample Incident

On November 17, 2008, Ryan Bucheit (age 4 years 10 months) died as a result of neck compression injuries suffered when his head became entrapped between the ladder and mattress of his bunk bed (see IDI 081021HWE7802). Ryan had been placed in the bottom bunk of the bunk bed overnight, with his sister sleeping in the upper bunk.

In the morning, Ryan's mother entered his room and observed that he was caught by the neck between the vertical post of the ladder and the side of the mattress. His bottom was on the floor. One foot was up like he had his knee up. His back was to the mattress. Ryan was already deceased when his mother found him.

The bunk bed on which Ryan died was a white metal, "twin over full" design. This bunk bed has a metal ladder attached to the sides of the lower and upper bunks. The ladder consists of two connected portions - a vertical portion that attaches to the lower bunk; and a slanted portion that attaches to the upper bunk. When the full mattress is placed on the lower bunk as far from the ladder as it will go, there is a 3-inch U-shaped gap between the side of the mattress and the inside, right-side vertical post of the ladder. There is also a 5-inch space between the upper edge of the mattress and the lower, inner edge of the second ladder rung. The torso probe slides easily through this space. The 9-inch sphere cannot pass through the opening. If this opening was located on the end structure of the bunk bed, it would be a clear violation of the CPSC standard.

When Ryan died, his face apparently passed through the 5-inch space between the mattress and the ladder. Once his head passed (partially) through the opening between the ladder rungs, his neck dropped down in the 3-inch space between the side of the mattress and the vertical post on the ladder. With his chin hooked over the vertical post, the mattress against the back of his head, and his body weight outside the bed, Ryan strangled on the vertical post of the ladder.

Head & Neck Entrapment

Head and neck entrapment incidents have occurred in playgrounds, toy chests, strollers, hospital beds, shopping carts, beds, bed rails, cribs, toddler beds and bunk beds. Over the last several decades, millions of products that pose a head entrapment hazard have been recalled and standards have been published to attempt to prevent future incidents.

There are three primary ways in which children become entrapped in the openings of products - head-first, feet-first, and neck-first. In head-first entrapment, the child inserts his or her head into a fully-bounded opening (e.g., to look through the opening) but is physically and/or cognitively incapable of extricating the head. Young children lack the cognitive skills necessary to figure out how to remove their heads from a space, particularly when they cannot see behind themselves and if they have re-oriented their heads after entering the space. Also, backing the head out of tight spaces is made more difficult if the ears flare out when pulling back through the opening.

In feet-first entrapment, a child enters a fully-bounded opening that is large enough to admit his or her torso, but not large enough for the head to pass through. As a result, the child becomes caught at the neck. Avoiding head entrapment in this scenario can be especially difficult if the opening is elevated as it requires the child to have sufficient upper-body strength to go backwards through the hole.

In neck-first entrapment, a child inserts his or her neck into a partially bounded opening in the top of the product, but cannot extricate the head. Removing the head is particularly difficult if the jaw becomes hooked and/or if the head is pinned.

It is important to note that even with the feet and knees on the ground, children have strangled as a result of their heads becoming entrapped in an opening. For example, strangulation deaths involving old-style toddler climbing gyms resulted after children inserted their heads through the spaces in ladders but were unable to figure out how to pull their heads out of the space. Though their feet were on the ground, the weight of their heads over the ladder rungs caused strangulation when the child was no longer able to hold his head and neck up.

The concern regarding head and neck entrapment hazards was illuminated in the Commission report entitled, *Structural Entrapment Hazards to Infants and Children* (September 1983). The authors of this report provided an assessment of products involved in structural entrapment incidents involving children less than 10 years of age. This analysis found that many different types of products can and do present an entrapment hazard to children. These products included beds and bedding accessories, children's products (e.g., toy chests, high chairs, playpens, baby swings, and walkers), household furnishings such as sofa beds and chairs, and public and home playground equipment. Beds and bedding accessories including beds, mattresses, bunk beds, youth beds, bedrails, cribs, bassinets and cradles were among the products cited most frequently. The authors concluded that some of the products are common to every household and A...children may be left alone in a potentially hazardous situation which parents or other caretakers are not aware.@

When entrapment occurs in products intended for the sleeping child, a fatal outcome is likely if the child is unable to extricate him or herself or effectively call for assistance. For example, in the 1983 study, over 80 percent of entrapment incidents involving bedding and bedding accessories (i.e., beds, mattresses, and hospital beds), youth rails, and infant bed products (i.e., cribs, bassinets and cradles) were fatal. Fifteen entrapment incidents involving bunk beds. Reported areas of entrapment included the mattress and guardrail and between the mattress and foot rail. Authors found that some of the incidents occurred when the victim, rolled over in bed while sleeping (p. B4).

The Specific Risk of Head and Neck Entrapment in Bunk Beds

The bunk bed industry has been aware of bunk beds hazards for decades and has developed and revised a number of voluntary standards to address this hazard. The evolution of these voluntary standards was based on incident data demonstrating the risk of head and neck entrapment in bunk beds. In the late 1980s, CPSC staff examined bunk bed-related incidents, injuries and deaths (see Aug 31, 1987 memo from Debbie Tinsworth to Elaine Tyrrell) and concluded that Aentrapment has been the most frequently reported cause of bunk-bed related deaths since 1973...@

The first standard for bunk beds was the "Voluntary Bunk Bed Safety Guideline", written in 1978 by an Inter-Industry Bed Safety Task Group. This Guideline, which became effective in January 1979, was to be used voluntarily by manufacturers and retailers of bunk beds intended for home use (CPSC Briefing Package, Options for Bunk Beds, Nov 26, 1997). This guideline included requirements for mattress and foundation size and fit, side rail dimensions and attachment, guard rails, ladders, and on-product labels. This 1978 voluntary guideline was incorporated into an American National Standards voluntary standard in 1981 Institute (ANSI Z357.1).

In May 1986, the American Furniture Manufacturers Association (AFMA) published Voluntary Bunk Bed Safety Guidelines, which were developed by an Inter-Industry Bunk Bed Committee (IIBBC). The purpose of the document was "...to establish nationally recognized safety requirements for Bunk Beds and to provide a basis for common understanding as to the safe use of bunk beds among producers, distributors and users." These Guidelines provided specifications for the dimensions of bunk bed structures and mattresses, including:

- There shall be no openings in the end structures of the upper bunk that would allow the free passage of a cube of any dimension between 3.5 inches and 8 inches in any orientation when the recommended mattress and foundation are in place. End structure openings of the upper bunk which permit free passage of an 8 inch or larger cube, or a 3.5 inch or smaller cube are acceptable. These specifications pertaining to the end structures of the upper bunk shall only apply to that portion of the upper bunk above the support system of the upper bunk.
- There shall be no openings in the rigid bed structure below the lower edge of the guardrail that would permit the free passage of a 3.5 inch cube in any orientation or the lower edge of the guardrail shall not be more than 1 inch from the mattress. These requirements shall be maintained when a lateral force of 33 lbf is applied to the center of the guardrail in an outward direction.

In July 1988, industry published "Revised Voluntary Bunk Bed Safety Guidelines" with input from the CPSC. This version expanded specifications for mattress and foundation size and fit: "The bunk bed must be constructed to allow a conventional-sized mattress when centered, to fit within : inches from the interior bed structure, so that a space of no greater than 1.5 inches can be created when the conventional-sized mattress is moved in any horizontal direction within the interior bed structure."

In 1992, ASTM published a Standard Consumer Safety Specification for Bunk Beds, F1427-92. The standard specified spacing limitations relating to the mattress and foundation size and fit, guard rails, and ladders. Further, the standard stated that "[t]here shall be no openings in the rigid end structures of the upper bunk that will permit the free passage of the wedge block...." As was the case with the guidelines that preceded the standard, the requirement only applied to bed end structures above the foundation of the upper bunk.

In a 2/13/96 meeting with the ASTM Subcommittee for Bunk Beds (F15.30), renowned CPSC engineer, John Preston, stated that after reviewing CPSC data involving entrapment incidents in bunk

beds, it appeared that life threatening incidents generally occur in openings at the level of the mattress sleeping surface or close to that surface (p. 1). Subsequently, the Bunk Bed standard was revised in 1996 to include requirements for entrapment testing in lower bunk end structures. The revised standard stated: "When tested in accordance with 5.6.2, there shall be no openings in the end structures of the lower bunk that will permit free passage of the wedge block shown in Fig 1, unless they are large enough to permit the free passage of a 9 inches diameter rigid sphere."

The Bunk Bed standard has been revised a number of times over the years. The most recent version was published in 2007.

In addition to the voluntary standard, the CPSC published a mandatory standard for bunk beds on December 22, 1999 (16 CFR Parts 1213, 1500, and 1513, FR Vol 64, No. 245). This standard is similar to the ASTM voluntary standard with some notable exceptions, including application of probes to assess head entrapment (the 3.5 inch torso and 9 inch head probe) to openings in end structures from the level of the lower bunk foundation support to the level of the upper bunk foundation support. In addition, any portion of the opening in the bed's end structure that is required to be probed by the torso probe and that allows free passage of a 9 inch sphere must satisfy neck entrapment provisions. This mandatory standard does not require testing for head and neck entrapment in spaces created by side structures, such as ladders, that are provided with the bunk bed.

Methods for Assessing Head and Neck Entrapment Potential

Entrapment can occur anytime there is a gap or juncture between two structures sufficient to allow a body part to become caught. Methods for determining if a gap presents a risk of head entrapment were developed in the 1980s at the time when the CPSC began studying the size and shape of the head and neck in relation to spaces causing entrapment.

