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

This document has been electronically approved and signed.

THIS MATTER IS NOT SCHEDULED FOR A BALLOT VOTE.

BRIEFING AND DECISIONAL MEETINGS FOR THIS MATTER IS TO BE DETERMINED.

DATE: July 14, 2021

TO: The Commission
Alberta E. Mills, Secretary

THROUGH: Jennifer Sultan, Acting General Counsel
Mary T. Boyle, Executive Director

FROM: Daniel R. Vice, Assistant General Counsel, Regulatory Affairs
Meridith L. Kelsch, Attorney, Regulatory Affairs

SUBJECT: Proposed Rule: Safety Standard for Clothing Storage Units

Staff is forwarding to the Commission a briefing package recommending that the Commission issue a notice of proposed rulemaking (NPR), pursuant to the Consumer Product Safety Act (CPSA), to address the risk of injury associated with clothing storage units tipping over. The Office of the General Counsel is providing for the Commission's consideration a draft NPR that would establish requirements for clothing storage units.

Please indicate your vote on the following options:

I. Approve publication of the attached notice in the *Federal Register*, as drafted.

________________________________ ______________________
(Signature) (Date)

II. Approve publication of the attached notice in the *Federal Register*, with the specified changes.

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(Signature) (Date)

III. Do not approve publication of the attached notice in the *Federal Register*.

(Signature) (Date)

IV. Take other action specified below.

(Signature) (Date)

Attachment: Draft Federal Register notice: Safety Standard for Clothing Storage Units

Billing Code 6355-01-P

CONSUMER PRODUCT SAFETY COMMISSION

16 CFR Parts 1112 and 1242

[Docket No. CPSC-2017-0044]

Safety Standard for Clothing Storage Units

AGENCY: Consumer Product Safety Commission.

ACTION: Notice of proposed rulemaking.

SUMMARY: The U.S. Consumer Product Safety Commission (Commission or CPSC) has determined preliminarily that there is an unreasonable risk of injury and death, particularly to children, associated with clothing storage units (CSUs) tipping over. To address this risk, the Commission proposes a rule addressing the stability of CSUs. Specifically, the proposed rule would require CSUs to be tested for stability, exceed minimum stability requirements, be marked and labeled with safety information, and bear a hang tag providing performance and technical data about the stability of the CSU. The Commission issues this proposed rule under the authority of the Consumer Product Safety Act (CPSA). The Commission requests comments about all aspects of this notice, including the risk of injury, the proposed requirements, alternatives to the proposed rule, and the economic impacts of the proposed rule and alternatives.

DATES: Submit comments by [INSERT DATE 75 DAYS AFTER DATE OF PUBLICATION IN THE FEDERAL REGISTER].

ADDRESSES: Direct comments related to the Paperwork Reduction Act aspects of the proposed rule to the Office of Information and Regulatory Affairs, the Office of Management and Budget, Attn: CPSC Desk Officer, fax to: 202-395-6974, or e-mail oira_submission@omb.eop.gov. Submit other comments, identified by Docket No. CPSC-2017-0044, by any of the following methods:

Electronic Submissions: Submit electronic comments to the Federal eRulemaking Portal at: https://www.regulations.gov. Follow the instructions for submitting comments. CPSC does not accept comments submitted by electronic mail (e-mail), except through https://www.regulations.gov, and as described below. CPSC encourages you to submit electronic comments by using the Federal eRulemaking Portal, as described above.

Mail/Hand Delivery/Courier Written Submissions: Submit comments by mail/hand delivery/courier to: Division of the Secretariat, Consumer Product Safety Commission 4330 East West Highway, Bethesda, MD 20814; telephone: (301) 504-7479. Alternatively, as a temporary option during the COVID-19 pandemic, you can e-mail such submissions to: cpsc-os@cpsc.gov.

Instructions: All submissions must include the agency name and docket number for this notice. CPSC may post all comments without change, including any personal identifiers, contact information, or other personal information provided, to: https://www.regulations.gov. Do not submit electronically: confidential business information, trade secret information, or other sensitive or protected information that you do not want to be available to the public. If you wish to submit such information, please submit it according to the instructions for mail/hand delivery/courier written submissions.

Docket: To read background documents or comments regarding this proposed rulemaking, go to: http://www.regulations.gov, insert docket number CPSC-2017-0044 in the "Search" box, and follow the prompts.

FOR FURTHER INFORMATION CONTACT: Kristen Talcott, Project Manager, U.S. Consumer Product Safety Commission, 5 Research Place, Rockville, MD 20852; telephone (301) 987-2311; e-mail: KTalcott@cpsc.gov.

SUPPLEMENTARY INFORMATION:

I. Background

CSUs are freestanding furniture items, typically used for storing clothes. Examples of CSUs include chests, bureaus, dressers, chests of drawers, drawer chests, door chests, chifforobes, armoires, and wardrobes. CPSC is aware of numerous deaths and injuries resulting from CSUs tipping over, particularly onto children. CPSC identified 226 fatalities associated with CSUs tipping over that were reported to have occurred between January 1, 2000 and December 31, 2020.[1] Of these, 193 (85 percent) involved children (*i.e.*, under 18 years old), 11 (5 percent) involved adults (*i.e.*, 18 to 64 years old), and 22 (10 percent) involved seniors (*i.e.*, 65 years and older). In addition, there were an estimated 78,200 nonfatal CSU tip-over injuries that were treated in U.S. hospital emergency departments (EDs) between January 1, 2006 and December 31, 2019. Of these, an estimated 56,400 (72 percent) involved children, and the remaining estimated 21,800 (28 percent) involved adults and seniors.

To address the hazard associated with CSU tip overs, the Commission has taken several steps. In June 2015, the Commission launched the Anchor It! campaign. This educational campaign includes print and broadcast public service announcements; information distribution at targeted venues, such as childcare centers; social media; blog posts; videos; and an informational website (www.AnchorIt.gov). The campaign explains the nature of the risk, provides safety tips

[1] Reporting is considered incomplete for the years 2018-2020 because reporting is ongoing.

for avoiding furniture and television tip overs, and promotes the use of tip restraints to anchor furniture and televisions.

In addition, CPSC's Office of Compliance and Field Operations has investigated and recalled CSUs. Between January 1, 2000 and March 31, 2021, 40 consumer-level recalls occurred to address CSU tip-over hazards. The recalled products were responsible for 328 tip-over incidents, including reports of 149 injuries and 12 fatalities.[2] These recalls involved 34 firms and affected approximately 21,500,000 CSUs.

In 2016, CPSC staff prepared a briefing package on furniture tip overs, looking at then-current levels of compliance with the voluntary standards, and the adequacy of the voluntary standards.[3]

In 2017, the Commission issued an advance notice of proposed rulemaking (ANPR), discussing the possibility of developing a rule to address the risk of injury and death associated with CSU tip overs. 82 Fed. Reg. 56752 (Nov. 30, 2017).[4] The ANPR began a rulemaking proceeding under the CPSA (15 U.S.C. 2051-2089). CPSC received 18 comments during the comment period, as well as five additional correspondences after the comment period, which staff also considered.

The Commission is now issuing a notice of proposed rulemaking (NPR), proposing to establish requirements for CSU stability. The information discussed in this preamble is derived from CPSC staff's briefing package for the NPR, which is available on CPSC's website at:

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[2] For the remaining incidents, either no injury resulted from the incident, or the report did not indicate whether an injury occurred.

[3] Massale, J., Staff Briefing Package on Furniture Tipover, U.S. Consumer Product Safety Commission (2016), available at: https://www.cpsc.gov/s3fs-public/Staff%20Briefing%20Package%20on%20Furniture%20Tipover%20-%20September%2030%202016.pdf.

[4] The briefing package supporting the ANPR is available at: https://www.cpsc.gov/s3fs-public/ANPR%20-%20Clothing%20Storage%20Unit%20Tip%20Overs%20-%20November%2015%202017.pdf?5IsEEdW_Cb3ULO3TUGJiHEl875Adhvsg. After issuing the ANPR, the Commission extended the comment period on the ANPR. 82 Fed. Reg. 2382 (Jan. 17, 2018).

_________. This preamble provides key information to explain and support the rule; however, for a more comprehensive and detailed discussion, see the NPR briefing package.

II. Statutory Authority

CSUs are "consumer products" that the Commission can regulate under the authority of the CPSA. *See* 15 U.S.C. 2052(a)(5). Section 7 of the CPSA authorizes the Commission to issue a mandatory consumer product safety standard that consists of performance requirements or requirements that the product be marked with, or accompanied by, warnings or instructions. *Id*. 2056(a). Any requirement in the standard must be "reasonably necessary to prevent or reduce an unreasonable risk of injury" associated with the product. *Id*. Section 7 requires the Commission to issue such a standard in accordance with section 9 of the CPSA. *Id*.

Section 9 of the CPSA specifies the procedure the Commission must follow to issue a consumer product safety standard under section 7. *Id*. 2058. Under section 9, the Commission may initiate rulemaking by issuing an ANPR or NPR. *Id.* 2058(a). As noted above, the Commission issued an ANPR on CSU tip overs in November 2017. 82 Fed. Reg. 56752 (Nov. 30, 2017). When issuing an NPR, the Commission must comply with section 553 of Administrative Procedure Act (5 U.S.C. 553), which requires the Commission to provide notice of a rule and the opportunity to submit written comments on it. 15 U.S.C. 2058(d)(2). In addition, the Commission must provide interested parties with an opportunity to make oral presentations of data, views, or arguments. *Id*.

Under section 9 of the CPSA, an NPR must include the text of the proposed rule, any alternatives the Commission proposes, and a preliminary regulatory analysis. 15 U.S.C. 2058(c). The preliminary regulatory analysis must include:

- a preliminary description of the potential costs and benefits of the rule, including costs and benefits that cannot be quantified, and the analysis must identify who is likely to receive the benefits and bear the costs;
- a discussion of the reasons any standard or portion of a standard submitted to the Commission in response to the ANPR was not published by the Commission as the proposed rule or part of the proposed rule;
- a discussion of the reasons for the Commission's preliminary determination that efforts submitted to the Commission in response to the ANPR to develop or modify a voluntary standard would not be likely, within a reasonable period of time, to result in a voluntary standard that would eliminate or adequately reduce the risk of injury addressed by the proposed rule; and
- a description of alternatives to the proposed rule that the Commission considered and a brief explanation of the reason the alternatives were not chosen.

Id.

In addition, to issue a final rule, the Commission must make certain findings and include them in the rule. *Id*. 2058(f)(1), (f)(3). Under section 9(f)(1) of the CPSA, before promulgating a consumer product safety rule, the Commission must consider, and make appropriate findings to be included in the rule, concerning the following issues:

- the degree and nature of the risk of injury the rule is designed to eliminate or reduce;
- the approximate number of consumer products subject to the rule;
- the need of the public for the products subject to the rule and the probable effect the rule will have on the cost, availability, and utility of such products; and

- the means to achieve the objective of the rule while minimizing adverse effects on competition, manufacturing, and commercial practices.

Id. 2058(f)(1). Under section 9(f)(3) of the CPSA, the Commission may not issue a consumer product safety rule unless it finds (and includes in the rule):

- the rule, including the effective date, is reasonably necessary to eliminate or reduce an unreasonable risk of injury associated with the product;
- that issuing the rule is in the public interest;
- if a voluntary standard addressing the risk of injury has been adopted and implemented, that either compliance with the voluntary standard is not likely to result in the elimination or adequate reduction of the risk or injury, or there is unlikely to be substantial compliance with the voluntary standard;
- that the benefits expected from the rule bear a reasonable relationship to its costs; and
- that the rule imposes the least burdensome requirement that prevents or adequately reduces the risk of injury.

Id. 2058(f)(3). At the NPR stage, the Commission is making these findings on a preliminary basis to allow the public to comment on the findings.

Section 9(g)(2) of the CPSA allows the Commission to prohibit manufacturers of a consumer product from stockpiling products subject to a consumer product safety rule to prevent manufacturers from circumventing the purpose of the rule. 15 U.S.C. 2058(g)(2). The statute defines "stockpiling" as manufacturing or importing a product between the date a rule is promulgated and its effective date at a rate that is significantly greater than the rate at which the product was produced or imported during a base period ending before the date the rule was promulgated. *Id.* The Commission is to define what constitutes a "significantly greater" rate and the base period in the rule addressing stockpiling. *Id.*

Section 27(e) of the CPSA authorizes the Commission to issue a rule to require manufacturers of consumer products to provide "such performance and technical data related to performance and safety as may be required to carry out the purposes of [the CPSA]." 15 U.S.C. 2076(e). The Commission may require manufacturers to provide this information to the Commission or, at the time of original purchase, to prospective purchasers and the first purchaser for purposes other than resale, as necessary to carry out the purposes of the CPSA. *Id.* Section 2(b) of the CPSA states the purposes of the CPSA, including:

- protecting the public from unreasonable risks of injury associated with consumer products; and
- assisting consumers in evaluating the comparative safety of consumer products.

Id. 2051(b)(1), (b)(2).

III. The Product and Market

A. Description of the Product

The proposed rule defines a "CSU" as a freestanding furniture item, with drawer(s) and/or door(s), that may be reasonably expected to be used for storing clothing, that is greater than or equal to 27 inches in height, and that has a total functional volume of the closed storage greater than 1.3 cubic feet and greater than the sum of the total functional volume of the open storage and the total volume of the open space. Common names for CSUs include, but are not limited to: chests, bureaus, dressers, armoires, wardrobes, chests of drawers, drawer chests, chifforobes, and door chests. CSUs are available in a variety of designs (*e.g.*, vertical or horizontal dressers), sizes (*e.g.*, weights and heights), dimensions, and materials (*e.g.*, wood, plastic, leather, manufactured wood or fiber board). Consumers may purchase CSUs that have been assembled by the manufacturer, or they may purchase CSUs as ready-to-assemble furniture.

The proposed definition includes several criteria to help distinguish CSUs from other furniture. As freestanding furniture items, CSUs remain upright without requiring attachment to a wall, when fully assembled and empty, with all extension elements closed. As such, built-in units or units intended to be permanently attached to a building structure (other than by tip restraints) are not considered freestanding. In addition, CSUs are typically intended and used for storing clothing and, therefore, they are commonly used in bedrooms. However, consumers may also use CSUs in rooms other than bedrooms and to store items other than clothing in them. For this reason, whether a product is a CSU depends on whether it meets the criteria in the proposed definition, rather than what the name of the product is or what is the marketed use for the product. The criteria in the proposed definition regarding height and closed storage volume (*i.e.*, storage space inside a drawer or behind an opaque door) aim to address the utility of a unit for holding multiple clothing items. Some examples of furniture items that, depending on their design, may not meet the criteria in the proposed definition and, therefore, may not be considered CSUs are: shelving units, office furniture, dining room furniture, laundry hampers, built-in closets, and single-compartment closed rigid boxes (storage chests).

CSUs may be marketed, packaged, or displayed as intended for children 12 years old and younger. Examples of such products include CSUs with pictures or designs on them that would appeal to children; CSU designs that would be useful for children; or CSUs that are part of a matching set with a crib, or similar infant product. However, CSUs are more commonly general-use products that are not specifically intended for children 12 years old and younger. The proposed rule applies to both children's products and non-children's products.

B. The Market

CPSC staff estimated the annual revenues and shipments of CSUs, using estimates of manufacturer and importer revenue, and estimated sales, by using data on retail sales. The shipment value of chests of drawers and dressers combined for an estimated $5.15 billion in 2018, and combined shipments of dressers and chests totaled 43.6 million units. Average manufacturer shipment value was $118 per unit in 2018 (about $104 for chests of drawers and $144 for dressers).

Retail prices of CSUs vary substantially. The least expensive units retail for less than $100, while more expensive units may retail for several thousand dollars. The estimated retail value of U.S. bedroom furniture sales in 2019 totaled $60.3 billion, of which $20.8 billion was sales of closets (which likely includes wardrobes and armoires), nightstands (some of which may be considered CSUs), and dressers (which likely includes chests of drawers).

According to data from the U.S. Census Bureau, in 2017, there were a total of 3,404 firms classified in the North American Industrial Classification System (NAICS) as non-upholstered wood household furniture manufacturing, upholstered household furniture manufacturing, metal household furniture manufacturing, or household furniture (except wood and metal) manufacturing. Of these firms, 2,024 were primarily categorized in the non-upholstered wood furniture category. However, these categories are broad and include manufacturers of furniture other than CSUs, such as tables, chairs, bed frames, and sofas. As such, it is likely that not all of the firms in these categories manufacture CSUs. Production methods and efficiencies vary among manufacturers; some use mass production techniques, and others manufacture their products one at a time or on a custom-order basis.

The number of U.S. firms that are primarily classified as manufacturers of non-upholstered wood household furniture has declined over the last few decades, as retailers have turned to international sources of CSUs and other wood furniture. Additionally, some firms that formerly produced all of their CSUs domestically have shifted production to foreign plants. More than half (64 percent) of the value of apparent consumption of non-upholstered wood furniture (net imports plus domestic production for the U.S. market) in 2019 was comprised of imported furniture, which may be true for CSUs as well. In addition to manufacturers, according to the Census Bureau data, in 2017, there were 5,117 firms involved in household furniture importation and distribution. According to the Census Bureau, there were 13,826 furniture retailers in 2017. Wholesalers and retailers may obtain their products from domestic sources or import them from foreign manufacturers.

IV. Risk of Injury

A. Incident Data[5]

CPSC staff analyzed reported fatalities, reported nonfatal incidents and injuries, and calculated national estimates of injuries treated in EDs that were associated with CSU instability or tip overs. Each year, CPSC issues an annual report on furniture instability and tip overs.[6] The information provided for this rulemaking is drawn from a subset of data from those annual reports, as well as from the National Electronic Injury Surveillance System[7] (NEISS), which includes reports of injuries treated in U.S. EDs, and the Consumer Product Safety Risk

[5] For more details about incident data, see Tab A of the NPR briefing package.
[6] These annual reports are available at: https://www.cpsc.gov/Research-Statistics/furniture-decor/tipovers.
[7] Data from the NEISS is based on a nationally representative probability sample of about 100 hospitals in the United States and its territories. NEISS data can be accessed from the CPSC website under the "Access NEISS" link at: https://www.cpsc.gov/Research--Statistics/NEISS-Injury-Data.

Management System[8] (CPSRMS). For this rulemaking, staff focused on incidents that involved products that would be considered CSUs.[9] Staff considered incidents that involved the CSU tipping over, as well as incidents of CSU instability with indications of impending tip over. Tip-over incidents are a subset of product instability incidents, and involve CSUs actually falling over. Product instability incidents are a broader category that includes tip-over incidents, but may also include incidents where CSUs did not fully tip over. Staff considered instability incidents relevant because product instability can lead to a tip over, and the same factors, such as product design, can contribute to instability and tip overs.[10]

The data presented here represent the minimum number of incidents or fatalities during the time frames described. Data collection is ongoing for CPSRMS, and is considered incomplete for 2018 and after, so CPSC may receive additional reports for those years in the future.[11]

1. Fatal Incidents

Based on NEISS and CPSRMS, CPSC staff identified 193 reported CSU tip-over fatalities to children (*i.e.*, under 18 years old),[12] 11 reported fatalities to adults (*i.e.*, ages 18 through 64 years), and 22 reported fatalities to seniors (*i.e.*, ages 65 years and older) that were

[8] CPSRMS is the epidemiological database that houses all anecdotal reports of incidents received by CPSC, "external cause"-based death certificates purchased by CPSC, all in-depth investigations of these anecdotal reports, as well as investigations of select NEISS injuries. Examples of documents in CPSRMS include: hotline reports, Internet reports, news reports, medical examiner's reports, death certificates, retailer/manufacturer reports, and documents sent by state/local authorities, among others.
[9] Staff considered incidents that involved chests, bureaus, dressers, armoires, wardrobes, portable clothes lockers, and portable closets.
[10] This section refers to tip-over incidents and instability incidents collectively as tip-over incidents.
[11] Among other things, CPSRMS houses all in-depth investigation reports, as well as the follow-up investigations of select NEISS injuries. As such, it is possible for a NEISS injury case to be included in the national injury estimate, while its investigation report is counted among the anecdotal nonfatal incidents, or for a NEISS injury case to appear on both the NEISS injury estimate and fatalities, if the incident resulted in death while receiving treatment.
[12] Of the 193 reported fatalities, there was one tip-over incident that resulted in two deaths, making the number of fatal incidents 192.

reported to have occurred between January 1, 2000 and December 31, 2020.[13] Of the 193 reported CSU tip-over child fatalities, 89 (46 percent) involved only a CSU tipping over, whereas, 104 (54 percent) involved a CSU and a television tipping over. Of the child fatalities, 190 (98 percent) involved a chest, bureau, or dresser, 2 involved a wardrobe, and 1 involved an armoire. Of the 33 reported adult and senior fatalities, 32 (97 percent) involved only a CSU tipping over, whereas, 1 (9 percent) involved both a CSU and a television tipping over. Of the adult and senior fatalities, 29 involved a chest, bureau, or dresser, 2 involved a wardrobe, 1 involved an armoire, and 1 involved a portable storage closet.

For the years for which reporting is considered complete—2000 through 2017—there have been from 3 to 21 child fatalities each year from CSU tip overs, and from 0 to 5 fatalities each year to adults and seniors.

Of the 193 reported child fatalities from tip overs, 166 involved children 3 years old or younger; 12 involved 4-year-olds; 7 involved 5-year-olds; 4 involved 6-year-olds; 1 involved a 7-year-old; and 3 involved 8-year-olds. Of the 89 reported child fatalities from tip overs involving only CSUs (*i.e.*, no televisions), 84 involved children 3 years old or younger; 2 involved 4-year-olds; 1 involved a 5-year-old; 1 involved a 6-year-old; and 1 involved a 7-year-old. Thus, 94 percent of these fatalities were children 3 years old and younger; 97 percent were 4 years old and younger; 98 percent were 5 years old and younger; and 99 percent were 6 years old and younger. Therefore, regardless of television involvement, the most reported CSU tip-over

[13] Different time frames are presented for NEISS, CPSRMS, fatal, and nonfatal data because of the timeframes in which staff collected, received, retrieved, and analyzed the data. One example of the reason for varied timeframes is that staff drew data from previous annual reports and other data-collection reports (which used varied start dates), and then updated the data set to include more recent data. Another example is that CPSRMS data are available on an ongoing basis, whereas NEISS data are not available until several months after the end of the previous calendar year.

fatalities happened to children 3 years old or younger. Among children 4 years and older, a television was more frequently involved than not involved.

CSU tip-over fatalities to children were most commonly caused by torso injuries when only a CSU was involved, and were more commonly caused by head injuries when both a CSU and television tipped over. For the 89 child fatalities not involving a television, 58 resulted from torso injuries (chest compression); 13 resulted from head/torso injuries; 12 resulted from head injuries; 4 involved unknown injuries; and 2 involved a child's head, torso, and limbs pinned under the CSU. For the 104 child fatalities that involved both a CSU and television tipping over, 91 resulted from head injuries (blunt head trauma); 6 resulted from torso injuries (chest compression resulting from the child being pinned under the CSU); 2 resulted from head/torso injuries; 4 involved unknown injuries; and 1 involved head/torso/limbs.

2. Reported Nonfatal Incidents

CPSC staff identified 1,002 reported nonfatal CSU tip-over incidents for all ages that were reported to have occurred between January 1, 2005 and December 31, 2020.[14] CPSRMS reports are considered anecdotal because, unlike NEISS data, they cannot be used to identify statistical estimates or year-to-year trend analysis, and because they include reports of incidents in which no injury resulted. Although these anecdotal data do not provide for statistical analyses, they provide detailed information to identify hazard patterns, and provide a minimum count of injuries and deaths.

Of the 1,002 reported incidents, 64 percent (639 incidents) involved only a CSU, and 36 percent (363 incidents) involved both a CSU and television tipping over. Of the 1,002 incidents,

[14] Nonfatal incident reports submitted to CPSC come from reports entered into CPSC's CPSRMS database no later than 12/31/2020, and includes completed NEISS investigations. All of the investigation reports based on NEISS injuries that occurred from 2006 through 2020 appear in the reported nonfatal incidents.

99.5 percent (997 incidents) involved a chest, bureau, or dresser; less than 1 percent (4 incidents) involved an armoire; and less than 1 percent (1 incident) involved a wardrobe.

For the years for which reporting is considered complete—2005 through 2017—there were from 6 to 256 reported nonfatal CSU tip-over incidents each year, with 2016 (256 incidents) and 2017 (101 incidents) reporting the highest number of incidents. Each year, there were from 5 to 232 reported nonfatal incidents involving only a CSU, with the highest number (232 incidents) occurring in 2016.

Of the 1,002 nonfatal CSU tip-over incidents reported, 362 did not mention any specific injuries; 628 reported one injury; and 12 reported two injuries, resulting in a total of 652 injuries reported among all of the reported nonfatal incidents. Of these 652 reported injuries, 64 (10 percent) resulted in hospital admission; 296 (45 percent) were treated in Eds; 28 (4 percent) were seen by medical professionals; and the level of care is unknown[15] for the remaining 264 (40 percent). Of 293 reports of nonfatal CSU tip-over injuries where only a CSU was involved; 7 resulted in hospital admission (of which 6 were children[16]); 23 were treated in the ED (of which 22 were children); 27 were seen by a medical professional (of which 19 were children); and the level of care is unknown for the remaining 236.

Of the victims whose ages were known, there were more injuries suffered by children 3 years old and younger, than to older victims; and the injuries suffered by these young children tended to be more severe, compared to older children and adults/seniors. The severity of injury ranged from cuts and bumps to concussions and skull fractures. Of the 7 victims admitted to the

[15] These reports include bruising, bumps on the head, cuts, lacerations, scratches, application of first-aid, or other indications of at least a minor injury that occurred, without any mention of aid rendered by a medical professional. There were three NEISS cases in which the victim went to the ED, but then left without being seen.

[16] Incidents involving children include those in which the age of the victim was reported as well as those in which the age was not reported, but the report included indications that the victim was a child (*e.g.*, a sibling of a small child, or referred to as a "child," "daughter," or "son"). For the remaining incidents, the victim was either an adult, or the age was unknown.

hospital, 5 were 3 years old or younger; 1 was a child of unknown age; and 1 was an adult. Of the 23 victims treated in the ED, 8 were 3 years old or younger; 4 were 4 to 5 years old; 4 were 6 to 17 years old; and 6 were children of unknown age.

3. National Estimates of ED-Treated Injuries[17]

According to NEISS, there were an estimated 78,200 injuries,[18] an annual average of 5,600 estimated injuries, related to CSU tip overs for all ages that were treated in U.S. hospital EDs from January 1, 2006 to December 31, 2019. Of the estimated 78,200 injuries, 56,400 (72 percent) were to children, which is an annual average of 4,000 estimated injuries to children over the 14-year period. For the remaining estimated 21,800 injuries to adults and seniors, about 3,200 (15 percent) were to seniors (*i.e.*, 65 years and older).

An estimated 61,700 (79 percent) of ED-treated injuries involved only a CSU tipping over, whereas, an estimated 16,500 (21 percent) involved both a CSU and television tipping over. This ratio was similar for injuries to children, with an estimated 40,700 (72 percent) of child incidents involving only a CSU, and an estimated 15,700 (28 percent) involving both a CSU and a television. In contrast, nearly all (an estimated 21,000 or 96 percent) of the estimated injuries to adults and seniors involved only a CSU. For each year from 2006 through 2019, there have been more estimated ED-treated injuries to children involving only a CSU tipping over, compared to incidents involving a CSU and a television tipping over.

For all ages, an estimated 77,000 (98 percent) of the ED-treated injuries involved a chest, bureau, or dresser. Similarly, for child injuries, an estimated 55,800 (99 percent) involved a

[17] Estimates are rounded to the nearest hundred and may not sum to total, due to rounding. NEISS estimates are reportable, provided the sample count is greater than 20, the national estimate is 1,200 or greater, and the coefficient of variation (CV) is less than 0.33.
[18] Sample size = 2,629, coefficient of variation = .0667.

chest, bureau, or dresser.[19] Of the ED-treated injuries to all ages, 93 percent were treated and released, and 4 percent were hospitalized. Among children, 93 percent were treated and released, and 3 percent were hospitalized.

For each year from 2006 through 2019, there were an estimated 2,500 to 5,900 ED-treated injuries to children from CSU tip overs. The estimated annual number of ED-treated injuries to adults and seniors from CSU tip overs is fairly consistent over most of the 14-year period, with an overall yearly average of 1,600 estimated injuries, although data were insufficient to support reliable statistical estimates for adults and seniors for 2014, 2015, and 2019.

CPSC focused on ED-treated injuries involving children because these make up the majority of ED-treated CSU tip-over injuries. For 2010 through 2019, there is a statistically significant linear decline in child injuries involving CSU tip overs (both with and without televisions);[20] however, there is no linear trend detected in injuries to children involving only CSUs tipping over. This indicates that the statistically significant decrease in all CSU tip overs involving children is driven by the decline in tip overs involving televisions, while the rate of ED-treated incidents involving CSUs without televisions has remained stable.

Of the estimated ED-treated injuries to children, most involved 2- and 3-year-olds, followed by 1- and 4-year-olds. An estimated 7,900 ED-treated injuries involved 1-year-olds[21]; an estimated 15,000 involved 2-year-olds[22]; an estimated 13,000 involved 3-year-olds[23]; and an estimated 7,500 involved 4-year-olds.[24] There were an estimated 2,300 injuries to 5-year-olds

[19] Data on armoires, wardrobes, portable closets, and clothes lockers were insufficient to support reliable statistical estimates.
[20] There were not enough CSU ED-treated incidents to children involving both a CSU and a television to make reliable estimates for the most recent 5 years, 2015 through 2019.
[21] An estimated 6,300 involved only a CSU and the remaining 1,600 involved a CSU and television.
[22] An estimated 10,600 involved only a CSU, and the remaining 4,400 involved a CSU and television.
[23] An estimated 9,200 involved only a CSU, and the remaining 3,800 involved a CSU and television.
[24] An estimated 5,100 involved only a CSU, and the remaining 2,400 involved a CSU and television.

that involved only a CSU, and an estimated 1,800 injuries to 6-year-olds that involved only a CSU, but data were insufficient to support reliable statistical estimates for incidents involving CSUs and televisions for these ages. For children 7 to 17 years old,[25] there were an estimated 4,700 ED-treated injuries involving only a CSU, and an estimated 1,600 involving a CSU and a television.

Of the estimated 56,400 ED-treated CSU tip-over injuries to children, an estimated 20,800 (37 percent) resulted in contusions/abrasions[26]; an estimated 14,900 (26 percent) resulted in internal organ injury (including closed head injuries)[27]; an estimated 7,600 (13 percent) resulted in lacerations[28]; an estimated 5,200 (9 percent) resulted in fractures[29]; and the remaining estimated 7,800 (14 percent) resulted in other diagnoses.

Overall, an estimated 33,700 (60 percent) of ED-treated tip-over injuries to children were to the head, neck, or face; and an estimated 10,300 (18 percent) were to the leg, foot, or toe. The injuries to children were more likely to be head injuries when a television was involved than when no television was involved. Of the estimated number of ED-treated injuries to children involving a CSU and a television, 73 percent were head injuries, compared to 55 percent of injuries involving only a CSU. In addition, of the estimated injuries to children involving only a CSU, 20 percent were leg, foot, or toe injuries, and 14 percent were trunk or torso injuries. Data were insufficient to generate estimates of trunk/torso or arm/hand/finger injuries when both a CSU and television tipped over.

[25] These ages are grouped together because data were insufficient to generate estimates for any single age within that range.
[26] Seventy-six percent of these involved only a CSU, and the remainder involved a CSU and television tipping over.
[27] Sixty-one percent of these involved only a CSU, and the remainder involved a CSU and television tipping over.
[28] Eighty-two percent of these involved only a CSU, and the remainder involved a CSU and television tipping over.
[29] Sixty-nine percent of these involved only a CSU, and the remainder involved a CSU and television tipping over.

B. Details Concerning Injuries[30]

To assess the type of injuries that result from CSU tip overs, CPSC staff focused on incidents involving children, because the vast majority of CSU tip-overs involve children. The types of injuries resulting from furniture tipping over onto children include soft tissue injuries, such as cuts and bruises (usually a sign of internal bleeding); skeletal injuries and bone fractures to arms, legs, and ribs; and potentially fatal injuries resulting from skull fractures, closed-head injuries, compressional and mechanical asphyxia, and internal organ crushing leading to hemorrhage. These types of injuries can result from tip overs involving CSUs alone, or CSUs with televisions.

As explained above, head injuries and torso injuries are common in CSU tip-overs involving children. The severity of injuries depends on a variety of factors, but primary determinants include the force generated at the point of impact, the entrapment time, and the body part impacted. The head, neck, and chest are the most vulnerable. The severity of injury can also depend on the orientation of the child's body or body part when it is hit or trapped by the CSU. Sustained application of a force that affects breathing can lead to compressional asphyxia and death. In most CSU tip-over cases, serious injuries and death are a result of blunt force trauma to the head and intense pressure on the chest causing respiratory and circulatory system impairment.

Head injuries are produced by high-impact forces applied over a small area and can have serious clinical consequences, such as concussions and facial nerve damage. Such injuries are often fatal, even in cases where the child is immediately rescued and there is rapid intervention. An incident involving blunt head trauma can result in immediate death or loss of consciousness.

[30] For more details about injuries, see Tab B of the NPR briefing package.

Autopsies from CSU tip-over fatalities to children reported crushing injuries to the skull and regions of the eye and nose. Brain swelling, deep scalp hemorrhaging, traumatic intracranial bleeding, and subdural hematomas were often reported. These types of injuries are typical of crush injuries caused by blunt head trauma and often have a fatal outcome. Children who survive such injuries may suffer neurological deficits, require neurosurgical interventions, and can face lifelong disabilities.

Compressional and mechanical asphyxia is another potential cause of injury and death in CSU tip-over incidents. Asphyxia can be fatal within minutes. In multiple CSU tip-over incidents, there was physical evidence of chest compression visible as linear marks or abrasions across the chest and neck, consistent with the position of the CSU. Compressional and mechanical asphyxia can result from mechanical forces generated by the sheer mass of an unyielding object, such as furniture, acting on the thoracic and abdominal area of the body, which prevents thorax expansion and physically interferes with the coordinated diaphragm and chest muscle movement that normally occurs during breathing. Torso injuries, which include compressional and mechanical asphyxia, are the most common form of injury for non-television CSU fatalities. External pressure on the chest that compromises the ability to breathe by restricting respiratory movement or on the neck can cause oxygen deprivation (hypoxia). Oxygen deprivation to the brain can cause unconsciousness in less than three minutes and may result in permanent brain damage or death when pressure is applied directly on neck by the CSU or a component of the CSU (such as the edge of a drawer). The prognosis for a hypoxic victim depends on the degree of oxygen deprivation, the duration of unconsciousness, and the speed at which cardiovascular resuscitation attempts are initiated relative to the timing of cardiopulmonary arrest. Rapid reversal of the hypoxic state is essential to prevent or limit the development of pulmonary and cerebral edema that can lead to death or other serious consequences. The sooner the CSU (compression force) is removed and resuscitation initiated, the greater the likelihood that the patient will regain consciousness and recover from injuries.

In addition to chest compression, pressure on the neck by a component of the CSU can also result in rapid strangulation due to pressure on the blood vessels in the neck. The blood vessels that take blood to and from the brain are relatively unprotected in the soft tissues of the neck and are vulnerable to external forces. Sustained compression of either the jugular veins or the carotid arteries can lead to death. Petechial hemorrhages of the head, neck, chest, and the periorbital area were reported in autopsy reports of CSU tip-over incidents.

Pediatric thoracic trauma has unique features that differ from adult thoracic trauma, because of differences in size, structure, posture, and muscle tone. While the elasticity of a child's chest wall reduces the likelihood of rib fracture, it also provides less protection from external forces. Impact to the thorax of an infant or small child can produce significant chest wall deflection and transfer large kinetic energy forces to vital thoracic organs such as the lungs and heart, which can cause organ deflection and distention and lead to traumatic asphyxia, respiratory and circulatory system impairment or failure. In addition, a relatively small blood volume loss in a child, due to internal organ injuries and bleeding, can lead to decreased blood circulation and shock.

The severity of the injury or likelihood of death can be reduced if a child is quickly rescued. However, children's ability to self-rescue is limited because of their limited cognitive awareness of hazards, limited skills to react quickly, and limited strength to remove the fallen CSU. Moreover, many injuries can result in immediate death or loss of consciousness, making self-rescue impossible.

C. *Hazard Characteristics*[31]

To identify hazard patterns associated with CSU tip overs, CPSC focused on incidents involving children and CSUs without televisions because the majority of fatal and nonfatal incidents involve children and, in recent years, there has been a statistically significant decrease in the overall number of ED-treated CSU tip-over incidents that appears to be driven by a decline in incidents involving CSUs with televisions, while the rate of ED-treated incidents involving CSUs without televisions has remained stable. Staff used NEISS and CPSRMS reports to identify hazard patterns, including In-Depth-Investigation (IDI) reports, and also considered child development and capabilities, as well as online videos of real-life child interactions with CSUs and similar furniture items (including videos of tip-over incidents).

1. *Filled Drawers*

Of the 89 fatal CPSRMS incidents involving children and only CSUs, 53 (59 percent) provided information about whether the CSU drawers contained items at the time of the tip over. Of those 53 incidents, 51 (96 percent) involved partially filled or full drawers. Of the 263 nonfatal CPSRMS tip overs involving children and only CSUs, drawer fill level was reported for 67 incidents (25 percent). Of these 67 incidents, 60 (90 percent) involved partially filled or full drawers.[32] CPSRMS incidents show that most items in the drawers were clothing, although a few mentioned other items along with clothing (*e.g.*, diaper bag, toys, papers).

2. *Interactions*

Of the 89 fatal CPSRMS tip overs involving children and only a CSU, 47 reported the type of interaction the child had with the CSU at the time of the incident. Of these 47 incidents, 35 (74 percent) involved a child climbing on the CSU; 8 (17 percent) involved a child sitting,

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[31] For additional information about hazard patterns, see Tab C of the NPR briefing package.
[32] Nonfatal NEISS incident reports did not contain information on drawer fill level or contents.

laying, or standing in a drawer; and 4 (9 percent) involved a child opening drawers. Climbing was the most common reported interaction for children 3 years old and younger.

Of the 263 nonfatal CPSRMS tip-over incidents involving children and only CSUs, the type of interaction was reported in 160 incidents. Of these, 101 (63 percent) involved opening drawers; 32 (20 percent) involved climbing on the CSU; 10 (6 percent) involved putting items in/taking them out of a drawer; 9 (6 percent) involved pulling on the CSU; 5 (3 percent) involved leaning or pushing down on an open drawer; 2 (1 percent) involved another interaction; and 1 (less than 1 percent) involved a child in the drawer. Opening drawers was the most common reported interaction for children 6 years old and younger, and was particularly common for 2- and 3-year-olds.

Of the 1,463 nonfatal NEISS incidents involving children and only CSUs, the type of interaction was reported in 559 incidents. Of these, the child was injured because of another person's interaction with the CSU in 22 incidents; the remaining 537 incidents involved the child interacting with the CSU. Of these 537 incidents, 412 (77 percent) involved climbing on the CSU; 42 (8 percent) involved opening drawers; and the remaining 83 incidents (15 percent) involved a child in the drawer, pulling on the CSU, putting items in or taking items out of a drawer, reaching, hitting, jumping, a child on top of the CSU, playing in a drawer, pulling up, swinging, or other interaction. For children 3 years old or younger, climbing constituted almost 80 percent of reported interactions. Overall, 81 percent (438 of 537) of the reported interactions in the nonfatal NEISS tip-over incidents involving children and only CSUs are those in which the child's weight was supported by the CSU (*e.g.*, climbing, in drawer, jump, on top, swinging), and 12 percent (64 of 537) were interactions in which the child's strength determines the force (*e.g.,* hit, opening drawers, pulled on, pulled up).

Thus, in fatal incidents, a child climbing on the CSU was, by far, the most common reported interaction; and in nonfatal incidents, opening drawers and climbing were the most common reported interactions. These interactions are examined further, below.

To learn more about children's interactions with CSUs during tip-over incidents, CPSC staff also reviewed videos, available from news sources, articles, and online, that involved children interacting with CSUs and similar products, and CSU tip overs. Videos of children climbing on CSUs and similar items show a variety of climbing techniques, including stepping on the top of the drawer face, stepping on drawer knobs, using the area between drawers as a foothold, gripping the top of an upper drawer with their hands, pushing up using the top of a drawer, and using items to help climb. Videos of children in drawers of CSUs and other similar products include children leaning forward and backward out of a drawer; sitting, lying, and standing in a drawer; and bouncing in a drawer. Some videos also show multiple children climbing a CSU or in a drawer simultaneously.

a. Climbing

As discussed above, climbing on the CSU was one of the primary interactions involved in CSU tip overs involving children and only a CSU. It was the most common reported interaction (74 percent) in fatal CPSRMS incidents; it was the most common reported interaction (77 percent) in nonfatal NEISS incidents; and it was the second most common reported interaction (20 percent) in nonfatal CPSRMS incidents.

Children as young as 9 months, and up to 13 years old were involved in climbing incidents. Fatal climbing incidents most often involved 1-, 2-, and 3-year-old children, and nonfatal climbing incidents most often involved 2- and 3-year-old children. Of climbing incidents with a reported age, the children were 3 years old or younger in 94 percent (33 of 35) of the fatal CPSRMS incidents; 73 percent (301 of 412) of the nonfatal NEISS incidents; and 63 percent (17 of 27) of the nonfatal CPSRMS incidents.

The prevalence of children climbing during CSU tip overs is consistent with the expected motor development of children. Between approximately 1 and 2 years old, children can climb on and off of furniture without assistance, use climbers, and begin to use playground apparatuses independently; and 2-year-olds commonly climb. The University of Michigan Transportation Research Institute (UMTRI) focus groups on child climbing (the UMTRI study is described in section **VII.B. Forces and Moments During Child Interactions with CSUs** of this preamble) demonstrated these abilities, with child participants showing interest in climbing CSUs and other furniture.

b. Opening Drawers

As discussed above, opening the drawers of a CSU was a common interaction in CSU tip overs involving children and only a CSU. It was the most common reported interaction (63 percent) in nonfatal CPSRMS incidents; it was the second most common reported interaction (8 percent) in nonfatal NEISS incidents; and it was the third most common reported interaction (9 percent) in fatal CPSRMS incidents.

Children as young as 11 months, and up to 14 years old were involved in incidents where the child was opening one or more drawers of the CSU. In nonfatal CPSRMS incidents, opening drawer incidents most commonly involved 2-year-olds; in nonfatal NEISS incidents, opening drawer incidents most commonly involved 3-year-olds, followed by 2-year-olds, followed by 4-year-olds, followed by children under 2 years old; and in nonfatal CPSRMS incidents, opening drawer incidents most commonly involved 3-year-olds, followed by 2-year-olds. Children of all ages were able to open at least one drawer.

Looking at both fatal and nonfatal CPSRMS tip overs involving children and only CSUs, where the interaction involved opening drawers, overall, about 53 percent involved children opening one drawer, 10 percent involved opening two drawers, and almost 17 percent involved opening “multiple” drawers. In several incidents (23 CPSRMS incidents), children opened “all” of the drawers; it is possible that additional incidents, mentioning a specific number of open drawers (between 2 and 8), also involved all of the drawers being opened. In incidents where all of the drawers were open, the CSUs ranged from 2-drawer to 8-drawer units. The youngest child reported to have opened all drawers was 13 months old.

Consistent with these incident data, the UMTRI child climbing study found that caregivers commonly reported that their children opened and closed drawers when interacting with furniture.

It is possible for CSUs to tip over from the forces generated by open drawers and their contents, alone, without additional interaction forces. However, pulling on a drawer to open it can apply increased force that contributes to instability. Once a drawer is fully opened, any additional pulling is on the CSU as a whole. The pull force, and the height of the drawer pull location, relative to the floor, are relevant considerations. To examine this factor, staff assessed 15 child incidents in which the height of the force application could be calculated based on descriptions of the incidents. Force application heights ranged from less than one foot to almost four feet (46.5 inches), and children pulled on the lowest, highest, and drawers in between.

c. Opening Drawers and Climbing Simultaneously

CPSC staff also examined incidents in which both climbing and open drawers occurred simultaneously. Of the 35 fatal CPSRMS climbing incidents, 13 reported the number of drawers open; in all of these incidents, the reported number of drawers open was one, although, based on further analysis, the number of open drawers could be as high as 8 in one incident.[33] Of the 32 nonfatal CPSRMS climbing incidents, 15 gave some indication of the number of open drawers. Of these, 7 reported that one drawer was open, 2 reported that half or less of the drawers were open, 4 reported that multiple drawers were open, and 2 reported that all of the drawers were open. In the 2 cases where all drawers were open, the children were 3 and 4 years old. Of the 412 climbing incidents in the nonfatal NEISS data, 28 gave some indication of the number of open drawers. Of these, 11 reported that one drawer was open, 12 reported that multiple drawers were open, 1 reported that two drawers were open, and 2 reported that all drawers were open. These data are consistent with the videos staff reviewed, which show a range of drawer positions when children climbed on units, including all drawers closed, one drawer open, multiple drawers open, and all drawers fully open.

There is limited information in the incident data about children's interaction with doors on CSUs, as opposed to interactions with drawers. Staff found two fatal CPSRMS and four nonfatal CPSRMS tip-over incidents involving wardrobes and armoires, which include doors. In one of the fatal incidents, the victim was found inside a wardrobe that had two doors and one drawer, suggesting that the child opened the doors of the wardrobe. In the other fatal incident, the victim was found under a two-door wardrobe. In most of the nonfatal incidents involving wardrobes or armoires, children were reportedly interacting with items inside the unit, which would require them to open the doors. The ages of the children in these incidents ranged from 3 to 11 years, although opening doors is easily within the physical and cognitive abilities of younger children.

[33] CPSC staff analysis suggests that 7 or more drawers of an 8-drawer unit were open and the child was in a drawer leaning out over the edge in a fatal incident. This analysis is described in Tab M of the NPR briefing package, as Model E.

These incidents indicate that children can and do open CSU doors. There is no direct evidence in the incident data that, once CSU doors are open, children put their body weight on the open doors (*i.e.*, open and climbing). However, this is a plausible interaction based on child capabilities, provided that the child has a sufficient hand hold.

d. Differences in Interactions by Age

Based on the incident data, children 3 years old and younger climb, open drawers without climbing, get items in and out of drawers, lean on open drawers, push down on open drawers, sit or lay in bottom drawers, or stand on open bottom drawers. Among fatal CPSRMS tip-over incidents involving children and only CSUs, climbing was the most common interaction for children 3 years old and younger; this drops off sharply for 4-year-olds. Starting at 4 years old, children do not appear to sit or lie in bottom drawers of a CSU. Among nonfatal CPSRMS tip-over incidents involving children and only CSUs, opening drawers was, by far, the most common interaction for children 7 years old and younger; and climbing was also common among 3-year-olds and, to a lesser extent, among 2- and 4-year-olds. Among nonfatal NEISS tip overs involving children and only CSUs, climbing was common for 2- and 3-year-olds, slightly less common for 4-year-olds and children under 2 years, and dropped off further for children 5 years and older.

3. Flooring

Of the 89 fatal CPSRMS tip overs involving children and only CSUs, the type of flooring under the CSU was reported for 55 incidents. Of these, 45 (82 percent) involved carpeting, which includes rugs; 8 (15 percent) involved wood, hardwood, or laminate wood flooring; and 2 (4 percent) involved tile or linoleum flooring. The reports for 30 of the of the fatal CPSRMS tip-over incidents involving carpet included photos with visible carpet. All carpet in these pictures appeared to be typical wall-to-wall carpeting. Four appear to be a looped pile carpet, and 26 appeared to be cut pile. Staff also identified two incidents with reported “shag” carpeting, including one fatal incident. Staff found one report mentioning a rug, although the thickness of the rug is unknown.

Of the 263 nonfatal CPSRMS tip overs involving children and only CSUs, the type of flooring under the CSU was reported for 60 incidents. Of these, 48 (80 percent) involved carpeting, which includes rugs; 10 (17 percent) involved wood, hardwood, or laminate wood flooring; 1 (2 percent) involved tile or linoleum flooring; and 1 (2 percent) indicated that the front legs of the CSU were on carpet while the back legs were on wood flooring.[34]

Thus, for incidents where flooring type was reported, carpet was, by far, the most prevalent flooring type.

4. Characteristics of Children in Tip-Over Incidents

a. Age of Children

Children in fatal CPSRMS tip-over incidents involving only CSUs were 11 months through 7 years old. A total of 33 fatal incidents involved children under 2 years old; 30 involved 2-year-old children; 21 involved 3-year-olds; 2 involved 4-year-olds; and 1 incident each involved 5-, 6-, and 7-year-old children. Among the nonfatal CPSRMS tip-over incidents involving children and only CSUs where age was reported, 3-year-olds were involved in the highest number of incidents (59 incidents), followed by 2-year-olds (47 incidents).

Nonfatal NEISS tip-over incidents involving children and only CSUs follow a similar distribution, with the highest number of reported incidents involving 2-year-olds, followed by 3-

[34] Flooring type was not reported in nonfatal NEISS incident reports.

year-olds, and children less than 2 years. Further details regarding the age of children involved in CSU tip overs is available in the discussion of incident data, above.

b. Weight of Children

Among the 89 fatal CPSRMS tip-over incidents involving children and CSUs without televisions, the child's weight was reported in 49 incidents and ranged from 18 pounds to 45 pounds. Where weight was not reported, staff used the most recent Centers for Disease Control and Prevention (CDC) Anthropometric Reference to estimate the weight of the children.[35] Staff used the 50th percentile values of weight that correspond to the victims' ages to estimate the weight range of the children. For the remaining 40 fatal CPSRMS incidents without a reported weight, the estimated weight range was 19.6 pounds to 45.1 pounds.

Among the 263 nonfatal CPSRMS incidents involving children and only CSUs, the weights of 47 children were reported, ranging from 26 pounds to 80 pounds. Where it was not reported, staff again estimated the weight of the children using the 50th percentile values of weight that correspond to the victims' ages from the most recent CDC Anthropometric Reference. The estimated child weights for the 164 nonfatal CPSRMS incidents without a reported child weight, but with a reported age (which included a 17-year-old), ranged from 19.6 pounds to 158.9 pounds.

Although nonfatal NEISS incident data did not include the children's weights, staff again estimated the children's weights by age, determining that for tip overs involving only CSUs, the

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[35] Fryar CD, Carroll MD, Gu Q, Afful J, Ogden CL (2021). Anthropometric reference data for children and adults: United States, 2015–2018. National Center for Health Statistics. Vital Health Stat 3(46). The CDC Anthropometric Reference is based on a nationally representative sample of the U.S. population, and the 2021 version is based on data collected from 2015 through 2018. CPSC staff uses the CDC Anthropometric Reference, rather than the CDC Growth Chart, because it is more recently collected data and because the data are aggregated by year of age, allowing for estimates by year. CDC growth charts are available at: https://www.cdc.gov/growthcharts/clinical_charts.htm.

estimated weights of the children ranged from 15.8 pounds to 158.9 pounds (this covered children from 3 months to 17 years old). The weighted average of children's estimated weight in nonfatal NEISS incidents was 40.26 pounds.[36]

Overall, the weighted average of children's reported weight for CPSRMS incidents is 34.23 pounds; whereas, the weighted average of children's estimated weight was 38.8 pounds.

The weight of a child is particularly relevant for climbing incidents because weight is a factor in determining the force a child generates when climbing. For this reason, CPSC staff looked at the weights of children involved in climbing incidents, specifically. Of the 35 fatal CPSRMS child climbing incidents, the weight of the child was reported for 23 incidents, and ranged from 21.5 to 45 pounds. For the remaining 12 climbing incidents in which the child's weight was not reported, CPSC staff estimated their weights, based on age, and the weights ranged from 23.8 to 39 pounds. Of the 32 nonfatal CPSRMS child climbing incidents, the weight of the child was reported in 8 incidents, and ranged from 26 to 80 pounds. For the remaining 24 incidents, staff estimated the weights based on age, and the weights ranged from 25.2 to 45.1 pounds. Weight was not reported in the nonfatal NEISS data, however, using the ages of the children in the 412 nonfatal NEISS child climbing incidents (9 months to 13 years old), staff estimates that their weights ranged from 19.6 to 122 pounds, and the weighted average was 34.2 pounds.

5. Televisions

Of the 104 child fatalities involving a CSU and television tipping over, 85 (90 percent) involved a box or cathode ray tube (CRT) television, 2 involved a flat-panel television, and 16 did not provide information about the television. Of the incidents that provided information

[36] Weighted average is equal to the sum of the product of the number of reported incidents for that age times the estimated weight for that age divided by the total number of reported incidents.

about television size, the most common television size was 27 inches. The approximate weight range of the CRT televisions, when provided, was between 70 pounds and 150 pounds.

Although televisions are involved in CSU tip overs, and the Commission raised the possibility of addressing televisions in the ANPR, the proposed rule does not focus on television involvement. This is primarily because, in recent years, there has been a decline in the overall number of CSU tip-over incidents that appears to be driven by a decrease in tip overs involving televisions, while the rate of ED-treated incidents involving CSUs without televisions has remained stable.

V. Relevant Existing Standards[37]

In the United States, the primary voluntary standard that addresses CSU stability is ASTM F2057-19, *Standard Consumer Safety Specification for Clothing Storage Units*. In addition, CPSC staff identified three international consumer safety standards and one domestic standard that are relevant to CSUs:

- AS/NZS 4935: 2009, the Australian/New Zealand Standard for *Domestic furniture – Freestanding chests of drawers, wardrobes and bookshelves/bookcases – determination of stability*;
- ISO 7171 (2019), the International Organization for Standardization *International Standard for Furniture – Storage Units – Determination of stability*;
- EN14749 (2016), the European Standard, *European Standard for Domestic and kitchen storage units and worktops – Safety requirements and test methods*; and
- ANSI/SOHO S6.5-2008 (R2013), *Small Office/Home Office Furniture – Tests American National Standard for Office Furnishings*.

[37] For additional information about relevant existing standards, see Tab C, Tab D, Tab F, and Tab N of the NPR briefing package.

This section describes these standards and provides CPSC staff's assessment of their adequacy to address CSU tip-over injuries and deaths.

A. ASTM F2057-19

ASTM first approved and published ASTM F2057 in 2000, and has since revised the standard seven times. The current version, ASTM F2057-19, was approved on August 1, 2019, and published in August 2019. ASTM Subcommittee F15.42, Furniture Safety, is responsible for this standard. Since the first publication of ASTM F2057, CPSC staff has participated in the F15.42 subcommittee and task group meetings and worked with ASTM to improve the standards; however, ASTM has not addressed several issues CPSC has identified.

1. Scope

ASTM F2057-19 is intended to reduce child injuries and deaths from hazards associated with CSUs tipping over and aims "to cover children up to and including age five." The standard covers CSUs that are 27 inches or more in height, freestanding, and defines CSUs as: "furniture item[s] with drawers and/or hinged doors intended for the storage of clothing typical with bedroom furniture." Examples of CSUs provided in the standard include: chests, chests of drawers, drawer chests, armoires, chifforobes, bureaus, door chests, and dressers. The standard does not cover "shelving units, such as bookcases or entertainment furniture, office furniture, dining room furniture, underbed drawer storage units, occasional/accent furniture not intended for bedroom use, laundry storage/sorting units, nightstands, or built-in units intended to be permanently attached to the building, nor does it cover 'Clothing Storage Chests' as defined in Consumer Safety Specification F2598."

2. *Stability Requirements*

ASTM F2057-19 includes two performance requirements for stability. The first is in section 7.1 of the standard, *Stability of Unloaded Unit*. This test consists of placing an empty CSU on a hard, level, flat surface, opening all doors (if any) to 90 degrees, and extending all drawers and pull-out shelves to the outstop (which is a feature that limits outward motion of drawers or pull-out shelves). In the absence of an outstop, all drawers and pull-out shelves are opened to two-thirds of the operational sliding length (which is the length from the inside face of the drawer back to the inside face of the drawer). All flaps and drop fronts are opened to their horizontal position or as near to horizontal as possible. If the CSU tips over in this configuration, or is supported by any component that was not specifically designed for that purpose, it does not meet the requirement.

The second stability requirement is in section 7.2 of the standard, *Stability with Load*. This test consists of placing an empty CSU on a hard, level, flat surface, and gradually applying a 50±2-pound test weight. The 50-pound test weight is intended to represent the weight of a 5-year-old child. For units with drawers, the test requires opening one drawer to the outstop, or in the absence of an outstop, to two-thirds of its operational sliding length, and gradually applying the test weight to the front face of the drawer. For units with doors, the test requires opening one door to 90 degrees and gradually applying the test weight. All other drawers and doors remain closed, unless they must be opened to access other components behind them (*e.g.*, a drawer behind a door). Each drawer and door is tested individually. If the CSU tips over in this configuration, or is supported by any component that was not specifically designed for that purpose, it does not meet this requirement.

3. Tip Restraint Requirements

ASTM F2057-19 requires CSUs to include a tip restraint that complies with ASTM F3096-14, *Standard Performance Specification for Tipover Restraint(s) Used with Clothing Storage Unit(s)*.[38] ASTM F2057-19 and F3096-14 define a tip restraint as a "supplemental device that aids in the prevention of tip over." ASTM F3096-14 provides a test protocol to assess the strength of tip restraints, but does not evaluate the attachment to the wall or CSU. The test method specifies that the tester attach the tip restraint to a fixed structure and apply a 50-pound static load.

4. Labeling Requirements

ASTM F2057-19 requires CSUs to be permanently marked in a conspicuous location with warnings that meet specified content and formatting. The warning statements address the risk of children dying from furniture tip overs; not allowing children to stand, climb, or hang on CSUs; not opening more than one drawer at a time; placing the heaviest items in the bottom drawer; and installing tip restraints. For CSUs that are not intended to hold a television, this is also addressed in the warning. Additionally, units with interlock systems must include a warning not to defeat or remove the interlock system. An interlock system is a device that prevents simultaneous opening of more drawers than intended by the manufacturer (like is common on file cabinets). The standard requires that labels be formatted in accordance with ANSI Z535.4, *American National Standard for Product Safety Signs and Labels*.

The standard also includes a performance requirement and test method for label permanence, which are consistent with requirements in other ASTM juvenile furniture product

[38] Approved Oct. 1, 2014 and published October 2014.

standards. The warning must be "in a conspicuous location when in use" and the back of the unit is not considered conspicuous; the standard does not define "conspicuous location when in use."

5. Assessment of Adequacy

CPSC does not consider the stability requirements in ASTM F2057-19 adequate to address the CSU tip-over hazard because they do not account for multiple open and filled drawers, carpeted flooring, and dynamic forces generated by children's interactions with the CSU, such as climbing or pulling on the top drawer. As discussed earlier in this preamble, these factors are commonly involved in CSU tip-over incidents; and, as discussed later in this preamble, testing indicates that these factors decrease the stability of CSUs.

Although ASTM F2057-19 includes a test with all drawers/doors open, the unit is empty and no additional force is applied during this test. Consumers are likely to fill drawers with clothing, since that is the intended purpose of the product, and a CSU with filled drawers is likely to be less stable than an empty unit when more than half of the drawers are open. In addition, although ASTM F2057-19 includes a static weight applied to the top of one open drawer or door (intended to represent a 5-year-old child), this 50-pound weight does not include the additional moment[39] due to the center of gravity of a child climbing, dynamic forces, and horizontal forces when a child climbs, even when only considering the forces generated by very young children. As the UMTRI study described in this preamble found, the forces children can exert while climbing a CSU exceed their static weights. Finally, the testing does not account for the effect of carpeting, which is common flooring in homes (particularly in bedrooms), is commonly present in tip-over incidents, and decreases CSU stability. Thus, by testing CSUs with

[39] Moment, or torque, is an engineering term to describe rotational force acting about a pivot point, or fulcrum.

open drawers empty, a 50-pound static weight, and on a hard, level, flat surface, ASTM F2057-19 does not reflect real-world use conditions that decrease the stability of CSUs.

Staff also looked at whether CSUs involved in tip-over incidents complied with ASTM F2057-19 because it would give an indication of whether F2057 is effective at preventing tip overs and, by extension, whether it is adequate. Of the 89 fatal CPSRMS tip-over incidents involving children and only CSUs, CPSC staff determined that 1 of the CSUs complied with the ASTM F2057-19 stability requirements, 1 CSU met the stability requirements when a test weight at the lower permissible weight range was used, and 11 units did not meet the stability requirements. For the remaining 76 units, staff was unable to determine whether they met the ASTM F2057-19 stability requirements, although staff did determine that an exemplar of one of these CSUs complied with the requirements. Of 263 nonfatal CPSRMS incidents involving children and CSUs without televisions for which staff assessed the compliance of the CSU, staff determined that 20 met the ASTM F2057-19 stability requirements, and 95 did not. For the remaining 148 units, staff was unable to determine whether the units met the ASTM F2057-19 stability requirements.[40]

Based on a limited review of the tip restraint requirements in ASTM F2057-19 and ASTM F3096-14, CPSC is concerned that these requirements may not be adequate either. ASTM F3096-14 does not address the whole tip-restraint system, which includes the connection to the CSU and the connection to the wall. The standard assumes an ideal connection to both the furniture and the wall, but incidents suggest that both of these are potential points of failure. In addition, ASTM F3096-14 uses a 50-pound static force. Based on the UMTRI study, this force may not represent the force on a tip restraint from child interactions, especially for interactions

[40] Staff did not assess whether NEISS incidents involved ASTM-compliant CSUs, because the reports do not contain specific information about the products.

that can generate large amounts of force, including from older children. For example, the UMTRI study found that when a child bounced, leaned, or yanked on a CSU, the forces generated were equivalent to 2.7, 2.7, and 3.9 times the child's body weight, respectively, at a distance of 1 foot from the fulcrum. However, staff did not evaluate the tip restraint requirements in ASTM F2057-19 and ASTM F3096-14 because, as discussed in this preamble, several research studies show that a large number of consumers do not anchor furniture, including CSUs, and there are several barriers to the use of tip restraints. As such, even if tip restraint requirements were effective, CSUs should be inherently stable to account for the lack of consumer use of tip restraints and additional barriers to proper installation and use of tip restraints.

CPSC also has some concerns with the effectiveness of the content in the warning labels required in ASTM F2057-19. For example, the meaning of "tipover restraint" may not be clear to consumers, and directing consumers not to open more than one drawer at a time is not consistent with consumer use. In addition, focus group testing discussed in this preamble indicated that consumers had trouble understanding the child climbing symbol required by the standard. CPSC staff also believes that greater clarity about the required placement of the label would make the warning more effective.

6. Compliance with ASTM F2057

CPSC staff assessed compliance with the stability requirements in ASTM F2057-19. In 2016,[41] staff tested 61 CSU samples and found that 50 percent (31 of 61) did not comply with

[41] Although this testing involved ASTM F2057-14, the stability requirements were the same as in ASTM F2057-19. The test results are available at: https://www.cpsc.gov/s3fs-public/2016-Tipover-Briefing-Package-Test-Results-Update-August-16-2017.pdf?yMCHvzY_YtOZmBAAj0GJih1lXE7vvu9K.

the stability requirements in ASTM F2057.[42] In 2018, CPSC staff assessed a total of 188 CSUs, including 167 CSUs selected from among the best sellers from major retailers, using a random number generator; 4 CSU models that were involved in incidents;[43] and 17 units assessed as part of previous test data provided to CPSC.[44] Of the 188 CSUs, 171 (91 percent) complied with the stability requirements in ASTM F2057. One CSU (0.5 percent) did not comply with the Stability of Unloaded Unit test, and 17 (9 percent) did not meet the Stability with Load test. The unit that did not meet the requirements of the Stability of Unloaded Unit test also did not meet the requirements of Stability with Load test.

In addition, as part of staff's incident recreation and modeling (discussed in section **VII.D. Incident Recreation and Modeling** of this preamble), staff determined that two of the seven tested CSU models that had been involved in tip-over incidents complied with the stability requirements in ASTM F2057, and one additional CSU was borderline on whether it complied with the standard. This suggests that the stability requirements in ASTM F2057-19 do not adequately reduce the risk of tip overs.

B. AS/NZS 4935: 2009

AS/NZS 4935 is a voluntary standard prepared by Standards Australia's and Standards New Zealand's Joint Technical Committee CS-088/CS-091, Commercial/Domestic Furniture. There is only one version of the standard, the current version AS/NZA 4935:2009, which was approved on behalf of the Council of Standards Australia on August 28, 2009, and on behalf of

[42] This testing also found that 91 percent of CSUs (56 of 61) did not comply with the labeling requirements in ASTM F2057-14, and 43 percent (26 of 61) did not comply with the tip restraint requirements.
[43] Staff tested exemplar units, meaning the model of CSU involved in the incident, but not the actual unit involved in the incident.
[44] The CSUs were identified from the Consumer Reports study "Furniture Tip-Overs: A Hidden Hazard in Your Home" (Mar. 22, 2018), available at: https://www.consumerreports.org/furniture/furniture-tip-overs-hidden-hazard-in-your-home/.

the Council of Standards New Zealand on October 23, 2009. It was published on November 17, 2009.

1. Scope

AS/NZS 4935 aims to address furniture tip-over hazards to children. It describes test methods for determining the stability of domestic freestanding chests of drawers over 500 mm (19.7 inch) high, freestanding wardrobes over 500 mm high (19.7 inch), and freestanding bookshelves/bookcases over 600 mm (23.6 inch) high. It defines "chest of drawers" as containing one or more drawers or other extendible elements and intended for the storage of clothing, and may have one or more doors or shelves. It defines "wardrobe" as a furniture item primarily intended for hanging clothing that may also have one or more drawers, doors or other extendible elements, or fixed shelves. It defines bookshelves and bookcases as sets of shelves primarily intended for storing books, and may contain doors, drawers or other extendible elements.

2. Stability Requirements

Similar to ASTM F2057-19, AS/NZS 4935 includes two stability requirements. The first requires the unit, when empty, to not tip over when a 29-kilogram (64-pound) test weight is applied to a single open drawer. The 64-pound test weight is based on the 95th percentile body mass of a 5 year 11-month-old child (which is 27 kilograms or 59.5 pounds), adjusted to reflect trends of increasing body mass. The test weight is applied to the top face of a drawer, with the drawer opened to two-thirds of its full extension length. The second test requires the unit not to tip over when all of the extension elements are open and the unit is empty. Each drawer or extendible elements is open to two-thirds of its extension length, and doors are open perpendicular to the furniture. Units do not pass the stability requirements if they cannot support the test weight, if they tip over, or if they are only prevented from tipping by an extendible element.

3. Tip Restraint Requirements

The standard does not require, but recommends, that tip restraints be included with units, along with attachment instructions.

4. Labeling Requirements

The standard requires a warning label, and provides example text that addresses the tip-over hazard. The standard also requires a warning tag with specific text and formatting. The label and tag include statements informing consumers about the hazard, warning of tip overs and resulting injuries, and indicating how to avoid the hazard. These requirements do not address the use of televisions. The standard includes label permanency requirements and mandates that the warning label be placed “inside of a top drawer within clear view when the drawer is empty and partially opened, or on the inside face of a drawer” for chests of drawers and wardrobes.

5. Assessment of Adequacy

CPSC does not consider the stability requirements in AS/NZS 4935 adequate to address the CSU tip-over hazard because they do not account for multiple open and filled drawers, carpeted flooring, and dynamic forces generated by children’s interactions with the CSU, such as climbing or pulling on the top drawer. As discussed in this preamble, these factors are commonly involved in CSU tip-over incidents and testing indicates that they decrease the stability of CSUs.

AS/NZS 4935 requires drawer extension to only two-thirds of extension length for both stability tests. This partial extension does not represent real-world use because children are able to open drawers fully, incidents involve fully open drawers, and opening a drawer further decreases the stability of a CSU. In addition, it does not account for filled drawers, which are expected during real-world use, are common in tip-over incidents, and contribute to instability when multiple drawers are open. It also does not account for carpeted floors, which are common in incidents and contribute to instability. Although AS/NZS 4935 uses a heavier test weight than ASTM F2057-19, it is inadequate because neither stability test accounts for the moments children can exert on CSUs during interactions, such as climbing. Considering additional moments, the 64 pounds of weight on the drawer face is equivalent to a 40-pound child climbing the extended drawer. A 40-pound weight corresponds to a 75th percentile 3-year-old child, 50th percentile 4-year-old child, and 25th percentile 5-year-old child.[45]

C. ISO 7171 (2019)

The International Organization for Standardization (ISO) developed the voluntary standard ISO 7171 through the Technical Committee ISO/TC 136, *Furniture* and published the first version in May 1988. The current 2019 version was published in February 2019.

1. Scope

ISO 7171 (2019) describes methods for determining the stability of freestanding storage furniture, including bookcases, wardrobes, and cabinets, but the standard does not define these terms.

2. Stability Requirements

ISO 7171 (2019) includes three stability tests, all of which occur on a level test surface. The first uses a weight/load on an open drawer. The second involves all drawers being filled and a load/weight placed on a single open drawer. In the loaded test, one drawer is opened to the outstop, and if no outstops exist, the drawer is opened to two-thirds of its full extension length. The test weight is applied to the top face of the opened drawer, and varies depending on the

[45] Fryar CD, Carroll MD, Gu Q, Afful J, Ogden CL. (2021). Anthropometric reference data for children and adults: United States, 2015–2018. National Center for Health Statistics. Vital Health Stat 3(46).

height of the unit (either 200 N (44 pounds) or 250 N (55 pounds)). The fill weight is also variable, depending on the clearance height and volume of the drawer (fill density ranges from 6.25 lb/ft^3 to 12.5 lb/ft^3). The third test is an unloaded test with all drawers open. For this test, drawers and extendible elements are open to the outstop and doors are open 90 degrees. If there are no outstops, then the extension elements are open to two-thirds of their extension length. Existing interlock systems are not bypassed for this test.

ISO 7171 (2019) does not include criteria for determining whether a unit passed or failed the loaded stability test. However, it includes a table of "suggested" forces, depending on the height of the unit.

An additional unfilled, closed drawer test is required for units greater than 1000 mm in height, where a vertical force of 350 N (77 pounds) along with a simultaneous 50 N (11 pounds) outward horizontal force is applied to the top surface of the unit.

3. Tip Restraint Requirements

ISO 7171 (2019) does not require tip restraints to be provided with units, but does specify a test method for them. The tip restraints are installed in both the wall and unit during the test and a 300 N (67.4 lbf) horizontal force is applied in the direction most likely to overturn the unit. The force is maintained between 10 and 15 seconds.

4. Labeling Requirements

The standard does not have any requirements or test methods related to warning labels.

5. Assessment of Adequacy

CPSC does not consider the stability requirements in ISO 7171 (2019) adequate to address the CSU tip-over hazard because they do not account for carpeted flooring, or dynamic and horizontal forces generated by children's interactions with the CSU, such as climbing or pulling on the top drawer. In addition, although ISO 7171 (2019) includes a stability test with filled drawers, the multiple open drawer test does not include filled drawers, and the simultaneous conditions of multiple open and filled drawers during a child interaction are not tested. As discussed in this preamble, these factors are commonly involved in CSU tip-over incidents and testing indicates that they decrease the stability of CSUs. Finally, test weights are provided only as recommendations and there are no criteria for determining whether a unit passes.

D. EN 14749: 2016

EN 14749: 2016 is a European Standard that was prepared by Technical Committee CEN/TC 207 "Furniture." This standard was approved by the European Committee for Standardization (CEN) on November 21, 2015, and supersedes EN 14749:2005, which was approved on July 8, 2005, as the original version. EN 14749:2016 is a mandatory standard and applies to all CEN members.

1. Scope

EN 14749: 2016 describes methods for determining the stability of domestic and non-domestic furniture with a height ≥ 600 mm (23.6 in) and a potential energy, based on mass and height, exceeding 60 N-m (44.25 ft-lbs). Kitchen worktops and television furniture are the only furniture types defined. The test methods in this standard are taken from EN 16122: 2012, *Domestic and non-domestic storage furniture-test methods for the determination of strength, durability and stability*, which covers "all types of domestic and non-domestic storage furniture including domestic kitchen furniture."

2. Stability Requirements

EN 14749: 2016 includes three stability tests, which are conducted with the units freestanding. In the first loaded test, a 75 N (16.9 lbf) test weight is applied to the top of the drawer face, when pulled to the outstop. However, if no outstops exist, the extension element is open to two-thirds of its full extension length. In the second test, all drawers and extendible elements are open to the outstop and doors are open 90 degrees. If no outstops are present, then the extension elements are open to two-thirds of their extension lengths. Existing interlock systems are not bypassed for this test. The third test involves filled drawers and a load; all storage areas are filled with weight and the loaded test procedure (above) is carried out but with a test weight that is 20 percent of the mass of the unit, including the drawer fill, not exceeding 300 N (67.4 pounds). Similar to ISO 7171, an additional unfilled, closed drawer test is required for units greater than 1000 mm in height, where a vertical force of 350 N (77 pounds) along with a simultaneous 50 N (11 pounds) outward horizontal force are applied to the top surface of the unit.

Relevant to the portions of stability testing that involve opening drawers, the standard also accounts for interlock systems, requiring one extension element to be open to its outstop, or in the absence of an outstop, two-thirds of its operational sliding length, and a 100 N (22 lbf) horizontal force to be applied to the face of all other extension elements. This is repeated 10 times on each extension element and all combinations of extension elements are tested.

3. Tip Restraint Requirements

EN 14749: 2016 does not include any requirements regarding tip restraints.

4. Labeling Requirements

EN 14749: 2016 does not include any requirements regarding warning labels.

5. Assessment of Adequacy

CPSC does not consider the stability requirements in EN 14749: 2016 adequate to address the CSU tip-over hazard because they do not account for carpeted flooring, or dynamic and horizontal forces generated by children's interactions with the CSU, such as climbing or pulling on the top drawer. In addition, although the standard includes a stability test with filled drawers, the multiple open drawer test does not include filled drawers, and the simultaneous conditions of multiple open and filled drawers during a child interaction are not tested. Moreover, the fill weight ranges from 6.25 lb/ft^3 to 12.5 lb/ft^3, which includes fill weights lower than staff identified for drawers filled with clothing (discussed in section **VII.A. Multiple Open and Filled Drawers** of this preamble). As discussed in this preamble, these factors are commonly involved in CSU tip-over incidents and testing indicates that they effect the stability of CSUs.

E. ANSI/BIFMA SOHO S6.5-2008 (R2013)

ANSI/SOHO S6.5 does not address CSUs, but rather, applies to office furniture, such as file cabinets. However, CPSC considered this standard because it addresses interlock systems, which some CSUs include and are relevant to stability testing. This standard was completed by BIFMA Engineering Committee and its subcommittee on Small Office/Home Office Products in 2000. The first version was approved by ANSI on August 4, 2008. The current version of the standard was approved on September 17, 2013.

This standard specifies tests for "evaluating the safety, durability, and structural adequacy of storage and desk-type furniture intended for use in the small office and/or home office." ANSI/BIFMA SOHO S6.5 includes testing to evaluate interlock systems. The test procedure calls for one extendable element to be fully extended while a 30 lbf horizontal pull force is applied to all other fully closed extendable elements. Every combination of open/closed extendable elements[46] must be tested. The interlock system must be fully functional at the completion of this test and no extendable element may bypass the interlock system.

As discussed in section **VIII.B.2.a.ii Interlocks** of this preamble, child strength studies show that children between 2 and 5 years old can achieve a mean pull force of 17.2 pounds. Therefore, CPSC considers a 30-pound horizontal pull force adequate to evaluate the strength of an interlock system. However, because ANSI/SOHO S6.5 does not include stability tests or requirements reflecting the real-world factors involved in CSU tip overs, the standard would not adequately address the CSU tip-over hazard.

VI. Technical Background

This preamble and the NPR briefing package include technical discussions of engineering concepts, such as center of gravity (also referred to as center of mass), moments, and fulcrums. Tab D of the NPR briefing package provides detailed background information on each of these terms, including how staff applies them to CSU tip-over analysis. This section provides a brief overview of that information; for further information, see Tab D of the NPR briefing package.

A. Center of Gravity and Center of Mass

Center of Gravity (CG) or Center of Mass (CM)[47] is a single point in an object, about which its weight (or mass) is completely balanced. In terms of freestanding CSU stability, if the CSU's CG is located behind the front foot, the CSU is stable and will not tip over on its own. Alternatively, if the CSU's CG is in front of the front foot, the CSU is unstable and will tip over. The CG (and CM) of an object is dependent on its geometry and materials. For example, CSU

[46] Excluding doors, writing shelves, equipment surfaces, and keyboard surfaces.
[47] For CSU-sized objects, CG and CM are effectively the same. Therefore, CG and CM are used interchangeably in this preamble.

drawers typically have a front that is thicker and larger than the back, which causes the drawer's CG to be closer to the front. The CSU's CG is defined by the position and weight of the CSU cabinet (without drawers), combined with the position and weight of each drawer. A CSU's CG is equal to the sum of the products of the position and the weight of each component, divided by the total weight.

The CG of a CSU will change as a result of the position of the drawers, doors, and pullout shelves (open or closed). Opening extendable elements, such as drawers, shifts the CG towards the front of the CSU. The closer the CG is to the front leg, the easier it is to tip forward if a force is applied to the drawer. Therefore, CSUs will tip more easily as more drawers are opened. The CG of a CSU will also change depending on the position and amount of clothing in each drawer. Closed drawers filled with clothing tend to stabilize a CSU, but as each filled drawer is pulled out, the CSU's CG will further shift towards the front.

B. Moment and Fulcrum

Moment, or torque, is an engineering term to describe rotational force acting about a pivot point, or fulcrum. The moment is created by a force or forces acting at a distance, or moment arm, away from a fulcrum. One simple example is the moment or torque created by a wrench turning a nut. The moment or torque about the nut is due to the perpendicular force on the end of the wrench applied at a distance (moment arm) from the fulcrum (nut). Likewise, a downward force on an open CSU drawer creates a moment about the fulcrum (front leg) of the CSU. A CSU will tip over about the fulcrum due to a force (*e.g.*, weight of a child positioned over the front of a drawer) and the moment arm (*e.g.,* extended drawer).

Downward force or weight applied to the drawer tends to tip the CSU forward around the fulcrum at the base of the unit, while the weight of the CSU opposes this rotation. The CSU's weight can be modeled as concentrated at a single point: the CSU's CG. The CSU's stability moment is created by its weight, multiplied by the horizontal distance of its CG from the fulcrum. A child can produce a moment opposing the weight of the CSU, by pushing down or sitting in an open drawer. This moment is created by the vertical force of the child, multiplied by the horizontal distance to the fulcrum. The CSU becomes unbalanced and tips over when the moments applied at the front of the CSU exceed the CSU's stability moment.

Horizontal forces applied to pull on a drawer also tend to tip the CSU forward around the front leg (pivot point or fulcrum) at the base of the unit, while the weight of the CSU opposes this rotation. In this case, the moment produced by the child is the horizontal pull force transmitted to the CSU (for example, through a drawer stop), multiplied by the vertical distance to the fulcrum. The CSU becomes unbalanced and tips over when the moments applied at the front of the CSU exceed the CSU's stability moment.

When a child climbs a CSU, both horizontal forces and vertical forces acting at the hands and feet contribute to CSU tip over. Figure 1 shows a typical combination of forces acting on a CSU while a child is climbing, and it describes how those forces contribute to a tip-over moment. Note that when the horizontal force at the hands and feet are approximately equal, which will occur when the child's CM is balanced in front of the drawers, the height of the bottom drawer becomes irrelevant when determining the tip-over moment. In this case, only the height of the hands above the feet matters. As Figure 1 shows, a child climbing on drawers opened distance A1 from the fulcrum, with feet at height B1 from the ground and hands at height B2 above the feet, will act on the CSU with horizontal forces F_H and vertical forces F_V. The CSU's weight at a distance A2 from the CSU's front edge touching the ground creates a stabilizing moment. The CSU will tip if Moment 1 is greater than Moment 2.

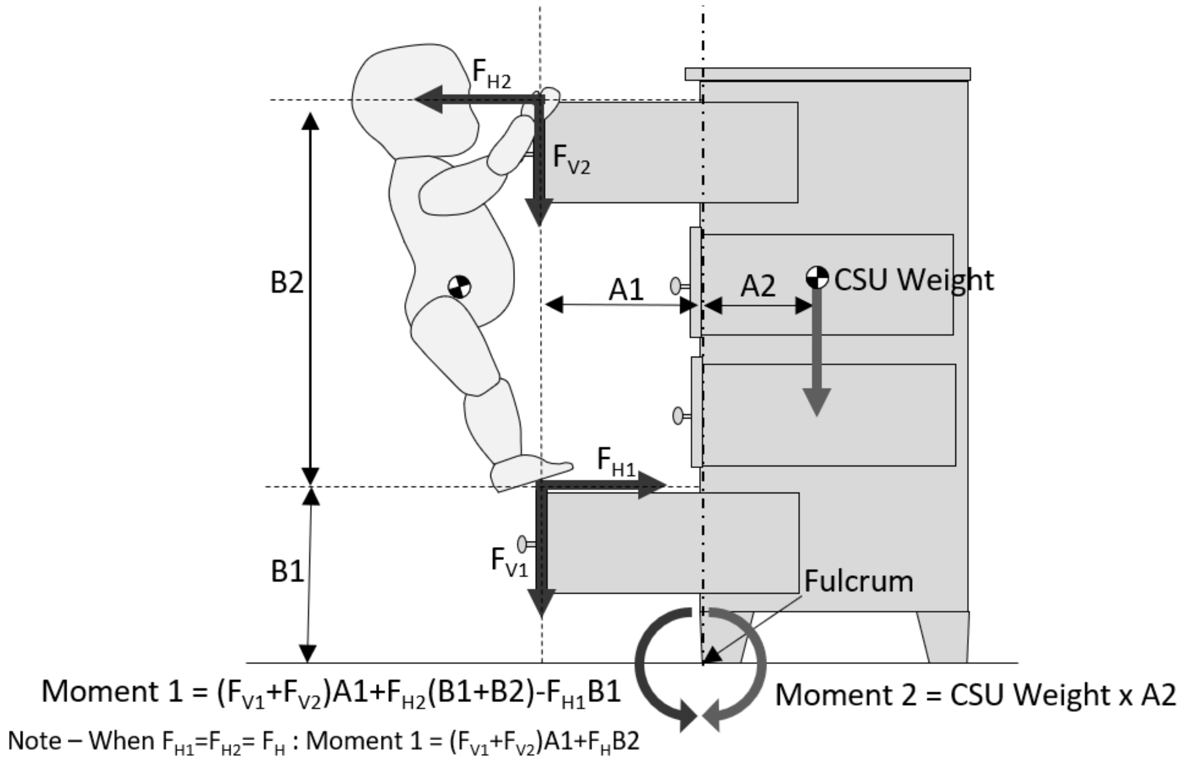

Figure 1: An example of opposing moments acting on a CSU.

VII. Technical Analysis Supporting the Proposed Rule

In addition to reviewing incident data, CPSC staff conducted testing and analysis, analyzed tip-over incidents, and commissioned several contractor studies to further examine factors relevant to CSU tip overs. This section describes that testing and analysis.

A. Multiple Open and Filled Drawers[48]

Staff's technical analysis, as confirmed by testing, indicates that multiple open drawers decrease the stability of a CSU, and filled drawers further decrease stability when more than half of the drawers by volume are open, but increase stability when more than half of the drawers by volume are closed. Thus, while multiple open drawers, alone, can make a unit less stable, whether the drawers are full when open is also a relevant consideration. When filled drawers are

[48] Further details about the effect of open and filled drawers on CSU stability is available in Tab D, Tab L, and Tab O of the NPR briefing package.

closed, the clothing weight contributes to the stability of the CSU, because the clothing weight is behind the front legs (fulcrum). However, open drawers contribute to the CSU being less stable, because the clothing weight is shifted forward in front of the front legs (fulcrum).

To assess the effect of open drawers and filled drawers on CSU stability, CPSC staff conducted testing to evaluate the effect of various combinations of open/closed and empty/filled drawers using a convenience sample of CSUs.[49] Staff conducted two phases of testing (Phase I and Phase II). The purpose of the testing was to assess the weight at which a CSU became unstable and tipped over with various configurations of drawers open/closed and filled/empty.

The primary variable of interest in the Phase I study was the influence of multiple open/closed drawers. The 11 CSUs tested in Phase I were primarily units with a single column of drawers. The Phase II study examined the influence of multiple open/closed drawers and filled/empty drawers. The 15 CSUs tested in Phase II included more complex units with multiple columns of drawers. Staff used the stability test methods in ASTM F2057-19, with some alterations, to collect information about variables that ASTM F2057-19 does not address (*i.e.*, the effect of opened/closed drawers, filled/empty drawers, and tip weight). Filled drawers contained weight bags to simulate a drawer filled with clothing, based on the interior volume of the drawer and 8.5 pounds per cubic foot (the explanation for this fill volume is provided below). In addition to various configurations of open/closed and empty/filled drawers, staff also varied the drawer on which the tip weight mechanism was applied, referred to as the "tip weight application location."

The primary goal of the Phase I study was to gain insight into the influence of multiple open or closed drawers on CSU stability as a function of tip weight. Additionally, this study was designed to test and ideally confirm that identical drawer open/closed patterns (*e.g.*, two open

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[49] Because of the limited number of units tested, this study provides useful information, but the results are limited to the tested units.

drawers) yielded nearly identical tip weights, particularly when drawers were identical in size, regardless of the specific configuration (drawers opened/closed and tip weight application location). The Phase I study confirmed that comparable tip weights existed for similar open/closed drawer configurations in the tested CSUs when considering a simple single column of drawers that are identically sized.

The primary goal of the Phase II study was to examine additional complexities with respect to real-world scenarios of CSUs. This included more complex CSUs and combinations of filled and/or empty drawers (including partially filed configurations, in which some drawers were filled and some were empty) within the same CSU, in addition to open/closed drawers. Staff also modified the test method to decrease test-to-test variability, for example, by adding cross hatches on the drawer and the weight bag to ensure weight bags were centered within drawers.

Based on this testing, lighter and shorter units appear to be less stable, although a taller and heavier unit was also unstable; and similar units passed and failed ASTM's stability requirements. This suggests that specific heights or weights of a CSU do not correlate with stability or instability. Similarly, the footprint ratio (depth-to-width ratio) of the CSU, alone, did not appear to affect tip weight.

From the 26 CSUs tested, CPSC staff analyzed 1,777 data points for a variety of combinations (filled/empty drawers, open/closed drawers, and tip weight application location),[50] and supplemented this data with results from other CSU testing CPSC staff had performed. The results of this testing indicated that individual CSUs vary in stability, depending on the configuration of open/closed drawers, and filled/empty drawers, and that different CSU drawer

[50] Staff excluded some data points for reasons explained in Tab O of the NPR briefing package.

structures (*e.g.*, number of columns, relative drawer sizes) have an influence on tip weight. In general, the results indicated that CSUs were less stable as more drawers were opened, and that filled drawers have a variable effect on stability. A filled closed drawer contributes to stability, while a filled open drawer decreases stability. Depending on the percent of drawers that are open and filled, having multiple drawers open decreased the stability of the CSU.

To determine the appropriate method for simulating CSU drawers that are partially filled or fully filled, staff considered previous analyses, and conducted additional testing. Although ASTM F2057-19 does not include filled drawers as part of its stability testing, the ASTM F15.42 subcommittee has considered a "loaded" (filled) drawer requirement and test method. The ASTM task group used an assumed clothing weight of 8.5 pounds per cubic foot in testing and other discussions of filled drawers. Kids in Danger and Shane's Foundation found a similar density (average of 8.9 pounds per cubic foot) when they filled CSU drawers with boys' t-shirts in a 2016 study on furniture stability.[51]

To assess whether 8.5 pounds per cubic foot reasonably represents the weight of clothing in a drawer, CPSC staff conducted testing. As part of this assessment, staff looked at four drawer fill conditions. Staff considered folded and unfolded clothing with a total weight equal to 8.5 pounds per cubic foot of functional drawer volume in the drawer; and the maximum amount of folded and unfolded clothing that could be put into a drawer that would still allow the drawer to open and close. For these tests, staff used an assortment of boys' clothing in sizes 4, 5, and 6. Staff used a CSU with a range of drawer sizes to assess small, medium, and large drawers; the functional drawer volume of these 3 drawer sizes were 0.76 cubic feet, 1.71 cubic feet, and 2.39 cubic feet, respectively. Staff determined the calculated clothing weight for the 8.5 pounds per

[51] Kids in Danger and Shane's Foundation (2016). Dresser Testing Protocol and Data. Data set provided to CPSC staff by Kids in Danger, January 29, 2021.

cubic foot drawer fill conditions by multiplying 8.5 by the drawer's functional volume, defined as:[52]

$$Functional\ Volume = \left\{[Interior\ Area](ft^2)\left[Clearance\ Height - \frac{1}{8}\right](in)\left[\frac{1}{12}\right]\left(\frac{ft}{in}\right)\right\}$$

For all three drawer sizes, staff was able to fit 8.5 pounds per cubic foot of folded and unfolded clothing in the drawers. When the clothing was unfolded, the clothing fully filled the drawers, but still allowed the drawer to close. Because the unfolded clothing was stuffed into the drawer fairly tightly, it was not easy to see and access clothing below the top layer. When the clothing was folded, the clothing also fully filled the drawers and still allowed the drawer to close. The folded clothing was tightly packed, but allowed for additional space when compressed. The maximum unfolded clothing fill weight was 6.52, 14.64, and 21.20 pounds for the three drawer sizes, respectively; and the maximum folded clothing fill weight was 7.72, 16.08, and 22.88 pounds for the three drawer sizes, respectively.

Staff also compared the calculated clothing weight (*i.e.*, using 8.5 pounds per cubic foot), maximum unfolded drawer fill weight, and maximum folded drawer fill weight for each drawer. The maximum unfolded clothing fill weight was slightly higher than the calculated clothing fill weight for all tested drawers. The difference between the maximum unfolded clothing fill weight and the calculated clothing weight ranged from 0.08 pounds to 0.87 pounds. The maximum unfolded clothing fill weight was 101 to 104 percent of the calculated clothing weight, depending on the drawer. The maximum folded clothing fill weight was higher than both the maximum unfolded clothing fill weight and the calculated clothing fill weight for all tested drawers; however, the differences were relatively small. The difference between the maximum

[52] "Clearance height" is the height from the interior bottom surface of the drawer to the closest vertical obstruction in the CSU frame. "Functional height" is clearance height minus ⅛ inch.

folded clothing fill weight and the calculated clothing weight ranged from 1.28 to 2.55 pounds. The maximum unfolded clothing fill weight was 111 to 120 percent of the calculated clothing weight, depending on the drawer. The maximum unfolded clothing fill density was slightly higher than 8.5 pounds per cubic foot for all tested drawers; and the maximum unfolded clothing fill density ranged from 8.56 to 8.87 pounds per cubic foot, depending on the drawer. The maximum folded clothing fill density was higher than both the maximum unfolded clothing fill density and 8.5 pounds per cubic foot for all tested drawers. The maximum folded clothing fill density ranged from 9.40 to 10.16 pounds per cubic foot, depending on the drawer. Thus, there does not appear to be a large difference in clothing fill density based on drawer size.

Based on this testing, staff found that 8.5 pounds per cubic foot of clothing will fill a drawer; however, this amount of clothing is less than the absolute maximum amount of clothing that can be put into a drawer, especially if the clothing is folded. The maximum amount of unfolded clothing that could be put into the tested drawers was only slightly higher than 8.5 pounds per cubic foot. Although staff achieved a clothing density as high as 10.16 pounds per cubic foot with folded clothing, consumers may be unlikely to fill a drawer to this level because it requires careful folding, and it is difficult to remove and replace individual pieces of clothing. On balance, staff concluded that 8.5 pounds per cubic foot of functional drawer volume is a reasonable approximation of the weight of clothing in a fully filled drawer.

B. Forces and Moments During Child Interactions with CSUs[53]

As indicated above, some of the common themes that staff identified in CSU tip-over incident data involve children interacting with CSUs, including climbing on them and opening drawers. To determine the forces and other relevant factors that exist during these expected

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[53] Further information about the study described in this section, and forces and moments generated by children's interactions with CSUs, is available in Tab C, Tab D, and Tab R of the NPR briefing package.

interactions between children and CSUs, CPSC contracted with UMTRI to conduct research. The researchers at UMTRI, in collaboration with CPSC staff, designed a study to collect information about children's measurements and proportions, interest in climbing and climbing behaviors, and the forces and moments children can generate during various interactions with a CSU. Forty children, age 20 months to 65 months old, participated in the study. For additional details about the study, see UMTRI's full report in Tab R of the NPR briefing package.

1. Overview of Interaction Portion of UMTRI Study

The interaction portion of the study included children interacting with a CSU test apparatus with instrumented handles and a simulated drawer and tabletop (to simulate the top of a CSU or other tabletop or furniture unit). Researchers measured the forces of the children acting on the test apparatus and calculated moments generated by the children based on the location of the CSU's front leg tip point (fulcrum). The researchers based the fulcrum's location on a dataset of CSU drawer extensions and heights provided by CPSC staff.[54]

The interaction portion of the study looked at forces associated with several climbing-related interactions of interest, which staff and researchers selected based on CSU tip-over incidents, videos of children interacting with CSUs and similar furniture items, and plausible interactions based on children's developmental abilities. Staff focused on the ascent/climbing[55] interaction for this rulemaking because climbing incidents were the most common interaction

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[54] CPSC staff provided UMTRI researchers with a dataset of drawer extensions and drawer heights from the ground from a sample of approximately 180 CSUs. The researchers selected the 90th percentile drawer extension (12 inches) and drawer height (16 inches) as the basis for placing the moment fulcrum in most of their analysis.

[55] Ascending is a subcategory of climbing, and is described as a child's initial step to climb up on to a CSU. Therefore, ascending is an integral part of climbing. The UMTRI study provided information about forces children generate during ascent, because that testing measured forces children generate during an initial step onto the CSU test fixture. Those forces can be used to model children climbing because ascent is the first and integral step to climbing, but not all climbing interactions can be modeled with ascent, as forces associated with some other behaviors can exceed those for ascent. The term "climbing" is often used in this preamble and the NPR briefing package because that is the general behavior described in many incidents. Both climbing and ascending are used to refer to the force children generate on a CSU, for purposes of the proposed rule.

among fatal CPSRMS incidents and nonfatal NEISS incidents, where the interaction was reported, and they were the second most common interaction in nonfatal CPSRMS incidents, where the interaction was reported; and because climbing begins with ascent, which is a child's initial step to climb up on to the CSU, and therefore, is considered an integral part of all climbing interactions.

2. Test Apparatus and Data Acquisition

UMTRI researchers created the test apparatus shown in Figure 2, which used a padded force plate to measure interactions with the floor and included a column to which the various instrumented test fixtures were attached. Tests were conducted with a pair of handle bars (simulating drawer handles or fronts), a simulated drawer, and a simulated table-top. In preparation for the study, CPSC staff worked with UMTRI researchers to develop a test fixture that modeled the climbing surfaces of a CSU. CPSC staff provided information to UMTRI researchers on drawer extension and heights from the sample of dressers used in CPSC staff's evaluation (Tab N of the NPR briefing package). Researchers selected and constructed a parallel bar test fixture, representing a lower foothold and an upper handhold. These bars represent a best-case CSU climbing surface, similar to the top of a drawer.

UMTRI researchers configured the test fixtures based on each child's anthropometric measurements. Researchers set the upper bar to three different heights relative to the padded floor surface: low (50 percent of the child's upward grip reach), mid (75 percent of the child's upward grip reach), and high (100 percent of the child's upward grip reach); researchers set the lower bar to two different heights: low (4.7 inches from the padded floor surface) and high (the child's maximum step height above the padded floor). The heights for the bars were within plausible heights for CSU drawers. Researchers set the horizontal position of the upper bar to two different positions: "aligned" with the lower bar, or "offset" from the lower bar, at a distance equal to 20 percent of the child's upward grip height. Tabs C and R of the NPR briefing package contain more information about the test fixture configurations. The bars, drawer, and tabletop, as well as the floor in front of the test fixture, had force measurement instrumentation that recorded forces over time in the horizontal (fore-aft, x) and vertical (z) directions.

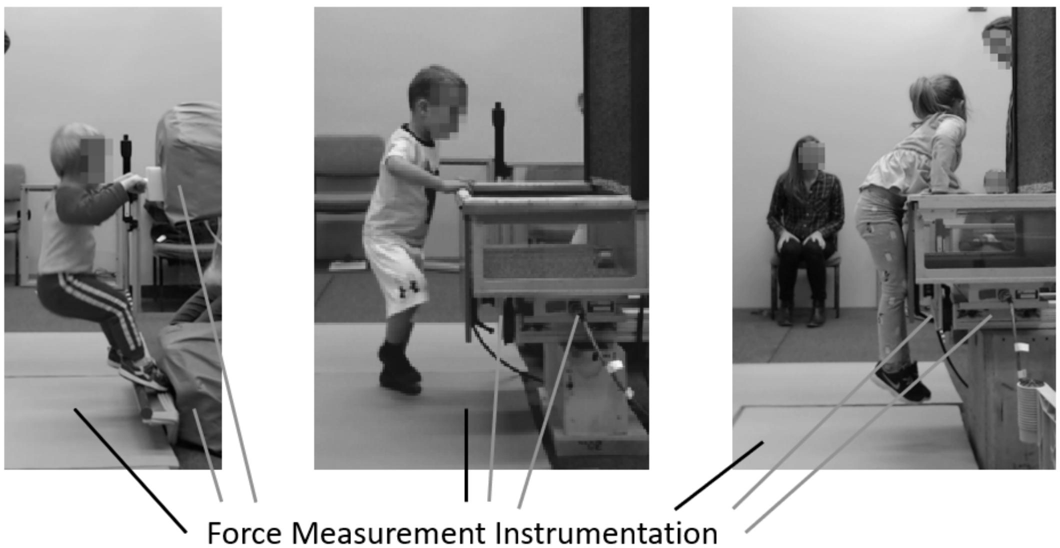

Figure 1: The test setup and location of instruments used to measure force during handle trials (left), box/drawer trials (center), and table trials (right).

3. Target Behaviors of Children Interacting with a CSU

CPSC staff worked with UMTRI researchers to develop a set of scripted interactions. Staff focused on realistic interactions in which the child's position and/or dynamic interactions were the most likely to cause a CSU to tip over. The interactions were based on incident data and online videos of children interacting with CSUs and other furniture items. The interactions UMTRI researchers evaluated included:

- *Ascend:* climb up onto the test fixture;
- *Bounce:* bounce vigorously without leaving the bar;
- *Lean back:* lean back as far as possible while keeping both hands and feet on the bars;

- *Yank:* from the lean back position, pull on the bar as hard as possible;
- *1 hand & 1 foot:* take one hand and foot (from the same side of the body) off the bars and then lean as far away from the bars as possible;
- *Hop up:* hold the upper bar and try to jump from the floor to a position where the arms are straight and the hips are in front of the upper bar, an action similar to hoisting oneself out of a swimming pool;
- *Hang:* hold onto the upper bar, lift feet off the floor by bending knees, hang still for a few seconds, and then straighten legs to return to the floor; and
- *Descend:* climb down from the test fixture.

As described above, the ascend interaction best models the climbing behavior commonly seen in incidents, and is analogous to a child's initial step to climb up on to the CSU, which is an integral climbing interaction. The other, more extreme interactions, such as bounce, lean, and yank, were identified as plausible interactions, based on child behavior; but these interactions were not directly observed in the incident data.

After the children performed the interaction, the researchers reviewed video from each trial to isolate and characterize interactions of interest. Interactions of interest for the handle trials were categorized as: Ascent, Bounce, Lean (lean back), Yank, and One Hand (see Figure 3). Researchers analyzed forces from each extracted behavior to identify peak forces and moments.

Ascent Bounce Lean Back Yank One Hand

Figure 2: Children were instructed to climb on (ascend) the test fixture and perform certain targeted behaviors. The Ascent image on the left also shows markers that were used to find the CM location, discussed in the next section.

4. Image-Based Posture Analysis

Participant postures have strong effects on the horizontal forces exerted by the child and the subsequent calculated moments, due to the location of the child's CM during each behavior. Thus, the CM of the child is important when evaluating the stability or tip-over propensity of the child/CSU-combined system. UMTRI researches used the images of the subjects to estimate the location of the child's CM. The UMTRI researchers extracted video frames at time points of interest (typically when the child produced the maximum moment during the interaction) and manually digitized the series of landmarks on the image of the child, as shown in Figure 4. The location of the CM was estimated, based on anthropometric information on children,[56] as 33 percent of the distance from the buttock landmark to the top-of-head landmark.

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[56] Snyder, R.G., Schneider, L.W., Owings, C.L., Reynolds, H.M., Golomb, D.H., & Schork, M.A., Anthropometry of Infants, Children and Youths to Age 18 for Product Safety Design (Report No. UM-HSRI-77-17), prepared for the U.S. Consumer Product Safety Commission (1977).

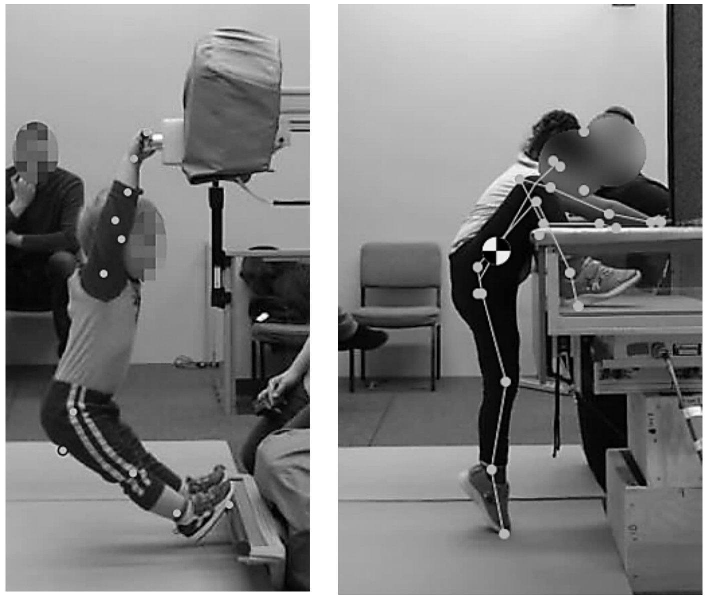

Figure 3: The photo on the left shows the right side of the body as it is digitized. The photo on the right shows the resulting body segments and the estimated location of the CM for a different child and test condition.

The UMTRI researchers estimated the location of the child's CM by examining the side-view images from the times of maximum moment, as shown in Figure 5. Table 1 shows the average estimated CM location for each behavior.[57] The children in the study extended their CM an average of about 6 inches from the handle/foothold while ascending.

57 Graphs are available in Tab R of the NPR briefing package (page 59, Figure 54).

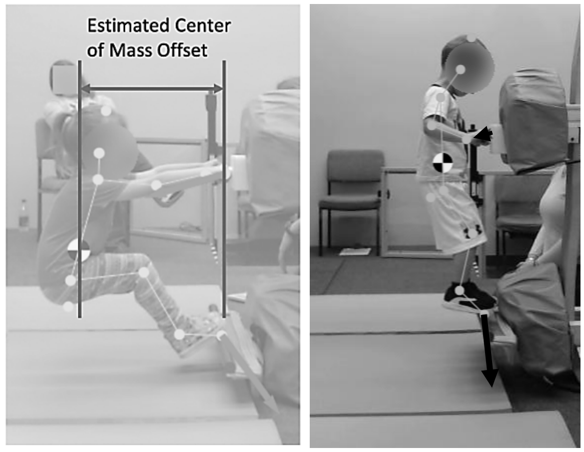

Figure 4. Example of digitized frame with estimated CM location and offset from upper handle. The lean behavior is shown on the left, and the ascend behavior is shown on the right. Forces at the hands and feet are shown with scaled arrows.

Table 1: Estimated CM Horizontal Offset from the Handles for Aligned Trials (inches)

Behavior	N Subjects	N Trials	Mean	SD	10th percentile	50th percentile	90th percentile
Ascent	36	109	6.1	2.0	4.3	6.1	8.6
Bounce	32	80	6.0	2.5	4.0	5.8	9.1
Lean Back	30	81	11.3	3.4	8.5	11.6	15.9
Yank	25	53	10.9	3.4	7.3	11.5	15.9

5. *Handle Trial Force Results*

Figure 6 shows side-view images of examples of children interacting with the handle fixture. The frames were taken at the time of peak tip-over moment. Forces exerted by the child at the hands and feet are illustrated using scaled vectors (longer lines indicate greater force magnitude; arrow direction indicates force direction). Digitized landmarks and estimated CM locations are shown. The images demonstrate that forces at both the hands and feet often have substantial horizontal components, and usually, but not always, the foot forces are larger than the hand forces. The horizontal components at the hands and feet are also in opposite directions: the horizontal foot forces are forward (toward the test fixture), while the hand forces are rearward (toward the child).

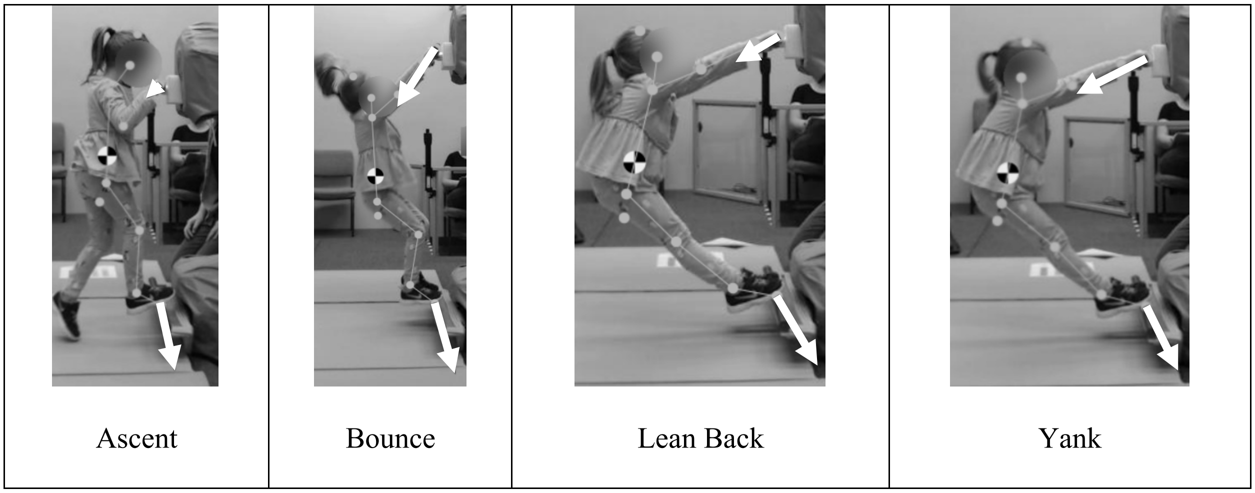

Figure 5: Depicts examples of interactions. Arrows illustrate the directions and relative magnitudes of forces at the hands and feet.

Figure 17 in Tab D of the NPR briefing package shows an exemplar time-history plot of the horizontal and vertical forces for the Ascent behavior of the depicted child. As that figure illustrates, the child’s body weight transitions from the force plate to the bars, with the lower bar bearing nearly all of the weight. The horizontal forces on the upper and lower bars are approximately equal in magnitude and opposite in direction, consistent with the posture being approximately static toward the end of the test, where the child completed the ascend maneuver. Under these conditions, the behavior is no longer dynamic, and the vertical forces sum to body weight.

UMTRI researchers modeled a child interacting with a CSU with opened drawers, by measuring forces at instrumented bars representing a drawer front or handle. Figure 7 is the free-body diagram of the child climbing the CSU. The horizontal and vertical forces at the hands and feet correspond to the positive direction of the measured forces. The CSU drawers were modeled using the top handle and bottom handle height, and the drawer extension was modeled from 0 inches to 12 inches.[58] The UMTRI researchers calculated the moment about the CSU's front foot or fulcrum, using the measured forces, vertical location of the top and bottom handles, and the defined drawer extension length (Fulcrum X).

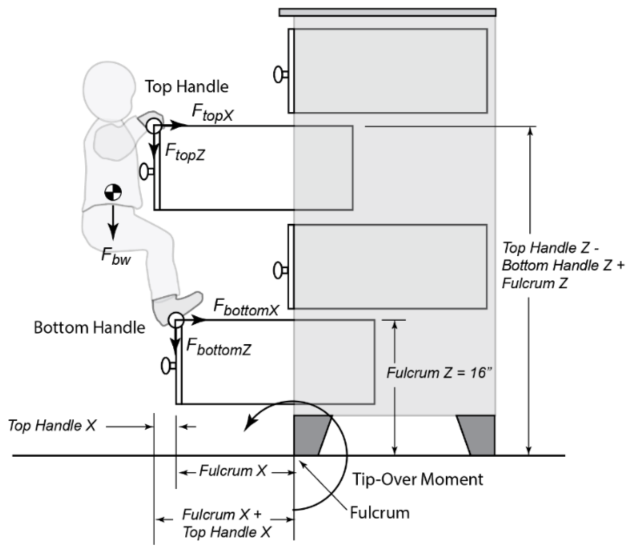

Figure 7. Free-body diagram of a child climbing a CSU.

Figure 7 shows that the child's body weight will generally be distributed between the two bars, but that the child's CM location will also typically be outboard of the bars (farther from the fulcrum than the bars). The quasi-static climbing moment is approximately equal to the location of the child's CM (the horizontal distance of the CM to the fulcrum), multiplied by the child's weight. In reality, the moment created by dynamic forces generated by the child during the activities in the UMTRI study, such as during ascend, exceed the moment created by body weight alone as a result of the greater magnitude horizontal and vertical forces.

58 Here, 0 inches corresponds with a closed drawer when the fulcrum lines up with the drawers. Additionally, 12 inches represents the 90th percentile drawer extension length in a dataset of approximately 180 CSUs.

6. Moment About the Fulcrum

UMTRI researchers analyzed the force data as generating a moment around a tip-over fulcrum. The UMTRI researchers calculated the maximum moment about a virtual fulcrum, based on the measured force data for each test and the location of the force. Figure 8 shows the test set up and the forces measured. Note that the test setup mimics a CSU with the drawers closed and the *Fulcrum X = 0.* UMTRI researchers defined the horizontal *Fulcrum X* distance of 1-foot (based on the 90th percentile drawer extension) to simulate a 1-foot drawer extension. The bottom handle vertical *Fulcrum Z* was set to 16 inches (based on the 90th percentile drawer height from the floor), and the *Top Handle Z* varied, depending on the size of the child.[59] Researchers calculated the moment that would be generated for a child interacting on a 1-foot extended CSU drawer, as shown in Figure 8, where Fulcrum X = 1 foot.

[59] The top handle varied from 7.4 to 47.3 inches above the bottom handle.

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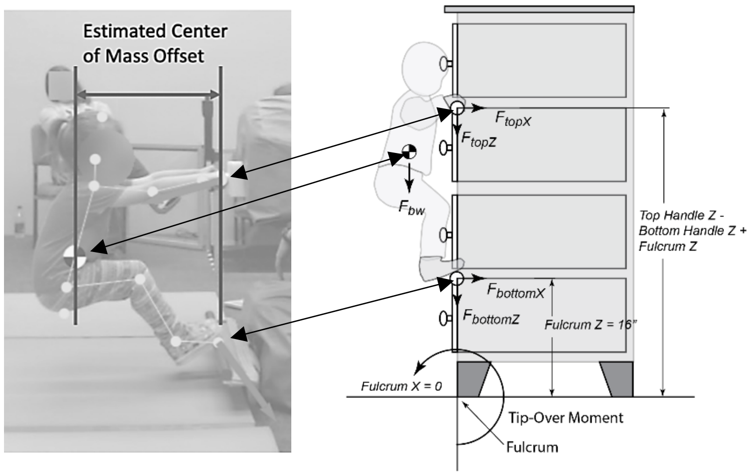
<td>


Test configuration consists of force transducers on upper and lower bars. Video image analysis is used to determine the center of mass of the child.
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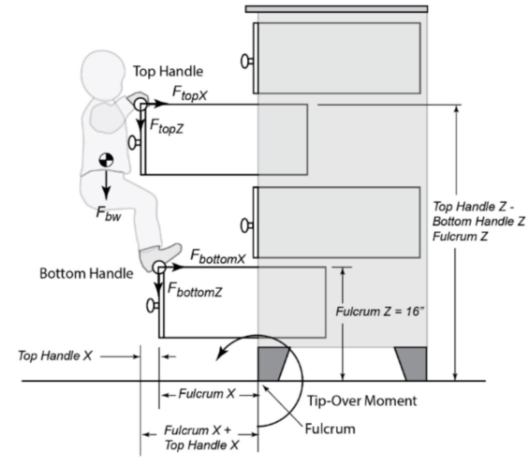

Note: For aligned trials, the top bar is directly under the bottom bar and Top Handle X = 0.
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<tr>
<td>Test configuration: force data collected on bars, $F_{top\ X}$, F_{topZ}, $F_{bottomX}$ and $F_{bottom\ Z}$. Image analysis determines the Estimated Center of Mass Offset.</td>
<td>The child's moment is calculated based on input values for Fulcrum X "virtual fulcrum" multiplied by the measured vertical force data. Horizontal force data multiplied by height Z also contributes to the moment.</td>
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</table>

Figure 8. These diagrams illustrate how the test configuration was used to determine the child's moment acting on the CSU.

Figure 20 in Tab D of the NPR briefing package (also Figure 44 in Tab R) shows the calculated maximum moment for each interaction of interest versus the child's body weight, and shows that the maximum moment tends to increase with body weight. UMTRI researchers normalized the moment by dividing the calculated moment by the child's body weight to enable the effects of the behaviors to be examined independent of body weight, as shown in Figure 21 in Tab D of the NPR briefing package (also Figure 46 in Tab R). As the figure illustrates, the greatest moments were generated in the Yank interaction, followed in descending order by Lean, Bounce, 1 Hand, and Ascend. As the weight of the child increased, so did the maximum moment. For all of the interactions, the maximum moment exceeded the weight of the child. For Ascend and Bounce, the slopes are close to zero, indicating that the difference in the moment generated for the Ascend and Bounce interaction is primarily due to the child's weight. A weak positive relationship can be seen for Lean and Yank. This suggests a difference in the Lean and Yank behavior for heavier children that is not accounted for by body weight. This difference for the Lean and Yank behavior is consistent with the heavier children also having longer arms and legs that would allow them to shift their CM further away from the handles, as well as being relatively stronger, leading to greater magnitude dynamic forces.

The preceding analysis was based on a 12-inch (one foot) horizontal distance between the location of force exertion and the fulcrum. The following analysis shows the effects of varying the *Fulcrum X* value, which is equivalent to a CSU's drawer extension from the fulcrum.

The net moment can be calculated using a *Fulcrum X* = 0 position, as shown in Figure 9, to bound the effects of drawer extension. Placing the fulcrum directly under the hands and feet in the aligned conditions eliminates the effects of vertical forces on moment, while amplifying the relative effects of horizontal forces.

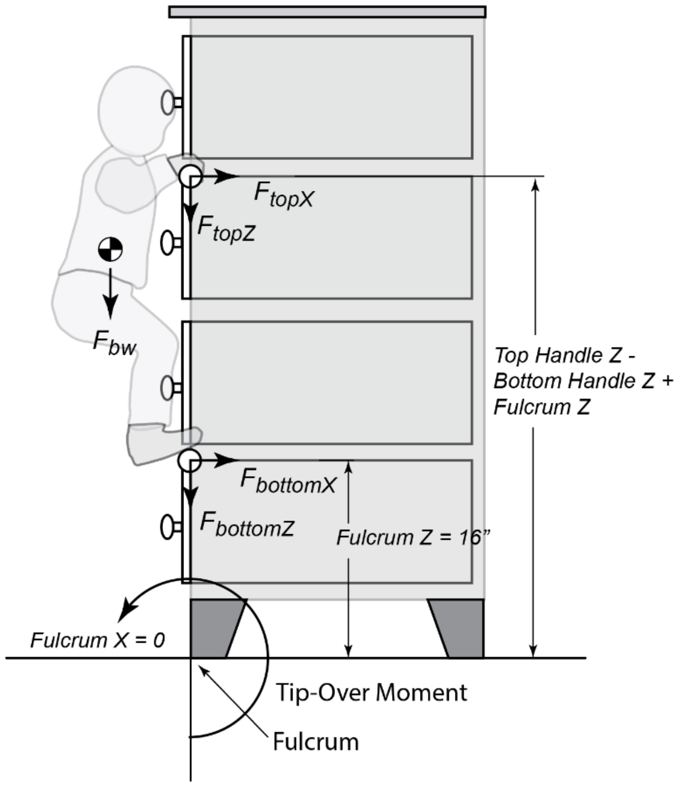

Figure 9. Depicts a schematic of effects of reducing *Fulcrum X* to zero (compare with Figure 7, which depicts a non-zero *Fulcrum X* distance).

UMTRI researchers analyzed the effects of the *Fulcrum X* (which corresponds to the drawer extension[60]) on the tip-over moment for the targeted behaviors. Since the moment about the fulcrum was calculated based on measured force data and input values for *Fulcrum X* distance, the authors were able to analyze the effects of the fulcrum position by varying the *Fulcrum X* value from 0 to 12 inches. UMTRI researcher used this virtual *Fulcrum X* value to calculate the corresponding maximum moment.

Figure 23 in Tab D of the NPR briefing package (also Figure 51 in Tab R) shows the maximum moments versus the *Fulcrum X* values of 0 and 12 inches across behaviors for aligned

[60] Drawer extension data provided by CPSC staff to UMTRI researchers was measured from the extended drawer to the front of the CSU, and did not account for how the fulcrum position will vary with foot geometry and position. UMTRI researchers assumed that the fulcrum was aligned with the front of the CSU to simplify their analysis.

conditions. For example, the calculated moment for Ascend at X=0 is about 17.5 pound-feet. The moment when X=0 is due entirely to horizontal forces. These horizontal forces exerted by the child on the top and bottom handles of the test apparatus are necessary to balance his/her outboard CM. UMTRI researchers concluded that the child's CM due to their postures have strong effects on the horizontal forces exerted and the calculated moments. Consequently, the location of the child's CM during the behavior is an important variable.

As previously discussed, the UMTRI researchers normalized the moment by dividing the calculated moment of each trial by the child's body weight to enable the effects of the behaviors to be examined independent of body weight. The graphs of Figure 23 in Tab D of the NPR briefing package show how the moments and the normalized moments increase with the fulcrum distance (which corresponds to the drawer extension). For the normalized moments shown in the bottom graph, this can be interpreted as the effective CM location outboard of the front foot of the CSU (fulcrum), in feet. For example, a child climbing on a drawer extended 12 inches (1 foot) from the front foot fulcrum will have an effective CM that is about 19 inches (1.6 feet) from the fulcrum. At *Fulcrum X* = 0, the contribution of vertical forces to the moment are eliminated, and only the horizontal forces exerted at the hands and feet contribute to the moment. The horizontal forces exerted by the child on the top and bottom handles are necessary to balance his/her outboard CM. The effective moment where the fulcrum = 0 is about 6 inches (0.5 feet) for the Ascend behavior, and it is primarily due to the outboard CM position of the child about 6 inches (0.5 feet) from the fulcrum.[61]

As the drawer is pulled out farther from the fulcrum, vertical forces have a greater impact on the total moment contribution. UMTRI researchers reported that at the time of peak moment

[61] UMTRI researchers reported that the average CM offset was 6.1 inches (0.51 feet) during ascent at the time the maximum moment was measured.

during ascent, the average (median) vertical force, divided by the child's body weight, was close to 1 (staff estimates this value is approximately 1.08 for aligned handle trials).[62] This suggests child body weight is the most significant vertical force, although dynamic forces also contribute. Based on the Normalized Moment for Ascend shown in the bottom graph of Figure 23 in Tab D of the NPR briefing package, CPSC staff estimated the Ascend line with the following equation 1:

Equation 1. $Normalized\ Moment\ for\ Ascend = 1.08 \times [Fulcrum\ X(\text{ft})] + 0.52$ ft.

Equation 1 can be multiplied by a child's weight to estimate the moment *M* generated by the child ascending, as shown in Equation 2:

Equation 2. $M = \{1.08 \times [Fulcrum\ X(\text{ft})] + 0.52\ \text{ft}\} \times child\ body\ weight$ (lb)

For example: for a 50-pound child *ascending* the CSU with a 1-foot drawer extension, the moment at the fulcrum is:

$M = \{1.08 \times [1\ \text{ft}] + 0.52\ \text{ft}\} \times 50\ \text{lb} = 54\ \text{lb-ft} + 26\ \text{lb-ft}$

$M = 80$ lb-ft

The child in the example above produces a total moment of 80 pound-feet about the fulcrum. The contribution to the total moment from vertical forces, such as body weight and vertical dynamic forces, is 54 pound-feet. The contribution to the total moment from horizontal forces, such as the quasi-static horizonal force used to balance the child's CM in front of the extended drawer and dynamic forces, is 26 pound-feet.

Similar climbing behaviors for drawer and table trials (*e.g.*, climbing into the drawer or climbing onto the table top) generated lower moments than ascent. Therefore, the equation for ascend is expected to cover those behaviors as well.

[62] Refer to Figure 48 in the UMTRI report (Tab R of the NPR briefing package).

7. *Summary of Findings from the Interaction Portion of the Study*

UMTRI researchers found that the moments caused by children climbing furniture exceed the effects of body weight alone. CPSC staff used the findings to develop an equation that could be used to calculate the moment generated by children ascending a CSU, based on the child's body weight and the drawer extension from the CSU fulcrum, shown in Equation 2. This equation, combined with the weight for the children involved in CSU tip-over incidents, is the basis for the moment requirements in the proposed rule.

8. *Focus Group Portion of UMTRI Study*

In addition to examining the forces children generate when interacting with a CSU, the UMTRI study, the researchers also asked participants and their caregivers questions about participants' typical climbing behaviors. This portion of the study identified many household items that children showed interest in climbing, including: CSUs, tables, desks, counters, cabinets, shelves, windows, sofas, chairs and beds. In the same study, six children climbed dressers, based on caregivers' reports. Caregivers described various tactics the children used for climbing, such as "jumped up," "hands and feet," "ladder style," and "grab and pull up," but the most common strategy was stepping into or onto the lowest drawer. Caregivers also mentioned children using chairs, stools, and other objects to facilitate climbing, including pulling out dresser drawers.

C. *Flooring*[63]

To examine the effect of flooring on the stability of CSUs, staff reviewed existing information and conducted testing. As background, staff considered a 2016 study on CSU

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[63] Details regarding staff's assessment of the effect of flooring on CSU stability is available in Tab D and Tab P of the NPR briefing package.

stability, conducted by Kids in Danger (KID) and Shane's Foundation.[64] In that study, researchers tested the stability of 19 CSUs, using the stability tests in ASTM F2057-19 on both a hard, flat surface, and on carpeting. The results showed that some CSUs that passed on the hard surface, tipped over when tested on carpet.

To further examine the effect of carpeting on the stability of CSUs, staff tested 13 CSUs, with a variety of designs and stability, on a carpeted test surface. For this testing, staff used a section of wall-to-wall tufted polyester carpeting with polypropylene backing from a major home-supply retailer and typical of wall-to-wall carpeting, based on staff's review of carpeting on the market. Staff installed and secured the carpet, with a carpet pad, on a plywood platform, and conditioned the CSU and carpeting by weighting the unit for 15 minutes. Staff then tested the unit using the same methods and CSU configurations (*i.e.*, number and position of open and filled drawers) as used with these units in the Multiple Open and Filled Drawers testing conducted on the hard surface (Tab O).

Using the 1,221 pairs of tip weights (*i.e.*, tip weight on the flat surface and on the carpet, with various configurations of multiple open and filled drawers), staff calculated the difference in tip weight when on the hard surface, compared to the carpeted surface for each CSU (tip weight difference). A CSU had a positive tip weight difference if the tip weight was higher on the hard surface than on the carpet, indicating that CSUs are less stable on carpet. The testing showed the CSUs tended to be more stable on the hard surface than they were on carpet. Of the 1,221 tip-over weight differences, the tip weight difference was positive for 1,149 (94 percent) of them; negative for 33 (3 percent) of them; and was zero (*i.e.*, the tip-over weights were equal) for 39 (3 percent). For all 1,221 combinations, the mean tip weight difference was 7.6 pounds, but

[64] *Furniture Stability: A Review of Data and Testing Results* (Kids in Danger and Shane's Foundation, August 2016).

for individual units, the mean tip weight difference ranged from 4.1 to 16.0 pounds. For all 1,221 combinations, the median tip weight difference was 7 pounds, but for individual units, the median ranged from 2 to 16 pounds. The standard deviation for the entire 1,221 data set was 5.1 pounds, but was smaller for individual units, ranging from 1.8 to 4.7 pounds, indicating that most of the variability in tip weight differences was between units, as opposed to within units, which suggests that some units are affected more than others by carpeting.

Staff also analyzed the relationship between tip weight difference and open/closed drawers and filled/empty drawers. The mean tip weight difference was 7.6 pounds (median was 7 pounds) when most of the drawers on the unit were open, and 8.5 pounds (median was 8 pounds) when most of the drawers were closed, indicating that the units were more stable (required more weight to tip over) when more drawers were closed. The mean tip weight difference was 7.2 pounds (median was 6 pounds) when most of the drawers on the unit were empty, and 7.7 pounds (median was 7 pounds) when most of the drawers were filled.[65] This shows that, in general, CSUs are less stable on carpet. All units tested, under various conditions, tended to tip with less weight on the carpet than on the hard surface.

Staff used the results from this study to determine a test method that approximated the effect of carpet on CSU stability by tilting the unit forward (Tab D). Using the CSUs that were involved in CSU tip-over incidents (Tab M), staff compared nine tip weights on carpet with tip weights for the same units in the same test configuration when tilted at 0, 1, 2, and 3 degrees in the forward direction on an otherwise hard, level, and flat surface.

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[65] To further assess whether the effect of carpet changed based on the CSU's stability—that is, to determine if the results reflected the change in flooring, or the overall stability of the unit—staff calculated the percent tip weight difference, as: percent tip weight difference = (hard surface tip weight – carpet tip weight)/hard surface tip weight. This revealed that, as the weight to tip the unit on a hard surface increased, shifting to a carpeted surface had less of an impact in terms of the percentage of the tip-over weight.

The tip weight of CSUs on carpet corresponded with tilting the CSUs 0.8 to 3 degrees forward, depending on the CSU; the mean tilt angle that corresponded to the CSU tip weights on carpet was 1.48 degrees. This suggests that a forward tilt of 0.8 to 3 degrees replicated the test results on carpet. Staff also conducted a mechanical analysis of the carpet and pad used in the test assembly, and found a similar forward tilt of 1.5 to 2.0 degrees would replicate the effects of carpet for one CSU.

D. Incident Recreation and Modeling[66]

CPSC staff analyzed incidents and tested products that were involved in CSU tip-over incidents to better understand the real-world factors that contribute to tip-overs. Staff analyzed 7 CSU models, associated with 13 tip-over incidents. The CSUs ranged in height from 27 to 50 inches and weighed between 45 and 195 pounds. Two of these CSU models did not comply with the stability requirements in ASTM F2057-19; one complied with the requirements in section 7.1, but not section 7.2; two complied with both sections 7.1 and 7.2; and one was borderline.[67] Through testing and analysis, staff recreated the incident scenarios described in the investigations and determined the weight that caused the unit to tip over in a variety of use scenarios, such as a child climbing or pulling on the dresser, multiple open drawers, filled and unfilled drawers, and the flooring under the CSU.

Based on this analysis and testing, staff identified several factors that contributed to the tip-over incidents. One factor was whether multiple drawers were open simultaneously. Opening multiple drawers decreased the stability of the CSU. A related factor was whether the drawers of

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[66] Details about staff's incident recreation and modeling are in Tab D and Tab M of the NPR briefing package.
[67] Staff tested this model two separate times. In one case, the tip weight just exceeded the ASTM F2057-19 minimum acceptable test fixture weight. In another case, the model tipped over just below the minimum allowed test fixture weight. These results are consistent with earlier staff testing that found that the model tipped when tested with a 49.66-pound test fixture; but did comply when tested with a 48.54-pound test fixture.

the CSU were filled, and to what extent. Staff's testing indicated that the weight of filled drawers increases the stability of a CSU when more drawers are closed, and reduces overall stability when more drawers are open. Generally, when more than half of filled drawers were open (by volume), the CSU was less stable.

Another factor was the child's interaction with the CSU at the time of the incident. In some incidents, the child was likely exerting both a horizontal and vertical force on the CSU. Staff found that, for some CSUs, either a vertical or horizontal force, alone, could cause the CSU to tip over, but that the presence of both forces significantly increased the tip-over moment acting on the CSU. These forces, in combination with the other factors staff identified, further contributed to the instability of CSUs. Some of the incident recreations indicated that the force on the edge of an open drawer associated with tipping the CSU was greater than the static weight of the child standing on the edge of an open drawer of the CSU. The equivalent force consists of the child's weight, the dynamic force on the edge of the drawer due to climbing, and the effects of the child's CG extending beyond the edge of the drawer. Some of the incident recreations indicated that a child pulling on a drawer could have contributed to the CSU tipping over.

Another factor that contributed to instability was flooring. Staff's testing indicated that the force needed to tip a unit over was less when the CSU was on carpet/padding than when it was on a hard, level floor.

E. Consumer Use Study[68]

In 2019, the Fors Marsh Group (FMG), under contract with CPSC, conducted a study to assess factors that influence consumer attitudes, behaviors, and beliefs regarding CSUs. The study consisted of two components. In the first component, the researchers conducted six 90-

[68] The full report from FMG, *Consumer Product Safety Commission: Furniture Tipover Report* (Mar. 13, 2020), is available in Tab Q of the NPR briefing package.

minute in-home interviews (called ethnographies). Three of the participants had at least one child between 18 and 35 months old in the home, and three participants had at least one child between 36 and 72 months old in the home. In this phase of the study, the researchers collected information about family interactions with and use of CSUs in the home.

In the second component of the study, FMG conducted six 90-minute focus groups, using a total of 48 participants. Each focus group included eight participants with the same caregiver status (parents of a child between 1 and 5 years old, people who are visited regularly by a child between 1 and 5 years old, and people who plan to have children in the next 5 years) and homeowner status (people who own their home, and people who rent their home). Participants included parents of children 12 to 72 months old, people without young children in the home who were planning to have children in the next five years, and people without young children in the home who are visited regularly by children 12 to 72 months old. The focus groups assessed consumer perceptions of and interactions with CSUs, perceptions of warning information, and factors that influence product selection, classification, and placement.

In describing CSUs, participants mentioned freestanding products; products that hold clothing; features to organize or protect clothing (*e.g.*, drawers, doors, and dividers); and named, as examples, dressers, armoires, wardrobes, or units with shelving or bins. Participants noted that whether storage components were large enough to fit clothing was relevant to whether a product was a CSU. However, participants also noted that they may use smaller, shorter products, with smaller storage components, as CSUs in children's rooms so that children can access the drawers, and because children's clothes are smaller. In distinguishing nightstands from drawers, participants noted the size and number of drawers, and some reported storing clothing in them. Some participants reported that how products were displayed in stores or in online marketing did not influence how they used the unit in their homes, and indicated that although a product name may have some influence on their perception of the product, they would ultimately choose and use a product based on its function and ability to meet their needs.

Focus group participants were provided with images of various CSU-like products, and asked what they would call the product, what they would put in it, and where they would put it. Participants provided diverse answers for each product, with products participants identified as buffets, nightstands, entry/side/hall tables, or entertainment/TV/media units also being called dressers or armoires by other participants. Products that participants were less likely to consider a CSU or use for clothing had glass doors, removable bins/baskets, or a small number of small drawers.

Participants primarily kept CSUs in bedrooms and used them to store clothing. However, they also noted that they had products that could be used as CSUs in other rooms to store non-clothing, and had changed the location and use of products over time, moving them between rooms and storing clothing or other items in them, depending on location.

Focusing on units that the participants' children interacted with the most, the researchers noted that CSUs in children's rooms held clothing and were 70 to 80 percent full of folded clothing. Participants reported that the children's primary interaction with CSUs was opening them to reach clothing, but also reported children climbing units to reach into a drawer or to reach something on top of the unit. A few participants reported having anchored a CSU. As reasons for not anchoring furniture, participants stated that they thought the unit was unlikely to tip over, particularly smaller and lighter units used in children's rooms, and they do not want to damage walls in a rental unit.

F. Tip Weight Testing[69]

As discussed earlier in this preamble, in 2016 and 2018-2019, CPSC staff tested CSUs to assess compliance with requirements in ASTM F2057. As part of the 2018-2019 testing, staff also assessed whether CSUs could hold weights higher than the 50-pound weight required in ASTM F2057, testing the CSUs with both a 60-pound test weight, and to the maximum test weight they could hold before tipping over. For this testing, staff assessed 188 CSUs, including 167 CSUs selected from among the best sellers from major retailers, using a random number generator; 4 CSU models that were involved in incidents;[70] and 17 units assessed as part of previous test data provided to CPSC.[71] Appendix A to Tab N in the NPR briefing package describes the test procedure staff followed. To summarize, after recording information about the weight, dimensions, and design of the CSU, staff used a test procedure similar to section 7.2 in ASTM F2057-19 (loaded weight testing), but with a 60-pound test fixture, and with test fixtures that allowed staff to add additional weight, in 1-pound increments, up to a maximum of 134 pounds.

Of the 188 CSUs staff tested, 98 (52 percent) held the 60-pound weight without tipping over. The mean weight at which the CSUs tipped over was 61.7 pounds and the median was 62 pounds.[72] The lowest weight that caused a CSU to tip over was 12.5 pounds. The next lowest tip weights were 22.5 pounds (2 CSUs), 25 pounds (6 CSUs), and 27.5 pounds (3 CSUs). One CSU did not tip over when the maximum 134-pound test weight was applied. The next highest tip weights were 117.5 pounds (1 CSU), 112.5 pounds (1 CSU), 102.5 pounds (1 CSU), 97.5 pounds

[69] A full discussion of this testing and the results is available in Tab N of the NPR briefing package.
[70] Staff tested exemplar units, using the model of CSU involved in the incident, but not the actual incident unit.
[71] The CSUs were identified from the Consumer Reports study "Furniture Tip-Overs: A Hidden Hazard in Your Home" (Mar. 22, 2018), available at: https://www.consumerreports.org/furniture/furniture-tip-overs-hidden-hazard-in-your-home/.
[72] This is based on the results for 185 of the units; staff omitted the test weight for 3 of the CSUs because of data discrepancies.

(1 CSU), 95 pounds (1 CSU), and 90 pounds (4 CSUs). Most CSUs tipped over with between 45 and 90 pounds of weight.

G. *Warning Label Symbols*[73]

In 2019, CPSC contracted a study to evaluate a set of 20 graphical safety symbols for comprehension, in an effort to develop a family of graphical symbols that can be used in multiple standards to communicate safety-related information to diverse audiences.[74] The contractor developed 10 new symbols for the project, including one showing the CSU tip-over hazard and one showing the CSU tip-over hazard with a tip restraint; the remaining 10 symbols already existed. The contractor recruited 80 adults and used the open comprehension test procedures described in ANSI Z535.3, *American National Standard Criteria for Safety Symbols* (2011).

One of the existing symbols the contractor evaluated is the child climbing symbol from the warning label in ASTM F2057. The symbol showed poor comprehension (63.8 percent) with strict (*i.e.*, fully correct) scoring criteria, but passing comprehension (87.5 percent), when scored with lenient (*i.e.*, partially correct) scoring criteria. ANSI Z535.3 defines the criteria for "passing" as at least 85 percent correct interpretations (strict), with fewer than 5 percent critical confusions (*i.e.*, the opposite action is conveyed). There was no critical confusion with the symbol.

The contractor conducted focus groups consisting of 40 of the 80 individuals who went through the comprehension study. Based on the feedback received in the comprehension study and in focus groups, the contractor developed the two new symbol variants shown in Figure 10.

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[73] Further details regarding staff's analysis of warning label symbols is available in Tab C of the NPR briefing package.

[74] Kalsher, M., CPSC Gather Consumer Feedback: Final Report (2019), available at: https://www.cpsc.gov/s3fs-public/CPSC%20Gather%20Consumer%20Feedback%20-%20Final%20Report%20with%20CPSC%20Staff%20Statement%20-%20REDACTED%20and%20CLEARED.pdf?GTPK5CxkCRmftdywdDGXJyVIVq.GU2Tx.

CPSC staff is currently working with the contractor to test these new symbol variants using the same methodology applied in the previous study. CPSC staff plans to assess whether one of the two variants performed better in comprehension testing than the F2057 child climbing symbol, and thereafter, will determine whether any changes to the symbol proposed in this NPR should be modified for the final rule.

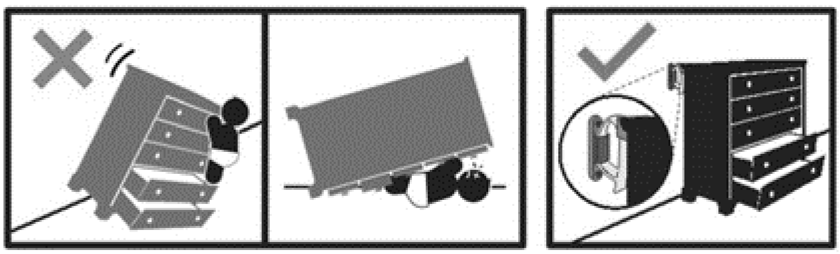
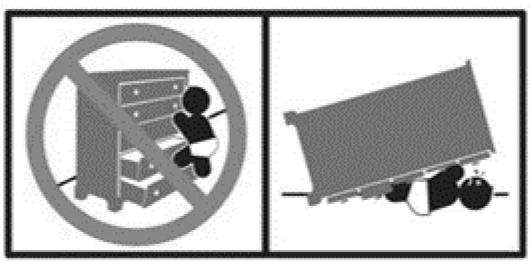
	Variant 1
	Variant 2

Figure 10: Two variant symbols being tested (one showing the importance of anchoring the CSU, the other demonstrating the tip-over hazard as a result of climbing). Note: the symbols are reproduced in grayscale here, but the color version includes a red "x" and prohibition symbol, and a green check mark.

H. Tip Restraints and Anchoring[75]

CPSC considered several studies regarding consumer anchoring of furniture to evaluate the potential effectiveness of tip restraints to help address the tip-over hazard. These studies indicate that a large number of consumers do not anchor furniture, including CSUs, in their homes, and that there are several barriers to anchoring, including consumer beliefs, and lack of knowledge about what anchoring hardware to use or how to properly install it.

[75] Further information about tip restraints and anchoring is in Tab C of the NPR briefing package.

A CPSC Consumer Opinion Forum survey in 2010, with a convenience sample of 388 consumers, found that only 9 percent of those who responded to the question on whether they anchored the furniture under their television had done so (27 of 295).[76] Although a majority of respondents reported that the furniture under their television was an entertainment center, television stand, or cart, 7 percent of respondents who answered this question (22 of 294) reported using a CSU to hold their television.[77] The consumers who reported using a CSU to hold their television had approximately the same rate of anchoring the CSU, 10 percent (2 of 21[78]), as the overall rate of anchoring furniture found in the study.

In 2018, Consumer Reports conducted a nationally representative survey[79] of 1,502 U.S. adults, and found that only 27 percent of consumers overall, and 40 percent of consumers with children under 6 years old at home, had an anchored furniture in their homes. The study also found that 90 percent of consumers have a dresser in their homes, but only 10 percent of those with a dresser have anchored it. Similarly, although 50 percent of consumers have a tall chest or wardrobe in their homes, only 10 percent of those with a tall chest or wardrobe have anchored it. The most common reasons consumers provided for not anchoring furniture, in declining order, included that their children were not left alone around furniture; they perceived the furniture to be stable; they did not want to put holes in the walls; they did not want to put holes in the

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[76] Butturini, R., Massale, J., Midgett, J., Snyder, S., Preliminary Evaluation of Anchoring Furniture and Televisions without Tools, Technical Report CPSC/EXHR/TR—15/001 (2015), available at: https://www.cpsc.gov/s3fs-public/pdfs/Tipover-PreventionProject-Anchors-without-Tools.pdf.
[77] Three consumers identified the furniture as an "armoire," and 19 consumers identified the furniture as a "dresser, chest of drawers, or bureau."
[78] Although 22 respondents reported using a CSU under their television, one of these respondents answered "I don't know" to the question about whether they anchored the furniture.
[79] Consumer Reports, Furniture Wall Anchors: A Nationally Representative Multi-Mode Survey (2018), available at: https://article.images.consumerreports.org/prod/content/dam/surveys/Consumer_Reports_Wall_Anchors_Survey_2018_Final.

furniture; the furniture did not come with anchoring hardware; they don't know what hardware to use; and they had never heard of anchoring furniture.

As discussed earlier in this preamble, the Commission launched the education campaign—Anchor It!—in 2015 to promote consumer use of tip restraints to anchor furniture and televisions. In 2020, a CPSC-commissioned study assessed consumer awareness, recognition, and behavior change as a result of the Anchor It! campaign.[80] The study included 410 parents and 292 caregivers of children 5 years or younger from various locations in the United States. The survey sought information about whether participants had ever anchored furniture in their homes, and their reasons for not anchoring furniture. The study found that 55 percent of respondents reported ever having anchored furniture, with a greater percentage of parents reporting anchoring furniture (59 percent) than other caregivers (50 percent), and a greater percentage of homeowners reporting ever having anchored furniture (57 percent) than renters (51 percent). For participants who did not report anchoring furniture or televisions, the most common reasons respondents gave for not anchoring, in declining order, were that they didn't believe it was necessary, they watch their children, they haven't gotten to it yet, it would damage walls, and they don't know what anchors to use.

These results indicate that one of the primary reasons parents and caregivers of young children do not anchor furniture is a belief that it does not need to be anchored if children are supervised. However, research shows that 2- to 5-year-old children are out of view of a supervising parent for about 20 percent of the time that they are awake, and are left alone

[80] The report for this study, Fors Marsh Group, CPSC Anchor It! Campaign: Main Report (July 10, 2020), is available at: https://www.cpsc.gov/s3fs-public/CPSC-Anchor-It-Campaign-Effectiveness-Survey-Main-Report_Final_9_2_2020....pdf?gC1No.oOO2FEXV9wmOtdJVAtacRLHIMK.

significantly longer in bedrooms, playrooms, and living room areas.[81] CSUs are likely to be in bedrooms, where children are expected to have unsupervised time, including during naps and overnight. Many of the CSU tip-over incidents occurred in children's bedrooms during these unsupervised times. According to the Consumer Reports study, 76 percent of consumers with children under 6 years old reported that dressers are present in rooms where children sleep or play; and the UMTRI study found that nearly all (95 percent) of child participants had dressers in their bedrooms. Notably, among the 89 fatal incidents, 55 occurred in a child's bedroom, 11 occurred in a bedroom, 2 occurred in a parent's bedroom, and 2 occurred in a sibling's bedroom. None of the fatal incidents occurred when the child was under direct adult supervision. However, some nonfatal incidents occurred during supervised time when parents were in the room with the child. As this indicates, supervision is neither a practical, nor effective way to prevent tip-over incidents.

Another common reason caregivers provided for not anchoring furniture was the perception that the furniture was stable. CPSC staff testing and modeling found that there is a large difference in stability of CSUs, depending on the number of drawers open. Adults are likely to open only one or a couple of drawers at a time on a CSU; as such, adult may only have experience with the CSUs in their more stable configurations and may underestimate the tip-over hazard. In contrast, incident analysis shows that some children open multiple or all drawers on a CSU simultaneously, potentially putting the CSU in a much less stable configuration; and children contribute further to instability by climbing the CSU.

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[81] Morrongiello, B.A., Corbett, M., McCourt, M., & Johnston, N., Understanding unintentional injury-risk in young children I. The nature and scope of caregiver supervision of children at home, Journal of Pediatric Psychology, 31(6): 529-539 (2006); Morrongiello, B. A., Ondejko, L., Littlejohn, A., Understanding Toddlers' In-Home Injuries: II. Examining Parental Strategies, and Their Efficacy, for Managing Child Injury Risk. Journal of Pediatric Psychology, 29(6), pp. 433-446 (2004).

CPSC staff also has concerns about the effectiveness of tip restraints and identified tip-over incidents in which tip restraints detached or broke. Overall, given the low rates of anchoring, the barriers to anchoring, and concerns about the effectiveness of tip restraints, CPSC concludes that tip restraints are not effective as the primary method of preventing CSU tip overs. Effective tip restraints may be useful as a secondary safety system to enhance stability, such as for interactions that generate particularly strong forces (*e.g.*, bouncing, jumping), or to address interactions from older/heavier children. In addition, tip restraints may help reduce the risk of tip overs for CSUs that are already in homes, since a rule would only apply to CSUs manufactured and imported on or after the effective date. In future work, CPSC may evaluate appropriate requirements for tip restraints, and will continue to work with ASTM to update its tip restraint requirements.

VIII. Description of and Basis for the Proposed Rule

A. Scope and Definitions

1. Proposed Requirements

The proposed rule applies to CSUs, defined as a freestanding furniture item, with drawer(s) and/or door(s), that may be reasonably expected to be used for storing clothing, that is greater than or equal to 27 inches in height, and with a total functional volume of the closed storage greater than 1.3 cubic feet and greater than the sum of the total functional volume of the open storage and the total volume of the open space. Several terms in that definition, as well as additional terms in the proposed rule, are also defined in the proposed rule. For example, for purposes of the proposed stability testing, tip over is defined as the point at which a CSU pivots forward such that the rear feet or, if there are no feet, the edge of the CSU lifts at least 1/4 inch from the floor or is supported by a non-support element.

The proposed rule specifically states that whether a product is a CSU depends on whether it meets this definition. However, to demonstrate which products may meet the definition of a CSU, the proposed standard provides names of common CSU products, including chests, bureaus, dressers, armoires, wardrobes, chests of drawers, drawer chests, chifforobes, and door chests. Similarly, it names products that generally do not meet the criteria in the proposed CSU definition, including shelving units, office furniture, dining room furniture, laundry hampers, built-in closets, and single-compartment closed rigid boxes (storage chests).

Additionally, the proposed rule exempts from its scope two products that would meet the proposed definition of a CSU—clothes lockers and portable storage closets. It defines clothes locker as a predominantly metal furniture item without exterior drawers and with one or more doors that either locks or accommodates an external lock; and defines portable storage closet as a freestanding furniture item with an open frame that encloses hanging clothing storage space and/or shelves, which may have a cloth case with a curtain(s), flap(s), or door(s) that obscures the contents from view.

2. Basis for Proposed Requirements

To determine the scope of products that the proposed rule should address, in order to adequately reduce the risk of injury from CSU tip overs, staff considered the nature of the hazard, assessed what products were involved in tip-over incidents, and assessed the characteristics of those products in relation to stability and children's interactions.

a. The Hazard

The CSU tip-over hazard relates to the function of CSUs, where they are used in the home, and their design features. A primary feature of CSUs is that typically they are used for clothing storage; however, putting clothing in a furniture item does not create the tip-over hazard on its own. Rather, the function of CSUs as furniture items that store clothing means that consumers and children are likely to have easy access to the unit and interact with it daily, resulting in increased exposure and familiarity. In addition, caregivers may encourage children to use a CSU on their own as part of developing independent skills. As a result, children are likely to know how to open drawers of a CSU, and are likely to be aware of their contents, which may motivate them to interact with the CSU. For this reason, one element of the proposed definition of CSUs is that they be reasonably expected to be used for storing clothing.

CSUs are commonly used in bedrooms, an area of the home where children are more likely to have unsupervised time. As stated, most CSU tip-over incidents occur in bedrooms: among the 89 fatal tip-over incidents involving children and CSUs without televisions, 99 percent of the incidents with a reported location (70 of 71 incidents) occurred in a bedroom.[82] This use means that children have more opportunity to interact with the unit unsupervised, including in ways more likely to cause tip over (*e.g.,* opening multiple drawers and climbing) that a caregiver may discourage.

Another primary feature of CSUs is closed storage, which is storage within drawers or behind doors. These drawers and doors are extension elements, which allow children to exert vertical force further from the tip point (fulcrum) than they would be able to without extension elements and that make it more likely that a child will tip the product during interactions. In

[82] Fifty-five incidents were in a child's bedroom; 11 were in a bedroom; 2 were in a parent's bedroom; another 2 were in a sibling's bedroom; and 1 occurred in a hallway. The location in 18 incidents was not clear.

addition, these features may make the product more appealing to children as a play item. Children can open and close the drawers and doors and use them to climb, bounce, jump, or hang; they can play with items in the drawers, or get inside the drawers or cabinet. Children can also use the CSU extension elements for functional purposes, such as climbing to reach an item on top of the CSU. Accordingly, the proposed definition of CSUs includes a minimum amount of closed storage and the presence of drawers and/or doors as an element. The element that a CSU has a total functional volume of the closed storage greater than 1.3 cubic feet and greater than the sum of the total functional volume of the open storage and the total volume of the open space is based on the total functional drawer volume for the shortest/lightest reported CSU involved in a nonfatal incident without a television. CPSC rounded the volume down, so that the CSU would be included in the proposed definition.

The proposed CSUs definition also states that they products are freestanding furniture items, which means that they remain upright, without requiring attachment to the wall, in their normal use position. The lack of permanent attachment to the building structure means that CSUs are more susceptible to tip over than built-in storage items in the home, such as kitchen cabinets and bathroom vanities.

b. Product Categories in Incident Data

For this rulemaking, staff focused on product categories that commonly meet the general elements of the definition of a CSU, in analyzing incident data; these included chests, bureaus, dressers, armoires, wardrobes, portable storage closets, and clothes lockers. As detailed in the discussion of incident data, of the 89 fatal CPSRMS tip-over incidents involving children and CSUs without televisions, 87 involved chests, bureaus, or dressers, and 2 involved wardrobes; none involved an armoire, portable storage closet, or clothes locker. Of the 263 nonfatal

CPSRMS incidents with children and CSUs without televisions, 259 involved chests, bureaus, or dressers, 1 involved an armoire, and 3 involved wardrobes. Of the estimated 40,700 emergency department-treated injuries to children from CSU tip overs (without a television) between January 1, 2006 to December 31, 2019, an estimated 40,200 involved "chests, bureaus, and dressers." There were not enough incidents involving armoires, wardrobes, portable storage closets, or clothes lockers to make estimates for these CSU categories.

Based on these data, the proposed definition of CSUs names chests, bureaus, dressers, wardrobes, and armoires as examples of CSUs that are subject to the standard. The proposed rule exempts clothes lockers and portable storage closets from the scope of the standard because there are no reported tip-over fatalities or injuries to children that involved those products. Compared to chests, bureaus, and dressers, wardrobes and armoires have been involved in fewer tip-over incidents. However, the proposed rule includes these products because there are some tip-over fatalities and injuries involving them, they are similar in design to the other CSUs included in the scope (unlike portable storage closets), and they are more likely to be used in homes than clothes lockers.

c. Product Height

ASTM F2057-19 applies to CSUs that are "27 in. (686 mm) and above in height." Previously, the ASTM standard had applied to CSUs taller than 30 inches. However, CPSC staff identified tip-over incidents involving CSUs that were 30 inches in height and shorter, and worked with the ASTM F15.42 Furniture Subcommittee to lower the minimum height of CSUs covered by the standard. This same 27-inch height is used in the proposed rule's definition of a CSU, consistent with this incident data and additional information regarding product heights.

The height of the CSU was reported for 53 fatal and 72 nonfatal CPSRMS tip-over incidents involving children and CSUs without televisions. The shortest reported CSU involved in a fatal incident without a television is a 27.5-inch-tall, 3-drawer chest, which tipped over onto a 2-year-old child. The shortest reported CSU involved in a nonfatal CPSRMS tip-over incident without a television is a 26-inch-tall, 2-drawer chest.[83] NEISS data do not provide information about the height of CSUs involved in incidents.

Results from the FMG's CSU focus group (Tab Q of the NPR briefing package) suggest that consumers seek out low-height CSUs for use in children's rooms "because participants would like a unit that is an appropriate height (*i.e.*, short enough) for their children to easily access their clothes." The average shoulder height of a 2-year-old is about 27.4 to 28.9 inches.[84] In the in-home interviews, researchers observed that CSUs in children's rooms typically were low to the ground and wide. Based on this information, children may have more access and exposure to low-height CSUs than taller CSUs.

Additionally, staff is aware of shorter CSUs on the market, as short as 18 inches.[85] For example, a major furniture retailer currently sells more than 10 products marketed as "chests" or "dressers," ranging in height from 19.25 inches to 26.75 inches, including a 25.25-inch-tall, 3-drawer chest advertised for use in a child's room. ESHF staff believes that children may still be motivated to climb or otherwise interact with shorter units: home interview participants in the

[83] The product is marketed as a "chest," but was called a "nightstand" in the consumer's report.
[84] The mean standing shoulder height of a 2-year-old male is 28.9 inches and 27.4 inches for a 2-year-old female. Pheasant, S., Bodyspace Anthropometry, Ergonomics & Design. London: Taylor & Francis (1986).
[85] Industrial Economics, Incorporated (2019). Final Clothing Storage Units (CSUs) Market Research Report. CPSC Contractor Report. Researchers analyzed the characteristics of 890 CSUs, and found a height range of 18 to 138 inches.

Fors Marsh CSU use study said that children climbed short furniture items in the home, such as nightstands and ottomans. For these reasons, the Commission seeks comments on the 27-inch height specified in the proposed CSU definition.

d. Children's Products

As discussed in section **III.A. Description of the Product**, section 14(a) of the CPSA includes requirements for certifying that children's products and non-children's products comply with applicable mandatory standards, and additional requirements apply to children's products. That section also explains what constitutes a "children's product." To summarize, a "children's product" is a consumer product that is "designed or intended primarily for children 12 years of age or younger." 15 U.S.C. 2052(a)(2).

CPSC is aware of CSUs that are marketed, packaged, displayed, promoted, or advertised as being for children under 12 years old. These CSUs may be sold as part of matching nursery or children's bedroom furniture sets, or have features or themes that appeal to children, such as bright colors and cartoons. CSUs may be sold at children's retailers, or by manufacturers that specialize in children's furniture.

However, some children's furniture is similar in appearance to general-use furniture. In addition, some CSUs convert from a child-specific design, such as a CSU with an integrated changing table, to a more general-use design. Children's furniture with a more general-use design or with the ability to convert may be appealing to consumers who want furniture that they can continue to use as a child gets older.

CSUs that are children's products have been involved in fatal and nonfatal incidents, and are among recalled CSUs. However, CSUs that are general-use products make up more of the CSUs in the tip-over incident data. Additionally, the CSU study shows that CSUs that children interact with are not limited to CSUs intended for children. For these reasons, the proposed rule applies to both children's products and non-children's products.

e. Product Names and Marketed Use

The proposed definition of CSUs relies on characteristics of the unit to identify covered products, rather than product names or the manufacturer's marketed use of the product. This is because, as this preamble discusses, there are various products that consumers identify and use as CSUs, and that pose the same tip-over hazard, regardless of how the product is named or marketed.

In the FMG CSU use study (Tab Q of the NPR briefing package), participants showed flexibility in how they used CSUs and other similar furniture in the home, depending on their needs, aesthetics, and where the unit was placed within the home. For example, one participant put a large vintage dresser in their living room and used it for non-clothing storage; one participant said that their dresser was used as a changing station and held diapers, wipes, creams, and medical supplies, but is now used to store clothes; and a participant said that the dresser in their child's room was originally used to store dishes.

Some participants in the in-home interviews and focus groups used nightstands for clothing storage, including for shirts, socks, pajamas, slippers, underwear, smaller/lighter items, such as tights or nightwear, seasonal items, and accessories. Some participants also reported storing clothing (*e.g.*, seasonal clothing items, underwear, pajamas, pants) in shelving units with removable bins (including those with cloth, canvas, or basket material). Consumers also had a wide variety of interpretations of the marketing term "accent piece," with some participants saying that they use accent pieces for clothing storage, and one identifying a specific accent piece in their home as a CSU.

As part of the study, researchers asked focus group participants to fill out a worksheet with pictures of unnamed furniture items with dimensions. Participants were asked to provide a product label (category of product) and answer the question: “What would you store in this piece of furniture?” “Where would you put this piece of furniture in your home?” Participants then discussed the items as a group. Results suggest that there is a wide variety in how people perceive a unit. For example, one unit in the study was classified by participants as a cabinet, television stand, accent/occasional/entryway piece or table, side table/sideboard, nightstand, kitchen storage/hutch/drawer, and dresser. Another was classified as an accent piece, buffet/sideboard, dresser, entry/hall/side table, chest/chest of drawers, kitchen storage unit/cabinet, sofa table, bureau, and china cabinet. One interesting item of discussion was the glass doors on one of the worksheet furniture items. Participants came to a general consensus that glass doors are typically used to display items, and thus, an item with glass doors is not a CSU.

Overall, the results from the study suggest that there is not a distinct line between units that people will use for clothing storage, as opposed to other purposes; and even within a unit, the use can vary, depending on the consumer’s needs at the time.

Moreover, staff is aware of products that are named and advertised as generic storage products with multiple uses around the house, or they are advertised without context suggesting a particular use. Many of these items clearly share the design features of CSUs, including closed storage behind drawers or doors. In addition, staff is aware of products that appear, based on design, to be CSUs, but are named and advertised for other purposes (*e.g.*, an “accent piece” with drawers staged in a foyer, and large multi-drawer “nightstands” over 27-inches tall). Staff is also aware of hybrid products that combine features of CSUs with features of other product categories; for example, bookshelf storage products with shelving and closed storage behind drawers or doors; desks or tables with large amounts of attached closed storage; bedroom media furniture with an electronics slot and drawers for clothing; and beds with integrated CSU storage.

Using the criteria in the proposed definition of a CSU, products typical of shelving units, office furniture, dining room furniture, laundry hampers, built-in units, and single-compartment closed rigid boxes likely would not be CSUs. The proposed rule excludes these products, by including in the definition of "CSUs" that a CSU is freestanding; has a minimum closed storage functional volume greater than 1.3-cubic feet; and a closed storage functional volume greater than the sum of the open storage function volume and open space volume; has drawer(s) and/or door(s); and it is reasonably expected to be used for clothing. Staff assesses that some underbed drawer storage units, occasional/accent furniture, and nightstands could be CSUs. The criteria for identifying a CSU in the proposed rule would keep some of these products within scope, and exclude others, depending on their closed storage, reasonable expected use, and the presence of doors/drawers, such that those products that may be used as CSUs and present the same hazard, would be within the scope of the standard, while those that would not, would be excluded.

Because consumers select units for clothing storage based on their utility, not necessarily their marketing, and there are products that are not named or advertised as CSUs, but are indistinguishable from CSUs, based on their design, the proposed scope and CSU definition do not rely on how a product is named or advertised by a manufacturer.

f. Number of Drawers

CPSC also considered including, as an element of the proposed CSU definition, the number of drawers in the unit, but did not ultimately do so. The FMG CSU use study (Tab Q of the NPR briefing package) examined how consumers define CSUs and what they use to store clothing in their homes. Focus group participants defined CSUs as anything that can hold clothing; dressers, closets, and armoires were the most common example product categories that participants provided. Participants said that CSUs are used "for organization and the protection of clothing (*e.g.*, drawers of various sizes, dividers to help with organization, and doors to keep clothing out of sight)." Researchers reported that "the majority of participants reported that they generally think of a CSU as having at least three drawers. However, a few participants noted that a CSU could have four drawers, whereas others mentioned that, to be considered a CSU, a unit only needed one drawer. Participants often considered a unit with two drawers or fewer to be a nightstand." Because of the varied perceptions about the number of drawers for a unit to be considered or used as a CSU, CPSC did not include this as an element of the definition.

g. Overall Size and Storage Volume

Apart from the functional volume of closed storage, which is included in the proposed CSU definition, CPSC also considered the overall size of units as potential elements of the CSU definition, but did not ultimately include them.

In the FMG CSU focus groups (Tab Q of the NPR briefing package), participants discussed how the size of a unit influenced their perception of whether a unit is a CSU. Researchers found: "[t]he majority of participants noted that if a unit is too small, they will not store clothing in it, because the clothing will not fit"; however, participant's perception of "too small" varied. Researchers found: "a few participants noted that CSUs in their children's room are smaller than their typical definitions. The units are shorter so that their children can more easily access drawers, and drawers are smaller to fit smaller clothing." Although there was no a consensus on drawer size for a CSU, participants preferred "to have drawers that are large enough (*e.g.*, bigger than a shirt) and deep enough to hold clothing." They also showed flexibility on drawer volume: "[o]ne participant mentioned that there is a difference between what they would ideally like in terms of drawer size and what they will accept." They said ideally, they would like drawers deep enough to easily store clothing; however, participants noted that the current dresser they have requires them to shove or stuff their clothing inside. Furthermore, the specific size of the drawers was reported to vary, based on the needs of each person and the size of the home.

The minimum drawer size that could reasonably accommodate clothing is fairly small. For example, the functional volume of each drawer of the shortest/lightest reported CSU involved in a nonfatal CSU tip-over incident without a television—a 26-inch-high by 15-inch-deep by 21 ¼-inch-wide, 2-drawer chest—is slightly less than 0.7 cubic feet;[86] and the manufacturer states that the drawer holds about 5 pairs of folded pants or 10 T-shirts. Furthermore, except for the extremes (*i.e.*, very short, very narrow, very shallow), the shape of the drawer should not have an effect on the amount of clothing that can be stored in the drawer because clothing can be folded or stuffed to match the drawer dimensions.

Because small units and small drawers can be used to hold clothing, the proposed CSU definition does not include additional requirements for overall size and storage volume.

h. Product Weight

CPSC also considered whether to include a weight criteria in the proposed CSU definition, but did not do so. The weight of the CSU was reported for 17 fatal and 25 nonfatal CPSRMS tip-over incidents with a child and no television. The lightest-weight reported CSU involved in a fatal tip-over incident without a television is a 5-drawer CSU with the bottom 3

[86] The drawers of the current model of the product are 12 ½ inches deep x 13 ⅜-inch-wide, and the clearance height is 7 ¼ inches. The functional drawer volume of each drawer is 0.69 cubic feet, using the equation in Tab L of the NPR briefing package; the total functional drawer volume for the 2-drawer CSU is 1.38 cubic feet.

drawers missing, which tipped over on a 2-year-old child. The unit weighed 34 pounds without the 3 drawers, the configuration at the time of the incident. The lightest weight reported, non-modified CSU involved in a fatal tip-over incident without a television is a 57 pound, 3-drawer chest, which tipped over onto a 2-year-old child.[87] Other fatal incidents involving light-weight CSUs include a 57.5 pound, 4-drawer wicker dresser without a television that tipped over onto an 18-month old child and a 68-pound, 3-drawer chest that tipped over in three separate fatal incidents without televisions, resulting in the death of a 23-month-old child, and two 2-year-old children.

The reported lightest weight CSU involved in a nonfatal incident without a television is a 31-pound, 2-drawer chest, which tipped over and pinned a 13-month-old child.[88] In another nonfatal incident with no television, a 45-pound, 3-drawer chest tipped onto a 3-year-old child.

Staff is aware of some lightweight plastic units marketed and used as CSUs.[89] Staff found many lightweight frame and drawer units marketed online as CSUs. Staff also found many online videos showing consumers using lightweight plastic units to store children's clothing. In addition, one of the participants in the CSU use study said they got a plastic stackable drawer unit to store children's clothing. Based on this information, consumers will perceive and use lightweight units as CSUs.

With an assumed clothing load of 8.5 pounds per cubic foot of storage volume, many lightweight units could be filled to the same weight as the incident-involved units. The 34-pound unit referenced above had minimal clothing in it, and the 57-pound unit was reportedly empty at

[87] This is the same unit as the shortest known CSU involved in a fatal tip-over incident involving a child and CSU without a television.
[88] This is the same unit, identified by the consumer as a "nightstand," but marketed as a "chest," as the shortest known CSU involved in a nonfatal tip-over incident a child and CSU without a television.
[89] For this analysis, staff only considered lightweight units with drawers and/or doors. Staff is also aware that consumers use storage bins with lids to store clothing; however, staff does not consider these to be CSUs, based on the proposed definition.

the time of the fatal incident. Staff did not identify any tip-over incidents involving plastic units in the fatal and nonfatal CSPRMS data involving children without a television; however, staff cautions that in 64 fatal and 20 nonfatal incidents, model names were not obtained and could have included plastic units.

Because consumers will perceive and use lightweight units as CSUs, and it is possible to fill lightweight units with clothing loads that exceed the lowest product weights seen in the incident data, these units are included in the proposed rule.

B. Stability Requirements

1. Proposed Requirements

The proposed requirements for stability of CSUs consist of configuring the CSU for testing, performing testing using a prescribed procedure, and determining whether the performance results comply with the criteria for passing the standard.

To configure the CSU for testing, the proposed rule requires the CSU to be placed on a hard, level, flat surface, which the standard defines. If the CSU has a levelling device, the device is adjusted to the lowest level and then according to the manufacturer's instructions. The CSU is then tipped forward 1.5 degrees, and if there is a levelling device intended for a carpeted surface, the device is adjusted in accordance with the manufacturer's instructions for a carpeted surface.

All doors (as defined in the standard) are then open to a specified position and fill weights are placed in drawers and pull-out shelves, depending on whether there are interlocks on the unit. Because the test configuration differs, depending on the presence of interlocks, the proposed rule requires testing the interlocks before conducting the stability testing.

The interlock testing consists of placing the CSU on a hard, level, flat surface (as defined in the standard), levelling according to manufacturer instructions, securing the unit to prevent sliding or tip over, and opening the number of drawers necessary to engage the interlock. A 30-pound horizontal pull force is then applied on each locked drawer, one at a time, over a period of 5 seconds, and held for at least 10 seconds. This pull test is repeated until all possible combinations of drawers have been tested. If any locked drawer opens or the interlock is damaged, during this testing, then the interlock is to be disabled or bypassed for the stability testing.

For the stability testing, for units without an interlock or that did not pass the interlock test, all drawers and pull-out shelves are open to their maximum extension (as defined in the standard), and a fill weight of 8.5 pounds per cubic foot times the functional volume (in cubic feet) is placed in the center of each drawer or pullout shelf. For units with an interlock that passed the interlock test, all drawers that are not locked by the interlock are open to the maximum extension (as defined in the standard), in the configuration most likely to cause a tip over (typically the largest drawers in the highest position open). If 50 percent or more of the drawers and pull-out shelves by functional volume are open, a fill weight is placed in the center of each drawer or pull-out shelf, including those that remain closed. The fill weight is 8.5 pounds per cubic foot) times the functional volume (cubic feet). If less than 50 percent of the drawers and pull-out shelves by functional volume are open, no fill weight is placed in any drawers or pull-out shelves.

The proposed rule provides two test methods for the tip-over test. Test Method 1 is most appropriate for CSUs with drawers or pull-out shelves. It involves applying a vertical force to the face of the uppermost extended drawer or pull-out shelf to cause the unit to tip over (defined as the point at which a CSU pivots forward such that the rear feet (or edge) lifts at least 1/4 inch from the floor or is supported by a non-support element). At that point, the tip-over moment of the unit is calculated by multiplying the tip-over force (as defined in the standard) by the horizontal distance from the force application point to the fulcrum (as defined in the standard). If a drawer breaks during the test due to the force, Test Method 2 should be used or the drawer can be secured or reinforced, as long as the modifications do not increase the tip-over moment.

Test Method 2 is appropriate for any CSU. It involves applying a horizontal force to the back of the CSU orthogonal (*i.e.*, at a right angle) to the fulcrum to cause the unit to tip over. The tip-over moment is then calculated by multiplying the tip-over force by the vertical distance from the force application point to the fulcrum.

Once the tip-over moment for the CSU has been determined, that value must be greater than several comparison moments, as applicable, depending on the design of the CSU. The first comparison moment applies to CSUs with drawers or pull-out shelves and is 55.3 pounds times the drawer or pull-out shelf extension form the fulcrum distance (as defined in the standard), plus 26.6 pounds feet. The second comparison moment is for units with doors and is 51.2 pounds times the *door extension from fulcrum distance* (as defined in the standard, in feet), minus 12.8. The third comparison moment applies to all CSUs and is 17.2 pounds times the maximum handhold height (as defined in the standard, in feet). The greatest of these three comparison tip-over moments is considered the threshold moment, which the tested CSU's tip-over moment must exceed.

2. Basis for Proposed Requirements

As described in this preamble and the NPR briefing package, there are several factors that are commonly involved in CSU tip-over incidents that contribute to the instability of CSUs, and a number of these factors often occur simultaneously. These include multiple open and filled drawers, carpeting, and forces generated by children's interactions with the CSU (such as climbing and opening/pulling on drawers). The proposed rule includes requirements to simulate or account for all of these factors, in order to accurately assess the stability of CSUs during real-world use.

The stability testing in the proposed rule simulates these factors simultaneously (*e.g.*, all drawers open and filled, on carpet, and accounting for child interaction forces). This is because incident data indicate that these factors commonly exist at the same time. For example, incidents include children climbing on open drawers, filled with clothing.

a. Multiple Open and Filled Drawers

As discussed in section **IV.C. Hazard Characteristics**, opening drawers of a CSU was a common interaction in CSU tip overs involving children and only a CSU. It was the most common reported interaction (63 percent) in nonfatal CPSRMS incidents; it was the second most common reported interaction (8 percent) in nonfatal NEISS incidents; and it was the third most common reported interaction (9 percent) in fatal CPSRMS incidents. Children as young as 11 months were involved in incidents where the child was opening one or more drawers of the CSU, and the incidents commonly involved 2- and 3-year-olds. In numerous incidents, the children opened multiple or all of the drawers. The youngest child reported to have opened all drawers was 13 months old.

The incident analysis also indicates that, of the CSU tip-overs involving children and only CSUs for which the reports indicated the contents of the CSU, 96 percent of fatal CPSRMS incidents involved partially filled or full drawers; and 90 percent of the nonfatal CPSRMS incidents involved partially filled or full drawers. Most items in the drawers were clothing.

As this preamble explains, opening extendable elements (drawers, doors, pull-out shelves) shifts the CG towards the front of the CSU, and the closer the CG is to the front leg, the easier it is to tip forward if a force is applied to the drawer. Therefore, CSUs will tip more easily as more drawers are opened. The CG of a CSU will also change depending on the position and amount of clothing in each drawer. Closed drawers filled with clothing tend to stabilize a CSU, but as each filled drawer is pulled out, the CG of the CSU will further shift towards the front. Staff's testing demonstrates this principle, finding that multiple open drawers decrease the stability of a CSU, and filled drawers further decrease stability when more than half of the drawers by volume are open, but increase stability when more than half of the drawers by volume are closed.

Taken together, this information indicates that children commonly open multiple filled drawers simultaneously during CSU tip-over incidents, and that doing so decreases the stability of the CSU if half or more of the drawers by volume are open. Accordingly, the proposed rule includes multiple open and filled drawers as part of the unit configuration for stability testing, and varies whether drawers are filled depending on how many of the drawers and pull-out shelves can open, as determined by an interlock system.

As staff testing showed, when all CSU drawers are pulled out and filled, the unit is more unstable. However, when CSU drawers have interlocks or other means that prevent more than half the drawers by volume from being pulled out simultaneously, the CSU tips more easily with all drawers empty. Accordingly, when an interlock or other means prevents more than half the drawers and pullout shelves by interior volume from being opened simultaneously, the proposed rule requires that no fill weight be placed in the drawers.

Although fewer incidents involved CSUs with doors, those incidents indicate that children opened the doors of the CSU. Moreover, in many CSUs with doors, the doors must be open to access the drawers. Given these considerations, and that opening doors makes a CSU less stable, the proposed rule also requires doors to be open during stability testing.

i. Fill Density

As discussed in section **VII.A. Multiple Open and Filled Drawers**, staff assessed the appropriate method for simulating CSU drawers that are partially filled or fully filled (Tab L of the NPR briefing package). To do this, staff looked at the standard that ASTM considered (8.5 pounds per cubic foot) and the results of the Kids in Danger and Shane's Foundation study[90] (which found an average density of 8.9 pounds per cubic foot). To assess whether the 8.5 pounds per-cubic-foot measure reasonably represents the weight of clothing in a drawer, CPSC staff conducted testing with folded and unfolded children's clothing on drawers of different sizes. For all three drawer sizes, staff was able to fit 8.5 pounds per cubic foot of unfolded and folded clothing fill in the drawers. When the clothing was folded and unfolded, the clothing fully filled the drawers, but still allowed the drawer to close. The maximum unfolded clothing fill density was slightly higher than 8.5 pounds per cubic foot for all tested drawers; and the maximum unfolded clothing fill density ranged from 8.56 to 8.87 pounds per cubic foot, depending on the drawer. The maximum folded clothing fill density ranged from 9.40 to 10.16 pounds per cubic foot, depending on the drawer.

Based on this testing, staff found that 8.5 pounds per cubic foot of clothing will fill a drawer. This amount of clothing is less than the absolute maximum amount of clothing that can be put into a drawer, especially if the clothing is folded, however, the maximum amount of unfolded clothing that could be put into the tested drawers was only slightly higher than 8.5 pounds per cubic foot. Although staff achieved a clothing density as high as 10.16 pounds per

[90] Kids in Danger and Shane's Foundation (2016). Dresser Testing Protocol and Data. Data set provided to CPSC staff by Kids in Danger, January 29, 2021.

cubic foot with folded clothing, consumers may be unlikely to fill a drawer to this level because it requires careful folding, and it is difficult to remove and replace individual pieces of clothing. On balance, CPSC considers 8.5 pounds per cubic foot of functional drawer volume a reasonable approximation of the weight of clothing in a fully filled drawer.

Because CSUs are reasonably likely to be used to store clothing, and incident data indicates that CSUs involved in tip-over incidents commonly include drawers filled with clothing, the proposed rule requires 8.5 pounds per cubic foot as fill weight when more than half of the drawers by volume are open.

ii. Interlocks

Because the fill level, as well as the stability of a CSU, depends on how many drawers can open, the standard also includes a requirement that the interlock system withstand a 30-pound horizontal pull force. Without such a requirement, consumers may be able to disengage the interlock, or the interlock may break, resulting in more filled drawers being open during real-world use, and less stability, than assessed during stability testing.

Staff assessed the pull strength of children to determine an appropriate pull force requirement for the interlock test (and the comparison moment for pulling open a CSU), and found that the mean pulling strength of 2- to 5-year-old children on a convex knob (diameter 40 mm) at their elbow height is 59.65 Newton (13.4 pound-force) for males and 76.43 Newton (17.2 pound-force) for females.[91] In the study from which staff drew these values, participants were asked to exert their maximum strength at all times, described as the highest force they could exert without causing injury. Participants were instructed to build up to their maximum strength in the first few seconds, and to maintain maximum strength for an additional few seconds.

[91] DTI (2000). Strength Data for Design Safety – Phase 1 (DTI/URN 00/1070). London: Department of Trade and Industry.

Participants were instructed to use their dominant hand. Based on this, children between 2 and 5 years old can achieve a mean pull force of 17.2 pounds. ANSI/SOHO S6.5 includes a slightly higher horizontal pull force of 30-pounds in its stability requirements. To ensure that the standard adequately assesses the integrity of interlock systems, the proposed rule includes a 30-pound horizontal pull force.

iii. Maximum Extension

The proposed rule requires that all extension elements—including drawers, doors, pullout shelves—be opened to the maximum extension and least-stable configuration. The proposed rule defines maximum extension. The general conceptual framework is that all drawers are opened fully, or if there is an interlock, the worst-case drawers that can be opened at the same time will be opened fully. Maximum extension for drawers and pull-out shelves is the furthest manufacturer recommended use position, as indicated by way of a stop; if there are multiple stops, they are open to the stop that allows the furthest extension; if there is no stop, they are open to 2/3 the shortest internal length of the drawer or 2/3 the length of the pullout shelf.

b. Carpeting

As discussed in section **IV.C. Hazard Characteristics**, of the fatal CPSRMS tip-over incidents involving children and only CSUs that reported the type of flooring the CSU was on, 82 percent involved carpeting. Of the incidents that provided photos, the carpet was typical wall-to-wall carpet, with most being cut pile, and a few being looped pile. Of the nonfatal CPSRMS tip-over incidents involving children and only CSUs that reported the type of flooring, 80 percent involved carpeting. Thus, for incidents where flooring type was reported, carpet was by far the most prevalent flooring type.

As discussed earlier, staff testing that showed that CSUs with a variety of designs and stability levels were more stable on a hard flooring surface than they were on carpeting. Consistent with incident data, staff used wall-to-wall carpet for this testing and tested the CSU stability with various configurations of open and filled drawers. For 94 percent of the comparison weights (including multiple variations of open and filled drawers), the units were more stable on the hard surface than on carpet, with a mean difference in tip weight of 7.6 pounds.

Therefore, based on incident data and testing, CSUs are commonly on carpet during CSU tip-over incidents, and carpet increases the instability of the CSU. Accordingly, the proposed rule includes a requirement that simulates the effect of carpet in order to accurately mimic real-world factors that contribute to CSU instability. To determine how to simulate the effect of carpet, section **VII.C. Flooring** explains that staff compared the tip weights of CSUs on carpet with the tip weights for the same units when tilted forward to various degrees on a hard, level, flat surface. Staff found that the tip weight of CSUs on carpet corresponded with tilting the CSUs forward 0.8 to 3 degrees, depending on the CSU, with the mean tilt angle that corresponded to the CSU tip weights on carpet being 1.48 degrees. Therefore, a forward tilt of 1.5 degrees replicates the effect of carpet on CSU stability, and this is included in the CSU configuration requirements for the stability testing in the proposed rule.

c. Test Methods

The proposed rule provides two test methods for applying force to a CSU to determine its tip-over moment. The first test method involves applying a vertical load to the top surface of a fully extended drawer on the CSU; the second test method involves applying a horizontal load to the rear of the CSU, causing it to tip forward. Based on staff's testing (Tab M of the NPR briefing package), these methods produce approximately equal tip-over moments. For this reason, the proposed rule allows either test method to be used. However, because the first test method requires the use of a drawer, the proposed rule specifies that the first test method is appropriate for such products. The second test involves applying force to the back of a CSU and, as such, it can be used for any design.

Both test methods require the location of the fulcrum to be determined and the distance from the open drawer face to the fulcrum to be measured. Intuitively, the fulcrum is located at the front of the bottom-most surface of the CSU.[92] This is the point or line about which the CSU pivots when it tips forward. Therefore, the proposed rule defines the fulcrum as the bottom point or line of the CSU touching the ground about which the CSU pivots when a tip-over force is applied. The fulcrum is typically located at the line connecting the front feet. However, for CSUs without feet, or for CSUs with an irregular pattern of feet, the fulcrum may be in a different location. Some CSUs may have multiple fulcrums that will vary, depending on the direction the tip-over force is applied. The fulcrum that results in the smallest tip-over moment should be determined. If testers choose to use a horizontal load, the load should be applied such that the tip-over moment is minimized (typically orthogonal to the fulcrum). For this reason, the proposed rule requires the horizontal force to be applied to the back of the unit orthogonal to the fulcrum.

[92] For CSUs with circular pads on the feet, ESMC staff typically had higher numerical correlation between test results and numerical analysis when the tip over fulcrum in the calculation was placed at the center of the pads on the front feet (rather than the front of the pads). The difference between the two results was small. Staff does not consider foot pad geometry a significant factor in determining the tip-over moment of a CSU.

d. Performance Requirements

i. Pass-Fail Criteria

Once the tip-over moment has been calculated using one of the methods above, the proposed rule specifies that the tip-over moment of the CSU must be greater than several comparison tip-over moments (the greatest of which is considered the threshold moment). These comparison tip-over moments determine whether that tip-over moment of the CSU is sufficient to withstand tipping over when child interactions identified in incidents and measured by UMTRI occur. Staff developed three pass-fail criteria based on three child interactions that can lead to CSU tip-over incidents. The first interaction is a child climbing (ascending) a CSU; the second is a child pulling on a handhold of a CSU while opening, or attempting to open a drawer; and the third is a child climbing (hanging) on the door of a CSU.

Staff expects that the comparison tip-over moment for ascending the CSU will be the most onerous requirement for most CSUs. However, some CSUs with particular geometric features, or without drawers, may have greater tip-over moments associated with the alternative criteria, based on children's interactions with the CSU.

ii. Climbing

As described earlier in this preamble, of the fatal CPSRMS tip-over incidents involving children and only a CSU that reported the type of interaction, 74 percent involved a child climbing on the CSU. Climbing was the most common reported interaction for children 3 years old and younger. Of the nonfatal CPSRMS tip-over incidents involving children and only a CSU that reported the type of interaction, 20 percent involved a child climbing on the CSU. Of the nonfatal NEISS CSU tip-over incidents involving children and only CSUs that reported the type of interaction the child was engaged in, 77 percent involved climbing on the CSU. For children 3 years old or younger, climbing constituted almost 80 percent of reported interactions. Overall, 81 percent of the reported interactions in the nonfatal NEISS tip-over incidents involving children and only CSUs are those in which the child's weight was supported by the CSU (*e.g.*, climbing, in drawer, jump, on top, swinging). Thus, in fatal and nonfatal incidents, a child climbing on the CSU was one of the most common reported interactions.

Of climbing incidents with a reported age, the children were 3 years old or younger in 94 percent of the fatal CPSRMS incidents; 73 percent of the nonfatal NEISS incidents; and 60 percent of the nonfatal CPSRMS incidents. Climbing behavior is consistent with expected motor development of children this age.

CPSC staff's analyses of tip-over incidents in Tab M of the NPR briefing package outline several scenarios where children climbing or interacting with the front of a CSU caused the CSU to tip over. In some of the scenarios, the force on the edge of an open drawer associated with tipping the CSU was greater than the static weight of a child standing on the edge of an open drawer of the CSU. The equivalent force consists of the child's weight, the dynamic force on the edge of the drawer due to climbing, and the effects of the child's CG extending beyond the edge of the drawer. Based on the UMTRI study, staff estimated the equivalent force to be more than 1.6 times the weight of the child for typical drawer extensions. Therefore, these tip over incidents occurred because the forces and moments associated with children climbing on a CSU exceeded the static body weight of a child standing on the edge of an open drawer.

Staff determined that the ascend interaction from the UMTRI child climbing study was the most representative of a child climbing interaction seen in the incident data. As discussed in Tab D of the NPR briefing package, based on the UMTRI study of child climbing behaviors (Tab R of the NPR briefing package), ascent can be described by the following equation:

$$M = \{1.08\,[Fulcrum\,X(\text{ft})] + 0.52\text{ ft}\,\} \times Weight\ of\ child\ (\text{lb})$$

In this equation, Fulcrum X is the horizontal distance from the front of the extended drawer to the fulcrum.

In the UMTRI study, other measured climbing interactions involving climbing into drawers and climbing onto the table top generated lower moments than ascent; thus, they are included within performance requirements based on ascent.

Because most climbing incidents involved children 3 years old and younger, the proposed rule uses the 95th percentile weight of 3-year-old children (51.2 pounds) in this equation to generate the first comparison tip-over moment. The 95th percentile weight of 3-year-old boys is 51.2 pounds and the 95th percentile weight of 3-year-old girls is 42.5 pounds.[93] To address the heaviest of these children, the proposed rule uses 51.2 pounds. Moreover, as described earlier in this preamble, this is consistent with the weight of children involved in tip-over incidents, particularly for climbing incidents, when known, or when estimated by their age.

Based on these considerations, to pass the moment requirement for a child ascending a CSU, the tip-over moment (M_{tip}) of the CSU must meet the following criterion: M_{tip} (lb-ft) > 51.2 (1.08X + 0.52), where X is the horizontal distance (in feet) from the front of the extended drawer to the fulcrum.[94] Simplified, this is M_{tip} (lb-ft) > 55.3X+26.6.

CPSC staff calculates that CSUs that meet a requirement based on the climbing force generated by a 51.2-pound child, and that considers the effects of all drawers (or doors) open and drawers filled, plus the effect of carpet on stability, likely will protect 95 percent of 3-year-old

[93] Fryar CD, Carroll MD, Gu Q, Afful J, Ogden CL. (2021). Anthropometric reference data for children and adults: United States, 2015–2018. National Center for Health Statistics. Vital Health Stat 3(46). Three years of age covers children who are at least 36 months old and under 48 months old.
[94] For a CSU without drawers, X is measured from the fulcrum to the front edge of the farthest extended element, excluding doors. If the CSU has no extension elements (other than doors), X is measured from the fulcrum to the front of the CSU.

boys by weight and more than 95 percent of 3-year-old girls, and virtually all younger children. For example, with the recommended test requirements, virtually all climbing incidents are presumably addressable involving 2-year-old children because they are all well under 51.2 pounds (95th percentile 2-year-old boys weigh 38.8 pounds and girls weigh 34.7 pounds). This requirement will also protect more than 90 percent of 4-year-old boys and 95 percent of 4-year-old girls who also engaged in this climbing scenario. This testing would protect 75 percent of 5-year-old boys and more than 50 percent of 5-year-old girls. It would also protect 50 percent of 6-year-old children; 25 percent of 7-year-old children; and 7.1 percent of 8-year-old children.

Overall, staff calculates that 91.2 percent of all nonfatal NEISS incidents involving climbing interactions are likely to be addressed with the proposed rule. Staff notes that this number is a low estimate, because it assumes that all climbing incidents occurred with all open and filled drawers on CSUs located on a carpeted surface, which is a worst-case stability condition.

iii. Opening Drawers

As described in this preamble, of the fatal CPSRMS tip-over incidents involving children and only a CSU that reported the type of interaction, 17 percent involved a child sitting, laying, or standing in an open drawer, and 9 percent involved a child opening drawers. Of the nonfatal CPSRMS tip-over incidents involving children and only a CSU that reported the type of interaction, 63 percent involved opening drawers, 6 percent involved putting items in/taking them out of a drawer; 6 percent involved pulling on the CSU; and 3 percent involved leaning or pushing down on an open drawer. Opening drawers was the most common reported interaction for children six years old and younger.

Of the nonfatal NEISS CSU tip-over incidents involving children and only CSUs that reported the type of interaction the child was engaged in, 8 percent involved opening drawers, and 15 percent involved a child in the drawer, pulling on the CSU, putting items in or taking items out of a drawer, reaching, hitting, jumping, a child on top of the CSU, playing in a drawer, pulling up, and swinging. Overall, 12 percent of the reported interactions in the nonfatal NEISS tip-over incidents involving children and only CSUs are those in which the child's strength determines the force (*e.g.,* hit, opening drawers, pulled on, pulled up). Thus, in nonfatal incidents, opening drawers was one of the most common reported interactions.

Moreover, looking at both fatal and nonfatal CPSRMS tip overs involving children and only CSUs, where the interaction involved opening drawers, overall, about 53 percent involved children opening one drawer, 10 percent involved opening two drawers, and almost 17 percent involved opening "multiple" drawers. Children as young as 11 months were involved in incidents where the child was opening one or more drawers of the CSU, and the youngest child reported to have opened all drawers was 13 months old. Incidents involving opening drawers most commonly involved children 3 years old and younger.

As discussed earlier, it is possible for CSUs to tip over from the forces generated by open drawers and their contents, alone, without additional interaction forces. However, pulling on a drawer to open it applies an increased force that contributes to instability. The moment generated with a horizontal force is higher as the location of the force application gets farther from the floor. Therefore, the proposed rule includes as the second required comparison tip-over moment, the moment associated with a child pulling horizontally on the CSU at the top reachable extension element handhold within the overhead reach dimension of a 95th percentile 3-year-old. This is because children 3 years old and younger are most commonly involved in these incidents.

The proposed rule applies the horizontal pull force to the top of an extended drawer in the top row of drawers, or to another potential handhold, that is less than or equal to 4.12 feet high (49.44 inches). The 4.12-foot height limit is based on the overhead reach height for a 95th percentile 3-year-old male; the proposed rule uses the overhead reach height of 3-year-olds because most children involved in opening drawer incidents were 3 years old or younger.[95] Consistent with this overhead reach height, staff's analysis of 15 incidents shows that the highest pull location was 46 inches from the floor.[96]

The proposed rule includes a 17.2 pound-force of horizontal pull force. This pull force is based on the mean pull strength of 2- to 5-year-old females exerted at elbow level on a convex knob. The mean pulling strength of 2- to 5-year-old females is 76.43 Newton (17.2 pound-force), and 59.65 Newton (13.4 pound-force) for males.[97] In the study that provided these pull strengths, participants were 2 to 5 years old, and the mean participants weight was 16.3 kilograms (36 pounds). Participants were asked to exert their maximum strength at all times, described as the highest force they could exert without causing injury, using their dominant hand. Participants were instructed to build up to their maximum strength in the first few seconds, and to maintain maximum strength for an additional few seconds.

The proposed rule uses this 17.2 pound-force pull strength because, in the study, females had a higher mean strength than males, and these incidents most commonly involve children 3

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[95] Pheasant, S. (1986) Bodyspace Anthropometry, Ergonomics & Design. London: Taylor & Francis.
[96] Staff assessed 15 child incidents in which the height of the force application could be calculated based on descriptions of the incidents. Force application heights ranged from less than one foot to almost four feet (46.5 inches), and children pulled on the lowest, highest, and drawers in between.
[97] DTI, Strength Data for Design Safety – Phase 1 (DTI/URN 00/1070). London: Department of Trade and Industry. (2000).

years old and younger. The weight of children in the study (36 pounds) is over the 50th percentile weight of 3-year-old children. Therefore, the pull force test requirement will address drawer opening and pulling on CSU incidents for 50 percent of 3-year-olds, 95 percent of 2-year-olds, 100 percent of children under 2 years, 25 percent of 4-year-olds, 10 percent of 5-year-olds, and will not address these incidents for children 6 years old and older.

Based on this 17.2-pound horizontal force on a handhold at a height of up to 4.12 feet, the moment created by this interaction can be described with the equation M (lb-ft) = 17.2 (lb) × Z (ft), where Z is the vertical distance (in feet) from the fulcrum to the highest handhold that is less than or equal to 4.12 feet high. Using this equation, the tip-over moment of the CSU in the second comparison value in the proposed rule is M_{tip} (lb-ft) > 17.2Z.

iv. Climbing on Doors

As discussed in **IV. Risk of Injury**, two fatal CPSRMS and four nonfatal CPSRMS tip-over incidents involved wardrobes and armoires, which include doors. In most of these incidents, children were interacting with things inside the CSU, indicating that the doors were open. The ages of the children in these incidents ranged from 3 to 11 years, although opening doors is easily within the physical and cognitive abilities of younger children. Once CSU doors are open, children are capable of putting their body weight on the open doors (*i.e.*, open and climbing/hanging), provided the child has a sufficient hand hold. For this reason, the third comparison tip-over moment in the proposed rule represents the force from a 95th percentile 3-year-old child hanging on an open door of the CSU.

UMTRI researchers found that the vertical forces associated with children hanging by the hands were close to the body weight of the child (Figure 48 in Tab R of the NPR briefing package). For this reason, the third comparison tip-over moment, representing a child hanging on an open door, uses the weight of a 95th percentile 3-year-old child, or 51.2 pounds. Staff considers the weight placement location for testing doors in ASTM F2057-19 (section 7.2) is reasonable. Therefore, the proposed rule uses the test location from the voluntary standard, which is approximately half the width of the test fixture, or 3 inches, from the edge of the door, to obtain the equation describing a 95th percentile weight 3-year-old child hanging from an open door of a CSU: M (lb-ft) = 51.2 (lb) × [Y – 0.25 (ft)], where Y is the horizontal distance (in feet) from the fulcrum to the edge of the door in its most extended position. Based on this equation, the tip-over moment of a CSU with doors must meet the following criterion: M_{tip} (lb-ft) > 51.2(Y – 0.25). Simplified, this is M_{tip} (lb-ft) > 51.2Y – 12.8.

v. Additional Interactions

For the reasons described above, the proposed rule focuses on the interactions of children climbing on and opening CSUs. Although other plausible climbing-associated behaviors (*e.g.*, yank, lean, bounce, one hand) included in the UMTRI study generated higher moments, there was no direct evidence of these interactions in the incident data. However, depending on the child's age, weight, and strength, some of these interactions could be addressable with the proposed performance requirements. Other measured climbing interactions, for example, including hop up, hang, in drawer, and climbing onto the table top, generated lower moments than ascent. Similarly, staff expects that putting items in/taking items out of a drawer, reaching, pulling up, and hitting the CSU (all indicated in the incident data) would also generate lower moments than those included in the proposed rule. As such, these additional interactions are addressed by the proposed performance requirements. In addition, staff evaluated each of the seven incidents involving children jumping, falling from the top of the CSU, or swinging, considering the possible moment and reported age of the child and determined that five of the seven would be addressed by the proposed rule.

Although the proposed rule focuses on addressing the CSU tip-over hazard to children, improving the stability of CSUs should also reduce a substantial portion of the incidents involving adults. This is because a majority of the incidents involved consumers interacting with the CSU by opening drawers and/or getting items in and out of drawers, or leaning on the CSU, all scenarios that are expected to be less than or equally severe compared to incidents of children climbing with all drawers filled and opened.

C. Marking and Labeling

1. Proposed Requirements

The proposed rule includes requirements for a warning label. The warning label requirements address the size, content, symbol, and format of the label. The required warning statements address the CSU tip-over hazard, and how to avoid it. They indicate that children have died from furniture tipping over, and direct consumers how to reduce the risk of tip overs, by securing furniture to the wall; not allowing children to stand, climb or hang on units; not defeating interlock systems (if the unit has them); placing heavier items in lower drawers; and not putting a television on CSUs (when the manufacturer indicates they are not designed for that purpose). The format, font, font size, and color requirements incorporate by reference the provisions in ASTM F2057-19. The proposed rule also includes requirements for the location of the warning label, addressing placement in drawers or doors, and the height of the label in the unit. The proposed rule also requires the warning label to be legible and attached after it is tested using the methods specified in ASTM F2057-19.

The proposed rule also includes requirements for an informational label. It requires the label to include the name and address of the manufacturer, distributor, or retailer; the model number; the month and year of manufacture; and state that the product complies with the proposed rule. There are size, content, and format, location, and permanency requirements as well. The label must be visible from the back of the unit when the unit is fully assembled, and must be legible and attached after it is tested using the methods specified in ASTM F2057-19.

2. Basis for Proposed Requirements

a. Warning Requirements, Generally

The proposed rule requires a warning label to inform consumers of the hazard and motivate them to install tip restraints as a secondary safety mechanism. However, there are limitations to the effectiveness of warning labels to address the risk of CSU tip overs. Risk perception is greatly influenced by product familiarity, hazardousness of the product, likelihood of injury, and severity of injury. Risk perception is also influenced by people's beliefs about their ability to control the hazard and whether they believe the warning message. An inherent problem with CSUs and the tip-over hazard is that people are less likely to recognize potential hazards associated with products that they use more frequently. CSUs are products with high familiarity because they are found in most households, and consumers are likely to interact with them daily.

Therefore, even well-designed warnings have limited effectiveness in changing a CSU user's behavior. In addition, although the warning may impact adult behavior, children would not read or comprehend the warnings.

b. Warning Label Placement

In the FMG CSU use study (Tab Q of the NPR briefing package), researchers evaluated warning labels in in-home interviews and focus groups. They found that participants indicated that they had not paid attention to or noticed warning labels on the units in their children's rooms, even when the researchers noted they were present. Participants also indicated that, even if they had seen a warning label on a CSU, they probably would not pay attention to it. Focus group participants identified the following as potential locations where a warning label could be seen easily and be more likely to grab their attention: top of the unit in the corner, on the handle of a unit, inside the top drawer of a unit, and in the instruction manual. Participants said the back of the unit was not an acceptable place for the warning label because it would not be visible. Participants also expressed that they would remove labels that were too conspicuous (*e.g.*, on the outside or top of a unit).

An effective warning label first must be visible and noticeable, and it must capture and maintain consumers' attention. The proposed rule requires the warning label to be placed in the uppermost clothing storage drawer or one drawer in the uppermost row that is entirely below 56 inches, which is the 5th percentile standing eye height of women in the United States.[98] This is consistent with the information CPSC obtained from the FMG study, regarding placement of warnings.

c. Warning Label Content

After noticing a warning label, consumers must read the message, comprehend the message, and decide whether the message is consistent with their beliefs and attitudes. In addition, consumers must be motivated enough to spend the effort to comply with the warning-directed safe behavior. Warnings should allow for customization of hazard avoidance statements

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[98] Nesteruk, H.E.J. (2017). Human Factors Analysis of Clothing Storage Unit Tipover Incidents and Hazard Communication. In Staff Briefing Package Advance Notice of Proposed Rulemaking: Clothing Storage Units. Available at: https://www.cpsc.gov/s3fs-public/ANPR%20-%20Clothing%20Storage%20Unit%20Tip%20Overs%20-%20November%2015%202017.pdf?5IsEEdW_Cb3ULO3TUGJiHEl875Adhvsg.

based on unit design, to reflect incident data (*e.g.*, television use). Similarly, the warning text should be understandable, not contradict typical CSU use, and be expressed in a way that motivates consumers to comply.

In the FMG CSU use study, focus group participants evaluated the ASTM F2057-19 warning label text. Participants had mixed opinions about the statement: "Children have died from furniture tip over." Some participants found it motivating, others believed that it was hyperbole and seemed likely to disregard it. The majority of participants said that they do not follow the instruction to install the tip restraint, especially if the tip restraint is not included with the CSU. Participants wanted more information about why they should not put a television on a CSU, and some thought consumers would disregard the warning if putting a television on top of a CSU fit their needs. A majority of participants said that they open more than one drawer at a time, and that children typically open one or two drawers. Participants believed that placing the heaviest items in the lowest drawers was common sense, and was a warning they would follow.

Based on this information, the proposed warning label includes warnings about the hazard, television use (where appropriate for the product), and placing heavier items in lower drawers, but does not include a statement to not open multiple drawers because that is inconsistent with consumer use. In addition, the proposed tip-restraint warning explicitly directs the consumer to secure the CSU to the wall and uses a term for tip restraint that consumers will likely understand. "Tipover restraint," used in ASTM F2057-19, might confuse some consumers because restraints generally describe what they contain (*e.g.*, child restraint), rather than what they prevent. Terminology such as "anti-tip device" is clearer.

a. Warning Label Format and Style

The proposed rule requires the warning label to be at least 2 inches wide by 2 inches tall. This size is consistent with the required content and format for the label, and it ensures that the label is not too narrow or short.

The proposed rule also requires the child climbing symbol that is ASTM F2057-19. However, as discussed in section **VII.G. Warning Label Symbols**, if one of the two variants being considered performs better in comprehension testing than the ASTM F2057-19 child climbing symbol, the Commission may consider requiring one of those variants in the final rule. The proposed rule also requires the ASTM F2057-19 no television symbol for CSUs that are not designed to hold a television.

CPSC staff regularly uses ANSI Z535.4, *American National Standard for Product Safety Signs and Labels*—the primary U.S. voluntary consensus standard for the design, application, use, and placement of on-product warning labels—when developing or assessing the adequacy of warning labels. The proposed rule uses the warning format in ASTM F2057-19, which is consistent with ANSI Z535.4.

To be effective, a warning label must remain present. Label permanency requirements are intended to prevent the warning label from being removed inadvertently and to provide resistance to purposeful removal by the consumer. CPSC staff evaluated the ASTM F2057-19 label permanency requirements (Tab F of the NPR briefing package) and concluded that they are adequate. Accordingly, the proposed rule includes the permanency testing prescribed in ASTM F2057-19.

b. Informational Label

Staff was able to identify the manufacturer and model of CSU associated with only 22 of the 89 fatal CPSRMS incidents involving children and CSUs without televisions[99] and 230 of the 263 nonfatal CPSRMS incidents involving children and CSUs without televisions. In the case of recalls, consumers must be able to identify whether their CSU is subject to the recall and is potentially unsafe. Accordingly, an identification label that provides the model, manufacturer information, date of manufacture, and a statement of compliance with the proposed rule is important to facilitate identification and removal of potentially unsafe CSUs. This label would also allow for easier identification of compliant and noncompliant CSUs by consumers and CPSC, and would provide information that would assist in identifying the CSU, allowing staff to assess more easily hazards associated with specific designs.

The proposed rule requires the informational label to be at least 2-inches wide by 1-inch tall, which is consistent with the required content and format, and ensures that the label is not too narrow or short. The proposed rule requires text size that is consistent with ANSI Z535.4. The proposed rule requires the identification label to be visible from the back of the unit when the unit is fully assembled because it is not necessary for the label to be visible to the consumer during normal use, but it should be visible to anyone inspecting the unit. In addition, the proposed rule requires permanency testing prescribed in ASTM F2057-19 to increase the likelihood that the label remains attached to the CSU.

[99] An additional CSU was identified as handmade.

D. Hang Tags

1. Proposed Requirements

As discussed above, section 27(e) of the CPSA authorizes the Commission to issue a rule to require manufacturers of consumer products to provide "such performance and technical data related to performance and safety as may be required to carry out the purposes of [the CPSA]." 15 U.S.C. 2076(e). The Commission may require manufacturers to provide this information to the Commission or, at the time of original purchase, to prospective purchasers and the first purchaser for purposes other than resale, as necessary to carry out the purposes of the CPSA. *Id.*

The proposed rule sets out requirements for providing performance and technical data related to performance and safety to consumers at the time of original purchase and to the first purchaser of the CSU (other than resale) in the form of a hang tag. The hang tag provides a stability rating, displayed on a scale of 0 to 5, that is based on the ratio of tip-over moment, as determined in the testing required in the proposed rule, to the minimally allowed tip-over moment, provided in the proposed rule. The proposed rule includes size, content, icon, and format requirements for the hang tag. It also includes a requirement that the hang tag be attached to the CSU and clearly visible to a person standing in front of the unit; that lost or damaged hang tags must be replaced such that they are attached and provided, as required by the rule; and that the hang tags may be removed only by the first purchaser. In addition, the proposed rule includes placement requirements that the hang tag appear on the product and the immediate container of the product in which the product is normally offered for sale at retail; that for ready-to-assemble furniture, the hang tag must appear on the main panel of consumer-level packaging; and that any units shipped directly to consumers shall contain the hang tag on the immediate container of the product. For a detailed description of the proposed requirement, see the proposed regulatory text.

2. Basis for Proposed Requirements

a. Purpose

Consistent with the requirements in section 27(e) of the CPSA, the proposed hang tag requirement helps carry out the purpose of the CPSA by "assisting consumers in evaluating the comparative safety of consumer products." 15 U.S.C. 2051(b)(2). The proposed rule would require CSUs to meet a minimum level of stability (*i.e.*, exceed a threshold tip-over moment). However, above that minimum level, CSUs may have varying levels of stability. A hang tag provided on the CSU will offer consumers comparative information about the stability of products, based on the tip-testing protocol in the proposed rule. By providing product information at the point of purchase, the hang tag will inform consumers who are evaluating the comparative safety of different CSUs and making buying decisions. This information may also improve consumer safety by incentivizing manufacturers to produce CSUs with higher levels of stability, to better compete in the market, thereby increasing the overall stability of the CSU market.

b. Background

CPSC based the formatting and information requirements in the proposed hang tag on work CPSC has done previously to develop performance and technical data requirements,[100] as well as the work of other federal agencies that require comparative safety information on products.[101] As part of CPSC's development of a similar requirement for recreational off-highway vehicles (ROVs), CPSC issued a contract for cognitive interviews and focus group

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[100] *E.g.*, 16 CFR 1401.5, 1402.4, 1404.4, 1406.4, 1407.3, and 1420.3.

[101] *E.g.*, the Federal Trade Commission's EnergyGuide label for appliances in 16 CFR part 305, requiring information about capacity and estimated annual operating costs; and the National Highway Traffic Safety Administration's New Car Assessment Program star-rating for automobiles, providing comparative information on vehicle crashworthiness.

evaluation to refine the proposed ROV hang tag. The contractor developed recommendations regarding the content, format, size, style, and rating scale, based on consumer feedback during this work.[102]

Studies on the usefulness and comprehension of point-of-sale product information intended to help consumers evaluate products and make buying decisions support the effectiveness of hang tags, and linear scale graphs, in particular. For example, a study on the EnergyGuide label for appliances, which also uses a linear scale, indicated that the label increased consumer awareness of energy efficiency as an important purchasing criterion.[103]

c. Specific Elements of the Proposed Requirements

One element of the proposed hang tag is a symbol depicting a CSU tipping over. This symbol identifies the product and hazard. Research studies have found that warning labels with pictorial symbols are more noticeable to consumers.[104] To allow consumers to identify exactly what product the label describes, the proposed hang tag requires the manufacturer's name and the model number of the unit. The proposed requirement also includes text to explain the importance of the graph, and the significance and meaning of the tip-over resistance value of the CSU. The proposed graph indicates the minimally acceptable tip rating, which is 1,[105] so that consumers can evaluate the extent to which the rating of a particular CSU meets or exceeds the minimal permissible rating. In addition, the proposal requires the front of the hang tag to be

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[102] EurekaFacts, LLC, *Evaluation of Recreational Off-Highway (ROV) Vehicle Hangtag: Cognitive Interview and Focus Group Testing Final Report* (Aug. 31, 2015), available at: https://www.cpsc.gov/s3fs-public/pdfs/ROVHangtagEvaluationReport.pdf.

[103] National Research Council. *Shopping for Safety: Providing Consumer Automotive Safety Information -- Special Report 248.* Washington, DC: The National Academies Press (1996).

[104] Wogalter, M., Dejoy, D., and Laughery, K., *Warnings and Risk Communication*. Philadelphia, PA: Taylor & Francis, Inc. (1999).

[105] The minimally acceptable rating is actually just above 1 because the tested moment of a CSU must be greater than the threshold moment, however, for simplicity, the proposed hang tag marks the minimally acceptable rating as 1.

yellow, to increase the likelihood consumers attend to the tag, and also consistent with EurekaFacts research recommendations (discussed below) and the EnergyGuide hang tag for household appliances, which is "process yellow."

The performance criteria in the proposed stability requirement requires the tested moment of a CSU to be greater than a calculated threshold moment requirement. The tip rating number on the hang tag is the ratio of tested moment to threshold requirement. This provides a simple calculation that results in a number greater than 1,[106] which can be easily represented on a scale. Additionally, due to the nature of a ratio, a rating of 2 means the unit can withstand twice the threshold moment, a rating of 3 is three times the threshold moment, and so forth. As an example: Unit A has an acceptable moment of 10 ft-lbs. When A is tested, the test engineer finds it tips at 25 ft-lbs. Unit A's ratio is 25:10, for a rating of 2.5. Unit B also has an acceptable moment of 10 ft-lbs. Testing on Unit B found it tipped at 50 ft-lbs. Unit B's ratio is 50:10 or a rating of 5. Unit C has an acceptable moment of 5 ft-lbs. Testing on Unit C found it tipped at 20 ft-lbs. Its ratio is 20:5 or a rating of 4. Therefore, Unit A is 2.5 times more stable than required; Unit B is 5 times more stable than required; and Unit C is 4 times more stable than required. Also, unit B is twice as stable as unit A. Unit C lies between units A and B in terms of stability.

Because the linear scale on the proposed hang tag is a graphical representation of the stability information, it is important to include labels so that consumers understand the data on the tag. To make clear the meaning of the information on the linear scale, CPSC staff placed the label "high" at the right side of the scale to identify for the consumer that the higher value equates to better stability or higher tip-over resistance. The proposed hang tag also includes a

[106] The equation is $Moment_{tested}/Moment_{threshold}$. If $Moment_{tested} = Moment_{thresholdF}$, then $Moment_{tested}/Moment_{threshold} = 1$. But, the staff's recommended performance requirement is that $Moment_{tested}$ *exceed* $Moment_{threshold}$. Therefore, all units must have a ratio greater than 1, although it may be only a small fraction over 1.

technical explanation of the graph and rating to explain how to interpret and use the graphic and number.

When EurekaFacts conducted research on CPSC's proposed ROV hang tag, focus group participants preferred to have whole numbers anchoring the scale, such as 1 to 10, to communicate comparative information. CPSC staff testing suggests that, although few CSUs currently meet the proposed requirement, many CSUs on the market today would achieve ratings between 1 and 2, with appropriate modifications. Therefore, using a 10-point scale may be difficult for consumers to differentiate between units. To minimize this difficulty, the proposed requirement uses a 5-point scale. CPSC expects that, over time, there may be units with a broader range of scores (beyond the current 1 and 2), as consumers desire more stable units, and manufacturers build more stable units. Although some units theoretically could have a normalized value over 5, representing this as a 5, or the highest point on the scale, would be reasonably interpreted by consumers as a high stability. If, in the future, many CSUs exceed 5, the Commission can revisit the scale.

In the proposed rule, the scale begins at 0. EurekaFacts found focus group participants preferred whole numbers as anchor points on the scale range and expressed confusion with decimals. Zero is lower than the minimal acceptable rating of 1 to provide a common anchor point in consumers' mental models of a scale, and the whole numbers allow for better relative comparisons. In addition, allowing the display of a rating lower than the requirement allows simple identification that CSUs at least meet the minimum requirement.

Research has shown that pictorial symbols and icons make warnings more noticeable and easier to detect than warnings without such symbols and icons.[107] Additionally, including a

[107] Wogalter, M., Dejoy, D., and Laughery, K. (1999). *Warnings and Risk Communication*. Philadelphia, PA: Taylor & Francis, Inc.

graphic before introducing text may serve as a valuable reference for consumers, by maintaining attention and encouraging further reading.[108] For these reasons, the proposed hang tag requirement includes a symbol of a CSU at a slight angle to identify the product and tipping characteristics. In addition, presenting information both graphically and textually offers a better chance of comprehension by a wide range of users, such as non-English-literate users.

The size, placement, and attachment specifications in the proposed hang tag requirement is consistent with the recommendations by EurekaFacts and similar requirements in other standards. The EurekaFacts report found that participants preferred hang tags to be large because they were more noticeable and easier to read. In addition, participants preferred a vertical orientation. Based on this information, the proposed hang tag must be 5-inches wide by 7-inches tall.

Consistent with similar standards, the proposed hang tag provision requires the tag to be provided at the time of original purchase, that it be replaced if lost or damaged, that it appear on the product and packaging, that it be clearly visible to a person standing in front of the unit, and that it be removable only with deliberate effort. These requirements facilitate the tag staying on the product so that consumers see and use the information on the hang tag when making purchasing decisions.

Because the proposed stability performance criteria are based on moments, which are not easily understood forces, CPSC expects that some consumers may wish to better understand the information provided. For this reason, the reverse side of the hang tag provides additional information about the test used to calculate the stability rating on the front of the hang tag and what the rating means. The required font sizes are intended to facilitate ease of reading.

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[108] Smith, T. P. (2003). *Developing consumer product instructions.* Washington, DC: U.S. Consumer Product Safety Commission.

E. Prohibited Stockpiling

1. Proposed Requirements

As explained earlier in this preamble, section 9(g)(2) of the CPSA allows the Commission to prohibit manufacturers of a consumer product from stockpiling products subject to a consumer product safety rule to prevent manufacturers from circumventing the purpose of the rule. 15 U.S.C. 2058(g)(2). The proposed rule prohibits manufacturers and importers of CSUs from manufacturing or importing CSUs that do not comply with the requirements of the proposed rule in any 12-month period between the date a rule is promulgated and the effective date of the rule at a rate that is greater than 120 percent of the rate at which they manufactured or imported CSUs during the base period for the manufacturer. The proposed rule defines the base period for as any period of 365 consecutive dates, chosen by the manufacturer or importer, in the 5-year period immediately preceding the promulgation of the final rule.

2. Basis for Proposed Requirements

The proposed stockpiling limit is intended to allow manufacturers and importers sufficient flexibility to meet normal levels and fluctuations in demand for CSUs, while limiting their ability to stockpile large quantities of CSUs that do not comply with the rule for sale after the effective date. Because most firms will need to modify their CSUs to comply with the proposed requirements, and the modifications may be costly, CPSC believes it is appropriate to prevent stockpiling of noncompliant products.

IX. Preliminary Regulatory Analysis[109]

The Commission is proposing to issue a rule under sections 7 and 9 of the CPSA. The CPSA requires that the Commission prepare a preliminary regulatory analysis and that the

[109] Further detail regarding the preliminary regulatory analysis is available in Tab H of the NPR briefing package.

preliminary regulatory analysis be published with the text of the proposed rule. 15 U.S.C. 2058(c). The following discussion is extracted from staff's memorandum, "Draft Preliminary Regulatory Analysis of the Proposed Clothing Storage Unit Stability Rule," available in Tab H of the NPR briefing package.

A. Preliminary Description of Potential Costs and Benefits of the Proposed Rule

The preliminary regulatory analysis must include a description of the potential benefits and potential costs of the proposed rule. The benefits of the rule are measured as the expected reduction in the societal costs of deaths and injuries that would result from adoption of the proposed rule and any benefits that cannot be quantified. The costs of the rule are defined as the added costs associated with modifying CSUs to comply with the requirements of the rule, including any impacts on the utility of the CSUs for consumers, as well as any costs that cannot be quantified.

Deaths and Injuries Related to Tip Overs of CSUs. CPSC identified 179 deaths related to CSU tip-over incidents involving children that occurred from 2001 through 2016.[110] This results in an average of 11.2 deaths per year over this 16-year period. These are the deaths associated with CSU tip-over incidents of which CPSC staff is aware. The actual number of deaths from CSU tip-over deaths during this period could be higher.

Ninety-seven of the 179 deaths also involved television sets that had been placed on top of the CSU. Of the 97 deaths involving televisions, 80 (82 percent) involved older, heavy CRT televisions, and only one of the deaths is known to have involved a flat-screen television. The older CRT televisions are usually substantially heavier than the newer flat-screen televisions,

[110] For this preliminary regulatory analysis, staff used the data for 2001 to 2016, rather than the more recent data provided in the full incident data, in order to calculate an annual average. Data collection is ongoing for more recent years. If the data included the years for which data collection is ongoing, the calculated annual average would be low.

which may pose more serious injuries during a tip over, and may shift the center of gravity of the CSU forward, making it less stable. Based on this, as the number of CRT televisions in use decreases, staff expects the number of tip-over incidents and their severity to decrease. In 2010, about 55 percent of all televisions in use were CRT televisions. By 2020, that percentage was expected to be about 9 percent; and it is expected to decline to less than 1 percent by 2030. Thus, incidents involving CRT televisions are not considered in the main analysis. Considering only those cases for which staff know that a CRT television was not involved, there were 99 fatalities (179 deaths less 80 that involved a CRT television) during the 16-year period, or an average of 6.2 per year.

Although the proposed standard is intended to address CSU fatalities involving children, during the same period from 2001 through 2016, there were 29 fatalities involving adults and CSUs tipping over, or an average of 1.8 a year. Fourteen of these victims were age 80 years or older, and none was younger than 40. It is possible that some of these or similar deaths could have been prevented had the CSUs involved met that stability requirements of the proposed rule.

Based on NEISS, there were an estimated 14,900 nonfatal injuries to children involving CSU tip-overs during the 5-year period 2015 through 2019 that were treated in hospital EDs. About 2,300 of these estimated injuries (16 percent) involved televisions that had been placed on top of the CSUs. However, staff is not making any adjustments for nonfatal injuries that also involved a television set because there is generally less information available about the nonfatal injuries than for the fatality cases, making it more difficult to determine if the television involved was a CRT or a flat screen.

In addition to injuries initially treated in hospital EDs, many product-related injuries are treated in other medical settings, such as physicians' offices, clinics, and ambulatory surgery centers. Some injuries also result in direct hospital admission, bypassing the hospital ED entirely. The number of CSU-related injuries treated outside of hospital EDs can be estimated with the CPSC's Injury Cost Model (ICM), which uses empirical relationships between the characteristics of injuries (diagnosis and body part) and victims (age and sex) initially treated in hospital EDs and the characteristics of those initially treated in other settings.

The ICM estimate of injuries treated outside of hospitals or hospital EDs (*e.g.*, in doctors' offices, clinics) is based on data from the Medical Expenditure Panel Survey (MEPS). The MEPS is a nationally representative survey of the civilian, non-institutionalized population that quantifies individuals' use of health services and corresponding medical expenditures. To project the number of direct hospital admissions that bypass hospital EDs, the ICM uses data from the Nationwide Inpatient Sample of the Healthcare Cost and Utilization Project (HCUP-NIS). HCUP is a family of healthcare databases and related software tools and products developed through a federal-state-industry partnership and sponsored by the Agency for Healthcare Research and Quality (part of the U.S. Department of Health and Human Services). The HCUP-NIS provides information annually on approximately 3 million to 4 million in-patient stays from about 1,000 hospitals.

Based on the NEISS estimate of 14,900 ED-treated injuries in 2015 through 2019, the ICM projects approximately 19,300 CSU tip-over injuries treated in other settings during the same 5-year period, or an average of 3,900 per year. Combining the NEISS estimate of injuries treated in hospital EDs with the ICM estimate of medically attended injuries treated in other settings brings the estimate of all nonfatal, medically attended CSU tip-over injuries to children under the age of 18 years to 34,100 during the years 2015 through 2019.

During the same 2015 to 2019 period, there were an estimated 7,000 adults and seniors that were treated in EDs because of injuries received when CSUs tipped over. Although the proposed rule is intended to reduce injuries to children, some portion of the injuries to adults would probably have been prevented had the CSUs involved met the stability requirements of the proposed rule. Based on the NEISS estimate of 7,000 injuries to adults treated in EDs, the ICM projects that there were 15,700 injuries treated in other medical settings, for a total of 22,700 medically attended injuries to adults involving CSU tip overs.

Societal Costs of Deaths and Injuries. To estimate the societal costs of CSU-related deaths, staff applied an estimate of the value of statistical life (VSL), an estimate used in benefit-cost analysis to place a value on reductions in the likelihood of premature deaths. For this analysis, staff applied estimates of the VSL developed by the U.S. Environmental Protection Agency (EPA). In 2018 dollars, the EPA estimate of the VSL is about $9.2 million, suggesting the societal cost of the fatalities is about $57.0 million annually, if only those deaths to children reported not to involve a CRT television are included (6.2 x $9.2 million). If all deaths are included, the societal costs of the fatalities would be $103.0 million annually ($9.2 million × 11.2 deaths per year). The societal cost of the adult fatalities would be $16.6 million a year (1.8 deaths x $9.2 million).

The societal costs of the nonfatal CSU injuries are quantified with the ICM. The ICM is fully integrated with NEISS, and in addition to providing estimates of the societal costs of injuries reported through NEISS, the ICM also estimates the costs of medically treated injuries that are initially treated outside of hospital EDs. The aggregated societal cost components provided by the ICM include medical costs, work losses, and the intangible costs associated with lost quality of life, or pain and suffering.

Information on the societal costs associated with nonfatal CSU injuries to children are presented in Table 2, and the societal costs of the nonfatal injuries to adults are presented in Table 3. The estimates are the average annual costs for the 5-year period from 2015 through 2019. The national estimates of medically attended injuries described above are presented in column 2, and include not only the 3,000 injuries to children initially treated in hospital EDs (1,400 in the case of adults), but also the 3,900 other medically attended injuries initially treated outside of hospital EDs (3,100 in the case of adults). The estimated injury costs range from about $15,015 per injury treated in physicians' offices, to about $34,522 for injuries treated and released from a hospital ED, to about $323,296 for hospital admitted injuries (averaging the costs associated with those admitted from the ED and those admitted to the hospital bypassing the ED). The average cost of injuries to adults was slightly lower than the average cost of injuries to children: $28,344 vs. $31,757. Altogether, the societal costs of nonfatal injuries to children involving CSUs averaged $216,747,160 annually, from 2015 through 2019. The cost of injuries to adults averaged $128,710,471 annually over the same period.

Table 2: Average Annual Nonfatal Injury Costs Associated with CSU Tip-Overs to Children Under the Age of 18 (2015–2019).