In 1986, Lawrence Schneider published an article entitled, "Protecting Infants and Toddlers from Head Entrapment Injuries in the UMTRI Research Review (May-Jun 1986)". This article described a study of anthropometry data that was conducted using 300 children from birth through four years of age. The results of this study are contained in the reference text, *Size and Shape of the Head and Neck from Birth to Four Years*, (1986). Based on CPSC fatality reports and published articles in the medical literature, the author identified 12 head entrapment hazards. Many of the identified hazard patterns involved gaps in the structures of cribs and beds.

In July 1991, Shelley Deppa published a paper entitled, "Procedure to Evaluate Openings in Children's Products for Head Entrapment Hazards" (Journal of Testing and Evaluation, 1991). In this article, she analyzed strangulation fatality data using applied principles of anthropometry, childhood development, perception, behavior and biomechanics. From this analysis, Ms. Deppa developed a standard procedure for evaluating product openings through the use of templates and probes.

Mandatory and voluntary standards for bunk beds specify methods for assessing head and neck entrapment potential using test probes and templates. To test for head entrapment, openings in the end

structure that admit a 3.5 inch test probe must also freely pass a 9" sphere. To protect against neck-first entrapment in a bed's end structures, a neck template is used that is similar to that developed to address neck entrapment in playground equipment and specified in F1487-98, *Standard Specification for Playground Equipment for Public Use*. Any portion of an opening in the bed's end structure below the foundation of the upper bunk required to be probed by torso probe and that allows for free passage of 9" diameter sphere, must be tested for neck entrapment. The neck entrapment test requirement (and the probe used to assess the risk) was added to the standard in response to a specific incident in which a child's neck became caught in a cut-out design in an end panel of a bunk bed.

Just as it is important to test for head and neck entrapment potential in bunk bed end structures, it is also important and feasible to test for entrapment potential in bunk bed side structures (i.e., spaces created where a side-mounted ladder intersects with the lower bunk). To become entrapped in a side structure opening: 1) the child's face must fit in the space between the upper edge of the mattress and the lower edge of the rung that is positioned just above the mattress, and (2) the child's neck must fit in the gap between the side of the mattress and the vertical post of the ladder; and (3) the child's head (from under the chin to the top of the head) must fit between the two vertical posts of the ladder.

If the child's head is able to pass (partially) through the space created by a horizontal ladder rung and the top of the mattress, the neck will drop into the gap between the vertical ladder post and the side of the mattress. This is the space that entraps the neck. Further contributing to the hazard pattern is the fact that the child's chin hooks over the vertical post of the ladder and is pinned at the back of the head by the mattress. The weight of the body outside of the bed pulls the head and neck against the vertical ladder post. All of these factors together contribute to the neck entrapment and resulting strangulation.

Assessing neck entrapment potential in the space between the side of the mattress and the vertical ladder post requires use of a neck probe that simulates the dimensions of the smallest user's neck. In fact, it is the depth of the neck that is the critical measurement since a child who is entrapped in this space is typically positioned sideways (with the chin hooked over the vertical post of the ladder and the back of the head pinned by the side of the mattress). Any gap that is large enough to admit the (compressed or non-compressed) neck depth of the smallest user and that has a depth greater than half the depth of a child's neck can entrap the neck and prevent it from easily rolling out of the space.

According to anthropometry data collected on U.S. children, the neck depth (measured front to back on the neck) of the 5th percentile 25-30 month-old child measures 2.2 inches or 5.6 cm (Schneider, Lehman, Pflug and Owings, 1986).¹ Given the compressibility of the neck, 25% is deducted to determine the minimum neck breadth measurement that can entrap a child's neck. Thus, spaces greater than 1.9 inches (4.8 cm) can pose a risk of neck entrapment.

¹ Bunk bed standards assume the youngest user to be two years of age (i.e., probes used to assess head entrapment are based on the smallest two-year-old). It should be noted that the age when children transition out of a crib depends on a number of factors and may be as young as a year (e.g., if they show signs of trying to get out of the crib or if the crib is needed for a subsequent sibling). In such cases, the

lower bunk is used akin to a toddler bed. The voluntary standard for toddler beds assumes the youngest user to be 15 months (F1821-06).

Injury Data

The following incidents involve entrapment between a side-positioned ladder and the bunk bed:

1. September 4, 1983 – A two-year-old male received minor contusions and abrasions to the underside of his chin when he slipped off the bottom bunk and entrapped his head between the bunk ladder and bottom bunk. The ladder is positioned at the side of the bed and mattress. The subject product had been purchased new by the victim's family and they had not previously had problems with the bed. The child had been put to bed for the evening.

A few hours later, his parents heard crying from the child's room. When they went to check on the child, they found him w/his chin resting on the bottom rung of the bunk bed ladder with his neck and head between the bottom of the ladder and the side of the bottom bunk bed. . "According to his mother, it didn't appear that the child was able to get himself out from between the ladder and the side of the bed" (p. 2).

A picture re-enacting the incident shows that the back of child's head was against the lower bunk mattress with his face through the space between the 1st and 2nd rungs (from the bottom) of the ladder (see photo #3, page 8). His body was somewhat on an angle with his feet on the floor. The spacing between the bottom step of the ladder and the bottom bunk, where the child was entrapped, measured 2 1/8" without being forced.

The mother sticks a bulky floor pillow under the ladder in order to push it in and secure it more closely to the bottom bunk. When the child does infrequently sleep on the bunk, the bed is made up so the child's head is at the opposite end from the ladder. [831003CCC1003]

2. Jan 5, 1998 – (*fatal*) - A developmentally disabled 22-month-old male was entrapped with his neck between the ladder rung and the mattress top of the lower bunk in which he had been sleeping. His mother found him trapped inside the bunk bed ladder in a prone position with his neck resting on the lower rung. The coroner determined that he died from asphyxia due to neck compression. The bunk bed was a white enamel tube metal construction bunk bed with a full mattress on the bottom bunk and a twin mattress up top.

"Extending from the top of the incident bunk bed, at an angle is a 4-rung metal ladder. The ladder's 2nd rung is about level with the top of the mattress when the lower bunk is not in use. However, under compression such as the weight of the victim space is generated between the mattress top and the ladder rung. It is in this space the victim reportedly entrapped his head and neck." [980112CNN0130]

3. January 25, 2000 – A 6-year-old boy fell out of the lower bunk and his head became entrapped between the mattress and wooden ladder on a bunk bed. He was sleeping on the lower bunk and fell out of bed. His

mother heard him yelling in a half-asleep condition. She found him with his face pointing upward towards the ceiling and his feet and legs were on the floor. His mother removed him and he did not suffer serious injury.

"The entrapment space is wider than three and a half inches and might be considered a potential hazard." The entrapment occurred in a U-shaped space between the inside vertical side of ladder on the right, the mattress on the left, and the wood spacer on the bottom. The wood spacer measures 3 15/16". The space between the edge of the bottom bunk mattress and the inside of the (vertical) ladder measures approximately 4.5 inches.

The parents still think there is a potential hazard with the space between the mattress and the ladder. They have the ladder placed at the foot of the bunk bed and not at the head of the bed where it was positioned at the time of the incident. "Toddlers in the home could also find this space between the ladder and the bottom sideboard the only access area to the lower bunk bed. Potential injury to an arm, leg, neck, or head could exist" (p.2).

"Review of the Consumer Product Safety Review Winter 2000, VOL. 4, No. 3, page 6 indicates the Model #... bed would not pass the new CPSC Bunk Bed Standard due to go into effect 6/19/00. The new standard requires openings on the lower bunk end structure to be small enough to prevent entry of the child's head or torso, or large enough to permit free passage of both head and torso. On the model... the opening between the ladder and mattress on the lower bed, even though it is no [sic] an end structure, might be a potential entrapment area" (p. 3). [000224CCC2320]

4. May 23, 2000 – A 2 year-old female, playing on and about the bunk bed in her bedroom, twice became "stuck" in the top opening of the bunk bed ladder. Both times she was extricated by her father without injury. The opening at issue is the top opening of the ladder which measures approximately 4" (vertically) x 12" wide. Additionally, the opening is angled because of the slanted ladder position, with the top of the opening approximately 1" from the top of the bed frame and the bottom of the opening approximately 6" from the bottom of the top bed frame.

Photographs re-enacting the first incident show that the victim appeared to have gone torso-first (stomach up) through the space between the 1st and second ladder rungs from the top. In the second incident, the victim passed through the same space in the stomach-down position, getting caught at the neck. The spacing between ladder rungs is much greater than 4 inches (cannot determine actual distance from one rung to another) when not attached to the bunk bed. However, when placed against the side of the bunk bed, the mattress support for the upper bunk intersects this opening, reducing it to 4" deep. [000525HCC0705]

5. January 14, 2003 – (*fatal*) -A 2 year-old female became suspended by her neck after being wedged between the inside top rung of the ladder and the bed on a loft-style bed. The child died of her injuries. The child was found wedged between the wood frame and the top inside rung of the ladder with her head facing out, away from the bed. Her neck was suspended in the top rung and her arms were straight up in

the air. The distance between the side of the wood bed frame and the top rung of the ladder measures just under 3.5 inches. [030115CCN0277]

6. April 1, 2003 – 18-month-old daughter's head became entrapped in a 3 ¼" opening between the mattress and a bunk bed ladder while playing on the lower bunk. The mother freed her daughter by pushing down on the mattress to release her head. She was uninjured. [050815CWE500]

7. October 17, 2008 – A 4 year-old male died as a result of asphyxia by neck compression when his head b/me wedged between the ladder and mattress of his bunk bed. The victim had been placed overnight on the bottom bunk of a bunk bed. [081021HWE7802]

Revising the Mandatory Standard

When the CPSC enacted a mandatory standard for Bunk Beds, it did so to address head and neck entrapment hazard patterns that were not already addressed in the ASTM F1427-96 voluntary standard (see Final Rule FR Vol. 64, No. 245, 12/22/99). Initially, the CPSC voted to publish a notice of proposed rulemaking (NPR) that addressed head entrapment (only) in bunk bed end structures. However, the agency subsequently determined that one fatality had occurred on a bunk bed end structure as a result of *neck* entrapment in the lower bunk and that in this case, the bunk bed involved would have met the proposed standard. To address the potential for the type of neck entrapment that occurred in that one incident, the Commission developed a new template and test procedure and incorporated these additional requirements into the standard in order "...to adequately address fatalities due to entrapment of children's necks in the end structures of bunk beds."