Place of Treatment	National Estimate	Medical Cost	Work Loss	Pain and Suffering	Average Total Cost	Total Cost
Doctor / Clinic	3,804	$653	$1,521	$12,842	$15,015	$57,112,589
Emergency Department	2,830	$2,886	$1,767	$29,899	$34,552	$97,786,129
Hospital-Adm Direct	53	$31,157	$105,672	$160,347	$297,176	$15,654,763
Hospital-Adm via ED	139	$34,371	$116,072	$182,813	$333,256	$46,193,679
AVERAGE		$2,499	$4,753	$24,505	$31,757	
TOTAL	6,825	$17,057,479	$32,438,983	$167,250,698		$216,747,160

Source: CPSC Injury Cost Model and NEISS cases involving CSU tip overs for the years 2015 through 2019.

Table 3: Average Annual Nonfatal Injury Costs Associated with CSU Tip-Overs to Adults 18 Years of Age and Older (2015–2019).

Place of Treatment	National Estimate	Medical Cost	Work Loss	Pain and Suffering	Average Total Cost	Total Cost
Doctor / Clinic	3094	$837	$2,692	$13,800	$17,329	$53,613,046
Emergency Department	1,284	$2,519	$2,516	$21,247	$26,281	$33,731,304
Hospital-Adm Direct	37	$38,728	$72,391	$139,589	$250,707	$9,396,404
Hospital-Adm via ED	126	$40,739	$69,784	$142,870	$253,393	$31,969,717
AVERAGE		$2,734	$5,081	$20,529	$28,344	
TOTAL	4,541	$12,412977	$23,074,265	$93,223,230		$128,710,471

Source: CPSC Injury Cost Model and NEISS cases involving CSU tip over for the years 2015 through 2019

Potential Benefits of Stability Requirements for CSUs. The proposed rule would require that the tip-over moment of a CSU, as determined by the method in the draft standard, exceed the moment that would be produced by a 51.2-pound child climbing up a drawer or hanging on a door, or a child pulling on drawers and doors of the CSU. The following discussion estimates the projected reduction in the societal costs of deaths and injuries under the proposed rule.

Table 4 summarizes the annual societal costs of deaths and injuries by age of the victims. Staff used this information to estimate the anticipated reduction in the societal costs of injuries that can be anticipated if the regulation is finalized. The costs associated with fatalities are based on the fatalities known to CPSC staff that occurred from 2001 through 2016, and excludes those fatalities in which CRT televisions were known to be involved. Incidents known to involve a CRT television were excluded for the reasons described above, however, cases for which the type of television involved could not be determined were included because some of these incidents might have involved a flat-screen television. The societal costs of nonfatal injuries are based on NEISS cases occurring from 2015 through 2019. No adjustment for the potential involvement of CRT televisions has been made in the nonfatal estimates for the reasons described above.

Given the multiple real-world factors that contribute to tip overs that the proposed rule accounts for, CPSC staff concludes that the proposed rule should prevent CSU tip-over incidents caused by children climbing up, hanging on, or pulling on drawers and doors of the CSU, provided that the child weighs 51.2 pounds or less. The proposed rule is also expected to prevent other common, but less severe scenarios such as opening drawers without climbing, putting items in and out of drawers, or playing in a drawer. CPSC staff believes that the proposed rule could prevent virtually all of these tip-over incidents involving children who are most at risk and probably many similar incidents involving older children and adult victims. The proposed rule would be less effective in reducing tip overs in some severe, but less common scenarios, such as bouncing and yanking; however, these scenarios were not directly observed in the incident data.

Table 4: Annual Societal Costs of Injuries and Deaths by Age (millions of dollars).

Age (in years)	Fatalities*	Societal Cost Fatalities	Injuries	Societal Cost of Nonfatal Injuries	Societal Costs of Injuries and Deaths
Less Than 2	2.4	$22.1	1,039	$29.3	$51.4
2	1.9	$17.5	1,498	$58.7	$76.2
3	1.4	$12.9	1,346	$43.5	$56.4
4	0.1	$0.9	980	$41.1	$42.0
5	0.1	$0.9	582	$13.9	$14.8
6	0.1	$0.9	532	$13.7	$14.6
7	0.1	$0.9	172	$5.7	$6.6
8	0.1	$0.9	244	$2.9	$3.8
9 to 17	-	-	431	$8.1	$8.1
Total Children	6.2	$57.0	6,824	$216.9	$273.9
18 and Over	1.8	$16.6	4,541	$128.7	$145.3
Total	8.0	$73.6	11,366	$345.6	$419.2

*Average fatalities per year from 2001 through 2016

** Average number of medically attended injuries from 2015 through 2019

Benefits from Reduced Fatalities. A review of the fatal CSU tip-over incidents involving children and used in this analysis found that all of the victims weighed less than 51.2 pounds.

Given staff's conclusion that the draft requirements would prevent nearly all tip-overs involving children who weigh less than 51.2 pounds, staff believe that all of these fatalities could have been prevented if the CSUs involved had complied with these requirements. More than 90 percent of the child fatalities involved children 3 years old or younger. The vast majority of children of this age weigh less than 51.2 pounds. However, there were a few fatalities, an average of about 1 every other year, to older children who could weigh more than 51.2 pounds. Therefore, for purposes of projecting the benefits of the proposed rule, although staff predicts that almost all fatalities involving children 3 years of age and younger could be prevented,[111] staff estimates that only about 48 percent of the deaths to children ages 4 through 8 would be prevented. These calculations are based on analysis by the Division of Human Factors staff concerning the potential of the proposed rule to prevent tip-over deaths by age. Therefore, based upon the fatalities between 2001 and 2016, staff estimate that, had all CSUs met the requirements of the proposed, about 94 percent of the deaths to children could have been prevented, or an average of 5.8 deaths could have been prevented each year. Assuming a VSL of $9.2 million, the benefit of the proposed rule in terms of reduced child deaths could be $53.4 million annually.

As noted above, there are also an average of 1.8 fatalities to adults each year from CSU tip-over incidents. There is less information available regarding the tip-over incidents involving adults. Many of the available narratives of these incidents suggest that victims were losing their balance and grabbed the CSU in an effort to balance themselves. Although adults weigh more than 51.2 pounds, because the adults were not attempting to climb the CSUs, the full weight of the adult victim was probably not on the CSU when the incident occurred. Moreover, many of

[111] staff assume all deaths involving children age 2 years old and younger would be prevented and about 95 percent of the deaths involving 3-year-old children would be prevented.

the nonfatal cases involved adults interacting with the CSU, by opening drawers, getting items in and out of drawers, or leaning on the CSU. In many cases, these scenarios are expected to be less or equally severe scenarios, compared to children climbing with all drawers filled and opened. Therefore, CPSC staff has concluded that a substantial portion of the CSU tip-over incidents involving adults would be prevented if the stability of the CSUs was improved. Although staff cannot estimate the exact portion of the incidents involving adults that would be prevented, for purposes of attempting to quantify the benefits of the proposed rule, this analysis assumes that the proposed rule would prevent adult tip-over incidents at about one-half the rate that it prevents child tip-over incidents. On average, this is approximately 0.8 adult fatalities prevented annually or a societal benefit of about $7.4 million annually.[112]

Together, the potential benefits of the proposed rule from reducing fatal tip-over incidents to both adults and children is estimated to be $60.8 million annually, if all CSUs complied with the requirements. This consists of an estimated $53.4 million from reducing approximately 5.8 child fatalities a year and 7.4 million from reducing an average of 0.8 adult fatalities a year. Staff emphasizes that the annual benefits would not actually reach this level until most CSUs in use meet the requirements of the proposed rule. Using the historical sales estimates and an estimated average product life of 15 years, CPSC staff estimates that about 463.5 million CSUs were in use in 2017 and 466 million CSUs were in use in 2018. Given that staff estimates there are approximately 460 million CSUs in use, annual sales are about 44 million units, and the average useful life of CSUs is 15 years, it would likely be more than 10 years after such a requirement goes into effect before the annual benefits approach this level.

[112] Staff estimates that the proposed rule could prevent about 94 percent of the fatalities involving children (5.5 deaths prevented/6.2 total deaths). If the proposed rule prevents adult fatalities at one-half this rate, then about 47 percent of the 1.8 annual deaths to adults might be prevented.

Benefits from Reduced Injuries. To evaluate the effectiveness of the proposed rule in reducing nonfatal injuries, CPSC staff examined 1,463 NEISS records to determine what the child was doing when the tip-over incident occurred. In 925 incidents, it was not possible to determine the interaction involved in the incident. The remaining 538 incidents were reviewed to determine whether it was likely that the proposed rule would have prevented the incident. A summary of staff's conclusions regarding these incidents is available in Tab H of the NPR briefing package (Table 6), but the following provides key insights.

Most of the incidents, accounting for 412 incidents (74 percent), involved a child climbing the CSU. Because the proposed rule is intended to prevent furniture tip-overs involving children 51.2 pounds or less climbing on CSUs, staff assumed that all of these incidents would be prevented if the victim weighed less than 51.2 pounds. The NEISS record does not include the weight of the victim, so staff used the age of the victims and data on the distribution of weight by age and sex to estimate the number of incidents that the proposed rule might have prevented. Staff assumed that all incidents involving children 2 years of age and younger that involved climbing a CSU would have been prevented by the proposed rule because the 95th percentile weight for boys is only about 75 percent of 51.2 pounds. Therefore, it is safe to conclude that virtually all 2-year-olds and younger weigh less than 51.2 pounds and would be protected by the proposed rule. For 3-year-old children, the 95th percentile weight for boys is 51.2 pounds, which means that an estimated 5 percent of 3-year-old boys weigh more than 51.2 pounds and might not be protected by the proposed rule. To account for this, staff assumed that only 95 percent of the incidents involving 3-year-old children would have been prevented by the proposed rule. For 4-year-old children, based on the percentile weights from the CDC, the 90th percentile weight for boys is 49.1 pounds and the 95th percentile weight is greater than 51.2. For 4-year-old girls, the 95th percentile weight is 50.1 pounds. Based on these percentile weights, staff assumed that 92.5 percent of the climbing-related incidents involving 4-year-old children would have been prevented. Staff followed the same procedure to estimate the percentage of incidents to children ages 5 years through 8 years. For example, for children 6 years old, the 75th percentile weight for both boys and girls is greater than 51.2 pounds. The 50th percentile weights for boys and girls are 50.3 and 48.6 pounds, respectively. Based on these weights, staff estimates that the proposed rule would have prevented 50 percent of the climbing incidents that involved 6-year-old children. Based on the percentile weights from the CDC, virtually all children 9 years old and older would be expected to weigh more than 51.2 pounds. Therefore, staff cannot be confident that any of the climbing incidents involving children older than 8 would have been prevented by the proposed rule.

Another 49 tip-over incidents involved children who were reaching into the CSU, or placing items in, or retrieving items from, the CSU. In a few cases, the victim was playing in the bottom drawer of the CSU, or was hit by the CSU when it tipped over. None of these scenarios would be expected to cause as much rotational force on a CSU as climbing a CSU would. Staff believes that CSUs that meet the requirements of the proposed rule, which is intended to prevent tip-over in more severe circumstances, would not tip over in these incidents. Therefore, staff believes that all of these incidents would have been prevented by the proposed rule.

A total of 58 incidents involved children pulling on the CSU, or opening drawers. Staff analyzed these incidents based on children’s pull strength ability and determined that 62 percent of these incidents would be prevented by the proposed rule.

Finally, there were 19 incidents that involved activities such as the victim “swinging” on the CSU, jumping from the CSU, and being on top of the CSU. Based on staff’s analysis, staff assumes that 47 percent of these incidents would be prevented by the proposed rule. Staff considers 22 incidents in which some "other person" caused the tip over as part of the unknown scenarios, because details on "other person" are not available to make an estimate.

In total, staff believes that the proposed rule would have prevented about 87 percent of NEISS tip-over injuries involving children 17 years of age and under, including about 91 percent of the tip-over incidents involving children climbing on CSUs. As Table 3 indicates, the average annual societal cost of nonfatal injuries to children from CSU tip-over incidents is about $216.9 million. If the proposed rule can prevent 87 percent of these injuries, the annual benefit from the reduction of nonfatal injuries to children would be $188.7 million.

As with the adult fatality victims, there is less information available on the activities of the adult victims of the nonfatal incidents. In many cases, the narrative in the NEISS record simply contains a statement such as "dresser fell onto hand," with no description of the interaction. Some narratives indicate that the victim might have grabbed onto the dresser for balance, was falling and hit the dresser, or may have been attempting to move the dresser. Staff also assumes that some dressers tipped over when the adult was opening drawers to place items in or remove items from the dresser given that some incidents involving children did. Given the very limited information on the activities of the adult victims at the time of the tip-over incident, staff do not have a basis for making strong estimates of the number of incidents that would have been prevented by the proposed rule. However, it is reasonable to expect that a rule that requires CSUs to be more stable will reduce nonfatal injuries to adults. In this analysis, staff will simply assume that nonfatal incidents involving adults will be reduced by half the percentage that nonfatal incidents to children are reduced. Because staff believes that the proposed rule will reduce nonfatal tip-over injuries to children by 87 percent, staff assumes that nonfatal adult tip-over injuries will decline by 43.5 percent. Because the average annual societal cost of nonfatal tip-over injuries to adults is estimated to be $128.7, when all CSUs comply with the proposed rule, the societal cost of the injuries would be reduced by $56.0 million annually.

Summary of Expected Benefits. In summary, if the Commission adopts the proposed rule, once all CSUs in use comply with the requirements, staff expects that there will be virtually no fatal tip-over injuries to children 8 years of age and under and fatal injuries to adults will be reduced by one-half. Staff expects nonfatal injuries to children to be reduced by 83 percent and nonfatal injuries to adults to be reduced by 41.5 percent. The total reduction in societal costs (or benefit from the proposed rule) would be $305.5 million annually and is summarized in Table 5.

Table 5: Summary of Expected Annual Benefits.

Description	Current Annual Number of Incidents	Current Societal Cost (millions)	Expected Reduction in Incidents	Expected Annual Benefit (millions)
Child Fatalities	6.2	$57.0	5.8	$53.4
Adult Fatalities	1.8	$16.6	0.8	$7.4
Non-Fatal Child Injuries	6,824	$216.9	5,937	$188.7
Non-Fatal Adult Injuries	4,541	$128.7	1,975	$56.0
Total	---	$419.2	--	$305.5

Benefits Per CSU in Use. Generally, it is useful to discuss the benefits of a rule on a per-unit basis. This facilitates the comparison of the benefits of a rule to the costs when the costs are also expressed on a per-unit basis. To calculate the benefits of a standard on a per-unit basis, staff divided the estimated annual benefit by the number of units in use during the year. The result is the benefit per unit per year. The present values of expected annual benefits over the expected life of the product are summed to obtain the per-unit benefit. In general, this should include only those injuries that occurred on products that do not meet the requirements of the standard, and divide that number by the units in use that do not meet the standard. In this analysis, however, given that staff has only identified one CSU that would meet the requirements of the proposed rule without some modifications, staff assumes that all injuries and deaths to children occurred on CSUs that did not meet the requirements of the proposed rule.

Staff estimates that there were 463.5 million CSUs in use in 2017, which because staff is using the NEISS data from 2015 through 2019 to calculate the societal cost of injuries, this is approximately the average number of CSUs in use during the period. Using these estimates, the estimated annual benefit per unit of the proposed rule would be $0.66. As noted, staff has assumed that the average product life of a CSU is 15 years. However, this includes the generally less expensive ready-to-assemble (RTA) CSUs that might have expected useful lives that are less than 15 years and the generally more expensive factory-assembled CSUs that could have expected lives greater than 15 years. Assuming the average CSU has a product life of 15 years, benefit per unit of the proposed rule is the present value of the annual benefits per unit summed over the expected 15-year life of a CSU. Table 6 gives the estimated benefits per unit of the proposed rule using the 3 percent and 7 percent discount rates recommended by the Office of Management and Budget in Circular A-4. However, because interest rates have declined significantly since Circular A-4 was issued in 2003, staff also include the undiscounted values. As shown in Table 6, the benefits per unit of the proposed rule range from $6.01 to $9.90, depending upon the discount rate considered appropriate.

Table 6: Benefits per Unit by Discount Rate.

Discount Rate	Annual Benefit/Unit	Benefit/Unit Over the 15-Year Life of the CSU
Undiscounted	$0.66	$9.90
3 Percent	$0.66	$7.88
7 Percent	$0.66	$6.01

Costs Associated with the Proposed Rule. This section discusses the costs the proposed rule would impose on society. The costs include the costs that would be incurred to redesign and modify CSUs so that they meet the requirements of each of the standards. These costs include the increased cost to manufacture and distribute compliant CSUs. The costs also include the costs and impacts on consumers. These include the cost of additional time to assemble RTA furniture and the loss of utility if certain desired characteristics or styles are no longer available, or if compliant CSUs are less convenient to use. The costs of designing, manufacturing, and distributing compliant CSUs would be initially incurred by the manufacturers and suppliers, but most of these costs would likely be passed on to the consumers via higher prices. The costs involving the added assembly time for RTA CSUs or the loss of utility because CSUs with certain features or characteristics are no longer available, of course, would be borne directly by those consumers who desired CSUs with those characteristics or features.

To ensure that they comply with a mandatory standard, furniture manufacturers must first determine whether their models comply with the standard. This would involve testing their models for compliance. Because a voluntary standard exists, with which staff believes that most CSUs on the market already comply, most manufacturers are probably already conducting stability testing similar to the testing in the proposed rule. Manufacturers would replace their current test methods with the requirements of the proposed rule. Even though the new tests would include additional steps (*e.g.*, weighting drawers, pull tests on interlock mechanisms, and testing the CSU on a 1.5-degree angle), on a per-unit basis, any increase in the cost of testing due to the proposed rule is likely to be very small, and therefore, the cost of compliance testing will not be considered further in this analysis. Manufacturers will also need to add a stability rating to a hang tag that will be included on each CSU, which would be derived from the testing. Staff expects that the cost of deriving the stability rating and adding the hang tag to each unit will also be small on a per-unit basis and will not be considered further in this analysis.

Additionally, the cost of providing the certificates of conformity will be very low on a per-unit basis. In the case of CSUs that are children's products, which are thought to constitute a very small portion of the market for CSUs, the cost of the certification testing could be somewhat higher, because an accredited third-party testing laboratory would be required to conduct the certification testing.

The number of CSU models currently on the market that would comply with the requirements of the proposed rule is very low. CPSC staff collected and examined 186 CSU models intended to be a representative sample of the available CSUs, and only identified one model that would meet the requirements of the proposed rule without modification. For each model that does not comply with a mandatory standard, manufacturers must decide whether to stop offering that model or modify the model so that it would comply with the standard. If the manufacturer ceases to offer a noncomplying model, the cost of this decision will be the lost utility to the consumer. This cost cannot be quantified, but it would be mitigated to the extent that other CSUs with similar characteristics and features are available that comply with the standard.

Costs of Potential Modifications to Increase CSU Stability.[113] CPSC staff tested and analyzed CSUs to identify several ways units could be modified to increase their stability.[114] The modifications staff assessed were: (1) adding drawer-interlock mechanisms to limit the number of drawers that can be opened at one time; (2) reducing the maximum drawer extensions; (3) extending the feet or front edge of the CSU forward; (4) raising the front of the unit; and (5) adding additional counterweight to the CSU. Manufacturers can use combinations of more than one method to increase the stability of a single CSU model.

One potential modification staff evaluated was drawer interlock systems. A drawer interlock system prevents multiple drawers from being open simultaneously. Typically, an interlock allows one drawer in a column of drawers to be open at a time, while locking or blocking the other drawers from opening, although some interlock systems allow more than one drawer to open at a time. Interlock systems are common in file cabinets, and they are included in some CSUs. An interlock system can improve the stability of a CSU because a CSU is less stable as more of the drawers are opened, causing the weight of the CSU to move forward. By preventing multiple drawers from opening, the CG of the drawers remains behind the tip point and shifts the CSU's CG back, improving its stability.

Based on staff's testing, a drawer interlock system is one of the most effective options to improve stability, raising the tip-over moment of the CSU more than any other modification that staff evaluated. Interlocks were particularly effective at improving instability when paired with

[113] Tab D of the NPR briefing package discusses staff's testing and analysis of potential modifications to CSUs to improve stability and comply with the proposed rule.
[114] The purpose of this testing was to assess options manufacturers would have for modifying CSUs to meet the performance requirements in the proposed rule; none of these potential modifications would be requirements. Some of these modifications could be applied to existing CSUs without extensive design changes. Staff did not evaluate structural design changes, such as increasing the depth of the CSU or using lighter materials for drawers because staff could not easily modify existing CSUs to implement these changes. However, such design modifications could also help increase the stability of CSUs.

other modifications. However, the benefit of interlocks assumes that they are effective and cannot be bypassed.

The cost of a drawer interlock mechanism includes the cost of design, materials, and labor required to manufacture the mechanism. It would also include the cost of warehousing the parts, the logistics involved in getting the parts to the factory floor, and the cost of incorporating the mechanism into the CSU. In the case of an RTA CSU, some of these costs could fall directly on the consumer. The value of the extra time that might be required of a consumer to assemble a CSU with a drawer interlock is another cost of adding a drawer interlock mechanism. Based on information provided by a manufacturer, the cost of adding a drawer interlock mechanism to a CSU would be around $12. On the assumption that a manufacturer does not have an incentive to provide us with a low estimate, in this analysis staff are assuming that this could be a high estimate. Nevertheless, if adding an interlock mechanism requires an additional 5 minutes in labor time to assemble the mechanism and incorporate it into the CSU, then the cost could be $3.34 in labor costs alone. Considering the added cost of materials and the fact that some CSUs could require two mechanisms, or may need to new mechanisms to meet their particular needs, a minimum cost for adding a single interlock mechanism could be $6.00.[115] The cost could be $12 or more, especially if more than one mechanism were required, or a new design were required.[116]

Another potential modification is to reduce the travel length of drawer extensions, such as with new drawer slides. Reducing the drawer travel decreases the moment arm, which increases

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[115] Staff does not have direct estimates of the additional labor time that would be required to manufacture and add one or two interlock mechanisms to a CSU; but 5 minutes seems like a reasonably low estimate, if much of the work is manual. The cost of 5 minutes of labor is based on the total employer cost for employee compensation for private industry manufacturing workers in goods producing industries, published by the Bureau of Labor Statistics (December 2020).

[116] One manufacturer estimated that interlocking drawer could add $12 to the cost of a CSU and increase the retail price by as much as $39.

stability. When comparing two drawers on the same unit, the force required to tip over the CSU is more for drawers with shorter extensions.

The manufacturing costs of reducing the maximum drawer extensions is low, because it does not necessarily require additional parts or labor time. Perhaps the largest cost is the potential impact on consumer utility if it is less convenient to use CSUs with drawers that cannot open as widely. Staff cannot quantify this cost with the information available.

Another potential modification is to extend the front feet of the CSU forward to extend the fulcrum towards the edge of the drawer. This could be done by extending the front feet forward with an attachment or replacement foot, or by attaching a platform to the bottom of the CSU. However, based on staff's testing, for CSUs with poor stability, the extension or platform may need to be long enough that it could introduce a tripping hazard.

The cost of extending the feet or the front edge of the CSU forward can be very low. In some cases, no additional parts would be required, and the only cost would be the time it takes for the manufacturer to make the change in the manufacturing procedure. This would be the case where already-present feet or glides are simply shifted forward an inch or so. In these cases, the cost of shifting the front edge forward could be less than $1 per unit. In other cases, feet might need to be added or redesigned. If these feet or glides could be used on multiple CSU models, the costs could be up to $5 per CSU unit.[117] The cost of adding a base to the unit could be more expensive. In addition to the cost of the materials, there would be manufacturing costs to form the material used for the base and attach it to the unit. For RTA manufacturers, adding a base could involve additional costs to redesign the shipping packages to accommodate the base, and

[117] Cost based on observed prices for furniture feet available on the Internet.

could impact the shipping costs. This could add costs significantly over the $1 to $5 estimated here.

Another potential option is to raise the front of the CSU, to tilt the unit back, thereby making it less likely to tip forward. Tilting the CSU and drawers back increases the distance from the CSU CG location to the fulcrum, and reduces the distance from the fulcrum to the location where the tip force is applied to the CSU. Several existing CSU designs have adjustable front feet to allow for these level adjustments. Currently, manufacturers typically instruct consumers to adjust the feet as necessary to become level on an unlevel surface. Manufacturers could instruct consumers to tilt the CSU back further on carpet, or other surfaces, such that the CSU is not level, but has more resistance to tipping forward. Similar outcomes could be achieved by replacing the front legs with longer legs, or placing an object under them.

However, there are potential issues with this option. While raising the front feet makes tipping the CSU forward more difficult, it also makes tipping the CSU backward less difficult. Additionally, any manual foot adjustment system requires action by consumers to determine the appropriate level, and it risks the CSU not being used as intended by the manufacturer. Raised front legs also may not be practical on CSUs that are intended to have a level top surface.

According to one manufacturer, leveling devices could cost $5 per CSU. Observed retail prices for leveling devices can be as little as 30 cents each (at least two would be required for a CSU). If the front of a CSU must be raised a significant amount, other changes might be required to the CSU in order to keep the top and drawers of the CSU relatively level. The full cost of such changes cannot be quantified with the information available.

The final potential modification staff evaluated was adding additional weight to the CSU. Currently, the back of many CSUs is a thin sheet of fiberboard or other light material. A heavier material could be substituted. Alternatively, manufacturers could add weights to the back or other sections of the CSU to increase stability. Depending on the amount of weight added, there could be an unquantifiable cost to the consumer, due to the added weight that they must manage in assembling and moving the CSU. Based on retail prices observed on July 2, 2020, medium-density fiberboard costs approximately $0.24 per pound, which is a starting point for estimating the additional cost of adding weight to the back of a CSU.[118] If the additional weight required is low, it could be the only additional cost, because the heavier material would replace a lighter material, and the manufacturing process would require minimal changes. In the case where the added weight that would be required is significant, the costs could be higher, because attaching the back to the CSU could require different hardware, the reinforcement of the sides of the CSU, or different manufacturing procedures might be required to manipulate the heavier weight (*e.g.*, an additional worker or machine to handle the heavier board). In the case of RTA furniture, the cost of packaging and shipping could increase, and there would be an unquantifiable cost to the consumer in the form of the need to handle more weight. Potentially, manufacturers could offset the additional weight by using lower-density or thinner materials for other components, such as drawer fronts or cabinet tops. The Commission requests comments on the cost and other impacts of adding weight to the rear of the CSU to meet the requirements of the proposed rule.

Annual Cost of the Proposed Rule. Of the potential modifications for which staff was able to estimate the potential cost, the lowest costs were about $5.80 per unit. Several were

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[118] Furniture manufacturers presumably would be able to obtain materials at less than retail prices. However, staff are using retail prices in this analysis because, as noted above, there would be costs involved, for which staff do not have estimates, in forming and handling the heavier material. In the absence of estimates for these costs, staff believe that using the retail prices would provide a better estimate of the cost to manufacturers of using heavier materials.

significantly higher. Even assuming the low cost of about $5.80 per unit, assuming annual sales of at least 43 million units, the annual cost of the proposed rule would be around $250 million.

Other Impacts on Consumers. The costs discussed above are the costs to manufacture CSUs that could comply with the proposed rule. Even where staff has used retail prices to estimate the costs, the retail price was used in an attempt to capture other costs that would be incurred by manufacturers, including the logistics of acquiring the parts, getting them to the factory floor, and the labor involved in installing them; or in the case of RTA CSUs, the costs of packaging the added parts and the cost to consumers in time and trouble of installing the added parts. The change in retail prices due to these costs could be greater if manufacturers, wholesalers, and retailers add a markup to their costs. Markups can vary among manufacturers and subsets of the market, but can be 2 to 4 times the cost to the manufacturer. However, it is not certain that the retail prices would increase from the proposed rule by the same factor. It is possible that competition among manufacturers and different models could prevent retail prices from rising by the usual mark-up over cost.

Some manufacturers may withdraw some CSU models from the market if the cost or difficulty of modifying that model to meet the requirements of the proposed rule are too great in relation to their expected sales. For a small and light CSU, the modifications required could be so substantial that the model no longer has the character of the original model and is simply withdrawn from the market. Consumers who desired these particular models will suffer an unquantifiable loss, which is mitigated to the extent other CSUs exist that are reasonable substitutes. If the CSU models that are withdrawn are disproportionately the lower-cost models, which are likely to include many lighter and RTA models, the proposed rule could disproportionately impact lower-income consumers or those seeking low-cost models. These consumers might keep using their older, non-compliant CSUs, purchase a previously owned CSU, or even choose other products for clothes storage in place of CSUs, such as shelving, boxes, or storage bins. Although these impacts would be costs associated with the proposed rule, they are not quantifiable.

General Conclusions. Staff found that the societal costs of deaths and injuries from CSU tip-over incidents is about $419.2 million annually. This includes injuries to children and adults and is based on known fatalities from 2001 through 2016, and NEISS injuries from 2015 through 2019. If all CSUs had met the requirements of the proposed rule, however, the societal cost of these incidents would have been reduced by $305.5 million annually. This then would be the estimated benefit of the proposed rule. On a per-CSU-in-use basis, the benefit estimate is $0.66 cents per unit annually. Assuming CSUs have an expected useful life of 15 years, the average benefit of the proposed rule would be $6.01 per unit, assuming a 7 percent discount rate, $7.88 assuming a 3 percent discount rate, and $9.90 without discounting.

The costs of the proposed rule highly depend upon the actual modifications that are required for the CSUs to comply with the rule. The costs would be higher for some models than for others. In some cases, the required modifications could change the character of a CSU model to the extent that it is not viable and will be withdrawn from the market.

In this analysis, staff used the cost to modify existing CSUs in ways that would allow them to comply with the proposed rule as a measure of the cost of manufacturing CSUs that would comply with the proposed rule. The estimates used in this analysis are reasonable approximations of the costs involved; but in some instances, they could be underestimates because they do not include all of the expected monetary costs (*e.g.*, the costs that would be associated with an interlock system that has not yet been developed), and they do not consider the nonmonetary cost to consumers of the added weight, the decreased maximum drawer extensions, or similar losses associated with the other modifications. Potentially, there could be lower cost options for modifying CSUs to meet the requirements not considered in this analysis. CPSC staff welcomes comments on any other potential options for modifying or manufacturing CSUs to meet the requirements of the proposed rule.

Sensitivity Analysis. Staff's analysis depends on certain estimates and assumptions. In conducting the analysis, staff used values that staff believed best reflected reality. However, in many cases, the basis was weak or lacked strong empirical evidence. To address this, staff examined how other reasonable assumptions could affect the results of the analysis. A description of staff's sensitivity analysis is available in Tab H of the NPR briefing package.

B. Reasons for Not Relying on a Voluntary Standard

No standard, or statement of intention to modify or develop a standard, was submitted to the Commission in response to the ANPR. However, staff did evaluate existing standards relevant to CSU tip overs and determined that these standards would not adequately reduce the risk of injury associated with CSU tip overs because they do not account for the real-world factors staff identified in CSU tip-over incidents that contribute to instability, including multiple open and filled drawers, children's interactions with the CSU (such as climbing and opening drawers), or carpeting. A detailed discussion of these standards, and why staff considers them inadequate, is in section **V. Relevant Existing Standards**.

With respect to the primary standard in the United States that addresses CSU tip overs—ASTM F2057—CPSC staff has worked with ASTM on this standard since its inception in 2000, but has not been successful, to date, in revising the standard to account for the relevant factors. For these reasons, the Commission is not relying on an existing standard.

C. Alternatives to the Proposed Rule

CPSC considered several alternatives to the proposed rule. These alternatives, their potential costs and benefits, and the reasons CPSC did not select them, are described in detail in section **XI. Alternatives to the Proposed Rule**, below, and Tab H of the NPR briefing package.

X. Response to Comments[119]

This section describes the comments CPSC received on the ANPR, and responds to them. CPSC received 18 comments during the ANPR comment period, as well as 5 additional correspondences after the comment period, which staff also considered. The comments are available on: www.regulations.gov, by searching under docket number CPSC-2017-0044.

A. Voluntary Standards

Comment: Several commenters expressed support for ASTM F2057 and felt the voluntary standard process would create a robust standard. Other commenters stated that a mandatory standard is necessary to address the hazard, citing incident data and numerous flaws with ASTM F2057 and ASTM F3096.

Response: ASTM F2057 does not account for forces associated with the weight of clothing in filled drawers, the impact of multiple open and filled drawers, children's interactions with CSUs (such as climbing), or CSUs placed on carpet, all of which contribute to instability. Incident reports show that incidents often combine these variables (*e.g.*, a child opening multiple filled drawers and climbing, or a child standing on an open drawer of a unit placed on carpet). The UMTRI child climbing study shows that children climbing can impart rotational forces (tip moments) on CSUs beyond the forces of the child's weight alone. CPSC staff has worked closely with the ASTM F15.42 committee to improve the voluntary standard; staff has attempted and

[119] For more details about the comments CPSC received on the ANPR, and CPSC's response to them, see Tab K of the NPR briefing package.

continues to attempt to help revise the ASTM standard to reflect these additional factors that contribute to instability, but, to date, has been unsuccessful.

The proposed rule focuses on inherent stability of CSUs, rather than tip restraints, because the current rate of tip restraint use is low, and staff has identified several factors that make it unlikely that consumers will use tip restraints. Given this, staff did not evaluate ASTM F3096 in detail for this proposed rule because, even if it was effective at ensuring the strength of tip restraints, low rates of consumer use make tip restraints an ineffective way to address the hazard. However, based on a limited review of ASTM F3096, staff shares the commenters' concerns that ASTM F3096-14 may not be adequate because: (1) the assumed forces may be too low to represent forces from children's interactions, and (2) the standard does not address the whole tip-restraint system, which includes the connection to the CSU and the connection to the wall.

Comments: Some commenters provided test data regarding compliance with ASTM F2057, or commented on these reports. One commenter submitted data sets indicating that about 20-23 percent of the CSUs it tested did not comply with the voluntary standard.[120] Another commenter's report contained test data for dressers and chests, indicating that more than half of the tested units did not comply with the voluntary standard.[121]

Response: CPSC staff conducted a market survey of 188 CSUs purchased in 2018 and found that 91 percent met the stability requirements in ASTM F2057-17, which has the same stability requirements and test methods as F2057-19 (Tab N of the NPR briefing package). Since

[120] This testing assessed compliance with then-current ASTM F2057-17. ASTM F2057-17 included the same stability requirements as ASTM F2057-19, except that F2057-17 applied to units more than 30 inches in height; whereas, F2057-19 applies to units 27 inches or taller. Some of the tested units were 27 to 30 inches tall.

[121] This testing assessed compliance with ASTM F2057-14. ASTM F2057-14 included the same stability requirements as ASTM F2057-19, except that F2057-14 applied to units more than 30 inches in height; whereas, F2057-19 applies to units 27 inches or taller. One of the tested units was 27 to 30 inches tall.

publication of the ANPR, CPSC has issued 20 recalls for CSUs that did not comply with the ASTM F2057 stability requirements. However, regardless of compliance levels, CPSC considers ASTM F2057-19 inadequate to address the hazard of CSU tip overs.

B. *Hazard Communication: Warnings and Public Awareness*

Comments: Several commenters supported the use of hazard communication, including the labeling requirement in ASTM F2057, displaying the warning as a hand out at furniture stores, and mandating labeling provisions that are "effective, seen, understood, reflect real world use," and "accurately and clearly describe hazard patterns." One commenter advocated for education campaigns to educate parents about the hazard and promote the use of tip restraints. Other commenters indicated that warning labels and education campaigns are insufficient to address the hazard because children do not comprehend warning labels; incidents occur when children are unattended (*e.g.*, while left alone to nap); and renters may not be allowed to anchor products.

Response: Warnings, on their own, are unlikely to adequately address the hazard because they are unlikely to prevent a child from opening multiple drawers or climbing on a CSU, and consumers are unlikely to heed warnings, including warnings to anchor CSUs. Nevertheless, warning labels they may have some benefit. Accordingly, the proposed rule requires a warning label on CSUs to inform consumers about the tip-over hazard; encourage the use of tip-restraints as a secondary safety mechanism; and provide other safety information. The proposed warning label requirement addresses the child climbing hazard, tip restraint use, interlocks (if the product includes them), drawer loading (place the heaviest items in the lowest drawers), and CSU use with a television.

In addition, the proposed rule requires a hang tag label to provide consumers with meaningful information on the stability of a particular CSU, using a graphical representation of tip-over resistance, combined with an icon and text explanation, to allow consumers to make more informed purchasing decisions. This hang tag would provide a rating of the stability of the specific CSU that consumers could use to compare CSUs.

CPSC agrees that education campaigns could increase consumer knowledge of the CSU tip-over hazard and increase rates of anchoring. In June 2015, the Commission launched the Anchor It! campaign to educate consumers about the risk of injury or death from furniture, television, and appliance tip-overs, and to promote the use of tip restraints to anchor furniture and televisions. However, educational campaigns, alone, have not adequately reduced the CSU tip-over hazard. As incident data demonstrates, there has not been a statistically significant decline in CSU tip-over incidents without televisions while these efforts have been in place. In addition, CPSC commissioned a study to assess consumer awareness, recognition and behavior change as a result of the Anchor It! Campaign. The 2020 report providing the results of this study indicates that the survey included 600 parents and caregivers of children 5 years old or younger and showed that only 55 percent of participants reported ever having anchored furniture.

C. Scope and Definitions

Comments: Comments about the scope of a rule varied. Several commenters suggested including in the scope furniture less than 30 inches in height, and others supported limiting the scope to furniture more than 30 inches in height. One commenter recommended limiting the scope of a rule to chests, bureaus, and dressers, because the CPSC annual tip-over and instability reports indicate that most incidents involve those products. One commenter recommended covering “freestanding chests, bureaus & dressers intended for clothing storage in a bedroom, with height dimensions over 30 inches (762 mm), consisting of a solid top and side panels and containing at least one drawer," and suggested definitions for chests, bureaus, and dressers.

Response: In August 2019, ASTM published F2057-19, which revised the scope from including CSUs above 30 inches in height, to including CSUs equal to or above 27 inches in height. This change was based on incidents involving units 30 inches in height and under, including a fatal incident with a 27.5-inch-high unit. However, CPSC is aware of products that are marketed as CSUs and are under 27 inches high, and is aware of a fatal incident involving a 24-inch-high CSU with a television. On balance, staff considers it reasonable to include in the scope CSUs that are 27-inches high or more, and seeks comments on this issue.

Although most CSU tip-over incidents involve chests, bureaus, and dressers, additional furniture items, with the same/similar design and function as chests, bureaus, and dressers present the same hazard because the tip-over hazard relates to the design and use of the products. Similar products include wardrobes and armoires, as well as other products that consumers commonly recognize as CSUs, regardless of marketing. The Fors Marsh study (Tab Q of the NPR briefing package) indicates that consumers consider a variety of products suitable for use as CSUs. The ASTM F2057 definition of CSUs may exclude items that consumers use as CSUs. For this reason, the scope of the proposed rule uses criteria to distinguish between in-scope and out-of-scope products.

D. Test Parameters

Comments: Several commenters recommended using a test weight of at least 60 pounds to address children younger than 6 years old. Commenters noted that covering children up to 6 years old would be consistent with the age and weight of victims in incidents and account for developmentally expected behaviors for children that age that are associated with incidents (*e.g.*, climbing). Several comments also noted that victims as old as 8 years have been killed by falling furniture. One commenter urged CPSC to consider the 90th percentile child at their 6th and 8th birthdays "to better understand the risks posed to children older than 5." One commenter supported the ASTM test weight of 50 pounds, stating: "the most at-risk age group are children 1 to 4 years old" and the 50-pound test weight "appropriately reflects the age and weight of the most at-risk children based on the reported IDI data."

Response: Staff agrees that the 50-pound test weight in ASTM F2057 is inadequate; however, the data and staff's assessment have evolved since the ANPR. The ANPR discussed increasing the test weight to 60 pounds to represent the weight of "children up to and including age five," which is the age group that ASTM F2057 aims to cover. After the ANPR, staff worked with the F15.42 Furniture Subcommittee to provide evidence to increase the test weight to 60 pounds, based on updated 95th percentile weight data. ASTM balloted the weight increase, but it did not pass. The primary data source for the 60-pound weight recommendation was the 2000 Centers for Disease Control and Prevention (CDC) Growth Charts.[122] In the updated 2021 CDC Anthropometric Reference, children's weights tend to be higher than those in the 2000 CDC Growth Charts.

After the ANPR, the UMTRI child climbing study (Tab R of the NPR briefing package) quantified forces and moments children generate when interacting with a simulated CSU. Staff focused on the ascent forces because CSU tip-over incident data indicates that children climbing CSUs is the most common hazard scenario in these incidents, and ascent is an integral climbing interaction. For the ascent interaction and an average drawer extension,[123] staff determined that a

[122] Sixty pounds is the approximate 95th percentile weight of a 72-month-old male or 72-month-old female (the 95th percentile weight of a child just before his or her 6th birthday).
[123] The average drawer extension was 9.75 inches, for the purposed of this estimate, this extension was assumed to be the same as the distance of the extended drawer to the fulcrum.

50-pound child climbing could exert forces equivalent to those from an 80-pound test weight on the face of a drawer opened 12 inches. These results show that the 50-pound test weight in F2057 or even a 60-pound test weight would be inadequate to replicate the forces of a 50-pound child climbing.

For this NPR, staff also evaluated the ages and weights of children in CSU tip-over incidents. Most tip-over incidents involving children and CSUs without televisions involve 1, 2, and 3-year-old children. These are also the ages of children who are most involved in climbing incidents (the dominant hazard pattern). The 95th percentile weight of 3-year-old children is 51.2 pounds.[124] The children involved in fatal incidents with CSUs and no televisions weighed 45 pounds and under.[125]

Based on this information, the proposed rule simulates a 95th percentile 3-year-old (51.2 pounds) climbing on a CSU and generating associated dynamic and horizontal forces, rather than the 60-pound 5-year-old. When the relevant forces are considered, the 51.2-pound child weight is approximately equivalent to an 82-pound test weight on the face of a drawer opened 12 inches.[126] In addition, the proposed requirements simulate real-world conditions, such as multiple open and filled drawers, a carpeted surface, and a child pulling on the CSU. These factors are present in many tip-over incidents and contribute to the instability of a CSU. Staff determined that the proposed requirements will address all of the fatal incidents and the majority of the nonfatal incidents involving children and CSUs without televisions. The proposed

[124] This weight is based on the 2021 CDC Anthropometric Reference for a 95th percentile 3-year-old male. The 95th percentile weight for a 3-year-old female is 42.5 pounds. A stability requirement based on the 51.2-pound male would also cover the 95th percentile 3-year-old female.
[125] Two fatal incidents involved 45-pound children, one involving a 2-year-old child, and one involving a 7-year-old child (the oldest CSU tip-over fatality without a television).
[126] The proposed requirements distinguish between child weight and test weight. The child weight is used in an equation, along with the distance from the fulcrum, that estimates the moment (rotational force) that a child will exert on a CSU while climbing.

requirements should also reduce incidents involving CSUs with televisions and incidents involving adults.

Comments: One commenter suggested a tiered test weight system, based on the height of the product, recommending that products less than 40 inches in height be tested with 50 pounds of weight, and products more than 40 inches in height be tested with 60 pounds of weight. The commenter reasoned that older children (who weigh more) are less likely to climb shorter products because they can reach the top without climbing." One comment supported a tolerance of ± 1 pound for the test weight, consistent with the ASTM standard.

Response: Regarding a tiered test weight protocol, staff does not support using different tip forces for different height units because incident analysis indicates that there is not a strong relationship between unit height and child weight for fatal tip-over incidents.[127]

For test weight tolerance, CPSC staff considers a tolerance of ±1 pound for each of the two test weight blocks required in ASTM F2057-19 to be too large. Based on the tolerance, the total weight of the test blocks can range from 48-52 pounds, an 8 percent variability between the lowest and highest allowed test weights. Staff has previously worked with the ASTM F15.42 Furniture Subcommittee to propose tighter tolerances for each test weight and for the total test weight. However, the proposed rule does not require a fixed test weigh—rather, it consists of a tip-over moment measurement—making it unnecessary to specify a test weight tolerance.

Comments: Two commenters stated that more specificity is needed in the voluntary standard regarding the time frame to apply and maintain the test weight and contact of the test fixture with the drawer bottom.

[127] See CPSC staff letter to ASTM from Nesteruk, H.E.J., Re: Update to CPSC Staff letter dated August 24, 2018 (Oct. 12, 2018), available at: https://cpsc.gov/s3fs-public/TipoverASTMLetter%20October18%20Update.pdf.

Response: ASTM F2057-19 does not specify a time requirement to apply the 50-pound test weight or a specific amount of time that the CSU must support the weight without tipping over. Test methods in other ASTM standards (*e.g.*, F963-17, *Standard Consumer Safety Specification for Toy Safety*, F2236-16a, *Standard Consumer Safety Specification for Soft Infant and Toddler Carriers*, and F2194-16^{e1}, *Standard Consumer Safety Specification for Bassinets and Cradles*) state to apply a weight or force over a specific period to avoid imparting an impulse force on the product. To address this, the proposed rule specifies that the force must be applied gradually over a period of at least 5 seconds to avoid a potential impulse force.

Comment: Several commenters addressed open drawers during testing. Commenters emphasized that testing should reflect real-world conditions, and that opening one empty drawer at a time, as the ASTM standard requires, does not do this. Suggestions included multiple drawers being open simultaneously, loaded drawers, and testing drawers "at all stages of open."

Response: CPSC agrees that stability testing should reflect real-world use, which includes opening more than one drawer at a time (unless the CSU prevents this, such as with an interlock system) and drawers filled with clothing. Staff tested a number of different types and sizes of CSUs with various configurations of open and filled drawers, and modeled CSUs involved in tip-over incidents. Staff concluded that having multiple open drawers decreases stability, and having filled drawers has a variable effect on stability, depending on whether the filled drawers are open or closed. Filled drawers make a CSU less stable if the drawers are open; whereas, filled drawers make the CSU more stable if the drawers are closed. Thus, the least stable configuration is when all drawers are filled and open. If less than half of the drawers are open, the least stable configuration (assuming that the drawer fill is consistent across drawers) is when all drawers are empty. The test method in the proposed rule includes all drawers open and filled to reflect the worst-case configuration. The test method also accounts for interlock systems that would prevent multiple drawers from being opened simultaneously and allows for a modified test configuration for these units. If the interlock allows fewer than half of the drawers to open, the proposed requirements involve the CSU being tested with all drawers empty, which reflects a worst-case configuration for these units. These recommendations reflect incident data, which include children opening all of the drawers in CSUs and incidents involving empty and filled CSU drawers.

Comment: Several commenters recommended that testing involve carpeting or a surface that mimics the effects of carpet, to reflect real-world use conditions and common incident conditions, and because this may decrease stability. Some commenters suggested using a standardized material, or some other way of ensuring carpet testing would be reliable and repeatable. One commenter submitted a report containing test data for dressers and chests tipping that found that CSUs were less stable on carpet than on hard floors. Another commenter asked for a clear definition of "a hard, level, flat surface," specified in ASTM F2057, and suggested evaluating floor materials, including carpet, but recommended using a standardized material.

Response: Incident data indicates that consumers commonly place CSUs on carpet, and testing indicates that carpet decreases CSU stability. CPSC staff tested CSUs on carpet to learn what effect a flooring surface can have on the stability of CSUs (Tab P of the NPR briefing package). Staff found that, in general, CSUs were less stable on carpet. Accordingly, the proposed rule includes an element to simulate the effect of carpet as part of the stability testing. Staff agrees with the concern that testing on actual carpet may present challenges and may not be repeatable. Staff testing (Tab D of the NPR briefing package) indicates that an incline of 1.5 degrees was the average angle that replicated tip weight on carpet. Accordingly, to provide a repeatable method, the proposed rule includes a 1.5-degree incline to simulate the effect of carpet during stability testing. For the testing on a "hard, flat, and level" surface, the proposed rule provides a definition of this phrase.

Comments: Several commenters mentioned operational sliding length with regard to how far to extend drawers during stability testing. One commenter provided specific suggestions for testing three different types of drawer slides: (1) drawers without an outstop should be tested at 2/3 of the drawer extension; (2) drawers with an outstop should be tested with the drawer extended to the "valid outstop" (meaning an outstop that meets certain pull force and timing criteria); and (3) drawers with a self-closing feature should be tested with the drawer extended to the "static outstop" (meaning a position where the drawer remains in a static open position for a set time). Another commenter suggested clarifying the requirement in the voluntary standard that drawers are to be extended to 2/3 of the operational sliding length if there is no outstop because, with no minimum operational sliding length specified, the procedure for testing products with multiple outstops is unclear.

Response: Drawer extension is a key component of a tip event because the distance from the force application site to the fulcrum (pivot point) determines the moment (rotational forces) on a CSU. The proposed test method uses a moment calculation based on full drawer extension for drawers with an outstop, and requires 2/3 extension for drawers without an outstop. The proposed rule requires that, for stability testing, drawers be open to the "maximum extension," which is defined as:

> Maximum extension means a condition when a drawer or pull-out shelf is open to the furthest manufacturer recommended use position, as indicated by way of a stop. In the case of slides with multiple intermediate stops, this is the stop that allows the drawer or

> pull-out shelf to extend the furthest. In the case of slides with a multi-part stop, such as a stop that extends the drawer or pull-out shelf to the furthest manufacturer recommended use position with an additional stop that retains the drawer or pull-out shelf in the case, this is the stop that extends the drawer or pull-out shelf to the manufacturer recommended use position. If the manufacturer does not provide a recommended use position by way of a stop, this is 2/3 the shortest internal length of the drawer measured from the inside face of the drawer front to the inside face of the drawer back or 2/3 the length of the pull-out shelf.

This definition addresses the issue of multiple outstops. The Commission requests comments on self-closing drawers.

E. Tip Restraints

Comments: Comments about anchoring systems generally supported the position that furniture should be stable on its own, without the need for tip restraints. Reasons included: consumers may not have the option to anchor products (*e.g.*, rentals that do not allow holes in walls, or brick/concrete walls); consumers may not have the skills to anchor furniture correctly; some consumers are not aware of the need to anchor furniture; and the burden should not be placed on consumers to make products safe. However, commenters noted that anchors could be useful for used or older furniture, but that consumers need to be informed about proper installation. In addition, commenters noted that ASTM F3096-14 is inadequate because requirements for anchors should "adequately assess the strength of all designs of anchoring devices and the components of such devices in real world use conditions" with clear pass/fail tests.

Response: Staff agrees that tip restraints should not be the primary method of preventing CSU tip overs and that CSUs should be inherently stable. Several research studies show that a large number of consumers do not anchor furniture, including CSUs. A 2010 CPSC Consumer Opinion Forum survey found that only 9 percent of participants had anchored the furniture under their televisions; for participants that had a CSU under their televisions, the anchoring rate was 10 percent of participants.[128] A 2018 Consumer Reports nationally representative survey found that only 27 percent of consumers overall, and 40 percent of consumers with children under 6 years old at home, have an anchored piece of furniture in their homes.[129] A 2020 CPSC study on the Anchor It! campaign found that 55 percent of respondents reported ever having anchored furniture.[130] As the 2020 Fors Marsh study on furniture tip overs indicates (Tab Q of the NPR briefing package), reasons that consumers do not anchor furniture include: the belief that furniture does not need to be anchored if children are supervised; a perception that the furniture was stable enough; potential damage to walls; lack of knowledge about products; and difficulty installing tip restraints. For these reasons, the proposed rule does not include requirements for tip restraints, and focuses, instead, on inherent stability.

However, tip restraints may be useful as a secondary safety system, to improve the stability of existing CSUs or address additional child interactions. In future work, outside of this

[128] CPSC report on *Preliminary Evaluation of Anchoring Furniture and Televisions without Tools* (Technical Report CPSC/EXHR/TR—15/001), Butturini, R., Massale, J., Midgett, J., Snyder, S. (May 2015), available at: https://www.cpsc.gov/s3fs-public/pdfs/Tipover-Prevention-Project-Anchors-without-Tools.pdf.
[129] Peachman, R.R. Furniture Anchors Not an Easy Fix, as Child Tip-Over Deaths Persist (Nov. 5, 2018), available at: https://www.consumerreports.org/furniture/furniture-anchors-not-an-easy-fix-as-child-tip-over-deaths-persist/.
[130] *CPSC Anchor It! Campaign: Main Report*, FMG (Sep. 2, 2020), available at: https://www.cpsc.gov/s3fs-public/CPSC-Anchor-It-Campaign-Effectiveness-Survey-Main-Report_Final_9_2_2020....pdf?gC1No.oOO2FEXV9wmOtdJVAtacRLHIMK.

rulemaking effort, CPSC may evaluate appropriate requirements for tip restraints, and may work with ASTM to update its tip-restraint requirements. Based on a preliminary analysis, CPSC staff agrees that ASTM F3096-14 does not adequately address tip restraints in real-world use conditions. Staff believes that an appropriate test should assess the strength of the connection between the CSU and the wall, the attachment to the CSU and the wall, and test the tip restraint with common wall surfaces. In addition, as with ASTM F2057-19, ASTM F3096-14 uses a 50-pound static force to test the strength of the tip restraint, which may not represent the force on the tip restraint from a child and the CSU, especially for interactions that can generate dynamic forces, including those from older children.

F. Televisions

Comments: Several commenters addressed the involvement of CRT televisions in CSU tip-over incidents. Commenters stated that manufacturers stopped producing CRT televisions around 2008-2010. One commenter provided information regarding the transition from CRT televisions to flat screens, and suggested that this transition "has significantly reduced the potential hazard posed by TVs being placed on CSUs." In addition, the commenter stated that "99 percent of TVs are taken out of service after 16 years, meaning the number of CRTs in consumers' homes should be nearing zero by 2027." Commenters also noted that the discontinued production of CRT televisions means that CPSC would be unable to regulate these products, making it difficult to address the hazard they present. One commenter stated that television involvement in tip-over incidents should not undermine CPSC's efforts to focus on CSUs because the common denominator in incidents is a CSU.

Response: CPSC agrees that manufacturers' widespread shift from CRT televisions to flat-panel televisions is likely to result in decreased use in homes and an associated decrease in tip-over incidents involving CSUs with CRT televisions. NEISS data indicates that, for 2010 through 2019, there is a statistically significant linear decline in child injuries involving all CSUs (including televisions); however, there is no linear trend detected in injuries to children involving CSU tip-over incidents without televisions. Therefore, the decline in estimated CSU tip-over injuries during that period was driven by a decrease in ED-treated tip-over injuries involving CSUs with televisions. It is important to note that the CPSC tip-over data include incidents with a variety of television types, including CRT televisions and flat-panel televisions. Because flat-panel televisions are generally much lighter than CRT televisions, staff believes they are less likely to cause severe injury. Staff also agrees that television involvement in CSU tip-over incidents should not undermine CPSC's efforts to focus on CSUs.

The proposed rule focuses on tip-over hazards involving CSUs without televisions. However, increasing CSU stability should also decrease deaths and injuries from tip-over incidents involving CSUs with televisions.

G. Incidents/Risk

Comments: One comment compared the deaths due to CSU tip overs to the number of children who drown, suggesting that deaths due to CSU tip overs were relatively low, by comparison. Another comment provided a lengthy discussion of incident data, suggesting that incidents were declining, televisions are the primary hazard, and that the majority of incidents affect children younger than 5 years old, rather than less than 6 years of age. This commenter stated: "for children 13 to 59-months, there has been a 34% reduction in reported IDIs for the 4-year period between 2011-2015." Another commenter stated that CSU tip overs present a particular risk to children under 6 years old, due to physical and mental abilities and behaviors at these ages, noting that children under 6 years old are involved in 95 percent of deaths and 83 percent of injuries to children.

Response: The existence of other hazards, such as drowning deaths, does not diminish the need to address tip-over hazards. There were 193 reported CSU tip-over fatalities involving children and CSUs that occurred between January 1, 2000 and December 31, 2020. With the exception of 2010, there were at least three reported fatal tip-over incidents involving children and CSUs without televisions, each year from 2001 through 2017 (the last year for which death reporting is considered complete). Based on data from NEISS, CPSC staff estimates that there were 78,200 injuries from CSU tip overs (an estimated annual average of 5,600 injuries) treated in EDs from January 1, 2006 to December 31, 2019. Of these, an estimated 72 percent (an estimated 56,400 total and an estimated annual average of 4,000) were injuries to children. The estimated number of ED-treated injuries to children involving CSU tip overs was between about 2,500 and 5,900 injuries for each year from 2006 through 2019.

Incident data indicates that younger children are the most affected age group. In 91 percent of the tip-over fatalities involving children and CSUs without televisions (81 of 89), the victim was 1, 2, or 3 years old. An estimated 76 percent of ED-treated injuries to children involving CSU tip overs without televisions were to children 1 through 4 years old (an estimated 31,100 of 40,700), and an estimated 64 percent were to children 1 through 3 years old (an estimated 26,100 of 40,700). The oldest child in a tip-over fatality involving a CSU without a television was 7 years old; the oldest child with a reported ED-treated tip-over injury involving a CSU without a television was 17 years old.[131]

[131] The oldest child in a tip-over fatality involving a CSU with a television was 8 years old.

With respect to the comment stating that CSU incidents are declining, CPSC staff found a statistically significant linear decline in ED-treated CSU tip-over injuries to children from 2010 to 2019. However, this trend is driven by the decline in CSU tip-over incidents that involve televisions; there was no detected decline in tip-over injuries to children involving CSUs without televisions during the same time frame.

With respect to the comment that there has been a 34 percent reduction in reported IDIs, CPSC notes that IDIs are not reported, but are based on staff assignments; that is, when CPSC receives a report of an incident, staff can request an IDI. Therefore, the raw number of IDIs is not a meaningful number for comparison; it only represents example scenarios for which staff has sought and compiled additional information through an investigation, and is not a representative number of annual incidents. Any increase or decrease in the number of IDIs is a function of various factors and not necessarily a reflection of the seriousness of the hazard or rate of incidents. Moreover, IDIs are based on many types of source documents, and it is not clear to which IDIs the commenter is referring.

H. Costs and Small Business Impacts

Comments: One commenter stated that increasing test weights would create costs because many CSUs do not comply with the existing test weight requirement in the ASTM standard. Another commenter stated that it is possible to alter designs to improve stability in an affordable way. The Small Business Administration (SBA) met with CPSC staff regarding the ANPR on February 7, 2018. The SBA expressed that its small business contacts are comfortable with the existing ASTM standard, but are concerned about a mandatory rule that differs from or is more stringent than the voluntary standard. Those concerns include the impacts a rule would have on existing inventories and when compliance with the mandatory standard would be required.

Response: CPSC believes that the proposed rule would require modifications or redesign of most CSUs on the market. To estimate the cost of modifying CSUs to comply with the recommended requirements, CPSC staff examined five CSU models (Tab H of the NPR briefing package). In some cases, the cost to modify a particular CSU could be around $5.80 per unit; but in other cases, the costs could exceed $25 per unit. The cost of modifying lighter or taller CSUs could be greater than for heavier CSUs. Changes in the design of CSUs could impose other costs on consumers in the form of altered utility or convenience, including increased weight, reductions in the maximum drawer extensions, changes in the storage capacity of the CSU, or changes in the footprint of the CSU.

The initial regulatory flexibility analysis (IRFA) for this rule (Tab I of the NPR briefing package) specifically considers the impact of the proposed rule on small businesses. The analysis concludes that the proposed rule would likely have a significant impact on a substantial number of small entities.

I. Technical Feasibility

Comments: Several commenters addressed the technical feasibility of designing CSUs that could reduce stability issues. Comments regarding feasibility primarily consisted of: (1) comments that used test data showing a proportion of CSUs could pass certain tests as proof that it was feasible, and (2) comments that proposed specific solutions to address furniture tipping over. Suggestions included drawer slides that automatically close drawers or that require users to apply force continually to keep a drawer open; reducing the maximum extension length of drawers; wider CSU bases; bins in place of bottom drawers; and interlock systems that limit how many drawers can be open simultaneously. One commenter recommended that test requirements account for interlock systems.

Response: CPSC staff is aware of one CSU that meets the stability requirements in the proposed rule without modification. To address CSUs that do not already meet the proposed requirements, staff examined five CSUs to determine what modifications would allow them to meet the proposed requirements. Several modifications, including in combination, may improve the stability of CSUs, such as adding drawer interlocks, adding weight to the rear of the unit, decreasing the maximum drawer extensions, and shifting the front edge or feet (the fulcrum) of the CSU forward. Of the potential modifications for which staff was able to estimate the potential cost, the lowest costs were about $5.80 per unit, but in other cases, the costs may exceed $25. However, the extent of the modifications required would depend upon the characteristics of the CSU, such as its weight, dimensions, and center of gravity.

Regarding the comments that provide specific design solutions, under Section 7 of the CPSA, the Commission may issue performance requirements, or requirements for warnings and instructions; the Commission may not issue design requirements. Accordingly, the Commission cannot require the use of particular designs. However, these suggestions demonstrate that it is feasible to design more stable CSUs, and these or other design changes may be useful in modifying CSUs to comply with performance requirements.

J. Stories of Loss

Comments: Three commenters shared their personal experiences with tragic incidents where a CSU tipped over and killed a child. These comments included valuable information about the activities and conditions involved in the tip-over incidents they described, including the loading of drawers, flooring, and how the child was interacting with the CSU. These comments also provided useful information about user knowledge of the risk, and the presence of warning labels and tip restraints.

These commenters expressed that safety needs to be built into the design of CSUs, rather than relying on consumer knowledge of the hazard, consumer installation of anchors, or warning labels. The commenters noted several factors that make it ineffective to rely on consumer knowledge and actions. For example, the commenters noted that children are exposed to the CSU hazard outside their homes, so anchors may not be installed; consumer buy used CSUs, which may not have anchors, instructions, or labels; and consumers may not be permitted to anchor products to a wall in a rental, or may lack the technical skills to anchor CSUs properly. The commenters stated that a mandatory standard should mimic real-life circumstances that have been involved in CSU incidents, including less stable flooring and loaded drawers.

Response: CPSC appreciates the courage of these parents in sharing their stories. To each of these parents, we thank you for sharing these stories and we are deeply sorry for your loss. CPSC staff has considered the information about the interactions and conditions involved in the tip-over incidents in developing this NPR. The performance criteria were based on the children's interactions seen in fatal and nonfatal incident reports, and they are based on measured child climbing forces and child strength data. The performance criteria also are based on real-life CSU use, as seen in the incident reports, including opening multiple drawers, drawers filled with clothing, and placing the CSU on a carpeted floor. The incidents described in these comments are captured in the incident data set and have been incorporated into staff's analyses.

CPSC agrees that CSUs should be inherently stable and should not require a tip restraint to prevent tip overs. As explains above, there are several barriers to the use of tip restraints and research that suggests that the rate of anchoring CSUs is low. Additionally, although the proposed rule includes a warning label requirement to inform consumers of the hazard and to motivate them to install tip restraints as a secondary safety mechanism, warnings have limited effectiveness in addressing the tip-over hazard.

XI. Alternatives to the Proposed Rule

The Commission considered several alternatives to reduce the risk of injuries and death related to CSU tip overs. However, as discussed below, the Commission concludes that none of these alternatives would adequately reduce the risk of injury.

A. No Regulatory Action

One alternative to the proposed rule is to take no regulatory action and, instead, rely on voluntary recalls, compliance with the voluntary standard, and education campaigns. The Commission has relied on these alternatives to address the CSU tip-over hazard to date.

Between January 1, 2000 and March 31, 2021, 40 consumer-level recalls occurred in response to CSU tip-over hazards. The recalled products were responsible for 328 tip-over incidents, involved 34 firms, and affected approximately 21,500,000 CSUs. ASTM F2057 has included stability requirements for unloaded and loaded CSUs since its inception in 2000 and, based on CPSC testing, there is a high rate of compliance with the standard; CPSC's market survey of 188 CSUs found that 91 percent complied with the stability requirements in ASTM F2057. In addition, CPSC's Anchor It! campaign—an education campaign intended to inform consumers about the risk of CSU tip overs, provide safety tips or avoiding tip overs, and promote the use of tip restraints—has been in effect since 2015.

Given that this alternative primarily relies on existing CPSC actions, the primary costs staff estimates for this alternative are associated with tip restraints. However, this alternative is unlikely to provide additional benefits to adequately reduce the risk of CSU tip overs. For one, CPSC does not consider ASTM F2057 adequate to address the hazard because it does not account for several factors involved in tip-over incidents that contribute to instability, including multiple open and filled drawers, carpeting, and forces generated by children's interactions with the CSU. Based on the UMTRI studies of the dynamic forces imparted by children climbing on CSUs and staff testing of CSUs on carpeting, staff estimates that, even if all CSUs complied with ASTM F2057-19, that would only protect children weighing less than 29.1 pounds when climbing on a CSU, providing 70 percent of the benefits expected from the proposed rule.[132]

In addition, as Tab C of the NPR briefing package explains, several studies indicate that the rate of consumer anchoring of furniture, including CSUs, is low. A 2010 CPSC survey found that 9 percent of participants who responded to a question about anchoring furniture under their television indicated that they had; the same survey found that 10 percent of consumers who used a CSU to hold their television reported anchoring the CSU. A 2018 Consumer Reports study found that 27 percent of consumers overall, and 40 percent of consumers with children under 6 years old in the home, had anchored furniture; the same study found that 10 percent of those with a dresser, tall chest, or wardrobe had anchored it. CPSC's 2020 study on the Anchor It! campaign found that 55 percent of respondents (which included parents and caregivers of children 5 years old and younger) reported anchoring furniture. As such, on their own, these options have limited ability to further reduce the risk of injury and death associated with CSU tip overs. CPSC's use of this alternative to date illustrates this since, despite these efforts, there has been no declining trend in child injuries from CSU tip overs (without televisions).

[132] Staff estimates that the proposed rule would reduce nonfatal climbing injuries by 91 percent, addressing 375.48 of the 412 climbing NEISS cases reviewed. Staff estimates that a rule that protects children weighing 29.1 pounds or less would address only 110.08 of the incidents or about 27 percent.

B. Require Performance and Technical Data

Another alternative is to adopt a standard that requires only performance and technical data, similar to or the same as the hang tag requirements in the proposed rule, with no performance requirements for stability. This could consist of a test method to assess the stability of a CSU model, a calculation for determining a stability rating based on the test results, and a requirement that the rating be provided for each CSU on a hang tag. A stability rating would give consumers information on the stability of CSU models they are considering, to inform their buying decisions, and potentially give manufacturers an incentive to achieve a higher stability rating to increase their competitiveness or increase their appeal to consumers that desire more stable CSUs. The hang tag could also connect the stability rating to safety concerns, providing consumers with information about improving stability.

Because this alternative would not establish a minimum safety standard, it would not require manufacturers to discontinue or modify CSUs. Therefore, the only direct cost of this alternative would be the cost to manufacturers of testing their CSUs to establish their stability rating and labeling their CSUs in accordance with the required information. Any changes in the design of the CSUs would be the result of manufacturers responding to changes in consumer demand for particular models.

However, the Commission does not consider this alternative adequate, on its own, to reduce the risk of injury from CSU tip overs. Similar to tip restraints, this alternative relies on consumers, rather than making CSUs inherently stable. This assumes that consumers will consider the stability rating, and accurately assess their need for more stable CSUs. However, this is not a reliable approach to address this hazard, based on the low rates of anchoring, and the Fors Marsh focus group, which suggests that caregivers may underestimate the potential for a

CSU to tip over, and overestimate their ability to prevent tip overs by watching children. In addition, this alternative would not address the risk to children outside their homes (where the stability of CSUs may not have been considered), or CSUs purchased before a child's birth. The long service life of CSUs and the unpredictability of visitors or family changes in that timespan, and these potential future risks might not be considered at the time of the original purchase.

C. Adopt a Performance Standard Addressing 60-Pound Children

Another alternative is to adopt a mandatory standard with the same requirements as the proposed rule, but addressing 60-pound children, rather than 51.2-pound children. This alternative would be more stringent than the proposed rule.

About 74 percent of CSU tip-over injuries to children involve children 4 years old and younger,[133] and these are addressed by the proposed rule, because the 95th percentile weight for 4-year-old children is approximately 52 pounds. The proposed rule would also address some of the injuries to children who are 5 and 6 years old, as well, because many of these children also weigh less than 51.2 pounds. Mandating a rule that would protect 60-pound children would increase the benefit associated with child fatal and nonfatal injuries by about $10.9 million, and the rule could increase the benefits associated with reductions in adult fatal and nonfatal injuries by $3.2 million or a total of $14.1 million annually. This comes to about 3 cents per unit on an annual basis. Over an assumed 15-year life of a CSU, this comes to 7 cents per unit, assuming a 7 percent discount rate, 36 cents assuming a 3 percent discount rate, or 45 cents without discounting. Therefore, increasing the weight of the child protected to 60 pounds would only increase benefits by about 4.5 percent over the benefits that could be obtained by the proposed rule.

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[133] Based on NEISS estimates for 2015 through 2019.

Presumably, the cost of manufacturing furniture that complies with this more rigorous alternative would be somewhat higher than the costs of manufacturing CSUs that comply with the proposed rule, using similar, but somewhat more extensive modifications. Because this alternative would provide only a limited increase in benefits, but a higher level of costs than the proposed rule, the Commission did not select this alternative.

D. Mandate ASTM F2057 with a 60-Pound Test Weight

Another alternative would be to mandate a standard like ASTM F2057-19, but replace the 50-pound test weight with a 60-pound test weight. Sixty pounds approximately represents the 95th percentile weight of 5-year-old children, which is the age ASTM F2057-19 claims to address. This alternative was discussed in the ANPR.

This alternative would be less costly than the proposed rule, because, based on CPSC testing, about 57 percent of CSUs on the market would already meet this requirement. The cost of modifying CSUs that do not comply is likely to be less than modifying them to comply with the proposed rule, which is more stringent.

By increasing the test weight, it is possible that this alternative would prevent some CSU tip overs. However, this alternative still would not account for the factors that occur during CSU tip-over incidents that contribute to instability, including multiple open and filled drawers, carpeting, and the horizontal and dynamic forces from children's interactions with the CSU. As this preamble and the NPR briefing package explain, a 60-pound test weight does not equate to protecting a 60-pound child. The UMTRI study demonstrates that children generate forces greater than their weight during certain interactions with a CSU, including interactions that are common in CSU tip-over incidents. Because this alternative does not account for these factors, staff estimates that it may only protect children who weigh around 38 pounds or less, which is approximately the 75th percentile weight of 3-year-old children. For these reasons, the Commission does not believe this alternative would adequately reduce the CSU tip-over hazard, and did not select this alternative.

E. Longer Effective Date

Another alternative would be to provide a longer effective date than the 180-day effective date in the proposed rule. It is likely that hundreds of manufacturers, including importers, will have to modify potentially several thousand CSUs models to comply with the proposed rule, which will require understanding the requirements, redesigning the CSUs, and manufacturing compliance units. Delays in meeting the effective date could result in disruptions to the supply chain, or fewer choices being available to consumers, at least in the short term. A longer effective date could reduce the costs associated with the rule and mitigate potential disruption to the supply chain. However, delaying the effective date would delay the safety benefits of the rule as well. As such, the Commission did not select this alternative. However, the Commission requests comments about the proposed effective date.

XII. Paperwork Reduction Act

This proposed rule contains information collection requirements that are subject to public comment and review by the Office of Management and Budget (OMB) under the Paperwork Reduction Act of 1995 (PRA; 44 U.S.C. 3501–3521). Under the PRA, an agency must publish the following information:

- a title for the collection of information;
- a summary of the collection of information;
- a brief description of the need for the information and the proposed use of the information;

- a description of the likely respondents and proposed frequency of response to the collection of information;
- an estimate of the burden that will result from the collection of information; and
- notice that comments may be submitted to OMB.

44 U.S.C. 3507(a)(1)(D). In accordance with this requirement, the Commission provides the following information:

Title: Safety Standard for Clothing Storage Units

Summary, Need, and Use of Information: The proposed consumer product safety standard prescribes the safety requirements, including labeling and hang tag requirements, for CSUs. These requirements are intended to reduce or eliminate an unreasonable risk of death or injury to consumers from CSU tip overs.

Requirements for marking and labeling, in the form of warning labels, and requirements to provide performance and technical data by labeling, in the form of a hang tag, will provide information to consumers. Warning labels on CSUs will provide warnings to the consumer regarding product use. Hang tags will provide information to the consumer regarding the stability of the unit. These requirements fall within the definition of "collection of information," as defined in 44 U.S.C. 3502(3).

Section 27(e) of the CPSA authorizes the Commission to require, by rule, that manufacturers of consumer products provide to the Commission performance and technical data related to performance and safety as may be required to carry out the purposes of the CPSA, and to give notification of such performance and technical data at the time of original purchase to prospective purchasers and to the first purchaser of the product. 15 U.S.C. 2076(e). Section 2 of the CPSA provides that one purpose of the CPSA is to "assist consumers in evaluating the comparative safety of consumer products." 15 U.S.C. 2051(b)(2).

Section 14 of the CPSA requires manufacturers, importers, or private labelers of a consumer product subject to a consumer product safety rule to certify, based on a test of each product or a reasonable testing program, that the product complies with all rules, bans or standards applicable to the product. In the case that a CSU could be considered to be children's products, the certification must be based on testing by an accredited third-party conformity assessment body. The proposed rule for CSUs specifies the test procedure be used to determine whether a CSU complies with the requirements. For products that manufacturers certify, manufacturers would issue a general certificate of conformity (GCC).

Identification and labeling requirements will provide information to consumers and regulators needed to locate and recall noncomplying products. Identification and labeling requirements include content such as the name and address of the manufacturer.

Warning labels will provide information to consumers on hazards and risks associated with product use. Warning label requirements include size, content, format, location, and permanency.

The standard requires that CSU manufacturers provide technical information for consumers on a hang tag at the point of purchase. The information provided on the hang tag will allow consumers to make informed decisions on the comparative stability of CSUs when making a purchase and will provide a competitive incentive for manufactures to improve the stability of CSUs. Specifically, the manufacturer of a CSU will provide a hang tag with every CSU that explains the stability of the unit. CSU hangtag requirements include:

- Size: Every hangtag shall be at least 5 inches wide by 7 inches tall.

- Content: Every CSU shall be offered for sale with a hang tag that states the stability rating for the CSU model.
- Attachment: Every hang tag shall be attached to the CSU and clearly visible. The hang tag shall be attached to the CSU and lost or damaged hang tags must be replaced. The hang tags may be removed only by the first purchaser.
- Placement: The hang tag shall appear on the product and immediate container of the product in which the product is normally offered for sale at retail. Ready-to-assemble furniture shall display the hang tag on the main panel of consumer-level packaging. Any units shipped directly to consumers shall contain the hang tag on the immediate container of the product.
- Format: The format of the hang tag is provided in proposed rule and the hang tag shall include the elements shown in the example provided.

The requirements for the GCC are stated in Section 14 of the CPSA. Among other requirements, each certificate must identify the manufacturer or private labeler issuing the certificate and any third-party conformity assessment body, on whose testing the certificate depends, the date and place of manufacture, the date and place where the product was tested, each party's name, full mailing address, telephone number, and contact information for the individual responsible for maintaining records of test results. The certificates must be in English. The certificates must be furnished to each distributor or retailer of the product and to the CPSC, if requested.

Respondents and Frequency: Respondents include manufacturers and importers of CSUs. Manufacturers and importers will have to comply with the information collection requirements when the CSUs are manufactured or imported; this addressed further in the discussion of estimated burden.

Estimated Burden: CPSC has estimated the respondent burden in hours, and the estimated labor costs to the respondent. The hourly burden for labeling can be divided into two parts. The first part includes designing the label and the hang tag that will be used for each model. The second part includes physically attaching the label and hang tag to each CSU. Additionally, the burden for third-party testing is estimated for a subset of CSUs.

Manufacturers will have to place a hang tag on each CSU sold. In 2018, about 43.6 million CSUs were sold in the United States. This would be a reasonable estimate of the number of responses per year. CPSC estimates there to be 7,000 suppliers of CSUs for which there would be an hourly burden, as defined by the PRA. We estimate that there are about 35,000 different models of CSUs, or an average of 5 models per manufacturer.

Estimate of Respondent Burden. The hourly reporting burden imposed on firms includes the time it will take them to design and update hang tags, and identification labeling, including warning labels, as well as the hourly burden of attaching to all CSUs sold domestically.

Table 7: Estimated Annual Reporting Burden.

Burden Type	Type of Supplier	Total Annual Reponses	Length of Response	Annual Burden (hours)
Labeling, design and update	Manufacturer or Importer	35,000	12 min.	7,000
Labeling, attachment	Manufacturer, Importer, or Retailer	43.6 million	.06 min.	43,600
Total Labeling Burden				**50,600**
Third-party recordkeeping, certification	Manufacturers of Children's CSUs	21,800	3 hours	65,400
Total Hourly Burden				**116,000**

CPSC estimates it could take an hour for a supplier to design the hang tags and identification labeling, and that the design could be used for a period of five years, or until the CSU is redesigned. At 60 minutes per hang tag, and an average of 5 models per firm, the hourly burden for designing a hang tag that will be used for five years is 1 hour (60 min × 5 models ÷ 5 years). Therefore, for 7,000 firms, the annual burden would be 7,000 hours.

CPSC estimates it could take 0.06 minutes (3.6 seconds) for a supplier to attach the hang tag to the CSU, for each of the 43.6 million units sold in the U.S. annually. Attaching the hang tag to the CSU would amount to an hourly burden of 43,600 hours (0.06 min × 43,600,000 CSUs).

In addition, three types of third-party testing of children's products are required: certification testing, material change testing, and periodic testing. Requirements state that manufacturers conduct sufficient testing to ensure that they have a high degree of assurance that their children's products comply with all applicable children's product safety rules before such products are introduced into commerce. If a manufacturer conducts periodic testing, they are required to keep records that describe how the samples of periodic testing are selected. The hour burden of recordkeeping requirements will likely vary greatly from product to product, depending upon such factors as the complexity of the product and the amount of testing that must be documented. Therefore, estimates of the hour burden of the recordkeeping requirements are somewhat speculative.

CPSC estimates that 0.05 percent of all CSUs sold annually, 21,800 CSUs, are children's products and would be subject to third-party testing, for which 3 hours of recordkeeping and record maintenance will be required. Thus, the total hourly burden of the recordkeeping associated with certification is 65,400 hours (3 × 21,800).

Labor Cost of Respondent Burden. According to the U.S. Bureau of Labor Statistics (BLS), Employer Costs for Employee Compensation, the total compensation cost per hour worked for all private industry workers was $36.64 (March 2021, Table 4, https://www.bls.gov/news.release/pdf/ecec.pdf). Based on this analysis, CPSC staff estimates that labor cost of respondent burden would impose a cost to industry of approximately $4,250,240 annually (116,000 hours × $36.64 per hour).

Respondent Costs Other Than Burden Hour Costs. In addition to the labor burden costs addressed above, the hang tag requirement imposes additional annualized costs. These costs include capital costs for cardstock used for each hang tag to be displayed and the wire or string used to attach the hang tag to the CSU. We estimate the cost of the printed hang tag and wire for attaching the hang tag to the CSU will be about $0.10. Therefore, the total cost of materials to industry for would be about $4.36 million per year ($0.10 × 43.6 million units).

Cost to the Federal Government. The estimated annual cost of the information collection requirements to the federal government is approximately $4,172, which includes 60 staff hours to examine and evaluate the information as needed for Compliance activities. This is based on a GS-12, step 5 level salaried employee. The average hourly wage rate for a mid-level salaried GS-12 employee in the Washington, DC metropolitan area (effective as of January 2021) is $47.35 (GS-12, step 5). This represents 68.1 percent of total compensation (U.S. Bureau of Labor Statistics, "Employer Costs for Employee Compensation," March 2021, Table 2, percentage of wages and salaries for all civilian management, professional, and related employees: https://www.bls.gov/news.release/ecec.t02.htm. Adding an additional 31.9 percent for benefits brings average annual compensation for a mid-level salaried GS-12 employee to $69.53 per hour. Assuming that approximately 60 hours will be required annually, this results in an annual cost of $4,172 ($69.53 per hour × 60 hours = $ 4,171.80).

Comments. CPSC has submitted the information collection requirements of this rule to OMB for review in accordance with PRA requirements. 44 U.S.C. 3507(d). CPSC requests that interested parties submit comments regarding information collection to the Office of Information and Regulatory Affairs, OMB (see the ADDRESSES section at the beginning of this NPR). Pursuant to 44 U.S.C. 3506(c)(2)(A), the Commission invites comments on:

- whether the proposed collection of information is necessary for the proper performance of CPSC's functions, including whether the information will have practical utility;
- the accuracy of CPSC's estimate of the burden of the proposed collection of information, including the validity of the methodology and assumptions used;
- ways to enhance the quality, utility, and clarity of the information the Commission proposes to collect;
- ways to reduce the burden of the collection of information on respondents, including the use of automated collection techniques, when appropriate, and other forms of information technology;
- the estimated burden hours associated with labels and hang tags, including any alternative estimates; and
- the estimated respondent cost other than burden hour cost.

XIII. Initial Regulatory Flexibility Analysis[134]

This section provides an analysis of the impact on small businesses of a proposed rule that would establish a mandatory safety standard for CSUs. Whenever an agency is required to publish a proposed rule, section 603 of the Regulatory Flexibility Act (5 U.S.C. 601-612) requires that the agency prepare an initial regulatory flexibility analysis (IRFA) that describes the impact that the rule would have on small businesses and other entities. An IRFA is not required if the head of an agency certifies that the proposed rule will not have a significant economic impact on a substantial number of small entities. 5 U.S.C. 605. The IRFA must contain:

(1) a description of why action by the agency is being considered;

(2) a succinct statement of the objectives of, and legal basis for, the proposed rule;

(3) a description of and, where feasible, an estimate of the number of small entities to which the proposed rule will apply;

(4) a description of the projected reporting, recordkeeping and other compliance requirements of the proposed rule, including an estimate of the classes of small entities which will be subject to the requirement and the type of professional skills necessary for preparation of the report or record; and

(5) identification, to the extent practicable, of relevant Federal rules that may duplicate, overlap or conflict with the proposed rule.

An IRFA must also describe any significant alternatives that would accomplish the stated objectives of the applicable statutes and that would minimize any significant economic impact of the proposed rule on small entities. Alternatives could include: (1) establishing different

[134] Further details about the initial regulatory flexibility analysis are available in Tab I of the NPR briefing package. Additional information about costs associated with the rule are available in Tab H of the NPR briefing package.

compliance or reporting requirements that consider the resources available to small businesses; (2) clarification, consolidation, or simplification of compliance and reporting requirements for small entities; (3) use of performance rather than design standards; and (4) an exemption from coverage of the rule, or any part of the rule thereof, for small entities.

A. Reason for Agency Action

The intent of this rulemaking is to reduce deaths and injuries resulting from CSUs tipping over on children. These tip-over incidents commonly result when young children attempt to climb on the CSU or open drawers; the weight and interaction of the child combined with the weight of any open and filled drawers causes the CSU to tip forward and fall on the child. Children can be killed or injured from the impact of the CSU falling on them or by being trapped beneath the CSU, restricting their ability to breathe. This preamble, and Tab A of the NPR briefing package, provide incident data for CSU tip overs. In addition, the Preliminary Regulatory Analysis, above, and in Tab H of the NPR briefing, package provide further information about medically-treated CSU tip-over injuries from the ICM. That data demonstrates the need for agency action, and staff considered that data for the IRFA.

B. Objectives of and Legal Basis for the Rule

The objective of the proposed rule is to reduce deaths and injuries resulting from tip-over incidents involving CSUs. The Commission published an ANPR in November 2017, which initiated this proceeding to evaluate regulatory options and potentially develop a mandatory standard to address the risks of CSU tip-over deaths and injuries. The proposed rule would be issued under the authority of the CPSA.

C. Small Entities to Which the Rule Will Apply

The proposed rule would apply to small entities that manufacture or import CSUs. Manufacturers of CSUs are principally classified in the North American Industrial Classification (NAICS) category 337122 (non-upholstered wood household furniture manufacturing), but may also be categorized in NAICS codes 337121 (upholstered household furniture manufacturing), 337124 (metal household furniture manufacturing), or 337125 (household furniture (except wood and metal) manufacturing). According to data from the U.S. Census Bureau, in 2017, there were a total of 3,404 firms classified in these four furniture categories. Of these firms, 2,024 were primarily categorized in the non-upholstered wood furniture category. More than 99 percent of the firms primarily categorized as manufacturers of non-upholstered wood furniture would be considered to be small businesses, as were 97 percent of firms in the other furniture categories, according to the U.S. Small Business Administration (SBA) size standards.[135] We note that these categories are broad and include manufacturers of other types of furniture, such as tables, chairs, bed frames, and sofas. It is also likely that not all of the firms in these categories manufacture CSUs. Production methods and efficiencies vary among manufacturers; some make use of mass-production techniques, and others manufacture their products one at a time, or on a custom-order basis.

The number of U.S. firms that are primarily classified as manufacturers of non-upholstered wood household furniture has declined over the last few decades because retailers have turned to international sources of CSUs and other wood furniture. Additionally, firms that formerly produced all of their CSUs domestically have shifted production to foreign plants. Well

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135 U.S. Small Business Administration, *Table of Small Business Size Standards Matched to North American Industry Classification System Codes* (2019), available at: https://www.sba.gov/sites/default/files/2019-08/SBA%20Table%20of%20Size%20Standards_Effective%20Aug%2019%2C%202019_Rev.pdf.

over half (64 percent) of the value of apparent consumption of non-upholstered wood furniture (net imports plus domestic production for the U.S. market) in 2019 was comprised of imported furniture, and this likely was true for CSUs, as well. Firms that import furniture would likely be impacted by any rule that the Commission might promulgate regulating CSUs because they would have to ensure that any products that they import meet the requirements of the rule.

Under the NAICS classification system, importers are classified as either wholesalers or retailers. Furniture wholesalers are classified in NAICS category 423210 (Furniture Merchant Wholesalers). According to the Census Bureau data, in 2017, there were 5,117 firms involved in household furniture importation and distribution. A total of 4,920 of these (or 96 percent) are classified as small businesses because they employ fewer than 100 employees (which is the SBA size standard for NAICS category 423210). Furniture retailers are classified in NAICS category 442110 (Furniture Stores). According to the Census Bureau, there were 13,826 furniture retailers in 2017. The SBA considers furniture retailers to be small businesses if their gross revenue is less than $22 million. Using these criteria, at least 97 percent of the furniture retailers are small (based on revenue data from the 2012 Economic Census of the United States). Wholesalers and retailers may obtain their products from domestic sources or import them from foreign manufacturers.

D. Compliance, Reporting, and Record Keeping Requirements in the Proposed Rule

The proposed rule would establish a mandatory standard that all CSUs would have to meet to be sold in the United States. The requirements of the proposed standard are described, in detail, in this preamble, and the proposed regulatory text is at the end of this notice.

In addition to performance, labeling, and performance and technical information requirements, the proposed rule would also prohibit any person from manufacturing or importing noncomplying CSUs in any period of 12 consecutive months between the date of promulgation of the final rule and the effective date, at a rate that is greater than 120 percent of the rate at which they manufactured or imported CSUs during the base period for the manufacturer. The base period is any period of 365 consecutive days, chosen by the manufacturer or importer, in the 5-year period immediately preceding promulgation of the rule.

In addition, section 14 of the CPSA requires manufacturers, importers, or private labelers of a consumer product subject to a consumer product safety rule to certify, based on a test of each product or a reasonable testing program, that the product complies with all rules, bans or standards applicable to the product. The proposed rule specifies the test procedure to use to determine whether a CSU complies with the requirements. For products that manufacturers certify, manufacturers would issue a general certificate of conformity (GCC). In the case of CSUs that could be considered to be children's products, the certification must be based on testing by an accredited third-party conformity assessment body.

The requirements for the GCC are stated in Section 14 of the CPSA. Among other requirements, each certificate must identify the manufacturer or private labeler issuing the certificate and any third-party conformity assessment body, on whose testing the certificate depends, the date and place of manufacture, the date and place where the product was tested, each party's name, full mailing address, telephone number, and contact information for the individual responsible for maintaining records of test results. The certificates must be in English. The certificates must be furnished to each distributor or retailer of the product and to the CPSC, if requested.

1. Costs of the Proposed Rule That Would be Incurred by Small Manufacturers

CPSC staff evaluated potential modifications that could be made to CSUs to improve their stability and comply with the proposed rule. These potential modifications represent changes that could be made to existing CSU designs, rather than design changes, and were merely intended as an example of potential options manufacturers could use to comply with the proposed rule. The potential modifications are described in detail in Tab D of the NPR briefing package. The most effective modification staff identified for improving CSU stability was interlock systems, which limit the number of drawers that can be open simultaneously. Additional options include adding a counterweight to the CSU; extending the front legs or edge of the CSU; reducing the distance that drawers may be extended; and increasing the height of the front legs to tilt the CSU backwards. Most CSUs may require a combination of these modifications.

Based on an analysis of how five CSUs could be modified to meet the cost of the proposed rule, CPSC staff estimated the potential cost increases to CSU manufacturers. For four of the CSUs, the cost estimates were $13 or more per unit, and in some cases exceeded $25, which exceeds the estimated average benefits per unit. For the fifth CSU, the estimated cost estimates of the modifications were in the same range as the estimated benefits per unit. Firms may choose other methods or different combinations resulting in lower or higher costs. In addition to costs of product modifications, any reductions in utility that might be caused by modifications such as reductions in the drawer extensions or significantly higher weights have not been quantified; nor have any aesthetic costs or the possibility of a tripping hazard that might result from the addition of significant foot extensions. Some models could require such substantial modifications that they no longer have the characteristics of the original models and manufacturers might withdraw them from the market, creating some unquantified loss of consumer utility.

The above estimates include the variable costs related to changes such as additional hardware, materials that increase the weight, and increased shipping costs. They also include the fixed costs associated with the research and development required to redesign CSUs and tooling costs. If products have to be completely redesigned to meet the draft standard (*e.g.,* if adding weight or other minor modifications are not sufficient, and suppliers need to make drawers deeper and add new drawer slides), the changes could add substantial costs, or they could be offset with lighter weight front panels or tops. One supplier contacted by Industrial Economics Corporation on behalf of the CPSC estimated the cost of redesigning a CSU model as $18,000, including prototype, testing, engineering, and design.[136]

Costs of model redesign per unit produced would be greater for smaller manufacturers with lower production volumes. For smaller, lower-volume producers, the per-unit costs of the components necessary to modify their CSUs might also be higher than those for higher volume producers. CSUs that meet the requirements of the proposed rule may incorporate hardware designed to limit the ability of consumers to open multiple drawers at a time. Therefore, manufacturers would incur the costs of adding such drawer-interlock components. Based on information obtained from a CSU manufacturer, the cost of these components might average $6 to $12 per unit if the CSU only has one column of drawers. Component suppliers are likely to charge higher per unit prices to manufacturers that purchase fewer units. Also, larger companies with vertically-integrated operations that own or operate suppliers can more easily adapt to

[136] Israel, J., Cahill, A., and Baxter, J., Final Clothing Storage Units Cost Impact Analysis, Industrial Economics, Incorporated contract report (June 7, 2019), available at: https://ecpsc.cpsc.gov/apps/6b-Temp/Section%206b%20Tracking/Final%20Clothing%20Storage%20Units%20(CSUs)%20Cost%20Impact%20Analysis.pdf.

changes in design and manufacturing, and therefore may experience fewer impacts than smaller manufacturers without vertical integration.

Manufacturers would likely incur some additional costs to certify that their CSUs meet the requirements of the proposed rule as required by Section 14 of the CPSA. The certification must be based on a test of each product or a reasonable testing program. The costs of the testing might be minimal, especially for small manufacturers that currently conduct testing for conformance to the current voluntary standard, ASTM F2057-19. Importers may also rely on testing completed by other parties, such as their foreign suppliers, if those tests provide sufficient information for the manufacturers or importers to certify that the CSUs comply with the proposed rule. In the case of CSUs that are children's products, which are thought to constitute a very small portion of the market for CSUs, the cost of the certification testing could be somewhat higher because it would be required to be conducted by an accredited third-party testing laboratory.

Small manufacturers and importers will also incur added costs of required warning labels and hang tags with comparative tip ratings. Those manufacturers currently using permanent warning labels in conformance with ASTM F2057-19, should not face significant incremental costs for the replacement labels specified by the proposed rule. The required hang tags showing tip ratings for each CSU would involve some incremental costs, although likely to be minor in relation to other product modifications required for compliance. The testing costs needed to generate the tip ratings will be incurred to comply with the performance testing of the proposed rule.

2. *Impacts on Small Businesses*

Average manufacturer shipment value for CSUs was $118 per unit in 2018 (about $104 for chests of drawers and $144 for dressers). The estimated costs to manufacturers for product modifications to comply with the proposed rule range from about $5.80 (in one case) up to $30 or more per unit. Generally, staff considers impacts that exceed one percent of a firm's revenue to be potentially significant. Because the estimated average cost per CSU could be between about 5 percent and 25 percent of the average revenue per unit for CSUs, staff believes that the proposed rule could have a significant impact on a substantial number of small manufacturers and importers that receive a significant portion of their revenue from the sale of CSUs.

For many small importers, the impact of the proposed rule would be expected to be similar to the impact on small domestic manufacturers. Foreign suppliers may pass much of the costs of redesigning and manufacturing CSUs that comply with the proposed rule to their domestic distributors. Therefore, the cost increases experienced by small importers would be similar to those experienced by small manufacturers.

Small importers will be responsible for issuing a GCC certifying that their CSUs comply with the rule. However, importers may rely upon testing performed and GCCs issued by their suppliers in complying with this requirement. In the case of CSUs that are children's products, the certification must be based on testing by an accredited third-party conformity assessment body, which may involve additional costs.

E. *Federal Rules That May Duplicate, Overlap, or Conflict with the Proposed Rule*

CPSC did not identify any federal rules that duplicate or conflict with the proposed rule.

F. Alternatives Considered to Reduce the Burden on Small Entities

As discussed in **XI. Alternatives to the Proposed Rule**, above, CPSC examined several alternatives to the proposed rule, which could reduce the burden on firms, including small entities. For the reasons described in that section, the Commission concluded that those alternatives would not adequately reduce the risk of injury and death associated with CSU tip overs, and is not proposing those alternatives.

As part of that analysis, staff considered alternatives that could reduce the impact on small entities, specifically. One such alternative that could be specific to small entities could be variations on the proposed standard, such as reducing the required tip moment or testing units with weight in closed drawers of units with drawer interlock systems. Such modifications might reduce the need for other product changes, such as foot extensions, raising front feet, and added weight in the backs of CSUs. However, while perhaps reducing costs for manufacturers, such lessening of requirements would reduce the stability of units complying with the standard, thereby reducing the benefits of the standard.

Another alternative that could be specific to small entities would be a longer effective date for the rule. In its report on potential cost impacts, Industrial Economics, Incorporated[137] concluded from its limited subset of interviews that it appears likely that, unlike larger firms involved in ASTM standards development, "many small furniture makers are not aware of the potential regulations under consideration." Smaller firms may, therefore, find it much more difficult to meet an effective date of 180 days after the rule is published. As discussed in **XI.**

[137] Industrial Economics, Incorporated (2019). Final Clothing Storage Units (CSUs) Market Research Report. CPSC Contractor Report. Researchers analyzed the characteristics of 890 CSUs, and found a height range of 18 to 138 inches.

Alternatives to the Proposed Rule, extending the period before the rule becomes effective could reduce costs, but would also delay the benefits of the rule.

See Tab I of the NPR briefing package for further discussion of alternatives to the proposed rule. The Commission seeks comments on any alternatives that would reduce the impact on small entities, while adequately reducing the risk of injury and death associated with CSU tip overs.

G. Request for Comments

The Commission invites comments on this IRFA and the potential impact of the proposed rule on small entities, especially small businesses. In particular, the Commission seeks comments on:

- the types and magnitude of manufacturing costs that might disproportionately impact small businesses or were not considered in this analysis;
- the costs of the testing and certification, warning label, and hang tag requirements in the proposed rule;
- the different impacts on small businesses associated with different effective dates;
- different impacts of the proposed rule on small manufacturers or suppliers that compete in different segments of the CSU market; and
- other alternatives that would minimize the impact on small businesses but would still reduce the risk of CSU tip-over incidents.

XIV. Incorporation by Reference

The proposed rule incorporates by reference ASTM F2057-19. The Office of the Federal Register (OFR) has regulations regarding incorporation by reference. 1 CFR part 51. Under these regulations, in the preamble of the NPR, an agency must summarize the incorporated material, and discuss the ways in which the material is reasonably available to interested parties or how the agency worked to make the materials reasonably available. 1 CFR 51.5(a). In accordance with the OFR requirements, this preamble summarizes the provisions of ASTM F2057-19 that the Commission proposes to incorporate by reference.

The standard is reasonably available to interested parties and interested parties can purchase a copy of ASTM F2057-19 from ASTM International, 100 Barr Harbor Drive, P.O. Box C700, West Conshohocken, PA 19428-2959 USA; telephone: 610-832-9585; www.astm.org. Additionally, during the NPR comment period, a read-only copy of ASTM F2057-19 is available for viewing on ASTM's website at: https://www.astm.org/CPSC.htm. Once a final rule takes effect, a read-only copy of the standard will be available for viewing on the ASTM website at: https://www.astm.org/READINGLIBRARY/. Interested parties can also schedule an appointment to inspect a copy of the standard at CPSC's Division of the Secretariat, U.S. Consumer Product Safety Commission, 4330 East West Highway, Bethesda, MD 20814, telephone: 301-504-7479; e-mail: cpsc-os@cpsc.gov.

XV. Testing, Certification, and Notice of Requirements

Section 14(a) of the CPSA includes requirements for certifying that children's products and non-children's products comply with applicable mandatory standards. 15 U.S.C. 2063(a). Section 14(a)(1) addresses required certifications for non-children's products, and sections 14(a)(2) and (a)(3) address certification requirements specific to children's products.

A "children's product" is a consumer product that is "designed or intended primarily for children 12 years of age or younger." *Id.* 2052(a)(2). The following factors are relevant when determining whether a product is a children's product:

- manufacturer statements about the intended use of the product, including a label on the product if such statement is reasonable;
- whether the product is represented in its packaging, display, promotion, or advertising as appropriate for use by children 12 years of age or younger;
- whether the product is commonly recognized by consumers as being intended for use by a child 12 years of age or younger; and
- the Age Determination Guidelines issued by CPSC staff in September 2002, and any successor to such guidelines.

Id. "For use" by children 12 years and younger generally means that children will interact physically with the product based on reasonably foreseeable use. 16 CFR 1200.2(a)(2). Children's products may be decorated or embellished with a childish theme, be sized for children, or be marketed to appeal primarily to children. *Id*. 1200.2(d)(1).

As discussed above, some CSUs are children's products and some are not. Therefore, a final rule on CSUs would subject CSUs that are not children's products to the certification requirements under section 14(a)(1) of the CPSA and would subject CSUs that are children's products to the certification requirements under section 14(a)(2) and (a)(3) of the CPSA. The Commission's requirements for certificates of compliance are codified at 16 CFR part 1110.

Non-Children's Products. Section 14(a)(1) of the CPSA requires every manufacturer (which includes importers[138]) of a non-children's product that is subject to a consumer product safety rule under the CPSA or a similar rule, ban, standard, or regulation under any other law enforced by the Commission to certify that the product complies with all applicable CSPSC-enforced requirements. 15 U.S.C. 2063(a)(1).

[138] The CPSA defines a "manufacturer" as "any person who manufactures or imports a consumer product." 15 U.S.C. 2052(a)(11).

Children's Products. Section 14(a)(2) of the CPSA requires the manufacturer or private labeler of a children's product that is subject to a children's product safety rule to certify that, based on a third-party conformity assessment body's testing, the product complies with the applicable children's product safety rule. *Id.* 2063(a)(2). Section 14(a) also requires the Commission to publish a notice of requirements (NOR) for a third-party conformity assessment body (*i.e.*, testing laboratory) to obtain accreditation to assess conformity with a children's product safety rule. *Id.* 2063(a)(3)(A). Because some CSUs are children's products, the proposed rule is a children's product safety rule, as applied to those products. Accordingly, if the Commission issues a final rule, it must also issue an NOR.

The Commission published a final rule, codified at 16 CFR part 1112, entitled *Requirements Pertaining to Third Party Conformity Assessment Bodies*, which established requirements and criteria concerning testing laboratories. 78 Fed. Reg. 15836 (Mar. 12, 2013). Part 1112 includes procedures for CPSC to accept a testing laboratory's accreditation and lists the children's product safety rules for which CPSC has published NORs. When CPSC issues a new NOR, it must amend part 1112 to include that NOR. Accordingly, as part of this NPR, the Commission proposes to amend part 1112 to add CSUs to the list of children's product safety rules for which CPSC has issued an NOR.

Testing laboratories that apply for CPSC acceptance to test CSUs that are children's products for compliance with the new rule would have to meet the requirements in part 1112. When a laboratory meets the requirements of a CPSC-accepted third party conformity assessment body, the laboratory can apply to CPSC to include 16 CFR part 1242, *Safety Standard for Clothing Storage Units*, in the laboratory's scope of accreditation of CPSC safety rules listed on the CPSC website at: www.cpsc.gov/labsearch.

XVI. Environmental Considerations

The Commission's regulations address whether CPSC is required to prepare an environmental assessment (EA) or an environmental impact statement (EIS). 16 CFR 1021.5. Those regulations list CPSC actions that "normally have little or no potential for affecting the human environment," and therefore, fall within a "categorical exclusion" under the National Environmental Policy Act (42 U.S.C. 4231-4370h) and the regulations implementing it (40 CFR parts 1500-1508) and do not require an EA or EIS. 16 CFR 1021.5(c). Among those actions are rules that provide performance standards for products. *Id.* 1021.5(c)(1). Because this proposed rule would create performance requirements for CSUs, the proposed rule falls within the categorical exclusion, and thus, no EA or EIS is required.

XVII. Preemption

Executive Order (EO) 12988, *Civil Justice Reform* (Feb. 5, 1996), directs agencies to specify the preemptive effect of a rule in the regulation. 61 Fed. Reg. 4729 (Feb. 7, 1996), section 3(b)(2)(A). In accordance with EO 12988, CPSC states the preemptive effect of the proposed rule, as follows:

The regulation for CSUs is proposed under authority of the CPSA. 15 U.S.C. 2051-2089. Section 26 of the CPSA provides that "whenever a consumer product safety standard under this Act is in effect and applies to a risk of injury associated with a consumer product, no State or political subdivision of a State shall have any authority either to establish or to continue in effect any provision of a safety standard or regulation which prescribes any requirements as to the performance, composition, contents, design, finish, construction, packaging or labeling of such product which are designed to deal with the same risk of injury associated with such consumer product, unless such requirements are identical to the requirements of the Federal Standard." 15

U.S.C. 2075(a). The federal government, or a state or local government, may establish or continue in effect a non-identical requirement for its own use that is designed to protect against the same risk of injury as the CPSC standard if the federal, state, or local requirement provides a higher degree of protection than the CPSA requirement. *Id.* 2075(b). In addition, states or political subdivisions of a state may apply for an exemption from preemption regarding a consumer product safety standard, and the Commission may issue a rule granting the exemption if it finds that the state or local standard: (1) provides a significantly higher degree of protection from the risk of injury or illness than the CPSA standard, and (2) does not unduly burden interstate commerce. *Id.* 2075(c).

Thus, the CSU requirements proposed in today's **Federal Register** would, if finalized, preempt non-identical state or local requirements for CSUs designed to protect against the same risk of injury and prescribing requirements regarding the performance, composition, contents, design, finish, construction, packaging or labeling of CSUs.

XVIII. Effective Date

The CPSA requires that consumer product safety rules take effect not later than 180 days after the date the rule is promulgated unless the Commission finds, for good cause shown, that a later effective date is in the public interest and publishes the reasons for that finding. 15 U.S.C. 2058(g)(1). To allow time for CSUs to come into compliance with the standard, the Commission proposes that this rule become effective 180 days after publication of the final rule in the *Federal Register*. The rule would apply to all CSUs manufactured or imported on or after that effective date. Consistent with that, the Commission also proposes that the amendment to part 1112 become effective 180 days after publication of the final rule. The Commission requests comments on the proposed effective date.

XIX. Proposed Findings

The CPSA requires the Commission to make certain findings when issuing a consumer product safety standard. Specifically, the CPSA requires the Commission to consider and make findings about the following:

- the degree and nature of the risk of injury the rule is designed to eliminate or reduce;
- the approximate number of consumer products subject to the rule;
- the need of the public for the products subject to the rule and the probable effect the rule will have on the cost, availability, and utility of such products;
- any means to achieve the objective of the rule while minimizing adverse effects on competition, manufacturing, and commercial practices;
- that the rule, including the effective date, is reasonably necessary to eliminate or reduce an unreasonable risk of injury associated with the product;
- that issuing the rule is in the public interest;
- if a voluntary standard addressing the risk of injury has been adopted and implemented, that either compliance with the voluntary standard is not likely to result in the elimination or adequate reduction of the risk or injury, or it is unlikely to be substantial compliance with the voluntary standard;
- that the benefits expected from the rule bear a reasonable relationship to its costs; and
- that the rule imposes the least burdensome requirement that prevents or adequately reduces the risk of injury.

15 U.S.C. 2058(f)(1), (f)(3). This section discusses these findings.

A. Degree and Nature of the Risk of Injury

Based on incident data available through NEISS and CPSRMS, there were 193 reported CSU tip-over fatalities to children (*i.e.*, under 18 years old), 11 reported fatalities to adults (*i.e.*, ages 18 through 64 years), and 22 reported fatalities to seniors (*i.e.*, ages 65 years and older) that were reported to have occurred between January 1, 2000 and December 31, 2020. Of the 193 reported child fatalities from CSU tip overs, 86 percent (166 fatalities) involved children 3 years old or younger, 6 percent (12 fatalities) involved 4-year-olds, 4 percent (7 fatalities) involved 5-year-olds, 2 percent (4 fatalities) involved 6-year-olds, less than one percent (1 fatality) involved a 7-year-old, and 2 percent (3 fatalities) involved 8-year-olds.

Based on NEISS, there were an estimated 78,200 injuries, an annual average of 5,600 estimated injuries, related to CSU tip overs for all ages that were treated in U.S. hospital EDs from January 1, 2006 to December 31, 2019. Of the estimated 78,200 injuries, 56,400 (72 percent) were to children, which is an annual average of 4,000 estimated injuries to children over the 14-year period. In addition, the ICM projects that there were approximately 19,300 CSU tip-over injuries treated in other settings from 2015 through 2019, or an average of 3,900 per year. Combining the NEISS estimate of injuries treated in hospital EDs with the ICM estimate of medically attended injuries treated in other settings brings the estimate of all nonfatal, medically attended CSU tip-over injuries to children to 34,100 during the years 2015 through 2019.

Injuries to children, resulting from CSUs tipping over, include soft tissue injuries, skeletal injuries and bone fractures, and fatalities resulting from skull fractures, closed-head injuries, compressional and mechanical asphyxia, and internal organ crushing leading to hemorrhage.

B. Number of Consumer Products Subject to the Proposed Rule

In 2017, there were approximately 463.5 million CSUs in use. In 2018, combined shipments of dressers and chests totaled 43.6 million units. Annual sales of CSUs total about 44 million units.

C. The Public Need for CSUs and the Effects of the Proposed Rule on Their Utility, Cost, and Availability

Consumers commonly use CSUs to store clothing in their homes. The proposed rule provides a performance standard that requires CSUs to meet a minimum stability threshold, but does not restrict the design of CSUs. As such, CSUs that meet the standard would continue to serve the purpose of storing clothing in consumers' homes. There may be a negative effect on the utility of CSUs if CSUs that comply with the standard are less convenient to use, such as altered designs to limit drawer extensions, an increase in the footprint of the product, or a reduction in storage capacity. Another potential effect on utility could occur if, in order to comply with the standard, manufacturers modify CSUs to eliminate certain desired characteristics or styles, or discontinue models. However, this loss of utility would be mitigated to the extent that other CSUs with similar characteristics and features are available that comply with the standard.

Retail prices of CSUs vary substantially. The least expensive units retail for less than $100, while some more expensive units may retail for several thousand dollars. Of the potential modifications to comply with the standard for which CPSC staff was able to estimate the potential cost, the lowest costs were about $5.80 per unit; however, several were significantly higher. CSU prices may increase to reflect the added cost of modifying or redesigning products to comply with the standard, or to account for increased distribution costs if CSUs are heavier or include additional parts. In addition, consumers may incur a cost in the form of additional time to assemble CSUs if additional safety features are included.

If the costs associated with redesigning or modifying a CSU model to comply with the standard results in the manufacturer discontinuing that model, there would be some loss in availability of CSUs.

D. Other Means to Achieve the Objective of the Proposed Rule, While Minimizing Adverse Effects on Competition and Manufacturing

The Commission considered alternatives to achieving the objective of the rule of reducing unreasonable risks of injury and death associated with CSU tip overs. For example, the Commission considered relying on voluntary recalls, compliance with the voluntary standard, and education campaigns, rather than issuing a standard. Because this is the approach CPSC has relied on, to date, this alternative would have minimal costs; however, it is unlikely to further reduce the risk of injury from CSU tip overs.

The Commission also considered issuing a standard that requires only performance and technical data, with no performance requirements for stability. This would impose lower costs on manufacturers, but is unlikely to adequately reduce the risk of injury from CSU tip overs because it relies on manufacturers choosing to offer more stable units; consumer assessment of their need for more stable units (which CPSC's research indicates consumers underestimate); and does not account for CSUs outside a child's home or purchased before a child was born.

The Commission also considered mandating a standard like ASTM F2057-19, but replacing the 50-pound test weight with a 60-pound test weight. This alternative would be less costly than the proposed rule, because many CSUs already meet such a requirement, and it would like cost less to modify noncompliance units to meet this less stringent standard.

However, this alternative is unlikely to adequately reduce the risk of CSU tip overs because it does not account for factors that are present in CSU tip-over incidents that contribute to CSU instability, including multiple open and filled drawers, carpeting, and forces generated by a child interacting with the CSU.

Another alternative the Commission considered was providing a longer effective date. This may reduce the costs of the rule by spreading them over a longer period, but it would also delay the benefits of the rule, in the form of reduced deaths and injuries.

Another alternative the Commission considered is adopting a mandatory standard with the requirements in the proposed rule, but addressing 60-pound children, rather than 51.2-pound children. However, this alternative would be more stringent than the proposed rule and, therefore, would likely increase the costs associated with the rule, while only increasing the benefits of the rule by about 4.5 percent.

E. Unreasonable Risk

As described above, incident data from NEISS and CPSRMS indicates that there were 226 reported CSU tip-over fatalities that were reported to have occurred between January 1, 2000 and December 31, 2020, of which 85 percent (193 incidents) were children, 5 percent (11 incidents) were adults, and 10 percent (22 incidents) were seniors. Of the reported child fatalities from CSU tip overs, 86 percent (166 fatalities) involved children 3 years old or younger.

Based on NEISS, there were an estimated 78,200 injuries, an annual average of 5,600 estimated injuries, related to CSU tip overs that were treated in U.S. hospital EDs from January 1, 2006 to December 31, 2019. Of these, 72 percent (56,400) were to children, which is an annual average of 4,000 estimated injuries to children over the 14-year period. In addition, the ICM projects that there were approximately 19,300 CSU tip-over injuries treated in other settings from 2015 through 2019, or an average of 3,900 per year. Combining the NEISS estimate of injuries treated in hospital EDs with the ICM estimate of medically attended injuries treated in other settings brings the estimate of all nonfatal, medically attended CSU tip-over injuries to children to 34,100 during the years 2015 through 2019.

Injuries to children when CSUs tip over can be serious. They include fatal injuries resulting from skull fractures, closed-head injuries, compressional and mechanical asphyxia, and internal organ crushing leading to hemorrhage; they also include serious nonfatal injuries, including skeletal injuries and bone fractures.

The Commission estimates that the rule would result in aggregate benefits of about $305.5 million annually. Of the potential modifications for which staff was able to estimate the potential cost, the lowest costs were about $5.80 per unit. Several were significantly higher. Even assuming the low cost of about $5.80 per unit, assuming annual sales of at least 43 million units, the annual cost of the draft proposed rule would be around $250 million. In addition, there is an unquantifiable cost to consumers associated with lost utility and availability, and increased costs.

The Commission concludes preliminarily that CSU tip overs pose an unreasonable risk of injury and finds that the proposed rule is reasonably necessary to reduce that unreasonable risk of injury

F. Public Interest

This proposed rule is intended to address an unreasonable risk of injury and death posed by CSUs tipping over. The Commission believes that adherence to the requirements of the proposed rule will significantly reduce CSU tip-over deaths and injuries in the future; thus, the rule is in the public interest.

G. Voluntary Standards

The Commission is aware of four voluntary and international standards that are applicable to CSUs: ASTM F2057-19, *Standard Consumer Safety Specification for Clothing Storage Units*; AS/NZS 4935: 2009, the Australian/New Zealand Standard for *Domestic furniture – Freestanding chests of drawers, wardrobes and bookshelves/bookcases – determination of stability*; ISO 7171 (2019), the International Organization for Standardization *International Standard for Furniture – Storage Units – Determination of stability*; and EN14749 (2016), the European Standard, *European Standard for Domestic and kitchen storage units and worktops – Safety requirements and test methods*. The Commission does not consider the standards adequate because they do not account for the multiple factors that are commonly present simultaneously in CSU tip-over incidents and that testing indicates decrease the stability of the CSU. These factors include multiple open and filled drawers, carpeted flooring, and dynamic forces generated by children's interactions with the CSU, such as climbing or pulling on the top drawer.

H. Relationship of Benefits to Costs

The aggregate benefits of the rule are estimated to be about $305.5 million annually; and the cost of the rule is estimated to be about $250 million annually (based on the lowest estimated cost of potential modifications to the units staff evaluated). On a per unit basis, the Commission estimates the expected benefits per unit to be $6.01, assuming a 7 percent discount rate; $7.88 assuming a 3 percent discount rate; and $9.90 without discounting. The Commission's lowest estimated expected costs to manufacturers per unit is $5.80 (based on the CSUs evaluated), plus an unquantifiable cost to consumers associated with lost utility and availability, and increased costs. Based on this analysis, the Commission preliminarily finds that the benefits expected from the rule bear a reasonable relationship to the anticipated costs of the rule.

I. Least Burdensome Requirement That Would Adequately Reduce the Risk of Injury

The Commission considered less-burdensome alternatives to the proposed rule, but preliminarily concludes that none of these alternatives would adequately reduce the risk of injury.

The Commission considered relying on voluntary recalls, compliance with the voluntary standard, and education campaigns, rather than issuing a mandatory standard. This alternative would have minimal costs, but would be unlikely to reduce the risk of injury from CSU tip overs. The Commission has relied on these efforts to date, but despite these efforts, there has been no declining trend in child injuries from CSU tip overs (without televisions) from 2006 to 2019.

The Commission considered issuing a standard that requires only performance and technical data, with no performance requirements for stability. This would impose lower costs on manufacturers, but is unlikely to adequately reduce the risk of injury because it relies on manufacturers choosing to offer more stable units; consumer assessment of their need for more stable units (which CPSC's research indicates consumers underestimate); and does not account for CSUs outside a child's home or purchased before a child was born.

The Commission considered mandating a standard like ASTM F2057-19, but replacing the 50-pound test weight with a 60-pound test weight. This alternative would be less costly than the proposed rule, because many CSUs already meet such a requirement, and it would likely cost less to modify noncompliant units to meet this less stringent standard. However, this alternative is unlikely to adequately reduce the risk of CSU tip overs because it does not account for several factors that are simultaneously present in CSU tip-over incidents and contribute to instability, including multiple open and filled drawers, carpeting, and forces generated by a child interacting with the CSU.

The Commission considered providing a longer effective date. This may reduce the costs of the rule by spreading them over a longer period, but it would also delay the benefits of the rule, in the form of reduced deaths and injuries.

XX. Request for Comments

The Commission invites comments on all aspects of the proposed rule. Comments should be submitted in accordance with the instructions in the **ADDRESSES** section at the beginning of this notice. The following are specific comment topics that the Commission would find helpful:

A. Scope and Definitions

- the scope of the proposed standard, including the products covered, and the characteristics used to define and identify CSUs;
- the listed exclusions, including whether the excluded products should be included, or whether other products should be excluded;
- whether the scope of the proposed rule should include CSUs under 27 inches, or all CSUs, regardless of height;
- whether lightweight units, including lightweight plastic units, should be excluded from the scope of the rule, and if so, the safety justification for doing so, and what the weight threshold should be and why;
- whether all freestanding items marketed and/or advertised as suitable for clothing storage should be included in the scope of the standard, even if they would otherwise be excluded based on their design;

- whether nightstands with drawers and/or doors should be included in the scope and what design features and safety considerations distinguish nightstands from CSUs;
- design features that distinguish non-CSU cabinets from door chests and other similar CSUs; and
- the proposed definitions, including whether any definitions should be modified, or any additional terms should be defined.

B. Fill Requirements

- whether the fill amounts for drawers and pull-out shelves at 8.5 pound per cubic foot are reasonable or should be revised;
- data on the weight of clothes in drawer; and
- whether pull-out shelves should be tested with the same storage density as drawers, or would a lower fill weight for pull-out drawers be appropriate (*e.g.*, 4.25 pound per cubic foot).

C. Performance Requirements

- the stability requirements, and whether they are adequate, or should be modified;
- whether the moment requirements should be increased (*e.g.*, the same stability requirements as in the proposed rule, but with a 60-pound child interaction, or simulating more aggressive behavior) or decreased (*e.g.*, use different force/moment values to simulate climbing);
- the proposed test methods and any alternatives;
- whether a 1.5-degree forward tilt adequately replicates the effects of a CSU resting on carpet;
- whether an inclined surface test should be added to account for sloped floors;

- whether ANSI/BIFMA SOHO S6.5-2008 (R2013) requirements for interlocks are appropriate to consider for CSU interlocks, or what different requirements to consider and why;
- whether the 30-pound proposed performance requirement is adequate to assess that the drawer interlock design cannot be easily defeated or over ridden by the consumer;
- whether drawer interlocks should be subject to a performance requirement to ensure designs cannot be easily defeated or overridden by the consumer;
- whether labeling or instructions for proper leveling on carpet should be a requirement;
- whether levelling devices should be non-adjustable to account for carpeting;
- whether levelling devices should be allowed to be adjusted per the manufacturer instructions during stability testing;
- whether levelling devices should include preset heights to account for carpeting;
- whether levelling devices should require a permanent adjustment mark that indicates the position recommended for use on a carpeted surface;
- whether the criteria to measure the maximum tip-over load should be the rear of the CSU lifting off at least ¼ inch from the test surface;
- whether interlocks for ready-to-assemble furniture should be pre-assembled and/or automatically engage;
- how to test interlock systems that have an override, such as two drawers opened simultaneously, and how to determine whether children can engage an override, and associated test methods;
- whether interlocks on other extendible elements besides drawers should be considered (*e.g.*, doors, shelves);

- whether and how to test automatically closing drawers;
- whether all three of the comparison tip-over moments should be included in the standard, whether any should not be included, or whether any additional forces or interactions should be included;
- pull force and force application location; and
- drawer extension requirements during testing.

D. Child Interactions and Associated Forces

- whether the test method should account for pull forces on the CSU, and the assumptions of pull force and force application location (*e.g.*, is the 17.2-pound horizontal force applied at maximum 4.12 feet vertical distance appropriate to simulate a child pulling a drawer or pulling on a CSU);
- assumptions relating to children's interactions with doors and associated forces, including whether interactions involving opening doors and climbing on doors should be addressed; and
- the adequacy of the proposed requirement regarding opening and climbing on doors.

E. Marking and Labeling

- whether the proposed warning requirements are adequate, or should be modified;
- suggestions for the language and format of the warning label;
- suggestions for the language and format of the informational label;
- whether the graphical symbols being studied, as well as the symbols included in ASTM F2057-19 are appropriate, effective, and understandable;
- the size, content, symbols, format, location, and permanency of marking and labeling;

- whether there should there be a warning on CSUs to anchor the television, when the CSU is suitable for holding a television;
- whether labeling or instructions for proper levelling on carpet should be a requirement, especially for CSUs with levelers to tilt the unit backwards on carpet; and
- whether the product and packaging should contain a label that states: "meets CPSC stability requirements."

F. Hang Tags

- all aspects of the proposed hang tag requirements;
- whether the hang tag rating and explanatory text is understandable;
- suggestions for the language or format of the hang tag;
- potential rating calculations, and suggestions for other ratings; and
- improvements in the graphic quality that maintain symbolic, iconic representation of a tip-over event.

G. Tip Restraints

- tip restraints, including their adequacy and suggestions for improving the tip restraint requirements outlined in ASTM F3096-14 and ASTM F2057-19;
- whether there should be a requirement that all CSUs come with a tip restraint and/or whether there should be a requirement that CSUs intended for use with televisions should include a television restraint device and/or means to anchor a television (including a flat panel televisions) on the CSU, such as a universal attachment point;
- potential test methods related to tip restraints, including whether requirements should address designs where tip restraint installation is mandatory to unlock drawers; and

- whether the Commission should develop tip restraint requirements, such as restraints permanently attached to the CSU or an attachment point, such as a D-ring, that will not fail when pulled at a specified force.

H. Economic Analysis (Preliminary Regulatory Analysis and IRFA)

- the annual unit sales of CSUs;
- the accuracy and reasonableness of the benefits estimates;
- the accuracy or reasonableness of the cost estimates for manufacturers and importers (if available, sales or other shipment data would be helpful);
- costs of the testing and certification requirements;
- costs associated with the warning label and hang tag requirements;
- the cost and other impacts of adding weight to the rear of the CSU to meet the requirements of the proposed rule;
- the practicality and costs of using levelers or other means of raising the front of a CSU as to meet the requirements of the proposed rule;
- the potential modifications discussed in this preamble and the NPR briefing package, and their estimated costs;
- other ways CSUs could be modified to comply with the requirements of the proposed rule, including the potential cost of the modifications and other impacts on the CSUs or their utility. CPSC is particularly interested in ways that the cost of the modifications could be offset by making other changes in the design of the CSUs or the manufacturing processes used;
- the sensitivity analysis and any other valuations used in CPSC's analysis;

- the types and magnitude of manufacturing costs that might disproportionately impact small businesses or were not considered in the agency's analysis;
- the different impacts on small businesses associated with different effective dates;
- the differential impacts of the proposed rule on small manufacturers or suppliers that compete in different segments of the CSU market; and
- other alternatives that would minimize the impact on small businesses but would still reduce the risk of CSU tip-over incidents.

I. Stockpiling

- the need for an anti-stockpiling requirement;
- the proposed manufacture and import limits; and
- the proposed base period for the stockpiling provision.

J. Effective Date

- the reasonableness of the proposed 180-day effective date and recommendations for a different effective date, if justified; and
- comments recommending a longer effective date should describe the problems associated with meeting the proposed effective date and the justification for a longer one.

XXI. Promulgation of a Final Rule

Section 9(d)(1) of the CPSA requires the Commission to promulgate a final consumer product safety rule within 60 days of publishing a proposed rule. 15 U.S.C. 2058(d)(1). Otherwise, the Commission must withdraw the proposed rule, if it determines that the rule is not reasonably necessary to eliminate or reduce an unreasonable risk of injury associated with the product, or is not in the public interest. *Id.* However, the Commission can extend the 60-day period for good cause shown, if it publishes the reasons for doing so in the *Federal Register*. *Id.*

The Commission finds there is good cause to extend the 60-day period for this rulemaking. Under both the Administrative Procedure Act (APA; 5 U.S.C. 551-559) and the CPSA, the Commission must provide an opportunity for interested parties to submit written comments on a proposed rule. 5 U.S.C. 553; 15 U.S.C. 2058(d)(2). The Commission typically provides 75 days for interested parties to submit written comments. Because of the size, complexity, and potential impacts of this proposed rule, the Commission considers it appropriate to provide a 75-day comment period. In addition, the CPSA requires the Commission to provide interested parties with an opportunity to make oral presentations of data, views, or arguments. 15 U.S.C. 2058. This requires time for the Commission to arrange a public meeting for this purpose, and provide notice to interested parties in advance of that meeting. After receiving written and oral comments, CPSC staff must have time to review and evaluate those comments.

These factors make it impossible for the Commission to issue a final rule within 60 days of this proposed rule. Accordingly, the Commission finds there is good cause to extend the 60-day period.

XXII. Conclusion

For the reasons stated in this preamble, the Commission proposes requirements for CSUs to address an unreasonable risk of injury associate with CSU tip overs.

List of Subjects

16 CFR Part 1112

Administrative practice and procedure, Audit, Consumer protection, Reporting and recordkeeping requirements, Third-party conformity assessment body.

16 CFR Part 1242

Consumer protection, Imports, Incorporation by reference, Information, Labeling, Safety.

For the reasons discussed in the preamble, the Commission proposes to amend Title 16 of the Code of Federal Regulations as follows:

PART 1112—REQUIREMENTS PERTAINING TO THIRD PARTY CONFORMITY ASSESSMENT BODIES

1. The authority citation for part 1112 continues to read as follows:

   Authority: Pub. L. 110-314, section 3, 122 Stat. 3016, 3017 (2008); 15 U.S.C. 2063.

2. Amend § 1112.15 by adding paragraph (b)(52) to read as follows:

§ 1112.15 When can a third party conformity assessment body apply for CPSC acceptance for a particular CPSC rule or test method?

* * * * *

(b) * * *

(52) 16 CFR part 1242, Safety Standard for Clothing Storage Units.

* * * * *

3. Add part 1242 to read as follows:

PART 1242—SAFETY STANDARD FOR CLOTHING STORAGE UNITS

Sec.

1242.8 Findings.

Authority: **15 U.S.C. 2051(b), 2056, 2058, 2063(c), 2076(e)**

§ 1242.1 Scope, purpose, application, and exemptions.

(a) *Scope and purpose*. This part 1242, a consumer product safety standard, prescribes the safety requirements, including labeling and hang tag requirements, for *clothing storage units*, as defined in 1242.2(a). These requirements are intended to reduce or eliminate an unreasonable risk of death or injury to consumers from clothing storage unit tip overs.

(b) *Application*. Except as provided in paragraph (c) of this section, all clothing storage units that are manufactured in the Unites States, or imported, on or after [effective date], are subject to the requirements of this part 1242, if they are *consumer products*. Section 3(a)(1) of the Consumer Product Safety Act (15 U.S.C. 2052(a)(1)) defines the term *consumer product* as an "article, or component part thereof, produced or distributed (i) for sale to a consumer for use in or around a permanent or temporary household or residence, a school, in recreation, or otherwise, or (ii) for the personal use, consumption or enjoyment of a consumer in or around a permanent or temporary household or residence, a school, in recreation, or otherwise." The term does not include products that are not customarily produced or distributed for sale to, or for the use or consumption by, or enjoyment of, a consumer.

(c) *Exemptions.* The following products are exempt from this part 1242:

(1) *Clothes lockers*, as defined in 1242.2(b), and

(2) *Portable storage closets*, as defined in 1242.2(s).

§ 1242.2 Definitions.

In addition to the definitions given in section 3 of the Consumer Product Safety Act (15 U.S.C. 2052), the following definitions apply for purposes of this part 1242:

(a) *Clothing storage unit* means a *freestanding* furniture item, with *drawer(s)* and/or *door(s)*, that may be reasonably expected to be used for storing clothing, that is greater than or equal to 27 inches in height, and with a total *functional volume* of the *closed storage* greater than 1.3 cubic feet and greater than the sum of the total *functional volume* of the *open storage* and the total volume of the *open space*. Common names for clothing storage units include, but are not limited to: chests, bureaus, dressers, armoires, wardrobes, chests of drawers, drawer chests, chifforobes, and door chests. Whether a product is a clothing storage unit depends on whether it meets this definition. Some products that generally do not meet the criteria in this definition and, therefore likely are not considered clothing storage units are: shelving units, office furniture, dining room furniture, laundry hampers, built-in closets, and single-compartment closed rigid boxes (storage chests).

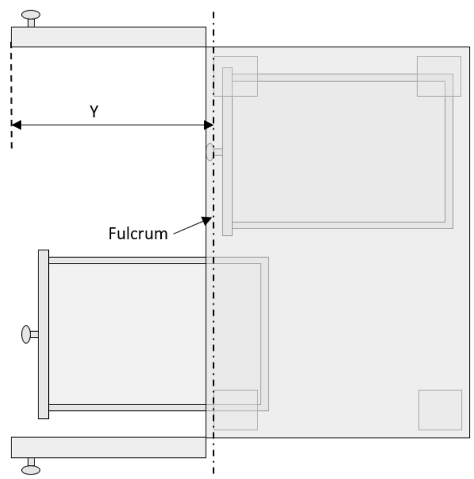
(b) *Clothes locker* means a predominantly metal furniture item without exterior drawers and with one or more doors that either locks or accommodates an external lock.

(c) *Closed storage* means storage space inside a *drawer* and/or behind an opaque *door*. For this part 1242, both sliding and hinged doors are considered in the definition of *closed storage*.

(d) *Door* means a hinged furniture component that can be opened or closed, typically outward or downward, to form a barrier; or a sliding furniture component that can be opened or closed by sliding across the face or case of the furniture item. This does not include vertically opening hinged lids.

(e) *Door extension from fulcrum distance* means the horizontal distance measured from the farthest point of a hinged door that opens outward or downward, while the door is in a position where the center of mass of the door is extended furthest from the front face of the unit (typically 90 degrees), to the *fulcrum*, while the CSU is on a *hard, level, and flat test surface*. See Figure 1. Sliding doors that remain within the CSU case are not considered to have a door extension.

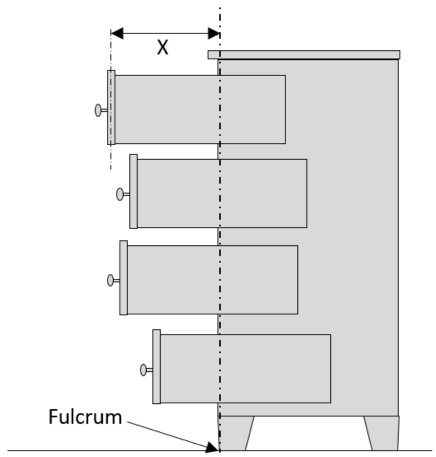
Figure 1 to paragraph (e)—(Top View) The *door extension from fulcrum distance,* illustrated by the letter Y.



(f) *Drawer* means a furniture component intended to contain or store items that slides horizontally in and out of the furniture case and may be attached to the case by some means, such as glides.

(g) *Drawer or pull-out shelf extension from fulcrum distance* means the horizontal distance measured from the centerline of the front face of the *drawer* or the outermost surface of the pull-out shelf to the *fulcrum*, when the drawer or pull-out shelf is at the *maximum extension* and the CSU is on a *hard, level, and flat test surface*. For a curved or angled surface this measurement is taken where the distance is at its greatest. See Figure 2.

Figure 2 to paragraph (g)—The *drawer extension from fulcrum distance*, illustrated by the letter X.



(h) *Freestanding* means that the unit remains upright, without requiring attachment to the wall, when it is fully assembled and empty, with all extension elements closed. Built-in units or units intended to be permanently attached to the building structure, other than by tip restraints, are not considered freestanding. Examples of units that are intended to be permanently installed include, but are not limited to, kitchen cabinets and bathroom vanities.

(i) *Functional volume* of a *drawer* or *pull-out shelf* means the interior bottom surface area multiplied by the effective *drawer*/*pull-out shelf* height, which is distance from the bottom surface of the *drawer*/*pull-out shelf* to the top of the *drawer*/*pull-out shelf* compartment minus 1/8 inches (see Figure 3a). *Functional volume* behind a *door* means the interior bottom surface area behind the *door*, when the *door* is closed, multiplied by the height of the storage compartment (see Figure 3b). *Functional volume* of *open storage* means the interior bottom surface area multiplied by the effective *open storage* height, which is distance from the bottom surface of the *open storage* to the top of the *open storage* compartment minus 1/8 inches.

Figure 3a to paragraph (i)—*Functional volume* of *drawer* or *pull-out shelf*.

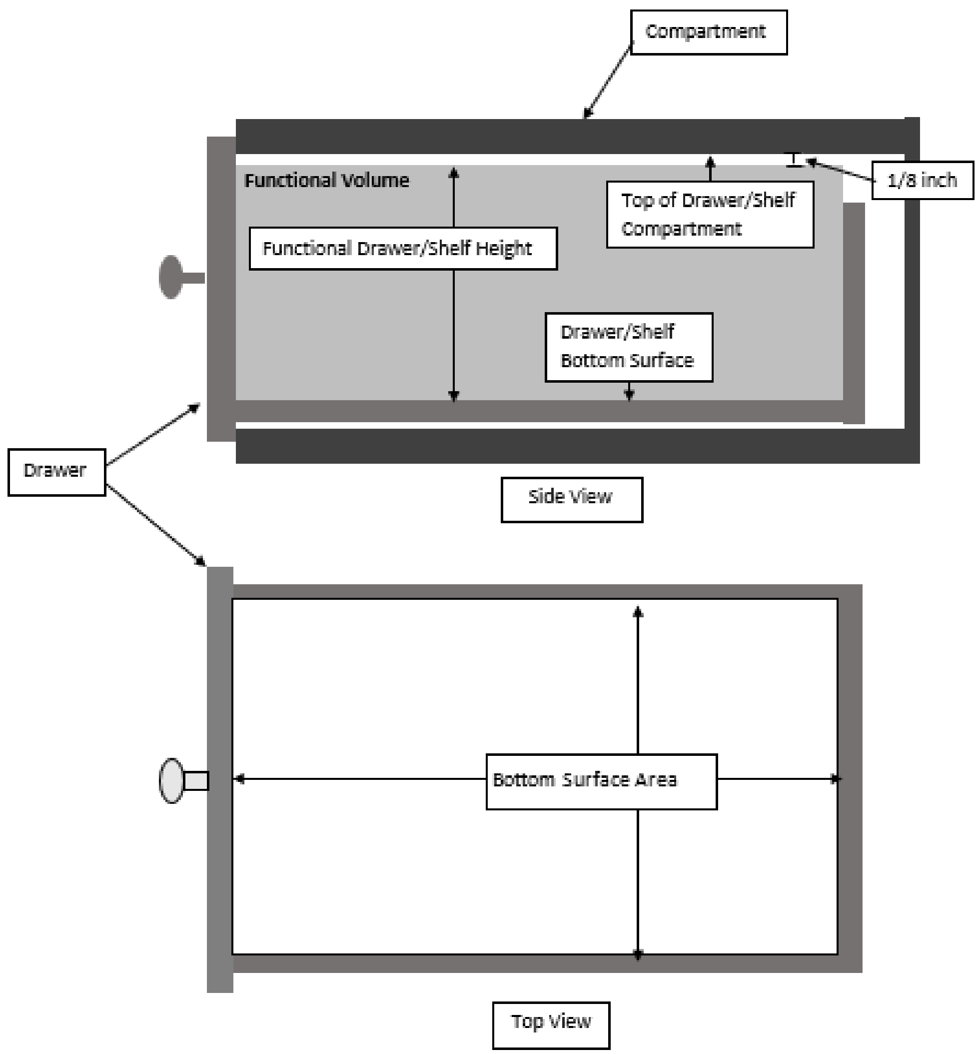
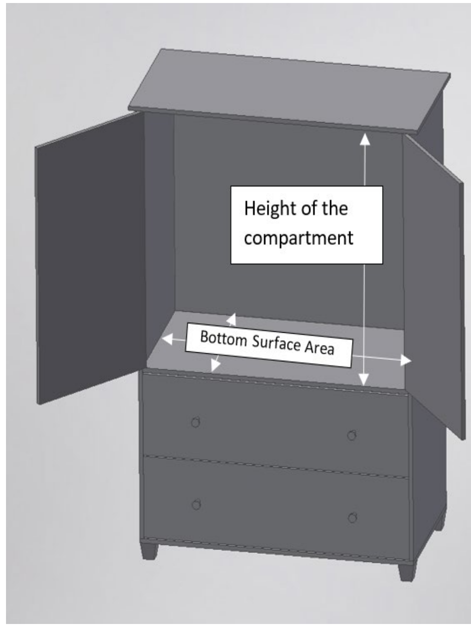


Figure 3b to paragraph (i)—*Functional volume* behind a *door*.



(j) *Fulcrum* means the point or line at the base of the CSU about which the CSU pivots when a *tip-over force* is applied (typically the front feet).

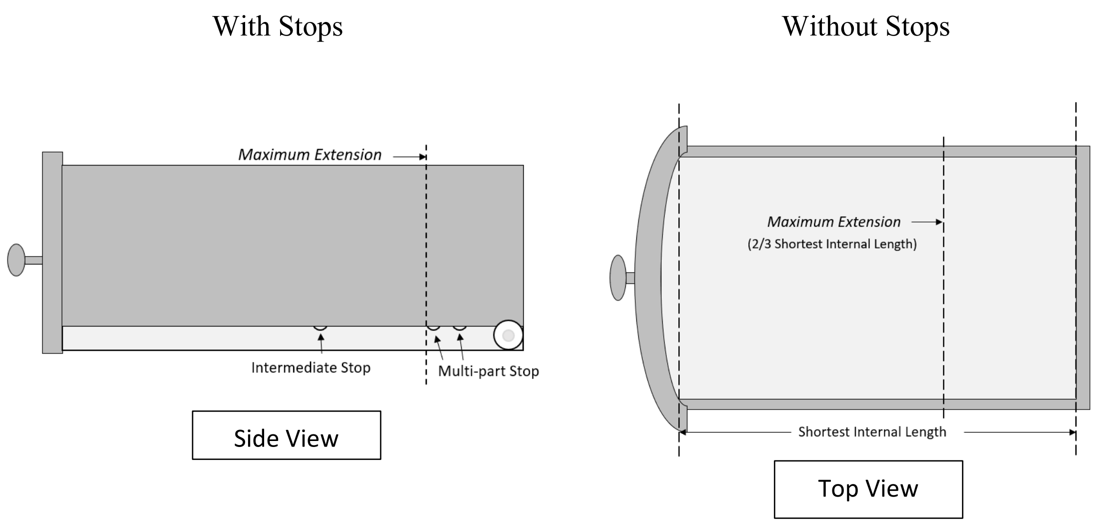
(k) *Hard, level, and flat test surface* means a test surface that is (1) sufficiently hard to not bend or break under the weight of a *clothing storage unit* and any loads associated with testing the unit; (2) level with no more than 0.5 degrees of variation; and (3) smooth and even.

(l) *Interlock* means a device that restricts simultaneous opening of *drawers*. An *interlock* may allow only one *drawer* to open at a time, or may allow more than one *drawer*, but fewer than all the *drawers*, to open simultaneously.

(m) *Levelling device* means an adjustable device intended to adjust the level of the clothing storage unit.

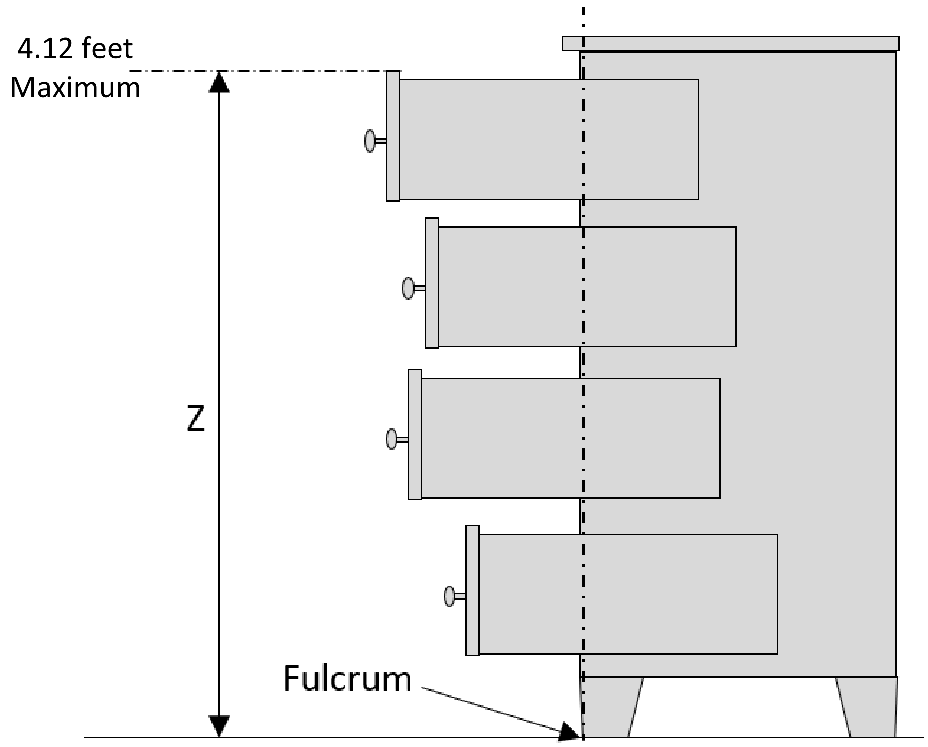
(n) *Maximum extension* means a condition when a *drawer* or *pull-out shelf* is open to the furthest manufacturer recommended use position, as indicated by way of a stop. In the case of slides with multiple intermediate stops, this is the stop that allows the *drawer* or *pull-out shelf* to extend the furthest. In the case of slides with a multipart stop, such as a stop that extends the *drawer* or *pull-out shelf* to the furthest manufacturer recommended use position with an additional stop that retains the drawer or pull-out shelf in the case, this is the stop that extends the drawer or pull-out shelf to the manufacturer recommended use position. If the manufacturer does not provide a recommended use position by way of a stop, this is 2/3 the shortest internal length of the drawer measured from the inside face of the drawer front to the inside face of the drawer back or 2/3 the length of the pull-out shelf. See Figure 4.

Figure 4 to paragraph (n)—Example of *maximum extension* on *drawers* and *pull-out shelves* with stops and without stops.



(o) *Maximum handhold height* means the highest position at which a child may grab hold of the CSU. This includes the top of the CSU. This height is limited to a maximum of 4.12 feet from the ground, while the CSU is on a flat and level surface. See Figure 5.

Figure 5 to paragraph (o)—The *maximum handhold height*, illustrated by the letter Z.



(p) *Moment* means a moment of a force, which is a measure of the tendency to cause a body to rotate about a specific point or axis. It is measured in pound-feet, representing a force multiplied by a lever arm, or distance from the force to the point of rotation.

(q) *Open storage* means storage space enclosed on at least 5 sides by a frame or panel(s) and/or behind a non-opaque door and with a flat bottom surface.

(r) *Open space* means space enclosed within the frame or panels, but without a bottom surface. For example, under legs or between storage components, as with a vanity.

(s) *Portable storage closet* means a freestanding furniture item with an open frame that encloses hanging clothing storage space and/or shelves. This item may have a cloth case with curtain(s), flap(s), or door(s) that obscure the contents from view.

(t) *Pull-out shelf* means a furniture component with a horizontal flat surface that slides horizontally in and out of the furniture case and may be attached to the case by some means, such as glides.

(u) *Tip over* means the point at which a clothing storage unit pivots forward such that the rear feet or, if there are no feet, the edge of the CSU lifts at least 1/4 inch from the floor and/or is supported by a non-support element.

(v) *Tip-over force* means the force required to cause tip over of the clothing storage unit.

(w) *Tip-over moment* means the minimum moment in pounds-feet about the *fulcrum* that causes *tip over*.

§ 1242.3 Requirements for interlocks.

(a) *General*. For all clothing storage units, including consumer-assembled units, the *interlock* components must be pre-installed, and automatically engage when the consumer installs the *drawer*s in the unit. All *interlocks* must engage automatically as part of normal use.

(b) *Interlock pull test*.

(1) If the unit is not fully assembled, assemble the unit according to the manufacturer's instructions.

(2) Place the unit on a *hard, level, and flat test surface*.

(3) If the unit has a *levelling device*, adjust the *levelling device* to the lowest level; then adjust the *levelling device* in accordance with the manufacturer's instructions.

(4) Secure the unit to prevent sliding or *tip over*.

(5) Open any *doors* in front of the *interlocked drawer*s.

(6) Engage the *interlock* by opening a *drawer*, or the number of *drawers* necessary to engage the interlock, to the *maximum extension*.

(7) Gradually apply over a period of at least 5 seconds a 30-pound horizontal pull force on each locked *drawer*, one *drawer* at a time, and hold the force for at least 10 seconds.

(8) Repeat this test until all possible combinations of *drawers* have been tested.

(c) During the testing specified in paragraph (b) of this section, if any locked *drawer* opens or the *interlock* is damaged, then the *interlock* will be disabled or bypassed for the stability testing in 1242.4, paragraph (c).

§ 1242.4 Requirements for stability.

(a) *General.* Clothing storage units shall be configured as described in paragraph (b) of this section, and tested in accordance with the procedure in paragraph (c) of this section. Clothing storage units shall meet the requirement for tip-over stability based on the minimum *tip-over moment* as specified in paragraph (d) of this section.

(b) *Test Configuration*. The clothing storage unit used for tip-over testing shall be configured in the following manner:

(1) If the unit is not fully assembled, assemble the unit according to the manufacturer's instructions.

(2) Place the unit on a *hard, level, and flat test surface*.

(3) If the CSU has a *levelling device*, adjust the *levelling device* to the lowest level; then adjust the *levelling device* in accordance with the manufacturer's instructions.

(4) Tilt the CSU forward to 1.5 degrees by one of the following methods:

(i) Raise the rear of the unit until the unit has a 1.5-degree forward tilt, or

(ii) Place the unit on a hard and flat 1.5-degree inclined surface, with the high point at the rear of the unit surface, or

(iii) Other means to achieve a 1.5-degree forward tilt.

(5) If the CSU has a *levelling device* intended for a carpeted surface, adjust the level in accordance with the manufacturer's instructions for a carpeted surface.

(6) Open all hinged *doors* that open outward or downward to the position where the center of mass of the *door* is extended furthest from the front face of the unit (typically 90 degrees).

(7) For units without an *interlock*:

(i) Open all *drawer*s and *pull-out shelves* to the *maximum extension*.

(ii) Place a fill weight in the center of each *drawer* or *pull-out shelf* consisting of a uniformly distributed mass in pounds that is 8.5 (pounds/cubic foot) times the *functional volume* (cubic feet).

(8) For units with an *interlock*:

(i) If, during the testing specified in 1242.3(b), any locked *drawer* opens or the *interlock* is damaged, then disable or bypass the *interlock* for the stability testing required in this section, and follow the requirements for units without an *interlock*.

(ii) If, during the testing specified in 1242.3(b), no locked *drawer* opens and the *interlock* is not damaged, then:

(A) Open all *drawers* that are not locked by the *interlock* system to the *maximum extension*, in the configuration most likely to cause tip over (typically the configuration with the largest *drawers* in the highest position open).

(B) If 50 percent or more of the *drawers* and *pull-out shelves* by *functional volume* are open, place a fill weight in the center of each *drawer* or *pull-out shelf*, including those that remain closed (see Figure 6a), consisting of a uniformly distributed mass in pounds that is 8.5

(pounds/cubic foot) times the *functional volume* (cubic feet). Secure the fill weights to prevent sliding.

(C) If less than 50 percent of the *drawers* and *pull-out shelves* by *functional volume* are open, do not place a fill weight in any *drawers* or on any *pull-out shelves* (see Figure 6b).

Figure 6a to paragraph (b)(8)—If 50 percent or more of the *drawers/pull-out shelves* open, clothing storage units tested with fill weights in all drawers.

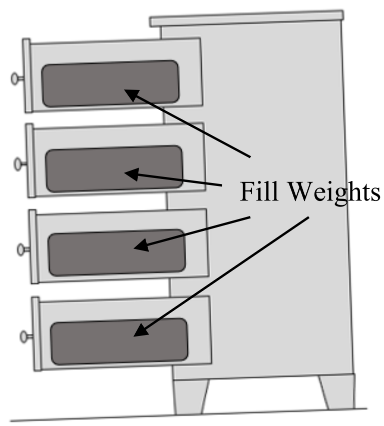
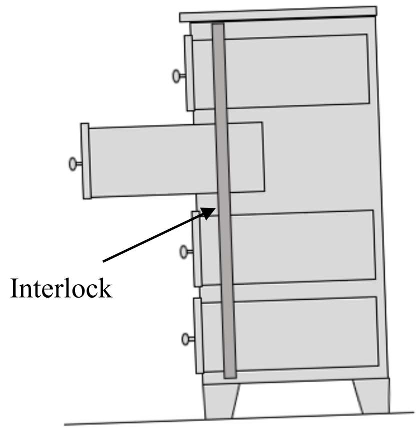


Figure 6b to paragraph (b)(8)—If less than 50 percent of the *drawers/pull-out shelves* open, clothing storage units tested empty.



(c) *Test Procedure to Determine Tip-over Moment of the Unit*. Perform one of the following two tip-over tests (Test Method 1 or Test Method 2), whichever is the most appropriate for the unit:

(1) Test Method 1 can be used for units with *drawers* or *pull-out shelves*. Gradually apply over a period of at least 5 seconds a vertical force to the face of the uppermost extended *drawer/pull-out shelf* of the unit to cause the unit to *tip over*. Record the *tip-over force* and horizontal distance from the force application point to the *fulcrum*. Calculate the *tip-over moment* of the unit by multiplying the *tip-over force* (pounds) by the horizontal distance from the force application point to the *fulcrum* (feet). See Figure 7a. NOTE: If a drawer breaks during the test due to the force, use Test Method 2 or secure or reinforce the drawer, as long as the modifications do not increase the *tip-over moment*.

(2) Test Method 2 can be used for any unit. Gradually apply over a period of at least 5 seconds a horizontal force to the back of the unit orthogonal to the *fulcrum* to cause the unit to *tip over*. Record the force and the vertical distance from the force application point to the

fulcrum. Calculate the *tip-over moment* of the unit by multiplying the *tip-over force* (pounds) by the vertical distance from the force application point to the *fulcrum* (feet). See Figure 7b.

Figure 7a to paragraph (c)(1)—Illustration of force application methods for Test Method 1 with vertical load L_V (tilt angle not to scale).

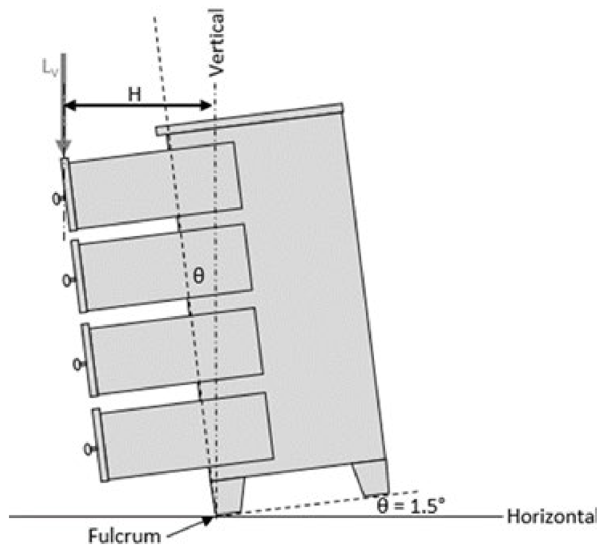
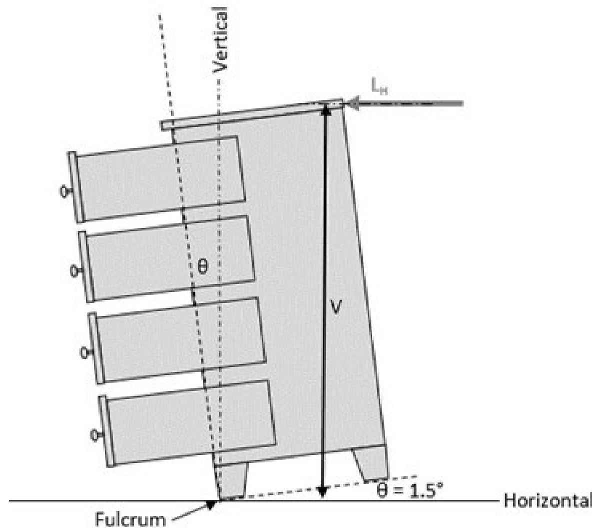


Figure 7b to paragraph (c)(2)—Illustration of force application methods for Test Method 2 with horizontal load L_H (tilt angle not to scale).



(d) *Performance requirement*. The *tip-over moment* of the clothing storage unit must be greater than the threshold moment, which is the greatest of all of the following applicable moments:

(1) For units with a *drawer(s)* or *pull-out shelf(ves)*: 55.3 pounds times the *drawer or pull-out shelf extension from fulcrum distance* in feet + 26.6 pounds feet;

(2) For units with a *door(s)*: 51.2 pounds times the *door extension from fulcrum distance* in feet – 12.8; and

(3) For all units: 17.2 pounds times *maximum handhold height* in feet.

§ 1242.5 Requirements for marking and labeling.

(a) *Warning Label Requirements*. The clothing storage unit shall have a warning label, as defined below and as shown in Figure 8, below.

(1) *Size.* The warning label shall be at least 2 inches wide by 2 inches tall.

(2) *Content.* The warning label shall contain the following text:

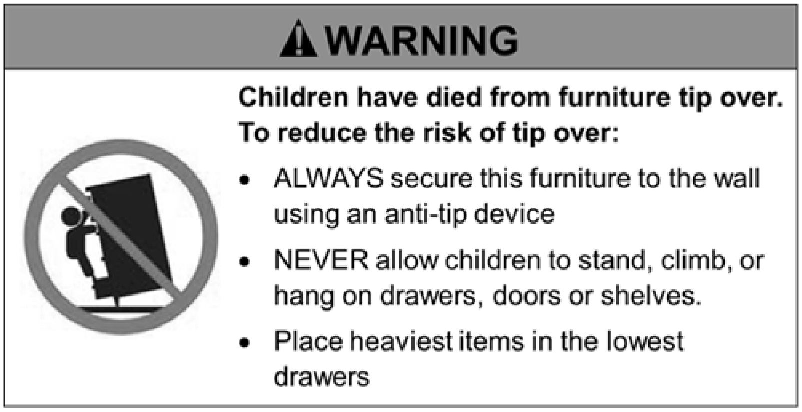
Children have died from furniture tip over. To reduce the risk of tip over:

- ALWAYS secure this furniture to the wall using an anti-tip device
- NEVER allow children to stand, climb, or hang on drawers, doors or shelves.
- [for units with interlocks only] Do not defeat or remove the drawer interlock system
- Place heaviest items in the lowest drawers
- [for units that are not designed to hold a television only] NEVER put a TV on this furniture

The warning label shall contain the child climbing symbol displayed in Figure 8, below, with the prohibition symbol in red. For units that are not designed to hold a television, the warning label shall contain the no television symbol displayed in Figure 8, below, with the prohibition symbol in red.

(3) *Format*. The warning label shall use the signal word panel content and format specified in Section 8.2.2. of ASTM F2057-19, *Standard Safety Specification for Clothing Storage Units*, and the font, font size, and color specified in Section 8.2.3 of ASTM F2057-19 (incorporated by reference, see paragraph (c) of this section). Each safety symbol shall measure at least 1 in. by 1 in. See Figure 8.

Figure 8 to paragraph (a)—Example warning label for a clothing storage unit with an interlock system and not designed to hold a television (top) and for a clothing storage unit without an interlock system and designed to hold a television (bottom).



(4) *Location*.

(i) For units with one or more drawer(s):

(A) The warning label shall be located on the interior side panel of a drawer in the upper most drawer row, or if the top of the drawer(s) in the upper most drawer row is more than 56 inches from the floor, on the interior side panel of a drawer in the upper most drawer row below 56 inches from the floor, as measured from the top of the drawer.

(B) The top left corner of the warning label shall be positioned within 1 inch of top of the drawer side panel and within the front 1/3 of the interior drawer depth.

(ii) For units with only doors: The warning label shall be located on an interior side or back panel of the cabinet behind the door(s), or on the interior door panel. The warning label shall not be obscured by a shelf or other interior element.

(iii) For consumer-assembled units: The warning label shall be pre-attached to the panel, and the assembly instructions shall direct the consumer to place the panel with the warning label according to the placement requirements above.

(5) *Permanency*. The warning label shall be legible and attached after it is tested using the methods specified in Section 7.3 of ASTM F2057-19, *Standard Safety Specification for Clothing Storage Units* (incorporated by reference, see paragraph (c) of this section).

(b) *Identification Labeling Requirements*. The clothing storage unit shall have an identification label, as defined below.

(1) *Size.* The identification label shall be at least 2 inches wide by 1 inch tall,

(2) *Content.* The identification label shall contain the following:

(i) Name and address (city, state, and zip code) of the manufacturer, distributor, or retailer; the model number; and the month and year of manufacture.

(ii) The statement "Complies with U.S. CPSC Safety Standard for Clothing Storage Units" as appropriate; this label may spell out "U.S. Consumer Product Safety Commission" instead of "U.S. CPSC."

(3) *Format*. The identification label text shall not be less than 0.1 in. (2.5 mm) capital letter height. The text and background shall be contrasting colors (*e.g.*, black text on a white background).

(4) *Location*. The identification label shall be visible from the back of the unit when the unit is fully assembled.

(5) *Permanency*. The identification label shall be legible and attached after it is tested using the methods specified in Section 7.3 of ASTM F2057-19, *Standard Safety Specification for Clothing Storage Units* (incorporated by reference, see paragraph (c) of this section).

(c) *Incorporation by reference.* Certain portions, identified in this section, of ASTM F2057-19, *Standard Safety Specification for Clothing Storage Units*, approved on August 1, 2019, are incorporated by reference into this part with the approval of the Director of the Federal Register in accordance with 5 U.S.C. 552(a) and 1 CFR part 51. You may obtain a copy from ASTM International, 100 Barr Harbor Drive, PO Box C700, West Conshohocken, PA 19428-2959; phone: (610) 832-9585; www.astm.org. A read-only copy of the standard is available for viewing on the ASTM website at https://www.astm.org/READINGLIBRARY/. You may inspect a copy at the Division of the Secretariat, U.S. Consumer Product Safety Commission, 4330 East West Highway, Bethesda, MD 20814, telephone (301) 504-7479, email: cpsc-os@cpsc.gov, or at the National Archives and Records Administration (NARA). For information on the availability of this material at NARA, email fedreg.legal@nara.gov, or go to: www.archives.gov/federal-register/cfr/ibr-locations.html.

§ 1242.6 Requirements to provide performance and technical data by labeling.

Manufacturers of clothing storage units shall give notification of performance and technical data related to performance and safety to prospective purchasers of such products at the time of original purchase and to the first purchaser of such product for purposes other than resale, in the manner set forth below:

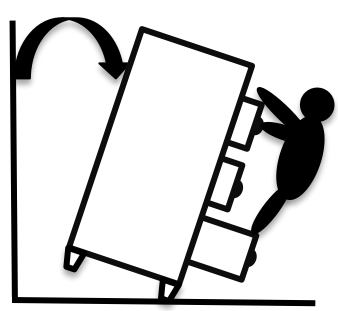
(a) *Consumer Information Requirements*. The manufacturer shall provide a hang tag with every clothing storage unit that provides the ratio of tip-over moment as tested to the minimally allowed tip-over moment of that model clothing storage unit. The label must conform in content, form, and sequence to the hang tag shown in Figure 9.

(1) *Size.* Every hang tag shall be at least 5 inches wide by 7 inches tall.

(2) *Side 1 Content.* The front of every hang tag shall contain the following:

(i) The title – "TIP OVER GUIDE."

(ii) The icon:



(iii) The statement – "Stability Rating."

(iv) The manufacturer's name and model number of the unit.

(v) Ratio of tip-over moment, as tested per 1242.4(c), to the threshold moment, as determined per 1242.4(d), of that model CSU displayed on a progressive scale. This value shall be the rating.

(vi) The scale shall start at 0 and end at 5.

(vii) "Less" and "More" on the left and right sides of the scale, respectively.

(viii) A rating of 1 shall be indicated by the text "Minimum rating" and a vertical dotted line.

(ix) A solid horizontal line from 0 to the calculated rating.

(x) The statement – "Compare with other units before you buy."

(xi) The statement – "This is a guide to compare the unit's resistance to tipping over."

(xii) The statement – "Higher number represent more stable units."

(xiii) The statement – "No unit is completely safe from tip over."

(xiv) The statement – "Always secure the unit to the wall."

(xv) The statement – "Tell children not to climb furniture."

(xvi) The statement – "See back side of this tag for more information."

(xvii) The statement – "THIS TAG NOT TO BE REMOVED EXCEPT BY THE CONSUMER."

(3) *Side 2 Content.* The reverse of every hang tag shall contain the following:

(i) The statement – "Stability Rating Explanation."

(ii) The icon in (2)(ii).

(iii) The tip rating determined in (2)(v).

(iv) The statement – "Test data on this unit indicated it withstood [insert rating determined in (2)(v)] times the minimally acceptable moment, per tests required by the Consumer Product Safety Commission (see below)."

(v) The statement – "Deaths or serious crushing injuries have occurred from furniture tipping over onto people."

(vi) The statement – "To reduce tip-over incidents, the U.S. Consumer Product Safety Commission (CPSC) requires that clothing storage units, such as dressers, chests, bureaus, and armoires, resist certain tip-over forces. The test that CPSC requires measures the stability of a clothing storage unit and its resistance to rotational forces, also known as moments. This test is based on threshold rotational forces of 3-year-old child climbing up, hanging on, or pulling on drawers and/or doors of this unit. These actions create rotational forces (moments) that can cause the unit to tip forward and fall over. The stability rating on this tag is the ratio of this unit's tip-over moment (using CPSC's test) and the threshold tip-over moment. More information on the test method can be found in 16 CFR 1242."

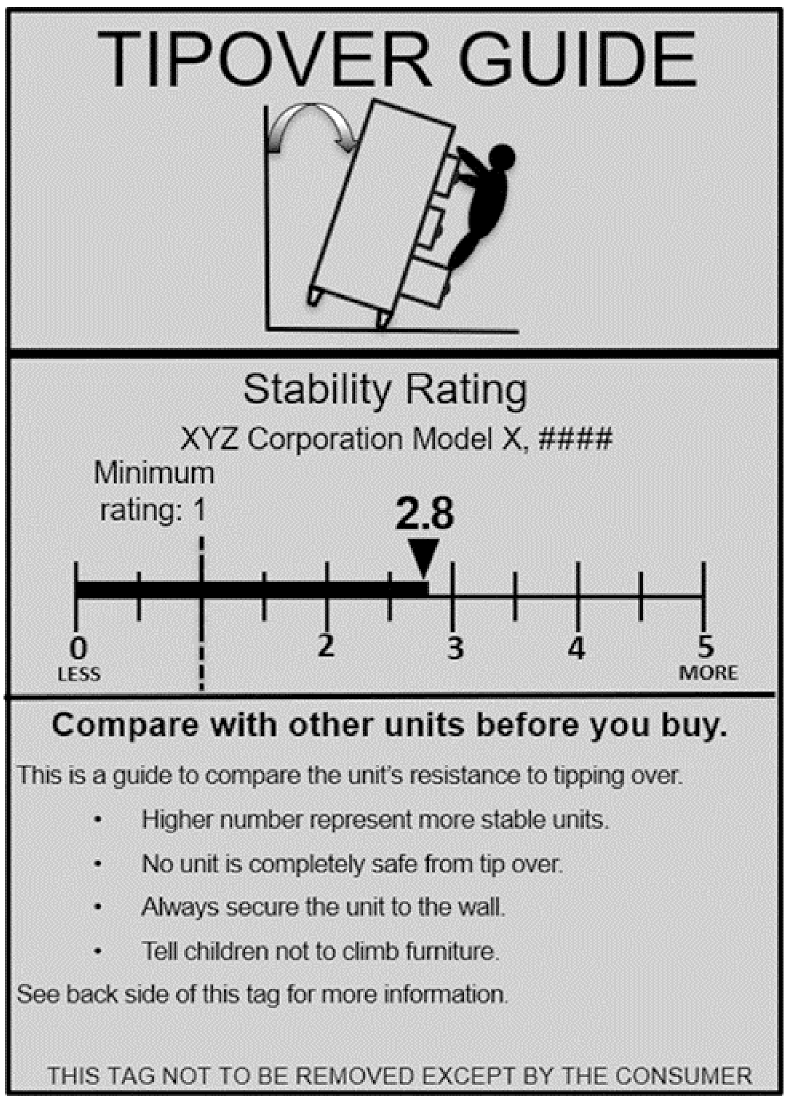
(4) *Format.* The hang tag shall be formatted as shown in Figure 1. The background of the front of the tag shall be printed in full bleed process yellow or equivalent; the background of the back of the tag shall be white. All type and graphics shall be printed in process black.

(5) *Attachment.* Every hang tag shall be attached to the CSU and clearly visible to a person standing in front of the unit. The hang tag shall be attached to the CSU and lost or damaged hang tags must be replaced such that they are attached and provided, as required by this section, at the time of original purchase to prospective purchasers and to the first purchasers other than resale. The hang tags may be removed only by the first purchaser.

(6) *Placement*. The hang tag shall appear on the product and the immediate container of the product in which the product is normally offered for sale at retail. Ready-to-assemble furniture shall display the hang tag on the main panel of consumer-level packaging. The hang tag shall remain on the product/container/packaging until the time of original purchase. Any units shipped directly to consumers shall contain the hang tag on the immediate container of the product.

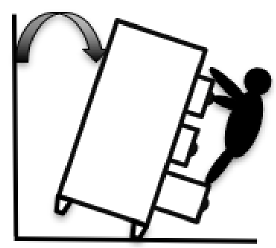
Figure 9 to paragraph (a)—Hang tag example shown for a unit with a tip rating of 2.8.

FRONT



REVERSE

Stability Rating: 2.8



Stability Rating Explanation

Test data on this unit indicated it withstood **2.8 times** the threshold tip over rotational force/moment, per tests required by the Consumer Product Safety Commission (see below)

Deaths and serious crushing injuries have occurred from furniture tipping over onto people.

To reduce tip-over incidents, the U.S. Consumer Product Safety Commission (CPSC) requires that clothing storage units, such as dressers, chests, bureaus, and armoires, resist certain tip-over forces. The test that CPSC requires measures the stability of a clothing storage unit and its resistance to rotational forces, also known as moments. This test is based on threshold rotational forces of 3-year-old child climbing up, hanging on, or pulling on drawers and/or doors of this unit. These actions create rotational forces (moments) that can cause the unit to tip forward and fall over. The stability rating on this tag is the ratio of this unit's tip-over moment (using CPSC's test) and the threshold tip-over moment. More information on the test method can be found in 16 CFR XXXX.

§ 1242.7 Prohibited stockpiling.

(a) *Prohibited acts.* Manufacturers and importers of clothing storage units shall not manufacture or import clothing storage units that do not comply with the requirements of this part in any 12-month period between [date of promulgation of the rule] and [effective date of the rule] at a rate that is greater than 120 percent of the rate at which they manufactured or imported clothing storage units during the *base period* for the manufacturer.

(b) *Base period.* The base period for clothing storage units is any period of 365 consecutive dates, chosen by the manufacturer or importer, in the 5-year period immediately preceding the promulgation of the final rule.

§ 1242.8 Findings.

(a) *General*. Section 9(f) of the Consumer Product Safety Act (15 U.S.C. 2058(f)) requires the Commission to make findings concerning the following topics and to include the findings in the rule. Because the findings are required to be published in the rule, they reflect the information that was available to the Consumer Product Safety Commission (Commission, CPSC) when the standard was issued on [insert final rule publication date].

(b) *Degree and nature of the risk of injury.* The standard is designed to reduce the risk of death an injury from clothing storage units tipping over onto children. The Commission has identified 193 clothing storage unit tip-over fatalities to children that were reported to have occurred between January 1, 2000 and December 31, 2020. There were an estimated 56,400 injuries, an annual average of 4,000 estimated injuries, to children related to clothing storage unit tip overs that were treated in U.S. hospital emergency departments from January 1, 2006 to December 31, 2019. Injuries to children, resulting from clothing storage units tipping over, include soft tissue injuries, skeletal injuries and bone fractures, and fatalities resulting from skull fractures, closed-head injuries, compressional and mechanical asphyxia, and internal organ crushing leading to hemorrhage.

(c) *Number of consumer products subject to the rule.* In 2017, there were approximately 463.5 million clothing storage units in use. In 2018, combined shipments of dressers and chests totaled 43.6 million units. Annual sales of clothing storage units total about 44 million units.

(d) *The need of the public for clothing storage units and the effects of the rule on their cost, availability, and utility.* Consumers commonly use clothing storage units to store clothing in their homes. The standard requires clothing storage units to meet a minimum stability threshold, but does not restrict the design of clothing storage units. As such, clothing storage units that meet the standard would continue to serve the purpose of storing clothing in consumers' homes. There may be a negative effect on the utility of clothing storage units if products that comply with the standard are less convenient to use. Another potential effect on utility could occur if, in order to comply with the standard, manufacturers modify clothing storage units to eliminate certain desired characteristics or styles, or discontinue models. However, this loss of utility would be mitigated to the extent that other clothing storage units with similar characteristics and features are available that comply with the standard.

Retail prices of clothing storage units vary widely. The least expensive units retail for less than $100, while some more expensive units retail for several thousand dollars. Of the potential modifications to comply with the standard for which CPSC was able to estimate the potential cost, the lowest costs were about $5.80 per unit; however, several were significantly higher. Clothing storage unit prices may increase to reflect the added cost of modifying or redesigning products to comply with the standard, or to account for increased distribution costs.

In addition, consumers may incur a cost in the form of additional time to assemble clothing storage units if additional safety features are included.

If the costs associated with redesigning or modifying a clothing storage unit model to comply with the standard results in the manufacturer discontinuing that model, there would be some loss in availability of clothing storage units.

(e) *Other means to achieve the objective of the rule while minimizing adverse effects on competition, manufacturing, and commercial practices.* The Commission considered alternatives to achieving the objective of the rule of reducing unreasonable risks of injury and death associated with clothing storage unit tip overs. For example, the Commission considered relying on voluntary recalls, compliance with the voluntary standard, and education campaigns, rather than issuing a standard. This alternative would have minimal costs; however, it is unlikely to further reduce the risk of injury from clothing storage unit tip overs because the Commission has relied on these efforts to date.

The Commission also considered issuing a standard that requires only performance and technical data, with no performance requirements for stability. This would impose lower costs on manufacturers, but is unlikely to adequately reduce the risk of injury from clothing storage unit tip overs because it relies on manufacturers choosing to offer more stable units; consumer assessment of their need for more stable units (which CPSC's research indicates consumers underestimate); and does not account for units outside a child's home or purchased before a child was born.

The Commission also considered mandating a standard like the voluntary standard, but replacing the 50-pound test weight with a 60-pound test weight. This alternative would be less costly than the proposed rule, because many clothing storage units already meet such a requirement, and it would likely cost less to modify noncompliant units to meet this less stringent standard. However, this alternative is unlikely to adequately reduce the risk of clothing storage unit tip overs because it does not account for factors that are present in tip-over incidents that contribute to clothing storage unit instability, including multiple open and filled drawers, carpeting, and forces generated by a child interacting with the unit.

Another alternative the Commission considered was providing a longer effective date. This may reduce the costs of the rule by spreading them over a longer period, but it would also delay the benefits of the rule, in the form of reduced deaths and injuries.

Another alternative the Commission considered is adopting a mandatory standard with the requirements in the proposed rule, but addressing 60-pound children, rather than 51.2-pound children. However, this alternative would be more stringent than the proposed rule and, therefore, would likely increase the costs associated with the rule, while only increasing the benefits of the rule by about 4.5 percent.

(f) *Unreasonable risk.* Incident data indicates that there were 226 reported tip-over fatalities involving clothing storage units that were reported to have occurred between January 1, 2000 and December 31, 2020, of which 85 percent (193 incidents) were children, 5 percent (11 incidents) were adults, and 10 percent (22 incidents) were seniors. Of the reported child fatalities, 86 percent (166 fatalities) involved children 3 years old or younger.

There were an estimated 78,200 injuries, an annual average of 5,600 estimated injuries, related to clothing storage unit tip overs that were treated in U.S. hospital emergency departments from January 1, 2006 to December 31, 2019. Of these, 72 percent (56,400) were to children, which is an annual average of 4,000 estimated injuries to children over the 14-year period. In addition, there were approximately 19,300 tip-over injuries involving clothing storage units treated in other settings from 2015 through 2019, or an average of 3,900 per year. Therefore, combined, there were an estimated 34,100 nonfatal, medically attended tip over injuries to children from clothing storage units during the years 2015 through 2019.

Injuries to children when clothing storage units tip over can be serious. They include fatal injuries resulting from skull fractures, closed-head injuries, compressional and mechanical asphyxia, and internal organ crushing leading to hemorrhage; they also include serious nonfatal injuries, including skeletal injuries and bone fractures.

(g) *Public interest.* This rule is intended to address an unreasonable risk of injury and death posed by clothing storage units tipping over. The Commission believes that adherence to the requirements of the rule will significantly reduce clothing storage unit tip-over deaths and injuries in the future; thus, the rule is in the public interest.

(h) *Voluntary standards.* The Commission is aware of four voluntary and international standards that are applicable to clothing storage units: ASTM F2057-19, *Standard Consumer Safety Specification for Clothing Storage Units*; AS/NZS 4935: 2009, the Australian/New Zealand Standard for *Domestic furniture – Freestanding chests of drawers, wardrobes and bookshelves/bookcases – determination of stability*; ISO 7171 (2019), the International Organization for Standardization *International Standard for Furniture – Storage Units – Determination of stability*; and EN14749 (2016), the European Standard, *European Standard for Domestic and kitchen storage units and worktops – Safety requirements and test methods*. The Commission does not consider the standards adequate because they do not account for the multiple factors that are commonly present simultaneously during clothing storage unit tip-over incidents and that testing indicates decrease the stability of clothing storage units. These factors include multiple open and filled drawers, carpeted flooring, and dynamic forces generated by children's interactions with the clothing storage unit, such as climbing or pulling on the top drawer.

(i) *Relationship of benefits to costs.* The aggregate net benefits of the rule are estimated to be about $305.5 million annually; and the cost of the rule is estimated to be about $250 million annually. On a per unit basis, the Commission estimates the expected benefits per unit to be $6.01, assuming a 7 percent discount rate; $7.88 assuming a 3 percent discount rate; and $9.90 without discounting. The Commission estimates the expected costs to manufacturers per unit to be $5.80 (based on the lowest estimated potential cost), plus an unquantifiable cost to consumers associated with lost utility and availability, and increased costs. Based on this analysis, the Commission preliminarily finds that the benefits expected from the rule bear a reasonable relationship to the anticipated costs of the rule.

(j) *Least burdensome requirement that would adequately reduce the risk of injury.* The Commission considered less-burdensome alternatives to the proposed rule, but preliminarily concluded that none of these alternatives would adequately reduce the risk of injury.

The Commission considered relying on voluntary recalls, compliance with the voluntary standard, and education campaigns, rather than issuing a mandatory standard. This alternative would be less burdensome by having minimal costs, but would be unlikely to reduce the risk of injury from clothing storage unit tip overs. The Commission has relied on these efforts to date, but despite these efforts, there has been no declining trend in child injuries from clothing storage unit tip overs (without televisions) from 2006 to 2019.

The Commission considered issuing a standard that requires only performance and technical data, with no performance requirements for stability. This would be less burdensome by imposing lower costs on manufacturers, but is unlikely to adequately reduce the risk of injury because it relies on manufacturers choosing to offer more stable units; consumer assessment of their need for more stable units (which CPSC's research indicates consumers underestimate); and does not account for clothing storage units outside a child's home or purchased before a child was born.

The Commission considered mandating a standard like ASTM F2057-19, *Standard Consumer Safety Specification for Clothing Storage Units*, but replacing the 50-pound test weight with a 60-pound test weight. This alternative would be less burdensome in terms of costs than the proposed rule, because many clothing storage units already meet such a requirement, and it would likely cost less to modify noncompliant units to meet this less stringent standard. However, this alternative is unlikely to adequately reduce the risk of tip overs because it does not account for several factors that are simultaneously present in clothing storage unit tip-over incidents and contribute to instability, including multiple open and filled drawers, carpeting, and forces generated by a child interacting with the unit.

The Commission considered providing a longer effective date. This may reduce the cost burden of the rule by spreading the costs over a longer period, but it would also delay the benefits of the rule, in the form of reduced deaths and injuries.

Therefore, the Commission concludes that the rule is the least burdensome requirement that would adequately reduce the risk of injury.

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Alberta E. Mills,

Secretary,

Consumer Product Safety Commission.

Staff Briefing Package

Draft Notice of Proposed Rulemaking for Clothing Storage Units

July 14, 2021

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TABLE OF CONTENTS

Executive Summary

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EXECUTIVE SUMMARY

Clothing Storage Units (CSUs) are freestanding furniture typically used for storing clothes. Examples of CSUs include chests, bureaus, dressers, chests of drawers, drawer chests, door chests, chifforobes, armoires, and wardrobes. CPSC staff is aware of 226 fatalities resulting from CSU tip-over from 2000 through 2020, including 193 child fatalities. Staff estimates that there were 78,200 CSU tip over-related injuries (an estimated annual average of 5,600 injuries) treated in a U.S. hospital emergency department from 2006 through 2019. Of these, staff estimates that 72 percent (an estimated 56,400 total and an estimated annual average of 4,000) were injuries to children.

Incident data suggest that children ages 1, 2, and 3 years old are the most at risk for death and severe injury. CPSC staff's analysis identified the following factors as being present in many CSU tip-over incidents and as contributing to instability: child climbing, opening multiple drawers, filled drawers, and carpet. Staff concludes that the current voluntary standards for CSU stability are not likely to eliminate or adequately reduce the risk of injury associated with tip overs because the performance requirements do not adequately address these factors.

Staff developed recommended requirements to address and account for the multiple hazard patterns involved in CSU tip-over incidents. The recommended requirements are based on a review of incident data, comments received in response to the ANPR, incident analyses, results from the contractor studies, and staff testing and analysis. As such, the recommended performance requirements involve determining the tip-over moment of a CSU when it has multiple open and filled drawers, and is on a surface simulating the effect of carpeting. Moment, or torque, is an engineering term to describe rotational force acting about a pivot point, or fulcrum. To assess whether the CSU is sufficiently stable to meet the recommended performance requirement, the tip-over moment must exceed 3 comparison tip-over moments, each of which represents a 95th percentile 3-year-old child's interaction with the CSU. The first comparison tip-over moment reflects the child ascending the CSU, the second comparison reflects a child hanging on the door of the CSU, and the third comparison reflects a child pulling on/opening the top drawer of the CSU. Furthermore, the testing and requirements which must be met in the draft proposed rule factor in the effects of dynamic forces and forces resulting from the position of a climbing child; forces from a childing pulling; the destabilizing effects of carpeting; and the effects of multiple loaded and open drawers on CSUs that do not prevent multiple drawers from opening simultaneously. Staff also proposes requirements for a warning label and an identification label, and hang tag with performance and technical data (stability rating).

CPSC staff assessed that improving the inherent stability of CSUs is an effective strategy for reducing deaths and injuries associated with CSU tip over. Technical analysis shows that CPSC staff's recommended requirements will reduce CSU deaths and injuries by reducing the occurrence of CSU tip overs. The total annual benefit of the draft proposed rule, reducing societal costs of injuries and deaths to children and adults, would be about $305.5 million. Given that there were about 463.5 million CSUs in use in 2017, the benefit per unit would be about $0.66 per unit annually. Over the estimated 15-year useful life of a CSU this comes to $6.01, $7.88, and $9.90 at discounts rates of 7 percent, 3 percent, and no discounting, respectively.

Modifications in the design of CSUs to improve stability likely include the use of drawer interlocks to limit the number of drawers which can be simultaneously opened, adding weight in the rear of the CSU, extending the front feet of the CSU, and perhaps using levelers to raise the front of the CSU to stabilize the CSU on carpeting. Alternatively, some CSUs may need other design modifications such as lighter drawer fronts or deeper cabinets. Staff's cost estimates for modifying example CSUs were generally $13 or more per unit, and in some cases exceeded $25, which is more than the estimated average benefits per unit. Staff notes that one of the samples investigated showed costs associated with modifications similar to benefits. In addition, unquantified costs, such as increased difficulty assembling CSU, changes to CSUs designs to meet the requirements, and some designs potentially being withdrawn from the market should also be considered.

Staff considered whether the Commission could rely on the current voluntary standard, ASTM F2057 – 19. Staff concluded that ASTM F2057 – 19 does not adequately protect children from CSU tip overs for several reasons: it does not consider the dynamic loading that can occur when a child interacts with a CSU; it does not consider filled drawers; it does not consider carpeting; and it does not account for the combination of multiple factors that can coexist that contribute to instability, such as multiple open filled drawers and climbing.

Staff examined the following alternatives to the draft proposed rule: (1) no regulatory action; (2) develop a stability rating standard for CSUs; (3) mandate a more rigorous standard (draft proposed rule, but addressing 60-pound children, instead of 51.2-pound children); (4) mandate ASTM F2057 but with a 60-pound test weight, and (5) longer effective date. Staff assesses that the less stringent alternatives to promulgating the draft proposed rule will not sufficiently reduce deaths and injuries. Staff does not recommend the more stringent alternative because it would have only increased the potential benefits of the rule by about 4 percent over what could be obtained from the draft proposed rule, and also has potential increased costs.

Briefing Memorandum

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

Memorandum

DATE: July 14, 2021

TO: The Commission
Alberta E. Mills, Secretary

THROUGH: Jennifer Sultan, Acting General Counsel
Mary T. Boyle, Executive Director
DeWane Ray, Deputy Executive Director for Safety Operations

FROM: Duane E. Boniface, Assistant Executive Director
Office of Hazard Identification and Reduction

Kristen Talcott, PhD, Project Manager
Division of Human Factors, Directorate for Engineering Sciences

SUBJECT: Draft Notice of Proposed Rulemaking for Clothing Storage Units

I. INTRODUCTION

Clothing Storage Units (CSUs) are freestanding furniture typically used for storing clothes. Examples of CSUs include chests, bureaus, dressers, chests of drawers, drawer chests, door chests, chifforobes, armoires, and wardrobes. Staff is aware of 226 fatalities resulting from CSU tip-over from 2000 through 2020, including 193 child fatalities.

The U.S. Consumer Product Safety Commission (CPSC, Commission) published an advance notice of proposed rulemaking (ANPR) on November 30, 2017 (82 Fed. Reg. 56752) to address the risk of death and injury associated with CSU tip overs. The ANPR began a rulemaking proceeding under the Consumer Product Safety Act (CPSA; 15 U.S.C. 2051-2089). Following publication, staff considered the comments received in response to the ANPR and conducted additional testing and analyses.

This briefing package summarizes the analyses performed by staff on the following:

- CSU-related incident data and hazard characteristics.
- Testing on:
    1. The weight of clothing in filled drawers;
    2. Incident recreation and modeling;
    3. Stability and compliance with ASTM F2057 – 19, *Standard Safety Specification for Clothing Storage Units*;

4. The effect of multiple open and filled drawers on CSU stability; and
5. The effect of carpet on CSU stability.

- The adequacy of current voluntary standards for CSUs.

These analyses showed that several factors are commonly involved in CSU tip-over incidents that contribute to the instability of CSUs. These factors include multiple open and filled drawers, carpeting, and the dynamic force children generate during common interactions, such as climbing on the CSU. Based on the information staff received from these analyses, staff developed recommended requirements to address the CSU tip-over hazard. Staff's recommended requirements include stability testing that accounts for these factors, assessment of interlock systems, marking and warning labels, and a hang tag with a stability rating to inform consumers about the relative stability of a particular CSU.

The briefing package also presents a preliminary regulatory analysis that discusses the potential benefits and costs of the draft proposed rule requirements, an evaluation of the relevant voluntary standards, a description of alternatives considered, and an initial regulatory flexibility analysis that discusses the potential impact of the draft proposed rule on small businesses. This briefing package also includes contractors' reports on (1) consumer use and perceptions of CSUs, (2) children's interactions with CSUs and the associated forces.

Staff recommends that the Commission publish a notice of proposed rulemaking (NPR) to address the tip-over hazard associated with CSUs.

II. DISCUSSION

A. Product Review

1. Description

Staff defines a CSU as a freestanding furniture item, with drawer(s) and/or door(s), that may be reasonably expected to be used for storing clothing, that is greater than or equal to 27 inches in height, and with a total functional volume of the closed storage greater than 1.3 cubic foot and greater than the sum of the total functional volume of the open storage and the total volume of the open space. Common names for clothing storage units include, but are not limited to: chests, bureaus, dressers, armoires, wardrobes, chests of drawers, drawer chests, chifforobes, and door chests. Whether a product is a clothing storage unit depends on whether it meets this definition. Some products that, depending on their design, may not meet the criteria in this definition and, therefore, may not be considered clothing storage units are: shelving units, office furniture, dining room furniture, laundry hampers, built-in closets, and single-compartment closed rigid boxes (storage chests).

CSUs are available in a variety of designs (e.g., vertical or horizontal dressers), sizes (e.g., weights and heights), and materials (e.g., wood, plastic) (Figure 1). Consumers may purchase CSUs that have been assembled by the manufacturer, or they can purchase CSUs as ready-to-assemble. "Chests, bureaus, and dressers" was, by far, the most common product sub-category in the reported fatal and nonfatal CSU tip-over incidents.

Figure 1. Examples of CSUs

Features of CSUs include:

- they are typically used for clothing storage;
- they have closed storage, that is storage within drawers or behind doors, that is sufficient to hold multiple clothing items; and
- they are freestanding furniture items, which means that they remain upright, without requiring attachment to the wall, in their normal use position.

2. CSU Market (see Tab H and I)

Manufacturers: According to data from the U.S. Census Bureau, in 2017 there were a total of 3,404 firms classified in the North American Industrial Classification System (NAICS) as non-upholstered wood household furniture manufacturing, upholstered household furniture manufacturing, metal household furniture manufacturing, or household furniture (except wood and metal) manufacturing. Of these firms, 2,024 were primarily categorized in the non-upholstered wood furniture category. More than 99 percent of the firms primarily categorized as manufacturers of non-upholstered wood furniture would be considered to be small businesses, as were 97 percent of firms in the other furniture categories. Staff notes that these categories are broad and include manufacturers of other types of furniture, such as tables, chairs, bed frames, and sofas, so it is likely that not all of the firms in these categories manufacture CSUs. Production methods and efficiencies vary among manufacturers; some use mass production techniques, and others manufacture their products one at a time or on a custom-order basis.

The number of U.S. firms that are primarily classified as manufacturers of non-upholstered wood household furniture has declined over the last few decades, as retailers have turned to international sources of CSUs and other wood furniture. Additionally, firms that formerly produced all of their CSUs domestically have shifted production to foreign plants. Well over half (64%) of the value of apparent consumption of non-upholstered wood furniture (net imports plus domestic production for the U.S. market) in 2019 was comprised of imported furniture, and this likely was true for CSUs as well. Firms that import furniture would be impacted by any rule that the Commission might promulgate regulating CSUs because they would have to ensure that any products that they import meet the requirements of the rule. According to the Census Bureau data, in 2017, there were 5,117 firms involved in household furniture importation and distribution. A total of 4,920 of these (or 96 percent) are classified as small businesses because they employ fewer than 100 employees.

According to the Census Bureau, there were 13,826 furniture retailers in 2017. At least 97 percent of the furniture retailers are small businesses (gross revenue is less than $22 million). Wholesalers and retailers may obtain their products from domestic sources or import them from foreign manufacturers.

Annual sales and shipments: Staff estimated the annual revenues and shipments of CSUs using estimates of manufacturer and importer revenue and sales and by using data on retail sales. The shipment value of chests of drawers and dressers combined for an estimated $5.15 billion in 2018, and combined shipments of dressers and chests totaled 43.6 million units. Average manufacturer shipment value was $118 per unit in 2018 (about $104 for chests of drawers and $144 for dressers).

The estimated retail value of U.S. bedroom furniture sales in 2019 total $60.3 billion, of which $20.8 billion was sales of "closets, nightstands, and dressers."[1] "Closets" likely includes products such as free-standing armoires and wardrobes. Staff believe that "dressers" also includes chests of drawers. Some, but not all nightstands may be considered CSUs.

Estimated CSUs in use: Staff estimates that unit sales of CSUs to U.S. consumers generally ranged from about 5 million to 10 million units annually from the 1950s to the early 1970s; 10 to 20 million units annually through 1990; 20 to 30 million units annually from 1991 – 2002, and;

[1] Statista, April 2020, https://www.statista.com/outlook/17020000/109/bedroom-furniture/united-states.

above 30 million units annually in more recent years. In 2018, CPSC staff estimates that about 43.6 million CSUs were sold. Using the historical sales estimates and an estimated average product life of 15 years, CPSC staff estimates that about 463.5 million CSUs were in use in 2017 and 466 million CSUs were in use in 2018.

B. Incident Data (see Tab A)

CPSC staff identified 226 reported CSU instability or tip-over[2] fatalities from the Consumer Product Safety Risk Management System (CPSRMS) that occurred between January 1, 2000 and December 31, 2020.[3] The fatalities included: 193 children (under 18 years old), 11 adults (18-64 years old), and 22 seniors (65 years old and older). Staff divided tip-over incidents into those that involved only CSU tip over (CSUs without televisions), and those that involved both CSU tip over and a television tip over (CSUs with televisions).[4] Forty six percent of the reported fatal tip-over incidents involving children (89 of 193) involved CSUs without televisions, and 54 percent (104 of 193) involved CSUs with televisions. Ninety seven percent of the reported fatal tip-over incidents involving adults or seniors (32 of 33) involved CSUs without televisions, and 3 percent (1 of 33) involved CSUs with televisions (Figure 2).

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[2] The included instability or tip-over incidents generally use the following words to describe the incident: fall/fell on/over, tilted/tipped forward, tilted/tipped over, began to tip, tipped, and unstable/wobbly with additional indications of an impending fall. In this briefing package, staff uses the term "tip-over incident" to refer to these incidents. Excluded incidents include such words to describe the incident: break, collapse, fell apart, flimsy, shaky, unstable, or wobbly with no additional indications of a CSU tipping or falling.

[3] CPSRMS is the epidemiological database which houses all anecdotal reports of incidents received by CPSC, "external cause"-based death certificates purchased by CPSC, all in-depth investigations of these anecdotal reports, as well as investigations of select NEISS injuries. Examples of documents in CPSRMS are: hotline reports, internet reports, news reports, medical examiner's reports, death certificates, retailer/manufacturer reports, and documents sent by state/local authorities, among others.

[4] There were 89 fatalities involving children without televisions during the time period examined in this briefing package. These fatalities were the result of 88 CSU tip-over events. The 89 fatal incidents referenced throughout this package count one tip-over event that resulted in two fatalities separately, so that each incident corresponds to a fatality.

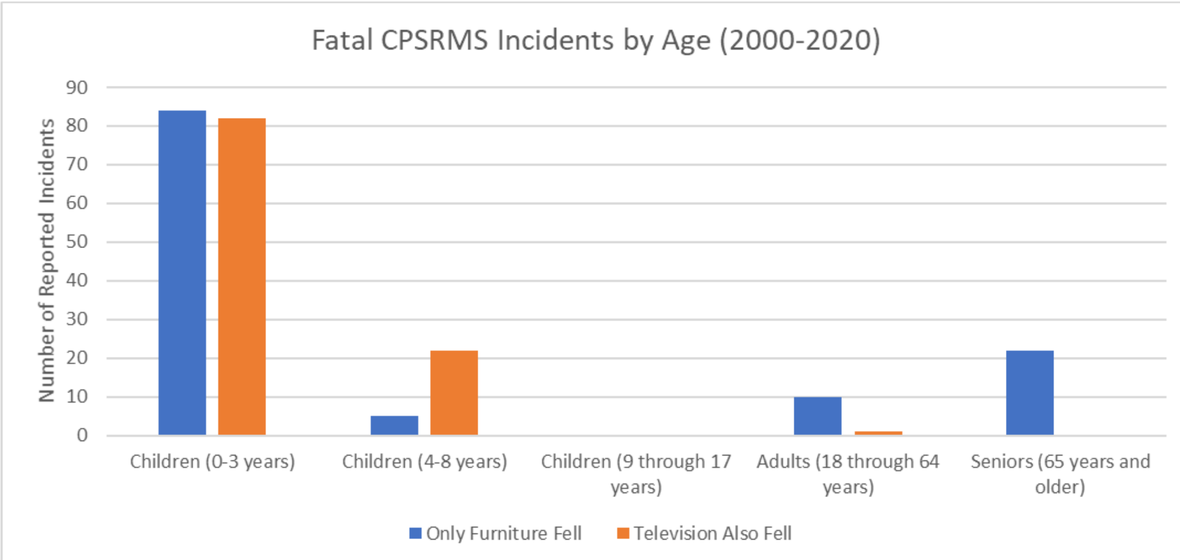

Figure 2. Fatal CPSRMS CSU Tip-Over Incidents by Age and Television Involvement (2000-2020).

With the exception of 2010, there were at least three reported fatal tip-over incidents involving children and CSUs without televisions each year for the years 2001 to 2017.[5] Similarly, with the exception of 2006, there was at least one reported fatal tip-over incident involving an adult or senior and a CSU without a television each year for the years 2000 to 2017.[6] In 94 percent of the fatal tip-over incidents involving children and CSUs without televisions (84 of 89), the victim was 3 years old or younger; this age group constituted 79 percent of the fatalities involving CSUs and televisions.

CPSC staff identified 1,002 reported nonfatal CPSRMS CSU instability or tip-over incidents involving children, adults, or seniors, including 652 reported injuries, that occurred between January 1, 2005 and December 31, 2020. Sixty four percent of these incidents (639 of 1,002) involved CSUs without televisions, and 36 percent (363 of 1,002) involved CSUs with televisions.[7]

Based on data from the National Electronic Injury Surveillance System (NEISS), CPSC staff estimates that there were 78,200 CSU tip over-related injuries (an estimated annual average of 5,600 injuries) treated in a U.S. hospital emergency department from January 1, 2006 to

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[5] There was one reported fatal tip-over incident involving a child and CSU without a television in 2000, and two reported fatal tip-over incidents involving children and CSUs without televisions in 2010. Because data reporting is ongoing, staff considers the data from 2018-2020 to be incomplete, so did not include these years.
[6] There were no reported fatal tip-over incidents involving adults and CSUs in 2006.
[7] It is important to note that one of the main sources for nonfatal CPSRMS incidents involving CSUs with televisions was data collected for a CPSC special study on television tip over. CPSC staff investigated 306 tip-over incidents involving CSUs with televisions from the NEISS data set; these incidents are in both the NEISS data set and the nonfatal CPSRMS data set. By contrast, staff only investigated three tip-over incidents involving CSUs without televisions from the NEISS data set.

December 31, 2019. Of these, staff estimates that 72 percent (an estimated 56,400 total) were injuries to children and 28 percent (an estimated 21,800 total) were injuries to adults or seniors.

Seventy two percent of the estimated emergency department-treated CSU tip over-related injuries to children (an estimated 40,700 of 56,400) involved CSUs without televisions, and 28 percent (an estimated 15,700 of 56,400) involved CSUs with televisions. Ninety six percent of the estimated emergency department-treated CSU tip over-related injuries to adults and seniors (an estimated 21,000 of 21,800) involved CSUs without televisions; there were not enough injuries to adults or seniors involving CSUs with televisions to make a statistically reliable estimate. Staff estimates that there were between about 2,500 and 5,900 emergency department-treated CSU tip over-related injuries to children for each year from 2006–2019.

An estimated 76 percent of emergency department-treated tip over-related injuries to children involving CSUs without televisions were to children 1 through 4 years old (an estimated 31,100 of 40,700), and an estimated 64 percent were to children 1 through 3 years old (an estimated 26,100 of 40,700). An estimated 78 percent of tip-over injuries to children involving CSUs with televisions were to children 1 through 4 years old (an estimated 12,200 of 15,700), and an estimated 62 percent were to children 1 through 3 years old (an estimated 9,800 of 15,700).

In this briefing package, staff focused on the subset of tip-over incidents involving children and CSUs without televisions primarily because the majority of fatal and nonfatal incidents involve children and, in recent years, there has been a statistically significant decrease in the number of CSU tip-over incidents that appears to be driven by a decline in tip overs involving televisions, while the rate of emergency department-treated incidents involving CSUs without televisions has remained stable.[8]

C. Hazard Characteristics

1. Age of Children Involved in Tip-Over Incidents (see Tab C)

Children in fatal CPSRMS tip-over incidents involving CSUs without televisions were 11 months through 7 years old. A total of 33 fatal incidents occurred with children under 2 years old, 30 incidents with two-year-old children, 21 incidents with 3-year-old children, two incidents with 4-year-old children, one incident with a 5-year-old child, one incident with a 6-year-old child, and one incident with a 7-year-old child. Among the 263 nonfatal CPSRMS tip-over incidents involving children and CSUs without televisions,[9] 3-year-old children were involved

[8] The EPHA staff memorandum (TAB A) shows a statistically significant decrease in emergency department-treated CSU instability or tip-over-related injuries from 2010 to 2019. The rate of emergency department-treated incidents involving CSUs without televisions has remained stable over the same period.
[9] The 263 nonfatal incidents are a subset of the 639 CSU-only (no television) nonfatal incidents referenced in Tab A that ESHF staff analyzed in Tab C. The 263 incidents are those that resulted in a tip over when a child started the

in the highest number of incidents with a reported age (59 incidents) followed by 2-year-old children (47 incidents). Nonfatal NEISS tip-over incidents[10] involving children and CSUs without televisions follow a similar distribution, with the highest number of reported incidents involving 2-year-old children, followed by 3-year-old children, and children less than 2 years of age.

2. Weight of Children Involved in Tip-Over Incidents (see Tab C)

Among the 89 fatal CPSRMS tip-over incidents involving children and CSUs without televisions, the child's weight was reported in 49 incidents and ranged from 18 pounds to 45 pounds. Among the 263 nonfatal CPSRMS tip-over incidents involving children and CSUs without televisions, the child's weight was reported in 47 incidents and ranged from 26 pounds to 80 pounds. For the incidents without a reported child weight, staff estimated the weight using the 50th percentile weight for the reported age and sex from the most recent Centers for Disease Control and Prevention (CDC) Anthropometric Reference (Fryar et al. 2021). The staff-estimated child weights for the 40 fatal CPSRMS incidents without a reported weight ranged from 19.6 pounds to 45.1 pounds. The staff-estimated child weights for the 164 nonfatal CPSRMS incidents without a reported child weight, but with a reported age, ranged from 19.6 pounds to 158.9 pounds. Overall, the weighted average of children's reported weight for CPSRMS incidents was 34.23 pounds whereas the weighted average of children's estimated weight was 38.8 pounds.[11] For nonfatal NEISS tip-over incidents involving children and CSUs without televisions, the staff-estimated weights ranged from 15.8 pounds to 158.9 pounds, which covered children from 3 months old to 17 years old. The weighted average of children's estimated weight in nonfatal NEISS incidents was 40.26 pounds.

3. Interaction Scenarios (see Tab C)

Overview: Among the 89 fatal CPSRMS tip-over incidents involving children and CSUs without a television, 47 reported the type of interaction. Climbing was the most frequent reported interaction, making up 74 percent of fatalities with a reported interaction. The second most frequent reported interaction was sitting, laying or standing in a drawer, which made up 17 percent of fatalities with a reported interaction.

Among the 263 nonfatal CPSRMS tip-over incidents involving children and CSUs without televisions, the type of interaction was reported in 160 incidents. Among the reported

interaction with the CSU. They do not include incidents that reported concerns about instability without a tip over or incidents in which a child did not initiate the interaction.

[10] ESHF staff removed the three fatal NEISS incidents from its analysis of NEISS data because the fatal NEISS incidents are included in the fatal CPSRMS incident set. With this change, incidents are not duplicated across data sets.

[11] Weighted average is equal to the sum of the product of the number of reported incidents for that age times the estimated weight for that age divided by the total number of reported incidents.

interactions, the most frequent interaction was opening drawers (64 percent) followed by climbing (20 percent), and putting items in/taking them out of a drawer (6 percent). Opening drawers followed by climbing were also the top two interactions for children three years old and younger.[12]

Among the 1,463 nonfatal NEISS incidents involving children and CSUs without televisions, the type of interaction was reported in 559 incidents. In 22 incidents with a reported interaction, the child was injured because of another person's interaction with the CSU. Of the remaining incidents with reported interactions the most frequent interaction was climbing (77 percent) and the second most frequently reported interaction was opening drawers (8 percent). For children three years old or younger, climbing constituted almost 80 percent of reported interactions.

Climbing: The age of children with climbing as the reported interaction ranged from 14 months to 7 years old in the fatal CPSRMS incidents, 16 months to 10 years old in the nonfatal CPSRMS incidents, and 9 months old to 13 years old in the nonfatal NEISS incidents. Ninety-four percent of the fatal CPSRMS climbing incidents, 60 percent of the nonfatal CPSRMS climbing incidents with a known age, and 73 percent of the nonfatal NEISS climbing incidents involved children 3 years old or younger.

The reported child weights for fatal CPSRMS climbing-related tip-over incidents involving children and CSUs without televisions, ranged from 21.5 to 45 pounds, and staff-estimated weight for the incidents without a reported child weight ranged from 23.8 to 39 pounds. The reported child weights for nonfatal CPSRMS climbing-related tip-over incidents involving children and CSUs without televisions, ranged from 26 to 80 pounds, and staff-estimated weight for the incidents without a reported child weight ranged from 25.2 to 45.1 pounds. Based on the age range for the 412 nonfatal NEISS climbing incidents, 9 months to 13 years old, the ESHF staff-estimated weight ranged from 19.6 pounds to 122 pounds; whereas, the weighted average of children's estimated weight was 34.2 pounds.

Staff-reviewed online videos show that children use a variety of climbing techniques when interacting with CSUs and similar furniture items, including stepping on the top of the drawer face, stepping on drawer knobs and handles, using the area between drawers as a foothold, gripping the top of an upper drawer with the hands, pushing up using the top of a drawer, and using items to help climb.

Staff findings from the incident data and the videos make sense in light of children's motor development. Children generally are able to walk up the stairs with support when they are 1 year old (Bayley, 1969), and older 1-year-olds are known to be capable of climbing on and off

[12] It is important to note that of the three data sources used in this briefing package, the nonfatal CPSRMS data are the most susceptible to reporting bias because the data are largely based on voluntary self-reports from consumers. Therefore, it is less likely to represent the true distribution of incidents that result in death and injury than the other two data sources (fatal CPSRMS and nonfatal NEISS).

furniture without assistance (Therrell, Brown, Sutterby, & Thornton, 2002). Frost and colleagues (2001) report that gross motor play and the use of climbers are dominant starting at about 1 ½ years of age, and, as these children approach age 2, they engage extensively in gross-motor play and begin to learn to use large playground apparatus independently. Two-year-old children especially enjoy climbing, and can climb steps, short ladders, and jungle gyms (Therrell, Brown, Sutterby, & Thornton, 2002; Hughes, 1991).

Opening multiple drawers and doors: Among the fatal CPSRMS incidents, opening drawers was indicated as the scenario in four incidents, involving children from 11 months of age to 5 years of age. Among the nonfatal CPSRMS incidents, opening drawers was the reported interaction in 101 incidents, involving children from 13 months of age to 12 years of age. Among the nonfatal NEISS incidents involving children and CSUs without televisions, opening drawers was the reported interaction in 42 incidents, involving children as young as 11 months old and as old as 14 years old, while the 2- and 3-year-old children were the most common. Among the 352 CPSRMS tip-over incidents involving children and CSUs without televisions (89 fatal and 263 nonfatal), 159 incidents reported that children opened at least one drawer; this total includes 27 incidents in which children opened "multiple" drawers, 44 incidents in which children opened a specific number of drawers greater than 1 (ranging from 2-8), and 3 incidents in which children opened "all" of the drawers. Twenty-three children in the CPSRMS incidents reportedly opened all drawers on the CSU. The youngest child reported to open all drawers of a CSU was 13 months old (single column, two-drawer unit); the youngest child who was reported to open all 8 drawers of an 8-drawer CSU was a two-year-old.

Although videos that staff reviewed show that it is possible for a child to climb a CSU without opening any drawers, or climb from the side or back, based on the incident narratives and videos, staff concludes that the most common climbing scenario leading to tip over is climbing on the drawers in the front of the CSU with one or more drawers open (about 42 percent of fatal and nonfatal CPSRMS climbing incidents reported a child opening one drawer or more; the remaining 58 percent did not report whether or not the drawers were open). Based on staff's evaluation of the pull strength to open drawers on various samples, which ranged between 1 and 6 pounds, opening drawers to their maximum drawer extension is within children's capability; videos and incidents support that children are opening drawers fully.

Of the 35 fatal CPSRMS climbing incidents, 13 reported the number of drawers open; in all of these incidents, the reported number of drawers open was one. However, based on further analysis, the number of open drawers could be as high as 8 in one incident: ESMC staff's analysis suggests that 7 or more drawers of an 8-drawer unit were open and the child was in a drawer leaning out over the edge in the fatal incident described in Tab M, Model E.

Of the 32 nonfatal CPSRMS climbing incidents, 15 gave some indication of the number of open drawers. Of these, 7 reported that one drawer was open, 2 reported that less than or equal to half of the drawers were open, 4 reported that multiple drawers were open, and 2 reported that all the drawers were open. In the two cases where all drawers were open, children were 3 and 4 years of age.

Of the 412 climbing incidents in the-nonfatal NEISS data, 28 gave some indication of the number of open drawers. Of these, 11 reported that one drawer was open, 12 reported that multiple drawers were open, 1 reported that two drawers were open, and 2 reported that all drawers were open. These data are consistent with the videos, which show a range of drawer positions, including all drawers closed, one drawer open, multiple drawers open, and all drawers fully open while a child is climbing.

In addition to climbing on open drawers, solely opening drawers without climbing also caused tip over in some incidents. Although it is possible for CSUs to tip over from the forces generated by open drawers and/or their contents alone (with no additional interaction forces), ESHF staff assesses that forces from a pulling interaction should be considered as well given that many incidents include children opening drawers. Large moments can be generated depending on the amount of pull force applied and the distance between the drawer pull location from the floor. Thus, pull strength and distance from the pull location to the floor, are relevant considerations. Staff analyzed 15 incidents in which the height of the force application could be calculated based on the details provided in the incident narratives. Staff also examined pull strengths that children can generate. In the 15 incidents that provided information about the height of pull force application, heights ranged from less than a foot to almost four feet (46.5 inches); children reportedly pulled the lowest drawer, highest drawer, and drawers in between.

The mean pulling strength of 2 to 5-year-old children on a convex knob (diameter 40mm) at their elbow height is 59.65 Newton (13.4 pound-force) for males and 76.43 Newton (17.2 pound-force) for females (DTI, 2000). Staff assesses that children may have been exerting similar forces on the drawer that may have caused the CSU to tip. Staff concludes that children at any age are able to open multiple drawers and pull drawers at a higher force than regular drawer opening forces to trigger a tip over of the CSU.

Although there is limited information in the incident data on children's interaction with doors on either CSUs with a combination of drawers and doors or on CSUs with only doors, staff found two fatal CPSRMS and four nonfatal CPSRMS tip-over incidents involving wardrobes and armoires. In one of the fatal incidents, the victim was found inside a two-door, one drawer wardrobe that led staff to conclude that she first opened the doors and got inside the wardrobe. In the other fatal incident, the victim was found under a two-door wardrobe; the interaction is unknown. In most of the nonfatal incidents, children were reportedly interacting with items inside the wardrobe or armoire which would require them to open the doors first. Although the ages of the children involved in these incidents ranged from 3 years to 11 years, staff concludes that the initial action of opening the doors is easily within physical and cognitive capabilities of even younger children based on child development.

While there is no direct evidence that children put their body weight on doors in the incident data, this is a plausible interaction based on child capabilities, provided that the child has a sufficient hand-hold. A climbing interaction on a door may be different than that with a drawer because a child is less likely to have a foothold on a door. Staff assess that a child may hang, hop up, and/or climb on a door.

4. Other Use-Related Factors that Can Decrease CSU Stability (see Tab C)

Filled drawers: For incidents with reported drawer fill level (53 fatal and 67 nonfatal CPSRMS incidents involving children and CSUs without televisions), most involved partially filled or fully filled drawers (96 percent of fatal CPSRMS incidents and 90 percent of nonfatal CPSRMS incidents with reported drawer fill). The proportion of incidents that reported full drawers was greater for fatal incidents (26 percent) than for nonfatal incidents (10 percent). CPSRMS incidents show that most items in the drawers were clothing, although a few mentioned other items along with clothing; for example, in the fatal incidents, clothing and additional items including a diaper bag (1), toys (1), papers (1), and miscellaneous (5) were reported.

Flooring type: Carpet was by far the most prevalent reported flooring type under the CSU in tip-over incidents involving children and CSUs without televisions (82 percent of fatal CPSRMS incidents and 80 percent of nonfatal CPSRMS incidents with a reported flooring type).[13] The second most prevalent reported flooring under a CSU was hardwood or wood; there were also a small number of incidents on tile or linoleum, and one in which the front legs of the CSU were on carpet and the back legs were on wood. A majority of the carpet in fatal incidents appears to have been wall-to-wall cut pile carpet; a small number of fatal incidents involved wall-to-wall looped pile carpet.

5. Injury Type and Severity (see Tab B)

The types of injuries resulting from furniture tip over can range from soft tissue injuries such as cuts and bruises (usually a sign of internal bleeding), to skeletal injuries, bone fracture of arms, legs, and ribs, to potentially fatal injuries resulting from skull fracture, closed-head injuries, compressional and mechanical asphyxia, and internal organ crushing leading to hemorrhage.

In most CSU tip-over incidents, serious injuries and deaths are a result of blunt force trauma to the head and intense pressure on the chest causing respiratory and circulatory system impairment. Head injuries are seen in CSU tip-over incidents with and without televisions, but are more common in CSU tip-over incidents with a television. These injuries can cause brain

[13] Flooring type was reported in 55 out of the 89 fatal CPSRMS tip-over incidents, and in 60 of the 263 nonfatal CPSRMS tip-over incidents.

swelling, deep scalp hemorrhaging, traumatic intracranial bleeding, and subdural hematomas and are often fatal even in cases of immediate rescue and rapid intervention. Compressional and mechanical asphyxia can result from the force of a CSU acting on the thoracic and abdominal area of the body, which prevents thorax expansion and physically interferes with the coordinated diaphragm and chest muscle movement that normally occurs during breathing. Torso injuries are the most common form of injury for tip-over fatalities involving CSUs without televisions. In addition to chest compression, pressure on the neck by a component of the CSU can also result in rapid strangulation due to pressure on the blood vessels in the neck. In incidents involving the sustained application of force to the chest or neck, the severity of the injury or likelihood of death can be reduced if the child is quickly rescued from the situation. Thus, in most nonfatal injuries, an adult was present and able to rescue the child and prevent fatal entrapment.

Sixty-five percent of the deaths (58 of 89) in fatal tip-over incidents involving children and CSUs without televisions were caused by chest compression, 13 percent (12 of 89) were caused by head injuries, 15 percent (13 of 89) were caused by injury to both the child's head and torso, and 2 percent (2 of 89) were caused by injury to the child's head, torso, and limb.[14] For fatal tip-over incidents involving children and CSUs with televisions, 6 percent of the deaths (6 of 104) were caused by chest compression, 88 percent (91 of 104) were caused by blunt head trauma, and 3 percent (3 of 104) reported multiple areas of the body as the primary areas injured (the chest and head and another part of the body). It is important to note that in all but two of the fatal incidents with a reported television type, the television was a cathode ray tube (CRT), and the approximate weight range of these televisions was 70-150 pounds. Heavy CRT televisions are more likely to cause severe injury, including head trauma, than lighter, flat panel televisions.

Seventy-seven percent (103 of 133) of the reported nonfatal CPSRMS tip-over incidents involving children and CSUs without televisions with a reported age were incidents involving children 5 years and younger, including 5 serious injuries that required hospitalization, 12 injuries that were treated in U.S. hospital emergency departments, 11 injuries that were seen by medical staff. The severity of injury and level of care required was not known in 75 of the 103 incidents.

An estimated 55 percent of emergency department-treated tip-over injuries to children involving CSUs without televisions were injuries to the head, neck, and face, 29 percent were to appendages (including leg, foot, toe, arm, hand, finger), and 14 percent were to the torso or trunk. Thirty nine percent of these estimated injuries were soft tissue injuries, such as contusions, abrasions and lacerations to the trunk, head and face, including eyelid, eye area, and nose; 22 percent were internal organ injuries, including closed head injuries; and 9 percent were bone fractures, including skull fractures. All other diagnoses made up the remaining 15 percent

[14] Four fatal tip-over incidents involving children and CSUs without televisions did not include information on the body part affected.

of these estimated injuries. For emergency department-treated tip-over injuries to children involving CSUs with televisions, an estimated 73 percent were to the head, neck, and face.

D. Voluntary Standards Assessment (see Tabs F, D and C)

1. ASTM F2057 – 19

In the United States, the primary voluntary standard that addresses CSUs is ASTM F2057 – 19, *Standard Consumer Safety Specification for Clothing Storage Units*.[15] ASTM first approved and published F2057 in 2000, as ASTM F2057 – 00, *Standard Consumer Safety Specification for Chests, Door Chests and Dressers*. Since then, ASTM has revised the voluntary standard seven times. The current version, ASTM F2057 – 19, Standard Consumer Safety Specification for Clothing Storage Units, was approved on August 1, 2019, and published in August 2019. The ASTM F2057 voluntary standard development is the responsibility of ASTM Subcommittee F15.42, Furniture Safety. Since the first publication of ASTM F2057, CPSC staff has participated in the F15.42 subcommittee and task group meetings.

ASTM F2057 – 19 defines clothing storage units as a "furniture item with drawers and/or hinged doors intended for the storage of clothing typical with bedroom furniture." Examples of CSUs stated in the standard include chests, chests of drawers, drawer chests, armoires, chifforobes, bureaus, door chests, and dressers. The standard covers CSUs that are 27 inches or more in height and that are freestanding.

ASTM F2057 – 19 has two stability requirements:

1. Stability of Unloaded Unit (test method described in Section 7.1): The CSU shall not tip over when all doors are opened 90° and all drawers are pulled to the outstop[16] or in the absence of such a feature, 2/3 of its operational sliding length.[17] This test is conducted on an unfilled CSU placed on a hard, flat, level test surface, and no additional force ("load") is added to the CSU beyond those from the open extension elements.
2. Stability with Load (test method described in Section 7.2): The CSU shall not tip over when the 50±2 pound test weight ("load") is applied over the front of each drawer pulled to the outstop or, in the absence of such a feature, 2/3 of its operational sliding length, with only one drawer open at a time. For units with doors, the same test applies, but the test weight is applied to "each door so that the outer edge of the test weight is flush with

[15] ASTM F3096-14, *Standard Performance Specification for Tipover Restraint(s) Used with Clothing Storage Unit(s)*, also relates to CSUs, but is largely an extension of ASTM F2057 because it provides test methods for assessing tip-over restraints in accordance with ASTM F2057 requirements.
[16] ASTM F2057 – 19 defines "outstop" as "any feature that limits outward motion of drawers or pullout shelves, or both."
[17] ASTM F2057 – 19 defines "operational sliding length" as "length measured from the inside face of the drawer back to the inside face of the drawer front with measurements taken at the shortest drawer depth dimension."

the outermost upper corner of the door," when the door is opened to 90° (this results in the load being centered approximately 3 inches from the door edge). This test is conducted on an unfilled CSU placed on a hard, flat, level surface.

ASTM F2057 – 19 requires that CSUs be permanently marked with the specified warning "in a conspicuous location when in use; the back of the unit intended to be placed against the wall is not considered conspicuous when in use." The warning has text describing the hazard, and addressing the use of tip restraints.[18] The warning includes a child climbing symbol and an additional no television symbol for CSUs not designed to be used with televisions. Formatting is consistent with ANSI Z535.4, American National Standard for Product Safety Signs and Labels, which is the primary U.S. voluntary consensus standard for the design, application, use, and placement of on-product warning labels.

ASTM F2057 – 19 also requires CSUs to include a tip restraint that complies with ASTM F3096-14, *Standard Performance Specification for Tipover Restraint(s) Used with Clothing Storage Unit(s)*. ASTM F3096-14 specifies a testing protocol for tip restraints, which includes a 50-pound pull force. ASTM F3096-14 does not require a test to assess the integrity of the connection between the tip restraint and the CSU or the wall.

2. Adequacy of ASTM F2057 – 19

Staff identified the following hazard patterns for CSU tip overs: children interacting with (*e.g.*, ascending/climbing) CSUs, multiple open drawers, filled drawers, and carpet (Tab C). Table 1 summarizes how ASTM F2057 – 19 addresses these hazard patterns and staff's assessment of the adequacy of those requirements.

[18] A tip restraint is a supplemental device, often a strap or bracket, that provides additional resistance to tip over by connecting the CSU to the wall.

Table 1. Hazard Pattern Adequacy Associated with CSUs within the Scope of ASTM F2057 – 19

Hazard Pattern	Addressed in ASTM F2057	Staff Assessment of Adequacy	Staff Comments
Child Interaction (Ascent/climb)	50 pounds applied to the top face of one open drawer (to outstop or in absence of outstop, 2/3 the operational sliding length, or door (90°) (Section 7.2)	Inadequate	The 50-pound test weight does not include the additional moment due to the outboard position of center of gravity of the child climbing, dynamic forces, and horizontal forces when a child climbs and does not exert the moment necessary to protect children 3 years and under from tip overs, as discussed in Tab D.
Multiple Open Drawers	All drawers (to outstop, or in absence of outstop, 2/3 of the operational sliding length) and doors (90°) opened simultaneously, and no additional weight or force applied (Section 7.1)	Inadequate	Incident data indicates that children open multiple drawers of a CSU. Opening multiple drawers significantly impacts the CSU stability by moving the center of gravity towards or in front of the fulcrum (Tab D).
Filled Drawers	Not addressed	Inadequate	Consumers are likely to fill drawers with clothing as that is the purpose of these consumer products. A CSU with filled drawers is likely to be less stable than an empty unit when more than half the drawers are open, as discussed in Tab D.
Carpet	Not addressed	Inadequate	Incident data (Tab C) suggest that many reported tip-over incidents, where flooring type is known, occur on carpeting, and it is reasonable to assume that some consumers place CSUs on carpeting, which is a common flooring in homes, particularly in bedrooms (Tab C). Staff testing showed that, in almost all cases, carpet decreases CSU stability (Tab P).

CPSC staff concludes that ASTM F2057 – 19 does not adequately address the stability of CSUs. This is largely because ASTM F2057 – 19 relies only on a static load based on the weight of a child standing or hanging on a drawer front, which does not adequately account for the forces created by children interacting with or climbing CSUs, or for the other common hazard patterns that lead to tip-over incidents: multiple open drawers, filled drawers, and the placement of the CSU on carpeted surfaces.

Staff assesses that the placement and content of the warning label could both be improved. The warning label should be placed on the side of an uppermost drawer below 56 inches from the floor (5^{th} percentile adult female eye height). For units with only doors, the warning label should be located on an interior side or back panel of the cabinet behind the door(s), or on the interior door panel. In addition, the warning language should be modified for clarity and eliminate non-warning language and non-credible warnings. However, staff considers the child climbing symbol in ASTM F2057 – 19 effective unless a variant that is currently undergoing testing proves to be comprehended better by consumers. Staff supports the formatting requirements in ASTM F2057 – 19, which follow ANSI Z535.4.

Staff did not evaluate the tip restraint device standard, ASTM F3096-14, in this briefing package, but has concerns about its adequacy related to the force and attachment to the CSU and wall. Staff concerns with ASTM F3096 – 14 are addressed in more detail in the ANPR briefing package (Sanborn, 2017).

3. Other CSU Standards

Staff identified four other consumer safety specifications related to CSUs:

1. AS/NZS 4935:2009, the Australian/New Zealand Standard for *Domestic furniture – Freestanding chests of drawers, wardrobes and bookshelves/bookcases – determination of stability*;
2. ISO 7171 (2019), the International Organization for Standardization *International Standard for Furniture – Storage Units – Determination of stability*;
3. EN14749:2016, the European Standard, *European Standard for Domestic and kitchen storage units and worktops – Safety requirements and test methods*.
4. ANSI/SOHO S6.5-2008 (R2013), *Small Office/Home Office Furniture – Tests American National Standard for Office Furnishings*, which is not a CSU standard, but has requirements for interlock systems that may be transferrable to CSUs.

Table 2 compares the key requirements of each standard.

Table 2. Key Performance Requirements for International Standards

	Test Weight or Force	CSU Height*	Element Extension	Tip Restraints	Warning Labels	Filled Drawer Test
F2057 – 19	50 pounds	27 inches	To outstop or 2/3 extension	Required	Required	None
AS/NZA 4935:2009	29 kilograms (64 pounds)	500 millimeters (19.7 inches)	2/3 extension	Strongly recommended	Required	None
ISO 7171:2019	200 Newtons (44 pounds) for component with height <1000 millimeters (39.4 inches) and ≥1600 millimeters (63 inches) 250 Newtons (55 pounds) for all other component**	Not specified	To outstop or 2/3 extension	Not required	Not mentioned	Yes†
EN 14749: 2016	75 Newtons (16.8 pounds)	Not specified	To outstop or 2/3 extension	Not mentioned	Not mentioned	Yes†

*Minimum height of furniture that is included in the scope of the standard.

** ISO 7171 does not have a pass/fail criterion for its loaded stability test, however it includes a table of "suggested" forces. These forces are included in this table.

† In this test, all storage areas are loaded with a fill-representative weight; however, only one extension element in each vertical line is opened and tested at a time. The multiple open-drawer test does not include filled drawers.

Staff concludes that, like ASTM F2057 – 19, the other standards, AS/NZA 4935:2009, ISO 7171:2019, and EN14749:2016, are inadequate to protect children against the tip-over hazards posed by CSUs. ANSI SOHO S6.5 does not address the stability of CSUs; it only assesses interlock systems. None of these standards adequately accounts for the hazard patterns (child interaction, multiple open drawers, filled drawers, and flooring surfaces) that staff identified.

4. Compliance with ASTM F2057 Stability Requirements (Tab N and Tab F)

Staff conducted testing on CSUs to determine whether they comply with the stability requirements in ASTM F2057, whether they could hold a 60-pound test weight, and the weight at which the unit tipped over (tip weight). Staff tested 188 CSUs, including 4 incident-involved exemplar units by placing weight on a single fully open drawer while the unit was empty and sitting on a hard, level, flat test surface. Of the 188 units tested, 171 (91 percent) met the stability requirements of ASTM F2057 – 17[19] sections 7.1 and 7.2, and 98 (52. percent) units were able to hold the 60-pound test weight. Measured tip weight ranged from 12.5 pounds to over 134 pounds, with a mean of 61.7 pounds and a median of 62 pounds.[20] These results suggest that a majority of CSUs on the market meet the stability requirements of ASTM F2057 – 17 (and ASTM F2057 – 19), and that a slight majority would be capable of meeting a performance test that had the same CSU configuration as ASTM F2057 – 19 (*i.e.*, single open drawer; empty unit; hard, level, flat test surface), but used a 60-pound test weight. A small number of CSUs were able to hold over 100 pounds on a single open drawer, with one CSU able to hold over 134 pounds.

Of the 89 fatal CPSRMS tip-over incidents involving children and CSUs without televisions, CPSC staff determined that one CSU clearly met the ASTM F2057 – 19 stability requirements, one CSU met the ASTM F2057 – 19 stability requirements in some conditions, and 11 units did not meet the ASTM F2057 – 19 stability requirements. For the remaining 76 units, staff was unable to determine whether they met the ASTM F2057 – 19 stability requirements. Of the 263 nonfatal CPSRMS incidents involving children and CSUs without televisions, CPSC staff determined that 20 CSUs met the ASTM F2057 – 19 stability requirements, and that 95 did not meet the ASTM F2057 – 19 stability requirements. For the remaining 148 units, staff was unable to determine whether the units met the ASTM F2057 – 19 stability requirements.

E. Technical Analysis of CSU Tip Overs (see Tab D, Tab C)

Based on the incident data, children's developmental abilities, and internal and external study findings, staff identified various factors that negatively impact the stability of CSUs and considered them in the development of performance requirements. These factors include forces on CSUs due to climbing; forces due to a child pulling on the drawer; effects of drawer fill; effects of multiple open drawers; and effects of carpet, as explained below.

1. Forces on CSUs due to Climbing.

In 2019, CPSC staff commissioned a child climbing study, conducted by University of Michigan Transportation Research Institute (UMTRI) researchers. The report describing the results, "Forces and Postures During Child Climbing Activities: Technical Report," is provided in Tab R.

The goal of the UMTRI child climbing study was to collect additional information on how children interact with CSUs and the forces that they can exert during interactions. UMTRI researchers worked with CPSC staff to develop the list of studied child interactions, which were

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[19] The stability requirements in ASTM F2057 – 17 are the same as those in ASTM F2057 – 19.
[20] Staff removed the tip weights for three CSUs from the data set because of data discrepancies. These data are based on the tip weights for the 185 remaining CSUs.

based on CSU tip-over incidents, videos, and children's developmental abilities. The studied interactions included: ascend, bounce, lean back, yank, 1 hand & 1 foot, hop up, hang, and descend. Child participants interacted with a test fixture with two bars representing a lower foothold and upper handhold of a CSU,[21] as well as with a simulated drawer, and a simulated tabletop (Figure 3). Instrumentation recorded forces over time in the horizontal (fore-aft, x) and vertical (z) directions (Figure 4).[22]

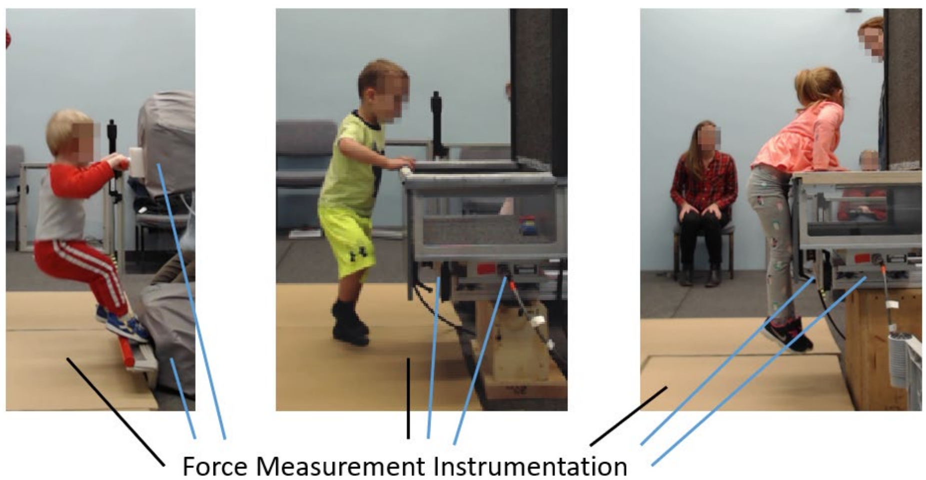

Figure 3: The test setup and location of instruments used to measure force during handle trials (left), box/drawer trials (center), and table trials (right).

[21] Staff reviewed online videos that show children using a variety of footholds and handholds when climbing a CSU, including the drawer pulls, the top of the drawer, the space between drawers, and the CSU top.
[22] UMTRI researchers also collected forces in the lateral (y) direction, but these forces were generally small and were not analyzed.

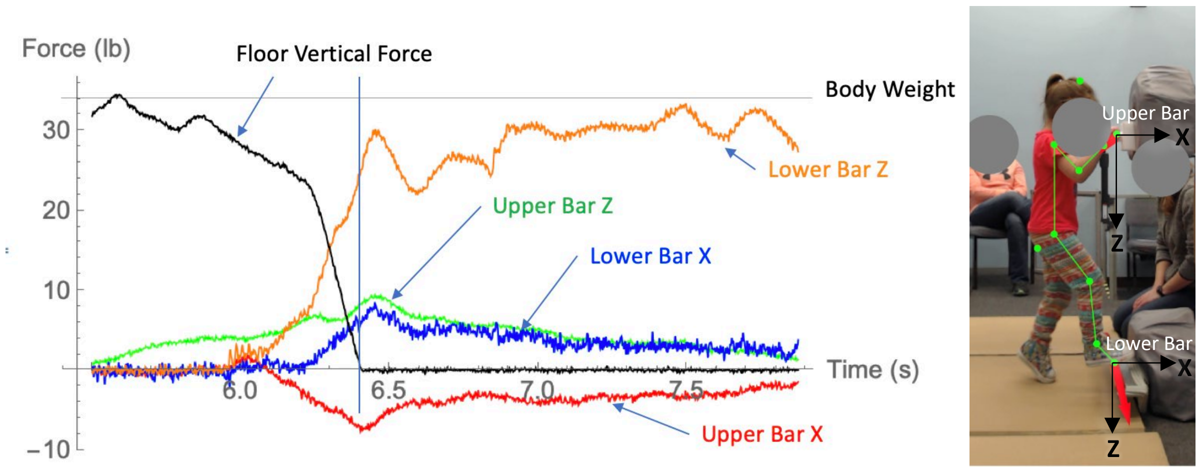

Figure 4: Example forces for the Ascend behavior in the handle trials. The image at the right shows the child at the time indicated by the vertical line in the figure, as well as the positive X and Z directions for each bar.

Researchers calculated the moments generated by the children using the forces measured from the instrumented test fixture. Moment, or torque, is an engineering term to describe rotational force acting about a pivot point, or fulcrum. The moment is created by force(s) acting at a distance, or moment arm, away from a fulcrum. For example, a child can produce a moment opposing the weight of the CSU by pushing down or sitting on an open drawer. This moment is created by the vertical force of the child multiplied by the horizontal distance to the fulcrum. The CSU becomes unbalanced and tips over when the moments applied at the front of the CSU exceed the CSU's stability moment.

Horizontal forces applied to pull on a drawer also tend to tip the CSU forward around the front leg (pivot point or fulcrum) at the base of the unit, while the weight of the CSU opposes this rotation. In this case, the moment produced by the child is the horizontal pull force multiplied by the vertical distance to the fulcrum. The CSU becomes unbalanced and tips over when the moments applied at the front of the CSU exceed the CSU's stability moment.

The UMTRI researchers calculated the moment about the CSU's front foot or fulcrum using the measured forces, vertical location of the top and bottom handles, and the defined drawer extension length (Fulcrum X, Figure 5). The CSU drawers were modeled using the top handle and bottom handle height, and the drawer extension was modeled from 0 inches to 12 inches.[23]

[23] 0 inches corresponds with a closed drawer when the fulcrum lines up with the drawers. 12 inches represents the 90th percentile drawer extension length in a dataset of approximately 180 CSUs.

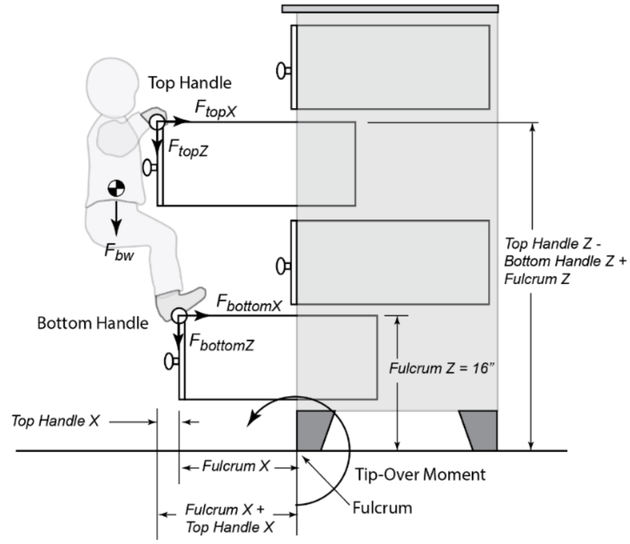

Figure 5. Free-body diagram of a child climbing a CSU.

For incidents involving children and CSUs without televisions, climbing was the primary interaction observed in fatal CPSRMS and nonfatal NEISS incidents as well as the second most common interaction in nonfatal CPSRMS incidents. For this reason, staff focused the criteria for passing the draft performance requirements, in part, on forces generated when a child climbs a CSU. The ascend interaction in the UMTRI study is analogous to a child's initial step to climb up on to the CSU, and therefore is considered an integral part of all climbing interactions. Although other plausible behaviors (e.g. yank, lean, bounce, one hand) included in the UMTRI study generated higher moments, staff did not see direct evidence of these interactions in the incident data. For this reason, staff did not focus the performance requirements on these interactions.

UMTRI researchers found that the moments caused by children ascending exceed the moments of body weight alone. UMTRI researchers estimated the equivalent force to be more than 1.6 times the weight of the child for typical drawer extensions.[24] The moments also vary based on the horizontal distance from the fulcrum, which is associated with drawer extension. CSPC staff used the UMTRI findings to develop the following equation to calculate the moment generated by children ascending a CSU based on the child's body weight and the drawer extension from the CSU fulcrum:

$$M = \{1.08 \times [Fulcrum\ X(\text{ft})] + 0.52\ \text{ft}\} \times Weight\ of\ child\ (lb)$$

[24] Analysis based on Reed, Matthew P., Ebert, Sheila M., Jones, Monica L.H, July 2020, "Forces and Postures During Child Climbing Activities" University of Michigan Transportation Research Institute (UMTRI), prepared for US Consumer Product Safety Commission, contract No. 61320618D0004, Table 16, page 44.

Where:

Fulcrum X is the horizontal distance from the front of the extended drawer to the fulcrum.

Considering literature on climbing-related behaviors and incident data as described in Tab C, CPSC staff determined that the appropriate *Weight of child* is the weight of a 95th percentile 3-year-old, or 51.2 pounds. Using the above parameters and equation, staff determined that the threshold tip over moment due to a child climbing on the drawer of a CSU should be:

$$M_{tip}\text{ (lb-ft)} > 55.3X - 26.6$$

Where:

X is the horizontal distance from the front of the extended drawer to the fulcrum.

The previous equations focus on child's climbing interactions with drawers, however some CSUs have doors in combination with drawers or doors only. While there is no direct evidence that children climb on doors in the incident data, this is a plausible interaction based on child capabilities, provided that the child has a sufficient handhold. Staff considers forces from a child hanging on a door to represent children climbing on the door of CSU. Accordingly, staff also focused the criteria for passing the draft performance requirements, in part, on forces generated when a child hangs from a CSU. UMTRI researchers found that the vertical forces associated with children hanging by the hands were close to the body weight of the child (Tab R). Staff adapted the test location from the door test in ASTM F2057 – 19 to obtain the equation describing a 95th percentile weight 3-year-old child hanging from an open door of a CSU. Based on this evaluation, staff determined that the threshold tip over moment due to a child climbing on the door of a CSU should be:

$$M_{tip}\text{ (lb-ft)} > 51.2Y - 12.8$$

Where:

Y is the horizontal distance (in feet) from the fulcrum to the edge of the door in its most extended position.

2. Forces and Moments on CSU due to Child Pulling on the Drawer

As discussed earlier, opening one or more drawers is a prevalent interaction in nonfatal CPSRMS incidents; out of the 101 opening drawer incidents, 57 resulted in injuries. In the nonfatal NEISS cases, there are reports of 42 incidents in which children opened one, two, multiple, or all drawers that resulted in injuries.

Large moments can be generated depending on the amount of pull force applied and the distance between the drawer pull location from the floor as shown in Figure 6. Thus, pull strength and distance from the pull location to the floor, are relevant considerations. When opening a drawer, children pull on the drawer. As the drawer opens, this pull is translated to outward motion of the drawer; once the drawer is fully opened to the stop, any additional pulling will be on the CSU as a whole.

Staff analyzed 15 incidents in which the height of the force application could be calculated based on the details provided in the incident narratives. Staff also examined pull strengths that children can generate. In the 15 incidents that provided information about the height of pull force application, heights ranged from less than a foot to almost four feet (46.5 inches) while children reportedly pulled the lowest, highest, and drawers in between.

The mean pulling strength of 2-5-year-old children on a convex knob (diameter 40mm) at their elbow height is 59.65 Newton (13.4 pound-force) for males and 76.43 Newton (17.2 pound-force) for females (DTI, 2000).

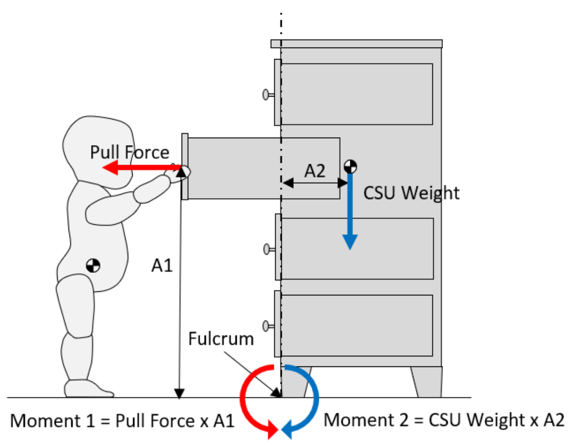

Figure 6. Child Pulling on drawer creating a tip over Moment 1.

Because opening/pulling on a drawer was a key interaction observed in incidents, staff focused the criteria for passing the draft performance requirements, in part, on forces generated when a child pulls on a CSU drawer. Based on this evaluation, staff determined that the threshold tip over moment due to a child pulling on the drawer of a CSU should be:

$$M_{tip} \text{ (lb-ft)} > 17.2Z$$

Where:

Z is the vertical distance (in feet) from the fulcrum to the highest handhold that is less than or equal to 4.12 feet high.

3. Drawer Fill Testing (Tab L)

As discussed previously, CSU tip-over incidents commonly involve CSUs that are partially filled or filled with clothing (Tab C). Although ASTM F2057 – 19 does not include filled drawers as part of its stability testing, the ASTM F15.42 subcommittee has considered whether a "loaded" (filled) drawer requirement and test method should be added to ASTM F2057. The ASTM F15.42 Loaded and Multiple Drawers task group used an 8.5 pound per cubic foot assumed clothing weight in testing and other discussion of filled drawers. Kids in Danger and Shane's Foundation found a similar density (average of 8.9 pounds per cubic foot) when it filled CSU drawers with boys t-shirts in its 2016 study on furniture stability.[25] However, CPSC staff was unable to determine the origin of the 8.5 pounds per cubic foot measure. For this reason, staff conducted testing with unfolded and folded children's clothing in the drawers of an exemplar CSU to evaluate whether 8.5 pound per cubic foot of drawer volume is a reasonable approximation of the weight of clothing in a filled drawer; staff also evaluated the weight of the maximum amount of clothing that they could put into a drawer. Staff concluded that 8.5 pounds per cubic foot of functional drawer volume is a reasonable approximation of the weight of clothing in a fully filled drawer and is an appropriate requirement for testing, modeling, and in the proposed performance requirements.

4. Multiple Open and Filled Drawers (Tab O)

As discussed previously, out of the 352 CPSRMS tip-over incidents involving children and CSUs without televisions (89 fatal and 263 nonfatal), 160 incidents reported that children opened at least one drawer; this total includes 27 incidents in which children opened "multiple" drawers. Twenty-three children in the CPSRMS incidents reportedly opened all drawers on the CSU. Staff used the stability test methods in ASTM F2057 – 19, with some alterations, to collect information about variables that ASTM F2057 – 19 does not address (i.e., the effect of multiple opened/closed drawers, the effect of filled/empty drawers, the tip weight). Staff conducted testing on 26 CSUs to learn what effect a variety of configurations with tip weight mechanism application location, drawers open/closed and drawers filled/empty can have on the stability of CSUs. Staff concluded that CSUs were less stable as more drawers were opened. The overall effect of filled or empty drawers was less pronounced because filled drawers have a variable effect on stability: a filled closed drawer would contribute to stability, while a filled open drawer would decrease stability.

5. Carpet Surface Testing (Tab P)

As discussed earlier, carpet was the reported flooring material in 82 percent of fatal and 80 percent of nonfatal CPSRMS incidents, both involving children and CSUs without televisions with a reported flooring type (Tab C). Staff tested 13 CSUs on a carpeted test surface to evaluate

[25] Kids in Danger and Shane's Foundation (2016). Dresser Testing Protocol and Data. Data set provided to CPSC staff by Kids in Danger, January 29, 2021.

the degree to which a carpeted surface can affect the stability of CSUs. Staff concluded that, in general, CSUs were less stable on carpet. All tested units, with various configuration of drawers open/closed and filled/unfilled, tended to tip over with less weight on the carpet than on the hard, flat surface. Staff determined that carpet reduced tip weight of the tested units by a mean of 7.6 pounds, and a median of 7 pounds, over permutations of the tested CSUs. Most of the variability in the tip weights was between units, as opposed to within them. Staff used the results from this study to determine a test method that approximated the effect of carpet on CSU stability by tilting the unit forward (Tab D).

6. Incident Recreation and Modeling (Tab M)

CPSC staff analyzed incidents and tested incident products to better understand the real-world factors that cause a tip-over injury or death. Staff analyzed 7 CSU models associated with 13 tip-over incidents. Through testing and analysis, staff recreated the incident scenario described in the investigation and determined tip weight in a variety of use scenarios such as a child climbing or pulling on the dresser, the dresser with multiple open drawers, filled and unfilled drawers, and the dresser on a hard level floor versus a carpeted floor. Staff found the following hazard patterns, often occurring simultaneously:

1. Multiple (more than one) drawers were opened.
2. Drawers empty, filled, or partially filled with clothing.
3. Carpeted surfaces.
4. Children climbing the CSU.
5. Children pulling on CSU drawers.

Two of the seven analyzed CSU models met the ASTM F2057 – 19 Standard Safety Specification for Clothing Storage Units stability requirements. An additional model was considered to be borderline meeting/not meeting the requirements. Based on staff's evaluation of meeting and borderline meeting CSUs and the observed hazard patterns, these results provide further support for staff's conclusion that ASTM F2057 – 19 does not address the consumer's use of CSUs and the hazards associated with children interacting with CSUs.

Staff also modeled potential fixes that could increase the stability of the CSUs for four of the models and enable them to pass the recommended performance requirements. The testing and analysis are detailed in Tabs M and D.

F. Tip Restraints (see Tab C)

Staff assesses that given the low rates of anchoring, the barriers to anchoring, and staff concerns about the effectiveness of tip restraints, that tip restraints should not be relied upon as the primary method of preventing CSU tip over. Instead, staff recommends that CSUs be inherently stable, without relying on additional intervention from the consumer. However, staff supports the use of effective tip restraints as a secondary safety system to enhance stability. For example, staff posits that tip restraints should be used to reduce the risk of tip over for more extreme interactions such as bouncing and jumping, and for interactions of older and heavier children. In addition, for existing CSUs in homes, installing a tip restraint may help reduce the risk of tip over.

Several research studies show that a large number of consumers do not anchor furniture, including CSUs. A CPSC Consumer Opinion Forum survey administered in 2010 with a convenience sample of 388 consumers, found that only 9 percent of respondents anchored the furniture under their television. The consumers who reported using a CSU to hold their television had approximately the same rate of anchoring the CSU, 10 percent, as the overall rate of anchoring furniture found in the study. A 2018 Consumer Reports nationally representative survey of 1,502 U.S. adults, found that only 27 percent of consumers overall, and 40 percent of consumers with children under 6 years old at home, have an anchored piece of furniture in their home (Peachman 2018, Consumer Reports 2018). The study also found that 90 percent of consumers have a dresser in their home, but only 10 percent of those who have a dresser have anchored it. Likewise, 50 percent of consumers have a tall chest or wardrobe in their home, but only 10 percent of those who have a tall chest or wardrobe have anchored it (Consumer Reports 2018).

In 2015, CPSC started an active education campaign, Anchor It!, to educate consumers about the risk of injury and death from furniture, television, and appliance tip-overs, and to promote the use of tip restraints to anchor furniture and TVs. The Anchor It! campaign includes a website, news and radio spots, social media, blog posts, and videos. More information on the campaign, including educational resources and safety tips, can be found at www.anchorit.gov.

A 2020 CPSC study on the Anchor It! campaign found that 55 percent of respondents reported ever anchoring furniture. A greater percentage of parents reported anchoring furniture (59 percent) than caregivers (50 percent), and a greater percentage of homeowners reported anchoring furniture (57 percent) than renters (51 percent) (Fors Marsh Group 2020a). The most common reasons consumers selected for not anchoring furniture included: children not left alone around the furniture, perception that the furniture is stable enough, concern about damage to walls and furniture, and lack of knowledge on what hardware to use.

In future work, outside of this rulemaking effort, staff may evaluate appropriate requirements for tip restraints, and will continue to work with ASTM to update its tip restraint requirements. As part of this potential future work, staff recommends evaluating the strength requirements for tip restraints to determine whether they account for the forces outlined in this draft NPR from children's interactions, multiple open and filled drawers, and carpet, as well as the forces from a tipping CSU. Because a tip restraint is intended to be a secondary safety system, staff recommends considering forces beyond those of younger children ascending, potentially including more extreme interactions such as bouncing, yanking, jumping, as well as forces from older, heavier, and stronger children. Staff also recommends evaluating tip restraints as a system, which includes the interface with the CSU and the wall, since even a very strong tip restraint will be ineffective if it detaches from the CSU or if it pulls out of the wall. Potential future revisions to requirements for tip restraints would likely benefit existing CSUs that predate a final rule that addresses inherent stability, and address stronger forces that aren't covered by the recommended requirements in this draft NPR, such as from older children or more onerous interactions.

III. RECOMMENDED REQUIREMENTS FOR PROPOSED RULE

This section covers the recommended scope and requirements. The recommended regulatory text for these requirements is provided in Tab G.

A. Scope and Definitions (Tab C)

The draft proposed rule covers CSUs, which are defined as a freestanding furniture item, with drawer(s) and/or door(s), that may be reasonably expected to be used for storing clothing, that is greater than or equal to 27 inches in height, and with a total functional volume of the closed storage greater than 1.3 cubic foot and greater than the sum of the total functional volume of the open storage and the total volume of the open space. Common names for clothing storage units include, but are not limited to: chests, bureaus, dressers, armoires, wardrobes, chests of drawers, drawer chests, chifforobes, and door chests. Whether a product is a clothing storage unit depends on whether it meets this definition, however, some examples of furniture items that, depending on their design, may not meet the criteria in this definition and, therefore, may not be considered clothing storage units are: shelving units, office furniture, dining room furniture, laundry hampers, built-in closets, and single-compartment closed rigid boxes (storage chests). This recommended definition includes several features/factors that staff considers necessary, based on incident information and the tip-over hazard, to distinguish products that are and are not subject to the draft rule; these include whether the unit is freestanding, whether the unit may be reasonably expected to be used for storing clothing, the height of the unit, and the closed storage of the unit behind doors and/or drawers. Staff also considered some additional factors, such as product weight, but did not ultimately recommend including them in the definition. These factors, and the support for them, are discussed below.

Product Types

Of the 89 fatal CPSRMS tip-over incidents involving a child and CSU without a television analyzed in this NPR briefing package, 87 involved chests, bureaus, or dressers and 2 involved wardrobes; none involved an armoire, portable storage closet, or clothes locker. Of the 263 nonfatal CPSRMS incidents with a child and CSU without a television, 259 involved chest, bureaus, or dressers, 1 involved an armoire, and 3 involved wardrobes. Of the estimated 40,700 emergency department-treated injuries to children from CSU tip over (without a television) between January 1, 2006 to December 31, 2019, an estimated 40,200 involved "chest, bureaus, and dressers." There were not enough incidents involving armoires, wardrobes, portable storage closets, or clothes lockers to make estimates for these CSU categories.

Staff recommends that chests, bureaus, dressers, wardrobes and armoires be included within the scope of the draft proposed rule. Although the ANPR and data set analyzed for this briefing memo included clothes lockers and portable storage closets as CSUs, staff recommends excluding these products from the scope of the draft proposed rule because there are no reported tip-over fatalities or injuries to children with these products. On the other hand, wardrobes and armoires have been involved in fatal and nonfatal incidents and armoires have been involved in nonfatal incidents. Both are more similar in design to the other CSUs included in the scope than clothes lockers and portables closets and are more likely to be used in homes than clothes lockers.

Product Height. The shortest reported CSU involved in a fatal incident without a television is a 27.5-inch-tall 3-drawer chest, which tipped over on a 2-year-old child, and the shortest reported CSU involved in a nonfatal tip-over incident without a television is a 26-inch-tall 2-drawer chest, which tipped over and pinned a 13-month-old child and caused bruising on both legs. Although there are no CSUs involved in fatal tip-over incidents without a television that are reported to be under 27 inches, ESHF staff is aware of shorter CSUs on the market. Results from the 2020 FMG CSU use study focus group (Tab Q) suggest that consumers seek out low-height CSUs for use in children's rooms "because [they] would like a unit that is an appropriate height (i.e., short enough) for their children to easily access their clothes" (p. 38). In the in-home interviews, researchers observed that CSUs in children's rooms were typically low to the ground and wide. For this reason, staff surmises that children may have more access and exposure to low-height CSUs than taller CSUs. Overall, staff recommends defining CSUs as including products that are a minimum height of 27-inches.

Clothing Storage, Closed Storage Behind Doors/Drawers, and Freestanding. The CSU hazard is related to the function of CSUs, where they are used in the home, and their design features. A primary feature of CSUs is that they are typically used for clothing storage; however, putting clothing in a furniture item does not create the tip over hazard on its own. Rather, the function of CSUs as furniture items that store clothing means that consumers and children are likely to have easy access to the unit and interact with it on a daily basis, resulting in increased exposure and familiarity. CSUs are commonly used in bedrooms, an area of the home where children are more likely to have unsupervised time; most CSU tip-over incidents occur in bedrooms. Another primary feature of CSUs is closed storage, that is storage within drawers or behind doors. These drawers and doors extend from the CSU case when open, which allows children to exert vertical force farther from the tip point (fulcrum) than they would be able to without extension elements and make it more likely that a child will tip the product during interactions. In addition, these features may make the product more appealing to children as a play item. Children can also use the CSU extension elements for functional purposes, such as to climb to reach an item on top of the CSU. CSUs are freestanding furniture items, which means that they remain upright, without requiring attachment to the wall, in their normal use position. The lack of permanent attachment to the building structure means that CSUs are more susceptible to tip over than built in storage items in the home.

Staff is aware of products that are named and advertised as generic storage products with multiple uses around the house, or are advertised without context suggesting a particular use. Many of these items clearly share the design features of CSUs, including closed storage behind drawers and/or doors. In addition, staff is aware of products that appear, based on design, to be CSUs, but are named and advertised for other purposes (*e.g.*, an "accent piece" with drawers staged in a foyer, and large multi-drawer "nightstands" over 27 inches tall). Staff is also aware of hybrid products that combine features of CSUs with features of other product categories, for example: bookshelf storage products with shelving and closed storage behind drawers or doors, desks or tables with large amounts of attached closed storage, bedroom media furniture with an electronics slot and drawers for clothing, and beds with integrated CSU storage. For these reasons, staff recommend that the determination of whether or not a product is in scope should be based on whether a reasonable consumer would perceive the product to be a CSU, regardless of marketing.

Product Weight. The lightest-weight reported CSU involved in a fatal tip-over incident without a television is a 5-drawer CSU with the bottom 3 drawers missing, which tipped over on a 2-year-old child. The unit weighed 34 pounds without the 3 drawers, the configuration at the time of the incident. The lightest weight reported non-modified CSU involved in a fatal tip-over incident without a television is a 57 pound 3-drawer chest, which tipped over on a 2-year-old child. The lightest weight reported CSU involved in a nonfatal incident without a television is a 31 pound 2-drawer chest, which tipped over and pinned a 13-month-old child and caused bruising on both legs. Staff is aware of some lightweight plastic units marketed and used as CSUs and therefore concludes that consumers will perceive and use lightweight units as CSUs. Staff notes that with an assumed clothing load of 8.5 pounds per cubic foot of storage volume, many lightweight units could be filled to the same weight as the incident-involved units; however, based on the lack of reported incidents with CSUs weighing under 31 pounds, staff speculates that lightweight CSUs may not pose the same hazard as heavier CSUs (Tab B). Staff did not propose excluding lightweight CSUs from the scope of the proposed rule.

B. Performance Requirements (Tab D and Tab G)

Staff developed recommended requirements to address and account for the multiple hazard patterns involved in CSU tip-over incidents. The recommended requirements are based on a review of incident data, incident analyses, results from the UMTRI child climbing study, and staff testing. To improve the inherent stability of CSU designs and reduce the number of tip-over incidents, CPSC staff recommends the following requirements/tests to simulate the hazard patterns involved in CSU tip-overs and assess their stability under these conditions. As such, the recommended performance requirements involve determining the tip-over moment of a CSU when it has multiple open and filled drawers, and is on a surface simulating the effect of carpeting. To assess whether the CSU is sufficiently stable, the tip-over moment must exceed 3 comparison tip-over moments, each of which represents a 95th percentile 3-year-old child's interaction with the CSU. The first comparison tip-over moment reflects the child ascending the CSU, the second comparison reflects a child hanging on the door of the CSU, and the third comparison reflects a child pulling on/opening the top drawer of the CSU. The following are staff's recommended requirements:

- Test Condition
  - *Carpet simulation.* The CSU shall be tipped forward 1.5 degrees as shown in Figure 7 to simulate the effect of carpeting. Staff determined a forward tilt angle of 1.5° replicated the effects of carpeting on CSU stability. The tilt can be achieved by raising the rear of the CSU, or by placing the CSU on an angled surface.

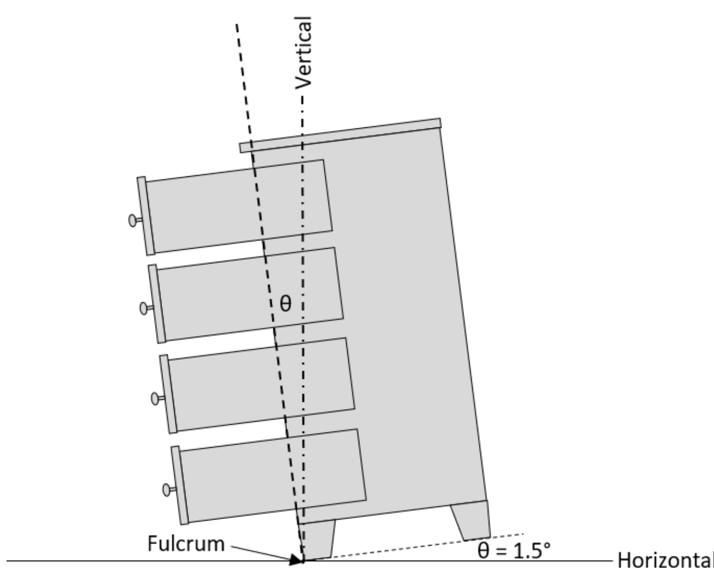

Figure 7: A 1.5° forward tilt (drawing tilt angle is not to scale) can be used to replicate the effects of a CSU resting on carpet.

- *Open drawers/doors.* Test with all doors open to the least stable configuration, and all drawers and pull-out shelves fully extended; for CSUs with interlocks that pass interlock testing, then test with all drawers that are not locked by the interlock system open to the least stable configuration.
- *Fill.* Fill all drawers and pull-out shelves with 8.5 pounds per cubic foot of functional volume placed at the center of the drawer if half or more of the drawers and pull-out shelves by functional volume remain pulled out as shown in Figure 8a. If less than half of the drawers and pull-out shelves by functional volume are open, do not place a fill weight in any drawers or pull-out shelves, as shown in Figure 8b.

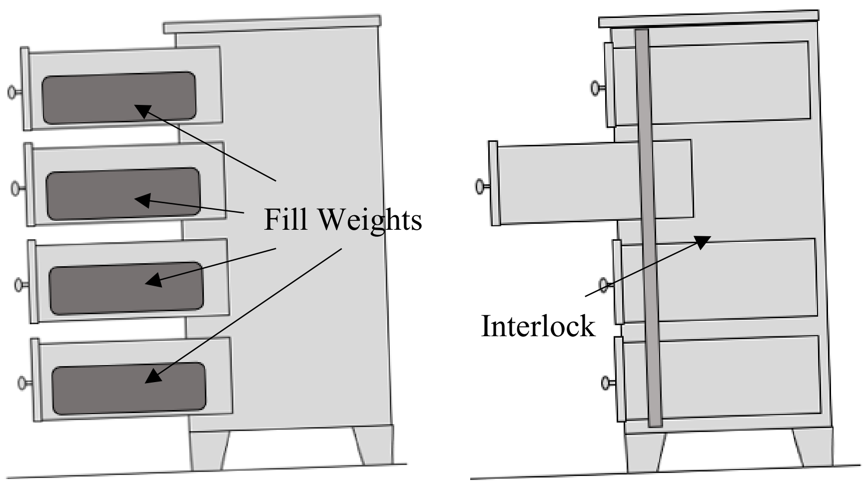

Figure 8a Figure 8b

Figure 8. All drawers and pull-out shelves are opened to the maximum extension and filled with 8.5 pounds per cubic foot of functional volume during the test (8a), unless an interlock or other means prevents more than half the drawers by volume to be extended simultaneously (8b).

- *Stability test – Minimum Tip over Moment Test*
  - *Apply force and calculate tip-over moment.* Use one of two test methods to apply force to the CSU to identify the force required to cause the CSU to tip over and to calculate the tip-over moment.
    1. Apply over a period of at least 5 seconds a gradually increasing horizontal load L_H to the rear of the CSU until the rear feet or edge of the CSU lifts ¼ inches off the test surface as show in Figure 9a.

Record the maximum load (pounds). Calculate the tip over moment by: *Tip over Moment* = L_H x V

or

2. Apply over a period of at least 5 seconds a gradually increasing vertical load L_V to the extended drawer of the CSU until the rear feet or edge of the CSU lifts ¼ inches off the test surface as shown in Figure 9b. Record the maximum load (pounds). Calculate the tip over moment by: *Tip over Moment* = L_V x H

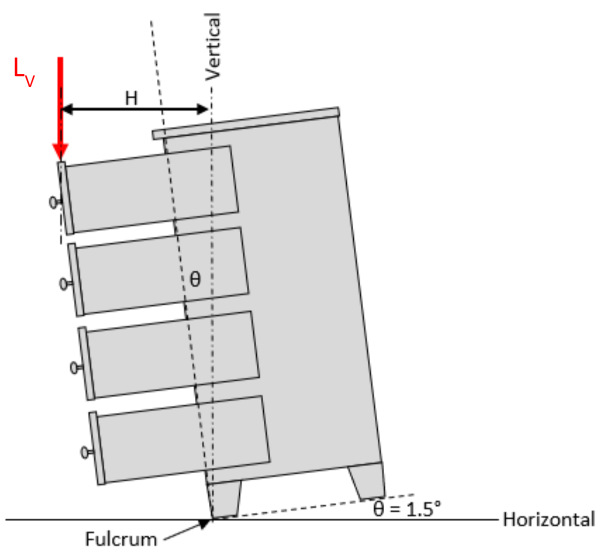

Figure 9a

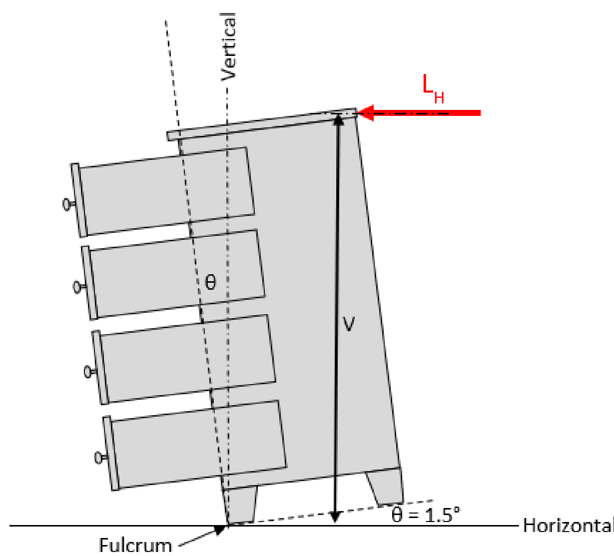

Figure 9b

Figure 9. Illustration of force application methods: a) vertical load L_V, and b) horizontal load L_H.

- *Assess Tip-Over Moment.* The tip-over moment of the unit shall be compared to the following three moments, (a) moment associated with children ascending a CSU, (b) hanging on a CSU door and (c) pulling on the top drawer or handhold of the CSU, using the 95th percentile 3-year-old weight of 51.2 pounds and the pull strength of a 2-5-year-old child as a basis for this comparison.

  The *tip-over moment* of the unit must be greater than all of the following applicable moments:

a. [for units with a drawer(s) or pull-out shelf(ves)] 55.3 pounds times the drawer or pull-out shelf extension from fulcrum distance in feet + 26.6 pounds feet.
b. [for units with a door(s)] 51.2 pounds times the door extension from fulcrum distance in feet – 12.8.
c. [for all units] 17.2 pounds times maximum handhold height in feet.

- *Interlock Test.* If the CSU has an interlock system that prevents drawers from opening, testing first assesses the integrity of that interlock by applying a 30-pound horizontal pull force to the drawer. If the interlock fails, resulting in the drawer opening or the interlock being damaged, the interlock will be disabled or bypassed for stability tests.

See Tab D for a detailed explanation of the rationale for these requirements.

C. Marking and Labeling Requirements (Tab C)

Staff recommends the following requirements for the warning label:

- *Placement.* Staff recommends that the warning label be placed in a conspicuous location. For unit with drawers, staff recommends a label to be placed on the interior side panel of in the uppermost clothing storage drawer or on a drawer in the uppermost row that is entirely below 56 inches, which is the fifth percentile standing eye height for a U.S. female age 18 to 64. Staff recommends that the top left corner of the warning label shall be positioned within 1 inch of top of the drawer side panel and within the front 1/3 of the interior drawer depth. For units with only doors, staff recommends that the warning label be located on an interior side or back panel of the cabinet behind the door(s), or on the interior door panel, and not obscured by a shelf or other interior element.
- *Content.* Staff recommends requiring the following wording in the label:

  Children have died from furniture tip over. To reduce the risk of tip over:
  - ALWAYS secure this furniture to the wall using an anti-tip device
  - NEVER allow children to stand, climb, or hang on drawers, doors or shelves
  - [*for units with interlocks only*] Do not defeat or remove the drawer interlock system
  - Place heaviest items in the lowest drawers
  - [*for units that are not designed to hold a television*] NEVER put a TV on this furniture

- *Symbols*. Staff recommends requiring the child climbing symbol in Section 8.2.4.1 of ASTM F2057 – 19. However, if one of the 2 variants that are currently being tested as part of a larger graphical symbol study (discussed in Tab C) performs better in comprehension testing than the F2057 – 19 symbol, staff recommends requiring one of those variants instead. For units that are not designed to hold a television, staff recommends including the no television symbol from F2057 – 19.

- *Format*. Staff recommends requiring the warning format in ASTM F2057 – 19, which is consistent with ANSI Z535.4 (see Tab G for the proposed language). Staff regularly uses ANSI Z535.4, American National Standard for Product Safety Signs and Labels—the primary US. voluntary consensus standard for the design, application, use, and placement of on-product warning labels—when developing or assessing the adequacy of warning labels.
- *Permanency*. In order to be effective, a warning label must remain present. Label permanency requirements are intended to prevent the warning label from being removed inadvertently and provide resistance to purposeful removal by the consumer. Staff evaluated the ASTM F2057 – 19 label permanency requirements in Tab F and concluded that they are adequate. Staff recommends requiring the permanency testing prescribed in Section 7.3 to increase the likelihood that labels remain attached to CSU.

An example of the recommended warning label is shown in Figure 10.

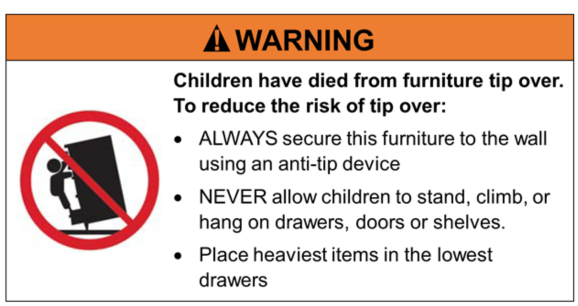

Figure 10. Example of the recommended warning label for a CSU (top: example label for CSU with an interlock system and not designed to hold a television and bottom: example label for a CSU without an interlock system and designed to hold a television). Note: These labels are not to scale.

Overall, staff recommends use of a warning label to inform consumers of the hazard and motivate them to install tip restraints as a secondary safety mechanism. However, staff cautions that risk perception is greatly influenced by product familiarity, hazardousness of the product, likelihood of injury, and severity of injury. Risk perception is also influenced by people's beliefs about their ability to control the hazard and whether they believe the warning message. Research shows that high familiarity with a product can lower a user's inclination to read warnings or reduce the likelihood that the user will believe such information, lowering the rate of compliance with the warning. Consumers have high familiarity with CSUs because they are found in most households, in one form or another, and consumers are likely to interact with them daily. Consumers are unlikely to perceive a CSU threatening or dangerous and thus are less likely to read and believe associated information on the hazard. Therefore, staff concludes that even well-designed warnings have limited effectiveness in changing user's behavior in the use of CSUs.

Staff also recommends a new identification label that provides the model, manufacturer information, date of manufacture, and a statement of compliance with the proposed rule. This label would allow for easier identification of compliant and non-compliant CSUs for both consumers and CPSC, and facilitate recalls.

D. CSU Hang Tag to Provide Comparative Information (Tab E)

Section 27(e) of the CPSA authorizes the Commission to require, by rule, that manufacturers of consumer products provide to the Commission performance and technical data related to performance and safety as may be required to carry out the purposes of the CPSA, and to give notification of such performance and technical data at the time of original purchase to prospective purchasers and to the first purchaser of the product. CPSC staff recommends including in the NPR a requirement to provide information about the stability of the CSU at the time of original purchase, so that consumers can compare the relative stability of products and make informed buying decisions.

The recommended requirements for the hang tag address the following key elements:

(1) comparative product information,
(2) linear scale graphical representation of stability,
(3) titled CSU icon,
(4) size and shape of the hang tag, and
(5) further explanation of the rating on the reverse side of the hang tag.

The tip rating is based on the recommended performance requirements detailed above, and uses a ratio of tested moment to the threshold moment to provide a simple calculation that results in a number, greater than 1, which can be easily represented on a scale. Additionally, due to the nature of a ratio, a rating of 2 means the unit can withstand twice the minimum moment, a rating of 3 is three times the minimum moment, etc. This means that two units can be compared, and a tip rating of 4 means the unit can withstand 4 times the minimum moment, and twice the moment of a CSU with a rating of 2. An example hang tag is provided in Figure 11.

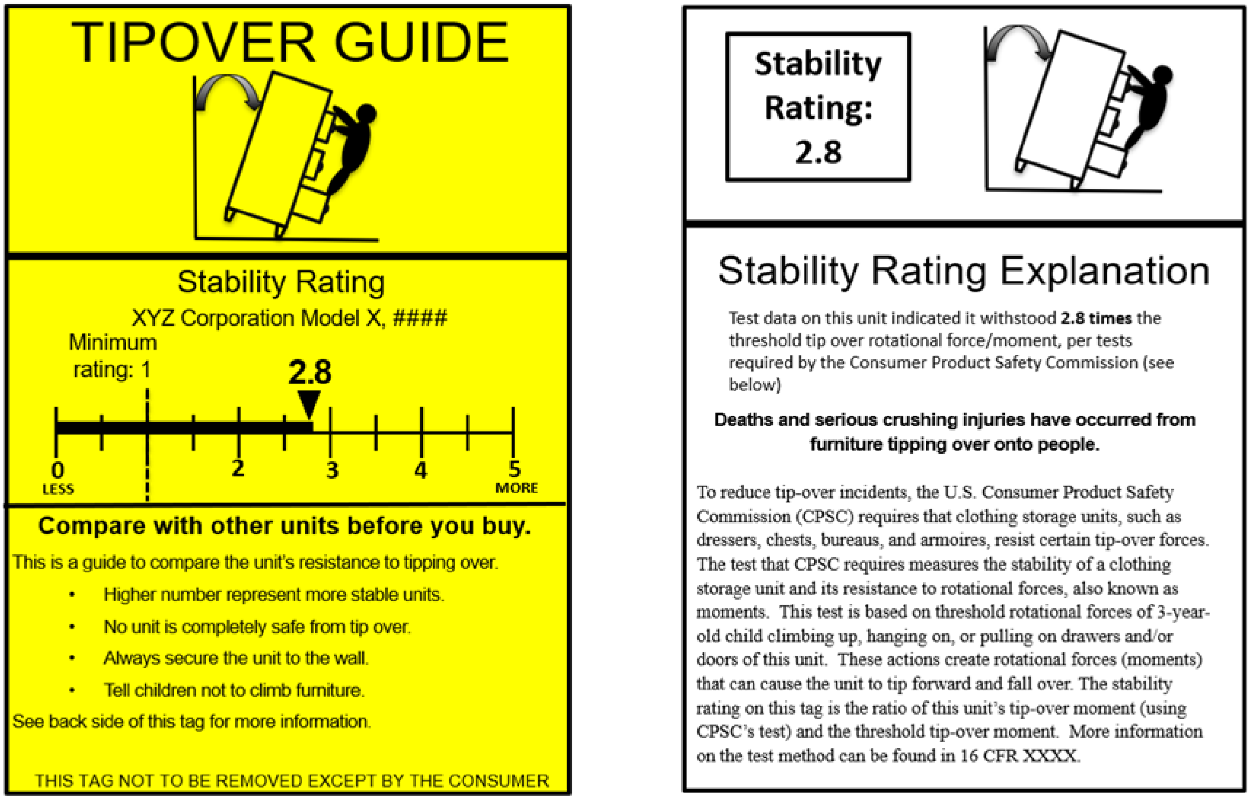

Figure 11. Recommended CSU Hang Tag, example CSU with rating of 2.8. Note: a larger hang tag sample is provided in Tab E.

E. Certification and Notice of Requirements

The CPSA defines "children's products" as products designed or intended primarily for children 12 years or younger. The designation of a product as a children's product is based on manufacturer statements about intended use (including labeling); whether the product is packaged, displayed, promoted, or advertised as appropriate for 12 and younger; whether it is commonly recognized by consumers as being intended for 12 and under; and the CPSC Age Determination Guidelines. Staff is aware of some CSUs that are marketed, packaged, displayed, promoted, and/or advertised as intended for children 12 years old and younger and incident data and some recalls include these products. However, tip-over incidents mainly involve CSUs that are not primarily intended for children and staff is aware that children interact with CSUs regardless of whether they are children's products; thus, many CSUs are non-children's products.

Section 14(a) of the CPSA includes requirements for certifying that children's products and non-children's products comply with applicable mandatory standards. Section 14(a)(1) addresses required certifications for non-children's products, and sections 14(a)(2) and (a)(3) address certification requirements specific to "children's products." The CPSA defines a "children's product" as "a consumer product designed or intended primarily for children 12 years of age or younger" and states that, when determining whether a product is primarily intended for children 12 years and younger, to consider the following factors:

(1) manufacturer statements about the intended use of the product, including a label on the product if such statement is reasonable;
(2) whether the product is represented in its packaging, display, promotion, or advertising as appropriate for use by children 12 years of age or younger;
(3) whether the product is commonly recognized by consumers as being intended for use by a child 12 years of age or younger; and
(4) the Age Determination Guidelines issued by CPSC staff in September 2002, and any successor to such guidelines.

The Commission interpreted this statute in its regulation at 16 CFR part 1200, and set forth specific examples involving home furnishings in § 1200.2(d)(1). Although some CSUs meet the definition of a "children's product," many do not. If the Commission issues a final rule for CSUs, manufacturers or importers of non-children's product CSUs must test products to the rule and issue a General Certificate of Conformity (GCC) demonstrating compliance, and manufacturers of CSUs that are children's products must have products third party tested by a CPSC-accepted laboratory, and issue a Children's Product Certificate (CPC) demonstrating compliance with the rule. The Commission's regulation on requirements for certificates of compliance is codified at 16 C.F.R. part 1110.

Section 14(a)(1) of the CPSA requires every manufacturer of a non-children's product, which includes the importer, that is subject to a consumer product safety rule under the CPSA or a similar rule, ban, standard, or regulation under any other law enforced by the Commission and which is imported for consumption or warehousing or distributed in commerce, to issue a certificate. The manufacturer must certify, based on a test of each product or upon a reasonable testing program, that the product complies with all rules, bans, standards, or regulations applicable to the product under the CPSA or any other law enforced by the Commission. The certificate must specify each such rule, ban, standard, or regulation that applies to the product.

For children's products, section 14(a)(2) of the CPSA states that, before importing for consumption or warehousing or distributing in commerce any children's product that is subject to a children's product safety rule, the manufacturer (including the importer) must submit sufficient samples of the children's product, or samples that are identical in all material respects to the product, to a CPSC-recognized third party conformity assessment body accredited under section 14(a)(3) of the CPSA ("recognized third party test laboratory"). The recognized third party test laboratory must test the children's product for compliance with such children's product safety rule. Based on the testing, the manufacturer (or private labeler) must issue a certificate that certifies that the children's product complies with the children's product safety rule based on the assessment of a recognized third party laboratory accredited to conduct such tests. The Commission's requirements for testing and labeling children's products is codified at 16 C.F.R. part 1107. Additionally, part 1109 sets forth requirements for using the testing of component parts to meet the testing and certification requirements for both children's and non-children's products.

Section 14(a)(3)(A) of the CPSA states that the third party testing requirement applies to any children's product manufactured more than 90 days after the Commission has established and published a "notice of requirements" (NOR) for the accreditation of third party conformity assessment bodies to assess conformity with a children's product safety rule. The Commission published a final rule regarding *Requirements Pertaining to Third Party Conformity Assessment Bodies*, codified in 16 C.F.R. part 1112. 78 Fed. Reg. 15836 (Mar. 12, 2013). Part 1112 establishes the requirements for accreditation of third party testing laboratories to test for compliance with a children's product safety rule. The final rule also codifies all of the NORs that CPSC has published, to date, for children's product safety rules. All new children's product safety rules require an amendment to part 1112 to create an NOR.

For CSUs that are children's products, staff recommends that the Commission propose to amend part 1112 to include CSUs that are children's products in the list of children's product safety rules for which CPSC has issued NORs. Commission approval of accreditation requirements for the testing of CSUs that are children's products will make effective the third party testing and certification requirement for CSUs that are children's products manufactured more than 90 days after the Commission has established and published an NOR for the accreditation of third party conformity assessment bodies to assess conformity with the children's product safety rule.

IV. ECONOMIC ANALYSIS

Preliminary Regulatory Analysis (see Tab H)

A proposed product safety rule published in the *Federal Register* in accordance with the requirements of section 9 of the Consumer Product Safety Act must include a preliminary regulatory analysis that contains a number of elements: a description of the proposed rule's potential benefits and potential costs; a discussion of why relevant voluntary standards would not eliminate or adequately reduce the risk of injury addressed by the proposed rule and a discussion of why a standard, if any, that had been submitted as a proposed standard was not being published as the proposed standard; and a description of reasonable alternatives, their potential costs and benefits, and why those alternatives should not be published as a proposed rule. 15 U.S.C. 2058(c). Staff's preliminary regulatory analysis (Tab H) addresses each of these issues.

Potential Benefits and Costs of the Rule

Societal cost of fatal and nonfatal injuries: Based on information from the Directorate for Epidemiology and estimates from the CPSC Injury Cost Model, in recent years there have been an average of 6.2 deaths[26] and 6,824 medically-attended injuries to children resulting from CSU tip overs each year. There has also been an average of 1.8 deaths and 4,451 medically-attended injuries each year to adults that could also be addressed to some extent by the draft proposed rule.

Assuming a value of a statistical life (VSL) of $9.2 million (2018 dollars), the societal cost of the deaths is about $73.6 million. The societal cost of the nonfatal injuries was estimated using the CPSC Injury Cost Model. The Injury Cost Model uses the NEISS estimates of emergency-department treated injuries and imputes estimates of injuries treated in other medical settings using the empirical relationships between injuries treated in emergency departments and these other settings. The societal cost estimates include the cost of medical treatment, lost worktime, and intangible pain and suffering costs. The total societal cost estimate of the nonfatal injuries to both children and adults is estimated to be about $345.4 million. The intangible pain and suffering costs account for about 75 percent of this total.

Potential benefits of the rule: More than 90 percent of the fatalities involving children and CSUs without CRT televisions involved children 3 years old or younger.[27] Based on analysis of the fatality cases involving children, including such factors as the child's weight and age and their interactions with the CSUs, staff concludes that the draft proposed rule could prevent almost all fatalities involving children 3 years of age and younger, but only about 48 percent of the deaths to children ages 4 through 8 would be prevented. Assuming a VSL of $9.2 million, the benefit of the draft proposed rule in terms of reduced child deaths could be $53.4 million annually, a reduction in the estimated societal costs of about 94 percent. Based on a similar analysis of the NEISS incidents involving children, CPSC staff believe that the draft proposed rule could reduce the nonfatal injuries by about 91 percent. Therefore, the benefit (reduction in societal cost of injuries) of the draft proposed rule in terms of reduced nonfatal injuries to children could be $188.7 million annually.

The draft proposed rule is not intended to reduce deaths and injuries to adults. Nevertheless, staff believes that a substantial number of adult injuries and deaths could be prevented if CSUs

[26] The death incidents exclude those incidents that are known to have also involved CRT televisions but include those cases involving televisions for which the type of television involved either could not be determined or was a flat panel television.
[27] The economic analysis includes fatal incidents involving children and CSUs without televisions and incidents involving children and CSUs with flat panel (non-CRT) televisions.

were inherently more stable. Less information is available on the scenarios of the tip-over incidents involving adults and, therefore, staff is unable to estimate the potential reduction with as much certainty. For this analysis, staff assumed that deaths and injuries from tip overs involving adults would be reduced at half the rate as they were for children, based on staff analysis. If adult tip-over deaths and injuries are reduced at this rate, the annual benefit would be $7.4 million in terms of reduced deaths and $56 million in terms of reduced nonfatal injuries.

The total annual benefit of the draft proposed rule in terms of the reduced societal costs of injuries and deaths to children and adults would be about $305.5 million. Given that there were about 463.5 million CSUs in use in 2017, the benefit per unit would be about $0.66 per unit annually. Over the estimated 15-year useful life of a CSU this comes to $6.01 at a discount rate of 7 percent, $7.88 at a discount rate of 3 percent, and $ 9.90 without discounting.

Cost analysis: The costs include the costs that would be incurred to redesign and modify CSUs so that they meet the requirements of each of the standards, including the increased cost to manufacture and distribute compliant CSUs. The costs also include the costs and impacts on consumers. These include the cost of additional time to assemble ready-to-assemble furniture and the loss of utility if certain desired characteristics or styles are no longer available, or if compliant CSUs are less convenient to use. The costs of designing, manufacturing, and distributing compliant CSUs would be initially incurred by the manufacturers and suppliers, but most of these costs would likely be passed on to the consumers via higher prices. The costs involving the added assembly time for RTA CSUs or the loss of utility because CSUs with certain features or characteristics are no longer available, of course, would be borne directly by consumers who desired CSUs with those characteristics or features.

Staff's review of CSUs on the market suggests that more stable CSUs tend to be costlier. Modifications in the design of CSUs to improve stability likely include the use of drawer interlocks, adding weight in the rear of the CSU, extending the front feet of the CSU, and perhaps using levelers to raise the front of the CSU to stabilize the CSU on carpeting. Based on an analysis of how five CSUs could be modified to meet the cost of the draft proposed rule, staff estimated the potential cost increases to CSU manufacturers. For four of the CSUs the cost estimates were $13 or more per unit and in some cases exceeded $25, which exceeds the estimated average benefits per unit. For the fifth CSU, the estimated cost estimates of the modifications were in the same range as the estimated benefits per unit. Of the potential modifications for which staff was able to estimate the potential cost, the lowest costs were about $5.80 per unit; several were significantly higher. Even assuming the low cost of about $5.80 per unit, assuming annual sales of at least 43 million units, the annual cost of the draft proposed rule would be around $250 million. Therefore, the draft proposed rule would be considered a major rule under the Congressional Review Act.

Staff notes that they only looked at five CSU models out of the hundreds or thousands available on the market and that the units analyzed were models that had been involved in tip-over incidents. Potentially they could be more unstable than other units, which suggests that the benefits of the draft proposed with respect to the specific models could be higher than average. However, staff does not have evidence that they are in fact more unstable than other CSUs on average.

In addition to the costs that staff attempted to quantify, there are unquantified costs that should also be considered. Many of the modifications required to conform to the draft propose rule would add weight to the CSUs, making them more difficult to move, and, especially in the case of ready-to-assemble CSUs, more difficult to assemble. Modifications that require feet extending several inches in front of the CSU could create a tripping hazard. Finally, some CSUs could be difficult to modify to comply with the draft proposed rule requirements and essentially might be withdrawn from the market. These might include tall and shallow CSUs. The cost in these cases would be the loss to the consumers of not being able to obtain CSUs in the desired dimensions (i.e., weight, height, width, and depth).

Staff assesses that the cost of providing the certificates of conformity will be very low on a per-unit basis. In the case of CSUs that could be considered to be children's products, which are thought to constitute a very small portion of the market for CSUs, the cost of the certification testing could be somewhat higher, because an accredited third party testing laboratory would be required to conduct the certification testing.

Voluntary Standard

In developing the draft proposed rule, CPSC staff considered whether the Commission could rely on the current voluntary standard, ASTM F2057 – 19 in lieu of a rule. The voluntary standard has been in effect for more than 20 years and has contained the same stability performance requirements since 2014. ASTM F2057-19 has two stability requirements: the CSUs is required not to tip when (1) all extension elements are opened and no additional force is applied, and (2) one extension element is opened and a 50-pound weight is placed on the front. Both tests are conducted with an empty CSU on a hard, flat, level surface (Tab F). The voluntary standard differs from the draft proposed rule in that each drawer is tested one at a time for the weighted test, the tests are conducted while the drawers are empty, the test is conducted on a flat surface rather than angled, and the voluntary standard does not account for the dynamic loading that a child would impart on a CSU while ascending it or the horizontal loading from a child pulling on the drawer.

CPSC staff concluded that ASTM F2057 – 19 does not adequately protect children from CSU tip overs for several reasons. For one, ASTM F2057 – 19 does not consider the dynamic loading that occurs when a child climbs on a CSU. Research by UMTRI suggests the actual force a child would impart while climbing on a CSU could exceed 160 percent of the weight of the child (Tab

D). ASTM F2057 – 19 also does not consider the effect of carpeting on stability. Testing by CPSC staff demonstrates that carpeting affects the stability of CSUs (Tab P). More than 80 percent of tip-over incidents involved CSUs on carpeted surfaces (when the flooring type was reported, Tab C). In addition, filled drawers are not considered in ASTM F2057 – 19. Testing by CPSC staff indicates that the weight of filled drawers increases the stability of CSUs when the drawers are closed, but decreases the stability of CSUs when drawers are opened. Finally, ASTM F2057 – 19 does not account for the combination of multiple factors that can coexist that contribute to instability, such as multiple open filled drawers and climbing.

CPSC staff determined that rather than fully protecting children that weigh 50 pounds or less (as ASTM F2057 – 19 aims to do), the current voluntary standard may only protect children that weigh 29.1 pounds or less, especially if the CSU is resting on a carpeted surface. For comparison, about 95 percent of all 3-year-old boys and about 85 percent of all 3-year-old girls weigh more than 29.1 pounds. CPSC staff is aware of 22 tip-over incidents involving CSUs that met the stability requirements in the voluntary standard. CPSC efforts to encourage the voluntary standard organization to consider more stringent stability requirements have been met with resistance from industry participants. Even if all CSUs eventually complied with the voluntary standard, the benefits would be about 70 percent lower than the benefits expected from the draft proposed rule, because it would only protect children up to 29.1 pounds. For these reasons, staff concludes that the voluntary standard does not adequately reduce the risk of injury resulting from CSUs tipping over.

The CPSA also requires a discussion of any efforts proposed in response to the ANPR to modify or develop a standard to address the risk of injury posed by CSUs; however, we received no proposals for any such standard modification or development.

Alternatives Considered

In developing the draft proposed rule, CPSC staff considered several alternatives to the rule. These included:

- No regulatory action
- Develop a stability rating standard for CSUs
- Mandate a more rigorous standard (draft proposed rule, but addressing 60-pound children, instead of 51.2-pound children)
- Mandate ASTM F2057 but with a 60-pound test weight
- Longer effective date

No Regulatory Action. If the Commission opted to take no regulatory action, there may nonetheless be a decline in the number of deaths and injuries from tip-over incidents involving CSUs with CRT televisions. As the number of CRT televisions in use continue to decline, the incidents, and associated deaths and injuries, involving these televisions should also decline.

Staff notes that although there was a statistically significant decline in the number of overall CSU tip-over injuries to children in recent data, there was not a decrease in the number of tip-over injuries to children involving CSUs without televisions.

The efforts of the Commission to encourage families with small children to anchor their furniture to the wall through the Anchor It! educational campaign could also reduce the number of deaths and injuries. However, there are many barriers to consumers anchoring their furniture, and historically the rates of anchoring have been low. Other after-market means of increasing the stability of furniture could also be explored and encouraged.

Given the fact that a high percentage of CSUs already comply with the stability requirements in the voluntary standard, efforts to make the voluntary standard more stringent have not been successful, and in spite of efforts to encourage households with children to anchor their furniture the rate of anchoring remains low, non-regulatory approaches are unlikely to significantly reduce the risk of injury from CSU tip overs.

Develop a Stability Rating Standard for CSUs. This alternative would include a test method to assess the stability of a specific CSU model, from which a stability rating would be calculated for that model, and require that rating to be provided for each CSU on a hang tag. A description of such a requirement along with background on the use of similar requirements at other agencies is provided in Tab E. A stability rating would give consumers information on the stability of the specific models that they were considering purchasing, which they could consider in their purchase decisions. A stability rating system could also give manufacturers an incentive to achieve a higher stability rating to increase their competitiveness or increase their appeal to consumers that desired CSUs that were less likely to tip-over. The hang tag could also note that consumers should not rely just on the stability ranking, and note other steps to provide stability, such as anchoring.

More than any of the regulatory options considered, including the requirements of the draft proposed rule, this option would directly address the market failure of limited information. This option would provide consumers with information allowing those who want to purchase more stable CSUs to do so while those who did not believe the additional stability was worth the additional cost could still opt for furniture with lower stability ratings. However, this would not address the risk to children who might be exposed to the CSU tip-over hazard outside their homes, or to CSUs purchased before the child's birth. The long service life of CSUs and the unpredictability of visitors or family changes in that timespan and these potential future risks might not be considered at the time of the original purchase.

Because this alternative would not establish a minimum safety standard, it would not require that manufacturers drop or modify any CSUs. Therefore, the only direct cost of this alternative would be the cost to manufacturers for testing their CSUs to establish their stability rating and labeling their CSUs in accordance with the required information. Any changes in the design of the CSUs that result from this alternative would be the result of manufacturers responding to changes in consumer demand for particular models in response to the new information on the stability of particular models.

However, while the costs of a stability rating system and labeling requirement would be significantly lower than the draft proposed rule and there is evidence that similar rating systems have resulted in improvements in product safety, we are unable to estimate the extent to which the stability information would affect consumer purchases or reduce CSU tip-over incidents. We do not know the extent to which consumers would demand and manufacturers offer CSUs with the higher ratings. And if the more stable options are more expensive, as is likely, consumers might not purchase them. Because it is not clear that this alternative would result in an acceptable reduction in deaths and injuries, staff does not recommend this alternative. Nevertheless, staff does see merit in such a rating system to compare the stability of the units and recommends it as one element of the draft proposed rule.

Mandate a More Rigorous Standard (Draft Proposed Rule, But Addressing 60-Pound Children, Instead of 51.2-Pound Children). The Commission could consider proposing a rule with more rigorous requirements, such as one that would protect 60-pound children rather than 51.2-pound children. About 74 percent of CSU tip-over injuries involving children occur to children ages 4 years and younger,28 and these are already addressed by the draft proposed rule, because the 95th percentile weight for 4-year-old children is approximately 52 pounds. However, the draft proposed rule would also address some of the injuries to children who are 5 and 6 years old, as well, because many of these children also weigh less than 51.2 pounds. Mandating a rule that would protect 60-pound children would increase the benefit associated with reducing fatal and nonfatal injuries to children by about $10.9 million and could increase the benefit associated with adult fatal and nonfatal injuries by $3.2 million or a total of $14.1 million annually. This comes to about 3 cents per unit on an annual basis. Over an assumed 15-year life of a CSU, this comes to 7 cents per unit assuming a 7 percent discount rate, 36 cents assuming a 3 percent discount rate, or 45 cents without discounting. Therefore, increasing the weight of the child protected to 60 pounds would only increase benefits by about 4.5 percent over the benefits that could be obtained by the draft proposed rule. Presumably, the cost of manufacturing furniture that complies with this more rigorous alternative would be somewhat higher than the costs of manufacturing CSUs that complied with the draft proposed rule, using similar, but somewhat more extensive, modifications that would be used to comply with the requirement of the draft proposed rule. Because this alternative would provide only a limited increase in benefits, but a higher level of costs than the draft proposed rule, staff does not recommend this alternative.

Mandate ASTM F2057 but with a 60-Pound Test Weight. Another alternative would be to mandate a standard like ASTM F2057 – 19, but replace the 50-pound test weight with a 60-

[28] Based on the NEISS estimates for the period 2015 through 2019

pound test weight. As discussed in the ANPR, 60 pounds better represents the 95th percentile weight of 5-year-old children, which is the age ASTM F2057 – 19 claims to address. However, a 60-pound test weight does not equate to protecting a 60-pound child because, as the UMTRI child climbing study demonstrates, children generate forces greater than their weight during certain interactions with a CSU.

This alternative would be less costly than the draft proposed rule because, based on CPSC testing (Tab N), about 57 percent of CSUs on the market would already meet this requirement. The cost of modifying those that do not is likely to be less than modifying them to comply with the draft proposed rule, which is more stringent.

By increasing the test weight, it is possible that this alternative would prevent some CSU tip overs. However, this alternative still would not account for the horizontal and dynamic forces of a child climbing on a CSU, or account for the effect of multiple open and filled drawers, or carpet. Because this alternative does not account for the horizontal and dynamic forces of a child climbing or for the effects of carpeting or filled, open drawers, its effectiveness at reducing tip overs is diminished. Although the test weight of 60 pounds is approximately equal to the 95^{th} percentile weight of a 5-year-old child, it does not represent the moment generated by a child of that weight while climbing or pulling on a CSU; nor does it account for multiple full and open drawers or carpeting. As such, it probably would only protect children that weigh around 38 pounds or less, which is approximately the 75^{th} percentile weight of a 3-year-old child. For this reason, staff does not believe that this alternative would adequately address the hazard. Therefore, staff does not recommend this alternative.

Longer Effective Date. As discussed in Section VIII of this memorandum, the draft proposed rule includes an effective date of 180 days after the final rule is published in the *Federal Register*. That would give manufacturers approximately 6 months to understand the requirements, redesign all of their CSUs to comply with the requirements, and begin manufacturing CSUs that meet the requirements. Given that hundreds of manufacturers, including importers, will have to modify probably several thousand models, it could be challenging for many firms to meet the 180-day effective date. This could cause a disruption in the supply of CSUs, or result in fewer choices being offered to consumers, at least in the short term. In order to reduce the costs or mitigate any disruption, CPSC staff considered recommending a longer effective date. However, delaying the effective date would delay realizing the potential benefits. Therefore, CPSC staff is not recommending an effective date longer than 180 days. However, staff does solicit comments regarding the reasonableness of the 180-day effective date and recommendations for a different effective date, if justified. Comments recommending a longer effective date should clearly describe the problems associated with meeting the shorter effective date and the justification for a longer one.

Initial Regulatory Flexibility Analysis (see Tab I)

Why the Commission is Considering this Rule

The intent of this rulemaking is to reduce deaths and injuries resulting from CSUs tipping over on children. These tip-over incidents commonly result when young children attempt to climb on the CSU or open drawers; the weight and interaction of the child combined with the weight of any open drawers causes the CSU to tip forward and fall on the child. Children can be killed or injured from the impact of the CSU falling on them or by being trapped beneath the CSU, restricting their ability to breathe. The Commission is considering this mandatory rule because the two stability requirements in ASTM F2057 – 19 do not adequately address the risk. The voluntary standard differs from the draft proposed rule in that each drawer is tested one at a time with a test weight, the tests are always conducted while the drawers are empty, the test is conducted on a flat surface rather than angled (to simulate carpet), and the voluntary standard does not account for the horizontal and dynamic forces that a child would impart on a CSU while ascending it. Staff concluded that, by not accounting for these factors, ASTM F2057 – 19 does not adequately protect young children.

Objectives and Legal Basis of the Draft Proposed Rule

The objective of the draft proposed rule is to reduce deaths and injuries resulting from tip-over incidents involving CSUs. The Commission published an ANPR in November 2017, which initiated this proceeding to evaluate regulatory options and potentially develop a mandatory standard to address the risks of CSU tip-over deaths and injuries. The draft proposed rule would be issued under the authority of the CPSA.

Small Entities to Which the Draft Proposed Rule Would Apply

The draft proposed rule would apply to small entities that manufacture or import CSUs. Manufacturers of CSUs are principally classified in the North American Industrial Classification (NAICS) category 337122 (non-upholstered wood household furniture manufacturing), but may also be categorized in NAICS codes 337121 (upholstered household furniture manufacturing), 337124 (metal household furniture manufacturing), or 337125 (household furniture (except wood and metal) manufacturing). According to data from the U.S. Census Bureau, in 2017 there were a total of 3,404 firms classified in these four furniture categories. More than 99 percent of the firms primarily categorized as manufacturers of non-upholstered wood furniture would be considered to be small businesses, as were 97 percent of firms in the other furniture categories, according to the U.S. Small Business Administration (SBA) size standards (Small Business Administration, 2016).

Firms that import furniture would likely be impacted by any rule that the Commission might promulgate regulating CSUs because they would have to ensure that any products that they import meet the requirements of the rule. Under the NAICS classification system, importers are classified as either wholesalers or retailers. Furniture wholesalers are classified in NAICS category 423210 (Furniture Merchant Wholesalers). According to the Census Bureau data, in 2017, there were 5,117 firms involved in household furniture importation and distribution. Furniture retailers are classified in NAICS category 442110 (Furniture Stores). A total of 4,920 of these (or 96 percent) are classified as small businesses because they employ fewer than 100 employees (which is the SBA size standard for NAICS category 423210).

Furniture retailers are classified in NAICS category 442110 (Furniture Stores). According to the Census Bureau, there were 13,826 furniture retailers in 2017. The SBA considers furniture retailers to be small businesses if their gross revenue is less than $22 million. Using these criteria, at least 97 percent of the furniture retailers are small (based on revenue data from the 2012 Economic Census of the United States).

Reporting and Recordkeeping Requirements

Section III of this memorandum provides the recommended requirements for the draft proposed rule. Section 14 of the CPSA requires manufacturers, importers, or private labelers of a consumer product subject to a consumer product safety rule to certify, based on a test of each product or a reasonable testing program, that the product complies with all rules, bans or standards applicable to the product. The draft proposed rule specifies the test procedure to use to determine whether a CSU complies with the requirements. For products that manufacturers certify, manufacturers would issue a general certificate of conformity (GCC). In the case of CSUs that could be considered to be children's products, the certification must be based on testing by an accredited third-party conformity assessment body.

The requirements for the GCC are stated in Section 14 of the CPSA. Among other requirements, each certificate must identify the manufacturer or private labeler issuing the certificate and any third party conformity assessment body on whose testing the certificate depends, the date and place of manufacture, the date and place where the product was tested, each party's name, full mailing address, telephone number, and contact information for the individual responsible for maintaining records of test results. The certificates must be in English. The certificates must be furnished to each distributor or retailer of the product and to the CPSC, if requested.

Costs of Draft Proposed Rule That Would Be Incurred by Small Manufacturers

The most likely product modifications manufacturers will use to comply with the proposed stability requirements are: 1. the addition of drawer interlock systems, which would only enable children (and other consumers) to open a limited number of drawers at a time; 2. adding a counterweight to the CSU; 3. extending the front legs or edge (that is, the fulcrum); 4. reducing the distance that drawers may be extended; and 5. increasing the height of the front legs to tilt the CSU backwards. It is likely that most CSUs would require a combination of these modifications to comply with the draft proposed standard. Based on staff analysis, the estimated costs to manufacturers for product modifications that would improve CSU stability to comply with the draft proposed rule could range from the same range as the estimated benefits per unit, to over $25. Firms may choose other methods or different combinations resulting in lower or higher costs to comply; the cost estimates are not comprehensive and costs could be underestimated. In addition to costs of product modifications, any reductions in utility that might be caused by modifications such as reductions in the drawer extensions or significantly higher weights have not been quantified, nor have any aesthetic costs or the possibility of a tripping hazard that might result from the addition of significant foot extensions. Some models could require such substantial modifications that they no longer have the characteristics of the original models and manufacturers might withdraw them from the market.

If products have to be completely redesigned to meet the draft standard the changes could add substantial costs. One supplier contacted by Industrial Economics Corporation (IEc) on behalf of the CPSC estimated the cost of redesigning a CSU model as $18,000 (Industrial Economics, Inc., (2019). Costs of model redesign per unit produced would be greater for smaller manufacturers with lower production volumes. For smaller, lower volume producers, the per unit costs of the components necessary to modify their CSUs might also be higher than those for higher volume producers.

Manufacturers would likely incur some additional costs to certify that their CSUs meet the requirements of the draft proposed rule as required by Section 14 of the CPSA. The certification must be based on a test of each product or a reasonable testing program. The costs of the testing might be minimal, especially for small manufacturers that currently conduct testing for conformance to the current voluntary standard, ASTM F2057 – 19. Importers may also rely upon testing completed by other parties, such as their foreign suppliers, if those tests provide sufficient information for the manufacturers or importers to certify that the CSUs comply with the draft proposed rule.

Small manufacturers and importers will also incur added costs of required warning labels and hang tags with comparative tip ratings. Manufacturers currently using permanent warning labels in conformance with ASTM F2057 – 19 should not face significant incremental costs for the replacement labels specified by the draft mandatory rule. The required hang tags showing tip ratings for each CSU would involve some incremental costs, although likely to be minor in relation to other product modifications required for compliance. The testing costs needed to generate the tip ratings will be incurred to comply with the performance testing of the draft proposed rule.

Impact on Small Businesses

Generally, staff considers impacts that exceed one percent of a firm's revenue to be potentially significant. Because the estimated average cost per CSU could be between about 5 percent and

25 percent of the average revenue per unit for CSUs, staff believes that the draft proposed rule could have a significant impact on a substantial number of small manufacturers and importers that receive a significant portion of their revenue from the sale of CSUs.

For many small importers, the impact of the draft proposed rule would be expected to be similar to the impact on small domestic manufacturers. One would expect that the foreign suppliers would pass much of the costs of redesigning and manufacturing CSUs that comply with the draft proposed rule to their domestic distributors. Therefore, the cost increases experienced by small importers would be similar to those experienced by small manufacturers.

Small importers will be responsible for issuing a GCC certifying that their CSUs comply with the draft proposed rule should it become final. However, importers may rely upon testing performed and GCCs issued by their suppliers in complying with this requirement. In the case of CSUs that could be considered to be children's products, the certification must be based on testing by an accredited third-party conformity assessment body, which may involve additional costs.

Federal Rules Which May Duplicate, Overlap or Conflict with The Draft Proposed Rule

Staff has not identified any Federal rules that duplicate or conflict with the draft proposed rule.

Alternatives Considered to Reduce the Burden on Small Entities

As discussed in the Preliminary Regulatory Analysis section of this memorandum, CPSC staff examined several alternatives to the draft proposed rule which could reduce the impact on small entities. These include: (1) less stringent stability requirements; (2) alternative compliance dates; (3) informational measures, and; (4) taking no action.

V. RECALLS (TAB J)

From January 1, 2000 through March 31, 2021, there were 40 consumer-level recalls conducted in response to tip-over and entrapment hazards of CSUs involving 34 different firms. The recalled products were responsible for 328 tip-over incidents, including reports of 149 injuries and 12 fatalities.[29] The 12 fatal incidents all involved children 3 years old or younger and most likely occurred when the CSU tipped over as a result of a child climbing, getting inside drawers, or opening the drawers.[30] The recalls affected approximately 21,500,000 CSUs in total.

[29] The remaining incidents did not result in injury, or did not indicate whether an injury occurred.

[30] Eleven of the 12 fatal incidents involving recalled products are in the data set analyzed for this briefing package (all involving children and CSUs without televisions); the remaining fatal incident occurred in 1989, so is outside the period analyzed in this briefing package.

VI. COMMENTS ON THE ANPR (TAB K)

Following the publication of the ANPR, the Commission received comments from a total of 18 people or entities, as well as several late-filed comments. Tab K includes a summary of those comments and staff's responses to them. In general, comments fell into one or more of the following topic areas: general support or opposition, the voluntary standard, hazard communication (*e.g.,* warnings and public awareness), scope and definitions, test parameters (including test weight as it relates to child age and weight), anchors, televisions, incidents/risk, costs and small business impacts, compliance with the voluntary standard, technical feasibility, and stories of loss.

VII. REQUEST FOR COMMENTS

Staff recommends requesting comments on the following items:

Child Interactions and Associated Forces

- Whether the test method should account for pull forces on the CSU, and the assumptions of pull force and force application location. Specifically, is the 17.2 pound-force horizontal force applied at maximum 4.12 feet vertical distance appropriate to simulate a child pulling a drawer or pulling on a unit?
- Assumptions relating to children's interactions with doors and associated forces. Specifically, should interaction of opening doors and climbing on doors be addressed? If so, is the proposed requirement adequate?

Tip Restraints

- Whether there should be a requirement that all CSUs come with a tip restraint and/or TV restraint device to anchor a TV to the CSU such as a universal attachment point.
- Tip restraints, including their adequacy and improvement suggestions on the tip restraint requirements outlined in ASTM F3096 – 14 and ASTM F2057 – 19.
- Potential test methods related to tip restraints. Specifically, staff requests comment on whether the requirements should address designs where tip restraint installation is mandatory to unlock drawers; and whether the Commission should develop tip restraint requirements such as restraints permanently attached to the CSU or an attachment point such as a D-ring that will not fail when pulled at a specified force.

Drawer and Pull-Out Shelf Fill

- Whether the fill amounts for drawers and pull-out shelves at 8.5 pound per cubic foot are reasonable and/or should be revised. In particular, should pullout shelves should be tested with the same storage density as drawers, or would a lower fill weight for pull-out drawers be appropriate (*e.g.*, 4.25 pound per cubic foot)?

Marking and Labeling

- Whether the draft proposed warning requirements are adequate, or should be modified. Specifically, staff requests suggestions to the language or format of the warning label and suggestions to the language or format of the informational label.
- Whether the graphical symbols currently being studied as well as the symbols included in the ASTM F2057 – 19 are appropriate, effective, and understandable.
- The recommended size, content, symbols, format, location, and permanency of marking and labeling.
- Whether there should there be a warning on CSUs to anchor the TV, when the CSU is suitable for holding a TV.
- Whether labeling and/or instructions for proper levelling on carpet should be a requirement, especially for CSUs with levelers to tilt the unit backwards on carpet.
- Whether the product and packaging should contain a label that states: "meets CPSC stability requirements."

Hang Tag

- All aspects of the draft proposed hang tag. In particular, staff requests comment on potential rating calculations, as well as suggestions for other ratings and comments with improvements in the graphic quality, while maintaining the iconic, symbol characteristics; whether the hang tag rating and explanatory text is understandable; suggestions to the language or format of the hang tag; and graphic artist improvements to the hang tag icon, that maintain symbolic, iconic representation of a tip-over event.

Scope

- The scope of the standard, and the listed exclusions, including whether the excluded products should be included, or whether certain products should be excluded.
- Whether the scope of the proposed rule should include CSUs under 27 inches, and/or all CSUs, regardless of height.

- Whether lower weight units, including lightweight plastic units, should be excluded from the scope of the rule, and if so, the safety justification for doing so, and what the weight threshold should be and why.
- Whether all freestanding items marketed and/or advertised as suitable for clothing storage should be included in the scope of the standard, even if they would otherwise be excluded based on their design.
- Whether nightstands with drawers and/or doors should be included in the scope and what design features and safety considerations distinguish nightstands from CSUs.
- Design features that distinguish non-CSU cabinets from door chests and other similar CSUs.

Performance Requirements

- The stability requirements, and whether they are adequate, or should be modified. In particular, whether the moment requirements should be increased (e.g., the same stability requirements as in draft proposed rule, but with 60-pound child interaction, instead of lower weight/younger child reflected in draft proposed rule, or simulating more aggressive behavior) or decreased (e.g., using different force/moment values to simulate climbing).
- The proposed test methods. In particular, comments on the following:
    - Whether a 1.5° forward tilt adequately replicates the effects of a CSU resting on carpet;
    - Whether an inclined surface test should be added to account for sloped floors;
    - Whether ANSI/BIFMA SOHO S6.5-2008 (R2013), Small Office Home Furniture-Tests requirements for interlocks are appropriate to consider for CSU interlocks, or what different requirements to consider and why;
    - Whether the 30-pound draft proposed performance requirement is adequate to assess that the drawer interlock design cannot be easily defeated or over ridden by the consumer;
    - Whether drawer interlocks should be subject to a performance requirement to ensure designs cannot be easily defeated or over ridden by the consumer;
    - Whether labeling and/or instructions for proper leveling on carpet should be a requirement;
    - Whether levelling devices should be non-adjustable to account for carpeting;
    - Whether levelling devices should be allowed to be adjusted per the manufacturer instructions during stability testing;
    - Whether levelling devices should include preset heights to account for carpeting;
    - Whether levelling devices should require a permanent adjustment mark that indicates the position recommended for use on a carpeted surface;

- Whether the criteria to measure the maximum tip-over load should be the rear of the CSU lifting off at least ¼ inch off the test surface;
- Whether the Commission should develop tip restraint requirements such as restraints permanently attached to the CSU or an attachment point such as a D-ring that will not fail when pulled at a specified force;
- Whether interlocks for ready-to-assemble furniture should be pre-assembled and/or automatically engage;
- How to test interlock systems that have an override, such as two drawers opened simultaneously, and how to determine whether children can engage an override, and associated test methods;
- Whether interlocks on other extendible elements besides drawers should be considered (e.g., doors, shelves);
- Whether and how to test automatically closing drawers; and
- Whether any alternative test method(s) should be considered.

- The definitions, including whether any definitions should be modified, or any additional terms should be defined;
- The performance criteria in the draft proposed rule, specifically whether all three of the comparison tip-over moments should be included in the standard, whether any should not be included, or whether any additional forces or interactions should be included.

Economic Analysis

- Items related to the economic analysis. In particular, on the following:
    - The types and magnitude of manufacturing costs that might disproportionately impact small businesses or were not considered in this analysis;
    - The costs of the testing and certification requirements, warning label, and hang tag of the draft proposed rule;
    - The different impacts on small businesses associated with different effective dates;
    - The differential impacts of the draft proposed rule on small manufacturers or suppliers that compete in different segments of the CSU market;
    - Other alternatives that would minimize the impact on small businesses but would still reduce the risk of CSU tip-over incidents;
    - The accuracy or reasonableness of the costs estimates for manufacturers and importers; If available, sales or other shipment data would be helpful;
    - The annual unit sales of CSUs;
    - The cost of the certification testing, warning labels, certificates of conformity, and hang tag and whether the additional cost would be significant;
    - The cost and other impacts of adding weight to the rear of the CSU to meet the requirements of the draft proposed rule;

  - The practicality and costs of using levelers or other means of raising the front of a CSU as one option for meeting the requirements of the draft proposed rule;
  - The suggested modifications in the economic analysis and their estimated costs, and other potential options for modifying or manufacturing CSUs to meet the requirements of the draft proposed rule;
  - Other methods or ways that the designs of CSUs could be modified to comply with the requirements of the draft proposed rule, including the potential cost of the modifications and other impacts on the CSUs or their utility. CPSC staff is particularly interested in ways that the cost of the modifications could be offset by making other changes in the design of the CSUs or the manufacturing processes used; and
  - The sensitivity analysis and any other valuations used in this analysis.
- The reasonableness of the 180-day effective date and recommendations for a different effective date, if justified. Comments recommending a longer effective date should clearly describe the problems associated with meeting the shorter effective date and the justification for a longer one.

VIII. STAFF RECOMMENDATION

Incident data suggest that children ages 1, 2, and 3 years old are the most at risk for death and severe injury. CPSC staff analysis identified the following factors as being present in many CSU tip-over incidents and as contributing to instability: child climbing, opening multiple drawers, filled drawers, and carpet. Staff's recommended rule accounts for those factors when assessing the stability of a CSU. CPSC staff assessed that improving the inherent stability of CSUs is an effective strategy for reducing deaths and injuries associated with CSU tip over. Technical analysis shows that CPSC staff's recommended requirements will reduce CSU deaths and injuries by reducing the occurrence of CSU tip overs.

Staff concludes that the current voluntary standards for CSU stability are not likely to eliminate or adequately reduce the risk of injury associated with tip overs because the performance requirements neither consider horizontal and dynamic forces from a child climbing on a CSU or pulling drawers nor additional factors such as filled drawers and carpet that negatively impact the stability of a CSU. Staff continues to work with ASTM, but to date, ASTM has not revised the standard as staff considers necessary to adequately address the risk.

CPSC staff recommends that the Commission publish an NPR for CSUs that includes specific requirements on stability, marking and labeling, and hang tags. These requirements are stated in the draft NPR. Additionally, CPSC staff recommends that the Commission propose an effective date of 180 days after publication of the final rule for manufacturers to comply with the stability requirements.

Stockpiling Provision

The draft proposed rule would also prohibit any person from manufacturing or importing noncomplying CSUs in any period of 12 consecutive months between the date of promulgation of the final rule and the effective date, at a rate that is greater than 120 percent of the rate at which they manufactured or imported CSUs during the base period for the manufacturer. The base period is any period of 365 consecutive days, chosen by the manufacturer or importer, in the 5-year period immediately preceding promulgation of the rule. Thus, the stockpiling limit would allow manufacturers and the industry to meet any foreseeable increase in the demand for CSUs, without allowing large quantities of CSUs to be stockpiled.

Effective Date

The draft proposed rule includes an effective date of 180 days after the final rule is published in the Federal Register. This is longest effective date permitted under the CPSA unless the Commission, for good cause, determines that a longer date is necessary. However, because staff is not aware of any CSUs currently on the market that meet the proposed requirements and because some CSUs may require more extensive redesign to meet the proposed requirements, staff assesses that it may be appropriate to consider a longer effective date, such as a year, instead and requests comments on the effective date.

REFERENCES

ASTM F2057 – 19 (2019). Standard Safety Specification for Clothing Storage Units, ASTM International, West Conshohocken, PA, 2019, www.astm.org.

ANSI/SOHO S6.5-2008 (R2013). Small Office/Home Office Furniture – Tests American National Standard for Office Furnishings.

AS/NZS 4935:2009 (2009). The Australian/New Zealand Standard for Domestic furniture – Freestanding chests of drawers, wardrobes and bookshelves/bookcases – determination of stability.

Bayley, N. (1969). Bayley Scales of Infant Development. New York, NY, USA: The Psychological Corporation.

EN 14749 (2016). the European Standard, European Standard for Domestic and kitchen storage units and worktops – Safety requirements and test methods.

Frost, J.L., Wortham, S., & Reifel, S. (2001). Play and Child Development. Upper Saddle River, NJ: Prentice-Hall.

Hughes, F.P. (1991). *Children, Play, and Development*. Boston: Allyn & Bacon.

Industrial Economics, Inc. (2019). Memorandum to Charles Smith, et. al. Consumer Product Safety Commission, Directorate for Economic Analysis, "Final Clothing Storage Units (CSUs) Cost Impact Analysis."

ISO 7171 (2019). the International Organization for Standardization International Standard for Furniture – Storage Units – Determination of stability.

Sanborn, M. (2017). Analysis of Voluntary Standards for Clothing Storage Units. In Staff Briefing Package Advance Notice of Proposed Rulemaking: Clothing Storage Units. Available at: https://www.cpsc.gov/s3fs-public/ANPR%20-%20Clothing%20Storage%20Unit%20Tip%20Overs%20-%20November%2015%202017.pdf?5IsEEdW_Cb3ULO3TUGJiHEl875Adhvsg.

Therrell, J.A., Brown, P., Sutterby, J.A., Thirnton, C.D., (2002). Age Determination Guidelines: Relating Children's Ages to Toy Characteristics and Play Behavior. T. P. Smith (Ed.), Bethesda, MD: U.S. Consumer Product Safety Commission.

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TAB A: Reported Clothing Storage Unit (CSU) Tip-Over-Related Fatalities, Nonfatal Incidents and Injuries, and ED-Treated Injuries

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United States
Consumer Product Safety Commission
4330 East West Highway
Bethesda, Maryland 20814

Memorandum

DATE: July 14, 2021

TO: Kristen Talcott, Ph.D., Furniture Tip-Over Project Manager
Division of Human Factors, Directorate for Engineering Sciences

THROUGH: Stephen Hanway, Associate Executive Director
Directorate for Epidemiology

Risana Chowdhury, Division Director
Directorate for Epidemiology, Division of Hazard Analysis

FROM: Adam Suchy, Mathematical Statistician
Directorate for Epidemiology, Division of Hazard Analysis

SUBJECT: Reported Clothing Storage Unit (CSU) Tip-Over-Related Fatalities, Nonfatal Incidents and Injuries, and ED-Treated Injuries

INTRODUCTION

This memorandum characterizes the number of reported fatalities, the number of reported nonfatal incidents and injuries, and the national injury estimates based on National Electronic Injury Surveillance System[1] (NEISS) emergency department-treated (ED-treated) injury reports, associated with instability or tip overs involving clothing storage units (CSUs) received by CPSC staff. For the reported fatalities and the injury estimates in this memorandum, the information presented is primarily based on CPSC's Directorate for Epidemiology, Division of Hazard Analysis (EPHA) annual reports on furniture instability or tip overs[2] (annual reports); for the

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[1] Data from the NEISS is based on a nationally representative probability sample of about 100 hospitals in the United States and its territories. NEISS data can be accessed from the CPSC webpage under the "Access NEISS" link at: https://www.cpsc.gov/Research--Statistics/NEISS-Injury-Data.
[2] Suchy, Adam, "Product Instability or Tip-Over Injuries and Fatalities Associated with Televisions, Furniture, and Appliances: 2020 Report" January 2021, U.S. Consumer Product Safety Commission. Suchy, Adam, "Product Instability or Tip-Over Injuries and Fatalities Associated with Televisions, Furniture, and Appliances: 2018 Report" October 2018, U.S. Consumer Product Safety Commission. Staff relied primarily on the 2020 and 2018 annual reports, rather than the 2019 report, because the 2018 and 2020 reports covered the same years as the 2019 report, plus additional years. The 2018 annual report covered 2006-2017; the 2019 annual report covered 2009-2018; and the 2020 annual report covered 2010-2019. Therefore, the 2018 and 2020 annual reports provided the longest range of information, covering earlier and later years, rather than the 2019 report. These annual reports are available at: https://www.cpsc.gov/Research-Statistics/furniture-decor/tipovers. There was one child CSU tip-over death involving a television and a dresser that is among the fatalities in this memorandum; however, this incident is not in

reported nonfatal incidents, staff extracted and analyzed additional data from the Consumer Product Safety Risk Management System[3] (CPSRMS).

For this memorandum, staff considered the following products to be CSUs: armoires; chests, bureaus, and dressers (CBDs); and wardrobes, as well as similar products that do not belong to these categories but have closed storage that may be reasonably expected to be used for storing clothing.[4] Similar storage products that staff did not consider CSUs for this analysis are: cabinets, coat racks, desks, file cabinets, lockers (that are not "clothes lockers"), safes, shelves, stands, tables, and vanities. We provide more detail below about staff's criteria for inclusion.

The data in this memorandum include incidents that involved product instability in CSUs and CSU tip overs. Product instability incidents are a broader category that includes tip-over incidents, but may also include incidents where CSUs did not fully tip over. Product instability can lead to a tip-over incident and can be caused or affected by an unstable product design (*e.g.*, small foot print, top heavy); use on a sloped or unstable surface (*e.g.*, carpet); non-use of a tip-over restraint device, or use of a defective tip-over restraint device; heavy objects on top of the unit; and/or multiple open drawers. Tip-over incidents are a subset of product instability incidents, and they involve CSUs falling over. Tip-over incidents can be the result of an individual interacting with the product (*e.g.*, climbing or exerting a force on the CSU) while it is in one of its positions of normal use. For this memorandum, staff included instability incidents with indications of impending tip over, as well as actual tip-over incidents because, even if a CSU does not tip over in these instability incidents, it has the potential to do so.[5]

Although staff included incidents with victims of all ages for this analysis, most of the fatality and injury victims are children 17 years of age and younger.

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death counts in any annual report, due to the incident being under investigation for child neglect when reported; and there has been no additional information about this incident.

[3] CPSRMS is the epidemiological database that houses all anecdotal reports of incidents received by CPSC, "external cause"-based death certificates purchased by CPSC, all in-depth investigations of these anecdotal reports, as well as investigations of select NEISS injuries. Examples of documents in CPSRMS include: hotline reports, Internet reports, news reports, medical examiner's reports, death certificates, retailer/manufacturer reports, and documents sent by state/local authorities, among others.

[4] Other clothes storage products include portable clothes lockers and portable closets.

[5] The included instability or tip-over incidents generally use such words to describe the incident: fall/fell on/over, tilted/tipped forward, tilted/tipped over, began to tip, tipped, and unstable/wobbly with additional indications of an impending fall. Excluded incidents include such words to describe the incident: break, collapse, fell apart, flimsy, shaky, unstable, or wobbly with no additional indications of a CSU tipping or falling.

INCIDENT DATA[6]

Table 1 shows the different databases and corresponding time frames staff searched for the incident data in this memorandum. The different time frames for the data sets in this memorandum resulted from the various dates these data sets became available and because staff updated already-existing information sources.[7]

Table 1. Databases and Corresponding Time Frames Included[8]

Data Components	Start Incident or Death Date	End Incident or Death Date	Database(s) Searched
Reported Fatalities	January 1, 2000	December 31, 2020	CPSRMS and NEISS
Reported Nonfatal Incidents	January 1, 2005	December 31, 2020	CPSRMS
NEISS ED-Treated Injuries	January 1, 2006	December 31, 2019	NEISS

Source: CPSRMS and NEISS databases
Reporting is ongoing for CPSRMS; the years 2018–2020 are considered incomplete.

Reported Fatalities and NEISS ED-Treated Injuries

EPHA staff publishes annual reports on furniture instability or tip overs. These reports are based on data from CPSRMS and NEISS. To compile the list of reported fatalities in this memorandum, staff started by using the fatalities in the 2020 annual report, which were reported to have occurred between January 1, 2000 and December 31, 2019, and were reported to CPSC by July 1, 2020. Staff then searched for any additional fatalities that were not included in the 2020 annual report, but were reported to have occurred by December 31, 2020, and were

[6] Incidents presented in this memorandum represent a minimum for the number of incidents or fatalities that have occurred during the given time frames.
[7] In this memorandum, different time frames are presented for NEISS, CPSRMS, fatal, and nonfatal data because of the time frames in which staff collected, received, retrieved, and analyzed these data. For example, data for this memorandum were drawn from previous annual reports and other data-collection reports and then updated to include more recent data; these previous reports used different start dates for the different data sources. Similarly, CPSRMS data are available on an ongoing basis, whereas NEISS data are not available until several months after the end of the previous calendar year. Consequently, staff used different date ranges for these data sources.
[8] Deaths and nonfatal incident reports submitted to CPSC come from reports entered into CPSC's CPSRMS and NEISS databases no later than 12/31/2020.

reported to CPSC by December 31, 2020.[9] The NEISS emergency department (ED)-treated injuries presented in this memorandum are a combination of those reported in the 2020 annual report (for injuries that occurred between January 1, 2010 and December 31, 2019), and those reported in the 2018 annual report (for injuries that occurred between January 1, 2006 and December 31, 2009).[10]

For the annual reports, staff initially extracted fatal incident reports and NEISS injury cases using a list of 39 product codes[11] with no other restrictions on the extraction criteria. Staff then reviewed each record to determine whether a tip-over or instability incident had occurred. This memorandum focuses on a subset of data from the annual reports, using the five product codes that include CSUs and related products: desks, chests, bureaus, or buffets (604), other furniture (4013), furniture, not specified (4014), cabinets, racks, room dividers, and shelves (4056), and tables (excl. baby changing tables, billiard tables, or pool tables) (4057). Staff reviewed the narratives to determine which incidents involved a CSU; staff considered the following to be CSUs: a chest, bureau, dresser (CBD); wardrobe; armoire; portable storage closet; or clothes locker.[12]

It is important to note that data collection is ongoing for CPSRMS, so CPSC may receive additional reports for the period covered in this memorandum in the future.[13] Additionally, as an incident is investigated and new information becomes available, or as other associated reports come in, the initial information is either corroborated or contradicted. If new information contradicts initial information, this may cause the reported fatality numbers to change.

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[9] In the 2020 annual report, there were no CSU deaths reported to have occurred in 2020, and there were no additional 2020 CSU deaths reported to CPSC by December 31, 2020. There are three CSU-related tip-over deaths in this memorandum that did not appear in the 2020 annual report; two due to being received after July 1, 2020; and one due to being under investigation for child neglect.

[10] The estimated ED-treated injuries for years 2010–2019 are from the 2020 annual report, and estimated ED-treated injuries for years 2006–2009 are from the 2018 annual report. Note that NEISS data for a calendar year is not completed and available until the spring of the following year, which is why staff's national injury estimates in this memorandum do not include 2020.

[11] To search for tip-over incidents for the annual reports, staff extracted and reviewed for inclusion all data coded under these 39 product codes: 101, 102, 106, 107, 126, 127, 135, 140, 259, 260, 263, 264, 266, 267, 273, 276, 278, 279, 280, 281, 482, 519, 557, 572, 604, 693, 709, 1260, 1269, 1684, 1726, 1821, 3233, 4013, 4014, 4056, 4057, 4065, 4067. With the exception of incidents occurring in U.S. military bases, all incidents that occurred outside of the United States have been excluded. To prevent any double-counting, when multiple reports of the same incident were identified, they were consolidated and counted as one incident.

[12] For fatalities, staff relied on all available information, including descriptions of the product and pictures, when available, to determine if a product was a CSU. For NEISS incidents without an additional follow-up investigation, staff relied on the name of the product and any description of the product in the incident narrative to determine whether the product was a CSU.

[13] For reported deaths, data from 3 or more years ago are generally considered complete. As of the data-extraction date for this memorandum, reported deaths from years 2017 and earlier are considered complete, and for years 2018 through 2020, reporting is considered ongoing, and new deaths may be reported during these years.

Among other features, CPSRMS houses all in-depth investigation reports of the anecdotal[14] reports that CPSC receives, as well as the follow-up investigations of select NEISS injuries. As such, it is possible for a NEISS injury case to be included in the national injury estimate, while its investigation report is counted among the anecdotal nonfatal incidents. There were 311 such injury cases presented in this memorandum. Additionally, there were four NEISS injury victims who died while receiving treatment between January 1, 2006 and December 31, 2019; these four deaths appear in the fatality and the NEISS injury estimate sections of this memorandum.

Reported Nonfatal Incidents

To search for nonfatal CSU incident reports, EPI staff extracted data for the five product codes mentioned earlier (604, 4013, 4014, 4056, and 4057) from the CPSRMS, with no other restrictions on the extraction criteria. Thereafter, staff reviewed every record to determine whether a tip-over or instability incident had occurred, and whether the involved product met the criteria for a CSU. Staff limited the data to nonfatal incidents that occurred between January 1, 2005 and December 31, 2020.[15] As with the fatality reports, the nonfatal reports from the CPSRMS are also anecdotal in nature and provide a minimum count for the number of nonfatal incidents that occurred.

Some incidents reported a CSU tipping over with no specific mention of a victim being injured during the incident. Other incidents reported injuries to more than one person during a single incident. Staff first analyzes the reported nonfatal CSU tip-over cases for the number of incidents reported, and then among those incidents, further analyzes the number of victim injuries reported. For example, a tip-over incident that results in injuries to two people is counted as one tip-over incident in the incident analysis, but it is counted as two injuries in the injury analysis of the reported nonfatal incident section.

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[14] CPSC staff considers CSPRMS reports to be anecdotal because, unlike NEISS data, they cannot be used to identify statistical estimates or year-to-year trend analysis, and because incident reports CPSC receives in CPSRMS can range in hazard severity, including incidents with only the potential to cause injury. Although these anecdotal data do not provide for statistical analyses, they often provide rich data with important information to identify hazard patterns, as well as provide a minimum count of certain injuries and deaths.
[15] Nonfatal incident reports submitted to CPSC come from reports entered into CPSC's CPSRMS database. These also include completed NEISS injury investigations.

RESULTS

Fatalities

CPSC staff is aware of 193 reported CSU tip-over or instability fatalities to children ages 17 years and younger,[16] 11 reported fatalities to adults ages 18 through 64 years, and 22 reported fatalities to seniors ages 65 years and older that were reported to have occurred between January 1, 2000 and December 31, 2020.[17] Of the 193 reported CSU tip-over child fatalities, 89 (46 percent) did not involve a television; and of the 33 reported adult and senior fatalities, 32 (97 percent) did not involve a television. Of the 193 reported child fatalities, 190 (98 percent) involved a CBD; and of the 33 adult and senior fatalities, 29 involved a CBD. Table 2 summarizes the number of reported CSU tip-over and instability fatalities by age group, CSU furniture type, and television involvement. Unlike NEISS data, reported fatality counts are anecdotal and cannot be used to identify statistical estimates or year-to-year trend analysis.

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[16] Fatalities is the number of deaths from CSU instability or tip over incidents. Of the 193 reported fatalities, there was one tip-over incident that resulted in two deaths; the number of fatal incidents is 192.

[17]Consistent with common practice, adults age 65 and older are considered seniors for this memorandum. In the annual reports, "adults" are defined as being between 18 and 59 years old, and "seniors" are defined as being 60 years and older. There were four reported CSU tip-over and instability deaths to victims between ages 60 and 64 years old; so those four deaths are classified as seniors in the annual reports, but classified as adults in this memorandum.

Table 2. CSU Instability or Tip-Over Fatalities Reported by Age Group, CSU Furniture Type, and Television Involvement: January 1, 2000–December 31, 2020

Product(s) Involved	**Reported Fatalities (Column %)**			
	Children (0 to 17 years)	**Adults (18 through 64 years)**	**Seniors (65 years and older)**	**All Ages**
Only Furniture Fell	**89 (46%)**	**10 (91%)**	**22 (100%)**	**121 (54%)**
Chest, Bureau, or Dresser (CBD)	*87 (45%)*	*9 (82%)*	*19 (86%)*	***115 (51%)***
Wardrobe	*2 (1%)*	*1 (9%)*	*1 (5%)*	***4 (2%)***
Armoire	–	–	*1 (5%)*	***1 (<1%)***
Portable Storage Closet	–	–	*1 (5%)*	***1 (<1%)***
Clothes Locker	–	–	–	**–**
Television Also Fell	**104 (54%)**	**1 (9%)**	**–**	**105 (46%)**
Chest, Bureau, or Dresser (CBD)/Television	*103 (53%)*	*1 (9%)*	–	***104 (46%)***
Armoire/Television	*1 (1%)*	–	–	***1 (<1%)***
Total Reported Fatalities	**193 (100%)**	**11 (100%)**	**22 (100%)**	**226 (100%)**

Source: CPSRMS and NEISS databases
Reporting is ongoing for CPSRMS; the years 2018–2020 are considered incomplete.

Figure 1 shows the number of reported CSU tip-over and instability fatalities, by year, to adults and seniors, and to children, by television involvement.[18] When considering fatalities by year, other than 2010, there have been at least three reported CSU tip-over fatalities to children without a television involved, each year, for the years 2001–2017. Similarly, there has been at least one CSU tip-over death to an adult or senior, without a television involved, in each year, with the exception of 2006, between 2000 and 2017.

[18] Figure 1 displays the combined incidents per year for adults/seniors, rather than showing separate adult/senior incidents by television involvement, because only one adult/senior fatality involved a television during the time frame shown (see Table 2). The television-related adult/senior death occurred in 2017.

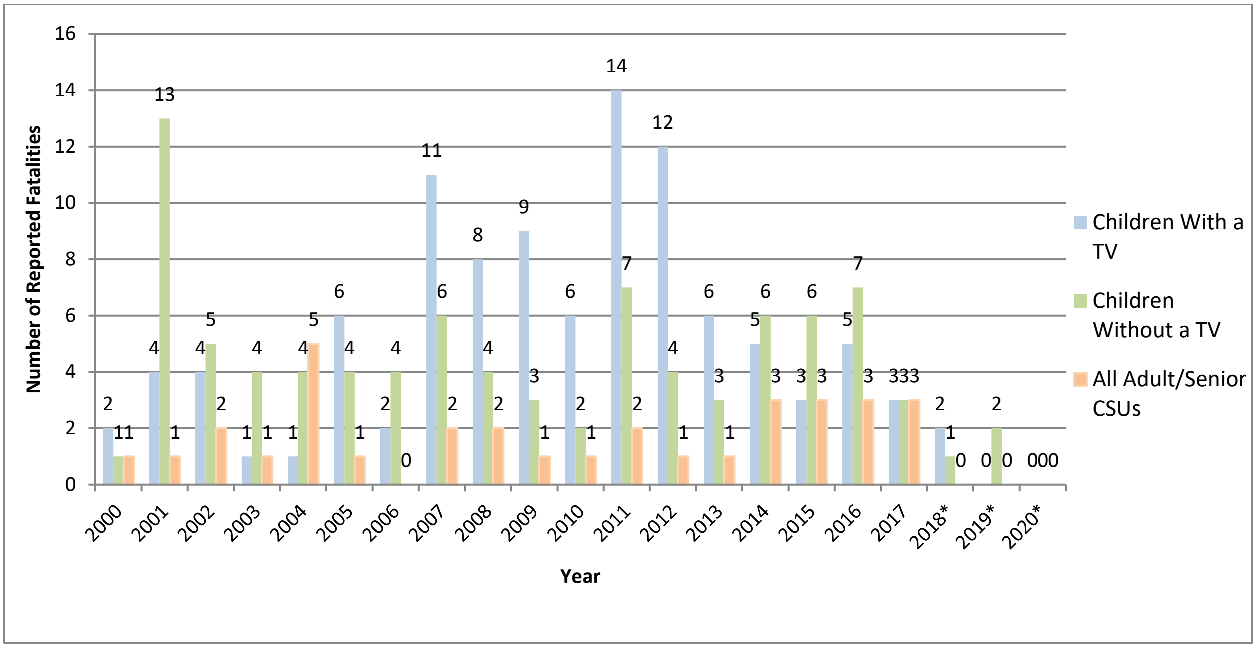

Figure 1. CSU instability or tip-over fatalities reported by year, age group, and television involvement: January 1, 2000–December 31, 2020.

Source: CPSRMS and NEISS databases.
Reporting is ongoing for CPSRMS; the years 2018–2020 are considered incomplete.
Asterisks (*) indicate that staff considers the data set to be incomplete because of ongoing reporting.

The majority of the reported instability or tip over fatalities involving a CSU happen to children. Table 3 presents the number of reported CSU tip-over and instability fatalities to children by age and television involvement, and the cumulative percent of child fatalities of a certain age or younger for the respective groups. Regardless of television involvement, the most reported CSU tip-over fatalities happened among children ages 1-year-old and 2-years-old, followed by 3-year-olds. Among the 89 child fatalities involving CSUs without televisions, 91 percent (81 out of 89 children) happened to children between 1 and 3 years old. Among children 4 years and older, a television was more frequently involved than not involved.

Table 3. Children (Under 18 Years) CSU Instability or Tip-Over Fatalities Reported by Age and Television Involvement: January 1, 2000–December 31, 2020

Age (in years)	**Reported Child Fatalities**			
	Involving Only a CSU	**Cumulative % (Up to and Including this Age) Involving Only a CSU**	**Involving a CSU and a Television**	**Cumulative % (Up to and Including this Age) Involving a CSU and a Television**
0	3	3%	4	4%
1	30	37%	28	31%
2	30	71%	32	62%
3	21	94%	18	79%
4	2	97%	10	88%
5	1	98%	6	94%
6	1	99%	3	97%
7	1	100%	0	97%
8	0	100%	3	100%
>=9	0	100%	0	100%
Total Reported Fatalities	**89**		**104**	

Source: CPSRMS and NEISS databases
Reporting is ongoing for CPSRMS; the years 2018–2020 are considered incomplete.

Figure 2 presents the number of reported CSU tip-over and instability fatalities to children with the area of the body most likely impacted resulting in the fatality and the television's involvement. Reported CSU tip-over fatalities not involving a television were much more likely to be caused by torso injuries; whereas, fatalities to children involving a television were much more likely to be caused by head injuries. Sixty-five percent (58 out of 89 deaths) of reported fatalities to children not involving a television resulted from torso injuries; only 6 percent (6 out of 104 deaths) of reported CSU tip-over fatalities to children involving a television arose from torso injuries. Eighty-eight percent (91 out of 104 deaths) of reported CSU tip-over fatalities to children involving a television resulted from injuries to the head; only 13 percent (12 out of 89 deaths) of reported fatalities to children not involving a television resulted from injuries to the head.

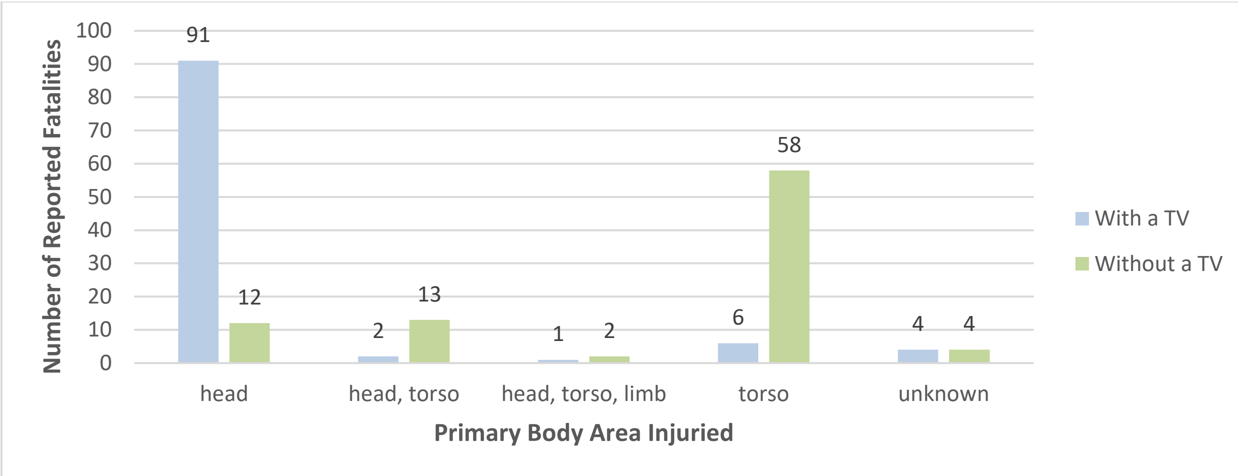

Figure 2. Children CSU instability or tip-over fatalities reported by primary body area injured and television involvement: January 1, 2000–December 31, 2020.

Source: CPSRMS and NEISS databases.
Reporting is ongoing for CPSRMS; the years 2018–2020 are considered incomplete.

Reported Nonfatal Incidents

CPSC staff identified 1,002 reported nonfatal CSU tip-over and instability incidents (for all ages[19]) that were reported to have occurred between January 1, 2005 and December 31, 2020.[20] Table 4 summarizes the reported nonfatal CSU tip-over incidents by CSU furniture type, television involvement, and whether the incident was an investigation initiated from a NEISS case, or an incident was reported by any other data source.[21] Of the 1,002 reported nonfatal CSU tip-over incidents, 64 percent (639 incidents) did not involve a television, and 99.5 percent (997 incidents) involved a chest, bureau, or dresser.

[19] No age breakdown was done for nonfatal incidents, because in many incidents, there was no injury reported.
[20] Nonfatal incident reports submitted to CPSC come from reports entered into CPSC's CPSRMS database no later than 12/31/2020, and includes completed NEISS investigations. All of the investigation reports based on NEISS injuries that occurred from 2006 through 2020 appear in the reported nonfatal incidents. The original NEISS ED-treated injuries from 2006 through 2019 are used for derivation of national estimates in this memorandum. There were two injuries reported in five of the NEISS investigated incidents. Three investigation reports of NEISS injuries from 2020 were also included in this section.
[21] Other data sources include hotline reports, Internet reports, news reports, retailer/manufacturer reports, and documents sent by state/local authorities, among others.

Table 4. Reported Nonfatal CSU Instability or Tip-Over Incidents for All Ages by Data Source, CSU Furniture Type, and Television Involvement: January 1, 2005–December 31, 2020

	Reported Nonfatal Incidents (Column %)		
Product(s) Involved	**NEISS Investigated Incidents**	**All Other Reports**	**All Reported Nonfatal Incidents**
Only Furniture Fell	**3 (1%)**	**636 (92%)**	**639 (64%)**
Chest, Bureau, or Dresser (CBD)	*3 (1%)*	*631 (91%)*	***634 (63%)***
Armoire	–	*4 (1%)*	***4 (<1%)***
Wardrobe	–	*1 (<1%)*	***1 (<1%)***
Clothes Locker	–	–	–
Portable Storage Closet	–	–	–
Television Also Fell	**306 (99%)**	**57 (8%)**	**363 (36%)**
Chest, Bureau, or Dresser (CBD)/Television	*306 (99%)*	*57 (8%)*	***363 (36%)***
Total Reported Nonfatal Incidents	**309 (100%)**	**693 (100%)**	**1,002 (100%)**

Source: CPSRMS database
Reporting is ongoing for CPSRMS; the years 2018–2020 are considered incomplete.

Table 5 presents the number of reported nonfatal CSU tip-over and instability incidents by year and television involvement. CPSC staff received more reports of nonfatal incidents between 2016 and 2018, perhaps due to increased public awareness from publication of recall notices.[22] Among the 380 reported nonfatal CSU tip-over and instability incidents with no television involved that occurred between 2016 and 2018, 80 percent (305 reports) were reported solely by manufacturers or retailers.

[22] The largest CSU recalls occurred in 2016 and 2017, and at least 70 percent of the nonfatal incidents that were reported to have occurred in each year, 2016 and 2017, involved those recalled CSUs, which may account for the increase in nonfatal incidents reported to have occurred in those two years. It is also possible that the CPSC Anchor It! campaign had some effect on this increase in reported nonfatal incidents since the education campaign began shortly before the increase, in early 2015.

Table 5. Reported Nonfatal CSU Instability or Tip-Over Incidents for All Ages by Year and Television Involvement: January 1, 2005–December 31, 2020

Year	Reported Nonfatal Incidents		
	Involving Only a CSU	Involving a CSU and a Television	All Reported Nonfatal Incidents
2005	12	0	**12**
2006	7	1	**8**
2007	5	1	**6**
2008	7	2	**9**
2009	11	44	**55**
2010	19	55	**74**
2011	22	48	**70**
2012	29	58	**87**
2013	31	47	**78**
2014	39	30	**69**
2015	40	26	**66**
2016	232	24	**256**
2017	87	14	**101**
2018*	61	7	**68**
2019*	22	4	**26**
2020*	15	2	**17**
Total Reported Nonfatal Incidents	**639**	**363**	**1,002**

Source: CPSRMS database
Reporting is ongoing for CPSRMS; the years 2018–2020 are considered incomplete.
Asterisks (*) indicate that staff considers the data set to be incomplete because of ongoing reporting.

Of the 1,002 nonfatal CSU tip-over and instability incidents reported, 362 incidents did not mention any specific injuries; 628 incidents reported one injury; and 12 incidents reported two injuries, resulting in a total of 652 injuries reported among all of the reported nonfatal incidents.

Table 6 presents the severity of the reported nonfatal CSU tip-over and instability injuries in the following categories: NEISS-investigated injuries, which includes 311 incidents involving a television, and three incidents not involving a television[23]; reported injuries from sources other than NEISS investigations involving only a CSU tipping over; and reported injuries from sources other than NEISS investigations involving a CSU and a television tipping over. Excluding the investigated NEISS injuries, in the past 16 years (between 2005 and 2020), there were 290 reported injuries as a result of a CSU tipping over with no television involved; and there were 48 reported injuries as a result of a CSU and a television tipping over. There were only two

[23] Among the three NEISS investigated ED-treated injuries not involving a television, two were to children 2 years old, and one was to a 6-year-old child.

reported CSU tip-over injuries not to a child that involved a television; those two incidents involved hospitalization of a 46-year-old, and a 96-year-old with the level of care not known.

Table 6. Reported Nonfatal CSU Instability or Tip-Over Injuries for All Ages by Data Source, Injury Severity, and Television Involvement: January 1, 2005–December 31, 2020

	Reported Nonfatal Injuries (Column %)			
Injury Severity	**All NEISS Investigations with and without Televisions Involved**	**Non-NEISS Involving Only a CSU**	**Non-NEISS Involving a CSU and a Television**	**All Reported Nonfatal Injuries**
Hospital Admission	39 (12%)	6 (2%)	19 (40%)	**64 (10%)**
Emergency Department Treatment Received	272 (87%)	21 (7%)	3 (6%)	**296 (45%)**
Seen by Medical Professional	–	27 (9%)	1 (2%)	**28 (4%)**
Injury, Level of care not known[24]	3 (1%)	236 (81%)	25 (52%)	**264 (40%)**
Total Reported Nonfatal Injuries	**314 (100%)**	**290 (100%)**	**48 (100%)**	**652 (100%)**

Source: CPSRMS database
Reporting is ongoing for CPSRMS; the years 2018–2020 are considered incomplete.

Table 7 presents the 293 reports of nonfatal, CSU tip-over or instability injuries with no television involved listed according to injury severity for all ages with age group breakdowns as follows: 3 years and younger (71 injuries), 4 to 5 years (32 injuries), 6 to 17 years (30 injuries), children with an unknown age (34 injuries), victims with an unknown age (96 injuries), and adults ages 18 years and older (30 injuries). Excluding the 96 injuries to victims in the unknown age category, of the 197 reported injuries involving only a CSU, where the age group of the victim is known, 167 injuries (85 percent) are known to be children. Of the victims with known ages, there were more injuries suffered by children 3 years old and younger, than to older victims; and the injuries suffered by these young children tended to be more severe, compared to older children and adults/seniors.

[24] Injuries classified as *Injury, level of care not known* include: bruising, bumps on the head, cuts, lacerations, scratches, application of first-aid, or other indications of at least a minor injury that occurred, without any mention of aid rendered by a medical professional. There were three NEISS cases in which the victim was taken to the emergency department, but then left without being seen.

Table 7. Reported Nonfatal CSU-Only Instability or Tip-Over Injuries by Age Group and Injury Severity: January 1, 2005–December 31, 2020

	Reported Nonfatal Injuries						
Injury Severity	**3 Years Old and Younger[25]**	**4-5 Years Old**	**6-17 Years Old**	**Children w/ an Unknown Age[26]**	**Unknown Age**	**Adults[27]**	**ALL AGES**
Hospital Admission	5	0	0	1	0	1	**7**
Emergency Department Treatment Received	8	4	4	6	1	0	**23**
Seen by Medical Professional	7	4	4	4	6	2	**27**
Injury, Level of care not known	51	24	22	23	89	27	**236**
Total Reported Nonfatal Injuries	**71**	**32**	**30**	**34**	**96**	**30**	**293**

Source: CPSRMS database
Reporting is ongoing for CPSRMS; the years 2018–2020 are considered incomplete.

ED-Treated National Injury Estimates[28]

According to the NEISS, there were an estimated total of 78,200 injuries (sample size = 2,629, coefficient of variation = .0667), an annual average of 5,600 estimated injuries, related to CSU instability or tip-over incidents for all ages that were treated in U.S. hospital EDs from January 1, 2006 to December 31, 2019. Of the estimated 78,200 CSU instability or tip-over ED-treated injuries, 56,400 (72 percent of all ages) were to children, which is an annual average of 4,000 estimated injuries to children over the 14-year period. Of all CSU instability or tip-over ED-

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[25] There was one child who was hospitalized and referred to as a "toddler," so this injury has been categorized in the "3 years and younger" age group.
[26] Of the children whose ages were unknown, staff categorized them as children because the victim was known to be a sibling of a small child or referred to as a "child," "daughter," or "son."
[27] In reports with no reported age of the injured person, if the respondent was the injured victim, then staff assumed that the victim was an adult, 18 years or older, and these injuries can be found in the "Adults" category.
[28] The estimates are rounded to the nearest hundred. Estimates may not sum to total, due to rounding; and asterisks (*) indicate that data were insufficient to support reliable statistical estimates. NEISS estimates are reportable, provided the sample count is greater than 20, the national estimate is 1,200 or greater, and the coefficient of variation (CV) is less than 0.33.

treated injuries to all ages, 93 percent were treated and released, and 4 percent were hospitalized. Among children only, 93 percent were treated and released, while 3 percent were hospitalized.

Table 8 below summarizes the estimated number of CSU instability or tip-over ED-treated injuries to children ages 17 years and younger, and to adults ages 18 years and older,[29] by CSU furniture type, and television involvement. Of the estimated number of CSU instability or tip-over, ED-treated injuries sustained by all ages, 98 percent of the CSUs were a CBD, and 79 percent of all injuries did not involve a television. Of the estimated number of CSU instability or tip-over, ED-treated injuries to children, 72 percent did not involve a television, and 96 percent of adult injuries did not involve a television.

Table 8. Estimated Number of CSU Instability or Tip-Over ED-Treated Injuries by Age Group, CSU Furniture Type, and Television Involvement: January 1, 2006–December 31, 2019

Product(s) Involved	**Estimated Number of ED-Treated Injuries (Column %)**		
	Children	**Adults**	**All Ages**
Only Furniture Fell	**40,700 (72%)**	**21,000 (96%)**	**61,700 (79%)**
Chest, Bureau, or Dresser (CBD)	*40,200 (71%)*	*20,400 (93%)*	*60,600 (77%)*
Armoire	*	*	*
Armoire or Dresser (unknown which)	*	*	*
Portable Closet/Large Clothes Locker	*	*	*
Wardrobe	*	*	*
Television Also Fell	**15,700 (28%)**	*	**16,500 (21%)**
Chest, Bureau, or Dresser (CBD)/Television	*15,600 (28%)*	*	*16,400 (21%)*
Armoire/Television	*	*	*
Total Estimated Number of Injuries	**56,400 (100%)**	**21,800 (100%)**	**78,200 (100%)**

Source: NEISS database
Data that were insufficient to support reliable statistical estimates are presented as "".*
Estimates are rounded to the nearest hundred and may not add up to the total, due to rounding.

Figure 3 presents the estimated number of CSU instability or tip-over ED-treated injuries by age group and year, and includes all incidents with and without a television involved. The estimated number of CSU tip-over, ED-treated injuries to children ranges from about 2,500 to 5,900 for each year from 2006 to 2019. The estimated annual number of CSU tip-over, ED-treated injuries to adults ages 18 years and older is fairly consistent over most of the 14-year period, with an

[29] Of the 21,800 estimated number of ED-treated CSU tip-over injuries to adults, about 3,200 (15 percent) injuries were to seniors ages 65 years and older.

overall yearly average of 1,600 injuries, of which 96 percent of the injuries did not involve a television.

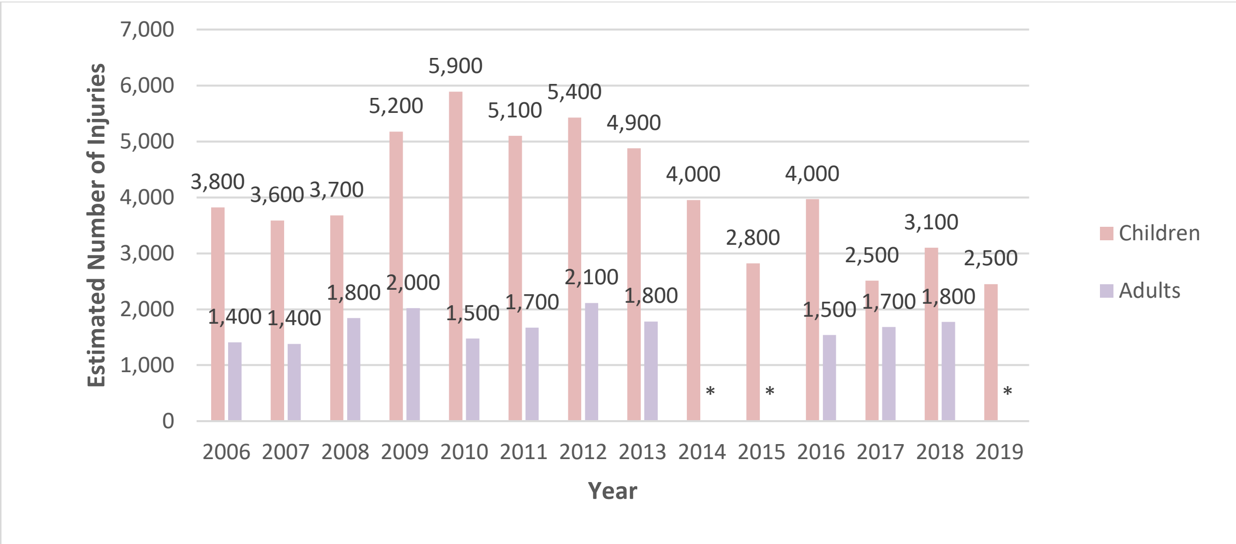

Figure 3. Estimated number of CSU instability or tip-over ED-treated injuries by age group and year: January 1, 2006–December 31, 2019.

Source: NEISS database
Data that were insufficient to support reliable statistical estimates are presented as "".*
Estimates are rounded to the nearest hundred and may not add up to the total, due to rounding.

Since the majority of the estimated number of ED-treated instability or tip over injuries involving CSUs are to children, children will be the focus of the rest of the NEISS injury section of this memorandum. For 2010 through 2019, there is a statistically significant linear decline in child injuries involving all CSUs (including televisions), as seen in Figure 3. However, as seen in Figure 4, there is no linear trend detected in injuries to children involving CSU-only tip overs.

Figure 4 presents the estimated number of CSU instability or tip-over ED-treated injuries to children by year and television involvement. Every year from 2006 through 2019, there have been more estimated CSU instability or tip-over ED-treated injuries to children not involving a television, compared to incidents involving a television. Over the 14-year period, there has been an estimated annual average of 2,900 CSU instability or tip-over ED-treated injuries to children with no television involved. There were not enough CSU instability or tip-over ED-treated incidents to children involving both a CSU and a television to make reliable estimates for the most recent 5 years, 2015 through 2019.

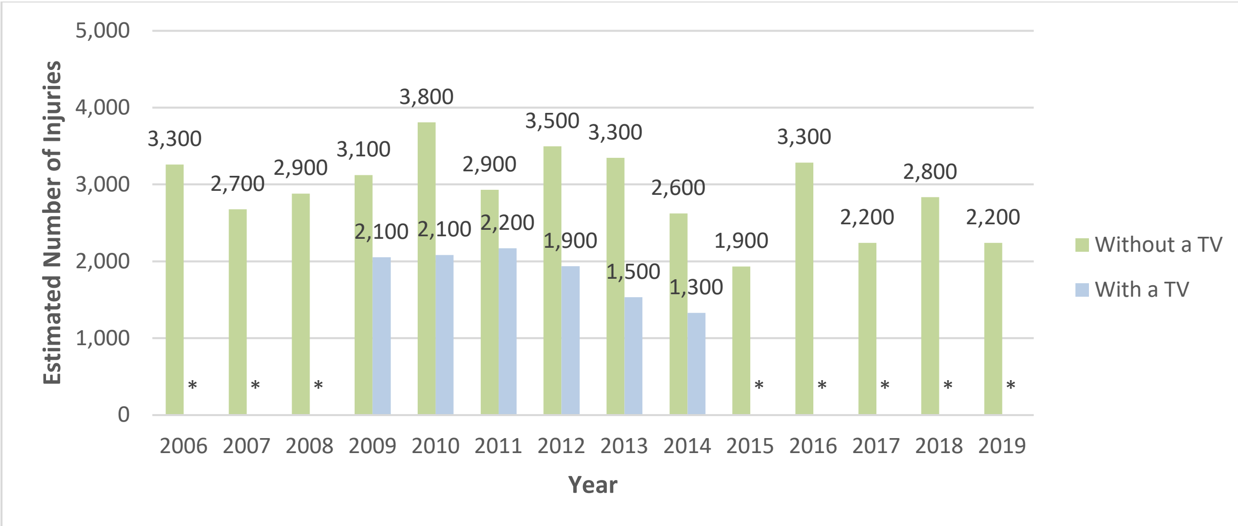

Figure 4. Estimated number of child CSU instability or tip-over ED-treated injuries by year and television involvement: January 1, 2006–December 31, 2019.

Source: NEISS database
Data that were insufficient to support reliable statistical estimates are presented as "".*
Estimates are rounded to the nearest hundred and may not add up to the total, due to rounding.

Figure 5 shows the estimated number of CSU instability or tip-over ED-treated injuries to children by age and television involvement. Children 2 years old suffer the most ED-treated CSU injuries, followed by 3-year-olds, and then 1-year-olds and 4-year-olds. Over the 14-year period, out of all children injuries, an estimated 76 percent (31,100 injuries) of the CSU tip-over ED-treated injuries not involving a television and an estimated 78 percent (12,200 injuries) of ED-treated injuries involving a television were to 1-, 2-, 3-, and 4-year-old children. Children ages 7–17 years old were grouped together because there were not enough reportable CSU tip-over, ED-treated injuries for any single age in that range.

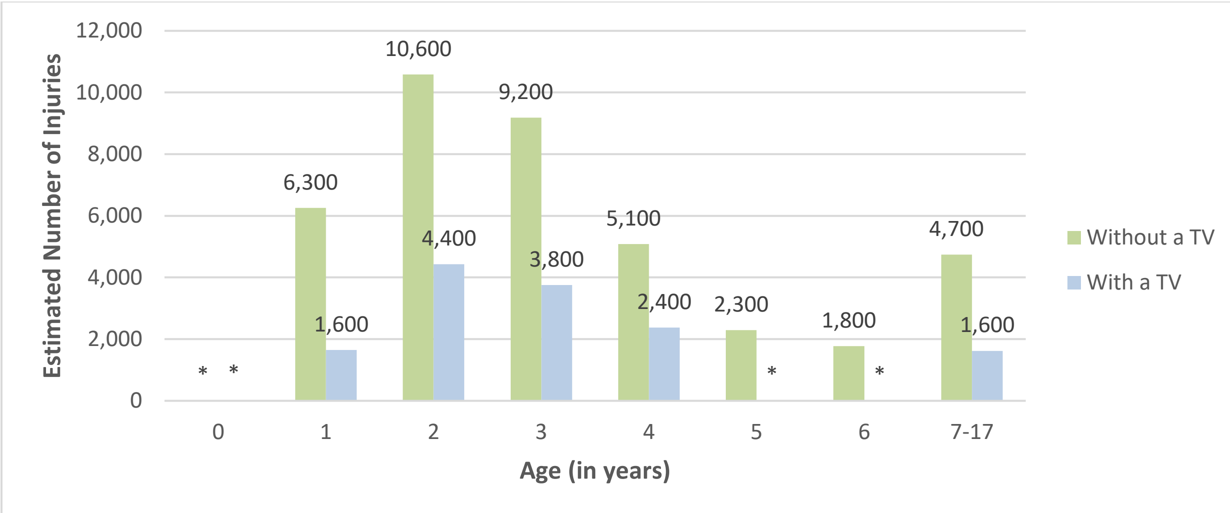

Figure 5. Number of child CSU instability or tip-over ED-treated injuries by age and television involvement: January 1, 2006–December 31, 2019.

Source: NEISS database
Data that were insufficient to support reliable statistical estimates are presented as "".*
Estimates are rounded to the nearest hundred and may not add up to the total, due to rounding.

Table 9 shows the estimated number of CSU instability or tip-over ED-treated injuries to children by injury type and television involvement. Among the estimated injuries to children involving a television, 37 percent were internal organ injuries (including closed head injuries); when no television was involved, that proportion dropped to 22 percent.

Table 9. Estimated Number of Child (Under 18 Years) CSU Instability or Tip-Over ED-Treated Injuries by Injury Type and Television Involvement: January 1, 2006–December 31, 2019

Diagnosis	**Estimated Number of ED-Treated Children Injuries**			
	CSU-Only	**% of CSU-Only**	**CSU and TV Involved**	**% of CSU and TV Involved**
Contusion/Abrasion	15,800	39%	5,000	32%
Internal Organ Injury (includes closed head injuries)	9,100	22%	5,800	37%
Laceration	6,200	15%	1,400	9%
Fracture	3,600	9%	1,600	10%
All Other Diagnoses	5,900	15%	1,900	12%
Total Estimated Number of Injuries	**40,700**	**100%**	**15,700**	**100%**

Source: NEISS database
Estimates are rounded to the nearest hundred and may not add up to the total, due to rounding.

Table 10 shows the estimated number of CSU instability or tip-over ED-treated injuries to children by body part injured and television involvement. The injuries to children were more likely to be head injuries when a television was involved than when no television was involved. Of the estimated number of CSU instability or tip-over ED-treated injuries to children involving a television, 73 percent were head injuries, compared to 55 percent of injuries not involving a television. Of the estimated injuries to children not involving a television, 20 percent were leg, foot, or toe injuries, and 14 percent were trunk or torso injuries.

Table 10. Estimated Number of Child CSU Instability or Tip-Over ED-Treated Injuries by Body Part Injured and Television Involvement: January 1, 2006–December 31, 2019

Body Part Injured	Estimated Number of ED-Treated Children Injuries			
	CSU-Only	% of CSU-Only	CSU and Television Involved	% of CSU and Television Involved
Head, Neck, Face	22,200	55%	11,500	73%
Leg, Foot, Toe	8,200	20%	2,100	13%
Trunk, Torso	5,600	14%	*	*
Arm, Hand, Finger	3,800	9%	*	*
All Other Body Parts	*	*	*	*
Total Estimated Number of Injuries	**40,700**	**100%**	**15,700**	**100%**

Source: NEISS database
Data that were insufficient to support reliable statistical estimates are presented as "".*
Estimates are rounded to the nearest hundred and may not add up to the total, due to rounding.

SUMMARY CONCLUSIONS

Of Reported CSU Instability or Tip-Over Incidents for All Ages:

- Children made up 74 percent of reported fatalities not involving a television, and 99 percent of reported fatalities involving a television.
- Children made up 66 percent of the estimated number of ED-treated injuries not involving a television, and 95 percent of estimated injuries involving a television.

Of Reported CSU Instability or Tip-Over Incidents to Children:

- In 98 percent of reported fatalities, and in 99 percent of the estimated number of ED-treated injuries, a CBD was the type of CSU involved.
- For 2010 through 2019, there is a statistically significant linear decline in child injuries involving all CSUs (including televisions); however, there is no linear trend detected in injuries to children involving CSU-only tip overs.
- For each year, between 2001 through 2017, there have been at least three reported fatalities with no television involved; 2010 was the only exception, with fewer such fatalities.

- Ninety-four percent of reported fatalities and 66 percent of ED-treated injuries to children involving only a CSU, and 79 percent of fatalities and 63 percent of ED-treated injuries to children involving both a CSU and a television happened to children ages 3 years and younger.
- Of fatalities not involving televisions, 65 percent resulted from injuries to the torso, and 13 percent resulted from injuries to the head.
- Of the estimated number of ED-treated injuries not involving televisions, 14 percent were injuries to the torso, and 55 percent were head injuries.
- Of incidents involving televisions, 88 percent of reported fatalities, and 73 percent of the estimated number of ED-treated injuries resulted from head injuries.

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TAB B: Health Sciences Staff Review of Fatal and Nonfatal Incidents Associated with Clothing Storage Unit Tip Overs Involving Children

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

Memorandum

DATE: July 14, 2021

TO: Kristen Talcott, Ph.D., Furniture Tip-Over Project Manager
Division of Human Factors, Directorate for Engineering Sciences

THROUGH: Mary Kelleher, Associate Executive Director
Directorate for Health Sciences

FROM: Suad Wanna-Nakamura, Ph.D., Physiologist
Division of Pharmacology and Physiology
Directorate for Health Sciences

SUBJECT: Health Sciences Staff Review of Fatal and Nonfatal Incidents Associated with Clothing Storage Unit Tip Overs Involving Children

INTRODUCTION

This memorandum provides Health Sciences (HS) staff's review of the mechanism and types of injuries or deaths associated with clothing storage unit (CSU) tip-over hazards. This memorandum focuses on cases associated with CSUs tipping onto children because CSU tip-over incidents predominantly involve children (see Tab A).

DISCUSSION

Television Involvement

In this memorandum, HS staff focuses on injuries involving CSUs without televisions. However, staff provides limited analysis of incidents involving CSUs with televisions to provide perspective on the mechanism for death and injury, because there is a different injury pattern than there is for incidents involving CSUs without televisions. Incidents involving CSUs with heavy cathode ray tube (CRT) televisions are more likely to involve head injury, which can cause immediate death. Therefore, even if the incident is witnessed and the child is rescued quickly, the child may still die from his/her injuries. By contrast, incidents involving CSUs without televisions are more likely to involve neck or chest compression. Therefore, for incidents involving CSUs without televisions, there may be opportunity to rescue a child and reduce the risk of injury or death associated with the incident.

However, in recent years, there has been a decline in the overall number of CSU tip-over incidents that appears to be driven by a decrease in child injuries involving the tip over of CSUs with televisions (see Tab A). This is likely due to the phasing-out of CRT technologies for televisions (Smith, 2010 and Lee and Volanth, 2015). For this reason, the draft proposed rule does not focus on television involvement.

Deaths and Injuries

Fatal Incidents Overview

The Division of Hazard Analysis[1] staff identified 226 fatalities[2] associated with CSU tip-over incidents (both with and without televisions, and including all ages) between January 1, 2000 and December 31, 2020. Of the reported 226 fatalities, there were 193 deaths of children under 18 years of age, 11 deaths to adults ages 18 through 64 years, and 22 fatalities of seniors ages 65 years and older. Of the 193 child deaths, 89 involved CSUs without televisions, and 104 involved CSUs with televisions. The age range of the children involved in fatal incidents was 3 months to 8 years (the 3-month-old was close to the CSU when a sibling caused the CSU to tip over). Regardless of television involvement, the most reported fatalities were children 1 year old and 2 years old, followed by 3 years old. HS staff reviewed all incident data, source documents, medical examiner autopsy reports, police report death certificates and other information attached to the incidents.

Fatal Incidents Involving Children and CSUs Without Televisions

Of the 89 fatal tip-over incidents involving children and CSUs without televisions, 84 (94 percent) involved children 3 years old and younger. Most of the fatalities (58 fatalities, 65 percent) were reported to be due to chest compression; 12 fatalities (13 percent) were due to head injuries, 13 deaths (15 percent) were due to injury to both the child's head and torso; and two (2 percent) involved a child's head, torso, and limb pinned under the CSU. The type of injury was not reported in four of the 89 incidents.

Weight and Height of Children in Fatal Incidents Involving CSUs Without Televisions

Among the 89 fatal tip-over incidents compiled in Consumer Product Safety Risk Management System (CPSRMS) and involving children and CSUs without televisions, the weights of 49 (55 percent) children were reported, ranging from 18 pounds to 45 pounds (8-20 kg). Where weight was not reported in the CPSRMS incidents, staff used the most recent CDC (Centers for Disease

[1] See Tab A.

[2] Fatality counts should be considered incomplete for years 2018-2020, due to a time lapse in reporting to CPSC.

Control and Prevention) Anthropometric Reference to estimate the weight of children.[3] Staff used the 50th percentile values of weight that correspond to the reported age to estimate the weight range of those children. The estimated weight range was determined to be between 19.6 pounds and 45.1 pounds (9-21 kg) (Tab C). Although the recorded height of the children was incomplete and reported in only 50 (56 percent) of the fatal incidents, the range recorded was from 24 inches to 46 inches (61 cm to 117 cm). The CSU heights were reported in 49 of the child fatality incidents, with a range of 27.5 inches to 84 inches (70 cm to 213 cm).

Incidents Involving Children and CSUs with Televisions

In a review of the 104 child fatalities that involved tip overs of a CSU and television, 100 (96 percent) included information about the type of injury, and four did not. Of the 104 child fatalities involving a CSU and television, 91 fatalities (88 percent) were due to blunt head trauma; similar injury patterns have been reported in the medical literature. Chest compression resulting from a child being pinned under the CSU was listed as the cause of death in six of the remaining incidents involving televisions; and three reported multiple areas of the body as the primary areas injured (the chest and head and another part of the body were listed).

Of the 104 child fatalities involving a CSU and television tipping over, 85 (90 percent) involved a box or CRT television, and two involved a flat-panel television; 16 did not have information in the record to identify the type of television. Of the incidents that provided information about television size, the most common television size was the 27-inch (69 cm) screen. The approximate weight range of the CRT televisions, when provided, was reported to be between 70 pounds to 150 pounds (32 kg to 68 kg). Heavy CRT televisions are more likely to cause severe injury, including blunt head trauma, than lighter, flat-panel televisions.

Nonfatal Incidents Reported in CPSC's CPSRMS

Based on reports entered in CPSC's CPSRMS databases,[4] CPSC staff identified 639 reported nonfatal CSU tip-over incidents (for all ages), resulting in 293 injuries, which were reported to have occurred between January 1, 2005 and December 31, 2020 and involved a CSU tip over with no television. Among the 293 nonfatal injuries, an indication of the victim’s age was provided for 197 injuries, and the age of the victim is unknown for 96 injuries. Of the 197 injuries for which some age information is available, 167 (85 percent) were injuries to children. Of the 167 child injuries, the child’s age was reported for 133 injuries, of which 103 involved children 5 years and younger. When injury severity was reported, the injuries suffered by this age group (5 years old and younger) tended to be more severe when compared to older children

[3] Fryar CD, Carroll MD, Gu Q, Afful J, Ogden CL. (2021). Anthropometric reference data for children and adults: United States, 2015–2018. National Center for Health Statistics. Vital Health Stat 3(46).
[4] Tab A, Table 7.

and adults. The severity of injury ranged from cuts and bumps to concussions and skull fracture. For children under 5 years of age, five of the 103 had serious injuries that required hospitalization, 12 were treated in U.S. hospital emergency departments, and 11 were seen by medical staff. The severity of injury and level of care required was not known for the remaining 75 injuries.

Weight of Children in Nonfatal CPSRMS Incidents Involving CSUs Without Televisions

Among the 264 nonfatal CPSRMS incidents involving children and CSUs without televisions,[5] the weights of 47 children were reported, ranging from 26 pounds to 80 pounds (12 kg to 36 kg). Where it was not reported in the CPSRMS incidents, staff used the most recent CDC Anthropometric Reference to estimate the weight of children.[6] Staff used the 50th percentile values of weight that correspond to the reported age to estimate the weight range of those children. The estimated weight range in 165 nonfatal incidents without a reported weight, but with a reported age, was determined to be between 19.6 pounds (9 kg) and 158.9 pounds (72 kg) (Tab C).

Nonfatal NEISS Incidents Reported to CPSC

According to CPSC NEISS data between 2005 and 2020, there were 290 reported injuries as a result of a CSU tip over with no television involved, and there were 48 reported injuries as a result of both a CSU and a television tipping over.

Based on the NEISS data, there were an estimated total of 78,200 injuries related to CSU tip-overs for all ages that were treated in U.S. hospital EDs from January 1, 2006 to December 31, 2019. Of these, an estimated 56,400 (72 percent) involved children, and 21,800 (28 percent) involved adults and seniors. Of the estimated child incidents, 2-year-olds and 3-year-olds were most commonly involved. Of the estimated 78,200 ED-treated injuries to all ages, an estimated 61,700 (79 percent) involved only a CSU, and the remaining 16,500 (21 percent) involved a CSU and a television. Of the estimated 56,400 ED-treated incidents involving children, an estimated 40,700 (72 percent) involved only a CSU, and the remaining 15,700 (28 percent) involved a CSU and a television. However, for the years 2015 through 2019, staff could only generate national estimates for ED-treated incidents for children that involved only a CSU because the number of incidents involving a television was insufficient to support a reliable estimate.

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[5] The 264 nonfatal incidents are a subset of the 639 CSU-only (no television) nonfatal incidents referenced in Tab A that ESHF staff analyzed in Tab C. The 264 incidents are those that resulted in a tip over when a child started the interaction with the CSU. They do not include incidents that reported concerns about instability without a tip over or incidents in which a child did not initiate the interaction.

[6] Fryer et al., 2021.

Of the estimated 40,700 ED-treated injuries involving children and only CSUs, 15,800 (39 percent) resulted in soft tissue injuries, such as contusions, abrasions and lacerations to the trunk, head and face, including eyelid, eye area, and nose. The next most common diagnosis for non-television-related child injuries was internal organ injuries (which included closed head injuries), at 9,100 (22 percent). The next most common diagnosis was lacerations, which made up an estimated 6,200 (15 percent) of non-television-related child injuries. Bone fractures, including skull fractures, accounted for 9 percent of diagnoses. All other diagnoses made up the remaining 15 percent of these estimated incidents.[7] For child injuries involving both a CSU and television, the most common diagnosis was internal organ injury (estimated 5,800, or 37 percent), followed by contusions and abrasions (estimated 5,000, or 32 percent).

Of the 56,400 estimated CSU tip-over emergency department-treated injuries to children, injuries related to the head, neck, and face accounted for the majority of injuries, with 55 percent of injuries when no television was involved, and 73 percent of injuries with television and CSU involvement. The next most common body parts injured were the appendages, which accounted for 29 percent of the injuries when no television was involved (including leg, foot, toe, arm, hand, finger), and 13 percent when televisions were also involved (including leg, foot, and toe). An additional 14 percent of child injuries involving only CSUs were to the torso/trunk.

Pathophysiology of Head, Chest, and Neck Injuries

The types of injuries resulting from furniture tipping over range from soft tissue injuries, such as cuts and bruises (usually a sign of internal bleeding), to skeletal injuries, bone fractures to arms, legs, and ribs, to potentially fatal injuries resulting from skull fractures, closed-head injuries, compressional and mechanical asphyxia, and internal organ crushing leading to hemorrhage. These types of injuries can occur with tip-over incidents involving both CSUs alone, and CSUs with televisions.

The severity of these injuries depends upon a variety of factors, but the primary determinants are the force generated at the point of impact, the entrapment time, and the body part impacted. The head, neck, and chest are the most vulnerable. The impact force of a falling object is a function of the mass of the object, its speed before impact, and the material properties of the surfaces involved. In CSU tip-over cases, the CSU and floor surfaces affect the loads or energies transferred to the impacted body or body part. The severity of injury can also depend on the orientation of the body or body part when it is hit or trapped by the object. Sustained application of a force that affects breathing can lead to compressional asphyxia and death; but severity of the injury or likelihood of death can be reduced if the child is quickly rescued from the situation. Thus, in most nonfatal injuries, an adult was present and able to rescue the child and prevent

[7] Tab A, Table 9.

fatal entrapment. The age of the child is also a factor because of a combination of their limited physical abilities, strength and ability to self-rescue.

In most CSU tip-over cases, serious injuries and death are a result of blunt force trauma to the head and intense pressure on the chest causing respiratory and circulatory system impairment.

Head Injuries

Cranial crush injuries are produced by high-impact forces applied over a small area and can have serious clinical consequences, such as concussions and facial nerve damage. Such injuries are often fatal, even in cases of immediate rescue and rapid intervention. Of the 104 CSU tip-over incidents that resulted in child fatalities involving televisions, in 91 (88 percent) of the cases, head injury was reported as a cause of death. Because the difference in weight of a television relative to a small child's head can be large, injuries sustained can be severe and often fatal (Befler et al., 2014, De Roo et al., 2013). Head injury was also reported in 12 of the 89 (13 percent) child fatalities that did not involve a television. Autopsies from fatalities to children reported crushing injuries to the skull and regions of the eye and nose. Brain swelling, deep scalp hemorrhaging, traumatic intracranial bleeding, and subdural hematomas were often reported. These types of injuries are typical of crush injuries caused by blunt head trauma and often have a fatal outcome (Muniz, 2012). Children who survive such injuries may suffer neurological deficits, require neurosurgical interventions, and can face lifelong disabilities (Bernard et al., 1998, Rutkoski et al., 2011, Philip et al., 1998).

Compressional and Mechanical Asphyxia

Compressional and mechanical asphyxia differ from forms of suffocation caused by airway blockage (Wolfe and Harding, 2011). Compressional and mechanical asphyxia can result from mechanical forces generated by the sheer mass of an unyielding object, such as furniture, acting on the thoracic and abdominal area of the body, which prevents thorax expansion and physically interferes with the coordinated diaphragm and chest muscle movement that normally occurs during breathing. The torso injuries are the most common form of injury for non-television CSU fatalities.

The thoracic region (upper part of chest) consists of a bony rib cage housing the lungs, heart, trachea, thymus, and major systemic and pulmonary blood vessels. In the abdominal cavity located below the diaphragm are the liver, kidneys, stomach and spleen. Pediatric thoracic trauma has unique features that differ from adult thoracic trauma, because of differences in size, structure, posture, and muscle tone. The smaller volume of the child's thorax means that the vital organs are in closer proximity to each other than in adults. Children have thinner thoracic walls than adults with more cartilage in their ribs, resulting in a more elastic and highly compliant thorax (Niranjan,1990). While the elasticity of the chest wall reduces the likelihood of rib fracture, it also provides less protection from external forces. Impact to the thorax of an infant or small child can produce significant chest wall deflection and transfer large kinetic energy forces to vital thoracic organs such as the lungs and heart. This can cause organ deflection and distention, which can lead to traumatic asphyxia, respiratory and circulatory system impairment or failure. Biomechanically, the smaller body size of a child results in greater forces applied per unit of body area on impact. In addition, because of the close proximity of organs, thoracic organ injuries can result in multisystem injuries. Because the blood volume of a pediatric patient is typically 7-8 percent of the total body weight (Sharma, 2016), a relatively small blood volume loss due to internal organ injuries can lead to decreased blood circulation and shock. This was reported in one CSU fatal incident, where the child, although immediately rescued, died on the scene due to internal bleeding. Additionally, the liver, which is located almost completely behind the lower right ribs in children, is susceptible to traumatic injuries, and traumatic liver injuries produce the highest mortality rate of any abdominal organ (Di Vincenti et al., 1998, Watson and Lowery, 1967 in Huelke, 1998).

Strangulation

In addition to chest compression, pressure on the neck by a component of the CSU can also result in rapid strangulation due to pressure on the blood vessels in the neck. This increases the risk of death caused by traumatic asphyxia, which occurs mostly in children (Shamblin 1963, Stickney 1944).

The blood vessels that take blood to and from the brain are relatively unprotected in the soft tissues of the neck and are vulnerable to external forces. The amount of force required to cause blockage of blood flow can be small. Compression of the jugular vein (venous return) in the neck with as little as (4.45 pounds-force) can lead to unconsciousness (Brouardel, 1897, Iserson, 1984). Baroreceptors are pressure sensors located in the carotid sinus of the internal carotid artery respond when pressure is applied externally to the carotid artery, such as from neck compression. Baroreceptors also respond to changes in arterial wall stretching due to changes in blood pressure. Sustained compression of either the jugular veins or the carotid arteries can lead to death (Iserson, 1984, Camps et.al., 1959 and Polson, 1973). In a mechanism known as "carotid sinus reflex" stimulation of the baroreceptors in the carotid sinus can produce cardiac arrythmia that can lead to loss of consciousness and eventually cardiac arrest. This may play a role in the pathophysiology of strangulation if sustained forces are applied to the area for a period in excess of 3-4 minutes, which can lead to unconsciousness and death (Iserson, 1984).

Intense pressure exerted on blood vessels in the neck from being pinned under the CSU can cause tiny blood vessels (capillaries) to burst and cause blood leakage leading to subconjunctival hemorrhage ecchymosis,[8] the pinpoint purplish red marks, known as petechial hemorrhages or

[8] Also known as "Tardieu ecchymosis," first described by A. Tardieu, a French physician and forensic scientist in 1859 as subpleural spots of "ecchymosis" observed in tissues of newborn who were strangled or suffocated.

petechia, often seen in strangulation deaths in areas above the occluded blood vessel (Ely and Hirsch, 2000; Luke et al., 1985; Polson, 1973). Petechial hemorrhages of the head, neck, chest, and the periorbital area were reported in autopsy reports of CSU tip-over incidents. There was also physical evidence of chest compression visible as linear marks or abrasions across the chest and neck, consistent with the position of the CSU.

The brain is the most sensitive organ in the body to oxygen deprivation. Brain hypoxia can cause unconsciousness in less than three minutes and may result in permanent brain damage or death thereafter when pressure is directly applied on neck by CSU or a component of the CSU such as the edge of a drawer. External pressure on the chest that compromises the ability to breathe by restricting respiratory movement or on the neck can cause hypoxia. The prognosis for a hypoxic victim is dependent on the degree of oxygen deprivation, the duration of unconsciousness, and the speed at which cardiovascular resuscitation attempts are initiated relative to the timing of cardiopulmonary arrest. Rapid reversal of the hypoxic state is essential to prevent or limit the development of pulmonary and cerebral edema that can lead to death. The sooner the CSU (compression force) is removed and resuscitation initiated, the greater the likelihood that the patient will regain consciousness and recover from his/her injuries.

Even victims who are revived after oxygen deprivation for periods of less than 4 minutes can suffer a wide range of serious consequences. Among the CSU tip-over incidents reported to CPSC, aside from one fatal incident that was witnessed as it occurred, the shortest time a child was left alone was 15 minutes. However, even shorter timeframes can result in death. As reported in literature regarding household furniture tip-over deaths of children (Wolfe et al., 2011), there was a fatality resulting from a furniture tip over where a 17-month-old child had been left alone for only 10 minutes. The cause of death was reported as asphyxia due to chest compression. Directorate for Engineering Sciences, Division of Human Factors (ESHF) staff concluded that children are likely to have unsupervised time, including during naps and overnight in bedrooms where the majority of the fatalities took place (Tab C).

Self-Rescue

Children's ability to avoid a falling CSU and self-rescue depends on their skills to react fast enough to avoid falling furniture and their strength to lift the heavy furniture off themselves when trapped underneath. Other factors are the child's size, weight, and position relative to the CSU. The position of the child relative to the falling CSU, as well as the size of the child can determine whether he/she becomes fully or only partially trapped.

As reported in the literature (DiScala, et al., Rutkoski, et al., 2011, Platt and Stanley, 2011, Marnewick, et al., 2011) and demonstrated in CPSC data (Tab A), most of the fatal injuries sustained from a CSU tipping over involved children 3-years-old and younger (94 percent). Most CSU tip-over fatalities involve children 1-year-old and 2-years-old, followed by 3-year-olds. This is the most vulnerable age group because, while they have the physical ability to climb and jump, they generally lack the cognitive awareness of hazards, lack the skills to react fast enough to avoid falling furniture, and are not generally strong enough to move the heavy furniture off themselves when trapped underneath. Most tip-over deaths to children happen when a child climbs onto a CSU or into a drawer (Tab C), causing the CSU to tip over and entrap the body. If the child is unable to get out from under a heavy object that is hindering breathing, asphyxia can be fatal within minutes (DiMaio & DiMaio, 2001, Gordon & Shapiro, 1982). An incident involving blunt head trauma can result in immediate death or loss of consciousness, which would prevent the victim from attempting self-rescue or calling for help.

Additional factors that play a role in self-rescue are: injuries the child might have suffered; and whether the child is able to move or extract his/her arm or leg to push the CSU off. In a standing position, 2-year-old children can push on a lever with an average force of 11-14 pounds-force (49–62 Newtons); 6-year-olds can push with an average force of about 39-47 pounds-force (174-209 Newtons) (Brown et al., 1973). Comparing these average push values that children can exert under optimal conditions in an upright posture to the weight of CSUs, which range from 45 to 220 pounds (20 -100 kg) (where reported in incident data), it is unlikely that a 2- to 5-year-old child will be able to stop a CSU from falling, or be strong enough to push it off, especially if the child is injured.

Light-Weight CSUs

The lightest and also the shortest CSU involved in a fatal tip-over incident is a 3-drawer chest that weighed 57 pounds (26 kg) and tipped over onto a 2-year-old child. A lighter, top-heavy CSU missing the bottom three drawers and weighing 34 pounds (15 kg) (without its three bottom drawers) was involved in a fatal incident with a 2-year-old child. There are some nonfatal incidents with CSUs weighing 31 pounds to 50 pounds (14kg to 23 kg). Staff is also aware of some lightweight plastic units marketed and used as clothing storage (Tab C). Staff is not aware of any tip-over incidents involving plastic or similar light-weight units in the fatal and nonfatal CSPRMS data involving children without a television, although staff does not have identifying information on all of the units. Staff also is not aware of any reported incidents with CSUs below 31 pounds (14 kg).

CONCLUSION

HS staff documented the incidences of CSU tip-overs involving children, which have resulted in a range of nonfatal injuries and death. The most common body parts injured in fatal CSU tip-over incidents involving children were the head and torso. These were also commonly the body parts involved in nonfatal incidents.

These injuries to head, neck, and torso can result from blunt force trauma to the head and/or sustained application of force on the chest and neck, which can result in respiratory or circulatory system impairment or both. Blunt force trauma can cause an immediate fatal blow to the head, internal bleeding and organ failure. A CSU can inflict serious injury or death to a child if the product falls on a child's torso and the child is not immediately rescued. Staff is aware of one reported witnessed incident, where the child's life was not saved even after the immediate rescue, due to internal bleeding. Sustained application of a force on the chest can lead to compressional asphyxia and death, while sustained pressure on the neck can lead to asphyxia by strangulation.

Most CSU tip-over fatalities involved children 1-year-old and 2-years-old, followed by 3-years-old. These incidents often happen in the bedroom where a child has been left alone to sleep, making the likelihood of the parent/caregiver becoming aware of the incident and rescuing the child low. Near-immediate rescue is vital for a good outcome, although in cases involving severe head injuries, outcomes in these circumstances can be fatal, despite rapid intervention. The likelihood of mitigating the occurrence or severity of injuries is particularly low for children because of their limited ability to self-rescue, the circumstances often surrounding an incident, and their susceptibility to severe injury.

REFERENCES

Befeler AR, Daniels DJ, Helms SA, Klimo P Jr, Boop F (2014). Head injuries following television-related accidents in the pediatric population. J Neurosurg Pediatr. Oct;14(4):414-7.

Bernard, PA, Johnston C, Curtis SE and King WD (1998). Toppled Television Sets Cause Significant Pediatric Morbidity and Mortality. Pediatrics Vol. 102 No. 3 September 1998.

Brouardel. La Pendaison: La strangulation, la suffocation, la submersion. Paris, France, 1897.

Camps FE and Hunt AC. Pressure on the neck. J Forensic Med 6:116, 1959.

DiMaio VJ, DiMaio D. (2001). Asphyxia. In: Geberth VJ, series editor. Forensic pathology, 2nd edn. Boca Raton, FL: CRC Press, p. 229–77.

DiScala, C, Barthel, M., Sege R. (2001). Outcomes from Television Sets Toppling onto Toddlers Arch Pediatr Adolesc Med. 155(2):145-148. doi:10.1001/archpedi.155.2.145.

Di Vincenti. The liver is an organ which is not well designed for withstanding traumatic insults even in the adult. Traumatic liver injuries produce the highest mortality rate of any abdominal organ (et al, July, 1998 14 106 1968).

Ely SF, and Hirsch CS. Asphyxial deaths and petechiae; a review. *J Forensic Sci* 2000; 45:1274-7.

Gordon I, Shapiro HA. Deaths usually initiated by hypoxic hypoxia or anoxic anoxia. In: Gordon I, Shapiro HA, editors. Forensic medicine: 2nded. Edinburgh, UK: Churchill Livingstone. 1982; 95–129.

Huelke DF, An overview of anatomical considerations of infants and children in the adult world of automobile safety designs university of Michigan transportation research institute Ann arbor, MI USA. 42nd Annual Proceedings Association For The Advancement Of Automotive Medicine October 5-7, 1998. Charlottesville, [Last accessed 4/2021] https://www.ncbi.nlm.nih.gov/pmc/articles/PMC3400202/pdf/aam42_p093.pdf/?tool=EBI

Iserson, K.V. Strangulation (1984). A review of ligature, manual, and postural neck compression injuries. Ann. Emerg. Med.; 13:179-185.

Lee, A. and Lee, A. (2017). *In-Depth Analysis of Nonfatal Injuries from TVs Falling off Furniture*. CPSC: Bethesda, MD. [Last accessed 3/2021] https://www.cpsc.gov/s3fs-public/NonFatalTVInjuriesreportOctober2016March17_0.pdf.

Lee, Arthur and Volanth, Casey, 2015, TVS - TIPPING THE SCALE TO SAFETY A look into falling TV dynamics and incidents, 2015 Directorate for Engineering Sciences U.S. Consumer Product Safety Commission, Rockville, Maryland (January 26, 2015). Available at https://cpsc.gov/s3fs-public/pdfs/TV-hazard-report-January2015.pdf. [last accessed June 2021]

Luke JL, Reay DT, Eisele JW, Bonnell HJ. (1985). Correlation of circumstances with pathological findings in asphyxial deaths by hanging: a prospective study of 61 cases from Seattle, WA. *JForensicSci.;30: JI40-7.*

Marnewick J, Dansey R, Morreau P, Hamill J. (2011). Television tip-overs: The Starship Children's Hospital experience and literature review. Injury. May;42(5):534-8.

Muñiz AE. (2012). Craniofacial injuries from television tip-over. Pediatr Emerg Care. 2012 Jan; 28(1):52-54.

Niranjan Kissoon, FRCPC, Jonathan Dreyer, FRCPC, Manjit Walia (1990). Pediatric trauma: differences in pathophysiology, injury patterns and treatment compared with adult trauma Can Med Assoc J; 142 (1) 27-38.

Philip A. Bernard, Carden Johnston, Scott E. Curtis, and William D. King, (1998). Toppled Television Sets Cause Significant Pediatric Morbidity and Mortality. Pediatrics Vol. 102 No. 3 September.

Polson CJ. Hanging In: Polson CJ and Gee DJ (eds.) Essentials of forensic medicine Oxford England, 1973 371-404.

Platt MS1, Stanley C. (2011). TV tip-over morbidity and mortality in children. J Forensic Sci. 2011 Sep;56(5):1364-7.

Roo AC, Chounthirath T, and Smith GA (2013). Television-related injuries to children in the United States, 1990-2011. Pediatrics 132:267-274.

Rutkoski JD, Sippey M, Gaines BA. (2011). Traumatic television tip-overs in the pediatric patient population. J Surg Res. Apr; 166(2):199-204.

Shamblin, J. R. and McGoon, D. C. (1963). Acute Thoracic Compression with Traumatic Asphyxia; Report of Six Cases. Arch. Surg., 87:967.

Sharma, M., MD; Chief Editor: John Kupferschmid, MD (2016) from Pediatric Thoracic Trauma Updated: Jan 05.

Smith, Charles (2010). CPSC Memorandum to Ian Hall, "CRT Televisions: Information on Unit Sales and Number in Use," July 2, 2010.

Stickney, J. M. and Hagedorn, A. B. (1944).: Chest Injuries and Traumatic Asphyxia. Proc. Mayo Clin., 19:207.

Wolfe BC and Harding BE (2011). Household Furniture tip-over deaths of young children. J Forensic Sci, 56 (4) 918-921.

TAB C: Human Factors Assessment of the Clothing Storage Unit (CSU) Incidents, Research, and Child Physical and Behavioral Characteristics to Develop Recommendations for the Proposed Rule

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

Memorandum

DATE: July 14, 2021

TO: The File

THROUGH: Mark Kumagai, Associate Executive Director,
Directorate for Engineering Sciences

FROM: Rana Balci-Sinha, Ph.D., Director,
Division of Human Factors, Directorate for Engineering Sciences

Kristen Talcott, Ph.D., Human Factors Engineer,
Division of Human Factors, Directorate for Engineering Sciences

SUBJECT: Human Factors Assessment of the Clothing Storage Unit (CSU) Incidents, Research, and Child Physical and Behavioral Characteristics to Develop Recommendations for the Proposed Rule

1. INTRODUCTION

In November 2017, the Commission approved for publication in the *Federal Register*, the advance notice of proposed rulemaking (ANPR) concerning the risk of injuries and deaths associated with clothing storage units (CSUs) tipping over (82 *Fed. Reg*. 56,752 (Nov. 30, 2017)). In this memorandum, staff of CPSC's Directorate for Engineering Sciences, Division of Human Factors (ESHF), discusses physical and behavioral characteristics of children at risk from tip overs associated with CSUs and human factors considerations for the recommended proposed rule.

2. DATA USED FOR ANALYSIS OF INCIDENT DATA

For the analysis in this memorandum, ESHF staff used the incident data sources outlined in the Directorate for Epidemiology, Division of Hazard Analysis (EPHA) memorandum (Tab A). Staff focused on the subset of incidents involving children and CSUs without televisions, primarily because the majority of fatal and nonfatal incidents involve children[1]; and, in recent years, there has been decrease in CSU tip-over-related emergency department-treated incidents

[1] As Tab A indicates, 193 of the 226 CSU tip-over fatalities involved children; 167 of the 197 nonfatal reported injuries that provided an age involved children; and 56,400 of the 78,200 estimated emergency-department-treated injuries involved children.

involving CSUs with televisions, while the rate of emergency department-treated incidents involving CSUs without televisions has remained stable.[2]

ESHF staff reviewed 89 fatal and 263 nonfatal Consumer Product Safety Risk Management System (CPSRMS) tip-over incidents that involved children and CSUs without televisions.[3] The 263 nonfatal incidents are the subset of the 639 CSU-only (no television), nonfatal incidents referenced in Table 5 of EPHA memorandum (Tab A). Because the focus was on identifying child interactions, ESHF staff analyzed the incidents that resulted in a tip over when a child started the interaction with the CSU.[4] ESHF staff used incident documents, and in 135 cases, In-Depth-Investigation (IDI) reports that were available, to identify interaction scenarios and other details that could impact the stability of the CSU.[5] Staff also reviewed 1,463 nonfatal National Electronic Injury Surveillance System (NEISS) tip-over incidents[6] that involved children and CSUs without televisions. ESHF staff used the nonfatal NEISS incident narratives to determine interaction scenarios; however, unlike IDI reports and other more detailed incident documents, these brief NEISS narratives did not have details on other factors that could influence the stability of the CSUs (*e.g.*, CSU contents and drawer fill level or whether the CSU was placed on carpet) or the child's weight. In addition, the nonfatal NEISS data list product type, but often do not include details on the design of the product (*e.g.*, dimensions, number of drawers) or information that would allow identification of the product (*e.g.*, manufacturer name or model number).

ESHF staff also examined online videos showing real-life child interactions with CSUs and similar furniture items, as well as information on child development and capabilities.

3. AGE OF CHILDREN INVOLVED IN INCIDENTS

Children in fatal CPSRMS tip-over incidents involving CSUs without televisions were 11 months through 7 years old. A total of 33 fatal incidents occurred with children under 2 years of

[2] The EPHA memorandum shows a statistically significant decrease in emergency department-treated CSU tip over-related injuries from 2010 to 2019, which is driven by decreasing injuries involving CSUs with televisions. The rate of emergency department-treated incidents involving CSUs without televisions has remained stable over the same period. There appears to be a decline in television involvement in recent years in fatal CSU tip-over incidents (Tab A, Figure 1), and reported nonfatal incidents (Tab A, Table 5), as well; although neither of these sources can be used to make statistical conclusions.

[3] As Tab A indicates, there are 89 fatalities involving children without television involvement. The 89 fatal incidents referenced in this memo count one incident resulting in two fatalities separately.

[4] From the 639 nonfatal incidents, we removed the incidents that reported concerns about instability without a tip over in addition to incidents in which a child did not initiate the interaction.

[5] IDI reports contain data from follow-up investigations conducted by CPSC staff. These investigations are done to gather detailed information on a death or injury associated with a consumer product.

[6] ESHF staff removed the three fatal NEISS incidents from their analysis of NEISS data because the fatal NEISS incidents are included in the fatal CPSRMS incident set. With this change, incidents are not duplicated across data sets.

age, 30 incidents with 2-year-old children, and 21 incidents with 3-year-old children. Two incidents occurred involving 4-year-old children and one incident each involving 5, 6, and 7-year-old children (Figure 1).

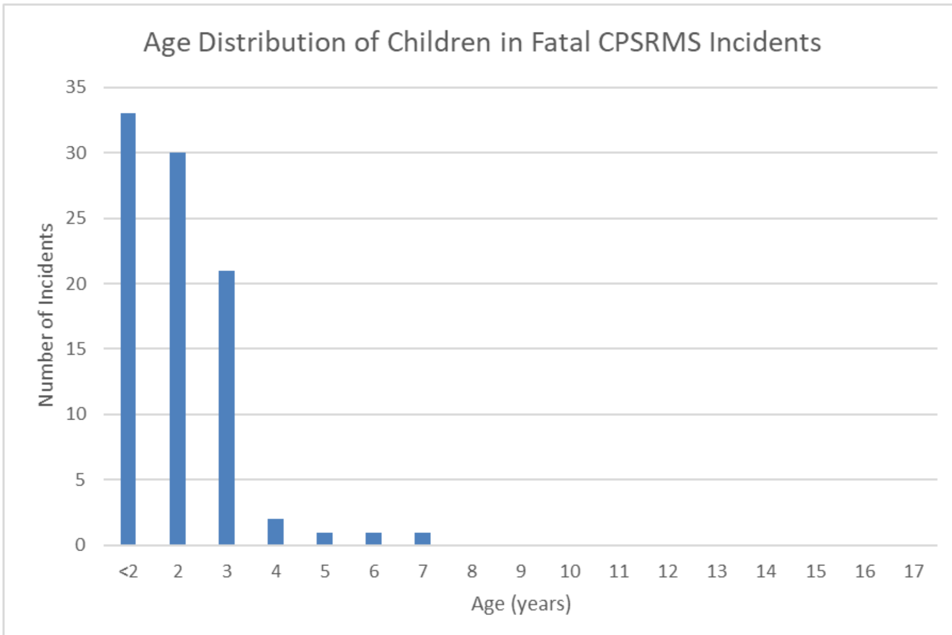

Figure 1. Ages of children in fatal CPSRMS tip-over incidents involving CSUs without televisions.

Among the nonfatal CPSRMS tip-over incidents involving children and CSUs without televisions, 3-year-old children were involved in the highest number of incidents, with a reported age (59 incidents) followed by 2-year-old children (47 incidents). Figure 2 shows the age distribution for nonfatal CPSRMS incidents.

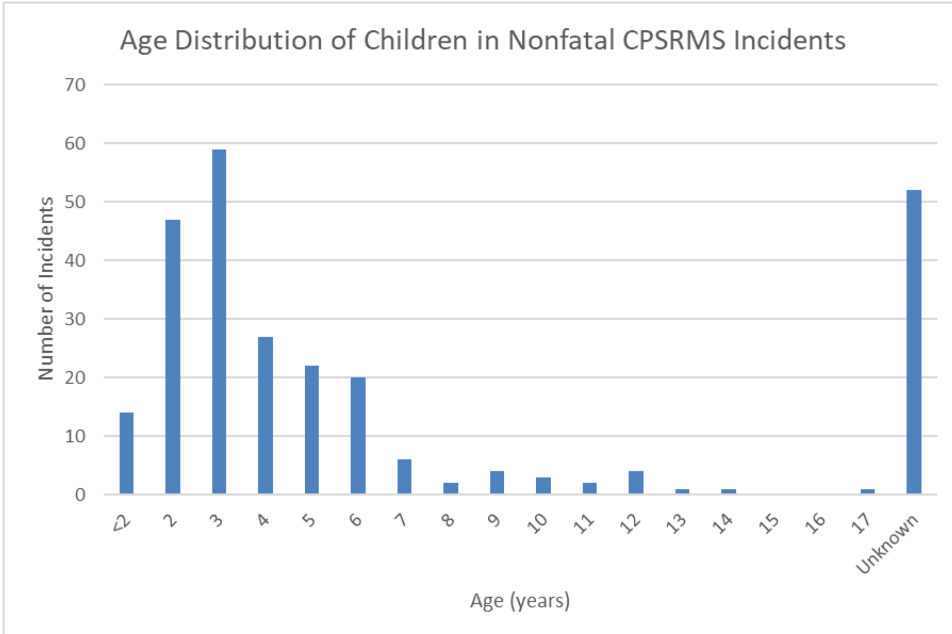

Figure 2. Ages of children in nonfatal CPSRMS tip-over incidents involving CSUs without televisions.

Nonfatal NEISS tip-over incidents involving children and CSUs without televisions follow a similar distribution, with the highest number of reported incidents involving 2-year-old children, followed by 3-year-old children, and children less than 2 years of age (Figure 3).

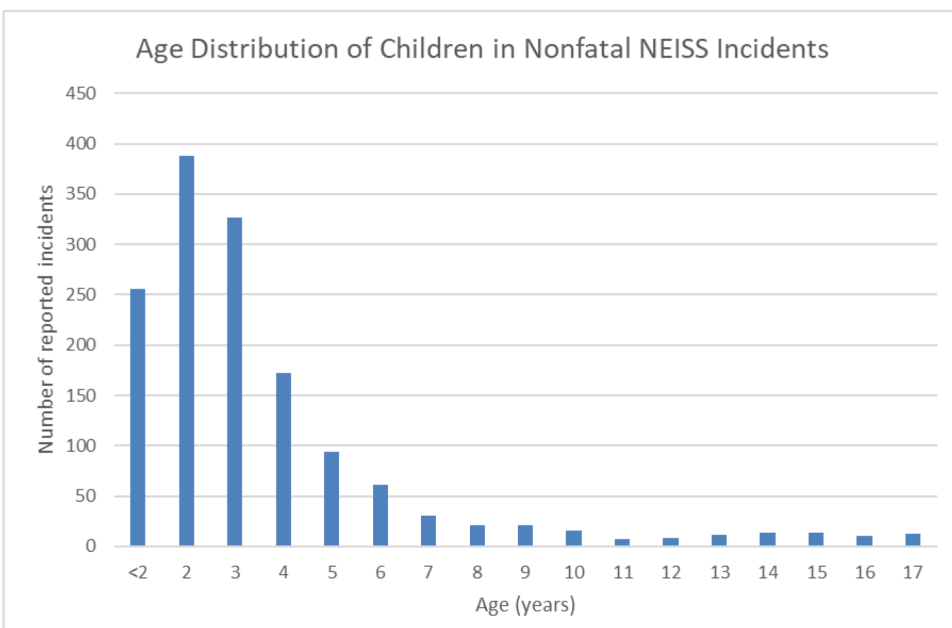

Figure 3. Ages of children in nonfatal NEISS tip-over incidents involving CSUs without televisions.

4. WEIGHT OF CHILDREN INVOLVED IN INCIDENTS

Among the 89 fatal CPSRMS tip-over incidents involving children and CSUs without televisions, the child's weight was reported in 49 incidents and ranged from 18 pounds to 45 pounds. Among the 263 nonfatal CPSRMS tip-over incidents involving children and CSUs without televisions, the child's weight was reported in 47 incidents and ranged from 26 pounds to 80 pounds. The nonfatal NEISS incident data did not include the child's weight.

5. CHILD WEIGHT BY AGE

In this memorandum, ESHF staff used the 2021 Centers for Disease Control and Prevention (CDC) Anthropometric Reference (Fryar et al., 2021) to estimate child weight by age (Figure 4). The CDC Anthropometric Reference is based on a nationally representative sample of the U.S. population, and the 2021 version is based on data collected from 2015 through 2018. ESHF staff prefers the CDC Anthropometric Reference over the CDC growth charts because it is more recently collected data and because the data are aggregated by year of age, allowing for estimates by year (*e.g.*, the 95th percentile weight of all 3-year-old males).[7]

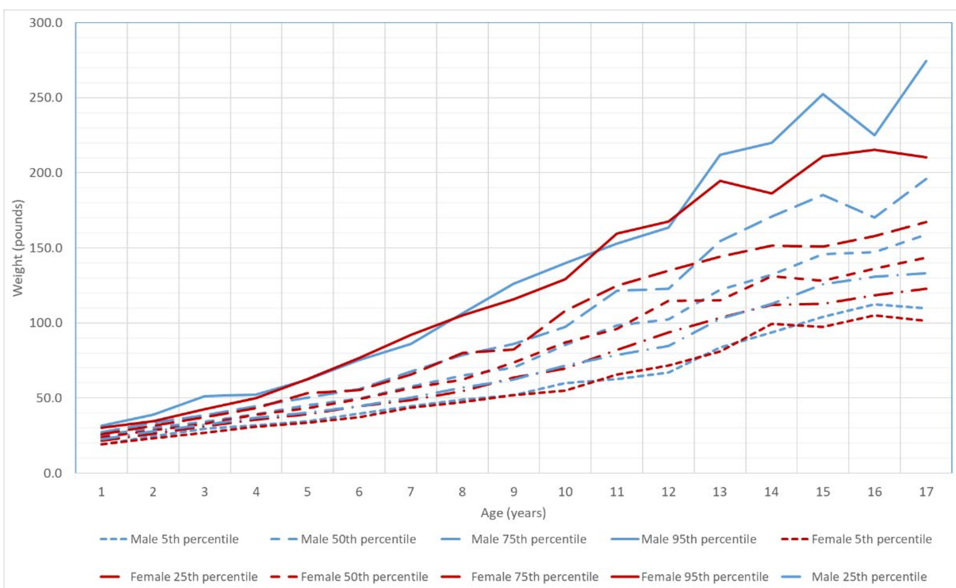

Figure 4. Child weight percentiles by age and sex from 2021 CDC Anthropometric Reference (Fryar et al., 2021).[8]

[7] CDC growth charts can be accessed via: https://www.cdc.gov/growthcharts/clinical_charts.htm.
[8] The fifth percentile 3-year-old female value is entered as the average of 2- and 4-year-old children because the estimate is not provided due to small sample size.

These data can be used to estimate the number of children of a certain age who would be covered by performance requirements that provide effective protection for certain weights of children interacting with CSUs. The 50^{th} percentile is the median value, which means that half of the covered population are below this value, and half are above.

The data in the 2021 Anthropometric Reference are divided by sex, and provide male and female weight percentiles separately. For our purposes, the data ideally would be aggregated by both age by year and sex, so that it would represent all children of a certain age. However, it is common for anthropometric data to be divided by sex. Human factors professionals typically use the more extreme of the two values to accommodate both. For example, a clearance height to accommodate all adults should be based on the 95^{th} percentile male height, because the 95^{th} percentile male is taller than the 95^{th} percentile female; so, a clearance that accommodates the 95^{th} percentile male will also accommodate the 95^{th} percentile female. Similarly, a reachable distance for all adults should be based on the 5^{th} percentile female reach, because the 5^{th} percentile female reach is shorter than the 5^{th} percentile male reach; thus, a distance that accommodates the 5^{th} percentile female will also accommodate the 5^{th} percentile male. In this memorandum, ESHF staff used the higher 95^{th} percentile value by sex for each age to estimate the upper weight limit for all children of that age.

As shown in Figure 4, there is considerable overlap in child weight by age. For example, the 95^{th} percentile 3-year-old weight (51.2 pounds for males), is similar to the 50^{th} percentile 6-year-old weight (49.6 pounds for males). Figure 5 shows the approximate percent of children under the 95^{th} percentile child weight by age. This chart shows that performance criteria based on a 95^{th} percentile child at a certain age will also protect lighter-weight children who are older than that age.

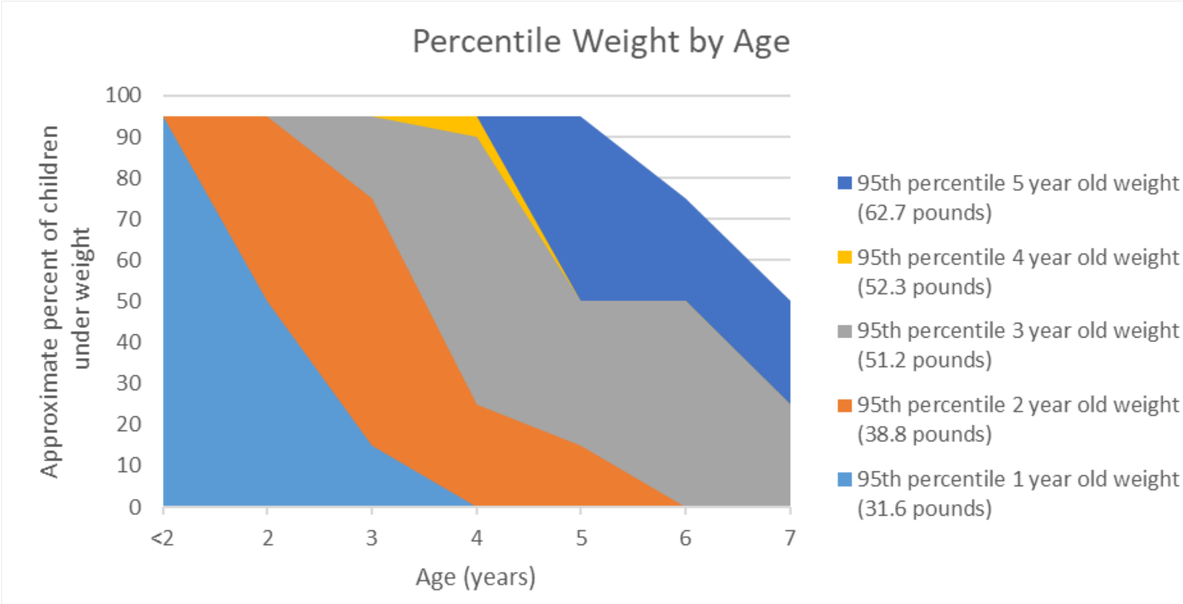

Figure 5. Approximate percent of children ages 1-7 years of age covered under 95th percentile weight by age. Based on staff analysis of Fryar et al., 2021.

For incidents without a reported child weight, ESHF estimated the weight using the 50th percentile weight by age. The staff-estimated child weights for the 40 fatal CPSRMS incidents without a reported weight range of 19.6 pounds to 45.1 pounds. The staff-estimated child weights for the 164 nonfatal CPSRMS incidents without a reported child weight, but with a reported age, ranged from 19.6 pounds to 158.9 pounds. Because the age of the child was unknown in the remaining 52 nonfatal CPSRMS incidents, staff did not provide a weight estimate for these incidents. Overall, the weighted average of children's reported weight for CPSRMS incidents is 34.23 pounds; whereas, the weighted average of children's estimated weight was 38.8 pounds.[9]

For nonfatal NEISS tip-over incidents involving children and CSUs without televisions, the staff-estimated weights ranged from 15.8 pounds to 158.9 pounds, which covered children from 3 months old to 17 years old. The weighted average of children's estimated weight in nonfatal NEISS incidents was 40.26 pounds.

[9] Weighted average is equal to the sum of the product of the number of reported incidents for that age times the estimated weight for that age divided by the total number of reported incidents.

6. INTERACTION SCENARIOS

6.1 Interactions in Fatal CPSRMS Incidents

Among the 89 fatal CPSRMS tip-over incidents involving children and CSUs without televisions, 47 reported the type of interaction in the incident narrative or IDI report; the type of interaction was either not reported or unknown in 42 incidents. Climbing was the most frequent reported interaction, making up 74 percent of fatalities with a reported interaction (35 of 47 incidents). The second most frequent reported interaction was sitting, laying, or standing in a drawer, which made up 17 percent of fatalities (8 of 47 incidents) with a reported interaction (Table 1).

Table 1. Interactions in Fatal CPSRMS Tip-Over Incidents Involving Children and CSUs Without Televisions by Age

	Age (years)							
Interaction Scenario	**<2**	**2**	**3**	**4**	**5**	**6**	**7**	**Grand Total**
Climbing	13	11	9	1			1	35
Opening drawers	1	2			1			4
In drawer	2	4	2					8
Unknown	17	13	10	1		1		42
Fatal	**33**	**30**	**21**	**2**	**1**	**1**	**1**	**89**

6.2 Interactions in Nonfatal CPSRMS Incidents

Among the 263 nonfatal CPSRMS tip-over incidents involving children and CSUs without televisions, the type of interaction was reported in 160 incidents and was not reported or was unknown in 103 incidents. Among the reported interactions, the most frequent interaction was opening drawers (101 of 160), followed by climbing (32 of 160), and putting items in/taking them out of a drawer (10 of 160). Opening drawers, followed by climbing, were also the top two interactions for children 3 years old and younger. Sixty-three percent of the nonfatal CPSRMS incidents with a reported interaction involved opening drawers, and 20 percent involved climbing (Table 2).

Table 2. Interactions in Nonfatal CPSRMS Tip-Over Incidents Involving Children and CSUs Without Televisions by Age

	Age (years)															
Interaction Scenario	**<2**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**14**	**17**	**Unknown**	**Grand Total**
Climbing	1	5	11	6	3					1					5	32
Opening drawers	4	17	28	12	15	9	3			1	1	1			10	101
Putting item in/out drawer		1	1	1	1	2						1			3	10
Other		1				1										2
Leaned/pushed down open drawer	1	1	1	1											1	5
In drawer	1															1
Pulled on	2	2	1						1		1				2	9
Unknown	5	20	17	7	3	7	3	2	3	1		2	1	1	31	103
Nonfatal	**14**	**47**	**59**	**27**	**22**	**19**	**6**	**2**	**4**	**3**	**2**	**4**	**1**	**1**	**52**	**263**

It is important to note that of the three data sources used in this memorandum, the nonfatal CPSRMS data are the most susceptible to reporting bias because the data are largely based on voluntary self-reports from consumers. Therefore, although it is useful for providing examples of how incidents can occur, it is less likely to represent the true distribution of incidents that result in death and injury than the other two data sources (fatal CPSRMS and nonfatal NEISS). Staff notes that there is a wide range of reported outcomes for the 263 nonfatal CPSRMS tip-over incidents involving children and CSUs without televisions, including 42 percent with an unknown level of injury, 38 percent resulting in no injury, 7.6 percent involving emergency department treatment, 7.2 percent seen by a medical professional, 2.3 percent admitted to a hospital, and 2.3 percent with unknown outcomes.

6.3 Interactions in Nonfatal NEISS Incidents

Among the 1,463 nonfatal NEISS incidents involving children and CSUs without televisions, the type of interaction was reported in 559 incidents and was not reported or was unknown in 904 incidents. In 22 incidents with a reported interaction, the child was injured because of another person's interaction with the CSU. Of the remaining incidents with reported interactions, 77 percent involved climbing (412 of 537). The second most frequently reported interaction was opening drawers, accounting for 8 percent of the interactions (42 of 537). For children 3 years old or younger, climbing constituted almost 80 percent of reported interactions (Table 3).

Table 3. Interactions in Nonfatal NEISS Tip-Over Incidents Involving Children and CSUs Without Televisions by Age

	Age in Years																	
	<2	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**	**15**	**16**	**17**	**Grand Total**
Climb	64	128	109	60	25	14	6	4		1			1					412
Hit	3		1														1	5
In drawer	5	5	5	1		1		1										18
Jump	0	2			1													3
On top	0		1	1										1				3
Opening drawers	7	9	11	8	1	2	1	1		1				1				42
Other	1	1		2	2				2			1				2		11
Other person	4	5	5	3	1	2		1									1	22
Playing in drawer	2	1	1		1													5
Pulled on	7	4	3	2														16
Pulled up	0			1														1
Putting item in/out drawer	0	1	3	1	5	2	1											13
Reaching	0	1	2			2				2								7
Swinging	0			1														1
Unknown	162	230	185	92	58	38	23	14	19	12	7	7	11	12	14	9	11	904
Grand Total	**255**	**387**	**326**	**172**	**94**	**61**	**31**	**21**	**21**	**16**	**7**	**8**	**12**	**14**	**14**	**11**	**13**	**1463**

Overall, 81 percent of the reported interactions in the nonfatal NEISS tip-over incidents involving children and CSUs without televisions are those in which the child's weight is supported by the CSU (climbing, in drawer, jump, on top, swinging) (438 of 537), and 12 percent of reported interactions are those in which the child's strength determines the force (hit, opening drawers, pulled on, pulled up) (64 of 537). The remaining 7 percent of reported interactions (36 of 537) are those in which it is unclear how the force was applied (other, playing in drawer, putting items in/out drawer, reaching).

6.4 Climbing

As discussed in 6.1, climbing was the most frequently reported interaction (35 of 47 reported interactions) for the fatal CPSRMS tip-over incidents involving children and CSUs without televisions, with the ages ranging from 14 months to 7 years old. Among the nonfatal CPSRMS tip-over incidents involving children and CSUs without televisions, climbing was the second most frequently reported interaction (32 of 160 reported interactions), with ages ranging from 16 months to 10 years old. Ninety-four percent of the fatal CPSRMS climbing incidents (33 of 35), and 63 percent (17 of 27) of the nonfatal CPSRMS climbing incidents with a reported age involved children 3 years old or younger (Figure 6 and Figure 7).

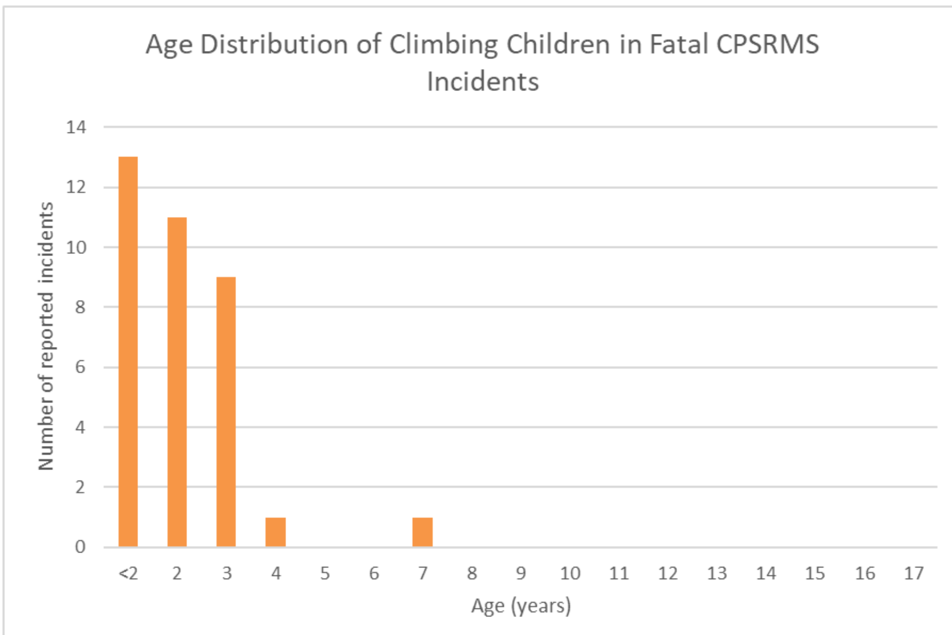

Figure 6. Number of reported climbing incidents by age in fatal CPSRMS tip-over incidents involving children and CSUs without televisions.

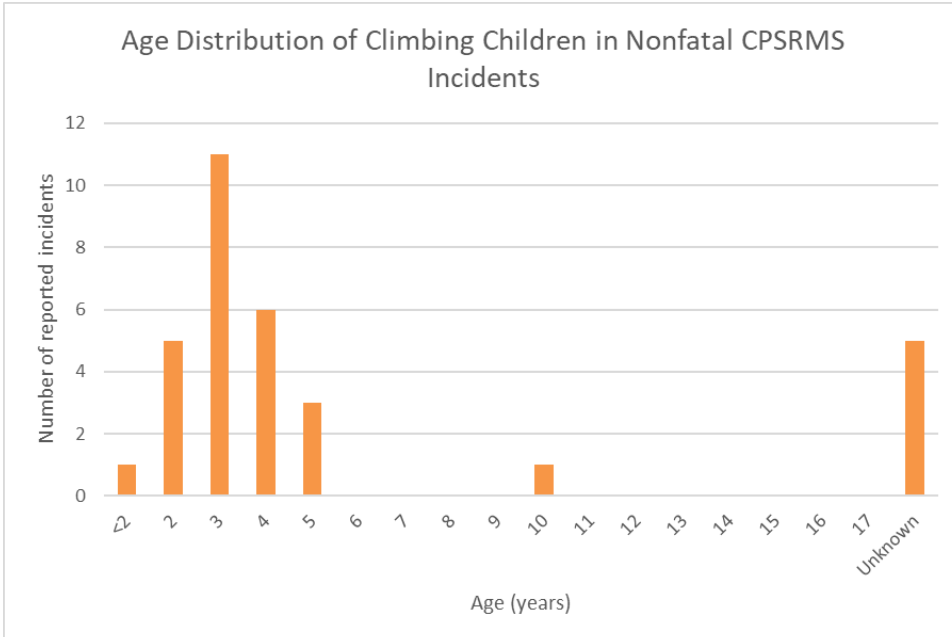

Figure 7. Number of reported climbing incidents by age in nonfatal CPSRMS tip-over incidents involving children and CSUs without televisions.

Climbing was the most frequently reported interaction in nonfatal NEISS tip-over incidents involving children and CSUs without televisions, with children as young as 9 months old and as old as 13 years old. Climbing incidents involving 2- and 3-year-old children were the most common. Seventy-three percent of the nonfatal NEISS climbing incidents (301 of 412) involved children 3 years old or younger (Figure 8).

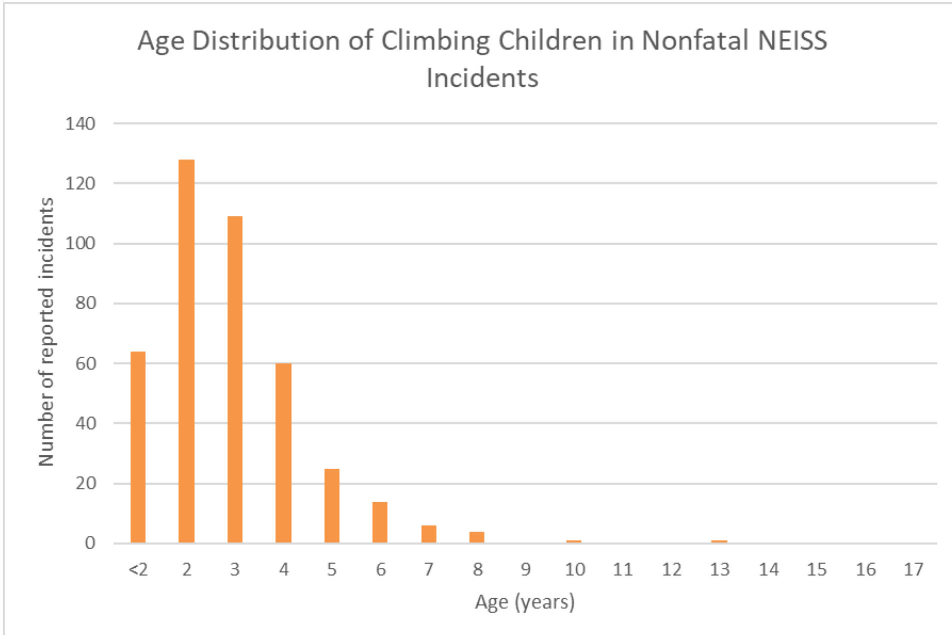

Figure 8. Number of reported climbing incidents by age in nonfatal NEISS tip-over incidents involving children and CSUs without a television.

This distribution mirrors the overall distribution of NEISS incidents by age (see Figure 3); and although the total number of CSU tip-over incidents decreases with increasing age, the percent of incidents in which the reported interaction was climbing appears to be fairly consistent across ages for children 8 years old and younger. There are limited data on interactions of children over age 8.

6.5 Opening Drawers

Staff examined incidents that involved opening drawers more closely because that represents the most common interaction among nonfatal CPSRMS tip-over incidents involving children and CSUs without televisions with a reported interaction and the second most common interaction among nonfatal NEISS tip-over incidents involving children and CSUs without televisions with a reported interaction. Among the fatal CPSRMS incidents, opening drawers was indicated as the scenario in four incidents, involving children from 11 months of age to 5 years of age (Figure 9). Among the nonfatal CPSRMS incidents, opening drawers was the reported interaction in 101 incidents, involving children from 13 months of age to 12 years of age (Figure 10). Among the nonfatal NEISS tip-over incidents involving children and CSUs without televisions, opening drawers was the reported interaction in 42 incidents, involving children as young as 11 months old and as old as 14 years old, while 2- and 3-year-old children were the most common (Figure 11).

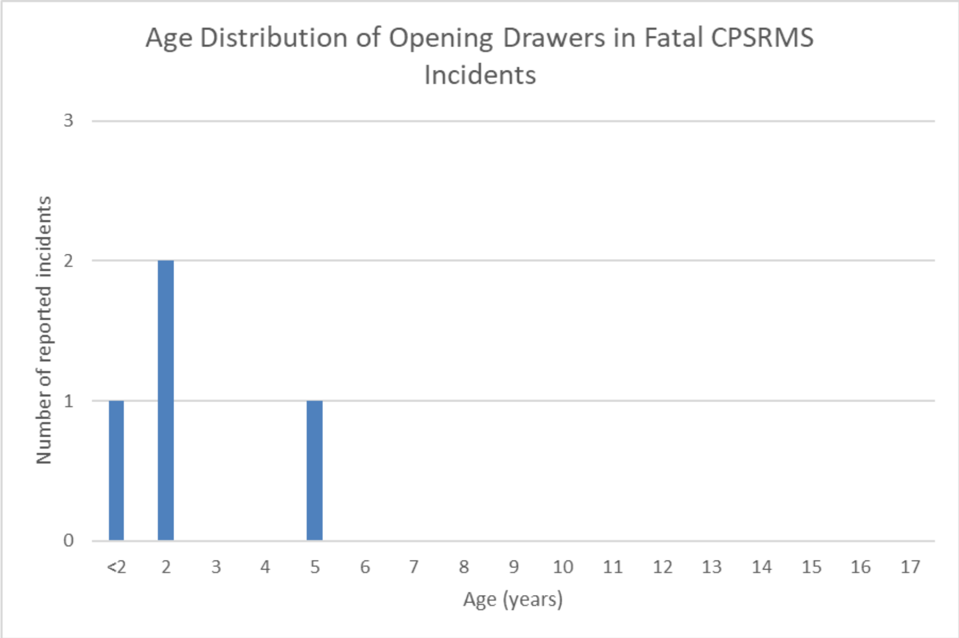

Figure 9. Age distribution of opening drawers in fatal CPSRMS tip-over incidents involving children and CSUs without televisions.

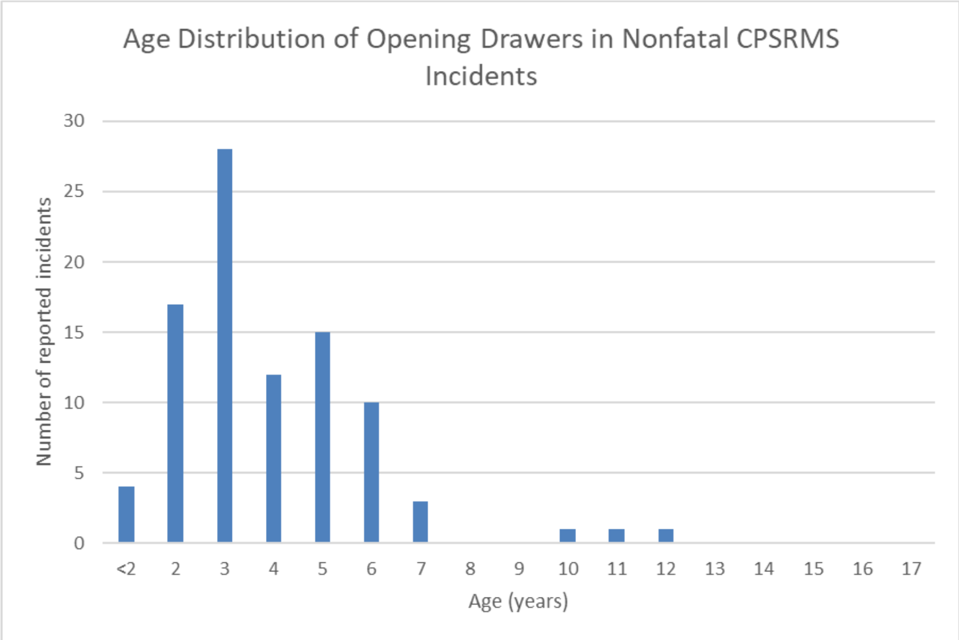

Figure 10. Age distribution of opening drawers in nonfatal CPSRMS tip-over incidents involving children and CSUs without televisions.

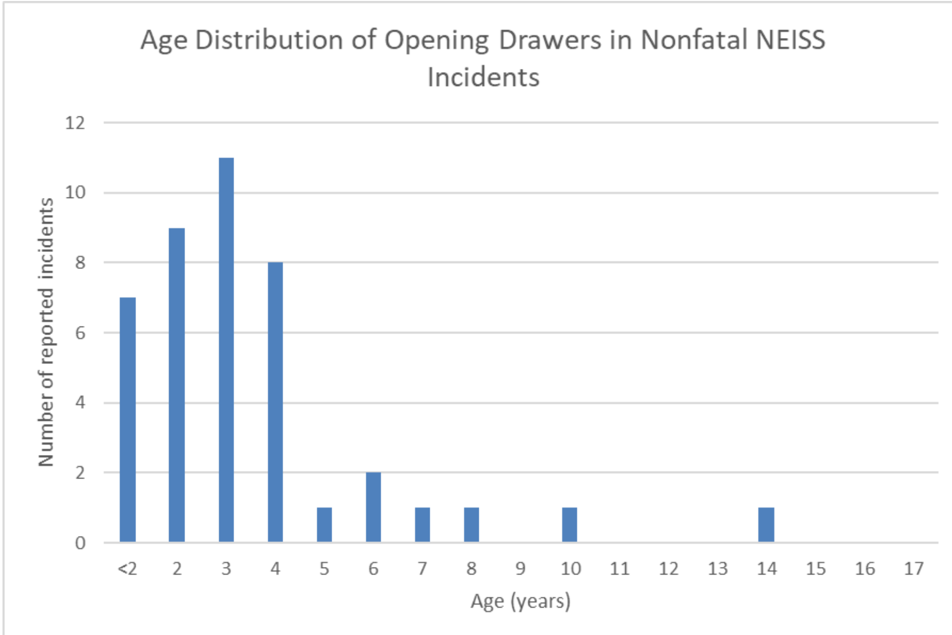

Figure 11. Age distribution of opening drawers in nonfatal NEISS tip-over incidents involving children and CSUs without televisions.

Among the 352 CPSRMS tip-over incidents involving children and CSUs without televisions (89 fatal and 263 nonfatal), 159 incidents reported that children opened at least one drawer. This total includes 85 incidents in which children opened one drawer, 27 incidents in which children opened "multiple" drawers, 44 incidents in which children opened a specific number of drawers greater than 1 (ranging from 2 to 8), and three incidents in which children opened "all" of the drawers. It is possible that some portion of the incidents that identified specific numbers of open drawers involved all of the drawers being open. Two additional cases reported that no drawers were opened, and the remaining 191 cases did not indicate whether drawers were open. Children of all ages were able to open at least one drawer, when reported (Figure 12). Overall, about 53 percent of incidents involved children opening one drawer, 10 percent involved opening two drawers, and almost 17 percent involved opening "multiple" drawers, when drawer opening was reported in the incidents.

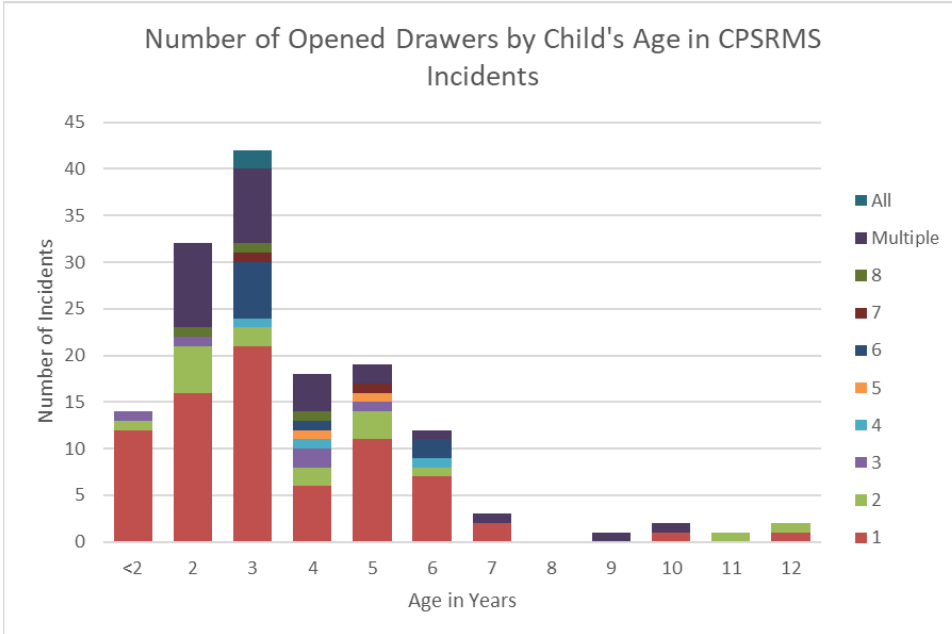

Figure 12. Number of opened drawers by age in CPSRMS tip-over incidents involving CSUs without televisions.

Children's Ability to Open All Drawers

A total of 23 children in the CPSRMS incidents were reportedly able to open all drawers on the unit. The CSUs in these incidents ranged from a minimum of 2-drawer units to a maximum of 8-drawer units. The youngest child reported to open all drawers in the CSU was 13 months old (single column, two-drawer unit); the youngest child who was able to open all eight drawers was a 2-year-old. Table 4 shows the number of drawers opened by child's age, when known. In addition, in one case, a child with an unknown age opened both drawers; in another case, a child with an unknown age opened all six drawers; in another case, a child with an unknown age opened "all" drawers; and in one case, a 3-year-old opened "all" drawers.

Table 4. Number of Drawers Opened in All-Drawers-Open Incidents by Age in the 352 CPSRMS Incidents

Age Group	*Number of open drawers in all-drawers-open incidents*							
	1	*2*	*3*	*4*	*5*	*6*	*7*	*8*
<2		1						
2								1
3				1		6	1	1
4			2		1	1		1
5					1			
6						2		

6.6 Differences in Interactions by Age

Based on the incident data, children 3 years old and younger appear to climb, open drawers without climbing, get items in and out of drawers, lean on open drawers, push down on open drawers, sit or lay in bottom drawers, or stand on open bottom drawers. Starting from 4 years of age, children did not appear to sit or lie in bottom drawers of a CSU. Figure 13 and Figure 14 show the known interaction scenarios by age for fatal and nonfatal CPSRMS tip-over incidents involving children and CSUs without televisions. Figure 15 shows the known scenarios by age in nonfatal NEISS tip-over incidents involving children and CSUs without televisions.

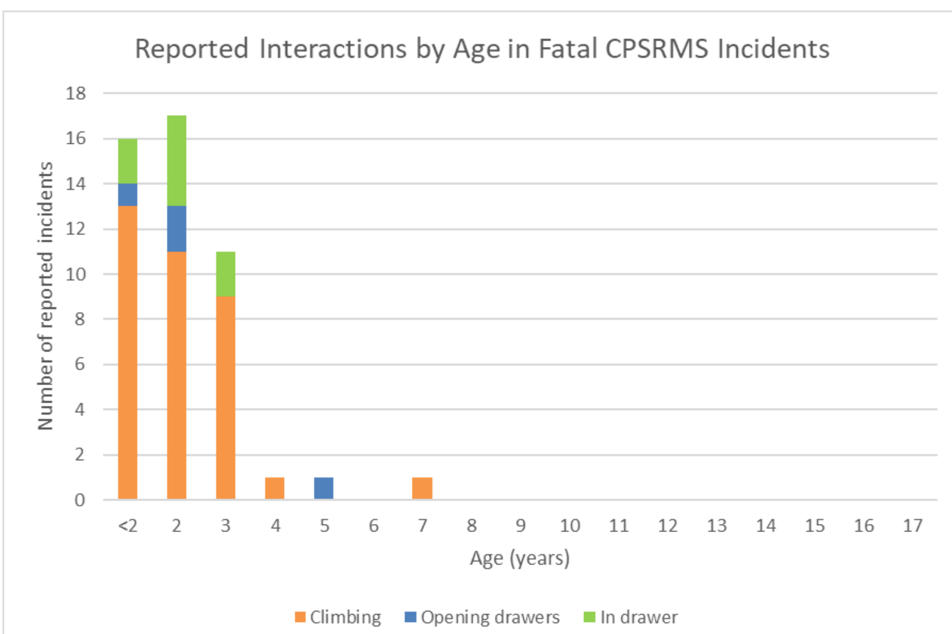

Figure 13. Reported interactions by age in fatal CPSRMS tip-over incidents involving children and CSUs without televisions.

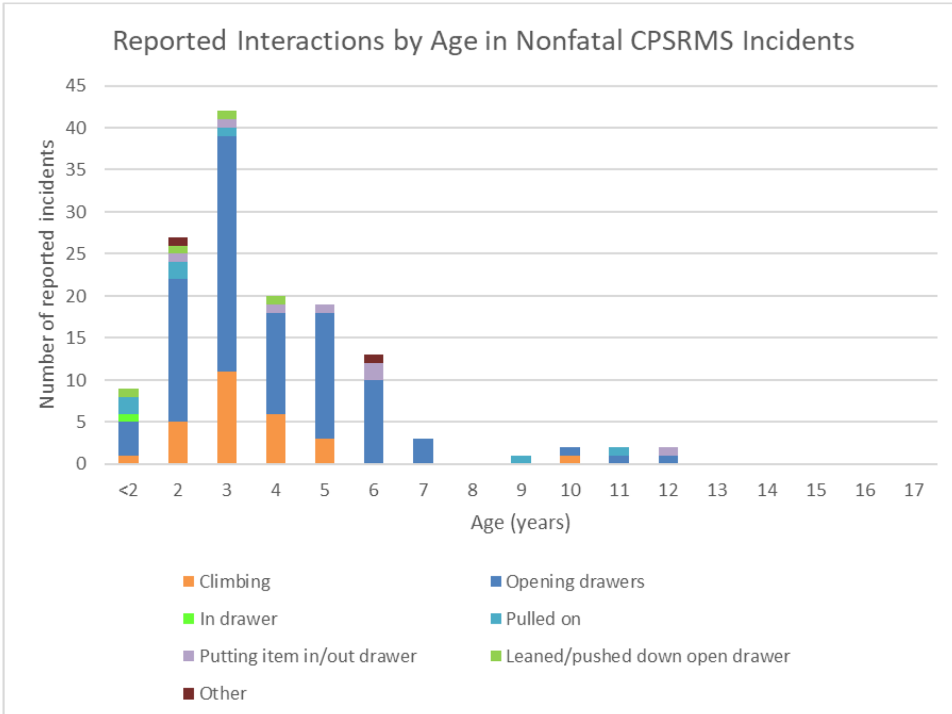

Figure 14. Reported interactions by age in nonfatal CPSRMS tip-over incidents involving children and CSUs without televisions.

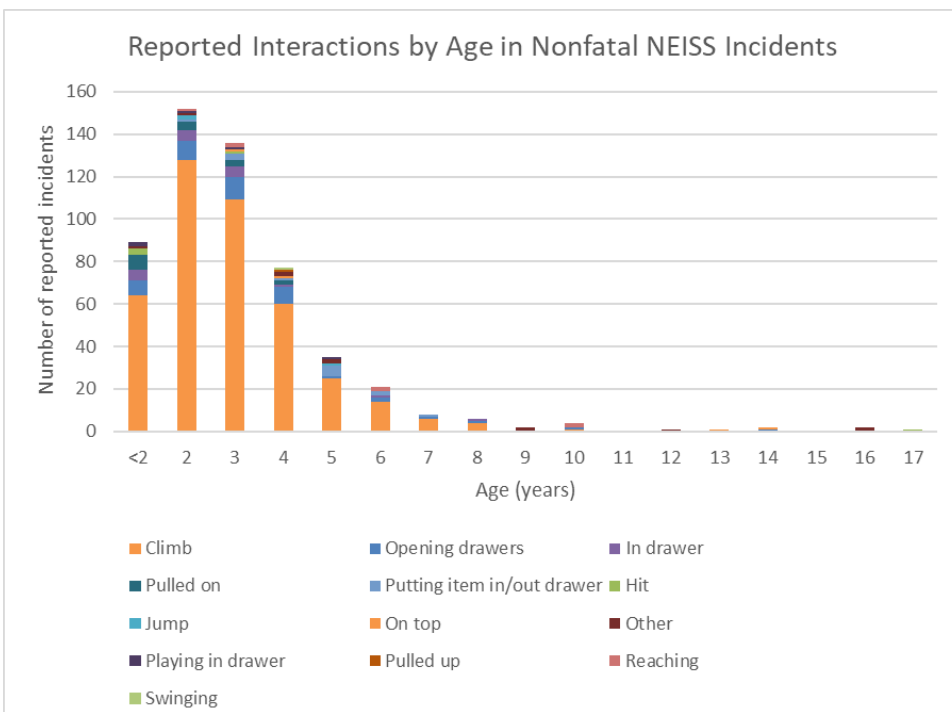

Figure 15. Reported interactions by age in nonfatal NEISS tip-over incidents involving children and CSUs without televisions.

7. CHILDREN'S INTERACTIONS WITH CSUS AND SIMILAR ITEMS BASED ON NATURALISTIC VIDEOS

Staff reviewed online videos to examine children's interactions with CSUs further, including climbing and other interactions that can contribute to tip over. Staff found these videos by searching YouTube using combinations of keywords such as "climb dresser," "child climb," "child drawer," "open drawer," and "child dresser," in addition to viewing related recommended videos.[10] Staff also reviewed videos from news programs, online news sources, and articles. Staff's analysis included videos that show a tip over and videos without a tip over. When enough information on the source of a tip over video was available, staff assigned a CPSC investigation into the incident; so, in these cases, the tip over shown in the video is also part of the CPSC incident data set. Staff included the videos without a tip over because they show child behavior that can contribute to CSU instability and tip over (*i.e.,* if a child interacted in a similar way with a less stable CSU, it could tip over). Staff also included some furniture items similar to CSUs because they show children's interactions with multiple-drawer units that could translate to children's interactions with CSUs.

Videos of children climbing on CSUs and other similar furniture items show a variety of climbing techniques, including stepping on the top of the drawer face, stepping on drawer knobs, using the area between drawers as a foothold, gripping the top of an upper drawer with the hands, pushing up using the top of a drawer, and using items to help climb (Figure 16). Some videos show multiple children climbing a CSU simultaneously.

[10] After opening or viewing a video, YouTube recommends additional videos with similar content, including videos that were not part of the original search results. See Appendix A for additional search terms.