The Commission's incorporation of a neck entrapment testing procedure into the mandatory standard based on a single incident is laudable and has surely prevented fatalities from occurring in this manner. However, neck entrapment in the space between the ladder and the side of the lower bunk has never been addressed. Neck entrapment incidents in side structures have been on record with the CPSC for decades. While such incidents do not occur often, they nonetheless continue to occur.

Children who become entrapped by the neck between the vertical post of a bunk bed ladder and the mattress are every bit as vulnerable as children who become entrapped by the neck in a bed end structure.

The Safety Hierarchy for Hazard Prevention dictates a methodology for addressing consumer product hazards. According to this hierarchy, inherent hazards should be designed out of a product or guarded against whenever possible. Head and neck entrapment should not occur on any bed structure that is provided with the product. Methods for assessing head and neck entrapment already exist. Methods for preventing head and neck entrapment are already well-known to industry.

As the death of Ryan Bucheit and other children exemplify, the mandatory bunk bed standard fails to address head entrapment in all bunk bed structures and as a result, fails to adequately protect children from head and neck entrapment. Through this petition, I request the Commission immediately begin rulemaking to revise the Bunk Bed standard to protect against head and neck entrapment in any integral structure provided with the bunk bed, including spaces created by the ladder at the side of the lower bunk.

I appreciate the Commission's consideration of this request. I am available to discuss this petition at your convenience.

Respectfully submitted,

Carol Pollack-Nelson, Ph.D.

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TAB B

LSM Staff Memorandum,

“Review of Entrapment Requirements in Bunk Bed Standards”



UNITED STATES
CONSUMER PRODUCT SAFETY COMMISSION
4330 EAST WEST HIGHWAY
BETHESDA, MD 20814

Memorandum

Date: February 9, 2011

TO : Timothy Smith, Engineering Psychologist
Human Factors Division

THROUGH: Andrew Stadnik, Assistant Executive Director
Directorate for Laboratory Sciences

James Hyatt, Director
Division of Mechanical Engineering
Directorate for Laboratory Sciences

FROM : Mark Eilbert, Mechanical Engineer
Division of Mechanical Engineering
Directorate for Laboratory Sciences

SUBJECT : Review of Entrapment Requirements in Bunk Bed Standards

This memorandum presents a review of current bunk bed standards, including federal regulations and voluntary and international standards, to determine how they address entrapment hazards in the side structures of the bunk bed.

A typical bunk bed comprises two end structures joined by side elements that include top- and bottom-bunk support rails, as well as top guard rails. Mattress foundation supports span laterally between the side rails. The end structures at the head and foot support the loads of the bunk bed and occupants and add rigidity to the bunk bed. A ladder to access the top bunk typically is secured to the top and bottom bunks, leaned onto the top bunk, or integrated into a side or end structure. Occupants are restrained by the top guard rails to prevent falls. In a bunk bed, the side structures that commonly are found with potential for entrapment are the top guard rails and support rails, and a side-positioned ladder.

REVIEW OF STANDARDS

I) Review of Federal Regulations for Bunk Beds 16 CFR Parts 1213 and 1513

16 CFR part 1213 addresses risks associated with bunk beds. 16 CFR part 1513 specifies identical performance requirements as 16 CFR part 1213, but also addresses the unreasonable risks of injury associated with bunk beds intended for use by children. 16 CFR parts 1213 and 1513 prescribe design and performance requirements for bunk beds to reduce risks to children from entrapments and falls. There also are requirements for labeling.

The test methods prescribed in 16 CFR parts 1213 and 1513 to address entrapments use probes that represent entrapment hazards associated with fingers, feet-first access beyond the torso, head entrapment, and neck entrapment. The wedge block or torso probe represents access for a 2-year-old child's torso. The 9-inch spherical head probe represents access for a 5-year-old child's head (chin-to-back-of-head). The neck probe represents the entrapment potential for a child's neck after head access is established. The rationales are that feet-first entry can lead to head or neck entrapment, and head-first entry can lead to neck entrapment. For the guard rail, a 33-lbf force is applied to the wedge block to test the hazard of a child sliding through the guard rail and falling.

a) Performance Requirements for Entrapment Hazards

i) Guardrails

For a bed where the underside of the mattress foundation is more than 30 inches from the floor, guardrails are required on each side of the bed. The wall-side guardrail must be continuous between the bunk bed end structures, which is defined as a gap less than 0.22 inches between the guardrail and end structure. This gap dimension was defined to prevent finger entrapment. The second guardrail may have a lateral gap of 15 inches between the ends of the guardrail and corresponding bed end structures to allow for a ladder. Without a mattress on the bed, openings between the underside of the upper bunk's foundation and the lower edge of the guardrail's uppermost portion cannot permit passage of the 3.5-inch wide wedge block when pulled with a 33-lbf force.

ii) Bed end structures

Without a mattress on the upper bunk, openings in the end structures above the foundation of the upper bunk cannot permit passage of the wedge block. Without a mattress on the lower bunk, any end structure openings between the underside of the upper bunk foundation and the upper-side of the lower bunk foundation (*i.e.*, "end structure openings") that permit passage of the 3.5-inch wide wedge block, must also allow passage of the 9-inch diameter head probe. If the head probe passes through, the opening must conform to neck entrapment requirements using a 75-degree angle neck probe, unless the "V" is inverted, such that one leg is 45 degrees or more below horizontal.

With the manufacturer's recommended maximum thickness mattress, all end structure openings are probed again and must conform to the wedge, head, and neck probe tests, as described.

iii) The bunk bed must have a warning label stating:

"To help prevent serious or fatal injuries due to entrapment or falls:

- Never allow a child under 6 years old on the upper bunk.
- Use only a mattress that is ___ inches long and ___ inches wide on upper bunk.

- Ensure thickness of mattress and foundation combined does not exceed ____ inches and that mattress surface is set at least 5 inches below upper edge of guardrails.”

2) Review of ASTM F1427-07 Voluntary Standard for Bunk Beds

The ASTM F1427 Standard Consumer Safety Specification for Bunk Beds contains performance tests to address hazards associated with falls from the upper bunk, strangling on vertical protrusions, entrapment in the end structures, entrapment between the mattress side and the interior bed structure, entrapment within interior foundation supports (cross members), ladders , and structural integrity of the foundation support system. The standard also contains requirements for a warning label, manufacturer identification, and consumer information regarding intended use of the bed. In 2001, ASTM F1427 adopted the performance requirements for head entrapments in 16 CFR parts 1213 and 1513 for guardrails and end structures. ASTM F1427 does not have a neck probe test.

- Entrapment in the End Structures. These requirements are essentially identical to those in 16 CFR parts 1213 and 1513, with the exception that the neck probe requirements are absent.
- Mattress and Foundation Size and Fit and Cross Member Spacing. The wedge block, when pulled down with 45 lbf force, must not enter through any gap between the side of the mattress and foundation and the “interior bed structure.” The wedge block may not pass freely through the mattress cross members unless the head probe also passes through the cross members.
- Ladder Requirements. A lean-on (slanted), hang-on (vertical), or integrated ladder is required. The width is a minimum of 10 inches. The spacing is a maximum of 12 inches between rungs or may be a maximum of 16 inches for ladders that are integrated into structures.

The bunk bed must have a warning label stating:

“To help prevent serious or fatal injuries due to entrapment or falls:

- Never allow a child under 6 years old on the upper bunk.
- Use only a mattress that is 74-75 inches long and 37 ½–38 ½ inches wide on upper bunk.
- Ensure thickness of mattress and foundation combined does not exceed ____ ” and mattress is at least 5” below upper edge of guardrails.
- Use guardrails on both sides of upper bunk.
- Prohibit horseplay on or under bed(s).
- Prohibit more than one person on upper bunk.
- Use ladder for entering and leaving upper bunk.

- STRANGULATION HAZARD - Never attach or hang items to any part of the bunk bed that are not designed for use with the bed; for example, but not limited to, hooks, belts, and jump ropes.”

3) Review of Other Standards with Entrapment Requirements

- i) Australian/New Zealand Voluntary Standard AS/NZS 4220; 2010 Bunk Beds Standard

The performance requirements in AS/NZS 4220 address hazards that include finger, limb, and head entrapment. The performance requirements for entrapment hazards are:

At 600 mm (23.6 inches) or more from the floor, openings must not have dimensions between 7–12 mm (0.3-0.5 inches) to protect against finger entrapment, 30–50 mm (1.2–2.0 inches) to protect against limb entrapment, and 95–230 mm (3.7-9.0 inches) to protect against head entrapment.

- ii) Voluntary Standard ASTM F1148-09 Home Playground Equipment

ASTM F1148-09 requires that rigid and nonrigid accessible openings meet performance requirements to reduce the risk of accidental head or neck entrapment by either a head-first or feet-first entry into openings. A completely bounded opening is accessible if the torso test probe may be inserted into the opening to a depth of 4 in. For nonrigid openings, the torso probe is pulled into the opening with 50 lbf. If the torso probe accesses the opening, the head probe must also pass through. Finally, all angles formed between members, including within accessible bounded openings, must be 55 degrees or more to conform to neck entrapment requirements, unless the “V” is shielded or inverted, such that one leg is horizontal or below.