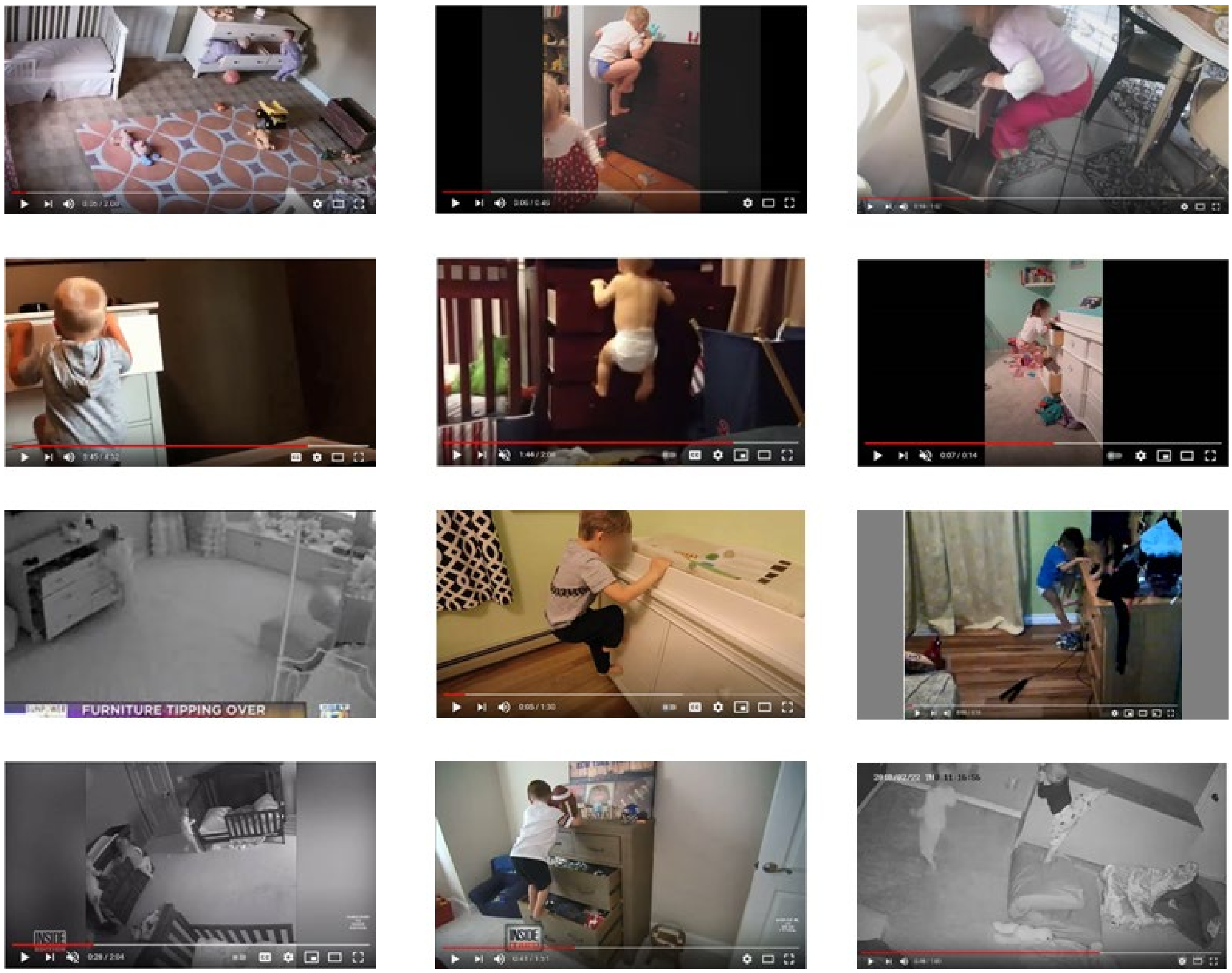

Figure 16. Images from online videos showing a variety of techniques that children use when climbing CSUs and other similar furniture items. NOTE: visible faces are blurred.

Videos of children in drawers of CSUs and other similar products include children leaning forward and backward out of a drawer; sitting, lying, and standing in a drawer; and bouncing in a drawer. Some videos also show multiple children in a drawer simultaneously (Figure 17).

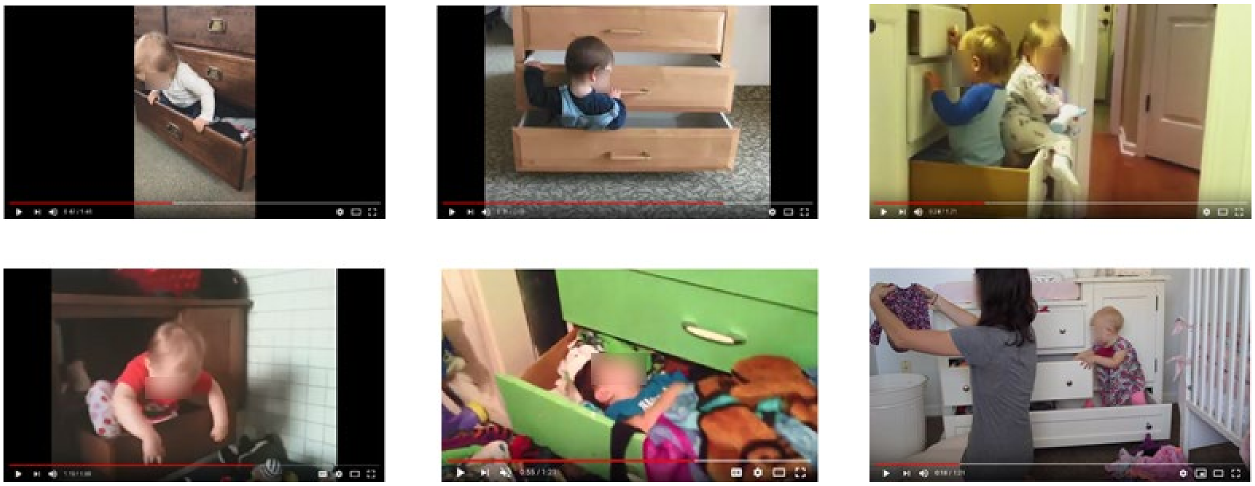

Figure 17. Images from online videos showing a variety of children's interactions in drawers of CSUs and other similar furniture items. NOTE: visible faces are blurred.

ESHF staff also reviewed videos showing a variety of other child interactions with CSUs and other similar products in homes, including opening and pulling on drawers, jumping off the top surface, falling, and standing inside the frame of the CSU (Figure 18).

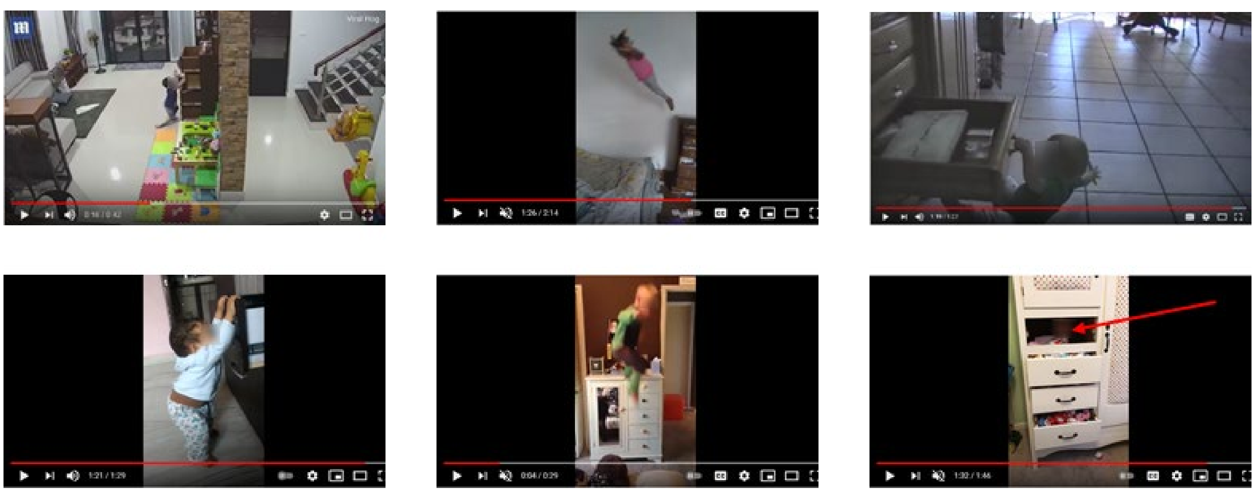

Figure 18. Images from online videos showing other interactions with CSUs and other similar furniture items. The videos on the left show children opening/pulling on drawers; the videos in the middle show children jumping off of CSUs; the top right video shows a child falling while holding a drawer; and the bottom right video shows a child inside of a CSU frame (arrow added). NOTE: visible faces are blurred.

8. CPSC-COMMISSIONED STUDIES

In 2019, CPSC staff commissioned two human subjects studies to provide additional information on CSU use and stability: the Fors Marsh Group (FMG) CSU use study (Tab Q), and the University of Michigan Transportation Research Institute (UMTRI) child climbing study (Tab R).

8.1 FMG CSU Use Study (Tab Q)

The purpose of the FMG CSU use study was to assess factors that influence consumers' perceptions and interactions with CSUs and their associated warning information, factors that influence consumers' decisions to select and use certain products, and their knowledge, awareness, and behaviors associated with furniture tip over. Work was completed under CPSC contract CPSC-D-16-0002, Task Order: 61320619F1103.

The study consisted of six in-home interviews with participants (also called "ethnographies") and six 90-minute focus groups with eight participants each (48 total focus group participants). The six interview participants had children between 18 months and 72 months old in the home. FMG researchers separated focus group participants by caregiver status (parents of a child age 1-5 years old; people who are visited regularly by children ages 1-5 years old; and people who plan to have children in the next 5 years); and homeowner status (people who rent their home and people who own their home). Each focus group contained people with the same caregiver and homeowner status, to allow comparisons between these groups. Researchers conducted the study in Richmond, VA, in November and December 2019.

In preparation for this study, CPSC staff worked with FMG researchers to develop a discussion guide for each part of the study, which researchers used as a roadmap during conversations with participants. This discussion guide was based on specific questions that CPSC staff generated, based on their work with the ASTM F15.42 Furniture Safety subcommittee and other CSU tip-over work. and the guide contained questions related to consumers' perceptions and use of CSUs, including their interactions with CSUs; how they use CSUs in their home; their opinions on warning label placement and content; their perception of what furniture constitutes a CSU; factors that influence product selection and placement; and experience with furniture anchoring and tip overs. Unlike a survey in which participants answer specific questions, the in-home interviews and focus groups were conversational, allowing participants to respond to prompts in the way they chose and elaborate on items of interest. In the focus groups, participants were also able to respond to and build on other participants' responses.

Researchers noted several limitations that should be considered when interpreting the results. Researchers noted that it would be beneficial to investigate further and obtain additional data on how the subpopulations of interest (parents, non-parents who are planning to have or are visited by young children, renters, homeowners) use and classify CSUs. To obtain a more diverse, geographic sample, it would be advantageous to expand this research into various areas across the country.

The full report, titled, "Consumer Product Safety Commission (CPSC): Furniture Tipover Report," is provided in Tab Q.

8.2 UMTRI Child Climbing Study (Tab R)

The purpose of the UMTRI child climbing study was to collect additional information on how children interact with CSUs and the forces they can exert during certain interactions. Work was completed under CPSC contract 61320618D0004, Task Order 61320619F1015.

The study consisted of a discussion with children, their caregivers, and the researchers that focused on the child's climbing behaviors. UMTRI researchers also collected information on the forces that children can exert during interactions with a CSU. Child participants interacted with a test fixture with two bars representing a lower foothold and an upper handhold of a CSU,[11] and separately, a simulated drawer and tabletop (to simulate the top of a CSU). Forty children, age 20 months to 65 months old, participated in the study. Researchers conducted the study in Ann Arbor, MI, in fall 2019, and winter 2020.

In preparation for this study, CPSC staff worked with UMTRI researchers to develop a test fixture that modeled the climbing surfaces of a CSU. CPSC staff provided information to UMTRI researchers on drawer extension and heights from the sample of dressers used in the Laboratory Sciences Mechanical Engineering Division (LSM) staff evaluation (Tab N). Researchers selected and constructed a parallel bar test fixture, representing a lower foothold and an upper handhold. These bars represent a best-case CSU climbing surface, similar to the top of a drawer. Because of safety concerns, researchers were not able to create a moving drawer, or stagger the upper bar farther from the participant than the lower bar. Despite these limitations, CPSC staff believes that the test fixture is sufficiently representative of a CSU to simulate children's interactions.

Researchers set the upper bar to three different heights relative to the padded floor surface: low (50 percent of the child's upward grip reach), mid (75 percent of the child's upward grip reach), and high (100 percent of the child's upward grip reach); researchers set the lower bar to two different heights: low (4.7 inches from the padded floor surface) and high (the child's maximum step height above the padded floor). The heights for the bars were within plausible heights for CSU drawers. Researchers set the horizontal position of the upper bar to two different positions:

[11] Staff reviewed online videos that show children using a variety of footholds and handholds when climbing a CSU, including the drawer pulls, the top of the drawer, the space between drawers, and the CSU top.

"aligned" with the lower bar, or "offset" from the lower bar, at a distance equal to 20 percent of the child's upward grip height.

Researchers constructed separate test fixture components for the drawer and tabletop conditions. The drawer was a 24-inch-wide by 16-inch-deep by 8-inch-high aluminum box with transparent plexiglass sides, with a separate 12-inch-high aluminum front face. The inside bottom surface was padded with the same material as the floor, decreasing the interior height to 6.75 inches. The tabletop was created by bolting a 28-inch-wide and 16-inch-deep wooden board to the back and sides of the drawer box (Figure 19).

The bars, drawer, and tabletop, as well as the floor in front of the test fixture, had force measurement instrumentation that recorded forces over time in the horizontal (fore-aft, x) and vertical (z) directions.[12]

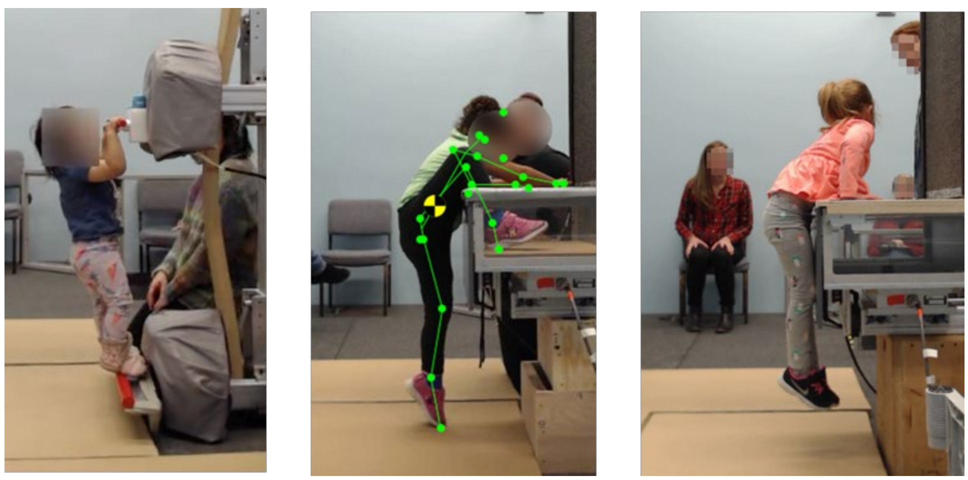

Figure 19. Study participants interacting with the parallel bars (left), drawer (center), and tabletop (right).

UMTRI researchers used the forces exerted by the children in the x and z directions to calculate the tip-over moment around a virtual fulcrum (see Tab D for more discussion of forces and moments). The researchers based the fulcrum location on a dataset of CSU drawer extensions and heights provided by CPSC staff. Researchers also mapped the participants' center of gravity during the interaction, to get a better understanding of the influence of the child's posture on the forces.

Staff worked with UMTRI researchers to develop a set of scripted interactions. Staff focused on realistic interactions in which the child's position and/or dynamic interactions were the most

[12] UMTRI researchers also collected forces in the lateral (y) direction, but these forces were generally small and were not analyzed.

likely to cause CSU tip over. The interactions were based on incident data and online videos of children interacting with CSUs and other furniture items. The interactions UMTRI researchers evaluated included:

- *Ascend:* climb up onto the test fixture;
- *Bounce:* bounce vigorously without leaving the bar;
- *Lean back:* lean back as far as possible while keeping both hands and feet on the bars;
- *Yank:* from the lean back position, pull on the bar as hard as possible;
- *1 hand & 1 foot:* take one hand and foot (from the same side of the body) off the bars and then lean as far away from the bars as possible;
- *Hop up:* hold the upper bar and try to jump from the floor to a position where the arms are straight and the hips are in front of the upper bar, an action similar to hoisting oneself out of a swimming pool;
- *Hang:* hold onto the upper bar, lift feet off the floor by bending knees, hang still for a few seconds, and then straighten legs to return to the floor; and
- *Descend:* climb down from the test fixture.

ESHF staff assesses that ascent best models the climbing behavior commonly seen in incidents. The ascent interaction in the UMTRI study is analogous to a child's initial step to climb up on to the CSU, which is an integral climbing interaction. The other, more extreme interactions: bounce, lean, and yank were identified as plausible interactions, based on child behavior; but these interactions were not directly observed in the incident data.

The drawer and table top interactions were also based on observed interactions in incident data and videos. For the drawer condition, researchers asked participants to climb into the drawer, sit down for a moment, and then climb out. The drawer was set to the height of the child's navel and then to the highest height, the height of the child's armpit, or a mid-height (*i.e.*, the halfway height between the child's navel and armpit task), depending on the child's ability to climb into the drawer. After the drawer trials, researchers left the drawer at the highest position the child was able to climb into the CSU successfully, and attached the wood board on top of the drawer to simulate the top of a CSU. The child was placed on top of the fixture and asked to climb down to the front.

For incidents involving children and CSUs without televisions, climbing was the most common reported interaction in fatal CPSRMS and nonfatal NEISS incidents, and the second most common reported interaction in nonfatal CPSRMS incidents. For this reason, staff focused the recommended performance requirements on forces generated when a child climbs a CSU. Although other plausible climbing-associated behaviors (*e.g.*, yank, lean, bounce, one hand) included in the UMTRI study generated higher moments, staff did not see direct evidence of these interactions in the incident data. Therefore, staff did not focus the recommended performance requirements on these interactions. However, staff notes that, depending on the child's age, weight, and strength, some of these interactions could be addressable with the recommended performance requirements. Other measured climbing interactions, for example, including hop up, hang, in drawer, and climbing onto the table top, generated lower moments than ascent; and thus, they are addressed by the recommended performance requirements based on ascent. Although researchers coached participants to perform the interactions, researchers did not specify exactly how the participants executed the interactions. Thus, within the data, there is between subject and within subject variability in the interaction and associated forces. Researchers reviewed the data to determine whether executed actions were within the scripted behavior definition, and staff eliminated interactions in which the child's interaction was inconsistent with the desired interaction. CPSC staff also reviewed the pictures and video of the children interacting with the test fixture to confirm that the behavior was plausible for a CSU interaction.

Researchers noted several limitations that should be considered when interpreting the results. The fixtures in the laboratory were intended to produce idealized boundary conditions; they were rigidly mounted and did not allow actual tip-over or instability to occur to keep the participants safe during the study. The fixtures were not designed to measure the dynamic events such as a change in the dresser center of mass location for the fulcrum. Researchers concluded that, in general, these dynamic changes would likely reduce the moment required to continue to move the unit toward tip over. The analysis focused on peak values of tip-over moment and used a low-pass filter frequency of 200 Hz to allow short-duration peaks to be identified. A lower filter frequency would tend to reduce the peak moment. In addition, recruited children reportedly liked to climb; it is unknown whether they represent the climbing tendencies of the general population. Finally, researchers directed the participants to perform a set of behaviors that were determined to be developmentally appropriate; however, laboratory setting and encouragement from their caregivers may have led the children to engage in riskier behaviors than they would have on their own. The full report, titled, "Forces and Postures During Child Climbing Activities: Technical Report," is provided in Tab R. Additional analysis of study data is in Tab D.

9. DISCUSSION OF INTERACTION SCENARIOS

9.1 Climbing and Child Behavior

As stated, climbing was the reported interaction in the analyzed fatal CPSRMS incidents for children as young as 14 months old and as old as 7 years old; 16 months to 10 years in the analyzed nonfatal CPSRMS incidents; and as young as 9 months old and as old as 13 years old in the analyzed nonfatal NEISS incidents. Fatal climbing incidents most often involved 1-, 2-, and 3-year-old children, and nonfatal climbing incidents most often involved 2- and 3-year-old children. These findings make sense in light of children's motor development. Children generally are able to walk up the stairs with support when they are 1 year old (Bayley, 1969)[13]; and older 1-year-olds are known to be capable of climbing on and off furniture without assistance (Therrell, Brown, Sutterby, & Thornton, 2002). Frost and colleagues (2001) report that gross motor play and the use of climbers are dominant, starting at about 1-½ years of age; and as these children approach age 2, they engage extensively in gross-motor play and begin to learn to use large playground apparatuses independently. Two-year-old children especially enjoy climbing, and can climb steps, short ladders, and jungle gyms (Therrell, Brown, Sutterby, & Thornton, 2002; Hughes, 1991). The UMTRI child climbing study focus group (Tab R) identified many household items that children showed interest in climbing, including: CSUs, tables, desks, counters, cabinets, shelves, windows, sofas, chairs and beds. In the same study, six children climbed dressers, based on caregivers' reports. Caregivers provided various tactics such as "jumped up," "hands and feet," "ladder style," and "grab and pull up" used for climbing, but the most common strategy (6 responses) was stepping into or onto the lowest drawer. Many caregivers mentioned children using chairs, stools, and other objects to facilitate their climbing, including pulling out dresser drawers. One caregiver reported that the child had tipped a dresser over by climbing on it.

9.2 Opening Drawers and Climbing

As explained in Directorate for Engineering Sciences, Division of Mechanical and Combustion Engineering (ESMC) memo (Tab D), CSUs tip more easily as more drawers are opened. Although the staff-reviewed videos show that it is possible for a child to climb a CSU without opening any drawers, or climb from the side or back, based on the incident narratives and videos, ESHF staff concludes that the most common climbing scenario leading to tip over is climbing on the drawers in the front of the CSU with one or more drawers open (about 42 percent of fatal and nonfatal CPSRMS climbing incidents had a child opening one drawer or more, 28 of 67; in 39 cases, whether or not the drawers were open was not reported). Based on staff's evaluation of the pull strength to open drawers on various samples, which ranged from 1 to 6 pounds, opening drawers to their *maximum drawer extension* is within children's capability; videos and incidents support that children are opening drawers fully.

Of the 35 fatal CPSRMS climbing incidents, 13 reported the number of drawers open; in all of these incidents, the reported number of drawers open was one. However, based on further analysis, the number of open drawers could be as high as 8 in one incident: ESMC staff analysis suggests that 7 or more drawers of an 8-drawer unit were open and the child was in a drawer leaning out over the edge in the fatal incident described in Tab M, Model E.

[13] The median age is 16.1 months, and the 5th and 95th percentile range is 12 to 23 months.

Of the 32 nonfatal CPSRMS climbing incidents, 15 gave some indication of the number of open drawers. Of these, 7 reported that one drawer was open, 2 reported that less than or equal to half of the drawers were open, 4 reported that multiple drawers were open, and 2 reported that all the drawers were open. In the two cases where all drawers were open, children were 3 and 4 years of age.

Of the 412 climbing incidents in the-nonfatal NEISS data, 28 gave some indication of the number of open drawers. Of these, 11 reported that one drawer was open, 12 reported that multiple drawers were open, one reported that two drawers were open, and two reported that all drawers were open. These data are consistent with the videos, which show a range of drawer positions, including all drawers closed, one drawer open, multiple drawers open, and all drawers fully open while a child is climbing.

9.3 Climbing and Weight

As explained in ESMC memo (Tab D), weight is a factor in determining the force generated by climbing interactions. The weight of the child was reported in 23 of the 35 fatal CPSRMS climbing incidents, and ranged from 21.5 pounds to 45 pounds. For the remaining 12 climbing incidents in which the child's weight was not reported, the ESHF staff-estimated weight ranged from 23.8 pounds to 39 pounds. The weight of the child was reported in 8 of the 32 nonfatal CPSRMS climbing incidents, and ranged from 26 pounds to 80 pounds. For the remaining 24 climbing incidents in which the child's weight was not reported, the ESHF staff-estimated weight ranged from 25.2 pound to 45.1 pounds. Weight was not reported in the nonfatal NEISS data. Based on the age range for the 412 nonfatal NEISS climbing incidents, 9 months to 13 years old, the ESHF staff-estimated weight ranged from 19.6 pounds to 122 pounds; whereas, the weighted average of children's estimated weight was 34.2 pounds.

9.4 Opening Doors and Climbing

Although there is limited information in the incident data on children's interaction with doors on either CSUs with a combination of drawers and doors or on CSUs with only doors, staff found two fatal CPSRMS and four nonfatal CPSRMS tip-over incidents involving wardrobes and armoires. In one of the fatal incidents, the victim was found inside a two-door, one drawer wardrobe that led staff to conclude that she first opened the doors and got inside the wardrobe. In the other fatal incident, the victim was found under a two-door wardrobe; the interaction is unknown. In most of the nonfatal incidents, children were reportedly interacting with items inside the wardrobe or armoire which would require them to open the doors first. Although the ages of the children involved in these incidents ranged from 3 years to 11 years, staff concludes that the initial action of opening the doors is easily within physical and cognitive capabilities of even younger children based on child development.

ASTM F2057 – 19, *Standard Safety Specification for Clothing Storage Units*, provides a test method for doors that uses the same 50-pound weight on the door face as used on the drawer face, implying that the simulated interaction is the same (a child applying their full body weight to the extension element). Staff assesses that while there is no direct evidence that children put their body weight on doors in the incident data, this is a plausible interaction, based on child capabilities, provided that the child has a sufficient hand-hold. ESHF staff assesses that a climbing interaction on a door may be different than with a drawer, because a child is less likely to have a foothold on a door. ESHF staff assesses that the hang and hop-up interactions measured by UMTRI researchers, in which the child is interacting with an upper hand hold, are likely to be more representative of a child climbing on a door than the ascend interaction. In the hang interaction, the child would hold onto an upper hand hold on the CSU and lift their feet off the floor. In the hop-up interaction, the child, while holding an upper hand hold, would try to jump from the floor to a position where their arms are straight and their hips are in front of the upper hand hold (similar to hoisting oneself from a swimming pool). It is also possible that children would put their feet against the door, or put a foot on a foothold, such as a door frame; this interaction could be similar to the ascent interaction.

Because there is no incident data confirming that the scenario of a child opening doors and climbing has been involved in incidents, staff requests comments on whether this interaction should be addressed in the rule.

ESHF staff also assesses that children are capable of opening doors to any normal-use extension (including fully open).

9.5 Opening Drawers Without Climbing

In addition to climbing on open drawers, as discussed previously, solely opening drawers without climbing also caused tip over in some incidents. The fatal CPSRMS incidents include four fatalities in which the CSU tipped when the child opened one or multiple drawers. In one case, an 11-month-old opened one drawer of a 5-drawer CSU; in the second case, a 2-year-old opened at least two drawers of a 3-drawer unit, and in the remaining two cases, a 5-year-old and a 2-year old opened multiple drawers of CSUs with unknown number of drawers. As discussed, opening one or more drawers is the most prevalent interaction in nonfatal CPSRMS incidents; out of the 101 opening drawer incidents, 57 resulted in injuries. In the nonfatal NEISS cases, there are reports of 42 incidents in which children opened one, two, multiple, or all drawers resulting in injuries. In the UMTRI child climbing study, described in Tab R, 29 out of 37 caregivers who responded on the question of how their child interacted with furniture, reported that their child opened and closed drawers. Children's ages in the UMTRI study ranged from 20 months to 65 months.

Although it is possible for CSUs to tip over from the moment generated by open drawers and/or their contents alone (with no additional interaction forces), ESHF staff assesses that forces from a pulling interaction should be considered as well. Large moments can be generated, depending on the amount of pull force applied, and the distance between the drawer pull location from the floor. Thus, pull strength and distance from the pull location to the floor, are relevant considerations. When opening a drawer, children pull on the drawer. As the drawer opens, this pull is translated to outward motion of the drawer; once the drawer is fully opened to the stop, any additional pulling will be on the CSU as a whole.

Staff analyzed 15 incidents in which the height of the force application could be calculated based on the details provided in the incident narratives. Staff also examined pull strengths that children can generate. In the 15 incidents that provided information about the height of pull force application, heights ranged from less than a foot to almost four feet (46.5 inches), while children reportedly pulled the lowest, highest, and drawers in between.

The mean pulling strength of 2- to 5-year-old children on a convex knob (diameter 40mm) at their elbow height is 59.65 Newton (13.4 pound-force) for males and 76.43 Newton (17.2 pound-force) for females (DTI, 2000.) In this study, participants were asked to exert their maximum strength at all times, described as the highest force they could exert without causing injury. Participants were instructed to build up to their maximum strength in the first few seconds, and to maintain maximum strength for an additional few seconds. Participants were instructed to use their dominant hand. Staff assesses that children may have been exerting similar forces on the drawer that may have caused the CSU to tip.

It is important to note that drawers identified in incidents as "open" could be partially or fully open, but this level of detail is not typically provided in the incident information. ESHF staff finds it reasonable to assume that drawers identified as open in the incident data are fully open (to the outstop), because fully open is the typical use position, and it is within a child's capabilities.

Staff concludes that children at any age are able to open multiple drawers and pull drawers at a higher force than regular drawer opening forces to trigger a tip over of the CSU.

10. FILLED DRAWERS

Information about the fill level of the CSU drawers at the time that the CSU tipped over was reported for 59 percent of fatal CPSRMS incidents (53 of 89) and 25 percent of nonfatal CPSRMS incidents (67 of 263) involving children and CSU tip overs without televisions. For incidents with reported drawer fill level, most involved partially filled or full drawers (96 percent of fatal incidents and 90 percent of nonfatal incidents). The proportion of incidents that reported full drawers was greater for fatal incidents (26 percent) than for nonfatal incidents (10 percent) (Table 5).

Table 5. Fill Level for Fatal and Nonfatal CPSRMS CSU Tip-Over Incidents, When Reported

	Fatal Incidents	Nonfatal Incidents
Empty	4% (2)	10% (7)
Partially Full	70% (37)	79% (53)
Full	26% (14)	10% (7)

CPSRMS incidents show that most items in the drawers were clothing, although a few mentioned other items along with clothing. For example, in the fatal incidents, clothing and additional items, including a diaper bag (1), toys (1), papers (1), and miscellaneous (5) were reported. Moreover, putting clothing in CSUs is the expected use. The nonfatal NEISS incident reports did not contain information on drawer fill level or contents.

In the in-home interview portion of the FMG CSU use study, researchers found that CSU drawers in consumers' homes were generally 70 percent to 80 percent full of folded clothing, with "some room between the clothing and the edge of the drawer." They also found that clothing was generally "loosely folded and did not appear to be stuffed or tightly packed" (Tab Q, p. 16).

As discussed in Tab D, and explored through testing in Tab M and Tab O, the weight of clothing (or other fill) in a drawer affects CSU stability. Members of the ASTM F2057 Multiple and Loaded Drawers Task Group previously used an 8.5 pound per cubic foot assumed clothing fill load for testing. In their study on furniture stability in 2016, Kids in Danger and Shane's Foundation researchers conducted testing with CSU drawers filled with 100 percent cotton, boy's size medium t-shirts (Kids in Danger and Shane's Foundation, 2016). Researchers measured the weight of the t-shirts in each drawer for four of the tested units and found that the density of the t-shirts ranged from 7.4 pound per cubic foot to 9.8 pound per cubic foot, with an average of 8.9 pound per cubic foot.[14] For this NPR briefing package, ESHF staff conducted additional drawer fill testing (Tab L), using the drawer volume calculation explained in Tab D:

$$Drawer\ Fill\ Weight = 8.5\frac{lb}{ft^3}[Drawer\ Area](ft^2)\left[Clearance\ Height - \frac{1}{8}\right](in)\left[\frac{1}{12}\right]\left(\frac{ft}{in}\right)$$

ESHF staff used this drawer volume because of its representation of real-world use: clothing can be stacked or folded above the height of the drawer sides, but needs sufficient clearance with the CSU case or other obstruction so that clothing does not get caught. Based on ESHF staff testing

[14] Data set provided to CPSC staff by Kids In Danger, January 29, 2021.

detailed in Tab L, 8.5 pound per cubic foot approximates the maximum amount of unfolded clothing that can fit in a drawer, as well as a drawer filled with folded clothing. Although ESHF staff determined that it is possible to get more than 8.5 pounds per cubic foot of folded clothing into a drawer, this maximum fill level was not usable (it was very difficult to remove and replace clothing), so staff concluded that this is not a likely drawer fill.

Because CSUs are intended to store clothing, and this use is supported by the incident data, ESHF staff concludes that the effect of clothing in drawers should be considered in the recommended performance requirements. Based on testing, staff concludes that 8.5 pounds per cubic foot is a reasonable approximation of the weight of clothing in a fully filled drawer. However, staff considers the amount that can be stored in pullout shelves that may be part of the CSU to be lower than this amount (*e.g.*, half of 8.5 pounds per cubic foot) because of the largely non-contained nature of a pullout shelf and low likelihood of consumers filling up the open area in a pullout shelf for fear of the clothes falling out. Staff requests data supporting or refining the estimates for both amounts.

11. FLOORING TYPE

The type of flooring under the CSU was reported for 62 percent of fatal CPSRMS tip-over incidents (55 of 89) and 23 percent of nonfatal CPSRMS tip-over incidents (60 of 263) involving children and CSUs without televisions. For the incidents where flooring type was reported, carpet was by far the most prevalent flooring type (Table 6).

Table 6. Reported Flooring Type for Fatal and Nonfatal CPSRMS CSU Tip-Over incidents, When Reported

	Fatal Incidents	Nonfatal incidents
Carpet*	81.8% (45)	80.0% (48)
Hardwood, Wood**	14.5% (8)	16.7% (10)
Front legs on carpet, back legs on wood	0% (0)	1.7% (1)
Tile/Linoleum	3.6% (2)	1.7% (1)

*Includes rug, ** Includes laminate wood

Flooring type was not reported in nonfatal NEISS incident reports.

The reports for 30 of the of the 46 fatal CPSRMS tip-over incidents involving carpet included photos with visible carpet. All carpet in these pictures appeared to be typical wall-to-wall carpeting. Four appear to be a looped pile carpet, and 26 appeared to be cut pile. ESHF staff found two incidents with reported "shag" carpeting, including one fatal incident. ESHF staff found one report mentioning a rug, although the thickness of the rug is unknown.

As discussed in TAB D, and explored through testing in Tab M and Tab P, carpet decreases CSU stability. Because CSUs are frequently placed on carpet, ESHF staff concludes that the effect of carpet should be considered in the recommended performance requirements. Based on the incident data, staff concludes that the carpet used in CSPC staff testing, detailed in TAB P, is reasonably representative of carpets in incident data.

12. HUMAN FACTORS RATIONALE FOR PROPOSED PERFORMANCE REQUIREMENTS

Based on the incident data review and results of the testing with sample units, ESHF staff recommends considering the factors listed below to be assessed through performance requirements:

1) Interaction scenario: Staff considered the most common and plausible interaction scenarios:

    a) *Climbing:* Nonfatal NEISS tip-over incidents involving children and CSUs without televisions demonstrate that climbing is the most frequent scenario at 77 percent of reported child interactions. This is supported by the fatal CPSRMS incidents, where climbing is the most frequently reported interaction (75 percent of reported child interactions), as well as nonfatal CPSRMS incidents, in which climbing is the second most common scenario (20 percent of reported child interactions).

    b) *Opening drawers:* Among nonfatal incidents, opening drawers was the most common interaction in CPSRMS incidents (101 of 160 reported interactions) and the second most common in NEISS incidents (42 of 559 reported interactions.) Nonfatal CPSRMS incidents show that children in incidents commonly opened multiple drawers.

        i) *Combined with climbing.* In addition to the sole action of opening drawers, children reportedly opened one or more drawers and climbed in 28 incidents out of the 67 fatal and nonfatal CPSRMS climbing incidents; in the remaining 39 incidents, it is unknown if the drawers were open. There are at least two nonfatal incidents in which a child reportedly opened all the drawers on a CSU and climbed: one 3-year-old who opened seven drawers, and one 4-year-old who opened five drawers. Given that opening multiple drawers significantly impacts the CSU stability, staff recommends performance requirements that address a child climbing on a CSU with all drawers open.

ii) *Exerting a pull force on a tall drawer to trigger a tip over*. As discussed, children can exert considerable pull forces on drawers, and the drawer could be high enough to generate a moment that causes a tip over. Staff recommends adding a pull force requirement that accounts for the force produced by a child pulling on a drawer, staff recommends testing with all drawers open to represent a worst-case scenario.

2) *Opening doors*: Staff analyzed two fatal CPSRMS and four nonfatal CPSRMS tip-over incidents involving wardrobes and armoires. Staff concluded that in one of the fatal incidents, the child first opened the two doors and got inside the wardrobe. In the other fatal incident, the interaction was unknown.

i) *Combined with climbing.* While staff concludes that there is no direct evidence in the incident data demonstrating that children have put their body weight on doors, it is a plausible interaction based on children's physical and cognitive abilities. UMTRI researchers found that the vertical forces associated with children hanging by the hands were close to the body weight of children. For these reasons, staff recommends testing CSUs with doors by simulating the weight of children hanging on an open door.

ii) *Exerting a pull force on a door to trigger a tip over*. Staff assesses that the initial action of opening the doors is easily within physical and cognitive capabilities of children, including younger ones, similar to opening drawers. ESHF staff also assesses that children are capable of opening doors to any normal-use extension (including fully open), considering that door knobs and pulls are handholds, and the top of the door can also function as a handhold. For these reasons, staff recommends adding a pull force requirement that is representative of children's pull strength, similar to opening a drawer, as explained above.

3) *Age group that is most severely impacted:* Children 3 years of age and younger are in the age group most affected in fatal tip-over incidents involving children and CSUs without televisions, with 94 percent of all fatalities involving children 3 years of age and younger. The same age range is also the most impacted group in nonfatal NEISS tip-over incidents involving children and CSUs without televisions and nonfatal CPSRMS tip-over incidents involving children and CSUs without televisions.

4) *Child weight:* Given that weight is a factor in determining the force generated by climbing interactions and that the most affected age group in tip-over incidents involving children and CSUs without televisions is children 3 years of age and younger, staff concludes that incorporating the 95^{th} percentile weight of 3-year-old boys will be the most protective for the most severely impacted age group. The 95^{th} percentile weight of 3-year-old boys is 51.2

pounds; whereas, girls for the same percentile weigh 42.5 pounds (Fryar et al., 2021).[15] Staff notes that boys were involved in 58 percent of NEISS incidents with children and CSUs without televisions, as opposed to girls at 42 percent. This weight will also cover the heaviest children in fatalities involving children and CSUs without televisions. There were two fatalities involving 45-pound children (a w-year-old and a 7-year-old). CSUs complying with a performance requirement based on 95th percentile weight of climbing 3-year-old boys would likely have prevented these two incidents.

5) *Flooring type:* Based on engineering testing and analysis, placing the CSU on a carpeted surface decreases stability. Given that 85 percent of fatalities and 80 percent of nonfatal CPSRMS incidents involving children and CSUs without televisions occurred on carpet, when flooring type was reported, staff recommends performance requirements that address the decreased stability of a CSU on a carpeted surface.

6) *Filled drawers:* Based on engineering testing and analysis, filled drawers decrease stability when more than half of the drawers are opened. Given that 96 percent of fatal and 90 percent of nonfatal CPSRMS tip-over incidents involving children and CSUs without televisions had full or partially full drawers when reported, staff recommends incorporating filled drawers into the test procedure.

Based on this information, ESHF staff recommends the following test requirements:

1. A test requirement to simulate a 51.2-pound child climbing on a CSU with all drawers open, placed on a carpeted surface with the drawers filled (unless a system such as interlocks prevents more than half of the drawers, by volume, to open, in which case all drawers must be empty). Staff also recommends a comparable test procedure for units with drawers to simulate children hanging on an open door. The 95th percentile weight of 3-year-old boys is 51.2 pounds; whereas, girls in the same percentile, weigh 42.5 pounds (Fryar et al., 2021).

   As discussed in Section 4, for fatal incidents where the child's weight was reported, the child's weight ranged from 18 pounds to 45 pounds. Therefore, staff believes that all of these fatalities could have been prevented if the CSUs involved had complied with the test recommendations detailed above.

   For the climbing interactions, staff calculates that CSUs that meet a requirement based on the climbing force generated by a 51.2-pound child, and that considers the effects of all drawers (or doors) open and drawers filled, plus the effect of carpet on stability, likely will protect 95 percent of 3-year-old boys by weight and more than 95 percent of 3-year-old girls, and

[15] Three years of age covers children who are at least 36 months old and under 48 months old.

virtually all younger children. This requirement will also protect more than 90 percent of 4-year-old boys and 95 percent of 4-year-old girls who also engaged in this climbing scenario. This testing would protect 75 percent of 5-year-old boys and more than 50 percent of 5-year-old girls.

2. A requirement to test CSUs to simulate a child pulling the top reachable extension element handhold within the overhead reach dimension of a 95th percentile 3-year-old. The goal is to ensure that the moment generated by pulling will not tip over the CSU. The moment generated with a horizontal force will be higher as the location of the force application gets farther from the floor. Staff's analysis of 15 incidents shows that the highest pull location was 46 inches from the floor. Staff recommends 17.2 pound-force of horizontal pull force to be applied to the top of an extended drawer in the top row of drawers that is less than or equal to 4.12-foot-high (49.44 inches). This recommended pull force is based on the mean pull strength of 2- to 5-year-old females exerted at elbow level on a convex knob (DTI, 2000).[16] The 4.12-foot height limit is based on the overhead reach height for a 95th percentile 3-year-old male (Pheasant, 1986). Staff notes the fatality resulting from opening one drawer is likely to be addressed with the recommended test procedure because the age of the victim in this fatality was 11 months; the recommended pull force of 17.2 pound-force is likely to be above an 11-month-old's pull force capabilities. The CSU in the incident had a height of 52 inches. However, given that the 95th percentile overhead reach of 2-year-old children is 46 inches (Pheasant, 1986), the 11-month-old victim would not have the ability to reach to the top of the incident unit. The second fatality resulting from opening drawers involved a 2-year-old male who was assumed to have opened two drawers of a 3-drawer unit, which was partially full of clothes. Staff estimates that this incident would likely have been prevented with the proposed test method. In the third fatality involving opening drawers, a 2-year-old female reportedly opened multiple drawers of a CSU with unknown number of drawers. Staff estimates this incident would likely have been prevented with the proposed test method. In the fourth fatality associated with opening drawers, a 5-year-old male reportedly opened multiple drawers of a CSU that was partially full. Staff believes that this incident would likely have been prevented with the proposed test method because according to the report, when all drawers were open, the CSU became unstable and tipped over easily with a very small amount of pressure from fingertips.

   Staff recommends performing this test with all possible drawers open and filled, if more than half of the drawers are open, and simulating a carpeted surface while pulling with a 17.2 pound-force horizontal force applied to the top of an extended drawer in the top row of drawers, or another handhold that is less than or equal to 4.12-foot-high (49.44 inches).

[16] Males had a lower mean strength in the same study. ESHF staff assesses that the mean strength for children 2 to 5 years old approximates more than 50th percentile 3-year-old strength.

Staff would like comments on the assumption of pull force and force application location. Staff would also like comments on the assumptions relating to children's interactions with doors and associated forces. Staff notes that there is one fatal incident with a CSU with doors only; but because the interaction was not reported, it is possible that the interaction did not include the child's body weight on the door.

13. ADDRESSABILITY OF INCIDENTS BASED ON NONFATAL NEISS DATA

Because of the ability to generate national estimates, staff used nonfatal NEISS interaction scenarios to estimate the number of incidents that could be prevented with the recommended performance requirements, as shown below:

Climbing. Staff assumed that all drawers were filled and opened and that the CSU was placed on carpet for all reported climbing interactions. Staff calculated the addressability of these incidents using the weight range for each age. For example, with the recommended test requirements, virtually all climbing incidents are presumably addressable involving 2-year-old children because they are all well under 51.2 pounds (95th percentile 2-year-old boys weigh 38.8 pounds and girls weigh 34.7 pounds). Staff estimates that 95 percent of such climbing scenarios are addressable for 3-year-old children; 92 percent are addressable for 4-year-old children; 64.5 percent for 5-year-old children; 50 percent for 6-year-old children; 25 percent for 7-year-old children; and 7.1 percent for 8-year-old children.[17]

Playing in drawer, putting items in/out of drawer, reaching, pulling up, hitting the CSU. Staff estimates that these scenarios will all generate fewer moments than the recommended test methods; therefore, staff assumes that these scenarios are addressable.

Jumping, falling from top of CSU (on top), and swinging. Staff evaluated each of the seven incidents separately considering the possible moment and reported age of the child and determined that five of the seven would be addressable.

Opening drawers and pulling on the dresser. Staff assumes that opening drawer incidents and pulling on interactions are addressable for some children and not addressable for others, because those actions are likely to generate higher moments than the proposed test requirement for older children. Staff-recommended pull strength of 17.2 pound-force is based on study participants with an age range of 2 to 5 years and the mean weight of 16.3 kilograms (36 pounds). This weight is over 50th percentile weight of 3-year-old children; so, we assume that the pull force test requirement will address drawer opening and pulling on CSU incidents for 50 percent of 3-year-

[17] For reference, only 25 percent of climbing incidents are presumably addressable for 7-year-olds because 25th percentile 7-year-old boy weighs 50.3, and girl weighs 48.6 pounds.

olds, 95 percent for 2-year-olds, 100 percent for under 2 years, 25 percent for 4-year-olds, 10 percent for 5-year-olds, and will not address these incidents for 6 years old and up.

Other. Staff evaluated each of the 11 incidents classified as "other" and found that three to four were addressable with the recommended test procedure.

Based on staff's assumptions, staff calculates that 91.2 percent of all nonfatal NEISS incidents involving *climbing* interactions are likely to be addressed with the recommended test procedure. Staff notes that this number is a low estimate, because we assumed that all climbing incidents occurred with all open and filled drawers on CSUs located on a carpeted surface. This is a worst-case stability condition, as discussed in the ESMC memo (Tab D). Even if we assume that all drawers were filled and the CSU was placed on a carpeted surface, it is unlikely that all climbing incidents occurred with all of the drawers open.

Staff calculates that 74.8 percent of interactions that did not involve climbing in the nonfatal NEISS incidents with known types of interactions are likely to be addressable with the recommended test procedure. Staff notes that this number is a low estimate for certain scenarios. For example, we assumed all opening drawer incidents involved a higher-than-normal opening force on a drawer. However, in some incidents, merely opening multiple drawers without a high force caused a tip over, which would have been addressable at a higher percent because both young and old children's interactions would have been addressed.

Overall, under these assumptions, staff estimates that 87.4 percent of the known interactions in nonfatal NEISS incidents are addressable.[18]

Figure 20 and Figure 21 show the addressability of climbing incidents and incidents that were not caused by child's climbing ("non-climbing") by age in the nonfatal NEISS data for tip overs involving children and CSUs without televisions.

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[18] Staff removed the unknown type incidents and the incidents in which "other person" triggered the tip over. This is due mainly to the unknown age of the "other person."

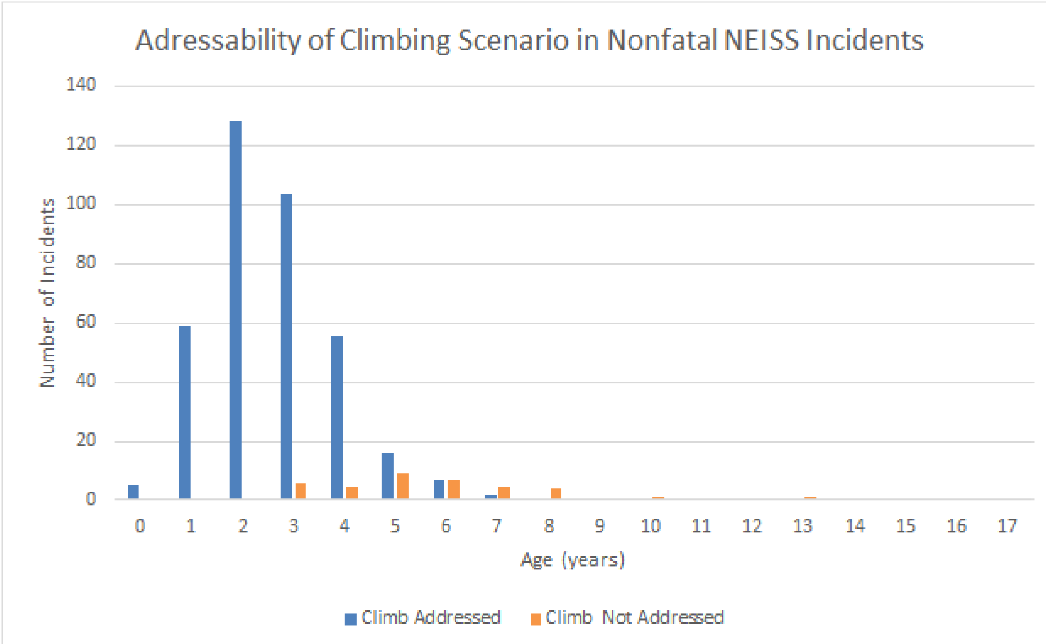


Figure 20. Addressability of climbing incidents (assuming all drawers open and filled, carpeted surface) by age in the nonfatal NEISS tip-over incidents involving children and CSUs without televisions.

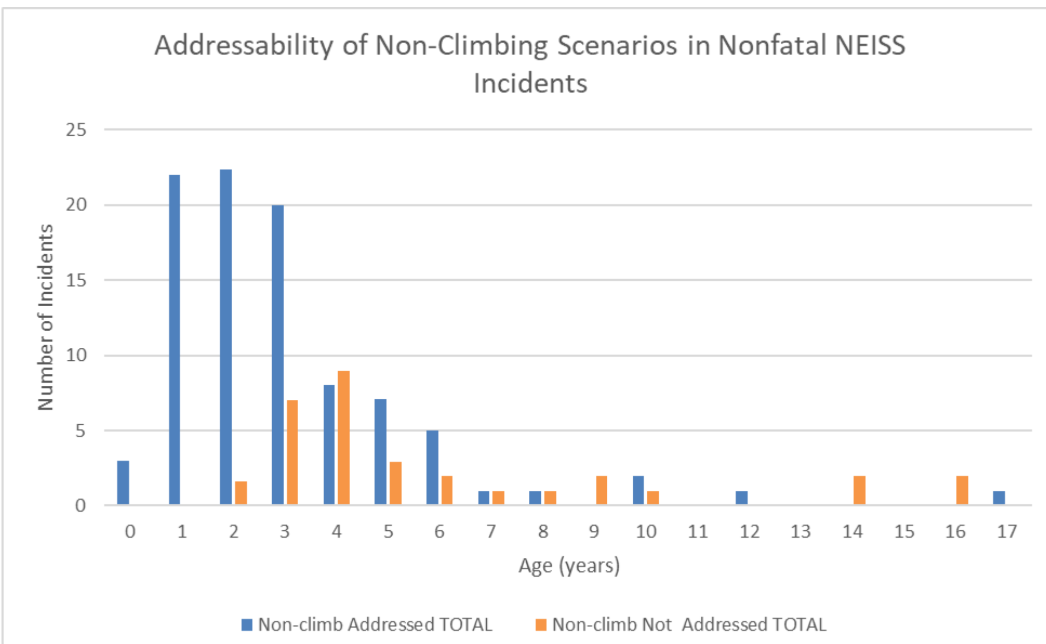


Figure 21. Addressability of incidents that were not categorized as Climbing by age in the nonfatal NEISS tip-over incidents involving children and CSUs without televisions.

14. MARKING AND LABELING

14.1 Marking and Labeling Requirements in Voluntary Standards

ASTM F2057 – 19 requires that CSUs be "permanently marked in at least one place" with the specified warning "in a conspicuous location when in use; the back of the unit intended to be placed against the wall is not considered conspicuous when in use." The standard does not further define "conspicuous location when in use."

ASTM F2057 – 19 requires the warning statements and pictorial safety symbol(s) shown in the examples in Figure 22, which vary depending on whether the unit is designed and intended by the manufacturer to be used with a television. Additionally, for units with interlock drawers only, there is an additional required warning statement: "DO NOT defeat or remove the drawer interlock system." The standard requires that the formatting be consistent with ANSI Z535.4 *American National Standard for Product Safety Signs and Labels*.

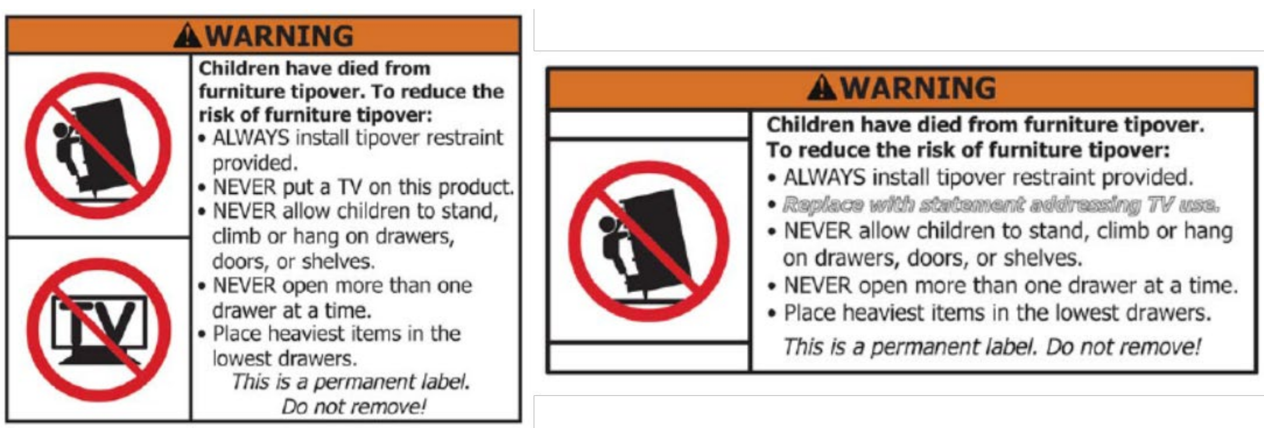


Figure 22. Color version of the example warning label in ASTM F2057 – 19 for CSUs that are not designed and intended by the manufacturer to be used with a television (left) and for CSUs that are designed and intended by the manufacturer to be used with a television (right). Reprinted, with permission, from ASTM F2057 − 19 Standard Safety Specification for Clothing Storage Units, copyright ASTM International, 100 Barr Harbor Drive, West Conshohocken, PA 19428. A copy of the complete standard may be obtained from ASTM International, www.astm.org.

The International Organization for Standardization *International Standard for Furniture – Storage Units – Determination of stability (*ISO 7171:2019) and the European Standard, *European Standard for Domestic and kitchen storage units and worktops – Safety requirements and test methods* (EN 14749) does not contain warning label-related requirements.

The Australian/New Zealand Standard for Domestic furniture – *Freestanding chests of drawers, wardrobes and bookshelves/bookcases – determination of stability* (AS NZS 4935-2009) requires that a standalone, legible warning label be durably affixed to the inside of a top drawer within clear view when the drawer is empty and partially opened, or on the inside face of a door. The word WARNING shall appear in red at the top of the warning label. Similarly, the standard also requires a readily visible standalone swing tag be attached to the outside of the furniture item. Both the label and the tag contain text informing consumers about the hazard (may topple if climbed upon, on both the label and tag); consequences (serious injury or death, stated on the label); and how to avoid the hazard (not placing objects of interest to children on top of the furniture, on both the label and tag, warning about uneven surfaces and carpet, attaching to a structural component of the building, indicated on the label, and not allowing children to climb on the furniture, indicated on the tag).

14.2 Warning Label Placement

An effective warning label first must be visible and noticeable, and it must capture and maintain consumers' attention. In the 2017 ANPR briefing package, Engineering Sciences staff expressed concern that the then-current version of the ASTM voluntary standard, F2057 – 17, did not adequately define the warning label placement requirement: "conspicuous location when in use" (Nesteruk 2017). Staff recommended that the warning label be placed in the uppermost clothing storage drawer or one drawer in the uppermost row that is entirely below 56 inches, which is the 5th percentile standing eye height of women in the United States (Nesteruk 2017). Since publication of the ANPR, ASTM added the clarification that "the back of the unit intended to be placed against the wall is not considered conspicuous when in use" in F2057 – 19. However, the standard does not provide additional requirements or guidance about what is "conspicuous."

In the 2020 FMG CSU use study, provided in Tab Q, researchers evaluated warning labels in in-home interviews and focus groups. The findings related to warning label conspicuity include:

- In-home interview participants said: "they had not paid attention or noticed warning labels on the units in their children's room," including a consumer who had two CSUs with warnings on the inside side the top drawer of the unit (a location that ESHF staff considers "conspicuous").
- Approximately half of the focus group participants "reported that they had never noticed a warning label on a CSU," often mentioning that, "even if they had seen one, they probably had not paid attention to it."
- Focus group participants identified the following as potential locations where a warning label could be seen easily and be more likely to grab someone's attention: top of the unit in the corner, on the handle of a unit, inside the top drawer of a unit, and in the instruction manual. Participants said the back of the unit was not an acceptable place for the warning label because it would not be visible. Participants also expressed that they

would remove labels that were too conspicuous (*e.g.*, on the outside or top of a unit). (Fors Marsh Group 2020b)

14.3 Warning Label Content

After noticing a warning label, consumers must read the message, comprehend the message, decide whether the message is consistent with their beliefs and attitudes. In addition, consumers must be motivated enough to spend the effort to comply with the warning-directed safe behavior. In the ANPR briefing package, staff recommended that the warning allow for customization of hazard avoidance statements based on unit design, to reflect incident data. This was to ensure that the known hazardous situations are identified. Similarly, staff recommended that the warning include message panel text that is understandable and does not contradict typical CSU use and be expressed in a way that motivates consumers to comply (Nesteruk 2017).

Prior to the 2017 ANPR briefing package, staff prepared a briefing package in 2016, describing the general state of CSU safety (Massale, 2016). In the 2016 briefing package, staff noted several concerns with elements of the then-current ASTM F2057 – 14 labeling requirements, including the warning statements. ASTM's two updates since the briefing package, F2057 – 17 and F2057 – 19, have addressed some of those concerns; but several concerns still hold true for the current ASTM F2057 – 19 labeling requirements. Those remaining concerns are provided in Table 7.

Table 7. Summary of Staff Comments and Concerns with the ASTM F2057 – 19 Warning Statements

ASTM F2057 – 19 Warning Statements:	**ESHF Staff Comments and Concerns**
Children have died from furniture tipover. To reduce the risk of furniture tipover:	[none]
• ALWAYS install tipover restraint provided.	Improvement is possible by emphasizing the need to secure the furniture to the wall, rather than just installing it on the product. In addition, "tipover restraint" terminology might confuse some users. This is because restraints generally describe what they contain (*e.g.*, child restraint, pet restraint) rather than what they prevent. Terminology such as "anti-tip device" might be clearer and is consistent with "anti-tip brackets" used for a kitchen range.
• NEVER put a TV on this product.	[none]
• NEVER allow children to stand, climb on, or hang on drawers, doors, or shelves.	[none]
• NEVER open more than one drawer at a time.	This statement lacks credibility for CSUs that allow for opening multiple drawers. Consumers may open multiple drawers when moving items from one drawer to another or putting laundry away. Although opening multiple drawers is a foreseeable use pattern in certain situations, interlocks are common in office furniture, which effectively eliminates opening multiple drawers by design. Once CSUs start adopting this feature, it is likely that consumers will become more familiar with it and start accepting it as a design characteristic.
• DO NOT defeat or remove the drawer interlock system. [For units with interlock drawers only]	This message is an appropriate hazard avoidance statement for units that include a drawer interlock system.
• Place heaviest items in the lowest drawers.	[none]
This is a permanent label. Do not remove!	This is a non-warning statement. In addition, a statement that a consumer should not remove the warning is not a substitute for permanency requirements.

In the 2020 FMG CSU use study, focus group participants evaluated the ASTM F2057 – 19 warning label text. The findings related to warning label text included:

- Participants had mixed opinions on the hazard consequence text: "Children have died from furniture tip over." Some participants found it motivating, others believed that it was hyperbole and seemed likely to disregard it.
- The majority of participants said that they do not follow the instruction to install the tip restraint, especially if the tip restraint is not included with the CSU.

- Some participants viewed the warning label language as protecting manufacturers from liability, as opposed to giving them valuable information.
- Participants wanted more information about why they should not put a TV on a CSU, and some thought: "people will likely disregard this warning if putting a TV on top of a CSU fits their space and layout needs."
- Participants believed that not allowing children to stand, climb, or hang on the CSU is common sense; but some also expressed skepticism that children could be prevented from engaging in these behaviors.
- A majority of participants said that they open more than one drawer at a time. They also said that children typically open one or two drawers, usually the bottom drawer of a CSU. Participants believed that a reasonable quality CSU should be able to have more than one drawer open at a time without tipping.
- Participants believed that placing the heaviest items in the lowest drawers was common sense, and was a warning they would follow.
- Of the participants who had seen a warning label, "only a few actually reported that they had read it," and several said: "they did not recall reading it fully or perhaps looked at it once and never again after that."

14.4 Warning Label Symbols

In 2019, ESHF staff contracted a study to evaluate a set of 20 graphical safety symbols for comprehension, in an effort to develop a family of graphical symbols that can be used in multiple standards to communicate safety-related information to diverse audiences (Kalsher 2019). The contractor, Kalsher & Associates, LLC, developed 10 new symbols for the project, including one showing the CSU tip-over hazard and one showing the CSU tip-over hazard with a tip restraint; the remaining 10 symbols already existed. The contractor recruited 80 adults and used the open comprehension test procedures described in ANSI Z535.3, American National Standard Criteria for Safety Symbols (2011).[19] One of the existing symbols the contractor evaluated is the child climbing symbol from the warning label in ASTM F2057 – 17, which is the same as that in ASTM F2057 – 19. The symbol showed poor comprehension (63.8 percent) with strict (i.e., fully correct) scoring criteria, but passing comprehension (87.5 percent), when scored with lenient (i.e., partially correct) scoring criteria. ANSI Z535.3 defines the criteria for "passing" as at least 85 percent correct interpretations (strict), with fewer than 5 percent critical confusions (i.e., the opposite action is conveyed). There was no critical confusion with the symbol. The contractor conducted focus groups consisting of 40 of the 80 individuals who went through the comprehension study. Based on the feedback received in the comprehension study and in focus groups, the contractor developed the two new symbol variants shown in Figure 23. ESHF staff is

[19] Open-ended comprehension testing requires collecting the meaning of each symbol and what action they would take in response to seeing the symbol from the appropriate target audience.

currently working with the contractor to test these new symbol variants using the same methodology applied in the previous study. ESHF staff plans to assess whether one of the two variants performed better in comprehension testing than the F2057 – 19 child climbing symbol, and thereafter, staff will determine whether a change in the symbol should be recommended for the final rule.

ASTM F2057 – 19 also contains a no television graphical symbol for CSUs not designed to hold a television. ESHF staff assesses that this symbol is adequate and recommends using it, along with the associated text, for CSUs not designed to hold a television. Staff requests comments on the studied symbols, as well as the current symbols included in ASTM F2057 – 19.

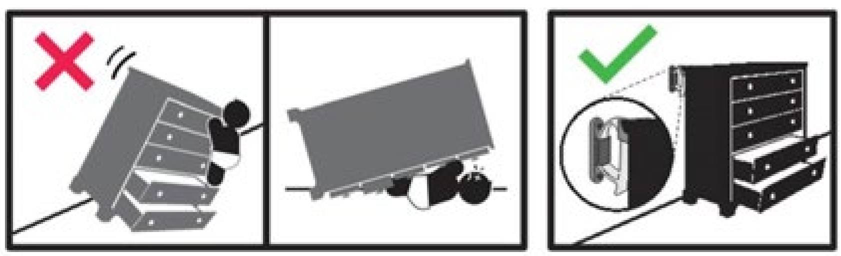
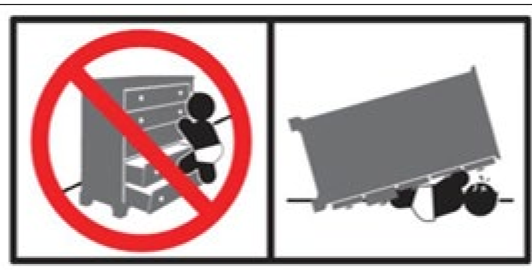
	Variant 1
	Variant 2

Figure 23. Two variant symbols being tested (one showing the importance of anchoring the CSU, the other demonstrating the tip-over hazard as a result of climbing)

14.5 Other Marking and Labeling

Staff was able to identify the manufacturer and model of CSU associated with only 21 of the 89 fatal CPSRMS incidents involving children and CSUs without televisions[20] and 230 of the 263 nonfatal CPSRMS incidents involving children and CSUs without televisions. In the case of recalls, consumers must be able to identify whether their CSU is subject to the recall and is potentially unsafe. Accordingly, staff assesses that an identification label that provides the model, manufacturer information, date of manufacture, and a statement of compliance with the proposed rule is important to facilitate identification and removal of potentially unsafe CSUs. This label would also allow for easier identification of compliant and noncompliant CSUs by

[20] An additional CSU was identified as handmade.

consumers and CPSC, and would provide information that would assist in identifying the CSU, allowing staff to assess more easily hazards associated with specific designs.

14.6 Marking and Labeling Recommendations

Based on their analysis, ESHF staff recommends the following requirements for the warning label, and staff requests comments on the recommended size, content, symbols, format, location, and permanency:

- *Size.* ESHF staff recommends that the warning label be at least 2 inches wide by 2 inches tall. This size is consistent with the required content and format, below, and it ensures that the label is not too narrow or short.

- *Content.* Based on previous staff analysis and the feedback from the FMG CSU consumer use study focus groups, ESHF staff recommends the following warning statements:

  Children have died from furniture tip over. To reduce the risk of tip over:
  - ALWAYS secure this furniture to the wall using an anti-tip device.
  - NEVER allow children to stand, climb, or hang on drawers, doors or shelves.
  - [*for units with interlocks only*] Do not defeat or remove the drawer interlock system.
  - Place heaviest items in the lowest drawers.
  - [*for units that are not designed to hold a television*] NEVER put a TV on this furniture.

- *Symbols.* ESHF staff recommends requiring a child climbing symbol. For this NPR, staff recommends requiring the child climbing symbol that is in Section 8.2.4.1 of ASTM F2057 – 19. However, if one of the two variants shown above performs better in comprehension testing than the F2057 – 19 child climbing symbol, staff recommends requiring one of those variants instead. Staff also recommends requiring the F2057 – 19 no television symbol for CSUs that are not designed to hold a television. Staff requests comments on all of the symbols referenced here.

- *Format.* ESHF staff regularly uses ANSI Z535.4, American National Standard for Product Safety Signs and Labels—the primary U.S. voluntary consensus standard for the design, application, use, and placement of on-product warning labels—when developing or assessing the adequacy of warning labels. Staff recommends retaining the warning format in ASTM F2057 – 19, which is consistent with ANSI Z535.4.

- *Location*. ESHF staff recommends that the warning label be placed. on the interior side panel of a drawer in the upper most drawer row, or if the top of the drawer(s) in the upper most drawer row is more than 56 inches from the floor, on the interior side panel of a drawer in the upper most drawer row below 56 inches from the floor, as measured from the top of the drawer. The placement near eye height will make the warning label more conspicuous, and its placement below the 5th percentile female eye height will ensure that it is visible to almost all adults. In order to make the warning label as visible as possible inside the drawer, including when the drawer is filled, ESHF staff recommends that the left corner of the label be positioned within 1 inch of top of the drawer side panel and within the front 1/3 of the interior drawer depth. For units with only doors, ESHF staff recommends that the warning label be located on an interior side or back panel of the cabinet behind the door(s), or on the interior door panel, and that it is not obscured by a shelf or other interior element. For consumer-assembled units, ESHF staff recommends that the warning label be pre-attached to the panel, and the assembly instructions direct the consumer to place the panel with the warning label according to the placement recommendations above.
- *Permanency*. To be effective, a warning label must remain present. Label permanency requirements are intended to prevent the warning label from being removed inadvertently and to provide resistance to purposeful removal by the consumer. LSM staff evaluated the ASTM F2057 – 19 label permanency requirements in their memorandum (Tab F) and concluded that they are adequate. Staff recommends retaining the permanency testing prescribed in ASTM F2057 – 19 Section 7.3 to increase the likelihood that the label remains attached to the CSU.

An example of the recommended warning label is provided in Figure 24.

Figure 24. Example of the recommended warning label for a CSU with an interlock system and not designed to hold a television (top) and for a CSU without an interlock system and designed to hold a television (bottom).

ESHF staff assesses that the recommended warning statements will be more effective than those in ASTM F2057 – 19 because they eliminate the two statements (warning about opening multiple drawers and non-warning statement about label permanency) that staff identified as concerns. In addition, the proposed tip-restraint warning explicitly directs the consumer to secure the CSU to the wall and uses a term for tip restraint that consumers will likely understand better.[21]

Overall, ESHF staff recommends using a warning label to inform consumers of the hazard and motivate them to install tip restraints as a secondary safety mechanism. However, staff cautions that risk perception is greatly influenced by product familiarity, hazardousness of the product,

[21] Per Nesteruk (2016), "tipover restraint" terminology might confuse some users. This is because restraints generally describe what they contain (*e.g.*, child restraint, pet restraint), rather than what they prevent. Terminology such as "anti-tip device" might be clearer and is consistent with "anti-tip brackets" used for a kitchen range."

likelihood of injury, and severity of injury. Risk perception is also influenced by people's beliefs about their ability to control the hazard and whether they believe the warning message. An inherent problem with CSUs and the tip-over hazard is that people are less likely to recognize potential hazards associated with products that they use more frequently (Godfrey et al., 1994). Research shows that high familiarity with a product can lower a user's inclination to read warnings or reduce the likelihood that the user will believe such information, lowering the rate of compliance with the warning (Riley 2004). ESHF staff assesses that CSUs are products with high familiarity because they are found in most households, in one form or another, and consumers are likely to interact with them daily. Experienced users are likely to repeat behaviors with little conscious thought, especially on a product with which they have had numerous prior experiences (Riley 2004). For these reasons, consumers are not likely to perceive a CSU as something that presents a risk to them, and they are less likely to read and believe associated information on the hazard. Therefore, staff concludes that even well-designed warnings have limited effectiveness in changing a CSU user's behavior. In addition, although the warning may impact adult behavior, ESHF staff concludes that it will not prevent the hazard of children climbing on CSUs and other child interactions that can cause tip over. This is, in part, because children would not read or comprehend the warnings and in part, because children are often without adult supervision during tip-over incidents. Among the 89 fatal incidents, 51 were reportedly unwitnessed by an adult or another child, while in 23 incidents, the child was with other children. None of the fatal incidents were reportedly witnessed by an adult; although in one incident, a relative of unknown age observed the child climbing on the CSU.

Staff also recommends a new identification label with the following requirements and requests comments on the recommended size, content, format, location and permanency:

- *Size.* ESHF staff recommends that the identification label be at least 2-inches wide by 1-inch tall. This size is consistent with the required content and format, below, and ensures that the label is not too narrow or short.
- *Content.* ESHF staff recommends that the identification label contain the following:
    - Name and address (city, state, and zip code) of the manufacturer, distributor, or retailer; the model number; and the month and year of manufacture.
    - The statement "Complies with U.S. CPSC Safety Standard for Clothing Storage Units" as appropriate; this label may spell out "U.S. Consumer Product Safety Commission" instead of "U.S. CPSC."
- *Format.* ESHF staff recommends retaining the text size in ASTM F2057 – 19, which is consistent with ANSI Z535.4.
- *Location.* ESHF staff recommends that the identification label be visible from the back of the unit when the unit is fully assembled. It is not necessary for the label to be visible to the consumer during normal use, but it should be visible to anyone inspecting the unit.

The back of the unit provides a consistent location for the label, and staff assesses that the precise location does not need to be specified.

- *Permanency.* Staff recommends retaining the permanency testing prescribed in ASTM F2057 – 19 Section 7.3 to increase the likelihood that the label remains attached to the CSU.

15. TIP RESTRAINTS AND CSU ANCHORING

15.1 Tip Restraint Requirements in Voluntary Standards

ASTM F2057 – 19 requires that tip restraints that meet the requirements of ASTM F3096, *Performance Specification for Tipover Restraints(s) Used with Clothing Storage Unit(s)*, be included with each item of furniture covered by the standard. ASTM F3096 – 14, the current version of the standard "assesses the strength of the tipover restraint only, and does not address the in-situ performance of the tipover restraint" (p. 1). The test method specifies that the tester attach the tip restraint to a fixed structure and apply a 50-pound static load. Because the tip restraint is attached to a fixed structure, this test method does not evaluate the attachment to the wall or CSU. The standard also requires that the tip restraint include "clear and complete" installation instructions with: (1) an illustration showing the installation methods, (2) step-by-step written installation instruction, and (3) a parts list with illustrations and that the manufacturer's name and address and the date of manufacture be provided with the tip restraint.

AS/NZS 4935 strongly recommends that attachment devices (*e.g*., angle brackets or webbing), along with adequate attachment instructions, be included with the furniture item. ISO 7171:2019 includes a strength test for wall attachments, defined as a "type of device to secure the unit to a wall or other fixed structure to prevent tip over" (p. 2). The test method specifies that the tester apply a 300 Newton (67 pounds) horizontal outwards force in the direction most likely to cause the unit to overturn (p. 12). EN 14749:2016 does not contain tip restraint requirements.

15.2 CPSC Anchor It! Campaign and Study

In 2015, CPSC started an active education campaign, Anchor It!, to educate consumers about the risk of injury and death from furniture, television, and appliance tip-overs, and to promote the use of tip restraints to anchor furniture and TVs. The Anchor It! campaign includes a website, news and radio spots, social media, blog posts, and videos. More information on the campaign, including educational resources and safety tips, can be found at: www.anchorit.gov.

In 2018, the CPSC Office of Communications (OCM) staff commissioned a study to gather information on consumers' knowledge of furniture anchoring, and exposure to the CPSC Anchor

It! Campaign messaging. The goal of the FMG Anchor It! Survey was to assess consumer awareness, recognition, and behavior change as a result of the Anchor It! campaign; and to assess knowledge, attitudes, and awareness around TV and furniture tip over and anchoring, including comprehension of hazards, risks, and remedies. Work was completed under CPSC contract CPSC-D-16-0002, Task Order: 61320618F1008.

The study consisted of an evaluation of the Anchor It! campaign materials and a survey, conducted in Winter 2020, of 410 parents and 292 caregivers of children 0 through 5 years old (702 people total) from various locations in the United States. OCM staff worked with FMG researchers to develop the list of specific questions for the survey, which included: "Have you ever anchored furniture (*e.g.*, dressers, bookshelves) in your home?" and "What are the main reasons you have not anchored your furniture (*e.g.*, dressers, bookshelves) and/or TVs?" (Fors Marsh Group 2020a). Although this study was not conducted for the CSU tip-over project, the information on rates of anchoring and perceptions and barriers of anchoring are relevant to developing a rule that effectively addressed the CSU tip-over hazard. The full report, titled, "CPSC Anchor It! Campaign: Main Report," is available online.[22]

15.3 Consumer Anchoring Behavior and Beliefs

Several research studies show that a large number of consumers do not anchor furniture, including CSUs. A CPSC Consumer Opinion Forum survey administered in 2010, with a convenience sample of 388 consumers, found that only 9 percent of those who responded to the question on whether they anchored the furniture under their television (27 of 295) answered "yes" (Butturini et al, 2015). Although a majority of respondents reported that the furniture under their television was an entertainment center, television stand, or cart, 7 percent of respondents who answered this question (22 of 294) reported using a CSU to hold their television.[23] The consumers who reported using a CSU to hold their television had approximately the same rate of anchoring the CSU, 10 percent (2 of 21), as the overall rate of anchoring furniture found in the study.[24] Of the 22 consumers reporting using a CSU for their televisions, one answered: "I don't know" to the anchoring question; two answered "yes"; and 19 answered: "no." Both consumers who reported anchoring their CSU identified their furniture as a "dresser, chest of drawers, or bureau."

A 2018 Consumer Reports nationally representative survey (Consumer Reports study) of 1,502 U.S. adults, found that only 27 percent of consumers overall, and 40 percent of consumers with

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[22] Link to report: https://www.cpsc.gov/s3fs-public/CPSC-Anchor-It-Campaign-Effectiveness-Survey-Main-Report_Final_9_2_2020....pdf?gC1No.oOO2FEXV9wmOtdJVAtacRLHIMK.
[23] Whether the product was a CSU was determined by ESHF staff's analysis of raw data. Three consumers identified the furniture as "armoire," and 19 consumers identified the furniture as a "dresser, chest of drawers, or bureau."
[24] Whether respondents who used CSUs under their televisions anchored the CSU was determined by ESHF staff's analysis of raw data.

children under 6 years old at home, have an anchored piece of furniture in their home (Peachman 2018, Consumer Reports 2018). The study also found that 90 percent of consumers have a dresser in their home, but only 10 percent of those who have a dresser have anchored it. Likewise, 50 percent of consumers have a tall chest or wardrobe in their home, but only 10 percent of those who have a tall chest or wardrobe have anchored it (Consumer Reports 2018). The most common reasons consumers selected for not anchoring furniture included:

- Children not left alone around the furniture (47 percent of consumers with children under 6 years old at home);
- Perception that the furniture is stable enough (41 percent of consumers);
- Unwillingness to put holes in the walls (25 percent of consumers);
- Unwillingness to put holes in the furniture (16 percent of consumers);
- Furniture did not come with the anchoring hardware (16 percent of consumers);
- Lack of knowledge on what hardware to use (7 percent of consumers) and
- Never heard of anchoring furniture (7 percent of consumers).

The 2020 CPSC Anchor It! Study found that 55 percent of respondents reported ever having anchored furniture. A greater percentage of parents reported anchoring furniture (59 percent) than other caregivers (50 percent); and a greater percentage of homeowners versus reported anchoring furniture (57 percent and 51 percent, respectively) (Fors Marsh Group 2020a).[25] Staff notes that among the limitations of the survey, researchers pointed out that the responses may have been biased by respondents' social desirability (tendency to answer questions in a way that is viewed favorably by others, which may result in over-reporting of "good behavior"), recall of media, recall of their own behavior, and other factors. Furthermore, the anchoring behavior questions relate to lifetime behaviors with categories of objects, rather than specific recent actions in their current home environments with specific types of TVs or furniture. For participants who did not report anchoring furniture or TVs, the most selected reasons for not anchoring were:

- I don't think I need to (35 percent of respondents).
- I can watch the children instead (35 percent of respondents).
- I intend to, but I just haven't gotten around to it (17 percent of respondents).
- It will damage my walls (16 percent of respondents).
- I don't know what anchors my furniture/TVs need (12 percent of respondents).

Both the Consumer Reports study and the CPSC Anchor It! study show that one of the main reasons that parents and other caregivers of young children do not anchor furniture is the belief

[25] Reported percent combines "Anchor TV and Furniture" and "Anchor Furniture Only." NOTE: This briefing package references two separate Fors Marsh Group studies conducted for CPSC: the 2020 CPSC Anchor It! study and the 2020 CPSC CSU use study. The CPSC Office of Communications initiated and oversaw the Anchor It! study referenced here.

that furniture does not need to be anchored if children are supervised. However, research shows that 2- to 5-year-old children are reportedly out of view of a supervising parent for about 20 percent of their awake time, and children are left alone significantly longer in the bedroom, playroom, and living room areas than in the bathroom or kitchen areas (Morrongiello et al., 2006, Morrongiello et al., 2004). CSUs are likely to be placed in a bedroom, where children are expected to have unsupervised time, including during naps and overnight. Many of the CSU tip-over incidents occurred in children's bedrooms during these unsupervised times. Notably, among the 89 fatal incidents analyzed in this memo, 55 occurred in a child's bedroom; 11 occurred in a bedroom, two occurred in a parent's bedroom, another two occurred in a sibling's bedroom; and one occurred in a hallway; the location in 18 incidents was not clear. None of the fatal incidents occurred when the child was under direct adult supervision. Incidents also occurred during supervised time, including nonfatal incidents with parents in the same room as the child. For these reasons, supervision is neither a practical, nor effective way to prevent tip-over incidents. According to the Consumer Reports study, 76 percent of consumers with children under 6 years of age reported that dressers are present in rooms where children sleep or play (Consumer Reports 2018). The UMTRI child climbing study found that nearly all (95 percent) of child participants had dressers in their rooms (Tab R).

The perception that the furniture was stable enough was one of the main reasons for consumers not anchoring furniture in the Consumer Reports study. CPSC staff testing and modeling presented in this briefing package show that there is a large difference in stability of CSUs, depending on the number of drawers open. An adult using a CSU will likely only open one or a couple of drawers at a time during normal use; and thus, an adult may only have experience with the CSUs in its more stable configurations.[26] By contrast, incident analysis shows that some children open multiple or all drawers on a CSUs simultaneously, potentially putting the CSU in a much less stable configuration; and children contribute further to instability by climbing the CSU. This difference in how adults and children CSUs might cause adults to underestimate the tip-over hazard to children, especially for CSUs with a large number of drawers.

Consumers' concerns about potential damage to walls, lack of knowledge about products, and difficulty installing tip restraints are also barriers to anchoring CSUs. Unwillingness to put holes in walls is a particular concern for renters who may not be allowed to put holes in the walls, or who may have the repair and repainting cost deducted from their security deposit. Even for homeowners, putting holes in the wall may not be appealing, especially if they plan to replace furniture, or move it to a different location.

For consumers who are motivated to install a tip-over restraint kit, the cost of compliance—that is, the time, effort, and monetary cost required to obtain and install the tip-over restraint kit—is a key consideration. Research has shown that compliance with warnings decreases rapidly as the

[26] The ASTM F2057 – 19 warning label includes a warning to open only one drawer at a time.

cost of compliance increases (DeJoy 1999). Both the Consumer Reports and the CPSC Anchor It! study found that the inclusion of a tip restraint kit with furniture, which is required in ASTM F2057 – 19, was one of the primary reasons people anchored furniture, suggesting that this is an effective method to raise anchoring rates (Peachman 2018, Fors Marsh Group 2020a).

However, obtaining a tip-restraint kit is not the only challenge for anchoring. In addition to the factors discussed above that undermine the likelihood of consumers to anchor furniture, both the Consumer Reports study and the CPSC Anchor It! study found that some consumers lack confidence in their ability to install tip restraints correctly, and the Consumer Reports study specifically identified the ability to locate a wall stud as one of the concerns (9 percent of those who do not anchor furniture). CSUs compliant with ASTM F2057 – 19 are required to include a tip-over restraint; however, the fastener for the wall is not specifically required to be included in the kit. Even if it is provided, the fastener may not be appropriate for a consumer's specific wall. Some consumers may find it difficult to figure out what fasteners are appropriate for their wall, how to locate a stud, or how to use a drill to complete a successful installation.

15.4 Tip Restraint Effectiveness

ESHF staff is also concerned about the effectiveness of tip restraints, including those that comply with the ASTM F3096 – 14. Staff notes that there are incidents in which tip restraints detached or broke.[27] ASTM F3096 – 14 assumes an ideal connection to both the furniture and the wall, but incidents suggest that both of these are potential points of failure. Staff raised this issue in the ANPR briefing package and concluded that the requirements in ASTM F3096 – 14 did not adequately assess the strength of the tip restraints under conditions in which they are commonly used (Sanborn 2017.) In addition, as with ASTM F2057 – 19, ASTM F3096 – 14 uses a 50-pound static force. Based on the ESMC staff analysis of the UMTRI child climbing study data, ESHF staff is concerned that this force may not represent the force on the tip restraint from child interactions, especially for interactions that can generate large amounts of force, including of older children. For example, UMTRI researchers found that bounce, lean, and yank behaviors were equivalent to a force 2.7, 2.7, and 3.9 times the child's body weight, respectively, at a distance of 1 foot from the fulcrum.

15.5 Tip Restraint Recommendations

Overall, ESHF staff concludes that given the low rates of anchoring, the barriers to anchoring, and staff concerns about the effectiveness of tip restraints, that tip restraints should not be relied upon as the primary method of preventing CSU tip over. Instead, staff recommends that CSUs

[27] For example: a plastic tether snapped in IDI 100907CCC3092, safety straps broke in IDI 140305CCC1448, a safety strap had pulled out of the product's fiberboard backing and was still attached to the strap that was hanging from the wall in IDI 141118CBB1130, and the plastic tip support bracket broke in I12C0310A.

be inherently stable, without relying on additional intervention from the consumer. However, ESHF staff supports the use of effective tip restraints as a secondary safety system to enhance stability. For example, staff posits that for more extreme interactions, such as bouncing and jumping, and for interactions of older and heavier children, tip restraints should be used. In addition, for existing CSUs in homes, installing a tip restraint properly may help reduce the risk of tip over. Studies suggest that the biggest motivator for anchoring is the inclusion of tip restraints with furniture (Peachman 2018, Fors Marsh Group 2020a). Therefore, staff supports the inclusion of a tip restraint with a CSU to increase the likelihood that the consumer will anchor the CSU.

In future work, outside of this rulemaking effort, staff may evaluate appropriate requirements for tip restraints, and will continue to work with ASTM to update its tip-restraint requirements. As part of this potential future work, ESHF staff recommends evaluating the strength requirements for tip restraints to determine whether they account for the forces outlined in this draft NPR from children's interactions, multiple open and filled drawers, and carpet, and the forces from a tipping CSU. Because a tip restraint is intended to be a secondary safety system, ESHF staff recommends considering forces beyond those of younger children ascending, potentially including more extreme interactions, such as bouncing, yanking, jumping, along with forces from older, heavier, and stronger children. ESHF staff also recommends evaluating tip restraints as a system, which includes the interface with the CSU and the wall, because even a very strong tip restraint will be ineffective if it detaches from the CSU, or if it pulls out of the wall. Potential future revisions to requirements for tip restraints would likely benefit existing CSUs that predate a final rule that addresses inherent stability, and addresses stronger forces that aren't covered by the recommended requirements in this draft NPR, such as from older children or more onerous interactions. Staff requests comments on tip restraints, including their adequacy, and suggestions on how to improve the tip-restraint requirements outlined in ASTM F3096 – 14 and ASTM F2057 – 19.

16. INCIDENTS INVOLVING ADULTS

There are 33 reports of fatal CPSRMS tip-over incidents involving adults that happened between January 1, 2000 and December 31, 2020. One of the reported incidents involved a CSU with a television; the other 32 involved CSUs without televisions. The ages of victims ranged from 42 years to 95 years. About 42 percent of fatal incidents involved consumers 85 years of age or older. Ages of the victims, as well as some of the incident narratives, support the assumption that the victims were likely losing their balance and reaching for the CSUs to balance themselves.

Among the nonfatal CPSRMS tip-over incidents involving adults and CSUs without televisions, 67 incidents were reported involving consumers from 20 years of age through 96 years of age.

The interactions between the consumer and the CSU were reported in 44 incidents (66 percent). For incidents with reported interactions, one or more drawers were open when the unit tipped in 28 incidents; consumers were getting items in and out of the drawers in 10 incidents; the consumer pushed down on the CSU while attempting to lift a changing tray from the top in one incident; and the consumer leaned on the CSU in another incidents. Two consumers got injured from a tipping CSU while they were moving the CSU, and another two were injured while cleaning the CSU.

Nonfatal NEISS data involving consumers 18 years to 98 years old include 540 tip-over incidents involving CSUs without televisions and another 14 incidents involving CSUs with televisions. Among the 540 incidents, only 38 cases (7 percent) reported the type of interaction. About one-third of the reported interactions (12 of 38) involved the consumer falling or pulling on the CSU. Staff hypothesizes that these incidents are due to consumers attempting to balance themselves by holding onto the CSU. Other interactions include: leaning on the CSU (5); opening drawers (4); hitting the CSU (4); getting injured by an CSU while pulling on it, climbing on it, or a child knocking it over (3); getting items in/out of a drawer (2); climbing (1); on top (1); putting item on unit (1); reaching (1); and other (4). Among the 14 incidents involving televisions, there were two falling/pulling incidents and one individual having a seizure and falling towards the dresser. In 11 incidents the type of interaction was unknown.

As explained, the recommended rule focuses on addressing the CSU tip-over hazard to children, because children make up the vast majority of CSU tip-over incident victims. However, staff concludes that improving the stability of CSUs should reduce a substantial portion of the nonfatal incidents and fatal incidents involving adults, assuming that the interactions in nonfatal incidents with adults are similar to the interactions in fatal incidents. This is because a majority of the incidents involved consumers interacting with the CSU by opening drawers and/or getting items in and out of drawers, or leaning on the CSU, all scenarios that are expected to be less than or equally severe compared to incidents of children climbing with all drawers filled and opened.

17. SCOPE

17.1 Scope in Voluntary Standards

ASTM F2057 – 19 defines "clothing storage units" as a "furniture item with drawers and/or hinged doors intended for the storage of clothing typical with bedroom furniture." The standard's scope includes free-standing CSUs "including but not limited to chests, chests of drawers, drawer chests, armoires, chifferobes, bureaus, door chests and dressers, 27 in. (686 mm) and above in height." The scope does not include "shelving units, such as bookcases or entertainment furniture, office furniture, dining room furniture, jewelry armoires, underbed drawer storage units, occasional/accent furniture not intended for bedroom use, laundry storage/sorting units, nightstands[28], or built-in units intended to be permanently attached to the building, nor does it cover "Clothing Storage Chests" as defined in Consumer Safety Specification F2598" (p. 1).

The scope of AS/NZS 4935:2009, which, like ASTM F2057 – 19, is designed to address the hazard of children through age 5 years old climbing on furniture, is "domestic freestanding chests of drawers over 500 mm high [19.7 in.], freestanding wardrobes over 500 mm high and freestanding bookshelves/bookcases over 600 mm [23.6 in.] high" (p. 5).

The scope of both European standards that cover CSUs, ISO 7171-19 and EN 14749:2016, are broader than the scope of F2057 – 19 and AS/NZS 4935:2009. The scope of ISO 7171-19 is "free-standing storage units that are fully assembled and ready for use" (p. 1). The scope of EN 14749:2016 is "all types of kitchen and bathroom storage units and domestic storage furniture and their components. The standard does not apply to non-domestic storage, office storage, industrial storage, catering equipment, retail storage and industrial storage lockers, or units covered by EN 71-1, Safety of toys — Part 1: Mechanical and physical properties and EN 60065, Audio, video and similar electronic apparatus — Safety requirements (IEC 60065)" (p. 6).

17.2 Scope in Previous CPSC Work

In the ANPR, CPSC staff described CSUs as:

> CSUs are freestanding furniture intended for storing clothing. CSUs are typically bedroom furniture, but may be used elsewhere. CSUs are available in a variety of designs (*e.g.*, vertical or horizontal dressers), sizes (*e.g.*, weights and heights), and materials (*e.g.*, wood, plastic, leather). CSUs usually have a flat surface on top and commonly include doors, or drawers for consumers to store clothing or other items. Examples of CSUs include chests of drawers, bureaus, dressers, armoires, wardrobes, portable closets, and clothing storage lockers. CSUs do not include products that are permanently attached or built into a structure or products that are not typically intended to store clothing, such as bookcases, shelves, cabinets, entertainment furniture, office furniture, or jewelry armoires. (82 Fed. Reg. 56752, 56753 (Nov. 30, 2017)).

17.3 Product Categories in Incident Data

For the data set in this briefing package, CPSC staff used the product categories from the ANPR description of a CSU: chest, bureau, or dresser; armoire; wardrobe; portable storage closet; or clothes locker. As detailed in the EPHA memo (Tab A), of the 89 fatal CPSRMS tip-over

[28] Defined as "a small furniture item for use beside a bed, intended to hold or store items including but not limited to a lamp, alarm clock, a book, magazines, or reading glasses" (ASTM F2057 – 19, p. 2).

incidents involving children and CSUs without televisions analyzed in this NPR briefing package, 87 involved chests, bureaus, or dressers, and two involved wardrobes; none involved an armoire, portable storage closet, or clothes locker. Of the 263 nonfatal CPSRMS incidents with children and CSUs without televisions, 259 involved chest, bureaus, or dressers, one involved an armoire, and three involved wardrobes. Of the estimated 40,700 emergency department-treated injuries to children from CSU tip overs (without a television) between January 1, 2006 to December 31, 2019, an estimated 40,200 involved "chests, bureaus, and dressers." There were not enough incidents involving armoires, wardrobes, portable storage closets, or clothes lockers to make estimates for these CSU categories.

Based on these data, ESHF staff recommends that chests, bureaus, dressers, wardrobes, and armoires be included within the scope of the draft proposed rule. Although the ANPR and data set analyzed for this briefing memo included clothes lockers and portable storage closets as CSUs, ESHF staff recommends excluding these products from the scope of the draft proposed rule because there are no reported tip-over fatalities or injuries to children with these products. On the other hand, wardrobes and armoires have been involved in fatal and nonfatal incidents, and armoires have been involved in nonfatal incidents. Both are more similar in design to the other CSUs included in the scope than clothes lockers and portables closets, and they are more likely to be used in homes than clothes lockers.

17.4 The CSU Hazard

ESHF staff assesses that the CSU hazard is related to the function of CSUs, where they are used in the home, and their design features. A primary feature of CSUs is that typically, they are used for clothing storage; however, putting clothing in a furniture item does not create the tip over hazard on its own. Rather, the function of CSUs as furniture items that store clothing means that consumers and children are likely to have easy access to the unit and interact with it daily, resulting in increased exposure and familiarity. In addition, caregivers may encourage children to use a CSU on their own as part of developing independent skills. As a result, children are likely to know how to open drawers of a CSU, and are likely to be aware of their contents, which may motivate them to interact with it. Therefore, staff recommends including, as an element of the definition of CSUs, that they be reasonably expected to be used for storing clothing.

CSUs are commonly used in bedrooms, an area of the home where children are more likely to have unsupervised time. As stated, most CSU tip-over incidents occur in bedrooms: among the 89 fatal tip-over incidents involving children and CSUs without televisions, 99 percent of the incidents with a reported location (70 of 71 incidents) occurred in a bedroom.[29] This use means that children have more opportunity to interact with the unit unsupervised, including in ways

[29] Fifty-five incidents occurred in a child's bedroom; 11 occurred in a bedroom; two occurred in a parent's bedroom; another two occurred in a sibling's bedroom; and one occurred in a hallway. The location in 18 incidents was not clear.

more likely to cause tip over (*e.g.,* opening multiple drawers and climbing) that a caregiver may discourage.

Another primary feature of CSUs is closed storage, which is storage within drawers, or storage behind doors. These drawers and doors are extension elements, which allow children to exert vertical force farther from the tip point (fulcrum) than they would be able to without extension elements and that make it more likely that a child will tip the product during interactions. In addition, these features may make the product more appealing to children as a play item. Children can open and close the drawers and doors and use them to climb, bounce, jump, or hang; they can play with items in the drawers, or get inside the drawers or cabinet. Children can also use the CSU extension elements for functional purposes, such as climbing to reach an item on top of the CSU. Accordingly, staff recommends including a minimum amount of closed storage and the presence of drawers and/or doors as an element of the definition of "CSUs." CSUs also have a top surface that can be used as a seat or platform to jump from or to climb onto other items.

CSUs are freestanding furniture items, which means that they remain upright, without requiring attachment to the wall, in their normal use position. The lack of permanent attachment to the building structure means that CSUs are more susceptible to tip over than built-in storage items in the home, such as kitchen cabinets and bathroom vanities. Consequently, staff recommends including freestanding as an element of the definition of "CSUs."

These characteristics common to CSUs may be why there are more fatal tip-over incidents involving children and CSUs than fatal tip over incidents involving children and other furniture items. In the CPSC report, *Product Instability or Tip-Over Injuries and Fatalities with Televisions, Furniture, and Appliances: 2020 Report* (Suchy 2021), EPHA staff analyzed tip-over incidents for all furniture types, including CSUs. For the 116 fatal tip-over incidents involving children and furniture items without televisions identified in the report,[30] 77 percent (89 of 116) involved a CSU (chest, bureau, dresser, or wardrobe).

17.5 Product Height

In the ANPR, CPSC staff expressed concern that the scope of the then-current version of ASTM F2057, F2057 – 17, was limited to CSUs "over 30 in. (762 mm) in height," although staff was aware of tip-over incidents involving CSUs that were 30 inches in height and shorter (Sanborn 2017). After the ANPR published, CPSC staff worked with the ASTM F15.42 Furniture Subcommittee to lower the minimum height of CSUs covered by the standard. ASTM revised the standard to include CSUs "27 in. (686 mm) and above in height" in the F2057 – 19 version.[31]

[30] In the report, staff analyzed incident reports received between 2000 and 2019.
[31] In F2057 – 19, ASTM also an added explicit exemption for "nightstands" and other products.

The height of the CSU was reported for 53 fatal and 72 nonfatal CPSRMS tip-over incidents involving children and CSUs without televisions. The shortest reported CSU involved in a fatal incident without a television is a 27.5-inch-tall, 3-drawer chest, which tipped over onto a 2-year-old child.[32] The shortest reported CSU involved in a nonfatal CPSRMS tip-over incident without a television is a 26-inch-tall, 2-drawer chest,[33] which tipped over and pinned a 13-month-old child and caused bruising on both legs. NEISS data do not provide information about the height of CSUs involved in incidents.

Results from the 2020 FMG CSU use study focus group (Tab Q) suggest that consumers seek out low-height CSUs for use in children's rooms "because participants would like a unit that is an appropriate height (*i.e.*, short enough) for their children to easily access their clothes" (p. 38). The average shoulder height of a 2-year-old is about 27.4 to 28.9 inches.[34] In the in-home interviews, researchers observed that CSUs in children's rooms were typically low to the ground and wide. For this reason, staff surmises that children may have more access and exposure to low-height CSUs than taller CSUs.

Although there are no CSUs involved in fatal tip-over incidents without a television that are reported to be under 27 inches, ESHF staff is aware of shorter CSUs on the market. For example, a major furniture retailer currently sells more than 10 products marketed as "chests" or "dressers," ranging in height from 19.25 inches to 26.75 inches, including a 25.25-inch-tall, 3-drawer chest advertised for use in a child's room. CPSC contractor Industrial Economics, Incorporated, identified CSUs as short as 18 inches in their CSU market research report (Industrial Economics, Inc, 2019).[35] ESHF staff believes that children may still be motivated to climb or otherwise interact with shorter units: home interview participants in the Fors Marsh CSU use study said that children climbed short furniture items in the home, such as nightstands and ottomans.

Overall, ESHF staff recommends retaining the 27-inch minimum height requirement from ASTM F2057 – 19, but recommends requesting comment on whether the 27-inch height is reasonable and/or whether the scope should include all CSUs, regardless of height.

17.6 Product Weight

The weight of the CSU was reported for 17 fatal and 25 nonfatal CPSRMS tip-over incidents with a child and no television. The lightest-weight reported CSU involved in a fatal tip-over

[32] https://www.cpsc.gov/Recalls/2019/south-shore-furniture-recalls-chest-of-drawers-due-to-serious-tip-over-and-entrapment.
[33] The product is marketed as a "chest," but was called a "nightstand" in the consumer's report.
[34] The mean standing shoulder height of a 2-year-old male is 28.9 inches and 27.4 inches for a 2-year-old female (Pheasant, 1986).
[35] Researchers analyzed the characteristics of 890 CSUs, and found a height range of 18 to 138 inches.

incident without a television is a 5-drawer CSU with the bottom 3 drawers missing, which tipped over on a 2-year-old child. The unit weighed 34 pounds without the 3 drawers, the configuration at the time of the incident. The lightest weight reported, non-modified CSU involved in a fatal tip-over incident without a television is a 57 pound, 3-drawer chest, which tipped over onto a 2-year-old child.[36] Other fatal incidents involving light-weight CSUs include a 57.5 pound, 4-drawer wicker dresser without a television that tipped over onto an 18-month old child and a 68-pound, 3-drawer chest that tipped over in three separate fatal incidents without televisions, resulting in the death of a 23-month-old child, and two 2-year-old children.

The lightest weight reported CSU involved in a nonfatal incident without a television is a 31-pound, 2-drawer chest, which tipped over and pinned a 13-month-old child and caused bruising on both legs.[37] In another nonfatal incident with no television, a 45-pound, 3-drawer chest tipped onto a 3-year-old child (see Tab M, Model 3, for more details).

ESHF staff is aware of some lightweight plastic units marketed and used as CSUs.[38] ESHF staff found many lightweight frame and drawer units marketed online as CSUs. Staff also found many online videos showing consumers using lightweight plastic units to store children's clothing.[39] In addition, one of the participants in the FMG CSU use study said they got a plastic stackable drawer unit to store children's clothing (Fors Marsh Group 2020b, p. 39). Therefore, ESHF staff concludes that consumers will perceive and use lightweight units as CSUs. ESHF staff also notes that, with an assumed clothing load of 8.5 pounds per cubic foot of storage volume, many lightweight units could be filled to the same weight as the incident-involved units. The 34-pound unit referenced above had minimal clothing in it, and the 57-pound unit was reportedly empty at the time of the fatal incident. Staff did not identify any tip-over incidents involving plastic units in the fatal and nonfatal CSPRMS data involving children without a television; however, staff cautions that in 64 fatal and 20 nonfatal incidents, model names were not obtained and could have included plastic units. CPSC contractor Industrial Economics, Incorporated, in their CSU market research report, identified CSUs as lightweight as 18 pounds (Industrial Economics, Inc, 2019).

ESHF staff does not recommend excluding products based on weight or product material for this briefing package. This recommendation is based on ESHF staff's assessment that consumers

[36] This is the same unit as the shortest known CSU involved in a fatal tip-over incident involving a child and CSU without a television.
[37] This is the same unit, identified by the consumer as a "nightstand," but marketed as a "chest," as the shortest known CSU involved in a nonfatal tip-over incident a child and CSU without a television.
[38] For this analysis, ESHF staff only considered lightweight units with drawers and/or doors. ESHF staff is also aware that consumers use storage bins with lids to store clothing; however, staff does not consider these to be "CSUs," as defined in the draft NPR.
[39] For example: Jady A. (2016, November 7). No FOLD children's drawers! Toddler approved! Never fold clothes again! [Video]. YouTube. https://www.youtube.com/watch?v=Q0nQD2Jk0Qg and PlayRightParent. (2018, February 4). Alternative dresser for little kids [Video]. YouTube. https://www.youtube.com/watch?v=uNtnuMotEoE.

will perceive and use lightweight units as CSUs, and that it is possible to fill lightweight units with clothing loads that exceed the lowest product weights seen in the incident data. Although ASTM task groups have discussed a weight threshold for in-scope CSUs, the current version of the standard, ASTM F2057 – 19, does not have a weight exemption. However, staff seeks comments and data on the potential hazards associated with lightweight storage units, and on the issue of whether a weight exemption is justifiable, and at what weight.

17.7 Overall Size and Storage Volume

In the 2020 FMG CSU use study focus groups, participants discussed how the size of a unit influenced their perception of whether a unit is a CSU. Researchers found: "[t]he majority of participants noted that if a unit is too small, they will not store clothing in it, because the clothing will not fit"; however, participant's perception of "too small" varied. Researchers found: "a few participants noted that CSUs in their children's room are smaller than their typical definitions. The units are shorter so that their children can more easily access drawers, and drawers are smaller to fit smaller clothing." Although there was no a consensus on drawer size for a CSU, participants preferred "to have drawers that are large enough (*e.g.*, bigger than a shirt) and deep enough to hold clothing." They also showed flexibility on drawer volume: "[o]ne participant mentioned that there is a difference between what they would ideally like in terms of drawer size and what they will accept." They said ideally, they would like drawers deep enough to easily store clothing; however, participants noted that the current dresser they have requires them to shove or stuff their clothing inside. Furthermore, the specific size of the drawers was reported to vary, based on the needs of each person and the size of the home. (Fors Marsh Group 2020b, p. 32)

ESHF staff estimates that the minimum drawer size that could reasonably accommodate clothing is fairly small. For example, the functional volume of each drawer of the shortest/lightest reported CSU involved in a nonfatal incident without a television, a 26-inch-high x 15-inch-deep x 21 ¼-inch-wide, 2-drawer chest, is slightly less than 0.7 cubic feet[40]; and the manufacturer claims that the drawer holds about five pairs of folded pants or 10 T-shirts. Furthermore, except for the extremes (*i.e.*, very short, very narrow, very shallow), the shape of the drawer should not have an effect on the amount of clothing that can be stored in the drawer because clothing can be folded or stuffed to match the drawer dimensions.

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[40] The drawers of the current model of the product are 12 ½ inches deep x 13 ⅜-inch-wide, and the clearance height is 7 ¼ inches. The functional drawer volume of each drawer is 0.69 cubic feet, using the equation is Tab L; the total functional drawer volume for the 2-drawer CSU is 1.38 cubic feet.

17.8 How Do People Define "CSU"?

The FMG CSU use study examined how people define "CSUs" and what they use to store clothing in their homes. Focus group participants defined "CSUs" as anything that can hold clothing; dressers, closets, and armoires were the most common example product categories that participants provided. Participants said that CSUs are used "for organization and the protection of clothing (*e.g*., drawers of various sizes, dividers to help with organization, and doors to keep clothing out of sight)." Researchers reported that "the majority of participants reported that they generally think of a CSU as having at least three drawers. However, a few participants noted that a CSU could have four drawers, whereas others mentioned that to be considered a CSU, a unit only needed one drawer. Participants often considered a unit with two drawers or fewer to be a nightstand."

In the in-home interviews, researchers found that the most common CSU in consumers' homes was "a freestanding unit with drawers (usually referred to as a "dresser" by participants)." Four of the six in-home interview participants had more than one dresser in their home. Three of the six participants also had "some type of freestanding unit with doors that opened and drawers, typically called an 'armoire' or 'wardrobe' by participants." Researchers found that participants "mostly placed CSUs in their bedrooms and/or their children's bedrooms."

Participants also showed flexibility in how they used CSUs and other similar furniture in the home, depending on their needs, aesthetics, and where the unit was placed within the home. For example, one participant put a large vintage dresser in their living room and used it for non-clothing storage; one participant said that their dresser was used as a changing station and held diapers, wipes, creams, and medical supplies, but is now used to store clothes; and a participant said that the dresser in their child's room was originally used to store dishes.

Some participants in the in-home interviews and focus groups used nightstands for clothing storage, including for shirts, socks, pajamas, slippers, underwear, smaller/lighter items, such as tights or nightwear, seasonal items, and accessories. Some participants also reported storing clothing (*e.g.*, seasonal clothing items, underwear, pajamas, pants) in shelving units with removable bins (including those with cloth, canvas, or basket material). Consumers also had a wide variety of interpretations of the marketing term "accent piece," with some participants saying that they use accent pieces for clothing storage, and one identifying a specific accent piece in their home as a CSU.

As part of the FMG CSU use study, researchers asked focus group participants to fill out a worksheet with pictures of unnamed furniture items with dimensions. Participants were asked to provide a product label (category of product) and answer the question: "What would you store in this piece of furniture?" "Where would you put this piece of furniture in your home?" Participants then discussed the items as a group. Results suggest that there is a wide variety in how people perceive a unit. For example, one unit in the study was classified by participants as a cabinet, tv stand, accent/occasional/entryway piece or table, side table/sideboard, nightstand, kitchen storage/hutch/drawer, and dresser. Another was classified as an accent piece, buffet/sideboard, dresser, entry/hall/side table, chest/chest of drawers, kitchen storage unit/cabinet, sofa table, bureau, and china cabinet. One interesting item of discussion was the glass doors on one of the worksheet furniture items. Participants came to a general consensus that glass doors are typically used to display items, and thus, an item with glass doors is not a CSU.

Overall, the results from the FMG CSU use study suggest that there is not a distinct line between units that people will use for clothing storage, as opposed to other purposes; and even within a unit, the use can vary, depending on the consumer's needs at the time. (Fors Marsh Group 2020b)

17.9 CSUs as Children's Products

The Consumer Product Safety Act (CPSA) defines "children's products" as products designed or intended primarily for children 12 years or younger.[41] The designation of a product as a children's product is based on manufacturer statements about intended use (including labeling); whether the product is packaged, displayed, promoted, or advertised as appropriate for 12 and younger; whether it is commonly recognized by consumers as being intended for 12 and under; and the CPSC Age Determination Guidelines.[42]

ESHF staff is aware of CSUs that are marketed, packaged, displayed, promoted, and/or advertised as being for children under 12 years old. These CSUs may be sold as part of matching nursery or children's bedroom furniture sets, and/or have features or themes that appeal to children, such as bright colors and cartoons. CSUs may be sold at children's retailers, or by manufacturers that specialize in children's furniture.

It is not always possible to determine, based on the design of the CSU, whether it is a children's product, since some children's furniture is similar in appearance to generic-use furniture. In addition, some CSUs convert from a child-specific design, such as a CSU with an integrated changing table, to a more generic design. Children's furniture with a more generic design or with the ability to convert may be appealing to consumers who want furniture that they can continue to use as a child gets older.

Children's product CSUs have been involved in fatal and nonfatal incidents, and are among recalled CSUs.[43] However, CSUs that are general-use products are more heavily represented in

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[41] 15 U.S.C. 2052(a)(2).
[42] Guidelines can be accessed via https://www.cpsc.gov/s3fs-public/pdfs/blk_media_adg.pdf.
[43] Natart Chelsea Dressers Recalled by Gemme Juvenile to Reduce Tip-Over Hazard; Death of Toddler Reported (https://www.cpsc.gov/Recalls/2013/Natart-Chelsea-Dressers/) and Million Dollar Baby Dressers Recalled by

the tip-over incident data. As the in-home photos of CSUs from the FMG CSU study show, and as the videos of children interacting with CSUs illustrate, CSUs that children interact with are not limited to CSUs intended for children. For these reasons, staff recommends that a safety standard for CSUs not be limited to children's products.

17.10 Product Names, Generic Storage Products, Products with Other Names, and Hybrid Products

ASTM F2057 – 19 lists the following product names for CSUs: chests, chests of drawers, drawer chests, armoires, chifferobes, bureaus, door chests and dressers. Based on the incident data and market research, ESHF staff concludes that all of these products should be within scope of the proposed draft rule. ESHF staff also concludes that wardrobes should be included in the scope, based on incidents and their similarity with the in-scope products.

ESHF staff is aware of products that are named and advertised as generic storage products with multiple uses around the house, or they are advertised without context suggesting a particular use. Many of these items clearly share the design features of CSUs, including closed storage behind drawers and/or doors. In addition, staff is aware of products that appear, based on design, to be CSUs, but are named and advertised for other purposes (*e.g.*, an "accent piece" with drawers staged in a foyer, and large multi-drawer "nightstands" over 27-inches tall).

ESHF staff is also aware of hybrid products that combine features of CSUs with features of other product categories; for example, bookshelf storage products with shelving and closed storage behind drawers or doors; desks or tables with large amounts of attached closed storage; bedroom media furniture with an electronics slot and drawers for clothing; and beds with integrated CSU storage.

The scope of ASTM F2057 – 19 does not include shelving units, such as bookcases or entertainment furniture, office furniture, dining room furniture, jewelry armoires, underbed drawer storage units, occasional/accent furniture not intended for bedroom use, laundry storage/sorting units, nightstands, built-in units intended to be attached permanently to the building, or products covered by ASTM F2598, Standard Consumer Safety Specification for Clothing Storage Chests (single-compartment closed rigid boxes). ESHF staff assesses that products typical of shelving units, office furniture, dining room furniture, laundry hampers, built-in units, and single-compartment closed rigid boxes are likely to be reasonably excluded as CSUs based on their design. The recommended rule excludes these products, by including in the definition of "CSUs" that a CSU is freestanding; has a minimum closed storage functional

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Bexco Due to Tip-Over Hazards; Two Toddler Deaths Reported (https://www.cpsc.gov/Recalls/2013/Million-Dollar-Baby-Dressers/).

volume greater than 1.3 cubic feet[44]; and a closed storage functional volume greater than the sum of the open storage function volume and open space volume; has drawer(s) and/or door(s); and it is reasonably expected to be used for clothing. Staff assesses that some underbed drawer storage units, occasional/accent furniture, and nightstands could be CSUs. Accordingly, staff does not recommend excluding these product categories from the scope of the draft proposed rule. The criteria for identifying a CSU in the recommended rule would keep some of these products within scope, and exclude others, depending on their closed storage, reasonable expected use, and the presence of doors/drawers, such that those products that may be used as CSUs and present the same hazard, would be within the scope of the standard, while those that would not, would be excluded.

The results of the 2020 FMG CSU use study show that consumers will select units for clothing storage based on their utility, not necessarily their marketing (Fors Marsh Group 2020b); and ESHF market research shows that there are products that are not named or advertised as CSUs, but are indistinguishable from CSUs, based on their design. Therefore, ESHF staff concludes that the scope definition of "CSU" should not solely rely on how a product is named or advertised by a manufacturer, or the manufacturer's intent, but it should also include whether the product is commonly recognized as a CSU based on similarity of design to products advertised and/or marketed as CSUs. ESHF staff concludes the following design features are typical of a CSU:

- The product has closed storage behind one or more extension element (drawer and/or door). Doors must be opaque to count as closed storage.
- The product is freestanding, which means that it remains upright, without requiring attachment to the wall, in its normal use position.
- The product has more than 1.3-cubic feet of closed storage space, which is enough to accommodate a minimal amount of clothing.
- The product has more closed storage than display storage (*e.g.*, storage behind glass doors) and other open storage (*e.g.*, cubbies), and/or open space (*e.g.*, space under legs).

17.11 Scope Recommendations

Based on their analysis, ESHF staff recommends the following:

- *Definition of CSU:* ESHF staff recommends defining a "CSU" as: a freestanding furniture item, with drawer(s) and/or door(s), that may be reasonably expected to be used for storing clothing, that is greater than or equal to 27 inches in height, and with a total closed storage functional volume greater than 1.3 cubic feet and greater than the sum of

[44] This volume is based on the total functional drawer volume for the shortest/lightest reported CSU involved in a nonfatal incident without a television, discussed in Section 17.7. Staff rounded the volume down, so that the CSU would be included in the definition.

the open storage functional volume and the open space volume. Common names for clothing storage units include, but are not limited to: chests, bureaus, dressers, armoires, wardrobes, chests of drawers, drawer chests, chifforobes, and door chests. Whether a product is a clothing storage unit depends on whether it meets this definition. However, some examples of furniture items that, depending on their design, may not meet the criteria in this definition, and therefore, may not be considered clothing storage units are: shelving units, office furniture, dining room furniture, jewelry armoires, laundry storage/sorting units, built-in units, and single-compartment closed rigid boxes (storage chests). Examples of CSUs are shown in Figure 25.

Figure 25. Example CSUs

- *Scope exclusions:* ESHF staff recommends a specific exclusion for clothes lockers[45] and portable storage closets,[46] although these products would meet the recommended definition of a "CSU." Examples of a clothes locker and a portable storage closet are shown in Figure 26.

[45] *Clothes locker* means a metal furniture item without exterior drawers and with one or more doors that either locks or accommodates an external lock.
[46] *Portable storage closet* means a freestanding furniture item with an open frame that encloses hanging clothing storage space and/or shelves. This item may have a cloth case with curtain(s), flap(s), or door(s) that obscure the contents from view.

Figure 26. Clothes locker (left) and portable storage closet (right).

- *Common recognition:* ESHF staff recommend that the determination of whether a product is in scope should be based on whether a reasonable consumer would perceive the product to be a CSU, regardless of marketing.

ESHF staff recommends seeking comments on the following scope items:

- Should the scope of the proposed rule include CSUs under 27 inches, and/or all CSUs, regardless of height?
- Should lower-weight units, including lightweight plastic units, be excluded from the scope of the rule? If so, what should be the threshold weight?
- Should all items marketed and/or advertised as CSUs be included in the scope of the standard, even if they would otherwise be excluded based on their design?
- Should nightstands with drawers and/or door be included in the scope? What design features distinguish nightstands from CSUs?
- What design features distinguish non-CSU cabinets from door chests and other similar CSUs?

REFERENCES

AS/NZS 4935 (2009) Australian/New Zealand Standard, Domestic furniture - Freestanding chests of drawers, wardrobes and bookshelves/bookcases - Determination of stability. Sydney, Australia; Wellington, New Zealand. Available at: www.standards.org.au and www.standards.co.nz.

ASTM F2057 – 19 (2019) Standard Safety Specification for Clothing Storage Units, ASTM International, West Conshohocken, PA, 2019, www.astm.org.

Bayley, N. (1969). Bayley Scales of Infant Development. New York, NY, USA: The Psychological Corporation

Butturini, R., Massale, J., Midgett, J., Snyder, S. (2015) Preliminary Evaluation of Anchoring Furniture and Televisions without Tools. [Technical Report CPSC/EXHR/TR—15/001]. Available at: https://www.cpsc.gov/s3fs-public/pdfs/Tipover-Prevention-Project-Anchors-without-Tools.pdf

Consumer Reports (2018). Furniture Wall Anchors: A Nationally Representative Multi-Mode Survey. Available at: https://article.images.consumerreports.org/prod/content/dam/surveys/Consumer_Reports_Wall_Anchors_Survey_2018_Final.

DeJoy, D.M. (1999). Motivation. In M. S. Wogalter, D. M. DeJoy & K. R. Laughery (Eds.), Warnings and risk communication. Philadelphia, PA: Taylor & Francis.

DTI (2000). Strength Data for Design Safety – Phase 1 (DTI/URN 00/1070). London: Department of Trade and Industry.

Fors Marsh Group (2020a) CPSC Anchor It! Campaign: Main Report – FINAL. July 10, 2020. Available: https://www.cpsc.gov/s3fs-public/CPSC-Anchor-It-Campaign-Effectiveness-Survey-Main-Report_Final_9_2_2020....pdf?gC1No.oOO2FEXV9wmOtdJVAtacRLHIMK.

Fors Marsh Group (2020b) Consumer Product Safety Commission (CPSC): Furniture Tipover Report. [Contractor Report]. Dated March 13, 2020.

Frost, J. L., Wortham, S., & Reifel, S. (2001). Play and Child Development. Upper Saddle River, NJ: Prentice-Hall.

Fryar CD, Carroll MD, Gu Q, Afful J, Ogden CL. (2021). Anthropometric reference data for children and adults: United States, 2015–2018. National Center for Health Statistics. Vital Health Stat 3(46).

Godfrey, S. S., Allender, L., Laughery, K. R., Smith, V. L. (1994). Warning Messages: Will the consumer bother to look? In Human Factors Perspectives on Warnings, by K. R., Wogalter M. S., Young, S. Laughery, pp. 53-57.

Hughes, F. P. (1991). *Children, Play, and Development*. Boston: Allyn & Bacon.

Industrial Economics, Incorporated (2019). Final Clothing Storage Units (CSUs) Market Research Report. CPSC Contractor Report.

ISO (2019). International Standard ISO 7171:2019(E). Furniture — Storage units — Test methods for the determination of stability.

Kalsher, M. (2019). CPSC Gather Consumer Feedback: Final Report. Contract Number HHSP233201860070A. Available at: https://www.cpsc.gov/s3fs-public/CPSC%20Gather%20Consumer%20Feedback%20-%20Final%20Report%20with%20CPSC%20Staff%20Statement%20-%20REDACTED%20and%20CLEARED.pdf?GTPK5CxkCRmftdywdDGXJyVIVq.GU2Tx.

Kids in Danger and Shane's Foundation (2016). Furniture stability: A review of data and testing results. [Report]. Kids in Danger. Chicago, IL. Available at: https://kidsindanger.org/wp-content/uploads/Furniture_Stability_Report_Final_(1).pdf.

Massale, J. (2016). Staff Briefing Package on Furniture Tip over. U.S. Consumer Product Safety Commission, Rockville, MD. Available at: https://www.cpsc.gov/s3fs-public/Staff%20Briefing%20Package%20on%20Furniture%20Tipover%20-%20September%2030%202016.pdf

McClelland, I.L. & Thompson, D. (1976). Ergonomic Data For Evaluation And Specification Of Operating Devices On Components For Use By School Children. Report No. 75/2/21. Loughborough, Leicestershire, UK: Research Institute for Consumer Ergonomics. Cited in: Norris, B. & Wilson, J.R. (1995). Childata: The Handbook of Child Measurements and Capabilities - Data for Design Safety (Datasheet 148). London, UK: Consumer Safety Unit of the Department of Trade and Industry.

Morrongiello, B.A., Corbett, M., McCourt, M., & Johnston, N. (2006). Understanding unintentional injury-risk in young children I. The nature and scope of caregiver supervision of children at home. Journal of Pediatric Psychology, 31(6): 529-539.

Morrongiello, B. A., Ondejko, L., Littlejohn, A. (2004). Understanding Toddlers' In-Home Injuries: II. Examining Parental Strategies, and Their Efficacy, for Managing Child Injury Risk. Journal of Pediatric Psychology, 29(6), pp. 433-446.

Nesteruk, H. E J. (2016). ASTM F2057 – 14 warning labeling requirements: market compliance and voluntary standard evaluation. CPSC memorandum to John Massale, Project Manager, U.S. Consumer Product Safety Commission, Rockville, MD. Available at: https://www.cpsc.gov/s3fs-public/Staff%20Briefing%20Package%20on%20Furniture%20Tipover%20-%20September%2030%202016.pdf.

Nesteruk, H.E.J. (2017). Human Factors Analysis of Clothing Storage Unit Tipover Incidents and Hazard Communication. In Staff Briefing Package Advance Notice of Proposed Rulemaking: Clothing Storage Units. Available at: https://www.cpsc.gov/s3fs-public/ANPR%20-%20Clothing%20Storage%20Unit%20Tip%20Overs%20-%20November%2015%202017.pdf?5IsEEdW_Cb3ULO3TUGJiHEl875Adhvsg

Open Ergonomics. (2008). Eye height standing US Female 18-64. PeopleSize 2008 Professional. Version 2.02.

Peachman, RR (2018) Not an Easy Fix, as Child Tip-Over Deaths Persist. Available at: https://www.consumerreports.org/furniture/furniture-anchors-not-an-easy-fix-as-child-tip-over-deaths-persist/. Accessed April 12, 2021.

Pheasant, S. (1986) Bodyspace Anthropometry, Ergonomics & Design. London: Taylor & Francis.

Riley, D. M. (2004). Beliefs, Attitudes, and Motivation. In The Handbook of Warnings, by Michael S. Wogalter. New Jersey: Lawrence Erlbaum Associates

Sanborn, M. (2017). Analysis of Voluntary Standards for Clothing Storage Units. In Staff Briefing Package Advance Notice of Proposed Rulemaking: Clothing Storage Units. Available at: https://www.cpsc.gov/s3fs-public/ANPR%20-%20Clothing%20Storage%20Unit%20Tip%20Overs%20-%20November%2015%202017.pdf?5IsEEdW_Cb3ULO3TUGJiHEl875Adhvsg

Suchy, A. (2021). Product Instability or Tip-Over Injuries and Fatalities Associated with Televisions, Furniture, and Appliances: 2020 Report. U.S. Consumer Product Safety Commission, Bethesda MD. Available at: https://www.cpsc.gov/s3fs-public/2020_Tip_Over_Report.pdf?nhwAgmMt9YXGhkqfsN75hMCNYgBTe5OJ.

Therrell, J. A., Brown, P., Sutterby, J. A., Thirnton, C. D., 2002: Age Determination Guidelines: Relating Children's Ages to Toy Characteristics and Play Behavior. T. P. Smith (Ed.), Bethesda, MD: U.S. Consumer Product Safety Commission

APPENDIX A: ONLINE VIDEO SEARCHES

Staff used combinations of keywords to search YouTube for videos that demonstrate children's interactions with CSUs. Keywords included, but were not limited to: child, toddler, baby, dresser, chest, drawer, cabinet, armoire, furniture, climb, open, jump, empty, fall, tip, and tip-over. Combinations of keywords included, but were not limited to: "climb dresser," "child climb," "child drawer," "open drawer," and "child dresser."

Staff also viewed related videos that were recommended by YouTube, allowing staff to follow a chain of videos of interest that weren't necessarily included in the original search results. Staff conducted periodic searches, starting in early 2019, and continuing through this NPR.

Search results included videos uploaded by consumers as well as segments of news reports and other media.

TAB D: Mechanical Evaluation of Clothing Storage Unit (CSU) Tip-Over Research, Incidents, and Design Solutions, Contributing to Draft Proposed Rule for CSU Inherent Stability

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

Memorandum

DATE: July 14, 2021

TO: Kristen Talcott, Ph.D., Furniture Tip-Over Project Manager,
Division of Human Factors, Directorate for Engineering Sciences

THROUGH: Mark Kumagai, P.E., Associate Executive Director,
Directorate for Engineering Sciences

Caroleene Paul, Director,
Division of Mechanical and Combustion Engineering
Directorate for Engineering Sciences

FROM: Daniel Taxier, Mechanical Engineer,
Division of Mechanical and Combustion Engineering
Directorate for Engineering Sciences

SUBJECT: Mechanical Evaluation of Clothing Storage Unit (CSU) Tip-Over Research, Incidents, and Design Solutions, Contributing to Draft Proposed Rule for CSU Inherent Stability

I. INTRODUCTION

Clothing storage units, or CSUs, are freestanding furniture items with drawers and/or doors, that may be reasonably expected to be used for storing clothing. Examples of typical CSUs are shown in Figure 1. CSUs commonly are used as bedroom furniture, but may also be used elsewhere. Common examples of CSUs include: dressers, chests of drawers, and armoires. CPSC staff is aware of 193 reported CSU tip-over and instability fatalities to children under 18 years old, 11 reported fatalities to adults ages 18 through 64 years, and 22 reported fatalities to seniors ages 65 years and older, which were reported to have occurred between January 1, 2000 and December 31, 2020 (see Tab A). The number of CSU tip-over incidents each year, and the resulting number of injuries and deaths, can be reduced by improving the inherent stability of the products.

Figure 1. Example clothing storage units (CSU). Most CSUs have drawers; CSUs can also have doors, shelves, or other elements.

As set forth in the Laboratory Sciences Mechanical Engineering Division (LSM) memorandum (Tab F) and this memorandum, CPSC staff concluded that the current voluntary standard for CSUs, ASTM F2057 – 19 *Standard Safety Specification for Clothing Storage Units*, does not adequately address the stability of these products. This is largely because ASTM F2057 – 19 relies only on a static load based on the weight of a child standing or hanging on a drawer front, which does not adequately account for the forces created by children interacting with or climbing on CSUs, or for other common hazard patterns that lead to tip-over incidents. Other common hazard patterns related to CSU tip overs are multiple open drawers, filled drawers, and the placement of the product on carpeted surfaces.

To develop requirements that would effectively assess and improve the stability of CSUs, staff took several approaches to identify factors that are relevant to CSU stability. These included analyses of In-Depth Investigations (IDIs) of actual CSU tip-over incidents (including interactions and behaviors involved in those incidents, and the CSUs involved in those incidents), modeling these incidents, and determining the forces and other relevant factors that exist during expected interactions, based on research conducted at the University of Michigan Transportation Research Institute (UMTRI) (Tab R).

Directorate for Engineering Sciences, Division of Mechanical and Combustion Engineering (ESMC) staff has developed a draft proposed rule for the inherent stability of CSUs, based on a review of incident data collected by Directorate for Epidemiology, Division of Hazard Analysis (EPHA) staff (Tab A), incident analyses conducted by Directorate for Engineering Sciences, Division of Human Factors (ESHF) and ESMC staff (Tab C and Tab M, respectively), a review of the UMTRI Study, "Forces and Postures During Child Climbing Activities" (Tab R), and testing performed by ESHF, ESMC, and LSM staff with analysis by EPHA staff (Tabs L, M, O, and P, respectively).The draft proposed rule accounts for real-world use conditions and interactions with CSUs, as follows:

- Multiple open drawers;
- Filled and unfilled drawers;
- Carpeted surfaces;
- Dynamic forces from a 51.2 pound (*i.e.*, 95th percentile 3-year-old) or lighter-weight child, climbing/ascending[1] and other interactions; and
- A child pulling on the top drawer that is within a 3-year-old child's reach.

Finally, staff identified and evaluated options for modifying current CSU products to comply with the recommended requirements.

II. TECHNICAL BACKGROUND

A. Introduction

This memo includes technical discussion of engineering concepts, such as center of gravity (also referred to as center of mass), moments, and fulcrums. This section provides background information on each of these terms, including how staff applies them to CSU tip-over analysis.

B. Center of Gravity and Center of Mass

Center of Gravity (CG) or Center of Mass (CM)[2] is a single point in an object, about which its weight (or mass) is completely balanced.

In terms of freestanding CSU stability, as illustrated in Figure 2, if the CSU's CG, denoted as the black and white checkered circle, is located behind the front foot, the CSU is stable and will not tip over. Alternatively, if the CSU's CG is in front of the front foot, the CSU is unstable and will tip over.

[1] Ascending is a subcategory of climbing, and is described as a child's initial step to climb up on to a CSU. Therefore, ascending is an integral part of climbing. The UMTRI study (Tab R) provided information about forces children generate during ascent, because that testing measured forces children generate during an initial step onto the CSU test fixture. Those forces can be used to model children climbing because ascent is the first and integral step to climbing, but not all climbing interactions can be modeled with ascent, as forces associated with some other behaviors can exceed those for ascent. The term "climbing" is often used in this briefing package because that is the general behavior described in many incidents. Both climbing and ascending are used to refer to the force children generate on a CSU, for purposes of the draft proposed rule.

[2] For CSU sized objects, CG and CM are effectively the same. Therefore, CG and CM terms are used interchangeably throughout this memorandum.

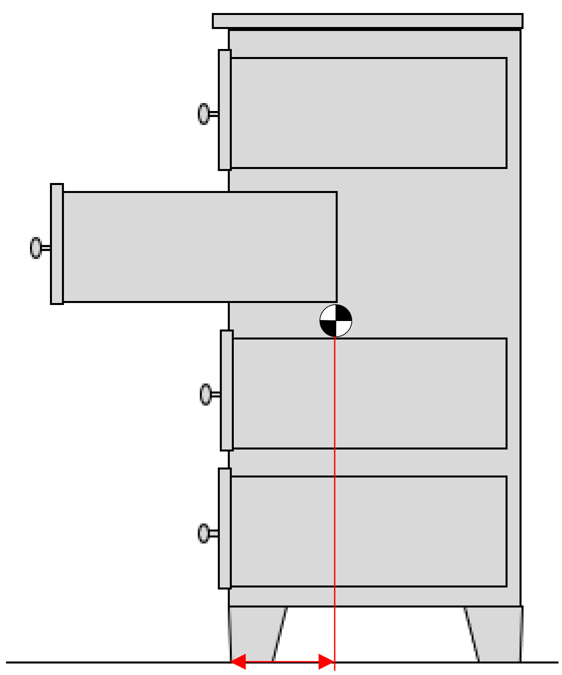


Figure 2a. CG behind leg – CSU is stable and will remain upright.

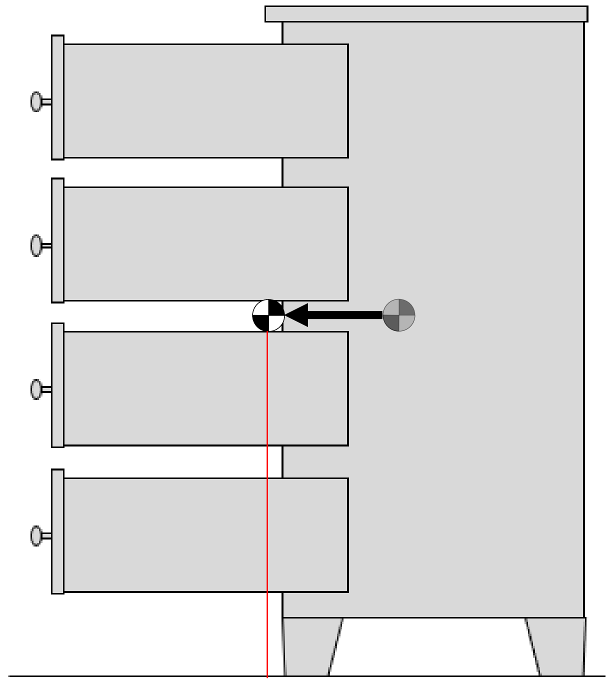


Figure 2b. CG in front of leg – CSU is unstable and tip over will occur.

Figure 2. A stable CSU can become unstable as a result of shifting the CG in front of the front leg.

The CG (and CM) of an object is dependent on its geometry and materials. For example, CSU drawers typically have a front that is thicker and larger than the back, which causes the drawer's CG to be closer to the front, as illustrated in Figure 3.

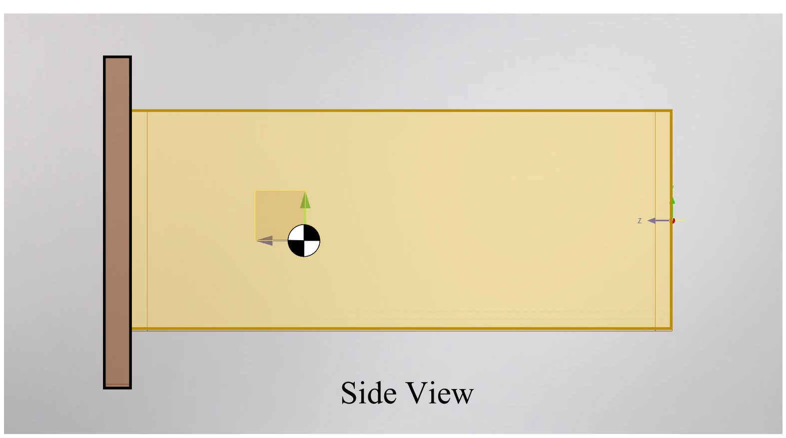


Figure 3. The larger front on this drawer causes the drawer's CG to be closer to the front than the back.

The CSU CG is defined by the position and weight of the CSU cabinet (without drawers), combined with the position and weight of each drawer. CSU CG is equal to the sum of the position, multiplied by the weight (W) of each component, divided by the total weight. For example, the CSU CG in an arbitrary Y direction can be represented by the following equation:

$$CG_Y = \frac{\sum_{i=1}^{n} W_i Y_i}{\sum_{i=1}^{n} W_i}$$

In this equation, Y equals the position of each component's CG in the Y direction, W equals the weight of each component, i equals the index number of each component (beginning with 1), and n equals the total number of components. A visual example of this is shown in Figure 4.

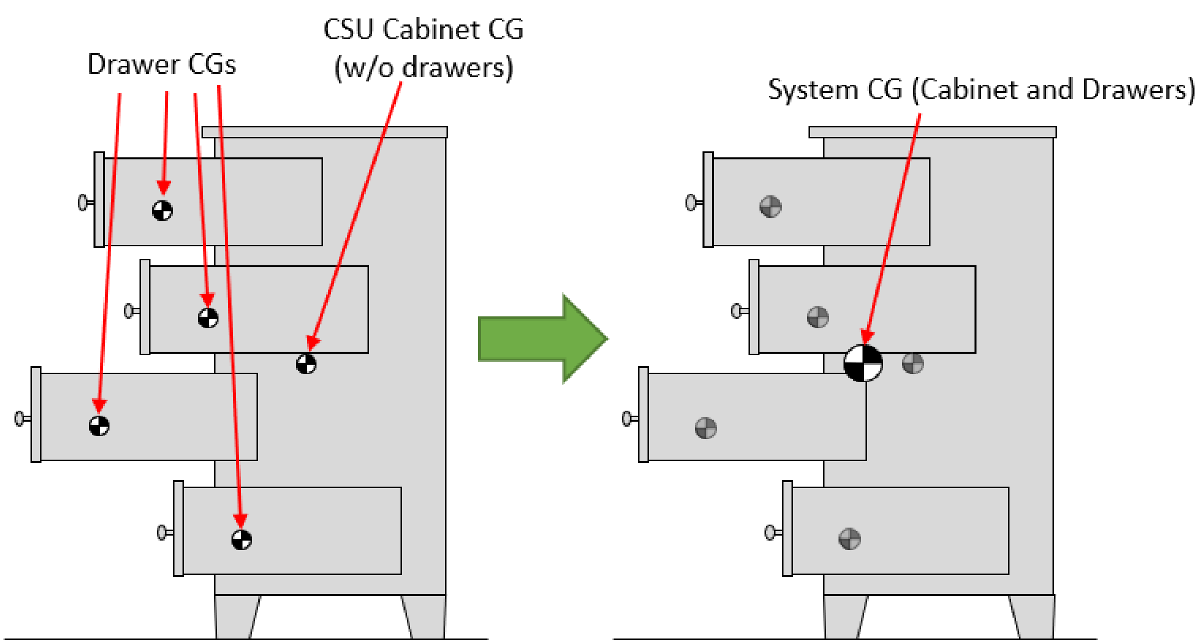


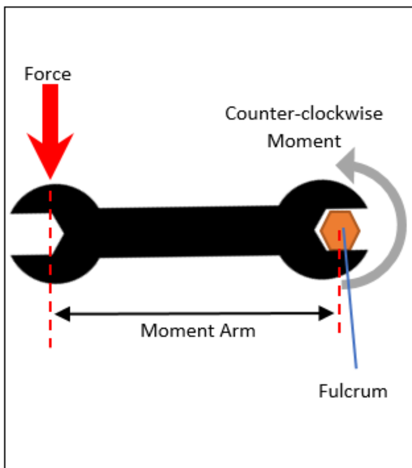
Figure 4. The CG of a CSU system is a combination of the CG locations and weights of the CSU cabinet and drawers.

The CG of a CSU will change as a result of the position of the drawers, doors, and pullout shelves (open or closed). Opening extendable elements, such as drawers, shifts the CG towards the front of the CSU, as previously shown in Figure 2. The closer the CG is to the front leg, the easier it is to tip forward if a force is applied to the drawer. Therefore, CSUs will tip more easily as more drawers are opened.

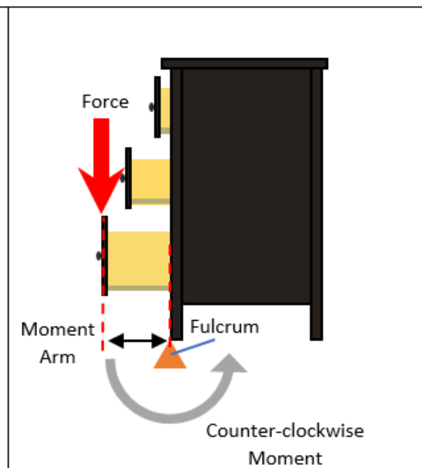
The CG of a CSU will also change depending on the position and amount of clothing in each drawer. Closed drawers filled with clothing tend to stabilize a CSU, but as each filled drawer is pulled out, the CSU CG will further shift towards the front.

C. Moment and Fulcrum

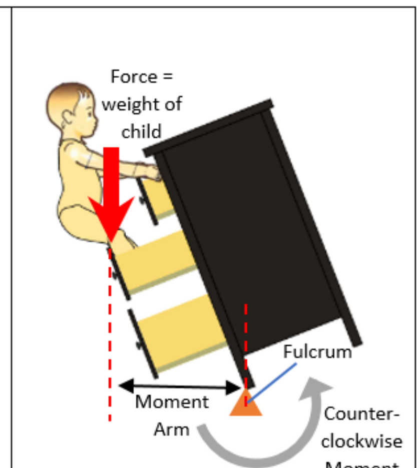
Moment, or torque, is an engineering term to describe rotational force acting about a pivot point, or fulcrum. The moment is created by force(s) acting at a distance, or moment arm, away from a fulcrum. Figure 5 shows three examples of a moment. Example 1 shows the moment or torque created by a wrench turning a nut. The moment or torque about the nut is due to the perpendicular force on the end of the wrench applied at a distance (moment arm) from the fulcrum (nut). Example 2 shows that a downward force on an open CSU drawer creates a moment about the fulcrum (front leg) of the CSU. Example 3 shows the CSU tipping over about the fulcrum due to a force (weight of a child positioned over the front of a drawer) and the moment arm (extended drawer).



Example 1: Wrench turning a nut.



Example 2: Force on a dresser drawer.



Example 3: Weight of a child tipping a dresser.

Figure 5. Three examples show how a force and moment arm create a rotational force, or moment.

Downward force or weight applied to the drawer tends to tip the CSU forward around the fulcrum at the base of the unit, while the weight of the CSU opposes this rotation, as shown in Figure 6. The CSU's weight can be modeled as concentrated at a single point: the CSU CG. The CSU's stability moment is created by its weight, multiplied by the horizontal distance of its

CG from the fulcrum. A child can produce a moment opposing the weight of the CSU, by pushing down or sitting on an open drawer. This moment is created by the vertical force of the child, multiplied by the horizontal distance to the fulcrum. The CSU becomes unbalanced and tips over when the moments applied at the front of the CSU exceed the CSU's stability moment.

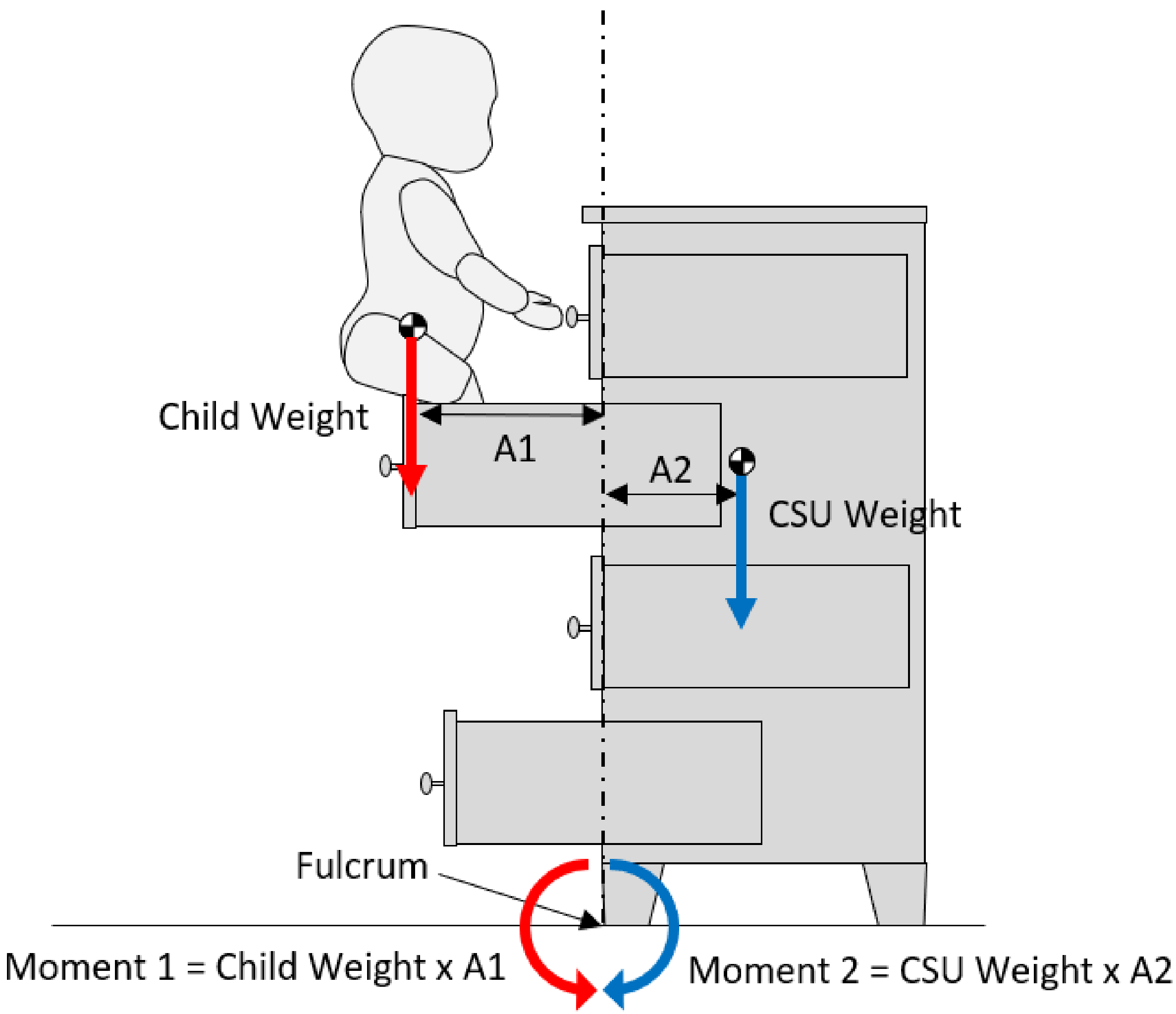


Figure 6. Depicts an example of opposing moments acting on a CSU. The weight of a child sitting on the open drawer at distance A1 from the CSU's front edge touching the ground creates a moment that tips the CSU forward (Moment 1); while the CSU's weight at a distance A2 from the CSU's front edge touching the ground creates a stabilizing moment (Moment 2). The CSU will tip if the moment generated by the child (Moment 1) is greater than the moment due to the CSU's weight (Moment 2).

Horizontal forces applied to pull on a drawer (Figure 7) also tend to tip the CSU forward around the front leg (pivot point or fulcrum) at the base of the unit, while the weight of the CSU opposes this rotation. In this case, the moment produced by the child is the horizontal pull force transmitted to the CSU (for example, through a drawer stop), multiplied by the vertical distance to the fulcrum. The CSU becomes unbalanced and tips over when the moments applied at the front of the CSU exceed the CSU's stability moment.

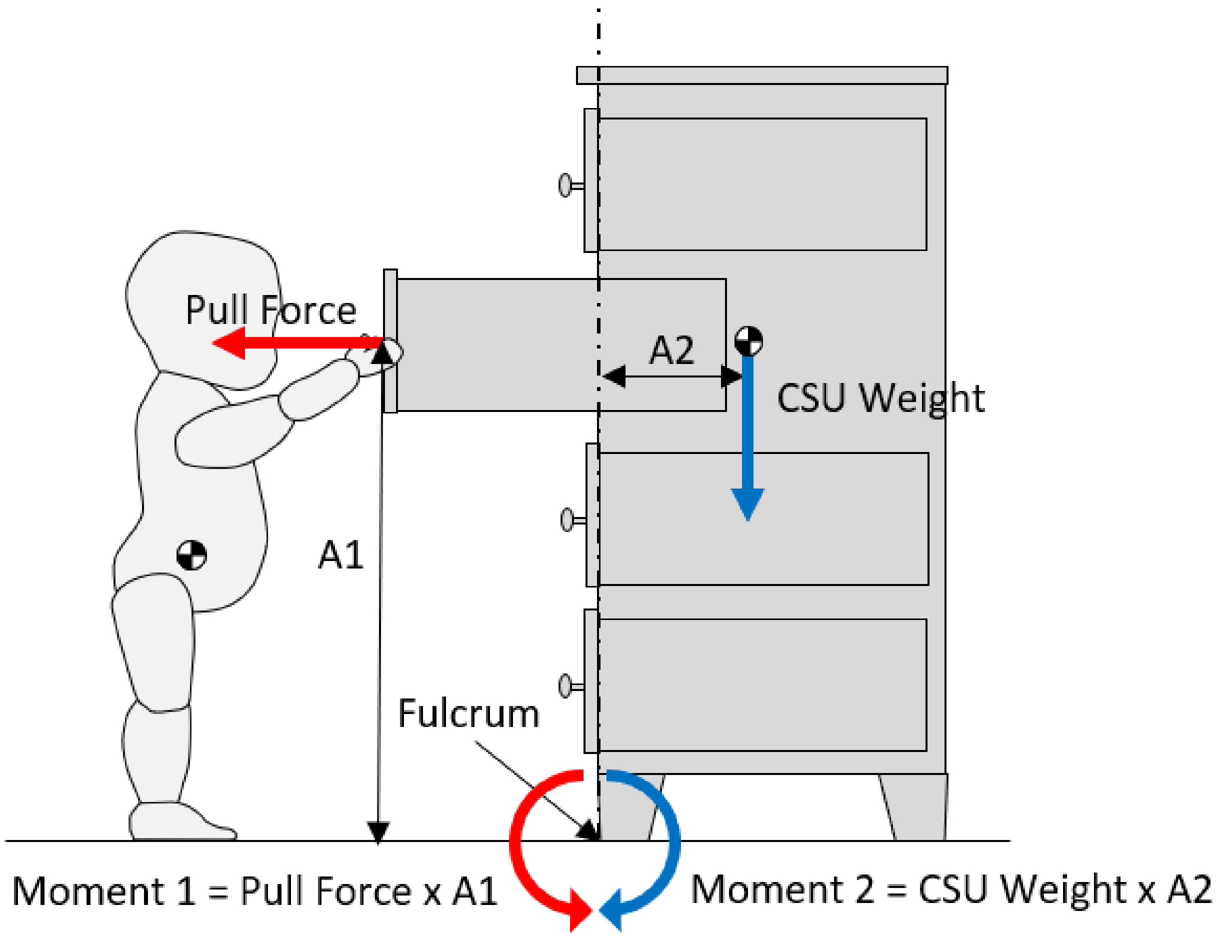


Figure 7. Depicts an example of opposing moments acting on a CSU. A child pulling on the open drawer at a height A1 above the ground creates a moment that tips the CSU forward, while the CSU's weight at a distance A2 from the CSU's front edge touching the ground creates a stabilizing moment. The CSU will tip if Moment 1 is greater than Moment 2.

When a child climbs a CSU, both horizontal forces and vertical forces acting at the hands and feet contribute to CSU tip over. Figure 8 shows a typical combination of forces acting on a CSU while a child is climbing, and it describes how those forces contribute to a tip-over moment. Note that when the horizontal force at the hands and feet are approximately equal, which will occur when the child's CM is balanced in front of the drawers, the height of the bottom drawer becomes irrelevant when determining the tip-over moment. In this case, only the height of the hands above the feet matters.

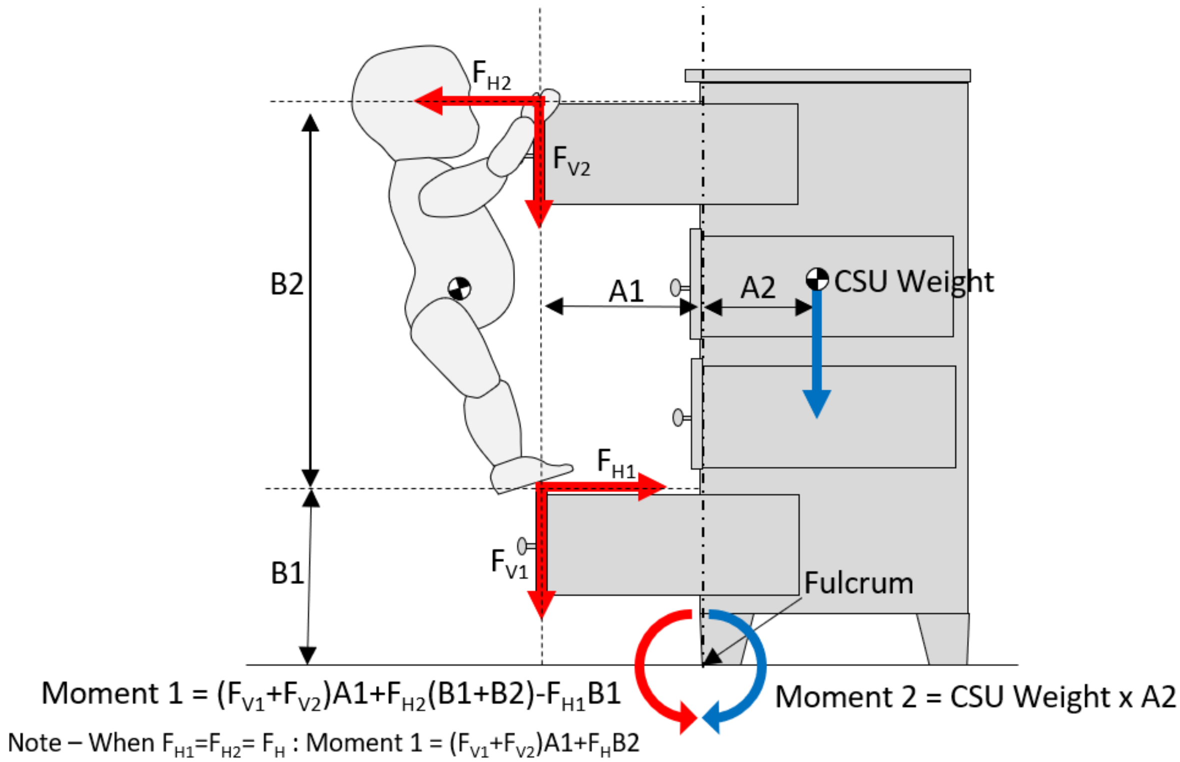


Figure 8. An example of opposing moments acting on a CSU. A child climbing on drawers opened distance A1 from the fulcrum, with feet at height B1 from the ground and hands at height B2 above the feet, will act on the CSU with horizontal forces F_H and vertical forces F_V. The CSU's weight at a distance A2 from the CSU's front edge touching the ground creates a stabilizing moment. The CSU will tip if Moment 1 is greater than Moment 2.

D. Conclusion

ESMC staff has defined the terms "CG," "moment," and "fulcrum." Staff has also shown how children can produce moments about the CSU fulcrum, and how this moment is opposed by the moment produced by the CSU weight located at its CG. The following section describes how ESMC staff used this information in combination with incident data to evaluate CSU models that were involved in incidents.

III. SUMMARY OF INCIDENT-INVOLVED CSU ANALYSES

A. Review of Incident Data

In Tab C, ESHF staff reviewed the compiled tip-over incident data involving children under the age of 18 years old and CSUs without televisions, and they determined the following:

1. Among 89 fatal and 263 nonfatal Consumer Product Safety Risk Management System (CPSRMS) incidents involving children and CSUs without a television, 159 of 352 (45 percent) described **one or more drawers being open**.[3] Incidents include a 13-month-old able to open two drawers and a 2-year-old able to open "all eight drawers."
2. Where drawer fill level was reported in CPSRMS data, **most involved partially full or full drawers,** including 51 of 53 (96 percent) fatal incidents and 60 of 67 (90 percent) nonfatal incidents. Additionally, the proportion of incidents that reported full drawers was greater for fatal incidents than for nonfatal incidents. Most items in the drawers were clothing.
3. Where flooring type was reported in CPSRMS data, **most involved a carpeted surface**, including 45 of 55 (82 percent) of fatal incidents and 48 of 60 (80 percent) nonfatal incidents.
4. Among fatal CPSRMS incidents where the interaction was known, 35 of 47 (74 percent) **involved climbing**. Among nonfatal National Electronic Injury Surveillance System (NEISS) incidents where the interaction was known and the incident was not caused by another person, 412 of 537 (77 percent) **involved climbing**.

ESMC staff considered these factors during staff's analysis of incident-involved CSUs.

B. Staff Analyses of Incident-Involved CSUs

ESMC staff conducted an analysis of incidents and tested incident products to understand the real-world factors that cause a CSU tip-over injury or death. ESMC staff used the following criteria to select incident-involved CSUs for further analysis:

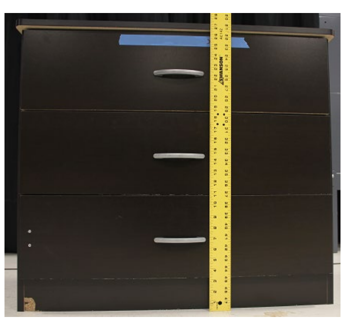
- CPSC investigated the incident.
- The investigation provided sufficient detail for ESMC staff to re-create or model the incident.

[3] Of the remaining 193 of 352 incidents, two incidents reported that no drawers were opened, and 191 incidents did not indicate whether drawers were open.

- CPSC was able to obtain either the CSU involved in the incident (incident samples[4]), or a CSU of the same make and model as the CSU involved in the incident (exemplar samples).

Based on these criteria, staff identified seven CSU models for analysis to determine common contributing factors in these incidents. Staff's reports of the analysis can be found in Tab M. In some cases, staff tested multiple versions of a CSU: for instance, the same model manufactured in two different years; the same model with a different material or finish; or an exemplar sample, in addition to an incident sample. Staff evaluated each model's attributes, such as weight, dimensions, drawer extension, CG, and stability. Table 1 summarizes basic attributes of these CSUs.

Table 1. Basic Attributes of CSUs tested by ESMC Staff – See Tab M.

Report	Photo	Weight, Dimensions (Outer Envelope), Drawer Extension from Fulcrum	ASTM F2057-19 7.2 Tip Weight
MODEL A: 7-drawer CSU (1 Incident sample)		Weight = 164 lb Height = 38-3/16 in Width = 64 in Depth = 18-1/4 in Drawer Extension from Fulcrum = 17-3/4 in	32 lb (does not meet)
MODEL B: 3-drawer CSU (1 exemplar sample)		Weight = 57.5 lb Height = 27-3/8 in Width = 31-1/4 in Depth = 15-1/2 in Drawer Extension from Fulcrum = 12.19 in	19 lb (does not meet)

[4] Some incident samples were damaged during the incident or as part of an investigation prior to CPSC's receipt of the sample. Staff could not fully test one sample due to the extent of the damage. Staff's reports in Tab M for each sample describe the condition of the samples before testing.

Report	Photo	Weight, Dimensions (Outer Envelope), Drawer Extension from Fulcrum	ASTM F2057-19 7.2 Tip Weight
MODEL C: 3-drawer CSU (1 exemplar sample)		Weight = 45 lb Height = 28-¼ in Width = 27-⅝ in Depth = 15-⅝ in Drawer Extension from Fulcrum = 8-¾ in	22 lb (does not meet)
MODEL D: 4-drawer CSU (1 exemplar sample)		Weight = 102 lb Height = 40 in Width = 41-3/16 in Depth = 20-11/16 in Drawer Extension from Fulcrum = 13-¼ in	44 lb (does not meet)
MODEL E: 8-drawer CSU (2 incident samples, 1 exemplar sample)		Weight = 113 lb - 148 lb Height = 37-½ in Width = 62-¾ in Depth = 19-¾ in Drawer Extension from Fulcrum = 12-½ in - 13-3/16 in	72 lb to 83 lb (meets)
MODEL F: 5-drawer CSU (1 incident sample)		Weight = 150 lb Height = 50 in Width = 35 in Depth = 18 in Drawer Extension from Fulcrum = 15-⅛ in	48 lb to 49 lb (does not meet/meets)

Report	Photo	Weight, Dimensions (Outer Envelope), Drawer Extension from Fulcrum	ASTM F2057-19 7.2 Tip Weight
MODEL G: 7-drawer CSU (1 incident sample, 1 exemplar sample)		Weight = 165 lb - 195 lb Height = 37.2 in Width = 55.3 in Depth = 21.6 in Drawer Extension from Fulcrum = 11.8 to 12.2 in.	84 lb to 114 lb (meets)

ESMC staff tested a total of 10 CSUs (as Table 1 indicates, for some of the 7 models, staff tested more than 1 unit) and analyzed 12 incidents. The CSUs ranged in height from 27 inches to 50 inches and weighed between 45 pounds and 195 pounds. Two CSUs did not consistently meet the requirements in ASTM F2057 – 19 Section 7.1[5] (all drawers open). Five of the 10 CSUs did not meet the requirements in ASTM F2057 – 19 Section 7.2 (50-pound test fixture on one open drawer).

ESMC staff then created computational models for each CSU, based on measured attributes and testing. Staff used those models to assist with re-creating several of the incidents in which the CSUs were involved. These re-creations included the following hazards leading to tip-over:

1. Multiple (more than one) drawers were opened;
2. Drawers were empty, filled, or partially filled with clothing;
3. CSUs on carpeted surfaces;
4. Children climbing the CSU;
5. Children pulling on CSU drawers.

Table 2 summarizes the possible hazard patterns contributing to tip over found in each incident.

[5] Model A did not pass the test in ASTM F2057 – 19 Section 7.1; while Model F passed in earlier tests, but failed during this more recent analysis. ES staff suspects the Model F product configuration changed over time, resulting in a different test outcome. Test results are discussed further in Tab M. The stability tests in ASTM F2057 – 19 are discussed in greater detail in Section V of this memorandum and in the LSM memorandum in Tab F.

Table 2. Summary of Hazard Patterns Leading to Tip-Over in Each Incident

Incident #	CSU Model	Multiple Open Drawers	Clothing in Drawers	On Carpet	Climbing	Pulling
1	Model A: 7 Drawer CSU	X	X			X
2*	Model B: 3-Drawer CSU	X		X		X
3	Model C: 3-Drawer CSU		X	X		X
4	Model D: 4-Drawer CSU	X	X	X		
5*	Model E: 8-Drawer CSU	X	X		X	
6	Model E: 8-Drawer CSU	X			X	
7	Model E: 8-Drawer CSU	X	X	X		
8	Model E: 8-Drawer CSU	X		X		X
9	Model E: 8-Drawer CSU	X		X		X
10	Model E: 8-Drawer CSU	X		X	X	
11*	Model F: 5-Drawer CSU	X	X	X	X	
12	Model G: 7-Drawer CSU	X	X	X	X	

*Indicates the incident resulted in a fatality.

Staff's findings were:

1. **Filled versus empty drawers and the number of drawers open** affect the stability of the CSU.

Based on ESHF staff's analysis in Tab L, clothing fill density for a full drawer can be modeled as 8.5 pounds per cubic foot. ESHF staff assessed that it is possible to fill drawers above the drawer side height, but there needs to be minimal clearance with the closest vertical obstruction. They defined functional drawer height as equal to clearance height, minus ⅛ inch, as shown in Figure 9. Therefore, the necessary weight required to model the weight of a drawer filled with clothing can be determined using the following equation:

$$Fill\ Weight = 8.5\frac{lb}{ft^3}\left\{[Interior\ Area](ft^2)\left[Clearance\ Height - \frac{1}{8}\right](in)\left[\frac{1}{12}\right]\left(\frac{ft}{in}\right)\right\}$$

ESMC staff used this equation to model CSU tipping behavior with filled drawers in comparison to unfilled (empty) drawers. In cases where the incident description described the drawers as only partially full, the fill weight was lowered accordingly.

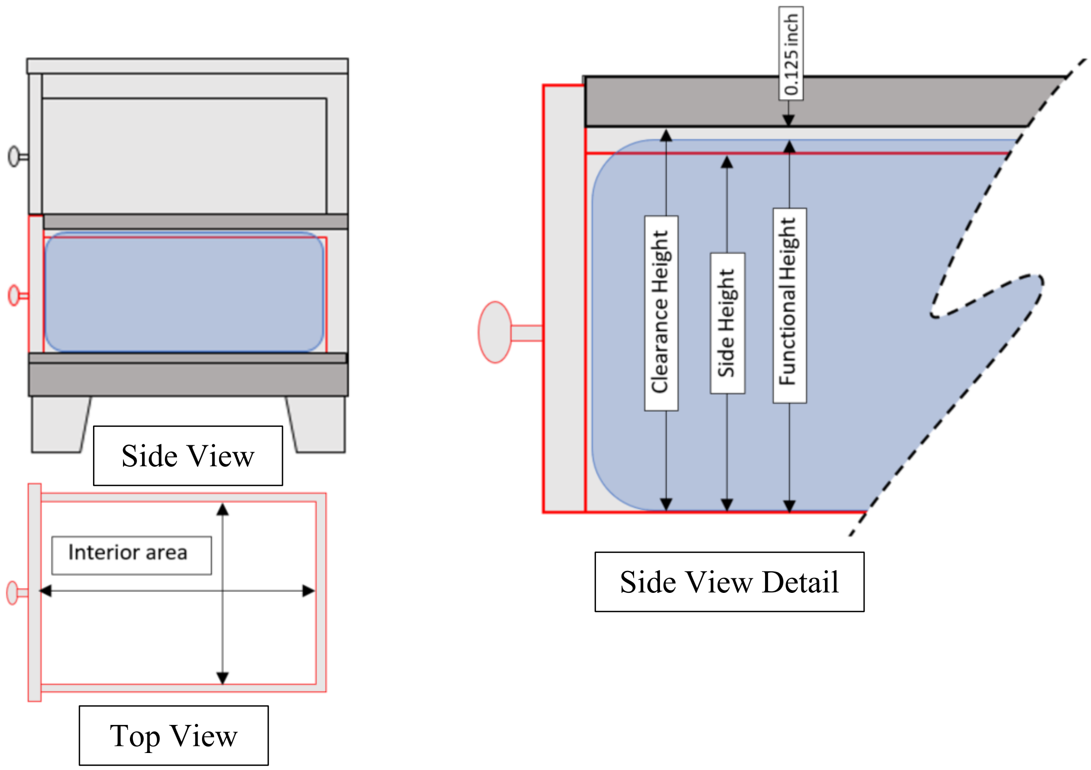


Figure 9. How to measure functional drawer height: the maximum drawer height that can reasonably be expected to be filled with clothing.

Staff analysis and testing reported in Tab M showed the CG of the CSU shifts forward as more drawers are opened, decreasing its stability. Additionally, when the drawers are filled, and less than half the drawers (by volume) are open, the CSU is more stable relative to an empty CSU in the same configuration (increases force required to tip the CSU); but when more than half the filled drawers by volume are open, the CSU is less stable (lessens the force required to tip the CSU). Therefore, when filled drawers are closed, the clothing weight contributes to the stability of the CSU, because the clothing weight is behind the front legs (fulcrum). However, open drawers contribute to the CSU being less stable, because the clothing weight is shifted forward in front of the front legs (fulcrum). Figure 10 shows how multiple open drawers and filled drawers affect tip-over force (*i.e.*, the force or weight needed to tip over the CSU)[6] for one Model E CSU (Tab M). While both become less stable as more drawers are pulled out, these results show that a CSU with filled drawers (orange bars) is more stable than an empty drawer (green bars) when less than half of the drawers (by volume) are pulled out, but a CSU becomes less stable as more than half of the drawers (by volume) are pulled out.

[6] The tip-over force is determined with weights or vertical force applied to the front face of an open drawer, and with computational modeling of these load scenarios.

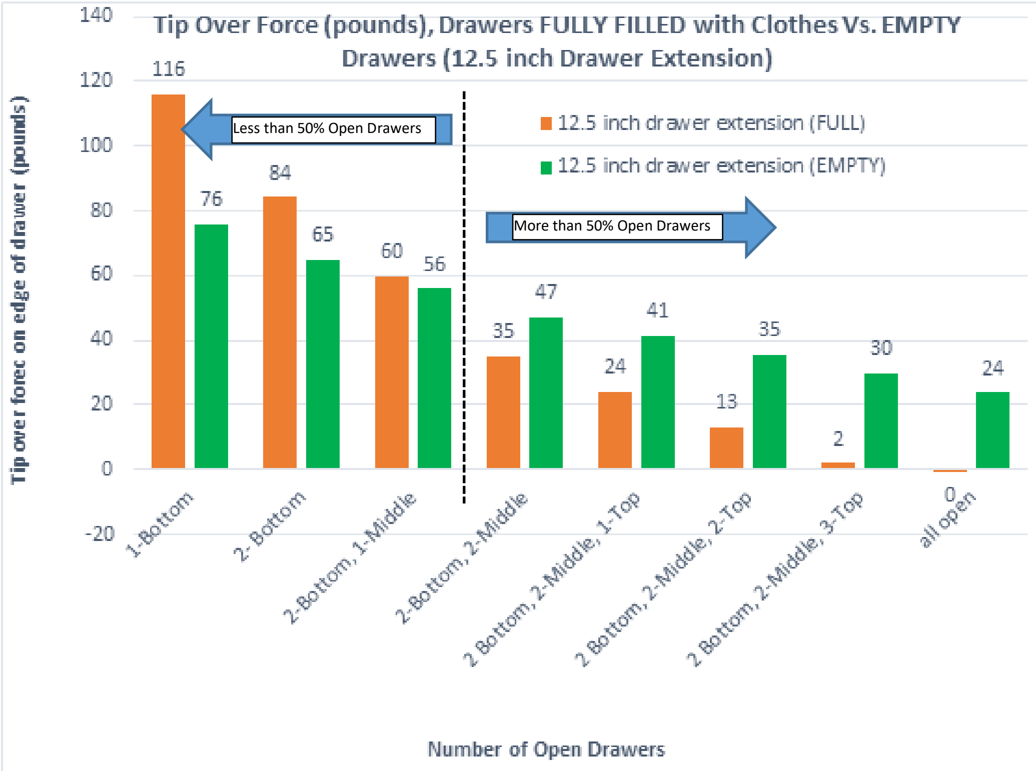


Figure 10. Model E, 8-drawer CSU (Tab M), comparison of tip-over force between *filled* drawers and *empty* drawers.

2. A CSU **on a carpet/pad is less stable** than one on a hard, level, and flat floor.

EPHA staff analyzed the difference in tip weights for CSUs tested on (1) a hard, level, and flat surface, and (2) a carpeted surface (Tab P) and found that, on average (mean), the CSUs on carpet required 7.6 pounds less weight to tip over, as compared to the same CSUs on a hard, level, and flat surface.

ESMC staff compared nine tip weights on carpet for incident-involved units included in EPHA staff's analysis[7] with tip weights for those same units in the same test configuration when tilted at 0°, 1°, 2°, and 3° in the forward direction on an otherwise hard, level, and flat surface. Table 3 and Figure 11 show the comparison of ESMC staff's testing of CSUs at forward tilt angles to the EPHA carpet testing. The tip weight of CSUs on carpet corresponded with tilting the CSUs 0.8° to 3° forward. The mean corresponding tilt angle was 1.48°. The results of this preliminary analysis suggest that a forward tilt of 0.8° to 3° replicated the test results on carpet. ES staff also conducted a mechanical analysis of the carpet and pad used in the test assembly, shown in Tab M

[7] EPHA staff's testing included some exemplar samples analyzed by ESMC staff.

(Model E), which similarly found a forward tilt of 1.5° to 2.0° would replicate the effects of carpet for one CSU.

Table 3. CSU Tip Weights on a Forward Incline Compared to Carpet

	Tip Weights on Forward Incline (lb)					
Sample	**0°**	**1°**	**2°**	**3°**	**Carpet Tip Weight (lb)**	**Incline Angle Corresponding with Carpet Tip Weight (°)**
Model B (5*): Test 1	19	18	16	15	15	3.00
Model D (2*): Test 1	11	7	4	2	7.5	0.90
Model D (2*): Test 2	44	40	36	33	38.5	1.40
Model E (26*): Test 1	24	18	13	8	15	1.60
Model F (4*†): Test 1	48	40	36	30	40.5	0.88
Model G (25*): Test 1	62	56	49	43	57	0.83
Model G (25*): Test 2	45	39	28	19	33	1.55
Model G (25*): Test 3	66	62	50	43	55	1.58
Model G (25*): Test 4	57	51	40	33	45	1.54
					Mean:	**1.48**
					Standard Deviation:	**0.66**

*Refers to the corresponding Unit # in Tab P.
†Unit 4 in Tab P was an exemplar of the Model F incident unit described in Tab M, with no discernable differences in weight, dimensions, drawer extension, or CG.

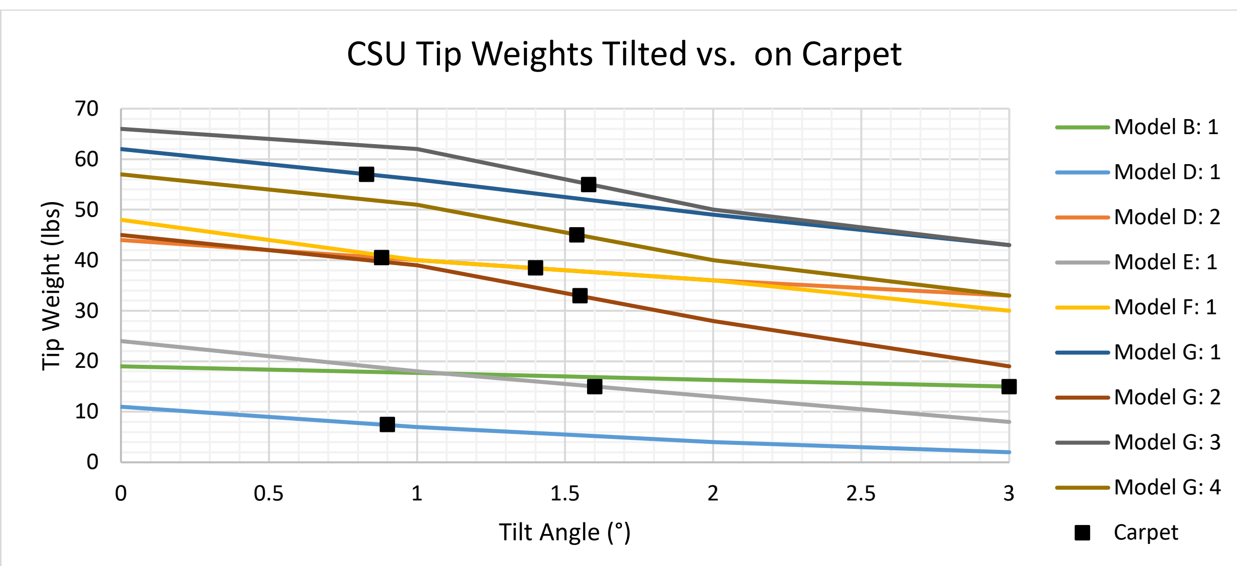


Figure 11. Depicts CSU tilt angle tip weight data (lines), compared to carpet test results (dots). The dots represent the tilt angle and tip weight, where tilted CSU tip weight is the same as the tip weight of that same CSU when tested on a carpeted surface. The average (mean) tilt angle that matched carpet data was approximately 1.5°.

EPHA staff described the carpet used in this testing as typical cut pile wall-to-wall carpeting purchased from a major home-supply retailer (Tab P). ESHF staff found that most fatal incidents involved cut pile wall-to-wall carpeting (Tab C). CPSC's data suggest a CSU tilted forward at an angle of 0.8° to 3°, with a mean forward tilt angle of 1.48°, replicates its behavior on carpet. Given this information, CPSC staff recommends using a forward tilt angle of 1.5° to replicate the effects of a CSU resting on carpet, because this angle represents the average effect of carpet on several CSUs of different sizes.

3. **Forces** associated with **child climbing** behaviors can **exceed body weight** on a drawer, and substantially contribute to the tip-over propensity of the CSU.

ESMC staff's analyses of tip-over incidents in Tab M outline several scenarios where children climbing or interacting with the front of a CSU caused the CSU to tip over. In some of the scenarios outlined for Models E and G, the force on the edge of an open drawer associated with tipping the CSU was greater than the static weight of a child standing on the edge of an open drawer of the CSU. The equivalent force consists of the child's weight, the dynamic force on the edge of the drawer due to climbing, and the effects of the child's CG extending beyond the edge of the drawer. Based on the UMTRI Study, ES staff estimated the equivalent force to be more than 1.6 times the weight of the child for typical drawer extensions.[8] Staff concludes that these tip over incidents occurred because the forces and moments associated with children climbing on a CSU exceeded the static body weight of a child standing on the edge of an open drawer.

4. **Moments** associated with **child pull strength** can **exceed body weight** on a drawer, and substantially contribute to the tip-over propensity of the CSU.

Staff analyzed five incidents involving Models A, B, C, and E in which a child pulling on a drawer could have contributed to the CSU tipping over. ESHF staff found that a 2- to 5-year-old child can pull on the top drawer of a CSU with a mean horizontal force of 17.2 pounds-force (Tab M). Consequently, ESHF recommends an additional requirement that CSUs be able to withstand 17.2 pounds-force applied horizontally at an upper drawer that can be reached by a 3-year-old child without tipping over. The tip-over moment created by this horizontal pull force on an upper drawer can exceed the moment created by the child's body weight on an extended drawer because CSUs are typically taller than the drawer extension. The longer moment arm, which contributes to the pull moment, has a multiplicative effect, allowing even small forces to tip CSUs.

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[8] Analysis based on Tab R, Table 16, page 44.

C. Conclusion

ESMC staff found common themes in incident data, based on their analysis of CSUs that have been involved in incidents:

- CSU tip-over incident data show that children are able to open multiple drawers simultaneously.
  - ESMC staff determined that multiple open drawers reduce the stability of CSUs.
- Incident data suggest a majority of tip-over incidents occur with drawers that are filled or partially filled with clothing.
  - ESMC staff determined that with more than half the drawers open by volume, drawers filled with clothing can reduce the stability of CSUs.
- Incident data suggest most CSU tip-over incidents occur on a carpeted surface.
  - EPHA staff determined in Tab P that CSUs on carpet tip over more easily than CSUs on a hard, level, and flat surface.
  - ESMC staff determined that a tilt angle of 1.5° could replicate many CSUs' behavior on common carpets.
- Incident data suggest more than half of CSU tip-over incidents occur due to child climbing behaviors.
  - UMTRI researchers have found that forces from child climbing can exceed body weight.
  - ESMC staff has found that the increased forces from child climbing behaviors may be directly responsible for some incidents.
- ESMC analysis of CSU tip-over incidents shows that a child pulling on the upper drawers can cause tip over.
  - ESHF staff estimated that a 2- to 5-year-old child can pull on a drawer with a 17.2-pound mean horizontal force.

IV. TECHICAL ANALYSIS OF UMTRI CHILD CLIMBING STUDY

As indicated above, some of the common themes that staff identified in CSU tip-over incident data involve children interacting with CSUs, including climbing and opening drawers. To determine the forces and other relevant factors that exist during these expected interactions between children and CSUs, CPSC contracted with the UMTRI to conduct research. UMTRI staff's report can be found in Tab R.

A. Introduction

The researchers at UMTRI, in collaboration with CPSC staff, designed a study to collect information about children's measurements and proportions, interest in climbing and climbing behaviors, and the forces and moments children can generate during various interactions with a CSU. The interaction portion of the study included children interacting with a CSU test apparatus with instrumented handles and a simulated drawer and tabletop[9] (shown below). Researchers measured the forces of the children acting on the test apparatus. Moments generated by the children were calculated based on the location of the CSU's front leg tip point (fulcrum). The researchers based the fulcrum's location on a dataset of CSU drawer extension and heights provided by CPSC staff.[10]

The interaction portion of the study looked at forces associated with several climbing-related interactions of interest, which staff and researchers selected based on CSU tip-over incidents, videos of children interacting with CSUs and similar furniture items, and plausible interactions based on children's developmental abilities. Staff focused on the ascent climbing interaction for this rulemaking because climbing incidents were the most common interaction among fatal CPSRMS incidents and nonfatal NEISS incidents, where the interaction was reported, and they were the second most common interaction in nonfatal CPSRMS incidents, where the interaction was reported, as described in a previous section and in Tab C; and because climbing begins with ascent, which is a child's initial step to climb up on to the CSU, and therefore, is considered an integral part of all climbing interactions. Other aspects of the study are discussed in the ESHF memo in Tab C.

B. Test Apparatus and Data Acquisition

UMTRI researchers created the test apparatus shown in Figure 12, which used a padded force plate to measure interactions with the floor and included a column to which the various instrumented test fixtures were attached. Tests were conducted with a pair of handle bars (simulating drawer handles or fronts), a simulated drawer, and a simulated table-top. UMTRI researchers configured the test fixtures based on each child's anthropometric measurements. Tabs C and R contain more information about the test fixture configurations.

[9] The tabletop was intended to simulate the top of a CSU or other tabletop or furniture unit.
[10] CPSC staff provided UMTRI researchers with a dataset of drawer extensions and drawer heights from the ground from a sample of approximately 180 CSUs. The researchers selected the 90th percentile drawer extension (12 inches) and drawer height (16 inches) as the basis for placing the moment fulcrum in most of their analysis.

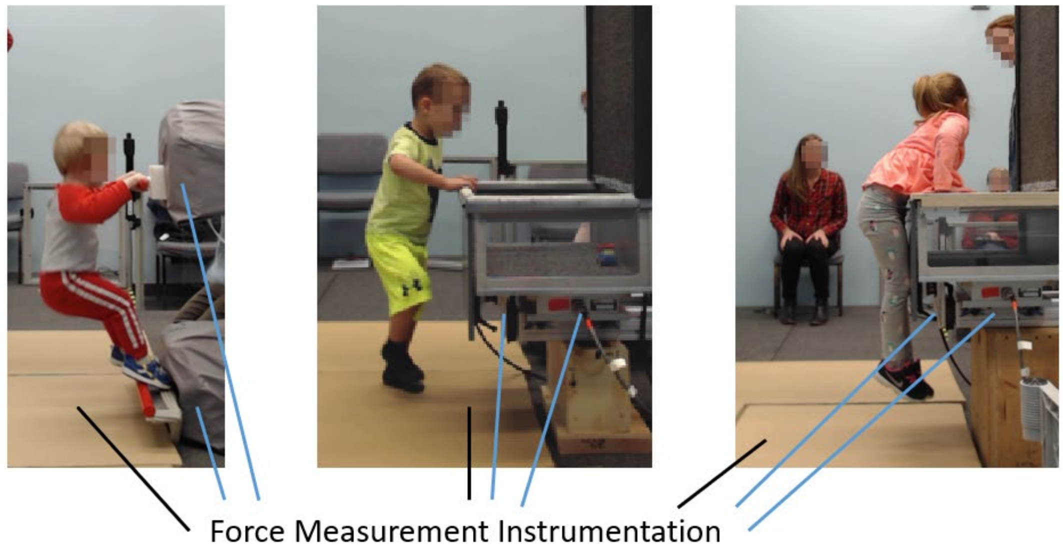


Figure 12. The test setup and location of instruments used to measure force during handle trials (left), box/drawer trials (center), and table trials (right).

C. Target Behaviors of Children Interacting with a CSU

UMTRI researchers instructed children to ascend the test fixture and perform scripted interactions; afterwards, the researchers reviewed video from each trial to isolate and characterize interactions of interest. Interactions of interest for the handle trials were categorized as: Ascent, Bounce, Lean (lean back), Yank, and One Hand (see Figure 13). Researchers analyzed forces from each extracted behavior to identify peak forces and moments.

Ascent Bounce Lean Back Yank One Hand

Figure 13. Children were instructed to climb on (ascend) the test fixture and perform certain targeted behaviors. The Ascent image on the left also shows markers that were used to find the CM location, discussed in the next section.

D. Image-Based Posture Analysis

Participant postures have strong effects on the horizontal forces exerted by the child and the subsequent calculated moments, due to the location of the child's CM[11] during each behavior. Thus, the CM of the child is important when evaluating the stability or tip-over propensity of the child/CSU-combined system.

UMTRI researches used the images of the subjects to estimate the location of the child's CM. The UMTRI researchers extracted video frames at time points of interest (typically when the child produced the maximum moment during the interaction) and manually digitized the series of landmarks on the image of the child, as shown in Figure 14. The location of the CM was estimated, based on data from Snyder et al. (1977), as 33 percent of the distance from the buttock landmark to the top-of-head landmark.[12]

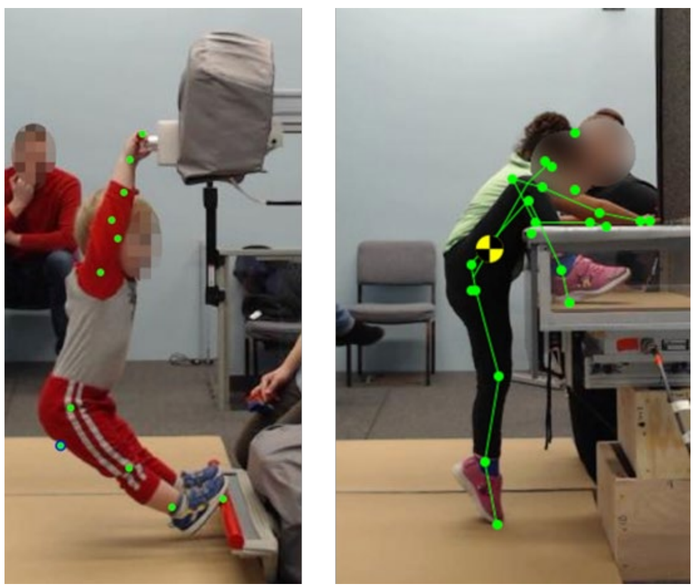


Figure 14. The photo on the left shows the right side of the body as it is digitized. The photo on the right shows the resulting body segments and the estimated location of the CM for a different child and test condition.

The UMTRI researchers estimated the location of the child's CM by examining the side-view images from the times of maximum moment, as shown in Figure 15. Table 4 (Table 21 of the

[11] CM is effectively the same as CG; see footnote 2.

[12] Snyder, R.G., Schneider, L.W., Owings, C.L., Reynolds, H.M., Golomb, D.H., & Schork, M.A. (1977). Anthropometry of Infants, Children and Youths to Age 18 for Product Safety Design (Report No. UM-HSRI-77-17). Prepared for the U.S. Consumer Product Safety Commission, Washington, D.C.

UMTRI report) shows the average estimated CM location for each behavior.[13] The children in the study extended their CM an average of about 6 inches from the handle/foothold while ascending.

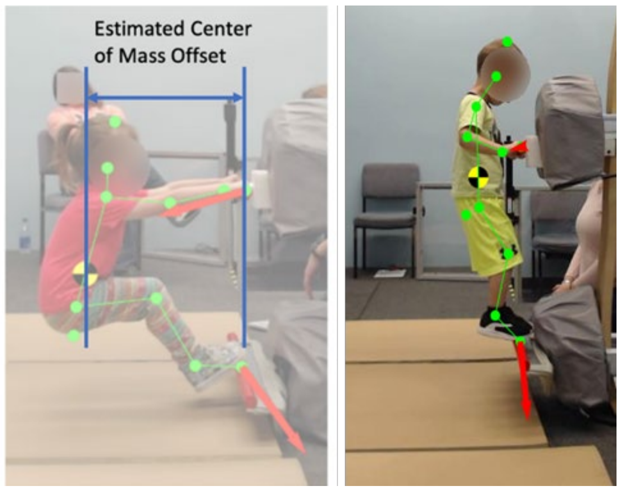


Figure 15. Example of digitized frame with estimated CM location and offset from upper handle. The lean behavior is shown on the left, and the ascend behavior is shown on the right. Forces at the hands and feet are shown with scaled arrows.

Table 4: Estimated CM Horizontal Offset from the Handles for Aligned Trials (inches)

Behavior	N Subjects	N Trials	Mean	SD	10th %ile	50th %ile	90th %ile
Ascent	36	109	6.1	2.0	4.3	6.1	8.6
Bounce	32	80	6.0	2.5	4.0	5.8	9.1
Lean Back	30	81	11.3	3.4	8.5	11.6	15.9
Yank	25	53	10.9	3.4	7.3	11.5	15.9

(See Table 21 in UMTRI Report, Tab R)

E. Handle Trial Force Results

Figure 16 shows side-view images of examples of children interacting with the handle fixture. The frames were taken at the time of peak tip-over moment. Forces exerted by the child at the hands and feet are illustrated using scaled vectors (longer lines indicate greater force magnitude; arrow direction indicates force direction). Digitized landmarks and estimated CM locations are shown. The images demonstrate that forces at both the hands and feet often have substantial horizontal components, and usually, but not always, the foot forces are larger than the hand

[13] Graphs are available in Tab R, page 59 Figure 54.

forces. The horizontal components at the hands and feet are also in opposite directions: the horizontal foot forces are forward (toward the test fixture), while the hand forces are rearward (toward the child).

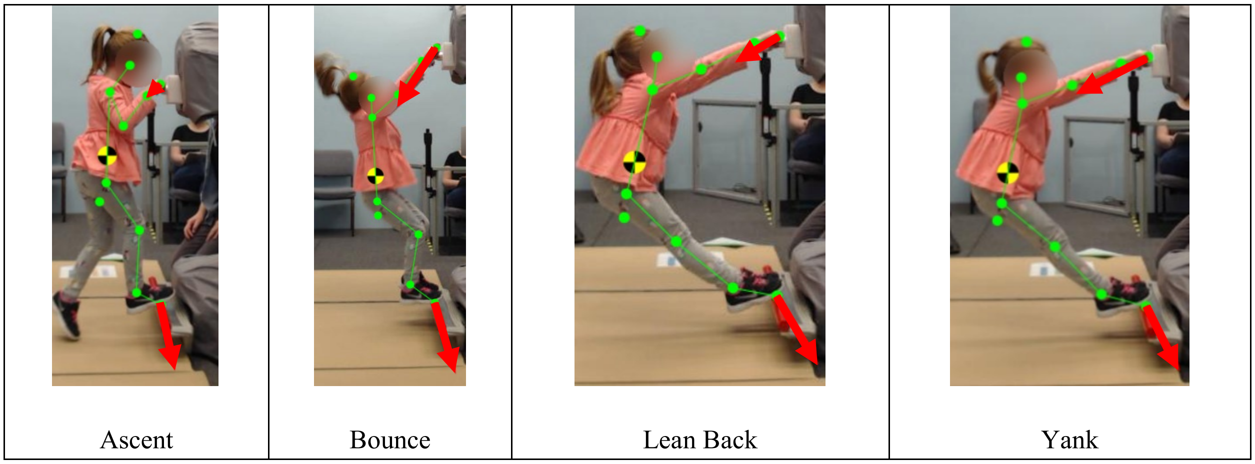


Figure 16. Depicts examples of interactions. Arrows illustrate the directions and relative magnitudes of forces at the hands and feet.

Figure 17 shows an exemplar time-history plot of the horizontal and vertical forces for the Ascent behavior of the depicted child. Horizontal forces are labeled X (Lower Bar X and Upper Bar X) and are positive (greater than zero) in the forward direction (away from the child). Vertical forces are labeled Z (Lower Bar Z and Upper Bar Z) and are positive in the downward direction. Forces on the floor plate are indicated as a black line (Floor Vertical Force). In this trial, the child's body weight transitions from the force plate (black line) to the bars, with the lower bar bearing nearly all of the weight, as demonstrated with the rise of the orange line labeled Lower Bar Z. Note that the horizontal forces on the upper and lower bars are approximately equal in magnitude and opposite in direction, consistent with the posture being approximately static toward the end of the test, where the child completed the ascend maneuver. Under these conditions, the behavior is no longer dynamic, and the vertical forces sum to body weight.

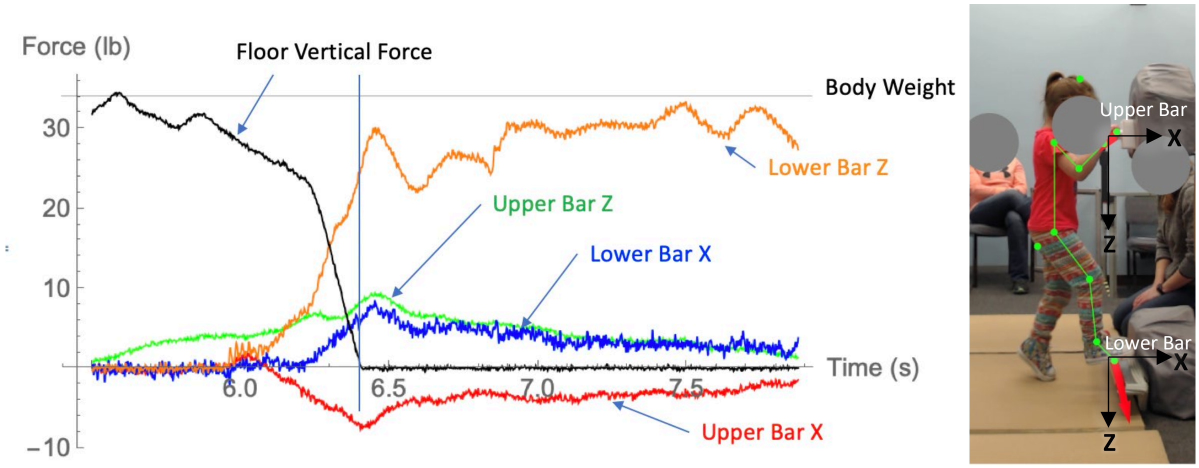


Figure 17. Forces for the exemplar Ascend behavior in the handle trials. The image at the right shows the child at the time indicated by the vertical line in the figure, as well as the positive X and Z directions for each bar.

UMTRI researchers modeled a child interacting with a CSU with opened drawers, by measuring forces at instrumented bars representing a drawer front or handle. Figure 18 (Figure 27 in the UMTRI report) is the free-body diagram of the child climbing the CSU. The horizontal and vertical forces at the hands and feet correspond to the positive direction of the measured forces. The CSU drawers were modeled using the top handle and bottom handle height, and the drawer extension was modeled from 0 inches to 12 inches.[14] The UMTRI researchers calculated the moment about the CSU's front foot or fulcrum, using the measured forces, vertical location of the top and bottom handles, and the defined drawer extension length (Fulcrum X).

[14] Here, 0 inches corresponds with a closed drawer when the fulcrum lines up with the drawers. Additionally, 12 inches represents the 90th percentile drawer extension length in a dataset of approximately 180 CSUs.

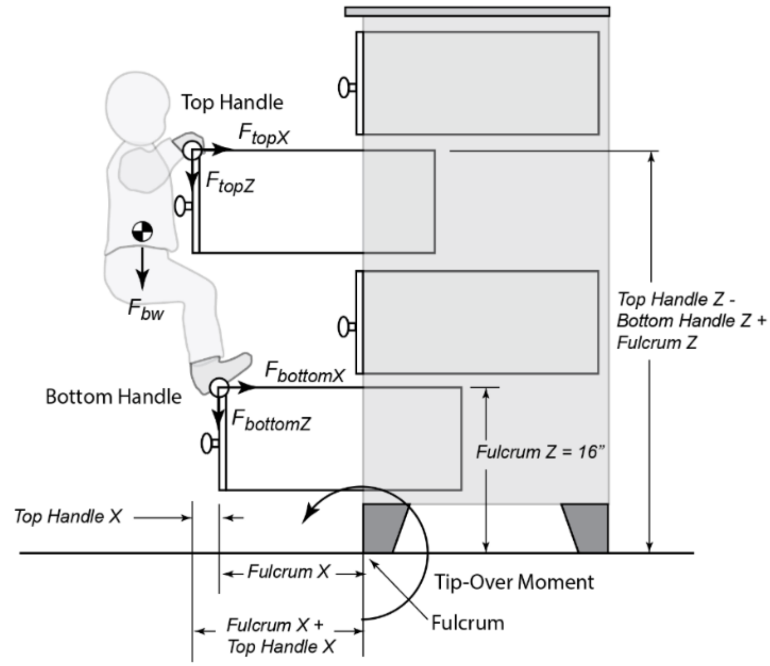


Figure 18. Free-body diagram of a child climbing a CSU.

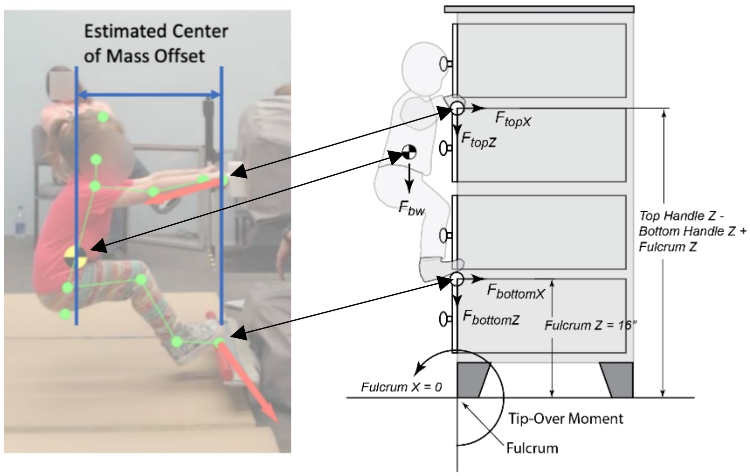
Figure 18 shows that the child's body weight will generally be distributed between the two bars, but that the child's CM location will also typically be outboard of the bars (farther from the fulcrum than the bars). The quasi-static climbing moment is approximately equal to the location of the child's CM (the horizontal distance of the CM to the fulcrum), multiplied by the child's weight. In reality, the moment created by dynamic forces generated by the child during the activities in the UMTRI study, such as during ascend, exceed the moment created by body weight alone as a result of the greater magnitude horizontal and vertical forces.

F. Moment About the Fulcrum

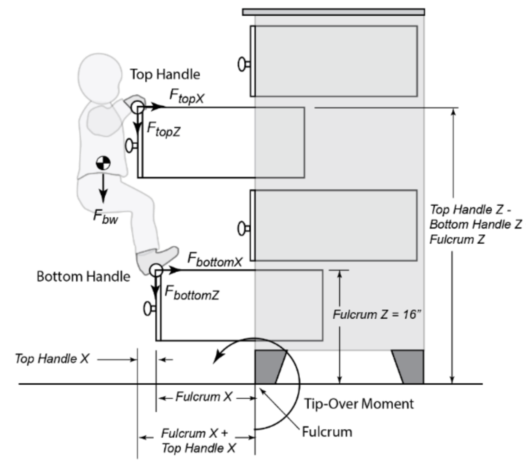
UMTRI researchers analyzed the force data as generating a moment around a tip-over fulcrum. The UMTRI researchers calculated the maximum moment about a virtual fulcrum, based on the measured force data for each test and the location of the force. Figure 19 shows the test set up and the forces measured. Note that the test setup mimics a CSU with the drawers closed and the *Fulcrum X = 0.* UMTRI researchers defined the horizontal *Fulcrum X* distance of 1-foot (based on the 90th percentile drawer extension) to simulate a 1-foot drawer extension. The bottom handle vertical *Fulcrum Z* was set to 16 inches (based on the 90th percentile drawer height from the floor), and the *Top Handle Z* varied, depending on the size of the child.[15] Researchers

[15] The top handle varied from 7.4 to 47.3 inches above the bottom handle.

calculated the moment that would be generated for a child interacting on a 1-foot extended CSU drawer, as shown in Figure 19, where Fulcrum X = 1 foot.



Test configuration consists of force transducers on upper and lower bars. Video image analysis is used to determine the center of mass of the child.



Note: For aligned trials, the top bar is directly under the bottom bar and *Top Handle X* = 0.

Test configuration: force data collected on bars, $F_{top\ X}$, F_{topZ}, $F_{bottomX}$ *and* $F_{bottom\ Z}$. Image analysis determines the Estimated Center of Mass Offset.	The child's moment is calculated based on input values for *Fulcrum X* "virtual fulcrum" multiplied by the measured vertical force data. Horizontal force data multiplied by height Z also contributes to the moment.

Figure 19. These diagrams illustrate how the test configuration was used to determine the child's moment acting on the CSU.

Figure 20 (Figure 44 in the UMTRI report) shows the calculated maximum moment for each interaction of interest versus the child's body weight, and shows that the maximum moment tends to increase with body weight. UMTRI researchers normalized the moment by dividing the calculated moment by the child's body weight to enable the effects of the behaviors to be examined independent of body weight, as shown in Figure 21 (Figure 46 in the UMTRI report). For Ascend and Bounce, the slopes are close to zero, indicating that the difference in the moment generated for the Ascend and Bounce interaction is primarily due to the child's weight. A weak positive relationship can be seen for Lean and Yank. This suggests a difference in the Lean and Yank behavior for heavier children that is not accounted for by body weight. This difference for the Lean and Yank behavior is consistent with the heavier children also having longer arms and legs that would allow them to shift their CM further away from the handles, as well as being relatively stronger, leading to greater magnitude dynamic forces.

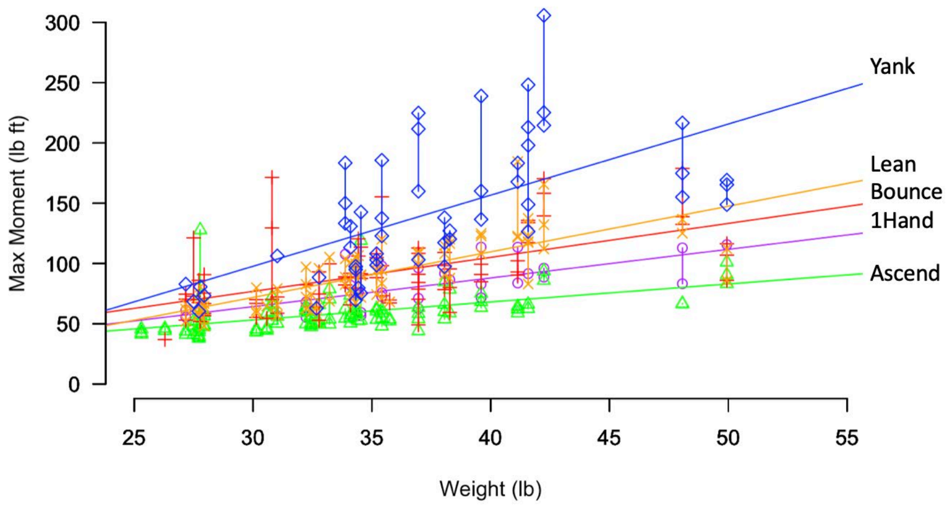


Figure 20. Maximum moment (lb ft) as a function of body weight (lb) for aligned handle trials, at a distance of 1 foot from the fulcrum. Vertical lines connect data from the same subject. Trend lines are shown for each behavior. The moments for each behavior tend to increase with body weight.

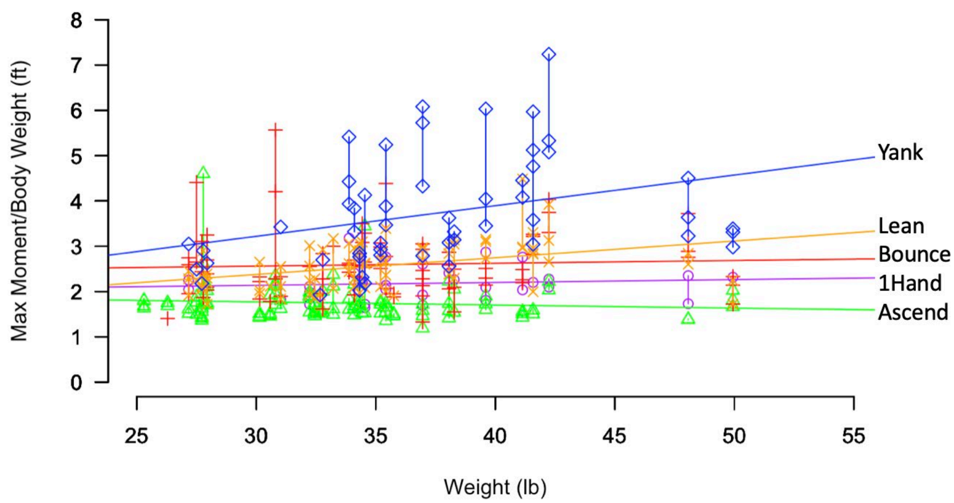


Figure 21. Depicts scatter plots of maximum moment (lb ft) normalized by body weight (normalized units: ft) as a function of body weight (lb) for aligned handle trials, at a distance of 1 foot from the fulcrum. For behaviors where the slope is approximately zero (Ascend, 1 Hand, Bounce), the increase in moment is primarily due to body weight. For other behaviors (Lean, Yank), factors such as heavier children having longer limbs play a role.

The preceding analysis of Figure 20 and Figure 21 were based on a 12-inch (one foot) horizontal distance between the location of force exertion and the fulcrum. The following analysis shows the effects of varying the *Fulcrum X* value, which is equivalent to a CSU's drawer extension from the fulcrum.

The net moment can be calculated using a *Fulcrum X* = 0 position, as shown in Figure 22, to bound the effects of drawer extension. Placing the fulcrum directly under the hands and feet in the aligned conditions eliminates the effects of vertical forces on moment, while amplifying the relative effects of horizontal forces.

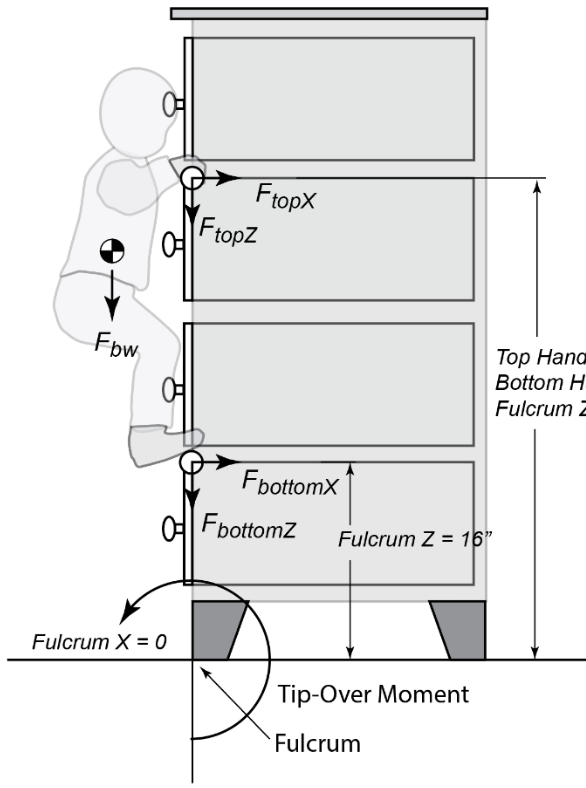


Figure 22. Depicts a schematic of effects of reducing *Fulcrum X* to zero (compare with Figure 18, which depicts a non-zero *Fulcrum X* distance).

UMTRI researchers analyzed the effects of the *Fulcrum X* (which corresponds to the drawer extension[16]) on the tip-over moment for the targeted behaviors. Since the moment about the fulcrum was calculated based on measured force data and input values for *Fulcrum X* distance, the authors were able to analyze the effects of the fulcrum position by varying the *Fulcrum X*

[16] Drawer extension data provided by CPSC staff to UMTRI researchers was measured from the extended drawer to the front of the CSU, and did not account for how the fulcrum position will vary with foot geometry and position. UMTRI researchers assumed that the fulcrum was aligned with the front of the CSU to simplify their analysis.

value from 0 to 12 inches. UMTRI researcher used this virtual *Fulcrum X* value to calculate the corresponding maximum moment.

Figure 23 (Figure 51 in the UMTRI report) shows the maximum moments versus the *Fulcrum X* values of 0 and 12 inches across behaviors for aligned conditions. For example, the calculated moment for Ascend at X=0, shown in the top graph, is about 17.5 pound-feet. The moment when X=0 is due entirely to horizontal forces. These horizontal forces exerted by the child on the top and bottom handles of the test apparatus are necessary to balance his/her outboard CM. UMTRI researchers concluded that the child's CM due to their postures have strong effects on the horizontal forces exerted and the calculated moments. Consequently, the location of the child's CM during the behavior is an important variable.

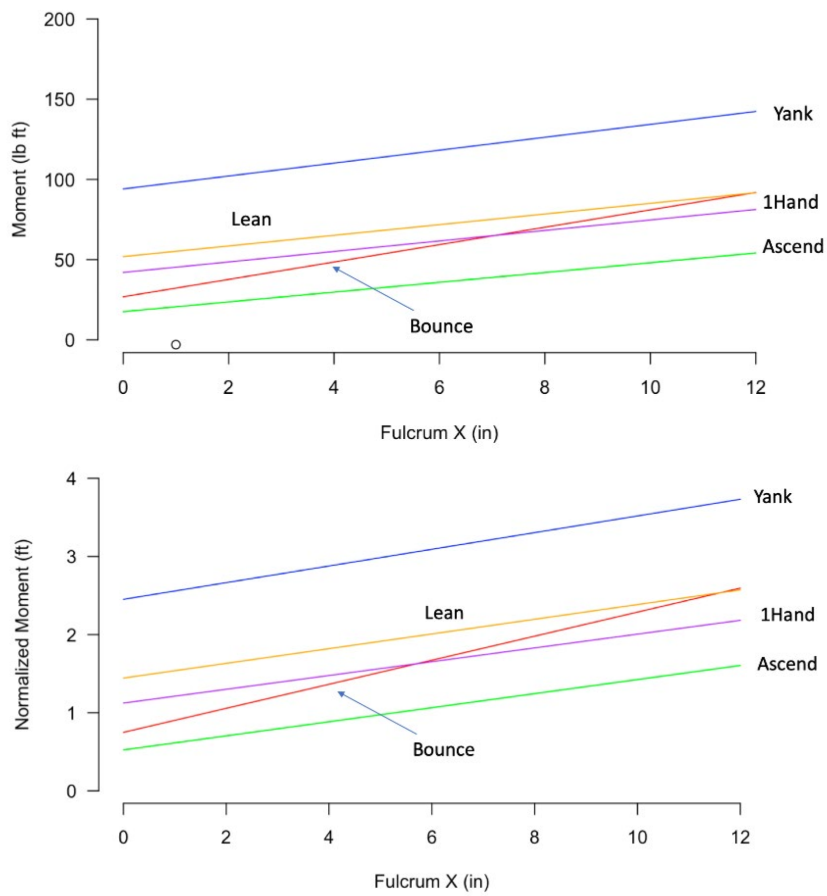


Figure 23. Effects of varying the horizontal distance to the virtual fulcrum from zero (directly under the bars) to 12 inches on moment (top) and moment normalized by body weight (bottom) for aligned trials.

As previously discussed, the UMTRI researchers normalized the moment by dividing the calculated moment of each trial by the child's body weight to enable the effects of the behaviors to be examined independent of body weight. The graphs of Figure 23 show how the moments and the normalized moments increase with the fulcrum distance (which corresponds to the drawer extension). For the normalized moments shown in the bottom graph, this can be interpreted as the effective CM location outboard of the front foot of the CSU (fulcrum), in feet. For example, a child climbing on a drawer extended 12 inches (1 foot) from the front foot fulcrum will have an effective CM that is about 19 inches (1.6 feet) from the fulcrum. At *Fulcrum X* = 0, the contribution of vertical forces to the moment are eliminated, and only the horizontal forces exerted at the hands and feet contribute to the moment. The horizontal forces exerted by the child on the top and bottom handles are necessary to balance his/her outboard CM. The effective moment where the fulcrum = 0 is about 6 inches (0.5 feet) for the Ascent behavior, and it is primarily due to the outboard CM position of the child about 6 inches (0.5 feet) from the fulcrum.[17]

As the drawer is pulled out farther from the fulcrum, vertical forces have a greater impact on the total moment contribution. UMTRI researchers reported that at the time of peak moment during ascent, the average (median) vertical force, divided by the child's body weight, was close to 1 (staff estimates this value is approximately 1.08 for aligned handle trials).[18] This suggests child body weight is the most significant vertical force, although dynamic forces also contribute.

Based on the Normalized Moment for Ascend shown in the bottom graph of Figure 23, ESMC staff estimated the Ascend line with the following Equation 1:

Equation 1. $Normalized\ Moment\ for\ Ascend = 1.08\ \times\ [Fulcrum\ X(\text{ft})] + 0.52\text{ ft.}$

Equation 1 can be multiplied by a child's weight to estimate the moment *M* generated by the child ascending, as shown in Equation 2:

Equation 2. $M = \{1.08\ \times [Fulcrum\ X(\text{ft})] + 0.52\text{ ft}\,\}\ \times\ child\ body\ weight\ (\text{lb})$

For example: for a 50-pound child *ascending* the CSU with a 1-foot drawer extension, the moment at the fulcrum is:

$M = \{1.08 \times [1\text{ ft}] + 0.52\text{ ft}\} \times 50\text{ lb} = 54\text{ lb-ft} + 26\text{ lb-ft}$

$M = 80\text{ lb-ft}$

[17] UMTRI researchers reported that the average CM offset was 6.1 inches (0.51 feet) during ascent at the time the maximum moment was measured.
[18] Refer to Figure 48 in the UMTRI report (Tab R).

The child in the example above produces a total moment of 80 pound-feet about the fulcrum. The contribution to the total moment from vertical forces, such as body weight and vertical dynamic forces, is 54 pound-feet. The contribution to the total moment from horizontal forces, such as the quasi-static horizonal force used to balance the child's CM in front of the extended drawer and dynamic forces, is 26 pound-feet.

Similar climbing behaviors for drawer and table trials (*e.g.*, climbing into the drawer or climbing onto the table top) generated lower moments than ascent. Therefore, the equation for ascent is expected to cover those behaviors as well.

G. Conclusion

UMTRI researchers found that the moments caused by children climbing furniture exceed the effects of body weight alone. ESMC staff used the findings to develop an equation that could be used to calculate the moment generated by children ascending a CSU, based on the child's body weight and the drawer extension from the CSU fulcrum, shown in Equation 2. This equation, combined with the weight for the children involved in CSU tip-over incidents, is the basis for the moment requirements in the draft proposed rule.

V. ADEQUACY OF STABILITY REQUIREMENTS IN ASTM F2057 – 19

Given the common factors staff identified in CSU tip over incidents, as well as the forces the UMTRI study identified that children generate during expected interactions in CSU tip overs, staff assessed whether ASTM F2057 – 19 adequately accounts for these factors in the performance requirements addressing stability of CSUs. As explained below, ESMC staff concludes that the stability requirements in ASTM F2057 – 19 leave a majority of the most vulnerable children unprotected, because the standard does not adequately address the common hazard patterns of multiple open drawers, drawers filled with clothing, carpeted surfaces, or the forces caused by expected interactions between children and CSUs.

A. Background

ASTM F2057 – 19 requires that CSUs not tip over when subjected to stability testing described in Sections 7.1 and 7.2. Under Section 7.1, "Stability of Unloaded Unit," the CSU must not tip over when all of the extension elements (drawers, doors, and pullout shelves) are open and extended outward. Under Section 7.2, "Stability with Load," the CSU must not tip over when a single extension element is extended outward and a 50-lb. test weight is placed at the location specified in the standard – for example, at the front face of a drawer, or near the end of a door. The test in Section 7.2 is repeated with each door and drawer, with one element open at a time, unless another element must be opened to reach the test element. Sections 7.1 and 7.2 both require testing to be done on a hard, level, and flat surface, and the CSU is empty. For a detailed description of the stability test procedure and requirements in ASTM F2057 – 19, see Tab F.

As Tab N states, LSM staff tested 188 CSUs for compliance with the stability requirements in ASTM F2057 – 19[19] and found that 171 (91.0 percent) met both stability requirements. One of 188 CSUs (0.5 percent) tested did not meet the performance requirements in Section 7.1, while 17 CSUs (9.1 percent) did not meet the performance requirements in Section 7.2 (including the CSU that did not comply with Section 7.1). LSM staff concluded that these results suggest a majority of CSUs on the market comply with the current stability requirements.

B. Adequacy of Sections 7.1 and 7.2

Staff previously identified the following hazard patterns during a review of incidents and an in-depth analysis of CSUs involved in those incidents:

1. Multiple drawers or all drawers were opened.
2. Drawers were filled or partially filled with clothing.
3. CSUs were on carpeted surfaces.
4. Children were climbing the CSU.
5. Children were pulling on CSU drawers.

As explained in Section III of this memorandum, where information was provided about these factors in CPSRMS captured CSU tip-over incidents involving children, ESHF staff found that nearly half of all incidents mentioned one or more open drawers; nearly all of the incidents involved partially filled or full drawers; most incidents occurred on carpeting; and a majority of the incidents involved a child climbing on the CSU. ESMC staff's analysis of CSUs involved in IDIs found that multiple (more than 1) open drawers may have contributed to 11 of 12 incidents; clothing in drawers was a factor in 7 of 12 incidents; carpeting was a factor in 9 of 12 incidents; climbing may have contributed to 5 of 12 incidents; and pulling on drawers may have contributed to 5 of 12 incidents. Additionally, ESMC staff's analysis of IDIs determined that many of these hazard patterns occur simultaneously.

The stability requirements in ASTM F2057 – 19 Sections 7.1 and 7.2 each consider a common hazard pattern, but do so independently. Section 7.1 addresses the hazard pattern of all extension elements extended at once (multiple open drawers). However, no weight is placed in the drawers to address the effect of clothing fill in the drawers, no additional load is placed on the CSU to replicate the force of a child interacting with it, and the testing is conducted on a hard, level, and flat surface, which does not account for the effect of carpeting on stability. The test fails to

[19] ASTM F2057 – 17 was used as the basis for testing because it was the standard in effect at the time; the stability requirements are unchanged in the newer version, ASTM F2057 – 19.

account for the multiple hazard patterns that can exist simultaneously during incidents, which further contributes to instability. For example, as Tab M explains, multiple open drawers that are filled make a CSU more unstable than multiple open drawers that are empty.

Section 7.2 addresses the hazard of children interacting with the CSU by using a 50-pound weight to simulate the force of a child standing on a single open drawer (or hanging on a door). This test involves only one open and empty drawer, and does not account for multiple open drawers, filled drawers, or the effect of carpeting on stability. Therefore, like Section 7.1, Section 7.2 does not account for the multiple hazard patterns that can occur simultaneously, which further impacts stability. Additionally, the static weight used in Section 7.2 fails to address the dynamic and horizontal forces children create while climbing on the CSU, and does not address children pulling on a drawer of the CSU.

ESMC staff compared the 50-pound weight used in Section 7.2 to simulate a child standing on the drawer front, to the moments created by children ascending a simulated CSU, as determined by UMTRI researchers. Based on ESHF analysis (Tab C), the most common child interaction resulting in tip-over incidents was climbing. Equation 2 in the previous section describes the average maximum moment created by children ascending a CSU.

ESMC staff used Equation 2 to determine the tip-over moment when children weighing between 10 pounds and 60 pounds climb/ascend a CSU, using common drawer extension distances.[20] Staff compared this to the tip-over moment generated by the static 50-pound test weight in ASTM F2057 – 19, Section 7.2. Figure 24 shows this comparison. This graph shows that Section 7.2 underestimates--by up to 50 percent--the average maximum moments that 50-pound children generate during ascent. As Figure 24 shows, when the drawer is extended 0.5 feet (6 inches), the moment generated by a 50-pound child is 53 pound-feet; whereas, the moment generated using Section 7.2 is 25 pound-feet (*i.e.*, about half). When the drawer is extended 1 foot (12 inches), the moment generated by a 50-pound child is about 80 pound-feet; whereas, the moment generated using Section 7.2 is about 50 pound-feet. The higher moment calculated by staff is due to the following factors: children must hold their weight offset from the drawers to ascend, which causes children to exert a horizontal force; and the act of ascending is a dynamic activity that results in greater magnitude forces than a child standing on the edge of a drawer. By setting the moment generated by a 50-pound child at the median drawer extension of 0.81 feet (9.75 inches) equal to the moment generated by the 50-pound weight in Section 7.2, staff determined that Section 7.2 of the ASTM standard only protects a child weighing 29.1 pounds under the following test conditions: a single open drawer; no clothing in the drawers; and the CSU is placed on a hard, level, and flat surface. If the hazard patterns of multiple open drawers,

[20] Drawer extension information is based on the dataset of 180 CSU drawer extensions CPSC staff provided to UMTRI researchers. The median drawer extension was approximately 0.81 feet (9.75 inches), with an approximate range of 0.53 feet (6.38 inches) to 1.15 feet (13.75 inches).

filled drawers, and carpeted surfaces are also accounted for, the weight of the protected child is even lower.

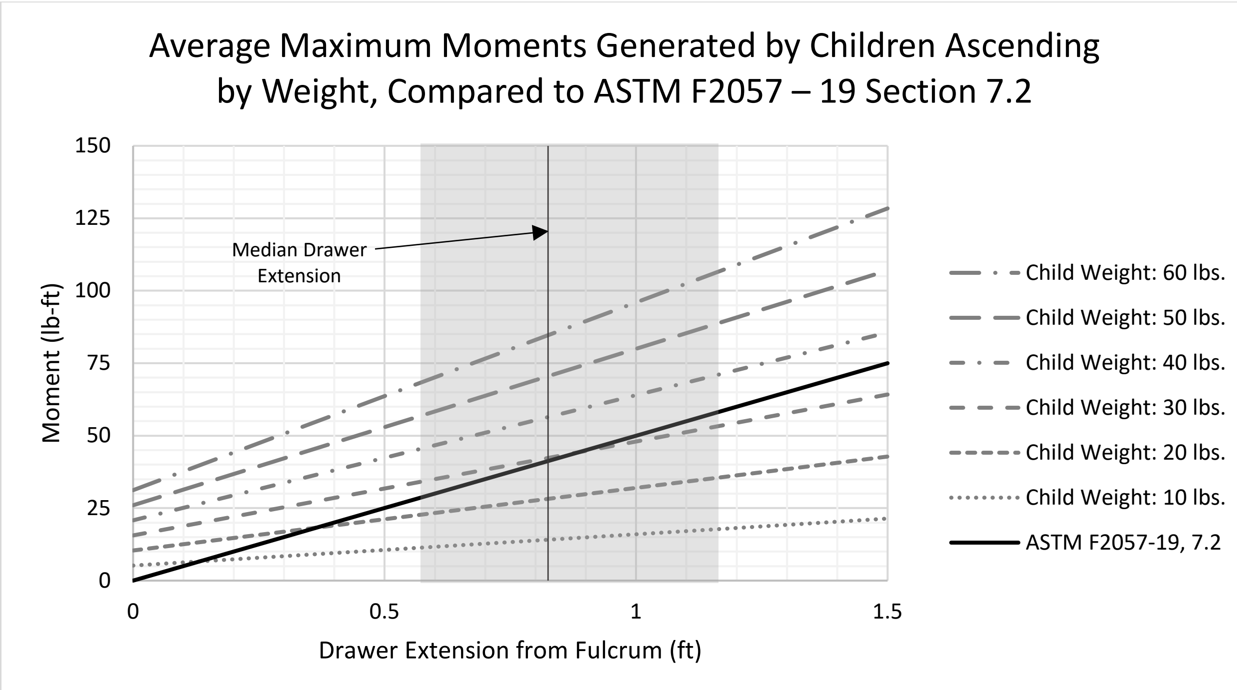


Figure 24. Moments generated by children ascending a CSU, compared to the moment generated by the static test weight in ASTM F2057 – 19 Section 7.2. The typical range of drawer extensions of a CSU is highlighted in gray, and the median drawer extension is indicated with a vertical line.