- iii) Voluntary Standard ASTM F1487.07 Public Playground Equipment

ASTM F1487.07 requires that rigid and nonrigid accessible openings meet performance requirements to reduce the risk of accidental head or neck entrapment by either a head-first or feet-first entry into openings. A completely bounded opening is accessible if the torso test probe may be inserted into the opening to a depth of 4 in. For nonrigid openings, the torso probe is pulled into the opening with 50 lbf. If the torso probe accesses the opening, the head probe must also pass through. Finally, partially bound openings and completely bound openings that accept the head probe, must conform to neck entrapment requirements, using a 55-degree angle neck probe, unless the “V” is inverted such that one leg is horizontal or below. The general procedures are similar to those in the mandatory bunk bed standard.

REVIEW OF INCIDENT DATA FOR ENTRAPMENT DIMENSIONS

The Directorate for Epidemiology provided CPSC incident data associated with bunk bed entrapments in side structures, exclusive of top bunk guard rails (O'Brien, "Entrapments in Side Structures of Bunk Beds, 1993–2009," February 9, 2011). Six of the eight in-scope incident reports had detailed in-depth investigations (IDI) from which the entrapping dimensions could be determined.

Table 1 Investigated Side Structure Entrapments

Incident IDI (yyymmddxxxxxx)	Side Structure Plus:	Upper/Lower	Opening (inch)	Body Entered by:	Body Entrapped by:
980112CCN0130	Ladder Rung	Lower	4	Head	Neck*
000224CCC2320	Ladder Rail	Lower	4	Head	Head
000525HCC0705	Ladder Rung	Upper	4–6	Feet	Head
030115CCN0277	Ladder Rung	Upper	3.5	Feet	Neck*
050815CWE5005	Ladder Rung	Lower	3.25	Feet	Head
081021HWE7802	Ladder Rail	Lower	5	Head	Neck*

*Fatality

IDI 980112CCN0130. Incident occurred in 1998. The 22-month-old victim was found in a face-down position with his head entrapped between the full-sized lower mattress and a ladder rung. The side-mounted ladder leaned onto the top bunk (twin size) and made an approximate 4-inch clearance to the lower mattress in the entrapping space. The coroner reported death was by asphyxiation through neck entrapment.

IDI 000224CCC2320. Incident occurred in 2000. The 6-year-old victim slid off the lower bunk while sleeping and became entrapped in a face-up position, parallel to the side of the bed, with his head between the mattress side and the ladder rail; a space that measured about 4 inches. The side-attached ladder was hooked to the top and bottom bunks and held away at the bottom by a 4-inch wood block. The mattress, ladder rail, and wood block created a U-shaped opening into which the victim's head fell. The victim was discovered by a parent and removed with no injury.

IDI 000525HCC0705. Incident occurred in 2000. Twice, in two similar incidents, the 2-year-old victim was found entrapped by the head between the second ladder rung from the top and the upper side of a wooden bunk bed. The ladder is floor-supported and held at an angle by brackets to the top bunk side rail. In the first incident, the victim was

found facing inward with the back of her head against the ladder rung and her body downwards through the ladder. In the second incident, the victim was found facing outward with her neck against the rung and feet down as before. The distance between the ladder's rung and side structure was between 4 and 6 inches, depending on entry. No injuries were reported, and the bunk bed still was in use at the time of the investigation.

IDI 030115CCN0277. Incident occurred in 2003. The 2-year-old victim climbed the side-attached ladder of a loft-type bunk bed and fell, feet first and facing outward, through the space between the top ladder rung and the bunk bed side rail. Neck contacted ladder rung and head was entrapped. Death was by asphyxiation. The entrapping space between top rung and side rail was 3.5 inches.

IDI 050815CWE5005. Incident occurred in 2003. The 18-month-old victim was playing on a newly assembled wood bunk bed with her sisters when she became entrapped between the mattress and the lower rung of the ladder. The victim's body was through the ladder towards the floor, and the head was trapped beneath the ladder rung. The ladder was flush with the side of the bunk bed, and the distance between the lower rung and the mattress was about 3.25." The victim was released, and there was no injury. In response, the parents increased intentionally the gap from 3.25 inches to about 6 to 7 inches by replacing the 7-inch mattress with a 4-inch mattress. In the three years since that incident, no further problem has occurred with the now 6- to 7- inch gap between the lower mattress and the ladder rung.

IDI 081021HWE7802. Incident occurred in 2008. The 4-year-old victim had been sleeping on the lower bunk and was found with his bottom resting on the floor and facing outward, and with his neck between the side of the mattress and inside the vertical post of the side-supported ladder. Apparently, his head slid off the mattress and between the first and second ladder rungs while his body also slid off the bed. With his head between the ladder posts, his neck slid down, entrapping his head/neck between the mattress side and one of the ladder posts. Death was ruled asphyxia by neck compression. The lateral distance between the mattress side and the post was 3 inches. An engineering firm measured a 4 lbf force to pull the wedge probe down vertically through that area. The distance between the upper edge of the mattress and the inner edge of the ladder rung was 5 inches. The force to pull the head probe through this area was not measured.

DISCUSSION

The requirements in 16 CFR parts 1513 and 1213 address head and neck entrapment hazards in end structures and upper bunk guard rails, but do not address side structure entrapments. Breaks in one guard rail are allowed for access to side-entry ladders. Requirements in ASTM F1427-07, *Voluntary Standard for Bunk Beds*, do not address entrapment in side structures, and the Standard does not have neck entrapment requirements. Ladder requirements do not include entrapment tests. Other standards with relevant entrapment requirements, such as voluntary standard ASTM F1487-

07ae1, *Public Playground Equipment*, require testing for head and neck entrapments throughout the product.

Side structure entrapments in bunk beds do occur. In those available investigated incidents, shown in Table 1, the entrapment space was between a side ladder rail or rung and a side structure. Entry into the entrapping space was 3.5 inches or more for five of these cases. Comparing the dimensions of the test probes in 16 CFR parts 1513 and 1213 to these spaces suggests that the 3.5-inch-wide wedge block would pass through, but the 9-inch head probe would not. The dimensions of the opening in these incidents either allowed the feet to enter, and the head/neck to become entrapped, or allowed the head to enter, but narrowed such that the neck became entrapped.

For example, in case 081021HWE7802, the victim rolled/slid out of bed while his head entered an opening 5-inches wide between a ladder rung and mattress side. This opening dimension is greater than the 3.5-inch wedge block but less than the 9-inch head probe. If this opening were in the end structure, it would not have conformed to the head entrapment requirements in 16 CFR parts 1513 and 1213.

The mandatory and voluntary standards for bunk beds include provisions for ladders to the upper bunk. None of these standards have entrapment requirements for ladders positioned on the bunk bed side or any other side structure, except the upper guard rail.

CONCLUSION

16 CFR parts 1513 and 1213 and ASTM F1427-07 do not have entrapment requirements for head and neck entrapments in side structures. Review of investigated side entrapment incidents with bunk beds suggests that the entrapping spaces likely would not have conformed to the same probe tests required of bunk bed end structures in 16 CFR parts 1513 and 1213.

TAB C

EPHA Staff Memorandum,

“Entrapment in Side Structures of Bunk Beds, 1993–2009”



UNITED STATES
CONSUMER PRODUCT SAFETY COMMISSION
4330 EAST WEST HIGHWAY
BETHESDA, MD 20814

Memorandum

Date: February 9, 2011

TO : Timothy Smith, Engineering Psychologist
Human Factors Division

THROUGH: Gregory Rodgers, Acting Assistant Executive Director
Directorate for Epidemiology

Kathleen Stralka, Division Director
Hazard Analysis Division

FROM : Craig O'Brien, Mathematical Statistician
Hazard Analysis Division

SUBJECT : Entrapments in Side Structures of Bunk Beds, 1993–2009

I. Overview

Bunk beds are regulated by the U.S. Consumer Product Safety Commission (CPSC), and standards for bunk beds are codified at 16 CFR parts 1213, 1500, and 1513 (“Bunk Bed Standard”). There is a concern that while there is a low risk of head and neck entrapment in the end structures of beds that comply with the Bunk Bed Standard, the risk may be greater for side structures of compliant beds, other than top bunk guardrails, as those structures are not addressed in the Standard. This memorandum examines the incidents reported to CPSC staff involving head and neck entrapments in side structures, other than top bunk guardrails of bunk beds, to aid in the evaluation of the risk of such injuries.

II. Results

A search was made for bunk bed-related incidents in CPSC data sources, as described in Section III (Methodology). These incident reports were reviewed by a multidisciplinary team of CPSC staff to include only head and neck entrapments involving the side structures of the bunk beds, excluding top bunk guardrails.¹ Eight incidents associated with bunk beds and involving head and neck entrapments in the side structures, excluding top bunk guardrails, were reported to the CPSC from 1993 through 2009. Three of the incidents resulted in no injury to the child; one incident resulted in a minor injury (bruising); and four incidents resulted in fatalities. The ages of the children ranged from 17 months to 6 years. In one case, the child was trapped between the mattress and a guardrail on the lower bunk; in five cases, the child was trapped between the mattress and a ladder; and in two cases, the child was trapped between two rungs of the ladder. Table 1 (next page) provides narrative descriptions of all eight incidents.

¹ After the initial team review, some team members changed their position on the scope of H9590259A. Therefore the list of in-scope incidents in Table 1 may not be consistent with all technical memos.