Based on analysis in the ESHF memorandum in Tab C, children ages 1 to 3 years old are the age group most affected by tip-over incidents. The scope of ASTM F2057 – 19 states that the standard is intended to cover children up to, and including, age 5. The ASTM test simulates an empty CSU on a hard, level, and flat surface while a 50-pound child stands on the edge of one opened drawer. Staff's draft proposed rule contains requirements that simulate a CSU on a carpet while a child climbs on the edge of multiple open drawers.

ESMC staff considered a climbing scenario involving an empty CSU with a single open drawer on a hard, level, and flat surface, to compare the range of children protected by the ASTM standard versus the proposed rule. ESMC staff used the most recent Centers for Disease Control and Prevention (CDC) Anthropometric Reference data[21] to compare the weight of a child

[21] Fryar CD, Carroll MD, Gu Q, Afful J, Ogden CL. (2021). Anthropometric reference data for children and adults: United States, 2015–2018. National Center for Health Statistics. Vital Health Stat 3(46).

protected by ASTM F2057 – 19, Section 7.2, (*i.e*., 29.1 pounds) to a 95th percentile 3-year-old male (51.2 pounds) and a 95th percentile 5-year-old female (62.7 pounds),[22] and estimated what percentage of children up to 7 years old[23] would be protected by a possible rule based on protecting a climbing child of each weight, combined with the moment equation from UMTRI data.

The results in Figure 25 show that for a child climbing an empty CSU with a single open drawer on a hard, level, and flat surface, the ASTM standard is expected to protect most 1-year-old children, but it will protect only about a quarter of 2-year-olds, and it will not protect children over 3 years old, leaving much of the most vulnerable children unprotected. The proportion of children protected by the ASTM standard is expected to be lower than described above, when considering the hazard patterns of multiple open drawers, filled drawers, and carpeted surfaces. Figure 25 also shows that the draft proposed rule, which staff developed to protect the 95th percentile 3-year-old children ascending (child weight = 51.2 pounds), would additionally be expected to protect approximately half of 5-year-old and 6-year-old children; while a similar rule considering the same factors as staff, and developed based on protecting 95th percentile 5-year-old children ascending (child weight = 62.7 pounds), would also be expected to protect approximately half of 7-year-old children.

[22] ESHF staff in Tab C described how the more extreme of two values can be used when it is divided by sex. In the case of the CDC anthropometric weight charts, a 95th percentile 3-year-old male weighs 51.2 pounds, while a 95th percentile 3-year-old female weighs 42.5 pounds; so the higher weight of 51.2 pounds was selected to accommodate both sexes. Similarly, a 95th percentile 5-year-old male weighs 62.4 pounds, while a 95th percentile 5-year-old female weighs 62.7 pounds, so the higher weight of 62.7 pounds was selected.

[23] Based on ESHF staff's analysis of fatal CPSRMS incidents in Tab C, the oldest child under the age of 18 in a fatal tip-over incident not involving a television was 7 years old.

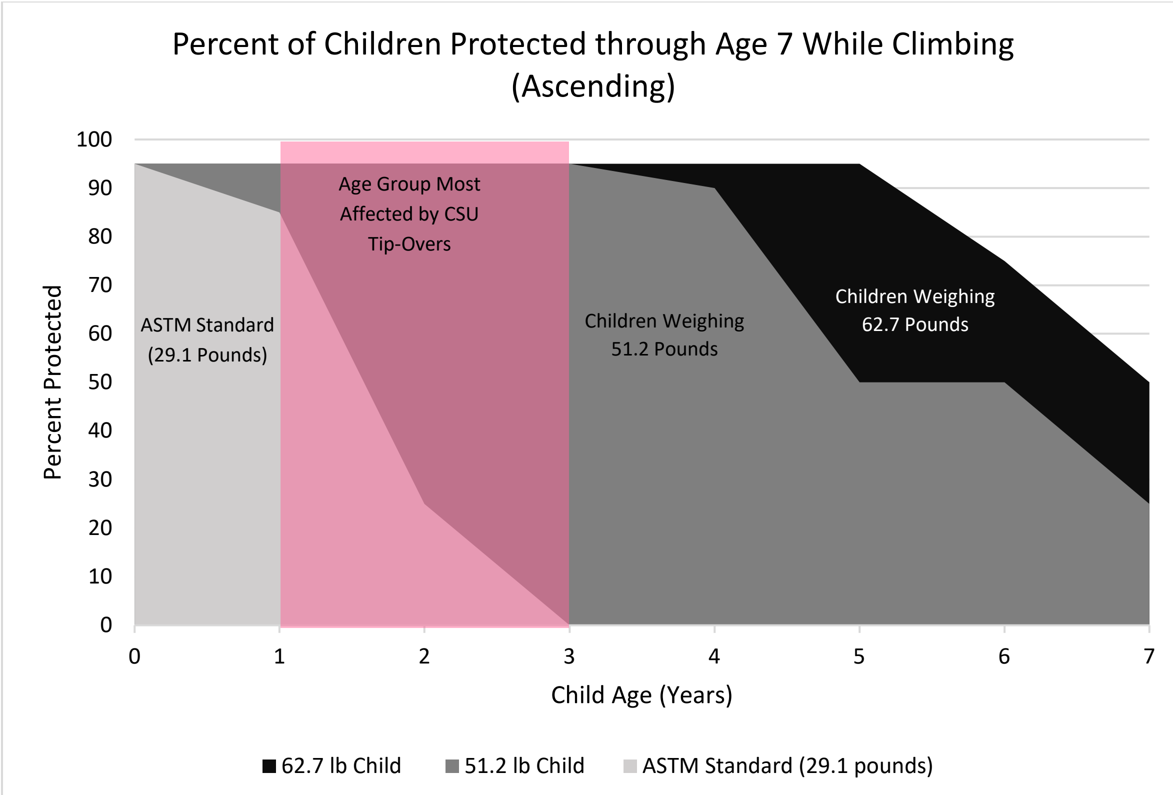


Figure 25. ESMC staff estimates that ASTM F2057 – 19 Section 7.2 does not protect most children between the ages of 1 and 3 from CSU tip-over incidents while climbing (ascending). The draft proposed rule based on a 51.2-pound child climbing would protect most children up to age 3 and some up to age 7. A similar rule based on a 62.7-pound child climbing would offer some additional protection for most children up to age 5 and additional older children.

ESMC staff concludes that the stability requirements in ASTM F2057 – 19 do not adequately address the common hazard patterns of multiple open drawers, drawers filled with clothing, carpeted surfaces, or the forces caused by children's interactions with CSUs. In the case of an empty CSU with a single open drawer on a hard, level, and flat surface, the ASTM standard is expected to protect most 1-year-old children (29.1 pounds), but only about a quarter of 2-year-olds, and no children over 3 years old, leaving much of the most vulnerable children unprotected. Staff's proposed requirements are expected to protect most 3-year-old children (51.2 pounds) and approximately half of 5-year-old and 6-year-old children for a CSU on carpet with multiple open drawers, and drawers filled with clothing and accounting for climbing behavior.

VI. PROPOSED PERFORMANCE REQUIRMENTS

As explained in the previous section and Tab F, staff concludes that ASTM F2057 – 19 is inadequate to protect children against the tip-over hazards posed by CSUs. Additionally, LSM staff in Tab F explain that the other international standards for CSUs (AS/NZA 4935:2009, ISO 7171:2019, EN14749:2016) are also inadequate to protect children against the tip-over hazards posed by CSUs. None of these standards account for real-world factors and hazard patterns that contribute to CSU instability, as indicated by incident data and testing.

Consequently, staff developed recommended requirements to address and account for the multiple hazard patterns involved in CSU tip-over incidents. For the draft proposed rule, staff's recommended requirements are based on a review of incident data collected by EPHA staff (Tab A), incident analyses conducted by ESHF and ESMC staff (Tab C and Tab M, respectively), a review of the UMTRI Study, "Forces and Postures During Child Climbing Activities" (Tab R), and testing performed by ESHF, ESMC, and LSM staff with analysis by EPHA staff (Tabs L, M, O, and P, respectively).

To improve the inherent stability of CSU designs and reduce the number of tip-over incidents, CPSC staff recommends that the test simulate the hazard patterns leading to CSU tip-overs by addressing the following:

- Carpeted surfaces;
- Multiple open drawers, doors, and pullout shelves;
- Drawers and pullout shelves filled or not filled with clothing;
- Children climbing the CSU; and
- Children pulling on CSU drawers.

Additionally, the test should address these hazards simultaneously.

This section of the memo will discuss the recommended test requirements and pass/fail criteria. Sections A, B, and C discuss these recommended requirements preliminarily, and Section D provides a step-by-step explanation of the recommended testing.

A. Carpeted Surface

Based on ESMC staff's analysis of CSU testing on carpeted surfaces in Section III Part B of this memorandum, staff determined a forward tilt angle of 1.5° replicated the effects of carpeting on CSU stability. Therefore, ESMC staff recommends the CSU tip-over moment be determined with the CSU tilted forward at an angle of 1.5°, as shown in Figure 26. The tilt can be achieved by raising the rear of the CSU, or by placing the CSU on an angled surface.

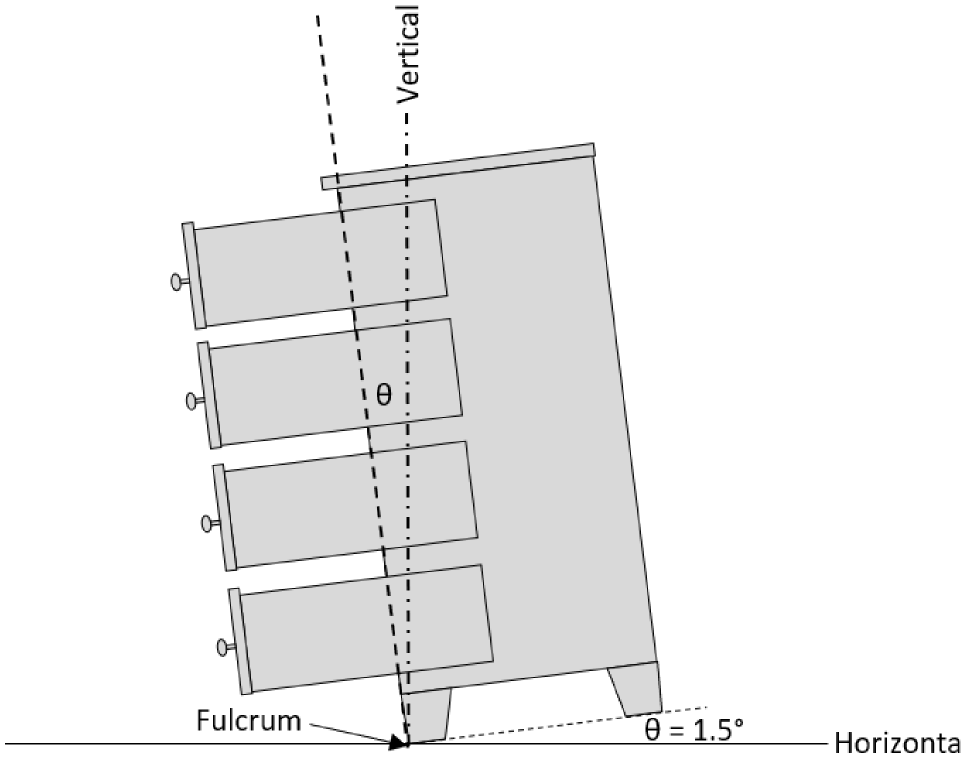


Figure 26. A 1.5° forward tilt (tilt angle in drawing not to scale) can be used to replicate the effects of a CSU resting on carpet.

B. Extended Drawers, Fill, and Interlocks

Staff's recommended test requirements vary, depending on whether a CSU has an interlock system or not. An interlock system is a device that prevents simultaneous opening of more drawers than intended by the manufacturer. Some CSUs with interlocks allow one drawer to open at a time. Much of the weight of a CSU consists of the weight of the drawers and their contents. If a person is able to open multiple drawers simultaneously, the weight of the drawers and their contents is shifted past the front edge of the fulcrum of the CSU, decreasing its stability. By limiting the number of opened drawers, a drawer interlock limits the weight that can be shifted, and thus, limit the change in the center of gravity of the CSU and its stability. Many office filing cabinets and tool storage cabinets have drawer interlock features; and they have been demonstrated to be feasible on CSUs, with them included by at least one major ready-to-assemble CSU manufacturer. Some furniture that commonly includes interlocks is within scope of ANSI/BIFMA SOHO S6.5-2008 (R2013), *Small Office Home Furniture-Tests*, which includes an interlock test. LSM staff's assessment of this interlock test can be found in Tab F.

For the proposed test requirements, ESMC staff recommends that all extension elements – including drawers, doors, pullout shelves, and any other extendable elements – be opened and extended to the maximum extension and least-stable configuration. The general conceptual framework is that all drawers are opened fully, or if there is an interlock, the worst-case drawers that can be opened at the same time will be opened fully. This is explained more fully for drawers and pull-out shelves, considering different manufacturing practices and designs, as: the maximum extension is the furthest most manufacturer-recommended use position, as indicated with a stop; or, in the absence of stops, two-thirds the shortest internal length of the drawer,[24] or two-thirds the length of the pullout shelf. In the case of slides with multiple intermediate stops, the maximum extension is the stop that allows the drawer to extend the furthest. In the case of slides with a multi-part stop, such as a stop that extends the drawer or pull-out shelf to the furthest manufacturer-recommended use position with an additional stop that retains the drawer in the case, this is the stop that extends the drawer or pull-out shelf to the manufacturer-recommended use position. For CSUs with interlocks, staff recommends requiring that all drawers and pull-out shelves that are not locked by the interlock system be open to the maximum extension, in the configuration most likely to cause tip over (typically the configuration with the largest drawers in the highest position extended).

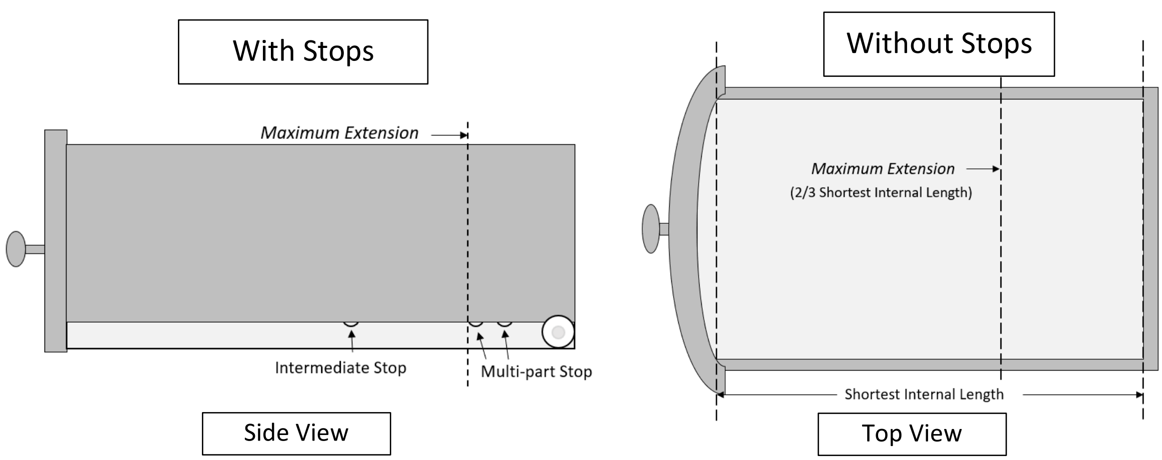


Figure 27. Example maximum extension on drawers and pull-out shelves with stops and without stops.

In addition, considering the effects of drawer fill weight being generally destabilizing for CSUs with filled open drawers, and stabilizing for CSUs with filled closed drawers, staff recommends adding a prescribed fill weight to all drawers and pullout shelves, if more than half of the drawers (by interior functional volume) can be opened, or to leave them all empty, if (such as because of interlocks) less than 50 percent (by interior volume) of drawers can be opened. Staff recommends that, when 50 percent or more of the drawers and pullout shelves by interior

[24] In the parlance of ASTM F2057 – 19, ⅔ the operational sliding length (OSL).

functional volume are open, all drawers and pullout shelves[25] have a fill weight, based on the usable storage volume and the fill density of clothing (8.5 pounds per cubic foot),[26] placed at the center of the inside of the drawer or pullout shelf (to match the assumption that clothing is evenly distributed within the drawer) while determining the tip-over moment of the CSU. The fill weight is calculated using the following equation:

$$Fill\,Weight = 8.5\frac{lb}{ft^3}\left\{[Interior\ Area](ft^2)\left[Clearance\ Height - \frac{1}{8}\right](in)\left[\frac{1}{12}\right]\left(\frac{ft}{in}\right)\right\}$$

This recommendation is based on staff's findings in Section III Part B of this memorandum that when all CSU drawers are pulled out and filled, this produces the worst-case (lowest) tip load – and consequently, the worst-case tip-over moment. However, when CSU drawers have interlocks[27] or other means that prevent more than half the drawers by volume from being pulled out simultaneously, the CSU tips more easily with all drawers empty.

Accordingly, when an interlock or other means prevents more than half the drawers and pullout shelves by interior volume from being opened simultaneously, staff recommends requiring that no fill weight be placed in the drawers, as shown in Figure 28.[28]

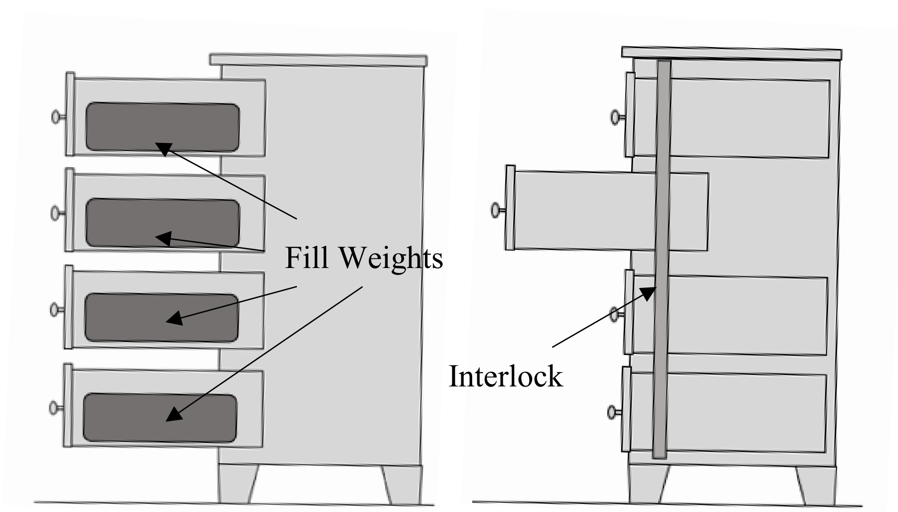


Figure 28. All drawers are opened to the maximum extension and filled with 8.5 pounds per cubic foot of storage volume during the test, unless an interlock or other means prevents more than half the drawers by volume to be extended simultaneously.

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[25] Internal fixed shelves should remain empty to test their least-stable configuration.
[26] See Tab L for discussion of the 8.5 pounds per cubic foot. Staff has not tested this fill density with pullout shelves, and requests comment on whether a different fill density should be used.
[27] Interlocks are discussed further in Section VII of this memorandum.
[28] Because fill weight is based on fill volume, the ratio of fill weights in extended drawers and pullout shelves to the total fill weight can be used to determine whether less than half of the drawers by volume are extended.

Staff recommends that the worst-case combination of drawers and extension elements that can be extended simultaneously be determined and placed in their least-stable configuration; and that these elements be extended while determining the tip-over moment of the CSU. For example, if an interlock only allows an upper drawer or a lower drawer of the same size to be opened, the worst case will be to open the upper drawer. The worst case can be determined through repeated testing, or by determining which configuration shifts the CSU CG closest to the fulcrum.

In addition, staff recommends a test to determine the effectiveness and integrity of the interlock system, if present. The CSU shall be secured in place to prevent sliding and tipping. A drawer shall be pulled out to engage the interlock, and each other drawer with the interlock engaged shall be pulled with a force that gradually increases up to 30 pounds[29] over a period of at least 5 seconds, and that the force be held for at least 10 seconds. Staff recommends that this test be repeated for every combination of open drawer and interlocked drawers. If any drawer fails this test, the interlock system is considered ineffective, the CSU must be tested with the interlock system disabled or bypassed. Generally, a failure will result in the test proceeding with all drawers at the maximum extension and filled.

C. Tip-Over Moment Determination and Limits

To account for the forces that children generate when interacting with CSUs, staff recommends requiring that, once the configurations discussed above are applied, the tip-over moment be determined using a prescribed test method, and require that the tip-over moment meet certain minimum thresholds. These test methods, calculations, and thresholds are discussed below.

1. Force Application Methods

CPSC staff has evaluated two methods of applying force to a CSU to determine the tip-over moment of the CSU. Those methods are:

i. applying a vertical load to the top surface of a fully extended drawer on the CSU; or
ii. applying a horizontal load to the rear of the CSU, causing it to tip forward.

Based on ESMC staff's testing described in Tab M, these methods produce approximately equal tip-over moments; therefore, either test method can be used. The methods are outlined below.

i. Vertical Load on Drawer Front

The tip-over moment of the CSU can be measured by applying a vertical downward force L_V on the top surface of any accessible open drawer, as shown in Figure 29. The tip-over moment of

[29] The 30 pounds is based on a test procedure for interlocks found in ANSI/BIFMA SOHO S6.5-2008 (R2013), *Small Office Home Furniture-Tests*, assessed by LSM staff in Tab F.

the CSU, M_{tip}, can be described as the vertical load required to tip the CSU placed at a horizontal moment arm H away from the CSU tip-over fulcrum:

$$M_{tip} = L_V H$$

The load is increased over a period of at least 5 seconds until the rear feet lift at least ¼ inches off the ground;[30] L_V is the maximum load measured. H is the horizontal distance measured from the fulcrum to the location where the load is applied.

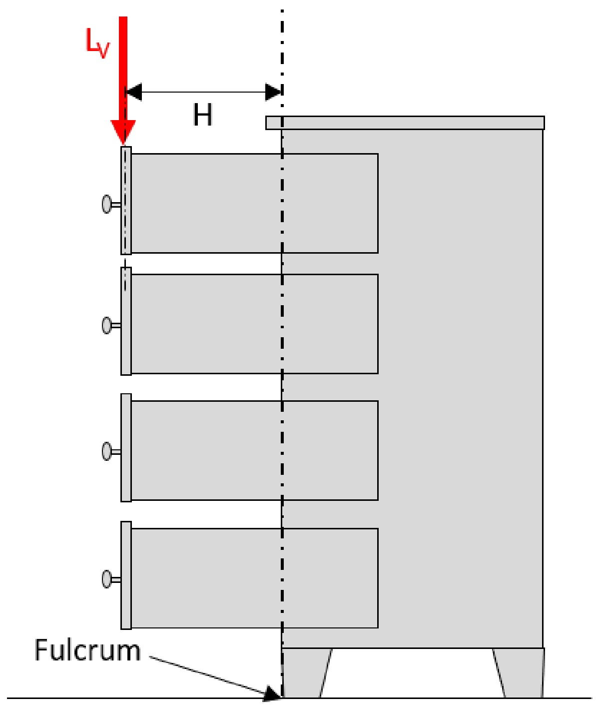

Figure 29. A tip-over moment can be applied to the CSU with a vertical load L_V applied a horizontal distance H away from the CSU fulcrum.

This test method can be used on any CSU with drawers. If the drawer breaks during the test due to the load, the alternative test method may be more appropriate. Repair options or methods to secure or reinforce the drawer may be considered, so long as they do not increase the tip-over moment.

[30] If the load is applied with weight, the CSU will tip forward uncontrollably, unless restrained, when the tip weight is reached. However, if a force gauge or other means is used, the CSU will continue balancing. Therefore, staff estimates the rear feet lifting ¼ inches is an appropriate distance to determine tip-over in these cases.

ii. Horizontal Load on CSU Rear

The tip-over moment of the CSU can be measured by applying a horizontal force L_H applied at height V above the fulcrum, as shown in Figure 30. In this case, the tip-over moment of the CSU, M_{tip}, is the horizontal tip load L_H applied at height V above the fulcrum:

$$M_{tip} = L_H V$$

The load is increased over a period of at least 5 seconds until the rear feet lift at least ¼ inches off the ground. L_H is the maximum load measured. V is the vertical distance measured from the fulcrum to the location where the load is applied.

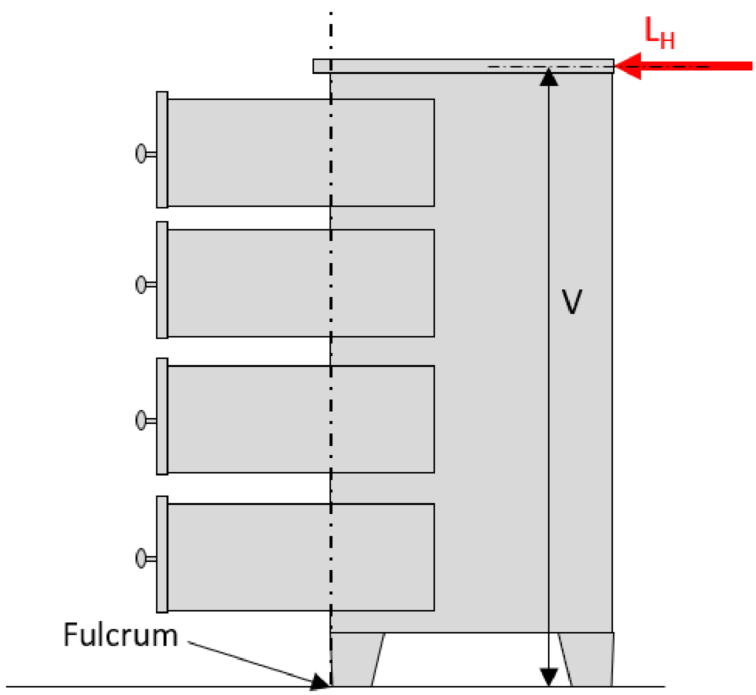

Figure 30. A tip-over moment can be applied to the CSU with a horizontal load L_H applied a vertical distance V away from the CSU fulcrum.

The horizontal load test method can be used on any CSU, including CSUs without drawers and CSUs with drawers that may fall apart when the test load is applied using the vertical load method.

2. Fulcrum Location

Both test methods described above require the location of the fulcrum to be determined and the distance from the open drawer face to the fulcrum to be measured. Intuitively, the fulcrum would seem to be located at the front of the bottom-most surface of the CSU.[31] This is the point or line about which the CSU pivots when it tips forward. Therefore, staff recommends the fulcrum to be defined as the following:

Fulcrum: The bottom point or line of the CSU touching the ground about which the CSU pivots when a tip-over force is applied.

The fulcrum will typically be located at the line connecting the front feet. However, for CSUs without feet, or for CSUs with an irregular pattern of feet, the fulcrum may be in a different location. Some CSUs may have multiple fulcrums that will vary, depending on the direction the tip-over force is applied. The fulcrum that results in the smallest tip-over moment should be determined. If testers choose to use a horizontal load, the load should be applied such that the tip-over moment is minimized (typically orthogonal to the fulcrum).

3. Pass-Fail Criteria

Once the tip-over moment has been calculated using one of the methods above, staff developed criteria to determine whether that tip-over moment is sufficient to withstand tipping over when child interactions identified in incidents and measured by UMTRI occur. Staff developed three pass-fail criteria based on three child interactions that can lead to CSU tip-over incidents:

1. a child climbing (ascending) a CSU;
2. children pulling on a handhold of a CSU while opening, or attempting to open a drawer; and
3. a child climbing (hanging) on the door of a CSU.

Each interaction produces a tip-over moment about the CSU fulcrum that depends on different characteristics of the CSU. Staff recommends requiring that the tip-over moment for a CSU must be greater than the highest of three values, each corresponding to one of the above interactions. Therefore, pass-fail criteria for each of these interactions is a minimum threshold moment, or moment requirement, which the CSU must surpass. Staff expects that the criterion for ascending the CSU will be the most onerous requirement for most CSUs. However, some CSUs with particular geometric features, or without drawers, may have greater tip-over moments

[31] For CSUs with circular pads on the feet, ESMC staff typically had higher numerical correlation between test results and numerical analysis when the tip over fulcrum in the calculation was placed at the center of the pads on the front feet (rather than the front of the pads). The difference between the two results was small. Staff does not consider foot pad geometry a significant factor in determining the tip-over moment of a CSU.

associated with the alternative criteria, based on children's interactions with the CSU. The moment requirement for each interaction is described below.

1. Children Ascending a CSU

ESHF staff determined that the ascend interaction from the UMTRI child climbing study was the most representative of a child climbing interaction seen in the incident data. ESMC staff discussed UMTRI researchers' study of child climbing behaviors in Section IV of this memorandum, and determined that ascent could be described by Equation 2:

Equation 2. $M = \{1.08\ [Fulcrum\ X(\text{ft})] + 0.52\ \text{ft}\} \times Weight\ of\ child\ (\text{lb})$

Where:
Fulcrum X is the horizontal distance from the front of the extended drawer to the fulcrum.

Other measured climbing interactions involving climbing into drawers and climbing onto the table top generated lower moments than ascent; thus, they are included within performance requirements based on ascent. Based on the incident data, the age group most susceptible to injury and death from the CSU tip over hazard is 1-, 2-, and 3-year-old children (Tab C). To protect a majority of 3-year-old children from climbing-related tip-over incidents, ESMC staff has determined a moment requirement based on this equation and using the weight of a 95th percentile 3-year-old, or 51.2 pounds. To pass the moment requirement for a child ascending a CSU, the tip-over moment M_{tip} of the CSU must meet the following criterion:

$$M_{tip}\ (\text{lb-ft}) > 51.2(1.08X+0.52)$$

Or, simplified:

$$M_{tip}\ (\text{lb-ft}) > 55.3X+26.6$$

Where:
X is the horizontal distance (in feet) from the front of the extended drawer to the fulcrum.

X is measured with the CSU on a hard, level, and flat surface, and is the horizontal distance from the fulcrum to the center of the drawer front of the CSU's most extended drawer, as shown in Figure 31. If the drawer front curves, the measurement is from the fulcrum to the center of the front face of the most extended drawer where the drawer face extends the most from the fulcrum. For a CSU without drawers, X is to be measured from the fulcrum to the front edge of the farthest extended element, excluding doors. If the CSU has no extension elements (other than doors), X is measured from the fulcrum to the front of the CSU.

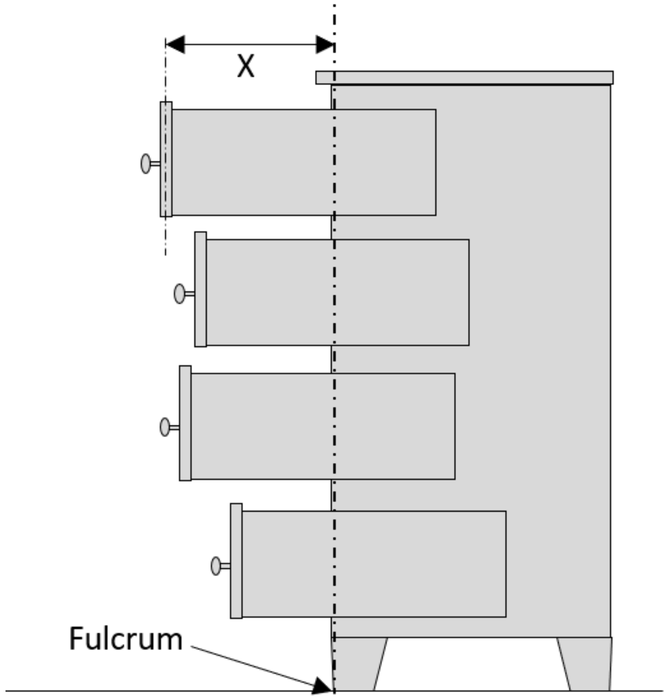

Figure 31. The drawer extension X is the horizontal distance from the fulcrum to the center of the drawer front of the CSU's most extended drawer. If the drawer is curved, the measurement should be to the center point of the drawer face where the drawer face extends most from the fulcrum.

2. Children pulling on a handhold of a CSU

ESHF staff in Tab C recommended that a requirement be developed based on a child being able to pull up to 17.2 pounds-force horizontally on a handhold at a height of up to 4.12 feet. The moment created by this interaction can be described with the following equation:

$$M \text{ (lb-ft)} = 17.2 \text{ (lb)} \times Z \text{ (ft)}$$

Where:

Z is the vertical distance (in feet) from the fulcrum to the highest handhold that is less than or equal to 4.12 ft high.

Based on this equation, ESMC staff has determined the tip-over moment of the CSU must meet the following criterion:

$$M_{tip} \text{ (lb-ft)} > 17.2Z$$

Where:

Z is the vertical distance (in feet) from the fulcrum to the highest handhold that is less than or equal to 4.12 feet high.

Z is measured with the CSU on a hard, level, and flat surface, and is the vertical distance from the fulcrum to the highest handhold that is at a height of 4.12 feet or lower, as shown in Figure 32.

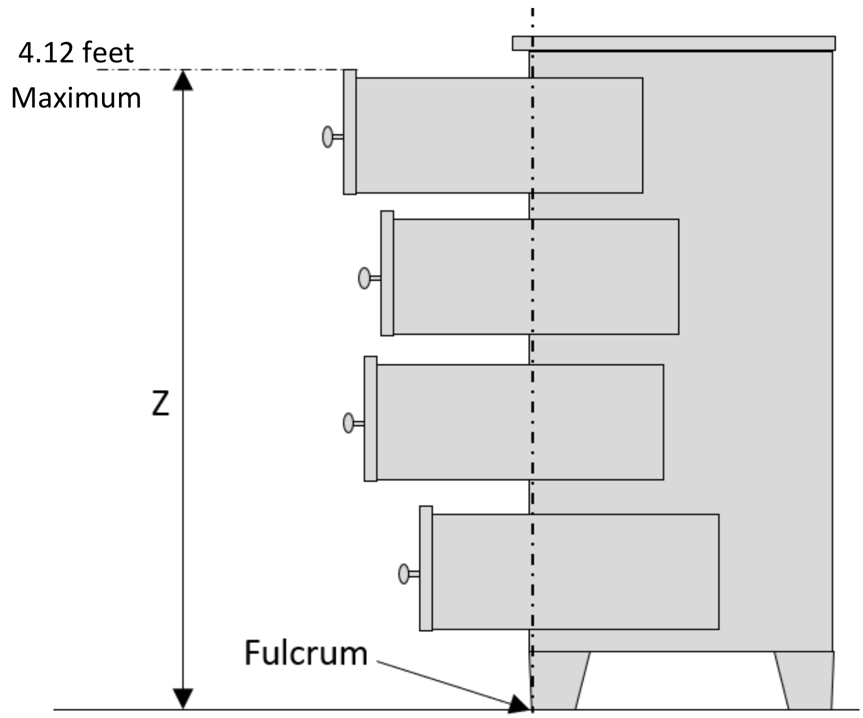

Figure 32. The handhold height Z is vertical distance (in feet) from the fulcrum to the highest handhold that is less than or equal to 4.12 ft high.

3. Children hanging on the door of a CSU

Not all CSUs have doors, but when a door is present, it is possible that a child may try to hang from it. UMTRI researchers found that the vertical forces associated with children hanging by the hands were close to the body weight of the child (Refer to Figure 48 in Tab R). Additionally, ESMC staff believes the weight placement location for testing doors per ASTM F2057 – 19 Section 7.2 (described in Tab F) is reasonable. Therefore, ESMC staff adapted this test location from Section 7.2 (approximately half the width of the test fixture, or 3 inches, from the edge of the door) to obtain the equation describing a 95^{th} percentile weight 3-year-old child hanging from an open door of a CSU:

$$M \text{ (lb-ft)} = 51.2 \text{ (lb)} \times [\text{Y} - 0.25 \text{ (ft)}]$$

Where:

Y is the horizontal distance (in feet) from the fulcrum to the edge of the door in its most extended position.

Based on this equation, ESMC staff has determined the tip-over moment of a CSU with doors must meet the following criterion:

$$M_{tip} \text{ (lb-ft)} > 51.2(\text{Y} - 0.25)$$

Or, simplified:

$$M_{tip} \text{ (lb-ft)} > 51.2\text{Y} - 12.8$$

Where:

Y is the horizontal distance (in feet) from the fulcrum to the edge of the door in its most extended position.

Y is measured with the CSU on a hard, level, and flat surface, and is the horizontal distance from the fulcrum to the edge of the door in its most extended position, as shown in Figure 33.

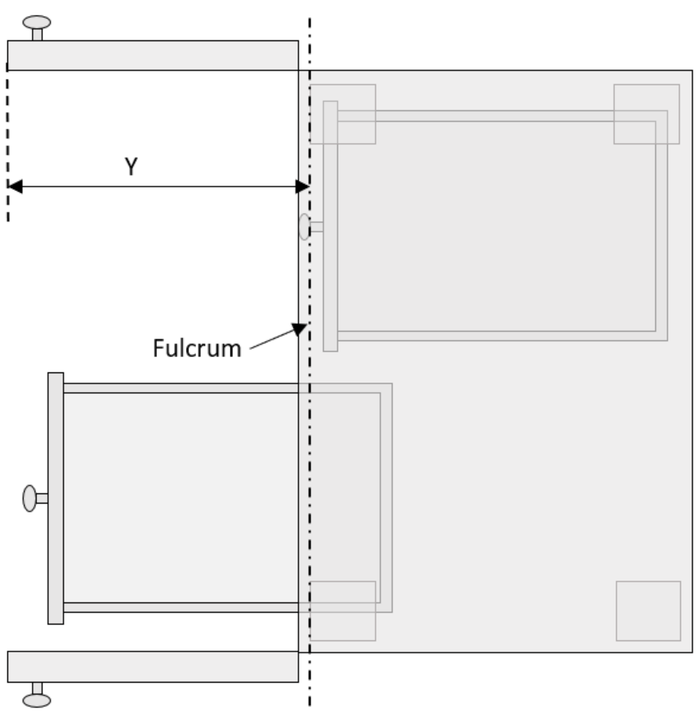

Figure 33. (Top View) The door length Y is the horizontal distance from the fulcrum to the edge of the door in its most extended position.

D. Summary of Performance Requirement Recommendations and Request for Comments

Figure 34 summarizes the measurements required to determine a CSU's tip-over moment.

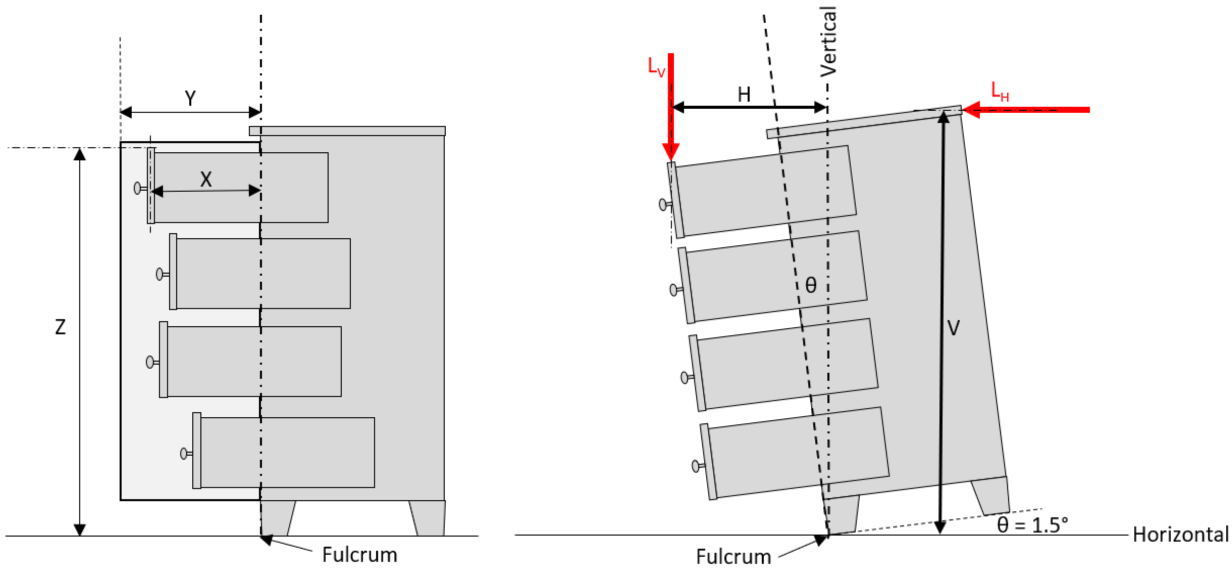

Figure 34. Summary of measurements required to determine a CSU's tip-over moment.

All testing should proceed with the CSU assembled per the manufacturer's instructions (if not pre-assembled) and placed on a hard, level, and flat surface.

ESMC staff recommends the following drawer interlock test for CSUs with interlocks:

1. If the CSU has a levelling device, adjust the levelling device to the lowest level; then adjust the levelling device in accordance with the manufacturer's instructions.
2. Secure the CSU to prevent any sliding or tipping during the interlock evaluation.
3. Open any doors in front of the interlocked drawers.
4. Engage the interlock by opening a drawer to the maximum extension.
5. Gradually apply over a period of at least 5 seconds a horizontal pull force of 30 pounds to each locked drawer, one drawer at a time. Hold the force on each drawer for at least 10 seconds.
6. Repeat the test until all possible combinations of drawers have been tested.
7. If any locked drawer opens, or the interlock is damaged, then the system shall be disabled or bypassed for the stability test.

ESMC staff recommends taking the following measurements before the stability test:

1. Measure the drawer extension, X (feet); the door length, Y (feet); and the highest handhold height, Z (feet), with respect to the fulcrum:
    a. X is the horizontal distance from the most extended portion of the front center thickness of the farthest open drawer to the fulcrum (leading contact edge with the floor).
    b. Y is the horizontal distance from the fulcrum to the edge of the door in its most extended position.
    c. Z is the vertical distance from the fulcrum to the highest handhold that is less than or equal to 4.12 feet high.

ESMC staff recommends the following stability test:

1. If the CSU has a levelling device, adjust the levelling device to the lowest level; then adjust the levelling device in accordance with the manufacturer's instructions.
2. Place the product at a forward incline angle of 1.5°.
    a. If the CSU has a level adjustment intended for a carpeted surface, adjust the level in accordance with manufacturer's instructions.
3. Extend all doors, drawers, pullout shelves, and other extension elements to their maximum extension, if possible. If the CSU has an interlock or other system that prevents all extension element from being open simultaneously, open the extension elements to the least stable configuration. Determining the least stable configuration may require repeated testing.[32]
4. If there is no drawer interlock system, or the drawer interlock system does not meet the requirements of the drawer interlock test, or the interlock system allows more than half of the drawers or pullout shelves by volume to remain fully extended at one time, add a fill weight to the center of each drawer and pullout shelf.
    a. The functional volume (cubic feet) shall be determined by multiplying the interior area A by the effective height E_H. E_H is the distance from the upper surface of the drawer interior or pullout shelf to the clearance height minus ⅛ inches.
    b. The fill weight shall be determined by multiplying the functional volume by 8.5 pounds per cubic foot.
5. Determine whether the tip load will be applied vertically on the open drawer or horizontally on the rear of the CSU.
    a. The point at which the load is applied is Point A.

[32] One method for determining the least stable configuration is to compare how the weight is distributed in each possible configuration. The least stable configuration will have the most weight towards the CSU fulcrum.

6. Apply a gradually increasing load over a period of at least 5 seconds at Point A until the rear feet or edge of the CSU lifts at least ¼ inches off the test surface. Record the maximum load (pounds).
7. Determine the tip-over moment of the product. The tip over moment M_{tip} (pound-feet) is the applied load multiplied by the appropriate moment arm. The moment can be produced with either a vertical load L_V or a horizontal load L_H.
   a. If L_V is applied, measure the horizontal moment arm H: the horizontal distance from Point A to the tip-over fulcrum. M_{tip} is L_v times H.
   b. If L_H is applied, measure the vertical moment arm V: The vertical distance from Point A to the tip-over fulcrum. M_{tip} is L_H times V.
8. Determine the threshold moment, $M_{threshold}$ (lb-ft). The threshold moment is the highest of the following three values:
   a. $M = 55.3X + 26.6$
   b. $M = 51.2Y – 12.8$, only applicable if the CSU has doors.
   c. $M = 17.2Z$, where $Z \leq 4.12$.
9. Compare the tip-over moment, M_{tip}, to $M_{threshold}$.
   a. M_{tip} must be greater than $M_{threshold}$.

The proposed regulatory language of the stability requirements and additional requirements proposed by staff can be found in Tab G.

Staff requests comments regarding the proposed stability requirements. Specifically, staff requests comments on the following:

- The stability requirements, and whether they are adequate, or should be modified;
- Whether a 1.5° forward tilt adequately replicates the effects of a CSU resting on carpet;
- Whether drawer interlocks should be subject to a performance requirement to ensure designs cannot be easily defeated or over ridden by the consumer;
- Whether levelling devices should be allowed to be adjusted per the manufacturer instructions during stability testing;
- Whether levelling devices should include preset heights to account for carpeting;
- Whether levelling devices should require a permanent adjustment mark that indicates the position recommended for use on a carpeted surface;
- Whether labeling and or instructions for proper levelling on carpet should be a requirement;
- Whether the criteria to measure the maximum tip-over load should be the rear of the CSU lifting off at least ¼ inch off the test surface;

- Whether the requirements should address designs where tip restraint installation is mandatory to unlock drawers;
- Whether the Commission should develop tip restraint requirements such as restraints permanently attached to the CSU or an attachment point such as a D-ring that will not fail when pulled at a specified force;
- Whether interlocks for ready-to-assemble furniture should be pre-assembled/automatically engage;
- How to test interlock systems that have an override, such as two drawers opened simultaneously;
- How to determine whether children can engage an override, and whether there should be a test for the override;
- Whether and how to test automatically closing drawers;
- Whether the drawer fill requirements are reasonable;
- And whether pullout shelves should be tested with the same storage density as drawers.

VII. MODIFICATIONS TO IMPROVE STABILITY

Because many existing CSU designs will not meet the recommended stability requirements described above, ESMC staff evaluated several possible options manufacturers could use to modify existing designs to meet the recommended requirements. ESMC staff evaluated the following potential product modifications to improve the stability of CSUs:

- Drawer interlock systems;
- Reduced drawer extension (travel length);
- Foot or platform extension;
- Raised front legs, or front leveling system; and
- Additional weight or counter balance weight.

The diagram in Figure 35 shows where these modifications would be applied on a CSU. In some cases, these modifications may be implemented on existing CSUs without extensive design changes to the body of the product. Staff did not evaluate structural design changes, such as increasing the CSU depth or using lighter materials for the drawers. These changes may also improve the stability of CSUs, but could not be easily implemented on CSUs already on the market. The modifications discussed below could be combined with other structural design changes and with each other to further improve the design. Details of staff's analysis can be found in Tab M for Models C, E, F, and G.

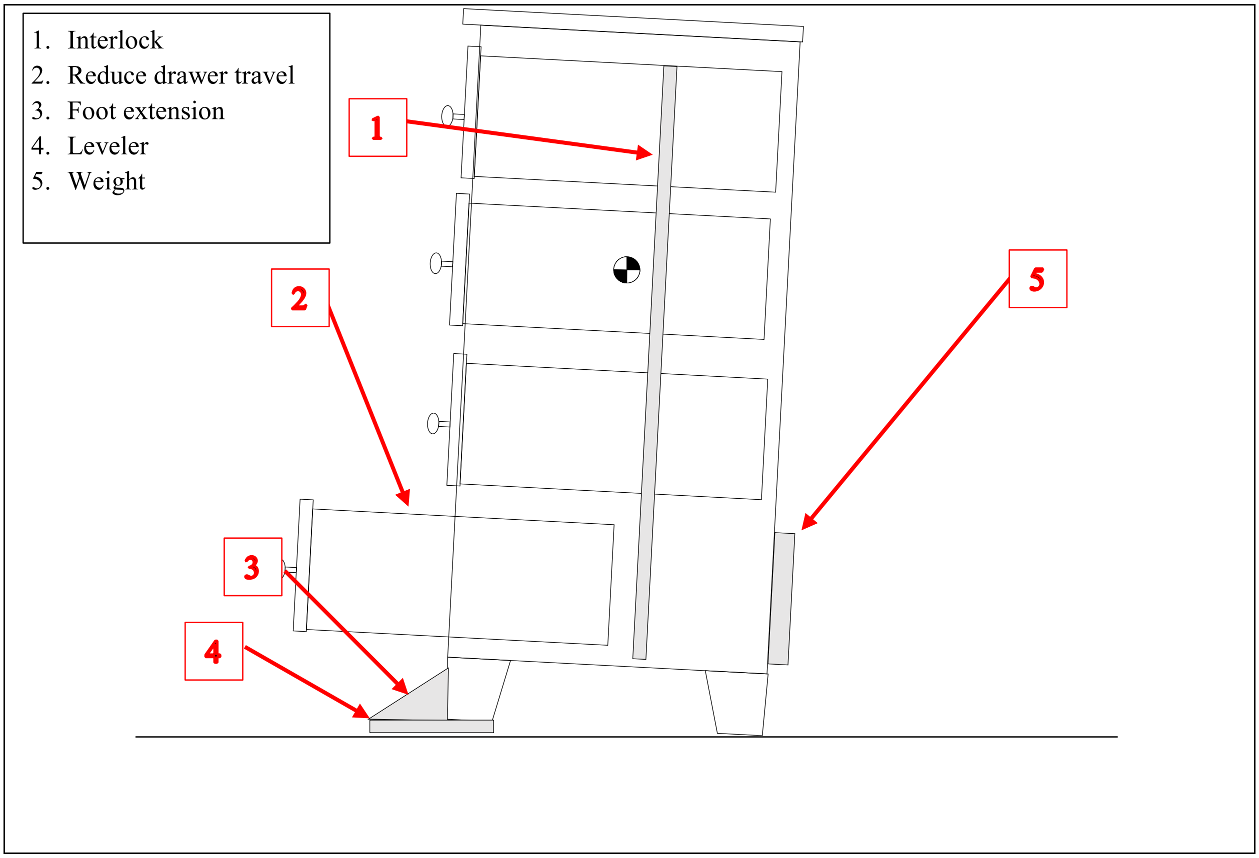

Figure 35. Modifications to improve stability.

Staff evaluated what modifications would be required to allow five sample CSUs that had been involved in incidents to meet the proposed performance requirements. In order to assess these modifications on CSUs with varying levels of stability, staff evaluated these modifications on three CSUs that exceeded the stability requirements in ASTM F2057 – 19 Sections 7.1 and 7.2; one CSU which minimally met the stability requirements in ASTM F2057 – 19 Section 7.1 and 7.2; and one CSU which performed well below the stability requirement in ASTM F2057 – 19 Section 7.2, but met the requirement in Section 7.1.

1. Drawer interlock system

As explained in Section VI, a drawer interlock system prevents simultaneous opening of multiple drawers. Typically, an interlock will allow one drawer in a column to be pulled out at a time, while locking or blocking the other drawers from opening. Some interlock systems allow more than 1 drawer to be open at a time, while blocking the remaining drawers from opening. These systems are commonly found in products like office file cabinets, and they have been found in some modern CSU designs. Some CSU interlock systems are designed to be disabled when the CSU is anchored. A CSU will become less stable as more of the drawers are opened because the weight of the CSU moves forward toward the front legs. By preventing multiple drawers from opening through the use of a drawer interlock system, the CG of the drawers remains behind the tip point and shifts the CSU CG back, which acts to prevent tip-over, as shown in Figure 36.

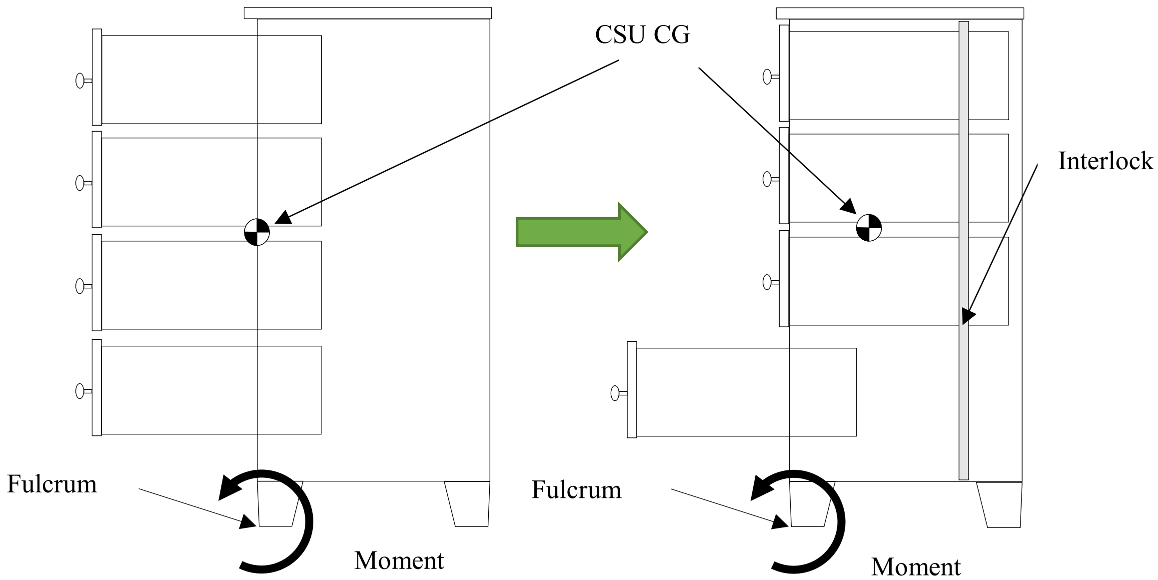

Figure 36. Scenario with all open drawers (left) compared to a system with an interlock (right).

Based on ESMC staff's analysis, a drawer interlock system would be one of the most effective methods to improve stability, because it raises the tip-over moment of the CSU more than any other modification evaluated. With the addition of one or two additional modifications to the CSU (described below), ESMC staff showed that some incident CSUs can be modified to meet the proposed requirements in Section VI of this memorandum. However, interlocks are not perfect, and can be bypassed. Additionally, ESMC staff is unaware of any currently available after-market interlock designs, or of any interlock designs that interact across multiple columns of drawers. Some of ESMC staff's analysis assumed these new interlock designs would become available, although it is unclear how much time will be necessary for the required research and development of these systems, or how much such systems would add to the cost of a CSU.

2. Reduction of drawer travel

Reducing the drawer travel will decrease the distance the drawer extends from the fulcrum, and the distance at which a tip force is applied. This can be accomplished by installing drawer slides with a new design. When comparing two drawers on the same unit, the force required to tip over the CSU placed on the drawer that extends farther will be less than the tip-over force on the drawer that has a shorter extension. This is because the magnitude of the tip-over moment is proportional to the moment arm–the distance of the force from the fulcrum. Figure 37 demonstrates the reduction of drawer extension.

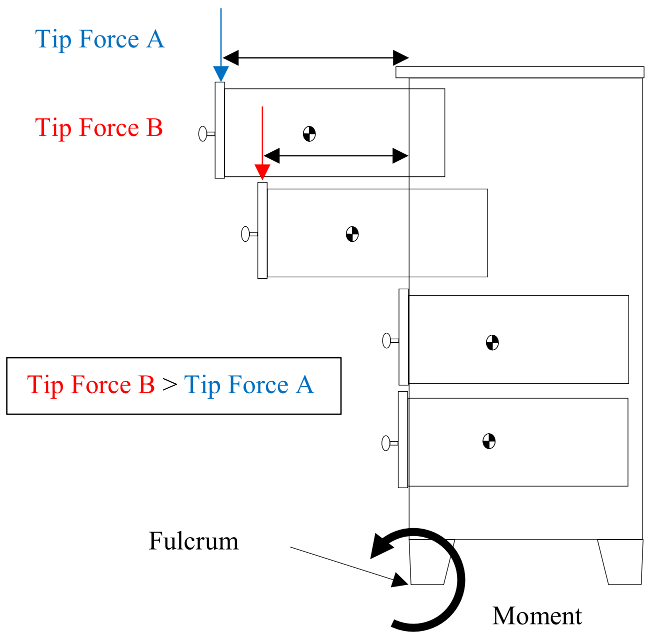

Figure 37. Reduction of drawer travel. The force required for tip over (Tip Force B) is greater with a shorter drawer travel compared to the force required for tip over (Tip Force A) with a longer travel.

Reducing the drawer travel can be effective at improving the stability of CSUs, particularly when combined with other design modifications. Reducing the drawer travel decreases the moment arm of the tip-over moment created by a child climbing a CSU, which increases its stability. It may not be an effective modification on its own, given that an extreme reduction of drawer extension would reduce the drawer's usability.

3. Extension of the front legs or feet of the CSU

Another way to reduce the distance the drawer extends from the fulcrum is to extend the fulcrum towards the edge of the drawer. This can be accomplished by extending the CSU's front feet forward (with an attachment or a replacement foot), or by attaching a platform to the bottom of the CSU. Figure 38 below showcases units with and without an example front foot extension and the general forces that act on the unit.

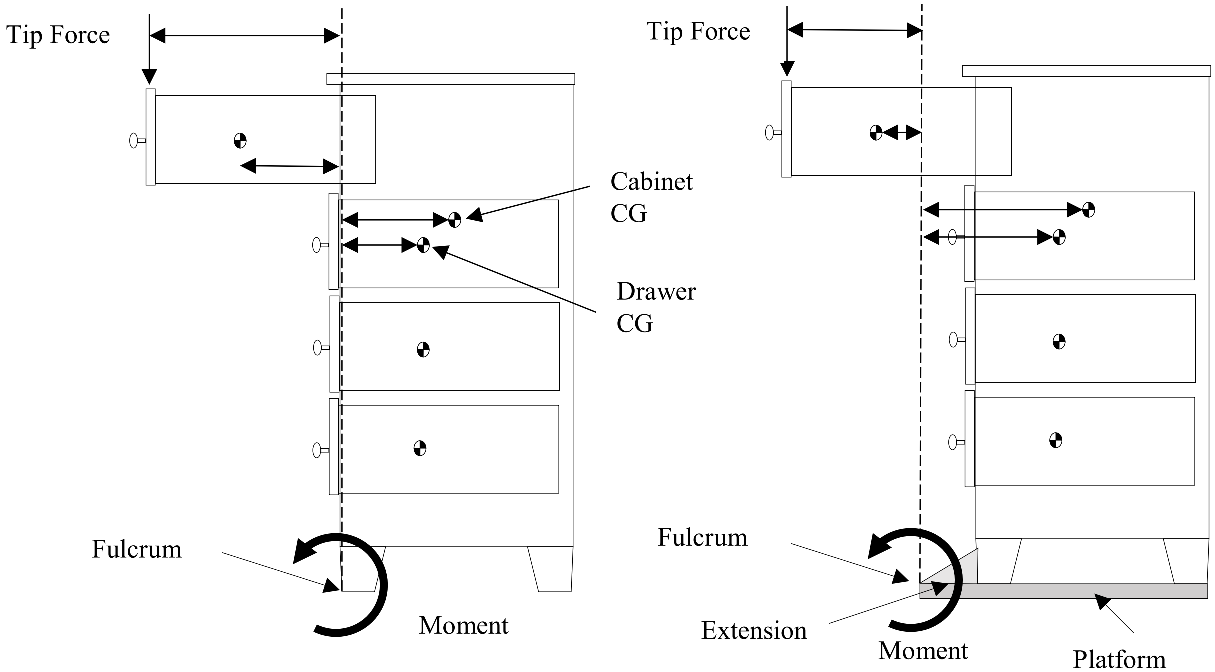

Figure 38. Example CSU without the foot extension (left) and with extension (right).

ESMC staff determined that on CSUs with poor stability performance, the extension or platform may need to be more than 3 inches, which could introduce a tripping hazard. For more stable CSUs, a smaller foot extension, in combination with an interlock and/or other modifications, can improve stability to meet the proposed requirements in Section VI of this memorandum.

4. Raised front legs, or front leg leveling system

As shown in Section III, a CSU on carpet can behave like it has been angled forward. In this situation, or when the floor is not level, increasing the height of the front feet to tilt the CSU back will increase the stability of a unit. Tilting the CSU and drawers back will increase the distance from the CSU CG location to the fulcrum, and it will reduce the distance from the fulcrum to the location where the tip force is applied to the CSU, as shown in Figure 39 below.

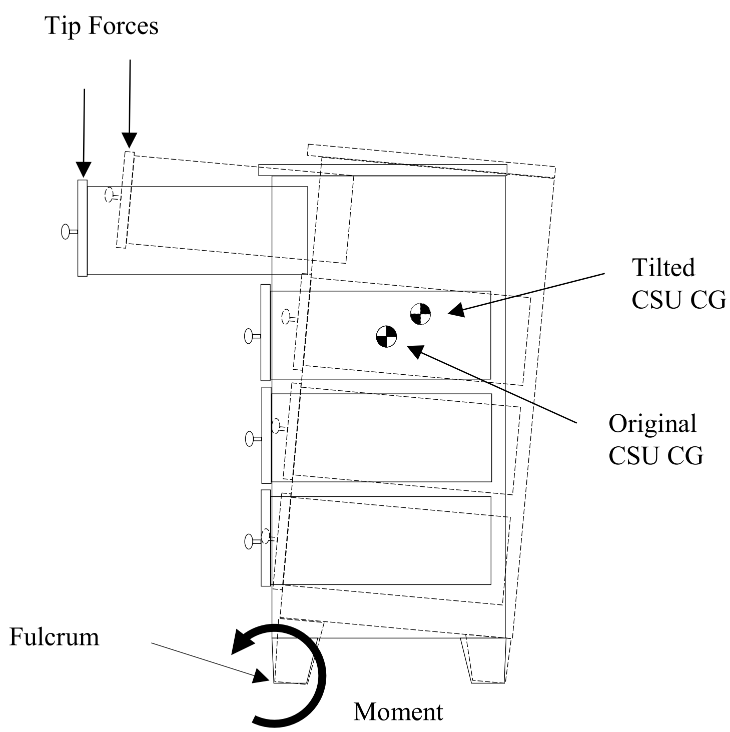

Figure 39. Raised front legs shift the CSU's CG back (Angle exaggerated for illustration purposes).

Several existing CSU designs have adjustable front feet to allow for these level adjustments. Currently, manufacturers typically instruct consumers to adjust the feet as necessary to become level on an unlevel surface. Manufacturers could instruct consumers to tilt the CSU back further on carpet, or other surfaces, such that the CSU is not level, but has more resistance to tipping forward. Similar outcomes could be achieved by replacing the front legs with longer legs, or placing an object under them. While raising the front feet makes tipping the CSU forward more difficult, it also makes tipping the CSU backward less difficult. This can be a concern if the front legs are raised too much, or if the CSU is not against a wall. Additionally, any manual foot adjustment system requires action by consumers to determine the appropriate level, and it risks the CSU not being used as intended by the manufacturer. If a manufacturer relies on levelers for stability on carpet, explicit directions on proper use should be included in the CSU's instructions and on the product labeling. Levelers can include markings indicating the proper adjustments when the CSU is used on carpet to facilitate proper use. Raised front legs or preset adjustments on levelers may not be practical on CSUs that are intended to have a level top surface.

5. Adding weight to the CSU

For two similarly shaped CSUs, where one CSU cabinet (*i.e.*, the CSU without its drawers/doors) weighs more than another, the heavier CSU will require more force to tip over. Concentrating that added weight at the back of the CSU, preferably the bottom rear, will have an even greater effect on stability, by shifting the CSU's center of gravity farther away from the tipping point; concentrating the additional weight at the front of the CSU may have the opposite effect and increase instability.

The effects of additional evenly distributed weight were demonstrated with two CSUs examined by ESMC staff (Tab M, Model G). The CSUs are the same model, with different manufacturing dates, and have similar dimensions and design. One unit weighs 165 pounds, and the other unit weighs 195 pounds, a difference of approximately 30 pounds. With all drawers open and fully loaded, the heavier unit can hold approximately 2.4 times the amount of weight on the top edge of the front face of the open drawer before the CSU tips over. Figure 40 below demonstrates the addition of weight on a unit.

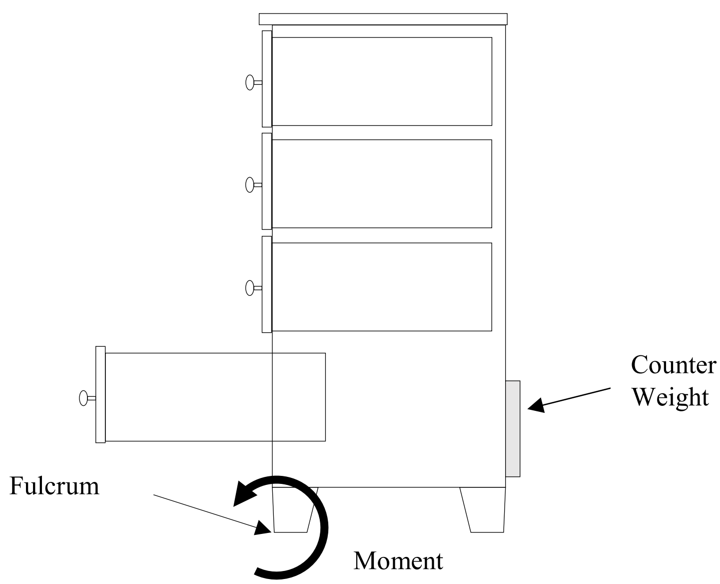

Figure 40. Example of a CSU with a counterweight.

For this CSU design, which exceeded the stability requirements in ASTM F2057 – 19, an additional 20 percent of evenly distributed weight increased the tip weight to 2.4 times the original tip weight. However, the weight alone was not sufficient for the design to meet staff's proposed performance requirements. This modification would need to be combined with other modifications, such as an interlock, to meet staff's proposed performance requirements. A counterweight of similar weight placed at the bottom rear of the CSU is more effective, but would also require combination with other modifications. Staff expects most CSUs would require an even higher proportion of weight added to achieve similar results. This additional weight could make CSUs cumbersome to move, and could make CSUs even more hazardous if they do tip over (Tab B). Allowing this weight to be removed by consumers would allow the

CSU to be moved more easily, but it risks the CSU being used in a configuration unintended by the manufacturer. A smaller weight added in combination with other modifications may be part of modifications to meet the requirements in the draft proposed rule.

Summary

Based on ESMC staff's analysis of these five modifications, a drawer interlock system was the most effective modification at potentially meeting staff's proposed performance requirement. Of the CSUs that met the stability requirements of ASTM F2057 – 19, one was able to meet the proposed performance requirements with the addition of an interlock, while the remainder required some additional minor modifications. The CSUs without an interlock required more extensive modifications that could be impractical or that could introduce new hazards.

VIII. CHILD PROTECTION LEVEL – CASE STUDY

Staff's proposed requirement will be protective of the climbing interaction of 95 percent of 3-year-old children (51.2 pounds). The proposed requirement will also be protective of over 90 percent of 4-year-old boys and 95 percent of 4-year-old girls, 75 percent of 5-year-old boys and more than 50 percent of 5-year-old girls.

Staff anticipates that the recommended requirement can protect older, heavier, children for other climbing scenarios in which children open fewer drawers or the closed drawers are filled with clothes that stabilize the CSU. Below are some examples to demonstrate this point.

A. Case Study 1: Model E Filled with Clothes

ESMC staff analyzed various models of incident-involved CSUs (Tab M). One of the investigated units is Model E with eight drawers. Model E with an 11.5-inch drawer extension has a tip weight of 3 pounds when the unit is filled and all drawers are extended. To meet the proposed requirement, Model E could be redesigned with an interlock system that allows two drawers to open simultaneously while the others remain closed, as described in Section 10, Modification #2. The resultant tip-over force would be 85 pounds (Figure 41a). The proposed requirement would test this configuration with the drawers empty because this is the worst case for stability. In reality, many drawers will likely be filled, resulting in a more stable CSU than one with empty drawers. For a filled CSU, Model E would have a tip over force of 108 pounds with two drawers open (Figure 41b).

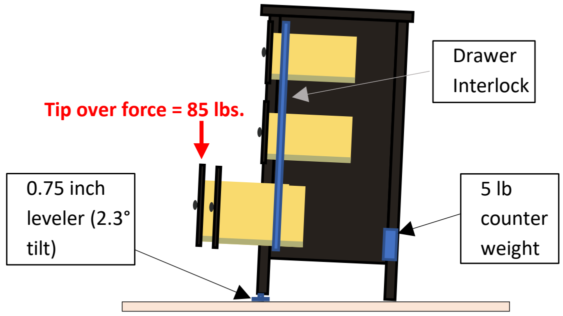

Figure 41a: Modified Model E CSU with 2-drawer interlock, front leveler and counter balance weight, all drawers **empty**. Tip-over force = 85 lbs.

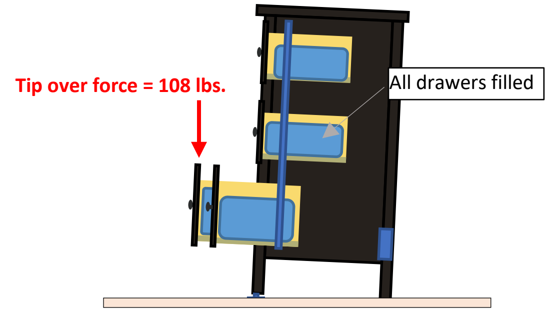

Figure 41b: Modified Model E CSU with 2-drawer interlock, front leveler and counter balance weight, all drawers **filled**. Tip-over force = 108 lbs.

Figure 41. Model E with modifications. Tip-over force of the empty CSU is compared to the filled CSU.

Using Equation 2, the tip-over force of 108 pounds produces approximately the same moment as a 66.6-pound child ascending the CSU, which is greater than the weight of the 95th percentile 5-year-old child, and the 85th percentile 6-year-old child, as shown in Figure 42. In summary, this CSU, modified to meet staff's proposed requirement, can protect 3-year-old children in the least-stable CSU configuration, as well as virtually all 5-year-old children and more than 85 percent of 6-year-old children, when two drawers are extended and the CSU is filled.

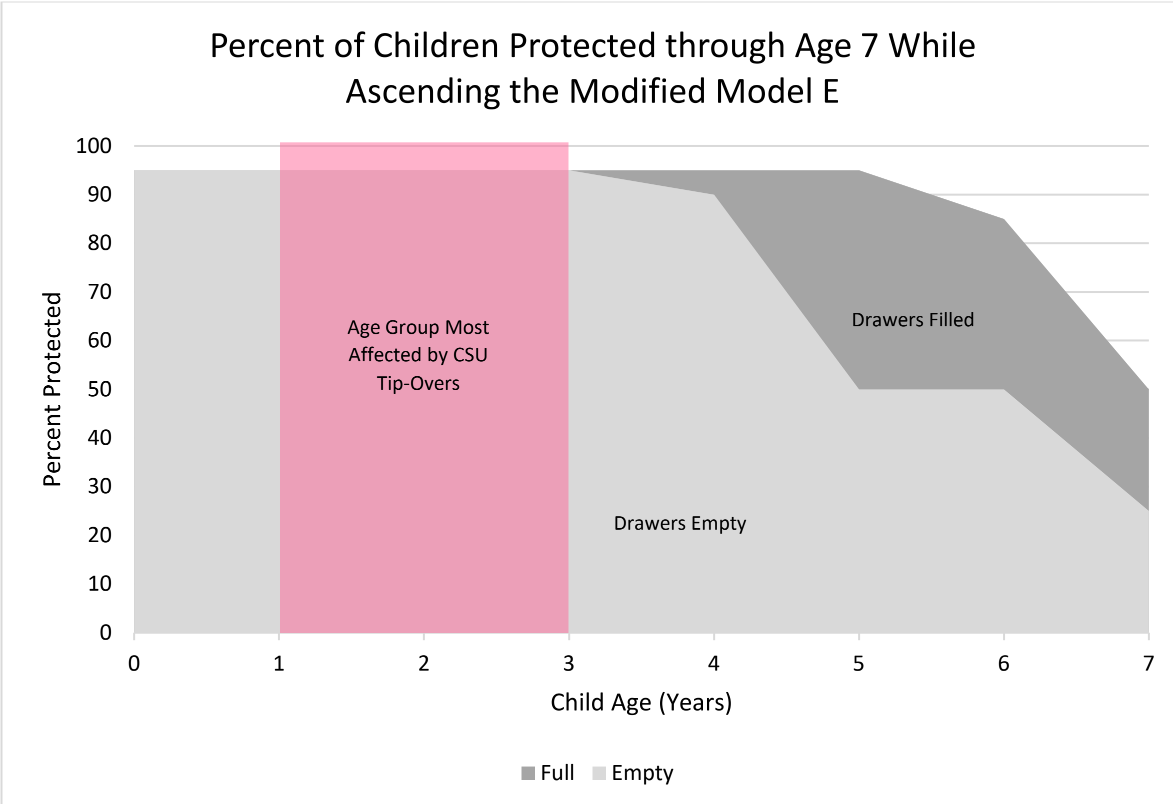

Figure 42. When Model E is modified to meet staff's proposed performance requirements, it can protect most children through age 3 years when drawers are empty, while offering a similar level of protection to children through age 5 years when drawers are full.

B. Case Study 2: Model G Filled with Clothes

One version of Model G with seven drawers has an 11.81-inch drawer extension and a tip weight of approximately 32 pounds when the unit is filled and all drawers are extended (see Tab M). To meet the proposed requirement, Model G could be redesigned with an interlock system that allows up to three drawers to open simultaneously while the others remain closed, as described in the Stability Modifications section of Model G (Exemplar Sample, Modification #1). The resultant tip-over force would be approximately 83 pounds (Figure 43a). The proposed requirement would test this configuration with the drawers empty because this is the worst case for stability. In real-world use, many drawers will likely be filled, resulting in a more stable CSU than one with empty drawers. For a filled CSU, Model G would have a tip-over force of approximately 92 pounds with three drawers open (Figure 43b).

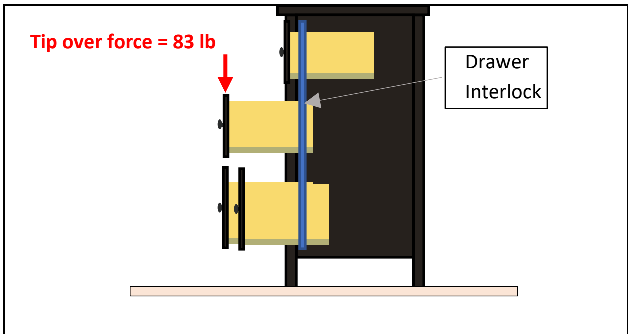	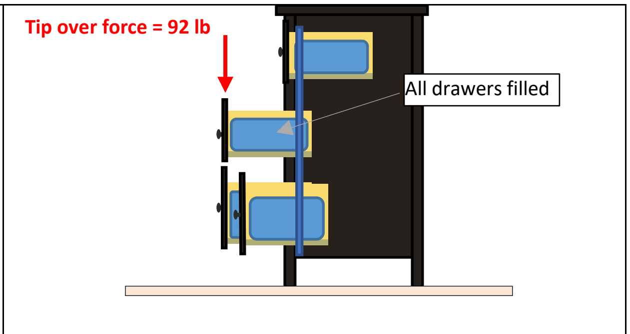
Figure 43a: Modified Model E CSU with 2-drawer interlock, front leveler and counter balance weight, all drawers **empty**. Tip-over force = 83 lb.	Figure 43b: Modified Model E CSU with 2-drawer interlock, front leveler and counter balance weight, all drawers **filled**. Tip-over force = 92 lb.

Figure 43. Model E with modifications. Tip-over force of the empty CSU is compared to the filled CSU.

Using Equation 2, the tip-over force of 92 pounds produces approximately the same moment as a 56.9-pound child ascending the CSU, which is greater than the weight of the 85th percentile 5-year-old child, and the 75th percentile 6-year-old child, as shown in Figure 44. In summary, this CSU modified to meet staff's proposed requirement can protect 3-year-old children in the most severe scenario, as well as 85 percent of 5-year-old children, and 75 percent of 6-year-old children, when two drawers are extended, and the CSU is filled.

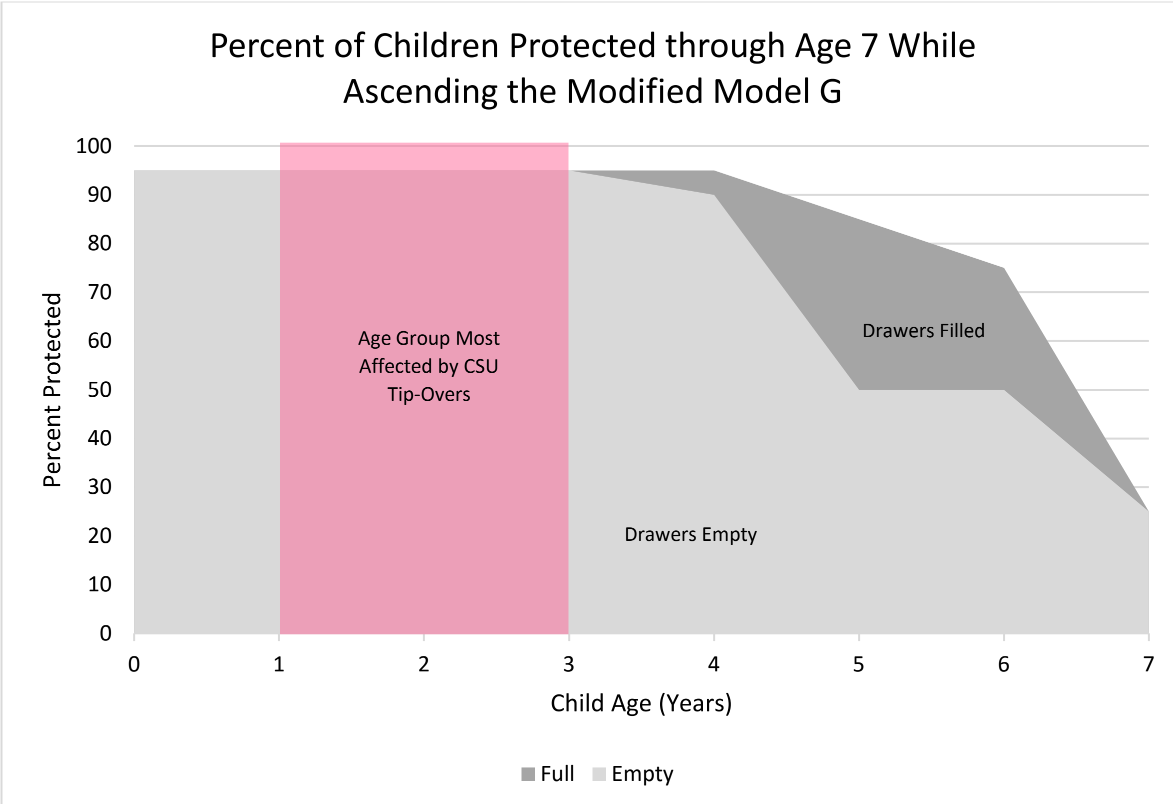

Figure 44. When Model G is modified to meet staff's proposed performance requirements, it can protect most children through age 3 years when drawers are empty, and continue to protect 85 percent of children through age 5 years when drawers are full.

IX. CONCLUSION

ESMC staff identified how the weight and CG of a CSU can contribute to its tip-over moment. Staff applied this information to analysis of several CSUs involved in incidents, and found that the following hazard patterns often occur simultaneously:

- Multiple open drawers;
- Drawers filled or partially filled with clothing;
- Carpeted surfaces;
- Children climbing the CSU; and
- Children pulling on CSU drawers.

These findings were supported by further analysis of incidents in the CPSRMS database.

ESMC staff also analyzed a UMTRI study of child climbing behaviors, which found that the moments caused by children climbing furniture could exceed the effects of body weight alone. ESMC staff developed an equation from the UMTRI study that could be used to calculate the moment generated by children ascending a CSU based on the child's body weight and the drawer extension from the CSU fulcrum.

ESMC staff found that ASTM F2057 – 19 does not adequately account for the simultaneous occurrence of the common hazard patterns. In light of this, staff has developed a draft proposed a rule that accounts for the simultaneous occurrence of multiple open drawers, drawers filled with clothing, carpeted surfaces, and children pulling on or climbing a CSU. Staff designed this draft proposed rule to protect 95 percent or more of children 3 years old or younger, based on incident data involving children and CSUs without televisions that show 94 percent of tip-over fatalities and 66 percent of nonfatal NEISS injuries involve children 3 years old or younger. Staff also determined that a large fraction of older children (for climbing, 92 percent for 4-year-old children; 64.5 percent for 5-year-old children; 50 percent for 6-year-old children; 25 percent for 7-year-old children; and 7.1 percent for 8-year-old children) would also be protected (see Tab C for ESHF staff's addressability assessment).

Finally, ESMC staff analyzed five design modifications that individually, or in combination, could improve CSU stability. ESMC staff found that a drawer interlock system could be particularly effective at improving stability, by directly addressing the hazards of multiple open and filled drawers. Implementing these modifications and other design changes to meet the requirements of staff's proposed rule will vastly improve the tip-over resistance of a CSU.

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TAB E: Recommendation for Clothing Storage Furniture Hang Tag Providing Tip-Over Resistance Information to Consumers

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B

E

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

Memorandum

DATE: July 14, 2021

TO: Kristen Talcott, Ph.D., Furniture Tip-Over Project Manager,
Division of Human Factors, Directorate for Engineering Sciences

THROUGH: Mark Kumagai, P.E., Associate Executive Director,
Directorate for Engineering Sciences

Caroleene Paul, Director,
Division of Mechanical and Combustion Engineering,
Directorate for Engineering Sciences

Rana Balci-Sinha, Ph.D., Director,
Division of Human Factors, Directorate for Engineering Sciences

FROM: Hope E J. Nesteruk, Children's Program Manager,
Division of Mechanical and Combustion Engineering,
Directorate for Engineering Sciences

SUBJECT: Recommendation for Clothing Storage Furniture Hang Tag Providing Tip-Over Resistance Information to Consumers

I. INTRODUCTION

Consumer Product Safety Commission (CPSC) staff is recommending that the Commission issue a notice of proposed rulemaking (NPR) that would require clothing storage unit (CSU) manufacturers to provide technical information for consumers on a hang tag at the point of purchase. Section 27(e) of the Consumer Product Safety Act (CPSA) authorizes the Commission to require, by rule, that manufacturers of consumer products provide to the Commission performance and technical data related to performance and safety as may be required to carry out the purposes of the CPSA, and to give notification of such performance and technical data at the time of original purchase to prospective purchasers and to the first purchaser of the product.[1] Section 2 of the CPSA provides that one purpose of the CPSA is to "assist consumers in evaluating the comparative safety of consumer products."[2] In Tab D, CPSC technical staff

[1] Section 27(e) of the Consumer Product Safety Act, 15 U.S.C. 2076(e).
[2] 15 U.S.C. § 2051(b)(2).

recommends that the Commission propose to require CSUs to meet a minimum level of stability (*i.e.*, exceed a threshold tip-over moment).[3] However, above that minimum level, CSUs may have varying levels of stability. A hang tag provided on the CSU will offer consumers comparative information about the stability of products, based on a specific tip-testing protocol that staff recommends as part of the draft proposed rule.

This memorandum lays out the rationale for staff's recommendation that a hang tag on each CSU state the actual measured ratio of tip-over moments to the allowable moment of each CSU model and the elements required for such hang tag. The recommended CSU hang tag, see Figure 1, shows the tip ratio. By providing product information at the point of purchase, the hang tag will inform consumers who are evaluating the comparative safety of different CSUs and making buying decisions. This information may also improve consumer safety by incentivizing manufacturers to produce CSUs with higher levels of stability, thereby increasing the overall stability of the CSU market.

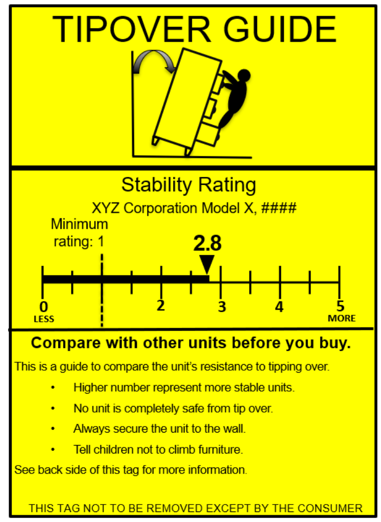

Figure 1. Recommended CSU Hang Tag, example CSU with rating of 2.8

Note: larger hang tag sample is found in Appendix A

II. BACKGROUND

History of Product Labels and Hang Tags Comparing the Safety of Products

Several U.S. federal government agencies and counterparts outside the United States require on-product labels to help consumers with buying decisions by offering information comparing the safety of products. In 1975, The Federal Trade Commission (FTC) was directed to develop and administer a mandatory appliance energy label; the EnergyGuide label was required on certain products beginning in 1980 to provide information such as the capacity of the model and the estimated annual operating cost of the model.[4] The National Highway Traffic Safety Administration (NHTSA) introduced a New Car Assessment Program (NCAP) star-rating system for automobiles in 1978 to provide comparative information on vehicle crashworthiness. The NCAP is a five-star rating system for the level of increased safety for frontal crashes, side crashes, as of 1997, and rollover assessments, as of 2001 (Hershman, 2001).

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[3] A moment is a measure of the tendency of a force to cause a body to rotate about a specific point.
[4] 16 CFR part 305.

Prior CPSC Work

CPSC has issued several rules requiring manufacturers to provide performance and technical information to consumers under CPSA Section 27(e). These include:

- Self-Pressurized Consumer Products Containing Chlorofluorocarbons (16 CFR § 1401.5);
- CB Base Station Antennas, TV Antennas, and Supporting Structures (§ 1402.4);
- Cellulose Insulation (§ 1404.4);
- Coal and Wood Burning Appliances (§ 1406.4);
- Portable Generators (§ 1407.3); and
- ATVs (§ 1420.3) (further explained below).

Point-of-purchase hang tags are a common mode of communication on off-road vehicles, such as all-terrain vehicles (ATVs). In 1988, the Commission entered into consent decrees with companies that were the major distributors of ATVs at that time. Among the provisions of the consent decrees was agreement that the ATV distributors would provide hang tags on ATVs at the point of sale.[5] The ATV action plans, which resulted from the consent decrees, also contain hang tag requirements. Additionally, the most recent ANSI/SVIA voluntary standard for ATVs, ANSI/SVIA 1-2017, *Four Wheel All-Terrain Vehicles*, which the Commission has mandated as a CPSC standard,[6] also contains hang tag requirements. The ATV hang tags are required to include descriptions of product categories, intended uses, and age recommendations for each category, as well as warned-against behaviors.[7]

In addition to these rules, in 2014, the Commission issued an NPR for recreational off-highway vehicles (ROVs) that included a proposal for a hang tag that displayed rollover resistance in a format that could be compared across ROV models. Shortly thereafter, CPSC issued a contract for cognitive interviews and focus group evaluation to refine the proposed hang tag (contract CPSC-F-15-0037). The staff statement on the final report[8] summarized the findings as follows:

> Based on consumer feedback obtained during the testing, EurekaFacts developed a final recommendation for a hang tag. The recommendations include the following requirements: that the hangtag be a 5-inch x 7-inch vertical design with an entirely yellow background; include a pictorial of a tipping vehicle; and use the heading,

[5] CPSC Approves Consent Decrees for All-Terrain Vehicles. 1988. Retrieved from http://www.cpsc.gov/en/Newsroom/News-Releases/1988/CPSC-Approves-Consent-Decrees-for-All-Terrain-Vehicles/.
[6] 16 CFR part 1420.
[7] The voluntary standard for ATVs ANSI/SVIA 1-2017, Section 4.24, addresses the requirements for the ATV hang tags.
[8] https://www.cpsc.gov/s3fs-public/pdfs/ROVHangtagEvaluationReport.pdf

> "Rollover Guide." EurekaFacts recommended that the engineering test data be presented in simple, easy-to-understand language, using terms understood by consumers. For example, EurekaFacts suggested using a 10-point scale positively related to the heading; in other words, that lower numbers on the scale are "less," and higher numbers are "more," as related to the heading title. In addition, the contractor recommended that supplemental information be made available, to include information on the scale range and rollover rating, an explanation of how rollover ratings are determined, and information on resources that provide additional information.

Taken together, CPSC's previous experiences, along with the work of other federal agencies, informed the formatting and information presentation in staff's recommended CSU hang tag. Staff invites comments on all aspects of the draft hang tag.

III. RECOMMENDED REQUIREMENTS AND RATIONALE

Purpose of Product Label & General Content

The purpose of the recommended hang tag is to inform consumers about the stability of a particular CSU, so that they can compare the relative stability of products and make informed buying decisions. This differs from a warning label, which is addressed in Tab C. "The objective of hazard warnings is to change behavior, whereas the purpose of information provisions is to inform purchase decisions" (National Research Council, 1996). In other words, the objective of a warning label is to communicate hazards, convey information on how to avoid the hazard, and describe the consequences of not avoiding the hazard; whereas the purpose of point-of-purchase information is to inform consumers of relative performance or technical information relating to the hazard, so that they can include safety considerations in their assessment of products. The recommended hang tag would convey information to consumers about the stability of CSUs, so that they can compare the relative stability of different products and make informed buying decisions, and a hang tag is distinct from a warning label.

In addition, point-of-purchase information can help improve the safety of products by encouraging manufacturers to produce safer products. For example, after the introduction of the NCAP rating system, NHTSA found that scores improved steadily, with the largest improvements occurring soon after inception (Kahane, 1994). This suggests that requiring comparative safety information on a hang tag may motivate manufacturers to increase the safety of their products. Staff believes that a CSU hang tag could lead to a similar trajectory in the CSU industry to improve the stability of CSUs and further reduce the risk of injury from CSU tip overs.

Recommendation:

1) **General.** Staff recommends requiring manufacturers of CSUs to provide with CSU technical and performance data on such products at the time of original purchase to prospective purchasers and to the first purchaser for purposes other than resale. Staff recommends that such information be required to appear on a hang tag and meet the requirements below.

2) **Content.** Staff recommends requiring the hang tag to provide graphically and textually the ratio of the measured moment at tip over to the calculated threshold moment, along with an explanation of the calculation on the reverse side, as shown in the recommended label (see Appendix A).

3) **CSU Symbol.** CPSC staff recommends that the hang tag be required to include a CSU symbol in a tipping condition to identify the product and hazard. Research studies have found that warning labels with pictorial symbols are more noticeable to consumers (Wogalter, Dejoy, & Laughery, 1999). Although the hang tag is not a warning label, staff believes the CSU icon will help consumers notice and understand the intent of the hang tag.

4) **Graph Label (Low/High).** Graphical information should be clear and informative with the axes labeled fully, complete with the units of measurement (Markel, 2001). CPSC staff recommends the labels "low" and "high" at the left and right ends of the scale, respectively, to indicate that the higher values (as shading increases to the right) correspond to a greater tip-over resistance when loaded.

5) **Manufacturer, Model, Model Number, Model Year.** The EnergyGuide label provides information on the manufacturer, model, and size of the product so that consumers can identify exactly what product the label describes.[9] CPSC staff recommends requiring a similar identification of the CSU model on the hang tag for consumers to compare values among different model CSUs.

6) **Textual information.** Staff recommends requiring text to paraphrase the importance of the graph and how to interpret the information presented. The EnergyGuide label provides textual information in the form of bullets below the graphic of the scale to inform the consumer further on the meaning of the value displayed. CPSC staff recommends similar textual information on the CSU hang tag to provide consumers with more definition of the tip-over resistance value

[9] Guide to EnergyGuide label. Retrieved at: http://www.consumer.ftc.gov/articles/0072-shopping-home-appliances-use-energyguide-label.

given in the graph. EurekaFacts (2015) "strongly" recommended that any "technical information is presented in plain, easily understood terms."

7) **Graph Identifier and Label (Minimally Acceptable).** CPSC staff recommends a vertical dotted line to show the extreme "worst" end of the tip-resistance scale, defined by the threshold tip moment for CSUs. This "minimally acceptable" label allows consumers to judge visually the CSU tip value, as compared to the minimum value of 1. The performance criteria state that the tested moment must be *greater* than the threshold moment. Because this ratio is 1 when the tested moment exactly equals the threshold moment, the minimal rating would be a value infinitesimally greater than 1. For practical purposes of consumer comparison of a hang tag, staff recommends placing the minimum acceptable rating at 1.

Rating Calculation

The performance criteria in the recommended rule (see Tab D) state that the tested moment of a CSU must be greater than a calculated threshold moment requirement. The Tip Rating number on the hang tag is the ratio of tested moment to threshold requirement. This provides a simple calculation that results in a number greater than 1,[10] which can be easily represented on a scale. Additionally, due to the nature of a ratio, a rating of 2 means the unit can withstand twice the threshold moment, a rating of 3 is three times the threshold moment, and so forth. Example 1, below, uses round numbers to illustrate the math behind the comparative rating.

---

[10] The equation is $Moment_{tested}/Moment_{threshold}$. If $Moment_{tested} = Moment_{threshold}$, then $Moment_{tested}/Moment_{threshold} = 1$. But, the staff's recommended performance requirement is that $Moment_{tested}$ *exceed* $Moment_{threshold}$. Therefore, all units must have a ratio greater than 1, although it may be only a small fraction over 1.

> **Example 1. Rating example** (uses easily understood numbers, not based on any specific, known clothing storage unit)
>
> Unit A has an acceptable moment of 10 ft-lbs. When A is tested, the test engineer finds it tips at 25 ft-lbs. Unit A's ratio is 25:10 for a rating of 2.5.
>
> Unit B also has an acceptable moment of 10 ft-lbs. Testing on Unit B found it tipped at 50 ft-lbs. Unit B's ratio is 50:10 or a rating of 5.
>
> Unit C has an acceptable moment of 5 ft-lbs. Testing on Unit C found it tipped at 20 ft-lbs. Its ratio is 20:5 or a rating of 4.
>
> Unit A is 2.5 times more stable than required. Unit B is 5 times more stable than required. Also, unit B is twice as stable as unit A.
>
> Unit C lies between units A and B in terms of stability. Unit C is 4 times greater than required, and a bit more stable than A but less stable than B.

ESMC testing suggests that although few CSUs currently meet the recommended requirement, many CSUs on the market today would achieve ratings between 1 and 2, with appropriate modifications. Consequently, many models of units may have tip-over ratings that are relatively equal. Staff expects that, over time, there may be units with a broader range of scores, as consumers desire more stable units, and manufacturers build more stable units.

Staff considered other methods of determining a comparison rating, including calculating a weight from the tested moment (*i.e.,* calculating the inverse of the test procedure). However, staff is concerned that this may lead consumers to interpret the rating as a guarantee that the unit is protective for children weighing up to the rating. However, weight of a child alone does not account for all factors that contribute to a tip-over event, and staff cannot guarantee that a child of a certain weight cannot tip over a CSU.

Another potential rating system is a categorical rating based on the voluntary standard (VS) and compliance with incrementally more stringent requirements. For example, a rating of 1 might be for units that do not meet the VS, a rating of 2 for units that do, 3 for units somewhere between the VS and the staff recommended performance test, 4 for units that meet the staff recommended performance standard, and 5 for some more stringent level. However, such a categorical rating system may not qualify as "performance and technical data" because it would only identify the test that is met, but not provide information about the underlying data. It may also be more difficult for consumers to understand a rating system that incorporates multiple standards.

Staff concludes that a tip rating that is the ratio of the tested moment to the threshold requirement moment is more appropriate for the recommended hang tag, because it provides both performance and technical data to prospective purchasers and provides a single point of comparison (See Tab D for a more fulsome discussion of the threshold moment and test requirements). Staff recommends rounding the calculated ratio to one significant digit (*e.g.,* X.Y) for a consumer-facing display. However, staff recommends inviting comments on potential rating calculations, as well as suggestions for other ratings.

Linear Scale Graph

Studies on the usefulness and comprehension of point-of-sale product information intended to help consumers evaluate products and make buying decisions support the effectiveness of hang tags, and linear scale graphs, in particular. With regard to the appliance energy label, a survey conducted in the 1980s by the FTC measured consumer awareness of energy information presented at the time of purchase. This study indicated that the energy label increased consumer awareness of energy efficiency as an important purchasing criterion (National Research Council, 1996). Therefore, CPSC staff concludes that CSU purchasers may use the tip test results represented as the resistance to tip over as an important purchase criterion when presented on a hang tag.

When initially released to the public in 1980, the EnergyGuide label presented the energy consumption of products as the primary disclosure as a linear scale graph. Beginning in 2005, the FTC conducted a 2-year review of the label that included a public workshop, consumer research, and public comments.[11] The FTC found that there was a high level of reported recognition and usefulness of the existing label; the FTC also found that respondents preferred the operating cost as the primary disclosure rather than the energy consumption (Newsome, Hampton. 2008). In 2007, the EnergyGuide label maintained the use of a linear scale, changing the primary disclosure from energy consumption to operating cost with the lowest and highest yearly operating cost for similar models so that consumers can compare products.[12] CPSC staff recommends that the CSU hang tag present information in a graph on a linear scale because the linear scale on the EnergyGuide provides almost 35 years of support, which was validated as recently as 2007, for consumer comprehension of linear scales to compare products using information labels.

Since the linear scale on the recommended CSU hang tag is a graphical representation of the stability information, it is important to include labels so that consumers understand the data on the tag. Graphs, such as the linear scale recommended, should have a unique title and the axes should be fully labeled with the units of measurement. To make clear the meaning of the information on the linear scale, CPSC staff placed the label "high" at the right side of the scale to

[11] FTC. (2007). Retrieved from: http://www.ftc.gov/news-events/press-releases/2007/08/concluding-two-year-rulemaking-ftc-announces-new-energyguide.
[12] FTC. Retrieved from: https://www.consumer.ftc.gov/articles/0072-shopping-home-appliances-use-energyguide-label.

identify for the consumer that the higher value equates to better stability or higher tip-over resistance. Graphs should also be distinguished from the text by adding blank space or enclosing the graphs in a box, and technical communication that includes graphs should also include text to paraphrase the importance of the graphic and explain how to interpret the information presented (Markel, M. 2001). The recommended CSU hang tag includes these features, enclosing the graph between bold border lines, and explaining how to interpret and use the graphic and number.

Recommendation:

8) **Scale.** When the proposed ROV hang tag was evaluated by focus groups, EurekaFacts found that participants preferred to have whole numbers anchoring the scale, such as 1 to 10, to communicate comparative information. However, based on ESMC testing to develop this draft NPR, staff concludes that most CSUs on the market are likely to have a tip rating between 1 and 2. Staff is concerned that using a 10-point scale will be difficult to differentiate between units. To minimize this difficulty, staff's draft requirement uses a 5-point scale. The recommended range allows for a shaded area for CSUs that meet the minimally acceptable tip resistance; the range also allows consumers to compare across models using the same scale. Although some units theoretically could have a normalized value over 5, representing this as a 5, or the highest point on the scale, would be reasonably interpreted by consumers as a high stability. Staff did not identify any CSUs currently on the market that would score a 5. Should there reach a point in the future where many models exceed 5, staff can revisit the scale, and the Commission could revise it to a 10-point scale.

9) **Graph scale, whole numbers beginning lower than the minimally acceptable value (1).** CPSC staff recommends the scale begin at 0. EurekaFacts (2015) found focus group participants preferred whole numbers as anchor points on the scale range, such as 1-10. EurekaFacts tested scales focused on the expected values (*e.g.,* 0.7 to 1.0), and found participants expressed confusion with decimals and understanding relative comparisons.[13] Zero is lower than the minimal acceptable rating of 1 to provide a common anchor point in consumers' mental models of a scale, and the whole numbers allow for better relative comparisons. In addition, allowing the display of a rating lower than the requirement allows simple identification that CSUs at least meet the minimum requirement.

[13] One quote from a participant stated "the graph is confusing. To me .81 is close to 1.0, but on the graph they are far apart, 0.7 means it just passed the standards." (EurekaFacts, 2015 pp 28)

Symbols and Icons

In addition to research on product labels, some aspects of warning label research apply to the development of the informational CSU hang tag. Specifically, human factors research on icons and symbols typically appears in warning research literature, and while creating an information provision is a different objective than creating a warning, the research from warnings icons is applicable when creating the information label. For example, research has shown that pictorial symbols and icons make warnings more noticeable and easier to detect than warnings without such symbols and icons (Wogalter, Dejoy, & Laughery, 1999). Additionally, including a graphic before introducing text may serve as a valuable reference for consumers, by maintaining attention and encouraging further reading (Smith, 2003). Therefore, CPSC staff recommends a CSU symbol on the hang tag to identify the product. The same symbol on a slight angle with an arrow representing movement may help consumers readily identify the label as addressing the CSU tipping characteristics. Staff invites comments with improvements in the graphic quality, while maintaining the iconic, symbol characteristics.

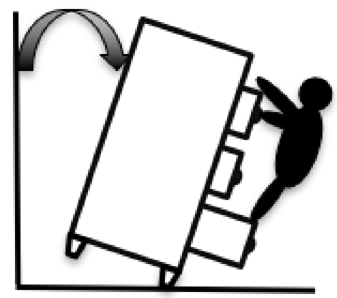


Figure 2. Recommended CSU Tipping Icon

The recommended CSU hang tag, shown in Appendix A, presents information graphically and textually, to explain the range of stability of CSUs to inform consumers during their purchasing process. Presenting information in this manner offers a better chance of comprehension by a wide range of users, such as non-English-literate users (Smith, 2003).

Size, Placement, and Attachment of CSU Hang Tag

CPSC staff recommends that the size, placement, and attachment specifications for CSU hang tags be similar to the hang tags used for other consumer products, such as ATVs, and be consistent with the recommendations by EurekaFacts (2015) for ROV hang tags.

ANSI/SVIA 1-2017, which ATVs must comply with under 16 CFR § 1420.3, requires ATV hang tags to be at least 6-inches tall × 4-inches wide. The EurekaFacts report found that participants preferred hang tags to be large. When testing 5-inch × 7-inch tags, and 4-inch × 6-inch tags, participants preferred the larger tag because it was more noticeable and easier to read. In addition, participants preferred a vertical orientation. Based on this information, CPSC staff recommends requiring CSU hang tags to be 5-inches wide × 7-inches tall.

Section 1420.3 and ANSI/SVIA 1-2017 require ATVs to be sold with a hang tag that is to be removed only by the initial purchaser of the ATV and replaced if lost or damaged. These provisions also require hang tags to be attached to the ATV in a manner that is conspicuous and removable only with deliberate effort. Staff recommends following this model to the extent allowed by 27(e).

Recommendation

10) **Placement.** Staff recommends requiring the hang tag to appear on the product, and also on the immediate container of the product in which the product is normally offered for sale at retail or shipped to consumers. Staff recommends requiring ready-to-assemble furniture to display the same information as the hang tag, with the same information in the same size and format, on the main panel of consumer-level packaging. Staff recommends requiring that the hang tag remain on the CSU until such time that the original consumer removes the tag.

11) **Size.** Staff recommends requiring that every hang tag be at least 5-inches wide x 7-inches tall.

12) **Attachment.** Staff recommends requiring that every hang tag be attached to the CSU and be clearly visible to a person standing in front of the unit, and also recommends that the hang tag be removable only with deliberate effort by the end consumer. Staff recommends requiring that the hang tag be attached to the CSU and that lost or damaged hang tags be replaced in the same manner that they are attached and provided, as required by this section, at the time of original purchase to prospective purchasers and to the first purchasers other than resale. The hang tags may be removed only by the first purchaser.

Text Explanation of the Test on Reverse

Because the recommended performance criteria, discussed in Tab D, are based on moments, rather than more easily understood forces, staff expects that some consumers may wish to better understand the information provided. Therefore, staff recommends that the reverse side of the hang tag provide additional information about the test used to calculate the stability rating on the front of the hang tag and what the rating means. Specifically, staff recommends that the text below be required to appear on the back of the hang tag, in a font with capital letters at least 0.13 inches tall (10 pt font), for reading ease.

Recommendation

13) **Tip Rating Explanation:** Each hang tag shall contain the following explanatory text for the rating on the reverse of the hang tag:

Test data on this unit indicated it withstood [insert tip rating] threshold tip-over rotational force/moment, per tests required by the Consumer Product Safety Commission (see below).

14) **Explanatory Text:** Each hang tag shall contain the following description of testing and moments on the reverse of the hang tag:

Deaths or serious crushing injuries have occurred from furniture tipping over onto people.

To reduce tip-over incidents, the U.S. Consumer Product Safety Commission (CPSC) requires that clothing storage units, such as dressers, chests, bureaus, and armoires, resist certain tip-over forces. The test CPSC requires to measure the stability of a clothing storage unit is based on a 3-year-old child climbing up, hanging on, or pulling on drawers and/or doors of this unit. These interactions create rotational forces, or moments, that cause the unit to tip forward. The tip rating on this tag is the ratio of this unit's tip-over moment (using CPSC's test) and the minimally acceptable tip-over moment. More information on the test method can be found in 16 CFR XXXX.

IV. CONCLUSION

In the discussion above, staff set forth the basis and support for the recommendations on (1) the use of the hang tag to communicate comparative product information, (2) a linear scale graphical representation of tip-over resistance, (3) titled CSU icon, (4) size and shape of the hang tag, and (5) further explanation of the rating on the reverse side of the hang tag. In summary, staff recommends that the CSU hang tag content and format include the same elements as those in the recommended hang tag (Appendix A).

V. REFERENCES

Consumer Product Safety Commission. (1988). CPSC Approves Consent Decrees for All-Terrain Vehicles. Retrieved from: http://www.cpsc.gov/en/Newsroom/News-Releases/1988/CPSC-Approves-Consent-Decrees-for-All-Terrain-Vehicles/.

Consumer Product Safety Commission. (2011). All-Terrain Vehicles. Retrieved from: http://www.cpsc.gov/Regulations-Laws--Standards/Voluntary-Standards/Topics/All-Terrain-Vehicles/.

EurekaFacts (August 31, 2015), Evaluation of Recreational Off-Highway (ROV) Vehicle Hangtag: Cognitive Interview and Focus Group Testing, Final Report. https://www.cpsc.gov/s3fs-public/pdfs/ROVHangtagEvaluationReport.pdf

Federal Trade Commission. Shopping for Home Appliances? Use the EnergyGuide Label. Retrieved from https://www.consumer.ftc.gov/articles/0072-shopping-home-appliances-use-energyguide-label.

Federal Trade Commission. (2007). Concluding Two-Year Rulemaking, FTC Announces New EnergyGuide Label. Retrieved from http://www.ftc.gov/news-events/press-releases/2007/08/concluding-two-year-rulemaking-ftc-announces-new-energyguide.

Hershman, L. (2001). The U.S. New Car Assessment Program (NCAP): Past, Present and Future. Paper Number 390. Retrieved from http://www-nrd.nhtsa.dot.gov/pdf/nrd-01/esv/esv17/proceed/00245.pdf.

Kahane, C.J. 1994. *Correlation Of NCAP Performance with Fatality Risk in Actual Head-On Collisions.* Report Number DOT HS 808 061. National Highway Traffic Safety Administration.

Markel, M. (2001). *Technical Communication.* Boston, MA: Bedford/St. Martin's.

National Research Council. (1996) *Shopping for Safety: Providing Consumer Automotive Safety Information -- Special Report 248.* Washington, DC: The National Academies Press.

Newsome, Hampton. (2008). FTC's Appliance Labeling Rule. Retrieved from http://www.energystar.gov/ia/business/downloads/FTCs%20Appliance%20Labeling%20Rule.pdf.

Smith, T. P. (2003). *Developing consumer product instructions.* Washington, DC: U.S. Consumer Product Safety Commission.

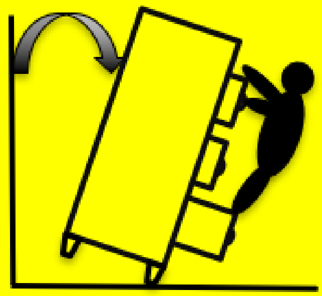
Specialty Vehicle Institute of America (SVIA). *American National Standard for Four Wheel All-Terrain Vehicles*. ANSI/SVIA 1-2017.

Wogalter, M., Dejoy, D., and Laughery, K. (1999). *Warnings and Risk Communication*. Philadelphia, PA: Taylor & Francis, Inc.

APPENDIX A: RECOMMENDED CSU HANG TAG OF AN EXAMPLE CSU WITH A STABILITY RATING OF 2.8

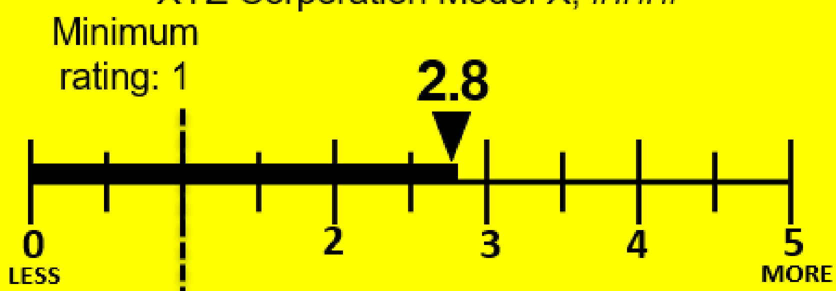
FRONT

TIPOVER GUIDE



Stability Rating

XYZ Corporation Model X, ####



Compare with other units before you buy.

This is a guide to compare the unit's resistance to tipping over.

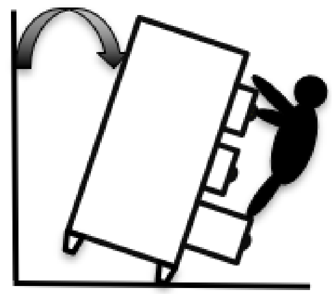
- Higher number represent more stable units.
- No unit is completely safe from tip over.
- Always secure the unit to the wall.
- Tell children not to climb furniture.

See back side of this tag for more information.

THIS TAG NOT TO BE REMOVED EXCEPT BY THE CONSUMER

REVERSE

Stability Rating: 2.8



Stability Rating Explanation

Test data on this unit indicated it withstood **2.8 times** the threshold tip over rotational force/moment, per tests required by the Consumer Product Safety Commission (see below)

Deaths and serious crushing injuries have occurred from furniture tipping over onto people.

To reduce tip-over incidents, the U.S. Consumer Product Safety Commission (CPSC) requires that clothing storage units, such as dressers, chests, bureaus, and armoires, resist certain tip-over forces. The test that CPSC requires measures the stability of a clothing storage unit and its resistance to rotational forces, also known as moments. This test is based on threshold rotational forces of a 3-year-old child climbing up, hanging on, or pulling on drawers and/or doors of this unit. These actions create rotational forces (moments) that can cause the unit to tip forward and fall over. The stability rating on this tag is the ratio of this unit's tip-over moment (using CPSC's test) and the threshold tip-over moment. More information on the test method can be found in 16 CFR XXXX.

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TAB F: Analysis of Voluntary Standards for Clothing Storage Units

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B

F

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

Memorandum

DATE: July 9, 2021

TO: Kristen Talcott, Ph.D., Project Manager,
Division of Human Factors, Directorate for Engineering Sciences

THROUGH: Andrew G. Stadnik, P.E., Associate Executive Director,
Directorate for Laboratory Sciences

Michael Nelson, Director,
Laboratory Sciences Mechanical Engineering Division,
Directorate for Laboratory Sciences

FROM: Maxwell Sanborn, Mechanical Engineer,
Laboratory Sciences Mechanical Engineering Division,
Directorate for Laboratory Sciences

Benjamin Mordecai, Mechanical Engineer,
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Directorate for Laboratory Sciences

Adam Howie, Mechanical Engineer,
Laboratory Sciences Mechanical Engineering Division,
Directorate for Laboratory Sciences

SUBJECT: Analysis of Voluntary Standards for Clothing Storage Units

EXECUTIVE SUMMARY

This memorandum discusses the evolution of ASTM F2057, *Standard Consumer Safety Specification for Clothing Storage Units*, as well as its adequacy to protect consumers against the tip over of clothing storage units (CSUs). This memorandum also analyzes the adequacy of other standards that are relevant to CSU tip overs. As part of the assessment of these standards, this memorandum discusses the hazard patterns identified by incident reports and testing, such as, child interaction, multiple open and filled drawers, and carpeted surfaces. Staff concluded that no current standard adequately addresses the identified hazard patterns.

INTRODUCTION

In November 2017, the U.S. Consumer Product Safety Commission (CPSC or Commission) approved publication of an advance notice of proposed rulemaking (ANPR) to address CSU tip-over hazards. This ANPR was published on November 30, 2017 (82 Fed. Reg. 56752). In the CPSC's 2019 Operating Plan, the Commission directed staff to prepare a notice of proposed rulemaking (NPR) to address furniture tip-over hazards, which includes CSUs. In response to this direction, CPSC's Laboratory Sciences Mechanical Engineering Division (LSM) staff developed this memorandum to provide a summary and evaluation of the voluntary standards.

In the United States, the primary voluntary standard that addresses CSUs is ASTM F2057 – 19, *Standard Consumer Safety Specification for Clothing Storage Units*.[1] LSM staff identified three other international consumer safety specifications related to CSUs and one additional American standard:

- AS/NZS 4935:2009, the Australian/New Zealand Standard for *Domestic furniture – Freestanding chests of drawers, wardrobes and bookshelves/bookcases – determination of stability*;
- ISO 7171 (2019), the International Organization for Standardization *International Standard for Furniture – Storage Units – Determination of stability*;
- EN14749, the European Standard, *European Standard for Domestic and kitchen storage units and worktops – Safety requirements and test methods*; and
- ANSI/SOHO S6.5-2008 (R2013), *Small Office/Home Office Furniture – Tests American National Standard for Office Furnishings*.[2]

HISTORY OF ASTM F2057 – 19, STANDARD CONSUMER SAFETY SPECIFICATION FOR CLOTHING STORAGE UNITS

ASTM first approved and published F2057 in 2000, as ASTM F2057 – 00, *Standard Consumer Safety Specification for Chests, Door Chests and Dressers*. Since then, ASTM International has revised the voluntary standard seven times. The current version, ASTM F2057 – 19, *Standard Consumer Safety Specification for Clothing Storage Units*, was approved on August 1, 2019, and

[1] ASTM F3096 – 14, *Standard Performance Specification for Tipover Restraint(s) Used with Clothing Storage Unit(s)*, also addresses CSUs, but it is largely an extension of ASTM F2057, because it provides test methods for assessing tip-over restraints in accordance with ASTM F2057 requirements.
[2] Although ANSI/SOHO S6.5 does not address CSUs, staff considered it for this memorandum because it addresses interlock systems, which some CSUs include, and which staff has addressed in the draft proposed rule.

published in August 2019. The ASTM F2057 voluntary standard development is the responsibility of ASTM Subcommittee F15.42, Furniture Safety.

Since the first publication of ASTM F2057, CPSC staff has participated in the F15.42 subcommittee and task group meetings. CPSC staff worked with ASTM to improve the standards; however, ASTM has not reached consensus on a majority of issues identified by CPSC staff in the ANPR, published in 2017. These issues include, but are not limited to:

- Dynamic and other forces generated by child interactions;
- Multiple open and filled drawers during testing;
- Tests that account for the effect of carpet on stability; and
- Test weight.

Since ASTM published the first version of the standard in 2000, several changes have occurred through its evolution. These changes are summarized below:

ASTM F2057 – 00 established requirements to address the following issues:

- Stability of an unloaded unit; and
- Stability of a loaded unit (i.e., loaded with a weight on the front of an opened drawer).

ASTM F2057 – 04 (approved on September 1, 2004):

- Added language regarding the construction of the test weight (Section 4.2.3).

ASTM F2057 – 09 (approved on March 1, 2009):

- Changed the definition of "operational slide length" for drawers with no stops in Section 2.1.4;
- Added the requirement to include tip restraints and their performance requirements (Sections 3.4 – 3.6);
- Added the requirement for instructional literature (Section 3.7);
- Added the requirements for warning labels (Section 3.8);
- Changed Figure 1 to show how to measure the operational slide length;
- Changed Figure 2 to show acceptable labels;
- Changed Figure 3 to show an example of a unit with doors (this was previously Figure 1); and
- Added an appendix with figures of varying drawer shapes and test weight placement.

ASTM F2057 – 09a (approved on September 1, 2009):

- Added the word "permanent" to the label requirements (Section 3.8).

ASTM F2057 – 09b (approved on October 15, 2009):

- Changed Figure 2 to include more descriptive language regarding placing heavy objects on top of furniture.

ASTM F2057 – 14 (approved on October 1, 2014):

- Changed the name of standard to "Standard Safety Specification for Clothing Storage Units";
- Consolidated information about the scope of the standard from several sections into one section, and added "free-standing" to the description of covered products (Section 1.1);
- Replaced Section 1.3 with a new Section 1.3, and refined the scope;
- Changed Section 2 to the "Referenced Documents" section, and included a reference to ASTM F3096, Standard Performance Specification for Tipover Restraint(s) Used with Clothing Storage Unit(s);
- Renumbered the terminology section to Section 3;
- Added the term "clothing storage unit" and its definition;
- Deleted terms "chest," "door chest," and "dresser" from the definitions;
- Changed definition of "operational sliding length." The – 09b version defined the "operational sliding length," in part, as follows: "In the absence of stops, the operational length is length measured from the inside back of the drawer to the inside face of the drawer front in its fully closed position with measurements taken at the shortest drawer depth dimension minus 3.5 in." The –14 definition is "length measured from the inside face of the drawer back to the inside face of the drawer front with measurements taken at the shortest drawer depth dimension";
- Added the terms "outstop" and "tipover restraint" and their definitions;
- Revised Section 4.1 to specify that performance testing is to be done "without the tipover restraint";
- Revised the criteria for passing performance testing to change the language that the unit must not be supported "only by an opened drawer, opened door, or opened or unopened flap" to say that the unit must not be supported "by any component unless that component was specifically designed for that purpose" (Section 4.1);
- Added Section 4.3, to include a requirement that failed components shall be repaired or replaced to the original specification;
- Added Section 4.4, to require that tip-over restraints must be included with CSUs;

- Replaced Sections 3.5 – 3.7 of -09b, which included provisions on tip restraints, with Section 4.5, which requires the tip-over restraint provided with a CSU to meet the requirements of ASTM F3096;
- Replaced the requirement that the warning label be attached to the "case good" with the requirements that the warning label be attached to the "clothing storage unit" (Section 4.6);
- Added a new Section 5 with a test method scope provision, stating: "This test method is designed to test free-standing clothing storage unit tipover";
- Added a new Section 6, titled, "Significance and Use," which states that the test methods were developed to show how far the drawers of the unit being tested should be pulled out, regardless of whether there are outstops;
- Added a new Section 7.1.1 that changed the test surface specifications from "a level flat surface composed of either concrete, wood flooring, or 1/8 in. vinyl over concrete" to "a hard, level, flat surface";
- Added a new Section 7.1.2 that changed the language regarding the positioning of drawers and sliding shelves and the operational sliding length during testing. The test procedure in -09b stated: "extend all drawers and pullout shelves to two thirds of their operational sliding length or to the stop, whichever is shorter"; while the test procedure in -14 stated: "extend all drawers or pullout shelves, or both, to the outstop or, in the absence of such feature, to ⅔ (66 percent) of their operational sliding length." Eliminating the term "whichever is shorter" made the -14 version more onerous;
- Added a new Section 7.2.2, which clarified the drawer testing technique;
- Added a new Section 7.2.3, which clarified the door testing technique;
- Added a new Section 7.2.4, which reflected new test weight and application requirements;
- Added a new Section 8 addressed, "Precision and Bias"; and
- Added a new Section 9 to the Keywords section with additional terms.

ASTM F2057 – 17 (approved on October 1, 2017):

- Revised introduction, clarifying the intention of the standard and hazards that the standard does not address, such as "blatant misuse";
- Added the words "and environmental practices" to the last sentence of the safety hazard caveat statement (Section 1.6);
- Added Section 1.7, stating that the standard was developed in accordance with internationally recognized principles on standardization;
- Added a reference to ASTM D3359, Tape Methods for Rating Adhesion by Tape Test (Section 2.1);
- Added Section 2.2, referencing ANSI Z535.4, Product Safety Signs and Labels;
- Added Section 4.6.1, referencing ANSI Z535.4 for alternate label formatting;

- Added Section 4.6.2, stating that the warning shall be permanent when tested in accordance with Section 7.3;
- Added Section 7.3, "Permanency of Labels and Warnings Testing," which has three subsections and describes how to test label permanency; and
- Changed the warning label infographic to include a pictogram of a child climbing a CSU with a prohibition symbol over it.

ASTM F2057 – 19 (approved on August 1, 2019):

- Changed introduction back to the – 14 version;
- Revised the scope to include the text, "including but not limited to," before examples of CSUs, and the minimum height of covered products changed from 30 inches to 27 inches;
- Added, "occasional/accent furniture not intended for bedroom use, laundry storage/sorting units, nightstands," and "nor does it cover 'Clothing Storage Chests' as defined in Consumer Safety Specification F2598" to the list of types of furniture not covered by the standard (Section 1.2);
- Added the term "nightstand" and its definition as "a small furniture item for use beside a bed, intended to hold or store items, including but not limited to, a lamp, alarm clock, a book, magazines, or reading glasses";
- Relocated the warning label requirements that were previously addressed in Section 4.6 to a new Section 8; and
- Added a new Section 10 additional terms to the Keywords section.

SUMMARY AND ANALYSIS OF ASTM F2057 – 19

Scope

The ASTM F2057 – 19 standard is intended to reduce injuries and deaths of children from hazards associated with CSUs tipping over. It "is intended to cover children up to and including age five" years old. The standard defines "CSUs" as: "furniture item[s] with drawers and/or hinged doors intended for the storage of clothing typical with bedroom furniture." Examples of CSUs stated in the standard include: chests, chests of drawers, drawer chests, armoires, chifforobes, bureaus, door chests, and dressers. The standard covers CSUs that are 27 inches or more in height and that are freestanding.[3] The standard further specifies that it does not cover "shelving units, such as bookcases or entertainment furniture, office furniture, dining room

[3] ASTM F2057 – 19 does not define "freestanding."

furniture, underbed drawer storage units, occasional/accent furniture not intended for bedroom use, laundry storage/sorting units, nightstands, or built-in units intended to be permanently attached to the building, nor does it cover "Clothing Storage Chests" as defined in Consumer Safety Specification F2598."

Staff's assessment of the appropriate scope to address CSU tip over is provided in Tab C.

Stability

ASTM F2057 – 19 sets forth two stability requirements:

1. Stability of Unloaded Unit (Section 7.1): An unloaded test in which the empty unit shall not tip over when all doors are opened 90° and all drawers are pulled to the outstop[4] or in the absence of an outstop, 2/3 of its operational sliding length.[5]
2. Stability with Load (Section 7.2): A loaded test in which the empty unit shall not tip over when a 50±2 pound test weight is applied over the front of each drawer pulled to the outstop or, in the absence of an outstop, 2/3 of its operational sliding length, with only one drawer open at a time. For units with doors, the same test applies, but the test weight is applied to "each door so that the outer edge of the test weight is flush with the outermost upper corner of the door," when the door is opened to 90° (this results in the load being centered approximately 3 inches from the door edge).

Staff discusses its assessment of the adequacy of these stability requirements below.

Tip Restraints

ASTM F2057 – 19 defines "tipover restraint" as a "supplemental device that aids in the prevention of tip over." In 2009, ASTM F2057 included new requirements to address a need for tip restraints. The tip-restraint provisions were intended to be separate from the freestanding stability requirements. The provisions did not specify the style or design of the tip restraints. The only performance requirement for tip restraints was that they should "withstand a pull force of 50 pounds." However, no test protocols accompanied this metric.

In 2014, the tip-restraint requirements were moved into a separate standard, ASTM F3096 – 14, *Standard Performance Specification for Tipover Restraint(s) Used with Clothing Storage Unit(s)*. This standard contains a testing protocol for tip restraints, which includes a 50-pound

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[4] ASTM F2057 – 19 defines "outstop" as "any feature that limits outward motion of drawers or pullout shelves, or both."
[5] ASTM F2057 – 19 defines "operational sliding length" as "length measured from the inside face of the drawer back to the inside face of the drawer front with measurements taken at the shortest drawer depth dimension."

pull force. The standard does not specify a test for the connection to either the CSU or the wall. Beginning with the 2014 version, ASTM F2057 requires CSUs to include a tip restraint that complies with ASTM F3096 – 14.

Staff did not evaluate tip restraints in detail in this briefing package; instead, staff recommends requirements for inherent CSU stability. Accordingly, this memorandum does not assess the adequacy of the tip-restraint requirements in ASTM F2057 or F3096. However, the Directorate for Engineering Sciences, Division of Human Factors (ESHF) staff memorandum (Tab C) provides additional detail on staff concerns regarding tip restraints, including the low rate of use, and discusses its concerns about the requirements in F3096.

Warning Labels

ASTM F2057 – 19 requires CSUs to be permanently marked in a conspicuous location with warnings that meet specified content and formatting. In this memorandum, LSM staff focuses on the requirements related to label permanence. In 2017, ASTM F2057 – 17 added a new performance requirement and test method for label permanence. It specified that paper labels and non-paper labels are permanent, if, when trying to remove them without tools or solvents, they cannot be removed, tear, or damage the surface they are attached to. It also specified that warning statements are permanent (if warnings are applied directly to the product surface) if they remain legible and attached after the tape test provided in ASTM D3359 *Test Methods for Rating Adhesion by Tape Test*. The 2019 version of the standard includes these same requirements. See the ESHF staff memorandum for the analysis of conspicuity, content, and formatting (Tab C).

The addition of these requirements harmonized label permanence with other juvenile furniture products, such as ASTM F1427, *Standard Consumer Safety Specification for Bunk Beds;* ASTM F1169, *Standard Consumer Safety Specification for Full-Size Baby Cribs;* and ASTM F2388, *Standard Consumer Safety Specification for Baby Changing Products for Domestic Use*. LSM staff assesses that these label permanence requirements are adequate, based on their inclusion in several rules promulgated under section 104 of the CPSIA.

ADEQUACY OF ASTM F2057 REQUIREMENTS TO ADDRESS IDENTIFIED HAZARDS

Incident Data

In the CPSC's Directorate for Epidemiology, Division of Hazard Analysis (EPHA) staff memorandum, Tab A, staff identified 89 fatal tip-over incidents from January 1, 2000 to December 31, 2020, involving children and CSUs without televisions. Staff also identified 639 nonfatal CPSRMS reports to CPSC between January 1, 2005 and December 31, 2020, involving the tip over of CSUs without televisions for individuals of all ages. Based on NEISS incidents, staff estimates that there were 40,700 injuries to children (under 18 years old) from January 1, 2006 to December 31, 2019, that were treated in hospital emergency departments and that involved the tip over of CSUs without televisions.

Incident Unit Compliance with F2057

Staff looked at whether CSUs involved in tip-over incidents complied with ASTM F2057 – 19 because it would give an indication of whether F2057 is effective at preventing tip overs and, by extension, whether it is adequate. Staff assessed compliance with F2057 – 19 because, although incident units may have predated that edition of the standard, the purpose of this assessment was to determine whether a unit that complies with F2057 – 19 could still be involved in a tip-over incident. If so, it suggests that F2057 – 19 does not adequately address the hazard.

Of the 89 fatal CPSRMS tip-over incidents involving children and CSUs without televisions, CPSC staff determined that one CSU clearly met the ASTM F2057 – 19 stability requirements,[6] one CSU met the ASTM F2057 – 19 stability requirements in some conditions, and 11 units did not meet the ASTM F2057 – 19 stability requirements. For the remaining 76 units, staff was unable to determine whether they meet the ASTM F2057 – 19 stability requirements.

The CSU that clearly met the stability requirements is the 8-drawer Model E CSU that is analyzed in detail in Tab M. Staff verified that the CSU met the stability requirements by testing two incident samples: one from a nonfatal incident and one from the fatal incident; and one exemplar sample.[7] The CSU that met the stability requirements in some conditions is the five-drawer Model F CSU, analyzed by the Directorate for Engineering Sciences, Division of Mechanical and Combustion Engineering (ESMC) staff in Tab M. Staff also tested the incident sample in 2017, and determined that it did not meet the stability requirements in ASTM F2057 – 14 when tested with a 49.66-pound test fixture; but, it did meet the stability requirements when tested with a 48.54-pound test fixture.[8]

For the 11 fatal incidents involving CSUs that do not meet the F2057 – 19 stability requirements:

- One incident involved the 3-drawer Model B CSU analyzed by ESMC staff in Tab M.
- Three involved a 3-drawer CSU that was recalled in 2017. Staff tested exemplar samples in 2014, and found that they did not meet the stability requirements of ASTM F2057 – 09, which has less stringent stability requirements than ASTM F2057 – 19.

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[6] CPSC staff tested the incident sample and multiple exemplar samples to the stability requirements in F2057 – 19. The stability of this unit is discussed further in the ESMC staff memorandum (Tab D).
[7] Staff also tested an additional three exemplar samples outside of the testing for this briefing package; those samples also met the ASTM F2057 – 19 stability requirements.
[8] The stability requirements in ASTM F2057 – 14 are the same as those in ASTM F2057 – 19.

- Two incidents involved a 6-drawer CSU that was recalled in 2017. Staff tested exemplars samples in 2014, and found that they did not meet the stability requirements of ASTM F2057 – 09.
- Two involved a 4-drawer CSU that was recalled in 2013. Staff tested both incident samples, and two exemplar samples and determined that they tipped when 50 pounds was placed on a single extended drawer of an empty unit. Staff tested two exemplar samples in 2012, and determined that they met the requirements of F2057 – 09[9].
- One involved a 5-drawer CSU that was recalled in 2017.
- One involved a 3-drawer CSU that was recalled in 2017.
- One involved a 3-drawer CSU that was recalled in 2013. Staff tested an exemplar sample in 2011, and determined that it tipped when a 50-pound test weight was placed on a single fully extended drawer (empty unit). The exemplar sample met the stability requirements of F2057 – 09b.

For the remaining 76 incidents involving CSUs for which staff was unable to determine if the CSU meets the ASTM F2057 – 19 stability requirements:

- One involved a 5-drawer CSU. Staff tested an exemplar sample of the same model and determined that it met the stability requirements of ASTM F2057 – 19. However, due to design changes by the manufacturer of the incident unit and the exemplar, staff could not determine if the exemplar sample was representative of the incident unit.
- One involved a 10-drawer CSU that was marketed: “meets or exceeds current mandatory and voluntary government and industry safety standards.” However, the incident unit was purchased in 2005, so it would have been subject to a version of ASTM F2057 with less onerous stability requirements (pre-ASTM F2057 – 14). Staff did not have test reports or a sample.
- One was described as handmade, and staff did not have the incident sample;
- Sixty-four lacked information on manufacturer/retailer or model, and staff did not have the incident sample.
- Two had information on manufacturer/retailer, but not model; and staff did not have the incident sample.
- Seven had information on manufacturer/retailer and model, but staff did not have test reports or a sample.

[9] Staff also tested one incident sample to the stability requirements in ASTM F2057 – 09b and found that the CSU tipped when the 50-pound weight was placed on the top drawer extended to two-thirds of its operational sliding length, but did not tip when the weight was placed on the lower two drawers.

Of the 263 nonfatal CPSRMS incidents involving children and CSUs without televisions,[10] CPSC staff determined that 20 CSUs involved in these incidents meet the ASTM F2057 – 19 stability requirements, and 95 do not meet the ASTM F2057 – 19 stability requirements. For the remaining 148 units, staff was unable to determine whether the units meet the ASTM F2057 – 19 stability requirements.

For the 20 nonfatal incidents involving a CSUs that meet the F2057 – 19 stability requirements:

- Thirteen involved the 8-drawer Model E CSU analyzed by ESMC staff in Tab M and described above. Staff verified that the unit met the stability requirements by testing incident samples and exemplars.
- One involved the 7-drawer Model G CSU analyzed by ESMC staff in Tab M. Staff verified that the unit met the stability requirements by testing the incident sample and an exemplar.
- One involved a 9-drawer CSU that the manufacturer claimed met the requirements of ASTM F2057 – 14, which has the same stability requirements of ASTM F2057 – 19. Staff did not have a sample of this product.
- One involved a 5-drawer CSU that the manufacturer claimed met the requirements of ASTM F2057 – 14, which has the same stability requirements of ASTM F2057 – 19. Staff did not have a sample of this product.
- Two involved a post-recall model of a 6-drawer CSU.[11]
- One involved a post-recall model of a 5-drawer CSU.
- One involved a post-recall model of a 3-drawer CSU.

For the 95 nonfatal incidents involving CSUs that do not meet the F2057 – 19 stability requirements:

- One involved the 7-drawer Model A CSU analyzed by ESMC staff in Tab M.
- Four involved the 3-drawer Model B CSU, analyzed by ESMC staff in Tab M.
- One involved the 3-drawer Model C CSU, analyzed by ESMC staff in Tab M.
- One involved a the 4-drawer Model D CSU, analyzed by ESMC staff in Tab M.
- One involved a 6-drawer CSU that was recalled in 2015.
- One involved a 4-drawer CSU that was recalled in 2016.
- One involved a 2-drawer CSU that was recalled in 2017.
- Four involved a 3-drawer CSU that was recalled in 2017.

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[10] The 263 nonfatal incidents are a subset of the 639 CSU-only (no television) nonfatal incidents referenced in Tab A that ESHF staff analyzed in Tab C. The 263 incidents resulted in a tip over when a child started the interaction with the CSU. They do not include incidents that reported concerns about instability without a tip over or incidents in which a child did not initiate the interaction.
[11] Products manufactured after the recall must meet the stability requirements of the voluntary standard.

- Two involved a 3-drawer CSU that was recalled in 2017.
- Two involved a 3-drawer CSU that was recalled in 2017.
- Thirteen involved a 4-drawer CSU that was recalled in 2017.
- Six involved a 4-drawer CSU that was recalled in 2017.
- Two involved a 4-drawer CSU that was recalled in 2017.
- One involved a 4-drawer CSU that was recalled in 2017.
- One involved a 4-drawer CSU that was recalled in 2017.
- Four involved a 5-drawer CSU that was recalled in 2017.
- One involved a 5-drawer CSU that was recalled in 2017.
- One involved a 5-drawer CSU that was recalled in 2017.
- One involved a 5-drawer CSU that was recalled in 2017.
- Twenty-two involved a 6-drawer CSU that was recalled in 2017.
- Six involved a 6-drawer CSU that was recalled in 2017.
- Six involved one of two models of a 6-drawer CSU that was recalled in 2017, but staff could not determine the exact model.
- Three involved a 6-drawer CSU that was recalled in 2017.
- One involved a 6-drawer CSU that was recalled in 2017.
- Two involved a modular CSU that was recalled in 2017.
- One involved an unknown CSU that was recalled in 2017.
- One involved a 3-drawer CSU that was recalled in 2019.
- Two involved a 4-drawer CSU that was recalled in 2019.
- One involved a 3-drawer, 1 door CSU that was recalled in 2020.
- One involved a 5-drawer CSU. Staff tested an exemplar sample and determined that it met the stability requirements in ASTM F2057 – 14.
- One involved a 5-drawer CSU. Staff tested the incident sample and determined that it did not meeting the stability requirements in ASTM F2057-19.

For the remaining 148 incidents involving CSUs for which staff was unable to determine if the CSU meets the ASTM F2057 – 19 stability requirements:

- Three involved CSUs that the manufacturer claimed met the requirements of older versions of ASTM F2057 (pre-ASTM F2057 – 14); but staff did not have information on whether the unit met ASTM F2057 – 14, F2057 – 17, or F2057 – 19, or a sample.
- Twenty lacked information on manufacturer/retailer or model.
- Thirteen had information on manufacturer/retailer, but not model.
- Eighty-four had information on manufacturer/retailer and model, but staff did not have test reports or a sample.
- Five were a recalled model, but staff could not determine if the incident unit was within the recall's scope.

- Twenty-three were a recalled model, but staff could not determine if the incident unit was pre-recall or post-recall.

CPSC staff does not have any data on whether the NEISS incidents involved ASTM-compliant or noncompliant CSUs, because the reports did not contain specific information about the products.

Description of Incidents

Staff also looked at the circumstances and factors involved in incidents in detail to understand what factors exist during actual incidents to help assess whether F2057 accounts for those factors, which influences whether it is adequate.

The ESMC staff memorandum (Tab D, Tab M) provides analysis of two fatal incidents and six non-fatal incidents involving CSUs that meet the ASTM F2057 – 19 stability requirements. Staff concluded that ASTM F2057 – 19 did not adequately account for factors that contribute to instability or are present in real-world incidents, such as:

- Multiple open drawers,
- Filled and unfilled drawers,
- Carpeted surfaces,
- Dynamic forces from a 51.2-pound (*i.e.*, 95^{th} percentile 3-year-old) or lighter-weight child, climbing (ascending) and other interactions, and
- A child pulling on the top drawer.

Hazard Patterns

In the ESHF staff memorandum (Tab C), staff identified the following hazard patterns for CSU tip overs: children interacting with (ascending/climbing) CSUs, multiple open drawers, filled drawers, and carpet.

Table 1 summarizes how ASTM F2057 – 19 addresses these hazard patterns and staff's assessment of the adequacy of those requirements. A detailed discussion of each of these hazard patterns and relevant ASTM F2057 requirements is below.

Table 1. Hazard Pattern Adequacy Associated with CSUs within the Scope of ASTM F2057 – 19

Hazard Pattern	Addressed in ASTM F2057	Staff Assessment of Adequacy	Staff Comments
Child Interaction (Ascent/climb)	50 lb applied to the top face of one open drawer (to outstop or in absence of outstop, 2/3 the OSL) or door (90°) (Section 7.2)	Inadequate	The 50-pound test weight does not include the additional moment due to the center of gravity of a child climbing, dynamic forces, and horizontal forces when a child climbs and does not exert the moment necessary to protect children 3 and under from tipover as discussed in Tab D.
Multiple Open Drawers	All drawers (to outstop, or in absence of outstop, 2/3 OSL) and doors (90°) opened simultaneously, and no additional weight or force applied (Section 7.1)	Inadequate	Incident data indicates that children open multiple drawers of a CSU. Opening multiple drawers significantly impacts the CSU stability by moving the center of gravity towards or in front of the fulcrum (Tab D).
Filled Drawers	Not addressed	Inadequate	Consumers are likely to fill drawers with clothing as that is the purpose of these consumer products. A CSU with filled drawers is likely to be less stable than an empty unit when more than half the drawers are open as discussed in Tab D.
Carpet	Not addressed	Inadequate	Incident data (Tab C) suggest that many reported tip-over incidents, where flooring type is known, occur on carpeting, and it is reasonable to assume that some consumers place CSUs on carpeting, which is a common flooring in homes, particularly in bedrooms (Tab C). Staff testing showed (Tab P) that, in almost all cases, carpet decreases CSU stability (Tab P).

Child Interaction

The stability requirement in ASTM F2057 – 19 is based on a 5-year-old child applying their full body weight (50 pounds, according to the standard) directly on the front face of a single, fully opened, drawer. As the ESHF staff memorandum (Tab C) explains, child climbing is commonly involved in CSU tip overs. In the ESMC memorandum (Tab D), staff describes the force a child can exert while ascending/climbing a CSU, based on testing conducted by UMTRI (Tab R), which exceeds their static weight. Staff is proposing a minimum moment requirement that simulates a 95th percentile 3-year-old weighing 51.2 pounds climbing a CSU. This proposed requirement is explained in Tab D.

Multiple Open Drawers, Filled Drawers, and Carpet

In the ANPR, staff identified multiple open drawers, filled drawers, and flooring surface as factors that were not addressed in the then-current ASTM F2057 – 17. Since publication of the ANPR, ASTM has discussed adding requirements related to these items, but has not added any requirements in the current version, ASTM F2057 – 19.

CPSC staff conducted two studies: a multiple open and filled drawer study on a hard-flat, level surface (Tab O), and another multiple open and filled drawer study on carpet (Tab P). The results of these studies suggest:

- Multiple open and filled drawers have a variable effect on stability, depending on whether the filled drawers are open or closed. Tab O describes CPSC staff testing on the effect of multiple open and filled drawers on CSU stability. For example, Unit 25 had a tip weight of roughly 123 pounds when only 28.5 percent of the drawers were filled and open; and it had a tip weight of only 45 pounds when 100 percent of the drawers were filled and open.
- Carpet decreases stability. Tab P describes CPSC staff's testing on the effect of carpet on CSU stability. All tested units, with various configurations of drawers open/closed and filled/unfilled, tended to tip over at a lower weight on the carpet than on the hard, flat surface. Staff determined that carpet reduced tip-over weight of the tested units by an average of 7.6 pounds over all the permutations tested for the 13 CSUs that were tested on carpet. For example, Unit 11 had a tip weight of 54 pounds when placed on a hard, flat, level surface. However, the tip weight for all permutations tested (open/closed and filled/unfilled) was reduced by a median value of 16 pounds when tested on carpet.
- Tip weight with varying combinations of multiple open, filled drawers, and carpet is different from a single open drawer, unfilled CSU, on a flat, level surface (ASTM F2057 – 19 configuration). Staff tested two units using the test method in ASTM F2057 – 19, Section 7.2, but on a carpeted surface with both filled and unfilled drawers. Unit 1 (3 rows of 1 drawer each) had a tip weight of 67 pounds when tested on a hard, flat, level surface, unfilled, and with only one drawer open. However, when tested on carpet, unfilled, and only the top drawer open, the unit tipped at 56 pounds, an 11-pound decrease. When staff applied weight with one drawer open (all unfilled), the tip weight increased to 82 pounds when tested in the same drawer configuration, an increase of 15 pounds. In another test of the same unit, where all drawers were open and filled, the tip weight decreased to 17 pounds. Similarly, when tested on a hard, flat, level surface, unfilled, with only one open drawer, Unit 8 (6 rows of 1 drawer) had a tip weight of 84 pounds. When tested on carpet, unfilled, with one drawer open, the unit tipped at 76 pounds, an 8-pound decrease. However, when loaded, the tip weight increased to 123 pounds when tested in the same drawer configuration (i.e., one drawer open, or 83 percent of the drawers were closed). When all drawers were open and filled, the tip

> weight decreased significantly, to 17 pounds. Based on these findings, CPSC staff concludes that the test in ASTM F2057 – 19 Section 7.2 overestimates the real-world stability of CSUs by not accounting for the effect of open and filled drawers or stability on carpeting.

Other Concerns

In addition to the stability testing requirements discussed above, LSM staff has concerns with specific test methods and the specificity and clarity of the test methods in ASTM F2057 – 19. The following sections address the concerns as they relate to the draft proposed requirements.

Outstops

As explained above, ASTM F2057 – 19 specifies that, during stability testing, drawers are opened to the outstop, which is defined as "any feature that limits outward motion of drawers or pullout shelves, or both," or, if no outstop exists, to 2/3 (66 percent) of the operational sliding length (OSL). During testing following the publication of the November 2017 ANPR, staff encountered CSU designs with multiple drawer outstops (multiple recommended use positions), including one with an outstop less than 20 percent of the OSL that did not allow the drawer to extend far enough to access the contents of the drawer. As such, staff assesses that if a tester interprets the language in ASTM F2057 – 19 to mean that the drawer is opened to the first of multiple outstops during testing, the stability test in ASTM F2057 – 19 will not accurately assess the tip-over hazard. In 2017, staff wrote a letter to ASTM on this issue, which stated:

> CPSC staff believes that testing should reflect the likely use of products. CPSC staff recommends that Section 7 be clarified to reflect that the addition of multiple outstops to a drawer guide mechanism shall not be considered in the test methods of Sections 7.1 and 7.2 and other related sections using drawer openings. Rather, staff believes that the standard should state that testing conditions shall specify a fully extended drawer. (Taylor 2017)

Staff concludes that clarifying the definition of the term "outstop" is necessary and recommends that, in the case of multiple outstops, the furthest recommended use position of a drawer be used.

Test Weight Timing

ASTM F2057 – 19 does not specify a time requirement to apply the test weight. CPSC staff notes language in other ASTM standards (*Standard Consumer Safety Specification for Toy Safety* [*F963*], *Standard Consumer Safety Specification for Soft Infant and Toddler Carriers* [*F2236*], *and Standard Consumer Safety Specification for Bassinets and Cradles* [*F2194*]) that refers to application of weight or force over a specific period to avoid imparting an impulse force on the product. Accordingly, LSM staff recommends that the draft proposed requirements specify the time of force application.

ADDITIONAL RELEVANT STANDARDS

In addition to the ASTM standard, staff identified four other consumer safety specifications relevant to CSUs, which are discussed below:

- AS/NZS 4935:2009, *the Australian/New Zealand Standard for Domestic furniture – Freestanding chests of drawers, wardrobes and bookshelves/bookcases – determination of stability*;
- ISO 7171 (2019), *International Standard for Furniture – Storage Units – Determination of Stability*;
- EN14749:2016, European Standard for Domestic and kitchen storage units and worktops – Safety requirements and test methods; and
- ANSI/SOHO S6.5-2008 (R2013), Small Office/Home Office Furniture – Tests American National Standard for Office Furnishings.

In this memorandum, LSM staff focuses on requirements related to testing the inherent stability of CSUs. The ESHF staff memorandum (Tab C) examines the Scope, Tip Restraints, and Warning Labels.

AS/NZA 4935

AS/NZA 4935 is a voluntary standard prepared by Standards Australia's and Standards New Zealand's Joint Technical Committee CS-088/CS-091, Commercial/Domestic Furniture. There is only one version of the standard, the current version AS/NZA 4935:2009, which was approved on behalf of the Council of Standards Australia on August 28, 2009, and on behalf of the Council of Standards New Zealand on October 23, 2009. It was published on November 17, 2009. The AS/NZA 4935 standard is voluntary in both Australia and New Zealand. However, Standards Australia and Standards New Zealand are responsible for ensuring that their viewpoints are considered at an international level.

AS/NZA 4935:2009 describes test methods for determining the stability of domestic freestanding chests of drawers 500 millimeters (19.7 inches) high, freestanding wardrobes over 500 millimeters high, and freestanding bookshelves/bookcases over 600 millimeters (23.6 inches) high. It defines "chest of drawers" as a "freestanding furniture item over 500 mm tall that contains one or more drawers or other extendible elements and intended for the storage of clothing. It may also contain one or more doors or one or more shelves, or both, in various configurations." It defines "wardrobe" as a "freestanding furniture item over 500 mm tall, primarily intended for the storage of hanging clothing. It may also contain one or more drawers, doors or other extendible elements, fixed shelves or a combination of the above." AS/NZA 4935:2009 differs from ASTM F2057 – 19, in that it also includes bookshelves and bookcases, defined as: "[a] freestanding set of shelves over 600 mm tall, primarily intended for the storage of books. It may also contain doors, drawers or other extendible elements."

Stability Requirements. AS/NZA 4935:2009 specifically addresses stability performance in relation to the hazard of children climbing on the front face of the unit, "which may feature common foot or handholds, *e.g.*, doors and extendible elements (drawers and similar), including their associated handles." "The objective of this specification is to assist in reducing the probability of [units] tipping and causing injury to, or the death of, users and in particular, children."

The standard is designed to address the interactions of children "up to and including 5 years and 11 months of age and in the 95th percentile stature and body mass." The referenced studies in this standard indicate that 27 kilograms (59.5 pounds) was the 95th percentile body mass for children at the time of their writing. However, due to trends of increasing body mass for children of this age, the standards committee chose a heavier 29-kilogram (64-pound) test weight for the standard.

AS/NZA 4935:2009 uses the same basic approach as ASTM F2057 – 19, with two stability requirements: (1) the unit does not tip when the 29-kilogram test weight is applied to a single open drawer; and (2) the unit does not tip when all of the extension elements are opened. The unit is not filled during these tests.

For the first test (weighted), the test weight is applied to the top face of a drawer, with the drawer opened to two-thirds of its full extension length, where "extension length" is defined as the "fully closed to the fully open position"; and the "fully open position" is defined as "where the drawer stops or extendible element stops prevent further extension or, where no stops are fitted, the drawer or extendible element is no longer supported by the cabinet." This is similar to ASTM F2057 – 19, except the drawers are open to their full extension length in ASTM F2057 – 19.

The second test (all drawers open) is conducted by opening and leaving open each drawer or extendible element to two-thirds of its extension length, with any doors open perpendicular to the furniture. This is similar to ASTM F2057 – 19, except the drawers are open to their full extension length in ASTM F2057 – 19.

Units are tested "freestanding and not supported by any other item or structure." Units do not pass the stability requirements if they cannot support the test weight or if they tip over, or are only prevented from tipping by an extendible element.

Staff sees several issues with the requirements in this standard, similar to those for ASTM F2057 – 19. Although AS/NZA 4935:2009 uses a heavier test weight than ASTM F2057 – 19, it is inadequate because neither stability test accounts for the moments children can exert on CSUs during interactions, such as climbing. Considering additional moments, the 64 pounds of weight on the drawer face used in the weighted test in the standard is equivalent to only a 40-pound child climbing a drawer extended to the same length. The 40-pound weight corresponds to 75th percentile 3-year-old children, 50th percentile 4-year-old children, and only 25th percentile 5-year-old children.[12]

Also, AS/NZA 4935:2009 uses drawer extension to only two-thirds of extension length for both the weighted and all drawers open tests. This extension length is similar to what was used in pre-2014 versions of ASTM F2057. The partial extension is not representative of real-world use because children are able to open drawers all the way; incidents and real-world use involve fully open drawers; and opening a drawer further decreases the stability of a CSU.

In addition, AS/NZA 4935:2009 does not account for filled drawers or carpeted floors, which are present in incidents, and also contribute to instability.

For these reasons, LSM staff concludes that AS/NZA 4935:2009 is inadequate to address the hazard patterns identified by CPSC staff. Table 2 shows the hazard patterns, how the standard addresses them, and CPSC staff's comments.

[12] Fryar CD, Carroll MD, Gu Q, Afful J, Ogden CL. (2021). Anthropometric reference data for children and adults: United States, 2015–2018. National Center for Health Statistics. Vital Health Stat 3(46).

Table 2. Hazard Pattern Adequacy Associated with CSUs within the Scope of AS/NZA 4935:2009

Hazard Pattern	Addressed in AS/NZA 4935	Staff Assessment of Adequacy	Staff Comments
Child Interaction	Drawers and other extendable elements: 29 kg (64 lb) applied to the top face of one drawer opened to two-thirds of its full extension length (Section 5.1(h)) Doors: 29 kg (64 lb) applied 50 mm (2.0 in) back from the outer edge of the door opened perpendicular to the front of the unit	Inadequate	The 64 pound test weight does not include the additional moments from horizontal forces and dynamic forces when a child climbs. In addition, the drawers are not extended to their full extension. Both of these factors reduce the moment applied to the CSU.
Multiple Open Drawers	All drawers opened, empty, and no additional weight or force applied (Section 5.1(d))	Inadequate	Children can open multiple extension elements, but this test does not account for a child's interaction. In addition, filled drawers, when open, decrease stability (see earlier discussion) but the test does not include filled drawers.
Filled Drawers	Not addressed	Inadequate	The standard does not include weight placed in drawers which, when opened, create a less stable unit.
Carpet	Not addressed	Inadequate	Testing on a hard/flat surface does not consider carpet, which can make a unit less stable.

Tip Restraints. The inclusion of tip restraints (called "attachment devices" in the standard) is "strongly recommended," but not required. As explained earlier, in the discussion of tip restraint requirements in F2057 – 19, staff did not evaluate tip restraints in detail in this briefing package. The ESHF staff memorandum (Tab C) provides additional detail on staff's concerns regarding tip restraints in general, and the importance of inherent stability.

Warning Requirements. The standard requires a warning label, and provides example text that addresses the tip-over hazard. However, the exact text is not mandated. The standard includes label permanency requirements and mandates that the warning label be placed "inside of a top drawer within clear view when the drawer is empty and partially opened, or on the inside face of a drawer" for chests of drawers and wardrobes.

The standard also requires a warning hang tag with specific text and formatting, which includes a statement about the hazard: "Do not allow children to climb on this furniture – it may topple over and badly injure a child," and a statement to not place toys or other items that appeal to children on top of the furniture.

The standard also includes non-mandatory warning labels for units that do not comply with the standard. As Tab C explains, warning labels have limited effectiveness at addressing the tip-over hazard. That memorandum explains, in detail, components of an effective warning label.

Televisions. The standard does not address the use of televisions with the covered products. Although, as explained in Tab C, staff does not recommend addressing televisions as part of this rulemaking. However, increasing the stability of CSUs should also decrease incidents involving CSUs with televisions. Staff recommends at least including information with a CSU about whether it is appropriate for holding a television.

ISO 7171(2019)

The International Organization for Standardization (ISO) developed the voluntary standard ISO 7171 through the Technical Committee ISO/TC 136, *Furniture* and published the first version in May 1988. The current 2019 version was published in February 2019.

ISO 7171:2019 describes methods for determining the stability of free-standing storage furniture, including bookcases, wardrobes, and cabinets. Specific definitions for these types of furniture do not exist in the standard. Additionally, no external sources are referenced.

Stability Requirements. Similar to ASTM F2057 – 19, ISO 7171:2019 includes (1) a stability test using a force on an open extension element; (2) an unloaded stability test with all extension elements open; and (3) a filled drawer - loaded stability tests with all storage areas filled with weight and a force on a single open drawer. In the loaded test, one drawer is opened to the outstop, and if no outstops exist, the drawer is opened to two-thirds of its full extension length. Next, the force, which varies depending on the height of the unit (see Table 3), is applied to the top face of the opened drawer. For doors, the load is applied 50 millimeters (2 inches) from the door edge.

In the all-extension elements-open test, drawers or extendible elements are to be opened and remain open to the outstop length with any doors open 90°. If no outstops are present, then the extension elements are opened to two-thirds of their extension length, which is similar to ASTM F2057 – 19. Existing interlock systems are not to be bypassed for this test.

In the filled drawers - loaded stability test, all storage areas are to be filled with weight according to Table 3. The test is then carried out with the same procedure as the loaded test, but with forces based on the total mass and height of the unit (20% of the mass of the loaded unit up to 200 or 300 Newtons, depending on unit height).

Units are tested freestanding and not supported. Units are placed on a level test surface for this testing.

ISO 7171 does not have a pass/fail criterion for its loaded stability test. However, it includes a table of "suggested" forces of 200 Newtons (45 pounds-force), for height less than 1000 millimeters (39 inches), 250 Newton (56 pounds-force), for a height between 1000 millimeters and 1600 millimeters (63 inches), and 200 Newton for a height above 1600 millimeters.

An additional unfilled, closed extension element test is required. For units 1000 millimeters or less in height, a vertical force a vertical force of 750 Newtons (169 pounds) is applied to the top surface of the unit. For units greater than 1000 millimeters in height, a vertical force of 350 Newtons (77 pounds) along with a simultaneous 50 Newton (11 pound-force) outward horizontal force is applied to the top surface of the unit.

CPSC staff concludes that this specification is inadequate because it does not account for child interaction based on the moments children can exert on CSUs; test weights are only set as recommendations; no pass/fail criteria are specified; and testing does not account for carpeting. In addition, although ISO 7171:2019 includes a stability test with filled drawers, the multiple open drawer test does not include filled drawers. Table 3 shows the hazard patterns, how the specification addresses them, and staff's comments.

Table 3. Hazard Pattern Adequacy Associated with CSUs Within the Scope of ISO 7171:2019

Hazard Pattern	Addressed in ISO 7171	Staff Assessment of Adequacy	Staff Comments
Child Interaction	Doors opened to maximum, no more than 90°, and all extension elements fully opened, except, in the absence of outstops, two-thirds of the internal length and flaps shall be opened. Only one extension element in each vertical line shall be tested at a time. Apply the specified force, 200 N (45 lbf), for height less than 1000 mm, 250 N (56 lbf), for a height between 1000 mm and 1600 mm, and 200 N for a height above 1600 mm, and to any point likely to cause overturning (Section 6.4.2).	Inadequate	The test weight does not include the additional moments from horizontal forces and dynamic forces when a child climbs.
Multiple Open Drawers	All doors opened to maximum, no more than 90°, and all extension elements fully opened, except in the absence of outstops, two-thirds of the internal length and flaps open (Section 6.4.1)	Inadequate	This does not account for weight in drawers to replicate contents, and forces associated with real-world interactions.
Filled Drawers	All storage areas shall be loaded, per Table 1 (ISO 7171), 0.2 kg/dm^3 (12.5 lb/ft^3) for clearance height ≤10 cm (3.9 in), or 0.1 kg/dm^3 (6.25 lb/ft^3) for clearance height ≥ 25 cm (9.8 in). For extension elements with clearance heights between 10 cm (3.9 in) and 25 cm (9.8 in), (.2667 – 0.0667H kg/dm^3) or (16.66 – 4.166H lb/ft^3). Doors opened to maximum, no more than 90°, and all extension elements fully opened, except in the absence of outstops, two-thirds of the internal length and flaps opened. Only one extension element in each vertical line shall be tested at a time. Apply the specified force to any point likely to cause overturning (Section 6.4.3).	Inadequate	ESHF staff determined that 8.5 lbs/ft^3 of functional drawer volume is a reasonable approximation of weight of children's clothing in a fully filled drawer. However, this filling is only required for the loaded, one-drawer-open test, and not the all-drawers-open test.
Flooring Surfaces	Not addressed	Inadequate	The test method does not replicate the effect of softer surfaces, such as carpeting, on stability.

Tip restraints. ISO 7171:2019 does not require tip restraints, referred to as "wall attachments," to be provided with CSUs, but does specify a test method for them. The tip restraints are installed in both the wall and unit during the test. Then, a 300 Newton (67.4 pounds-force) horizontal force is applied in the direction most likely to overturn the unit. The force is maintained between 10 seconds and 15 seconds. The specification states: "this test is applicable to safety devices intended to prevent overturning of an unfilled storage furniture." As explained above, staff did not evaluate tip restraints in detail in this briefing package. The ESHF staff memorandum (Tab C) provides additional detail on staff concerns regarding tip restraints in general, and the importance of inherent stability.

Warning requirements. The standard does not have any requirements or test methods related to warning labels. Although, as Tab C explains, warning labels have limited effectiveness, they can inform consumers of the hazard and how to avoid it. See Tab C for further discussion of warnings.

Televisions. The standard does not address the use of televisions with the covered products. See Tab C for staff's assessment of addressing televisions as part of a CSU tip-over standard.

LSM staff concludes that ISO 7171:2019 is inadequate to address the hazard patterns identified by CPSC staff.

EN 14749

EN 14749:2016 is a European Standard that was prepared by Technical Committee CEN/TC 207 "Furniture." This standard was approved by the European Committee for Standardization (CEN) on November 21, 2015, and supersedes EN 14749:2005, which was approved on July 8, 2005, as the original version. EN 14749:2016 is a mandatory standard and applies to all CEN members. The standard specifies safety requirements and test methods for all types of kitchen and bathroom storage units and domestic storage furniture that is fully assembled and ready for use.

EN 14749:2016 describes methods for determining the stability of domestic and non-domestic furniture with a height ≥ 600 millimeters (23.6 inches) and a potential energy, based on its mass and height, exceeding 60 Newton-meters (44.25 pound-feet). Kitchen-worktops and TV-furniture are the only furniture types defined. The test methods in this standard are taken from EN 16122:2012, *Domestic and non-domestic storage furniture-test methods for the determination of strength, durability and stability*, which covers "all types of domestic and non-domestic storage furniture including domestic kitchen furniture."

Stability Requirements. As with ASTM F2057 – 19, in EN 14749:2016, there are three stability tests. In the first loaded test, the test weight of 75 Newtons (16.9 pounds-force) is applied to the top of the drawer face, when pulled to the outstop. However, if no outstops exist, the extension element should be opened to two-thirds of its full extension length.

The second test is an all drawers open test and is conducted by opening and leaving open each drawer or extendible element to the outstop length with doors open 90°. If no outstops are present, then the extension elements should be opened to two-thirds of their extension length, which is similar to ASTM F2057 – 19. Existing interlock systems are not to be bypassed for this test. Units are tested freestanding and not supported.

The third test is a filled drawer - loaded stability test. All storage areas are to be filled with weight according to Table 4. The test is then carried out with the same procedure as the loaded test, but the test weight is specified to be 20 percent of the mass of the unit, including the drawer fill, as described in Table 4, but not to exceed 300 N (67.4 pounds-force). Table 4 shows the hazard patterns, how the specification addresses them, and staff's comments.

Similar to ISO 7171, an additional unfilled, closed drawer test is required for units greater than 1000 millimeters in height, where a vertical force of 350 Newtons (77 pounds-force) along with a simultaneous 50 Newton (11 pounds-force) outward horizontal force are applied to the top surface of the unit.

Table 4. Hazard Pattern Adequacy Associated with CSUs Within the Scope of EN 14749:2016

Hazard Pattern	Addressed in EN 14749	Staff Assessment of Adequacy	Staff Comments
Child Interaction	Doors opened to maximum, no more than 90°, and all extension elements fully opened, except in the absence of outstops, two-thirds of the internal length and flaps shall be opened. Only one extension element in each vertical line shall be tested at a time. Apply the specified force to any point likely to cause overturning (Section 6.4.2).	Inadequate	The test weight does not include the additional moments from horizontal forces and dynamic forces when a child climbs.
Multiple Open Drawers	All doors opened to maximum, no more than 90°, and all extension elements fully opened, except in the absence of outstops, two-thirds of the internal length and flaps open (Section 6.4.1)	Inadequate	Testing does not include weight in drawers to replicate contents, and applying force associated with real-world interactions.
Filled Drawers	All storage areas shall be loaded, per Table 3 (EN 14749), 0.2 kg/dm^3 (12.5 lb/ft^3) for clearance height ≤10 cm (3.9 in), or 0.1 kg/dm^3 (6.25 lb/ft^3) for clearance height ≥ 25 cm (9.8 in). For extension elements with clearance heights between 10 cm (3.9 in) and 25 cm (9.8 in), (.2667 – 0.0667H kg/dm^3) or (16.66 – 4.166H lb/ft^3). Doors opened to maximum, no more than 90°, and all extension elements fully opened, except in the absence of outstops, two-thirds of the internal length and flaps opened. Only one extension element in each vertical line shall be tested at a time. Apply the specified force to any point likely to cause overturning (Section 6.4.3).	Inadequate	ESHF staff determined that 8.5 lbs/ft^3 of functional drawer volume is a reasonable approximation of weight of children's clothing in a fully filled drawer. However, the fill requirement only applies to the loaded test, and not the all drawers open test.
Flooring Surfaces	Not addressed	Inadequate	The test method does not replicate the effect of softer surfaces, such as carpeting, on stability.

LSM staff concludes this specification is inadequate because it does not account for the moments children can exert on CSUs when interacting with them, such as when climbing, as explained in the ESMC staff memorandum, Tab D. Additionally, LSM staff concludes that this specification is inadequate in addressing multiple open drawers because it does not include fill weights to replicate drawer contents, which further contribute to instability when drawers are opened. Additionally, LSM staff concludes this safety specification is inadequate in addressing both the filled drawer hazard pattern for the loaded test and the multiple open drawer test. Staff concluded that a fill of 8.5 pounds per cubic reasonably replicated real-world use (Tab L), while this standard requires a variable fill ranging from 6.25 pounds per cubic foot to 12.5 pounds per cubic foot. No study or other documentation was cited for this fill value. LSM staff also concludes this specification does not adequately address stability from uneven surfaces or carpeted surfaces.

Tip Restraints. EN 14749:2016 does not include any discussion of tip restraints. See Tab C for discussion of tip restraints.

Warning Requirements. EN 14749:2016 does not include any discussion of warning labels. See Tab C for discussion of warning labels.

Televisions. The standard does address televisions, however only in regard to furniture designed to house them. Because this briefing package does not focus on television involvement, these requirements are not discussed in detail here. See Tab C for staff's assessment regarding televisions.

Interlocks. In the referenced standard, EN 16122, where the test methods are described, an interlock test is specified. The test calls for one extension element to be pulled out to its outstop, or in the absence of an outstop, two-thirds of its operational sliding length. A 100 Newton (22 pounds-force) horizontal force is then applied to the face of all other extension elements. This process is repeated 10 times on each extension element. All combinations of extension elements are tested.

LSM staff concludes that EN 14749: 2016 is inadequate to address the hazard patterns identified by CPSC staff.

ANSI/BIFMA SOHO S6.5

The scope of ANSI/BIFMA SOHO S6.5-2008 (R2013), *Small Office Home Furniture-Tests*, does not include CSUs. However, the standard includes an interlock test that CPSC staff believes is relevant to CSUs because of the similarity of file cabinets and CSUs with drawers and interlock systems.

This standard was completed by BIFMA Engineering Committee and its subcommittee on Small Office/Home Office Products in 2000. The first version was approved by ANSI on August 4, 2008. The current version of the standard was approved on September 17, 2013, and it included only non-substantive changes. The use of this standard, as well as any other ANSI standard, is voluntary. This standard specifies tests for "evaluating the safety, durability, and structural adequacy of storage and desk-type furniture intended for use in the small office and/or home office." It also "defines tests used to determine acceptability of the product for the intended and reasonably foreseeable use of the product."

Stability Requirements. ANSI/BIFMA SOHO S6.5-2008 (R2013) describes an interlock test to evaluate interlock systems. The test procedure calls for one extendable element to be fully extended while a 30 pound horizontal pull force is applied to all other fully closed extendable elements. Every combination of open/closed extendable elements must be tested to fully evaluate the interlock system. The interlock system shall be fully functional at the completion of this test. No "extendable element," which is defined in this standard as "a movable load bearing storage component, including, but not limited to: drawers and filing frames," shall bypass the interlock system. "This excludes doors, writing shelves, equipment surfaces, and keyboard surfaces." Based on child-strength studies described by ESHF staff in Tab C, which show that children between ages 2 and 5 years old can achieve a mean pull force of 17.2 pounds, a 30-pound horizontal pull force is adequate to evaluate the strength of an interlock system.

Comparison of Standards

Table 5 compares the key requirements of each standard.

Table 5. Key Performance Requirements for International Standards

	Test Weight or Force	CSU Height*	Element Extension	Tip Restraints	Warning Labels	Filled Drawer Test
F2057 – 19	50 lb	27 in	To outstop or 2/3 extension	Required	Required	None
AS/NZA 4935	29 kg (64 lb)	500 mm (19.7 in)	2/3 extension	Strongly recommended	Required	None
ISO 7171	200 N (45 lbf) for components with height <1000 mm (39.4 in), 250 N (56 lbf) for components >1000mm and ≤1600 mm (63 in) in height, and 200 N for all other components**	Not specified	To outstop or 2/3 extension	Not required	Not mentioned	Yes†
EN 14749	75 N (16.8 lbf)	Not specified	To outstop or 2/3 extension	Not mentioned	Not mentioned	Yes†

* Minimum height of furniture that is included in the scope of the standard.
** ISO 7171 does not have a pass/fail criterion for its loaded stability test. However, it includes a table of "suggested" forces. These forces are included in this table.
† In this test, all storage areas are loaded with a fill-representative weight; however, only one extension element in each vertical line is opened and tested at a time. The multiple open drawer test does not include filled drawers.

Products Covered. It should be noted that ASTM F2057 – 19 only covers CSUs, while AS/NZA 4935:2009 also covers bookshelves and bookcases. Both ISO 7171:2019 and EN 14749:2016 cover all domestic storage furniture, including kitchen and bath storage units.

Types of Requirements. ASTM F2057 – 19 and AS/NZA 4935 are similar in that their performance requirements are limited to stability and warnings (ASTM F2057 – 19 also has a requirement for tip restraints). In addition to stability and warning requirements, EN 14749 also has strength and durability requirements. ISO 7171 describes a test method for determining stability, but the test methods do not prescribe force values that must be met. However, the standard does include a table of "suggested" force and other performance requirement values that testers may use.

The stability tests of ASTM F2057 – 19 and AS/NZA 4935 both require extending one empty drawer or door out to a specified distance and applying a load test weight to the drawer or door front. EN 14749 and ISO 7171 also use empty drawers; however, all drawers in a row are pulled out. This difference in test methods would not affect units consisting of a single column of drawers. EN 14749 and ISO 7171 also have two more stability tests that are not in ASTM F2057 – 19 or AS/NZA 4935. One test requires a vertical force of 750 Newtons (169 pounds-force) 50 millimeters (2 inches) from the top edge for units 1000 millimeters in height or less. For units greater than 1000 millimeters in height, the vertical force is 350 Newtons (77 pounds-force), along with a simultaneous 50 Newton (11 pounds-force) outward horizontal force. They also have a loaded test with a force applied. In this test, all drawers are filled with weight, depending on the volume of the drawer, per Table 3 and Table 4. Then, one row of drawers is fully opened and then a specified force (20% of the mass of the loaded unit or 300 Newtons, whichever is less) is applied to one drawer.

The multiple stability tests specified in EN 14749 are not as stringent as the static test in ASTM F2057 – 19 or in AS/NZA 4935 or that apply 50 pounds and 63.88 pounds, respectively, to the front edge of an empty CSU.

Although all of the standards have performance requirements for stability, only ASTM F2057 – 19 has a requirement specifying that a tip restraint must be provided with the furniture item. ESHF staff raises several issues about the tip restraint devices that may need to be explored in the future (see Tab C).

CONCLUSION

LSM staff concludes that ASTM F2057 – 19, as well as the other standards, AS/NZA 4935:2009, ISO 7171:2019, and EN14749:2016, are all inadequate to protect children against the tip-over hazards posed by CSUs. ANSI SOHO S6.5 does not address the stability of CSUs; it only assesses interlock systems. None of these standards account for the hazard patterns, such as:

- Child Interaction (Ascent/climb) – climbing is frequently reported in the incident data.
- Multiple open drawers – opening multiple drawers significantly impacts CSU stability. Incidents indicate that children opened one or more drawers.
- Filled drawers – Consumers are likely to fill drawers with clothing because that is the purpose of these consumer products. A CSU with filled drawers is likely to be less stable than an empty unit when more than half the drawers are open.
- Flooring Surfaces – Incident data indicate that many reported tip-over incidents, when flooring type is known, occur on carpeting. When CSUs are placed on a carpeted surface, they become less stable.

Some of the standards address individual hazard patterns more than other standards, but they do not address each of the issues highlighted by incident data and testing identified in this briefing package. For example, AS/NSA 4935:2009 recommends the highest test weight of all the standards, at 29 kilograms (64 pounds). However, as Tab E explains, a static test weight of 29 kilograms (64 pounds) does not adequately reflect other real-world hazards that exist during incidents, including dynamic forces, such as children climbing, and multiple open and filled drawers. All four CSU standards contain an all drawer open test, but fail to account for multiple filled and open drawers; and, again, they do not account for dynamic forces that may coexist with open drawers. Only the ISO 7171:2019 and EN 14749:2016 standards have test methods involving filled drawers, but neither addresses the filled drawers hazard pattern because they fail to consider multiple open and filled drawers. None of the standards account for carpeted floors, which, as Tab Q explains, is a common factor in CSU tip-over incidents and decreases the stability of CSUs. Therefore, CPSC staff concludes that the international and voluntary standards that address CSU stability are not adequate to effectively reduce the CSU tip-over hazard.

REFERENCES

ANSI/SOHO S6.5-2008 (R2013), Small Office/Home Office Furniture – Tests American National Standard for Office Furnishings.

ASTM F1427 – 13 (2013), Standard Safety Specification for Bunk Beds, ASTM International, West Conshohocken, PA, 2019, www.astm.org.

ASTM F1169 – 19 (2019), Standard Consumer Safety Specification for Full-Size Baby Cribs, ASTM International, West Conshohocken, PA, 2019, www.astm.org.

ASTM F2057 – 00 (2000), Standard Safety Specification for Clothing Storage Units, ASTM International, West Conshohocken, PA, 2019, www.astm.org.

ASTM F2057 – 04 (2004), Standard Safety Specification for Clothing Storage Units, ASTM International, West Conshohocken, PA, 2019, www.astm.org.

ASTM F2057 – 09 (2009), Standard Safety Specification for Clothing Storage Units, ASTM International, West Conshohocken, PA, 2019, www.astm.org.

ASTM F2057 – 09a (2009), Standard Safety Specification for Clothing Storage Units, ASTM International, West Conshohocken, PA, 2019, www.astm.org.

ASTM F2057 – 09b (2009), Standard Safety Specification for Clothing Storage Units, ASTM International, West Conshohocken, PA, 2019, www.astm.org.

ASTM F2057 – 14 (2014), Standard Safety Specification for Clothing Storage Units, ASTM International, West Conshohocken, PA, 2019, www.astm.org.

ASTM F2057 – 17 (2017), Standard Safety Specification for Clothing Storage Units, ASTM International, West Conshohocken, PA, 2019, www.astm.org.

ASTM F2057 – 19 (2019), Standard Safety Specification for Clothing Storage Units, ASTM International, West Conshohocken, PA, 2019, www.astm.org.

ASTM F2388-18 (2018), Standard Consumer Safety Specification for Baby Changing Products for Domestic Use, ASTM International, West Conshohocken, PA, 2019, www.astm.org.

AS/NZS 4935:2009,(2009) the Australian/New Zealand Standard for Domestic furniture – Freestanding chests of drawers, wardrobes and bookshelves/bookcases – determination of stability.

ISO 7171 (2019), the International Organization for Standardization International Standard for Furniture – Storage Units – Determination of stability.

EN14749, the European Standard, European Standard for Domestic and kitchen storage units and worktops – Safety requirements and test methods.

Taylor, M. (2017). [Letter to Rick Rosati, F15.42 Standard Safety Specification for Clothing Storage Units on CPSC staff's position regarding multiple outstops]. Dated February 6, 2017. Available: https://www.cpsc.gov/s3fs-public/Furniture%20Tipover%20Multiple%20Outstops%20Memo.pdf.

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TAB G: Recommended Regulatory Text for Draft Proposed Rule

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

Memorandum

DATE: July 14, 2021

TO: The File

THROUGH: Duane Boniface, Assistant Executive Director,
Office of Hazard Analysis and Reduction (EXHR)

FROM: Furniture Tip-Over EXHR Team

SUBJECT: Recommended Regulatory Text for Draft Proposed Rule

I. INTRODUCTION

This memorandum includes the regulatory text that staff recommends including in the draft proposed rule. This regulatory text includes general provisions, such as scope and definitions, as well as the recommended requirements for stability testing and assessment (discussed in more detail in Tab D), warning labels (discussed in more detail in Tab C), and hang tags (discussed in more detail in Tab E). This memorandum also includes topics regarding these recommended requirements that staff recommends seeking comments on in the draft proposed rule.

II. RECOMMENDED REGULATORY TEXT

PART XXXX—SAFETY STANDARD FOR CLOTHING STORAGE UNITS

Sec.

XXXX.1 Scope, purpose, application, and exemptions.

XXXX.2 Definitions.

XXXX.3 Requirements for interlocks.

XXXX.4 Requirements for stability.

XXXX.5 Requirements for marking and labeling.

XXXX.6 Requirements to provide performance and technical data by labeling.

Authority: 15 U.S.C. 2051(b), 2056, 2058, 2063(c), 2076(e)

§ XXXX.1 Scope, Purpose, Application, and Exemptions

(a) Scope and purpose. This part XXXX, a consumer product safety standard, prescribes the safety requirements, including labeling and hang tag requirements, for *clothing storage units*, as defined in XXXX.2(a). These requirements are intended to reduce or eliminate an unreasonable risk of death or injury to consumers from clothing storage unit tip overs.

(b) Application. Except as provided in paragraph (c) of this section, all clothing storage units that are manufactured in the Unites States, or imported, on or after [effective date], are subject to the requirements of this part XXXX if they are *consumer products*. Section 3(a)(1) of the Consumer Product Safety Act (CPSA; 15 U.S.C. 2052(a)(1)) defines the term *consumer product* as an "article, or component part thereof, produced or distributed (i) for sale to a consumer for use in or around a permanent or temporary household or residence, a school, in recreation, or otherwise, or (ii) for the personal use, consumption or enjoyment of a consumer in or around a permanent or temporary household or residence, a school, in recreation, or otherwise." The term does not include products that are not customarily produced or distributed for sale to, or for the use or consumption by, or enjoyment of, a consumer.

(c) Exemptions. The following products are exempt from this part XXXX:

(1) *Clothes lockers*, as defined in XXXX.2(b), and

(2) *Portable storage closets*, as defined in XXXX.2(s).

§ XXXX.2 Definitions

In addition to the definitions given in section 3 of the Consumer Product Safety Act (15 U.S.C. 2052), the following definitions apply for purposes of this part XXXX:

(a) *Clothing storage unit* means a *freestanding* furniture item, with *drawer(s)* and/or *door(s)*, that may be reasonably expected to be used for storing clothing, that is greater than or equal to 27 inches in height, and with a total *functional volume* of the *closed storage* greater than 1.3 cubic feet and greater than the sum of the total *functional volume* of the *open storage* and the total volume of the *open space*. Common names for clothing storage units include, but are not limited to: chests, bureaus, dressers, armoires, wardrobes, chests of drawers, drawer chests, chifforobes, and door chests. Whether a product is a clothing storage unit depends on whether it meets this definition. Some products that, depending on their design, may not meet the criteria in this definition and, therefore, may not be considered clothing storage units are: shelving units, office furniture, dining room furniture, laundry hampers, built-in closets, and single-compartment closed rigid boxes (storage chests).

(b) *Clothes locker* means a predominantly metal furniture item without exterior drawers and with one or more doors that either locks or accommodates an external lock.

(c) *Closed storage* means storage space inside a *drawer* and/or behind an opaque *door*. For this part XXXX, both sliding and hinged doors are considered in the definition of *closed storage*.

(d) *Door* means a hinged furniture component that can be opened or closed, typically outward or downward, to form a barrier; or a sliding furniture component that can be opened or closed by sliding across the face or case of the furniture item. This does not include vertically opening hinged lids.

(e) *Door extension from fulcrum distance* means the horizontal distance measured from the farthest point of a hinged door that opens outward or downward, while the door is in a position where the center of mass of the door is extended furthest from the front face of the unit (typically 90 degrees), to the *fulcrum*, while the CSU is on a *hard, level, and flat test surface*. See Figure 1. Sliding doors that remain within the CSU case are not considered to have a door extension.

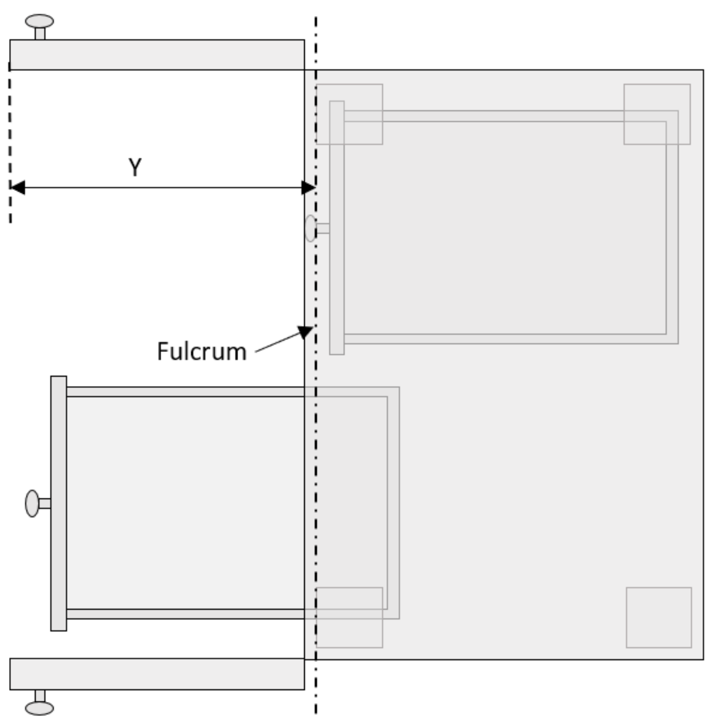


Figure 1. (Top View) The *door extension from fulcrum distance,* illustrated by the letter Y.

(f) *Drawer* means a furniture component intended to contain or store items that slides horizontally in and out of the furniture case and may be attached to the case by some means, such as glides.

(g) *Drawer or pull-out shelf extension from fulcrum distance* means the horizontal distance measured from the centerline of the front face of the *drawer* or the outermost surface of the pull-out shelf to the *fulcrum*, when the drawer or pull-out shelf is at the *maximum extension* and the CSU is on a *hard, level, and flat test surface*. For a curved or angled surface this measurement is taken where the distance is at its greatest. See Figure 2.

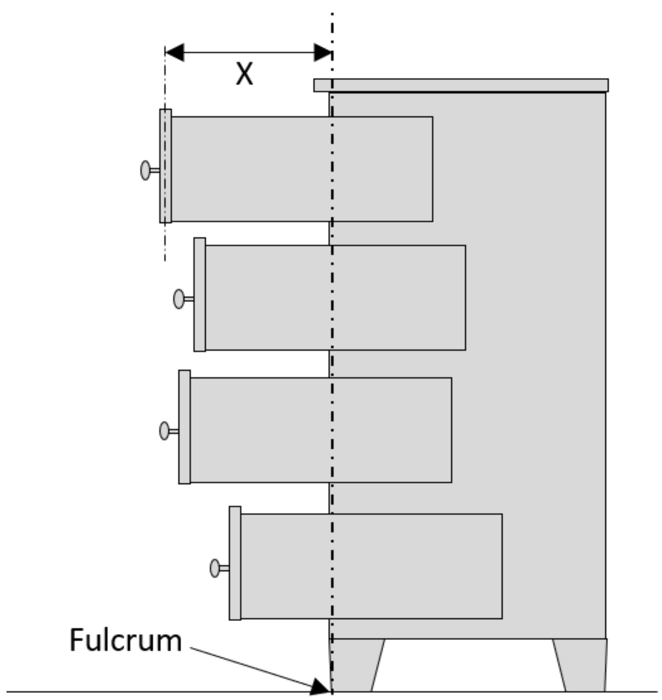


Figure 2. The *drawer extension from fulcrum distance*, illustrated by the letter X.

(h) *Freestanding* means that the unit remains upright, without requiring attachment to the wall, when it is fully assembled and empty, with all extension elements closed. Built-in units or units intended to be permanently attached to the building structure, other than by tip restraints, are not considered freestanding. Examples of units that are intended to be permanently installed include, but are not limited to, kitchen cabinets and bathroom vanities.

(i) *Functional volume* of a *drawer* or *pull-out shelf* means the interior bottom surface area multiplied by the effective *drawer*/*pull-out shelf* height, which is distance from the bottom surface of the *drawer*/*pull-out shelf* to the top of the *drawer*/*pull-out shelf* compartment minus 1/8 inches (see Figure 3a). *Functional volume* behind a *door* means the interior bottom surface area behind the *door*, when the *door* is closed, multiplied by the height of the storage compartment (see Figure 3b). *Functional volume* of *open storage* means the interior bottom surface area multiplied by the effective *open storage* height, which is distance from the bottom surface of the *open storage* to the top of the *open storage* compartment minus 1/8 inches.

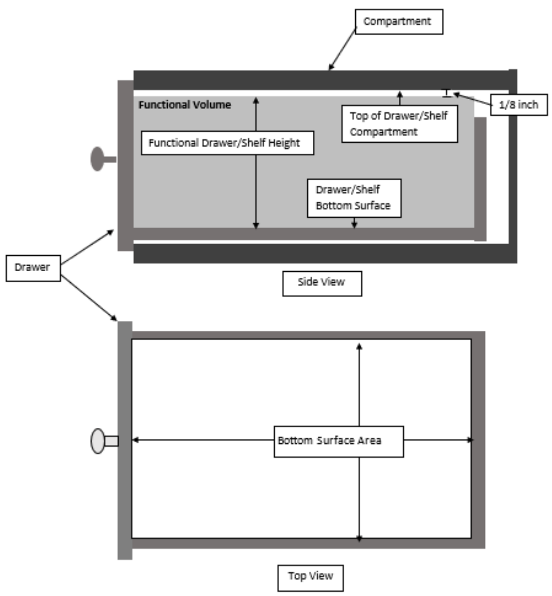


Figure 3a. *Functional Volume* of Drawer or Pull-Out Shelf

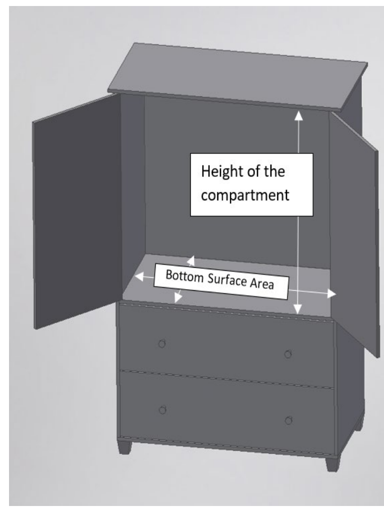


Figure 3b. *Functional Volume* behind a *Door*

(j) *Fulcrum* means the point or line at the base of the CSU about which the CSU pivots when a *tip-over force* is applied (typically the front feet).

(k) *Hard, level, and flat test surface* means a test surface that is (1) sufficiently hard to not bend or break under the weight of a *clothing storage unit* and any loads associated with testing the unit; (2) level with no more than 0.5 degrees of variation; and (3) smooth and even.

(l) *Interlock* means a device that restricts simultaneous opening of *drawers*. An *interlock* may allow only one *drawer* to open at a time, or may allow more than one *drawer*, but fewer than all the *drawers*, to open simultaneously.

(m) *Levelling device* means an adjustable device intended to adjust the level of the clothing storage unit.

(n) *Maximum extension* means a condition when a *drawer* or *pull-out shelf* is open to the furthest manufacturer recommended use position, as indicated by way of a stop. In the case of slides with multiple intermediate stops, this is the stop that allows the *drawer* or *pull-out shelf* to extend the furthest. In the case of slides with a multipart stop, such as a stop that extends the *drawer* or *pull-out shelf* to the furthest manufacturer recommended use position with an additional stop that retains the drawer or pull-out shelf in the case, this is the stop that extends the drawer or pull-out shelf to the manufacturer recommended use position. If the manufacturer does not provide a recommended use position by way of a stop, this is 2/3 the shortest internal length of the drawer measured from the inside face of the drawer front to the inside face of the drawer back or 2/3 the length of the pull-out shelf. See Figure 4.

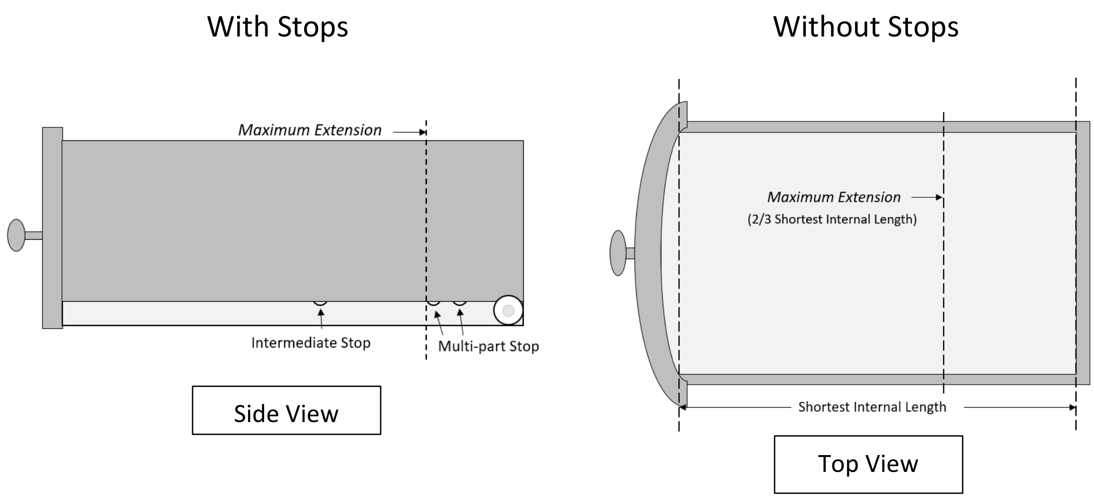


Figure 4. Example of *maximum extension* on *drawers* and *pull-out shelves* with stops and without stops.

(o) *Maximum handhold height* means the highest position at which a child may grab hold of the CSU. This includes the top of the CSU. This height is limited to a maximum of 4.12 feet from the ground, while the CSU is on a flat and level surface. See Figure 5.

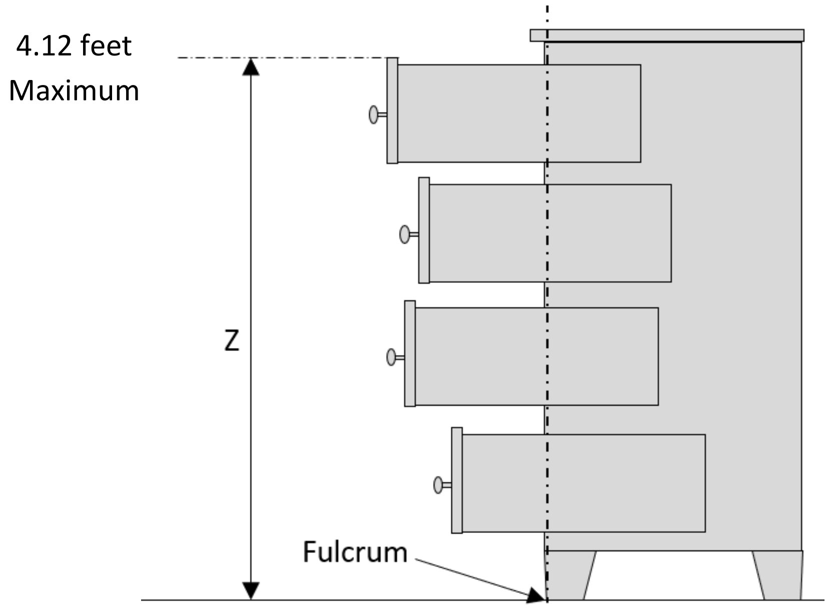


Figure 5. The *maximum handhold height*, illustrated by the letter Z.

(p) *Moment* means a moment of a force, which is a measure of the tendency to cause a body to rotate about a specific point or axis. It is measured in pound-feet, representing a force multiplied by a lever arm, or distance from the force to the point of rotation.

(q) *Open storage* means storage space enclosed on at least 5 sides by a frame or panel(s) and/or behind a non-opaque door and with a flat bottom surface.

(r) *Open space* means space enclosed within the frame or panels, but without a bottom surface. For example, under legs or between storage components, as with a vanity.

(s) *Portable storage closet* means a freestanding furniture item with an open frame that encloses hanging clothing storage space and/or shelves. This item may have a cloth case with curtain(s), flap(s), or door(s) that obscure the contents from view.

(t) *Pull-out shelf* means a furniture component with a horizontal flat surface that slides horizontally in and out of the furniture case and may be attached to the case by some means, such as glides.

(u) *Tip over* means the point at which a clothing storage unit pivots forward such that the rear feet or, if there are no feet, the edge of the CSU lifts at least 1/4 inch from the floor and/or is supported by a non-support element.

(v) *Tip-over force* means the force required to cause tip over of the clothing storage unit.

(w) *Tip-over moment* means the minimum moment in pounds-feet about the *fulcrum* that causes *tip over*.

§ XXXX.3 Requirements for Interlocks

(a) General. For all clothing storage units, including consumer-assembled units, the *interlock* components must be pre-installed, and automatically engage when the consumer installs the *drawer*s in the unit. All *interlocks* must engage automatically as part of normal use.

(b) *Interlock* pull test.

(1) If the unit is not fully assembled, assemble the unit according to the manufacturer's instructions.

(2) Place the unit on a *hard, level, and flat test surface*.

(3) If the unit has a *levelling device*, adjust the *levelling device* to the lowest level; then adjust the *levelling device* in accordance with the manufacturer's instructions.

(4) Secure the unit to prevent sliding or *tip over*.

(5) Open any *doors* in front of the *interlocked drawer*s.

(6) Engage the *interlock* by opening a *drawer*, or the number of *drawers* necessary to engage the interlock, to the *maximum extension*.

(7) Gradually apply over a period of at least 5 seconds a 30-pound horizontal pull force on each locked *drawer*, one *drawer* at a time, and hold the force for at least 10 seconds.

(8) Repeat this test until all possible combinations of *drawers* have been tested.

(c) During the testing specified in paragraph (b) of this section, if any locked *drawer* opens or the *interlock* is damaged, then the *interlock* will be disabled or bypassed for the stability testing in XXXX.4, paragraph (c).

§ XXXX.4 Requirements for Stability

(a) *General.* Clothing storage units shall be configured as described in paragraph (b) of this section, and tested in accordance with the procedure in paragraph (c) of this section. Clothing storage units shall meet the requirement for tip-over stability based on the minimum *tip-over moment* as specified in paragraph (d) of this section.

(b) *Test Configuration:* The clothing storage unit used for tip-over testing shall be configured in the following manner:

(1) If the unit is not fully assembled, assemble the unit according to the manufacturer's instructions.

(2) Place the unit on a *hard, level, and flat test surface*.

(3) If the CSU has a *levelling device*, adjust the *levelling device* to the lowest level; then adjust the *levelling device* in accordance with the manufacturer's instructions.

(4) Tilt the CSU forward to 1.5 degrees by one of the following methods:

(i) Raise the rear of the unit until the unit has a 1.5-degree forward tilt, or

(ii) Place the unit on a hard and flat 1.5-degree inclined surface, with the high point at the rear of the unit surface, or

(iii) Other means to achieve a 1.5-degree forward tilt.

(5) If the CSU has a *levelling device* intended for a carpeted surface, adjust the level in accordance with the manufacturer's instructions for a carpeted surface.

(6) Open all hinged *doors* that open outward or downward to the position where the center of mass of the *door* is extended furthest from the front face of the unit (typically 90 degrees).

(7) For units without an *interlock*:

(i) Open all *drawer*s and *pull-out shelves* to the *maximum extension*.

(ii) Place a fill weight in the center of each *drawer* or *pull-out shelf* consisting of a uniformly distributed mass in pounds that is 8.5 (pounds/cubic foot) times the *functional volume* (cubic feet).

(8) For units with an *interlock*:

(i) If, during the testing specified in XXXX.3(b), any locked *drawer* opens or the *interlock* is damaged, then disable or bypass the *interlock* for the stability testing required in this section, and follow the requirements for units without an *interlock*.

(ii) If, during the testing specified in XXXX.3(b), no locked *drawer* opens and the *interlock* is not damaged, then:

(A) Open all *drawers* that are not locked by the *interlock* system to the *maximum extension*, in the configuration most likely to cause tip over (typically the configuration with the largest *drawers* in the highest position open).

(B) If 50% or more of the *drawers* and *pull-out shelves* by *functional volume* are open, place a fill weight in the center of each *drawer* or *pull-out shelf*, including those that remain closed (see Figure 6a), consisting of a uniformly distributed mass in pounds that is 8.5 (pounds/cubic foot) times the *functional volume* (cubic feet). Secure the fill weights to prevent sliding.

(C) If less than 50% of the *drawers* and *pull-out shelves* by *functional volume* are open, do not place a fill weight in any *drawers* or on any *pull-out shelves* (see Figure 6b).

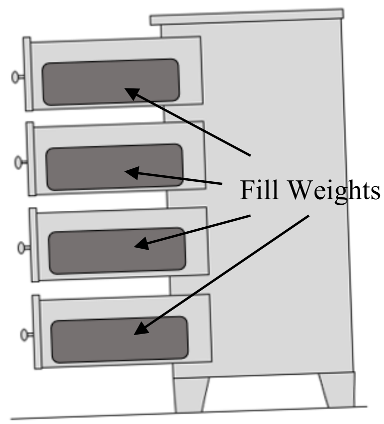


Figure 6a. If 50% or more of the *drawers*/*pull-out shelves* open, CSU tested with fill weights in all drawers.

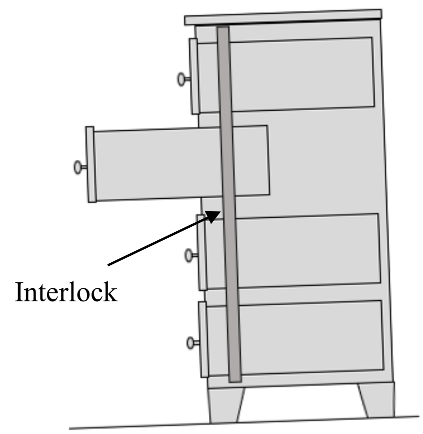


Figure 6b. If less than 50% of the *drawers*/*pull-out shelves* open, CSU tested empty.

(c) *Test Procedure to Determine Tip-over Moment of the Unit:* Perform one of the following two tip-over tests (Test Method 1 or Test Method 2), whichever is the most appropriate for the unit:

(1) Test Method 1 can be used for units with *drawers* or *pull-out shelves*. Gradually apply over a period of at least 5 seconds a vertical force to the face of the uppermost extended *drawer/pull-out shelf* of the unit to cause the unit to *tip over*. Record the *tip-over force* and horizontal distance from the force application point to the *fulcrum*. Calculate the *tip-over moment* of the unit by multiplying the *tip-over force* (pounds) by the horizontal distance from the force application point to the *fulcrum* (feet). NOTE: If a drawer breaks during the test due to the force, use Test Method 2 or secure or reinforce the drawer, as long as the modifications do not increase the *tip-over moment*.

(2) Test Method 2 can be used for any unit. Gradually apply over a period of at least 5 seconds a horizontal force to the back of the unit orthogonal to the *fulcrum* to cause the unit to *tip over*. Record the force and the vertical distance from the force application point to the *fulcrum*. Calculate the *tip-over moment* of the unit by multiplying the *tip-over force* (pounds) by the vertical distance from the force application point to the *fulcrum* (feet).

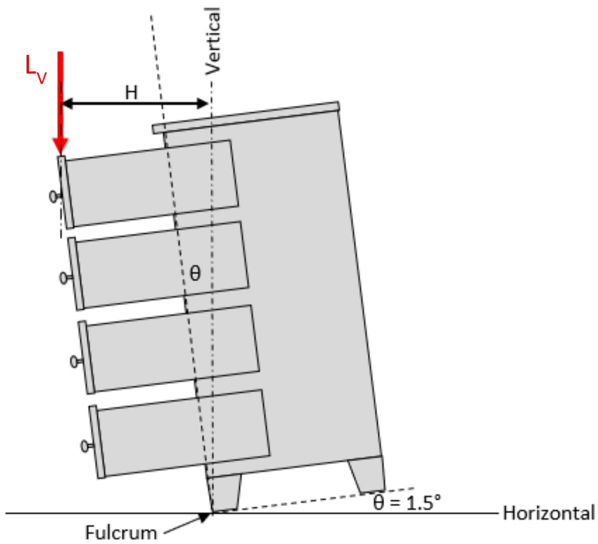


Figure 7a) Test Method 1.

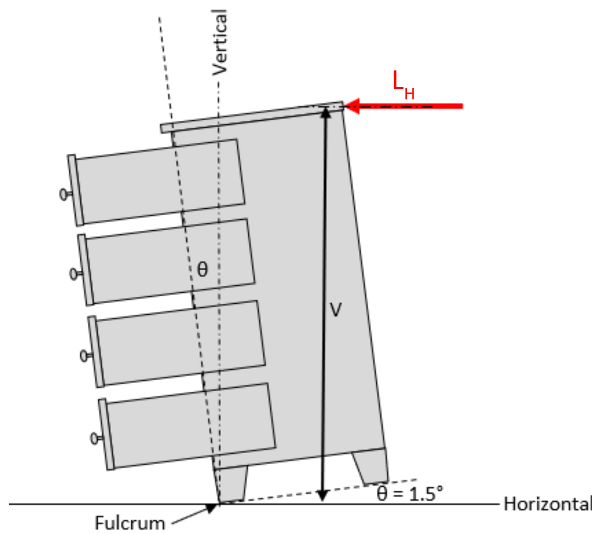


Figure 7b) Test Method 2.

Figure 7. Illustration of force application methods (tilt angle not to scale): a) Test Method 1 with vertical load L_V, and b) Test Method 2 with horizontal load L_H.

(d) *Performance requirement:* The *tip-over moment* of the clothing storage unit must be greater than the threshold moment, which is the greatest of all of the following applicable moments:

(1) [for units with a *drawer(s)* or *pull-out shelf(ves)*] 55.3 pounds times the *drawer or pull-out shelf extension from fulcrum distance* in feet + 26.6 pounds feet;

(2) [for units with a *door(s)*] 51.2 pounds times the *door extension from fulcrum distance* in feet – 12.8; and

(3) [for all units] 17.2 pounds times *maximum handhold height* in feet.

§ XXXX.5 Requirements for Marking and Labeling

(a) *Warning Label Requirements:* The clothing storage unit shall have a warning label, as defined below.

(1) *Size.* The warning label shall be at least 2 inches wide by 2 inches tall.

(2) *Content.* The warning label shall contain the following text:

Children have died from furniture tip over. To reduce the risk of tip over:

- ALWAYS secure this furniture to the wall using an anti-tip device
- NEVER allow children to stand, climb, or hang on drawers, doors or shelves.

- [for units with interlocks only] Do not defeat or remove the drawer interlock system
- Place heaviest items in the lowest drawers
- [for units that are not designed to hold a television only] NEVER put a TV on this furniture

The warning label shall contain the child climbing symbol displayed in Figure 7, below.

For units that are not designed to hold a television, the warning label shall contain the no television symbol displayed in Figure 7, below.

(3) *Format:* The warning label shall use the signal word panel content and format specified in ASTM F2057-19, Section 8.2.2, and the font, font size, and color specified in ASTM F2057-19, Section 8.2.3, as shown in Figure 7. [will include incorporation by reference language] Each safety symbol shall measure at least 1 in. by 1 in.

Figure 8. Example warning label for a CSU with an interlock system and not designed to hold a television (top) and for a CSU without an interlock system and designed to hold a television (bottom).

(4) *Location:*

(i) For units with one or more drawer(s):

(A) The warning label shall be located on the interior side panel of a drawer in the upper most drawer row, or if the top of the drawer(s) in the upper most drawer row is more than 56 inches from the floor, on the interior side panel of a drawer in the upper most drawer row below 56 inches from the floor, as measured from the top of the drawer.

(B) The top left corner of the warning label shall be positioned within 1 inch of top of the drawer side panel and within the front 1/3 of the interior drawer depth.

(ii) For units with only doors:

(A) The warning label shall be located on an interior side or back panel of the cabinet behind the door(s), or on the interior door panel. The warning label shall not be obscured by a shelf or other interior element.

(iii) For consumer-assembled units:

(A) The warning label shall be pre-attached to the panel, and the assembly instructions shall direct the consumer to place the panel with the warning label according to the placement requirements above.

(5) *Permanency:* The warning label shall be legible and attached after it is tested using the methods specified in ASTM F2057-19 Section 7.3, Permanency of Labels and Warnings Testing. [Note: this will include incorporation by reference language]

(b) Identification Labeling Requirements: The clothing storage unit shall have an identification label, as defined below.

(1) *Size.* The identification label shall be at least 2 inches wide by 1 inch tall,

(2) *Content.* The identification label shall contain the following:

(i) Name and address (city, state, and zip code) of the manufacturer, distributor, or retailer; the model number; and the month and year of manufacture.

(ii) The statement "Complies with U.S. CPSC Safety Standard for Clothing Storage Units" as appropriate; this label may spell out "U.S. Consumer Product Safety Commission" instead of "U.S. CPSC."

(3) *Format:* The identification label text shall not be less than 0.1 in. (2.5 mm) capital letter height. The text and background shall be contrasting colors (*e.g.* black text on a white background).

(4) *Location:* The identification label shall be visible from the back of the unit when the unit is fully assembled.

(5) Permanency: The identification label shall be legible and attached after it is tested using the methods specified in ASTM F2057-19 Section 7.3, Permanency of Labels and Warnings Testing. [Note: this will include incorporation by reference language]

§ XXXX.6 Requirements to Provide Performance and Technical Data by Labeling

Manufacturers of clothing storage units shall give notification of performance and technical data related to performance and safety to prospective purchasers of such products at the time of original purchase and to the first purchaser of such product for purposes other than resale, in the manner set forth below:

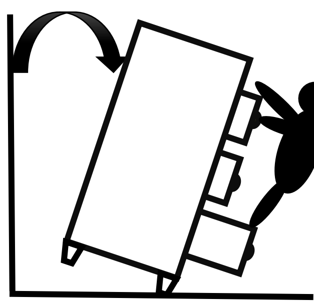
(a) Consumer Information Requirements: The manufacturer shall provide a hang tag with every clothing storage unit that provides the ratio of tip-over moment as tested to the minimally allowed tip-over moment of that model clothing storage unit. The label must conform in content, form, and sequence to the hang tag shown in Figure 1.

(1) *Size.* Every hang tag shall be at least 5 inches wide by 7 inches tall.

(2) *Side 1 Content.* The front of every hang tag shall contain the following:

(i) The title – “TIP OVER GUIDE.”

(ii) The icon:



(iii) The statement – “Stability Rating.”

(iv) The manufacturer’s name and model number of the unit.

(v) Ratio of tip-over moment, as tested per XXXX.4(c), to the threshold moment, as determined per xxxx.4(d), of that model CSU displayed on a progressive scale. This value shall be the rating.

(vi) The scale shall start at 0 and end at 5.

(vii) “Less” and “More” on the left and right sides of the scale, respectively.

(viii) A rating of 1 shall be indicated by the text “Minimum rating” and a vertical dotted line.

(ix) A solid horizontal line from 0 to the calculated rating.

(x) The statement – “Compare with other units before you buy.”

(xi) The statement – "This is a guide to compare the unit's resistance to tipping over."

(xii) The statement – "Higher number represent more stable units."

(xiii) The statement – "No unit is completely safe from tip over."

(xiv) The statement – "Always secure the unit to the wall."

(xv) The statement – "Tell children not to climb furniture."

(xvi) The statement – "See back side of this tag for more information."

(xvii) The statement – "THIS TAG NOT TO BE REMOVED EXCEPT BY THE CONSUMER."

(3) *Side 2 Content.* The reverse of every hang tag shall contain the following:

(i) The statement – "Stability Rating Explanation."

(ii) The icon in (2)(ii).

(iii) The tip rating determined in (2)(v).

(iv) The statement – "Test data on this unit indicated it withstood [insert rating determined in (2)(v)] times the minimally acceptable moment, per tests required by the Consumer Product Safety Commission (see below)."

(v) The statement – "Deaths or serious crushing injuries have occurred from furniture tipping over onto people."

(vi) The statement – "To reduce tip-over incidents, the U.S. Consumer Product Safety Commission (CPSC) requires that clothing storage units, such as dressers, chests, bureaus, and armoires, resist certain tip-over forces. The test that CPSC requires measures the stability of a clothing storage unit and its resistance to rotational forces, also known as moments. This test is based on threshold rotational forces of 3-year-old child climbing up, hanging on, or pulling on drawers and/or doors of this unit. These actions create rotational forces (moments) that can cause the unit to tip forward and fall over. The stability rating on this tag is the ratio of this unit's tip-over moment (using CPSC's test) and the threshold tip-over moment. More information on the test method can be found in 16 CFR XXXX."

(4) *Format.* The hang tag shall be formatted as shown in Figure 1. The background of front of the label shall be printed in full bleed process yellow or equivalent; the background of the back of the label shall be white. All type and graphics shall be printed in process black.

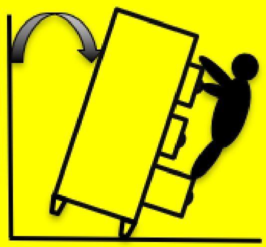
(5) *Attachment.* Every hang tag shall be attached to the CSU and clearly visible to a person standing in front of the unit. The hang tag shall be attached to the CSU

and lost or damaged hang tags must be replaced such that they are attached and provided, as required by this section, at the time of original purchase to prospective purchasers and to the first purchasers other than resale. The hang tags may be removed only by the first purchaser.

(6) *Placement*. The hang tag shall appear on the product and the immediate container of the product in which the product is normally offered for sale at retail. Ready-to-assemble furniture shall display the hang tag on the main panel of consumer-level packaging. The hang tag shall remain on the product/container/packaging until the time of original purchase. Any units shipped directed to consumers shall contain the hang tag on the immediate container of the product.

FRONT

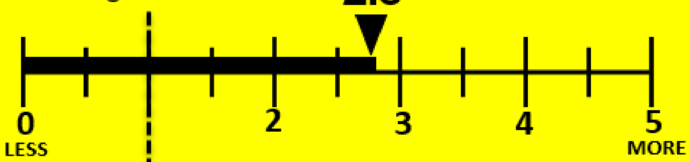
TIPOVER GUIDE



Stability Rating

XYZ Corporation Model X, ####

Minimum rating: 1



Compare with other units before you buy.

This is a guide to compare the unit's resistance to tipping over.

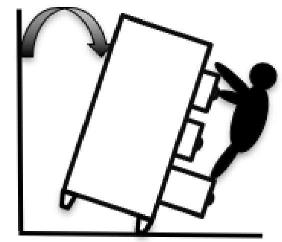
- Higher number represent more stable units.
- No unit is completely safe from tip over.
- Always secure the unit to the wall.
- Tell children not to climb furniture.

See back side of this tag for more information.

THIS TAG NOT TO BE REMOVED EXCEPT BY THE CONSUMER

REVERSE

Stability Rating: 2.8



Stability Rating Explanation

Test data on this unit indicated it withstood **2.8 times** the threshold tip over rotational force/moment, per tests required by the Consumer Product Safety Commission (see below)

Deaths and serious crushing injuries have occurred from furniture tipping over onto people.

To reduce tip-over incidents, the U.S. Consumer Product Safety Commission (CPSC) requires that clothing storage units, such as dressers, chests, bureaus, and armoires, resist certain tip-over forces. The test that CPSC requires measures the stability of a clothing storage unit and its resistance to rotational forces, also known as moments. This test is based on threshold rotational forces of 3-year-old child climbing up, hanging on, or pulling on drawers and/or doors of this unit. These actions create rotational forces (moments) that can cause the unit to tip forward and fall over. The stability rating on this tag is the ratio of this unit's tip-over moment (using CPSC's test) and the threshold tip-over moment. More information on the test method can be found in 16 CFR XXXX.

Figure 9. Hang Tag example shown for a unit with a stability rating of 2.8.

III. REQUEST FOR COMMENTS

Staff recommends seeking comments, in the draft proposed rule, on these recommended requirements, and specifically recommends seeking comments on the following:

- The scope of the standard, and the listed exclusions, including whether the excluded products should be included, or whether certain products should be excluded (e.g., light-weight products). In addition, staff recommends seeking comments on whether there should be other exclusions, such as based on a minimum storage volume, ratio of closed storage to total volume or open storage, or an exemption based on leg height or design.
- The definitions, including whether any definitions should be modified, or any additional terms should be defined.
- Whether ANSI/BIFMA SOHO S6.5-2008 (R2013), *Small Office Home Furniture-Tests* requirements for interlocks are appropriate to consider for CSU interlocks, or what different requirements and why.
- Whether the 30-pound proposed performance requirement is adequate to assess that the drawer interlock design cannot be easily defeated or over ridden by the consumer.
- Whether levelling devices should be allowed to be adjusted per the manufacturer instructions during stability testing.
- Whether levelling devices should be non-adjustable to account for carpeting.
- Whether levelling devices should require a permanent adjustment mark that indicates the position recommended for use on a carpeted surface.
- Whether 1.5-degree tilt angle is adequate to simulate carpet effect.
- Whether an inclined surface test should be added to account for sloped floors.
- Whether labeling and or instructions for proper leveling on carpet should be a requirement.
- Whether the proposed stability/moment requirements are adequate, or should be increased (e.g., the same stability requirements as in draft proposed rule, but with 60 lb child interaction, instead of lower weight/younger child reflected in draft proposed rule, or simulating more aggressive behavior) or decreased (e.g., using different force/moment values to simulate climbing).
- Whether the test method should allow for pull forces on the CSU.
- Whether any alternative test method(s) should be considered.
- Whether the drawer fill requirements are reasonable.
- Whether pull-out shelves should be tested with the same storage density as drawers.
- Whether the requirements should address designs where tip restraint installation is mandatory to unlock drawers.
- Whether the Commission should develop tip restraint requirements such as restraints permanently attached to the CSU or an attachment point such as a D-ring that will not fail when pulled at a specified force.

- Whether there should be a requirement that all CSUs come with a TV restraint device to anchor a TV to the CSU such as a universal attachment point.
- Whether there should there be a warning on CSUs to anchor the TV, when the CSU is suitable for holding a TV.
- Whether interlocks for ready-to-assemble furniture should be pre-assembled/automatically engage.
- How to test interlock systems that have an override, such as two drawers opened simultaneously.
- How to determine whether children can engage an override and whether there should be a test to override the system.
- Whether and how to test automatically closing drawers.
- Whether the product and packaging should contain a label “meets CPSC stability requirements”.
- Whether the warning requirements are adequate, or should be modified.
- Suggestions to the language or format of the warning label.
- Suggestions to the language or format of the informational label.
- Whether the hang tag rating and explanatory text is understandable.
- Suggestions to the language or format of the hang tag.
- Graphic artist improvements to the hang tag icon, that maintain symbolic, iconic representation of a tip-over event.
- Whether interlocks on other extendible elements besides drawers should be considered (e.g., doors, shelves).

TAB H: Draft Preliminary Regulatory Analysis of the Proposed Clothing Storage Unit Stability Rule

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Draft Preliminary Regulatory Analysis of the Proposed Clothing Storage Unit Stability Rule

Robert Franklin
Charles Smith
Directorate for Economic Analysis
U.S. Consumer Product Safety Commission
July 14, 2021

TABLE OF CONTENTS

EXECUTIVE SUMMARY

The U.S. Consumer Product Safety Commission (CPSC, or Commission) is considering a draft proposed rule that would establish performance and other requirements for clothing storage units (CSUs). According to the draft performance requirements, "*clothing storage unit* means a free-standing furniture item, with drawer(s) and/or door(s), that may be reasonably expected to be used for storing clothing, that is greater than or equal to 27 inches in height, and with a total functional volume of the closed storage greater than 1.3 cubic feet and greater than the sum of the total functional volume of the open storage and the total volume of the open space " (CPSC staff, 2021, Tab G). Examples include chests of drawers, bureaus, dressers, armoires, and wardrobes. The purpose of the draft proposed rule is to address deaths and injuries to children from tip overs of CSUs.

A proposed product safety rule published in the *Federal Register* in accordance with the requirements of section 9 of the Consumer Product Safety Act must include a preliminary regulatory analysis that contains a number of elements: a description of the proposed rule's potential benefits and potential costs; a discussion of why relevant voluntary standards would not eliminate or adequately reduce the risk of injury addressed by the proposed rule and a discussion of why a standard, if any, that had been submitted as a proposed standard was not being published as the proposed standard; and a description of reasonable alternatives, their potential costs and benefits, and why those alternatives should not be published as a proposed rule. 15 U.S.C. 2058(c). Staff's preliminary regulatory analysis addresses each of these issues.

Based on information from the Directorate for Epidemiology and estimates from the CPSC Injury Cost Model, in recent years, there has been an average of 6.2 deaths[1] and 6,824 medically attended injuries to children resulting from CSU tip overs each year. There has also been an average of 1.8 deaths and 4,451 medically attended injuries to adults each year that also could be addressed, to some extent, by the draft proposed rule. According to section 7(a) of the CPSA, the Commission may establish a standard to address the risk posed by CSUs if the Commission finds that the risk of CSU tip overs is "unreasonable" and that the standard is "reasonably necessary to prevent or reduce" the risk of death or injury associated with CSUs. 15 U.S.C. 2056(a).

Assuming a value of a statistical life (VSL) of $9.2 million (2018 dollars), the societal cost of the deaths is about $73.6 million. The societal cost of the nonfatal injuries was estimated using the CPSC Injury Cost Model (ICM). The ICM uses the NEISS estimates of emergency department-treated injuries and imputes estimates of injuries treated in other medical settings using the empirical relationships between injuries treated in emergency departments and these other

[1] The death incidents exclude those incidents known to have also involved CRT televisions, but they include those cases involving televisions for which the type of television involved either could not be determined, or was a flat screen.

settings. The societal cost estimates include the cost of medical treatment, lost worktime, and intangible pain and suffering costs. The total societal cost estimate of the nonfatal injuries to both children and adults is estimated to be about $345.4 million. The intangible pain and suffering costs account for about 75 percent of this total.

More than 90 percent of the fatalities not involving cathode ray tubes (CRTs) televisions happened to children 3 years old or younger. Based on analysis of the fatality cases involving children, including factors such as the child's weight and age and their interactions with the CSUs, staff concludes that the draft proposed rule could prevent almost all fatalities involving children 3 years of age and younger, but it would prevent only about 48 percent of the deaths to children ages 4 through 8. Assuming a VSL of $9.2 million, the benefit of the draft proposed rule in terms of reduced child deaths could be $53.4 million annually, a reduction in the estimated societal costs of about 94 percent. Based on a similar analysis of the NEISS cases involving children, CPSC staff believe that the draft proposed rule could reduce the nonfatal injuries to children by about 91 percent. Therefore, the benefit (reduction in societal cost of injuries) of the draft proposed rule in terms of reduced nonfatal injuries to children could be $188.7 million annually.

The draft proposed rule is not intended to reduce deaths and injuries to adults. Nevertheless, staff believes that a substantial number of adult injuries and deaths could be prevented if CSUs were inherently more stable. Less information is available on the scenarios of the tip-over incidents involving adults; therefore, staff is unable to estimate the potential reduction with as much certainty. For this analysis, based on analysis by the Division of Human Factors concerning the draft proposed rule's improvement to CSU stability, staff assumed that deaths and injuries from tip overs involving adults would be reduced at half the rate as they were for children. If adult tip-over deaths and injuries are reduced at this rate, the annual benefit would be $7.4 million in terms of reduced deaths and $56 million in terms of reduced nonfatal injuries.

The total annual benefit of the draft proposed rule in terms of the reduced societal costs of injuries and deaths to children and adults would be about $305.5 million. Given that there were about 463.5 million CSUs in use in 2017, the benefit per unit would be about $0.66 per unit annually. Over the estimated 15-year useful life of a CSU, this comes to $6.01 at a discount rate of 7 percent, $7.88 at a discount rate of 3 percent, and $ 9.90 without discounting.

Modifications in the design of CSUs to improve stability likely include the use of drawer interlocks, adding weight in the rear of the CSU, extending the front feet of the CSU, and perhaps using levelers to raise the front of the CSU to stabilize the CSU on carpeting. Based on an analysis of how five CSUs could be modified to meet the cost of the draft proposed rule, CPSC staff estimated the potential cost increases to CSU manufacturers. For four of the CSUs, the cost estimates were $13 or more per unit, and in some cases, the cost exceeded $25, which is more than the estimated average benefit per unit. For the fifth CSU, the estimated cost estimates of the modifications were in the same range as the estimated benefits per unit.

We note that we only looked at five CSU models out of the hundreds or thousands available on the market. We also note that the units analyzed were models that had been involved in tip-over incidents. Potentially they could be more unstable than other units, which suggests that the benefits of the draft proposed rule for the specific models could be higher than average. However, we do not have evidence that they are, in fact, more unstable than other CSUs, on average.

In addition to the costs that we attempted to quantify, there are unquantified costs that should also be considered. Many of the modifications required to conform to the draft proposed rule would add weight to the CSUs, making them more difficult to move; and especially in the case of ready-to-assemble CSUs, more difficult to assemble. In addition, modifications that require feet extending several inches in front of the CSU could create a tripping hazard. Finally, some CSUs could be difficult to modify to comply with the draft proposed rule requirements, and essentially might be withdrawn from the market. These might include tall and shallow CSUs. The cost in these cases would be the loss to the consumers of not being able to obtain CSUs in the desired dimensions (*i.e*., weight, height, width, and depth).

Staff considered whether the Commission could rely on the current voluntary standard, ASTM F2057-19. Staff concluded that ASTM F2057-19 does not adequately protect children from CSU tip overs for several reasons. ASTM F2057-19 does not consider the dynamic loading that can occur when a child interacts with a CSU. In addition, filled drawers are not considered in ASTM F2057-19. Finally, ASTM F2057-19 does not account for the combination of multiple factors that can coexist that contribute to instability, such as multiple open filled drawers and climbing. Staff examined alternatives to the draft proposed rule. CPSC staff did not believe that a less-stringent alternative would sufficiently reduce deaths and injuries. A more-stringent alternative was considered, but it would have increased the potential benefits of the rule only by about 4 percent over what could be obtained from the draft proposed rule. Presumably, the costs of this alternative would also be higher.