Table 1: Narrative Descriptions of Head and Neck Entrapments in Side Structures of Bunk Beds, 1993–2009

Year	Document Number	Age	Narrative
1995	H9590259A	2 yr.	A 2YOM WAS BRUISED WHEN CAUGHT BETWEEN THE BOTTOM SIDE RAIL AND MATTRESS ON HIS BUNKBED.
1998	980112CCN0130	22 mo.	A DEVELOPMENTALLY DISABLED 22-MONTH-OLD CHILD ENTRAPPED HIS NECK BETWEEN A LADDER RUNG AND THE MATTRESS TOP OF THE LOWER BUNK BED IN WHICH HE HAD BEEN SLEEPING. THE CORONER DETERMINED HE DIED FROM ASPHYXIA DUE TO NECK COMPRESSION.
2000	000525HCC0705	2 yr.	A 2-YEAR-OLD FEMALE, PLAYING ON AND ABOUT THE BUNK BED SET IN HER BEDROOM, TWICE BECAME "STUCK" IN THE TOP OF THE BUNK BED LADDER. BOTH TIMES SHE WAS EXTRICATED BY HER FATHER, NO INJURY OR MEDICAL ATTENTION REQUIRED.
2000	000224CCC2320	6 yr.	A BOY, AGE 6, COULD HAVE BEEN INJURED WHEN HE GOT HIS HEAD LODGED BETWEEN THE MATTRESS AND LADDER OF HIS BUNK BED AS HIS BODY FELL TO THE FLOOR.
2001	J0380003A	17 mo.	A 17-MONTH-OLD MALE DIED WHEN HE BECAME ENTRAPPED BETWEEN THE LOWER BUNK BED MATTRESS AND THE HORIZONTAL LADDER RUNG OF A CONVERTIBLE BUNK BED.
2003	050815CWE5005	18 mo.	COMPLAINANT'S 18-MONTH-OLD DAUGHTER'S HEAD BECAME ENTRAPPED IN A 31/4" OPENING BETWEEN THE MATTRESS AND A BUNK BED LADDER, WHILE PLAYING AROUND ON THE LOWER BUNK BED. THE MOTHER FREED HER DAUGHTER BY PUSHING DOWN ON THE MATTRESS TO RELEASE HER HEAD. SHE WAS NOT INJURED.
2003	030115CCN0277	2 yr.	A GIRL, AGE 2, WAS HOSPITALIZED AND LATER DIED AFTER TRYING TO CLIMB UP A LADDER OF A BUNK BED. HER HEAD GOT CAUGHT BETWEEN TWO RUNGS OF THE LADDER AND THE BED FRAME AT A HOME DAYCARE.
2008	081021HWE7802	4 yr.	A FOUR-YEAR-OLD MALE DIED AS A RESULT OF ASPHYXIA BY NECK COMPRESSION WHEN HIS HEAD BECAME WEDGED BETWEEN THE LADDER AND MATTRESS OF HIS BUNK BED. THE VICTIM HAD BEEN PLACED OVERNIGHT ON THE BOTTOM BUNK OF A BUNK BED. THE VICTIM'S MOTHER FOUND THE VICTIM IN THE MORNING WHEN SHE WENT IN TO WAKE HIM FOR THE DAY. THE MOTHER FREED THE CHILD AND CALLED 911. THE VICTIM WAS PRONOUNCED AT THE SCENE.

In addition to the 8 incidents in Table 1, there were 20 incidents that did not provide enough information to include them in this analysis. Reasons for incidents being unclear included entrapment in rails that were not clearly guard rails (8 incidents), entrapment in guard rails that

may have been top bunk guard rails (5 incidents), entrapment in a ladder that may have been an end structure (5 incidents), and entrapments without a part of the bunk bed specified (2 incidents). Of the unclear incidents, 8 involved no injury to the child; 2 involved injuries; and 10 were fatalities. The age range for children in the unclear incidents was 7 months to 11 years.

III. Methodology

The incidents reported in Table 1 were derived from three sources: the National Electronic Injury Surveillance System (NEISS), the CPSC's death certificate database, and the CPSC's Injury and Potential Injury Incident file (IPII).

NEISS is a probability sample of approximately 100 U.S. hospitals having 24-hour emergency rooms (ERs) and more than six beds. NEISS collects injury data from these hospitals. Coders in each hospital code the data from the ER record, and the data is then transmitted electronically to the CPSC.

The CPSC purchases death certificates from all 50 states, New York City, the District of Columbia, and some territories. Only those certificates in certain E-codes (based on the World Health Organization's International Classification of Diseases ICD-10 system) are purchased. These are then examined for product involvement before being entered into the CPSC's death certificate database. The result is neither a statistical sample, nor a complete count of product-related deaths; nor does the result constitute a national estimate. The database provides only counts for product-related deaths from a subset of E-codes. For this reason, these counts tend to be underestimates of the actual numbers of product-related deaths. Death certificate collection from the states also takes time. As of September 2010, the Death Certificates database was considered 98 percent complete for 2006; 85 percent complete for 2007; 72 percent complete for 2008; and 48 percent complete for 2009.

The CPSC's Injury and Potential Injury Incident File (IPII) is a database containing reports made to the Commission of injuries or potential injuries. These reports come from news clips, consumer complaints received by mail or through the CPSC's telephone hotline or website, Medical Examiners and Coroners Alert Program (MECAP) reports, letters from lawyers, and similar sources. While the IPII database does not constitute a statistical sample, it can provide CPSC staff with guidance or direction in investigating potential hazards.

In November 2010, all data coded was pulled from the above databases that had product code 661 (Bunk Beds) and one of the following keywords: between, hang, rail, ladder, neck, or side. These reports were reviewed by CPSC staff to include only head and neck entrapments involving the side structures of the bunk beds, excluding top bunk guard rails.

TAB D

ESHF Staff Memorandum,

“Human Factors Analysis for Petition CP 10-2 & HP 10-1, Petition for Change to the Bunk Bed Standard”



UNITED STATES
CONSUMER PRODUCT SAFETY COMMISSION
4330 EAST WEST HIGHWAY
BETHESDA, MD 20814

Memorandum

Date: February 9, 2011

TO : Timothy P. Smith, Bunk Bed Petition Project Manager
Division of Human Factors
Directorate for Engineering Sciences

THROUGH: Erlinda Edwards, Acting Associate Executive Director
Directorate for Engineering Science

Robert B. Ochsman, Director
Division of Human Factors

FROM : Hope E.J. Nesteruk, Engineering Psychologist
Division of Human Factors
Directorate for Engineering Sciences

SUBJECT : Human Factors Analysis for Petition CP 10-2 and HP 10-1, Petition for Change to the Bunk Bed Standard

Introduction

In July 2010, the U.S. Consumer Product Safety Commission (CPSC) docketed a petition brought by Carol Pollock-Nelson, Ph.D., requesting a change to the Bunk Bed Standard (16 CFR parts 1213, 1500, and 1513) to incorporate requirements for head and neck entrapment testing in spaces created by side structures that are provided with a bunk bed, including ladders. While the current regulations require two separate entrapment tests for bunk bed end structures, Dr. Pollock-Nelson contends that the same entrapment requirement should apply to side structures and ladders.

Summary and History of Human Factors Aspects of Entrapment Regulations

16 CFR parts 1213 and 1513 prescribe requirements for bunk beds to reduce or eliminate the risk that children will die or be injured "from being trapped between the upper bunk and the wall, in openings below guardrails, or in other openings in the end structures in the bed" (CPSC, 2001). These regulations set forth certain entrapment testing requirements for bunk beds, including the use of several anthropometrically developed probes to test for partially bound and completely bound entrapment hazards. The requirements in the regulations are based on work conducted in the 1980s as part of the Structural Entrapment Project (*e.g.*, Deppa, 1989; Tyrrell, 1983). As a result of this project, CPSC staff identified side structures as a potential hazard (Deppa, 1989); however, at the time, entrapments involving guardrails appeared to be the primary hazard pattern (Miles, Rutherford, and Coonley, 1983).

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Guardrails are specifically included for testing with a torso probe as part of 16 CFR §§1213.4(a) and 1513.4(a). The probes used for bunk bed testing were developed based on anthropometric dimensions of the children at risk of entrapment. The small torso probe (also called Wedge Block in §§ 1213.4(a), (b), and (c) and 1513.4(a), (b), and (c)), which tests for feet-first entry, was based on hip and buttocks dimensions of a small 2-year-old. The partially bound opening probe, which tests for neck entrapment, was also based on the anthropometric dimensions of a 2-year-old, specifically a 25- to 30-month-old child (Deppa, 1989).¹

Additionally, §§ 1213.5, 1213.6, 1513.5, and 1513.6 require that the markings and instructions state that the upper bunk is for children ages six years and older. The CPSC has maintained the guidance that children under 6 years old should not use the top bunk of a bunk bed due to their cognitive development stage. Specifically, their cognition and coordination may not allow them to safely navigate the bunk bed, especially while drowsy or during nighttime awakenings. However, incident data continues to show that children under 6 years old do play and sleep on the top bunk. For example, a more recent CPSC staff memorandum regarding bunk beds (Marut, 2003), while focused on entanglement hazards, stated “children under six are likely to climb on bunk beds and interact with items attached to upper bunks.”

Incident Summary

CPSC staff is aware of eight head and neck entrapment incidents between 1993 and 2009, associated with side structures of bunk beds that currently are not required to be tested (O’Brien, 2011). Six of these incidents were investigated as in-depth investigations, while much less information is available about the other two incidents. A summary of the incidents is found in Table 1.

Table 1. Incident Summary

Document Number	Age	Bunk	Entrapping Structure	Behavior	Fatal
J0380003A	17 months	Lower	Ladder	Unknown	Yes
050815CWE5005	18 months	Lower	Ladder	Playing	No
980112CCN0130	22 months	Lower	Ladder	Sleeping	Yes
030115CCN0277	2 years	Upper	Ladder	Playing	Yes
000525HCC0705	2 years	Upper	Ladder	Playing	No
H9590259A	2 years	Likely Lower	“Bottom Side Rail”	Unknown	No
081021HWE7802	4 years	Lower	Ladder	Sleeping	Yes
000224CCC2320	6 years	Lower	Ladder	Sleeping	No

Of note:

- Four victims were fatally entrapped.
- Three victims were rescued by a caretaker before an injury occurred.