1. INTRODUCTION

The CPSC is considering a draft proposed rule to establish a mandatory stability standard for CSUs. CPSC staff initiated this rulemaking proceeding on November 30, 2017, with the publication of an advance notice of proposed rulemaking (ANPR) in the *Federal Register*.[2] The intent of this rulemaking is to reduce deaths and injuries to children resulting from CSUs tipping over on children. These tip overs often result when young children attempt to climb on the CSU;

[2] Federal Register, Vol. 82, No. 229, November 30, 2017 (56752-56759).

the weight and activity of the child, combined with the weight of any open drawers, cause the CSU to tip forward and fall on the child. Children can be killed or injured from the impact of the CSU falling on them, or from being trapped beneath the CSU, which can potentially restrict their ability to breathe. At the time of the ANPR, the Commission noted that between 2000 and 2016, there were 195 deaths associated with CSU tip-overs (an average of 12 each year), and between 2006 and 2016, there were an estimated 65,200 CSU tip-over-related injuries treated in hospital emergency departments (an average of 5,930 each year). Eighty-six percent of the deaths and 73 percent of the injuries involved children under the age of 18 years. These fatalities and injuries included incidents with and without televisions.

1.1. Draft Proposed Rule

The draft proposed rule would establish a mandatory performance standard that all CSUs would have to meet in order to be sold in the United States. The requirements of the draft proposed standard are detailed in Tab G, and the justifications for each provision are detailed in Tab C, Tab D, Tab E, and Tab M. In brief, the performance requirements of the draft standard include the following points:

1. When testing a CSU for conformance, the CSU shall be tilted forward by 1.5 degrees. This is done to mimic the effect of carpeting on the stability of CSUs. CPSC testing has found that, in general, CSUs installed on carpeted surfaces are less stable than CSUs installed on hard surfaces. More than 80 percent of the CSU tip-over incidents for which CPSC staff has been able to identify the type of flooring have occurred on carpeted surfaces (Tab C).
2. CSUs shall be tested with all doors open and all non-interlocked drawers and pullout shelves opened to their maximum extension. This provision is included because many tip-over incidents have occurred when the child had opened multiple drawers of the CSU.
3. The drawers shall be filled with 8.5 pounds per cubic foot of storage volume placed at the center of the drawer, if half or more of the drawers, by volume, can be opened simultaneously. This provision is included because, in the vast majority of cases, the CSUs involved in incidents are being used, and the drawers are filled with clothing or other items. The fill weight applies if half or more of the drawers, by volume, are open, because filled drawers make a CSU less stable when those drawers are open.
4. For CSUs with interlock systems (devices that restricts simultaneous opening of drawers than that intended by the manufacturer), the draft standard requires assessment of the integrity of that system, by applying a 30-pound force to the locked drawers to ensure they do not open or damage the interlock.
5. A tip moment will be applied to the CSU with a vertical force on the open drawer or a horizontal force acting on the back. The tip moment shall be greater than: (1) the

moment produced by a 51.2-pound child climbing (ascending) the front of the dresser; (2) the moment produced by a child climbing or hanging on an open door or drawer; and (3) the moment produced by a child pulling on an upper extended drawer. The minimum tip-over moments that a CSU must exceed to model climbing are determined based on research conducted for CPSC by the University of Michigan Transportation Research Institute (UMTRI), as well as from testing and modeling by CPSC staff. The tip-over moments will vary by CSU and will be impacted by the distance from the front edge of the drawers and doors when fully extended to the front edge of the CSU that touches the floor, and the height of the highest handhold within reach of a 95th percentile 3-year-old child or 4.12 feet.

In addition to the stability performance requirements, the draft proposed rule includes specific requirements for placement, content, symbols, and format of a permanent warning label. ESHF staff provides details about the recommended label (Balci-Sinha & Talcott, ESHF, 2021; Tab C). Manufacturers would also be required to provide consumers at the time of purchase with information about the tip rating of each CSU, so that consumers can compare the stability ratings of different CSUs. The stability information would be provided in a hang tag. A detailed discussion of the proposed hang tag is provided in a memorandum by CPSC engineering staff (Nesteruk, ESMC, 2021; Tab E).

In accordance with section 14 of the CPSA, manufacturers, importers, and private labelers would also be required to certify that their CSUs comply with the applicable standard.

The proposed rule also includes a stockpiling limit which should allow firms to meet any foreseeable increase in the demand for CSUs, without allowing large quantities of CSUs to be stockpiled. Therefore, this anti-stockpiling provision should not adversely impact manufacturers. CPSC staff welcomes comment from any manufacturer or importer that believes that they could be adversely impacted by this provision.

1.2. Preliminary Regulatory Analysis

Pursuant to section 9(c) of the Consumer Product Safety Act, publication of a proposed rule must include a preliminary regulatory analysis containing the following:

(1) a preliminary description of the potential benefits and costs of the proposed rule, including any benefits or costs that cannot be quantified in monetary terms, and an identification of those likely to receive the benefits and bear the costs;

(2) a discussion of the reasons why a standard submitted to the Commission was not published as the proposed rule;

(3) a discussion of why a relevant voluntary safety standard would not eliminate or adequately reduce the risk of injury addressed by the proposed rule; and

(4) a description of any reasonable alternatives to the proposed rule, together with a summary description of their potential costs and benefits and why such alternatives should not be published as a proposed rule.

15 U.S.C. § 2058(c).

A discussion of each of these elements follows.

2. MARKET INFORMATION

2.1. Retail Prices

The retail prices of CSUs vary substantially. The least- expensive units retail for less than $100, hile some more expensive units may retail for several thousand dollars. The less expensive units may be in use for only a few years, while the most expensive units may remain in use for decades, and they might be passed from one generation to the next.

2.2. Annual Sales and Shipments

CPSC staff estimated the annual revenues and shipments of CSUs using estimates of manufacturer and importer revenue and sales and by using data on retail sales.

The shipment value of chests of drawers and dressers combined for an estimated $5.15 billion in 2018, and combined shipments of dressers and chests totaled 43.6 million units. Average manufacturer shipment value was $118 per unit in 2018 (about $104 for chests of drawers and $144 for dressers). Well over half (64%) of the value of apparent consumption of non-upholstered wood furniture (net imports plus domestic production for the U.S. market) in 2019 was comprised of imported furniture, and this likely was true for CSUs, as well.

The estimated retail value of U.S. bedroom furniture sales in 2019 totaled $60.3 billion, of which $20.8 billion was sales of "closets, nightstands, and dressers."[3] "Closets" likely includes

[3] Statista, April 2020, https://www.statista.com/outlook/17020000/109/bedroom-furniture/united-states.

products such as free-standing armoires and wardrobes. Staff believe that "dressers" probably includes chests of drawers. Some, but not all nightstands may be considered CSUs.

2.3. Estimated CSU Units in Use

We estimate that unit sales of CSUs to U.S. consumers generally ranged from about 5 million to 10 million units annually from the 1950s to the early 1970s; 10 to 20 million units annually through 1990; 20 to 30 million units annually from 1991 – 2002, and; above 30 million units annually in more recent years. In 2018, CPSC staff estimates that about 43.6 million CSUs were sold. Using the historical sales estimates and an estimated average product life of 15 years, CPSC staff estimates that about 463.5 million CSUs were in use in 2017 and 466 million CSUs were in use in 2018.

3. PRELIMINARY REGULATORY ANALYSIS: BENEFITS ASSESSMENT

The preliminary regulatory analysis, which requires a description of the potential benefits and potential costs of the draft proposed rule, is conducted from a societal perspective, considering all of the significant costs and health outcomes (Gold et al., 1996; Haddix, Teutsch, and Corso, 2003; Neumann et al, 2016). The benefits of the rule are measured as the expected reduction in the societal costs of deaths and injuries that would result from adoption of the draft proposed rule. The costs of the rule are defined as the added costs associated with modifying CSUs to comply with the requirements of the rule, including any impacts on the utility of the CSUs for consumers. Our primary outcome measures are the expected net benefits (*i.e.*, benefits minus costs) of the rule.

This section of the regulatory analysis is laid out as follows: Section 4.1 discusses the number of deaths and injuries associated with CSU tip overs and the societal costs of these deaths and injuries. Section 4.2 discusses how the draft proposed rule and the other regulatory options considered by the Commission could reduce the number of deaths and injuries, as well as the societal costs associated with the tip-over incidents.

3.1. Deaths and Injuries Related to Tip Overs of CSUs

CPSC's Directorate for Epidemiology, Division of Hazard Analysis, identified 179 deaths related to CSU tip-over incidents involving children that occurred from 2001 through 2016.[4]

[4] As explained above, for this preliminary regulatory analysis, we used the data for 2001 to 2016, rather than the more recent data provided in the briefing package for this draft proposed rule, in order to calculate an annual average. Data collection is ongoing for more recent years. If the data included the years for which data collection is ongoing, the calculated annual average would be low.

This results in an average of 11.2 deaths per year over this 16-year period. These are the deaths associated with CSU tip-over incidents of which CPSC staff is aware. The actual number of deaths from CSU tip-over deaths during this period could be higher. All of the known deaths involving children were to children 8 years of age or younger.

Ninety-seven of the 179 deaths also involved television sets that had been placed on top of the CSU. Of the 97 deaths involving televisions, 80 (82 percent) involved older, heavy CRT televisions. There was not enough information in the records to determine the type of television associated with 15 of the deaths involving a television. Only one of the deaths is known to have involved a flat-panel television. The older CRT televisions are usually substantially heavier than the newer flat-panel televisions. CRT televisions with 19- to 32-inch screens can weigh between about 40 pounds to 163 pounds; while similarly sized flat-screen televisions typically weigh less than 30 pounds. An analysis by Lee and Volanth (2015) of the dynamics of tip-over incidents involving televisions found that in a tip-over incident, a CRT television would predictably begin to slide forward, and in the case of a child positioned in the front of a CSU, the television could easily "strike the child, knocking the child to the ground, with the TV and furniture possibly landing on top of the child." The analysis found that the fall pattern of flat-screen televisions was more random. The report notes that a front-heavy CRT television placed on the top of a dresser could shift the center of gravity of the CSU forward, making it less stable. This is especially a concern if a large CRT television is placed on a surface that is too small for the television (Lee and Volanth, 2015). Based on this analysis, one could conclude that as the number of CRT televisions in use decreases, the number of tip-over incidents and their severity will decrease. In 2010, about 55 percent of all televisions in use were CRT televisions. By 2020, that percentage was expected to be about 9 percent; and it is expected to decline to less than 1 percent by 2030 (Smith, 2010). Thus, incidents involving CRT televisions are not considered in the main analysis. Considering only those cases for which we know that a CRT television was not involved, there were 99 fatalities (179 deaths less 80 that involved a CRT television) during the 16-year period, or an average of 6.2 per year.

Although the draft proposed standard is intended to address CSU fatalities involving children, during the same period from 2001 through 2016, there were 29 fatalities involving adults and CSUs tipping over, or an average of 1.8 a year. Fourteen of these victims were age 80 years or older, and none was younger than 40. It is possible that some of these or similar deaths could have been prevented had the CSUs involved met that stability requirements of the draft proposed rule. None of these 29 adult fatalities involved a television.

Based on data from the National Electronic Injury Surveillance System (NEISS), a national probability sample of U.S. hospital emergency departments (EDs), there were 14,843 nonfatal injuries to children under the age of 18 years involving CSU tip-overs during the 5-year period 2015 through 2019, or an average of 2,969 per year, that were treated in hospital emergency departments. About 2,312 of these injuries (an average of 462 per year), or about 16 percent, involved televisions that had been placed on top of the CSUs. However, we are not making any adjustments for nonfatal injuries that also involved a television set, because there is generally less information available about the nonfatal injuries than for the fatality cases, making it more difficult to determine if the television involved was a CRT or a flat screen. We also only used the NEISS incidents in the period 2015 through 2019, and as discussed above, during this period, the average number of CRT televisions in use would have been significantly less than in the period 2001 through 2015, for fatalities.

In addition to injuries initially treated in hospital EDs, many product-related injuries are treated in other medical settings, such as physicians' offices, clinics, and ambulatory surgery centers. Some injuries also result in direct hospital admission, bypassing the hospital ED entirely. The number of CSU-related injuries treated outside of hospital EDs can be estimated with the CPSC's Injury Cost Model (ICM), which uses empirical relationships between the characteristics of injuries (diagnosis and body part) and victims (age and sex) initially treated in hospital EDs and the characteristics of those initially treated in other settings.

The ICM estimate of injuries treated outside of hospitals or hospital EDs (*e.g.*, in doctors' offices, clinics) is based on data from the Medical Expenditure Panel Survey (MEPS). The MEPS is a nationally representative survey of the civilian, non-institutionalized population that quantifies individuals' use of health services and corresponding medical expenditures. To project the number of direct hospital admissions that bypass hospital EDs, the ICM uses data from the Nationwide Inpatient Sample of the Healthcare Cost and Utilization Project (HCUP-NIS). HCUP is a family of healthcare databases and related software tools and products developed through a federal-state-industry partnership and sponsored by AHRQ. The HCUP-NIS provides information annually on approximately 3 million to 4 million in-patient stays from about 1,000 hospitals. A detailed discussion of the methodology used by the ICM to estimate medically treated injuries outside of hospital EDs is given in Lawrence et al. (2018).

Based on the NEISS estimate of 14,843 ED-treated injuries in 2015 through 2019, the ICM projects approximately 19,282 CSU tip-over injuries treated in other settings during the same 5-year period, or an average of 3,857 per year. Combining the NEISS estimate of injuries treated in hospital emergency departments with the ICM estimate of medically attended injuries treated in other settings brings the estimate of all nonfatal, medically attended CSU tip-over injuries to children under the age of 18 years to 34,126 during the years 2015 through 2019, an average of 6,825 per year.

During the same 2015 to 2019 period, there were an estimated 7,048 adults, 18 years of age and older, that were treated in emergency departments because of injuries received when CSUs tipped over. Some of the scenarios involved in the injuries to adults included a CSU falling when the victim attempted to open drawers or when the victim held onto the CSU for support. Although the draft proposed rule is intended to reduce injuries to children, some portion of the injuries to adults would probably have been prevented had the CSUs involved met the stability requirements of the draft proposed rule. Based on the NEISS estimate of 7,048 injuries to adults treated in emergency departments, the ICM projects that there were 15,657 injuries treated in other medical settings, for a total of 22,705 medically attended injuries to adults involving CSU tip overs, or an average of 4,451 a year.

3.2. Societal Costs of Deaths and Injuries

To estimate the societal costs of CSU-related deaths, we apply an estimate of the value of statistical life (VSL), an estimate used in benefit-cost analysis to place a value on reductions in the likelihood of premature deaths (OMB, 2003). The VSL does not place a value on individual lives, but rather, it represents an extrapolated estimate, based on the rate at which individuals trade money for small changes in mortality risk (OMB, 2003). Estimates of the VSL in the economics literature are based on a "willingness to pay" methodology, which attempts to measure how much individuals are willing to pay for a small reduction in their own mortality risks, or how much additional compensation they would require to accept slightly higher mortality risks. For this analysis, we apply estimates of the VSL developed by the U.S. Environmental Protection Agency (EPA) (2014). In 2018 dollars, the EPA estimate of the VSL is about $9.2 million, suggesting the societal cost of the fatalities is about $57.0 million annually, if only those deaths to children reported not to involve a CRT television are included (6.2 x $9.2 million). If all deaths are included, the societal costs of the fatalities would be $103.0 million annually ($9.2 million × 11.2 deaths per year). The societal cost of the adult fatalities would be $16.6 million a year (1.8 deaths x $9.2 million).

The societal costs of the nonfatal CSU injuries are quantified with the ICM. The ICM is fully integrated with NEISS, and in addition to providing estimates of the societal costs of injuries reported through NEISS, the ICM also estimates the costs of medically treated injuries that are initially treated outside of hospital emergency departments. The aggregated societal cost components provided by the ICM include medical costs, work losses, and the intangible costs associated with lost quality of life, or pain and suffering (Lawrence et al., 2018).

Medical costs include three categories of expenditures: (1) medical and hospital costs associated with treating the injury victim during the initial recovery period and in the long run, including the costs associated with corrective surgery, the treatment of chronic injuries, and rehabilitation services; (2) ancillary costs, such as costs for prescriptions, medical equipment, and ambulance transport; and (3) costs of health insurance claims processing. Cost estimates for these expenditure categories were derived from a number of national and state databases, including the Medical Expenditure Panel Survey, the Nationwide Inpatient Sample of the Healthcare Cost and Utilization Project (HCUP-NIS), the Nationwide Emergency Department Sample (NEDS), the National Nursing Home Survey (NNHS), MarketScan® claims data, and a variety of other federal, state, and private databases.

Work loss estimates are intended to include: (1) the forgone earnings of the victim, including lost wage work and household work; (2) the forgone earnings of parents and visitors, including lost wage work and household work; (3) imputed long-term work losses of the victim that would be associated with permanent impairment; and (4) employer productivity losses, such as the costs incurred when employers spend time juggling schedules or training replacement workers. Estimates are based on information from the MEPS, the Detailed Claim Information (a workers' compensation database) maintained by the National Council on Compensation Insurance, the National Health Interview Survey, the U.S. Bureau of Labor Statistics, and other sources.

The intangible, or non-economic, costs of injury reflect the physical and emotional trauma of injury, as well as the mental anguish of victims and caregivers. Intangible costs are difficult to quantify because they do not represent products or resources traded in the marketplace. Nevertheless, they typically represent the largest component of injury cost and need to be accounted for in any benefit-cost analysis involving health outcomes (Rice et al., 1989; Haddix, Teutsch, and Corso, 2003; Cohen and Miller, 2003; Neumann et al, 2016). The ICM develops a monetary estimate of these intangible costs from jury awards for pain and suffering. Although these awards can vary widely on a case-by-case basis, studies have shown them to be systematically related to a number of factors, including economic losses, the type and severity of injury, and the age of the victim (Viscusi, 1988; Rodgers, 1993; Cohen and Miller, 2003). The ICM estimates were derived from regression analysis of jury awards in nonfatal product liability cases involving consumer products compiled by Jury Verdicts Research, Inc.

Information on the societal costs associated with nonfatal CSU injuries to children under the age of 18 years are presented in Table 1.a., and the societal costs of the nonfatal injuries to adults are presented in Table 1.b. The estimates are the average annual costs for the 5-year period from 2015 through 2019. The national estimates of medically attended injuries described above are presented in column 2, and include not only the 2,969 injuries to children initially treated in hospital EDs (1,410 in the case of adults), but also the 3,857 other medically attended injuries initially treated outside of hospital EDs (3,131 in the case of adults). The estimated injury costs range from about $15,015 per injury treated in physicians' offices, to about $34,522 for injuries treated and released from a hospital ED, to about $323,296 for hospital admitted injuries (averaging the costs associated with those admitted from the ED and those admitted to the hospital bypassing the ED). The average cost of injuries to adults was slightly lower than the average cost of injuries to children: $28,344 vs. $31,757. Altogether, the societal costs of nonfatal injuries to children involving CSUs averaged $216,747,160 annually, from 2015 through 2019. The cost of injuries to adults averaged $128,710,471 annually over the same period.

Table 1.a. Average Annual Nonfatal Injury Costs Associated with CSU Tip-Overs to Children Under the Age of 18 (2015–2019).

Place of Treatment	National Estimate	Medical Cost	Work Loss	Pain and Suffering	Average Total Cost	Total Cost
Doctor / Clinic	3,804	$653	$1,521	$12,842	$15,015	$57,112,589
Emergency Department	2,830	$2,886	$1,767	$29,899	$34,552	$97,786,129
Hospital-Adm Direct	53	$31,157	$105,672	$160,347	$297,176	$15,654,763
Hospital-Adm via ED	139	$34,371	$116,072	$182,813	$333,256	$46,193,679
AVERAGE		$2,499	$4,753	$24,505	$31,757	
TOTAL	6,825	$17,057,479	$32,438,983	$167,250,698		$216,747,160

Source: CPSC Injury Cost Model and NEISS cases involving CSU tip over for the years 2015 through 2019

Table 1.b. Average Annual Nonfatal Injury Costs Associated with CSU Tip-Overs to Adults 18 Years of Age and Older (2015–2019).

Place of Treatment	National Estimate	Medical Cost	Work Loss	Pain and Suffering	Average Total Cost	Total Cost
Doctor / Clinic	3094	$837	$2,692	$13,800	$17,329	$53,613,046
Emergency Department	1,284	$2,519	$2,516	$21,247	$26,281	$33,731,304
Hospital-Adm Direct	37	$38,728	$72,391	$139,589	$250,707	$9,396,404
Hospital-Adm via ED	126	$40,739	$69,784	$142,870	$253,393	$31,969,717
AVERAGE		$2,734	$5,081	$20,529	$28,344	
TOTAL	4,541	$12,412977	$23,074,265	$93,223,230		$128,710,471

Source: CPSC Injury Cost Model and NEISS cases involving CSU tip over for the years 2015 through 2019

3.3. Potential Benefits of Stability Requirements for CSUs

As discussed in 1.1 above, the draft proposed rule would establish a performance standard that is intended to reduce significantly the risk of CSUs tipping over when children climb on or otherwise interact with them. The standard would require that the tip-over moment of a CSU, as determined by the method in the draft standard, exceed the moment that would be produced by a

51.2-pound child climbing up a drawer or hanging on a door, or a child pulling on drawers and doors of the CSU. The following section estimates the projected reduction in the societal costs of deaths and injuries should the draft proposed rule be promulgated.

Table 5 summarizes the annual societal costs of deaths and injuries by age of the victims. This information will be used in estimating the anticipated reduction in the societal costs of injuries that can be anticipated if a regulation is promulgated. The costs associated with fatalities are based on the fatalities known to CPSC staff that occurred from 2001 through 2016, and excludes those fatalities in which CRT televisions were known to be involved. Incidents known to involve a CRT television were excluded because, in many cases, the CRT televisions are believed by the investigators and CPSC staff to have contributed to the instability of the CSU and the severity of the injury. In addition, because sales of CRT televisions largely ceased by about 2008, there will be significantly fewer incidents involving CRT televisions in the coming years. Based on CPSC's staff projections, we expect that by 2030, there will be fewer than 4.5 million CRT televisions in use, and they will make up less than 1 percent of all televisions in use.[5]

Cases for which the type of television involved could not be determined were included because some of these incidents might have involved a flat-panel television and also to account for the possibility that some of the cases involving a CRT television might have occurred, even if a CRT television had not been placed on the CSU. Because incidents involving CRT televisions will continue to decrease without any CPSC action, the estimates excluding incidents involving CRT televisions probably better represents the societal costs that would be reduced by a CPSC regulation.[6] The societal costs of nonfatal injuries are based on NEISS cases occurring from 2015 through 2019. No adjustment for the potential involvement of CRT televisions has been made in the nonfatal estimates. This is because there were fewer CRT televisions in use in the period 2015 through 2019, which is the period we used for estimating the number of nonfatal injuries. Fewer than 16 percent of the nonfatal injuries involving children, and less than 4 percent of the injuries involving adults, also involved a television of any kind.

[5] Charles Smith, "CRT Televisions: Information on Unit Sales and Number in Use," CPSC Memorandum to Ian B. Hall, Consumer Product Safety Commission, Bethesda, Maryland (July 2, 2010).

[6] Excluding just the cases known to have involved a CRT television while including all cases involving an unknown type of television is not the ideal way of adjusting for the influence of CRT televisions. Although it is clear from the case reports that in many cases, the presence of a heavy CRT television was a significant factor in the incident, it is possible that some cases might have occurred even if a CRT television was not involved. The presence of a television on the CSU itself might have provided the incentive for a child to climb on the CSU. However, the rate of children climbing in incidents involving CSUs with televisions is similar to that for incidents involving CSUs without televisions. This incentive would exist even if the CRT television was eventually replaced with a flat-screen television. Therefore, it seems likely that including all cases, including those involving CRT televisions, would result in estimates that are too high. On the other hand, excluding all cases that could have involved a CRT television might result in estimates that are somewhat low. Therefore, the approach taken here, which allows that some cases that cases that involved a CRT television would have occurred even if the CRT television was replaced with a flat-screen television might be a reasonable approach.

As discussed above, the requirements of the draft proposed rule are intended to protect children that weigh 51.2 pounds or less, which is the 95th percentile weight of 3-year-old males. The test method in the draft proposed rule simulates a reasonable worst-case scenario under which a CSU tip-over incident could occur. The CSU is tilted forward at an angle of 1.5 degrees to simulate the effect of carpeting. A CSU placed on a carpeted surface is expected to be less stable than a CSU placed on a hard surface. All drawers that can be opened are opened, and if more than half the drawers can be opened, they are weighted or filled at a rate of 8.5 pounds per cubic foot of storage volume to simulate the weight of clothing. When drawers are opened, the CSU is less stable than when drawers are closed. When fewer than half of the drawers can be opened, they are not weighted or filled. This is to ensure that the CSU is tested under a more severe condition. If the drawers that were closed were weighted or filled, it would increase the stability of the CSU; open and filled drawers decrease stability.

Given the severity of the test procedures, CPSC staff concludes that the draft proposed rule should prevent CSU tip-over incidents caused by children climbing up, hanging on, or pulling on drawers and doors of the CSU, provided that the child weighs 51.2 pounds or less. The draft proposed rule is also expected to prevent other common, but less severe, scenarios such as opening drawers without climbing, putting items in and out of drawers, or playing in a drawer. CPSC staff believes that the draft proposed rule could prevent virtually all of these tip-over incidents involving children who are most at risk and probably many similar incidents involving older children and adult victims. The draft proposed rule would be less effective in reducing tip overs in some severe, but less common scenarios, such as bouncing and yanking. These scenarios were not directly observed in the incident data (Balci-Sinha and Talcott, ESHF, 2021; Tab C).

Table 2: Annual Societal Costs of Injuries and Deaths by Age (millions of dollars)

Age (in years)	Fatalities*	Societal Cost Fatalities	Injuries	Societal Cost of Nonfatal Injuries	Societal Costs of Injuries and Deaths
Less Than 2	2.4	$22.1	1,039	$29.3	$51.4
2	1.9	$17.5	1,498	$58.7	$76.2
3	1.4	$12.9	1,346	$43.5	$56.4
4	0.1	$0.9	980	$41.1	$42.0
5	0.1	$0.9	582	$13.9	$14.8
6	0.1	$0.9	532	$13.7	$14.6
7	0.1	$0.9	172	$5.7	$6.6
8	0.1	$0.9	244	$2.9	$3.8
9 to 17	-	-	431	$8.1	$8.1
Total Children	6.2	$57.0	6,824	$216.9	$273.9
18 and Over	1.8	$16.6	4,541	$128.7	$145.3
Total	8.0	$73.6	11,366	$345.6	$419.2

*Average fatalities per year from 2001 through 2016
** Average number of medically attended injuries from 2015 through 2019

3.3.1. Benefits from Reduced Fatalities

A review of the fatal CSU tip-over incidents involving children and used in this analysis found that all of the victims weighed less than 51.2 pounds. Given staff's conclusion that the draft requirements would prevent most all tip-overs involving children who weigh less than 51.2 pounds, we believe that all of these fatalities could have been prevented if the CSUs involved had complied with these requirements. More than 90 percent of the child fatalities involved children 3 years old or younger. The vast majority of children of this age weigh less than 51.2 pounds. However, there were a few fatalities, an average of about 1 every other year, to older children who could weigh more than 51.2 pounds. Therefore, for purposes of projecting the benefits of the draft proposed rule, although we predict that almost all fatalities involving children 3 years of age and younger could be prevented,[7] we estimate that only about 48 percent of the deaths to children ages 4 through 8 would be prevented. These calculations are based on analysis by the Division of Human Factors staff concerning the potential of the draft proposed rule to prevent tip-over deaths by age. Therefore, based upon the fatalities between 2001 and 2016, we estimate that had all CSUs met the requirements of the draft proposed, about 94 percent of the deaths to children could have been prevented, or an average of 5.8 deaths could have been

[7] We assume all deaths involving children age 2 years old and younger would be prevented and about 95 percent of the deaths involving 3-year-old children would be prevented.

prevented each year. Assuming a VSL of $9.2 million, the benefit of the draft proposed rule in terms of reduced child deaths could be $53.4 million annually.

As noted above, there are also an average of 1.8 fatalities to adults each year from CSU tip-over incidents. There is less information available regarding the tip-over incidents involving adults. In general, the incidents involving adults tend to involve older adults. All of the adult fatalities involved victims over the age of 42 years; and more than half were over 80 years old or over. Many of the available narratives of these incidents suggest that victims were losing their balance and grabbed the CSU in an effort to balance themselves. Although adults weigh more than 51.2 pounds, because the adults were not attempting to climb the CSUs, the full weight of the adult victim was probably not on the CSU when the incident occurred. Moreover, many of the nonfatal cases involved adults interacting with the CSU, by opening drawers, getting items in and out of drawers, or leaning on the CSU. In many cases, these scenarios are expected to be less or equally severe scenarios, compared to children climbing with all drawers filled and opened. Therefore, CPSC staff has concluded that a substantial portion of the CSU tip-over incidents involving adults would be prevented if the stability of the CSUs was improved (Balci-Sinha and Talcott, ESHF, 2021; Tab C). Although we cannot estimate the exact portion of the incidents involving adults that would be prevented, for purposes of attempting to quantify the benefits of the draft proposed rule, this analysis assumes that the draft proposed rule would prevent adult tip-over incidents at about one-half the rate that it prevents child tip-over incidents. On average, this is approximately 0.8 adult fatalities prevented annually or a societal benefit of about $7.4 million annually.[8]

Together, the potential benefits of the draft proposed rule from reducing fatal tip-over incidents to both adults and children is estimated to be $60.8 million annually, if all CSUs complied with the requirements. This consists of an estimated $53.4 million from reducing approximately 5.8 child fatalities a year and 7.4 million from reducing an average of 0.8 adult fatalities a year. We emphasize that the annual benefits would not actually reach this level until most CSUs in use meet the requirements of the draft proposed rule. Given that staff estimates there are at least 460 million CSUs in use, annual sales are about 44 million units, and the average useful life of CSUs is 15 years, it would likely be more than 10 years after such a requirement goes into effect before the annual benefits approach this level.

3.3.2. Benefits from Reduced Injuries

To evaluate the effectiveness of the draft proposed rule in reducing nonfatal injuries, CPSC staff examined 1,463 NEISS records to determine what the child was doing when the tip-over incident occurred. In 925 incidents, it was not possible to determine the interaction involved in the

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[8] We estimate that the draft proposed rule could prevent about 94 percent of the fatalities involving children (5.5 deaths prevented/6.2 total deaths). If the draft proposed rule prevents adult fatalities at one-half this rate, then about 47 percent of the 1.8 annual deaths to adults might be prevented.

incident. The remaining 538 incidents were reviewed to determine whether it was likely that the draft proposed rule would have prevented the incident. Staff's conclusions regarding these incidents are summarized in Table 3. The following discussion explains the basis for staff's conclusions.

Most of the incidents, accounting for 412 incidents (74 percent), involved a child climbing the CSU. Because the draft proposed rule is intended to prevent furniture tip-overs involving children 51.2 pounds or less climbing on CSUs, staff assumed that all of these incidents would be prevented if the victim weighed less than 51.2 pounds. The NEISS record does not include the weight of the victim, so staff used the age of the victims and data on the distribution of weight by age and sex to estimate the number of incidents that the draft proposed rule might have prevented.

Staff assumed that all incidents involving children 2 years of age and younger that involved climbing a CSU would have been prevented by the draft proposed rule because the 95th percentile weight for boys is only about 75 percent of 51.2 pounds. Therefore, it is safe to conclude that virtually all children 2 years of age and younger weigh less than 51.2 pounds and would be protected by the draft proposed rule. For 3-year-old children, the 95th percentile weight for boys is 51.2 pounds, which means that an estimated 5 percent of 3-year-old boys weigh more than 51.2 pounds and might not be protected by the draft proposed rule. To account for this, staff assumed that only 95 percent of the incidents involving 3-year old children would have been prevented by the draft rule. For 4-year old children, based on the percentile weights from the CDC, the 90th percentile weight for boys is 49.1 pounds and the 95th percentile weight is greater than 51.2. For 4-year-old girls the 95th percentile weight is 50.1 pounds. Based on these percentile weights, staff assumed that 92.5 percent of the climbing-related incidents involving 4-year-old children would have been prevented. Staff followed the same procedure to estimate the percentage of incidents to children ages 5 years through 8 years. For example, for children 6 years of age, the 75th percentile weight for both boys and girls is greater than 51.2 pounds. The 50th percentile weights for boys and girls are 50.3 and 48.6 pounds, respectively. Based on these weights, staff estimates that the draft proposed rule would have prevented 50 percent of the climbing incidents that involved 6-year-old children. Based on the percentile weights from the CDC, virtually all children 9 years of age and older would be expected to weigh more than 51.2 pounds. Therefore, staff cannot be confident that any of the climbing incidents involving children older than 8 would have been prevented by the draft proposed rule.

Another 49 tip-over incidents involved children who were reaching into the CSU, or placing items in, or retrieving items from, the CSU. In a few cases, the victim was playing in the bottom drawer of the CSU, or hit the CSU when it tipped over. None of these scenarios would be expected to cause as much rotational force on a CSU as climbing a CSU would. Staff believes that CSUs that meet the requirements of the draft proposed rule, which is intended to prevent tip-over in more severe circumstances, would not tip over in these incidents. Therefore, staff believes that all of these incidents would have been prevented by the draft proposed rule.

A total of 58 incidents involved children pulling on the CSU, or opening drawers. Staff analyzed these incidents based on children's pull strength by age and determined that 62 percent of these incidents would be prevented by the draft proposed rule.

Finally, there were 19 incidents that involved activities such as the victim "swinging" on the CSU, jumping from the CSU, and being on top of the CSU. Based on staff's analysis, we are assuming that 47 percent would be prevented by the draft proposed rule. Staff considers 22 incidents in which some "other person" caused the tip over as part of the unknown scenarios, because details on the "other person" are not available to make an estimate.

In total, as shown in Table 3, staff believes that the draft proposed rule would have prevented about 87 percent of NEISS tip-over injuries involving children 17 years of age and under, including about 91 percent of the tip-over incidents involving children climbing on CSUs. As indicated in Table 2, the average annual societal cost of nonfatal injuries to children from CSU tip-over incidents is about $216.9 million. If the draft proposed rule can prevent 87 percent of these injuries, the annual benefit from the reduction of nonfatal injuries to children would be $188.7 million.

As with the adult fatality victims, there is less information available on the activities of the adult victims of the nonfatal incidents. In many cases, the narrative in the NEISS record simply contains a statement such as "dresser fell onto hand," with no description of the interaction. In perhaps a dozen cases (out of 177), the narrative indicates that the victim might have grabbed onto the CSU for balance, or was falling and hit the CSU. We can also assume that some dressers tipped over when the adult was opening drawers to place items in or remove items from the dresser as some incidents involving children did. Given the very limited information on the activities of the adult victims at the time of the tip-over incident, we do not have a basis for making strong estimates of the number of incidents that would have been prevented by the draft proposed rule. However, it is reasonable to expect that a rule that requires CSUs to be more stable will reduce nonfatal injuries to adults. In this analysis, we will simply assume that nonfatal incidents involving adults will be reduced by half the percentage that nonfatal incidents to children are reduced. Because we believe that the draft proposed rule will reduce nonfatal tip-over injuries to children by 87 percent, we assume that nonfatal adult tip-over injuries will decline by 43.5 percent. Because the average annual societal cost of nonfatal tip-over injuries to adults is estimated to be $128.7 (see Table 2), when all CSUs comply with the draft proposed rule, the societal cost of the injuries would be reduced by $56.0 million annually.

Table 3. Projected Reductions in Nonfatal Injuries

	Age of Child in Years									
Scenario	< 2	2	3	4	5	6	7	8	9 - 17	Total
Climbing front of CSU	*64*	*128*	*109*	*60*	*25*	*14*	*6*	*4*	*2*	*412*
Percent Prevented	*100%*	100%	*95%*	*92%*	*63%*	*50%*	*25%*	*8%*	*0%*	*91%*
Number Prevented	*64*	*128*	*104*	*55*	*16*	*7*	*2*	*0*	*0*	*375*
In drawer	5	5	5	1	-	1	-	1	*0*	18
Playing in drawer	2	1	1	-	1	-	-	-	*0*	5
Putting item in/out drawer	-	1	3	1	5	2	1	-	*0*	13
Reaching	-	1	2		-	2	-	-	*2*	7
Pulled up	-	-	-	1	-	-	-	-	*0*	1
Hit	3	-	1	-	-	-	-	-	1	5
Subtotal	10	8	12	3	6	5	1	1	3	49
Percent Prevented	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%
Number Prevented	10	8	12	3	6	5	1	1	3	49
Jump	-	2	-	-	1	-	-	1	*0*	4
On top	-	-	1	1	-	-	-	-	*1*	3
Swinging	-	-	-	1	-	-	-	-	*0*	1
Other	1	1	-	2	2	-	-	-	*5*	11
Subtotal	1	3	1	4	3	-	-	1	*6*	19
Percent Prevented	100%	67%	100%	63%	33%	na	na	na	17%	45%
Number Prevented	1	2	1	2.5	1	0	0	0	*1*	8.5
Opening drawers	7	9	11	8	1	2	1	1	*2*	42
Pulled on	7	4	3	2	-	-	-	-	*0*	16
Subtotal	14	13	14	10	1	2	1	1	*2*	58
Percent Prevented	100%	95%	50%	25%	0%	0%	0%	0%	0%	62%
Number Prevented	14	12.4	7	2.5	0	0	0	0	0	*35.9*
Total NEISS Incidents Reviewed	89	152	136	77	35	21	8	7	13	538
Total Number Prevented	89	150	124	63	23	12	3	1	4	469
Percent Prevented	100%	99%	91%	82%	65%	57%	31%	19%	31%	87%

3.3.3. Summary of Expected Benefits

In summary, if the Commission adopts the draft proposed rule, once all CSUs in use comply with the requirements, we expect that there will be virtually no fatal tip-over injuries to children 8 years of age and under and fatal injuries to adults will be reduced by one-half. We expect nonfatal injuries to children to be reduced by 83 percent and nonfatal injuries to adults to be reduced by 41.5 percent. The total reduction in societal costs (or benefit from the draft proposed rule) would be $305.5 million annually and is summarized in Table 4.

Table 4. Summary of Expected Annual Benefits

Description	Current Annual Number of Incidents	Current Societal Cost (millions)	Expected Reduction in Incidents	Expected Annual Benefit (millions)
Child Fatalities	6.2	$57.0	5.8	$53.4
Adult Fatalities	1.8	$16.6	0.8	$7.4
Non-Fatal Child Injuries	6,824	$216.9	5,937	$188.7
Non-Fatal Adult Injuries	4,541	$128.7	1,975	$56.0
Total	---	$419.2	--	$305.5

3.3.4. Benefits per CSU in Use

Generally, it is useful to discuss the benefits of a rule on a per-unit basis. This facilitates the comparison of the benefits of a rule to the costs when the costs are also expressed on a per-unit basis. To calculate the benefits of a standard on a per-unit basis, one divides the estimated annual benefit, by the number of units in use during the year. The result is the benefit per unit per year. The present values of expected annual benefits over the expected life of the product are summed to obtain the per-unit benefit. In general, one should include only those injuries that occurred on products that do not meet the requirements of the standard, and divide that number by the units in use that do not meet the standard. In this analysis, however, given that staff has only identified one CSU that meets the requirements of the draft proposed rule without some modifications, staff assumes that all injuries and deaths to children occurred on CSUs that did not meet the requirements of the draft proposed rule.

Staff estimates that there were 463.5 million CSUs in use in 2017, which because staff is using the NEISS data from 2015 through 2019 to calculate the societal cost of injuries, this is approximately the average number of CSUs in use during the period. Using these estimates, the estimated annual benefit per unit of the draft proposed rule would be $0.66. As noted, we have assumed that the average product life of a CSU is 15 years. However, this includes the generally less expensive ready-to-assemble (RTA) CSUs that might have expected useful lives that are less than 15 years and the generally more expensive factory-assembled CSUs that could have expected lives greater than 15 years. Assuming the average CSU has a product life of 15 years, benefit per unit of the draft proposed rule is the present value of the annual benefits per unit summed over the expected 15-year life of a CSU. Table 5 gives the estimated benefits per unit of the draft proposed rule using the 3 percent and 7 percent discount rates recommended by the Office of Management and Budget in Circular A-4. However, because interest rates have declined significantly since Circular A-4 was issued in 2003, we also include the undiscounted values.[9] As shown in Table 5, the benefits per unit of the draft proposed rule range from $6.01 to $9.90, depending upon the discount rate considered appropriate.

Table 5. Benefits per Unit by Discount Rate

Discount Rate	Annual Benefit/Unit	Benefit/Unit Over the 15-Year Life of the CSU
Undiscounted	$0.66	$9.90
3 Percent	$0.66	$7.88
7 Percent	$0.66	$6.01

4. PRELIMINARY REGULATORY ANALYSIS: COST ANALYSIS

This section discusses the costs the draft proposed rule would impose on society. The costs include the costs that would be incurred to redesign and modify CSUs so that they meet the requirements of each of the standards. These costs include the increased cost to manufacture and distribute compliant CSUs. The costs also include the costs and impacts on consumers. These include the cost of additional time to assemble RTA furniture and the loss of utility if certain desired characteristics or styles are no longer available, or if compliant CSUs are less convenient to use. The costs of designing, manufacturing, and distributing compliant CSUs would be

[9] In supporting the 3 percent discount rate in 2003, OMB noted that the nominal rate of return on 10-year Treasury notes had averaged 8.1 percent for the previous 20 years, and the consumer price index had averaged 5 percent, suggesting a real rate of return of about 3.1 percent. However, the real yield on 10-year Treasury notes has been substantially less than 3 percent in recent years. In 2019, it was less than 1 percent, and as of December 2019, it was less than 0.5 percent, which suggests that significantly lower discount rates might now be appropriate. In all cases, the ICM results used a 3 percent discount rate in discounting costs of long-term medical treatment and long-term work loss. Therefore, there is some inconsistency in Table 5 in the per-unit results, with the 0 percent results being somewhat low, and the 7 percent result being somewhat high.

initially incurred by the manufacturers and suppliers, but most of these costs would likely be passed on to the consumers via higher prices. The costs involving the added assembly time for RTA CSUs or the loss of utility because CSUs with certain features or characteristics are no longer available, of course, would be borne directly by those consumers who desired CSUs with those characteristics or features.

Staff's review of CSUs on the market suggests that there is some indication that more stable CSUs tend to be more costly; this can be observed in the retail prices of CSUs in Table 6. To assess the stability of CSUs currently on the market, CPSC tested 186 CSU models to determine the tip weights using the method based on the performance requirements in ASTM F2057-17. The CSUs were selected in a manner that was intended to be representative of the models available on the market (Sanborn, 2021). Table 6 provides the number of models that had tip weights at several levels and the lowest-priced model at each level. The lowest-priced model tested was $49, but of the 186 models tested, 156 had a tip weight of at least 50 pounds; but the lowest-priced model that had a tip weight of at least 50 pounds was $62.39. Only 105 models had a tip weight of at least 60 pounds, and the lowest-priced model at that level was $79. Only 21 models had tip weights of 80 pounds, and the lowest-priced model of this group was $139. Only one model, with a price of $899.99, had a tip weight of over 134 pounds. This information is consistent with the principle that the cost of a standard will tend to increase with the level of stringency. However, other characteristics of the CSU affect the price, and the price differentials shown in Table 6 are not solely due to the differences in tip weight.[10] Other factors that could affect the price include the material from which the CSU is constructed, and whether the CSU comes fully assembled, or must be assembled by the consumer.

Table 6. Number of CSUs Tested by Tip-over Weight

Tip Weight	Number	Percent	Lowest Priced Unit
At least 12 pounds	182	100.0	$49.00
At least 50 pounds	156	86	$62.39
At least 60 pounds	105	58	$79.00
At least 80 pounds	21	21	$139.00
At least 133 pounds	1	1	$899.99

To ensure that they comply with a mandatory standard, furniture manufacturers must first determine whether their models comply with the standard. This would involve testing their models for compliance. Because a voluntary standard exists, with which we believe that most

[10] Note that the prices in Table 6 are the observed retail prices and not the manufacturer's cost.

CSUs on the market already comply, most manufacturers are probably already conducting stability testing similar to that which would be required by the draft proposed rule. Manufacturers would replace their current test methods with the requirements of the draft proposed rule. Even though the new tests would include additional steps (*e.g.*, weighting drawers, pull tests on interlock mechanisms, and testing the CSU on a 1.5-degree angle), on a per-unit basis, any increase in the cost of testing due to the draft proposed rule is likely to be very small, and therefore, the cost of compliance testing will not be considered further in this analysis. Manufacturers will also need to add a stability rating to a hang tag that will be included on each CSU, which would be derived from the testing. We expect that the cost of deriving the stability rating and adding the hang tag to each unit will also be small on a per-unit basis and will not be considered further in this analysis. Additionally, the cost of providing the certificates of conformity will be very low on a per-unit basis. In the case of CSUs that could be considered to be children's products, which are thought to constitute a very small portion of the market for CSUs, the cost of the certification testing could be somewhat higher, because an accredited third party testing laboratory would be required to conduct the certification testing. We seek comment from furniture manufacturers regarding the cost of the certification testing, warning labels, certificates of conformity, and hang tag and whether the additional cost would be significant.

The number of CSU models currently on the market that would comply with the requirements of the draft proposed rule is very low. In fact, although CPSC staff collected and examined 186 CSU models intended to be a representative sample of the available CSUs, staff only identified one model that would meet the requirements of the draft proposed rule without modification. For each model that does not comply with a mandatory standard, manufacturers must decide whether to stop offering that model or modify the model so that it would comply with the standard. If the manufacturer ceases to offer a noncomplying model, the cost of this decision will be the lost utility to the consumer. This cost cannot be quantified, but it would be mitigated to the extent that other CSUs with similar characteristics and features are available that comply with the standard.

4.1. Costs of Potential Modifications to Increase CSU Stability

A CSU that tips over could be thought of as pivoting forward on the front edge of the base or legs of the CSU that contacts the floor, which acts as a fulcrum. A child who opens one or more drawers and climbs on the open drawers is effectively adding weight to the front side of fulcrum; the additional weight consisting of the weight of the child and the weight of the open drawers and their contents, and reducing the weight on the opposite side; the reduced weight consisting of the weight of the open drawers and their contents. The interaction of the child on the CSU adds additional rotational tip-over force that increases the likelihood that the CSU will pivot or tip over. This force varies by interaction. The force imparted by a child ascending the CSU can exceed 1.6 times the child's body weight for typical drawer extensions. The force of a child sitting or standing in a drawer of a CSU will be less.[11] To prevent tip over, the manufacturer must counteract the force being imparted by the child's activities.

CPSC staff has identified several ways CSUs could be modified to increase the stability of the CSU. These are (1) adding drawer-interlock mechanisms to limit the number of drawers that can be opened at one time; (2) reducing the maximum drawer extensions; (3) extending the feet or front edge of the CSU forward; (4) using adjustable levelling devices to raise the front of the unit; and (5) adding additional weight to the back of the CSU. Manufacturers can use combinations of more than one method to increase the stability of a single CSU model.

4.1.1. Drawer-Interlock Mechanisms

CPSC staff expects that drawer interlock mechanisms will be one of the most effective fixes and so would be added to many CSUs in order to comply with the draft proposed rule. Much of the weight of a CSU consists of the weight of the drawers and their contents. If a person is able to open multiple drawers simultaneously, the weight of the drawers and their contents is shifted past the front edge of the fulcrum of the CSU, decreasing its stability. By limiting the number of opened drawers, a drawer interlock limits the weight that can be shifted. Many office filing cabinets and tool storage cabinets have drawer interlock features; and at least one major RTA CSU manufacturer already includes drawer interlocks on some of its CSUs.

The cost of a drawer interlock mechanism includes the cost of design, materials, and labor required to manufacture the mechanism. It would also include the cost of warehousing the parts, the logistics involved in getting the parts to the factory floor, and the cost of incorporating the mechanism into the CSU. In the case of an RTA CSU, some of these costs could fall directly on the consumer. The value of the extra time that might be required of a consumer to assemble a CSU with a drawer interlock is rightfully counted as a cost of adding a drawer interlock mechanism. Based on information provided by a manufacturer, the cost of adding a drawer interlock mechanism to a CSU would be around $12. On the assumption that a manufacturer does not have an incentive to provide us with a low estimate, in this analysis we are assuming that this could be a high estimate. Nevertheless, if adding an interlock mechanism requires an additional 5 minutes in labor time to assemble the mechanism and incorporate it into the CSU, then the cost could be $3.34 in labor costs alone. Considering the added cost of materials and the fact that some CSUs could require two mechanisms, or may need to new mechanisms to meet their particular needs,[12] a minimum cost for adding a single interlock mechanism could be

[11] Forces imparted by children as they interact with clothing storage units is the subject of a technical report prepared for the CPSC by the University of Michigan Transportation Research Institute.

[12] All interlock mechanisms of which staff is aware are designed to control the opening of drawers in only one column. CSUs with two columns of drawers might require two interlock mechanisms that could limit the number of drawers that could be opened at one time, to one in each column, or two total. If the manufacturer wished to further

$6.00.[13] The cost could be $12 or more, especially if more than one mechanism were required, or a new design were required.[14]

4.1.2. Reducing Drawer Extensions

Reducing the maximum drawer extensions will decrease the tip-over moment, as defined by the draft proposed rule. The manufacturing costs of reducing the maximum drawer extensions is low, because it does not necessarily require additional parts or labor time. Perhaps the largest cost is the potential impact on consumer utility if it is less convenient to use CSUs with drawers that cannot open as widely. We cannot quantify this cost with the information available.

4.1.3. Extending the Feet or Front Edge of the CSU Forward

Another method of improving the stability of CSUs is to move the front edge of the CSU that contacts the floor, forward, closer to the child, or even under the child. Some CSUs have feet or glides that might be set back an inch or so from the front edge of the CSU. These could simply be moved forward so that they are flush with the front edge. In other cases, the glides or feet could be modified to extend out from the front of the CSU. A solution, proposed by HinesLab, Inc., is to attach a base to the CSU, the front edge of which would extend a significant distance from the front edges of the closed drawers of the CSU, effectively moving the fulcrum under the child, or even behind the child.[15]

The cost of extending the feet or the front edge of the CSU forward can be very low. In some cases, no additional parts would be required, and the only cost would be the time it takes for the manufacturer to make the change in the manufacturing procedure. This would be the case where already-present feet or glides are simply shifted forward an inch or so. In these cases, the cost of shifting the front edge forward could be less than $1 per unit. In other cases, feet might need to be added or redesigned. If these feet or glides could be used on multiple CSU models, the costs could be up to $5 per CSU unit.[16] The cost of adding a base to the unit, similar to the prototype from HinesLab could be more costly. In addition to the cost of the materials, there would be manufacturing costs to form the material used for the base and attach it to the unit. For RTA

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limit the number of drawers that could be opened at one time, the manufacturer might have to develop new interlock designs. Therefore, the cost would likely be higher for interlocks on dressers.

[13] Note: We do not have direct estimates of the additional labor time that would be required to manufacture and add one or two interlock mechanisms to a CSU; but 5 minutes seems like a reasonably low estimate, if much of the work is manual. The cost of 5 minutes of labor is based on the total employer cost for employee compensation for private industry manufacturing workers in goods producing industries, published by the Bureau of Labor Statistics (December 2020).

[14] One manufacturer estimated that interlocking drawer could add $12 to the cost of a CSU and increase the retail price by as much as $39 (IEc, June 2019).

[15] This solution is described on their website at: https://www.hineslab.com/mechanical-projects/kidsafe-dresser-baseboard/.

[16] Cost based on observed prices for furniture feet available on the Internet.

manufacturers, adding a base could involve additional costs to redesign the shipping packages to accommodate the base, and could impact the shipping costs. This could add costs significantly over the $1 to $5 estimated here. However, extending the feet forward to increase stability could result in a loss of product utility (*e.g*., it could be less attractive) and, depending upon the distance the feet had to be extended, could result in an additional tripping injury hazard; although for shorter extensions, this could be accomplished much like wall baseboards and quarter-round moldings to minimize the trip hazard to be akin to approaching a wall with these features.

4.1.4. Raising the Front of the CSU

Another method that could be used to stabilize a CSU is to design the unit so that the front of the CSU is raised, compared to the back of the CSU (*i.e*., tipped back slightly), or to provide adjustable levelling feet with manufacturer instructions to adjust the levelling feet to a certain level, on carpet, or to tip the unit back slightly. Tipping the unit back would increase the force required to tip the CSU forward. This method is sometimes used on an ad hoc basis by consumers when they attempt to shim unstable CSUs by placing shims or other materials under the front feet of a CSU that they believe is unstable. According to one manufacturer, leveling devices could cost $5 per CSU. Observed retail prices for leveling devices can be as little as 30 cents each (at least two would be required for a CSU), but these devices do not necessarily meet the specifications required for CSU to satisfy the draft proposed rule or the logistics and labor involved in manufacturing a CSU with the leveling devices. If the front of a CSU must be raised a significant amount, more than a small fraction of an inch to stabilize the unit, other changes might be required to the CSU in order to keep the top and drawers of the CSU relatively level. If these changes are not made, items on the top of the CSU could easily slide off, or items in the drawers could shift to the rear. For these reasons, levelers probably have only a limited usefulness in modifying CSUs to meet the requirements of the draft proposed rule, and the full cost of such changes cannot be quantified with the information available. Moreover, there is the risk that this modification would not be a reliable solution to improve stability, because it relies on the consumer taking steps to adjust the level appropriately to raise the front of the CSU, unless the raised feet are designed into the CSU.

4.1.5. Adding Weight to the Back or Rear of the CSU

Another way to increase the stability of a CSU is to add weight to the back of the unit. Currently, the back of many CSUs consists of a thin sheet of fiberboard or other light material. A heavier material could be substituted for the lighter materials currently used. Alternatively, manufacturers could simply add weights to the back or other sections of the CSU to increase its stability.[17] Depending upon the amount of weight added, there could be an unquantifiable cost to

[17] A 32 in. x 10 in. three-quarter-inch particle board with melamine veneer panel would add at least 10 pounds to the CSU. According to one manufacturer, if a change increases the weight of the package over certain limits, the

the consumer, due to the added weight that they must manage in assembling and moving the CSU.

Based on retail prices observed on July 2, 2020, medium-density fiberboard costs approximately $0.24 per pound, which is a starting point for estimating the additional cost of adding weight to the back of a CSU.[18] If the additional weight required is low, it could be the only additional cost, because the somewhat heavier material would replace a somewhat lighter material, and the manufacturing process would require minimal changes. In the case where the added weight that would be required is significant, the costs could be higher, because attaching the back to the CSU could require different hardware, the reinforcement of the sides of the CSU, or different manufacturing procedures might be required to manipulate the heavier weight (*e.g.*, an additional worker or machine to handle the heavier board). In the case of RTA furniture, the cost of packaging and shipping could increase, and there would be an unquantifiable cost to the consumer in the form of the need to handle more weight. Potentially, manufacturers could offset the additional weight by using lower-density or thinner materials for other components, such as drawer fronts or cabinet tops. Commission staff welcomes comments on the cost and other impacts of adding weight to the rear of the CSU to meet the requirements of the draft proposed rule.

4.2. Estimated Costs to Modify Current CSUs to Comply with the Draft Proposed Rule

CPSC engineering staff examined five CSUs from four manufacturers to evaluate how these CSUs could be modified, using the methods described above, to comply with the requirements of the draft proposed rule (Mella, et. al., 2021). The cost estimates discussed above were applied to these evaluations in order to estimate the cost of the modifications. In each case, a high and a low estimate was produced.

In the case of drawer interlocks, we assumed that the high cost per mechanism was $12, and the low cost was $6. However, the interlock mechanisms with which CPSC staff is familiar are capable of controlling drawers in a single column. Therefore, in a CSU with one column of drawers, the interlock mechanisms could prevent more than one drawer from being opened simultaneously. In a CSU with two columns of drawers, two interlock mechanisms would be required, and together, they could prevent no more than two drawers from being opened simultaneously. Many chests of drawers and dressers have additional drawers in the top row. We are not aware of any existing mechanisms that could prevent these additional drawers from

change in shipping costs can be significant. For example, it might be necessary to increase the number of packages per unit, if there is a weight limit for each package.

[18] Furniture manufacturers presumably would be able to obtain materials at less than retail prices. However, we are using retail prices in this analysis because, as noted above, there would be costs involved, for which we do not have estimates, in forming and handling the heavier material. In the absence of estimates for these costs, we believe that using the retail prices would provide a better estimate of the cost to manufacturers of using heavier materials.

being opened. We are also unaware of single mechanisms that could limit the number of open drawers in two columns. Such mechanisms could probably be developed, but we are unable to estimate a cost for such mechanisms at this time. Although we cannot quantify the costs for options that would limit the number of open drawers in CSUs with two columns to one open drawer, or that would require the opening of any additional drawers in the top row to be controlled, the costs would likely be in excess of our estimate of $6 to $12 per interlock mechanism.

We did not include any cost for reducing the drawer extensions, but we note that limiting the drawer extensions could have an unquantifiable cost in terms of inconvenience or loss of utility to the consumer.

We assumed that the cost of extending the feet or front of a CSU ranges from $1 to $5. The high estimate is based on the cost provided by a manufacturer for adding leveling glides, which we assumed would involve similar costs. The low cost is based on the belief that in some cases, the existing glides or feet can simply be moved forward an inch or so, at much lower cost. However, if the required foot extension is more than a few inches, the costs could be higher, especially when other impacts on the consumer are considered, such as the CSU now having a larger footprint in the home and possibly creating a tripping hazard.

We did not attempt to quantify the cost of raising the front of the CSU, because raising the front of the CSU would probably require additional modifications (and hence, manufacturing costs) beyond simply adding levelers. Conceivably, in cases where the front of the CSU was raised only slightly, a manufacturer might not modify the design to keep the top surface level when used on a level floor. In these cases, the cost of raising the front of the CSU could be low. CPSC staff welcomes comments on the practicality and costs of using levelers or other means of raising the front of a CSU as one option for meeting the requirements of the draft proposed rule.

Many of the potential modification options included the addition of weight to the rear of the CSU. As noted above, we assumed that the cost of adding weight to the CSU was $0.24 per pound.

We emphasize that the modifications discussed above and in the examples below are not necessarily comprehensive, and we acknowledge there could be other potential modifications not considered above. The combinations of modifications discussed below are also not comprehensive, and manufacturers could use other combinations to bring their CSUs into compliance with the draft proposed rule. CPSC welcomes comments on the suggested modifications in this analysis, the estimated costs, and other potential modifications and their costs not mentioned in this analysis.

Example 1

The first CSU evaluated is an RTA, 8-drawer dresser, consisting of two columns of three rows of drawers. The top row consists of two smaller drawers in each column. The dresser has a depth of 18.5 inches, a height of 37.625 inches, and a width of 59.25 inches. It weighs 122 pounds. CPSC staff determined that this dresser could comply with the requirements of the draft proposed rule if one of the following options was taken:

> Option 1: Add drawer interlocks to limit open drawers to one, raise the front of the CSU 0.485 inches.
>
> Option 2: Add drawer interlocks to limit the open drawers to two, decrease the drawer extension by 0.5 inches, raise the front 0.75 inches, add a 5-pound counter weight.
>
> Option 3: Add drawer interlocks to limit the open drawers to two, extend the front feet by 1 inch, add raise the front of the CSU 0.5 inches.
>
> Option 4: Add a drawer interlock to limit the open drawers to two, decrease the drawer extension by 0.5 inches, extend the front foot by 1 inch, raise the front of the CSU by 0.5 inches.
>
> Option 5. Decrease the maximum drawer extension by 1.5 inches, add a 1.7-inch foot extension, raise the front of the CSU 1.0 inch, add a 20-pound counter weight.

Example 2

The second CSU evaluated is a 5-drawer chest of drawers consisting of one column of five rows of drawers, each with one drawer. The CSU has a depth of 18 inches, a height of 35 inches, and a width of 35 inches. The weight of the dresser is 150 pounds. CPSC staff determined that this dresser could comply with the requirements of the draft proposed rule if one of the following options was taken:

> Option 1: Add a drawer interlock to limit the number of open drawers to one, decrease the maximum drawer extension by 4.13 inch, add a 1.375-inch foot extension, and a 3-pound counter weight.
>
> Option 2: Add a drawer interlock to limit the number open drawers to one, decrease the maximum drawer extension by 1 inch, add a 1.5-inch foot extension, and a 35-pound counter weight.

Option 3: Add a drawer interlock to limit the number of open drawers to one, add a 2-inch foot extension, add a 40-pound counter weight.

Option 4: Add a drawer interlock to limit the number of open drawers to one, decrease the maximum drawer extension by 2 inches, add a 60-pound counter weight.

Option 5: Decrease the maximum drawer extension by 2 inches, add a 2-inch foot extension, and add a 51-pound counter weight.

Example 3

The third CSU evaluated is a 7-drawer dresser arranged in three rows. The bottom two rows contain two drawers each and the top row contains three drawers. The dimensions of the CSU are 55.3-inches wide, 21.6-inches deep, and 37.2-inches high. The unit weighs 165 pounds. CPSC staff believes that this unit could pass the requirements of the draft proposed rule, if the modifications in one of the following options were made:

Option 1: Add drawer interlocks to limit the open drawers to one, add a 5-pound counter weight.

Option 2: Add drawer interlocks to limit the open drawers to two, add a 10-pound counter weight.

Option 3: Add drawer interlocks to limit the open drawers to three. Add a 1-inch foot extension, add a 5-pound counter weight.

Option 4: Add drawer interlocks to limit the open drawers to one, decrease the drawer extension by 1 inch, add a 1-inch foot extension.

Example 4

The fourth CSU evaluated was essentially the same as Example 3, except that it weighed about 29.5 pounds more. CPSC staff believe that it could conform to the requirements of the draft proposed rule, if the modifications in one of the following options were made:

Option 1: Add a drawer interlock mechanism to limit the open drawers to three.

Option 2: Decrease the maximum drawer extension by 1 inch, and add a 24-pound counterweight.

Option 3: Extend the foot by 1 inch, and add a 20-pound counterweight.

Option 4. Add a 35-pound counter weight.

Example 5

The 5th CSU evaluated by CPSC staff was a three-drawer RTA chest of drawers. The CSU measures 27.625-inches wide, 15.625-inches deep, 28.125-inches high, and weighs 45 pounds. Each drawer extends about 8.25 inches. CPSC staff determined that if the modifications in one of the following options were made, the CSU would meet the requirements of the draft proposed rule:

Option 1: Include a drawer interlock mechanism, extend the foot of the CSU by 6.6 inches.[19]

Option 2: Include a drawer interlock mechanism, extend the foot of the CSU by 6.25 inches, and add a 1.5-pound counter weight.

Option 3: Add drawer interlocks and a 50-pound counter weight.

Option 4: Add drawer interlocks, reduce the drawer travel by 1 inch, extend the foot of the CSU by 2.25 inches, add a 25-pound counter weight, and raise the front of the CSU by 0.37 inches.

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[19] The same $1 to $5 cost is assumed as it assumed for all feet extensions. However, an extension greater than 6 inches would likely cost more than the 1- or 2-inch extensions used in other cases.

Table 7. Summary of Modifications and Partial Costs

CSU-Description	Option	Maximum Number of Open Drawers	Decrease Drawer Extension (inches)	Foot Extension (inches)	Front Raised (inches)	Counter Weight (pounds)	Quantified Cost	Comments
1-RTA, 8-drawer dresser	I	1 drawer--Staff unaware of any existing mechanism that could limit the open drawers to 1 in this unit	---	---	0.485	---	More than $13 – see comments	Multiple interlock mechanisms or a newly designed one would likely be required, which would result in costs higher than $6 to $12. Raising the front of the CSU by almost half an inch will probably cause other changes with significant costs.
	II	2 drawers --Staff unaware of any existing mechanism that could limit the open drawers to 2 in this unit	0.5	---	.75	5	More than $15 – see comments?	Multiple interlock mechanisms or a newly designed one would likely be required, which would result in costs higher than $6 to $12. Raising the front of the CSU by ¾ of an inch will probably cause other changes with significant costs. Decrease in drawer extensions could reduce utility.
	III	2--Staff unaware of any existing mechanism that could limit the open drawers to 1 in this unit	---	1	0.5	---	More than $13	Multiple interlock mechanisms or a newly designed one would likely be required, which would result in costs higher than $6 to $12. Raising the front of the CSU by ½ of an inch will probably cause other changes with significant costs.
	IV	2--Staff unaware of any existing mechanism that could limit the open drawers to 1 in this unit	0.5	1	0.5	---	More than $14 – see comments	Multiple interlock mechanisms or a newly designed one would likely be required, which would result in costs higher than $6 to $12. Raising the front of the CSU by ½ of an inch will probably cause other changes with significant costs. Decrease in drawer extensions could reduce utility.
	V	---	1.5	1.7	1	20	More than $6.80, possibly more than $14.80 – see comments	Decrease in drawer extension could reduce utility. Raising the front of the CSU by 1 inch will probably require other changes with costs not quantified here.

CSU-Description	Option	Maximum Number of Open Drawers	Decrease Drawer Extension (inches)	Foot Extension (inches)	Front Raised (inches)	Counter Weight (pounds)	Quantified Cost	Comments
Ex 2, 5-drawer chest of drawers	I	1	4.13	1.375	---	3	More than $1.72	Decreasing the drawer extension by 4.13 inches could reduce utility.
	II	1	1	1.5	---	35	$15.40 to 25.40	Unknown utility cost from reduced drawer extension
	III	1	---	2	---	40	$16.60 to $26.60	Increases weight by 27 percent
	IV	1	2	---	---	60	$20.40 to $26.40	Decrease in drawer extension could reduce utility. Increases weight by 40%.
	V	0	2	2		51	$13.24 to $17.24	Decrease in drawer extension could reduce utility. Increases weight by 33%.
Ex. 3, 7-drawer dresser, pre-assembled	I	1--Staff unaware of any existing mechanism that could limit the open drawers to 1 in this unit	----	----	----	5	More than $13.20 – see comments	Multiple interlock mechanisms or a newly designed one would likely be required, which would result in costs higher than $6 to $12.
	II	2--Staff unaware of any existing mechanism that could limit the open drawers to 2 in this unit	---	---	---	10	More than $14.40 – see comments	Multiple interlock mechanisms or a newly designed one would likely be required, which would result in costs higher than $6 to $12.
	III	3		1	---	5	$14.2 to $30.2	Might be the only option with an existing type of interlock mechanism
	IV	1--Staff unaware of any existing mechanism that could limit the open drawers to 1 in this unit	1	1	---	0	More than $13 – see comments	Multiple interlock mechanisms or a newly designed one would likely be required, which would result in costs higher than $6 to $12.

CSU-Description	Option	Maximum Number of Open Drawers	Decrease Drawer Extension (inches)	Foot Extension (inches)	Front Raised (inches)	Counter Weight (pounds)	Quantified Cost	Comments
Ex. 4, (same as Ex 3 but 29 pounds heavier)	I	3 drawers					$12 to $24	
	II	---	1	---	---	24	$5.76	Unknown utility loss from reduce drawer extension. Impact of raising weight from 195 to 219 unknown.
	III	---	---	1	---	20	$5.80 to $9.80	In addition to raising costs by $5.80 to $9.80, increasing the weight by 20 pounds will reduce utility by some unknown amount.
	IV	---	---		---	35	$8.40	Increasing the weight by 35 pounds could have a negative impact on the consumer.
Ex. 5, RTA 3-drawer chest of drawers	1	1	---	6.6	---	----	?	A 6.6 inch foot extension might not be acceptable to consumers. It could also create a tripping hazard.
	2	1		6.25		1.5	?	A 6.25 inch foot extension might not be acceptable to consumers and could create a tripping hazard.
	3	1				50	$18 to $24	Increases weight of model by more than 100%.
	4	1	1	2.25	0.37	25	$14 to $28	Increases weight of model by more than 50%.

4.3. Discussion of the Cost and Other Impacts of the CSU Modifications

Although staff attempted to quantify some of the costs of modifying CSUs to meet the requirements of the draft proposed rule, the costs used are based on information provided by some manufacturers and prices observed for similar components, such as leveling devices and the price per pound of medium density fiberboard (MDF). In many cases, staff does not have sufficient information to estimate the costs. Staff is not aware of any interlock systems that could limit the number of open drawers in CSUs with more than one column to no more than one open drawer, for example. Such a system might require multiple interlock mechanisms, or a new system might have to be designed. In any case, the cost is likely to be greater than the $6 to $12 estimated for single interlock mechanisms. Staff also cannot estimate the full cost of options that involve raising the front of the CSU, because this would probably require other significant changes in the design of the model to keep the top of the CSU or the drawers level. The use of levelers to increase stability might be limited to allowing the consumer to make minor adjustments in the height of a CSU to accommodate stability on carpeting. Staff has assumed that the cost of adding counterweights to the CSU was $0.24 per pound, but staff has not accounted for any other impact of the higher weight on the consumer. Especially in the case of RTA CSUs, significantly higher weights could impact the packaging and shipping costs. We have not quantified any reductions in utility that might be caused by reductions in the drawer extensions or any aesthetic impacts that might result from the addition of significant foot extensions.

For three of CSUs evaluated (Examples 2, 4, and 5), 11 of the 13 potential modifications either required the addition of counter weights of at least 20 pounds or extensive foot extensions of greater than 6 inches. This could suggest that to comply with the draft proposed rule, CSUs, on average, could become heavier or deeper than CSUs currently on the market. In the case of the CSU in Example 5, the unquantified costs could be quite high. For example, extending the foot by 6 inches essentially increases the depth of the CSU by 38 percent, as well as likely creates a tripping hazard. Adding a counter weight of 25 pounds to 50 pounds increases the weight by 50 to more than 100 percent. In the case of another tall but shallow chest of drawers, CPSC staff have speculated that to pass the requirements of the draft proposed rule, that model would have to be made deeper. However, that would change the characteristics of the model, essentially removing it from the market. In the case of CSUs that are removed from the market, the cost would be the lost utility to consumers resulting from no longer being able to obtain CSUs with those characteristics. We cannot quantify this cost, but it would seem to impact mostly consumers with small or crowded living spaces.

Although staff did not quantify the costs for the options in Example 1, they are likely to be relatively high. This is because most of the options require a drawer interlock mechanism or mechanisms that can limit the number of open drawers to one or two. However, the model includes four drawers in the top row and the opening of the middle two drawers could not be limited by the interlock mechanisms with which staff is aware. Typically, CSUs with two columns would require two standard interlock mechanisms at an estimated cost of $6 to $12 each. The cost for the interlock system for the model in Example 1 is likely to be higher. Additionally, several of the options required raising the front of the CSU significantly. Such a modification would likely necessitate other modifications in the model to ensure that the top of the CSU and the drawers remain parallel to the floor. These modifications would add to the cost of modifying the unit. Alternatively, the firm may modify or replace the design to one with only 2 drawers in the top row, diminishing consumer utility for those who prefer the existing design.

The dresser in Example 4 could potentially comply with the requirements of the draft proposed rule simply by adding drawer interlock mechanisms to limit the number of drawers that can be opened simultaneously to three, by adding 20 to 35 pounds, and in one case extending the foot by an inch. The quantifiable costs of the options in this example are roughly in the same range as the average benefits per unit. Note, however, that it is the same as the dresser in Example 3, but about 30 pounds heavier.

The effectiveness of any of the modifications at reducing tip-over incidents could be impacted by actions taken (or not taken) by consumers. For example, in the case of RTA furniture, if the consumer could opt not to install the drawer interlocks, the counterweights, the foot extensions, or levelers, the stability of the CSU would be lessened and the potential benefits decreased. In the case of levelers, there might need to be some mechanism for ensuring the consumer adjusted the levelers correctly to ensure that the full benefits were obtained. Likewise, if the consumer could modify factory-assembled furniture, such as by removing the counterweights or foot extensions, the stability of the CSU would also be lessened. Some of these impacts could be reduced or eliminated by firms pre-installing key safety components, such as interlocks and counterweights.

Again, staff emphasizes that the potential modification options discussed above are not intended to be a comprehensive examination of all possible modifications or combinations of modifications that manufacturers could use. It is possible that the cost of some of these other options could be lower than the cost estimates for the options considered here. Staff welcomes comments on the options discussed above and any other possible options, including the cost estimates.

4.4. Annual Cost of the Draft Proposed Rule

Of the potential modifications for which staff was able to estimate the potential cost, the lowest costs were about $5.80 per unit (see Table 7). Several were significantly higher. Even assuming the low cost of about $5.80 per unit, assuming annual sales of at least 43 million units, the annual cost of the draft proposed rule would be around $250 million. Therefore, the draft proposed rule would be considered a major rule under the Congressional Review Act.

4.5. Other Impacts on Consumers

The costs of the draft proposed rule discussed above are the costs to manufacture CSUs that could comply with the draft proposed rule. Even where we have used retail prices to estimate the costs, the retail price was used in a crude attempt to capture other costs that would be incurred by manufacturers, including the logistics of acquiring the parts, getting them to the factory floor, and the labor involved in installing them; or in the case of RTA CSUs, the costs of packaging the added parts and the cost to consumers in time and trouble of installing the added parts. The change in retail prices due to these costs could be greater if manufacturers, wholesalers, and retailers add a markup to their costs. Markups can vary among manufacturers and subsets of the market, but can be 2 to 4 times the cost to the manufacturer. However, it is not certain that the retail prices would increase from the draft proposed rule by the same factor. It is possible that competition among manufacturers and different models could prevent retail prices from rising by the usual mark-up over cost.

Some manufacturers may withdraw some CSU models from the market if the cost or difficulty of modifying that model to meet the requirements of the draft proposed rule are too great in relation to their expected sales. As discussed above, with regard to the example of a small and light CSU, the modifications required could be so substantial that the model no longer has the character of the original model and is simply withdrawn from the market. Consumers who desired these particular models or variants will suffer an unquantifiable loss, which is mitigated to the extent other CSU variants exist that are reasonable, if not perfect, substitutes. If the CSU models that are withdrawn are disproportionately the lower-cost models, which are likely to include many lighter and RTA models, the draft proposed rule could disproportionately impact lower-income consumers or those seeking low-cost models. These consumers might keep using their older (less safe) CSUs, purchase a previously owned CSU, or even choose other products for clothes storage in place of CSUs, such as shelving, boxes, storage bins, and so forth. Although these impacts would properly be considered costs of the draft rule, they are not quantifiable.

5. BENEFIT-COST DESCRIPTION AND DISCUSSION

5.1. General Conclusions

Staff found that the societal costs of deaths and injuries from CSU tip-over incidents is about $419.2 million annually. This includes injuries to children and adults and is based on known fatalities from 2001 through 2016, and NEISS injuries from 2015 through 2019. If all CSUs had met the requirements of the draft proposed rule, however, the societal cost of these incidents would have been reduced by $305.5 million annually. This then would be the estimated benefit of the draft proposed rule. On a per-CSU-in-use basis, the benefit estimate is $0.66 per unit annually. Assuming CSUs have an expected useful life of 15 years, the average benefit of the draft proposed rule would be $6.01 per unit, assuming a 7 percent discount rate, $7.88 assuming a 3 percent discount rate, and $9.90 without discounting.

The costs of the draft proposed rule highly depend upon the actual modifications that are required for the CSUs to comply with the rule. The costs would be higher for some models than for others. In some cases, the required modifications could change the character of a CSU model to the extent that it is not viable and will be withdrawn from the market.

Staff attempted to estimate the cost of modifying five different CSUs using rough estimates for certain modifications. However, for many options, staff was only able to provide a lower-bound estimate. For example, we assumed that the cost of extending the feet of a CSU averaged $1 to $5 per unit, regardless of the length of the foot extension. This could be a reasonable estimate when the length of the extension is less than 3 inches, but for one CSU the extension required would be 6.25 inches to 12 inches. The cost in that case would probably exceed the estimated amount significantly. In fact, the required modifications in terms of extending the front feet or adding counterweights would probably change the character of the unit (a 3-drawer chest of drawers under 30 inches tall and weighing 45 pounds) to the extent that it would essentially be removed from the market.

For one of the models examined, the costs of modifying the unit would be roughly in line with the estimated benefits. The estimated costs ranged from about $5.76 to $9.80, while the average benefits range from $6.01 to $9.90. Where quantifiable, the cost estimates for the other four units were higher. It is also possible that firms will make use of different combinations of design modifications and additional or replacement components that were not considered in this analysis. We note that all five of the units analyzed were involved in tip-over incidents. However, based on their tip weights, these CSUs do not appear to be more unstable, on average, than other CSUs tested. The tip weights for two of the units were in the bottom 20 percent of the CSUs tested. However, the tip weights for the other three units were in the top 20 percent (Taxier, 2021 and Sanborn, 2021).

In this analysis, we are using the cost to modify existing CSUs in ways that would allow them to comply with the draft proposed rule as a measure of the cost manufacturing CSUs that would comply with the draft proposed rule. CSUs are relatively simple products, and the options for modifying CSUs, without having substantial impacts on their utility, are limited. The modifications considered here are largely limited to combinations of adding interlocks, modifications that shift the feet of the CSUs forward, adding weight towards the back of the

CSUs, raising the front of the CSUs, and reducing the maximum drawer extensions. Thus, the estimates used in this analysis are reasonable first approximations of the costs involved; but in some instances, they could be underestimates because they do not include all of the expected monetary costs (*e.g*., the costs that would be associated with an interlock system that has not yet been developed), and they do not consider the nonmonetary cost to consumers of the added weight, the decreased maximum drawer extensions, or similar losses associated with the other fixes. Potentially, there could be lower cost options for modifying CSUs to meet the requirements not considered in this analysis. CPSC staff welcomes comments on any other potential options for modifying or manufacturing CSUs to meet the requirements of the draft proposed rule.

It is conceivable that CSUs could be redesigned in other ways. For example, some engineers have suggested that CSUs could be redesigned to make them lighter in the front and heavier in the back. They have suggested that this could be accomplished by making the tops, fronts, and sides out of thinner or less dense, lighter material and the back out of thicker or more dense, heavier material. They suggested that the cost savings from using the thinner or less dense, lighter materials on the top, front, and sides would make up for the cost of the heavier materials in the back, and the overall weight of the CSU would be unchanged. Other designs that would create more stable CSUs might have other offsetting utility costs. For example, a CSU that is wide and deep on the bottom drawer(s), but becomes increasing narrower or shallower towards the top of the CSU might be more stable than other CSUs, but might be less useful to consumers because it would have either have less storage volume than a CSU that had the same dimensions at the top and the bottom or else would have a larger footprint if the volume was the same. CPSC staff welcomes comments on any other methods or ways that the designs of CSUs could be modified to comply with the requirements of the draft proposed rule, including the potential cost of the modifications and other impacts on the CSUs or their utility. CPSC staff is particularly interested in ways that the cost of the modifications could be offset by making other changes in the design of the CSUs or the manufacturing processes used.

Based on the limited testing done for this analysis, it appears that lighter CSUs could have difficulty complying with the requirements of the draft proposed rule. Options for modifying three of the five models analyzed by CPSC staff included the addition of significant additional weight and the model for which the estimated costs were the lowest was the heaviest of the samples evaluated. To the extent that lighter CSUs tend to be less expensive, the costs of the draft proposed rule could disproportionately impact lower-income households or those seeking lower-cost models. Some more shallow CSUs might also have some difficulty complying with the draft proposed rule, except by redesigning them to be deeper. However, this could adversely affect those consumers that might have desired the shallower units perhaps because they needed CSUs with smaller footprints to fit into their living space.

The benefit estimate is an average of benefits over all CSUs in use. It would be desirable to estimate the benefits and costs associated with RTA CSUs and factory or pre-assembled CSUs separately. It is possible that the annual risk associated with RTA CSUs is higher, and therefore, the annual benefits of the draft proposed rule could be higher for RTA CSUs. On the other hand, we used an average life of 15 years for all CSUs in this analysis. It is also likely that the average useful life of RTA CSUs is less than 15 years. Therefore, the annual benefit for RTA CSUs would be summed over a shorter useful life. This would tend to counterbalance the impact of the higher annual benefit. Likewise, factory or pre-assembled CSUs might be associated with lower annual risks of a tip-over incident but they might have useful lives longer than 15 years. Therefore, the lower annual benefit estimate would be summed over a longer useful life, which would tend to counter balance the impact of a lower annual risk.

The costs of the draft proposed rule were examined in the case of only five different CSUs out the many hundreds of different models. It is likely that the cost of modifying some CSUs would be higher than estimated for these five models, while the cost of modifying some models would be lower.

5.2. Sensitivity Analysis

Our analysis is dependent upon certain estimates and assumptions. In conducting the analysis, we used those values that we believed best reflected reality. However, in many cases, the basis was weak or lacked strong empirical evidence. In this section, we examine how other reasonable assumptions could affect the results of the analysis.

5.2.1 Higher Value of Statistical Life for Children

In estimating the benefit associated with reduced mortality, we applied an estimate of the value of a statistical life of $9.2 million per premature death potentially averted by the draft proposed rule. This estimate was based on estimates of the VSL developed by the EPA. As noted in the earlier discussion, the VSL does not place a value on individual lives, but rather, it represents an extrapolated estimate based on the rate at which individuals trade money for small changes in mortality risk (OMB, 2003).

Some recent studies have suggested that the VSL for children could be higher than that for adults. In other words, people might be willing to pay more to reduce the risk of premature death of children than to reduce the risk of premature death of adults. A review of the literature conducted for the CPSC suggested that the VSL for children could exceed that of adults by a factor of 1.2 to 3, with a midpoint of around 2 (IEc, 2018). Using the midpoint, the VSL for children would be $18.4 million per premature death averted. Given the estimate that the draft proposed rule could reduce child deaths by 5.8 per year (see Table 4), the value of the benefit from reduced mortality would be $106.7 million annually, instead of $53.4 million. This would increase the annual benefit per unit by 11.5 cents. Over a useful life of 15 years, this would come to an additional $1.05/unit, $1.37/unit or $1.73, at discount rates of 7 percent, 3 percent and no discounting, respectively. If one assumed that the VSL for children was three times that of adults, the increased benefit would be twice these amounts, or $2.10, $2.64, and $3.46, respectively.

5.2.2. Approximate a Confidence Interval for the Nonfatal Injuries

The estimates of the nonfatal injuries are generated by the Injury Cost Model and are based on the NEISS estimates. A 95 percent confidence interval can be estimated around the NEISS estimates, which would provide a reasonable upper and lower bound for the NEISS estimate. Staff has not developed the methodology for estimating a confidence interval about the estimates from the ICM, but we can approximate one by using the NEISS confidence interval and assuming that the 95 percent confidence interval for the ICM is the same percentage higher and lower than the point estimate.

For estimating the number of nonfatal injuries, we used the NEISS cases involving CSU tip overs for the 5-year period from 2015 through 2019. During this period, there were 14,848 children age 17 years and younger treated in emergency departments due to CSU tip overs (or about 2,969 a year as reported in Table 1.a). The coefficient of variation (cv) for this estimate is 0.1189, and therefore, the 95 percent confidence interval is 11,388 to 18,308 or about 23.3 percent higher or lower than the point estimate. Applying this percentage to the ICM estimates, it suggests that the actual annual nonfatal injury costs associated with tip-over incidents involving children 17 years old and younger is between $166.4 million and $267.4.[20]

Similarly, during the same 5-year period, there were 7,048 CSU tip-over injuries to adults treated in emergency departments or about 1,410 annually, as reported in Table 1.b. The CV for this estimate is 0.1076, and the 95 percent confidence interval around the NEISS estimate of injuries treated in emergency departments would be 5,562 to 8,534. Applying the same percentage to the ICM estimates suggests that the annual societal costs of adult injuries is between $101.5 million and $155.9 million.

We estimated that the draft proposed rule would reduce the societal cost of nonfatal injuries to children by 83 percent and to adults by 41.5 percent. Using the lower-bound estimates, the expected annual benefits would be $245.5 million or $0.53 per unit, assuming 463.5 million CSUs in use. Over a 15-year expected life, the benefit per unit would be $4.83 at a 7 percent discount rate, $6.33 assuming a 3 percent discount rate, and $7.95 without discounting. Using the upper-bound estimates, the expected annual benefit would be $351.9 million or about $0.76 per unit. Over a 15-year expected life, the benefit per unit would be $6.92 assuming a 7 percent discount rate, $9.07 assuming a 3 percent discount rate, and $11.4 without discounting. These

[20] The point estimate for non-fatal injuries to children is $216.9 million annually (see Table 4).

results would not change the overall results of the analysis. These are summarized in Table 8. For one of the four CSUs where staff estimated the costs of modifying the CSUs, the costs were approximately the same as the benefits per unit. For the other three, the cost of modifying the CSUs examined by staff are generally higher than the estimated benefits per unit, and for one CSU, where staff did not estimate the costs of modifying the CSUs, the costs were likely higher than the estimated benefits per unit.

Table 8. Approximated Lower and Upper Per-Unit Benefit Estimates

Discount Rate	(Approximated) Lower Bound	Estimate Used in Analysis	(Approximated) Upper Bound
7	$4.83	$6.01	$6.92
3	$6.33	$7.88	$9.07
0	$7.95	$9.90	$11.40

5.2.3. Summary of Sensitivity Analysis

If one combined the highest values of the sensitivity analyses above, the estimated benefits would be $9.02, $11.71, and $14.86 at discount rates of 7 percent, 3 percent, and no discounting, respectively. This could be considered a high estimate of the benefits. If the high benefit estimates are not discounted, the benefits could potentially exceed the costs of a few more of the modifications analyzed. However, several caveats should be considered. First, while it can be argued that the appropriate discount rates that should be considered are lower than the 7 and 3 percent rates suggested by OMB in Circular A-4 in 2003, the appropriate discount rate is unlikely to be zero. Second, while the possibility cannot be ruled out that the actual nonfatal injuries are at the upper bound in Table 8, they could also be at the lower bound. Thirdly, while some evidence literature suggests that the VSL for children is higher than for adults, the degree to which it is higher, is not settled. Finally, the estimated costs in Table 7 are generally minimum costs estimates, the actual cost estimates could be higher, but the degree to which they could be higher is not known. Staff welcomes comments on this sensitivity analysis and any other valuations used in this analysis.

6. STAFF EVALUATION OF THE VOLUNTARY STANDARD

In developing the draft proposed rule, CPSC staff considered whether the Commission could rely on the current voluntary standard, ASTM F2057-19 in lieu of a rule. The voluntary standard has been in effect for more than 20 years and has contained the same stability performance requirements since 2014. ASTM F2057-19 has two relevant performance requirements. One requires that the CSU not tip over when all drawers are opened to the outstop or two-thirds of the operational sliding length if there is no outstop. The second requires that each drawer be opened one at a time and a 50-pound weight be placed on the front of the drawer. If the CSU tips when the test is conducted with any drawer, the unit fails. The voluntary standard differs from the draft proposed rule in that each drawer is tested one at a time for the weighted test, the tests are conducted while the drawers are empty, the test is conducted on a flat surface rather than angled, and the voluntary standard does not account for the dynamic loading that a child would impart on a CSU while ascending it or the horizontal loading from a child pulling on the drawer.

CPSC staff concluded that ASTM F2057-19 does not adequately protect children from CSU tip overs for several reasons. ASTM F2057-19 does not consider the dynamic loading that occurs when a child climbs on a CSU. Research by UMTRI suggests the actual force a child would impart while climbing on a CSU could exceed 160 percent of the weight of the child.[21] ASTM F2057-19 also does not consider the effect of carpeting on stability. Testing by CPSC staff demonstrates that carpeting affects the stability of CSUs (Tab P), and more than 80 percent of the tip-over injuries have occurred on CSUs installed on carpeted surfaces (when the flooring type was reported). In addition, filled drawers are not considered in ASTM F2057-19. Testing results by CPSC staff indicate that the weight of filled drawers increases the stability of CSUs when the drawers are closed, but decreases the stability of CSUs when drawers are opened. Finally, ASTM F2057-19 does not account for the combination of multiple factors that can coexist that contribute to instability, such as multiple open filled drawers and climbing. Based on its work so far, CPSC staff determined that rather than fully protecting children that weigh 50 pounds or less (as ASTM F2057-19 aims to do), the current voluntary standard might only be fully protecting children that weigh 29.1 pounds or less, especially if the CSU is resting on a carpeted surface. For comparison, about 95 percent of all 3-year-old boys and about 85 percent of all 3-year-old girls weigh more than 29.1 pounds. CPSC staff is aware of 22 tip-over incidents involving CSUs that met the stability requirements in the voluntary standard.[22] CPSC efforts to encourage the voluntary standard organization to consider more stringent stability requirements have been met with resistance from industry participants. Even if all CSUs eventually complied with the voluntary standard, the benefits would be about 70 percent lower than the benefits expected from the draft proposed rule, because it would only protect children up

[21] Matthew P. Reed, Sheia M. Ebert, and Monica L.H. Jones, "Forces and Postures During Child Climbing Activities," University of Michigan Transportation Research Institute, July 2020. Technical Report sponsored by the U.S. Consumer Product Safety Commission, p. 69.

[22] This includes: a fatal incident involving a CSU that clearly met the ASTM F2057 – 19 stability requirements, a fatal incident involving a CSU that met the ASTM F2057 – 19 stability requirements in some conditions, and 20 nonfatal incidents involving CSUs that met the ASTM F2057 – 19 stability requirements (Tab F).

to 29.1 pounds.[23] For these reasons, staff concludes that the voluntary standard does not adequately reduce the risk of injury resulting from CSUs tipping over.[24]

The CPSA also requires a discussion of any efforts proposed in response to the ANPR to modify or develop a standard to address the risk of injury posed by CSUs; however, we received no proposals for any such standard modification or development.

7. ALTERNATIVES TO THE DRAFT PROPOSED RULE

7.1. No Regulatory Action

If the Commission opted to take no regulatory action, there may nonetheless be a decline in the number of deaths and injuries associated with CSUs with CRT televisions. First, as the number of CRT televisions in use continues to decline, the incidents involving these televisions should also decline. As noted earlier, since 2001, there has been an average of 11.2 child deaths a year due to CSU tip-over incidents; but at least five of these deaths, on average, also involved CRT televisions. As the number of CRT televisions in use continues to decline, the number of deaths associated with CRT televisions will also decline. There could be a similar decrease in the number of nonfatal injuries associated with CRT televisions. This would not impact the deaths and injuries associated with CSUs without CRT televisions; as Tab A indicates, there has been no declining trend in child injuries from CSU tip overs (without televisions) for the tracked period from 2006 to 2019.

The efforts of the Commission to encourage families with small children to anchor their furniture to a wall could also reduce the number of deaths and injuries. An advantage of anchoring a CSU to the wall is that the cost is borne strictly by those that believe they could be at risk from a tip-over accident. There need not be any costs imposed upon households that do not have children

[23] Using the methodology developed by the Division of Human Factors, the draft proposed rule is expected to reduce nonfatal climbing injuries by 91 percent, addressing 375.48 of the 412 climbing NEISS cases reviewed. A rule that protected children weighing 29.1 pounds or less would be expected to address only 110.08 of the incidents or about 27 percent.

[24] While the benefits of taking actions that brought compliance with the voluntary standard to about 100 percent would be significantly lower than the draft proposed rule, the costs would also be expected to be lower. Because the voluntary standard is less stringent than the draft proposed rule, it is expected that the cost of modifying CSUs to conform would also be less than for the draft proposed rule. Also, based on the testing conducted on the 186 samples collected in 2018 and 2019, 81 percent of the units had tip-over weights of at least 50 pounds and so probably would not require any modifications to comply with requirements similar to those in the voluntary standard. Although both the benefits and costs of such actions would be lower than for the draft proposed rule, we do not have sufficient information to compare the per-unit benefits and costs; and therefore, we cannot estimate what the net benefits of such a rule would be.

living in the house or that frequently visit the house or that otherwise do not believe that they are at risk from CSU tip overs. However, several studies have indicated that the rate at which households with young children anchor furniture is low (Tab C).

There are several costs associated with anchoring furniture to a wall that serve to reduce the likelihood of consumers anchoring their furniture. The cost of the anchor or anchoring straps are themselves low, no more than a few dollars per unit. However, there are other costs involved in anchoring furniture to the wall. The consumer must acquire tools required, which might include a drill and hammer. The consumer must also have acquired the skill to use these tools. For example, the consumer might need to know how to locate a stud, or, if a stud cannot be located, the consumer must know the type of wall anchor that is appropriate for the type of wall. Some consumers might already possess these tools and the skill to use them and so the cost to these consumers will be low. Other consumers might not have these tools or skills, and the cost to these consumers will be much higher at least for the first several units that they anchor because they will have to acquire the knowledge, skills, and tools required to complete the task. One would expect the cost to decline with each additional unit anchored. For many consumers there will also be a cost to repair the wall should they decide to move the furniture at a later date, which could be as much as the cost of the initial anchoring and includes the cost of patching the holes and repainting the wall. An additional limitation is that furniture may not be anchored properly. As Tab C explains, CPSC is aware of at least some incidents in which furniture that was anchored tipped over; and staff is aware of anchors failing at the connection to the furniture and others at the connection to the wall; and there is no standard that addresses connections to the furniture or to the wall.

According to one website, the cost to have to have furniture anchored to a wall by a professional "child-proofing" service provider ranges from $6 to $30 per item. However, these costs are likely to apply when the service provider is providing multiple services in a single visit, such as anchoring multiple pieces of furniture, adding safety latches to cabinets, and installing safety gates. The cost to anchor a single item, such as when a single new CSU is brought into a home, are likely to be higher. Efforts by the Commission to make anchoring furniture easier or cheaper for the consumer could increase the number of households anchoring CSUs. For example, it might be possible to encourage landlords to offer anchoring services for their tenants. Most landlords have access to the skills required to anchor furniture and some renters have cited leases that do not allow tenants to put holes in the walls as the reason that they have not anchored furniture. Therefore, if successful, efforts to encourage landlords to offer anchoring services to their tenants could increase the number of CSUs that are properly anchored. Other efforts to encourage handymen or other professionals to advertise anchoring CSUs as a service could also help to increase the rate at which CSUs are anchored.

One firm mentioned earlier, HinesLab, has developed a prototype of a base that could be retrofitted to CSUs that extends several inches in front of the CSU and adds significant stability to the CSU. The advantage of this approach is that it does not require making holes in the walls of the residence, and the CSU can be moved without the need to re-anchor it. However, this does not yet appear to be commercially available. This and similar efforts could be encouraged.

Given the fact that a high percentage of CSUs already comply with the stability requirements in the voluntary standard, efforts to make the voluntary standard more stringent have not been successful, and in spite of efforts to encourage households with children to anchor their furniture the rate of anchoring remains low, non-regulatory approaches are unlikely to significantly reduce the risk of injury from CSU tip overs.

7.2. Develop a Stability Rating Standard for CSUs

This alternative would include a test method to assess the stability of a specific CSU model, from which a stability rating would be calculated for that model, and require that rating to be provided for each CSU on a hang tag. A description of such a requirement along with background on the use of similar requirements at other agencies is provided in Tab E. A stability rating would give consumers information on the stability of the specific models that they were considering purchasing, which they could consider in their purchase decisions. A stability rating system could also give manufacturers an incentive to achieve a higher stability rating to increase their competitiveness or increase their appeal to consumers that desired CSUs that were less likely to tip-over. The hang tag could also note that consumers should not rely just on the stability ranking, and note other steps to provide stability, such as anchoring.

More than any of the regulatory options considered, including the requirements of the draft proposed rule, this option would directly address the lack of information available to consumers. This option would provide consumers with information allowing those who want to purchase more stable CSUs to do so, while those who did not believe the additional stability was worth the additional cost, could still opt for furniture with lower stability ratings. However, this would not address risk to children who might be exposed to the CSU tip-over hazard outside their homes, or to CSUs purchased before the child's birth. The long service life of CSUs and the unpredictability of visitors or family changes in that timespan, and these potential future risks might not be considered at the time of the original purchase. Alternatively, a factor supporting this approach is that some retailers might not want to offer furniture with low stability ratings, which could put additional pressure on manufacturers to modify or eliminate the lowest rated models in their product lines.

There is evidence that such requirements have improved safety in some situations. For example, the National Highway Traffic Safety Administration (NHTSA) found that the safety ratings of automobiles improved after they introduced their star rating system for comparing the frontal crashworthiness of automobiles in 1978 (Kahane 1994). Later, in 2001, NHTSA introduced another rating system to allow consumers to compare the rollover resistance of passenger cars, based on the static stability factor (SSF) of the vehicles. The SSFs for sport utility vehicles (SUVs) generally fall in the range of 1 to 1.3. In 2001, the first year of NHTSA's rollover resistance rating, the average SSF of SUVs was 1.12, and only 12.7 percent of the models had SSFs exceeding 1.2. By 2006, the average SSF of SUVs was 1.18, and the proportion that exceeded 1.2 had increased to 31.7 percent (Kallan and Jermakian, 2008).

Because this alternative would not establish a minimum safety standard, it would not require that manufacturers drop or modify any CSUs. Therefore, the only direct cost of this alternative would be the cost to manufacturers of testing their CSUs to establish their stability rating and labeling their CSUs in accordance with the required information. Any changes in the design of the CSUs that result from this alternative would be the result of manufacturers responding to changes in consumer demand for particular models in response to the new information on the stability of particular models.

However, while the costs of a stability rating system and labeling requirement would be significantly lower than the draft proposed rule, and there is evidence that similar rating systems have resulted in improvements in product safety, we are unable to estimate the extent to which the stability information would affect consumer purchases or reduce CSU tip-over incidents. We do not know the extent to which consumers would demand and manufacturers would offer CSUs with the higher ratings. And if the more stable options are more expensive, as is likely, consumers might not purchase them. Therefore, although this alternative could lead to a reduction in deaths and injuries from tip overs, there is no certainty that it would. Because it is not clear that this alternative would result in an acceptable reduction in deaths and injuries, staff does not recommend this alternative. Nevertheless, we do see some merit in such a rating system to compares the stability of the units that already meet the proposed performance requirements and hang tag requirements and recommend it as one element of the draft proposed rule.

7.3 Mandate a More Rigorous Standard (Draft Proposed Rule, But Addressing 60-lb Children, Instead of 51.2-lb Children)

The Commission could consider proposing a rule with more rigorous requirements, such as a rule that would protect 60-pound children rather than 51.2-pound children. About 74 percent of CSU tip-over injuries involving children occur to children ages 4 years and younger,[25] and these are already addressed by the draft proposed rule, because the 95th percentile weight for 4-year-old children is approximately 52 pounds. However, the draft proposed rule would also address some of the injuries to children who are 5 and 6 years old, as well, because many of these children also weigh less than 51.2 pounds. Mandating a rule that would protect 60-pound children would increase the benefit associated with child fatal and nonfatal injuries by about $10.9 million, and the rule could increase the benefits associated with reductions in adult fatal

[25] Based on the NEISS estimates for the period 2015 through 2019

and nonfatal injuries by $3.2 million or a total of $14.1 million annually. This comes to about 3 cents per unit on an annual basis. Over an assumed 15-year life of a CSU, this comes to 7 cents per unit, assuming a 7 percent discount rate, 36 cents assuming a 3 percent discount rate, or 45 cents without discounting. Therefore, increasing the weight of the child protected to 60 pounds would only increase benefits by about 4.5 percent over the benefits that could be obtained by the draft proposed rule. Presumably, the cost of manufacturing furniture that complies with this more rigorous alternative would be somewhat higher than the costs of manufacturing CSUs that comply with the draft proposed rule, using similar, but somewhat more extensive, modifications that would be used to comply with the requirement of the draft proposed rule.

Because this alternative would provide only a limited increase in benefits, but a higher level of costs than the draft proposed rule, staff does not recommend this alternative.

7.4 Mandate ASTM F2057 but With a 60-Pound Test Weight

Another alternative would be to mandate a standard like ASTM F2057-19, but replace the 50-pound test weight with a 60-pound test weight. As discussed in the ANPR, 60 pounds better represents the 95th percentile weight of 5 year old children, which is the age ASTM F2057-19 claims to address. However, a 60-pound test weight does not equate to protecting a 60-pound child because, as the UMTRI study demonstrates, children generate forces greater than their weight during certain interactions with a CSU.

This alternative would be less costly than the draft proposed rule, because, as discussed above, based on CPSC testing, about 57 percent of CSUs on the market would already meet this requirement. The cost of modifying CSUs that do not comply is likely to be less than modifying them to comply with the draft proposed rule, which is more stringent.

By increasing the test weight, it is possible that this alternative would prevent some CSU tip overs. However, this alternative still would not account for the horizontal and dynamic forces of a child climbing on a CSU, or account for the effect of multiple open and filled drawers, or CSUs placed on carpet. Because this alternative does not account for the horizontal and dynamic forces of a child climbing or for the effects of carpeting or filled, open drawers, its effectiveness at reducing tip overs is diminished. Although the test weight of 60 pounds is approximately equal to the 95th percentile weight of a 5-year-old child, it does not represent the moment generated by a child of that weight while ascending a CSU; nor does it account for multiple full and open drawers or carpeting. As such, it probably would only protect children who weigh around 38 pounds or less, which is approximately the 75th percentile weight of children 3 years of age. For this reason, staff does not believe that this alternative would adequately address the hazard. Therefore, staff does not recommend this alternative.

7.5 Longer Effective Date

The draft proposed rule includes an effective date of 180 days after the final rule is published in the *Federal Register*. That would give manufacturers approximately 6 months to understand the requirements, redesign all of their CSUs to comply with the requirements, and begin manufacturing CSUs that meet the requirements. Given that hundreds of manufacturers, including importers, will have to modify probably several thousand models, it could be challenging for many firms to meet the 180-day effective date. This could cause a disruption in the supply of CSUs, or result in fewer choices being offered to consumers, at least in the short term. To reduce the costs or mitigate any disruption, CPSC staff considered recommending a longer effective date. However, delaying the effective date would delay realizing the potential benefits. Therefore, CPSC staff is not recommending an effective date longer than 180 days. However, staff does solicit comments regarding the reasonableness of the 180-day effective date and recommendations for a different effective date, if justified. Comments recommending a longer effective date should clearly describe the problems associated with meeting the shorter effective date and the justification for a longer one.

8. SUMMARY AND CONCLUSIONS

If the draft proposed rule were promulgated, serious injuries and deaths of children due to CSU tip overs would be reduced. This would result in average benefits of $6.01 (at a 7 percent discount rate) to $9.90 (without discounting) per CSU. Based on the testing staff has conducted so far, CPSC staff is only aware of one CSU on the market that would meet the requirements of the draft proposed rule. CPSC staff analyzed five CSU models to determine what types of modifications would allow those units to comply with the draft proposed rule and estimate the costs. For one of the models, the estimated costs of the modifications were in the same range as the benefits. For the other four models, the estimated costs exceeded $13 per unit and could exceed $25 in some cases, which is higher than the average benefit per unit. A sensitivity analysis considered a potential upper- and lower-confidence interval around the Injury Cost Model estimates of nonfatal injuries and a potential higher VSL for children. If the highest estimates for both variables considered in the sensitivity analysis are combined and the annual benefits are not discounted over the expected life of a CSU, the benefits and costs for some of the potential modifications examined in the analysis could be close.

The draft proposed rule could impact consumers in other ways, including causing many CSUs to be heavier, making them more difficult to move or assemble. CSUs with some dimensions might prove difficult to modify to meet the requirements of the draft proposed and could be withdrawn from the market. RTA CSUs are frequently less expensive than factory-assembled CSUs. To the extent that RTA CSUs could be disproportionately impacted by the draft proposed rule, because they tend also to be lighter than factory-assembled CSUs, the draft proposed rule could have a disproportionate impact on lower-income consumers and others who desired less expensive CSUs.

Staff considered several alternatives to the draft proposed rule. Three of the alternatives could be deemed less stringent than the draft proposed rule. These were not taking any regulatory action, or mandating a requirement similar to the current voluntary standard but requiring a 60-pound test weight, or mandating a hang tag providing a stability rating, but no mandatory performance standard. Staff does not recommend any of these alternatives because they would not likely reduce deaths and injuries from CSU tip overs to the same extent as the draft proposed rule.

A more stringent alternative was considered, one that attempted to address incidents involving children weighing 60 pounds or less climbing the front of CSUs, as opposed to the 51.2 pounds or less that the draft proposed rule attempts to address. Staff did not recommend this alternative because it would only increase the benefits slightly, and meanwhile increase its costs. Staff notes that 51.2 pounds is approximately the 95th percentile weight for 4 year olds. Almost 95 percent of fatalities and about 74 percent of nonfatal injuries involving children are to children 4 years of age or younger, and these are largely addressed by the draft proposed rule.

9. REFERENCES

Asch, Peter, 1988. Consumer safety regulation. Oxford University Press: New York.

Balci-Sinha, Rana and Kristen Talcott. CPSC Memorandum: "Human Factors Assessment of the Clothing Storage Unit (CSU) Incidents, Research, and Child Physical and Behavioral Characteristics for Developing Recommendations for the Proposed Rule," Consumer Product Safety Commission, (2021).

Bhattachara, S., Lawrence, B., Miller, T.R, Zaloshnja, E., Jones, P.R., 2012. Ratios for Computing Medically Treated Injury Incidence and Its Standard Error from NEISS Data (Contract CPSC-D-05-0006, Task Order 8). Calverton, MD: Pacific Institute for Research and Evaluation, (Aug 2012).

CPSC, 2000. The National Electronic Injury Surveillance System: A tool for researchers. Bethesda, MD: U.S. Consumer product Safety Commission. Available at: https://www.cpsc.gov/s3fs-public/pdfs/blk_media_2000d015.pdf

Fors Marsh Group, Consumer Product Safety Commission (CPSC): Furniture Tip-Over Report, March 13, 2020.

Gold, Marthe R., Siegel, Joanna E., Russell, Louise B., Weinstein, Milton C., 1996. Cost-effectiveness in health and medicine. New York: Oxford University Press.

Haddix, Anne C., Teutsch, Steven M., Corso, Phaedra S., 2003. Prevention effectiveness: A guide to decision and economic evaluation (2nd ed.). New York: Oxford University Press.

Industrial Economics, Inc. (January 2018), "Valuing Reductions in Fatal Risks to Children," Final Contractor Report to the Consumer Product Safety Commission, Directorate for Economic Analysis. Prepared by William Raich and Jennifer Baxter (Industrial Economics) and Lisa A Robinson and James K. Hammitt (Harvard University, Center for Health Decision Sciences and Center for Risk Analysis.

Industrial Economics, Inc. (March 2019), Memorandum to Charles Smith, et. al., Consumer Product Safety Commission, "Final Clothing Storage Units (CSUs) Market Research Report".

Industrial Economics, Inc. (June 2019, Memorandum to Charles Smith, et. al. Consumer Product Safety Commission, Directorate for Economic Analysis, "Final Clothing Storage Units (CSUs) Cost Impact Analysis."

Jenkins, Jill L., Rodgers, Gregory B., 2020. Combining measures of risk exposure with injury incidence estimates to estimate nursery product injury rates, Journal of Safety Research, 72, 43-46.

Kahane, C.J. 1994. Correlation of NCAP Performance with Fatality Risk in Actual Head-On Collisions. National Highway Traffic Safety Administration Report (1994). (Available at https://crashstats.nhtsa.dot.gov/Api/Public/ViewPublication/808061.)

Kallan, Michael J. and Jessica Steps Jerakia. SUV Rollover Vehicle Crashes and the Influence of ESC and SSF, 52nd AAAM Annual Conference, Annals of Advances in Automotive Medicine, October 2008.

Lahr, M.L., Gordon, B.B., 1980. Product life model feasibility and development study. Contract CPSC-C-79-009, Task 6, Subtasks 6.01-6.06). Columbus, OH: Battelle Laboratories.

Lawrence, BA, Miller, TR, Waejrer, GM, Spicer, RS, Cohen, MA, Zamula, WW, 2018. The Consumer Product Safety Commission's Revised Injury Cost Model. Maryland: Pacific Institute for Research and Evaluation (PIRE). (February, 2018). Available at: https://www.cpsc.gov/s3fs-public/ICM-2018-Documentation.pdf?YWuW4Jn0eb2hExeA0z68B64cv6LlUYoE

Lee, Arthur and Volanth, Casey, 2015, TVS - TIPPING THE SCALE TO SAFETY A look into falling TV dynamics and incidents, 2015 Directorate for Engineering Sciences U.S. Consumer Product Safety Commission, Rockville, Maryland (January 26, 2015). Available at https://cpsc.gov/s3fs-public/pdfs/TV-hazard-report-January2015.pdf.

Mella, Lawrence, Andrew Newens, Daniel Taxier, (2021) CPSC Memorandum to Kristen Talcott, "Mechanical Evaluation and Analytical Modeling of Incident-Involved Clothing Storage Units, Consumer Product Safety Commission, Bethesda, MD.

Miller et al., 2000. The Consumer Product Safety Commission revised injury cost model. Calberton, MD: Public Services Research Institute. Available at https://www.cpsc.gov/s3fs-public/pdfs/Revised-Injury-Cost-Model-120100.pdf

Nesteruck, Hope E J., "Recommendation for Clothing Storage Furniture Hang Tag Providing Tip-Over Resistance to Consumers," U.S. Consumer Product Safety Commission, Bethesda, MD (2021).

Neumann, Peter J., Sanders, Gillian D,, Russell, Louise B., Siegel, Joanna E., Ganiats, Theodore G., 2016. Cost-effectiveness in health and medicine: Second Edition. New York: Oxford University Press.

OMB, 1993. Executive Order 12866 of September 10, 1993: regulatory planning and review, Federal Register 58(90), 51735-51744. Available at: http://www.archives.gov/federal-register/executive-orders/pdf/12866.pdf

OMB, 2003. Circular A-4: Regulatory analysis. Washington, DC: Office of Management and Budget. Available at: https://www.transportation.gov/sites/dot.gov/files/docs/OMB%20Circular%20No.%20A-4.pdf

Rice, Dorothy P., MacKenzie, Ellen J., and Associates, 1989. Cost of injury in the United States: A report to Congress. San Francisco, CA: Institute for Health & Aging, University of California and Injury Prevention Center, The Johns Hopkins University.

Rodgers, Gregory B., 1993. Estimating jury compensation for pain and suffering in product liability cases involving nonfatal personal injury. Journal of Forensic Economics 6(3), 251-262.

Rodgers, Gregory B., Garland, Sarah E., 2016. An economic analysis of requirements to prevent handheld hair dryer immersion electrocutions in the USA. Journal of Consumer Policy, 39, 223-240.

Rodgers, Gregory B., Rubin, Paul H., 1989. Cost-benefit analysis of all-terrain vehicles at the CPSC. Risk Analysis, 9(1), 63-69.

Sanborn, Maxwell, 2021. CPSC Memorandum: FY18 Midyear Clothing Storage Unit Testing Program Summary, Consumer Product Safety Commission, Bethesda, MD.

Schroeder, Tom, and Ault, Kimberly, 2001. The NEISS sample (design and implementation) 1997 to present. Bethesda, MD: U.S. Consumer product Safety Commission. Available at: http://www.cpsc.gov//PageFiles/106617/2001d011-6b6.pdf

Smith, Charles (2010). CPSC Memorandum to Ian Hall, "CRT Televisions: Information on Unit Sales and Number in Use," July 2, 2010.

Smith, Charles, Draft Proposed Rule Establishing a Safety Standard for Portable Generators: Preliminary Regulatory Analysis, U.S. Consumer Product Safety Commission, Bethesda, MD, September 2016. (TAB L in the NPR briefing package.)

Smith, Timothy P., 2016. Human factors assessment of blade-contact scenarios and responses to ANPR public comments (Tab D). Bethesda, MD: U.S. Consumer Product Safety Commission (November 15).

Taxier, D. (April 2021). Staff Analysis Report: Mechanical evaluation of clothing storage unit (CSU) tip-over research, incidents, and design solutions, contributing to proposed rule for CSU inherent stability. Directorate for Engineering Sciences, Division of Mechanical Engineering (ESMC), CPSC. Bethesda, MD. (TAB C in the NPR briefing package)

Tohamy, Soumaya M., 2006. Final regulatory analysis of staff's draft final standard to address open-flame ignitions of mattress sets. (January 10, 2006). Bethesda, MD: U.S. Consumer Product Safety Commission.

Viscusi, W. Kip, 1988. The determinants of the disposition of product liability cases: Systematic compensation or capricious awards? International Review of Law and Economics, 8, 203-220.

Viscusi, W. Kip, Harrington, Joseph E., Vernon, John M., 2005. Economics of regulation and antitrust, 4th Edition. Cambridge, MA: MIT press.

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TAB I: Draft Proposed Rule Establishing a Safety Standard for Clothing Storage Units: Initial Regulatory Flexibility Analysis

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DRAFT Proposed Rule Establishing a Safety Standard for Clothing Storage Units: Initial Regulatory Flexibility Analysis

Charles Smith
Directorate for Economic Analysis
July 9, 2021

DRAFT Proposed Rule Establishing a Safety Standard for Clothing Storage Units: Initial Regulatory Flexibility Analysis

BACKGROUND

The Consumer Product Safety Commission (CPSC or Commission) is considering a draft proposed rule to establish a mandatory stability standard for clothing storage units (or CSUs). This rulemaking proceeding was initiated on November 30, 2017, with the publication of an advance notice of proposed rulemaking (ANPR) in the Federal Register.[1] Whenever an agency is required to publish a notice of proposed rulemaking, the Regulatory Flexibility Act (5 U.S.C. 601 – 612) requires that the agency prepare an initial regulatory flexibility analysis (IRFA) that describes the impact that the rule would have on small businesses and other entities. The IRFA must contain –

(1) a description of why action by the agency is being considered;

(2) a succinct statement of the objectives of, and legal basis for, the proposed rule;

(3) a description of and, where feasible, an estimate of the number of small entities to which the proposed rule will apply;

(4) a description of the projected reporting, recordkeeping and other compliance requirements of the proposed rule, including an estimate of the classes of small entities which will be subject to the requirement and the type of professional skills necessary for preparation of the report or record; and

(5) an identification to the extent practicable, of all relevant Federal rules which may duplicate, overlap or conflict with the proposed rule.

The IRFA must also describe any significant alternatives to the proposed rule that would accomplish the stated objectives and would minimize any significant economic impact of the proposed rule on small entities. This report provides the IRFA of the draft proposed rule.

WHY THE COMMISSION IS CONSIDERING THIS RULE

The intent of this rulemaking is to reduce deaths and injuries resulting from CSUs tipping over on children. These tip-over incidents commonly result when young children attempt to climb on the CSU or open drawers; the weight and interaction of the child combined with the weight of

[1] 82 Fed. Reg. 56752 (Nov. 30, 2017).

any open drawers causes the CSU to tip forward and fall on the child. Children can be killed or injured from the impact of the CSU falling on them or by being trapped beneath the CSU, restricting their ability to breathe. CPSC epidemiology staff (Suchy, 2021; Tab A) noted that, between January 1, 2000, and December 31, 2020, there were 193 reported deaths[2] associated with CSU tip overs involving children (an average of about 11 each year); 89 of these deaths (46%) only involved a CSU; and 104 of the deaths (54%) involved a CSU with a television on top. Over these years, the oldest child involved in just a CSU tip over (*i.e.*, no television) was 7 years old, and three 8-year old children were reportedly killed in incidents involving both CSUs and televisions. Among the 89 child fatalities involving a CSU with no television involved, 91 percent (81 out of 89 children) were between 1 and 3 years old. Among children ages 4 years and older, a television was more likely than not to be involved (Suchy, 2021; Tab A). For the 89 fatal tip-over incidents involving children and CSUs without televisions, analysis by staff of CPSC's Directorate for Engineering Sciences, Division of Human Factors (ESHF), found that 47 reported the type of interaction in the incident narratives. For these fatal tip-over incidents, 91 percent involved children climbing on the CSU (74%), or sitting, laying or standing in a drawer (17%) (Balci-Sinha & Talcott, 2021; Tab C).

Based on data from the National Electronic Injury Surveillance System (NEISS), a national probability sample of U.S. hospital emergency departments (EDs), there were 14,843 nonfatal injuries to children under the age of 18 years involving CSU tip overs during the 5-year period 2015 through 2019[3], or an average of 2,969 per year that were treated in hospital EDs. In addition to injuries initially treated in hospital EDs, many product-related injuries are treated in other medical settings, such as physicians' offices, clinics, and ambulatory surgery centers. The number of CSU-related injuries treated outside of hospital EDs can be estimated with the CPSC's Injury Cost Model (ICM). Based on the NEISS estimate of 14,843 ED-treated injuries in 2015 through 2019, the ICM projects approximately 19,282 CSU tip-over injuries treated in other settings during the same 5-year period, or an average of 3,857 per year. Combining the NEISS estimate of injuries treated in hospital EDs with the ICM estimate of medically attended injuries treated in other settings brings the estimate of all nonfatal, medically attended CSU tip-over injuries to children under the age of 18 years to 34,126 during the years 2015 through 2019, an average of 6,825 per year. More details on these estimates, the methodology employed by the ICM, and cost estimates for these estimated injuries may be found in the preliminary regulatory analysis (Franklin & Smith, 2021; Tab H).

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[2] Source: CPSRMS and NEISS databases; reporting is ongoing for CPSRMS; 2018–2020 are considered incomplete (Suchy, 2021).

[3] The more-recent period for analysis of nonfatal injuries was chosen to reduce the likelihood that older, heavier CRT televisions were involved, since information on the type of television involved is often lacking in the NEISS reports. A more detailed discussion of this issue may be found in the preliminary regulatory analysis (Franklin & Smith, Tab H).

The Commission is considering this mandatory rule because the two stability requirements in the voluntary standard for CSUs, ASTM F2057-19 *Standard Safety Specification for Clothing Storage Units*[4] (Sanborn, 2021; Tab N) do not adequately address the risk. ASTM F2057-19 requires that CSUs not tip over when each drawer is opened one at a time and a 50-pound weight is attached to the front of the drawer, and also when all of the drawers are open simultaneously (with no added weight). The voluntary standard differs from the draft proposed rule in that each drawer is tested one at a time with a test weight; the tests are always conducted while the drawers are empty; the test is conducted on a flat surface rather than angled (to simulate carpet); and the voluntary standard does not account for the horizontal and dynamic forces that a child would impart on a CSU while ascending it. CPSCs Laboratory Sciences Mechanical (LSM) staff concluded that, by not accounting for these factors, ASTM F2057-19 does not adequately protect young children (Sanborn et al., 2021; Tab F).[5]

OBJECTIVES AND LEGAL BASIS OF THE DRAFT PROPOSED RULE

The objective of the draft proposed rule is to reduce deaths and injuries resulting from tip-over incidents involving CSUs. According to the draft performance requirements, *"clothing storage unit"* means a free-standing furniture item, with drawer(s) and/or door(s), that may be reasonably expected to be used for storing clothing, that is greater than or equal to 27 inches in height, and with a total closed storage functional volume of the closed storage greater than 1.3 cubic feet and greater than the sum of the total functional volume of the open storage and the total volume of the open space half of the total product volume" (CPSC staff, 2021, Tab G). Common names for clothing storage units include, but are not limited to: chests, bureaus, and dressers, armoires, wardrobes, chests of drawers, drawer chests, chifforobes, and door chests.

The Commission published an ANPR in November 2017, which initiated this proceeding to evaluate regulatory options and potentially develop a mandatory standard to address the risks of CSU tip-over deaths and injuries. The draft proposed rule would be issued under the authority of the Consumer Product Safety Act (CPSA).

SMALL ENTITIES TO WHICH THE DRAFT PROPOSED RULE WOULD APPLY

The draft proposed rule would apply to small entities that manufacture or import CSUs. Manufacturers of CSUs are principally classified in the North American Industrial Classification

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[4] At the time staff conducted the testing, ASTM F2057-17 was the applicable version of the voluntary standard. The stability tests in ASTM F2057-19 (the current version of the standard) are unchanged from the stability tests in ASTM F2057-17 used by CPSC staff to assess the stability of the sample of CSUs.

[5] A more detailed discussion of the staff's assessment of the inadequacy of the voluntary standard may be found in the preliminary regulatory analysis (Franklin & Smith, 2021, Tab H).

(NAICS) category 337122 (non-upholstered wood household furniture manufacturing), but may also be categorized in NAICS codes 337121 (upholstered household furniture manufacturing), 337124 (metal household furniture manufacturing), or 337125 (household furniture (except wood and metal) manufacturing). According to data from the U.S. Census Bureau, in 2017, there were a total of 3,404 firms classified in these four furniture categories. Of these firms, 2,024 were primarily categorized in the non-upholstered wood furniture category. More than 99 percent of the firms primarily categorized as manufacturers of non-upholstered wood furniture would be considered to be small businesses, as were 97 percent of firms in the other furniture categories, according to the U.S. Small Business Administration (SBA) size standards (U.S. Small Business Administration, 2019). We note that these categories are broad and include manufacturers of other types of furniture, such as tables, chairs, bed frames, and sofas. It is also likely that not all of the firms in these categories manufacture CSUs. Production methods and efficiencies vary among manufacturers; some make use of mass-production techniques, and others manufacture their products one at a time, or on a custom-order basis.

The number of U.S. firms that are primarily classified as manufacturers of non-upholstered wood household furniture has declined over the last few decades because retailers have turned to international sources of CSUs and other wood furniture. Additionally, firms that formerly produced all of their CSUs domestically have shifted production to foreign plants.

Well over half (64%) of the value of apparent consumption of non-upholstered wood furniture (net imports plus domestic production for the U.S. market) in 2019 was comprised of imported furniture, and this likely was true for CSUs, as well. Firms that import furniture would likely be impacted by any rule that the Commission might promulgate regulating CSUs because they would have to ensure that any products that they import meet the requirements of the rule. Under the NAICS classification system, importers are classified as either wholesalers or retailers. Furniture wholesalers are classified in NAICS category 423210 (Furniture Merchant Wholesalers). According to the Census Bureau data, in 2017, there were 5,117 firms involved in household furniture importation and distribution. A total of 4,920 of these (or 96 percent) are classified as small businesses because they employ fewer than 100 employees (which is the SBA size standard for NAICS category 423210). Furniture retailers are classified in NAICS category 442110 (Furniture Stores). According to the Census Bureau, there were 13,826 furniture retailers in 2017. The SBA considers furniture retailers to be small businesses if their gross revenue is less than $22 million. Using these criteria, at least 97 percent of the furniture retailers are small (based on revenue data from the 2012 Economic Census of the United States). Wholesalers and retailers may obtain their products from domestic sources or import them from foreign manufacturers.

COMPLIANCE REQUIREMENTS OF THE DRAFT PROPOSED RULE, INCLUDING REPORTING AND RECORDKEEPING REQUIREMENTS

The draft proposed rule would establish a mandatory standard that all CSUs would have to meet in order to be sold in the United States. The requirements of the draft proposed standard, including the justifications for each provision, are detailed in the evaluation report by the Directorate for Engineering Sciences, Division of Mechanical Engineering staff (Taxier, 2021; Tab D). In brief, the provisions of the draft standard include the following points:

1. When testing a CSU for conformance, the CSU shall be tilted forward by 1.5 degrees. This is done to mimic the impact of carpeting on the stability of CSUs. CPSC testing has found that in general, CSUs installed on carpeted surfaces are less stable than CSUs installed on hard surfaces. More than 80 percent of the CSU tip-over incidents for which Directorate for Engineering Sciences, Division of Human Factors (ESHF) staff have been able to identify the type of flooring have occurred on carpeted surfaces (Balci-Sinha & Talcott, 2021; TAB C).

2. CSUs shall be tested with all doors open, and all drawers and pull-out shelves pulled out that can maintain the outward position. This provision is included because many tip-over incidents have occurred when the child had opened multiple drawers of the CSU.

3. The drawers shall be filled with 8.5 pounds per cubic foot of storage volume placed at the center of the drawer if more than half of the drawers by volume remain pulled out. This provision is included because in the vast majority of cases, the CSUs involved in incidents are being used and the drawers are filled with clothing or other items.

4. The drawers shall remain empty if less than half of the drawers by volume remain pulled out. This provision is to ensure that the test is a stringent test in the cases where a drawer interlock device is included on the CSU. If the drawers were filled even though they were not opened, it would increase the stability of the CSU being tested.

5. Staff developed three pass-fail criteria based on three child interactions that can lead to CSU tip-over incidents: a child climbing (ascending) a CSU; a child pulling on a handhold of a CSU while opening, or attempting to open a drawer, and; a child climbing (hanging) on the door of a CSU. Each interaction produces a tip-over moment[6] about the CSU fulcrum (typically the front feet) that depends on different characteristics of the CSU. Staff recommends requiring that the tip-over moment for a CSU must be greater than the three values, each corresponding to one of the above interactions. The threshold tip-over

[6] The *Recommended Regulatory Text for Draft Proposed Rule* (Tab G) defines *moment* as "a moment of a force, which is a measure of the tendency to cause a body to rotate about a specific point or axis."

> moment that a CSU must exceed for the climbing interactions is determined by a formula based on research conducted for CPSC by the University of Michigan Transportation Research Institute (UMTRI). The tip-over moment will vary by CSU and will be impacted by the distance from the front edge of the drawers when fully extended to the front edge of the CSU that touches the floor.

The proposed rule would also prohibit any person from manufacturing or importing noncomplying CSUs in any period of 12 consecutive months between the date of promulgation of the final rule and the effective date, at a rate that is greater than 120 percent of the rate at which they manufactured or imported CSUs during the base period for the manufacturer. The base period is any period of 365 consecutive days, chosen by the manufacturer or importer, in the 5-year period immediately preceding promulgation of the rule. Thus, the stockpiling limit would allow manufacturers and the industry to meet any foreseeable increase in the demand for CSUs, without allowing large quantities of CSUs to be stockpiled.

Section 14 of the CPSA requires manufacturers, importers, or private labelers of a consumer product subject to a consumer product safety rule to certify, based on a test of each product or a reasonable testing program, that the product complies with all rules, bans or standards applicable to the product. The draft proposed rule specifies the test procedure to use to determine whether a CSU complies with the requirements. For products that manufacturers certify, manufacturers would issue a general certificate of conformity (GCC). In the case of CSUs that could be considered to be children's products, the certification must be based on testing by an accredited third-party conformity assessment body.

The requirements for the GCC are stated in Section 14 of the CPSA. Among other requirements, each certificate must identify the manufacturer or private labeler issuing the certificate and any third-party conformity assessment body, on whose testing the certificate depends, the date and place of manufacture, the date and place where the product was tested, each party's name, full mailing address, telephone number, and contact information for the individual responsible for maintaining records of test results. The certificates must be in English. The certificates must be furnished to each distributor or retailer of the product and to the CPSC, if requested.

In addition to the stability performance requirements, the draft proposed standard includes specific requirements for placement, content, symbols, and format of a permanent warning label. Staff recommends use of a warning label to inform consumers of the hazard and motivate them to install tip restraints as a secondary safety mechanism. ESHF staff provides details about the recommended label (Balci-Sinha & Talcott, 2021; Tab C).

The draft proposed standard also includes a requirement, under section 27(e) of the CPSA, to provide comparative technical information about the tip rating of each CSU at the time of original purchase, so consumers may make informed buying decisions and compare the stability ratings of products. The information is to be provided in the form of a hang tag. The tip rating is the ratio of tested moment to threshold moment requirement to provide a simple calculation that results in a number, greater than 1, which is represented on a scale. A detailed discussion of the proposed hang tag is provided by a memorandum by CPSC engineering staff (Nesteruk, 2021; Tab E).

COSTS OF DRAFT PROPOSED RULE THAT WOULD BE INCURRED BY SMALL MANUFACTURERS

Staff of CPSC's Directorate for Engineering Sciences evaluated product modifications intended to improve the tip-over resistance or stability of clothing storage units (Taxier, 2021, Tab D). The most likely product modifications manufacturers will use to comply with the proposed stability requirements are: (1) the addition of drawer interlock systems, which would only enable children (and other consumers) to open a limited number of drawers at a time; (2) adding a counterweight to the CSU; (3) extending the front legs or edge (that is, the fulcrum); (4) reducing the distance that drawers may be extended; and (5) increasing the height of the front legs to tilt the CSU backwards. It is likely that most CSUs would require a combination of these modifications to comply with the draft proposed standard. Based on an analysis of how five CSUs could be modified to meet the cost of the draft proposed rule, CPSC staff estimated the potential cost increases to CSU manufacturers. For four of the CSUs the cost estimates were $13 or more per unit, and in some cases exceeded $25, which exceeds the estimated average benefits per unit. For the fifth CSU, the estimated cost estimates of the modifications were in the same range as the estimated benefits per unit (Franklin & Smith, 2021; Tab H).

Firms may choose other methods or different combinations resulting in lower or higher costs to comply. As noted in the preliminary regulatory analysis, in many cases the cost estimates are not comprehensive, and these costs could be underestimated. In addition to costs of product modifications, any reductions in utility that might be caused by modifications such as reductions in the drawer extensions or significantly higher weights have not been quantified; nor have any aesthetic costs or the possibility of a tripping hazard that might result from the addition of significant foot extensions. Some models could require such substantial modifications that they no longer have the characteristics of the original models and manufacturers might withdraw them from the market, creating some unquantified loss of consumer utility.

The above estimates include the variable costs related to changes such as additional hardware, materials that increase the weight, and increased shipping costs. They also include the fixed costs associated with the research and development required to redesign CSUs and tooling costs. If products have to be completely redesigned to meet the draft standard (*e.g.,* if adding weight or other minor modifications are not sufficient, and suppliers need to make drawers deeper and add new drawer slides), the changes could add substantial costs, or they could be offset with lighter weight front panels or tops. One supplier contacted by Industrial Economics Corporation (IEc) on behalf of the CPSC estimated the cost of redesigning a CSU model as $18,000, including prototype, testing, engineering, and design (Israel et al., 2019, June 7). Costs of model redesign per unit produced would be greater for smaller manufacturers with lower production volumes.

For smaller, lower-volume producers, the per-unit costs of the components necessary to modify their CSUs might also be higher than those for higher volume producers. As discussed in the preliminary regulatory analysis (Franklin & Smith, 2021; Tab H), CSUs that meet the requirements of the draft proposed rule would probably incorporate hardware designed to limit the ability of consumers to open multiple drawers at a time. Therefore, manufacturers would incur the costs of adding such drawer-interlock components. Based on information obtained from a CSU manufacturer, the cost of these components might average $6 to $12 per unit if the CSU only has one column of drawers. Component suppliers are likely to charge higher per unit prices to manufacturers that purchase fewer units. Also, larger companies with vertically-integrated operations that own or operate suppliers can more easily adapt to changes in design and manufacturing, and therefore may experience fewer impacts than smaller manufacturers without vertical integration (Israel et al., June 7, 2019, p. 6).

Manufacturers would likely incur some additional costs to certify that their CSUs meet the requirements of the draft proposed rule as required by Section 14 of the CPSA. The certification must be based on a test of each product or a reasonable testing program. The costs of the testing might be minimal, especially for small manufacturers that currently conduct testing for conformance to the current voluntary standard, ASTM F2057-19. Importers may also rely upon testing completed by other parties, such as their foreign suppliers, if those tests provide sufficient information for the manufacturers or importers to certify that the CSUs comply with the draft proposed rule. In the case of CSUs that could be considered to be children's products, which are thought to constitute a very small portion of the market for CSUs, the cost of the certification testing could be somewhat higher because it would be required to be conducted by an accredited third-party testing laboratory. CPSC staff welcomes comments from the public regarding the costs or other impacts of the certification requirements under Section 14 of the CPSA.

Small manufacturers and importers will also incur added costs of required warning labels and hang tags with comparative tip ratings. Those manufacturers currently using permanent warning labels in conformance with ASTM F2057-19, should not face significant incremental costs for the replacement labels specified by the draft mandatory rule. The required hang tags showing tip ratings for each CSU would involve some incremental costs, although likely to be minor in relation to other product modifications required for compliance. The testing costs needed to generate the tip ratings will be incurred to comply with the performance testing of the draft proposed rule.

IMPACT ON SMALL BUSINESSES

As discussed in the preliminary regulatory analysis for the draft proposed rule (Franklin & Smith, 2021; Tab H, p. 11), average manufacturer shipment value was $118 per unit in 2018 (about $104 for chests of drawers and $144 for dressers). The estimated costs to manufacturers for product modifications to comply with the draft proposed rule range from about $5.80 (in one case) up to $30 or more per unit. Generally, staff considers impacts that exceed one percent of a firm's revenue to be potentially significant. Because the estimated average cost per CSU could be between about 5 percent and 25 percent of the average revenue per unit for CSUs, staff believes that the draft proposed rule could have a significant impact on a substantial number of small manufacturers and importers that receive a significant portion of their revenue from the sale of CSUs.

For many small importers, the impact of the draft proposed rule would be expected to be similar to the impact on small domestic manufacturers. One would expect that the foreign suppliers would pass much of the costs of redesigning and manufacturing CSUs that comply with the draft proposed rule to their domestic distributors. Therefore, the cost increases experienced by small importers would be similar to those experienced by small manufacturers.

Small importers will be responsible for issuing a GCC certifying that their CSUs comply with the draft proposed rule should it become final. However, importers may rely upon testing performed and GCCs issued by their suppliers in complying with this requirement. In the case of CSUs that could be considered to be children's products, the certification must be based on testing by an accredited third-party conformity assessment body, which may involve additional costs.

FEDERAL RULES THAT MAY DUPLICATE, OVERLAP, OR CONFLICT WITH THE DRAFT PROPOSED RULE

We have not identified any Federal rules that duplicate or conflict with the draft proposed rule.

ALTERNATIVES CONSIDERED TO REDUCE THE BURDEN ON SMALL ENTITIES

Under section 603(c) of the Regulatory Flexibility Act, an initial regulatory flexibility analysis should "contain a description of any significant alternatives to the proposed rule which accomplish the stated objectives of the applicable statutes and which minimize any significant impact of the proposed rule on small entities." CPSC staff examined several alternatives to the draft proposed rule which could reduce the impact on small entities. These are discussed below and include: (1) less stringent stability requirements; (2) alternative compliance dates; (3)

informational measures, and; (4) taking no action. Each of these alternatives is discussed in more detail below.

1. Less Stringent Stability Requirements

The first alternative would be to rely on the current voluntary standard, ASTM F2057-19, rather than issuing a mandatory standard. As noted above, ASTM F2057-19 requires that CSUs not tip over when each drawer is opened one at a time and a 50-pound weight is attached to the front of the drawer, and also when all of the drawers are open simultaneously (with no added weight). The voluntary standard differs from the draft proposed rule in that each drawer is tested one at a time with a test weight, the tests are always conducted while the drawers are empty, the test is conducted on a flat surface rather than angled (to simulate carpet), and the voluntary standard does not account for the horizontal and dynamic forces that a child would impart on a CSU while ascending it.

CPSC's Laboratory Sciences Mechanical (LSM) staff concluded that, by not accounting for these factors, ASTM F2057-19 does not adequately protect young children (Sanborn et al., 2021; Tab F). As UMTRI's research suggests, the actual force a child would impart climbing on a CSU could be 160 percent of the weight of the child.[7] EPHA analysis of limited testing by CPSC staff of CSUs on both a hard, level, flat surface and on a carpeted surface found that, on average, the CSUs on carpet required 7.6 ± 5.1 pounds ***less*** weight to tip over compared to the same CSUs on a hard, level, flat surface (Miller, 2021; Tab P). Also, analysis of tip-over incidents by ESHF staff found that 85 percent of fatalities and 80 percent of nonfatal CPSRMS incidents involving children and CSUs without televisions occurred on carpet, when flooring type was reported (Balci-Sinha & Talcott, 2021; Tab C). Finally, the loading effect of clothing in the CSUs was not considered in developing ASTM F2057-19. Staff testing and analysis by CPSC staff indicate that loading of the drawers increases the stability of CSUs when the drawers are loaded and closed, but decreases the stability of CSUs when loaded drawers are opened.

Based on this information, CPSC staff believe that rather than fully protecting children who weigh 50 pounds or less, the current voluntary standard might only be fully protecting children who weigh 29.1 pounds or less, especially if the CSU is resting on a carpeted surface (Taxier, 2021; Tab D). The 50th percentile weight for 2-year-old children is around 30 pounds. Therefore, at best, this alternative would address perhaps 50 percent of the tip overs due to 2-

[7] Matthew P. Reed, Sheia M. Ebert, and Monica L.H. Jones, "Forces and Postures During Child Climbing Activities," University of Michigan Transportation Research Institute, July 2020. Technical Report sponsored by the U.S. Consumer Product Safety Commission (TAB R of the NPR package), p. 69.

year-old children climbing the front of a CSU and very few of the cases involving children 3-years old and older, and these ages are most commonly involved in CSU tip overs.

CPSC staff also considered an option that would replace the 50-pound test weight in the current voluntary standard with a 60-pound test weight, but leave the other test procedures in the voluntary standard largely unchanged.[8] The 60-pound weight was considered because it is closer to the 95th percentile weight of a 5-year-old, which is the age the voluntary standard claims to address, but this alternative still would not account for the horizontal and dynamic forces of a child climbing on a CSU, the impacts of full and open drawers or carpeting, and the moments created by a child ascending a CSU. For this reason, the alternative does not accomplish the stated objectives of the applicable statutes, in the view of the CPSC staff.

Other options that could be less-burdensome to small manufacturers could be variations on the draft standard, such as reducing the required tip moment or testing units with weight in closed drawers of units with drawer interlock systems. Such modifications might reduce the need for other product changes, such as foot extensions, raising front feet, and added weight in the backs of CSUs. While perhaps reducing costs for manufacturers, such lessening of requirements would reduce the stability of units complying with the standard, and place more children at risk from tip-over incidents, thereby reducing the benefits of the standard. The Commission seeks comments on any methods that would sufficiently address the hazard but would reduce the impact on small firms.

2. Different (Longer) Compliance Dates

CPSC staff recommends that the draft proposed rule take effect 180 days after a final rule is published in the Federal Register. In its report on potential cost impacts, IEc concluded from its limited subset of interviews that it appears likely that, unlike larger firms involved in ASTM standards development, "many small furniture makers are not aware of the potential regulations under consideration" (Israel et al., June 7, 2019, p. 6). Smaller firms may, therefore, find it much more difficult to meet an effective date of 180 days after the rule is published. A possible alternative to reduce the impact of the rule on smaller manufacturers would be extending the period before the rule becomes effective. This could ease disruptions by allowing more time to design units that comply and plan for needed hardware. Staff seeks comments on the advantages and disadvantages to a different effective date.

[8] This alternative could be done in a mandatory standard, rather than relying on the voluntary standard, because it includes a more stringent requirement than the voluntary standard to better address the hazard.

3. Informational Measures

Another alternative would be to focus on informational measures instead. This would reduce the burden on small manufacturers and importers because they would not incur the costs of developing a new technology. This alternative could be strengthened if combined with the hang tag requirements similar to those recommended by CPSC staff as part of the draft proposed rule, which would involve assessing the stability of a CSU and indicating a stability rating, based on those results, on a tag attached to the CSU. A description of such a requirement along with background on the use of similar requirements at other agencies is provided in a memorandum by CPSC engineering staff (Nesteruk, 2021; Tab E). A stability rating system and labeling requirement would give consumers information on the stability of the specific models that they were considering purchasing, which they could consider in their purchase decisions. A stability rating system could also give manufacturers an incentive to achieve a higher stability rating to increase their competitiveness or increase their appeal to consumers that desired CSUs that were less likely to tip over. In addition, a label could contain warnings regarding anchoring the furniture to address tip overs. However, consumers may underestimate the actual risk they face from CSU tip overs, particularly due to a lack of understanding of the effects of open and full drawers and climbing behavior on the stability of the furniture. Even if a recommended minimum (rather than mandatory minimum as in the draft proposed rule) was indicated on the hang tag, consumers are not likely to perceive a CSU as something that presents a risk to them and are less likely to read and believe associated information on the hazard, as discussed by ESHF staff with respect to warning labels (Balci-Sinha & Talcott, 2021; Tab C).

4. Taking No Action to Establish a Mandatory Standard

If the Commission opted to take no regulatory action, there may, nonetheless, be a decline in the number of deaths and injuries. First, as the number of CRT televisions in use continue to decline, the incidents involving these older, heavier televisions will also decline.

The efforts of the Commission to encourage families with small children to anchor their furniture to the wall (Anchor It! campaign), to encourage manufacturers to comply with the voluntary standard, and to push for recalls of furniture that it considers insufficiently stable could lead to an increase in the stability of CSUs being offered for sale, which could lead to decreases in deaths and injuries. However, we cannot quantify the extent to which deaths and injuries could decline in the absence of a mandatory regulation. An additional limitation to relying on anchoring is that furniture may not be anchored properly or anchoring systems may not be effective to prevent tip overs. As ESHF staff explains, CPSC is aware of at least some incidents in which furniture that was anchored tipped over and staff is aware of anchors failing at the connection to the furniture and others at the connection to the wall and there is no standard that addresses connections to the furniture or to the wall (Balci-Sinha & Talcott, 2021; Tab C). Improving compliance with the voluntary standard would have limited impact, as staff has shown ASTM F2057-19 does not adequately protect young children.

Moreover, as reported by CPSC epidemiology staff (Suchy, 2021; Tab A), there has not been a statistically significant decline in CSU tip-over incidents not involving televisions, even while some of these efforts have been in place.

REQUEST FOR COMMENTS

CPSC staff invites comments on this IRFA and the potential impact of the draft proposed rule on small entities, especially small businesses. In particular, CPSC staff is seeking comment on:

- the types and magnitude of manufacturing costs that might disproportionately impact small businesses or were not considered in this analysis,
- the costs of the testing and certification requirements, warning label, and hang tag of the draft proposed rule,
- the different impacts on small businesses associated with different effective dates,
- differential impacts of the draft proposed rule on small manufacturers or suppliers that compete in different segments of the CSU market, and finally,
- Other alternatives that would minimize the impact on small businesses but would still reduce the risk of CSU tip-over incidents.

REFERENCES

Balci-Sinha, R. & Talcott, K. (2021, April). Staff Analysis Report: Human factors assessment of the clothing storage unit (CSU) incidents, research, and child physical and behavioral characteristics to develop recommendations for the proposed rule. Directorate for Engineering Sciences, Division of Human Factors (ESHF), CPSC. Bethesda, MD. (TAB C in the NPR briefing package)

CPSC staff (2021, April). Recommended regulatory text for draft proposed rule. CPSC, Bethesda, MD. (Tab G in the NPR briefing package.)

Franklin, R. and Smith, C. (2021, April). Staff Analysis Report: Preliminary regulatory analysis of the proposed clothing storage unit stability rule. Directorate for Economic Analysis (EC), CPSC. Bethesda, MD. (TAB G in the NPR briefing package.)

Israel, J., Cahill, A. & Baxter, J. (2019, March 11). Memorandum: Final clothing storage units (CSUs) market research report. Industrial Economics, Incorporated (IEc) contract report submitted to Charles Smith, William Zamula, and Robert Franklin, Consumer Product Safety Commission, Directorate for Economic Analysis. CPSC Contract # CPSC-D-15-0004, Task 18 under Task Order 61320618F1018. https://ecpsc.cpsc.gov/apps/6b-Temp/Section%206b%20Tracking/Final%20Clothing%20Storage%20Units%20(CSUs)%20Market%20Research%20Report.pdf

Israel, J., Cahill, A. & Baxter, J. (2019, June 7). Memorandum: Final Clothing Storage Units (CSUs) Cost Impact Analysis. Industrial Economics, Incorporated (IEc) contract report submitted to Charles Smith, Jill Jenkins, and Robert Franklin, Consumer Product Safety Commission, Directorate for Economic Analysis. CPSC Contract # CPSC-D-15-0004, Task 18 under Task Order 61320618F1018. https://ecpsc.cpsc.gov/apps/6b-Temp/Section%206b%20Tracking/Final%20Clothing%20Storage%20Units%20(CSUs)%20Cost%20Impact%20Analysis.pdf

Miller, D. (2021). Memorandum: Analysis of the tip-over weight for CSUs on carpet in combination with multiple open and filled drawers. Division of Hazard Analysis, Directorate for Epidemiology (EPHA), CPSC. Bethesda, MD. (Tab P in the NPR briefing package.)

Nesteruk, H. (2021). Memorandum: Recommendation for clothing storage furniture hang tag providing tip-over resistance information to consumers. Division of Mechanical and Combustion Engineering, Directorate for Engineering Sciences, CPSC. Bethesda, MD. (Tab E in the NPR briefing package)

Sanborn, M. (2021, April). Staff Analysis Report: FY18 midyear clothing storage unit testing program summary. Division of Mechanical Engineering, Directorate for Laboratory Sciences (LSM), CPSC. Bethesda, MD. (TAB N in the NPR briefing package)

Sanborn, M., Mordecai, B. & Howie, A. (2021, April). Staff Analysis Report: Analysis of voluntary standards for clothing storage units. Division of Mechanical Engineering, Directorate for Laboratory Sciences (LSM), CPSC. Bethesda, MD. (TAB F in the NPR briefing package)

Suchy, A. (2021, February 2). Staff Analysis Report: Reported clothing storage unit (CSU) tip-over-related fatalities, nonfatal incidents and injuries, and ED-treated injuries. Division of Hazard Analysis, Directorate for Epidemiology (EPHA), CPSC. Bethesda, MD. (TAB A in the NPR briefing package.)

Taxier, D. (2021, April). Staff Analysis Report: Mechanical evaluation of clothing storage unit (CSU) tip-over research, incidents, and design solutions, contributing to proposed rule for CSU inherent stability. Directorate for Engineering Sciences, Division of Mechanical Engineering (ESMC), CPSC. Bethesda, MD. (TAB C in the NPR briefing package)

U.S. Small Business Administration (SBA). Table of Small Business Size Standards Matched to North American Industry Classification System Codes (2019 version). https://www.sba.gov/sites/default/files/2019-08/SBA%20Table%20of%20Size%20Standards_Effective%20Aug%2019%2C%202019_Rev.pdf

TAB J: Clothing Storage Units: Summary of Recalls from January 1, 2000 – March 31, 2021

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United States
Consumer Product Safety Commission
4330 East West Highway
Bethesda, Maryland 20814

Memorandum

DATE: July 14, 2021

TO: Kristen Talcott, Ph.D., Furniture Tip-Over Project Manager
Division Human Factors, Directorate for Engineering Sciences

THROUGH: Robert Kaye, Assistant Executive Director,
Office of Compliance and Field Operations

Mary Murphy, Director,
Division of Enforcement and Litigation,
Office of Compliance and Field Operations

Howard Tarnoff, Deputy Director,
Division of Enforcement and Litigation,
Office of Compliance and Field Operations

FROM: Gina Collins, Compliance Officer,
Division of Enforcement and Litigation,
Office of Compliance and Field Operations

Amelia Hairston-Porter, Trial Attorney,
Division of Enforcement and Litigation,
Office of Compliance and Field Operations

SUBJECT: Clothing Storage Units: Summary of Recalls from January 1, 2000 – March 31, 2021

PURPOSE

CPSC staff is drafting a proposed rule for a mandatory standard related to the stability of clothing storage units (CSUs) for Commission consideration. In support of the draft proposed rule, this memorandum summarizes Office of Compliance and Field Operations (Compliance) investigations and recalls of CSUs from January 1, 2000 through March 31, 2021.

COMPLIANCE INVESTIGATION INFORMATION

Compliance staff reviewed recalls of CSUs from January 1, 2000 through March 31, 2021. During that period, there were 40 consumer-level recalls conducted in response to tip-over hazards of CSUs involving 34 different firms. The recalled products were responsible for 328 tip-over incidents, including reports of 149 injuries and 12 fatalities.[1] The 12 fatal incidents all involved children 3 years old or younger.[2] According to information reported to Compliance staff, including consumer reports, In-Depth Investigations (IDIs), Product Safety Assessments (PSAs), and reports by staff in the Office of Hazard Analysis and Reduction, the fatal incidents most likely occurred when the CSU tipped over as a result of a child climbing, getting inside drawers, or opening the drawers. Analysis by Health Sciences staff determined that, due to their small size and limited strength, children are often unable to self-rescue when entrapped beneath a CSU, and the weight or position of the CSU can quickly cause death from asphyxia, crush injuries, or blunt force trauma.

Table 1 below lists the details of each recall. All referenced CSUs were recalled for tip-over and entrapment hazards. The recalls affected approximately 21,500,000 CSUs in total. In addition, Compliance staff continues to monitor and investigate CSUs that may pose tip-over and entrapment hazards.

[1] The remaining incidents did not result in injury, or did not indicate whether an injury occurred.
[2] Recalled products that involved fatalities are presented in red text in the table below. Eleven of the 12 fatal incidents involving recalled products are in the data set analyzed for this briefing package (all involving children and CSUs without televisions); the remaining fatal incident occurred in 1989, which is outside the period analyzed in this briefing package.

Table 1. Clothing Storage Unit Recalls Relating to Tip Over from January 1, 2000–March 31, 2021

Date	**Firm**	**Incidents and Injuries**[3]	**# Recalled**	**Press Release #**[4]
12/18/2001	Sandberg Manufacturer	1 incident, no injury	Unknown	02-069
1/30/2013	Million Dollar Baby	2 deaths	18,000	13-106
1/30/2013	Gemme Juvenile	1 death	Unknown	13-105
6/9/2015	Pali Design	1 incident, no injury	18,000	15-160
5/20/2016	BESTAR	None reported in the U.S.[5], 1 injury in Canada	26	16-745
7/12/2016	Bernhardt	2 incidents, including 1 injury	1,700	16-222
8/16/2016	Sauder Woodworking	None Reported	8,000	16-767
1/11/2017	Linon Home	None Reported	200	17-725
1/31/2017	South Shore	None Reported	3,500	17-731
1/31/2017	Simpli Home	None Reported	240	17-730
1/31/2017	Bolton Furniture	None Reported	1,000	17-075
4/4/2017	Safavieh	None Reported	500	17-737
4/10/2017	Vanguard Furniture	None Reported	170	17-738
6/28/2017	Homestar North America	None Reported	1,470	17-752
6/28/2017	South Shore Expanded Recall	None Reported	68,300	17-182
9/6/2017	Ameriwood Home	1 injury	1.6 million	17-217
9/13/2017	Target	12 incidents, no injury	175,000	17-223
11/21/2017	IKEA	299 incidents, including 8 deaths and 144 injuries	17.3 million	18-040
5/9/2019	South Shore	2 incidents, including 1 death and 1 injury	310,000	19-116
8/28/2019	Kirkland’s	None Reported	3,000	19-190
9/24/2019	Home Meridian	None Reported	640	19-209
10/3/2019	Ridgewood	None Reported	1 million	20-003
10/3/2019	E&E	None Reported	1,800	20-002
12/18/2019	Hillsdale	None Reported	31,000	20-041
2/26/2020	Home Depot	None Reported	200	20-079
2/26/2020	Safavieh	None Reported	760	20-078
3/4/2020	IKEA	6 incidents, including 2 injuries	820,000	20-085
3/12/2020	Homestar	None Reported	33,000	20-721
4/6/2020	Joybird	None Reported	100	20-106
5/6/2020	Prepac	None Reported	21,000	20-117
5/13/2020	Hodedah	None Reported	26,500	20-102
5/21/2020	Herman Miller	1 incident, no injury	2,700	20-747
6/18/2020	Modus	None Reported	1,300	20-752
8/11/2020	Transform	None Reported	19,900	20-161
11/4/2020	Walker Edison	None Reported	24,000	21-019
12/10/2020	Homfa	None Reported	6,375	21-714
1/7/2021	Noble House	None Reported	780	21-718
1/27/2021	CB2	10 incidents, no injuries	11,000	21-071

[3] Includes incidents and injuries known to the CPSC at the time of the recall.
[4] Press releases can be found at: www.cpsc.gov/Recalls.
[5] Product was sold in the United States.

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TAB K: Advance Notice of Proposed Rulemaking (ANPR) Comments and Staff Response

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

Memorandum

DATE: July 14, 2021

TO: The File

THROUGH: Duane Boniface, Assistant Executive Director,
Office of Hazard Analysis and Reduction (EXHR)

FROM: Furniture Tip-Over EXHR Team

SUBJECT: Advance Notice of Proposed Rulemaking (ANPR) Comments and Staff Response

BACKGROUND

The Commission published an advance notice of proposed rulemaking (ANPR) regarding clothing storage units (CSUs) on November 30, 2017, stating that the Commission was contemplating developing a rule to address the risk of injury and death associated with CSU furniture tip overs. The request for comments and information included all aspects of the ANPR, along with 17 specific requests for additional data, studies, and alternatives. CPSC received 18 comments during the comment period, which was extended once, and closed on April 14, 2018. After that date, the Commission received five additional correspondences related to the ANPR, which are also addressed here. Fourteen of the 18 original comments on the ANPR were in favor of a mandatory rule, 2 were against the rule, favoring instead the existing voluntary standard, and 2 had no clear opinion. The five additional comments were in favor of rulemaking. This memorandum summarizes the comments and provides technical staff's responses to the issues raised.

COMMENTS AND RESPONSES

General Support

Comments

Fourteen comments expressed support for the rulemaking effort, stating, for example: "we need stronger CSU safety standards in place to protect [children] and prevent future tragedies," and also: "safety should be built into the design of clothing storage units (CSUs) and not left to the consumer."

Staff Response

Staff generally agrees with those supporting the rulemaking. CPSC staff agrees that CSUs should be inherently stable and should not require a tip restraint to prevent tip over for the main hazard pattern identified in this draft notice of proposed rulemaking (NPR): a young child climbing the CSU in a foreseeable use condition, including multiple open drawers, drawers filled with clothing, and the CSU placed on a carpet.

General Opposition

Comments

Two comments were against rulemaking and government intervention. Examples include: "don't regulate things that makes [sic] it unusable for everyone; up to the person buying it not the government telling how things should be designed"; and "[i]t is unnecessary to create new regulation as far as the manufacturing of CSUs in order to solve this issue."

Staff Response

The staff package addresses the need for a regulation, and the recommended requirements would retain the utility of CSUs. The staff's Preliminary Regulatory Analysis (Tab H) identifies the need for the rule to address the risk of injury and death associated with CSU furniture tip overs. Staff explains throughout the package information on the injuries and deaths that occur as a result of hazard patterns associated with CSUs that support a finding of an unreasonable risk of injury.

Voluntary Standard

Comments

Several commenters expressed support for the voluntary standard and felt the voluntary standard process would create a more robust standard. However, other commenters cited numerous flaws with the voluntary standards (ASTM F2057[1] and ASTM F3096[2]), as well as incident data, to support the assertion that a mandatory standard is necessary to address the hazard.

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[1]ASTM F2057 is the *Standard Safety Specification for Clothing Storage Units.*
[2] ASTM F3096 is the *Standard Performance Specification for Tipover Restraint(s) Used with Clothing Storage Unit(s)*. ASTM F2057-19 requires that tip restraints that meet the requirements of ASTM F3096 be included with each CSU. The current version of F3096 is F3096-14.

Staff Response

Staff has worked closely with the ASTM F15.42 committee over the years to effect improvements in the voluntary standard. However, for the reasons outlined in this briefing package, staff is recommending that the Commission issue an NPR. Staff agrees with the commenters that asserted that the voluntary standard ASTM F2057 – 19, *Standard Safety Specification for Clothing Storage Units,* is not sufficiently protective of children climbing CSUs. The University of Michigan Transportation Research Institute (UMTRI) child climbing study (Tab R) showed that children climbing can impart rotational forces (tip moments) on CSUs beyond the forces of the child's weight alone. The current version of ASTM F2057, F2057 – 19, does not account for forces due to climbing, the weight of clothing in filled drawers, the impact of multiple open drawers, or CSUs placed on carpet. Staff's analysis of incident reports shows that incidents often combine these variables (*e.g.*, a child opening multiple filled drawers and climbing, or a child standing on an open drawer of a unit placed on carpet). CPSC staff has attempted and continues to attempt to help revise the ASTM voluntary standard to reflect these additional factors that contribute to instability, but, to date, has been unsuccessful.

As outlined in the briefing package, the recommended rule focuses on inherent stability of CSUs, rather than tip restraints, because the current rate of tip restraint use is low, and staff has identified several factors that make it unlikely that consumers will use tip restraints. Given the low rate of use of tip restraints, staff did not do a detailed evaluation of ASTM F3096 *Standard Performance Specification for Tipover Restraint(s) Used with Clothing Storage Unit(s)*, because even if it were effective at ensuring the strength of the tip restraints, it would likely not induce consumers to use them more (see *Tip Restraints* section below for more discussion). However, as discussed in Tab C, staff shares the commenters' concerns that ASTM F3096 – 14 may not be adequate because: (1) the assumed forces may be too low to represent forces from children's interactions, and (2) the standard does not address the whole tip-restraint system, which includes the connection to the CSU and the connection to the wall.

Hazard Communication: Warnings and Public Awareness

Comments

Five commenters mentioned various aspects of hazard communication. In support of hazard communication, two felt that a labeling requirement in the voluntary standard is sufficient. One of these comments suggested displaying the warning as a hand out at furniture stores. One commenter urged CPSC to mandate labeling provisions that are "effective, seen, understood, reflect real world use," and "accurately and clearly describe hazard patterns." One commenter advocated for education campaigns to educate parents about the hazard and promote anchoring.

Other commenters felt that the warning labels and education campaigns are "wholly insufficient to address CSU tip overs." The commenter stated that warning labels are insufficient because *children do not comprehend them and incidents occur when children are unattended (e.g., while left alone to nap). Commenters also asserted that education campaigns on anchoring products are ineffective because renters may not be permitted to anchor products.*

Staff Response

In Tab C, staff discusses the reasons that CSU warnings, on their own, are unlikely to adequately address the hazard, including: they are unlikely to prevent a child from opening multiple drawers and/or climbing on a CSU; and consumers are unlikely to heed warnings, including warnings to anchor CSUs. Although warning labels are not a very effective method of hazard control, they may have some benefit. Accordingly, staff recommends requiring a warning label on CSUs to provide information to the consumer about the tip-over hazard, encourage tip-restraint use as a secondary safety mechanism, and provide other safety information. Staff's recommended warning label addresses the child climbing hazard, tip restraint use, interlocks (if the product includes them), drawer loading (place the heaviest items in the lowest drawers), and CSU use with a television.

In addition, as discussed in Tab E, staff recommends requiring a hang tag label to provide consumers with meaningful information on the stability of a particular CSU, using a graphical representation of tip-over resistance combined with an icon and text explanation, to allow consumers to make more informed purchasing decisions. This hang tag would provide a rating of the stability of the specific CSU that consumers could use to compare CSUs.

CPSC staff agrees with commenters that educational campaigns could increase consumer knowledge of the CSU tip-over hazard and increase rates of anchoring. In 2015, CPSC started an active education campaign, Anchor It!, to educate consumers about the risk of injury or death from furniture, television, and appliance tip-overs, and to promote the use of tip restraints to anchor furniture and televisions.[3] More information on the campaign, including educational resources and safety tips, can be found at: www.anchorit.gov. However, educational campaigns, alone, have not proven effective at adequately reducing the CSU tip-over hazard. In 2018, CPSC commissioned a study to assess consumer awareness, recognition and behavior change as a result of the Anchor It! Campaign. The study included a survey of 600 parents and caregivers of children 5 years old or younger. The survey results showed that only 55 percent of respondents reported ever having anchored furniture. Although this percent is higher than found in previous studies, it is still low, and it may overestimate the percent of people who anchor CSUs (See Tab C). Moreover, as reported by CPSC epidemiology staff (Tab A), there has not been a statistically significant decline in CSU tip-over incidents without televisions, even while some of these efforts have been in place.

[3] Anchor It!: CPSC Launches Nation's Largest Campaign to Prevent Furniture and TV Tip-Over Deaths and Injuries [Press Release 15-157]. Available: https://www.cpsc.gov/zhT-CN/node/21728.

Scope and Definitions

Comments

Comments about the scope varied, with several commenters suggesting including in the scope furniture less than 30 inches in height, while at least two comments supported limiting the scope to furniture more than 30 inches in height. Another commenter recommended limiting the scope of a rule to chests, bureaus, and dressers, because the CPSC annual tip-over and instability reports indicate that most incidents involve those specific CSUs. In addition, one comment provided specific wording suggestions for definitions of chests, bureaus, and dressers. The same commenter suggested wording for the scope of covered furniture, such as: "free-standing chests, bureaus & dressers intended for clothing storage in a bedroom, with height dimensions over 30 inches (762 mm), consisting of a solid top and side panels and containing at least one drawer."

Staff Response

Staff worked with the applicable ASTM subcommittee, and in August 2019, ASTM published F2057 – 19, which revised the scope from including CSUs "over 30 in. (762 mm) in height," to including CSUs "27 in. (686 mm) and above in height." This change was based on incidents involving units 30 inches in height and under, including a fatal incident with a 27.5-inch-high unit. Staff is aware of units under 27 inches that are marketed as CSUs, and is aware of a fatal incident involving a 24-inch-high CSU with a television. However, on balance, staff believes that the 27-inch minimum height is reasonable, and recommends using this in the scope of the NPR. Staff also recommends seeking comments on this issue.

Although most CSU tip-over incidents involve chests, bureaus, and dressers, staff believes that additional furniture items that have the same or similar design and function as chests, bureaus, and dressers (*e.g.*, have extension elements, are used by consumers for clothing storage) should also be within the scope of this rule. This includes wardrobes and armoires, as well as other products that would be commonly recognized as CSUs, regardless of marketing. As Tabs C and Q explain, consumers consider a variety of products to be suitable for use as CSUs, and the tip-over hazard relates to the design and use of the products. The ASTM F2057 – 19 definition of CSUs may exclude items that consumers use as CSUs. For this reason, in the scope of the draft rule, staff recommends using criteria to distinguish between in-scope and out-of-scope products. Staff requests comments on the scope, such as whether light-weight units should be included in the scope, and also whether other products should be covered or exempt from the draft rule.

Test Parameters

Comment

A number of comments suggested the test weight should be at least 60 pounds to address children younger than 6 years old. Commenters noted that covering children up to 6 years old would be consistent with the age and weight of victims in incidents and account for developmentally expected behaviors for children that age that are associated with incidents (e.g., climbing). Several comments also brought up that victims as old as 8 years old have been killed by falling furniture. One comment urged CPSC to consider the 90th percentile child at their 6th and 8th birthdays "to better understand the risks posed to children older than 5." On the other hand, one comment supported the ASTM test weight of 50 pounds, stating: "the most at-risk age group are children 1 to 4 years old" and the 50-pound test weight "appropriately reflects the age and weight of the most at-risk children based on the reported IDI data."

Staff Response

Staff agrees that the 50-pound test weight used in ASTM F2057 – 19 is inadequate; however, the data and staff's assessment have evolved since the ANPR. In the ANPR, staff recommended increasing the weight to 60 pounds, to represent better the weight of "children up to and including age five," which is the age group that ASTM F2057 intends to cover. After the ANPR, staff worked with the F15.42 Furniture Subcommittee to provide evidence to increase the test weight to 60 pounds, based on updated 95th percentile weight data. ASTM balloted the weight increase, but it did not pass. The primary data source for the 60-pound weight recommendation is the 2000 Centers for Disease Control and Prevention (CDC) Growth Charts.[4] For this draft NPR, staff uses the latest, 2021, CDC Anthropometric Reference. The children's weights in the 2021 CDC Anthropometric Reference tend to be higher than those in the 2000 CDC Growth Charts.

Staff commissioned the UMTRI child climbing study (TAB R), which quantified the forces and moments generated by child interactions with a CSU test fixture, including ascent. Staff focused on the ascent forces because CSU tip-over incident data indicates that children climbing CSUs is the most common hazard scenario in these incidents, and ascent is an integral climbing interaction. For the ascent interaction and an average drawer extension,[5] staff determined that a 50-pound child climbing could exert forces equivalent to those from an 80-pound test weight on the face of a drawer opened 12 inches. These results show that the 50-pound test weight in

[4] Sixty pounds is the approximate 95th percentile weight of either a 72-month-old male or 72-month-old female (the 95th percentile weight of a child just before their 6th birthday).
[5] The average drawer extension was 9.75 inches, for the purposed of this estimate, this extension was assumed to be the same as the distance of the extended drawer to the fulcrum.

F2057 – 19 or even a 60-pound test weight would be inadequate to replicate the forces of a 50-pound child climbing.

For this draft NPR, staff also evaluated the ages and weights of children in incidents. Staff analysis of the data showed that most tip-over incidents involving children and CSUs without televisions involve children age 1, 2, and 3 years old. These are also the ages of children who are most involved in climbing incidents (the dominant hazard pattern). The 95th percentile weight of 3-year-old children is 51.2 pounds.[6] Staff's analysis of fatal incidents involving CSUs without televisions indicated that children involved in these incidents were 45 pounds and under.[7] Based on incident data, staff developed performance requirements to simulate a 95th percentile 3-year-old (51.2 pounds) climbing on the CSU and generating associated dynamic and horizontal forces, and not on the 60-pound 5-year-old originally considered, and as commenters suggested. When the forces are considered, the 51.2-pound child weight is approximately equivalent to an 82-pound test weight on the face of a drawer opened 12 inches.[8] The draft proposed requirements simulate real-world conditions, such as multiple drawers open, filled drawers, a carpeted surface, and a child pulling on the CSU. Staff determined that these requirements will address the hazard patterns in all of the analyzed fatal incidents and in the majority of the nonfatal incidents involving children and CSUs without televisions. Staff assess that the proposed requirements should also reduce incidents involving CSUs with televisions and incidents involving adults.

Comments

One comment suggested a tiered test weight system, based on the height of the product, recommending that products less than 40 inches in height should be tested with 50 pounds of weight, and products more than 40 inches in height should be tested with 60 pounds of weight. The commenter reasoned that older children (who weigh more) are less likely to climb shorter products because they can reach the top without climbing." One comment supported a tolerance of ± 1 pound for the test weight, consistent with the current ASTM voluntary standard.

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[6] This weight is based on the 2021 CDC Anthropometric Reference (Fryar et al., 2021) for a 95th percentile 3-year-old male. The 95th percentile weight for a 3-year-old female is 42.5 pounds. A stability requirement based on the 51.2-pound male will also cover the 95th percentile 3-year-old female.

[7] Two fatal incidents involved 45-pound children, one involving a 2-year-old child, and one involving a 7-year-old child (the oldest CSU tip-over fatality without a television).

[8] The draft proposed requirements distinguish between child weight and test weight. The child weight is used in an equation, along with the distance from the fulcrum, that estimates the moment (rotational force) that a child will exert on a CSU while climbing.

Staff Response

Regarding a tiered test weight protocol, staff does not support using different tip forces for different height units because there is not a strong relationship between unit height and child weight for fatal tip-over incidents.[9]

For test weight tolerance, staff assesses that the current tolerance of ±1 pound for each of the two test weight blocks required in ASTM F2057 – 19 is too large. Based on these requirements, the total weight of the test blocks can range from 48-52 pounds, an 8 percent variability between the lowest and highest allowed test weights. Staff has previously worked with the ASTM F15.42 Furniture Subcommittee to propose tighter tolerances for each test weight and for the total test weight. However, the recommended test in this draft NPR consists of a tip-over moment measurement and does not require a fixed test weight (Tab D); therefore, there is no need to specify a test weight tolerance.

Comments

Two comments stated that more specificity is needed in the voluntary standard regarding the time frame to apply and maintain the test weight and contact of the test fixture with the drawer bottom.

Staff Response

ASTM F2057 – 19 does not specify a time requirement to apply the 50-pound test weight or a specific amount of time that the CSU must support the weight without tipping over. CPSC staff notes test methods in other ASTM standards (*e.g.*, F963 – 17, *Standard Consumer Safety Specification for Toy Safety*, F2236 – 16a *Standard Consumer Safety Specification for Soft Infant and Toddler Carriers*, and F2194 – 16e1, *Standard Consumer Safety Specification for Bassinets and Cradles*) refer to application of weight or force over a specific period to avoid imparting an impulse force on the product. To address this, in the draft performance requirements, staff has specified that the force must be applied gradually over a period of at least 5 seconds to avoid a potential impulse force.

Comment

Six comments addressed drawers during testing. Commenters emphasized that testing should reflect real-world conditions, and that opening one empty drawer at a time, as the ASTM standard requires, does not do this. Suggestions included multiple drawers being open simultaneously, loaded drawers, and testing drawers "at all stages of open."

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[9] Nesteruk, H.E.J. (2018, October 12). Re: Update to CPSC Staff letter dated August 24, 2018. [CPSC staff letter to ASTM]. Available: https://cpsc.gov/s3fs-public/TipoverASTMLetter%20October18%20Update.pdf

Staff Response

Staff agrees that stability testing should reflect real-world use, and that real-world use of CSUs includes opening more than one drawer at a time, unless the CSU prevents this, such as with an interlock system; and real-world use also includes CSUs with drawers filled with clothing. Staff tested a number of different types and sizes of CSUs with various configurations of open and filled drawers, and modeled CSUs involved in tip-over incidents. Staff concluded that having multiple open drawers decreases stability, and that having filled drawers has a variable effect on stability, depending on whether the filled drawers are open or closed. Filled drawers make a CSU less stable if the drawers are open; whereas, filled drawers make the CSU more stable if the drawers are closed. The worst case for stability is all drawers filled and open. If less than half of the drawers are open, the worst case for stability, assuming that the drawer fill is consistent across drawers, is all drawers empty. The recommended test method includes all drawers open and filled to reflect the worst-case configuration. The test method also accounts for interlock systems that would prevent multiple drawers from being opened simultaneously and allows for a modified test configuration for these units. If the interlock allows fewer than half of the drawers to open, the recommended requirements involve the CSU being tested with all drawers empty, which reflects a worst-case configuration for these units. These recommendations reflect incident data, because staff is aware of incidents involving children opening all drawers of CSUs and incidents involving empty and filled CSU drawers.

Comment

Five commenters specifically mentioned that testing should involve carpeting or a surface that mimics the effects of carpet, to reflect real-world use conditions and common incident conditions, which may decrease stability. Some commenters suggested using a standardized material, or some other way of ensuring carpet testing would be reliable and repeatable. One commenter submitted a report containing test data for dressers and chests tipping that found that CSUs were less stable on carpet than on hard floors. Another asked for a clear definition of "a hard, level, flat surface," specified in ASTM F2057, and suggested evaluating floor materials, including carpet, but recommended using a standardized material.

Staff Response

Staff agrees with commenters that it is common for consumers to place CSUs on carpet and that carpet decreases CSU stability. Staff conducted tip-over testing (see Tab P) for CSUs on carpet and found that, in general, CSUs were less stable on carpet. Accordingly, the recommended rule includes an element to simulate the effect of carpet as part of the stability testing. Staff also agrees with the concern that testing on actual carpet may present challenges and may not be repeatable. Staff has included a 1.5-degree incline in the draft performance requirements to simulate the effects of carpet, because staff concludes that an angled surface is more repeatable than carpet; and staff assessed that an incline of 1.5 degrees was the average angle that replicated tip weight on carpet (see Tab D). Staff has also harmonized the surface requirements with those in the voluntary standard – that is "hard, flat, and level," and has provided a definition of this surface.

Comments

Three commenters mentioned operational sliding length with regard to how far to extend drawers during stability testing. One of these comments provided specific suggestions for testing three different types of drawer slides: (1) drawers without an outstop should be tested at 2/3 of the drawer extension; (2) drawers with an outstop should be tested with the drawer extended to the "valid outstop" (meaning an outstop that meets certain pull force and timing criteria); and (3) drawers with a self-closing feature should be tested with the drawer extended to the "static outstop" (meaning a position where the drawer remains in a static open position for a set time). Another comment suggested clarifying the requirement in the voluntary standard that drawers are to be extended to 2/3 of the operational sliding length if there is no outstop; the commenter noted that testing products with multiple outstops is unclear because there is no minimum operational sliding length specified in the standard.

Staff Response

Regarding operational sliding length/drawer extension, staff agrees that the drawer extension is a key component of a tip event, because the distance from the force application site to the fulcrum (pivot point) determines the moment (rotational forces) on a CSU. The draft test method uses a moment calculation based on full drawer extension for drawers with an outstop, and retains the two-thirds extension for drawers without an outstop. The draft proposed rule requires that, for stability testing, drawers be open to the "*maximum extension*," which is defined as:

> *Maximum extension* means a condition when a drawer or pull-out shelf is open to the furthest manufacturer recommended use position, as indicated by way of a stop. In the case of slides with multiple intermediate stops, this is the stop that allows the drawer or pull-out shelf to extend the furthest. In the case of slides with a multi-part stop, such as a stop that extends the drawer or pull-out shelf to the furthest manufacturer recommended use position with an additional stop that retains the drawer or pullout shelf in the case, this is the stop that extends the drawer or pullout shelf to the manufacturer recommended use position. If the manufacturer does not provide a recommended use position by way of a stop, this is 2/3 the shortest internal length of the drawer measured from the inside face of the drawer front to the inside face of the drawer back or 2/3 the length of the pullout shelf.

Staff considers this definition to address the issue of multiple outstops. Staff has requested additional comment on self-closing drawers.

Tip Restraints

Comments

Comments about anchoring systems generally supported the position that furniture should be stable on its own, without the need for anchors. Reasons included: consumers may not have the option to anchor products (e.g., rentals that do not allow holes in walls, or brick/concrete walls); consumers may not have the skills to anchor furniture correctly; some consumers are not aware of the need to anchor furniture; and the burden should not be placed on consumers to render products safe. However, comments noted that anchors could be useful for used or older furniture, but that consumers need to be informed about proper installation. In addition, commenters noted that ASTM F3096 – 14 is inadequate because requirements for anchors should "adequately assess the strength of all designs of anchoring devices and the components of such devices in real world use conditions" with clear pass/fail tests.

Staff Response

Staff agrees that that tip restraints should not be relied on as the primary method of preventing CSU tip overs and that CSUs should be inherently stable without relying on additional intervention from the consumer. Accordingly, the recommended rule does not include requirements for effective tip restraints, and it focuses, instead, on inherent stability. However, staff supports the use of effective tip restraints as a secondary safety system.

Several research studies show that a large number of consumers do not anchor furniture, including CSUs. A 2010 CPSC Consumer Opinion Forum survey found that only 9 percent of respondents had anchored the furniture under their television; for respondents that had a CSU under their television, the anchoring rate was 10 percent of respondents.[10] A 2018 Consumer Reports nationally representative survey found that only 27 percent of consumers overall, and 40 percent of consumers with children under 6 years old at home, have an anchored piece of furniture in their homes (Peachman 2018, Consumer Reports 2018). The study also found that the rate of anchoring dressers and tall chests or wardrobes was 10 percent (Consumer Reports 2018). The 2020 CPSC Anchor It! Study found that 55 percent of respondents reported ever having anchored furniture (Fors Marsh Group 2020a). The reasons that consumers do not anchor furniture include: the belief that furniture does not need to be anchored if children are supervised; their perception that the furniture was stable enough; their concern about potential damage to walls; lack of knowledge about products; and difficulty in installing tip restraints.

In addition, staff agrees that F3096 – 14 does not adequately address tip restraints in real-world use conditions (see Tab C for further discussion of tip restraints). The F3096 – 14 test procedure

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[10] Butturini, R., Massale, J., Midgett, J., Snyder, S. (2015). Preliminary Evaluation of Anchoring Furniture and Televisions without Tools. [Technical Report CPSC/EXHR/TR—15/001]. Available at: https://www.cpsc.gov/s3fs-public/pdfs/Tipover-PreventionProject-Anchors-without-Tools.pdf.

tests the strength of the connector between the CSU and the wall, which is only a component of the system, which also includes the attachment to the CSU and the wall. Staff believes that F3096 – 14 should include test procedures that test the tip restraint on the CSU and with common wall surfaces. In addition, as with ASTM F2057 – 19, ASTM F3096 – 14 uses a 50-pound static force to test the strength of the tip restraint. Staff is concerned that this force may not represent the force on the tip restraint from the child and CSU, especially for interactions that can generate dynamic forces, including those from older children. In future work, outside of this rulemaking effort, staff may evaluate appropriate requirements for tip restraints, and may work with ASTM to update its tip-restraint requirements.

Televisions

Comments

Several commenters addressed the involvement of cathode-ray tube (CRT) TVs in CSU tip-over incidents. Commenters stated that manufacturers stopped producing CRT TVs around 2008-2010. One commenter provided information regarding transition from CRT TVs to flat screen TVs, and suggested that this transition "has significantly reduced the potential hazard posed by TVs being placed on CSUs" (as flat screens pose less risk of injury). In addition, the commenter's data suggest that "99 percent of TVs are taken out of service after 16 years, meaning the number of CRTs in consumers' homes should be nearing zero by 2027." Commenters also noted that the discontinued production of CRT TVs means that CPSC would be unable to regulate CRT TVs, making it difficult to address the hazard they present. One commenter stated that TV involvement in tip-over incidents should not undermine CPSC's efforts to focus on CSUs because the common denominator in TV incidents is a CSU.

Staff Response

Staff agrees that manufacturers' widespread shift from CRT televisions to flat-panel televisions is likely to result in decreased use in homes and an associated decrease in tip-over incidents involving CSUs with CRT televisions. Staff's analysis of National Electronic Injury Surveillance System (NEISS) data found that, for 2010 through 2019, there is a statistically significant linear decline in child injuries involving all CSUs (including televisions); however, there is no linear trend detected in injuries to children involving CSU only tip-over incidents.[11] Thus, the decline in estimated CSU tip-over injuries during that period was driven by a decrease in ED-treated, tip-over injuries from incidents involving CSUs with televisions. It is important to note that the CPSC tip-over data include incidents with a variety of television types, including CRT televisions and flat-panel televisions. Because flat-panel televisions are generally much lighter than CRT televisions, they are less likely to cause severe injury. Staff also agrees with

[11] NEISS data is the only CPSC data source that can be used for statistical analyses.

the commenter who stated that television involvement in CSU tip-over incidents should not undermine CPSC's efforts to focus on CSUs, because the common denominator in these incidents is a CSU.

In the recommended rule, staff focused on tip-over incidents involving CSUs without televisions. This allowed staff to focus on the hazards associated with CSU tip over. However, increasing CSU stability should also decrease deaths and injuries from tip-over incidents involving CSUs with televisions.

Incidents/Risk

Comments

One comment compared the deaths due to CSU tip overs to the number of children who drown, suggesting that deaths due to CSU tip overs were relatively low, by comparison. Another comment provided a lengthy discussion of incident data, suggesting that incidents were declining, televisions are the primary hazard, and that the majority of incidents affect children less than 5 years of age, rather than less than 6 years of age. This comment also stated: "for children 13 to 59-months, there has been a 34% reduction in reported IDIs for the 4-year period between 2011 – 2015." Another commenter stated that CSU tip overs present a particular risk to children under 6 years old, due to physical and mental abilities and behaviors at these ages, noting that children under 6 years old are involved in 95 percent of deaths and 83 percent of injuries to children.

Staff Response

There are more drowning deaths of children than tip-over deaths involving children each year. However, that does not diminish the seriousness of tip-over hazards, nor the necessity of creating a performance standard to reduce tip-over events. There were 193 reported CSU tip-over fatalities involving children and CSUs (89 involving CSUs without televisions and 104 involving CSUs with televisions) that occurred between January 1, 2000 and December 31, 2020. With the exception of 2010, there were at least three reported fatal tip-over incidents involving children and CSUs without televisions each year for the years 2001–2017 (the last year for which death reporting is considered complete at the time of this analysis).

Based on data from the NEISS, CPSC staff estimates that there were 78,200 CSU tip-over-related injuries (an estimated annual average of 5,600 injuries) treated in U.S. hospital emergency departments (EDs) from January 1, 2006, to December 31, 2019. Of these, staff estimates that 72 percent (an estimated 56,400 total and an estimated annual average of 4,000) were injuries to children. The estimated number of ED-treated CSU tip-over-related injuries to children was between about 2,500 and 5,900 injuries for each year from 2006 through 2019.

Staff agrees that younger children are the most affected age group. In 91 percent of the tip-over fatalities involving children and CSUs without televisions (81 of 89), the victim was 1, 2, or 3 years old. An estimated 76 percent of ED-treated, tip-over-related injuries to children involving CSUs without televisions were to children 1 through 4 years old (an estimated 31,100 of 40,700), and an estimated 64 percent were to children 1 through 3 years old (an estimated 26,100 of 40,700). For the draft NPR data set, the oldest child in a tip-over-related fatality involving a CSU without a television was 7 years old; the oldest child in a reported ED-treated, tip-over-related injury involving a CSU without a television was 17 years old.[12]

Considering the comment stating that CSU incidents were declining, CPSC staff found a statistically significant linear decline in ED-treated, CSU tip-over-related injuries to children from 2010 to 2019. However, as explained in the earlier response, there was no detected decline in tip-over-related injuries to children involving CSUs without televisions during the same time frame.

Finally, staff cannot respond to the comment about a 34 percent reduction in reported IDIs without further clarification. In-Depth Investigations (IDIs) are based on many types of source documents, and it is not clear which IDIs are being referred to. Moreover, IDIs are not reported; they are based on staff assignments – that is, when an incident is reported, staff requests the IDI. Therefore, the raw number of IDIs is not a meaningful number for comparison; it only represents example scenarios for which staff has sought and compiled additional information through an investigation, but it is not a representative number of annual incidents. Any increase/decrease in this number is a function of various factors and not necessarily a reflection of the seriousness of the hazard or rate of incidents.

Costs and Small Business Impacts

Comments

One commenter stated that increasing test weights would create costs, since many CSUs do not comply with the existing test weight requirement in the ASTM standard. Another commenter stated that it is possible to alter designs to improve stability in an affordable way. The Small Business Administration (SBA) met with CPSC staff regarding the ANPR on February 7, 2018. The SBA expressed that its small business contacts are comfortable with the existing ASTM standard, but are concerned about a mandatory rule that differs from or is more stringent than the current voluntary standard. Those concerns included the impacts a rule would have on existing inventories and when compliance with the mandatory standard would be required.

[12] The oldest child in a tip-over-related fatality involving a CSU with a television was 8 years old.

Staff Response

Staff believes that the draft proposed rule would require modifications or redesign of most, if not virtually all, CSUs on the market. To estimate the cost of modifying CSUs to comply with the recommended requirements, staff examined five CSU models (see Tab H). In some cases, staff found the cost to modify a particular CSU could be around $5.80 per unit; but in other cases, the costs could exceed $25 per unit. The cost of modifying lighter or taller CSUs could be greater than for heavier CSUs. Staff notes that changes in the design of CSUs could impose other costs on consumers in the form of altered utility or convenience. These include increases in the weight, reductions in the maximum drawer extensions (which could make the CSU less convenient to use), changes in the storage capacity of the CSU, or changes in the footprint of the CSU that might reduce the utility of the CSU for the consumer. These are potential costs of the draft proposed rule, although they cannot be quantified at this time.

An initial regulatory flexibility analysis (IRFA) is included in this package (Tab I) that specifically considers the impact of the draft proposed rule on small businesses. The analysis concludes that the draft proposed rule would likely have a significant impact on a substantial number of small entities. The IRFA requests input on the impacts of the draft standard and on alternatives that could reduce the impact on small firms while still meeting the objectives of the draft proposed rule.

Compliance with the Voluntary Standard

Comments

Some comments provided reports of test data regarding compliance with ASTM F2057, or commented on these reports. One commenter submitted several data sets of test results for CSUs; these indicated that about 20-23 percent of the dressers it tested did not comply with the voluntary standard.[13] *Another commenter submitted a report containing test data for dressers and chests tipping, which found that more than half of the units tested did not comply with the voluntary standard.*[14]

Staff Response

LSM staff testing (Tab N) of a market survey of 188 CSUs purchased in 2018 found that 91 percent met the stability requirements in ASTM F2057 – 17, which has the same stability

[13] This testing assessed compliance with then-current ASTM F2057 – 17. ASTM F2057 – 17 included the same stability requirements as ASTM F2057 – 19, except that F2057 – 17 applied to units more than 30 inches in height; whereas, F2057 – 19 applies to units 27 inches or taller. Some of the tested units were 27 to 30 inches tall.
[14] This testing assessed compliance with ASTM F2057 – 14. ASTM F2057 – 14 included the same stability requirements as ASTM F2057 – 19, except that F2057 – 14 applied to units more than 30 inches in height; whereas, F2057 – 19 applies to units 27 inches or taller. One of the tested units was 27 to 30 inches tall.

requirements and test methods as F2057 – 19. Since publication of the ANPR in November 2017, CPSC has issued 20 recalls for CSUs that did not comply with the ASTM F2057 stability requirements (Tab J).

However, based on the analysis for this draft NPR, staff concludes that ASTM F2057 – 19 is inadequate to address the hazard of CSU tip overs.

Technical Feasibility

Comments

Several commenters addressed the technical feasibility of designing CSUs that could reduce stability issues. Comments regarding feasibility fell mostly into two types: (1) comments that used test data showing a proportion of CSUs could pass certain tests as proof that it was feasible, and (2) comments that proposed specific solutions to address furniture tipping. Suggestions included drawer slides that automatically close drawers or that require users to apply force continually to keep a drawer open; reducing the maximum extension length of drawers; wider CSU bases; bins in place of bottom drawers; and interlocking drawers that limit how many drawers can be open simultaneously. One commenter recommended that test requirements account for interlock systems.

Staff Response

While staff testing showed that most CSUs could pass the 50-pound "Stability with Load" requirement in Section 7.2 of F2057 – 19, and many CSUs appear to be able to support weights greater than 50 pounds on a single open drawer without tipping, staff determined that ASTM F2057 – 19 does not adequately reduce the hazard of CSU tip over because it fails to address multiple open and filled drawers, the moments created when a child climbs onto a CSU, or the destabilizing effects of carpeting under CSUs. The requirements of the draft proposed rule are much more stringent. Staff has found only one CSU that meets the stability requirements in the draft proposed rule without modification. However, staff examined five CSUs and determined examples of how they could be modified to meet the recommended requirements. This can be accomplished by various means in combination, such as adding drawer interlocks, adding weight to the rear of the unit, decreasing the maximum drawer extensions, and shifting the front edge of feet (the fulcrum) of the CSU forward. Of the potential modifications for which staff was able to estimate the potential cost, the lowest costs were about $5.80 per unit (see Tab H), but in other cases, the costs may exceed $25. However, the extent of the modifications required would depend upon the characteristics of the model, such as its weight, dimensions, and center of gravity.

Regarding the comments that provide specific design solutions, under Section 7 of the CPSA, the Commission may issue performance requirements, or requirements for warnings and instructions; the Commission may not issue design requirements. Accordingly, the Commission cannot require the use of particular designs. However, these suggestions demonstrate that it is feasible to design more stable CSUs, and these or other design changes may be useful in modifying CSUs to comply with performance requirements.

Stories of Loss

Comments

Three commenters shared their personal experiences with tragic incidents where a CSU tipped over and killed a child. These comments included valuable information about the activities and conditions involved in the tip-over incidents they described, including the loading of drawers, flooring, and how the child was interacting with the CSU. These comments also provided useful information about user knowledge of the risk, and the presence of warning labels and tip restraints.

These commenters expressed that safety needs to be built into the design of CSUs, rather than relying on consumer knowledge of the hazard, consumer installation of anchors, or warning labels. The commenters noted several factors that make it ineffective to rely on consumer knowledge and actions. For example, the commenters noted that children are exposed to the CSU hazard outside their homes, so anchors may not be installed; many CSUs are bought used, so may not have anchors, instructions, or labels anymore; and consumers may not be permitted to anchor products to a wall in a rental, or may lack the technical skills to anchor CSUs properly.

The commenters stated that a mandatory standard should mimic real-life circumstances that have been involved in CSU incidents, including less stable flooring and loaded drawers.

Staff Response

Staff appreciates the courage of these parents in sharing their stories. To each of these parents, we thank you for sharing these stories and we are deeply sorry for your loss. CPSC staff has considered the information about the interactions and conditions involved in the tip-over incidents in developing this draft NPR. The performance criteria were based on the children's interactions seen in fatal and nonfatal incident reports, and they are based on measured child climbing forces and child strength data. The performance criteria also are based on real-life CSU use, as seen in the incident reports, including opening multiple drawers, drawers filled with clothing, and placing the CSU on a carpeted floor. The incidents described in these comments are captured in the incident data set and have been incorporated into staff's analyses.

CPSC staff agrees that CSUs should be inherently stable and should not require a tip restraint to prevent tip over. In this package, staff discusses the barriers to the use of tip restraints and research that suggests that the rate of anchoring CSUs is low. Additionally, although staff recommends use of a warning label to inform consumers of the hazard and to motivate them to install tip restraints as a secondary safety mechanism, staff assesses that warnings will have limited effectiveness in addressing the tip-over hazard.

TAB L: Staff Testing on the Weight of Clothing in a Filled Drawer

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

Memorandum

DATE: July 14, 2021

TO: The File

THROUGH: Mark Kumagai, P.E., Associate Executive Director,
Directorate for Engineering Sciences

Rana Balci-Sinha, Ph.D., Director,
Division of Human Factors, Directorate for Engineering Sciences

FROM: Kristen Talcott, Human Factors Engineer,
Division of Human Factors, Directorate for Engineering Sciences

SUBJECT: Staff Testing on the Weight of Clothing in a Filled Drawer

BACKGROUND

As detailed in the Directorate for Engineering Sciences, Division of Human Factors (ESHF) staff memorandum (see Tab C), clothing storage unit (CSU) tip-over incidents commonly involve CSUs that are partially filled or fully filled with clothing. In determining the appropriate method for simulating this during stability testing, staff looked at several methods that have been considered to replicate filled CSU drawers. Although ASTM F2057 – 19, *Standard Safety Specification for Clothing Storage Units*, does not include filled drawers as part of its stability testing, the ASTM F15.42 subcommittee has considered whether a "loaded" (filled) drawer requirement and test method should be added to ASTM F2057. The ASTM F15.42 Loaded and Multiple Drawers task group used an 8.5 pound per-cubic-foot assumed clothing weight in testing and other discussions of filled drawers. Kids in Danger and Shane's Foundation found a similar density (average of 8.9 pounds per cubic foot) when it filled CSU drawers with boy's t-shirts in its 2016 study on furniture stability.[1] However, CPSC staff was unable to determine the origin of the 8.5 pounds per-cubic-foot measure. For this reason, ESHF staff conducted testing to determine whether this value reasonably represented the weight of clothing in a drawer.

[1] Kids in Danger and Shane's Foundation (2016). Dresser Testing Protocol and Data. Data set provided to CPSC staff by Kids in Danger, January 29, 2021.

OBJECTIVE

The objectives of this test were: (1) to evaluate whether 8.5 pounds per cubic foot is a reasonable approximation of the weight of clothing in a filled drawer, and (2) to evaluate the weight of the maximum amount of clothing that ESHF staff could put into a drawer.

METHOD

In this testing, ESHF staff evaluated four drawer fill conditions:

1. Unfolded clothing with a total weight equal to 8.5 pounds per cubic foot of functional drawer volume in the drawer;
2. Folded clothing with a total weight equal to 8.5 pounds per cubic foot of functional drawer volume in the drawer;
3. The maximum amount of unfolded clothing that could be put into a drawer that would still allow the drawer to open and close; and
4. The maximum amount of folded clothing that could be put into a drawer that would still allow the drawer to open and close.

The clothing used in these tests was an assortment of boy's clothing in sizes 4, 5, and 6 and included shirts (long sleeve and short sleeve), pajamas, pants (including jeans) and shorts, swim wear, and sweaters and sweatshirts. For the unfolded clothing test conditions, staff stuffed the unfolded clothing into the drawer wherever it would fit. For the folded clothing test conditions, staff folded clothing to a similar width and height, with the height just under the drawer clearance height. Staff placed the folded clothing vertically in the drawer (Figure 1).

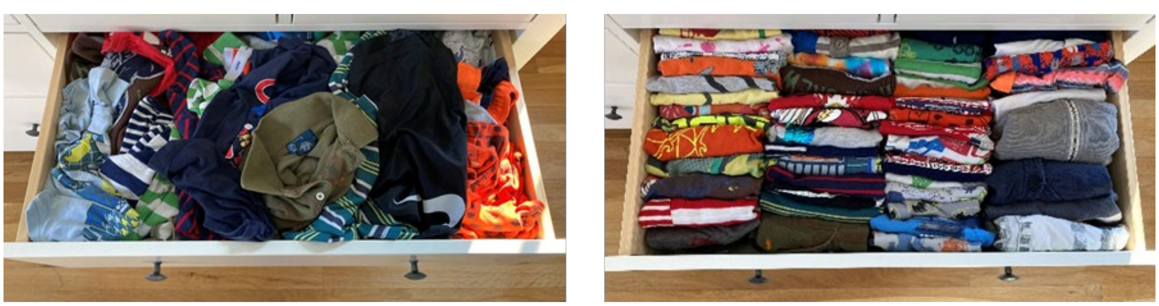

Figure 1. Example of unfolded clothing in drawer (left) and folded clothing in drawer (right).

ESHF staff put clothing into three drawers of an exemplar CSU, which is a model similar to the fatal incident unit described in Tab M, Model E. Staff selected this CSU because it is involved in fatal and non-fatal incidents and because of the range of drawer sizes. This CSU has four small-sized drawers in the top row, two medium-sized drawers in the middle row, and two large-sized drawers in the bottom row. For this testing, staff put clothing into one small-sized drawer (Drawer 1), one medium-sized drawer (Drawer 2), and one large-sized drawer (Drawer 3). Testing with multiple drawer sizes allowed staff to compare results to determine whether the size of the drawer made a difference in clothing fill density; however, because clothing can be stuffed or folded into different sizes, the size of drawer should not matter.

Staff determined the calculated clothing weight for the 8.5 pounds per cubic foot drawer fill conditions by multiplying 8.5 by the drawer's functional volume, which they defined as:

$$Functional\ Volume = \left\{[Interior\ Area](ft^2)\left[Clearance\ Height - \frac{1}{8}\right](in)\left[\frac{1}{12}\right]\left(\frac{ft}{in}\right)\right\}$$

Staff defined "clearance height" as the height from the interior bottom surface of the drawer to the closest vertical obstruction in the CSU frame. For the exemplar CSU, the closest vertical obstruction for each drawer was the cross bar separating drawers on the face of the CSU frame. Staff defined "functional height" as clearance height minus ⅛ inch. ESHF staff used this functional height because it is possible to fill drawers above the drawer's side height; however, there needs to be minimal clearance with the closest vertical obstruction so that the items do not get caught when the drawer is opened and closed.

ESHF staff measured drawer dimensions and calculated interior area, functional height, and functional drawer volume for the three tested drawers (Table 1).

Table 1. Measured Drawer Dimensions and Calculated Interior Drawer Area, Functional Height, and Functional Volume

	Drawer 1	Drawer 2	Drawer 3
Interior drawer width (in)	11 ⅜	25 ½	25 ½
Interior drawer depth (in)	17 1⁄16	17 1⁄16	17 1⁄16
Drawer clearance height (in)	6 ¾	6 ¾	9 ½
Interior area (ft^2)	1.35	3.02	3.02
Functional height (in)	6 ⅝	6 ⅝	9 ⅜
Functional drawer volume (ft^3)	0.76	1.71	2.39

For the clothing fill based on calculated clothing weight, staff attempted to create a measured clothing weight as close as possible to the calculated clothing weight, by adding and subtracting pieces of clothing until the difference between measured and calculated weight was within the weight of a single piece of clothing.

RESULTS

Clothing Fill Based on Calculated Clothing Weight

The calculated and measured clothing weights used in the test conditions for clothing fill based on calculated clothing weight are shown in Table 2. For all three drawers, ESHF staff was able to get within 0.1 pounds of the calculated clothing weight.

Table 2. Calculated and Measured Clothing Weight for Clothing Fill Based on Calculated Clothing Weight Test Conditions

	Drawer 1	Drawer 2	Drawer 3
Calculated clothing weight (lb)	6.44	14.45	20.33
Measured clothing weight (lb)	6.52	14.50	20.32
Difference (measured clothing weight minus calculated clothing weight, lb)	0.08	0.05	-0.01

Unfolded and folded clothing fill based on calculated clothing weight is shown in Figure 2.

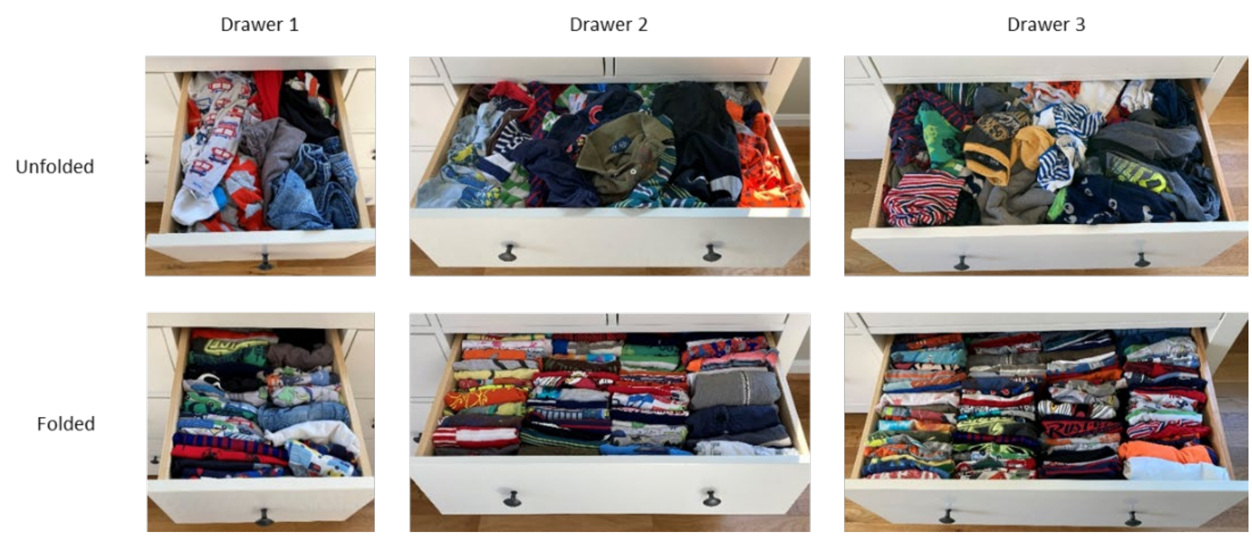

Figure 2. Drawers filled with unfolded and folded clothing with a weight of 8.5 lbs per cubic foot of functional drawer volume.

For all three drawers, ESHF staff observed that they were able to fit 8.5 pounds per cubic foot of unfolded and folded clothing fill in the drawers. When the clothing was unfolded, the clothing fully filled the drawers, but still allowed the drawer to close. Because the unfolded clothing was stuffed into the drawer fairly tightly, it was not easy to see and access clothing below the top layer. When the clothing was folded, the clothing also fully filled the drawers and still allowed the drawer to close. The folded clothing was tightly packed, but allowed for additional space when compressed. The folded clothing was easy to see, and individual items of clothing could be removed and replaced.

Clothing Fill Based on Maximum Folded and Unfolded Capacity

Maximum unfolded and folded clothing fill in each drawer is shown in Figure 3, and the maximum unfolded and folded clothing fill weights for each drawer are shown in Table 3.

Figure 3. Drawers filled with the maximum amount of unfolded and folded clothing that ESHF staff was able to fit into the drawers, while still allowing the drawer to open and close.

Table 3. Maximum Unfolded and Folded Clothing Fill Weight

	Drawer 1	Drawer 2	Drawer 3
Maximum unfolded clothing fill weight (lb)	6.52	14.64	21.20
Maximum folded clothing fill weight (lb)	7.72	16.08	22.88

ESHF staff observed that the unfolded clothing could be compressed a considerable amount, so that a drawer could appear full well before the maximum clothing fill was reached. As with the clothing fill based on calculated clothing weight, the unfolded maximum clothing fill was stuffed in the drawer as tightly as possible, and it was not easy to see and access clothing below the top layer. ESHF staff observed that the folded clothing could also be compressed and that there was a large difference between the amount of folded clothing that could minimally fill the drawer and the maximum folded clothing fill. For the maximum folded clothing fill conditions, the folded clothing was very tightly packed; and although it was easy to see all the clothing, it was difficult to remove and replace individual pieces of clothing because of the compression.

Comparisons Between Values

Figure 4 shows a comparison of the calculated clothing weight (*i.e.*, using 8.5 pounds per cubic foot), maximum unfolded drawer fill weight, and maximum folded drawer fill weight for each drawer.

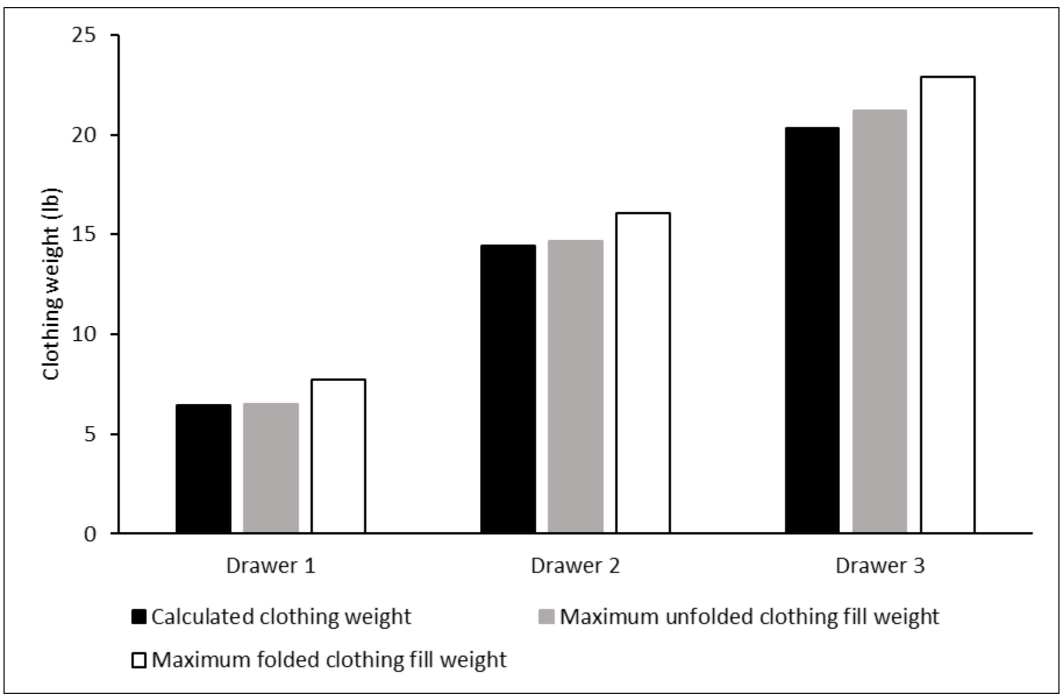

Figure 4. Maximum unfolded and folded fill weights compared to calculated clothing weight.

The maximum unfolded clothing fill weight was slightly higher than the calculated clothing fill weight for all tested drawers. The difference between the maximum unfolded clothing fill weight and the calculated clothing weight ranged from 0.08 pounds (Drawer 1) [2] to 0.87 pounds (Drawer 3). The maximum unfolded clothing fill weight was 101 percent of the calculated clothing weight for Drawer 2 and Drawer 1, and 104 percent of the calculated clothing weight for Drawer 3. The maximum folded clothing fill weight was higher than both the maximum

[2] The collection of clothing used for the maximum unfolded clothing fill for Drawer 2 was the same as that used for the clothing fill based on calculated clothing weight condition.

unfolded clothing fill weight and the calculated clothing fill weight for all tested drawers; however, the differences were relatively small. The difference between the maximum folded clothing fill weight and the calculated clothing weight ranged from 1.28 pounds (Drawer 1) to 2.55 pounds (Drawer 3). The maximum unfolded clothing fill weight was 111 percent of the calculated clothing weight for Drawer 2, 113 percent of the calculated clothing weight for Drawer 3, and 120 percent of the calculated clothing weight for Drawer 1.

Figure 5 shows the staff-calculated clothing density, based on the maximum unfolded and folded fill weights and the functional drawer volume, for each drawer in comparison to 8.5 pounds per cubic foot.

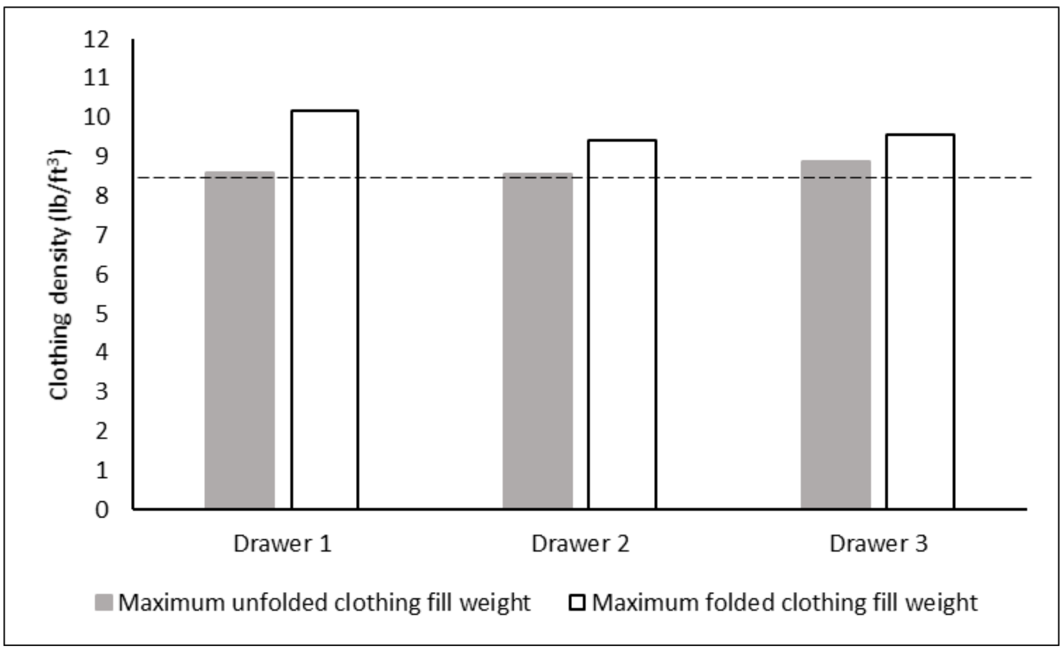

Figure 5. Maximum unfolded and folded clothing density in comparison to 8.5 pounds per cubic foot (dashed line).

The maximum unfolded clothing fill density was slightly higher than 8.5 pounds per cubic foot for all tested drawers. The maximum unfolded clothing fill density ranged from 8.56 pounds per cubic foot (Drawer 1) to 8.87 pounds per cubic foot (Drawer 3). The maximum folded clothing fill density was higher than both the maximum unfolded clothing fill density and 8.5 pounds per cubic foot for all tested drawers. The maximum folded clothing fill density ranged from 9.40 pounds per cubic foot (Drawer 2) to 10.16 pounds per cubic foot (Drawer 3). There does not appear to be large difference in clothing fill density based on drawer size.

CONCLUSIONS

ESHF staff found that 8.5 pounds per cubic foot of clothing will fill a drawer; however, this amount of clothing is less than the absolute maximum amount of clothing that can be put into a drawer, especially if the clothing is folded. ESHF staff found that the maximum amount of unfolded clothing that could be put into the tested drawers was only slightly higher than 8.5 pounds per cubic foot. Although ESHF staff achieved a clothing density as high as 10.16 pounds per cubic foot with folded clothing, ESHF staff assesses that consumers are unlikely to fill a drawer to this level because it requires careful folding, and it is difficult to remove and replace individual pieces of clothing. On balance, ESHF staff concludes that 8.5 pounds per cubic foot of functional drawer volume is a reasonable approximation of the weight of clothing in a fully filled drawer. Staff requests comments and data on the weight of clothing in drawers. Staff cautions that these results apply to filling drawers with clothing and do not account for other items that consumers may put into CSUs.

TAB M: Mechanical Evaluation and Analytical Modeling of Incident-Involved Clothing Storage Units

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

Memorandum

DATE: July 14, 2021

TO: Kristen Talcott, Ph.D., Furniture Tip-Over Project Manager
Division of Human Factors, Directorate for Engineering Sciences

THROUGH: Mark Kumagai, P.E., Associate Executive Director,
Directorate for Engineering Sciences

Caroleene Paul, Director,
Division of Mechanical and Combustion Engineering, Directorate for Engineering Sciences

FROM: Lawrence Mella, Mechanical Engineer,
Andrew Newens, Mechanical Engineer,
Daniel Taxier, Mechanical Engineer,
Division of Mechanical and Combustion Engineering, Directorate for Engineering Sciences

SUBJECT: Mechanical Evaluation and Analytical Modeling of Incident-Involved Clothing Storage Units

INTRODUCTION

Directorate for Engineering Sciences (ES), Division of Mechanical and Combustion Engineering (ESMC) staff conducted an analysis of incidents and tested incident products to understand the real-world factors that cause a tip-over injury or death. ESMC staff used the following criteria to select incident-involved CSUs for further analysis:

- The incident was investigated by CPSC staff.
- The investigation resulted in sufficient detail for ESMC staff to recreate or model the incident.
- CPSC was able to obtain either the CSU involved in the incident (incident samples), or a CSU of the same make and model as the CSU involved in the incident (exemplar samples).

Based on these criteria, staff identified seven CSU models for analysis in order to determine common contributing factors to these incidents. Staff found the following hazard patterns, often occurring simultaneously:

1. Multiple (more than one) drawers were opened.
2. Drawers empty, filled, or partially filled with clothing.
3. Carpeted surfaces.
4. Children climbing the CSU.
5. Children pulling on CSU drawers.

Two (2) of the seven (7) CSU models (Models E and G) met the ASTM F2057 – 19 *Standard Safety Specification for Clothing Storage Units* stability requirements. An additional model (Model F) was considered to be borderline meeting/not meeting the requirements. The incident scenarios for these three units were consistent with the hazard patterns described above. Based on staff's evaluation of meeting and borderline meeting CSUs and the observed hazard patterns, staff concluded that ASTM F2057 – 19 does not address the consumer's use of CSUs and the hazards associated with children interacting with CSUs. The analysis for each CSU model is provided in this memorandum.

TABLE OF CONTENTS

MODEL A: 7-DRAWER CSU

Executive Summary

ES staff evaluated a 7-drawer dresser that was involved in a non-fatal incident and reviewed the In-Depth Investigation (IDI) related to the incident dresser. As part of the analysis, ES staff first determined the physical characteristics of the 7-drawer dresser by measuring: (1) the weight and center of gravity of each drawer; (2) the weight and center of gravity of the dresser cabinet (without drawers); and (3) the weight and center of gravity of the dresser as each drawer is extended.

ES staff developed the most likely hazard scenario based on information obtained from the IDI, including: weight and height of the victim, dresser dimensions, dresser drawer slide extension distance, and interactions of the victim with the dresser. ES staff then conducted laboratory testing using weights and the incident sample 7-drawer dresser to validate the hazard scenarios.

Critical Findings

1. **A 32-pound child pulling on one row of fully extended drawers will result in tip over of the dresser with *empty* or *full* drawers.** The child's exerted force on the edge of the drawer likely consisted of both a horizontal and a vertical component. The presence of a horizontal component (compared to a purely vertical component) significantly increases the tip-over moment acting on the dresser, sufficient to counter the opposing moment of clothes in the dresser.
2. **A dresser on a sloped floor is less stable than one on a level floor.** The dresser tip-over force is about 3 pounds less when on a sloped hard floor (angled 0.8 degrees towards the front, based on information provided in the IDI) compared to a hard, level floor.
3. **The ASTM Standard did not fully address the hazard scenario.** The 7-drawer dresser does not meet the ASTM Standard because when *empty,* the dresser tips over when all the drawers are fully extended. The dresser also does not meet the "stability with load" criteria because the dresser becomes unstable and tips over when less than a 50-pound weight is applied to one open drawer (only 32 to 38 pounds was required to cause a tip over, depending on which drawer the weight was applied). Staff found the ASTM standard did not address the following hazards occurring simultaneously:
    a. multiple open drawers,
    b. drawers filled with clothing,
    c. child pulling with a horizontal force, and
    d. dresser placed on a hard, sloped surface.

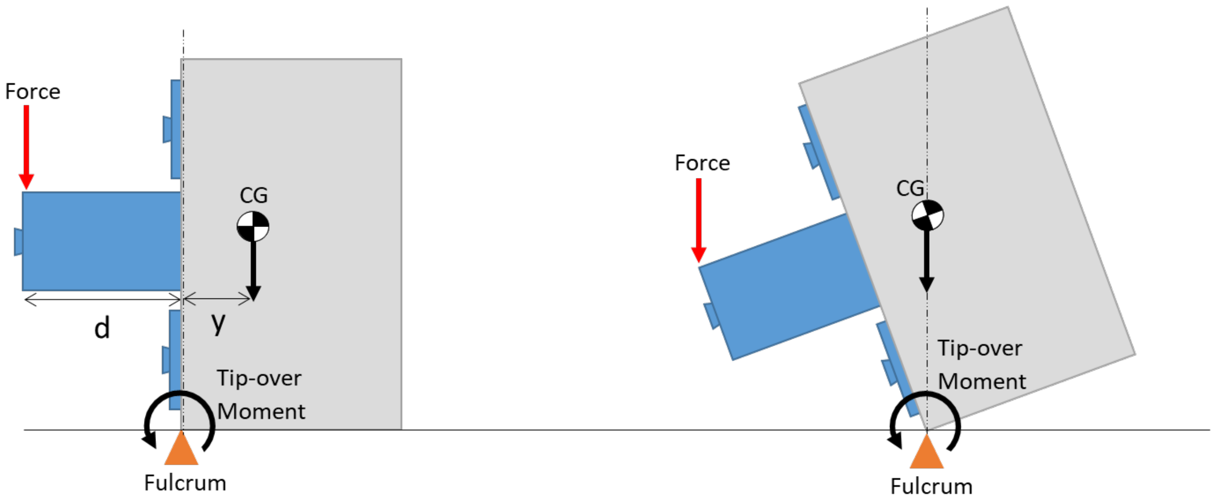
Model A: 7-Drawer Dresser

ES staff examined an incident sample 7-drawer dresser that was involved in a nonfatal incident. The incident unit dresser is a 165-pound, seven- (7) drawer dresser with overall dimensions: 64 inches wide, 18.25 inches deep, and 38 inches tall (including the 4.25-inch-tall feet, see Figure 1). Each drawer extends approximately 16 inches. The usable volume of the drawers is the area inside each drawer, multiplied by the height (as measured to the edge of the opening minus $\frac{1}{8}$ inch).

Figure 1. Model A Dresser

Stability Analysis - ESMC Lab Testing and Computational Model

Tip over of a dresser is related to the center of gravity (CG) of the dresser and the point of tip over (fulcrum), which is the bottom of the front feet of this particular dresser. Tip over occurs when a moment (force times the horizontal distance to the fulcrum (Force*d), Figure 2a) is applied to rotate the dresser's CG past the fulcrum (Figure 2b). The closer the CG is to the fulcrum (distance y, Figure 2a), the less force is required to tip the dresser over. See ESMC Main Memorandum, Tab D, for a more detailed discussion.



a) Before tip over occurs b) The CG begins to pass the fulcrum

Figure 2. Tip over occurs when a moment rotates the CG past the fulcrum.

ASTM F2057 Stability Requirements

ESMC staff tested the incident dresser to the stability requirements in ASTM F2057 – 19 *Standard Safety Specification for Clothing Storage Units*.

Section 7.1 Stability of Unloaded Unit: Section 7.1 specifies that the unit (without clothing weight in the drawers) shall be tested on a hard, level surface, and all drawers should be fully extended. Section 4.2 specifies that the unit shall not tip over when tested to Section 7.1.

ESMC staff pulled the drawers of the dresser to their fullest extension and determined that the dresser did not meet the performance requirement, tipping forward before all of the drawers could be pulled out the full 16.125 inches to the stops.

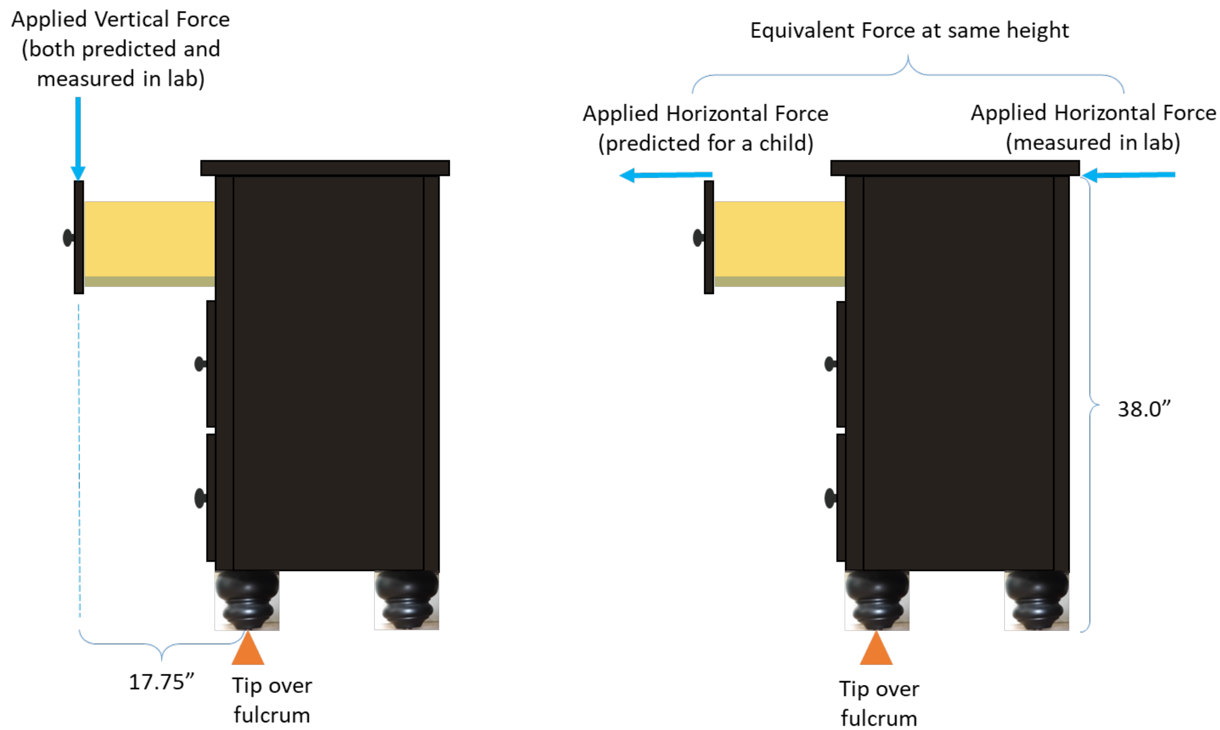
Section 7.2 Stability with Load: Section 7.2 specifies that the unit (without clothing weight in the drawers) shall be tested on a hard, level surface, and one drawer at a time should be fully extended and a 50 ± 2-pound weight applied to the top edge of the open drawer face. Section 4.2 specifies that the unit shall not tip over when tested to Section 7.2.

ESMC staff tested one extended bottom-level drawer and determined the dresser tipped over with approximately 32 pounds on the front edge. ESMC staff repeated the test with one extended top-level drawer and determined the dresser tipped over with approximately 38 pounds on the front edge (the bottom drawers are heavier than the top drawers). Either result is significantly less than the performance requirement to hold 50 pounds on the front edge of one open drawer without tipping over.

Measured Versus Modeled Tip Over

ESMC staff collected data on the dresser's CG by placing each corner of the dresser on a scale and using the ratio of the rear scale measurements to the combined measurements of all the scales to determine the CG depth from the front of the dresser. Staff measured the dresser CG when opening one drawer at a time, starting at the top, until the maximum number of drawers could be fully extended before the dresser tipped over on its own.

To complement the lab testing, ESMC staff developed a computational model that was used to predict the tipping behavior of the unit in various loading conditions. Staff used the unit's dimensions, drawer extension length, weight, and the CG of the dresser and each of its drawers individually to develop the model. The tip-over fulcrum of the unit was assumed to be at the contact point between the floor and the centerline of the front feet. The tip weight was calculated and measured for each configuration in two different ways as shown in Figure 3.



a) vertical force or weight b) horizontal force

Figure 3. Comparison of the two ways that ESMC staff analyzed tip force.