¹ The petitioner provided a more detailed history on bunk bed standards and regulations; Division of Human Factors (HF) staff does not disagree with this characterization of the history.

- Three incidents involved children younger than the age range for which the current bunk bed testing probes are designed (*i.e.*, victims under 24 months vs. anthropometric probes representative of children 25 to 30 months old).
- Two of the incidents involved children on the upper bunk but who were under the recommended age for the upper bunk.
- All but one incident involved a ladder structure. The report for this one remaining incident (H9590259A) contains only the following information:

A 2YOM WAS BRUISED WHEN CAUGHT BETWEEN THE BOTTOM SIDE RAIL AND MATTRESS ON HIS BUNKBED.

HF staff cannot be certain whether “bottom side rail” refers to a side rail on the lower bunk or the lower of a pair of upper bunk guardrails (see example in Figure 1).

Therefore, HF staff is not certain whether this entrapment involved a lower or upper bunk guardrail. The latter case would be addressed under the current regulation. The Bunk Bed Petition Team consensus was to include this incident.

Other Foreseeable Entrapment Patterns

The incident data available demonstrate a hazard pattern in which a child becomes entrapped between the bunk bed structure and a ladder side structure; however, there are other side structure configurations that also may result in a head and neck entrapment hazard.

Configuration One: Open-ended guardrails

HF staff identified several bunk beds on the market that have a pair of guardrails on each side of the upper bunk, and at least one pair of guardrails is supported by two vertical posts along the length of the guardrail but not at the end. An example of such a configuration is shown in Figure 1. Although CPSC staff found no bunk bed-related incidents conclusively identified as occurring on such structures, based on knowledge gained in other product areas,² staff recognizes that the open areas at the ends of such structures may present a potential entrapment hazard. Current requirements for bunk beds would test these structures with a torso probe only, which would ensure that the torso cannot slip between the slats. The open ends of this configuration, however, could allow a child to slip their neck into the side and become entrapped, perhaps while entering or exiting the bed using the ladder.

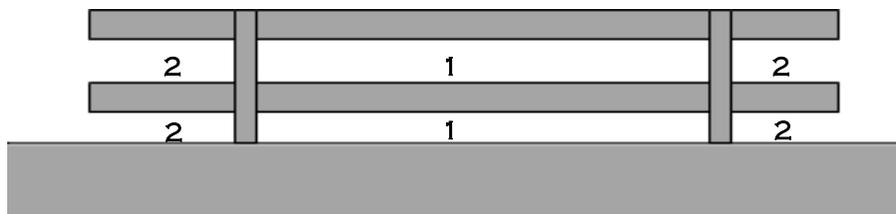


Figure 1. Open-ended guardrail example

² E.g., The ASTM standard for public playgrounds (F1487) and the CPSC Public Playground Safety Handbook (#325) use a similar partially bound opening probe and test. The lack of fatal neck entrapment incidents on playgrounds suggests that the test is adequate.

Although the risk of neck entrapment in a partially bound opening declines by the time children reach age two (Deppa, 1989), this type of structure could present an entrapment hazard.

Configuration Two: Lower bunk guardrails

Currently, guardrails attached to the side of a lower bunk³ are not subject to the CPSC's regulatory entrapment test procedures. While not all bunk beds have attached guardrails on the lower bunk, fixed guardrails can be installed on some lower bunks. A family may find this to be a good solution for children sharing a room, as there are no age guidelines for the use of a lower bunk. CPSC staff is aware of three fatal entrapment incidents that involved a lower bunk and one nonfatal incident that may have involved a lower bunk guardrail. These data suggest that fatal entrapments can occur in a lower bunk and that testing the guardrails on the lower bunk to the same entrapment testing requirements as the upper bunk could improve safety.

Configuration Three: Angles at corner posts

HF staff is aware of some bunk beds that have rounded corners that meet in a v-shape (see Figure 2). This v-shape, a form of a partially bound opening, has been identified as a possible neck entrapment hazard on several other products, such as baby gates and crib headboard cutouts (Deppa, 1989). Acute angles have also been recognized as a hazard on playground equipment for more than 30 years (NBS, 1978). The neck entrapment probe was designed to identify angles and other partially bound openings that may entrap a child's neck. Although CPSC staff did not identify any entrapment incidents in structures of this type, it is a foreseeable entrapment hazard. The petition pertains to side structures only, and it is not clear if this corner angle would be covered as a side structure.

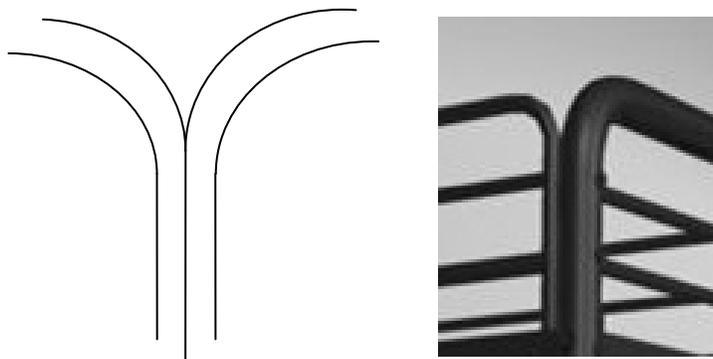


Figure 2. Example of rounded corners meeting in a v-shape

Children's Behavior

In a 1990 study of bunk bed injuries, Selbst et al. found three primary hazard patterns: playing in or near the bed (43 percent), while sleeping (29 percent), and getting in or out of bed (20 percent). Of the incidents identified by O'Brien (2011), three occurred while the victim was sleeping, three while playing, and the reports for the other two did not contain enough information to determine what the child was doing at the time of entrapment.

³ Less than 30 inches from the floor.

Play Patterns

Head and neck entrapments that occur during play typically affect children under age five because children at this age do not have the reasoning abilities to reverse the motions that lead to their entrapment, nor do they have the strength to lift themselves from a hanging situation. Children are known to play on bunk beds, for example, by using them as climbing structures. Some bunk bed manufacturers even include a slide as an egress method from the top bunk, virtually ensuring that the bed will be viewed not only as a sleeping structure, but also as a play structure. Three of the incidents analyzed occurred when children were playing on the bunk bed. Behaviorally, there is nothing to suggest that play patterns involving end structures and side structures of a bunk bed will differ, especially because ladders on some models have been moved from the end structure to the sides, and new features, such as slides, have been added.

During sleep and while navigating the bunk bed

Three of the incidents analyzed for the petition involved children who became entrapped during the night or after being put to bed. Settling problems and nighttime waking are common in young children (Ramchandani et al., 2000) and still affect up to 6.5 percent of children over 5 years old (Blader et al., 1997). Selbst et al.'s (1990) bunk bed study noted that 68 percent of the children who were injured during sleep were under 6 years old, and it is well documented that children under 6 years old still fall out of bed with some frequency while sleeping (*e.g.*, Lyons et al., 1993; Nimityongskul et al., 1987; Selbst et al., 1990). Young children do not yet possess the cognition to safely navigate a bunk bed. This cognitive deficit is amplified when a child is drowsy during a nighttime awakening and further compounded by the low-light condition likely present during the night. Older children are also subject to diminished cognition during nighttime awakenings and low-light visibility issues when navigating a bunk bed at night. Therefore, children, especially younger children, may encounter any portion of the bunk bed during nighttime behaviors because they may not be fully aware of their surroundings. These studies support the longstanding guidance that children under 6 years old should not sleep on the upper bunk; however, incident data continue to indicate that children under 6 years old sleep and play on the upper bunk.

Conclusion

Eight incidents were analyzed by HF staff. Four fatal and four nonfatal incidents occurred in areas of the bunk bed that currently are not required to be tested with anthropometric probes per 16 CFR parts 1213 and 1513. Two fatal incidents and one nonfatal incident involved children under 2 years old, which is younger than the age range that the test probes are designed to represent and well below the youngest recommended user. Therefore, it is unclear whether the provisions in the petition would affect these incidents. However, since the probes are designed based on the anthropometric dimensions of the smallest 25- to 30-month-old children, some younger children, who are average size or larger, likely will be protected, too.

The literature supports the CPSC's longstanding position that children under 6 years old should not sleep on the top bunk of a bunk bed because they still are likely to fall out of bed while sleeping; however, incident data continues to indicate that children under 6 years old are sleeping and interacting with both upper and lower bunks. The test probes used in 16 CFR parts 1213 and 1513 are based on 2-year-old children to account for this foreseeable use, but the performance requirements do not currently address all areas of the bunk bed that a child may interact with

during play or sleep. Some side structures, specifically completely bound openings formed by upper-bunk guardrails, currently are addressed by the regulations; however, incident data, play patterns, and sleep behaviors combine to suggest that no portion of the bunk bed should be excluded from the entrapment provisions, including the side structures specified by the petitioner.

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TAB E

EC Staff Memorandum,

“Petition Requesting Revision of Bunk Bed Standard: Economic Considerations”



UNITED STATES
CONSUMER PRODUCT SAFETY COMMISSION
4330 EAST WEST HIGHWAY
BETHESDA, MD 20814

Memorandum

Date: January 19, 2011

TO : Timothy P. Smith, Bunk Bed Petition Project Manager, Division of Human Factors,
Directorate of Engineering Sciences

THROUGH : Gregory B. Rodgers, Ph.D., Associate Executive Director, Directorate for
Economic Analysis
Deborah V. Aiken, Ph.D., Senior Staff Coordinator,
Directorate for Economic Analysis

FROM : John W. Peternel, Economist, Directorate for Economic Analysis

SUBJECT: Petition Requesting Revision of Bunk Bed Standard: Economic Considerations

On April 16, 2010, the U.S. Consumer Product Safety Commission (CPSC) received Petition CP 10-2 & HP 10-1 ("the petition"), requesting that the Commission initiate a rulemaking to revise the Commission's regulations regarding bunk beds, codified under both the Consumer Product Safety Act ("CPSA") and the Federal Hazardous Substances Act ("FHSA") at 16 CFR parts 1213, 1500, and 1513 ("Bunk Bed Standard"). The petition requests that the CPSC incorporate testing requirements for bunk beds to include testing of spaces created by side structures for head and neck entrapment. The proposed testing requirements are similar to the current head and neck testing of spaces created by end structures and the upper guardrail. On July 12, 2010, the Commission issued a notice in the *Federal Register* requesting public comments concerning the petition. In response, four comments were received, and all comments favored amending the current Bunk Bed Standard to incorporate the changes that the petitioner requested.