Vertical Tip Over Force – Empty Dresser

The calculated and measured CG depth and vertical tip weights (Figure 3a), while opening drawers from the top down, are shown in Table 1. Drawers 1-3 are in the top row, and drawers 4-5 are in the middle row. The unit tipped over by itself before the fifth drawer of this 7-drawer unit could be fully extended.

Table 1. Calculated and Measured CG and Vertical Tip Weight Data

# of Open Drawers (from top down)	CG Depth from Front (in)		Vertical Tip Weight (lb)	
	Calculated	**Measured**	**Calculated**	**Measured**
0	4.97	4.85	N/A	N/A
1	4.30	4.18	39.86	38.0
2	3.33	3.17	30.85	29.0
3	2.66	2.46	24.61	22.5
4	1.40	1.18	12.93	11.0
5	0.14	0 - Tip over	1.26	0 - Tip over
6	N/A	N/A	N/A	N/A
7	N/A	N/A	N/A	N/A

The data from Table 1 are graphed in Figure 4 and Figure 5. The segments with flatter slopes indicate the smaller drawers and the segments with steeper slopes indicate the larger drawers.

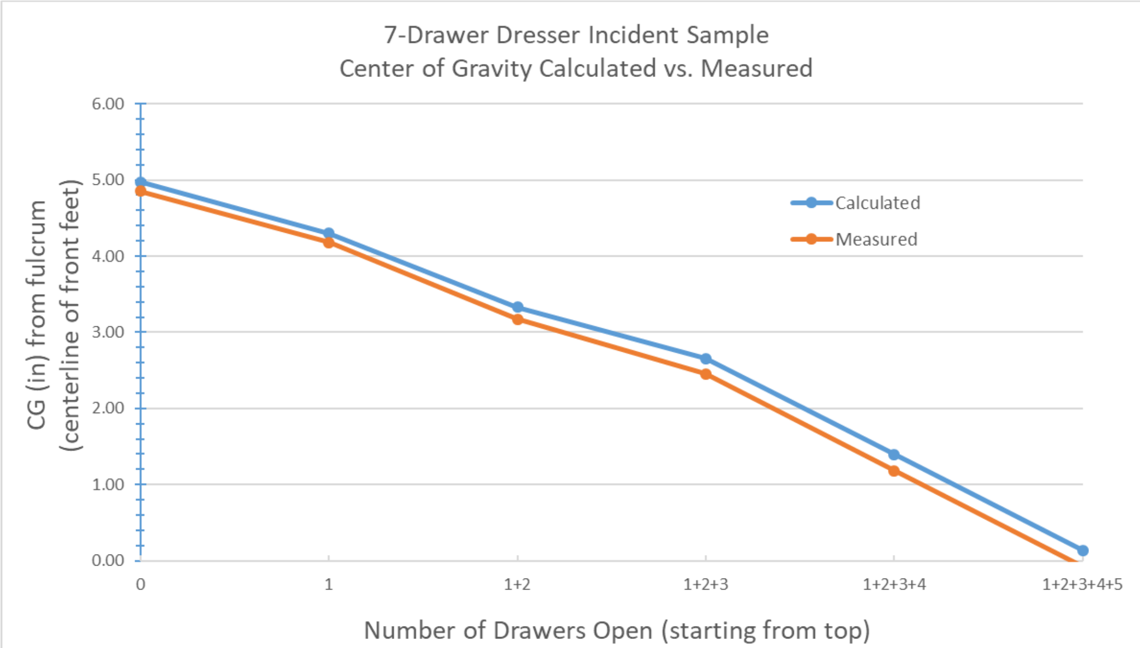


Figure 4. Calculated vs. measured CG distance from the tipping fulcrum as drawers were opened from the top down.

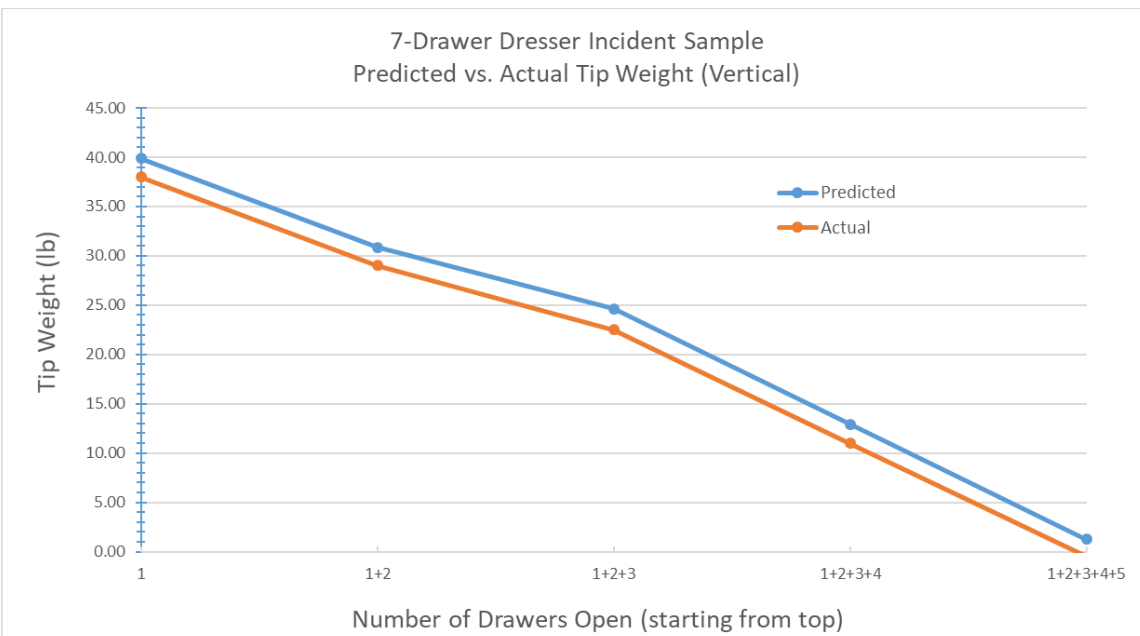


Figure 5. Calculated (predicted) vs. measured (actual) vertical tip weight applied to the front of the top open drawer as drawers were opened from the top down.

The calculated CG values correlated well with the measured CG values, all within 0.25 inch of each other. The predicted vertical tip weight, derived from the calculated CG, was typically within 2 pounds of the measured tip weight. Therefore, staff concludes that the computational model adequately predicts the tipping behavior of the dresser in the measured loading conditions and other loading conditions.

Horizontal Tip Over Force – Empty Dresser

The corresponding horizontal tip force (Figure 3b) data while opening drawers from the top down are shown in Table 2. The first three drawers are in the top row, and the next two drawers are in the middle row. The unit tipped over by itself before the fifth drawer of this 7-drawer dresser could be fully extended.

Table 2. Calculated and Measured Horizontal Tip Force Data

	Horizontal Tip Force (lbf)	
# of Open Drawers (from top down)	**Calculated**	**Measured**
0	21.53	20.0
1	18.62	17.75
2	14.41	13.5
3	11.50	10.5
4	6.04	5.25
5	0.59	0 - Tip over
6	N/A	N/A
7	N/A	N/A

The data from Table 2 are graphed in Figure 6. The segments with flatter slopes indicate the smaller drawers, and the segments with steeper slopes indicate the larger drawers.

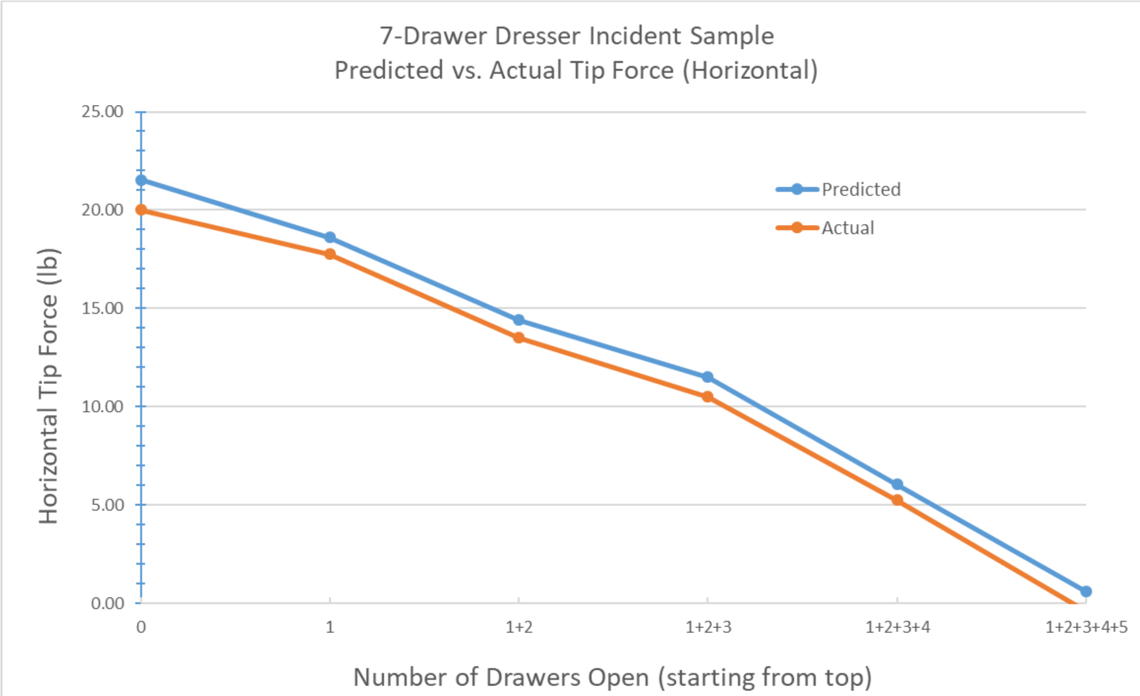


Figure 6. Calculated (predicted) vs. measured (actual) horizontal tip force applied to the top of the unit as drawers were opened from the top down.

The predicted horizontal tip force was typically within 1 pound of the actual horizontal tip force.

IDI Summary:

160818CBB3823	A 30 MO female was with her mother in the mother's bedroom. When the mother briefly turned her back (10-15 seconds), she heard a crash and turned to see her daughter's body from the neck down was under the tipped over dresser while her head was located above the top of the dresser. The open drawers were holding the dresser at an angle. The daughter survived and suffered only a 2" laceration on the back of the head plus bruised legs and back, needing only a brief visit to the ER. The floor was hardwood but sloped, and a tip restraint was not installed.

Incident Hazard Scenario Description

The victim was a 30-month-old girl at 32 pounds and 39 inches tall. On the day of the incident, the mother was in her bedroom with her toddler, getting some clothes from the incident dresser. All of the drawers had clothes in them, but it is not known how full they were. The mother opened the top left and right drawers half-way (the top center remained closed). When asked how she thought the dresser might have tipped over, the mother hypothesized that while she had her back turned, her daughter opened the top center drawer while the top left and right drawers were still open. After all three drawers were opened, her daughter either pulled or pushed down on one of the drawers, which may have caused the dresser to tip forward. She also speculated that as the dresser tipped over, the child was struck in the back of the head and lacerated by the large (20 pound) wooden jewelry box that was sitting on top of the dresser at the time of the incident.

The scenario, as described in the IDI report, is depicted in Figure 7.

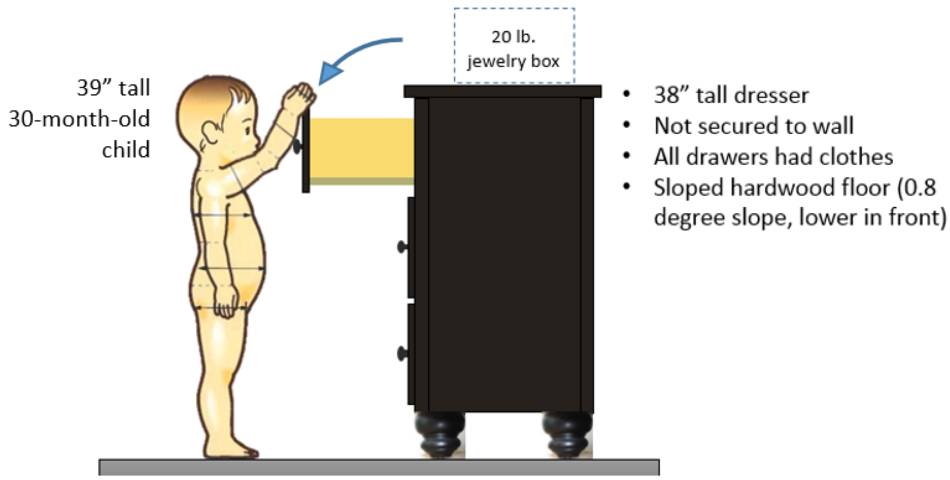


Figure 7. The illustration of the hazard scenario shows the toddler (victim) scaled to the height of the dresser. The victim likely pulled down and horizontally on the front edge of the top center drawer, causing the unit to tip forward.

ESMC Re-creation of the Incident Scenario

Based on the presumed incident scenario in Figure 7, staff added initial assumptions to both the model and the lab testing to re-create that scenario. One assumption is that the top three drawers were fully extended when the child pulled on them. Even though the length to which the drawers were pulled out by the child in the incident is unknown, it is possible that the child pulled the drawers out all the way to the stop (16.125 inches), so staff used this assumption for the calculation. Other initial conditions that staff added to re-create the incident included:

- The weight of the 20-pound jewelry box on the dresser
- An average clothing density of 8.5 pounds per cubic foot for the weight of a filled drawer
- A sloped floor (0.8 degrees, lower in front)
- The child pulling both horizontally and vertically

ESMC staff addressed the effect of each initial condition separately and then considered the combined result.

Including the Effect of the 20-Pound Jewelry Box

Staff modified the model calculations from Figure 5 to include effect of a 20-pound jewelry box on the top of the dresser, near the back, as shown in the IDI photographs (see Figure 8).

Figure 8. The location of the dresser during the incident. Front and side view of a re-creation (from the IDI) of the position of the drawers just prior to the incident.

Predicted vertical tip weight with and without the jewelry box is shown in Figure 9.

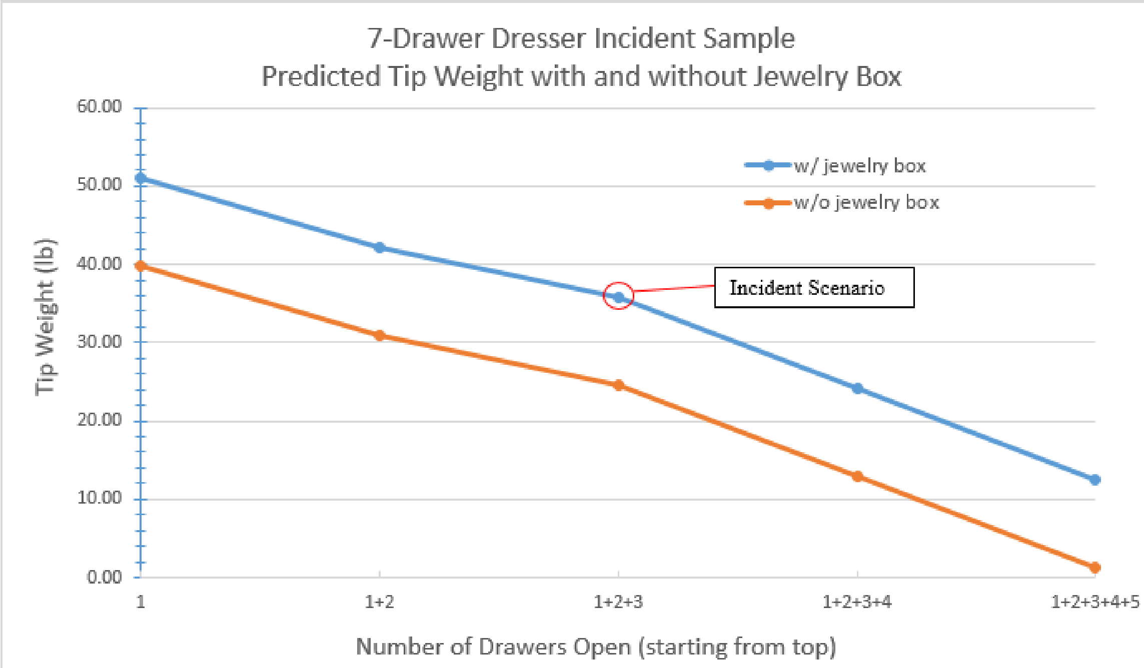


Figure 9. Predicted vertical tip weight applied to the front of the top open drawer as drawers were opened from the top down, showing the effect of a 20-pound jewelry box on top of the dresser.

The jewelry box added 11.3 pounds to the vertical tip weight.

Including the Effect of Clothes in the Drawers

The IDI stated that the dresser drawers had clothes in them during the incident, but did not specify how full they were. ESMC staff used the model to calculate the predicted vertical tip weight in various drawer-fill scenarios of empty, half full, and full (see Figure 10).

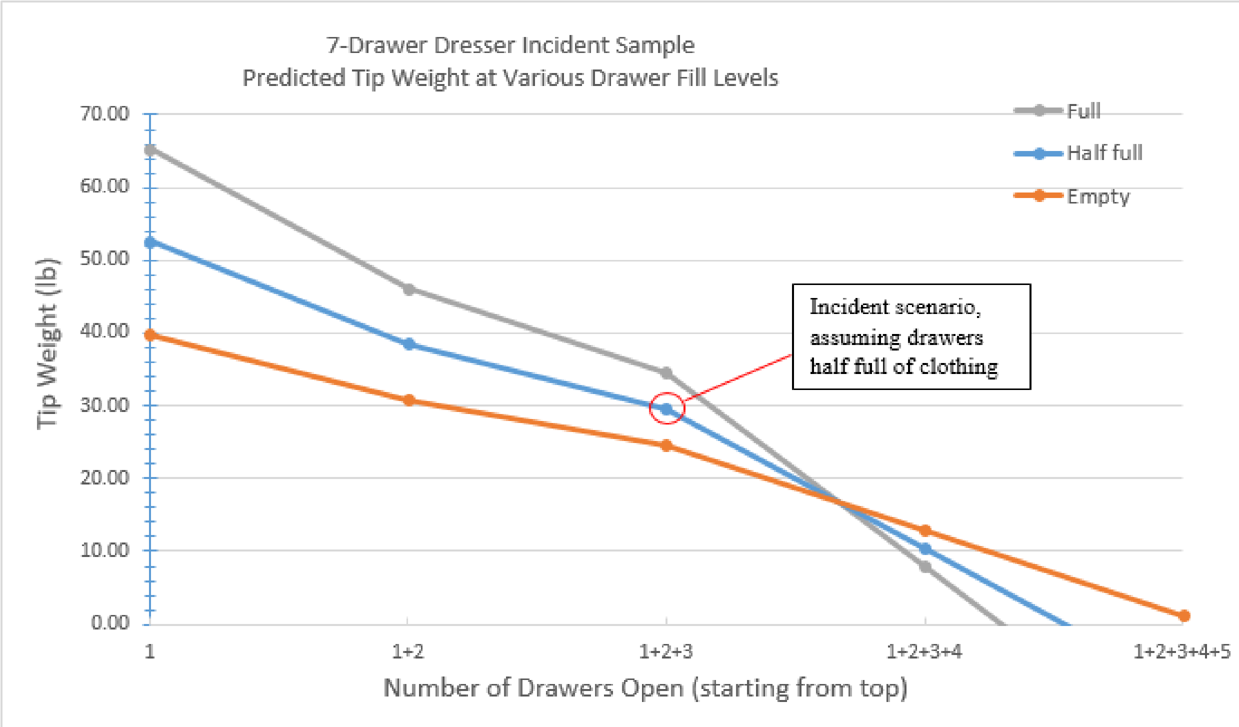


Figure 10. The effect of clothing in drawers on vertical tip weight modeled with various levels of filling.

Staff used an average clothing density of 8.5 pounds per cubic foot to calculate the weight and CG of filled drawers. For the presumed incident scenario (the three top drawers fully extended), the predicted tip weight increased from 24.6 pounds with empty drawers to 29.6 pounds with half-full drawers and 34.6 pounds with full drawers. ESMC staff's working definition of "full" drawers assumes that all of the interior volume is used to the effective height of the drawer. Given drawers typically have some unused space, staff assumed that the incident scenario involved half-full drawers.

Including the Effect of a Sloped Floor

As mentioned, the initial analysis was calculated assuming the floor was a level surface. In this incident, the dresser was on a hardwood floor that was sloped 0.8 degrees, toward the front of the dresser (confirmed by IDI photographs showing the measurements). This forward incline causes the dresser to tip forward more easily than it would on a level surface. ESMC staff used the model to calculate the effect of a sloped floor on the tip weight (see Figure 11).

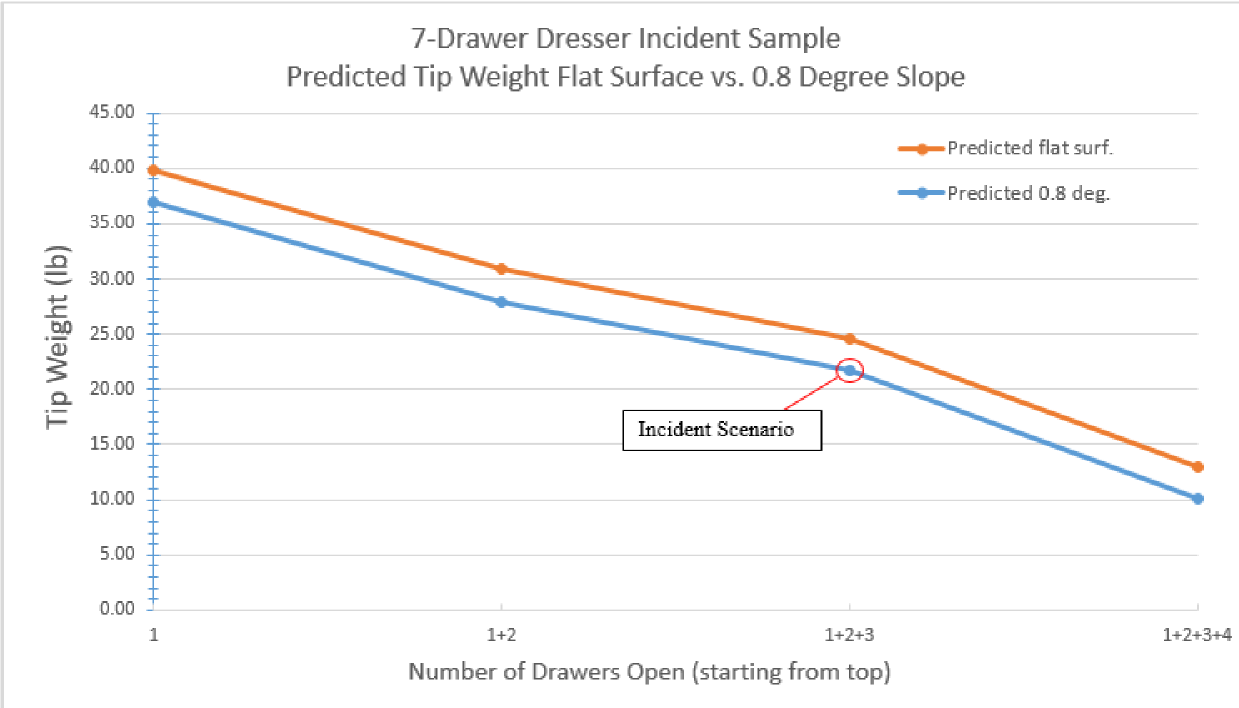


Figure 11. The predicted vertical tip weight is reduced when the floor is sloped down, compared to a level floor.

For the presumed incident scenario (the three top drawers fully open), the predicted vertical tip weight is reduced by about 3 pounds with the effect of the floor sloped downward 0.8 degrees, from 24.6 pounds for a level floor to 21.7 pounds on the sloped floor.

Cumulative Effects of All Incident Scenario Assumptions

Table 3 summarizes the individual and cumulative effects of each incident scenario assumption on the predicted ***vertical*** tip weight.

Table 3. Cumulative Effects of Each Incident Scenario Condition

Condition	Vertical Tip Weight (lb)	Change from Baseline (lb)
Baseline (the three top drawers fully open)	24.6	
20 lb jewelry box on top	35.9	+11.3
Half full drawers w/clothes	29.6	+5.0
Sloped floor downward 0.8 deg.	21.7	-2.9
Cumulative effect	38.0	+13.4

A predicted vertical tip weight of 38 pounds would be required to cause a tip over, given the indicated conditions. However, ESMC considered that a child, standing on the floor as in the incident scenario, would likely exert a force with both a horizontal and a vertical component simultaneously on the drawer (see Figure 7). Therefore, ESMC analyzed the total moment and the amount contributed by both components.

The Child Pulling both Horizontally and Vertically

The subject dresser's lever arm for a vertical force on the edge of a fully opened drawer is 17.75 inches (see Figure 3a). Therefore, a 38-pound vertical tip weight creates a moment of 38 pounds x 17.75 inches = 674 pound-inch. Absent additional details about the child's actions from the incident, ESMC assumed that a likely scenario was that the child could have exerted half of the tip over moment horizontally and half vertically.

If half of the 674 pound-inch moment was exerted vertically, then the vertical force would be (674/2) / 17.75 = 19 pound-force.

If half of the 674 pound-inch moment was exerted horizontally, then with a lever arm of 38.0 inches (see Figure 3b), the horizontal force would be (674/2) / 38 = 8.9 pound-force.

Conclusion

The incident dresser did not meet the requirements for stability of an unloaded unit in ASTM F2057 – 19 *Standard Specifications for Clothing Storage Units*, which specifies that an unloaded unit with all drawers fully extended shall not tip over. The unit also did not meet the requirements for stability of a loaded unit, which specifies that the unit shall not tip over when a 50-pound weight is applied to the front face of any single fully extended drawer. Staff determined the unit on a hard, level floor will become unstable and tip over when 32 to 38 pounds is applied vertically to any single fully extended drawer (depending on which drawer the force is applied).

The nonfatal incident involved a 30-month-old female (approximately 39 inches tall and weighing 32 pounds), who was in the same room with her mother and the 7-drawer dresser. While the mother briefly turned after opening two of the dresser drawers to retrieve clothes, the dresser tipped over onto the victim. The open drawers were holding the dresser at an angle, and the victim survived, needing only a brief visit to the emergency room for a 2-inch laceration the back of her head and bruised legs/back. The dresser was on a hardwood floor that sloped towards the front of the dresser.

ES staff's analysis of the incident dresser's stability determined the following:

- A static vertical weight of approximately 32 to 38 pounds on the front edge of a single fully extended drawer was sufficient to tip the dresser over on a hard, level floor.
- A horizontal pulling force of 17.75 pound-force on the front edge of a single fully extended top-level drawer was sufficient to tip the dresser over on a hard, level floor.
- The force required to tip the dresser over is affected by the level to which they are filled. The weight of fill in the drawers increases overall stability when fewer than half of the drawers are opened, and reduces overall stability when more than half of the drawers are opened. In the case of this incident dresser, whether empty or full, it tips over on its own before five of the seven drawers can be fully extended.
- The force required to tip over the dresser decreases when the dresser is on a surface that is sloped towards the front.
- The result of all the incident-scenario conditions combined is a predicted total tip moment of 674 pound-inch. This could be created by a vertical force on the edge of the top drawer of 19 pound-force and a simultaneous horizontal force on the edge of the top drawer of 8.9 pound-force. This seems to be a plausible scenario for a 30-month-old child weighing 32 pounds (based on child strength studies for pushing[1] and pulling[2]), demonstrating how the child in the incident had the ability to cause this dresser to tip over with all the initial conditions as reported in the IDI.

---

[1] Owings, C.L., Norcutt, R.H., Snyder, R.G., Golomb, D.H., & LLoyd, K.Y. (1977). Gripping Strength Measurements of Children for Product Safety Design (Contract No. CPSC-C-76-0119). Prepared for the U.S. Consumer Product Safety Commission, Washington, D.C. The mean push-down force for 2.5- to 3.5-year-olds using one arm is 9.58 lbf, estimated 19.16 lbf using both arms.

[2] Brown, W.C., Buchanan, C.J. & Mandel, J. (1973). *A Study of the Strength Capabilities of Children Ages Two through Six*. Report No. NBSIR 73-156. U.S. Department of Commerce, Bureau of Standards, Washington, D.C.

MODEL B: 3-DRAWER CSU

Executive Summary

ES staff evaluated an exemplar of a 3-drawer dresser that was involved in a fatal incident and reviewed the IDI related to the incident dresser. As part of the analysis, ES staff first determined the physical characteristics of the 3-drawer dresser by measuring: (1) the weight and center of gravity of each drawer; (2) the weight and center of gravity of the dresser cabinet (without drawers); and (3) the weight and center of gravity of the dresser as each drawer is extended.

ES staff developed the most likely hazard scenario based on information obtained from the IDI, including: weight and height of the victim, dresser dimensions, dresser drawer slide extension distance, and interactions of the victim with the dresser. ES staff then conducted laboratory testing using weights and sample 3-drawer dresser to validate the hazard scenarios.

Critical Findings

1. **Incident occurred while multiple drawers were opened.** For all the scenarios analyzed, multiple drawers of the dresser needed to be extended or *open* to cause tip-over (*unstable condition*) and entrapment of the victim.
2. **A 26-pound child pushing or pulling on one fully extended drawer will result in tip over of the dresser with *empty* drawers.** The child's exerted force on the edge of the drawer likely consisted of both a horizontal and a vertical component. The presence of a horizontal component (compared to a purely vertical component) significantly increases the tip-over moment acting on the dresser.
3. **A dresser on a carpet/pad is less stable than one on a hard level floor.** The dresser tip-over force is about 4 to 6 pounds less when the dresser is on a carpet/pad, as compared to when the same dresser is on a hard, level floor. The stability or tip-over force of a dresser on a 1- to 3-degree incline is similar to a dresser on a carpet/pad.
4. **The ASTM Standard did not fully address the hazard scenario.** The 3-drawer dresser meets part of the ASTM Standard because, when *empty,* the dresser remains upright when all the drawers are fully extended. However, the dresser does not meet the "stability with load" criteria because the dresser becomes unstable and tips over when less than a 50-pound weight is applied to one open drawer (only 19 to 21 pounds was required to cause tip over). Staff found the ASTM standard did not address the following hazards occurring simultaneously:
   a) multiple open loaded drawers,
   b) child pulling with a horizontal force,
   c) dresser placed on a carpeted surface, and
   d) child's head becoming entrapped between two open drawers.

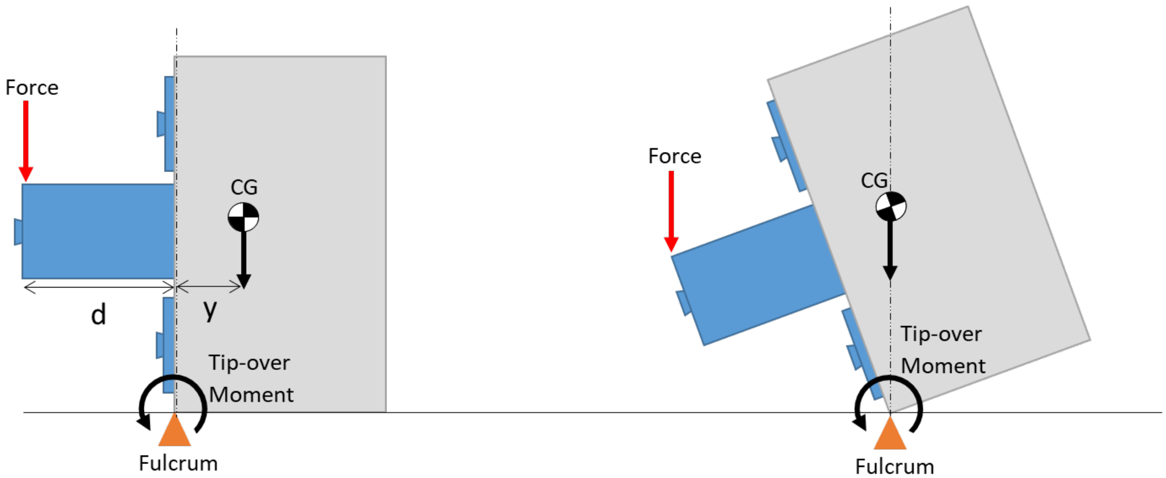
Model B: 3-Drawer Dresser

ES staff examined an exemplar of a 3-drawer dresser that was involved in a fatal incident. The incident unit dresser is a 57.5-pound, three (3) drawer dresser with overall dimensions: 31.25 inches wide, 15.5 inches deep, and 27.5 inches tall (there are no feet, see Figure 12). Each drawer extends approximately 11.5 inches. The usable volume of the drawers is the area inside each drawer multiplied by the height (as measured to the edge of the opening minus ⅛ inch).

Figure 12. Model B Dresser

Stability Analysis - ESMC Lab Testing and Computational Model

Tip over of a dresser is related to the center of gravity (CG) of the dresser and the point of tip over (fulcrum), which is the bottom of the front edge of this particular dresser. Tip over occurs when a moment (force times the horizontal distance to the fulcrum (Force*d), Figure 13a) is applied to rotate the dresser's CG past the fulcrum (Figure 13b). The closer the CG is to the fulcrum (distance y, Figure 13a), the less force is required to tip the dresser over. See ESMC Main Memorandum, Tab D, for a more detailed discussion.



a) Before tip over occurs b) The CG begins to pass the fulcrum

Figure 13. Tip over occurs when a moment rotates the CG past the fulcrum.

ASTM F2057 Stability Requirements

ESMC staff tested the sample dresser to the stability requirements in ASTM 2057-19 *Standard Safety Specification for Clothing Storage Units*.

Section 7.1 Stability of Unloaded Unit: Section 7.1 specifies that the unit (without clothing weight in the drawers) shall be tested on a hard, level surface, and all drawers should be fully extended. Section 4.2 specifies that the unit shall not tip over when tested to Section 7.1.

ESMC staff pulled out all the drawers of the dresser to their fullest extension and determined that the dresser met the performance requirement for stability of an unloaded unit.

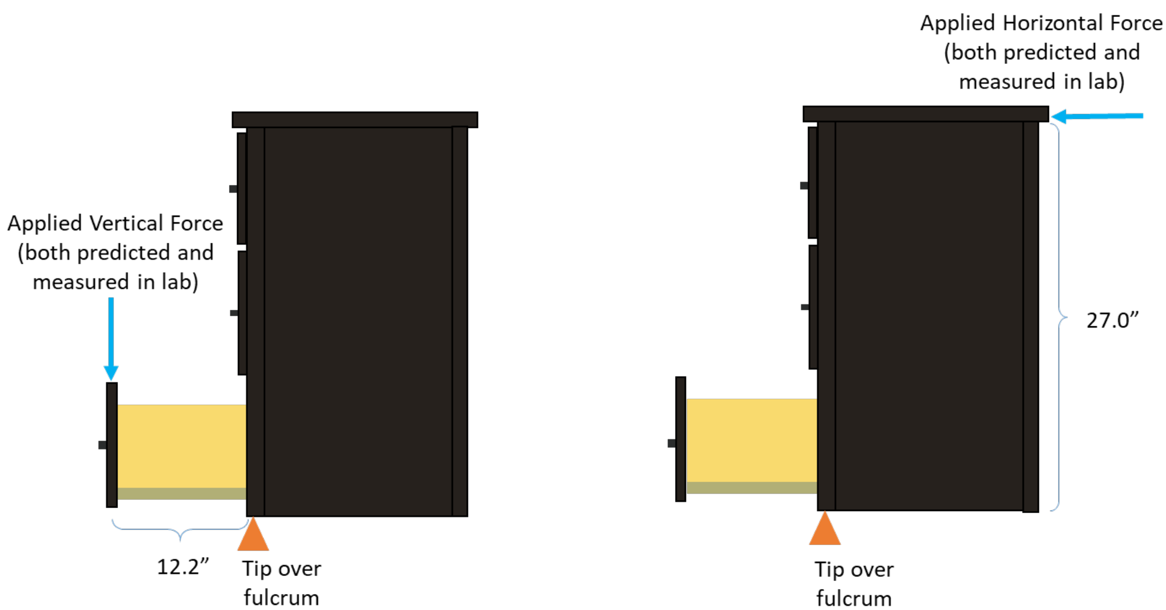
Section 7.2 Stability with Load: Section 7.2 specifies that the unit (without clothing weight in the drawers) shall be tested on a hard, level surface, and one drawer at a time should be fully extended and a 50 ± 2-pound weight applied to the top edge of the open drawer face. Section 4.2 specifies that the unit shall not tip over when tested to Section 7.2.

ESMC staff tested one extended drawer at a time and determined the dresser tipped over with approximately 19 to 21 pounds on the front edge of any single drawer. Staff determined the incident dresser does not meet the performance requirement to hold 50 pounds on the front edge of one open drawer without tipping over. This indicates that the victim's static weight (26 pounds) was more than enough to cause the dresser to tip over with her weight on the front of an open drawer.

Measured Versus Modeled Tip Over

ESMC staff collected data on the dresser's CG by placing each corner of the dresser on a scale and using the ratio of the rear scale measurements to the combined measurements of all the scales to determine the CG depth from the front of the dresser. Staff measured the dresser CG when opening one drawer at a time, starting at the bottom, until all the drawers were fully extended.

To complement the lab testing, ESMC staff developed a computational model that could be used to predict the tipping behavior of the unit in various loading conditions. Staff used the unit's dimensions, drawer extension length, weight, and the CG of the dresser and each of its drawers individually to develop the model. Because the dresser has no feet, the tip-over fulcrum was assumed to be at the contact point between the floor and the bottom edge of the front face. The tip weight was calculated and measured for each configuration in two different ways as shown in Figure 14.



a) vertical force or weight b) horizontal force

Figure 14. Comparison of the two ways that ESMC staff analyzed tip force.

Vertical Tip Over Force – Empty Dresser

The calculated and measured CG depth and vertical tip weights (Figure 14a), while opening drawers from the bottom up, are shown in Table 4.

Table 4. Calculated and Measured CG and Vertical Tip Weight Data

# of Open Drawers (from bottom up)	CG Depth from Front (in.)		Vertical Tip Weight (lb)	
	Calculated	Measured	Calculated	Measured
0	5.84	5.88	N/A	N/A
1	3.93	3.96	18.58	18.75
2	2.04	2.07	9.65	10.07
3	0.15	0.17	0.70	0.51

The data from Table 1 are graphed in Figure 15 and Figure 16.

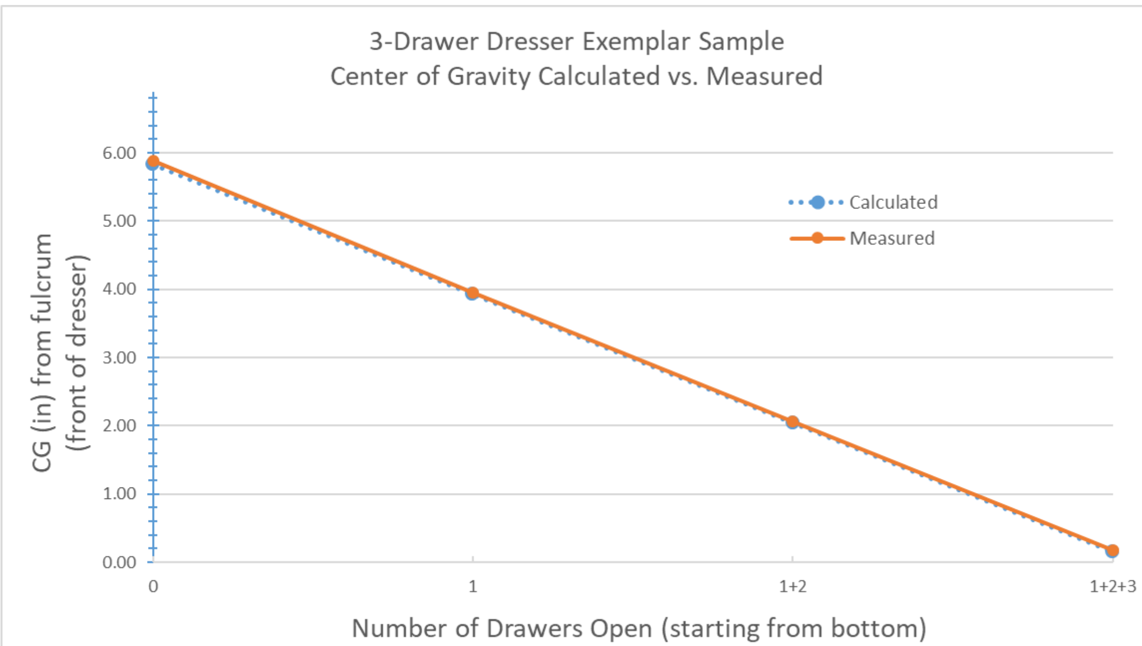


Figure 15. Calculated vs. measured CG distance from the front of the unit as drawers were opened from the bottom up.

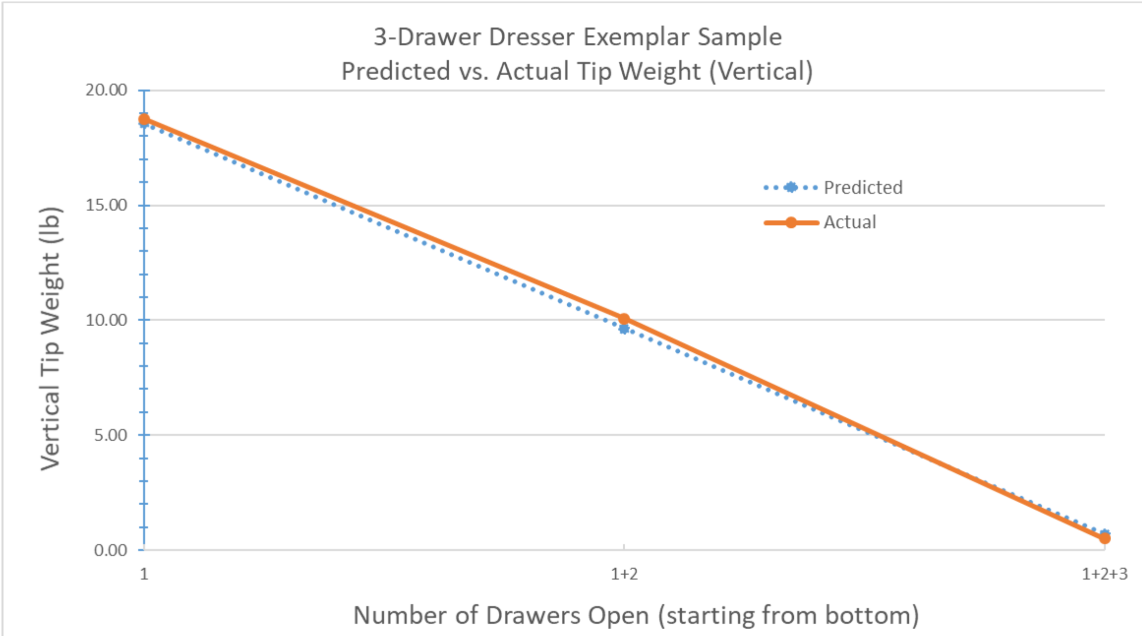


Figure 16. Calculated (predicted) vs. measured (actual) vertical tip weight applied to the front of the highest open drawer as drawers were opened from the bottom up.

The calculated CG values correlated well with the measured CG values, all within 0.04 inch of each other. The predicted vertical tip weight, derived from the calculated CG, was within 0.4 pounds of the measured tip weight. Therefore, staff concludes the computational model adequately predicts the tipping behavior of the dresser in the measured loading conditions, as well as other loading conditions.

Horizontal Tip Over Force – Empty Dresser

The corresponding horizontal tip force (Figure 14b) data while opening drawers from the bottom up are shown in Table 5.

Table 5. Calculated and Measured Horizontal Tip Force Data

	Horizontal Tip Force (lbf)	
# of Open Drawers (from bottom up)	**Calculated**	**Measured**
0	12.45	13.10
1	8.39	8.57
2	4.36	4.33
3	0.31	0.32

The data from Table 5 are graphed in Figure 17.

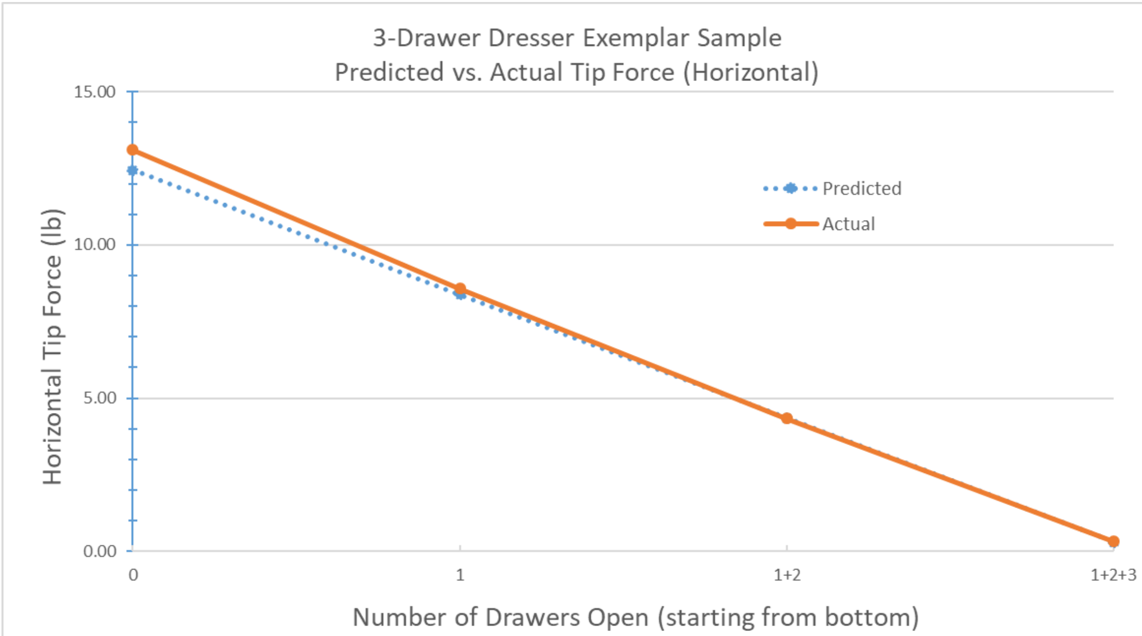


Figure 17. Calculated (predicted) vs. measured (actual) horizontal tip force applied to the top of the unit as drawers were opened from the bottom up.

The predicted horizontal tip force was typically within 0.5 pound-force of the actual horizontal tip force.

IDI Summary

180423CCC1630	A 2 YO female was left alone briefly in her bedroom with the empty dresser when the parents "heard a sound of something fall." They discovered the toddler laying on the floor on her back with the dresser on top of her. The top drawer was pinned against her head, and the middle drawer was pinned on her neck. The parents called 911 for help, but the toddler died at the scene of asphyxia. The floor was carpeted and a tip restraint was not installed.

Incident Hazard Scenario Description

The victim was a 2-year-old girl (estimated to be 24 months) who weighed 26 pounds and was 32 inches tall. Directorate for Engineering Sciences, Division of Human Factors (ESHF) staff provided a scaled drawing comparing the size of the girl to the dresser (see Figure 18). Even though the parents heard the dresser fall, they did not witness the child's actions. From the description of the account, the police believed that the toddler may have attempted to climb up the dresser to reach a toy when the dresser tipped over on her.

Figure 18. Scaled drawing of the 32 in. 2-year-old child with 27.5 in. dresser.

HF and HS staff determined the following to be the plausible scenario involving the dresser and victim (see Figure 19):

> The victim opened the middle drawer and used it to pull herself up. With her arms pulling, she leaned over the edge of the middle drawer and pulled, dropping her head as she did. The dresser started to tip towards her. As it tipped, the top drawer slid out and contacted her head. Her neck was now over the middle drawer edge with her head contacting the top drawer, as reported. Further tipping caused the dresser to roll onto her, and the top drawer was pinned against her head, and the middle drawer was pinned on her neck.

Figure 19. The illustration of the hazard scenario described above shows a doll with a height of about 32 inches, the height of the victim.

ESMC Re-creation of the Incident Scenario

Based on the presumed incident scenario in Figure 19, staff added initial assumptions to both the model and the lab testing to re-create that scenario. Since the dresser was reported to be empty during the incident, the analysis did not consider weight in the drawers.

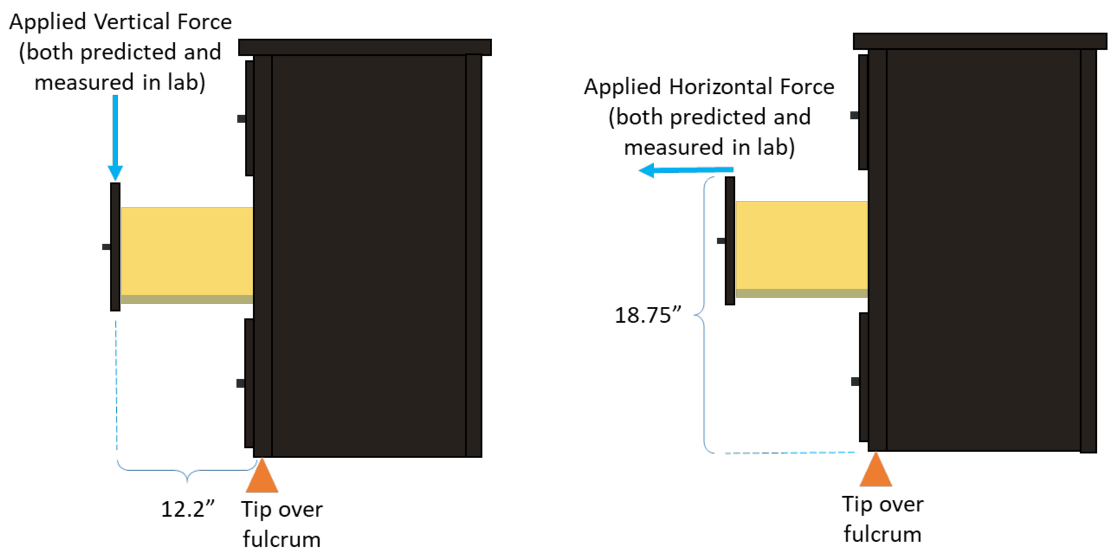
Initial conditions that staff added to re-create the incident included:

- Pushing down or pulling horizontally on the fully extended second drawer
- Effect of a carpeted floor

ESMC staff addressed the effect of each initial condition separately and then considered the combined result.

Pushing Down or Pulling Horizontally on the Fully Extended Second Drawer

The second drawer was presumed to be the only drawer open when the child pulled and/or pushed down on it. Staff calculated and measured separately the vertical and horizontal tip forces when only the second drawer was open (see Figure 20 and Table 6).



a) vertical force b) horizontal force

Figure 20. Tip force measurements with only the second drawer open.

Table 6. Calculated and Measured Tip Force – 2nd drawer open only

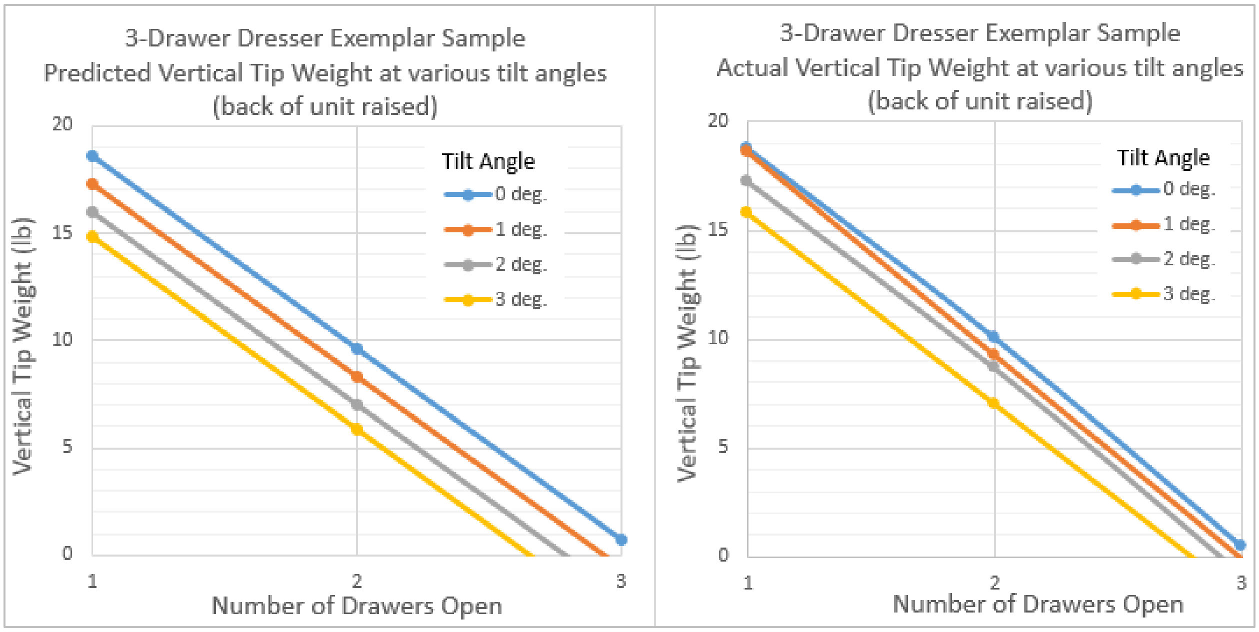
	Vertical Tip Force (lbf)		Horizontal Tip Force (lbf)	
Drawers Open	**Calculated**	**Measured**	**Calculated**	**Measured**
2nd only	18.65	19.2	12.12	13.0

Absent additional details about the child's actions from the incident, ESMC assumed a likely scenario that the child simultaneously exerted half of the tip moment horizontally and half vertically. If half of the tip moment was exerted vertically, the vertical force would be approximately 9.6 pound-force. If half of the tip moment was simultaneously exerted horizontally, then the horizontal force would be approximately 6.5 pound-force.

Effect of a Carpeted Floor

LSM staff performed tip-over testing of several dressers, including this exemplar dresser, on a carpeted surface, to compare the results to the same tests on a hard surface. The test included a platform covered with foam carpet padding and a medium pile carpet, to represent typical household carpeting surface on which a dresser may be used. When tested to Section 7.2 *Stability with Load* (apply a 50-pound weight to the front of one fully extended drawer at a time), the unit tipped on carpeting with 15 pounds of weight. In comparison, the unit tipped on a hard, level surface at 21 pounds of weight.

ESMC staff used the computational model to predict vertical tip weight with the back of the dresser raised at various tilt angles (1, 2, and 3 degrees) to simulate the effect of carpet on tip weight (see Figure 21a). The compressible carpet surface allows slight movement of the dresser, with commensurate tilt in CG location by a couple of degrees before tipping over. When the dresser begins to tilt forward slightly, the CG moves closer to the fulcrum, resulting in a lower weight required for tip over, compared to a hard surface.



a) Predicted results b) Actual measurements

Figure 21. Predicted vs. Actual vertical tip weight, at various dresser tilt angles, applied to the edge of the highest open drawer as drawers were opened from the bottom up.

In a scenario with one dresser drawer open, ESMC staff's predicted results (Figure 21a) for a 3-degree forward tilt were similar to LSM staff's test results on carpeting. ESMC staff's predicted tip weight of about 19 pounds for a level surface was reduced to 15 pounds at a 3-degree forward tilt. Additional lab measurements by ESMC staff (see Figure 21b) with the back of the dresser raised to create various tilt angles confirmed the results of the calculations, within a tolerance of 1 pound.

Conclusion

The exemplar dresser met the requirements for stability of an unloaded unit in ASTM F2057 – 19 *Standard Specifications for Clothing Storage Units*, which specifies that an unloaded unit with all drawers fully extended shall not tip over. However, the unit did not meet the requirements for stability of a loaded unit, which specifies that the unit shall not tip over when a 50-pound weight is applied to the front face of any single fully extended drawer. Staff determined the unit on a hard, level floor will become unstable and tip over when about 19 to 21 pounds is applied vertically to any single fully extended drawer.

The fatal incident involved a 2-year-old female (approximately 32 inches tall and weighing 26 pounds) who was found under the tipped-over incident dresser, with her head pinned between the top and middle drawer. Staff's analysis determined the most likely scenario involved the victim pulling the middle drawer open and pushing down or pulling to climb the dresser, which caused the dresser to tip over, with the top drawer sliding out and trapping the victim's head between the top and middle drawer (the position in which she was found).

ES staff's analysis of the dresser's stability determined the following:

- A static vertical weight of approximately 19 to 21 pounds on the front edge of any single fully extended drawer was sufficient to tip the dresser over on a hard, level floor.
- A horizontal pulling force of approximately 13 pound-force on the front edge of the fully extended second-row drawer was sufficient to tip the dresser over on a hard, level floor.
- A carpeted floor would reduce the forces required for tip over even further. A static vertical weight on the edge of a single fully extended drawer was reduced from approximately 20 pounds without carpet to 15 pounds with carpet, which is significant considering that represents a 25% reduction. Testing the exemplar dresser on a 3-degree forward incline simulated the reduction in stability when the exemplar dresser was tested on a carpet/pad.
- In a scenario on carpet with equal horizontal and vertical force components exerted simultaneously on the front edge of the fully extended second-row drawer, the required vertical force would be reduced to 7.5 pound-force and the horizontal force would only need to be 4.9 pound-force to cause a tip over. This is a plausible scenario for a 2-year-old child weighing 26 pounds (based on child strength studies for pushing[3] and pulling[4]), demonstrating that the child in the incident had the ability to cause this dresser to tip over with all the initial conditions as reported in the IDI.

[3] Owings, C.L., Norcutt, R.H., Snyder, R.G., Golomb, D.H., & LLoyd, K.Y. (1977). Gripping Strength Measurements of Children for Product Safety Design (Contract No. CPSC-C-76-0119). Prepared for the U.S. Consumer Product Safety Commission, Washington, D.C. The mean push-down force for 2.5- to 3.5-year-olds using one arm is 9.58 lbf, estimated 19.16 lbf using both arms.
[4] Brown, W.C., Buchanan, C.J. & Mandel, J. (1973). *A Study of the Strength Capabilities of Children Ages Two through Six*. Report No. NBSIR 73-156. U.S. Department of Commerce, Bureau of Standards, Washington, D.C.

MODEL C: 3-DRAWER CSU

Executive Summary

ESMC staff evaluated a 3-drawer CSU that was an exemplar of the same CSU design for which the manufacturer had reported six tip-over incidents (no fatalities). Staff reviewed one IDI completed as a result of the reports. As part of the evaluation, staff determined the physical characteristics of the 3-drawer CSU by measuring: (1) the weight and center of gravity of each drawer; (2) the weight and center of gravity of the CSU cabinet (without drawers); (3) the weight and center of gravity of the CSU as each drawer is extended; and (4) the weight at the front edge of the extended drawer required to tip the CSU over. Using these data, ESMC staff modeled the 3-drawer CSU with various open and closed drawer configurations, empty and filled drawers with various clothing fill weights, and interactions of the child with the CSU. The results were used to determine CSU tip-over scenarios.

ESMC staff developed two likely interaction scenarios based on information obtained from the IDI, including the weight of the child and the type of floor surface (carpet). ESMC staff validated the analytical results with laboratory test data and a weighted dummy. The test results confirmed analytical modeling.

Critical Findings

1. ***Filled* versus *empty* drawers and the number of drawers open affect the stability of the CSU.**
    a. The 3-drawer CSU with empty drawers is less stable than the same CSU with fully filled drawers if two out of three drawers or fewer are opened.
    b. The 3-drawer CSU with fully filled drawers is less stable than the same CSU with empty drawers if three out of three drawers are opened.
2. **A 30-pound child can tip the CSU by leaning on or pulling an open drawer.**
    a. The tip weight of the 3-drawer CSU is 25 pounds or less when drawers are empty or partially full.
    b. The pull force on the middle drawer required to tip the CSU is 16 pounds when filled, and less when empty.
3. **A CSU on a carpet/pad is less stable than one on a hard level floor.**

    A carpet is expected to reduce the tip weight of the CSU by 1 to 5 pounds.

4. **The ASTM standard did not fully address the hazard scenario.**

   Although the 3-drawer CSU did not meet the stability requirements in Section 7.2 of the standard (tip weight of 22 to 23.4 pounds), staff found the ASTM standard did not address the following hazards occurring simultaneously:

   a. Multiple open and filled drawers during interactions.
   b. Child pulling with a horizontal force.
   c. CSU placed on a carpeted surface.

CSU Characteristics

The 3-drawer CSU measures approximately 27.625 inches wide, 15.625 inches deep, and 28.125 inches high (Figure 22). It weighs 45 pounds. Each drawer extends approximately 8.25 inches. The sample number of the tested unit is 18-420-0062-17. This CSU was an exemplar of a model involved in multiple reported incidents.

Figure 22. The 3-drawer CSU from the front and side.

The usable volume of the drawers was determined by multiplying the area inside each drawer by the clearance height minus $\frac{1}{8}$ inch (see Tab L). The top drawer had a usable volume of approximately 0.82 cubic feet and weighed 5.7 pounds, while the bottom two drawers had usable volumes of approximately 1.21 cubic feet and weighed 7.2 pounds.

IDI Summaries

There were six manufacturer reports of the 3-drawer CSU tipping as a result of children interacting with it. Three children were 1 to 3 years old, and three children were of an unknown age. The reported child interactions with the CSU included climbing, opening drawers, and playing with toys near it. CPSC staff were able to contact one of the consumers mentioned in these reports. A summary of that incident is below.

190628CBB3471	On July 30, 2016, a three-year-old boy had a 3 - drawer dresser tip over on him. The boy was removing a shirt from the middle drawer when the dresser tipped over falling on his legs with his back against his bed. The boy suffered a laceration to the top of his left foot and a bruise to his right calf. There is no property damage associated with this incident.

Engineering Evaluations

Conformance to ASTM:

ESMC staff reviewed prior testing by LSM of the same sample. LSM staff tested the CSU for conformance to the stability requirements in ASTM F2057 – 17 *Standard Safety Specification for Clothing Storage Units*. The CSU was tested to the performance requirements in sections 7.1 Stability of Unloaded Unit and 7.2 Stability with Load. These requirements are the same as the more recent ASTM F2057 – 19. This CSU was considered out-of-scope in ASTM F2057 – 17 based on its height, but is in-scope for ASTM F2057 – 19.

LSM staff determined that the CSU met the performance requirements in Section 7.1. The CSU did not meet the performance requirements in Section 7.2. The measured tip-over weight was determined to be 23.4 pounds (applied to the top drawer).

ESMC Evaluation

When ESMC staff began evaluating sample 18-420-0062-17, the right rear foot was missing (Figure 23). This was not believed to have had a significant effect on test results, as ESMC staff had similar tip weight results as LSM staff. ESMC staff determined the tip weight of the CSU by placing weight on the front face of the top open drawer while opening each drawer in sequence, starting with the bottom drawer, until all drawers were open. Drawers were considered open when they reached the outstop, per ASTM F2057 – 19. Staff also measured the center of gravity (CG) of the unit, beginning with all drawers closed and opening one drawer at a time, starting from the bottom, until all drawers were opened. Staff took CG measurements by placing the CSU on top of four scales, with one scale under each corner. The ratio of the rear weights to the sum of the four weights measured on each scale were used to determine the CG horizontal distance from the bottom front edge of the CSU.

Figure 23. The bottom of the CSU with 1 missing foot.

Staff also used the dimensions (including drawer extension), weight, and center of gravity of the CSU and its drawers to develop a computational model that could be used to predict the tipping behavior of the unit in various loading conditions. The fulcrum of the unit was assumed to be at the bottom front edge, and the weight was assumed to be applied on the front face of the drawer.

The CG distance from the front bottom edge and tip weights were calculated using the computational model and measured on the exemplar sample. The results are shown in Table 7 and Figure 24 and Figure 25.

Table 7. Calculated and Measured CG and Tip Weight Data

# of Open Drawers	Calculated CG from Front (in)	Measured CG from Front (in)	Calculated Tip Weight (lb)	Measured Tip Weight (lb)
0	5.67	5.60	-	-
1	4.39	4.04	23	22
2	3.11	2.80	16	16
3	2.08	1.87	11	11

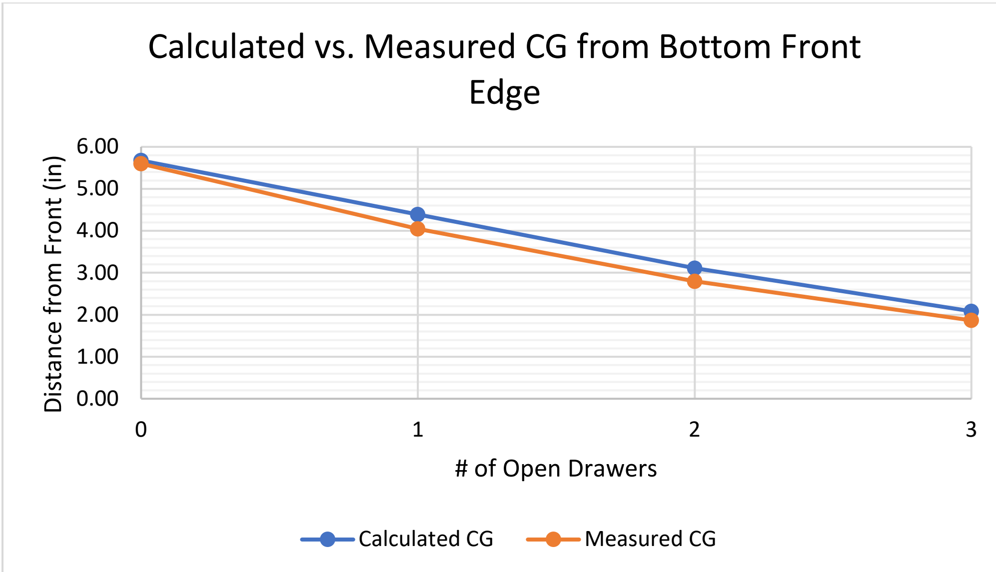


Figure 24. Calculated vs. measured CG distance from the bottom front edge of the unit as drawers are opened from the bottom up.

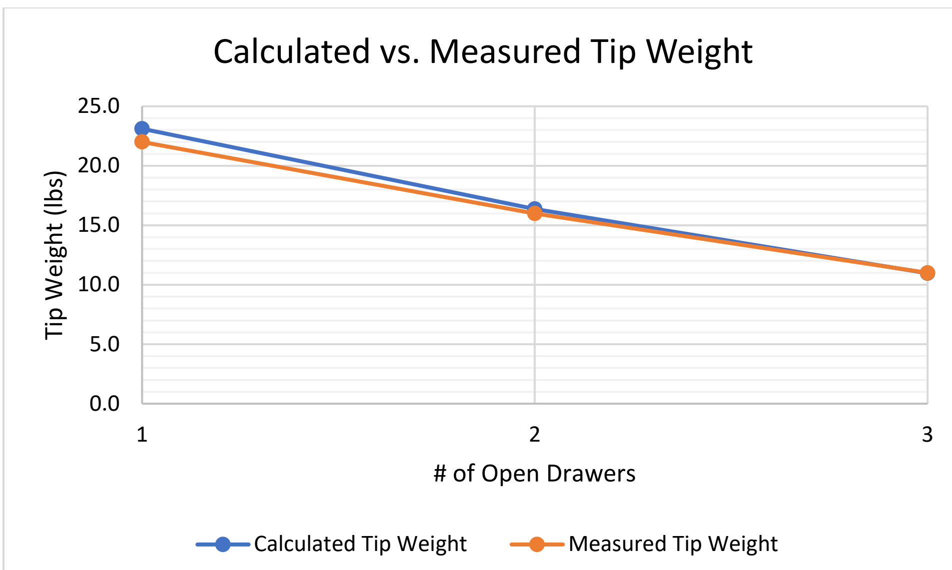


Figure 25. Calculated vs. measured tip weight applied to the front of the top open drawer as drawers are opened from the bottom up.

The calculated CG was within 0.35 inches of the measured value. The calculated tip weight was within 1 pound of the measured tip weight. Therefore, staff concludes the computational model adequately predicts the tipping behavior of the dresser in the measured loading conditions as well as other loading conditions.

190628CBB3471 Review:

The synopsis for the incident is described above.

Injury Victim Description

The victim was a three-year-old boy, estimated to be 3 feet tall and weigh 30 pounds at the time of the incident.

Expected Hazard Scenarios

The CSU was located in the child's room. The CSU reportedly had a limited quantity of clothing inside. The floor was carpeted. A tip restraint was not installed. The incident was not witnessed. The boy may have pushed down or put his weight on the front of the open drawer, causing the unit to tip.

LSM and ESMC staff determined through testing, that the 3-drawer CSU would tip with one drawer opened and 22 to 23.4 pounds applied to the front of the drawer. The boy weighed approximately 30 pounds, which is more than enough to cause the CSU to tip when applied to the front of an open drawer.

ESMC staff modeled this scenario in the lab using a CRABI-18MO crash test dummy, with 10 pounds added to the torso, for a total dummy weight of 30 pounds, and an empty CSU, as shown in Figure 26. When the dummy's weight was pushed forward slightly onto the edge of the open middle drawer, the CSU tipped forward.

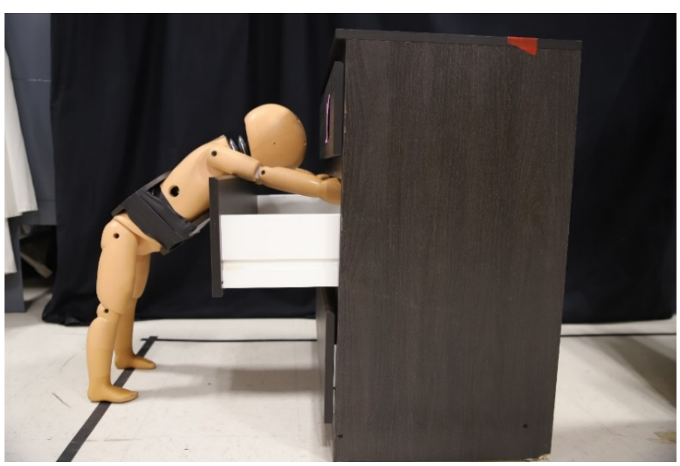


Figure 26. A dummy weighing approximately 30 lbs. is shown balanced on the front of the middle drawer of the product. Pushing the dummy forward slightly caused the product to tip.

ESMC staff used the computational model to predict the tip weight of the CSU as each drawer is opened when the CSU was empty, full, or partially full per the incident scenario. A clothing density of 8.5 pounds per cubic foot was used to estimate the weight of clothing in a full drawer[5]. The incident report stated that some clothing was present in the bottom two drawers, but not in the top drawer; therefore, the drawer fill for the incident was modeled with the bottom two drawers ¼ full, while the top drawer was empty. The CG of the fill weight was placed in the center of each drawer.

The calculated CG and tip weight in each drawer fill scenario are shown in Figure 27 and Figure 28. The empty results are the same as the calculated results in Figure 24 and Figure 25.

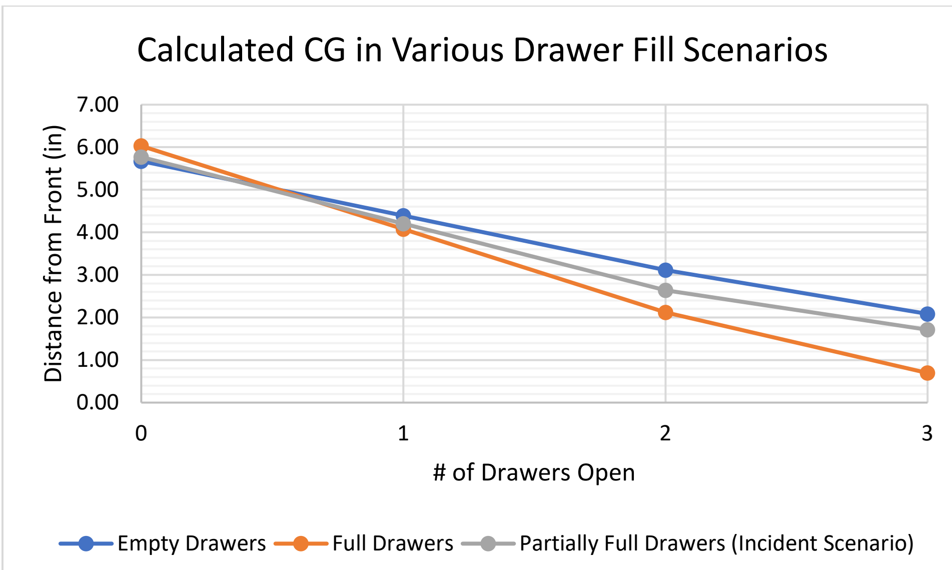


Figure 27. The shift in Center of Gravity (CG) of the CSU towards the front as drawers are opened in various drawer fill scenarios.

[5] The justification for an 8.5 pounds per cubic foot fill density can be found in the ESHF staff memorandum in Tab L.

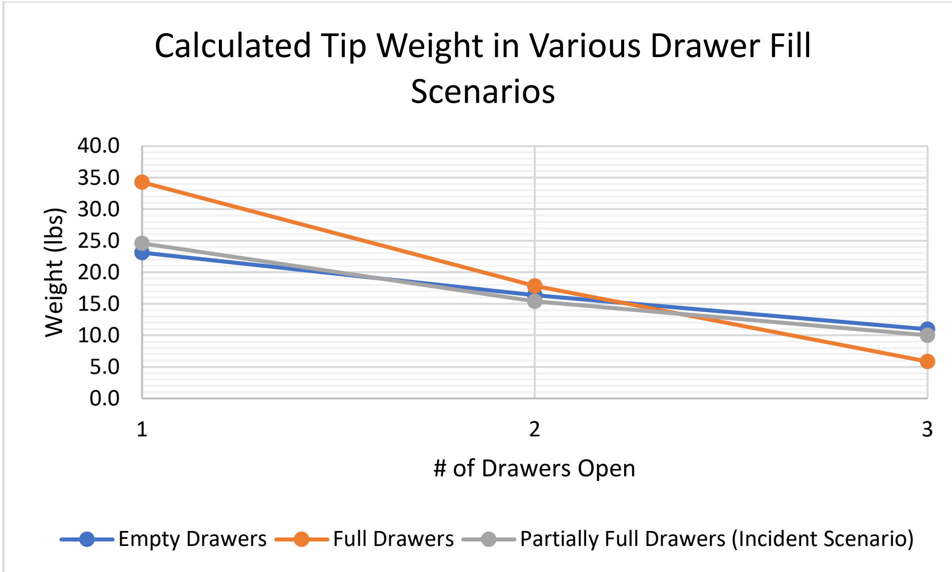


Figure 28. The calculated tip weight of the CSU as drawers are opened in various drawer fill scenarios.

The results show that filled drawers can improve the stability of the CSU with only a single drawer open, but has mixed results with two drawers open, and contributes to instability with all three drawers open. With the bottom two drawers only partially filled with clothing, the stability of the CSU with only one drawer open was just expected to improve by 1 or 2 pounds. This would not be enough to withstand a 30-pound child placing their weight on the front of the middle drawer. To withstand this scenario, each drawer would need to be more than half full.

An alternative scenario is that the child pulled on the middle drawer face (or pushed the inside of the middle drawer outward, toward his body) while trying to pull out clothing out of the drawer. By determining the moment induced by the tip weights in the drawer fill scenarios shown in Figure 28, the vertical tip weight can be converted into a horizontal tip force at any particular height. The tip moments are shown in Figure 29. The equivalent horizontal loads required to tip the CSU at a height of 19 inches, near the top of the middle drawer face, are shown in Figure 30.

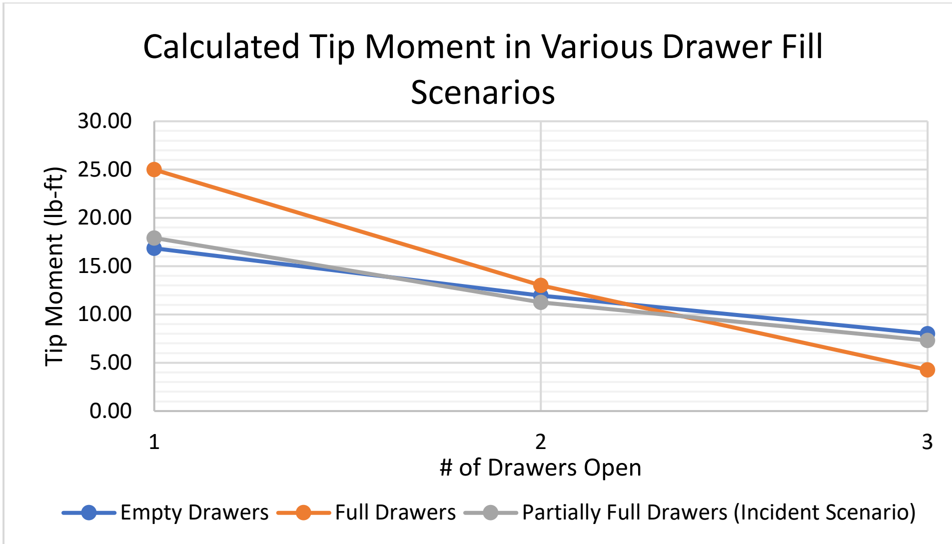


Figure 29. The calculated tip moment of the CSU as drawers are opened in various fill scenarios.

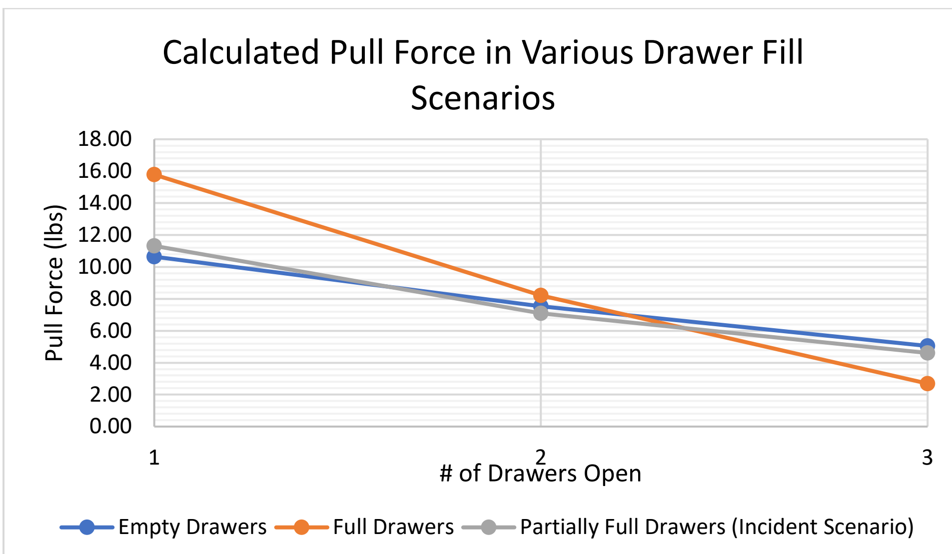


Figure 30. The calculated pull force applied near the top of the middle drawer face required to tip the CSU as drawers are opened in various fill scenarios.

In this scenario, with just the middle drawer open, both the empty and incident scenarios require approximately 11 pounds of pull force to tip the CSU, while the full CSU requires approximately 16 pounds. These forces are ⅓ to ½ the required vertical force to tip the CSU. This scenario also seems plausible, based on pull strengths reported the ESHF memorandum in Tab C.

Effects of Carpet

Thus far, the analysis conducted by ESMC staff assumed the product was on a flat surface. However, the incident in question occurred with the product placed on carpet, which reduces the stability of CSUs (Tab P). Staff estimates tilting the product forward between 0.8° and 3° will imitate the effects of most carpets (Tab D). The effects of this tilt require details of the center of gravity in the vertical (height) direction, CGz, to be accurately modeled, as the height of each drawer affects how far the drawer extends from the fulcrum when at an angle.

Staff computed the expected CGz of the empty product, and compared the results to measurements taken with the unit resting on its back. Additional measurements were taken by tilting the unit backward with 2×4 wood blocks. The calculated and measured CGz data is shown in Table 8.

Table 8. Calculated and Measured CGz Data

# of Open Drawers	Calculated CGz (in)	Measured CGz with Unit on Back (in)	Measured CGz with Unit Tilted by Blocks (in)
0	16.0	15.1	15.8
1	16.0	-	16.0
2	16.0	-	16.2
3	16.0	-	16.4

The calculated CGz was within the range of values measured with the unit tilted by blocks, and was within 1 inch of the measured value with the unit resting on its back.

The calculated CGz values were used to calculate the depth center of gravity, CGy, at forward tilt angles of 1°, 2°, and 3°, as well as the corresponding tip weights. Tip weight measurements were taken by shimming the rear of the unit upward until an inclinometer on the top surface measured the appropriate change in angle. The calculated and measured tip weights are shown in Table 9.

Table 9. Calculated and Measured Tip Weights at Forward Tilt Angles

# of Open Drawers	Calculated Tip Weights				Measured Tip Weights			
	0°	1°	2°	3°	0°	1°	2°	3°
1	23.1	21.3	19.5	18.0	22	21	20	17
2	16.4	14.4	12.5	10.9	16	15	13.5	11
3	11.0	9.1	7.2	5.7	11	10	8.5	6

The calculated tip weights were within 1.3 lbs. of the measured tip weights. Both values show a trend of decreasing tip weight with increasing tilt angle. Based on these results, a carpet is expected to reduce the tip weight of the CSU by 1 to 5 pounds. The carpet in this case increased the likelihood of an incident occurring.

Potential Modifications to Improve Stability

ESMC staff considered five potential product modifications (Figure 31) to improve the inherent stability of the 3-drawer CSU:

1. Add a drawer interlock feature that prevents more than one drawer from opening.
2. Reduce the drawer extension.
3. Install a foot extension.
4. Add front feet leveler to tilt the CSU back.
5. Add a counter balance weight to the lower back of the CSU.

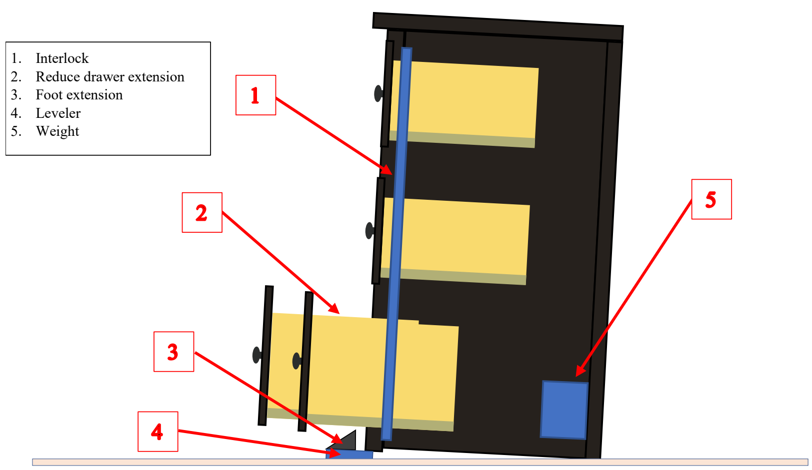


Figure 31. Modifications to improve stability.

ESMC staff evaluated the effectiveness of the modifications by modeling the 3-drawer CSU with a combination of the possible modifications. Based on staff's recommended test procedure in Tab D, the CSU was modeled with full drawers without an interlock, and with empty drawers with an interlock. Staff compared the tip-over moment to the minimum acceptable moment in the draft proposed rule to determine if the configuration would pass or fail the draft proposed rule. Four configurations were evaluated, and the results are shown in Table 10.

Table 10. Modifications to Improve Stability

Configuration	Moment Requirement = 51.2(1.08X+0.52) (ft-lbs)	Interlock – Yes/No (# of Open Drawers)	Drawer Travel (in)	Foot Extension (in)	Counterweight (lbs)	Front Level Height Increase (in)	Tip-Over Moment (Pass/Fail) (ft-lbs)
Baseline	66.9	No (3)	8.25	0	0	0	1.1 (fail)
1	36.5	Yes (1)	8.25	6.6	0	0	40.6 (pass)
2	38.1	Yes (1)	8.25	6.25	1.5	0	40.9 (pass)
3	66.9	Yes (1)	8.25	0	50	0	67.8 (pass)
4	52	Yes (1)	7.25	2.25	25	0.37	52.7 (pass)

These results show that substantial changes are required for the 3-drawer CSU to pass the draft proposed rule. These results are expected since this CSU is very unstable and fails to meet the minimum ASTM stability requirements by more than 25 pounds. The drawer extension – the distance from the drawer front edge to the fulcrum, affected by both the drawer travel and the foot position – needs to be reduced significantly. Alternatively, a counterweight that doubles the overall weight of the CSU could be combined with an interlock. Raising the CSU's front feet a reasonable amount does not make a substantial difference compared to reducing the drawer extension or adding weight. ESMC staff does not consider these extreme modifications a reasonable approach to improve stability for this CSU. A more reasonable approach is to redesign the CSU with different dimensions, materials and/or design parameters.

Appendix 1 – Vertical vs. Horizontal Loading

ESMC staff compared the vertical and horizontal loading methods to produce a tip-over moment described in the ESMC memorandum in Tab D, as shown in Figure 32. Staff observed that tip moments produced using vertical loads and horizontal loads were approximately equal.

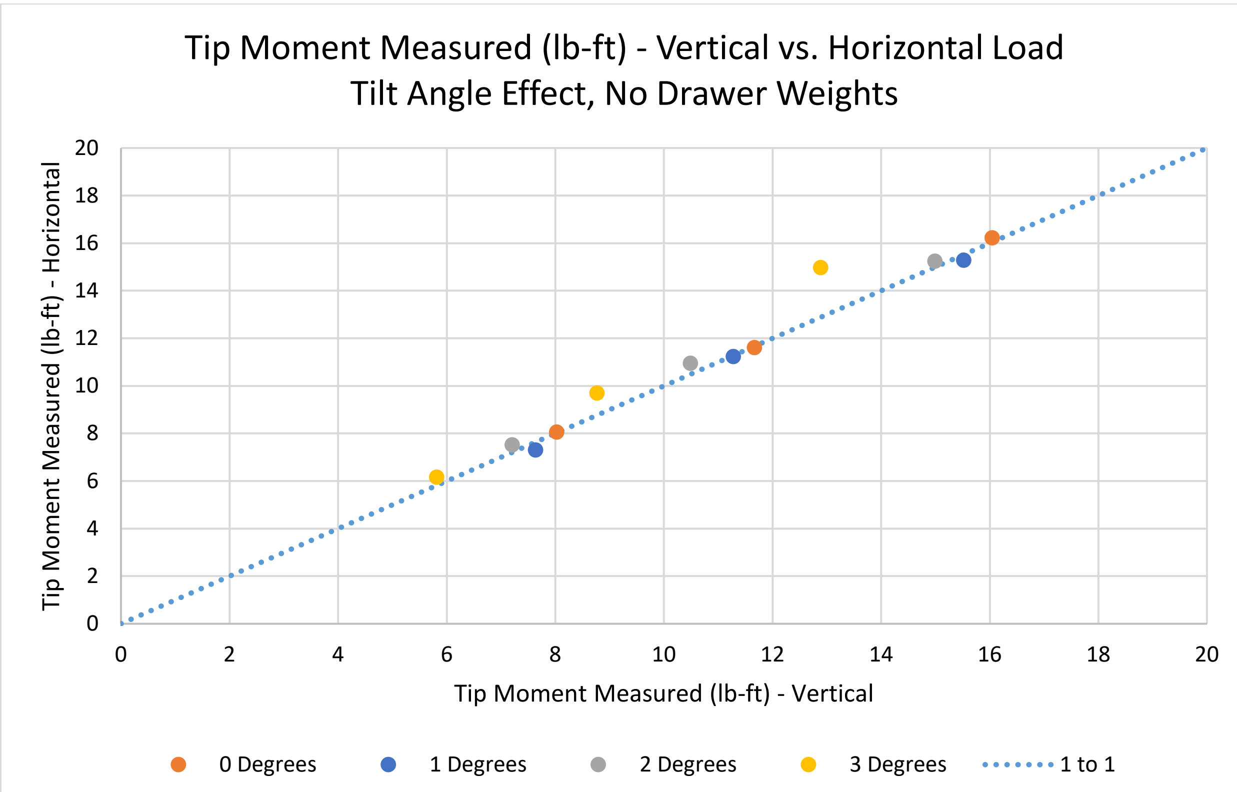


Figure 32. Comparison of tip moments measured using a horizontal load and a vertical load.

MODEL D: 4-DRAWER CSU

Executive Summary

ESMC staff evaluated a 4-drawer CSU which was an exemplar of the same CSU design for which a tip-over incident was reported (no fatalities). Staff reviewed one IDI completed as a result of the report. As part of the evaluation, staff determined the physical characteristics of the 4-drawer CSU by measuring 1) the weight and center of gravity of each drawer; 2) the weight and center of gravity of the CSU cabinet (without drawers); 3) the weight and center of gravity of the CSU as each drawer is extended; and 4) the weight at the front edge of the extended drawer required to tip the CSU over. Using these data, ESMC staff modeled the 4-drawer CSU with various open and closed drawer configurations, empty and filled drawers, and interactions of the child with the CSU. The results were used to determine CSU tip-over scenarios.

ESMC staff developed a hazard scenario based on information obtained from the IDI, including the weight of the child and the type of floor surface (carpet). ESMC staff validated the analytical results with laboratory test data. The test results confirmed analytical modeling.

Critical Findings

1. ***Filled* versus *empty* drawers and the number of drawers open affect the stability of the CSU.**
    a. The 4-drawer CSU with empty drawers is less stable than a CSU with fully filled drawers if 50% (2 out of 4) of the drawers or fewer are opened.
    b. The 4-drawer CSU with fully filled drawers is less stable than a CSU with empty drawers if more than 50% of the drawers are opened.
2. **The 4-drawer CSU tips on its own when all drawers are filled and opened.**
3. **The CSU on a carpet/pad is less stable than one on a hard level floor.**

    A carpet is expected to reduce the tip weight of the CSU by 3.5 to 6.5 pounds. This tip weight reduction corresponds with a forward tilt angle of 0.9° to 1.4°.
4. **The ASTM standard did not fully address the hazard scenario.**

    Although the 4-drawer CSU did not meet the stability requirements in Section 7.2 of the standard (tip weight of 44 to 48 pounds), staff found the ASTM standard did not address the following hazards occurring simultaneously:

    a. Multiple open and filled drawers.
    b. CSU placed on a carpeted surface.

CSU Characteristics

The 4-drawer CSU measures approximately 39.75 inches wide, 19.125 inches deep, and 40.125 inches high (Figure 33). It weighs 102 pounds. On the tested unit, the drawer extension was typically 12.5 inches, though the top drawer extended 12.625 inches. The sample number is 17-302-1097. This CSU was an exemplar of a model involved in a reported incident.

Figure 33. The 4-drawer CSU

The usable volume of the drawers was determined by multiplying the area inside each drawer by the clearance height minus $\frac{1}{8}$ inch (refer to Tab L). Each drawer's usable volume was approximately 2.04 cubic feet, and each weighed approximately 12.1 pounds.

IDI Summary

161221CBB3268	On August 10, 2012, a 3 year old female was playing alone in her bedroom and fully opened all of the dresser drawers that were filled with clothing. The dresser fell forward and was stopped by the bottom drawer before it fell completely forward to the floor. The dresser was not tethered to the wall. The complainant's daughter was not injured. There was no property damage, other than to the incident unit.

Engineering Evaluations

ASTM Conformance

LSM staff tested to the performance requirements in sections 7.1 Stability of Unloaded Unit and 7.2 Stability with Load of ASTM F2057 – 14. These requirements are the same as the more recent ASTM F2057 – 19. The CSU met the performance requirements in section 7.1, but did not meet the performance requirements in section 7.2. The unit had a reported tip weight of 48 pounds.

ESMC Evaluation

ESMC staff determined the tip weight of the CSU by placing weight on the front face of the top open drawer while opening each drawer in sequence, starting from the bottom, until all drawers were open. Drawers were considered open when they reached the outstop. This testing was conducted twice. The first test was conducted without any changes made to the unit. During this test, the feet of the unit appeared to be loose. The feet were tightened, and the test was repeated. Staff hypothesizes that the feet became loose while the sample was moved from storage, and that the tightened feet better represent the use condition.

Staff then measured the center of gravity (CG) of the unit, beginning with all drawers closed and opening one drawer at a time, starting from the bottom, until all drawers were opened. CG measurements were taken by placing the CSU on top of four scales, with one scale under each foot. The ratio of the rear weights to the sum of the four weights measured on each scale were used to determine the CG horizontal distance from the middle of the front feet of the CSU.

Staff also used the dimensions (including drawer extension), weight, and center of gravity of the CSU and its drawers to develop a model that could be used to predict the tipping behavior of the unit in various loading conditions. The fulcrum of the unit was assumed to be at the middle of the front feet, and the weight was assumed to be applied on the front face of the drawer.

The calculated and measured CG distance from the front bottom edge and tip weight are shown in Table 11 and Figure 34 and Figure 35.

Table 11. Calculated and Measured CG and Tip Weight Data

# of Open Drawers	Calculated CG from Front (in)	Measured CG from Front (in)	Calculated Tip Weight (lbs)	Measured Tip Weight (lbs) – Loose Feet	Measured Tip Weight (lbs) – Tightened Feet
0	7.07	7.35	-	-	-
1	5.58	5.72	43.2	41	44
2	4.10	4.37	31.7	30	33
3	2.61	2.78	20.2	19.5	22
4	1.14	1.31	8.7	8.5	11

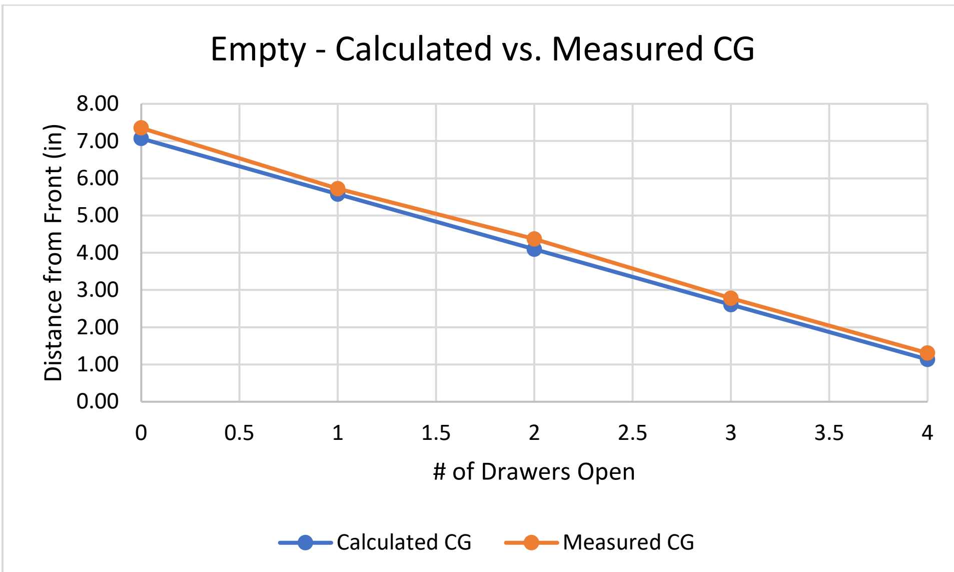


Figure 34. Calculated vs. measured CG distance from the middle of the front feet of the unit as drawers are opened from the bottom up.

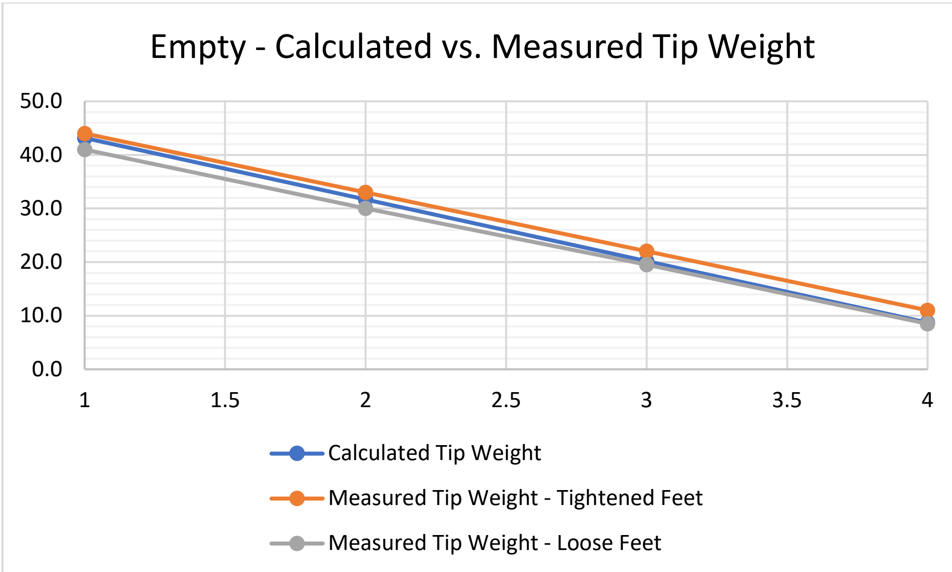


Figure 35. Calculated vs. measured tip weight applied to the front of the top open drawer as drawers are opened from the bottom up.

The calculated CG was typically within 0.3 inches of the measured value. The calculated tip weight was between the tip weights measured with the feet loose and after tightening, with a maximum difference of 3 pounds. Therefore, staff concludes the computational model adequately predicts the tipping behavior of the dresser in the measured loading conditions as well as other loading conditions.

161221CBB3268 Review

The synopsis for this incident is described above. In addition, CPSC staff determined that the incident occurred on medium shag carpet and that no tip restraints were installed.

Description of Child Involved in Near-Miss Incident

The child involved in this near-miss incident was a three-year-old girl, estimated to be 38 inches tall and weigh 30 pounds at the time of the incident.

Expected Hazard Scenarios

Based on the incident description, the girl opened all of the drawers, at which point the CSU tipped over. The child avoided injury because the open bottom drawer supported the weight of the CSU after it tipped. One of the rails on the bottom drawer may have been damaged during the incident. The report stated the drawers were mostly full.

ESMC staff used an average clothing density of 8.5 pounds per cubic foot to calculate the weight of a full drawer, which was determined to be 17.3 pounds in each drawer. Staff used 15 pounds in each drawer to simulate the drawers being mostly full. Staff placed 15 pounds in the approximate center of each drawer, and measured the CG as the drawers were opened sequentially from the bottom. These values were compared to the calculated CG values for 15 pounds placed in the same location of each drawer. The calculated tip weights were determined. The CSU tipped on its own as the top drawer was opened. These results are shown in Table 12 and Figure 36. Negative values indicate the CSU tips over on its own.

Table 12. Calculated vs. Measured Values for CG, and Calculated Tip Weight with 15 Pounds of Fill Weight in Each Drawer

# of Open Drawers	Calculated CG from Front (in)	Measured CG from Front (in)	Calculated Tip Weight (lbs)
0	7.50	7.64	-
1	5.41	5.50	66.4
2	3.32	3.44	40.8
3	1.23	1.33	15.1
4	-0.86	-0.78*	-10.5

*This value was projected based on the difference between the previous two measurements.

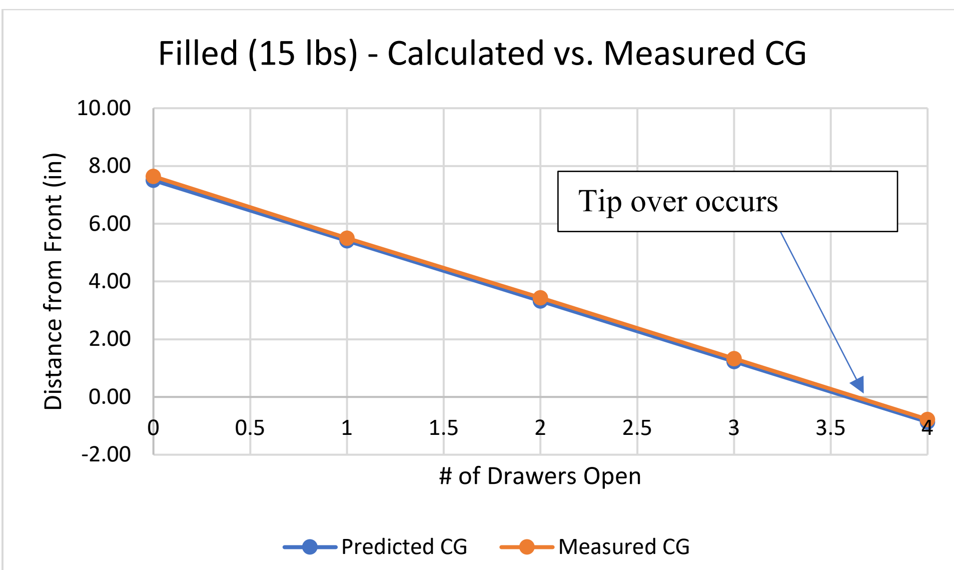


Figure 36. Calculated vs. Measured CG distance from the middle of the front feet of the unit as drawers are opened from the bottom up. The two values were typically within ⅛ inch of each other. One Measured CG data point was projected (see Table 12).

The negative CG and tip weight values calculated by the model correctly show that the CSU will tip on its own with all drawers filled and extended. The model was also used to predict the minimum fill weight required to cause the CSU to tip on its own. The result was that if over 30% of the maximum fill weight was used, the CSU would likely tip on its own.

Based on the analysis, when all the drawers are full and pulled to the outstop, the CSU is expected to tip on its own; the child would not need to add any additional force to cause the CSU to tip over. This matches the scenario described in incident 161221CBB3268.

Effects of Carpet

Thus far, the analysis conducted by ESMC staff assumed the product was on a flat surface. However, the incident in question occurred with the product resting on carpet, which reduces the stability of CSUs. Staff estimates that tilting the product forward between 0.8° and 3° will imitate the effects of most carpets (see Tab D). For this CSU, test results indicate a forward tilt between 0.9° and 1.4° (corresponding with a reduction in tip weight of 3.5 to 6.5 pounds) matched the tipping behavior on the test carpet. The effects of this tilt require details of the center of gravity in the vertical direction, CGz, to be accurately modeled.

Staff computed the expected CGz of the empty product, and compared the results to measurements taken with the unit resting on its back. Additional measurements were taken by tilting the unit backward with 2X4 wood blocks. The calculated and measured CGz data is shown in Table 13.

Table 13. Calculated and Measured CGz Data

# of Open Drawers	Calculated CGz (in)	Measured CGz with Unit on Back (in)	Measured CGz with Unit Tilted by Blocks (in)
0	22.64	22.71	22.10
1	22.64	-	21.90
2	22.64	-	22.22
3	22.64	-	22.24
4	22.64	-	21.94

The calculated CGz was within 0.75 inches of all measured values of CGz.

The calculated CGz values were used to calculate the depth center of gravity, CGy, at forward tilt angles of 1°, 2°, and 3°, as well as the corresponding tip weights. Tip weight measurements were taken by shimming the rear of the unit upward until an inclinometer on the top surface measured the appropriate change in angle. The calculated and measured tip weights are shown in Table 14.

Table 14. Calculated and Measured Tip Weights at Forward Tilt Angles

# of Open Drawers	Calculated Tip Weights				Measured Tip Weights			
	0°	1°	2°	3°	0°	1°	2°	3°
1	43.2	39.6	36.1	32.8	44	40	36	33
2	31.7	28.0	24.5	21.1	33	29	24.5	22
3	20.2	16.6	13.2	10.0	22	18	14	12
4	8.7	5.5	2.5	-0.3	11	7	4	2

The calculated tip weights were within 2.3 pounds of the measured tip weights. Both values show a trend of decreasing tip weight with increasing tilt angle. Each degree of tilt results in an additional decrease in tip weight of 2 to 4 pounds. The carpet in this case increased the likelihood of an incident occurring.

Appendix 1 – Vertical vs. Horizontal Loading

ESMC staff compared the vertical and horizontal loading methods to produce a tip-over moment described in the ESMC memorandum in Tab D, as shown in Figure 37. Staff observed that tip moments produced using vertical loads and horizontal loads were approximately equal.

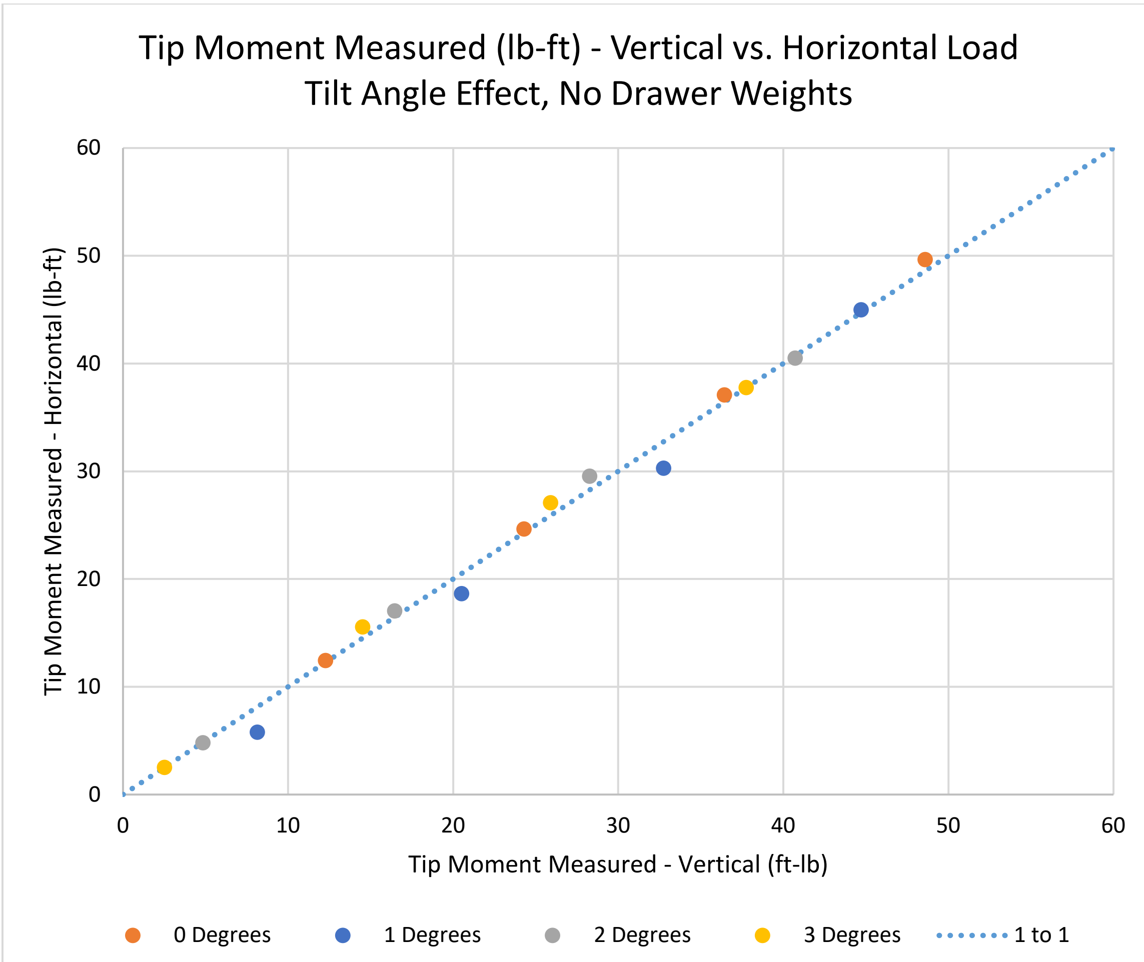


Figure 37. Comparison of tip moments measured using a horizontal load and a vertical load.

MODEL E: 8-DRAWER CSU

Executive Summary

ES staff evaluated three samples of an 8-drawer dresser model made by the same manufacturer, including two incident samples and one exemplar sample. ES staff analyzed the potential hazard scenarios in which the 8-drawer dresser can become unstable and tip over, potentially causing injury. ES staff reviewed six IDIs involving the 8-drawer dresser model, including an IDI associated with the incident samples. As part of the analysis, ES staff first determined the physical characteristics of the 8-drawer dresser by measuring: (1) the weight and center of gravity of each drawer; (2) the weight and center of gravity of the dresser cabinet (without drawers); and (3) the weight and center of gravity of the dresser as each drawer is extended. ES staff also analyzed the dynamic effects (movements) of children climbing and performing other interactions with the dresser.[6] Using these data, ES modeled the 8-drawer dresser with various open and closed drawer configurations, empty and filled drawer with various clothing fill weight and the interactions of the child with the dresser to determine dresser tips over scenarios.

ES staff developed seven (7) likely hazard scenarios based on information obtained from the six (6) IDIs, including: weight of the child/children, dresser drawer slide extension distance, and interactions of the child/children with the dresser. Each hazard scenario was evaluated to determine the factors impacting the stability of the dresser. For incidents that occurred without an eyewitness, possible interactions of the child/children with the dresser were determined based upon observations found in multiple YouTube videos. ES staff then conducted laboratory testing using a weighted dummy and sample 8-drawer dressers to validate the hazard scenarios. All test results confirmed analytical modeling.

Critical Findings

1. **Incidents occurred while multiple drawers were opened.** For all the scenarios analyzed, multiple drawers (at least 4 of 8) of the dresser needed to be extended or *open* to cause tip-over (*unstable*).
2. ***Filled* versus *empty* drawers and the number of drawers open affect the stability of the dresser.**
    a) **The 8-drawer dresser model with empty drawers is less stable than the same dresser model with fully filled drawers if less than 50% (by fill weight) of the drawers are opened.** The 8-drawer dresser with less than three empty lower

[6] Analysis based on Reed, Matthew P., Ebert, Sheila M., Jones, Monica L.H, July 2020, "Forces and Postures During Child Climbing Activities" University of Michigan Transportation Research Institute (UMTRI), prepared for US Consumer Product Safety Commission, contract No. 61320618D0004. Tab R.

drawers (2 bottom, 1 middle) open, will be a less stable dresser than the fully filled 8-drawer dresser of the same model with the same drawers open.

b) **The 8-drawer dresser with fully filled drawers is less stable than a dresser of the same model with empty drawers if more than 50% (by fill weight) are opened**. The 8-drawer dresser with more than three fully filled lower drawers (2 bottom, 1 middle) open, will be a less stable dresser than the empty 8-drawer dresser with the same drawers open.

3. **A 31-35 pound child climbing up the dresser with a 12.5-inch drawer extension, will result in tip over of the dresser/child for a dresser with *fully filled or empty* drawers and the 4 lower drawers open.** The equivalent force on the edge of the drawer consist of child's weight (31 pounds) the dynamic force due to climbing and the effects of the child's CG extending beyond the edge of the drawer. Based on the UMTRI report, ES staff estimated the equivalent force to be 1.6 times the weight of the child or about 50 pounds (1.6 x 31 pounds)[7].
4. **The dresser on a carpet/pad is less stable than the same one on a hard level floor.** The dresser tip over force is about 5 pounds less when the dresser is on a carpet/pad as compared to when the same dresser is on a hard, flat surface. The stability or tip over force of a dresser on a 1.5-2.0 degree incline is similar to a dresser on a carpet/pad.
5. **The ASTM standard did not fully address the hazard scenario.** As discussed above, the 8-drawer dresser meets the ASTM standard because when *empty,* the dresser remains upright when a 50-pound weight is applied to one open drawer. The measured tip weight was between 72 and 83 pounds. Staff found the ASTM standard did not address the following hazards occurring simultaneously:
   a) Multiple open drawers.
   b) Drawers filled with clothing.
   c) Child's dynamic forces and extended center of gravity while climbing a dresser.
   d) Dresser placed on a carpeted surface.
   e) Child pulling on an open top drawer.
   f) Child's head becoming entrapped between 2 open drawers.

[7] Analysis based on Reed, Matthew P., Ebert, Sheila M., Jones, Monica L.H, July 2020, "Forces and Postures During Child Climbing Activities" University of Michigan Transportation Research Institute (UMTRI), prepared for US Consumer Product Safety Commission, contract No. 61320618D0004, Table 16, page 44 (Tab R).

Section 1. Product: 8-Drawer Dresser.

ES staff examined the following samples (Figure 38) to develop possible scenarios that could cause tip over. The 8-drawer dresser measures approximately 63 inches wide, 19 5/8 inches deep, 37 3/4 inches high.

Sample and associated IDI	Weight, Dimensions, Drawer Extension	Photo
Sample 20-800-0347, IDI 17052CBB1878	Weight =113.51 pounds Width (leg-leg) = 59.25 inches Depth (leg-leg) = 18.5 inches Height = 37.625 inches	
Sample 20-800-0665, IDI 200130CBB1256	Weight = 148 pounds Width (leg-leg) = 59.25 inches Depth (leg-leg) = 18.5 inches Height = 37.625 inches	
Sample 19-420-0014, no associated IDI	Weight = 122 pounds Width (leg-leg) = 59.25 inches Depth (leg-leg) = 18.5 inches Height = 37.625 inches	

Figure 38. Dresser samples

Section 2. Stability Analysis/Methodology

As part of its analysis, ES staff first determined the physical characteristics of the 8-drawer dresser by measuring: 1) the weight and center of gravity of each drawer; 2) the weight and center of gravity of the dresser cabinet (without drawers); and 3) the weight and center of gravity of the dresser as each drawer is extended. ES staff also estimated the dynamic effects due to a child climbing on the dresser based on a report from the University of Michigan Transportation

Research Institute (UMTRI).[8] Using these data, ES modeled the 8-drawer dresser drawer open/close position, drawer clothing fill weight and the interactions of the child with the dresser to determine dresser tips over scenarios. As illustrated in Figure 39 and Figure 40, if the CG is located behind the dresser's front foot, the dresser/child combined unit is stable and will not tip over. Alternatively, if the CG is in front of the dresser's front foot, the dresser/child combined unit is unstable and will tip over.

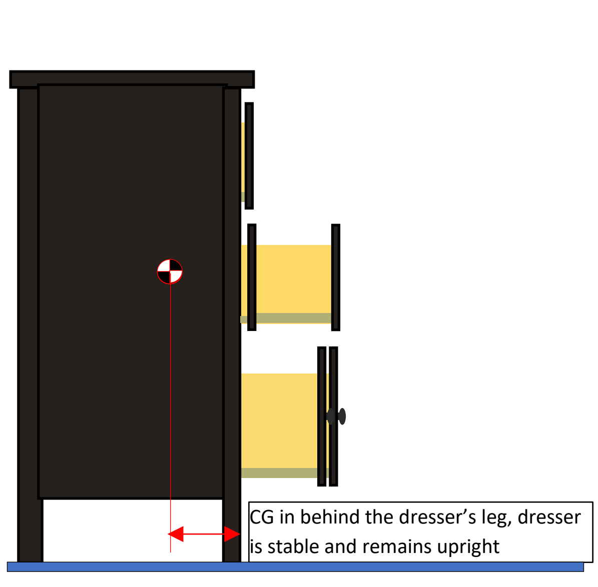


Figure 39. CG behind leg – dresser is stable and will remain upright

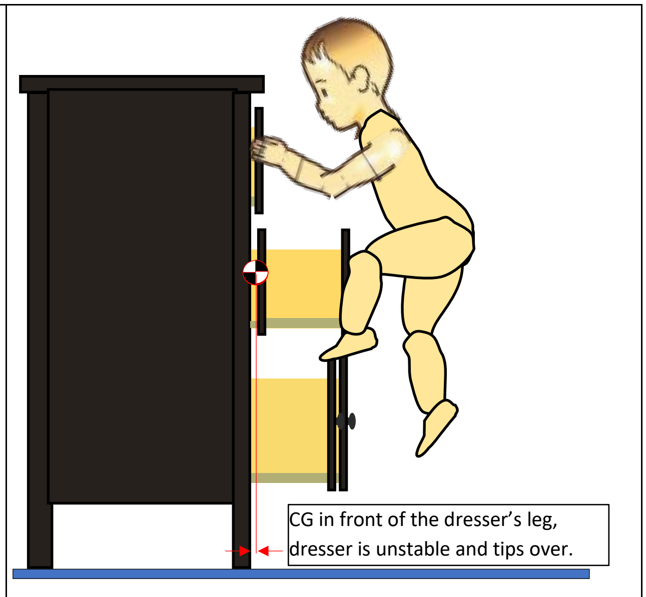


Figure 40. CG in front of leg – dresser is unstable and tip over will occur.

Model vs. Measured

ES staff modeled the dresser based on three samples. Figure 41, Figure 42, and Figure 43 show the measured CG compared to the CG model. The CG for each dresser was measured was measured using floor scales as each drawer was opened from the bottom. The dresser was modeled using the measured CG value of each drawer and the cabinet (dresser without drawers). The CG values were entered into a spreadsheet and the CG of the dresser and drawers were calculated. The spreadsheet allowed the dresser to be modeled with drawers open or closed and filled or empty. Additional inputs such as a child climbing on the dresser or pulling was used to determine if the dresser tips over.

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[8] Reed, Matthew P., Ebert, Sheila M., Jones, Monica L.H, July 2020, "Forces and Postures During Child Climbing Activities" University of Michigan Transportation Research Institute (UMTRI), prepared for US Consumer Product Safety Commission, contract No. 61320618D0004.

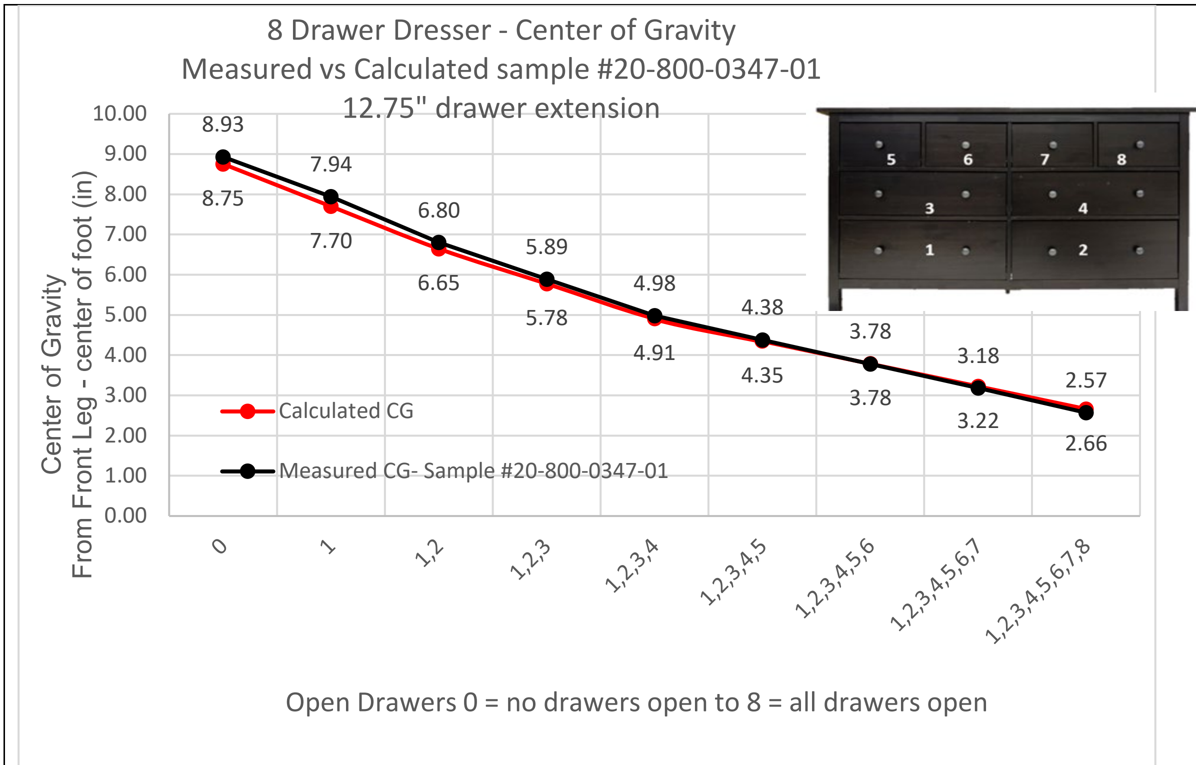

Figure 41. Measured and calculated CG.

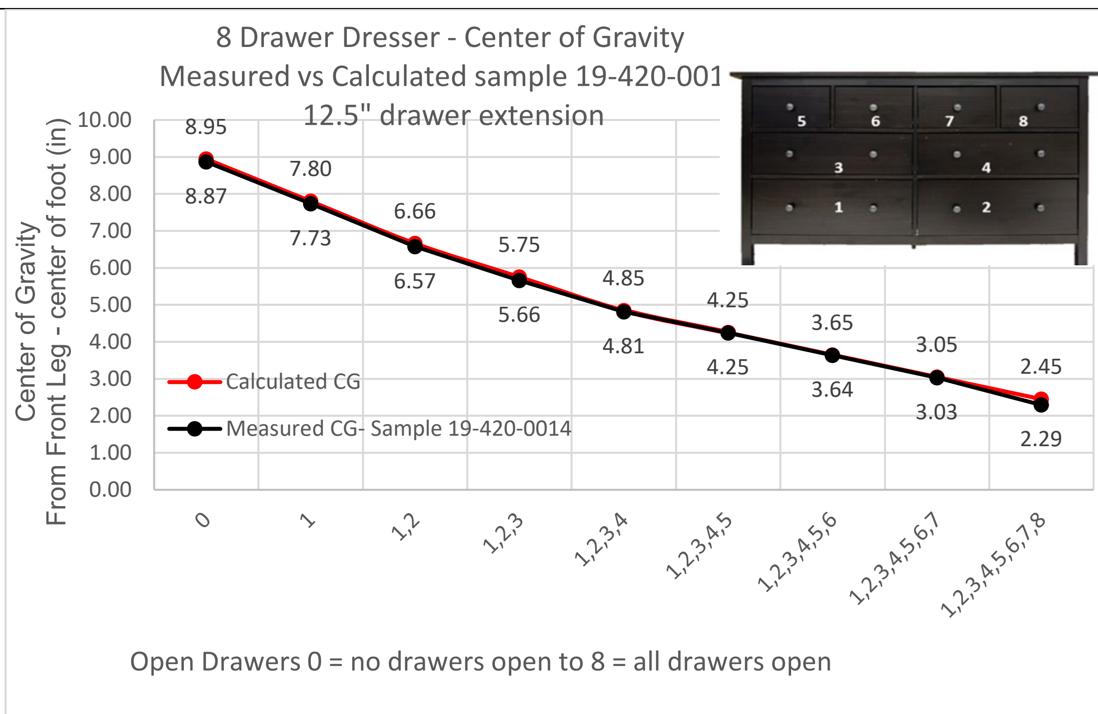

Figure 42. Measured and calculated CG.

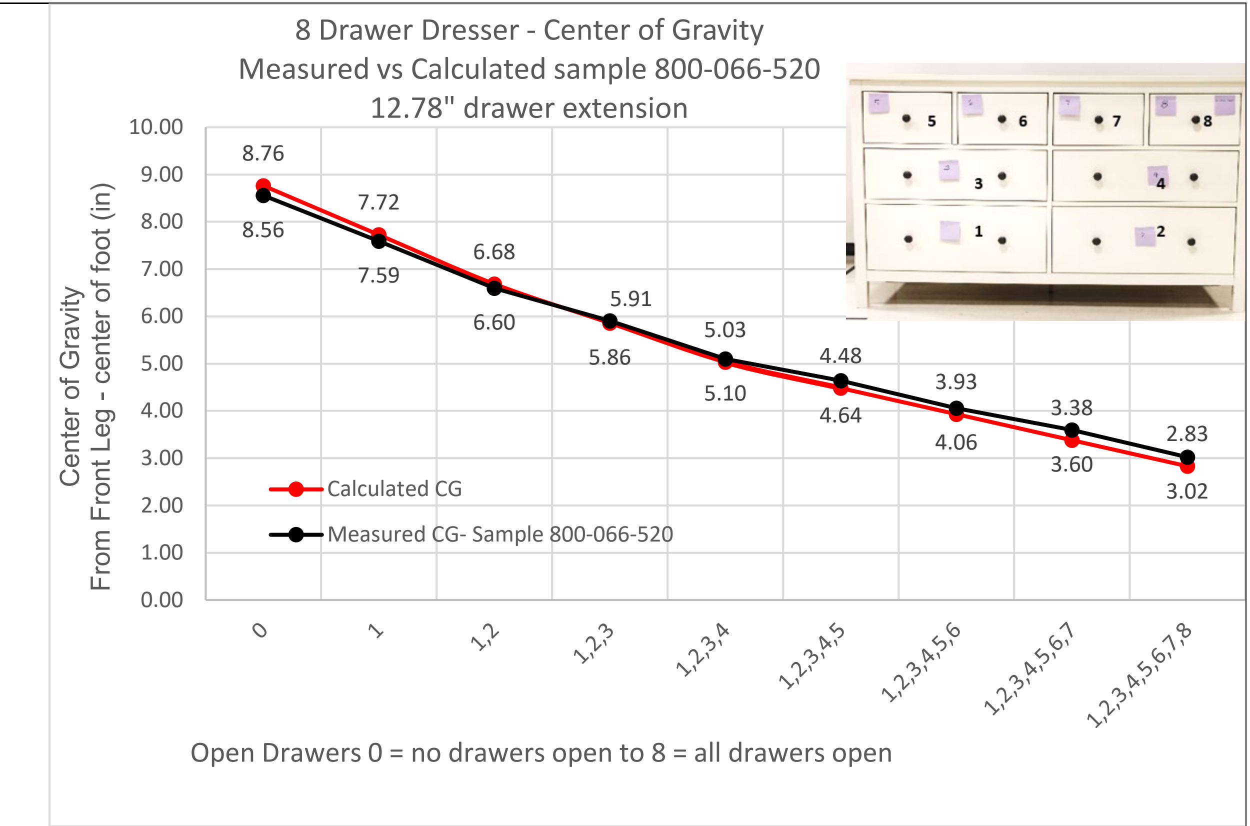

Figure 43. Measured and calculated CG.

Stability Analysis

ES staff characterized the tip over propensity or stability of the dresser by calculating the downward force on the edge of the drawer required to cause tip over (see Figure 44 and Figure 45). More stable dressers can withstand a larger force/weight on the edge of an open drawer without tipping over. Therefore, larger tip over forces correspond to better stability. A child standing on or in the drawer, dynamic forces due to the child climbing (ascending) using the extended drawers as foot holds, or pulling or pushing down on the drawer can create a tip over force.

Tip over force is related to the CG of the dresser. The closer the CG is to the front foot (fulcrum) the less force is required to tip the dresser over. As discussed above, the dresser's configuration such as open or closed drawers, the weight of the clothing in the drawers and the mass distribution of the dresser establish the CG of the dresser.

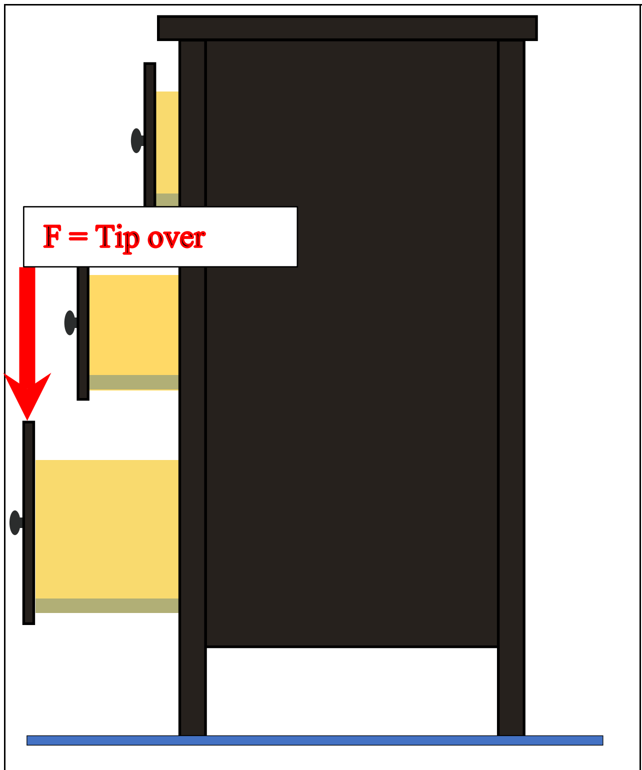

Figure 44. Tip over force **F** (empty drawers)

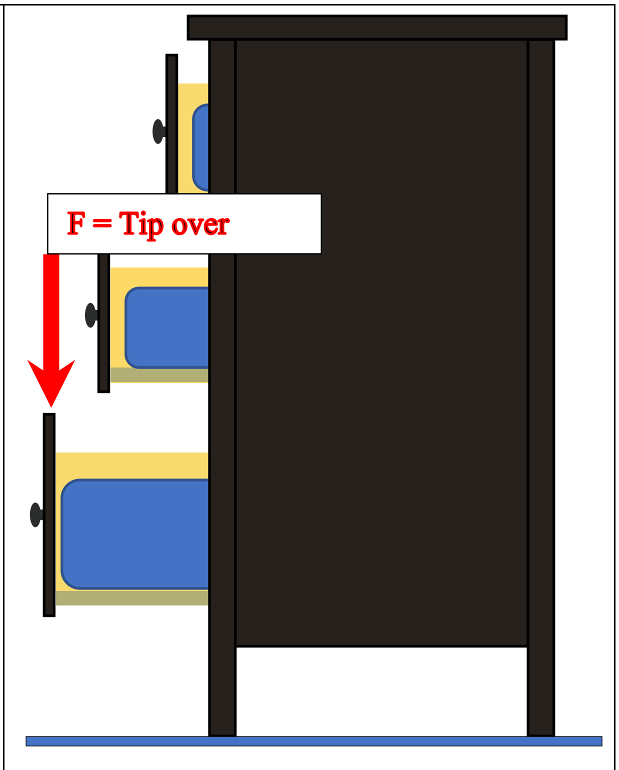

Figure 45. Tip over force **F** (filled drawers)

Section 3. IDI Summaries.

ES staff reviewed six IDIs associated with the 8-drawer dresser. Table 15 shows the IDI number and link, the synopsis and the associated analysis section in this analysis.

Table 15. 8-Drawer Dresser IDIs

IDI	Synopsis	Analysis section
170523CBB1878 • Death • Flooring: hardwood • Multiple drawer opened • Child climbing	The mother entered her two year old son's bedroom and found the dresser on top of her son. It appears he had been climbing on top of the dresser to retrieve the baby monitor. He was transported to the hospital where he died the next day. Medical Examiner's cause of death is listed as Mechanical Asphyxia.	Section 4
200130CBB2238 • Injury: no medical treatment • Flooring: not reported • Child climbing	A 39 year-old female stated that her dresser fell onto her three year-old daughter. The dresser was not secured to the wall when her child attempted to climb the drawers to reach something on top. The dresser tipped forward hitting the child, inflicting scratches to her arms and a cut to her lip. The dresser did not land on top of the child because the bottom drawers extended and hit the floor, propping the dresser up on an approximate 45 degree angle. The consumer stated the injuries were minor, therefore no medical assistance was sought.	Section 5
160322CBB3496 • No injury • Flooring: Carpet • Multiple drawer open • No climbing	On January 18, 2016, an eight drawer dresser tipped over when a three-year-old boy was opening the drawers to his parent's dresser. The child was opening the 8th drawer on the bottom when it suddenly tipped over. The father was nearby and was able to catch the falling dresser. The boy was not injured. The dresser was located in the master bedroom of the family's home.	Section 6
190205CCC1154 • No injury • Flooring: Carpet • 2 drawers open	A 5 year old male had two drawers open on his eight drawer dressers when it tipped over. The drawers and top surface of the dresser were damaged during the tip over. The 5 year old male was not injured during this incident	Section 7
170131CCC3408 • No injury • Flooring: Carpet	6 yom uninjured after opening top drawer of dresser that tipped over. Incident reported to retailer who picked up unit and refunded purchase to consumer.	Section 7
170103CFE0001 • Injury: No medical treatment • Flooring: Carpet • Multiple drawer open • Children climbing	An 8-drawer dresser tipped over when two 2-year-old boys attempted to climb up the front of it. The dresser landed on top of one of the boys but neither boy sustained injuries that required medical attention.	Section 8

In this report, ES staff examined incident samples, exemplar samples and the seven IDIs listed in table 1. ES staff developed tip over scenarios based on the IDIs, performed calculations of the tip over scenarios and verified calculations through testing. The following sections are ES staff's analysis of each IDI and staff's assessment of the root cause of the incident.

Section 4. IDI 17052CBB1878 – Death, 2 Year Old Boy Climbing.

Synopsis: The mother entered her two year old son's bedroom and found the dresser on top of her son. It appears he had been climbing on top of the dresser to retrieve the baby monitor. He was transported to the hospital where he died the next day. Medical Examiner's cause of death is listed as Mechanical Asphyxia.

Victim: A 28-month-old male, 31 pounds and 35 inches tall. The child died due to mechanical asphyxia.

Product: The product is the incident sample 20-800-0347. The consumer purchased the dresser 2-3 years prior to the incident (incident occurred on 5/14/2017). Figure 46 shows the police photograph of the dresser at the consumer's home. Figure 38 shows the incident sample as received by ES staff on October 13, 2020. ES staff observed damage to the incident sample drawers as shown in Figure 38. In the IDI, the mother of the victim reported that the dresser did not have broken drawers until after the Sheriff's office conducted reenactment testing.

Incident scene: After the incident dresser tipped over and was on top of her child, the victim's mother described the dresser as tilted and at an inclined position, not lying flat (horizontal) on the floor. She believed the dresser was propped up due to the contact of the extended drawers with the floor and was pressing the child's head against the floor. She lifted the dresser and discovered the child nearly fully inside the middle right hand side drawers with only his head sticking out. He was not bleeding and he did not appear to have any injuries, bruises or broken bones. However, he was not breathing.

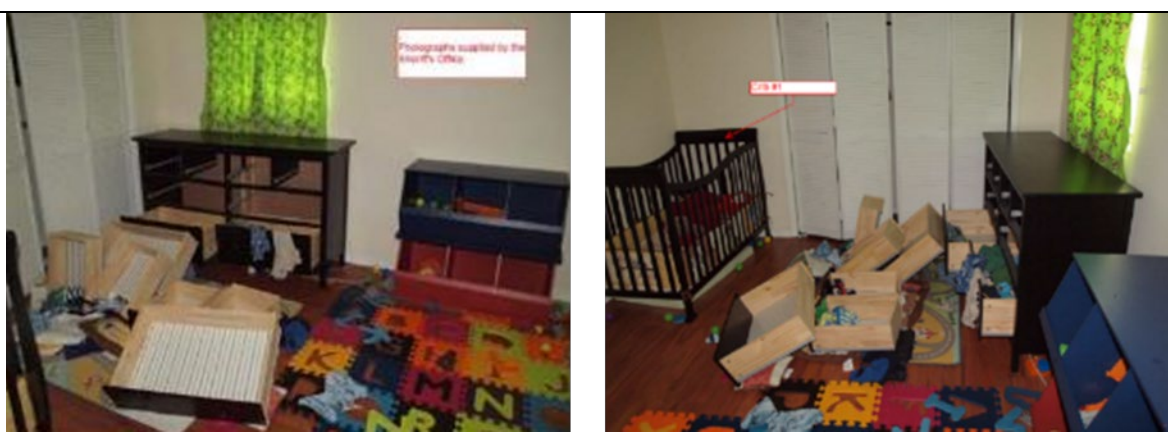

Figure 46. Photos of incident scene from IDI 17052CBB1878, Exhibit #7.

Since the victim was found inside the drawer, ES staff concluded that the victim's feet and or buttocks were likely inside the drawer when the dresser tipped over. The mother reported to the Sheriff during a reenactment video, that she could not initially see the child entrapped in the dresser. Figure 47 shows a video still of the reenactment performed by the mother for the Sheriff. Based on the description the mother provided, ES staff recreated the incident scene using an exemplar 8-drawer dresser (sample 19-420-0014) and a 32-inch-tall, 3-year-old CPR dummy as shown in Figure 48 and Figure 49. The ES staff recreation shows the child in the middle drawer with his neck compressed between the top edge of the middle drawer and the bottom edge of the top drawer above him.

Figure 47. Reenactment of incident by mother for the Sheriff's investigation.

	
Figure 48. ES staff reenactment of incident. Dresser propped up by the lower drawers with dummy in the middle right drawer (left).	Figure 49. Dummy's neck wedged between the top edge of the middle drawer and bottom edge of the top drawer (right).

Based on the IDI, ES staff considered the following plausible scenarios (Table 16) of a 31-pound child interacting with the dresser, dresser drawers open or closed and drawer(s) partially filled or empty.

Table 16. Summary of Scenario Analyses for IDI 17052CBB1878

Scenario	Description of Scenario	Does tip over occur?
1a	Child climbs on open drawers from the side of the dresser. Child sitting/kneeling forward in middle drawer leaning out over the edge of the drawer, all drawers empty, 7 of 8 drawers open.	Yes (Unstable)
1b	Child climbs on open drawers from the side of the dresser. Child sitting/kneeling forward in middle drawer leaning out over the edge of the drawer, 10 pounds of clothes in bottom drawer, 7 of 8 drawers open.	Yes (Unstable)
2a	Child climbs on open drawers from the side of the dresser. Child sitting rearward in the middle drawer, all drawers empty, 6 of 8 drawers open. Child leans backward while pulling out the top (7th) drawer.	Yes (Unstable)
2b	Child sitting rearward in the middle drawer, 10 pounds of clothes in bottom drawer, 6 of 8 drawers open. Child leans backward while pulling out the top (7th) drawer.	Yes (Unstable)
3a	Child climbing and stepping into the middle drawer. Child's CG is 4 inches extended out from the drawer front face, 5 of 8 drawers open, all drawers empty.	Yes (Unstable)
3b	Child climbing and stepping into the middle drawer. Child's CG is 4 inches extended out from the drawer front face, 4 of 8 drawers open, 10 pounds of clothes in open bottom drawer.	Yes (Unstable)

Based on the photos of the incident scene (Figure 50), ES staff estimated the clothing weight in the incident to be about 10 pounds.[9]

[9] Staff confirmed this estimate by recreating the incident photos in Figure 50 with 10 pounds of children's clothing in an exemplar of the same model CSU. The volume of clothing in the recreation appeared to match the incident photos.

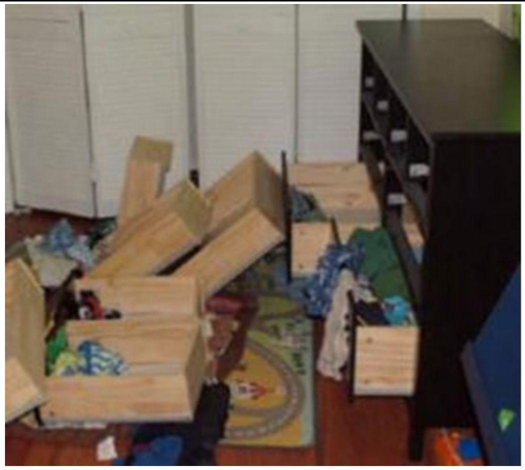

Figure 50. Incident scene show one filled bottom drawer and various partially filled drawers (left). ES staff filled the drawers with 10 pounds of clothing to recreate the incident scene.

Scenario 1a: *Child sitting/kneeling forward in middle drawer leaning out over edge of drawer. All drawers empty. 7 of 8 drawers open*

Analytical Modeling: As shown in Figure 51, for **Scenario 1a**, the 31-pound child climbs up the side of the dresser using the open drawers as foothold. The drawers are empty. Climbing from the side will not cause tip- over when multiple drawers are open since the CG of the child remains inside the front edge of the open drawer.

Subsequently, as shown in Figure 52, the child steps into the middle drawer and sits/kneels in the middle drawer facing outward/forward, and leaning over the edge of the drawer. On-line video shows this behavior/activity (Figure 53). **For Scenario 1a**, seven (7) of the eight (8) drawers are opened and the top drawer (above the child) is closed. **Scenario 1a** was modeled for a child that is stationary or moving slowly and therefore, there are no impact and/or dynamic loads created by motion of the child.

As shown in Figure 52, with the child leaning over the front of the drawer, the child's CG moves to the front edge of the drawer and the CG of the dresser/child combined unit is 0.10 inches in front of the front foot and the dresser is unstable and tip-over occurs.

As shown in Figure 54, as the dresser/child combined unit are moving and tipping over, the top drawer (above the child's head), starts to extend open and in turn wedges the child's head/neck between the bottom edge of the top drawer, and upper edge of the middle drawer.

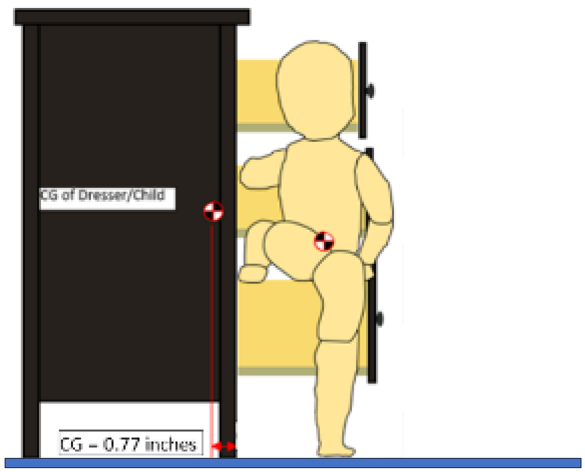

Figure 51. The 31 pounds child climbs up the side of the dresser, 6 of 8 drawers open, all drawers empty. Child uses open drawers as footholds. Dynamic effect due to climbing = 1.3 times body weight. CG of dresser/child is 0.77 inches rear of the front leg and the dresser remains stable.

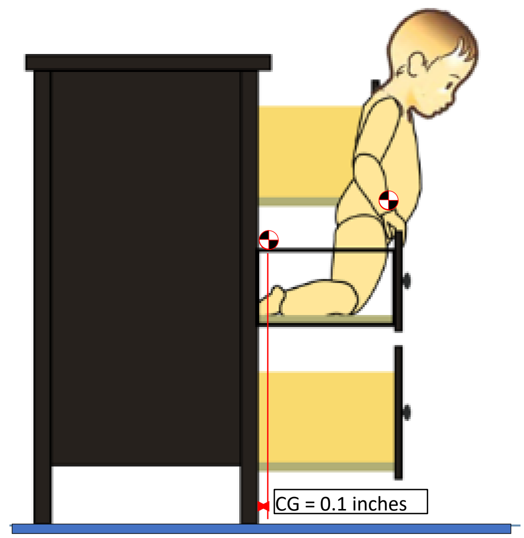

Figure 52. Child climbs into the middle drawer 7 of 8 drawers opened (right) and leans out, no dynamic effects or sudden movement. The dresser/child CG is 0.10 inches in front of the front leg and the dresser is unstable (this is a tip over condition).

Figure 53. YouTube video still of Child playing in drawer and leaning over the front face of the drawer. NOTE: face is blurred.

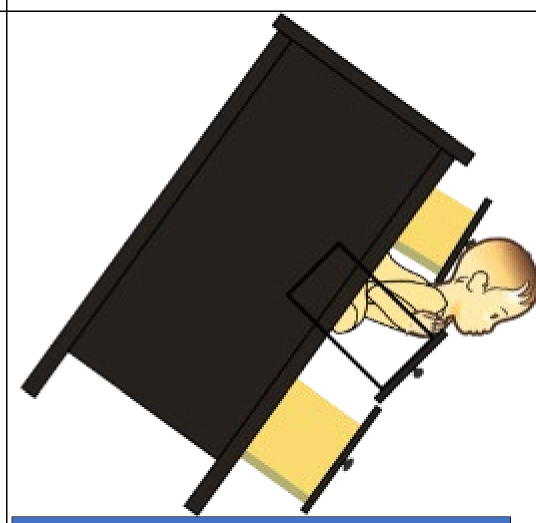

Figure 54. Tipping motion. Drawer above child's head (that was closed) starts to slide out as the dresser tips over. The child's head/neck becomes wedged/pinched between the drawers.

Modeling Conclusion: The analyses for **Scenario 1a** indicate that the dresser and child combined unit is unstable, and therefore tip-over would occur.

Validation Testing: To evaluate analytical modeling for **Scenario 1a** described above, ES staff performed laboratory testing using the incident unit dresser and a weighted dummy. To approximate the victim/child, ES staff attached 10 pounds of weight onto a CRABI- 18MO crash test dummy, for a total dummy weight of 30 pounds (Figure 55). As shown in Figure 56, ES staff placed the weighted dummy in the middle drawer of the incident unit dresser, Sample 20-800-0347 (note that ES staff holding the dresser to prevent it from tipping over). As shown in Figure 56 and Figure 57, the dresser/dummy combined unit is unstable (will tip over) as ES staff opened the 7th of 8 drawers to 3.25 inches.

Figure 55. 18-month-old CRABI crash test dummy with added weight, such that total weight = 30 pounds (left).

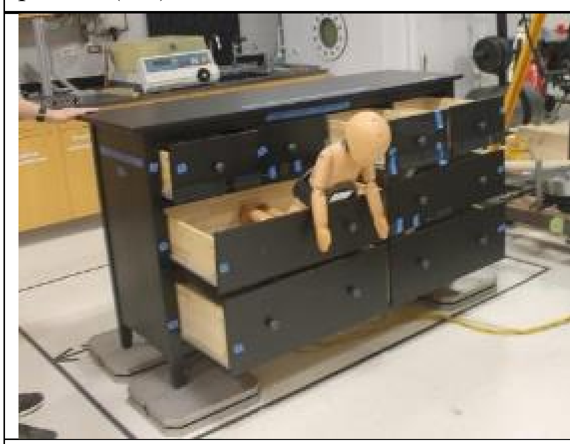

Figure 56. Dresser in the tip over condition- dummy leaning forward, (ES staff holding dresser from falling over) 6 of 8 drawers fully open, one top drawer partially open (7th drawer), one top drawer closed (8th drawer). All drawers empty (no weight). Weighted dummy (30 pounds) leaning over front edge of drawer.

Figure 57. Dresser unstable (tip over occurs), 6 drawers open, 7th drawer partially open. The dresser becomes tips over when 6 of 8 drawers are fully open (Figure 27), the 7th drawer is extended/partially opened 3.25 inches, and the 8th drawer remains closed.

Testing Conclusion: These tests confirmed that analytical model for **Scenario 1a** which indicates that the dresser/child combined unit is unstable, and therefore tip-over would occur.

Scenario 1b: *Child in Middle Drawer Leaning Out Over the Edge, 10 Pounds of Clothes in Bottom Drawer*

Analytical Modeling: Scenario 1b is identical to **Scenario 1a**, except ES staff modeled the dresser with 10 pounds of clothes in the open lower bottom drawer. The additional 10 pounds of clothing in the open lower bottom drawer adds to the instability of the dresser (tendency for tip-over). **For Scenario 1b**, ES staff modeled the dresser with seven (7) of the eight (8) drawers opened and the top drawer (above the child) closed. Scenario 1b was modeled for a child that is stationary or moving slowly and therefore, there are no impact and/or dynamic loads created by motion of the child.

As shown in Figure 58, the child climbs up the side of the dresser. Next, as shown in Figure 59, the child sits/kneels in the middle drawer facing outward/forward, and leaning over the edge of the drawer. If seven (7) of the eight (8) drawers are opened, the dresser/child CG extends moves to 0.37 inches in front of the front leg and the dresser is unstable and tip-over occurs. As shown in Figure 60, as the dresser/child combined unit tips over, the top drawer (above the child's head), starts to open and wedges the child's head/neck between the bottom edge of the top drawer, and upper edge of the middle drawer.

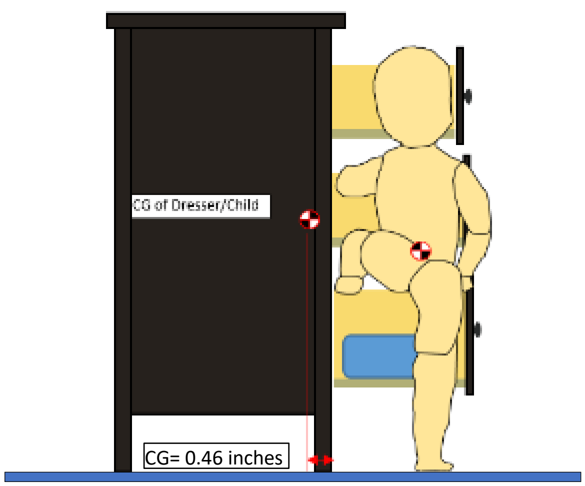

Figure 58. The 31 pounds. child climbs up the side of the dresser, 7 of 8 drawers open, all drawers empty. Child uses open drawers as footholds. Dynamic effect due to climbing = 1.3 times body weight. CG of dresser/child = 0.46 inches behind the front legs and dresser remains stable.

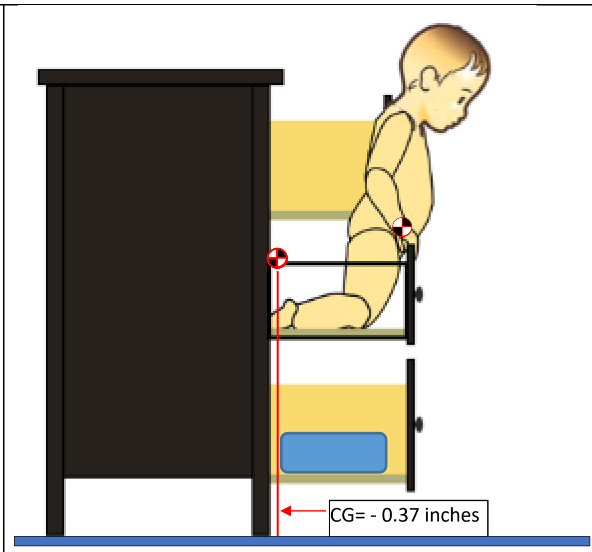

Figure 59. Child climbs into the middle drawer 7 of 8 drawers opened, 10 pounds of clothes in the bottom drawer. The child leans out over the drawer edge, no dynamic effects or movement. The dresser/child CG is 0.37in in front of the front leg and the dresser is unstable (this is a tip over condition)

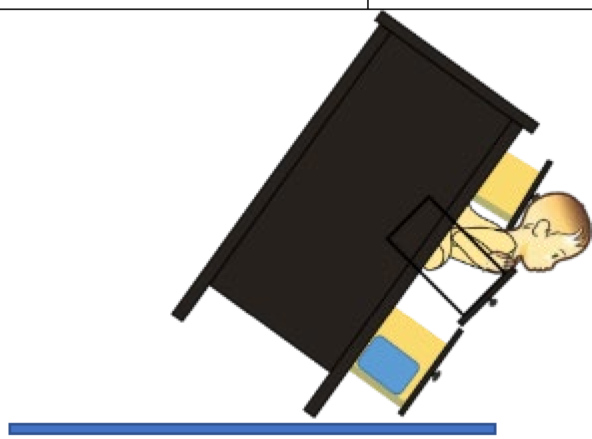

Figure 60. Tipping motion. Drawer above child's head (that was closed) starts to slide out as the dresser tips over. The child's head/neck becomes wedged/pinched between the drawers.

Modeling Conclusion: The analysis for **Scenario 1b** indicate that the dresser become unstable and tip-over occurs.

Scenario 2a. *Child Sitting Rearward in Middle Drawer and Leans Backward While Pulling Out the Top (7th or 8th) Drawer, NO clothes in drawer.*

Analytical Modeling: For **Scenario 2a**, the dresser has six (6) of the eight (8) drawers open and all drawers are empty (no weight). As shown in Figure 61, the 31-pound child climbs up the side of the dresser using the open drawers as footholds. Since the CG of dresser/child is 1.19 inches behind the front leg, the dresser is stable and climbing from the side will not cause tip over when multiple drawers are open.

As shown in Figure 62, the child subsequently steps into the middle drawer and sits in the middle drawer facing inward/toward the dresser. Six (6) of the eight (8) drawers are open, and the two top drawers (above the child) are closed. **Scenario 2a** was modeled for a child that is stationary or moving slowly and therefore, there are no impact and/or dynamic loads created by motion of the child. In this position, the CG of the dresser/child combined unit is 1.66 inches behind the front feet (Figure 62) and the dresser is stable.

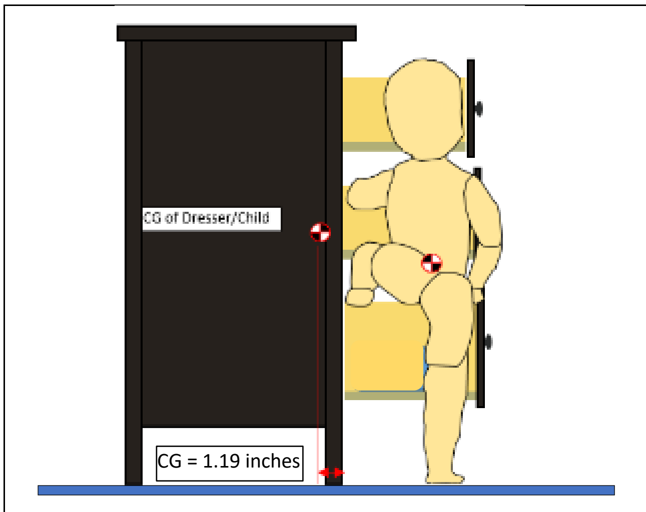

Figure 61. 31 pounds. child climbs up the side of the dresser, 6 of 8 drawers open, all drawers empty. Child uses open drawers as footholds. Dynamic effect due to climbing = 1.3 times body weight. CG of dresser/child is 1.19 inches *behind* of the front leg and the dresser remains *stable*.

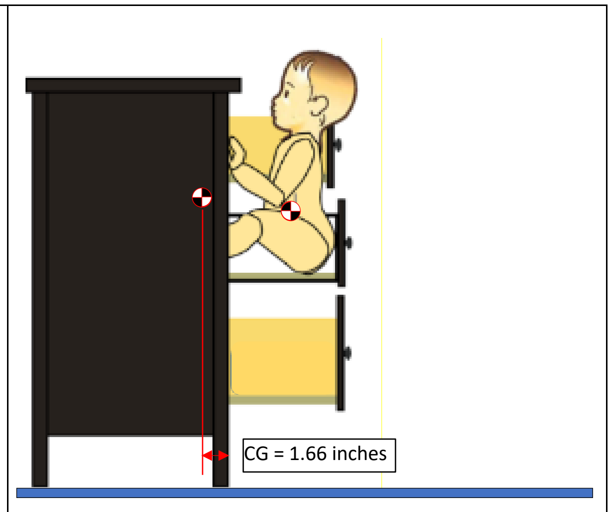

Figure 62. Child sitting in middle of drawer, 6 of 8 drawers open. CG of dresser/child is 1.66 inches *behind* the front leg and the dresser remains *stable*.

Next, as shown in Figure 63, the child reclines backward or lies back, and pulls open one of the top drawers above the child. As shown in the still image of an on-line video in Figure 64, this behavior/activity is observed in children. As the child moves to this reclined position, the CG that was located 1.66 inches behind the front feet in a stable position (Figure 62), moves to an unstable position 0.10 inches in front of the front feet, causing the dress/child combine unit to tip-over (Figure 63 and Figure 64).

As shown in Figure 65, as the dresser/child combined unit are tipping over, the top drawer, starts to extend open and in turn wedges the child's head/neck between the bottom edge of the top drawer, and upper edge of the middle drawer.

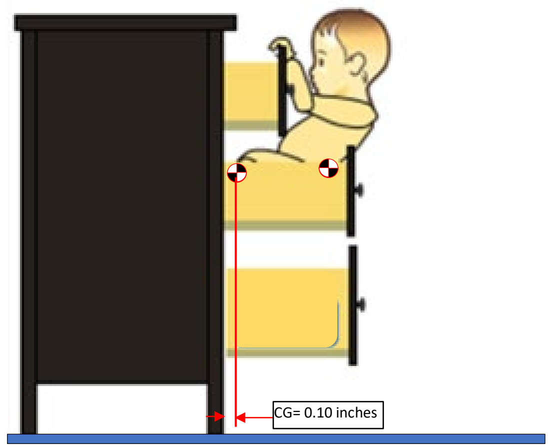

Figure 63. Child leans back rearward and pulls out the top drawer (now 7 of 8 drawers are open). CG moves from previously *stable* position, 1.66 inches *behind* the front legs to an *unstable* position, 0.1inches *in front* of the front leg.

Figure 64. Video still of child sitting inside the bottom drawer while pulling out the drawer above him. NOTE: face is blurred.

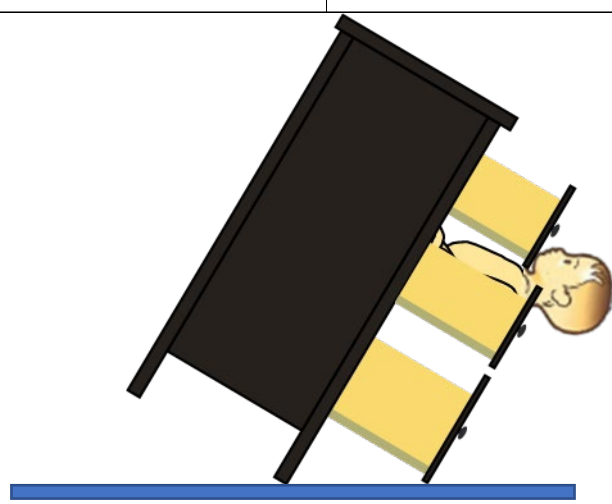

Figure 65. **Scenario 2a**, as the dresser/child tips over, the drawer above child's head starts to slide out. The child's head/neck becomes wedged/pinched between the drawers. If the bottom drawer is wedged/cocked in place, the dresser will rest at an angle without completely falling over.

Modeling conclusion: The analyses for **Scenario 2a** indicate that the dresser /child combined unit is unstable, and therefore tip-over would occur.

Validation testing: To evaluate analytical calculations as described above for **Scenario 2a**, ES staff performed laboratory testing using the incident unit dresser and a weighted dummy. To approximate the victim/child, ES staff attached 10 pounds of weight onto a CRABI-18MO crash test dummy, for a total dummy weight of 30 pounds (Figure *55*). As shown in Figure 66, ES staff place the weighted dummy in the middle drawer of the incident unit dresser (Sample 20-800-0347). As shown in Figure 66 and Figure 67, the dresser/dummy combined unit is about to tip over as ES staff opens the 7th (of eight) drawer out nine (9) inches. The dresser/dummy combined unit is will tip over as staff extends the 7th drawer fully opened.

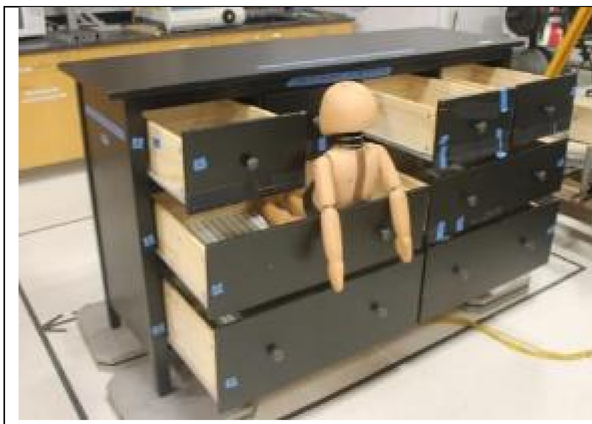	
Figure 66. Weighted dummy (30 pounds) in the middle drawer. Six (6) drawers are fully opened/extended, the 7th top left drawer is partially opened/extended to 9 inches, and the 8th drawer is closed.	Figure 67. Dresser is balanced on front legs when the top 7th drawer is pulled out 9 inches. If the 7th drawer is then fully opened, the dresser tips over.

Testing Conclusion: These tests confirmed the analytical model for **Scenario 2a** which indicates that the dresser and child combined unit is unstable, and therefore tip-over would occur.

***Scenario 2b:** Child Sitting Rearward in Middle Drawer and Leans Backward While Pulling Out the Top (7th) Drawer, 10 pounds of Clothes in Bottom Drawer.*

Analytical Modeling: Scenario 2b is identical to **Scenario 2a** except the dresser has a total of 10 pounds of clothing in the open bottom drawer. This additional weight contributes to the tip over moments. The dresser has six (6) of the eight (8) drawers open. A 31-pound child climbs up the side of the dresser using the open drawers as footholds as shown in Figure 68. Since the CG of dresser/child is 0.85 inches behind the front leg, the dresser is stable and climbing from the side will not cause tip over when multiple drawers are open.

As shown in Figure 69, the child steps into the middle drawer and sits in the drawer inward/facing the dresser. Six (6) of the eight (8) drawers are open and the two top drawers (above the child) are closed. ES staff modeled **Scenario 2b** for a child that is stationary or moving slowly and therefore, there is no impact and/or dynamic loads created by motion of the child. In this position, the CG of the dresser/child combined unit is 1.27 inches behind the front feet and the dresser is stable.

Next, as shown in Figure 70 and Figure 71, the child reclines backward or lies back, and pulls open one of the top drawers above the child. As shown in the still image of an on-line video in Figure 64, this behavior/activity is observed in children. As the child moves to this reclined position, the CG that was located 1.27 inches behind the front feet in a stable position (Figure 69), moves to an unstable position 0.37 inches in front of the front feet, causing the dress/child combine unit to tip-over (Figure 70 and Figure 72).

As shown in Figure 72, as the dresser/child combined unit are moving and tipping over, the top drawer, starts to extend open and in turn wedges the child's head/neck between the bottom edge of the top drawer, and upper edge of the middle drawer.

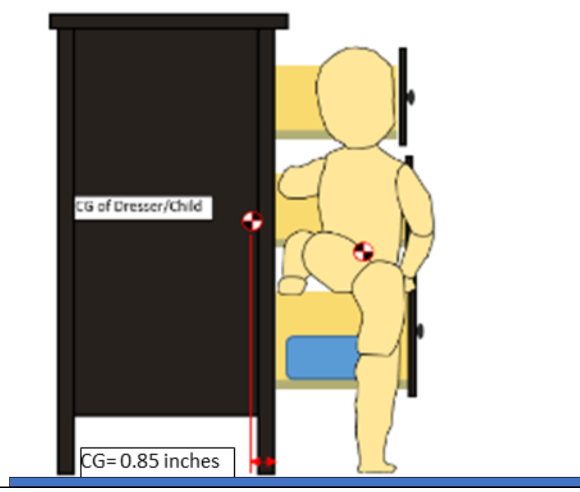

Figure 68. Child climbs up along the side of the dresser and climbs into the middle drawer (6 of 8 drawers opened, one drawer with 10 pounds of clothes). CG of dresser/child is 0.85 inches behind the front leg, the dresser is stable.

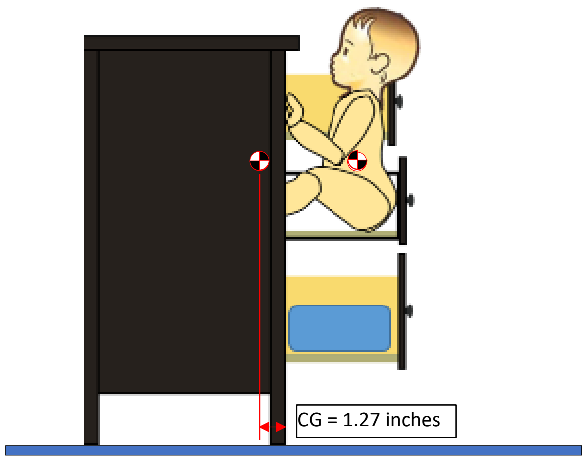

Figure 69. Child sitting in middle of drawer, six (6) of eight (8) drawers open, CG of the dresser/child combined unit is 1.27 inches behind the front feet and the dresser is stable.

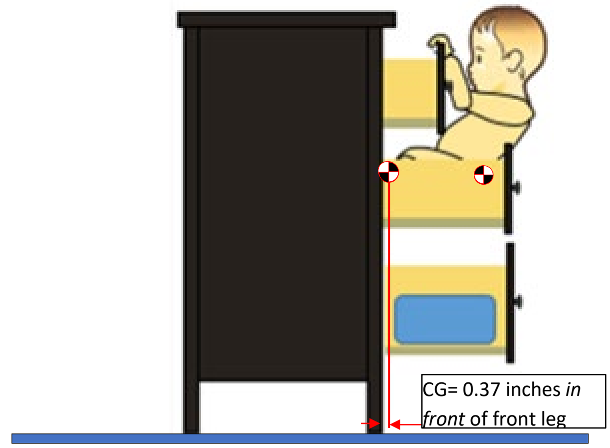

Figure 70. Child leans back reward, pulls out the top drawer (10 pounds clothes in drawer). The CG that was located 1.27 inches behind the front feet in a stable position (Figure 40), is now located 0.37 inches in front of the front leg in an unstable position (tip over conditions).

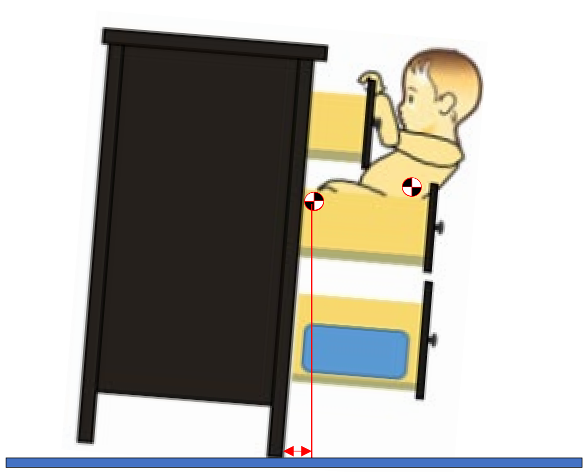

Figure 71. Dresser begins to tip over as child leans back (CG continues to move forward/out due to the tilt angle) and rear leg lifts off of the floor

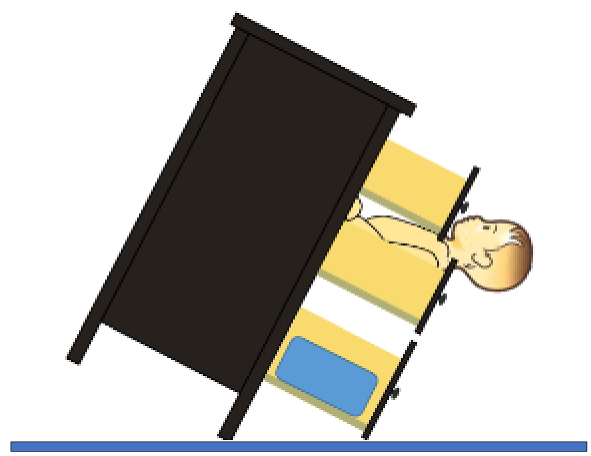

Figure 72. Drawer above child's head starts to slide out as the dresser tips over. The child's head/neck becomes wedged/pinched between the drawers.

Modeling Conclusion: The analysis for ***Scenario 2b*** indicates that the dresser/child combined unit is *unstable*, and therefore tip-over would occur.

Scenario 3a: *Child Climbing the Front of the Dresser by Stepping in the Middle of Drawer, NO Clothes in Drawers.*

Analytical Modeling*:* As shown in Figure 73, for ***Scenario 3a***, the 31-pound child climbs up the front of the dresser using the open drawers as footholds. Five (5) of the eight (8) drawers are opened and the top drawer above the child is closed. All the drawers are empty (no weights).

Subsequently, as shown in Figure 74, the child steps into the middle drawer, and the child's CG is located 4 inches *in front* of the edge of the drawer, or 16.25 inches *in front* of the dresser front legs. In this position, the CG of the dresser/child combined unit is 0.07 inches *in front* of the front leg of the dresser or *unstable*, which causes the dresser to tip over.

ES staff estimated the location of the child's CG as shown in Figure 73, to be 7 inches from the stepping/extended foot based on the UMTRI report[10]. The UMTRI report shows that children can extend their CG over 8 inches from the foothold while climbing.

Next, as shown in Figure 74, the dresser starts moving/tipping, and the child reacts to the motion by placing both feet into the drawer and holding onto either the top of the dresser, or the top of the drawer.

[10] Reed, Matthew P., Ebert, Sheila M., Jones, Monica L.H, July 2020, "Forces and Postures During Child Climbing Activities" University of Michigan Transportation Research Institute (UMTRI), page 59 figure 54, prepared for US Consumer Product Safety Commission, contract No. 61320618D0004

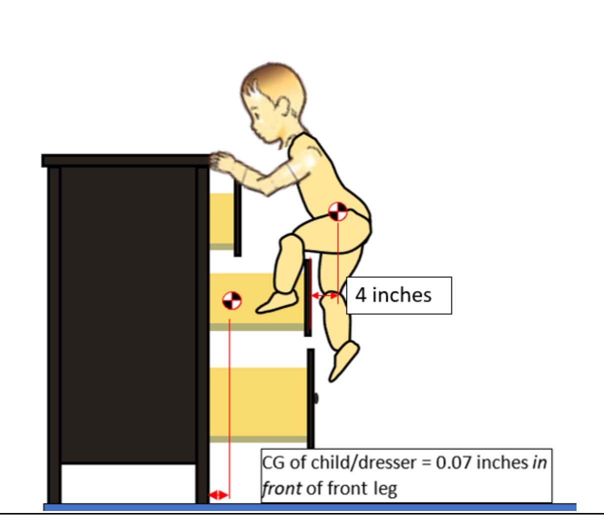

Figure 73. Child climbs up (or down) the front of the dresser with 5 open drawers, placing one foot inside the middle drawer. Estimating the child's CG as 4 inches from the drawer face. The CG of the child/dresser combined unit = 0.07 inches in front of the dresser front leg (5 of 8 drawers open) and the unit is unstable

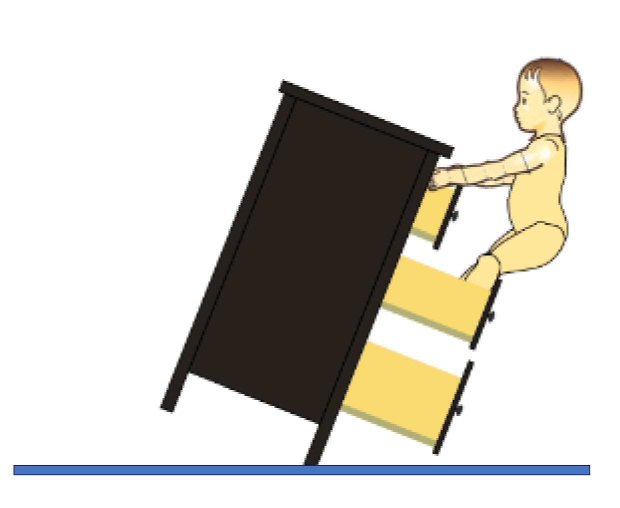

Figure 74. Dresser begins to tip over and the child reacts by placing both feet into the drawer and holding onto the dresser or top drawer.

ES staff considered two different conditions related to the child's movement as the dresser is tipping over. First, as shown in Figure 75 and Figure 76, the child remains standing in the middle drawer as the dresser starts to tip over, and then the dresser tips over completely and rests on top of the child.

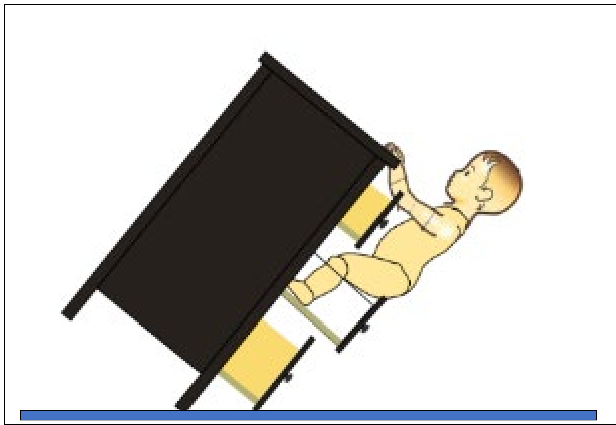

Figure 75. Dresser begins to tip over and the child remains standing in the drawer

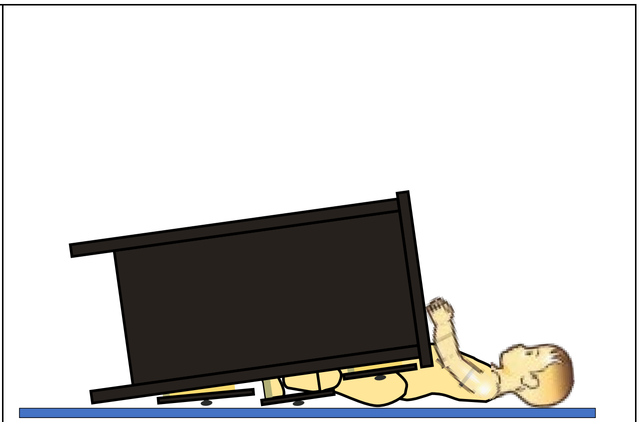

Figure 76. Dresser tips completely over and rests on top of the child.

Alternatively, as shown in Figure 77, Figure 78, and Figure 79 the child moves into a sitting position inside the middle drawer as the dresser starts to tip over, and then as the dresser tips over completely the drawer above the child's head moves out and wedges the child's head and neck between the drawers at the rest position.

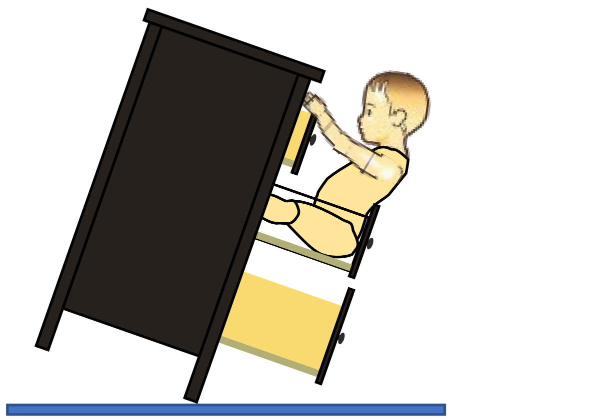

Figure 77. Dresser begins to tip over and the child slides into the drawer. Child continues to move down into the sitting position into the drawer.

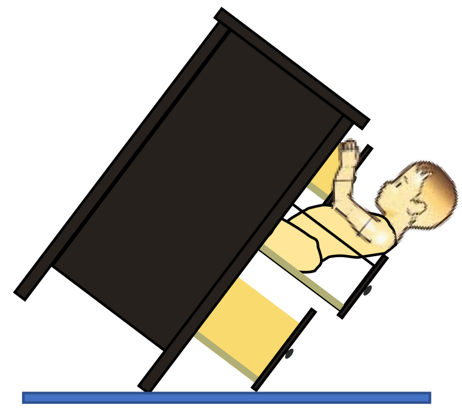

Figure 78. Dresser continues to tips over and the child slides further down into the drawer

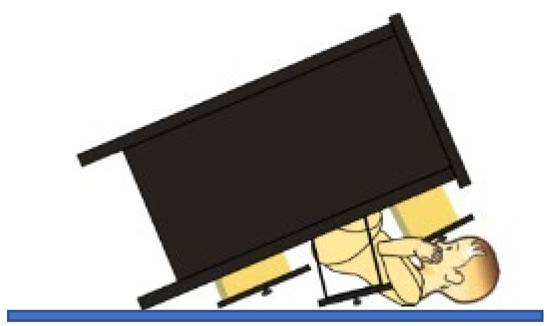

Figure 79. Dresser tips over completely and the drawer above child's head slides out and the child's head/neck becomes wedged/pinched between the drawers.

Modeling Conclusion: The analyses for ***Scenario 3a*** indicated that the dresser and child combined unit is *unstable,* and therefore tip-over would occur.

Validation Testing*:* To evaluate analytical calculations as described above for ***Scenario 3a***, ES staff performed laboratory testing using the incident unit dresser and a weighted dummy. To approximate the victim/child, ES staff attached 10 pounds of weight onto a CRABI-18MO crash test dummy, for a total dummy weight of 30 pounds (Figure 55). As shown in Figure 80, ES staff placed the weighted dummy in the middle drawer of the incident unit dresser (sample 20-

800-0347). As shown in Figure 81, the CG of the dummy was located approximately 15 inches *in front* of the front leg of the dresser (Note: Calculations in the modeling analysis section above were based on the child's CG located at 16.25 inches *in front* of the front leg of the dresser). As shown in Figure 82, the dresser/dummy combined unit is *unstable* (will tip over) once the 5th drawer of the dresser is opened.

Figure 80. Incident dresser with 30-pound weighted dummy standing in middle drawer.

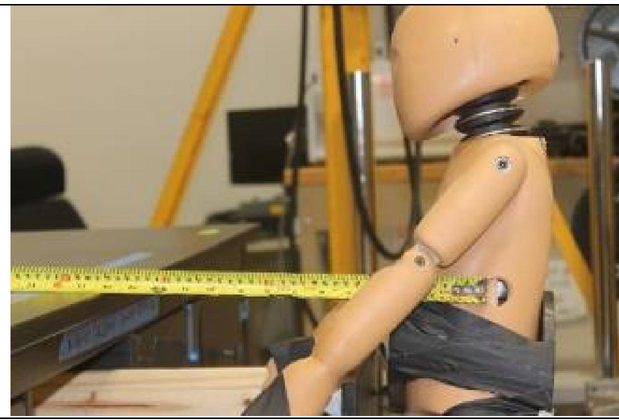

Figure 81. The CG of the weighted dummy is located approximately 15 inches in front of the front leg of the dresser or 3.75 inches in front of the open middle drawer face.

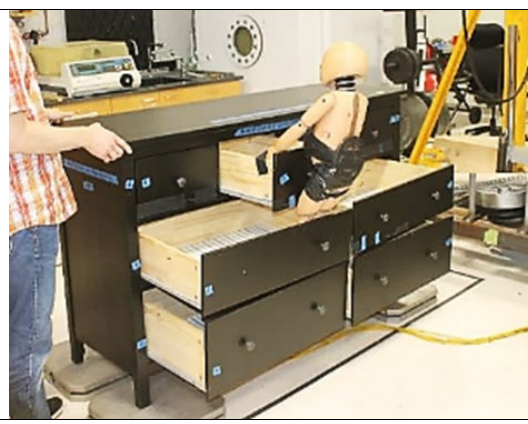

Figure 82. Incident dresser with 30-pound weighted dummy. Dresser/dummy unit is unstable (will tip over) once the 5th drawer of the dresser is opened.

Testing Conclusion: These tests confirmed that the analytical model for ***Scenario 3a*** which indicates that the dresser and child combined unit is *unstable,* and therefore tip-over would occur.

Scenario 3b: *Child Climbing the Front of the Dresser by Stepping in the Middle of Drawer, Bottom Drawer has 10 pounds of Clothing.*

Analytical Modeling: ***Scenario 3b*** is identical to ***Scenario 3a*** except the dresser has a total of 10 pounds of clothing in the open bottom drawer. This additional weight contributes to the tip over moments. As shown in Figure 83, the 31-pound child climbs up the front of the dresser using the open drawers as footholds. Five (5) of the eight (8) drawers are opened and the top drawer above the child is closed. The child steps into the middle drawer, and the child's CG is located 4 inches *in front of* the edge of the drawer, or 16.25 inches *in front of* the dresser front legs. In this position, the CG of the dresser/child combined unit is 0.35 inches *in front of* the front leg of the dresser or *unstable*, which causes the dresser to tip over.

Next, as shown in Figure 84, the dresser starts moving/tipping, and the child reacts to the motion by placing both feet into the drawer and holding onto either the top of the dresser, or the top of the drawer.

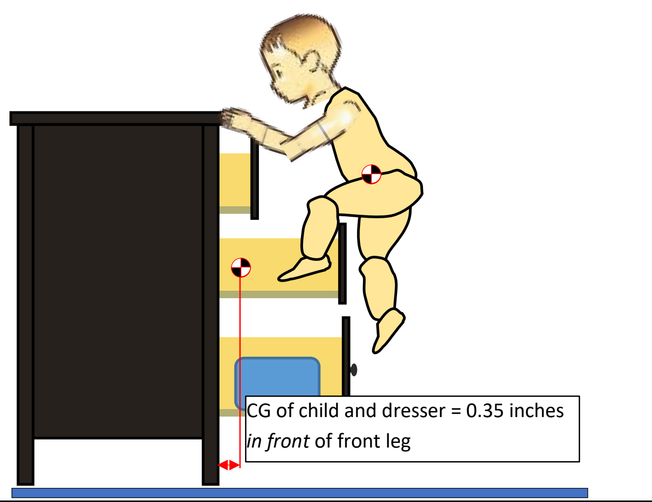

Figure 83. Child climbs up or down the front of the dresser with 5 of 8 open drawers, placing his/her foot inside the middle drawer. Estimating the child's CG is 7 inches from front step foot and 4 inches from the open middle drawer face, the CG of the child/dresser = 0.35 inches forward of the front dresser leg.

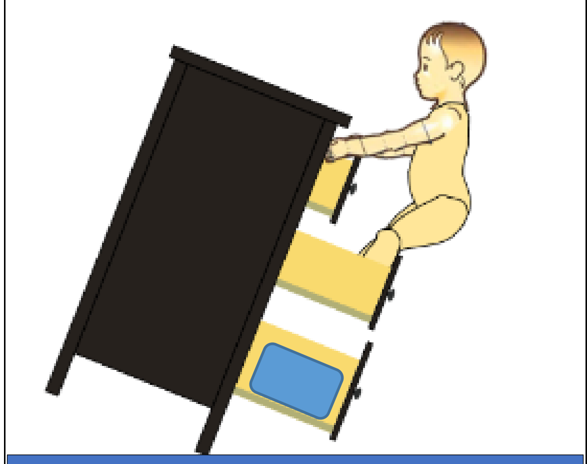

Figure 84. Dresser begins to tip over and the child reacts by placing both feet into the drawer and holding onto the dresser or top drawer.

ES staff considered two different conditions related to the child's movement as the dresser is tipping over. First, as shown in Figure 85 and Figure 86, the child remains standing in the middle drawer as the dresser starts to tip over, and then the dresser tips over completely and rests on top of the child.

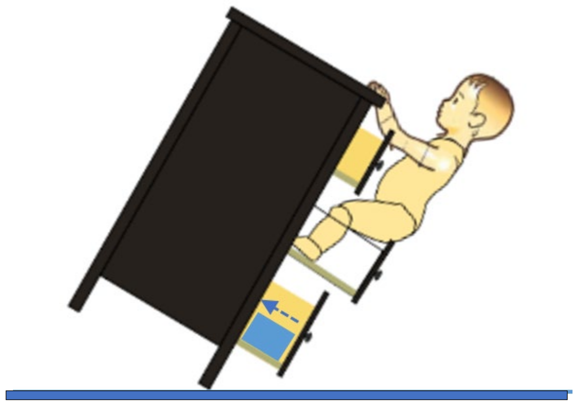	
Figure 85. Dresser begins to tip over and the child remains standing in the drawer.	Figure 86. Dresser tips completely over and rests on top of the child.

Alternatively, as shown in Figure 87 and Figure 88 the child moves into a sitting position inside the middle drawer as the dresser starts to tip over, and then as the dresser tips over completely the drawer above the child's head moves out and wedges the child's head and neck between the drawers at the rest position.

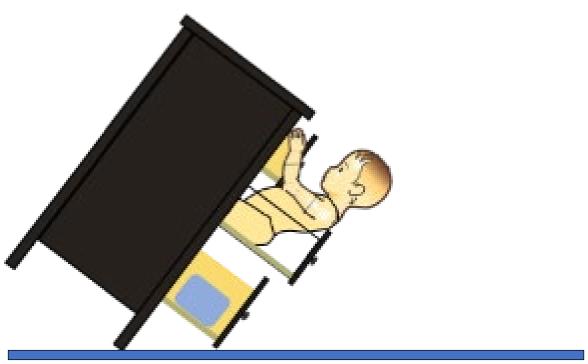	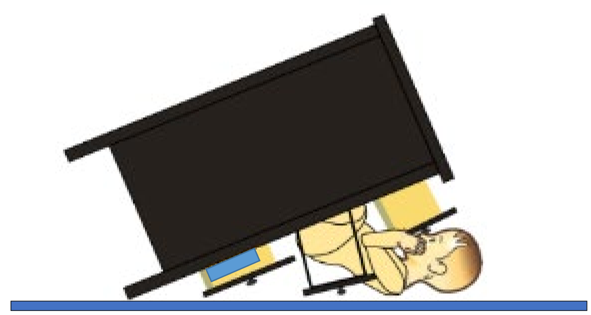
Figure 87. Dresser begins to tip over and the child slides into the drawer. Child continues to move down into the sitting position into the drawer.	Figure 88. Dresser tips over completely and the drawer above child's head slides out and the child's head/neck becomes wedged/pinched between the drawers

Modeling Conclusion: The analyses for ***Scenario 3b*** indicate that the dresser and child combined unit is *unstable,* and therefore tip-over would occur.

Conclusion- Summary Analysis of IDI175023CBB1878

Based on the IDI 175023CBB1878, ES staff concludes that ***Scenarios 1, 2*** and ***3*** these are the most likely scenarios led to the dresser becoming *unstable* and then tipping over/falling onto the two-year-old child. Since the victim was found inside the middle drawer, ES staff considers that either ***Scenario 1a/1b*** or ***2a/2b*** or a similar condition (where the child is inside the middle drawer as the dresser tips over) to be the most likely scenario.

Although not analyzed here, dynamic movements/activity of the child, such as the child playing or rocking in the middle drawer are also plausible. Adding dynamic movements of the child would exacerbate the unstable condition of the child/dresser combined unit, and increase the likelihood for tip-over. Considering a rocking motion of the child's weight would periodically move the location of the CG of the child/dresser combined unit *in front of* the dresser legs into an *unstable* dynamic condition (causing tip over).

Section 5. IDI 200130CBB2238 – Child Climbing Up Front of Dresser

Synopsis: A 39-year-old stated that her dresser fell onto her three-year-old daughter. The dresser was not secured to the wall when her child attempted to climb the drawers to reach something on top. The dresser tipped forward hitting the child, inflicting scratches to her arms and a cut to her lip. The dresser did not land on top of the child because the bottom drawers extended and hit the floor, propping the dresser up on an approximate 45-degree angle. The consumer stated the injuries were minor, therefore no medical assistance was sought.

Victim: A 3-year-old female with a weight of 35 pounds and 36 inches tall. The child sustained cuts and bruises due to the dresser falling on her.

Product: 8-Drawer dresser. During the CPSC investigation (10/18/2018) the consumer (mother) stated to the investigator that she purchased the dresser approximately two to three years prior. The investigator did not obtain the dresser from the consumer, however based on the product description, ES concluded that the dresser was similar to the sample 20-800-0347 examined by ES staff. ES staff estimated the weight to be approximately 114 pounds and that the drawer extension was 12.6 to12.7 inches, similar to the fatal incident unit discussed above. The empty dresser weights over three times the child's weight, similar to the fatal incident discussed above.

The mother stated that the incident occurred on August 7, 2018 and the dresser, located in her three-year-old daughter's room, tipped over while the child attempted to climb on it. The tip-over inflicted scratches to the child's arms and cut to her lip. The consumer stated the injuries were minor and she did not seek medical assistance.

The mother of the victim stated that the dresser fell when her child attempted to climb the drawers to reach something on top of the dresser. The dresser did not land on top of the child because the bottom drawers extended and hit the floor, propping the dresser up on an approximate 45-degree angle. Propping of the fallen dresser was also reported in the fatal incident IDI 170523CBB1878.

To evaluate this incident, ES staff considered the following possible Scenarios of a child climbing up the front of the dresser with all drawers empty (no weight).

Scenario 4: *Child Climbing, Stepping on the Top Edge of Open Drawers, NO Clothes in Drawers*

Analytical Modeling: Based on the description of the incident in IDI 200130CBB2238, ES staff modeled **Scenario 4** with a 35-pound child. The IDI reported that the child was climbing on the dresser and tipped it over. ES staff modeled the dresser without clothes in the drawers. ES modeled the child stepping on the top edge of a drawer of the dresser as shown in Figure 89. As shown in Figure 89, a 35-pound child climbs the front of the dresser with two (2) bottom and one (1) middle drawer open or three (3) drawers open of the eight (8) total. All the drawers are empty (no weights). As shown in Figure 89, the child steps onto the edge of a bottom drawer, and the child's CG is located 7 inches from the front/stepping foot or 19.25 inches in front of the front leg of the dresser (drawer extension of 12.25 inches plus 7 inches). In this position, the CG of the dresser/child combined unit is 0.12 inches in front of the front leg of the dresser creating an unstable condition, which causes the dresser to tip over.

ES staff considered two different outcomes after the dresser tips over. The first outcome as shown in Figure 90, the dresser starts moving/tipping and the bottom drawers fully extend and contact the floor. This initial contact (of the bottom drawers of the dresser with the floor) essentially catches the dresser from completely falling onto the child and in turn minimized the impact/energy transfer of the falling dresser onto the child.

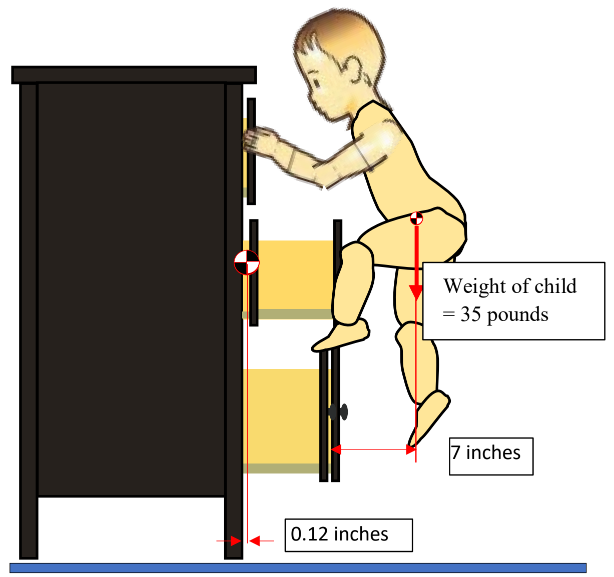

Figure 89. Scenario 4, Two (2) bottom drawers + one (1) middle drawer open, CG = 0.12 inches front of the leg.

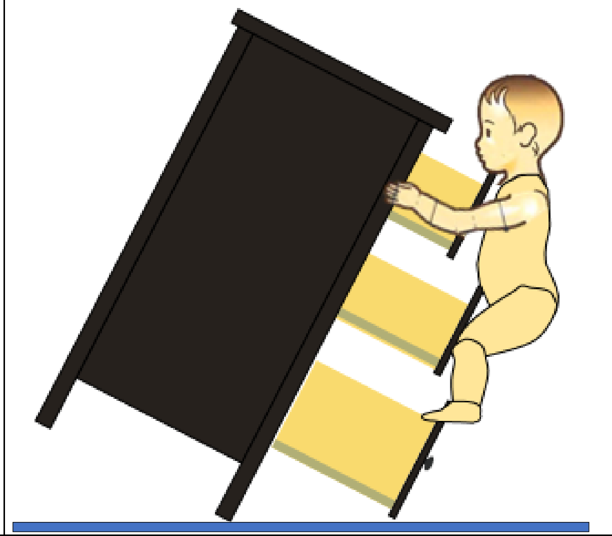

Figure 90. Scenario 4, Lower drawer is wedged in the open position and prevents dresser from tipping over onto the child.

The second outcome as shown in Figure 91, the bottom drawers are slide back into the dresser as the dresser/child combined unit tips over, resulting in the dresser resting on top of the child as shown in Figure 92.

Figure 91. **Scenario 4**, Lower drawers slides back into the dresser allowing the dresser/child to continue to tip over.

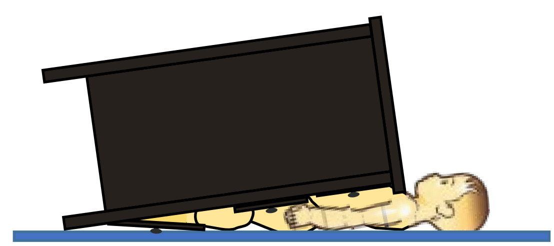

Figure 92. **Scenario 4**, The full weight of the dresser (122 pounds) rests on top of the child.

Modeling conclusion: The analyses for ***Scenario 4*** indicate that the dresser/child combined unit is *unstable*, and therefore tip-over would occur. If the bottom drawers remain fully extended during tip over, the dresser does not completely fall onto the child. If the bottom drawers slide back into the dresser during tip over, the dresser fall onto the child and the full weight (122 pounds) of the dresser rest on top of the child.

Section 6. IDI 160322CBB3496, Child Opening Several Drawers

ES staff reviewed IDI 160322CBB3496 where the child opened several drawers of their 8-drawer dresser causing it to tip over and used the information from the IDI to develop ***Scenario 5***.

IDI 160322CBB3496

Synopsis: On January 18, 2016, an eight-drawer dresser tipped over when a three-year-old boy was opening the drawers to his parent's dresser. The child was opening the 8th drawer on the bottom when it suddenly tipped over. The father was nearby and was able to catch the falling dresser. The boy was not injured. The dresser was located in the master bedroom of the family's home.

Victim: A 3-year-old, weight and height unknown. The child was not injured.

Product: 8-Drawer dresser, model number 402.392.74 shown in Figure 93.

Figure 93. Incident dresser, 8-Drawer dresser (photo from IDI160322CBB3496).

The consumer reported that he purchased the dresser about three (3) years prior to this investigation (date of investigation 4/6/2016). Based on other samples, ES staff determined that the drawers extended open 12.6 inches to 12.7 inches in front of the dresser. The consumer placed the dresser on carpet, against the wall, did not install a restraint and did not remember if the dresser came with one. At the time of the incident, the consumer stated that there were no objects on top of the dresser and the drawers were filled with clothing such as shirts, underwear, socks, etc. as shown in Figure 94. The consumer demonstrated the incident scenario by pulling out seven (7) of the eight (8) drawers and partially pulling out the eighth drawer as shown in Figure 94.

PHOTO #5: This photo demonstrates how the child was opening the drawers on the day of the incident. According to the father all these drawers were open and his son went to open the last one.

PHOTO #6: This photo shows just after the father started opening the last drawer on the bottom the dresser came immediately forward. During the recreation, the entire incident took just a few seconds.

PHOTO #7: This photo shows the father catching the dresser during the recreation.

PHOTO #18: This photo was taken by the victim's father and shows the clothing in the dresser on the day of the incident (the dresser has since been moved).

Figure 94. Photo 5, 6, 7, and 18 from IDI 160322CBB3496. Consumer demonstration of tip over incident and drawer fill.

ES staff considered the following scenario of a child opening multiple filled drawers.

Scenario 5: *Child Opens All Drawers (starting from top to bottom), Drawers Fully Filled with Clothing.*

Analytical Modeling: ES staff developed ***Scenario 5*** based on the analysis of IDI 160322CBB3496. ***Scenario 5*** [11] considers that the child opens all the dresser drawers starting from the top and moving to the bottom. ES staff modeled all drawers of the dresser *fully filled* with clothes. ES staff estimated the weight of the clothing in the drawers using the ASTM proposal of 8.5 pounds/cubic foot of interior volume of the drawer.[12] Table 17 shows the estimated weight calculation for each drawer of the dresser.

Table 17. Estimated Weight Added to Each Drawer Filled with Clothing Based on Interior Volume of Each Drawer (8.5 pounds per cubic foot).

	Drawer interior dimensions and volume (measured)			Volume of Drawer (cubic feet)	Weight of clothes = Volume x 8.5 pounds/cubic foot	No of drawers	Total weight inside drawer row (pounds)
	Length (inches)	Depth (inches)	Height (inches)				
Top Drawer	11.31	17.06	6.63	0.74	6.29	4	25.16
Middle Drawer	25.50	17.06	6.63	1.67	14.18	2	28.36
Bottom Drawer	25.50	17.06	9.56	2.41	20.47	2	40.94
Total weight inside drawers =							94.46

Based on the calculations in Table 17, ES staff modeled the dresser13 with 5 pounds per top drawer (four drawers, total weight = 20 pounds), 15 pounds per middle drawer (two drawers, total weight = 30 pounds), and 20 pounds per bottom drawer (two drawers, total weight = 40 pounds). Figure 95 and Figure 96 show the calculated CG location for ***Scenario 5***.

[11] ES staff developed ***Scenario 5*** based on the analysis of IDI 160322CBB3496
[12] In 2019, the ASTM task group tested the stability of dressers with filled drawers. The task group used 8.5 pounds per cubic feet (inside volume of the drawer) to simulate the weight of clothing in a drawer. Refer to Tab L.
[13] Model based on the physical dimensions of an exemplar unit sample 19-420-0014

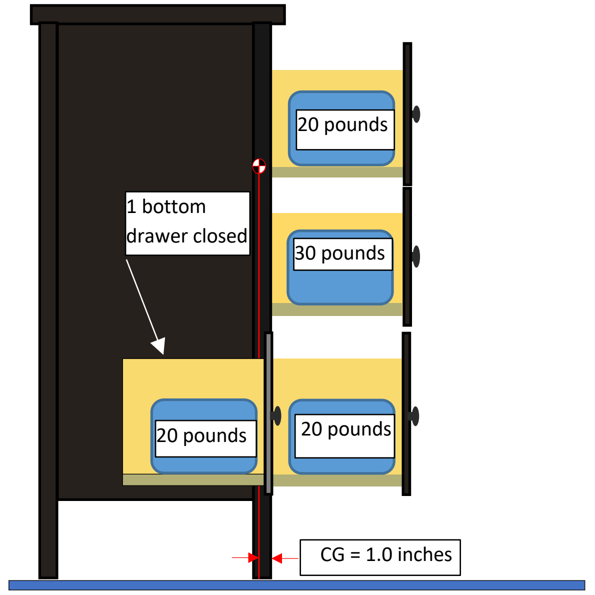	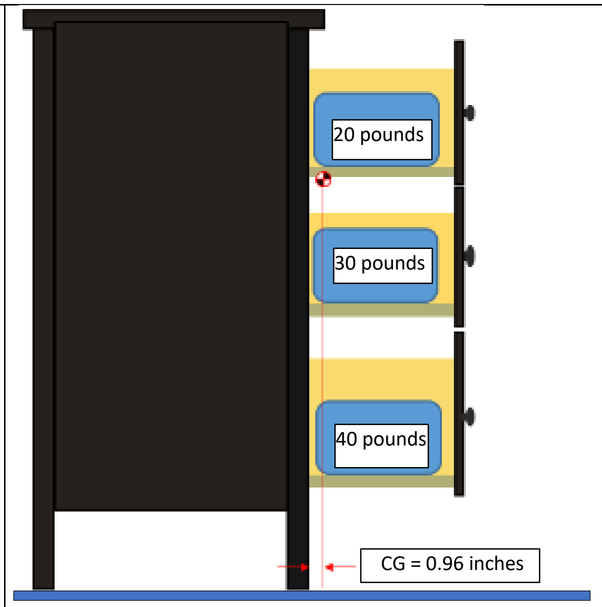
Figure 95. Drawers loaded with clothing weight. Seven (7) of eight (8) drawers open, and one (1) bottom drawer closed, CG = 1.0 inch behind the front leg, and the dresser is stable (does not tip)	Figure 96. Drawers loaded with clothing weight. Eight (8) drawers are open, CG = 0.96 inches in front of the front leg and the dresser is unstable (resulting in tip over).

The orange data line (-●-) in Figure 97**.** shows the calculated CG of the dresser with drawers filled with clothes and the drawers opened from the top to the bottom. As shown Figure 97, with seven (7) of the eight (8) drawers open, as the 8th drawer (last bottom drawer) is opened, the CG of the dresser moves in front of the front legs to 0.54 inches and into the unstable condition (tip over).

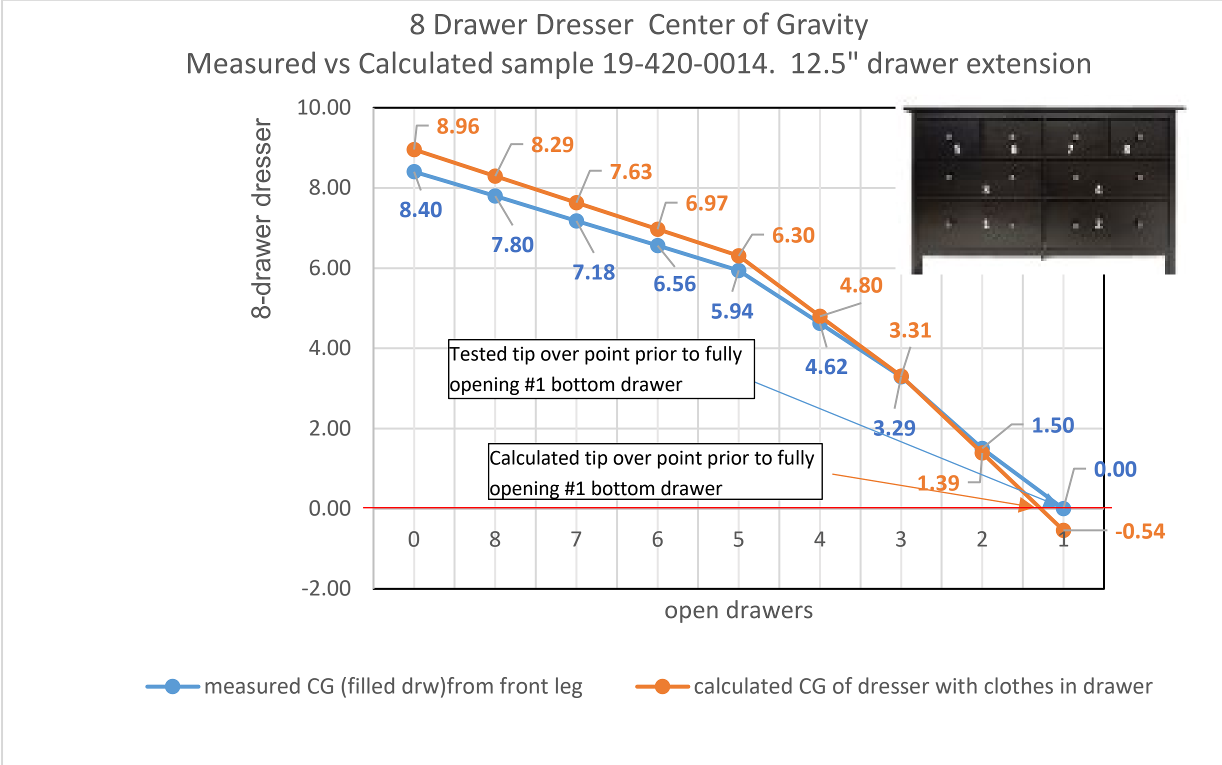

Figure 97. Dresser CG (distance to the front leg of dresser) vs. Number of Open Drawers (opening each drawer starts from the Top right drawer (#8) and proceeds to the Bottom left Drawer (#1). Weight inside drawers (4 total): Top = 5 pounds per drawer, Middle =15 pounds per drawer, Bottom = 20.

Modeling conclusion: The analyses for ***Scenario 5*** indicates that the dresser filled with clothes, with a 12.5-inch drawer extension and all eight drawers are opened, the dressers becomes *unstable* and therefore tip over occurs.

Validation Testing: ES staff tested exemplar Sample 19-420-0014 by extending the drawers to 12.5 inches and loading the drawers with barbell weights (5 pounds per top drawer, 15 pounds per middle drawer, 20 pounds per bottom drawer). ES staff determined that the dresser remains *stable* and upright but tip over is *imminent* with seven (7) of eight (8) drawers open and one bottom drawer (drawer #1) partially open to 9.875 inches as shown in Figure 98 and Figure 99. When the bottom drawer is extended beyond 10.625 inches, the dresser tips over.

The blue data line (-●-) in Figure 97**.** shows the measured CG of the dresser loaded with the 90 pounds of equivalent clothing weight. As shown in Figure 97, these measured results correlated well with the calculated results.

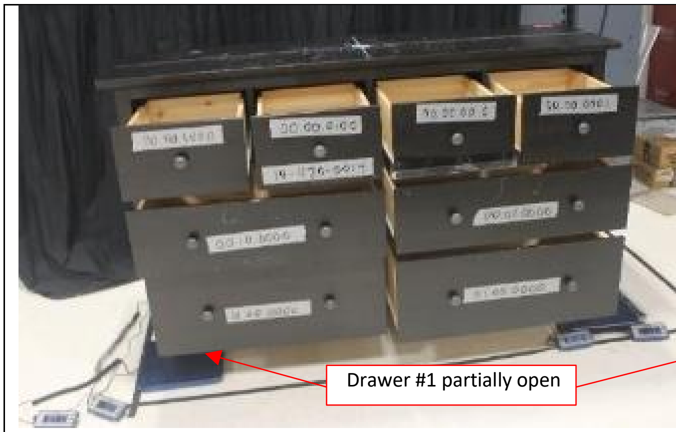	
Figure 98. Dresser drawers loaded to simulate clothing weight: 5 pounds per top drawer, 15 pounds per middle drawer, and 20 pounds per bottom drawer. In this condition, most of the dresser weight is on the front feet and tip over is imminent (Rear left scale = 0 pounds, Rear right scale = 1.25 pounds).	Figure 99. Close up of bottom left drawer (#1) of loaded dresser (as shown in Figure 70), when partially open/extended to 9.875 inches. Tip over is imminent with most of the weight on the front feet of the dresser.

Testing Conclusion: These tests confirmed the analytical model for ***Scenario 5*** which indicates that a dresser filled with clothes and all eight (8) drawers are opened, the dresser is *unstable,* and therefore tip-over would occur.

Summary: For ***Scenario 5***, ES staff reviewed the information in IDI 160322CBB3496. Every drawer of the dresser in this incident was filled with clothing. ES staff estimated the weight of the clothing using the proposed ASTM specification of 8.5 pounds per cubic foot. This totals to approximately 90 pounds of equivalent clothing weight added to the empty dresser weight to recreate the incident. Using physical dimensions of an exemplar unit (Sample 19-420-0014), ES staff calculated the CG of the dresser relative to the front leg as ES staff opened each loaded drawer. Calculations showed that when ES staff opened all eight (8) drawers, the dresser's CG moved *in front of* the front leg to an *unstable* condition resulting in the dresser tipping over. ES tested exemplar Sample 19-420-0014 by loading the dresser with barbell weights to simulate the estimated weight of clothing in the drawers. The dresser tipped over with all eight (8) drawers opened, confirming ES staff's calculations. ES staff concludes that this incident most likely occurred in the following sequence:

1. All drawers filled with clothes (weighted).
2. Child opens seven (7) of the eight (8) drawers.
3. As the child pulls open the last drawer (bottom left drawer), the dresser becomes *unstable* and begins to tip.
4. Once all eight (8) drawers are open, the CG of the dresser moves *in front of* the front leg causing the dresser to tip over onto the victim.

Section 7. IDI 190205CCC1154 and IDI 170131CCC3408, Child Pulling on the Top Drawer, NO clothes in Drawers.

ES staff reviewed IDI 190205CCC1154 and 170131CCC3408 indicating that the child pulled on the top drawer causing the dresser to tip over.

IDI190205CCC1154

Synopsis: A 5-year-old male had two drawers open on his eight drawer dressers when it tipped over. The drawers and top surface of the dresser were damaged during the tip over. The 5-year-old male was not injured during this incident.

Victim: A 5-year-old male, weight and height unknown. The child was not injured.

Product: 8 Drawer Dresser in Black Brown, Model #40239274. The consumer reported that she purchased the dressers in 2015 or 2016. This date indicates that the drawer extension was 12.6 inches to12.7 inches. The dresser was place on a carpeted floor.

IDI 170131CCC3408

Synopsis: *A 6 year-old male uninjured after opening top drawer of dresser that tipped over. Incident reported to retailer who picked up unit and refunded purchase to consumer*.

Victim: A 6-year-old male, weight and height unknown. The child was not injured.

Product: 8 Drawer Dresser in White. The consumer reported that he purchased the dresser approximately one year prior to the incident date (incident occurred on November 22, 2016). ES staff concluded that because the dresser was manufactured prior to November 2016, the maximum drawer extension was 12.6 inches to 12.7 inches. The dresser was placed on a carpeted floor.

These two IDIs indicated that the child pulled on the top drawer causing the dresser to tip over. ES staff analyzed these incidents using the following assumptions and dresser characteristics:

- Dresser weights and CGs were similar to the exemplar sample 19-420-0014 with a 12.5 inches drawer extension (pulled out beyond the first stop) and incident sample 20-800-0665 with a drawer extension of 12.78 inches.
- Two (2) top drawers opened and the remaining six (6) drawers closed.
- Four (4) top drawers opened and the remaining four (4) drawers closed
- Dresser drawers were empty (no clothing weight)
- Dresser placed on a carpeted surface

Using the above assumptions, ES staff considered the following ***scenario 6*** of a child pulling on the top opened drawers (two (2) or four (4) top drawers) while the remaining drawers are closed.

Scenario 6: *Child Pulls on Open Top Drawer at a 45 Degree Downward Angle.*

Analytical Modeling: For **Scenario 6**, as shown in Figure 102, ES staff calculated the pull force a child would need to exert to tip over the dresser with the force located on the top drawers at a 45-degree angle.

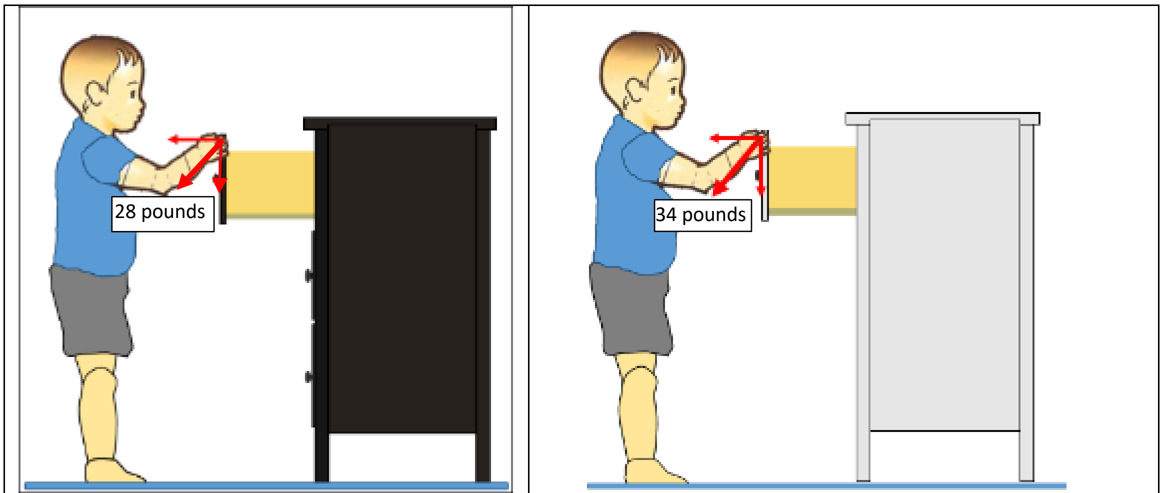

Figure 100. Two (2) Top drawers extended, child pulls on drawer with 26.58 pounds at 45 degrees on a hard floor (122-pound, sample 19-420-0014) and 34 pounds at 45 degrees (148-pound, sample 20-800-0065).

Table 18 shows the tip over force calculations for the 122-pound exemplar sample 19-420-0014 and the 148-pound incident sample 20-800-065 with either two (2) top drawers open, or four (4) top drawers open.

Table 18. Pull Force Required to Tip Over Dresser

Sample (all drawers empty, no carpet)	Weight of dresser (pounds)	Top drawer height from floor (inches)	Drawer extension (inches)	Tip over force at 45 degrees, two top drawers open (pounds)	Tip over force at 45 degrees, four top drawers open (pounds)
19-420-0014 (black)	122	34.5	12.5 (pulled beyond stops)	26.6	22.6
20-800-0665 (white)	148	34.5	12.8	34.0	30.0

Modeling Conclusion: The analyses for ***Scenario 6*** indicate that a child exerting a 22 to 30 pound pull force on an open, top drawer at a 45-degree angle with two (2) to four (4) top drawers open, will cause the dresser to tip over.

Validation Testing: ES staff tested exemplar sample 19-420-0014 (122-pound) to determine the pull force required to tip over the dresser. As shown in Figure 101, ES staff placed each foot of the dresser on a scale[14] to measure the load per foot. The drawers were empty (no weights) and two (2) top drawers were extended 12.5 inches from the dresser front surface. As shown in Figure 102, ES staff applied a gradually increasing pull force on the open top drawer at approximately a 45-degree angle. Consistent with the analysis, at an applied force of approximately 25 pounds (28 pounds calculated), the dresser began to tip over.

Figure 101. Sample 19-420-0014 (weight = 122 pounds), two (2) top drawers open.

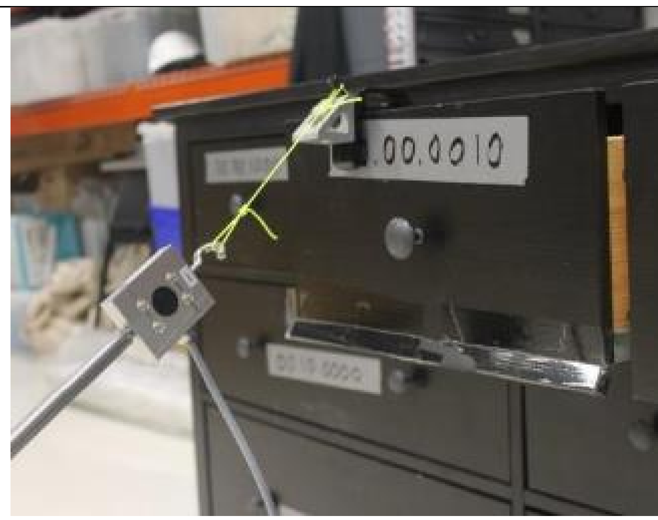

Figure 102. Approximately 25 pounds applied at 45 degrees on the top drawer caused tip over.

Then, as shown in Figure 103, ES staff placed the same dresser (sample19-420-0014) onto a 0.40-inch-thick carpet pad and repeated the pull testing.

[14] Acutek Model ACB440, accuracy +/- 0.05 pounds scales were used to determine the tip over point by monitoring the rear scales. Tip over occurs when both scales read 0 pounds.

Figure 103. Sample 19-420-0014 placed on carpet pad and floor scale (left). Close-up foot on carpet pad on floor scale (right).

When ES staff repeated the pull tests with the carpet pad under each dresser foot, a pull force of approximately 23.8 pounds applied at approximately 45 degrees on the top drawer caused tip over. ES staff concluded that when the dresser is located on carpet padding, instead of on a hard floor, a slightly lower pull force will tip over the dresser.

Testing Conclusion: These tests confirmed the analytical model for ***Scenario 6***, which indicates that a child pulling on the top open drawer with a pull force of approximately 23.8 pounds, can tip over the dresser.

Summary Conclusion: For ***Scenario 6***, ES staff calculated and measured the pull force required to tip over the 8-drawer dresser with two or more top drawers open as described in IDI 190205CCC1154 and IDI 170131CCC3408. If the child pulled on the top drawer with a downward force of approximately 23 to 34 pounds at a 45-degree angle, the dresser would tip over. If the same dresser were placed on carpet padding, the tip over pull force would be slightly lower or easier for a child to tip over.

Section 8. IDI 170103CFE0001 – Two, 2-year old Children (Twins) Climbing on the Dresser.

Synopsis: An 8-drawer dresser tipped over when two 2-year-old boys attempted to climb up the front of it. The dresser landed on top of one of the boys but neither boy sustained injuries that required medical attention.

Victims: 2-year-old male twin brothers (two male children). The mother estimated their weights to total 72 pounds. The height of the children was not reported. Neither child was injured.

Product: 8-drawer dresser. Sample was not obtained. The incident occurred on December 30, 2016. Based on samples, ES staff determined that the dresser's drawer extension were likely 12.6 inches to 12.7 inches.

This incident was captured in an on-line video and a CPSC investigator interviewed the mother (IDI 170103CFE0001). The IDI report stated:

> On December 30, 2016, twin, two-year-old, brothers were attempting climb up the front of an unsecured eight drawer dresser in their bedroom. They pulled out the middle drawers and tried to traverse the dresser by climbing inside. The combined weight of the two, approximately 72 pounds, pulled the dresser forward and on top of one of them.

ES staff estimated each twin child weighed 36 pounds (total weight of 72 pounds). Based on the video analysis (). ES staff determined that one child climbed or hopped up the side of the left extended middle drawer and one hopped up onto the front of the right extended middle drawer. Figure 104 shows the two middle drawers were empty and therefore ES staff assumed that all drawers were empty.

	
A. Child (left) hops up onto middle drawer from side of dresser.	B. Child (right) is seen completely off the floor with full weight of 36 pounds in drawer – dresser remains upright.
	
C. Child (right) hops up onto middle drawer.	D. Both children are off the floor, full weight of both children on the dresser (72 pounds).
	
E. Dresser begins to tip over.	F. Dresser fall on children.

Figure 104. Stills from video showing tipover. NOTE: visible faces are blurred.

To evaluate this incident, ES staff considered the following possible Scenario of two (2) children climbing up the side and front of the dresser, with the middle drawers open and all drawers empty (no weight).

***Scenario** 7: Two Children (Twins) Climbing on Dresser*

Analytical Model: For ***Scenario** 7*, as shown in Figure 105, ES staff modeled one 36-pound child (child #1) climbing up the side of the dresser using the open drawers as footholds. At the same time, as shown in Figure 106, a second 36 pounds child (child #2, the twin brother) climbs up the front of the dresser by hopping up onto the middle drawer. ES staff used the weights and dimensions of sample 20-800-0655 to model the dresser.

As shown in Figure 105, ES staff calculated the Center of Gravity (CG) of the dresser/child combined as the child #1 climbs the side of the dresser. This is similar to the child climbing from the side in ***Scenario 1a*** except the child is heavier (36 pounds versus 31 pounds) and based on the video analysis, ES staff determined the that child#1 was climbing closer to the front of the drawer than in the middle. ES staff estimated the CG of child#1 to be about two (2) inches from the front (10.7 inches from the dresser front leg/foot as shown in Figure 105). Based on the UMTRI report, ES staff estimated the maximum force on the dresser drawer due to the dynamic effect of the child #1 climbing the side of the dresser to be approximately 30% of the child's body weight (or 1.3 times body weight)[15].

ES staff calculated the CG of the dresser/child #1 combined unit to be 2.8 inches *behind* the front leg and a *stable* condition (no tip over). As shown in the video stills (Figure 104), one child climbing up from the side will not cause tip over when multiple drawers are open, because the CG of the dresser/child combined unit is *behind* the front leg and *stable*.

Figure 105 depicts video stills A and B from Figure 104. Figure 106 shows child #1 climbing up into the left middle drawer as child #2 hops up on the front edge of the right middle drawer. ES staff determined that a tip over would occur if both children simultaneously climbed up the side of the dresser and hopped up on the front middle drawers. Both children would exert dynamic forces onto the dresser as they climb and hop up onto the drawers. Child #1 applies 1.3 times his body weight at middle of the drawer extension, while child #2 applies 1.6 times his body weight at the front edge of the right middle drawer[16]. ES staff calculated the CG of the dresser/child #1/child #2 combined unit moves forward from a stable location 2.8 inches *behind* the front leg (Figure 105) to an *unstable* location 0.74 inches *in front* of the front leg (Figure 106) causing the dresser to tip over.

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[15] Reed, Matthew P., Ebert, Sheila M., Jones, Monica L.H, July 2020, "Forces and Postures During Child Climbing Activities" University of Michigan Transportation Research Institute (UMTRI), prepared for US Consumer Product Safety Commission, contract No. 61320618D000451, page 51, figure 48, Ascent data - a maximum vertical force (upper bound of ascent box) equivalent to 1.3 times the body weight of the child.

[16] IBID, page 50, figure 47, ES staff estimated Hop Up maximum moment/body weight for 30-40 lbs. children = 1.6-times body weight.

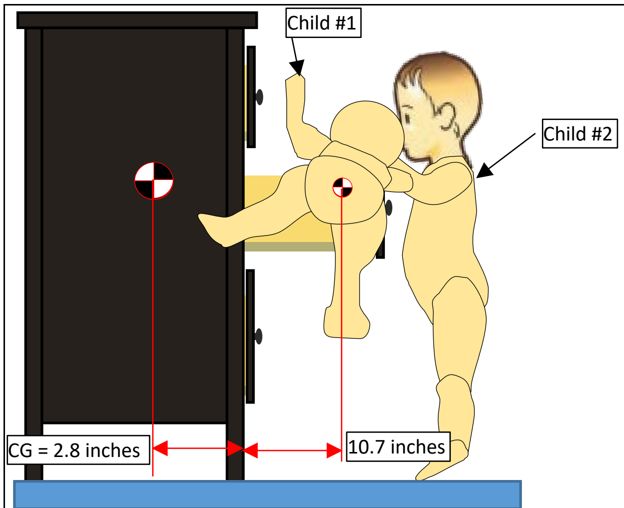


Figure 105. Child #1 climbs up into the middle drawer near the front of the drawer. The dynamic force created by the hop up of Child #1 is1.3 times his body weight (36 x1.3 = 46.80 pounds). This results in the CG of the dresser/child #1 combined unit to 2.8 inches behind the front leg and a stable condition (no tip over).