This memorandum summarizes the current state of the bunk bed market, defines side structures and their entrapment risk, and describes the potential costs and benefits associated with the additional requirements requested by the petition.

The Product

A typical bunk bed consists of two end structures joined by side elements constructed of wood or metal frames that include top and bottom bunk support rails and top guard rails. Mattress foundation supports span laterally between the side rails. The end structures at the head and foot support the loads of the bunk bed, and occupants add rigidity to the bunk bed. A ladder to access the top bunk is secured to the top and bottom bunks, leaned onto the top bunk, or is integrated into an end structure. Occupants are protected by the top guard rails, which are intended to prevent falls.

Based on an industry review, the average retail price of a bunk bed is about \$350, with most prices falling within a range from \$150 to \$1,400.¹ Consumers can acquire a bunk bed through several channels, including specialty stores, furniture stores, and department stores, or by mail-order and over the Internet. Additionally, consumers can acquire a used bunk bed in secondary markets. Lastly, institutions (*e.g.*, colleges, prisons) tend to purchase large quantities of bunk beds from wholesalers, where average wholesale prices generally are less than average retail prices.

Manufacturers and Importers

Compliance staff has developed a list estimating the number of domestic bunk bed manufacturers at 78 and the number of importers at 639. Therefore, there are more than 700 entities that either manufacture domestically and/or import directly bunk beds. Compliance staff believes that there may be more firms that produce or import bunk beds in addition to those identified already. Additionally, every manufacturer of bedroom furniture is a potential producer of bunk beds.

Sales and Number in Use

There are no reported data on the number of bunk beds sold domestically. However, industry sources estimate that about 500,000 new bunk beds are sold annually.² The annual retail value of bunk beds sold for residential use may be approximately \$175 million. Bunk bed sales have been relatively stable over time. According to trade sources, the estimated expected useful life of a bunk bed is between 13 to 17 years.³ Based on the Directorate of Economic Analysis's Product Population Model, which uses sales information to estimate the number of products in use, there currently may be approximately 9 million bunk beds in use.

No data are available on the percentage of firms that produce bunk beds with side structures, such as ladders or lower guardrails; nor is there current information on the number of bunk beds sold that may have side structures that would fail the additional testing requirements for side structures.

Potential Risk of Side Structures in Bunk Beds

Bunk beds may have several types of side structures that may pose a risk of head and neck entrapment. Those side structures include: (1) upper and lower guardrails; (2) a ladder placed on the side; and (3) side rails that support the mattress foundation. According to the petitioner, side structures are a concern because a child may become severely or fatally injured as a result of the child's head and/or neck being trapped between: (1) the guardrail and the mattress, (2) a step or rung on the ladder and other side structure or mattress, or (3) the mattress foundation and the mattress. Because of these potential risks, the petitioner requested revision of the Bunk Bed

¹ Prices were estimated based on a review of bunk beds from internet-based price search engines.

²Karels, Terrance. Petition CP 03-1/HP 03-1. "Bunk Bed Petition." Table C. Directorate of Economic Analysis. U.S. Consumer Product Safety Commission. December 3, 2003.

³ Ibid.

Standard to include entrapment testing requirements for all side structures in bunk beds, including the use of several anthropometrically developed probes to test for partially bound and completely bound entrapment hazards.

Costs of Revising the Standard

If the Bunk Bed Standard is amended as the petitioner requests, manufacturers may incur additional costs associated with production and testing of bunk beds. While the percentage of bunk beds that would require modification to comply with a revised standard is unknown, all bunk bed manufacturers would be subject to additional testing requirements. However, because bunk beds already undergo significant testing pursuant to the Bunk Bed Standard and the Consumer Product Safety Improvement Act (CPSIA), the increase in testing costs is likely to be small.

Manufacturers that produce bunk beds that fail a test for side structures may redesign the bunk bed to meet standards or cease production of that style of bunk bed. A manufacturer that redesigns a bunk bed may incur costs related to altering the product design and changing the production process. A manufacturer that ceases production of a particular model may experience a decrease in revenue, unless the manufacturer is able to produce an alternative product.

Benefit of Revising the Standard

Since 1994, CPSC staff is aware of a total of eight bunk bed incidents that are within the scope of the petition, including four deaths and one minor injury. Given that these incidents have occurred over a 17-year period and that there are about 9 million bunk beds in use, the bunk bed deaths that might have been addressed appear to be quite rare: about 1 death for every 38 million bunk beds in use per year.

CPSC staff also identified 20 other incidents, including 10 deaths, which lacked sufficient detail to determine whether they would have been addressed by the proposed standard. For the most part, staff believes that it is unlikely that these deaths would have been addressed by the proposed standard. For example, several of the deaths reportedly involved a guard rail, but the reports did not specify whether the guard rail was on the upper bunk, which is addressed by the existing standard, or on the lower bunk, which would be addressed by the proposed standard. However, side guard rails on lower bunk beds appear to be uncommon; consequently, these deaths most likely involved the top bunk rail, which is addressed by the current standard. Nevertheless, if we assume that half of the deaths within this group of 20 incidents would have been addressed by the proposed standard, the total number of potentially addressable deaths would amount to 9 (*i.e.*, 4 in-scope fatalities, plus half of the 10 questionable fatalities), or about 1 death for every 17 million bunk beds in use per year.

TAB F

Public comments in response to Petition CP 10-2 & HP 10-1

PUBLIC SUBMISSION

As of: 3/29/11 11:33 AM Tracking No. 80b191bd Comments Due: September 10, 2010

Docket: [CPSC-2010-0071](#)

Petition for Revision of Bunk Bed Standards: Incorporation of Requirements for Head and Neck Entrapment Testing in Spaces Created by Side Structures, Including Ladders

Comment On: [CPSC-2010-0071-0001](#)

Petition for Revision of Bunk Bed Standards: Incorporation of Requirements for Head and Neck Entrapment Testing in Spaces Created by Side Structures, Including Ladders

Document: [CPSC-2010-0071-0002](#)

Comment from Jack Walsh

Submitter Information

Name: Jack Walsh

Organization: Keeping Babies Safe

General Comment

I fully support the Bunk Bed Petition submitted by Carol Pollack Nelson, Docet No. CPSC-2010-0071, that the Unites States Consumer Product Safety Commission initiate rulemaking to revise the Bunk Bed Standard to incorporate requirements for head and neck entrapment in spaces created by side structures that are provided with a bunk bed. I am especially concerned with the potential gap created between a ladder's horizontal rung and the mattress. I serve on the ASTM Voluntary Bunk Bed Subcommittee and I can assure you that this matter will be addressed at the next meeting. The petition identifies a danger that is easily correctable and should be addressed in the mandatory bunk bed standard.

PUBLIC SUBMISSION

As of: 3/29/11 11:46 AM Tracking No. 80b48423 Comments Due: September 10, 2010

Docket: [CPSC-2010-0071](#)

Petition for Revision of Bunk Bed Standards: Incorporation of Requirements for Head and Neck Entrapment Testing in Spaces Created by Side Structures, Including Ladders

Comment On: [CPSC-2010-0071-0001](#)

Petition for Revision of Bunk Bed Standards: Incorporation of Requirements for Head and Neck Entrapment Testing in Spaces Created by Side Structures, Including Ladders

Document: [CPSC-2010-0071-0003](#)

Comment from Rachel Weintraub

Submitter Information

Name: Rachel Weintraub

General Comment

Please see comments attached.

Attachments

[CPSC-2010-0071-0003.1](#) Comment from Rachel Weintraub

*** Consumer Federation of America * Consumers Union *
Keeping Babies Safe * Kids in Danger * U.S. Public Interest
Research Group ***

September 10, 2010

Office of the Secretary
Consumer Product Safety Commission
Room 502
4330 East-West Highway
Bethesda, Maryland 20814
Via e-mail: <http://www.regulations.gov>
Docket No. CPSC-2010-0071

**Comments of Consumer Federation of America, Consumers Union,
Keeping Babies Safe, Kids In Danger, and the U.S. Public Interest Research
Group to the U.S. Consumer Product Safety Commission
on
“Petition Requesting Revision of Bunk Bed Standard to Incorporate
Requirements for Head and Neck Entrapment Testing in Spaces Created by
Side Structures, Including Ladders”**

Introduction

Consumer Federation of America (CFA), Consumers Union of U.S., Inc. (CU), Keeping Babies Safe, Kids In Danger, and the U.S. Public Interest Research Group (jointly “We”) submit the following comments in response to the U.S. Consumer Product Safety Commission (“CPSC” or “Commission”) in the above-referenced matter (“Bunk Bed Petition”).¹ The CPSC has received a petition requesting the Commission to initiate a rulemaking to revise CPSC’s existing mandatory Bunk Bed Standard to incorporate requirements for head and neck entrapment testing in spaces created by side structures that are provided with a bunk bed, including ladders. We submit these comments in response to the

¹ “Petition Requesting Revision of Bunk Bed Standard to Incorporate Requirements for Head and Neck Entrapment Testing in Spaces Created by Side Structures, Including Ladders,” Vol. 75, No. 9132 Federal Register pg. 39666 (July 12, 2010).

CPSC's invitation for written comments concerning the request for revisions to the Bunk Bed Standard.

Background

CPSC regulates bunk beds under both the Federal Hazardous Substances Act (FHSA) (16 CFR 1500 and 1513) for bunk beds intended for use by children, and the Consumer Product Safety Act (CPSA) (16 CFR 1213) for bunk beds not specifically intended for children. The mandatory standards for bunk beds were promulgated after the Commission "determined that unreasonable risks of injury and death are associated with bunk beds that are constructed so that children can become entrapped in the beds' structure or become wedged between the bed and a wall."² Further, the mandatory standard also includes requirements "to adequately address fatalities due to entrapment of children's necks in the end structures of bunk beds."³

The petitioner, Dr. Carol Pollack-Nelson, in her petition filed with the Commission states that, "the same risk of injury continues to exist with regard to the space between a ladder and the side of the bed, which the standard does not address."⁴ Dr. Pollack-Nelson identified that the hazard arises when a child's head passes through the space between a horizontal ladder rung and the top of the mattress.

In addition, Dr. Pollack-Nelson explains that, "[j]ust as it is important to test for head and neck entrapment potential in bunk bed end structures, it is also

² U.S. Consumer Product Safety Commission, "Safety Standard for Bunk Beds," Federal Register Vol. 64, No. 245, 71888, Wednesday, December 22, 1999.

³ U.S. Consumer Product Safety Commission, "Safety Standard for Bunk Beds," Federal Register Vol. 64, No. 245, 71888, Wednesday, December 22, 1999.

⁴ Petition filed by Dr. Carol Pollack Nelson to the U.S. Consumer Product Safety Commission, April 16, 2010, page 1.

important and feasible to test for entrapment potential in bunk bed side structures.”⁵

The petition identifies three fatalities and four non-fatal incidents that occurred when a child’s head and /or neck were entrapped between the side of the bed and the bunk bed ladder.

The revised bunk bed standard should rely on anthropometric data to eliminate the risk of entrapment by limiting the dimensions of the spaces on side structures. The revision should also include a test method to ensure compliance with the standard. Side structures should include, but not be limited to slides, ladders, and cut-outs in any side structure accessory.

Comments

Our organizations strongly support the petition filed and urge the Commission to act favorably on the petition and revise the Bunk Bed Standard to address head and neck entrapment in bunk bed side structures. We agree with the petitioner that:

- the hazard of side structure entrapments on bunk beds have not been addressed;
- that the hazard pattern and data documenting side structure entrapments on bunk beds is well documented and known to the bunk bed industry as well as to CPSC;
- that means to address this hazard are known, possible and practical; and
- that failing to take action to address this hazard will lead to more deaths and injuries caused by entrapment in bunk bed side structures.

⁵ Petition filed by Dr. Carol Pollack Nelson to the U.S. Consumer Product Safety Commission, April 16, 2010, page 6.

We agree with Dr. Pollack-Nelson's statement in her petition that, "[c]hildren who become entrapped by the neck between the vertical post of a bunk bed ladder and the mattress are every bit as vulnerable as children who become entrapped by the neck in a bunk bed end structure."⁶ We urge the Commission to close this unintended loophole in the Bunk Bed Standard and look forward to working with the Commission as it promulgates this necessary revision.

Respectfully submitted,

Rachel Weintraub
Director of Product Safety and Senior Counsel
Consumer Federation of America

Donald L. Mays
Senior Director, Product Safety / Technical Policy
Consumers Union

Nancy A. Cowles
Executive Director
Kids in Danger

Elizabeth Hitchcock
Public Health Advocate
U.S. PIRG

Jack Walsh
Director Emeritus
Keeping Babies Safe

⁶ Petition filed by Dr. Carol Pollack Nelson to the U.S. Consumer Product Safety Commission, April 16, 2010, page 9.

PUBLIC SUBMISSION

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Comments Due: September 10, 2010

Docket: [CPSC-2010-0071](#)

Petition for Revision of Bunk Bed Standards: Incorporation of Requirements for Head and Neck Entrapment Testing in Spaces Created by Side Structures, Including Ladders

Comment On: [CPSC-2010-0071-0001](#)

Petition for Revision of Bunk Bed Standards: Incorporation of Requirements for Head and Neck Entrapment Testing in Spaces Created by Side Structures, Including Ladders

Document: [CPSC-2010-0071-0004](#)

Comment from George Sushinsky

Submitter Information

Name: George Sushinsky

General Comment

See attached file(s)

Attachments

[CPSC-2010-0071-0004.1](#) Comment from George Sushinsky

George F. Sushinsky
Sushinsky Product Safety Consulting, LLC
908 Wade Avenue
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September 9, 2010

Mr. Todd Stevenson, Director
Office of the Secretary
U.S. Consumer Product Safety Commission
4330 East-West Highway
Bethesda, MD 20814

Re: Docket No. CPSC-2010-0071 – Petition Requesting Revision of Bunk Bed Standard to Incorporate Head and Neck Entrapment Testing in Spaces Created by Side Structures, Including Ladders.

Dear Mr. Stevenson:

I am writing in support of the referenced petition that requests the Consumer Product Safety Commission (CPSC) to initiate rulemaking to revise the Bunk Bed Standard (16 CFR Parts 1213, 1500, and 1513, FR Vol 64, No. 245) such that it incorporates requirements for head and neck entrapment testing in spaces created by side structures that are provided with a bunk bed, including ladders. I am a Mechanical Engineer and have worked in the field of consumer product safety since 1984. From 1984 through 2005, I was employed by the CPSC in the Directorate for Engineering Sciences and the Directorate for Laboratory Sciences. In 2005, I retired from government service and now I work independently as an engineering safety consultant.

This past year, I was retained as an engineering expert, in a case involving the fatal neck entrapment and strangulation of a child, Ryan Buchheit, between a side ladder and the lower mattress platform of a bunk bed (see IDI 081021HWE7802). This area is not covered by either the CPSC or voluntary bunk bed standard. The CPSC bunk bed standard limits head and neck entrapment testing to the end structure. It does not require testing of integral structures positioned on the side of the bed, such as a side-mounted ladder. The risk of head and neck entrapment in the space between the ladder and side of the bed and mattress exists in some bunk bed designs. Children have died as a result of a design defect that allows a gap to exist between a side structure and the bed /mattress as outlined in Dr. Pollack-Nelson's petition.

CPSC is aware of the incidents involved with side structure entrapment as noted in Dr. Pollack-Nelson's petition. Furthermore, in calendar year 2000, I

reviewed submittals from manufacturers about various bunk bed design issues. During this same period, I also reviewed in-depth investigation reports (IDIs) involving bunk beds. In memos to compliance staff, I pointed out the inconsistency in the entrapment regulations that covered end structures in the Bunk Bed standard but did not provide the same protection from entrapment in side structures. (See attached list of memoranda.) One incident described in IDI 000224CCC2320, is uncannily similar to the circumstances leading to ther entrapment death of Ryan Buchheit in October 2007

I cannot overemphasize the need for the requested changes to the Bunk Bed Standard (16 CFR Parts 1213, 1500, and 1513, FR Vol 64, No. 245). These changes require not only the torso and spherical probe test described in the current standard for evaluating end structures, but the changes also need to incorporate a neck probe test to evaluate gaps between any bunk bed side structure and the bed (frame and mattress). In evaluating the Buchheit incident, the lower bunk mattress fit loosely in the bed frame. Currently, there are no requirements for mattress fit on the lower bunk.

I reiterate my support for Dr. Pollack-Nelson's request. The requested revision to the Bunk Bed standard, to protect against head and neck entrapment in any integral structure provided with the bunk bed, including spaces created by the ladder at the side of the lower bunk, is at least one death too late. I urge the Commission and CPSC staff to act promptly on this request.

I am available to discuss my comments on this petition and specific testing issues at your convenience.

Sincerely,

/s/ GFS

George F. Sushinsky

Referenced Memoranda:

1. Memo from George Sushinsky to Pam Major, Re: Review of IDI 000224CCC2320, dated May 15,2000.
2. Memo from George Sushinsky to Dennis Kacoyanis, Re: Review of Exhibits from Fine Pine Inspection, dated March 21, 2000.
3. Memo fro George Sushinsky to Pamela Major, Re: Bunk bed – angle support braces, dated 5/15/2000

PUBLIC SUBMISSION

As of: 3/29/11 11:49 AM
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Docket: [CPSC-2010-0071](#)

Petition for Revision of Bunk Bed Standards: Incorporation of Requirements for Head and Neck Entrapment Testing in Spaces Created by Side Structures, Including Ladders

Comment On: [CPSC-2010-0071-0001](#)

Petition for Revision of Bunk Bed Standards: Incorporation of Requirements for Head and Neck Entrapment Testing in Spaces Created by Side Structures, Including Ladders

Document: [CPSC-2010-0071-0005](#)

Comment from Shelley Deppa

Submitter Information

Name: Shelley Deppa

Submitter's Representative: Shelley Waters Deppa

Organization: Safety Behavior Analysis, Inc.

Government Agency Type: Federal

Government Agency: CPSC

General Comment

I agree with this petition. I too have researched a bunk bed death that occurred in Arlington, Texas on 12/16/01 when a 19 month old male died from asphyxia due to entrapment between the mattress and vertical ladder in the lower bunk. The child was found between the side of the mattress and the vertical ladder stile, lying on his left side, his back against the mattress, the front of his neck pressed against a vertical ladder stile (that was 4-6" away from the mattress side), and his head and body on either side of the vertical ladder stile in unbounded width openings. He was entrapped in such a way that his thinnest body part front to back (neck) was wedged between mattress and vertical ladder stile, and his thicker body parts (head, torso) were in the unbounded width openings on either side of the stile. There was nothing stopping the mattress from sliding away from the ladder towards the other side, creating a hazardous opening.