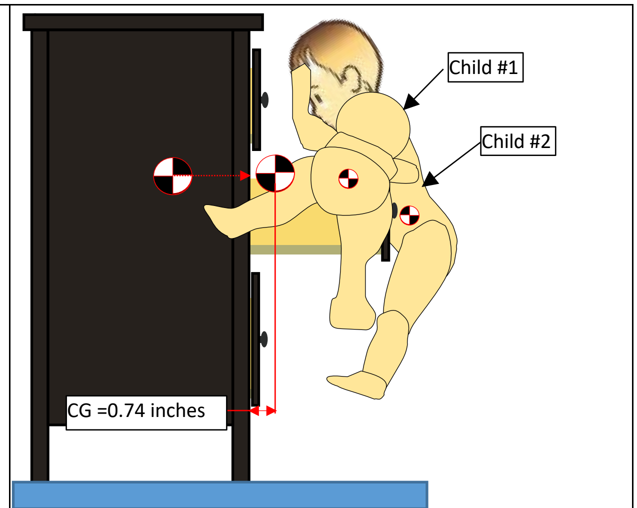


Figure 106. Child #2 simultaneously hops up onto the front of the drawer. The dynamic force created by the hop up of Child #2 is1.6 times his body weight (36 x 1.6 = 57.60 pounds). This results in moving the CG of the dresser/child #1/child #2 combined unit forward from a stable location 2.8 inches behind the front leg (Figure 82, dresser/child #1) to an unstable location 0.74 inches in front of the front leg, causing the dresser to tip over.

Modeling Conclusion: For ***Scenario 7***, based on calculations and video of the incident, ES staff determined that an 8-drawer dresser (weight of 123 pounds), with two (2) middle drawers extended 12.5 inches, will remain *stable* when one 36-pound child (child #1) climbs up the side (Figure 105). If a second 36-pound child (child #2) simultaneously hops up and applies his weight to the front of an open drawer (Figure 106), the dresser/child #1/child #2 combined unit will become *unstable* and will tip over.

Section 9. Effects of Carpeting

Of the 6 IDIs reviewed in this report four of the dressers were on carpet, two were on hardwood and one IDI did not report the flooring type. In the previous section, ES staff modeled the dressers on a hard surface. The tip over force was dependent on the horizontal distance of the CG of the dresser/child combined unit from the dresser's front leg.

A dresser on carpet tends to tilt forward if the CG is closer to the front legs (typical of most dressers) rather than the rear legs. The tip over force and stability for a dresser on carpet decreases as the tilt angle of the dresser increases due to the carpet compression. Dresser with higher CGs (top heavy) are less stable than dressers with a lower CG as the tilt angle increases.

In this section, ES staff determined that a dresser tested on a 1.5 -2-degree incline tips over with a similar force when testing the same dresser on a carpet/pad surface.

Testing on Carpet/Pad

LSM staff conducted tip over testing of the sample 19-420-0014 on a carpet/pad surface and hard surface. Table 19 show the tip over force for the dresser with all drawers open on carpet/pad and hard surface.

Table 19. Tip Over Force for Sample 19-420-0014, Empty, All Drawers Open

Test	Carpet/Pad (lbs.)	Hard Surface (lbs.)	Difference (lbs.)
1	15	20	5
2	15	19	4
3	15	19	4
4	15	20	5

ES staff conducted testing and analysis to determine if testing the dresser on an inclined surface would be an appropriate surrogate for testing on carpet. The testing and geometric analysis shows that the sample dresser placed on a carpet/pad can tilt forward about 2 degrees due to the compression of the carpet/pad (see appendix for analysis)

ES staff modeled an empty dresser on an incline as shown in Figure 107. The model inputs were the measured CG_Z height and calculated CGY of sample 19-420-0014.

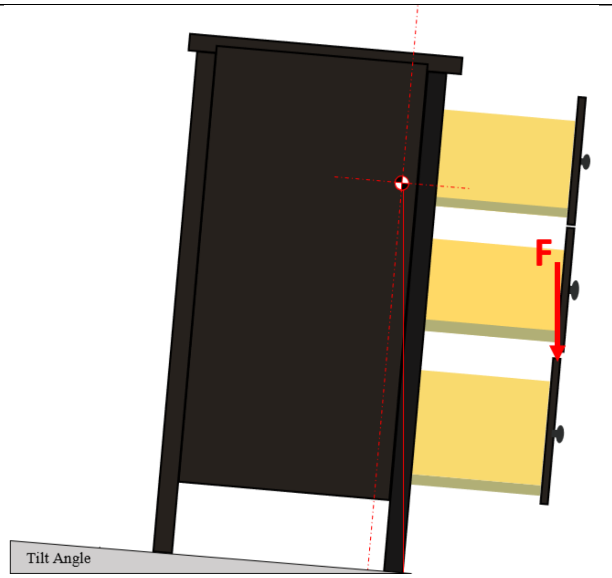


Figure 107. Tip over Force F with the dresser on an Incline.

Figure 108 shows the calculated tip over force F for a dresser with all drawers open versus the tilt angle.

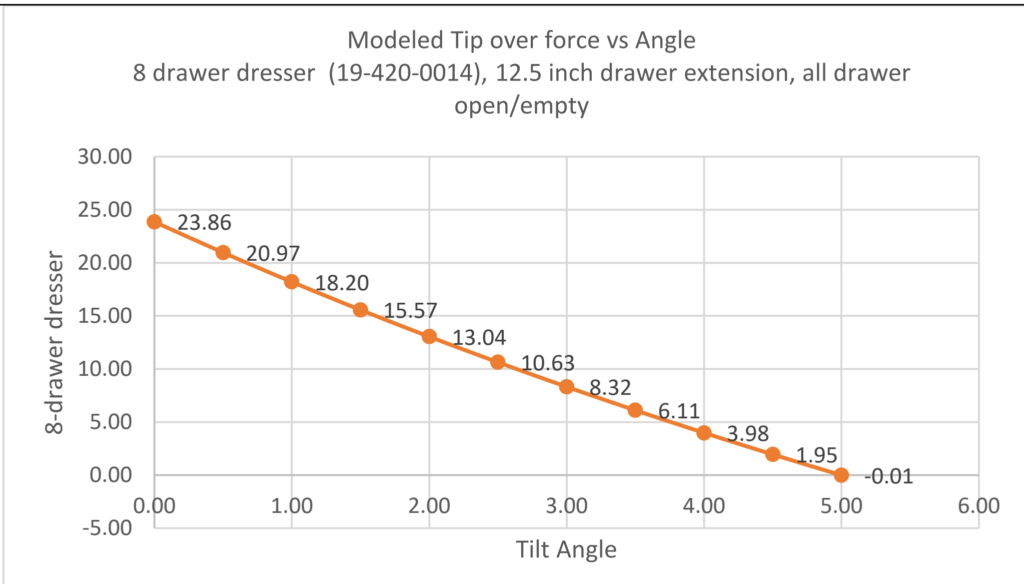


Figure 108. Calculated Tip Over Force vs Tilt Angle.

Effects of Carpeting Conclusion: ES staff concluded that a dresser placed on a 1.5 - 2-degree incline will tip over when a similar force is applied as when testing the same dresser on a carpet/pad surface. Therefore, testing on an incline is a reasonable surrogate to testing on a carpet/pad surface.

Section 10. Potential Modifications to Improve Stability

ES staff considered the following potential product modification (Figure 109) to improve the tip over stability of the 8-drawer dresser:

1. Add a drawer interlock feature that prevents more than one or two drawers from opening.
2. Reduce the drawer extension.
3. Install a foot extension.
4. Add front feet leveler to tilt the dresser back.
5. Add a counter balance weight to the lower back of the dresser.

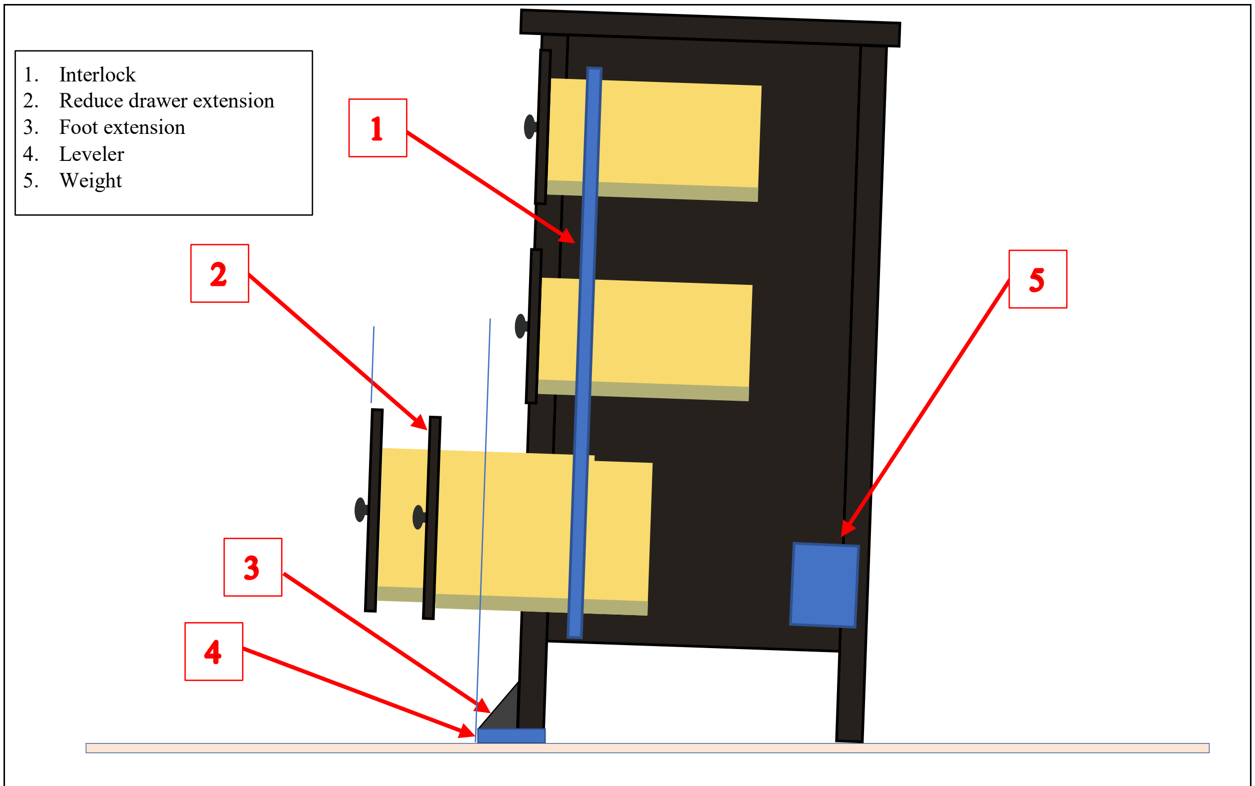


Figure 109. Modifications to improve stability.

ES staff evaluated the effectiveness of the stability by modeling the 8-drawer dresser with a combination of modifications. ES staff compared the dressers actual tip over moment to a minimum acceptable moment:

$$M_{minimum\ acceptable} = \text{child's weight} \times [1.0806 \times (\text{drawer extension} - \text{foot extension}) + 0.5244]$$

For the baseline 8-drawer dresser, with a 11.5-inch drawer extension, no foot extension and a 51.2 pound child ascending:

$$M_{minimum\ acceptable} = 51.2 \text{ lbs} \times [1.0806 \times (11.5/12 \text{ ft.} - 0 \text{ ft.}) + 0.5244] = 79.87 \text{ ft-lbs.}$$

This moment value was based on a 95th percentile 3-year-old male climbing (ascending) the dresser as described in Tab D. Table 20 shows the modifications to the 8-drawer dresser (baseline) needed to improve the dresser to a minimum acceptable stability.

Table 20. Modification to Improve Stability

Modification	Mmin = Minimum acceptable tip over moment (lb-ft) required for 51.2 lbs child	M = Actual tip over Moment of product (foot-pounds) M>Mn (pass)	Fmin = Minimum acceptable tip over force on extended drawer (lbs.) for 51.2 lb child	Ftip = Actual tip over force of the product on extended drawer (lbs.) Ftip >Fmin	Interlock Yes/No (number of open drawers)	Drawer extension (inches)	Decrease from 11.5 (inches)	Foot extension (inches)	Counter weight (pounds)	Front Leveler Height (inches)
Baseline	79.87	72.47 (fail)	83.34	75.32 (fail)	No (8)	11.5	0	0	0	0
#1	79.87	79.95 (pass)	83.34	83.42 (pass)	Yes (1)	11.5	0	0	0	0.485
#2	78.00	78.04 (pass)	84.62	85.09 (pass)	Yes (2)	11	0.5	0	5	0.75
#3	79.62	75.26 (pass)	86.01	90.99 (pass)	Yes (2)	11.5	0	1	0	0.5
#4	75.26	75.44 (pass)	86.01	86.22 (pass)	Yes (2)	11	0.5	0.5	0	0.5
#5	65.12	65.82 (pass)	94.14	95.16 (pass)	No (8)	10	1.5	1.7	20	1
Note: Dresser modeled with empty drawers if less than 3 bottom drawers can open due to an interlock feature. If all drawers can open (no interlock), dresser modeled with filled drawers. Tip over moment Pass/Fail criteria: M >51.2[1.0806X(drawer extension)+ 0.524]lb-ft (pass)										

Conclusion: ES staff evaluated some simple modifications concepts that could improve stability of the 8-drawer dresser to meet potential minimum tip over moment requirements. ES staff compared the modified dresser's resultant tip over moment to the minimum acceptable moment in the draft proposed rule. This moment value was based on a 95th percentile 3-year-old male climbing (ascending) the dresser (see Tab D). Five modification examples were presented; however, these examples do not represent all possibilities, especially stability features that could be incorporated during the initial design of the dresser.

General Findings

1. **The 8-drawer dresser meets the ASTM F2057 – 19 standard**. The 8-drawer dresser meets the ASTM F2057 – 19 stability requirements, Section 7.1 *Stability of Unloaded Unit*, and Section 7.2 *Stability with Load.* The standard requires that the dresser remains upright and does not tip over when:

    a. Section 7.1 - all drawers are extended at once, with all drawers are empty.
    b. Section 7.2 - with all drawer empty, a 50-pound load is place on one (1) extended drawer, repeat test for each drawer.

    The CSU meets the ASTM standard because the *empty* dresser remains upright when a 50-pound weight is placed on the edge of one open drawer. The tip weight of the *empty* 8-drawer dresser with one drawer open is 83 pounds for a 11.5 inch drawer extension and 76 pounds for a 12.5 inch drawer extension. The 8-drawer dresser exceeds the ASTM stability requirements; however, the ASTM standard does not address real world scenarios, such as multiple drawers opened, filled drawers or dynamic forces due to a child climbing the dresser.

2. **Tip over occurs when multiple drawers are open.** For the all the hazard scenarios analyzed, multiple drawers of the dresser needed to be extended or *open* to cause the unit to tip over.

3. **Stability Analysis** – More *stable* dressers can withstand a larger force/weight on the edge of an open drawer without tipping over. ES staff characterized the tip over propensity or stability of the dresser by calculating the downward force on the edge of the drawer required to cause tip over (see Figure 110 and Figure 111). Larger tip over forces means a heavier weight on the edge of the dresser drawer is required to induce tip over. Therefore, larger tip over forces correspond to better stability. Tip over forces can be created by the weight of a child standing on or in the drawer, dynamic forces due to the child climbing (ascending) using the extended drawers as foot holds, or pulling or pushing down on the drawer.

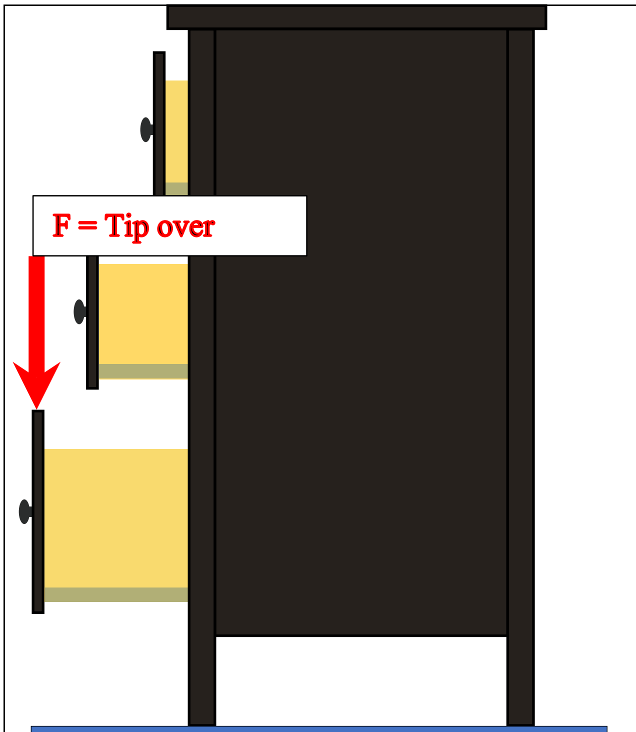


Figure 110. Tip over force F (empty drawers)

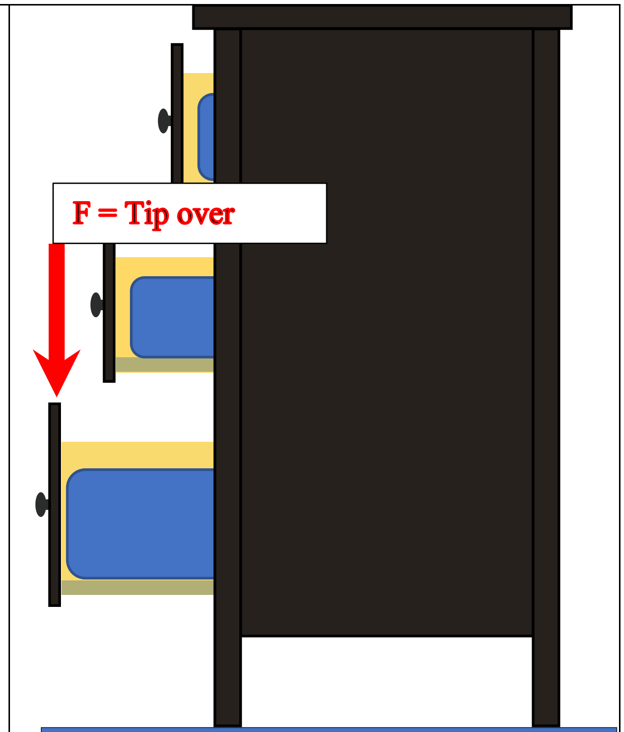
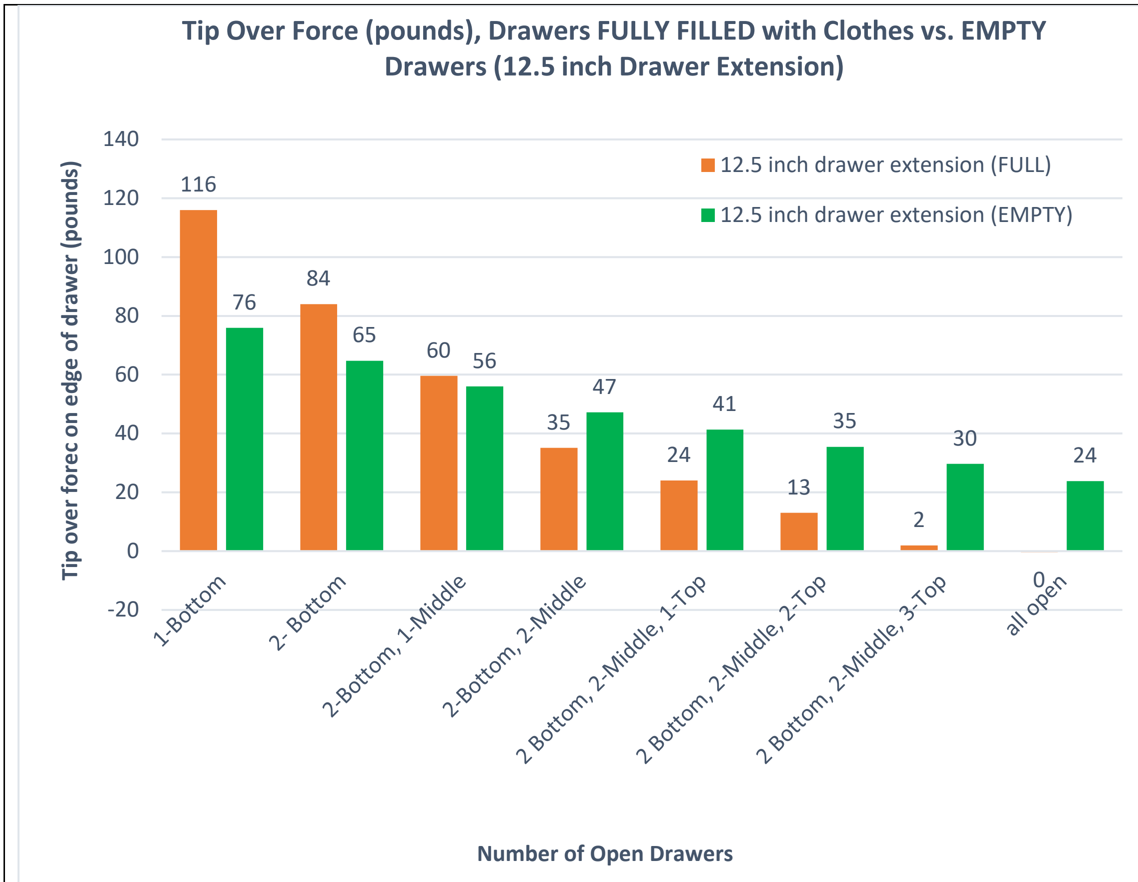


Figure 111. Tip over force F (filled drawers)

4. ***Filled* versus *empty* drawers and the number of drawers open affect the stability of the dresser.** ES staff estimated that clothing inside a *fully filled* drawer weights about 8.5 pounds/cubic feet of interior drawer volume. [17] For the 8-drawer dresser, the estimated clothing weight for each drawer was; 20 pounds per bottom drawer, 15 pounds per middle drawer and 5 pounds per top drawer. A *fully filled* dresser can hold about 90 pounds of clothes. Figure 112 shows a comparison of required tip over force between a *filled* dresser and an *empty* dresser with a 12.5-inch drawer extension.

[17] Calculated fill weights per drawer: Bottom drawer = 20 pounds, Middle drawer = 15 pounds, Top drawer = 10 pounds



Notes:

1. Clothing weight: 20 pounds per bottom drawer (40 pounds total), 15 pounds per middle drawer (30 pounds total), 5 pounds per top drawer (20 pounds total). Total clothing weight = 90 pounds.
2. The tip over force calculated assuming the drawer filled with clothing weighing about 8.5 pounds/cubic feet of interior drawer volume.

Figure 112. Comparison of tip over force between a filled dresser and an empty dresser with a 12.5-inch drawer extension.

By comparing the tip over forces for a dresser with *empty* drawers to a dresser with *filled* drawers, ES staff determined that a dresser with both *filled* or *empty* drawers becomes less *stable* as more drawers are opened. However, the relative tip over force or stability for a *filled* versus *empty* dressers is dependent on the number of open/closed drawers. Figure 112 shows a **higher** tip over force (more *stable*) for *filled* dresser with **less than** three (3) of the lower drawers open and as more drawers are opened, the *filled* dresser becomes less *stable.*

This analysis shows:

- The 8-drawer dresser with empty drawers is less stable than the same dresser with fully filled drawers if less than 50% (by fill weight) of the drawers are opened. The 8-drawer dresser with less than three empty lower drawers (2 bottom, 1 middle) open, will be a less stable dresser than a fully filled 8-drawer dresser with the same drawers open.

- The 8-drawer dresser with fully filled drawers is less stable than the same dresser with empty drawers if more than 50% (by fill weight) are opened. A 8-drawer dresser with more than three fully filled lower drawers (2 bottom, 1 middle) open, will be a less stable dresser than an empty 8-drawer dresser with the same drawers open.

5. **The fully filled 8-drawer dresser can unexpectedly tip over if more than four (4) lower drawers are open.** A child can climb (ascend) an 8-drawer dresser without tipping it over if only three lowers (two (2) bottom and one (1) middle drawers are open), but the dresser will tip over with the dresser if the four (4) lower drawers (two (2) bottom and two (2) middle drawers) are open. The filled dresser may appear stable to the consumer with the four (4) drawers open because pressing down (with less than 35 pounds) on the open drawer will not cause the dresser to tip.
6. **A 31-35 pound child climbing up the dresser, will result in tip over of the dresser/child for a dresser with *fully filled* drawers and the 4 lower drawers open**. As discussed in 5, the stability of the dresser is dependent on the drawer *fill* weight and the number of the drawers open. Figure 113 shows a 31-pound child climbing (ascending) the dresser. The equivalent force on the edge of the drawer consist of child's weight (31 pounds) the dynamic force due to climbing and the effects of the child's CG extending beyond the edge of the drawer. Based on the UMTRI report, ES staff estimated the equivalent force to be 1.6 times the weight of the child or about 50 pounds (1.6 x 31 pounds).[18]

[18] Analysis based on Reed, Matthew P., Ebert, Sheila M., Jones, Monica L.H, July 2020, "Forces and Postures During Child Climbing Activities" University of Michigan Transportation Research Institute (UMTRI), prepared for US Consumer Product Safety Commission, contract No. 61320618D0004. Tab R.

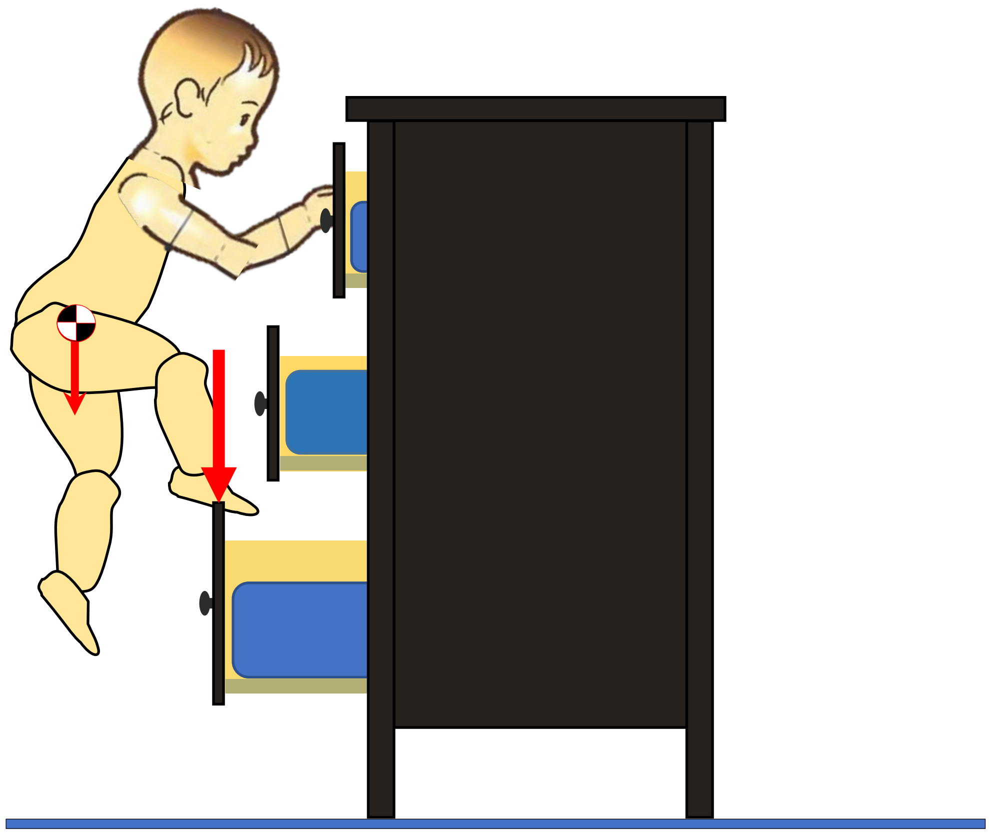


Figure 113. Equivalent force on the edge of the drawer consist of child's weight (31 pounds) the dynamic force due to climbing and the effects of the child's CG extending beyond the edge of the drawer.

Figure 114 shows the tip over force for various open drawers, filled with clothes as a 31 pound child climbs steps up onto the open drawers. If only one bottom drawer is open, an additional 79 pounds can be applied to the edge of the drawer for the shorter 11.5 inch drawer extension and 46 pounds for the longer 12.5 inch drawer extension. The one drawer open is a very stable condition even with a child climbing on the dresser. As more drawers are opened the additional tip over force decreases as shown in Figure 114. If the two bottom drawers and two middle drawers are open, the dresser will tip over as the child climbs (ascends) the front of the dresser.

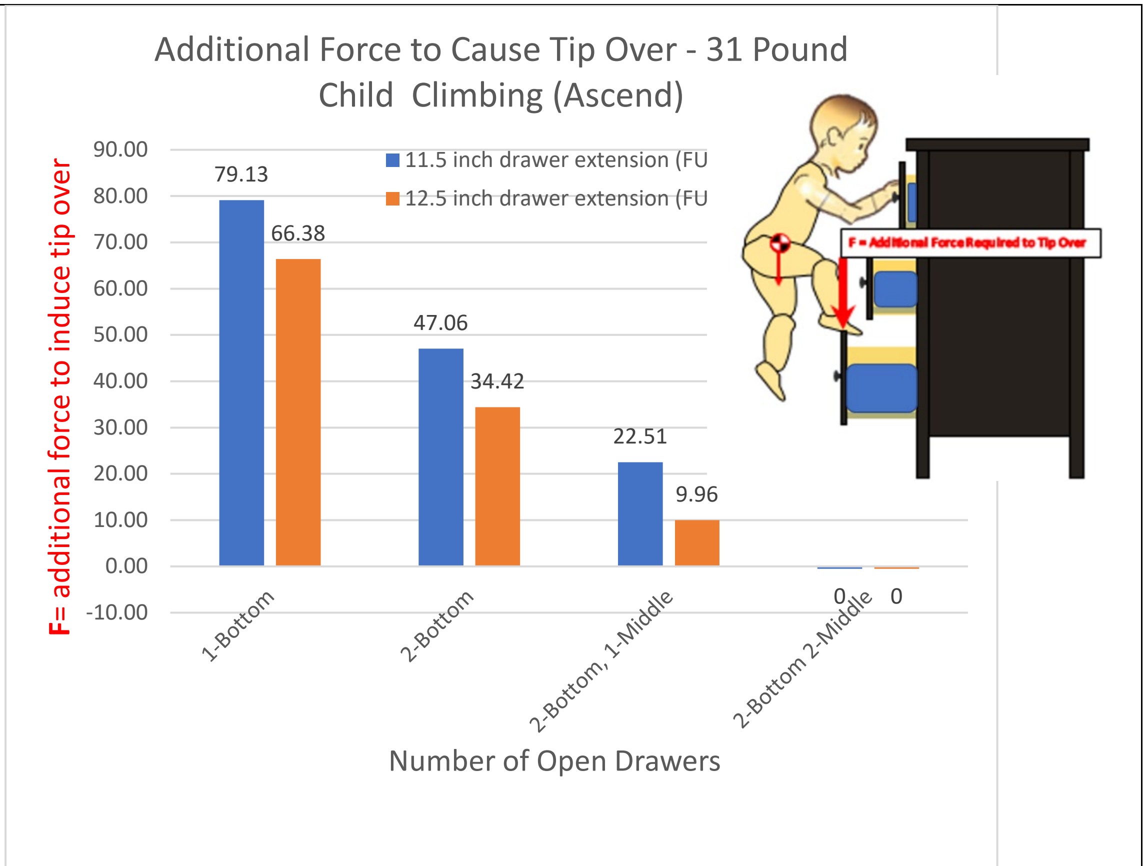


Figure 114. Force F required to induce tip over while a 31-pound child climbs (ascends) the front of the dresser.

Figure 115 is pictorials of Figure 114 showing a child climbing the dresser with various opened drawers. ES staff analysis shows dressers (with a 12.5 inch or 11.5 inch drawer extension) will tip over when the two (2) bottom and (2) middle drawers are open and a 31 pound child climbs (ascends) using the drawer edge as a step.

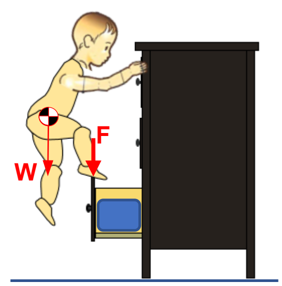
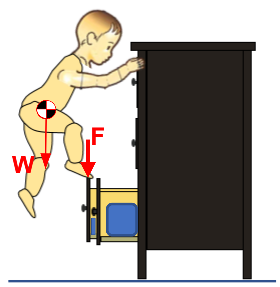
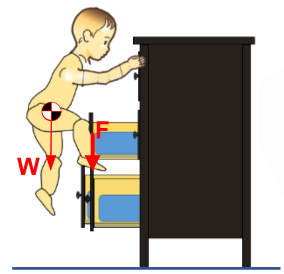
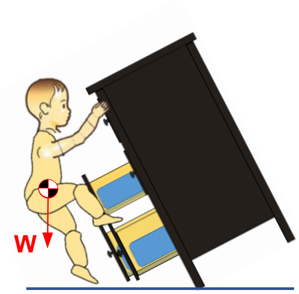
			
One (1) bottom drawer open. **Additional force to cause tip over:** **F** = 79 pounds (11.5-inch drawer extension) **F** = 46 pounds (12.5-inch drawer extension) **Dresser/Child *Stable***	Two (2) bottom drawers open. **Additional force to cause tip over** **F** = 47 pounds (11.5-inch drawer extension) **F** = 25 pounds (12.5-inch drawer extension) **Dresser/Child *Stable***	Two (2) bottom drawers + one (1) middle drawer open. **Additional force to cause tip over** **F** = 22.5 pounds (11.5-inch drawer extensions) **F** = 8 pounds (12.5-inch drawer extension) **Dresser/Child Borderline *Stable***	Two (2) bottom drawers + two (2) middle drawers open. **Additional force to cause tip over** **F**= 0 pounds for both (11.5 and 12.5-inch drawer extension) **Dresser/child tips over, *unstable***

Figure 115. Child climbing dresser (1 – 4 drawers open), W = 31-pound child ascending, F = additional force to induce tip over.

Appendix: Testing and Analysis of Dresser Stability on a Carpet/Pad Surface

Dresser Testing on a Carpet/Pad Surface:

ES staff conducted test and analysis of the sample dresser 19-420-0014 on a carpet/pad surface to understand how the dresser behaves on carpet/pad and the mechanism that effect stability.

As shown in Figure 116, ES staff placed a carpet/pad /scale under each leg of the sample 19-420-0014. The drawers were extended to 12.5 inches and 30-pound barbell weights were placed in the bottom drawers to create a near tip over condition. During this test, the dresser tilted forward about 2 degrees and the rear scales indicated that rear legs are carrying less than 2 pounds of the dresser's total weight (122 pounds). The Center of Gravity (CG) was calculated to be about 0.2 inches behind the leading edge of the front feet. This indicated that the dresser was near the tip over point and a downward force of less than 3 pounds on the edge of an extended drawer would result in tip over.

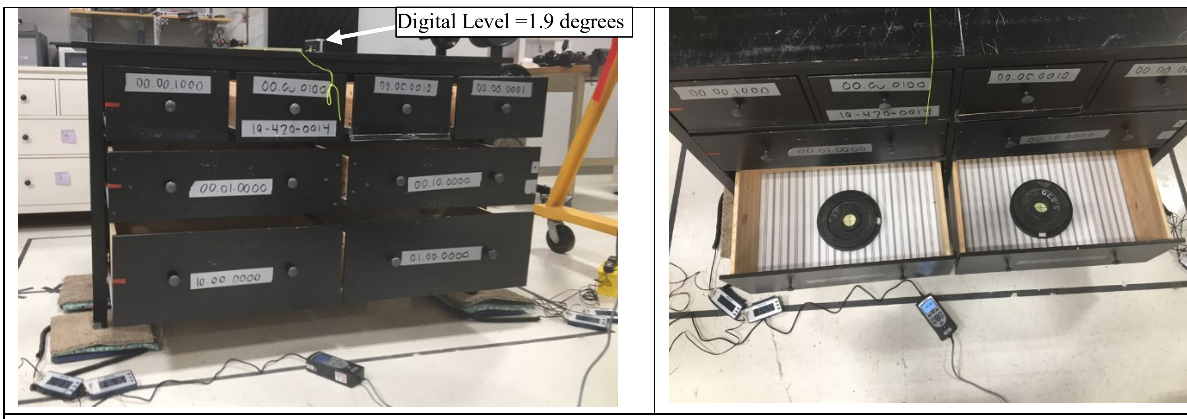


Figure 116. Test setup - Sample 19-420-0014 placed on carpet, pad, scales, all drawers open, bottom drawer filled with 30 pounds.

Figure 117 and Figure 118 shows the left rear and left front leg with the dresser in the same configuration shown in Figure 116 (drawers open and 30 pounds placed in the bottom drawers). As shown in Figure 117, the rear leg has lifted to the top of the carpet pile. ES staff placed a witness mark on the rear leg when the dresser was empty and the drawers closed. ES staff placed a second witness mark on the rear leg after opening all the drawers and placing 30 pounds of weight in the bottom drawers. The dresser was close to tipping over in this configuration. ES staff measured the distance that the rear leg lifted to be 0.25 inches Figure 119.

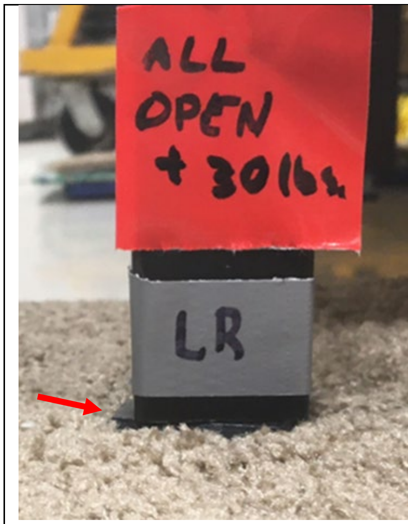


Figure 117. Left Rear leg lifted up to the top of the carpet pile

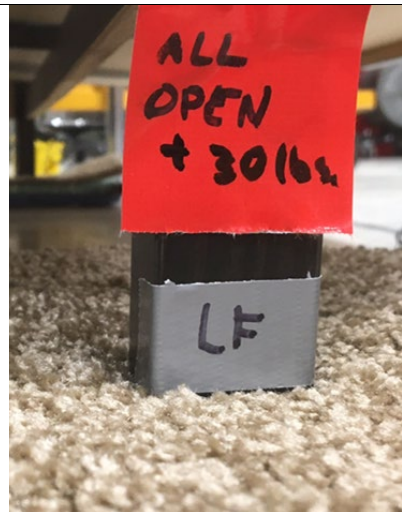


Figure 118. Left Front leg pushed down into the carpet/pad

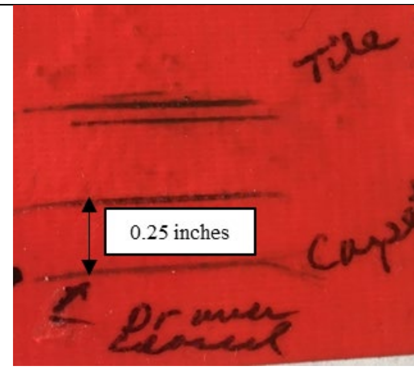


Figure 119. Witness marks

Geometric Analysis.

To confirm the effect of the carpet on the tilt angle of the dresser ES staff performed a geometric analysis of the dresser compressing the carpet/pad to achieve a tilt angle of 2 degrees as measured during testing.

Carpet and pad characteristics: LSM staff purchased carpet and padding shown in Figure 120 from the local big box DIY store. The padding consisted of a contractor grade, nominal 3/8 inch (0.4 inch measured, Figure 121) thick, 6-pound per square yard density and made from recycled material. The carpet was a polyester pile with a polypropylene backing as show in Figure 120 and measured about 0.56 inches thick (Figure 121).

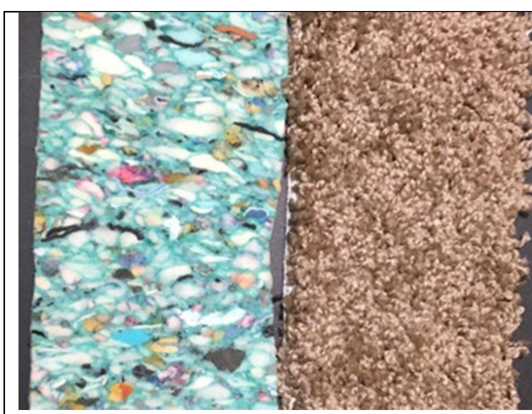


Figure 120. Padding and carpet

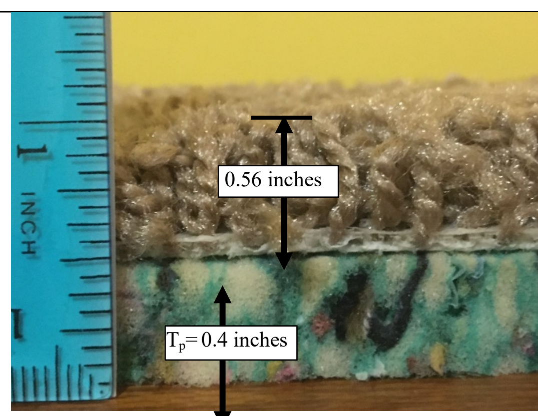


Figure 121. Carpet and pad thickness uncompressed

ES staff placed a light compression of about 1 psi load on the carpet/pad, as shown in Figure 122. The carpet compressed to 0.25 inches. The pad did not compress significantly under the 1 psi load. The height of the carpet/pad under light compression is 0.65 inches. This is the initial height of the carpet/pad. As shown in Figure 123, when the carpet/pad is compressed by a block tilted forward, the carpet/pad compresses to about 0.19 under the edge of the block. This shows that the front legs can sink into the carpet/pad about 0.46 inches from the original as the dresser tilts forward.

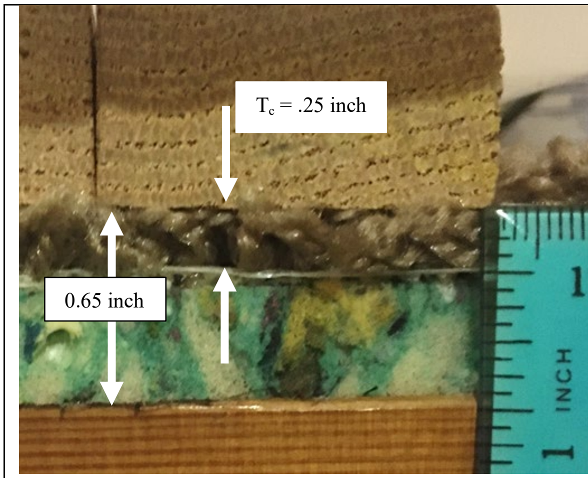
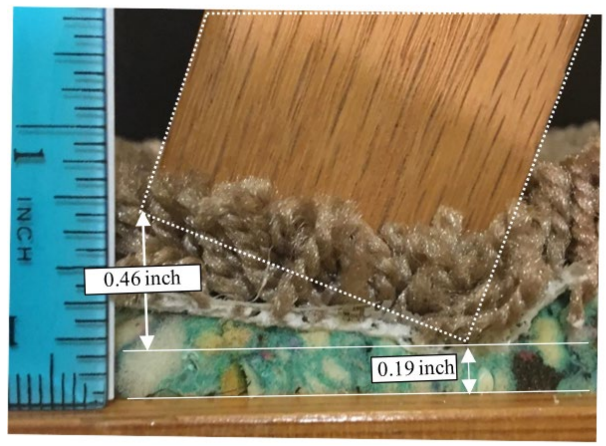
	

Figure 122. Lightly compressed carpet/pad – 1 psi. Carpet compresses to thickness = 0.25 inch and the total carpet/pad thickness = 0.65 inches.	Figure 123. Leading edge of 1.5 x 0.75 inch block compressing the carpet/pad showing tilt angle. Total compressed height of the carpe/pad is 0.19 inches

Tilt Angle on Carpet Analysis:

The above tests show that the dresser's rear leg lifts off about 0.25 inches when the bottom drawer is weighted with 30 pounds and the drawers are pulled out (figure 131-133) and the front legs can sink into the carpet/pad about 0.46 inches as the dresser tilts forward (figure 137). Figure 138 shows that the dresser with the rear legs lifting up 0.25 inches and the front legs sinking into the carpet/pad surface 0.45 inches will result in a tilt angle of 2.2 degrees. This analysis closely replicates the 1.9 degree tilt angle test results when the dresser is placed on a carpet/pad. Therefore, ES staff concludes that a dresser placed on a typical carpet/pad can tip forward up to 2 degrees due to the compression of the carpet/pad under the front legs.

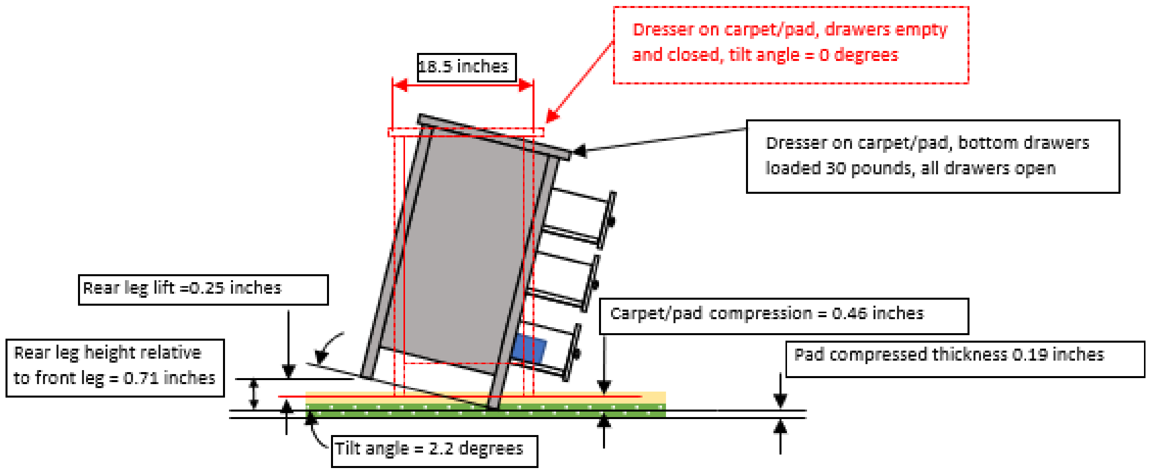


Figure 138. Tilt Angle of dresser Carpet/Pad (tilt angle and show carpet/pad not to scale)

Tilt angle model: ES staff modeled an empty dresser on an incline as shown in Figure 124. The model inputs were the measured CG_Z height and calculated CG_Y of sample 19-420-0014.

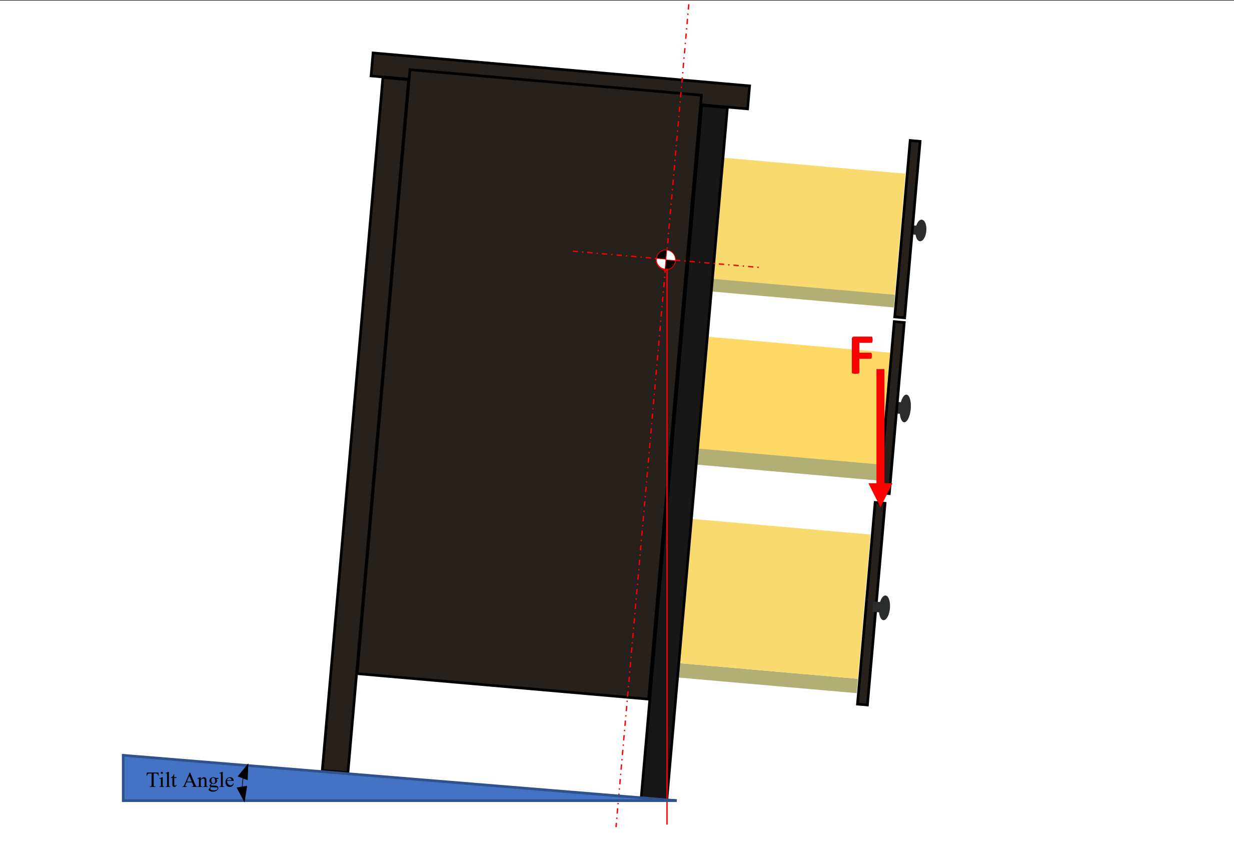


Figure 124. Tip over Force F with the dresser on an incline.

Figure 125 shows the calculated tip over force **F** for a dresser with all drawers open versus the tilt angle.

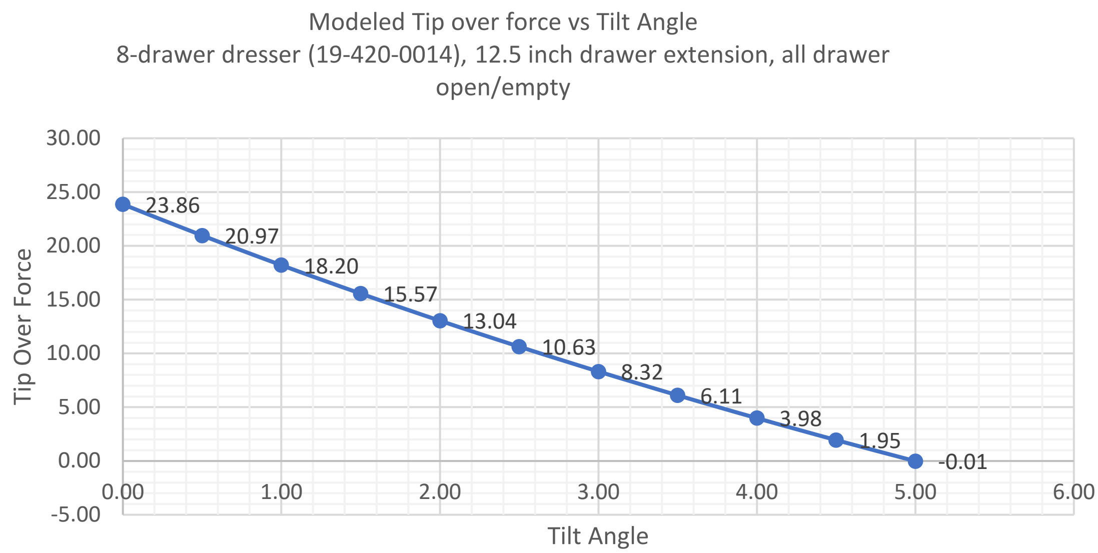
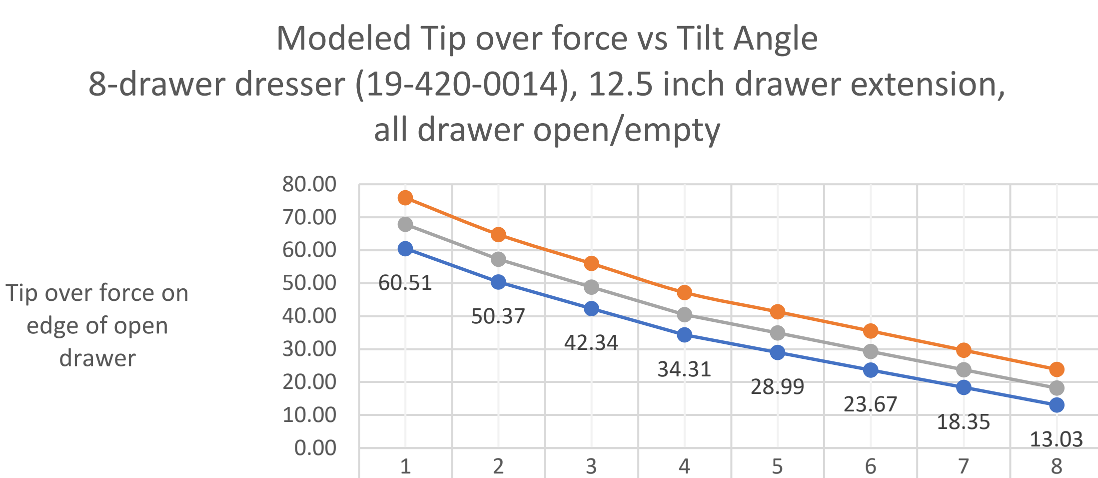


Figure 125. Calculated tip over force vs tilt angle.

Figure 126 shows the effects of 0^0, 1^0 and 2^0 tilt angles versus open drawers.



	1	2	3	4	5	6	7	8
tip over force at 0 degree tilt	75.88	64.77	55.96	47.16	41.33	35.50	29.67	23.83
tip over force at 1 degree tilt	67.84	57.24	48.84	40.44	34.87	29.31	23.75	18.18
tip over force at 2 degree tilt	60.51	50.37	42.34	34.31	28.99	23.67	18.35	13.03

open drawers

Figure 126. Tip over force vs tilt angle.

Validation Testing: ES staff tested exemplar sample 19-420-0014 (122-pound 8-drawer dresser) to determine the downward force on an extended drawer required to tip over the dresser. As shown in Figure 128 and Figure 129, each foot of the dresser was placed on a scale to measure weight, the drawers were empty (no weights) and the drawer extension was about 12.5 inches from the dresser front surface. The rear legs were raised on shims to incline the dresser. Figure 127 and Figure 128 shows the dresser on two (2) shims (.250-inch-thick each), raising the rear leg 0.5 inches above the surface of the scale. In this configuration the dresser was tilted 2.3 degrees when all the drawers were closed to 2.5 degrees when all the drawer were open. As shown in Figure 129 and Figure 130, ES staff applied a gradually increasing downward pull force on a clamp attached to the top edge of the open drawer. This test was performed with #1, #2, #3 and #4 bottom drawers open and then repeated with the remaining drawer opened one at a time. Testing could not be performed with less than four (4) drawers opened because the excessive force required to tip over the dresser was damaging the drawers and slides.

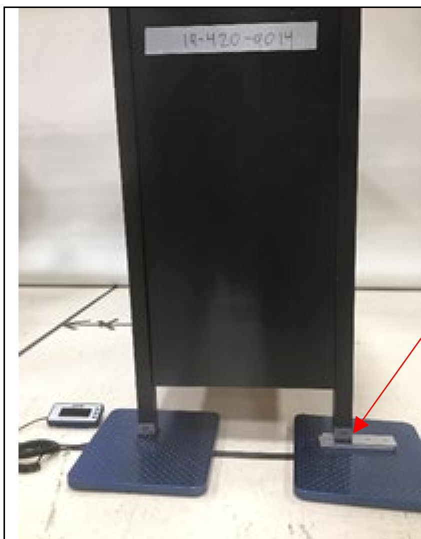


Figure 127. Inclined dresser test setup with shims under rear legs

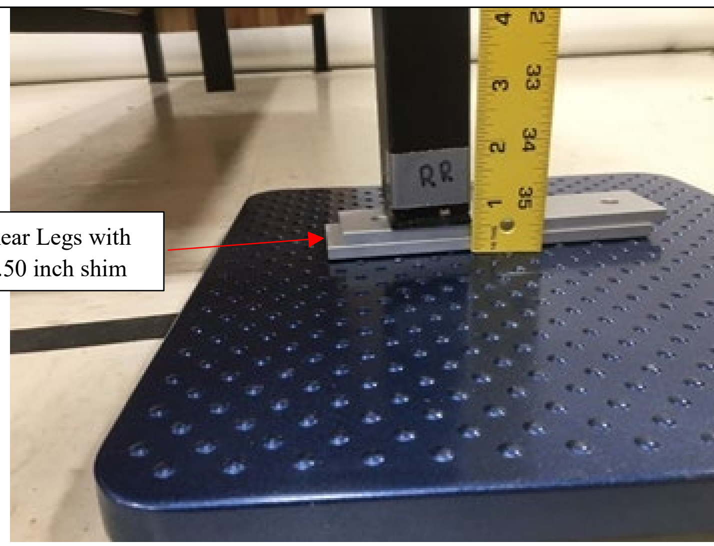


Figure 128. Close up of 0.50 inch shims (0.25 inch each) under the rear leg

	
Figure 129. Force gauge on drawer	Figure 130. Force gauge attachment

Figure 131 shows the calculated tip over force and the measured tip over force with the dresser's rear legs on 0.5 inch shims tilted to 203-205 degrees.

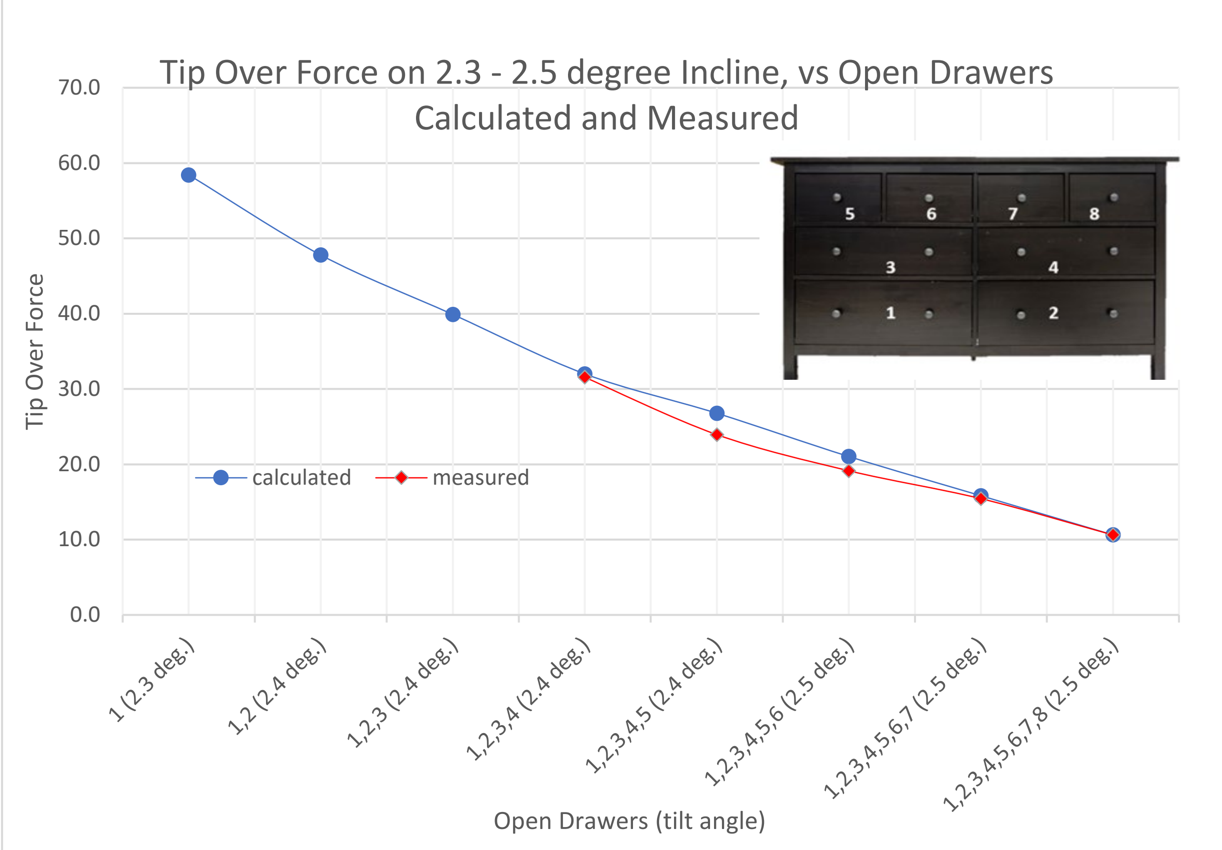


Figure 131. Measured and calculated tip over force vs opened drawers on a 2.3 – 2.5 incline.

Testing/modeling conclusion: The testing verified that the model of the dresser on an incline. Based on the model, a dresser on a 2-degree incline, all drawers empty and open would tip over with a force of 13 pounds, and a dresser on a 1.5-degree incline would tip over with a force of 15.6 pounds as shown in Figure 126.

MODEL F: 5-DRAWER CSU

Executive Summary

ES staff evaluated an incident sample of a five-drawer clothing storage unit (CSU) that was involved in a fatal incident and reviewed the In-Depth Investigation (IDI) related to the incident unit. As part of the analysis, ES staff determined the physical characteristics of the five-drawer unit by measuring: (1) the weight and center of gravity (CG) of each drawer; (2) the weight and center of gravity of the unit body (without drawers); and (3) the weight and center of gravity of the unit as each drawer was extended.

ES staff developed the most likely hazard scenario based on information obtained from the IDI, including: weight of the victim, unit dimensions, drawer slide extension distance, and interactions of the victim with the unit. ES staff conducted laboratory testing using weights and the incident sample to validate the hazard scenarios.

Critical Findings

1. **Incident occurred while multiple drawers were opened.** For the hazard scenario analyzed, multiple drawers of the unit needed to be extended or open to cause the unit to tip over.
2. **In a unit configuration based on the incident description (three filled top drawers and two empty bottom drawers), a 30-pound child can statically tip over the unit with three fully extended drawers (two empty bottom drawers and one filled drawer) and a 30-pound child climbing up the unit will result in tip over if the two bottom drawers are opened and one filled drawer is partially extended.** The unit tipped over when staff placed 30 pounds of weight on the edge of an open drawer when the unit was in the above configuration. The climbing equivalent force on the edge of the drawer consists of the child's weight, the dynamic force due to climbing, and the effects of the child's CG extending beyond the edge of the drawer. Staff estimated an equivalent force of 48 pounds (1.6 times the bodyweight[19]) can tip over the unit when the two bottom drawers are opened and one loaded drawer was partially extended.
3. **A unit on a carpet/pad is less stable than one on a hard level floor.** Compared to the tip over force measured on level floor, the tip over force measured when the unit was tilted approximately 1 degree was six to eight pounds less.
4. **The ASTM standard did not fully address the hazard scenario.** The test results of the five-drawer unit were not consistent. The CSU met sections 7.1 and 7.2 of ASTM F2057 – 19 in testing performed in 2017, but did not meet the ASTM sections 7.1 and 7.2

[19] Taxier, Daniel (2021). Mechanical Evaluation of Clothing Storage Unit (CSU) Tip-Over Research, Incidents, and Design Solutions, Contributing to Draft Proposed Rule for CSU Inherent Stability. Tab D, pg. 17.

tests for this analysis. For this analysis the unit tipped over when 48 pounds was applied to a single open empty drawer. However, in testing performed over 3 years earlier, the unit remained stable when 48.54 pounds was applied to a single open empty drawer. ES staff suspects the product configuration may have changed over time, resulting in at least a 0.54-pound difference in the tip over weight. ES staff considers this unit to be borderline meeting/not meeting the stability requirements. Staff found the ASTM standard did not address the following hazards occurring simultaneously:

a. multiple open drawers.
b. drawers filled with clothing.
c. children dynamic forces and extended center of gravity while climbing units.
d. unit placed on a carpeted surface.

Product

The incident clothing storage unit (CSU) is a 150-pound five (5) drawer dresser with overall dimensions: 50 inches Height, 35 inches Width, and 18 inches Depth. Figure 132 below is a photograph of the incident unit.

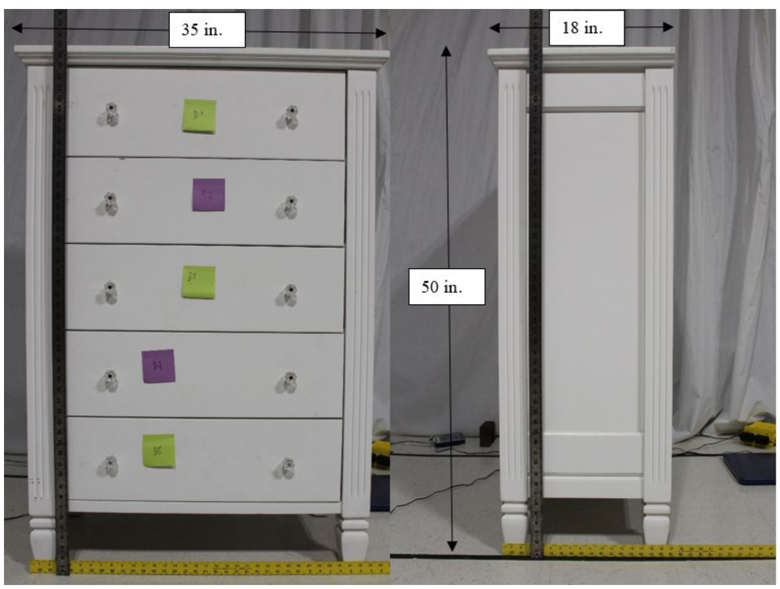


Figure 132 Photographs of incident unit with measurements.

Background

ESMC staff reviewed IDI 161025HFE0002, which summarized a police report of a fatal incident involving a three-year-old female and a CSU tip over (no eyewitnesses). According to the IDI summary, the victim was believed to have opened the bottom drawers and had attempted to climb the unit when it tipped over on her. The two bottom drawers were empty, the three top drawers were filled with clothing, and a picture frame was on top of the unit. The CSU was originally placed against a wall in a bedroom, and reportedly on medium pile carpet and pad. Tip over restraints were not installed.

Inspection, Examination, and Measurements

ESMC staff determined physical characteristics of the incident unit including: (1) overall unit dimensions, (2) dimensions of each drawer, (3) weights of each drawer, (4) weight of the unit with drawers removed, 5) the center of gravity (CG) of each drawer, and (6) the CG of the unit (see Table 21 and Figure 133).

The CG, as facing the front of the CSU, was located relative to the fulcrum or pivot point (origin of coordinate system, or 0,0,0 coordinate) of the unit. For this unit, the fulcrum was located at the contact point between the floor and the bottom of the left front leg. The CG for each drawer, was located relative to the lowest point of the left corner of the drawer.

Table 21. Summary of Physical Characteristics Measured for the Five-Drawer Unit

Weights	
Unit without drawers	85 lb.
Drawer 1	13.84 lb.
Drawer 2	12.50 lb.
Drawer 3	12.50 lb.
Drawer 4	12.50 lb.
Drawer 5	12.50 lb.
Clothing Equivalent Weight	10 lb.

Distances	
Unit CG to fulcrum	7.02 in.
Drawer CG to fulcrum	9.19 in.
Drawer CG to fulcrum	4.56 in.
Clothing Equivalent Weight to fulcrum when drawer is opened	7.00 in.
Clothing Equivalent Weight to fulcrum when drawer is closed	6.75 in.
Drawer Edge to fulcrum when drawer is opened	15.13 in.

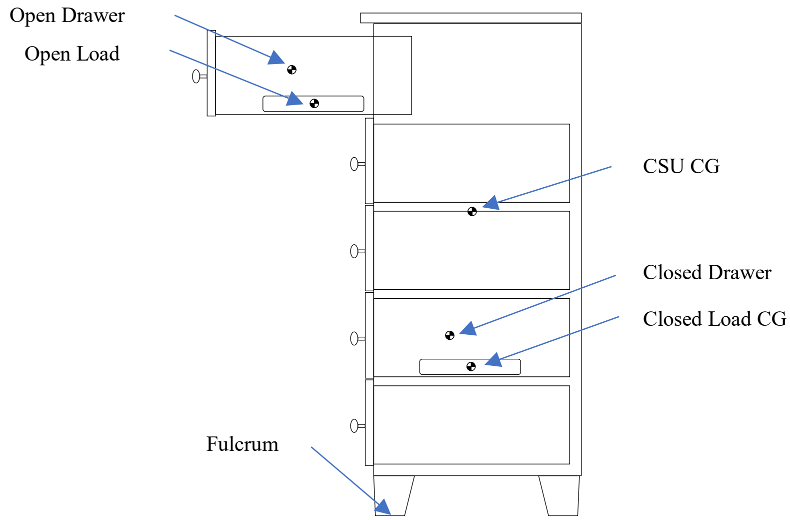


Figure 133. CSU (Not to Scale) CG locations and fulcrum.

During the inspection, staff observed that the plastic slide for the unit left rear foot was missing, as compared to the right rear foot. Plastic slides on the unit rear feet are fixed in height, whereas plastic slides on the unit front feet are adjustable in height. Height of the front feet plastic slides were set at the lowest position to configure the unit in the most forward leaning configuration for all physical characteristic measurements.

Stability Analysis

ESMC staff developed an analytical model to predict the weight (or force) necessary to cause the unit to become unstable (or tip over), and to calculate the dresser CG location during various configurations, including: (1) the number of drawers opened or closed, and (2) drawers empty, or filled with a clothing equivalent weight (see Table 22). The CG in the width, depth, and height dimensions were determined as CG_X, CG_Y, and CG_Z, respectively.

The clothing equivalent weight for the filled drawer configuration was approximated by multiplying the interior drawer volume by 8.5 pounds per cubic feet. This equated to approximately 10 pounds of weight added to each drawer.

Table 22. Calculated CG location and Tip Weight of Empty and Loaded CSU

Empty Clothing Storage Unit				
# of Open Drawers	CG_X (in.)	CG_Y (in.)	CG_Z (in.)	Tip Weight (lb)
0	15.06	5.97	27.06	
1	15.06	4.81	27.06	47.37
2	15.06	3.66	27.06	36.01
3	15.06	2.50	27.06	24.64
4	15.06	1.35	27.06	13.28
5	15.06	0.07	27.06	0.70

Loaded Clothing Storage Unit				
# of Open Drawers	CG_X (in.)	CG_Y (in.)	CG_Z (in.)	Tip Weight (lb)
0	15.06	6.17	26.56	
1	15.06	4.61	26.56	60.59
2	15.06	3.05	26.56	40.14
3	15.06	1.50	26.56	19.68
4	15.06	-0.06	26.56	-0.77
5	15.06	-1.71	26.56	-22.44

Additionally, in order to evaluate a fact-pattern similar to the incident description, a scenario was developed for analysis: the upper three of five total drawers were weighted with a clothing equivalent weight, and the remaining lower two drawers were empty. The CG location and tip weights are summarized in Table 23 below.

Table 23. Calculated CG Location and Tip Weight of CSU with Top Three Drawers Loaded and Bottom Two Drawers Empty.

Clothing Storage Unit – Top Three Drawers Loaded and Bottom Two Drawers Empty				
# of Open Drawers	CG_X (in.)	CG_Y (in.)	CG_Z (in.)	Tip Weight (lb)
0	15.06	6.10	28.10	
1	15.06	5.14	28.10	60.76
2	15.06	4.18	28.10	49.40
3	15.06	2.45	28.10	28.94
4	15.06	0.72	28.10	8.49
5	15.06	-1.12	28.10	-13.18

In order to simulate the effect of the dresser being on carpet as described in the incident, additional analyses at various angles of forward tilt[20] of the unit were calculated. For this incident scenario, the upper three of five total drawers were filled with a clothing equivalent weight, and the remaining lower two drawers were empty. Calculated tip weight and CG locations were determined using specific tilt angles measured in the laboratory. Table 24 below summarizes the calculated CG locations and tip weights.

[20] ESMC staff determined that a forward tilt angle of 0.8° to 3.0° can replicate the effects of carpet (Tab D).

Table 24. Calculated CG Location and Tip Weight of CSU with Top Three Drawers Loaded and Bottom Two Drawers Empty at 0.9, 2.07, and 2.83 Degree Tilts

Clothing Storage Unit at 0.9° Tilt – Top Three Drawers Loaded and Bottom Two Drawers Empty				
# of Open Drawers	CG_X (in.)	CG_Y (in.)	CG_Z (in.)	Tip Weight (lb)
0	15.06	5.67	27.15	
1	15.06	4.71	27.14	54.67
2	15.06	3.75	27.12	43.12
3	15.06	2.02	27.10	22.96
4	15.06	0.29	27.07	3.14
5	15.06	-1.54	27.04	-17.52

Clothing Storage Unit at 2.07° Tilt – Top Three Drawers Loaded and Bottom Two Drawers Empty				
# of Open Drawers	CG_X (in.)	CG_Y (in.)	CG_Z (in.)	Tip Weight (lb)
0	15.06	5.12	27.26	
1	15.06	4.16	27.23	47.07
2	15.06	3.20	27.19	35.42
3	15.06	1.47	27.13	15.77
4	15.06	-0.26	27.07	-3.19
5	15.06	-2.09	27.00	-22.56

Clothing Storage Unit at 2.83° Tilt – Top Three Drawers Loaded and Bottom Two Drawers Empty				
# of Open Drawers	CG_X (in.)	CG_Y (in.)	CG_Z (in.)	Tip Weight (lb)
0	15.06	4.75	27.33	
1	15.06	3.79	27.28	42.23
2	15.06	2.83	27.23	30.61
3	15.06	1.11	27.15	11.34
4	15.06	-0.62	27.06	-7.02
5	15.06	-2.45	26.97	-25.56

Laboratory Tests

As verification for the analyses, ESMC staff performed laboratory tests to measure the weight (or force) necessary to cause the unit to become unstable (or tip over), and to determine the unit CG location during various configurations, include: 1) the number of drawers opened or closed, and 2) drawers empty, or weighted with a clothing equivalent weight (see Table 25).

Test methods for determining the tip over weight included placing four scales under each of the four dresser legs, and then applying an increasing weight on the top edge of each open drawer. The unit CG location was calculated after measuring the weight distribution by using the four scales at the dresser feet. When a filled drawer was tested, the drawer was filled with the clothing equivalent weight of 10 pounds as a weight plate taped inside centrally at the bottom of the drawer.

Table 25. Measured CG Location and Tip Weight on Empty and Loaded CSU

Empty Clothing Storage Unit				
# of Open Drawers	CG_X (in.)	CG_Y (in.)	CG_Z (in.)	Tip Weight (lb)
0	15.06	6.18	26.26	
1	15.06	4.94	26.29	48
2	14.96	3.77	25.99	36
3	15.06	2.53	26.05	25
4	14.96	1.32	26.54	13
5				0

Loaded Clothing Storage Unit				
# of Open Drawers	CG_X (in.)	CG_Y (in.)	CG_Z (in.)	Tip Weight (lb)
0	15.32	6.55	24.99	
1	15.31	4.89	25.20	63
2	15.29	3.30	25.37	41
3	15.29	1.62	25.62	21
4				0
5				0

Additionally, testing was performed on the unit configured as described in the incident scenario (the upper three of five total drawers were filled with a clothing equivalent weight, and the remaining lower two drawers were empty). Figure 134 below is a visual representation of the unit configuration and Table 26 summarizes the measurements.

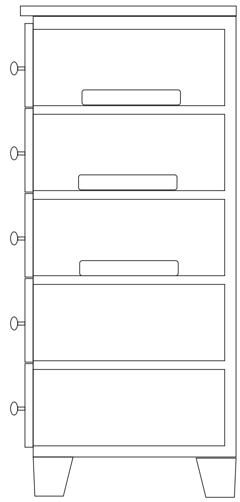


Figure 134. CSU with top three drawers loaded and two bottom drawers empty.

Table 26. Measured CG Location and Tip Weight of CSU with Top Three Drawers Loaded and Bottom Two Drawers Empty

Top three drawers loaded, bottom two drawers empty Clothing Storage Unit				
# of Open Drawers	CG_X (in.)	CG_Y (in.)	CG_Z (in.)	Tip Weight (lb)
0	15.38	6.39	26.64	
1	15.37	5.35	26.87	63
2	15.34	4.32	27.11	51
3	15.30	2.49	27.85	30
4	15.23	0.63	29.58	8
5				0

In order to simulate the effect of the unit being on carpet during the incident, additional tests at various angles of forward tilt of the dresser were performed (the rear feet of the dresser were raised using shims). For this incident scenario, the upper three of five total drawers were filled with a clothing storage equivalent weight, and the remaining lower two drawers were empty.

Figure 135 is a representation of the CSU tilted forward using shims. Measured tip weight and CG at the various tilt angles are shown in Table 27 below.

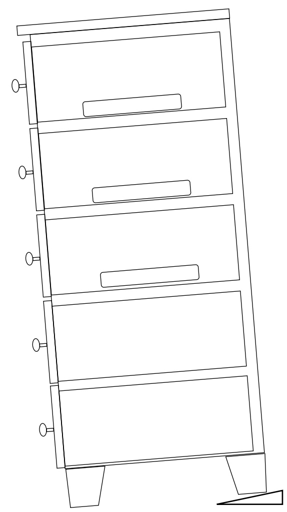


Figure 135. CSU tilted forward using shims.

Table 27. Measured CG Location and Tip Weight of CSU with Top Three Drawers Loaded and Bottom Two Drawers Empty at 0.9, 2.07, and 2.83 Degree Tilts

Top three drawers loaded, bottom two drawers empty Clothing Storage Unit – 0.9-degree tilt			
# of Open Drawers	CG_X (in.)	CG_Y (in.)	Tip Weight (lb)
0	15.31	5.93	
1	15.32	4.92	57
2	15.29	3.90	43
3	15.23	2.07	23
4	15.15	0.18	1
5			0

Top three drawers loaded, bottom two drawers empty Clothing Storage Unit – 2.07-degree tilt			
# of Open Drawers	CG_X (in.)	CG_Y (in.)	Tip Weight (lb)
0	15.29	5.32	
1	15.29	4.31	49
2	15.28	3.29	37
3	15.26	1.46	16
4			0
5			0

Top three drawers loaded, bottom two drawers empty Clothing Storage Unit – 2.83-degree tilt			
# of Open Drawers	CG_X (in.)	CG_Y (in.)	Tip Weight (lb)
0	15.29	5.32	
1	15.29	4.31	49
2	15.28	3.29	37
3	15.26	1.46	16
4			0
5			0

Calculated vs. Measured Comparisons

Graphical comparisons between calculated and measured data for tip weight are shown in Figure 136, Figure 137, and Figure 138.

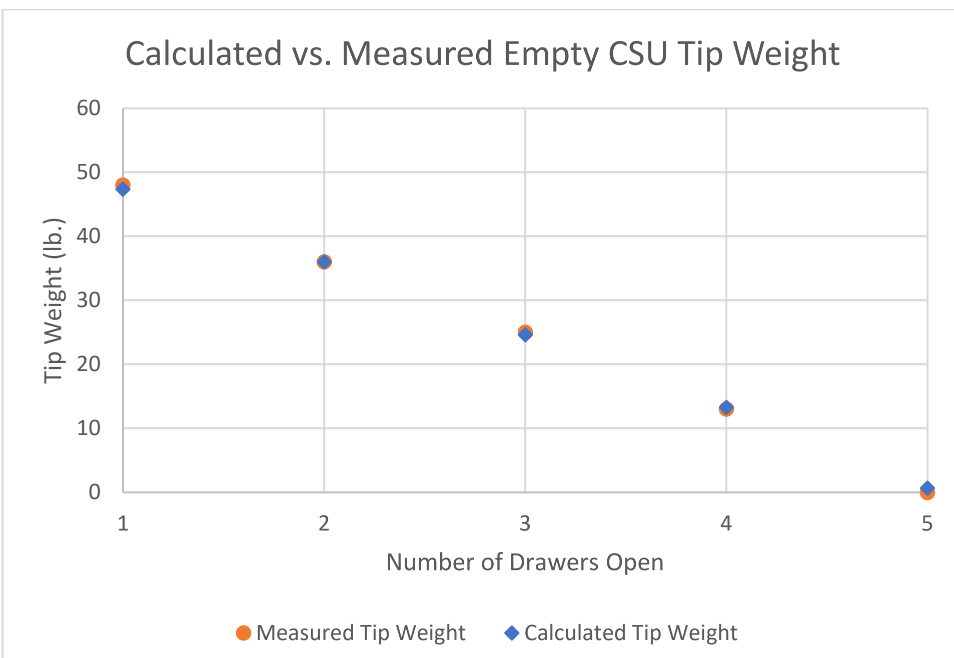


Figure 136. Calculated vs. measured tip weight for empty CSU.

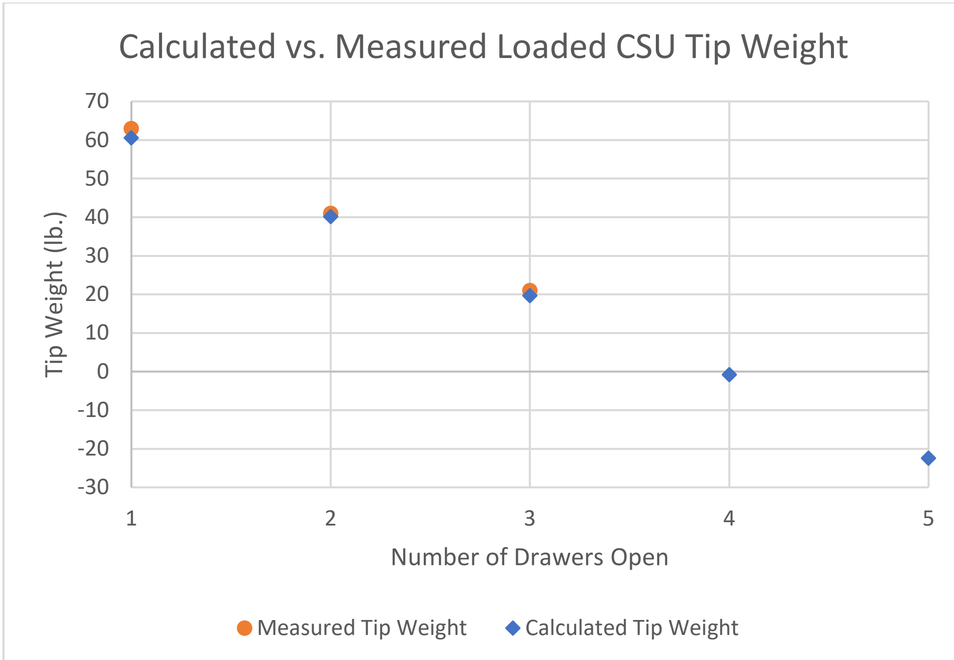


Figure 137. Calculated vs. measured tip weight for loaded CSU.

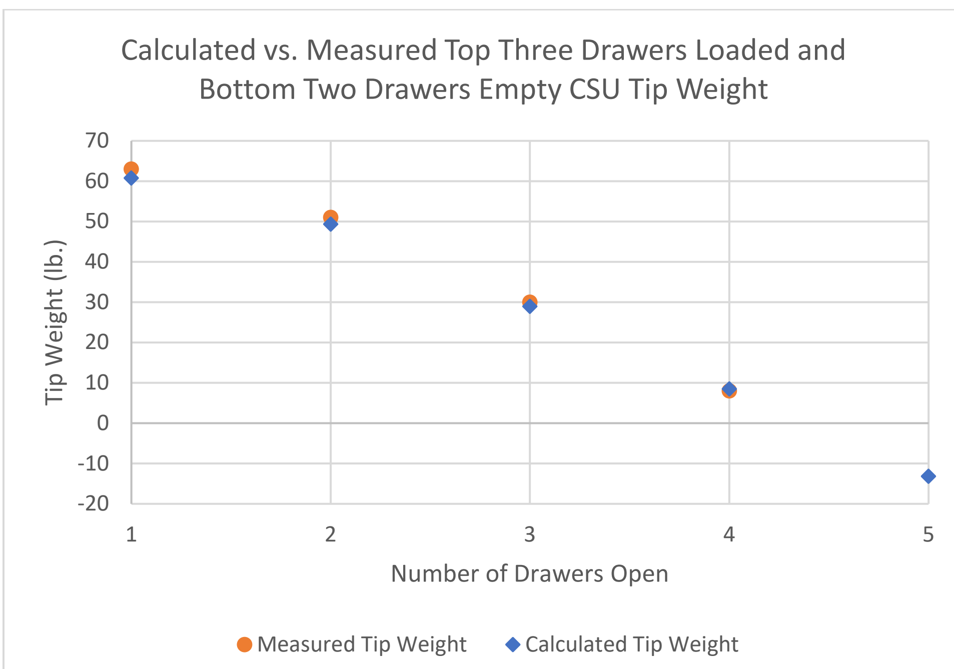


Figure 138. Calculated vs. measured tip weight for CSU with top three drawers loaded and bottom two drawers empty.

Graphical comparisons between calculated and measured data for the CG of the unit are shown in Figure 139, Figure 140, and Figure 141.

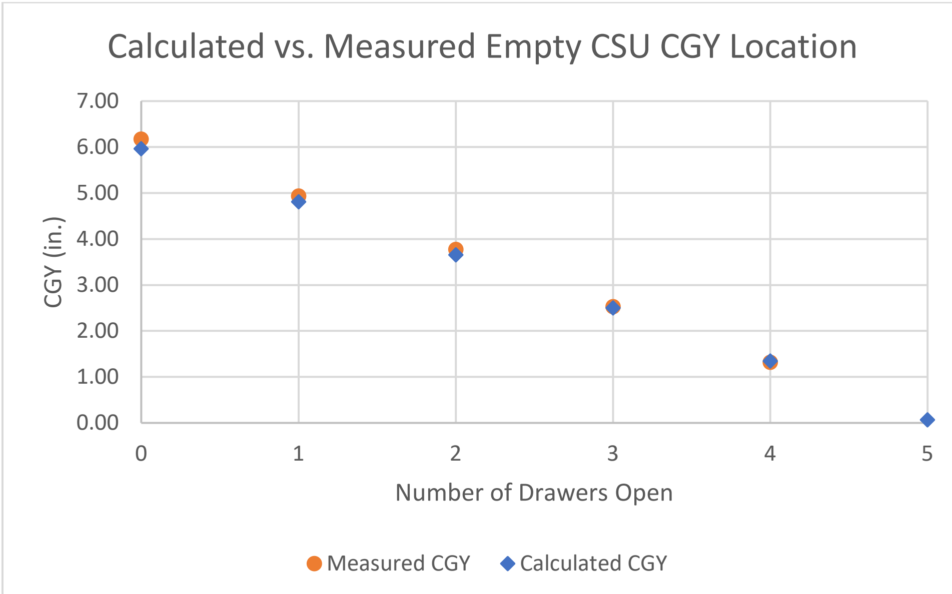


Figure 139. Calculated vs. measured CGY location for empty CSU.

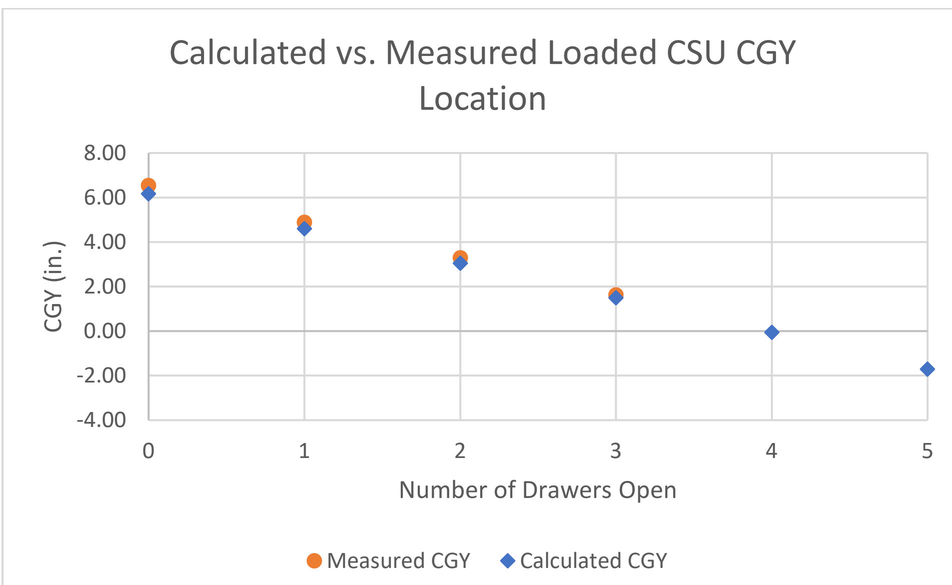


Figure 140. Calculated vs. measured CGY location for loaded CSU.

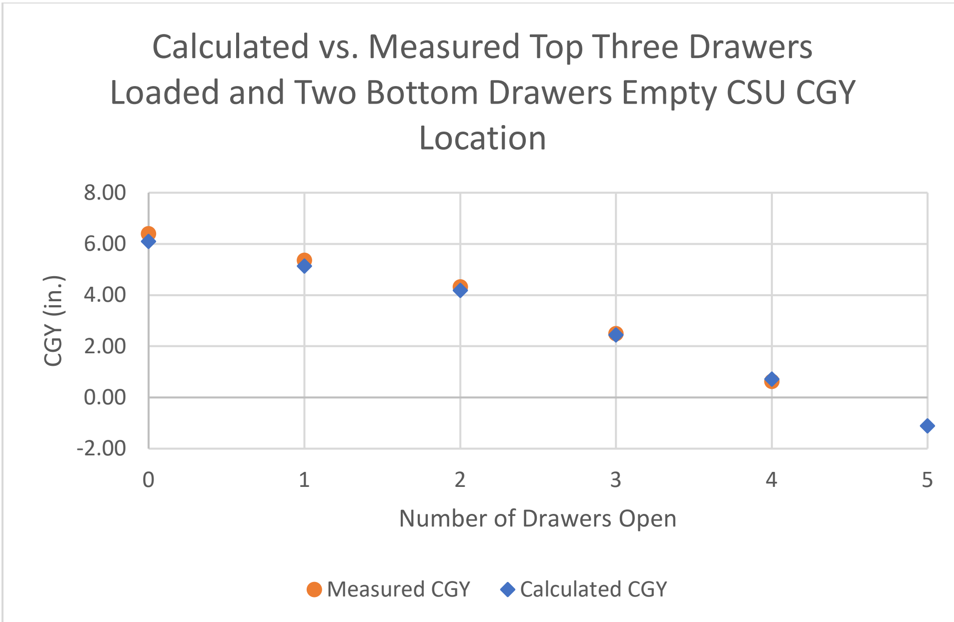


Figure 141. Calculated vs. measured CGY location for CSU with top three drawers loaded and two bottom drawers empty.

Graphical comparisons between calculated and measured tip weight at the various tilt angles to simulate the effect of carpet are shown in Figure 142, Figure 143, and Figure 144.

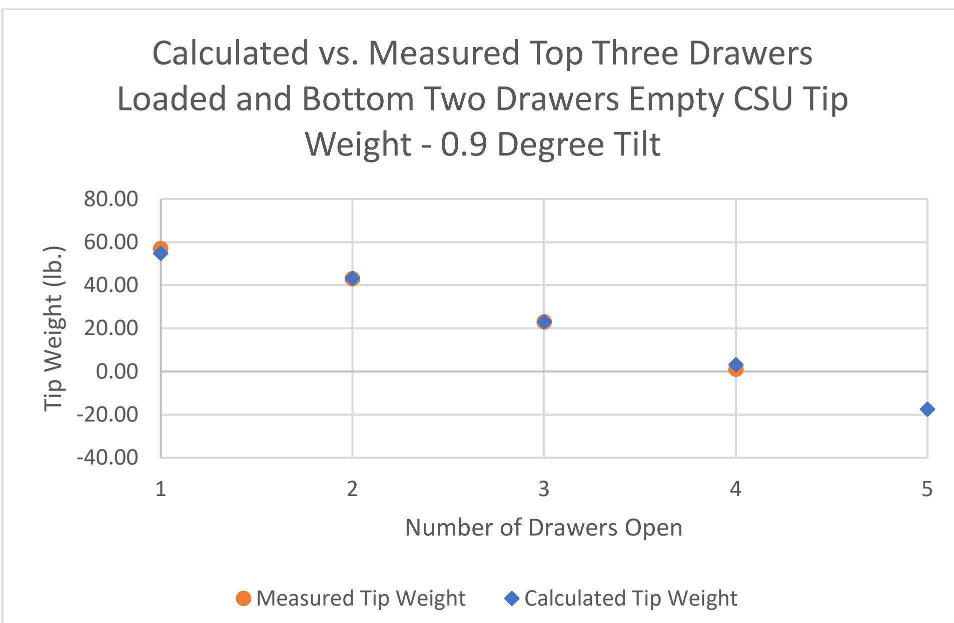


Figure 142. Calculated vs. measured tip weight for CSU with top three drawers loaded and bottom drawers empty at 0.9-degree tilt.

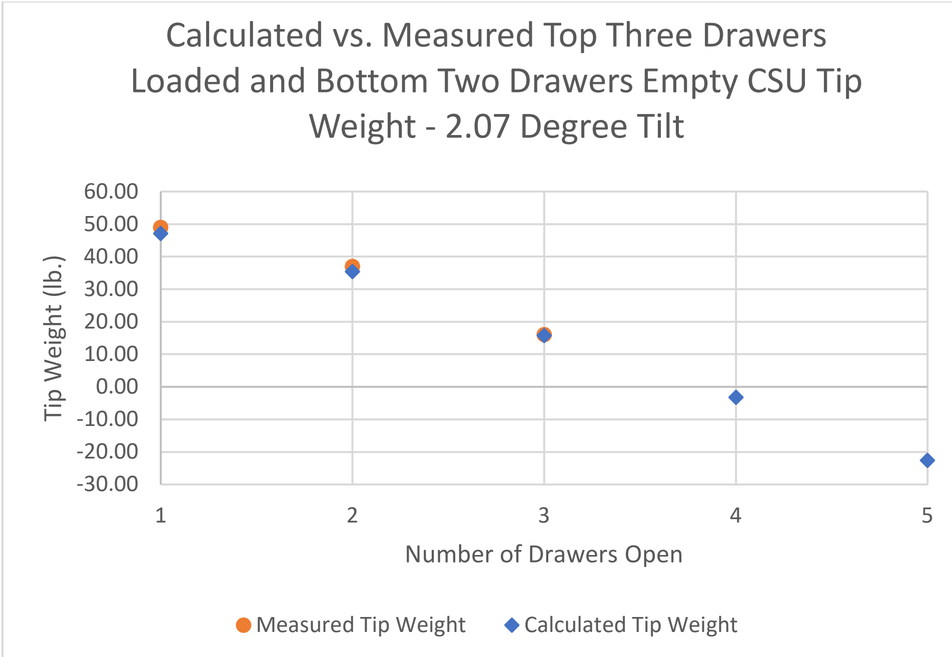


Figure 143. Calculated vs. measured tip weight for CSU with top three drawers loaded and bottom drawers empty at 2.07-degree tilt.

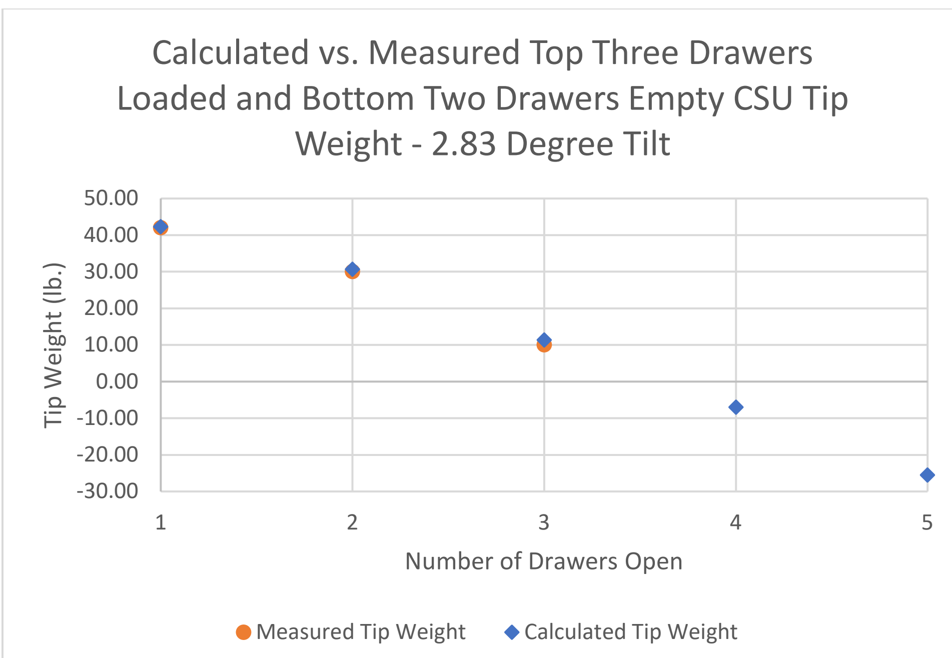


Figure 144. Calculated vs. measured tip weight for CSU with top three drawers loaded and bottom drawers empty at 2.83-degree tilt.

Discussion

ESMC staff reviewed the 2017 LSM report on the incident clothing storage unit. In the report, LSM staff tested the unit per ASTM F2057 – 14, *Standard Safety Specification for Clothing Storage Units*. The incident unit met the requirements of Section 7.1 of this standard, which evaluates the stability of the unit when all drawers are opened and empty. The incident unit met the requirements of Section 7.2 of this standard, which evaluates the stability of the unit when one drawer at a time is opened and a 50 ± 2-pound weight is applied to the top edge of the open drawer face (without weight in the drawers). The incident unit met Section 7.2 due to the 2-pound applied weight tolerance. When LSM staff tested the unit using their "low weight" 48.54-pound test fixture applied, the unit met the requirement (did not tip over), but at 49.66 pounds applied, the unit tipped over. These results were within the tolerance allowed by the ASTM standard.

ESMC staff tested the sample dresser to the stability requirements in ASTM F2057 – 19, *Standard Safety Specification for Clothing Storage Units* and found the unit did not meet the requirements. The requirements of section 7.1 and 7.2 of the 2019 revision were unchanged from the 2014 standard. For this analysis, the unit tipped over when 48 pounds was applied to a single open empty drawer. However, the 2017 testing of the unit indicate that the unit remained stable when 48.54 pounds was applied to a single open empty drawer. ES staff suspected that the product configuration may have changed over time resulting in slightly different tip over weights. ES staff considers this unit to be borderline meeting/not meeting the stability requirements.

7.1 Stability of Unloaded Unit

Section 7.1 specifies that the unit (without clothing weight in the drawers) shall be tested on a hard, flat surface, and all drawers should be fully extended. Section 4.2 specifies that the unit shall not tip over when tested to Section 7.1.

ESMC staff pulled all the drawers of the unit to their fullest extension and determined that the dresser did not meet the performance requirements for stability of an unloaded unit. The unit tipped over when the last drawer was pulled to the fullest extension.

7.2 Stability with Load

Section 7.2 specifies that the unit (without clothing weight in the drawers) shall be tested on a hard, flat surface, and one drawer at a time should be fully extended and a 50 ± 2-pound weight applied to the top edge of the open drawer face. Section 4.2 specifies that the unit shall not tip over when tested to Section 7.2.

ESMC staff placed a 48-pound weight on the top edge of the top open drawer and the unit tipped over. The analytical model calculations indicated that the unit with empty drawers is imminently unstable because the location of CG in the y-direction (depth) is approximately 1-inch behind the front legs or the fulcrum. Slight variability in the angle of the floor where the dresser is tested per the ASTM standard can be enough to move the CG in front of the front legs (fulcrum) creating an unstable condition leading to the CSU not meeting the requirements.

ASTM F2057 Stability Requirements

The current ASTM standard has several limitations in its adequacy for evaluating unit stability under real world conditions, including: not opening multiple drawers before application of a static force/weight to the top of an open drawer, not evaluating drawers when weighted with a clothing equivalent weight, and not evaluating the effects of dynamic forces created by a child interacting with the unit (such as during ascent). For this unit, when a static weight of 30 pounds was applied to an open drawer for different configurations (multiple open drawers, weighted drawers, and the scenario-specific configuration) the unit was unstable (tipped over).

IDI Summary

ESMC staff reviewed IDI 161025HFE002, which summarized a police report of a fatal incident involving a three-year-old female and clothing storage unit tip over. According to the IDI summary, there were no eyewitnesses. The victim was believed to have opened the bottom drawers and had attempted to climb the dresser when it tipped over on her. The two bottom drawers were empty, the three top drawers were filled with clothing, and a picture frame was on top of the dresser. The dresser was originally placed against a wall in a bedroom, on approximately medium pile carpet and pad. Tip over restraints were not installed.

Incident Recreation

Based on information in the IDI, the upper three of five total drawers were filled with a clothing equivalent weight, and the remaining lower two drawers were empty. The victim was identified as a three-year-old female, without weight information. ESMC staff assumed the average weight of 2.5 to 3-year-old 50th percentile female as approximately 30 pounds[21].

When the unit is in a configuration described in the incident scenario (top three drawers filled and bottom two drawers empty), with only three drawers open (two empty lower drawers and one filled upper drawer), approximately 29 pounds of static force will cause the dresser to become unstable and tip over. Once a tilt angle of approximately 0.9 degrees was added to the unit (to simulate the carpet effect), the static force necessary for the dresser to become unstable dropped to approximately 23 pounds.

[21] Tilley, Alvin R., The Measure of Man and Woman, 1993.

When a child is climbing the unit, the clothing storage unit would be more unstable. The equivalent force on the edge of the drawer consist of the child's weight, the dynamic force due to climbing, and the effects of the child's CG extending beyond the edge of the drawer. Based on the University of Michigan Transportation Research Institute (UMTRI) report,[22] ESMC staff estimated the equivalent force to be 1.6 times the weight of the child for typical drawer extensions[23] or about 48 pounds (1.6 x 30 pounds) in this scenario. When the unit was configured as described in the incident scenario (top three drawers filled, two bottom drawers empty), the tip weight was 51 pounds when the two empty bottom drawers were opened. When the unit was tilted 0.9 degrees forward, the tip weight decreased to 43 pounds.

Staff concludes that the child's static weight can cause the unit to tip over when the two empty bottom drawers and one loaded drawer was fully opened or the child climbing can cause the unit to tip over when the two empty bottom drawers are fully opened and one of the filled drawers is partially opened.

Potential Stability Modifications

ESMC staff analyzed several potential dresser stability solutions that could increase the stability of the five-drawer incident unit. The solutions considered include: (1) adding a drawer interlock system (only one drawer can be opened simultaneously), (2) decreasing the drawer extension, (3) adding a foot extension to the unit front feet, (4) adding front feet leveler to tilt the dresser back, and (5) adding weight to the unit that is both low to the ground/floor and at the rear of the unit. Figure 145 visually represents a range of possible modifications that can be made to the clothing storage unit individually or in combination.

[22] Analysis based on Reed, Matthew P., Ebert, Sheila M., Jones, Monica L. H, July 2020, "Forces and Postures During Child Climbing Activities" University of Michigan Transportation Research Institute (UMTRI), prepared for US Consumer Product Safety Commission, contract No. 61320618D0004.
[23] Taxier, Daniel (2021). Mechanical Evaluation of Clothing Storage Unit (CSU) Tip-Over Research, Incidents, and Design Solutions, Contributing to Draft Proposed Rule for CSU Inherent Stability. Tab D, pg. 17.

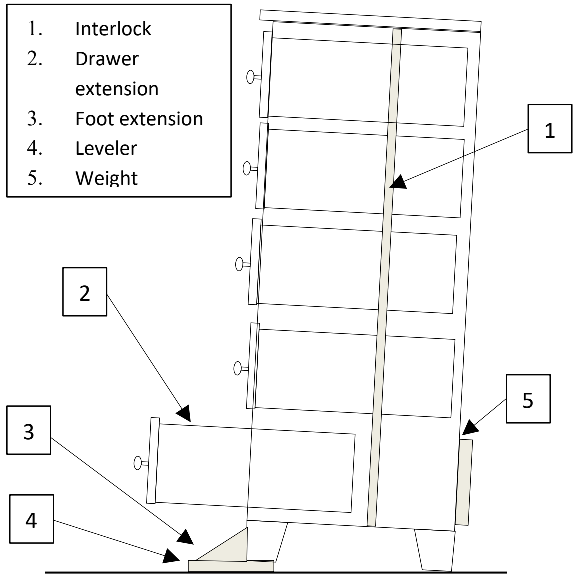


Figure 145. Potential modifications to CSU.

Stability modifications analyzed include:

1. Adding an interlock (limit to 1 open drawer), decreasing drawer extension 4.13 inches, extending front foot 1.375 inches, and adding a 3-pound counterweight.
2. Adding an interlock (limit to 1 open drawer), decreasing drawer extension 1 inch, extending front foot 1.5 inches, and adding a 35-pound counterweight.
3. Adding an interlock (limit to 1 open drawer), extending front foot 2 inches, and adding 40-pound counterweight.
4. Adding interlock (limit to 1 open drawer), decreasing drawer extension 2 inches, and adding 60-pound counterweight.
5. Decrease drawer extension 2 inches, extending front foot 2 inches, and adding 51-pound counterweight.

For all of these modification combinations, these changes would increase the stability of the dresser and reduce the propensity for the dresser tipping over. See Table 28 below.

Table 28. Calculated Five Drawer Incident CSU Performance with Modifications.

Modification	Requirement = 51.2(1.08X+0.52) (lb-ft)	Moment (lb-ft)	Interlock Y/N (# of Open Drawers)	Drawer Extension (in.)	Drawer Extension Decrease (in.)	Foot Extension (in.)	Counter Weight (lb.)	Front Leveler Height (in.)
Original	96.32	-39.80	No (5)	15.13	0	0	0	0
1	77.312	79.50	Yes (1)	15.13	4.13	1.375	3	0
2	84.80	87.00	Yes (1)	15.13	1	1.5	35	0
3	87.10	88.88	Yes (1)	15.13	1	2	40	0
4	87.10	88.36	Yes (1)	15.13	2	0	60	0
5	70.98	71.80	No (5)	15.13	2	2	51	0

The drawer extension and foot extension modifications were made relative to the fulcrum of the CSU. For this incident unit, the fulcrum was located along the middle of the front feet, where there is a plastic floor protector. For example, decreasing the drawer extension 4.13 inches relative to the fulcrum, reduced the drawer extension to 11 inches relative to the front of the CSU. Additionally, the foot design tapered inward. Modification to extend the foot does not necessarily mean the foot extends past the front of the unit. Moving the fulcrum 1.375 inches forward, makes the fulcrum flush with the front of the CSU. Modification #1 consist of foot extension modification of 1.375 inches, a 3-pound counter weight and a reduction of the drawer extension to 11 inches (See Figure 146 below).

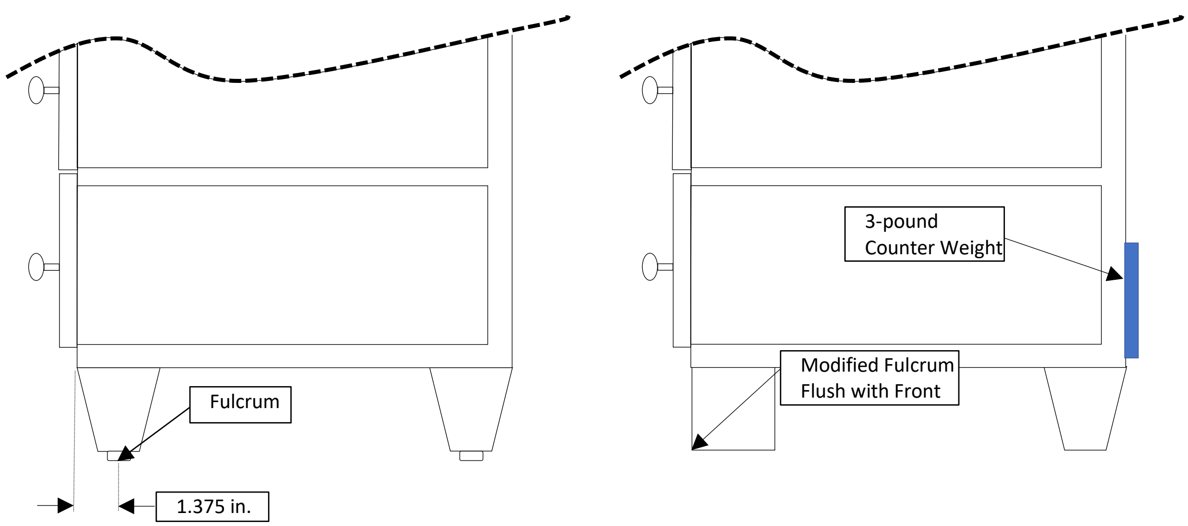


Figure 146. Modification #1. By modifying the front foot to be flush with the front face, the fulcrum is extended forward by 1.375 inches. Additional modifications include limiting the drawer extension to 11 inches (relative to the front of the CSU) and adding a 3-pound counter weight to meet the proposed stability requirements.

Conclusion

The incident clothing storage unit marginally did not meet the requirements of Section 7.1 and 7.2 of ASTM F2057 – 19, *Standard Safety Specification for Clothing Storage Units*. Slight angle differences in the test location floor surface can affect whether the dresser meets or does not meet the requirements. Considering ASTM F2057 test methods, ESMC staff measured a 48-pound weight applied on a single open drawer will make the dresser unstable (tip over occurs).

Considering different unit configurations, tip weight results indicate:

- When three lower empty drawers are open, the unit will tip over with approximately 25 pounds of applied static weight when all drawers are empty.
- When three lower weighted drawers are open, the unit will tip over with approximately 20 pounds of applied static weight when all drawers are filled.
- When the top three drawers are filled, and the lower two drawers are empty, the tip weight was 30 pounds when the bottom three drawers are open.

MODEL G: 7-DRAWER CSU

Executive Summary

ES staff evaluated an incident seven drawer clothing storage unit (CSU) that was involved in a fatal incident and reviewed the In-Depth Investigation (IDI) related to the incident unit. ES staff also examined an exemplar CSU. As part of the analysis, ES staff determined the physical characteristics of the seven drawer units by measuring: (1) the weight and center of gravity (CG) of each drawer; (2) the weight and center of gravity of the unit body (without drawers); and (3) the weight and center of gravity of the unit as each drawer was extended.

ES staff developed the most likely hazard scenario based on information obtained from the IDI, including: weight of the victim, unit dimensions, drawer slide extension distance, and interactions of the victim with the unit. ES staff concluded laboratory testing using weights and the incident sample to validate the hazard scenarios.

Critical Findings

1. **Incident occurred while multiple drawers were opened.** For the hazard scenario analyzed, multiple drawers of the unit needed to be extended or open to cause the unit to tip over.
2. **When the incident unit had all drawers filled and fully extended and filled, a 26-pound child can tip over the unit.** The CSU drawers were opened and filled based on the incident description. Staff applied 26 pounds to the edge of an open drawer, and the unit tipped over.
3. **A unit on a carpet/pad is less stable than one on a hard level floor.** Compared to the tip over force measured on level floor, the tip over force measured when the unit was tilted approximately 1 degree was about three pounds less compared to the tip weights measured when the CSU was on level floor.
4. **The ASTM standard did not fully address the hazard scenario.** The seven drawer units met the ASTM standard. The CSUs were stable when all empty drawers were fully extended. The incident and exemplar CSUs were stable when 50 pounds was applied on the edge of a single open empty drawer with a measured tip weight of 84 to 114 pounds. Despite this, the CSU tipped when a 26-pound child attempted to climb the CSU. Staff found the ASTM standard did not address the following hazards occurring simultaneously:
   a. multiple open drawers.
   b. drawers filled with clothing.
   c. children dynamic forces and extended center of gravity while climbing units.
   d. unit placed on a carpeted surface.

Product

The subject product is a seven-drawer clothing storage unit (CSU). The product was manufactured and sold from 2005 until the end of 2016, when it was discontinued. The CSU was sold fully assembled and came with an anti-tipping restraint kit. The unit has three rows with seven drawers. Figure 147 below is a photograph of an example CSU.

Figure 147. Seven drawer clothing storage unit.

Background

The incident was recorded by a stationary video camera (nanny cam), which showed the CSU tipping over as a child attempted to climb the CSU after opening all the drawers (see Figure 148). The CSU was purchased in the spring of 2016 and came pre-assembled. The mother was unsure whether the CSU came with the tip restraint. The bottom drawers were filled with blankets and miscellaneous items like brushes and hair ties in the top drawers. The CSU was on carpet. The mother believes her daughter had never attempted to climb the CSU until the day of the incident. The daughter was 42 months old and weighed approximately 26 pounds.

Figure 148. Screen captures from the video showing the child climbing and tipping the CSU. NOTE: face is blurred.

Examination

ES staff received the incident and exemplar samples. Staff measured the physical characteristics of the incident and exemplar units including: (1) overall unit dimensions, (2) dimensions of each drawers, (3) weights of each drawers, (4) weight of the unit with drawers removed, (5) the center of gravity (CG) of each drawer, and (6) the CG of the unit. See Figure 149.

The center of gravity (CG), as facing the front of the CSU, was located relative to the fulcrum or pivot point (origin of coordinate system, or 0,0,0 coordinate) of the unit. For this unit, the fulcrum was located at the contact point between the floor and the bottom of the left front leg. The CG for each drawer, was located relative to the lowest point of the left corner of the drawer.

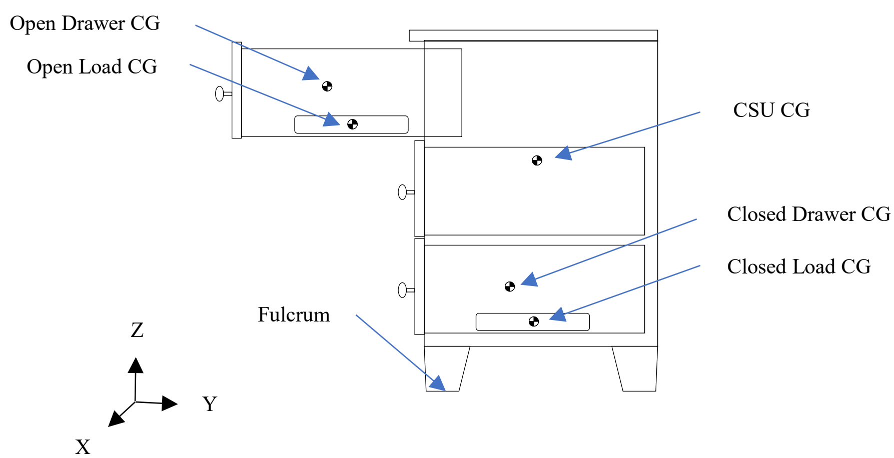


Figure 149. CSU (not to scale) CG locations and fulcrum.

Staff measured the weight of the CSUs applied through the four feet by placing scales underneath each foot. The measurement was repeated seven times as drawers were opened. Beginning with the bottom drawers and moving up, each drawer was extended to the out stop and remained open until all drawers were opened. Using the weight measurements, staff calculated the front, rear, right, and left weight biases. A weight bias occurs when the weight distribution of an object favors a direction. For example, the incident unit has 60% of the total weight measured in the front legs and 40% of the total weight measured in the rear legs. Therefore, the incident unit carries more of its weight towards the front of the unit and has a front weight bias.

The drawer weights were made based on the maximum interior volume of the drawers and the assumption of 8.5 pounds per cubic foot. The top three drawers had interior measurements of 14.875-inch width, 15.5-inch depth, and 5-inch height. The interior volume was calculated to be 0.65 cubic feet and the weight was 5.5 pounds. The two middle drawers had interior measurements of 23.75-inch width, 15.5-inch depth, and 7.625-inch height. The interior volume was calculated to be 1.62 cubic feet and the weight was 13.6 pounds. The bottom two drawers had interior measurements of 23.75-inch width, 15.5-inch depth, and 7.125-inch height. The interior volume was calculated to be 1.52 cubic feet and the weight was 12.7 pounds.

Staff notes that the incident and exemplar unit were different. The exemplar unit weighed 194.5 pounds and the incident unit weighed 165.0 pounds, for a difference of approximately 29 pounds. Without drawers, the difference in the weights of the exemplar and incident unit CSU bodies was approximately 24.5 pounds. Staff compared the weights of the drawers, independent of the CSU bodies and found a 4.5-pound difference in the weight. The incident unit drawers extended approximately half an inch more than the exemplar unit drawers. In addition, the feet of the exemplar unit were 0.23 inches thicker and the distance from the front to rear feet was 0.51 inches longer when compared to the incident unit.

Stability Analysis

ES staff developed an analytical model to predict the weight (or force) necessary to cause the unit to become unstable (or tip over), and to calculate the CSU CG location during various configurations, including: 1) the number of drawers opened or closed, and 2) drawers empty, or weighted with a clothing equivalent weight. The CG in the width, depth, and height dimensions were determined as CG_X, CG_Y, and CG_Z, respectively. See Table 29 and Table 30 below.

Table 29. Calculated CG Location and Tip Weight of Empty and Filled Incident CSU

Empty Clothing Storage Unit				
# of Open Drawers	CG_X (in.)	CG_Y (in.)	CG_Z (in.)	Tip Weight (lb)
0	24.375	7.32	20.15	
1	24.375	6.51	20.15	88.48
2	24.375	5.70	20.15	77.50
3	24.375	4.92	20.15	66.86
4	24.375	4.13	20.15	56.18
5	24.375	3.66	20.15	49.67
6	24.375	3.18	20.15	43.19
7	24.375	2.71	20.15	36.64

Filled Clothing Storage Unit				
# of Open Drawers	CG_X (in.)	CG_Y (in.)	CG_Z (in.)	Tip Weight (lb)
0	24.375	7.46	19.73	
1	24.375	6.30	19.73	121.46
2	24.375	5.13	19.73	98.97
3	24.375	3.94	19.73	75.99
4	24.375	2.75	19.73	52.97
5	24.375	2.15	19.73	41.44
6	24.375	1.55	19.73	23.94
7	24.375	0.96	19.73	18.58

Table 30. Calculated CG Location and Tip Weight of Empty and Filled Exemplar CSU

Empty Clothing Storage Unit				
# of Open Drawers	CG_X (in.)	CG_Y (in.)	CG_Z (in.)	Tip Weight (lb)
0	24.25	7.85	19.84	
1	24.25	7.13	19.84	117.51
2	24.25	6.41	19.84	105.57
3	24.25	5.69	19.84	93.71
4	24.25	5.00	19.84	82.40
5	24.25	4.57	19.84	75.24
6	24.25	4.13	19.84	68.05
7	24.25	3.72	19.84	61.22

Filled Clothing Storage Unit				
# of Open Drawers	CG_X (in.)	CG_Y (in.)	CG_Z (in.)	Tip Weight (lb)
0	24.25	7.92	19.58	
1	24.25	6.86	19.58	153.17
2	24.25	5.80	19.58	129.48
3	24.25	4.70	19.58	104.99
4	24.25	3.63	19.58	81.05
5	24.25	3.08	19.58	68.77
6	24.25	2.53	19.58	56.45
7	24.25	1.99	19.58	44.48

In order to simulate the effect of the CSU being on carpet as described in the incident, additional analysis at various angles of forward tilt of the unit were calculated. Calculated tip weights and CG locations were determined using specific tilt angles measured in the laboratory. Table 31,

Table 32, and Table 33 below summarize the calculated CG locations and tip weights of the incident unit.

Table 31. Calculated CG Location and Tip Weight of Incident CSU at 1.1-degree tilt

Empty Clothing Storage Unit

# of Open Drawers	CG_X (in.)	CG_Y (in.)	CG_Z (in.)	Tip Weight (lb)
0	24.375	6.93	20.29	
1	24.375	6.12	20.27	80.97
2	24.375	5.32	20.26	70.29
3	24.375	4.53	20.24	59.02
4	24.375	3.75	20.23	48.79
5	24.375	3.27	20.22	42.03
6	24.375	2.79	20.21	35.90
7	24.375	2.32	20.20	29.89

Filled Clothing Storage Unit

# of Open Drawers	CG_X (in.)	CG_Y (in.)	CG_Z (in.)	Tip Weight (lb)
0	24.375	7.08	19.87	
1	24.375	5.92	19.85	111.06
2	24.375	4.75	19.82	89.18
3	24.375	3.56	19.80	65.80
4	24.375	2.37	19.78	43.74
5	24.375	1.77	19.77	32.30
6	24.375	1.17	19.76	21.42
7	24.375	0.58	19.74	10.67

Table 32. Calculated CG Location and Tip Weight of Incident CSU at 1.86-degree tilt

Empty Clothing Storage Unit

# of Open Drawers	CG_X (in.)	CG_Y (in.)	CG_Z (in.)	Tip Weight (lb)
0	24.375	6.66	20.38	
1	24.375	5.85	20.35	76.02
2	24.375	5.05	20.32	65.53
3	24.375	4.26	20.3	53.98
4	24.375	3.48	20.27	44.03
5	24.375	3.00	20.26	37.22
6	24.375	2.52	20.24	31.30
7	24.375	2.06	20.23	25.51

Filled Clothing Storage Unit

# of Open Drawers	CG_X (in.)	CG_Y (in.)	CG_Z (in.)	Tip Weight (lb)
0	24.375	6.82	19.96	
1	24.375	5.66	19.92	104.21
2	24.375	4.49	19.89	82.73
3	24.375	3.30	19.85	59.25
4	24.375	2.11	19.81	37.81
5	24.375	1.51	19.79	26.54
6	24.375	0.91	19.77	16.05
7	24.375	0.32	19.75	5.68

Table 33. Calculated CG Location and Tip Weight of Incident CSU at 3.1-degree tilt.

Empty Clothing Storage Unit				
# of Open Drawers	CG_X (in.)	CG_Y (in.)	CG_Z (in.)	Tip Weight (lb)
0	24.375	6.22	20.52	
1	24.375	5.41	20.47	68.32
2	24.375	4.61	20.43	58.13
3	24.375	3.82	20.39	46.34
4	24.375	3.04	20.34	36.83
5	24.375	2.56	20.32	30.06
6	24.375	2.08	20.29	24.48
7	24.375	1.62	20.27	19.00

Filled Clothing Storage Unit				
# of Open Drawers	CG_X (in.)	CG_Y (in.)	CG_Z (in.)	Tip Weight (lb)
0	24.375	6.39	20.10	
1	24.375	5.22	20.04	93.55
2	24.375	4.06	19.98	72.69
3	24.375	2.87	19.91	49.33
4	24.375	1.68	19.85	28.83
5	24.375	1.08	19.82	17.99
6	24.375	0.48	19.79	8.07
7	24.375	-0.10	19.75	-1.73

Laboratory Tests

As verification for the analyses, ES staff performed laboratory tests to measure the weight (or force) necessary to cause the incident and exemplar units to become unstable (or tip over), and to determine the unit CG location during various configurations, include: 1) the number of drawers opened or closed, and 2) drawers empty, or weighted with a clothing equivalent weight (see Table 34 and Table 35).

Table 34. Measured CG location and Tip Weight of Empty and Filled Incident CSU.

Empty Clothing Storage Unit

# of Open Drawers	CG_X (in.)	CG_Y (in.)	CG_Z (in.)	Tip Weight (lb)
0	24.38	7.23	18.12	
1	24.40	6.40	18.20	84
2	24.38	5.60	18.27	74
3	24.41	4.80	18.50	65
4	24.39	4.01	18.74	53
5	24.40	3.54	18.80	46
6	24.38	3.05	18.98	40
7	24.38	2.56	19.22	34

Filled Clothing Storage Unit

# of Open Drawers	CG_X (in.)	CG_Y (in.)	CG_Z (in.)	Tip Weight (lb)
0	24.43	7.55	17.13	
1	24.45	6.37	17.64	117
2	24.44	5.21	17.70	95
3	24.45	3.99	17.92	74
4	24.43	2.76	18.45	50
5	24.44	2.15	18.61	39
6	24.44	1.54	18.80	27
7	24.44	0.92	19.15	16

Table 35. Measured CG location and Tip Weight of Empty and Filled Exemplar CSU.

Empty Clothing Storage Unit

# of Open Drawers	CG_X (in.)	CG_Y (in.)	CG_Z (in.)	Tip Weight (lb)
0	24.25	8.02	18.25	
1	24.12	7.28	16.94	114
2	24.12	6.60	15.86	104
3	24.25	5.89	15.68	94.5
4	24.00	5.22	15.75	85
5	24.12	4.76	16.15	76
6	24.00	4.35	15.91	70
7	24.13	3.94	15.85	62

Filled Clothing Storage Unit

# of Open Drawers	CG_X (in.)	CG_Y (in.)	CG_Z (in.)	Tip Weight (lb)
0	24.16	8.19	17.12	
1	24.25	7.17	14.97	
2	24.07	6.10	15.15	133
3	24.07	4.97	15.53	114
4	24.06	3.86	16.10	91
5	24.07	3.34	15.79	66
6	24.16	2.85	15.70	57
7	24.16	2.28	15.96	45

In order to simulate the effect of the unit being on carpet during the incident, additional tests at various angles of forward tilt of the CSU were performed (the rear feet of the CSU were raised using shims). Figure 150 below is a representation of the CSU tilted forward using shims. Measured tip weight and CG of the incident unit at the various tilt angles are shown in Table 36, Table 37, and Table 38 below.

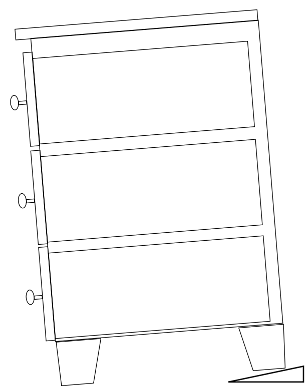


Figure 150. CSU tilted forward using shims.

Table 36. Measured CG Location and Tip Weight of Incident CSU at 1.1-degree tilt.

Empty Clothing Storage Unit			
# of Open Drawers	CG_X (in.)	CG_Y (in.)	Tip Weight (lb)
0	24.46	6.87	
1	24.48	6.09	83
2	24.49	5.29	72
3	24.46	4.53	60
4	24.48	3.74	50
5	24.46	3.28	43
6	24.43	2.80	37
7	24.43	2.33	37

Filled Clothing Storage Unit			
# of Open Drawers	CG_X (in.)	CG_Y (in.)	Tip Weight (lb)
0	24.53	7.09	
1	24.50	5.92	109
2	24.48	4.75	86
3	24.44	3.55	63
4	24.39	2.35	41
5	24.38	1.74	30
6	24.36	1.13	20
7	24.35	0.54	9

Table 37. Measured CG location and Tip Weight of Incident CSU at 1.86-degree tilt.

Empty Clothing Storage Unit			
# of Open Drawers	CG_X (in.)	CG_Y (in.)	Tip Weight (lb)
0	24.48	6.47	
1	24.48	5.68	76
2	24.47	4.89	68
3	24.46	4.12	54
4	24.45	3.36	45
5	24.44	2.88	37
6	24.45	2.42	32
7	24.43	1.96	21

Filled Clothing Storage Unit			
# of Open Drawers	CG_X (in.)	CG_Y (in.)	Tip Weight (lb)
0	24.48	6.75	
1	24.48	5.60	105
2	24.47	4.45	84
3	24.46	3.27	61
4	24.46	2.08	39
5	24.43	1.50	27
6	24.44	0.90	16
7	24.42	0.31	6

Table 38. Measured CG location and Tip Weight of Incident CSU at 3.1-degree tilt.

Empty Clothing Storage Unit			
# of Open Drawers	CG_X (in.)	CG_Y (in.)	Tip Weight (lb)
0	24.43	6.16	
1	24.44	5.36	72
2	24.42	4.58	61
3	24.40	3.79	48
4	24.40	3.02	38
5	24.40	2.55	31
6	24.41	2.08	26
7	24.39	1.60	26

Filled Clothing Storage Unit			
# of Open Drawers	CG_X (in.)	CG_Y (in.)	Tip Weight (lb)
0	24.44	6.41	
1	24.44	5.28	100
2	24.43	4.13	78
3	24.42	2.97	52
4	24.38	1.78	32
5	24.38	1.19	21
6	24.37	0.60	11
7			0

Calculated vs. Measured Comparisons

Graphical comparisons between calculated and measured data for tip weight are shown in Figure 151, Figure 152, Figure 153, and Figure 154.

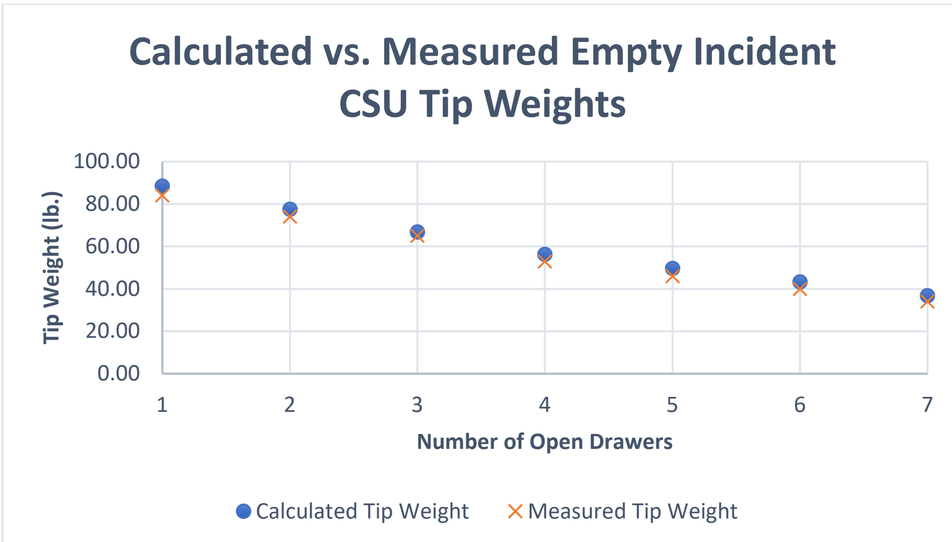


Figure 151. Calculated vs. measured tip weights for incident CSU with empty drawers.

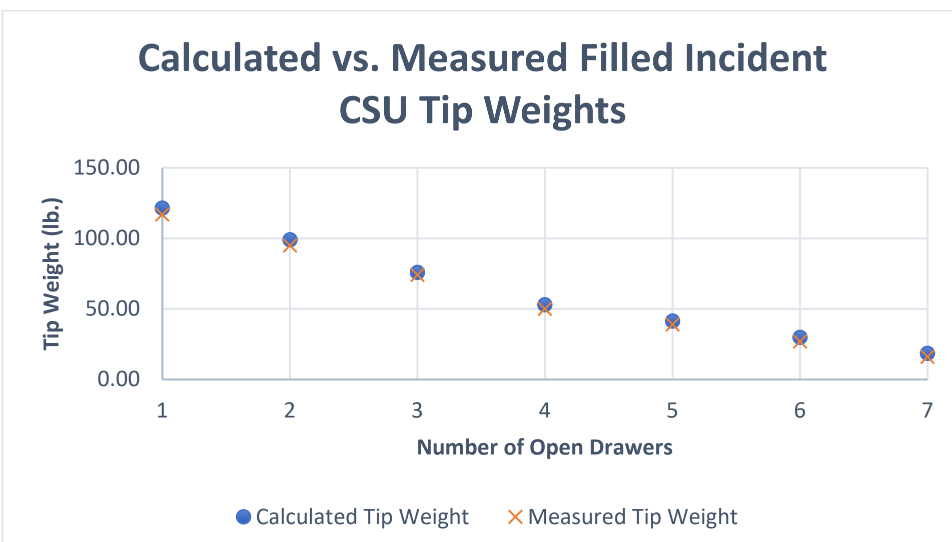


Figure 152. Calculated vs. measured tip weights for incident CSU with filled drawers.

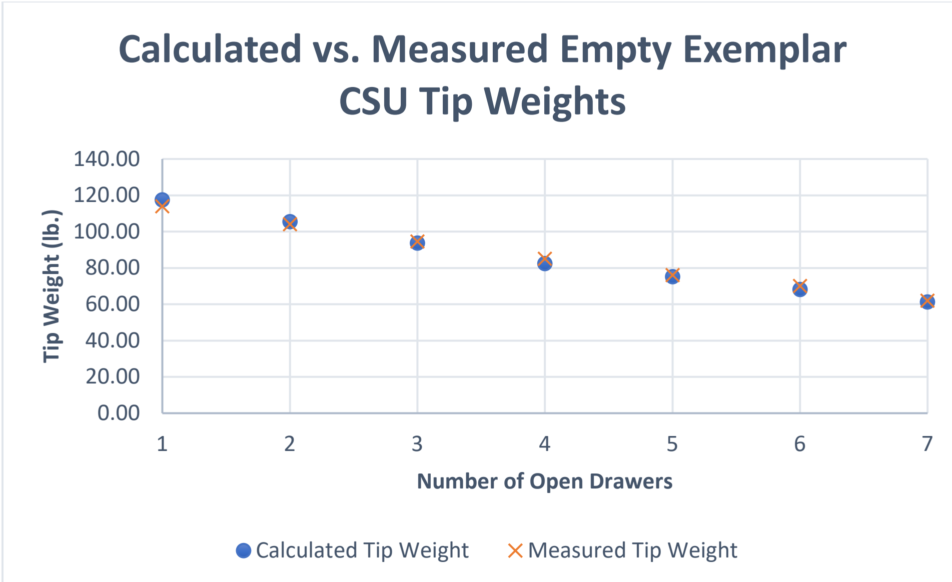


Figure 153. Calculated vs. measured tip weights for exemplar CSU with empty drawers.

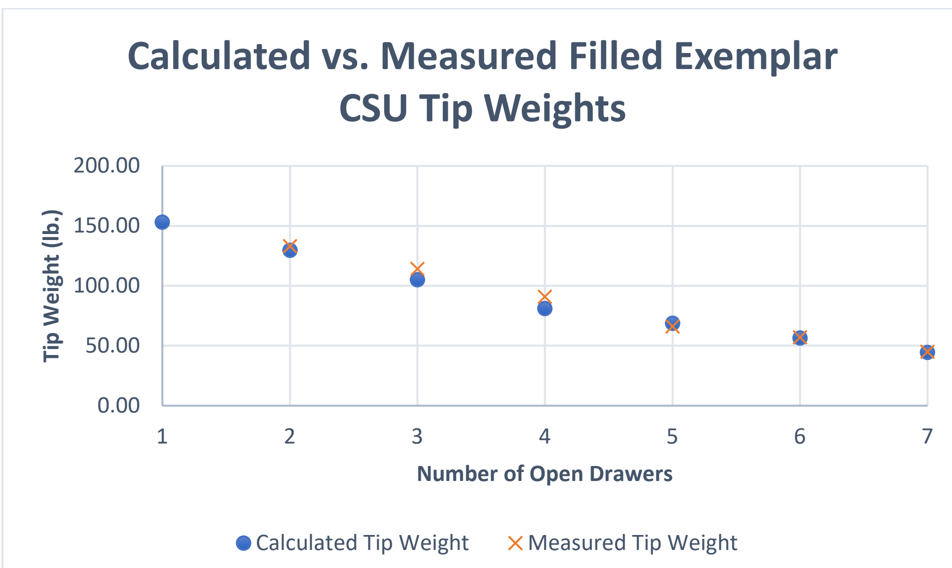


Figure 154. Calculated vs. measured tip weights for exemplar CSU with filled drawers.

Graphical comparisons between calculated and measured data for the CG depth of the units are shown in Figure 155, Figure 156, Figure 157, and Figure 158.

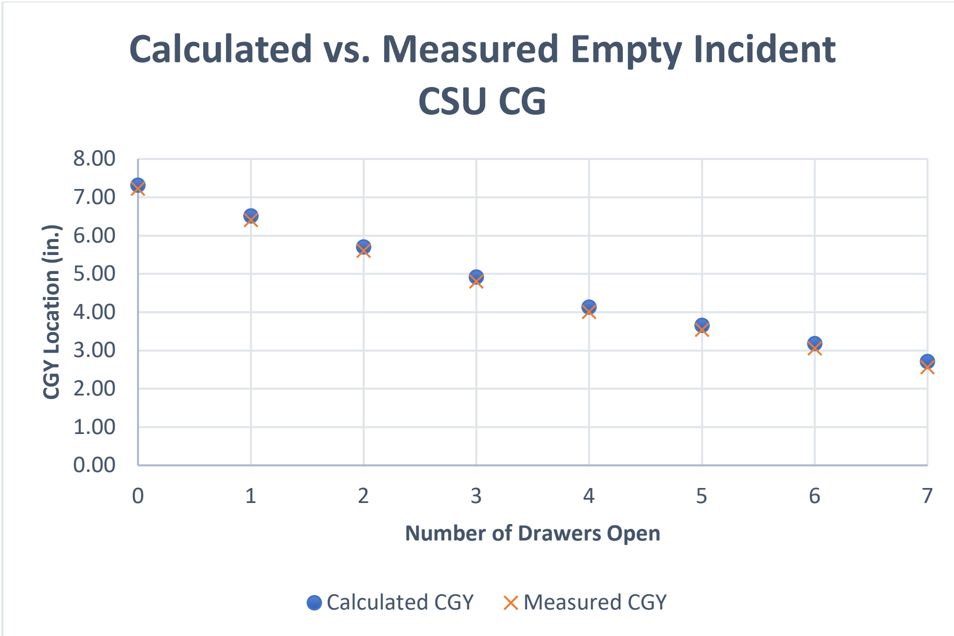


Figure 155. Calculated vs. measured CG depth of incident unit with empty drawers.

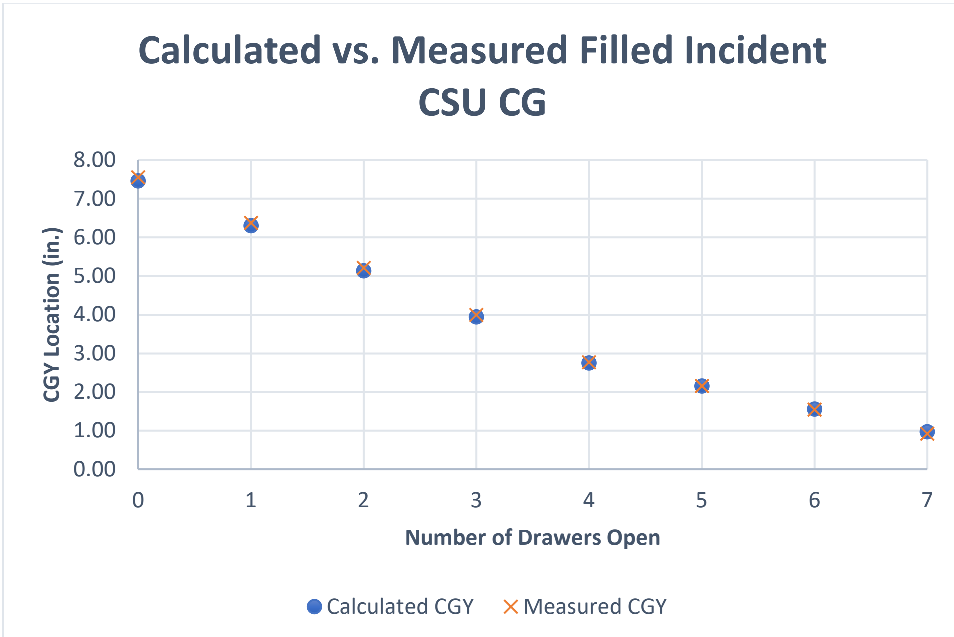


Figure 156. Calculated vs. measured CG depth of incident unit with filled drawers.

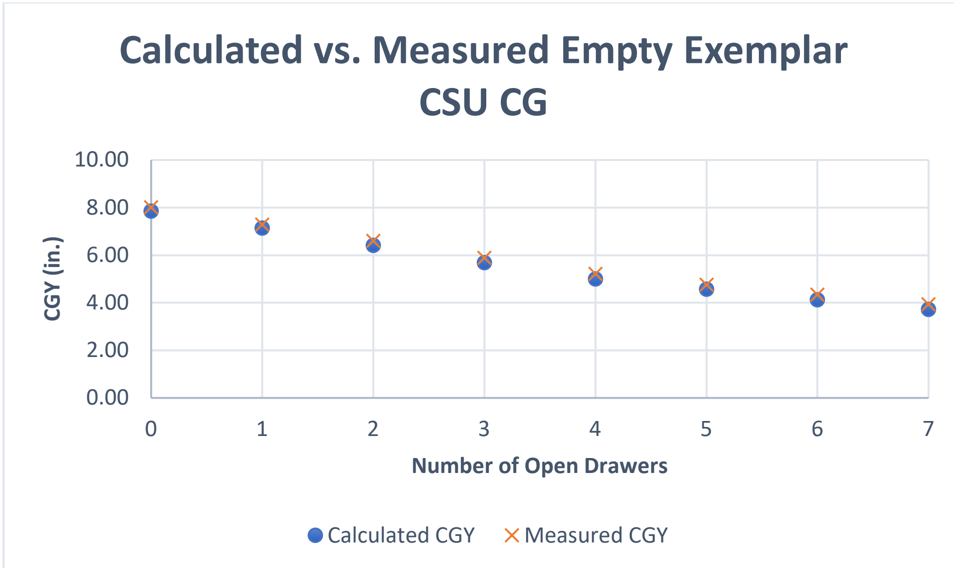


Figure 157. Calculated vs. measured CG depth of exemplar unit with empty drawers.

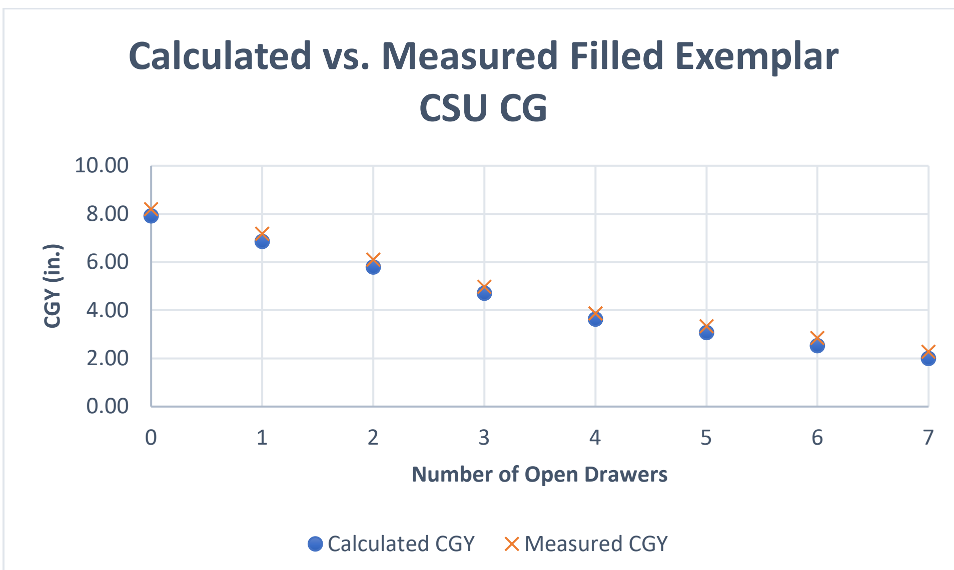


Figure 158. Calculated vs. measured CG depth of exemplar unit with filled drawers.

Graphical comparisons between calculated and measured tip weights at the various tilt angles to simulate the effect of carpet are shown in Figure 159, Figure 160, and Figure 161.

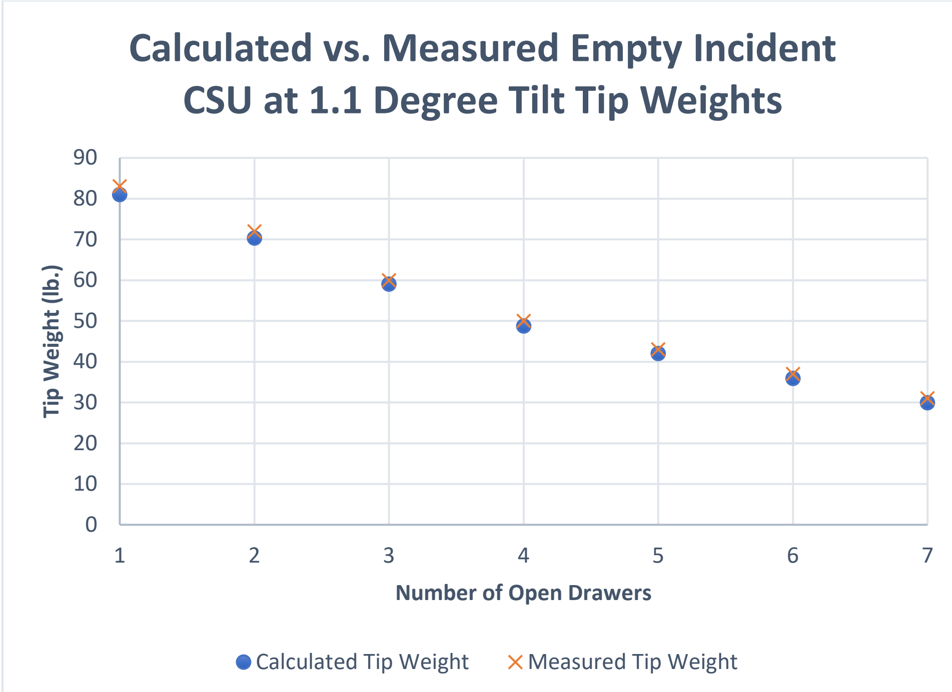


Figure 159. Calculated vs. measured tip weights of empty incident CSU tilted 1.1 degrees.

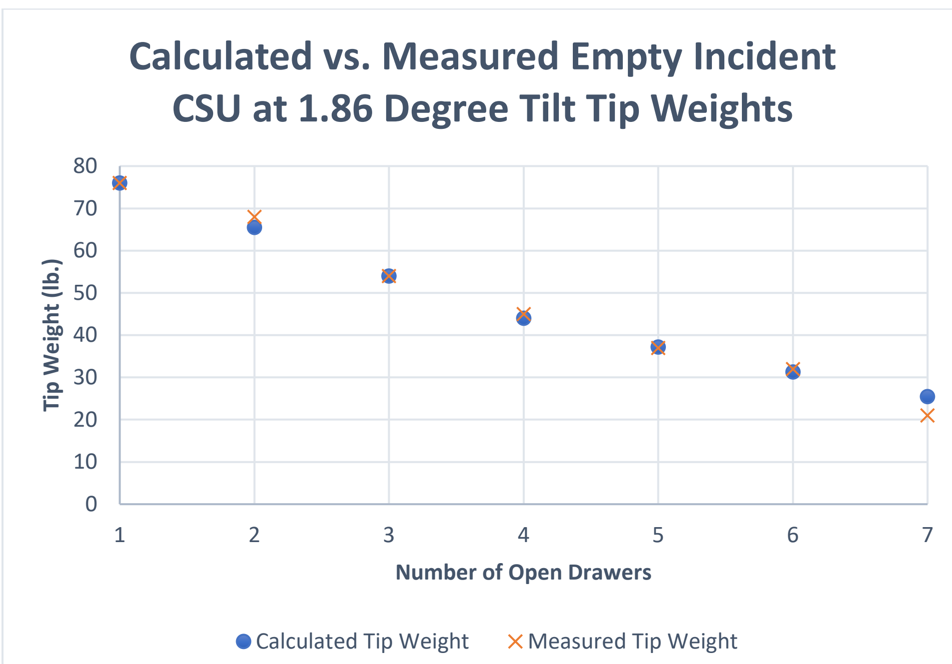


Figure 160. Calculated vs. measured tip weights of empty incident CSU tilted 1.86 degrees.

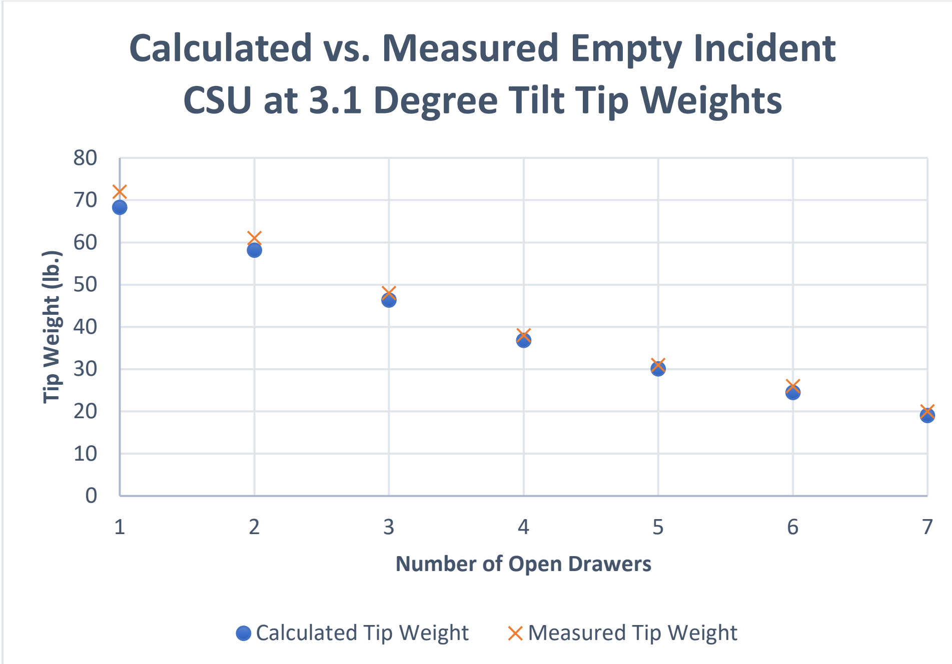


Figure 161. Calculated vs. measured tip weights of empty incident CSU tilted 3.1 degrees.

Discussion

ASTM Standard

The incident unit met Section 7.1 of ASTM F2057 – 19, *Standard Safety Specification for Clothing Storage Units*. Section 7.1. requires all drawers to be opened without the CSU tipping over. The incident unit met 7.2 of ASTM F2057 – 19, *Standard Safety Specification for Clothing Storage Units*, which requires the unit remains upright while a 50-pound load is placed over the front a single open drawer. For a single open drawer, the incident unit began tipping over at 84 pounds however, the video of the incident and tip testing show that the incident unit was tipped over by an approximately 26-pound child. Staff's testing found that the CSU can be tipped by a minimum of 16 pounds in a worst-case scenario (all drawers open and loaded).

The exemplar unit met the requirements in sections 7.1 and 7.2 of the ASTM standard. For a single open drawer and unloaded, the exemplar unit began tipping over when 114 pounds of weight was applied over the top edge of the front drawer. For all drawers open and loaded, the exemplar unit tipped when 45 pounds were applied over the top edge of the front of a drawer.

The current ASTM standard has several limitations in its adequacy for evaluating unit stability under real world conditions, including: not opening multiple drawers before application of a static force/weight to the top of an open drawer, not evaluating drawers when weighted with a clothing equivalent weight, and not evaluating the effects of dynamics forces created by a child interacting with the unit (such as during ascent).

Incident Recreation of the Incident Unit

Based on the information provided, ES staff evaluated the stability of the CSUs using the following parameters:

1. Victim weighed approximately 26 pounds.
2. All drawers were opened.
3. Victim was stepping onto the open bottom drawer knob and grabbing onto the top edge of a top open drawer.
4. Fully filled drawers.

Using the above parameters, staff determined:

1. When all drawers are opened and the drawers are filled with 69.2 pounds, the unit tipped over when a 26-pound load was applied to the top edge of any drawer front face.
2. The victim center of gravity was approximately 5 to 6 inches away from the edge of the drawer (see Figure 16).

To recreate the incident, staff applied 26 pounds of weight on the top edge of an open top drawer when all drawers were opened and filled. The incident unit tipped over. The video footage shows the victim climbing the edge of the drawers using the drawer knobs. Using an approximately 32-pound anthropometric dummy,[24] staff estimates that her body was about 5 to 6 inches away from the edge of the drawer (see Figure 162).

Figure 162. Video footage of the child climbing incident unit and anthropometric dummy climbing recreation. NOTE: face is blurred.

[24] The dummy used is similar to the CAMIs used in an ASTM standard, but has been scaled up to represent an average 3-year-old. The mannequin weighs 32 pounds and represents a stature of 37.5 inches.

Additional Stability Examination of the Incident Unit

Based of additional testing of the incident unit, staff determined:

1. When all drawers are opened and the drawers are filled with 69.2 pounds, the unit will tip over when a 16-pound load is applied to the top edge of any drawer front face.
2. For an unloaded/empty drawer scenario, the CSU will tip over when 34 pounds is applied to the top edge of any drawer front face when all drawers are opened.
3. Staff determined that a 16 – 34-pound loading range can cause the CSU to tip over depending on the amount of load carried within the drawers.

Referring back to the incident, the victim's center of gravity appeared to be 5 to 6 inches from the front of the open drawer. Her applied moment on the CSU was greater compared to a situation where her weight is applied on the top edge of the drawer as demonstrated in Figure 163.

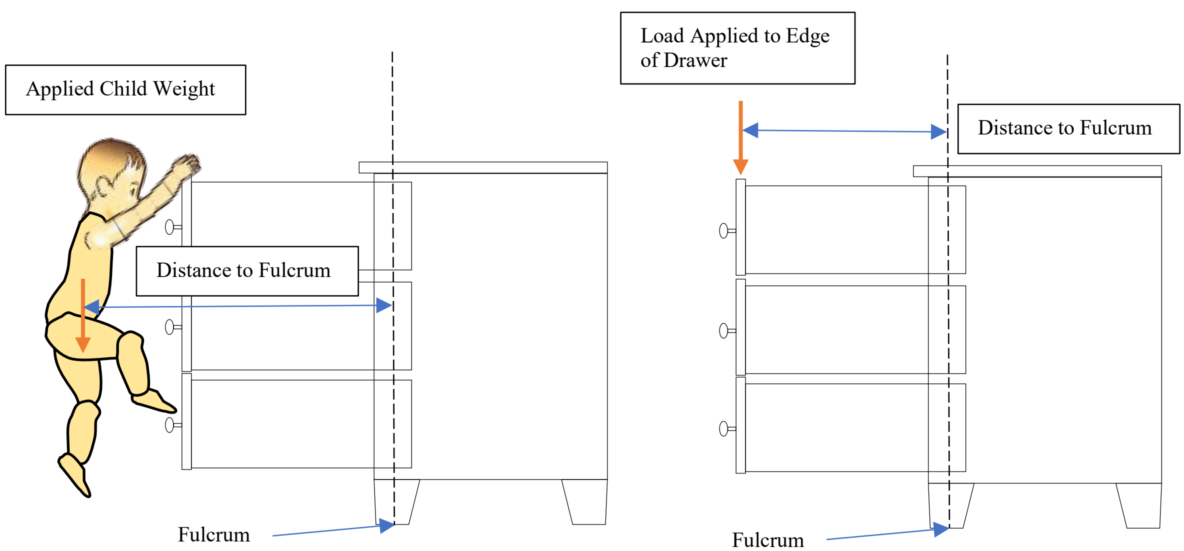


Figure 163. Child climbing on CSU compared to applying load directly on edge of drawer.

Potential Stability Modifications

ESMC staff analyzed several potential CSU stability solutions that could increase the stability of the five-drawer incident unit. The solutions considered include: 1) adding a drawer interlock system (only one drawer can be opened simultaneously), 2) decreasing the drawer extension (reducing the lever effect or see-saw effect created by the child), 3) adding a horizontal extension to the unit front feet (moving the fulcrum or increasing the lever effect for the unit), 4) adding front feet leveler to tilt the dresser back, and 5).adding weight to the unit that is both low to the ground/floor and at the rear of the unit (increasing the y-direction CG of the CSU or increasing the lever effect for the unit). Figure 164 visually represents some of a range of possible modifications that can be made to the clothing storage unit individually or in combination.

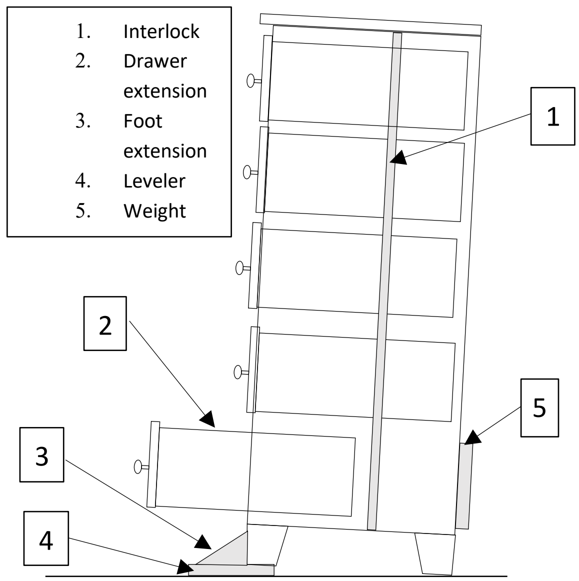


Figure 164. Potential modifications to CSU.

Stability modifications analyzed for the incident unit include:

1. Adding an interlock (limit to 1 open drawer), and adding a 5-pound counterweight.
2. Adding an interlock (limit to 2 open drawers), and adding a 10-pound counterweight.
3. Adding an interlock (limit to 3 open drawers), extending front foot 1 inch, and adding a 5-pound counterweight.
4. Adding an interlock (limit to 1 open drawer), decreasing drawer extension 1 inch, and extending front foot 1 inch.

The drawer extension and foot extension modifications were made relative to the fulcrum of the CSU. For all of these modification combinations, these changes would increase the stability of the CSU and reduce the propensity for the CSU tipping over. See Table 39 below for modifications to the incident unit.

Table 39. Calculated Seven Drawer Incident CSU Performance with Modifications.

Modification	Requirement = 51.2(1.08X+0.52) (lb-ft)	Moment (lb-ft)	Interlock Y/N (# of Open Drawers)	Drawer Extension (in.)	Drawer Extension Decrease (in.)	Foot Extension (in.)	Counter Weight (lb.)	Front Leveler Height (in.)
Original	82.68	8.41	No (7)	12.17	0	0	0	0
1	82.68	89.90	Yes (1)	12.17	0	0	5	0
2	82.68	86.28	Yes (2)	12.17	0	0	10	0
3	78.07	79.95	Yes (3)	12.17	0	1	5	0
4	73.47	75.38	Yes (1)	12.17	1	1	0	0

Stability modifications analyzed for the exemplar unit include:

1. Adding an interlock (limit to 3 open drawers).
2. Decreasing drawer extension 1 inch, and adding 24-pound counterweight.
3. Extending front foot 1 inch, and adding 20-pound counterweight.
4. Adding 35-pound counterweight.

For all of these modification combinations, these changes would increase the stability of the CSU and reduce the propensity for the CSU tipping over. See Table 40 below for modifications to the exemplar unit.

Table 40. Calculated Seven Drawer Exemplar CSU Performance with Modifications

Modification	Requirement = 51.2(1.08X+0.52) (lb-ft)	Moment (lb-ft)	Interlock Y/N (# of Open Drawers)	Drawer Extension (in.)	Drawer Extension Decrease (in.)	Foot Extension (in.)	Counter Weight (lb.)	Front Leveler Height (in.)
Original	81.05	31.28	No (7)	11.81	0	0	0	0
1	81.05	82.02	Yes (3)	11.81	0	0	0	0
2	76.44	77.12	No (7)	11.81	1	0	24	0
3	76.44	81.03	No (7)	11.81	0	1	20	0
4	81.05	81.80	No (7)	11.81	0	0	35	0

Conclusion

The incident and exemplar units meet the requirements 7.1 and 7.2 of ASTM F2057 – 19, *Standard Safety Specification for Clothing Storage Units.* For a single open drawer, the incident unit tipped over at 84 pounds and the exemplar unit tipped over at 114 pounds.

The incident unit was involved in a tip over by an approximately 26-pound child. Staff recreated the incident with the incident CSU, filled with 69.2 pounds and applied a 26-pound force on the edge of an open drawer. Based on staff testing, the finding is consistent with the events captured in the video footage of the child climbing and tipping over the clothing storage unit.

ESMC staff found that the provided incident and exemplar units differed in physical dimensions and performance. The incident unit weighed 165 pounds and the exemplar unit weighed 195 pounds. The exemplar unit tip weights were 30 to 40 pounds greater than the incident unit. The incident unit tipped over with 16 pounds applied to the edge of the open drawer with all drawers open and loaded. The exemplar unit tipped over with 45 pounds applied to the edge of the open drawer with all drawers open and loaded.

Although both the incident unit and exemplar unit meet the requirements of the ASTM standard, staff concludes that both CSUs can be tipped over if 51.2 pounds (95th percentile 3-year old male) is applied to the edge of an open drawer if the CSU has multiple open and loaded drawers.

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TAB N: FY 2018 Midyear Clothing Storage Unit Testing Program Summary

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

Memorandum

DATE: July 14, 2021

TO: Kristen Talcott, Ph.D. Furniture Tip Over Project Manager
Division of Human Factors, Directorate for Engineering Sciences

THROUGH: Andrew G. Stadnik, P.E., Associate Executive Director,
Directorate for Laboratory Sciences

Michael Nelson, Director,
Laboratory Sciences Mechanical Engineering Division
Directorate for Laboratory Sciences

FROM: Maxwell Sanborn, Mechanical Engineer,
Laboratory Sciences Mechanical Engineering Division,
Directorate for Laboratory Sciences

SUBJECT: FY 2018 Midyear Clothing Storage Unit Testing Program Summary

INTRODUCTION

CPSC staff has conducted several tests to address the tip-over hazard associated with clothing storage units (CSUs). This memorandum discusses testing staff conducted in a program initiated in Fiscal Year (FY) 2018, referred to as the FY 2018 Midyear Clothing Storage Unit Testing Program. This testing program (spanning 2018 and 2019) was intended to: (1) assess compliance with the two stability requirements in the voluntary standard for CSUs, ASTM F2057, Standard Safety Specification for Clothing Storage Units (ASTM F2057); (2) assess the stability of CSUs with a 60-pound test weight on a single open drawer; and (3) assess maximum weight CSUs could hold on a single open drawer before tipping over.

BACKGROUND

2017 ANPR

In November 2017, the U.S. Consumer Product Safety Commission (CPSC or Commission) approved the publication of an advance notice of proposed rulemaking (ANPR) to address CSU furniture tip-over hazards. This ANPR published on November 30, 2017. In the notice, the Commission invited interested parties to submit existing voluntary standards or a statement of intent to modify or develop a voluntary standard that addresses the risk associated with furniture tip over.[1]

2016 Testing

In September 2016, as directed by the Commission in the FY 2020 Operating Plan, CPSC staff assessed conformance with ASTM F2057-14[2] and the tip restraint standard, ASTM F3096-14, *Standard Performance Specification for Tipover Restraint(s) Used with Clothing Storage Unit(s)*. In that testing, Laboratory Sciences Mechanical Engineering Division (LSM) staff evaluated 61 CSU samples and found that 50 percent (31/61) did not meet at least one of the F2057 – 14 stability requirements. Staff also found 91 percent (56/61) did not meet the F2057 – 14 labeling requirements, and that 43 percent (26/61) did not meet the F3096 – 14 tip restraint requirements by not being able to withstand a 50-pound load applied to the tip restraint (8/61) or not including a tip restraint with the CSU at all (18/61)[3].

2018-2019 Testing

In working towards a notice of proposed rulemaking (NPR), CPSC staff performed a variety of tests on CSUs to determine the most effective safety and performance requirements. The tests included the testing to F2057, testing to F2057, but with a 60-pound test weight, and testing to failure described in this memorandum, as well as the multiple loaded drawer testing, described in Tab O, and the carpet testing described in Tab P.

ASTM F2057 Requirements

At the time staff conducted the FY 2018 testing addressed in this memorandum, ASTM F2057 – 17 was the current version of the ASTM standard. The stability tests in ASTM F2057 – 19 (the current version of the applicable standard) are unchanged from the stability tests in ASTM F2057 – 17.

ASTM F2057 – 17 has two performance requirements for stability: Stability of Unloaded Unit, described in Section 7.1, and Stability with Load, described in Section 7.2. The Stability of Unloaded Unit test, consists of placing an empty CSU on a hard, level, flat surface; then opening all doors (if any) to 90 degrees, and extending all drawers and pullout shelves to the outstop. In the absence of an outstop, all drawers and pullout shelves are opened to two-thirds of the

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[1] 82 Fed. Reg. 56752 (Nov. 30, 2017), available at: https://www.federalregister.gov/documents/2017/11/30/2017-25779/clothing-storage-unit-tip-overs-request-for-comments-and-information.

[2] ASTM F2057 – 14 was the current version at the time of testing. The stability requirements in the standard are the same as those in ASTM F2057 – 19.

[3] https://www.cpsc.gov/s3fs-public/2016-Tipover-Briefing-Package-Test-Results-Update-August-16-2017.pdf?yMCHvzY_YtOZmBAAj0GJih1lXE7vvu9K.

operational sliding length. In addition, all flaps or drop fronts are opened to their horizontal position or as near to horizontal as possible. The standard defines an "outstop" as "any feature that limits outward motion of drawers or pullout shelves, or both"; it defines the "operational sliding length" as "length measured from the inside face of the drawer back to the inside face of the drawer front with measurements taken at the shortest drawer depth dimension." With all doors open, and all drawers and shelves pulled out, if the CSU tips over, or is supported by any component that was not specifically designed for that purpose, it does not meet the stability requirements.

The Stability with Load test consists of placing an empty CSU on a hard, level, flat surface, and gradually applying a 50-pound test weight. For units with drawers, the test requires opening one single drawer to the outstop, or in the absence of an outstop, to two-thirds of its operational sliding length, and gradually applying the test weight over the front face of the drawer. For units with doors, the test requires opening one door to 90 degrees and gradually applying the test weight so that the outer edge of the test weight is flush with the outermost upper corner of the door. All other drawers and doors remain closed, unless they must be opened to access other components behind them (*e.g.*, a drawer behind a door). The remaining drawers and doors are also tested individually. ASTM F2057 – 17 allows for two types of test weights: one made from lead and one made from steel, each with different dimensions. CPSC used test weights made from steel. The test weight consists of two 25-pound (± 1 pound) steel blocks connected by a 3-inch by 6-inch strap, such that the inside distance between the two blocks is 6 inches. The total mass of the test weight staff used was 48.5 pounds, which was near the lower tolerance limit of 48-52 pounds allowed under F2057 – 17. If the CSU tips over, or is supported by any component that was not specifically designed for that purpose, it does not meet the requirement.

SAMPLE SELECTION PROCESS

CPSC staff from the Directorate of Economic Analysis (EC) and LSM compiled an open market-based sample of 286 CSUs from 21 furniture retailers' top 10 dressers and best sellers listed on their websites. Major retailers were identified from rankings in the trade magazine *Furniture Today*.[4] The top-selling CSUs were identified using a product search of "best sellers," or similar terms, on the retailers' websites. For retailers without this search function, staff identified the CSUs with the greatest number of consumer ratings.

From this list, a sub-set consisting of 170 CSUs was chosen at random, using the random number generator function in Microsoft Excel. CPSC purchased these 170 CSUs in August and September 2018. If a selected CSU(s) was not available at the time of purchase, CPSC staff

[4] *Furniture Today* publishes annual lists of the Top 100 furniture retailers based on total retail sales values for furniture, bedding, and accessories.

replaced it with a similar unit, if possible. The final sample staff tested included 167 CSUs from this selection method.[5]

Staff also supplemented the market sample with additional units of interest. This included 4 incident-involved exemplar units (*i.e.*, the model of CSU involved in an incident, but not the actual model involved in the incident). In addition, staff also included CSUs tested in the 2018 Consumer Reports study "Furniture Tip-Overs: A Hidden Hazard in Your Home."[6] Four of the 24 units that Consumer Reports tested in their study were already included in the samples from the market survey and incident-involved units. Staff attempted to purchase the additional 20 units, but only 17 were available on the market. CPSC staff added these 17 to the final sample total.

The total number of CSUs in the final sample was 188 (167 from the market sample, 4 incident-involved CSUs, and 17 additional samples from the Consumer Reports study).

TEST PROCEDURE

Upon receiving each sample at the CPSC National Product Testing and Evaluation Center (NPTEC), staff inspected it for damage, assembled it (if applicable) according to the manufacturer's instructions, weighed the unit and measured the height, width, and depth. Staff measured the center of gravity (CG) using two methods for each CSU. The first method involved placing the unit on four separate scales, with each leg or floor contact point on its own scale. The weight distribution was used to determine the CG.[7] The other method to determine the CG involved tipping the unit on its front pivot point until it was balancing on that point, then drawing a vertical line through the pivot point. Then the unit was balanced on its rear pivot point, and another vertical line was drawn through the rear pivot point. The CG was identified by the intersection of the two lines. Staff verified that the results of these two methods were consistent.

Staff then tested the sample to the performance requirements of ASTM F2057 – 17, Section 7.1 Stability of Unloaded Unit, and Section 7.2, Stability with Load. For the Section 7.2 test, staff used a test weight slightly under 50 pounds, but still within the tolerance specified in ASTM F2057 – 17 (Figure 1).

[5] The remaining three units were not available to purchase.
[6] March 22, 2018: https://www.consumerreports.org/furniture/furniture-tip-overs-hidden-hazard-in-your-home/.
[7] The percent of weight on the front of the unit is determined by dividing the weight from the front scales by the total weight.

Figure 1. ASTM F2057 – 17 compliant test weight used in testing.

Staff also performed additional stability testing to assess the ability of the CSUs to withstand tipping over with weights greater than the 50-pound called for in ASTM F2057 – 17. First, staff conducted a stability test similar to Section 7.2, but with a 60-pound test weight, instead of a 50-pound test weight (Figure 2). The 60-pound test was based on information CPSC staff considered relevant to tip overs, at the time, as indicated in the 2017 ANPR.[8] In the ANPR, the Commission was considering whether increasing test weights to 60 pounds would help address the tip-over hazard. CPSC staff has since revised the recommended weight and test methods, based on additional data and analysis presented in this NPR (see Tab D).

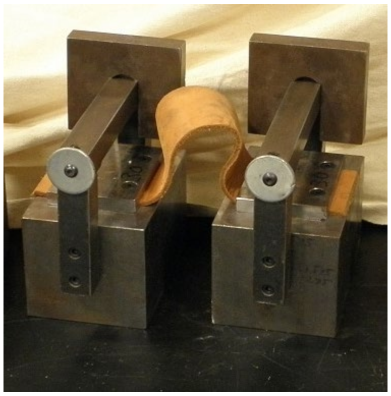

Figure 2. Sixty-pound test weight used in testing (shown with additional weights).

Then staff determined the tip weight, the minimum weight at which the unit tipped over. Staff used the CSU configuration (single open drawer, empty CSU) and test weight placement specified in ASTM F2057 – 17 Section 7.2, but designed and fabricated two new drawer loading

[8] 82 Fed. Reg. 56752 (Nov. 30, 2017), available at: https://www.federalregister.gov/documents/2017/11/30/2017-25779/clothing-storage-unit-tip-overs-request-for-comments-and-information.

test fixtures, covering different weight ranges, that allowed additional weights to be added, in 1-pound increments, to determine the tip weight (Figure 3). The base test weights were placed on the drawer front, and additional weight was added until the unit began to tip over, according to the ASTM criteria for when tip over occurs. The maximum measurable tip-over weight was limited to 134 pounds due to test fixture material limitations.

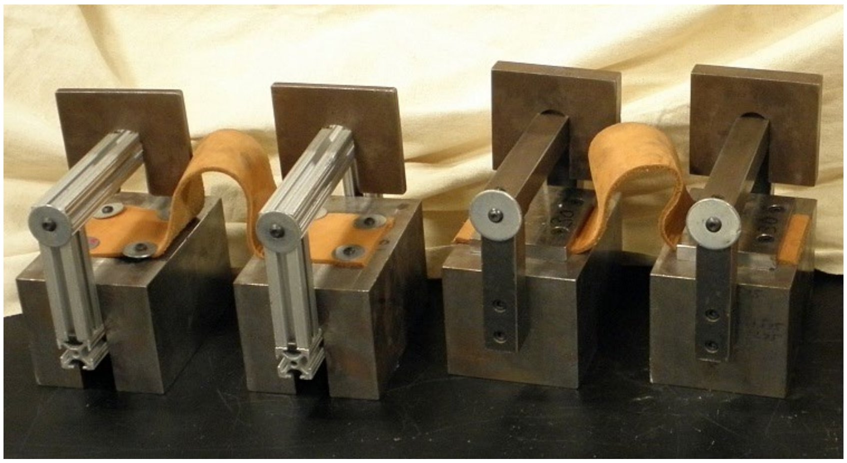

Figure 3. The test weights staff used to determine tip weight. The 30-pound base test weight, used for 30-59 pounds, is shown on the left with 2 pounds of additional weight added (1 pound on each side). The 60-pound base test weight, used for 60-134 pounds, is shown on the right with 5 pounds of additional weight added (2.5 pounds on each side).

If, during application of the test weight, a drawer, drawer glides, or any other supporting hardware broke, bent, separated, or otherwise prohibited the completion of the test, staff stopped the test and repaired the drawer or other component. Staff reinforced drawers that could not bear the test weights with load support blocks placed under the drawer or by fastening the drawer to the case with screws. These adjustments are consistent with ASTM F2057 – 17, Section 4.3, which instructs testers to repair or replace failed components that prevent completing the stability testing. The full test procedure staff used for these tests is in Appendix A.

TEST RESULTS

Of the 188 CSUs tested, 171 (91 percent) met both of the ASTM F2057 – 17 stability requirements. One did not meet the Stability of Unloaded Unit test (0.5 percent), and 17 did not meet the Stability with Load test (9 percent). The unit that did not meet the requirements of the Stability of Unloaded Unit test also did not meet the requirements of Stability with Load test. Ninety-eight units (52.1 percent) held the 60-pound weight without tipping over.

Staff removed the tip weights for three CSUs from the data set because of data discrepancies. For the 185 remaining CSUs, the mean tip weight was 61.7 pounds and the median was 62 pounds. One unit had all of the available test masses placed on its drawer and still did not tip over; so, staff was not able to determine its actual tip weight, and recorded its tip weight as 134+ pounds. The lowest measured tip weight was 12.5 pounds.

Nine units met both ASTM F2057 – 17 stability requirements yet had tip-over weights of less than 50 pounds. This is due to variations of the test weights used (±2 pounds). Compliance with the performance requirements of F2057 was determined with test weights built to the specifications in F2057 – 17, while the tip-over weight was determined using a test weight device that allowed additional weight to be added. The difference in weight distribution along the drawer resulted in some tip-over weights being less than 50 pounds, even though the same sample did not tip over with the F2057 – 17 test weights.

The tip weights are shown in Figure 4.

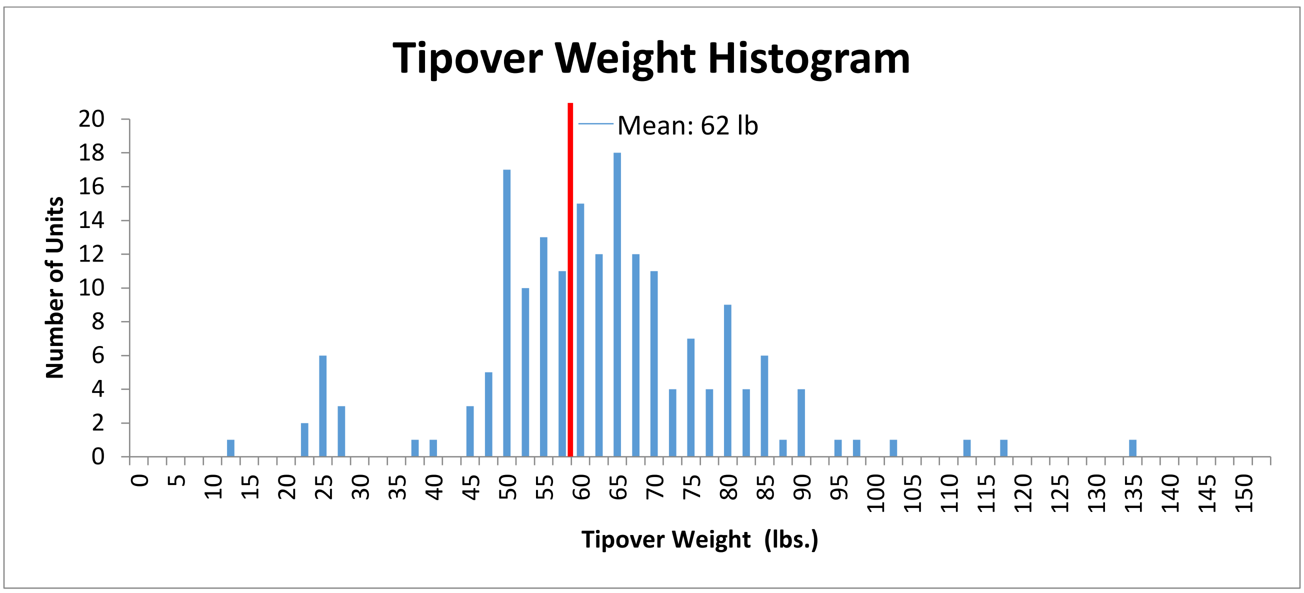

Figure 4. Histogram showing the tip weight of the tested units.

A table of individual test results for all three tests (ASTM F2057 – 17 Section 7.1 and 7.2, 60-pound weight, and tip weight), along with other data, such as dimensions, weight and drawer configuration, is in Appendix B.

CONCLUSION

Of the 188 units tested, 171 (90.9 percent) complied with the stability requirements of ASTM F2057 – 17 sections 7.1 and 7.2, and 98 (52.4 percent) units were able to hold the 60-pound test weight. The tip weight ranged from 12.5 pound to more than134 pounds, with a mean of 62 pounds. These results suggest that a majority of units on the market meet the stability requirements of ASTM F2057 – 17 (and F2057 – 19), and that a slight majority can hold a 60-pound test weight on a single open drawer. Additionally, some CSUs are capable of withstanding tip overs with much higher weights. A small number of units were able to hold more than 100 pounds on a single open drawer, with one unit able to hold more than 134 pounds.

APPENDIX A: EXCERPT FROM TEST PROCEDURE USED IN FY 2018 MIDYEAR CLOTHING STORAGE UNIT TESTING PROGRAM

1.0 Required Test Equipment

1.1 These are the tools and equipment needed to accurately complete the evaluation of Clothing Storage Units. Appropriate substitutions can be made.

- Permanent marker (Grey and Black)
- Four Digital Scales w/ Electronic Display
- Vertical Laser Line or any projectable gravity assisted vertical indicator
- Level
- Shrink Wrap
- Camera
- 50lbs test mass saddle fixture
- Tape measure

2.0 Material Determination

2.1 Record Sample Number
2.2 Record Make, Model, and Manufacturer
2.3 Visually determine the material composition of the front face, chassis (sides or framework), and backing as "particle board," "solid wood," or "other," used on the clothing storage unit.
2.4 Record results

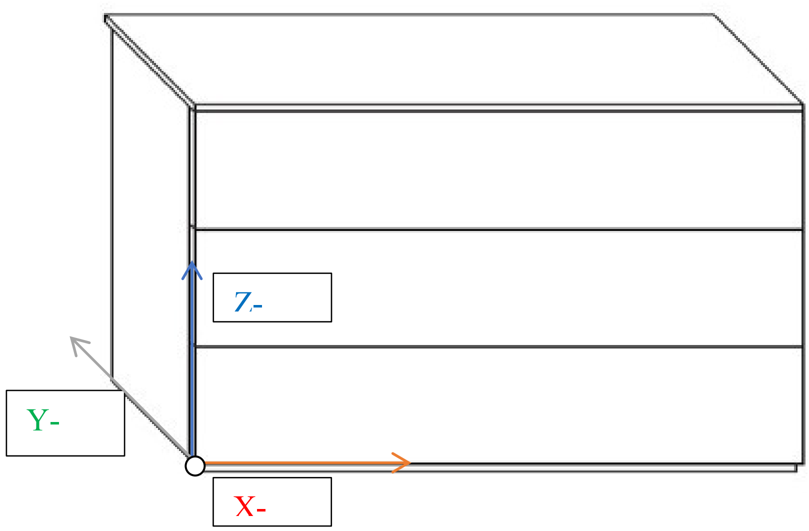

Figure 1: Coordinate system for measuring clothing storage units. All measurements reference to the center of gravity are made from the outside of the front right corner[1] of the unit.

3.0 Dimensional Measurements

3.1 Take pictures of the unit (front, back, side, isometric).
3.2 With the unit empty and all drawers and doors in the closed position, use a measuring tape to measure the side-to-side (left to right) width (X), to the outermost points of the clothing storage unit within 1/8th inch.
3.3 Using a tape measure, measure the front-to-back depth (Y) to the outermost points of the clothing storage unit within 1/8th inch.
3.4 Using a tape measure, measure the floor to the top-most surface height (Z) of the clothing storage unit within 1/8th inch.
3.5 With the drawers closed, and using the corner scales, place each corner of the clothing storage unit on the appropriate scale (*i.e.,* left front, right front).
3.6 Record the total weight in lbs., as well as the weight at each corner of the storage unit.
3.7 Measure the Operational Sliding Length of each drawer. This measurement is from the inside face of the rear panel to the inside face of the drawer front, as shown in Fig. 1 of F2057-17.
3.8 Measure the farthest drawer extension, FDE, of each drawer, and note any differences. This value is the displacement of the inside face of the drawer front from the front face of the case to its maximum extension.
    3.8.1 Calculate and record two-thirds of the FDE.
3.9 Remove from scales.

4.0 Stability Testing

4.1 *Drawers*

4.1.1 Stability of Unloaded Unit[9]:

4.1.1.1 Position the empty unit on a hard, level, flat surface.
4.1.1.2 The unit shall be level during testing, unless specifically designed otherwise.
4.1.1.3 Open all doors to 90,° and extend all drawers and pullout shelves to the outstop or, in the absence of such feature, to two-thirds OSL.
4.1.1.4 Open flaps or drop fronts to their horizontal position, or to as near horizontal as possible.
4.1.1.5 Record whether the unit tips over.

4.1.2 Stability with Load[10]:

4.1.2.1 Position the empty unit on a hard, level, flat surface. The unit shall be level during testing, unless specifically designed otherwise.

[9] This section is similar to ASTM F2057-17 section 7.1.
[10] This section is similar to ASTM F2057-17 section 7.2.

4.1.2.2 ***Drawers -*** Open one drawer to the outstop; or, in the absence of such feature to two-thirds OSL.
4.1.2.3 All other drawers and doors not undergoing testing shall be in the closed position, unless they must be opened to access other components behind them.
4.1.2.4 Gradually apply test weights over the front of each drawer.
4.1.2.5 For odd-shaped drawers, apply test weights to the front edge that protrudes the farthest.
4.1.2.6 Close the drawer and repeat this process on each drawer until all drawers have been tested.
4.1.2.7 ***Doors -*** Open one door to 90°.
4.1.2.8 All other doors and drawers not undergoing testing shall be in the closed position, unless they must be opened to access other components behind them.
4.1.2.9 Apply test weights to each door so that the outer edge of the test weight is flush with the outermost upper corner of the door.
4.1.2.10 Close door, and repeat with another door until all doors have been tested.
4.1.2.11 Record whether the unit tips over.
4.1.2.12 If unit tips over, proceed to section 4.2.1. Otherwise, proceed to section 4.2.2.

4.2 Failure weight testing

4.2.1 Testing units to failure that did not meet requirements of 4.1.2. Test one uppermost drawer that can accommodate the test fixture. See appendix X for explanation of accommodating drawers. Also, test one other drawer that did not meet 4.1.2.

4.2.1.1 Apply the 30-lb test weights in accordance with 4.1.2. If unit tips with only the 30-lb weights, stop test.
4.2.1.2 If unit does not tip, place the 7.5-lb plates on the center of each test weight handle.
4.2.1.3 If unit does not tip, add the 1-lb plates on the center of each test. If unit still does not tip, continue to add half-pound shot bags evenly over both test weights until the unit tips over. Record total tip-over weight.
4.2.1.4 If unit does tip with added 7.5-lb plates, remove and replace them with 5-lb plates. If unit does not tip, repeat 4.2.1.3.
4.2.1.5 If unit does tip with added 5-lb plates, remove and replace them with 2.5-lb plates. If unit does not tip, repeat 4.2.1.3.
4.2.1.6 If unit does tip with added 2.5-lb plates, remove and replace them with 1-lb plates. If unit does not tip, repeat 4.2.1.3.

4.2.2 Testing units to failure that met requirements of 4.1.2. Test one uppermost drawer that can accommodate test fixture. See appendix X for explanation of accommodating drawers.

4.2.2.1 Apply the 60-lb test weights in accordance with 4.1.2. If unit tips with only the 60-lb weights, remove test weights, and replace with 30-lb test weights, and add 7.5-lb plates and 5-lb plates to each test weight.
4.2.2.2 If unit does not tip, add the 1-lb plates on the center of each test. If unit still does not tip, continue to add half-pound shot bags evenly over both test weights until the unit tips over. Record total tip-over weight.
4.2.2.3 If unit does tip, remove and replace 5-lb plates with 2.5-lb plates.
4.2.2.4 If unit does tip, remove and replace 2.5-lb plates with 1-lb plates.
4.2.2.5 If unit does tip, remove and replace 1-lb plates with half-pound shot bags.
4.2.2.6 Record total tip-over weight.

APPENDIX B: SUMMARY RESULTS FROM FY 2018 MIDYEAR CLOTHING STORAGE UNIT TESTING PROGRAM

Table 1. Test Data

Sample	Drawers	Rows of Drawers	Description	Weight (lb)	Height (in)	Width (in)	Depth (in.)	F2057 7.1	F2057 7.2	60 lb. test	Tip Over Weight
1	9	4	3 rows 2 drawers, 1 on top and 2 on bottom, 1 row of 3 drawers in middle	178	41.5	32	18	Y	Y	Y	64
2	3	3	3 rows of 1 drawer	61	32.25	32	16	Y	N	N	25
3	6	3	3 rows of 2 drawers	137	36.125	63.5	17	Y	Y	N	54
4	6	3	3 rows of 2 drawers	112	32	53.3	15.625	Y	Y	Y	84
5	5	5	5 rows of 1 drawer	112	54	34.25	16	Y	Y	N	55
6	6	3	3 rows of 2 drawers	152	43	61.375	16	Y	Y	Y	79
7	4	4	4 rows of 1 drawer	84	40.75	31.5	15.625	Y	Y	Y	62
8	6	3	3 rows of 2 drawers	107	27.375	51.125	19	Y	Y	N	65
9	6	3	3 rows of 2 drawers	91	29.25	59	15.75	Y	Y	N	50

Sample	Drawers	Rows of Drawers	Description	Weight (lb)	Height (in)	Width (in)	Depth (in.)	F2057 7.1	F2057 7.2	60 lb. test	Tip Over Weight
10	6	3	3 rows of 2 drawers	89	29	58.875	15.875	Y	Y	N	49
11	6	3	3 rows of 2 drawers	92	29	59	15.875	Y	Y	N	54
12	6	3	3 rows of 2 drawers	91	29.25	60	15.75	Y	Y	N	57
13	6	3	3 rows of 2 drawers	92	29.25	58.5	15.875	Y	Y	N	55
14	4	4	4 rows of 1 drawer	47	29.75	27.75	15.75	Y	N	N	40
15	6	3	3 rows of 2 drawers	97	33.5	44.75	19	Y	Y	Y	79
16	5	5	5 rows of 1 drawer	85	49.25	31.5	15.75	Y	Y	N	55
17	6	3	3 rows of 2 drawers	92	29	59	16	Y	Y	N	55
18	8	4	4 rows of 2 drawers	142	36.25	53.875	18.5	Y	Y	Y	79
19	6	5	Top row of 2 drawers, 4 rows of 1 drawer	147	53.75	38.5	20.25	Y	Y	Y	80
20	5	5	5 rows of 1 drawer	85	45.25	31.5	16	Y	Y	N	52

Sample	Drawers	Rows of Drawers	Description	Weight (lb)	Height (in)	Width (in)	Depth (in.)	F2057 7.1	F2057 7.2	60 lb. test	Tip Over Weight
21	6	3	3 rows of 2 drawers	143	36.875	61.5	19.875	Y	Y	N	60
22	4	4	4 rows of 1 drawer	123	54.25	40	17.75	Y	Y	Y	82
23	8	3	1 rows of 3 drawers, 2 rows of 2 drawers	124	36.125	58	18.125	Y	Y	Y	67
24	6	3	3 rows of 2 drawers	136	35.75	57.875	17	Y	Y	Y	79
25	7	3	3 drawers across the top, 2 rows of 2 drawers	130	38.375	58	16.5	Y	Y	N	55
26	4	4	4 rows of 1 drawer	82	39.75	31	16.75	Y	Y	Y	64
27	4	4	4 rows of 1 drawer	97	41.375	31.25	19.75	Y	Y	N	58
28	4	4	4 rows of 1 drawer	98	41	31.25	19.75	Y	Y	Y	55
29	6	3	3 rows of 2 drawers	118	32.625	55.25	16.25	Y	Y	N	57
30	6	3	3 rows of 2 drawers	119	32.625	55.25	16.25	Y	Y	N	54
31	6	3	3 rows of 2 drawers	108	33.25	53.25	16.75	Y	Y	Y	75

Sample	Drawers	Rows of Drawers	Description	Weight (lb)	Height (in)	Width (in)	Depth (in.)	F2057 7.1	F2057 7.2	60 lb. test	Tip Over Weight
32	6	3	3 rows of 2 drawers	111	33.375	53.375	16.75	Y	Y	Y	68
33	6	3	3 rows of 2 drawers	108	33.25	53.25	16.75	Y	Y	Y	*
34	4	4	4 rows of 1 drawer	93	40.625	28	16.25	Y	Y	N	49
35	4	4	4 rows of 1 drawer	92	40.625	28	16.25	Y	Y	N	52
36	5	4	Top row of 2 drawers, 3 rows of 1 drawer	50	35.25	31.75	14	N	N	N	13
37	6	4	Top row of 3 drawers, 3 rows of 1 drawer	68	37	42.125	11.875	Y	N	N	26
38	4	3	Top row of 2 drawers, 2 rows with 1 drawer	77	31.875	41.875	19	Y	Y	Y	69
39	6	3	3 rows of 2 drawers	122	21.5	21.625	18.75	Y	Y	Y	87
40	6	3	3 rows of 2 drawers	112	31.125	51.125	18.875	Y	Y	N	51
41	6	3	3 rows of 2 drawers	108	51.25	51.25	18.875	Y	Y	N	57
42	4	4	4 rows of 1 drawer (w/ audio cabinet on top)	199	52.25	50	21	Y	Y	Y	112

Sample	Drawers	Rows of Drawers	Description	Weight (lb)	Height (in)	Width (in)	Depth (in.)	F2057 7.1	F2057 7.2	60 lb. test	Tip Over Weight
43	9	3	3 rows of 3 drawers	203	35	56	19	Y	Y	Y	75
44	5	5	5 rows of 1 drawer	106	42.5	32.875	19	Y	Y	Y	62
45	5	5	5 rows of 1 drawer	93	49.25	29.75	19.5	Y	Y	N	47
46	4	4	4 rows of 1 drawer	91	41.625	32.25	18.75	Y	Y	N	62
47	3	3	3 rows of 1 drawer	47	28.75	27.625	15.625	Y	N	N	23
48	5	5	5 rows of 1 drawer	83	44.75	27.625	16.625	Y	Y	N	59
49	6	3	3 rows of 2 drawers	94	28.125	54.5	15.625	Y	Y	N	52
50	5	5	5 rows of 1 drawer	116	50.375	40	18	Y	Y	Y	*
51	5	5	5 rows of 1 drawer	170	55.125	41.25	18.625	Y	Y	Y	82
52	5	5	5 rows of 1 drawer	106	53.625	33	18.25	Y	Y	Y	72
53	5	5	5 rows of 1 drawer	141	56	38	18.25	Y	Y	Y	78

Sample	Drawers	Rows of Drawers	Description	Weight (lb)	Height (in)	Width (in)	Depth (in.)	F2057 7.1	F2057 7.2	60 lb. test	Tip Over Weight
54	6	3	3 rows 2 drawers	108	32.25	63	16.5	Y	Y	Y	77
55	8	4	4 rows of 2 drawers, one door in middle	143	41.25	64	17.375	Y	Y	Y	82
56	5	5	5 rows of 1 drawer	120	52.125	36	16.5	Y	Y	Y	61
57	8	5	3 rows of 2 drawers on bottom, 3 rows of 1 drawer on top right, mirror on top left	119	44.25	56.25	17	Y	Y	Y	82
58	6	5	1 row of 2 drawers on top, 4 rows of 1 on bottom	148	53.625	40	18	Y	Y	Y	67
59	6	5	1 row of 2 drawers on top, 4 rows of 1 on bottom	145	53.875	40	17.75	Y	Y	Y	67
60	6	3	3 rows of 2 drawers	115	37.125	61.5	17	Y	Y	Y	77
61	5	5	5 rows of 1 drawer	108	54.25	40.125	17	Y	Y	N	59
62	6	6	6 rows of 1 drawer	120	52.125	37.25	17.875	Y	Y	Y	84
63	9	4	1 row of 3 drawers on top, 3 rows of 2 drawers on bottom	162	44.5	62	18.125	Y	Y	Y	67

Sample	Drawers	Rows of Drawers	Description	Weight (lb)	Height (in)	Width (in)	Depth (in.)	F2057 7.1	F2057 7.2	60 lb. test	Tip Over Weight
64	5	5	5 rows of 1 drawer	104	42.5	32.875	19.875	Y	Y	N	56
65	4	4	4 rows of 1 drawer	109	42.125	32	19	Y	Y	Y	90
66	7	6	Top row of 2 drawers, 5 rows of 1 drawer	170	48.5	47.25	17.625	Y	Y	Y	>60
67	7	6	Top row of 2 drawers, 5 rows of 1 drawer	171	48.75	47.325	17.75	Y	Y	Y	77
68	3	3	3 rows of 1 drawer	47	28.125	27.625	15.75	Y	N	N	21
69	6	3	3 rows of 2 drawers	116	31.25	51.25	19	Y	Y	Y	62
70	4	4	4 rows of 1 drawer	75	40.375	27.625	15.5	Y	N	N	36
71	4	4	4 rows of 1 drawer	91	42.125	29.25	16.25	Y	Y	N	57
72	8	4	4 rows of 2 drawers	116	32.25	55.125	16	Y	Y	N	48
73	7	5	5 rows of 1 drawer plus door compartment with 2 drawers	222	56.25	44	19	Y	Y	Y	134+
74	7	6	Top row of 2 drawers, 5 rows of 1 drawer	170	56	40	19	Y	Y	Y	67

Sample	Drawers	Rows of Drawers	Description	Weight (lb)	Height (in)	Width (in)	Depth (in.)	F2057 7.1	F2057 7.2	60 lb. test	Tip Over Weight
75	5	5	5 rows of 1 drawer	172	56.25	40	17.875	Y	Y	Y	75
76	5	5	5 rows of 1 drawer	175	53.875	40	18.375	Y	Y	N	63
77	6	3	3 rows of 2 drawers	149	30.375	63	18.125	Y	Y	Y	62
78	9	4	Top row of 3 drawers, 3 rows of 2 drawers	197	41.375	62.625	19.75	Y	Y	Y	63
79	5	5	5 rows of 1 drawer	130	56.25	42	17.75	Y	Y	Y	64
80	7	3	Top row of 3 drawers, 2 rows of 2 drawers	154	35.875	63.375	19.75	Y	Y	Y	88
81	8	3	Top row of 4 drawers, 2 rows of 2 drawers	164	36.25	65.25	19	Y	Y	Y	71
82	6	5	Top row of 2 drawers, 4 rows of 1 drawer	154	52.125	40	19	Y	Y	Y	68
83	7	3	Top row of 3 drawers, 2 rows of 2 drawers	147	36	62	18	Y	Y	Y	67
84	5	5	5 rows of 1 drawer	105	42.5	33	18.875	Y	Y	N	60
85	6	3	5 rows of 1 drawer	105	44.625	33	19	Y	Y	N	57

Sample	Drawers	Rows of Drawers	Description	Weight (lb)	Height (in)	Width (in)	Depth (in.)	F2057 7.1	F2057 7.2	60 lb. test	Tip Over Weight
86	3	3	3 rows of 1 drawer	76	29.25	31.875	16	Y	N	N	23
87	3	3	3 rows of 1 drawer	76	29.25	32	16	Y	N	N	22
88	6	4	3 rows of 2 drawers	132	36.625	62.5	15.375	Y	Y	Y	64
89	6	3	3 rows of 2 drawers	127	36.375	63	15.75	Y	Y	N	48
90	7	3	Top row of 3 drawers, 2 rows of 2 drawers	169	43	61.5	15.875	Y	Y	Y	101
91	6	3	3 rows of 2 drawers	126	34.25	63.25	16.25	Y	Y	N	60
92	6	3	3 rows of 2 drawers	124	36.5	58.25	15.5	Y	Y	Y	62
93	6	3	3 rows of 2 drawers	155	40.625	60.875	15.625	Y	Y	Y	79
94	6	3	3 rows of 2 drawers	130	36.875	53.875	15.875	Y	Y	Y	72
95	6	3	3 rows of 2 drawers	131	36.5	62.5	15.375	Y	Y	N	52
96	7	3	Top row of 3 drawers, 2 rows of 2 drawers	166	43.875	61.125	16.875	Y	Y	Y	92

Sample	Drawers	Rows of Drawers	Description	Weight (lb)	Height (in)	Width (in)	Depth (in.)	F2057 7.1	F2057 7.2	60 lb. test	Tip Over Weight
97	5	5	5 rows of 1 drawer	119	52.75	33.875	15.5	Y	Y	Y	54
98	5	5	5 rows of 1 drawer	99	48.5	30	15.5	Y	Y	N	56
99	5	5	5 rows of 1 drawer	108	54	33.25	16.125	Y	Y	N	50
100	6	3	3 rows of 2 drawers	161	40.75	61	15.75	Y	Y	Y	74
101	6	3	3 rows of 2 drawers	122	36	63.125	15.875	Y	Y	N	57
102	6	3	3 rows of 2 drawers	131	34.125	63.25	16.125	Y	Y	N	60
103	6	3	3 rows of 2 drawers	131	36.375	63	15.75	Y	Y	Y	64
104	5	5	5 rows of 1 drawer	95	48.625	29.375	15.5	Y	Y	N	51
105	5	5	5 rows of 1 drawer	108	53.875	33.25	16.25	Y	Y	N	50
106	6	3	3 rows of 2 drawers	125	36.375	62.375	15.375	Y	Y	N	47
107	6	3	3 rows of 2 drawers	140	36.5	61.75	14.75	Y	Y	Y	64

Sample	Drawers	Rows of Drawers	Description	Weight (lb)	Height (in)	Width (in)	Depth (in.)	F2057 7.1	F2057 7.2	60 lb. test	Tip Over Weight
108	6	4	3 rows of 2 drawers	125	36.375	62.375	15.375	Y	Y	N	54
109	5	5	5 rows of 1 drawer	88	44.75	29.75	15.75	Y	Y	N	50
110	5	5	5 rows of 1 drawer	107	54.5	33.5	15.375	Y	Y	N	57
111	6	3	3 rows of 2 drawers	118	35.875	63.5	15.875	Y	Y	Y	64
112	5	5	5 rows of 1 drawer	96	50	31.875	15.75	Y	Y	N	47
113	3	3	3 rows of 1 drawer	82	29.25	32	16	Y	N	N	25
114	3	3	3 rows of 1 drawer	80	29.125	31.875	16.125	Y	N	N	25
115	6	3	3 rows of 2 drawers	96	28.25	54.5	15.625	Y	Y	N	55
116	6	3	3 rows of 2 drawers	119	27.625	60.5	19.625	Y	Y	N	58
117	6	3	3 rows of 2 drawers	128	32.875	53.625	18.5	Y	Y	Y	77
118	5	5	Top row of 2 drawers, 3 rows of 1 drawer	170	52.25	40	18	Y	Y	N	52

Sample	Drawers	Rows of Drawers	Description	Weight (lb)	Height (in)	Width (in)	Depth (in.)	F2057 7.1	F2057 7.2	60 lb. test	Tip Over Weight
119	3	3	3 rows of 1 drawer	70	27.5	29.75	19.375	Y	Y	N	52
120	5	5	5 rows of 1 drawer	106	42.5	33	19	Y	Y	N	60
121	5	5	5 rows of 1 drawer	105	42.625	32.875	19	Y	Y	N	60
122	5	5	5 rows of 1 drawer	93	49.125	29.625	19.375	Y	N	N	45
123	5	5	5 rows of 1 drawer	114	49.125	31.125	19.5	Y	Y	N	52
124	8	4	4 rows of 2 drawers	234	40.25	68	20	Y	Y	Y	117
125	5	5	5 rows of 1 drawer	83	44.75	27.625	16.625	Y	Y	N	53
126	1	2	2 door armoire, 1 drawer	115	34.625	34.625	17.5	Y	Y	N	60
127	2	2	2 door armoire, 2 drawer	111	58.5	31.5	22	Y	Y	Y	89
128	2	2	2 door armoire, 2 drawer	109	58.625	31.5	22	Y	Y	Y	89
129	4	4	4 rows of 1 drawer	107	42.75	34.75	18.625	Y	Y	Y	61

Sample	Drawers	Rows of Drawers	Description	Weight (lb)	Height (in)	Width (in)	Depth (in.)	F2057 7.1	F2057 7.2	60 lb. test	Tip Over Weight
130	5	5	5 rows of 1 drawer	126	49.75	32	17.625	Y	Y	Y	65
131	6	3	3 rows of 2 drawers	97	33.5	47.5	18.875	Y	Y	Y	66
132	4	4	4 rows of 1 drawer	55	29.75	30	15.75	Y	N	N	26
133	9	4	Top row of 2 drawers, 1 row of 3 drawers, 2 rows of 2 drawers and a cabinet	189	43.625	70	18.875	Y	Y	Y	69
134	3	3	3 rows of 1 drawer	100	37.5	42.5	19.375	Y	Y	Y	67
135	6	3	top row 2 drawers, 4 rows of 1 drawer	111	51.375	42.24	19.5	Y	Y	Y	67
136	8	3	top row 4 drawer, 2 rows w/ 2 drawers	122	37.625	62.75	19.5	Y	Y	Y	79
137	3	3	3 rows of 1 drawer	94	30.5	31.625	19	Y	Y	N	52
138	4	4	4 rows of 1 drawer	106	39.5	31.625	19	Y	Y	Y	62
139	6	5	top row 2 drawers, 4 rows of 1	136	48.5	31.625	19	Y	Y	Y	69

Sample	Drawers	Rows of Drawers	Description	Weight (lb)	Height (in)	Width (in)	Depth (in.)	F2057 7.1	F2057 7.2	60 lb. test	Tip Over Weight
140	6	3	3 rows of 2 drawers	140	30.625	63.125	19	Y	Y	Y	85
141	3	3	3 rows of 1 drawer	67	36	29.625	15.5	Y	Y	N	56
142	5	5	5 rows of 1 drawer	83	49.625	29.625	15.75	Y	Y	Y	62
143	6	3	3 rows of 2 drawers	92	36.25	59.25	15.75	Y	Y	Y	64
144	4	4	4 rows of 1 drawer	94	38.875	15.75	18.5	Y	Y	Y	74
145	3	3	3 rows of 1 drawer	106	37.5	30.75	18	Y	Y	Y	63
146	4	4	4 rows of 1 drawer	117	48.875	30.875	18	Y	Y	Y	84
147	3	3	3 rows of 1 drawer	85	32.625	35.5	18.25	Y	Y	N	60
148	5	5	5 rows of 1 drawer	98	44.625	35.5	17.375	Y	Y	N	52
149	6	3	3 rows of 2 drawers	129	32.5	67.625	17.25	Y	Y	Y	75
150	3	3	3 rows of 1 drawer	45	28.125	27.625	15.625	Y	N	N	23

Sample	Drawers	Rows of Drawers	Description	Weight (lb)	Height (in)	Width (in)	Depth (in.)	F2057 7.1	F2057 7.2	60 lb. test	Tip Over Weight
151	5	5	5 rows of 1 drawer	82	44	27.625	15.625	Y	Y	Y	65
152	6	3	3 rows of 2 drawers	88	28.25	55.125	15.625	Y	Y	N	49
153	5	5	5 rows of 1 drawer	148	54.625	30	19	Y	Y	Y	79
154	6	3	3 rows of 2 drawers	156	33.25	54	18	Y	Y	Y	69
155	5	5	5 rows of 1 drawer	126	54	31	17.75	Y	Y	Y	67
156	5	5	5 rows of 1 drawer	127	51.875	35	17	Y	Y	Y	65
157	9	3	3 rows of 3 drawers	155	36.625	66.25	19.5	Y	Y	Y	82
158	6	3	3 rows of 2 drawers	141	35.625	55.75	17.875	Y	Y	N	52
159	6	3	3 rows of 2 drawers	139	36.75	54	15.75	Y	Y	Y	65
160	6	3	3 rows of 2 drawers	138	36.75	54.25	15.75	Y	Y	Y	65
161	6	3	3 rows of 2 drawers	143	36.75	54	15.75	Y	Y	N	54

Sample	Drawers	Rows of Drawers	Description	Weight (lb)	Height (in)	Width (in)	Depth (in.)	F2057 7.1	F2057 7.2	60 lb. test	Tip Over Weight
162	5	5	5 rows of 1 drawer	110	48.75	30	15.875	Y	N	N	47
163	5	5	5 rows of 1 drawer	83	42.25	31.625	15.75	Y	Y	N	*
164	6	3	3 rows of 2 drawers	81	28.75	47.25	15.5	Y	Y	N	52
165	5	5	5 rows of 1 drawer	85	45.25	31.5	15.75	Y	Y	N	65
166	6	3	3 rows of 2 drawers	91	29	59	16	Y	Y	N	53
167	6	3	3 rows of 1 drawer	73	36.25	30	19.125	Y	N	N	26
168	4	4	4 rows of 1 drawer	85	41	31.5	15.625	Y	Y	N	59
169	6	3	3 rows of 2 drawers	145	36	54.5	16.5	Y	Y	Y	95
170	6	3	3 rows of 2 drawers	119	31.5	57.75	19.5	Y	Y	N	49
171	6	3	3 rows of 2 drawers	152	40.75	61	15.625	Y	Y	Y	67
172	4	4	4 rows of 1 drawer	90	37.75	36.25	18.75	Y	Y	Y	62

Sample	Drawers	Rows of Drawers	Description	Weight (lb)	Height (in)	Width (in)	Depth (in.)	F2057 7.1	F2057 7.2	60 lb. test	Tip Over Weight
173	6	3	3 rows of 2 drawers	108	27.5	51.25	18	Y	Y	Y	63
174	3	3	3 rows of 1 drawer	70	33	36.5	18.75	Y	Y	Y	64
175	6	3	3 rows of 2 drawers	123	34	47.625	19.125	Y	Y	Y	64
176	3	3	3 rows of 1 drawer	102	47.25	30.125	16.75	Y	Y	N	50
177	3	3	3 rows of 1 drawer	85	36.625	34.75	17.75	Y	Y	Y	70
178	5	5	5 rows of 1 drawer	91	42.5	29.75	18.875	Y	Y	N	52
179	6	3	3 rows of 2 drawers	111	31.25	52	19.5	Y	Y	Y	62
180	4	3	top row of 2 drawers, 2 rows of 1 drawer	91	31	38.375	18	Y	Y	Y	65
181	7	3	top row of 3 drawers, 2 rows of 2 drawers	119	31.125	56.25	18	Y	Y	Y	74
182	6	3	3 rows of 2 drawers	110	33.5	47.125	18.875	Y	Y	Y	67
183	6	3	3 rows of 2 drawers	101	33.375	47.125	18.5	Y	Y	Y	64

Sample	Drawers	Rows of Drawers	Description	Weight (lb)	Height (in)	Width (in)	Depth (in.)	F2057 7.1	F2057 7.2	60 lb. test	Tip Over Weight
184	3	3	3 rows of 1 drawer	77	33.5	37	19	Y	Y	N	57
185	5	5	5 rows of 1 drawer	164	48.25	35.625	21.125	Y	Y	Y	89
186	5	5	5 rows of 1 drawer	145	46.25	33.875	20.875	Y	Y	Y	70
187	6	3	3 rows of 2 drawers	100	32.625	50	18	Y	Y	N	54
188	6	5	top row of 2 drawers, 4 rows of 1 drawer	88	48.25	35.875	17	Y	N	N	45

*These tip weights were inconsistent between tests and so were not included in the mean and median calculations.

TAB O: Testing to Assess the Effect of Open/Closed and Filled/Empty Drawers on Clothing Storage Unit Stability

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

Memorandum

Date: July 14, 2021

TO: Kristen Talcott, Ph.D., Project Manager,
Division of Human Factors, Directorate for Engineering Sciences

THROUGH: Stephen Hanway, Associate Executive Director,
Directorate for Epidemiology

Risana Chowdhury, Director,
Division of Hazard Analysis, Directorate for Epidemiology

FROM: Tammy Massie, Ph.D., Statistician
Division of Hazard Analysis, Directorate for Epidemiology

SUBJECT: Testing to Assess the Effect of Open/Closed and Filled/Empty Drawers on Clothing Storage Unit Stability

INTRODUCTION

In November 2017, the Commission published an advance notice of proposed rulemaking (ANPR) to address the risk of deaths and injuries caused by clothing storage units (CSUs) tipping over. As part of the ongoing rulemaking effort, CPSC staff examined various factors that affect the stability of CSUs. These factors include open drawers, filled drawers, child interactions (addressed in Tab D), and flooring (addressed in Tab P). As Tab C explains, these factors are common in CSU tip-over incidents. To assess the effect of open drawers and filled drawers on CSU stability, CPSC's Laboratory Sciences Mechanical Engineering Division (LSM) staff conducted testing to evaluate the effect of various combinations of open/closed and empty/filled drawers. This memorandum presents the analytical results-based laboratory test data from this testing. This study provides insight into the patterns of instability based on these factors. However, it should be noted that this study used a convenience sample of CSUs. Accordingly, although it provides useful information, the results are limited to the tested units.

Overview of Tip-Over Testing Study

Staff conducted two phases of testing, referred to in this memorandum as Phase I and Phase II. The purpose of the testing was to assess the weight at which a CSU became unstable and tipped (or "tip weight") with various configurations of drawers open/closed and filled/empty. The primary variable of interest in the Phase I study was the influence of multiple open/closed drawers. The CSUs tested in Phase I were primarily units with a single column of drawers. The Phase II study examined the influence of multiple open/closed drawers and as filled/empty drawers. The CSUs tested in Phase II included more complex units with multiple columns of drawers.

The test method and results of the Phase I and II testing are included in this memorandum. This memorandum provides insight into the currently available data and descriptive statistics from the Phase I and Phase II studies illustrating the effect of open and closed drawers and filled and empty drawers on CSU stability.

The staff testing presented in the memorandum includes testing similar to testing for compliance with the stability requirements in ASTM International's standard F2057 – 19, *Standard Safety Specification for Clothing Storage Units*. Staff used the stability test methods in ASTM F2057 – 19, with some alterations, to collect information about variables that ASTM F2057 – 19 does not address (*i.e.*, the effect of opened/closed drawers, the effect of filled/empty drawers, and the explicit tip weight that causes the CSU to become unstable and tip over). In ASTM F2057 – 19, there are two stability-related tests. The first test (referred to in this memorandum as "ASTM 7.1") assesses the stability of the unloaded unit. The unit is placed on a hard, flat, level surface, and all of the doors and drawers are opened. The unit must not tip over. The second test (referred to as "ASTM 7.2") assesses the stability of the unit with a load. The unit is placed on a hard, flat, level surface, with only one drawer or door open at a time, and a 50-pound weight is applied to that drawer's front face. This test weight is intended to simulate the weight of a child. To comply with the standard, the unit must not tip over. Tab N provides a detailed description of the stability requirements in ASTM F2057 – 19.

For the testing described in this memorandum, LSM staff evaluated various combinations of open and closed drawers, in addition to filled and empty drawers, with the filled drawers containing weight bags to simulate a drawer filled with clothing (Tab D). Staff also varied the drawer on which the tip weight mechanism was applied, referred to in this memorandum as the "tip weight application location." This testing was not designed to be comprehensive in terms of the variety of all combinations of drawer open/closed, drawers filled/empty, and the tip weight application location. Additionally, the selection of units to be studied in the project was not comprehensive or representative of all CSUs. Specific details related to the samples selected can be found in Tab N. However, the samples included the most commonly purchased units, a variety of drawer patterns, heights, and weights and select units identified by CPSC compliance staff. It used a convenience sample of CSUs available, based on a 2018 study and incident units held by CPSC.

Study Plan

Staff conducted the Phase I testing from late January 2020 to March 2020, and conducted the Phase II study from March 2020 to December 2020.[1] All testing was conducted at the CPSC National Product Testing and Evaluation Center laboratory (NPTEC).

To determine the tip weight, staff opened a specific drawer and placed a tip weight mechanism[2] on the fully extended pre-selected open drawer. First, staff added weight to the unit until the CSU "tipped over," which was defined as the point at which the unit pivoted forward and continued to fall, unless prevented. Staff then used an iterative process of removing and adding weight, until they determined the lowest weight, using 1-pound increments, at which the unit tipped over. This weight was identified and recorded as the "tip weight." Figure 1 below provides a sample illustration of a tip weight mechanism. Staff placed the tip weight mechanism centered in the middle of the front face of the drawer, when possible.

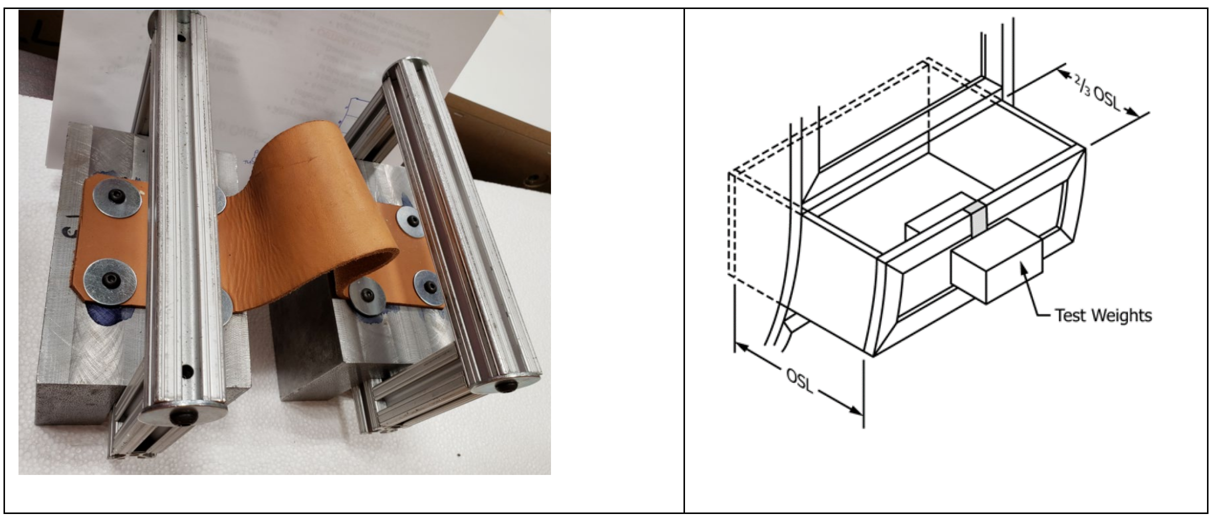


Figure 1. Tip weight measurement mechanism (left) and placement on drawer: center or furthest extension (right). Drawing on right reprinted, with permission, from ASTM F2057−19 Standard Safety Specification for Clothing Storage Units, copyright ASTM International, 100 Barr Harbor Drive, West Conshohocken, PA 19428. A copy of the complete standard may be obtained from ASTM International, www.astm.org."

[1] Due to COVID-19, there was a pause of approximately 6-months in testing, from mid-March through August.
[2] The tip weight mechanism was the same as that described in Tab N.

Patterns of Interest - Phase I Study

The primary goal of the Phase I study was to identify and gain insight into the influence of multiple open or closed drawers on CSU stability as a function of tip weight. In the Phase I study, staff examined simple CSUs with a single column of drawers. Additionally, this study was designed to test and ideally confirm that identical drawer open/closed patterns (*e.g*., two open drawers) yielded nearly identical tip weights, particularly when drawers were identical in size, regardless of the specific configuration (drawers opened/closed and tip weight application location).

Figure 2 illustrates the types of CSUs that were studied in Phase I. From these graphics, it can be seen that even a "simple" single column of drawers may have different sizes of drawers that could influence tip weight, depending on which drawers are open.

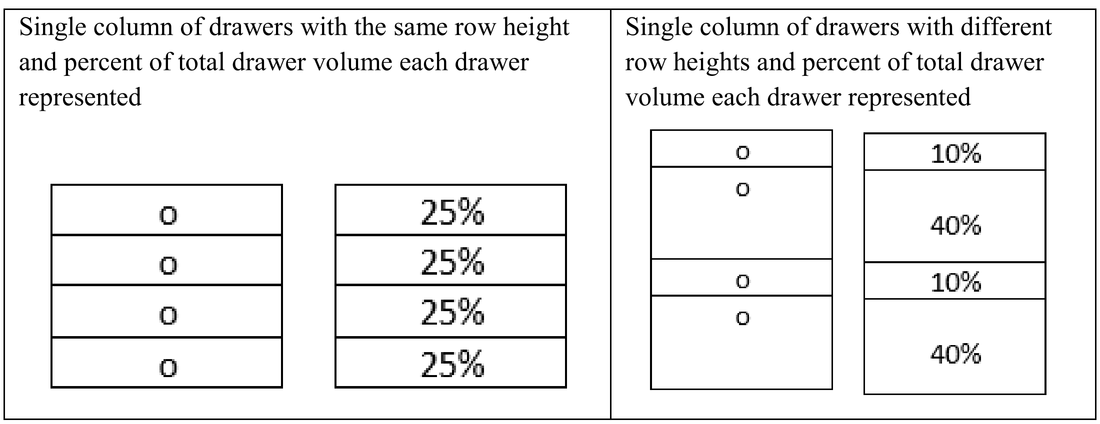


Figure 2. Illustration of drawer structure of single column of drawers with varying drawer heights.

Staff conducted the first two tip weight tests using configurations similar to those in ASTM 7.1 and 7.2. In the test similar to ASTM 7.1, all drawers were open and empty. In the test similar to ASTM 7.2, all but one drawer was closed, and all drawers were empty. Within this testing, the tip weight application location could be any drawer within the CSU, and staff noted the tip weight.

For the remainder of the tests, for each CSU within the Phase I study, staff filled all the drawers with weight bags to represent the weight of clothing in a fully filled drawer. The fill weight was based on the interior volume of the drawer and 8.5 pounds per cubic foot. The weight bags were rectangular plastic bags filled with steel shot and were placed at the center of the drawer. The inclusion or exclusion of these weight bags in the drawer is noted within this report as "filled" or "empty." More details related to justification and computation of the filled weight bags can be found in in Tab D, Tab L, and Tab N.

In addition to the drawer structure, filled drawers were open or closed to understand what influence different numbers and different locations of drawers had on the tip weight that acts as a surrogate for stability of the CSU. The following figure, Figure 3, illustrates different scenarios of drawers open/closed.

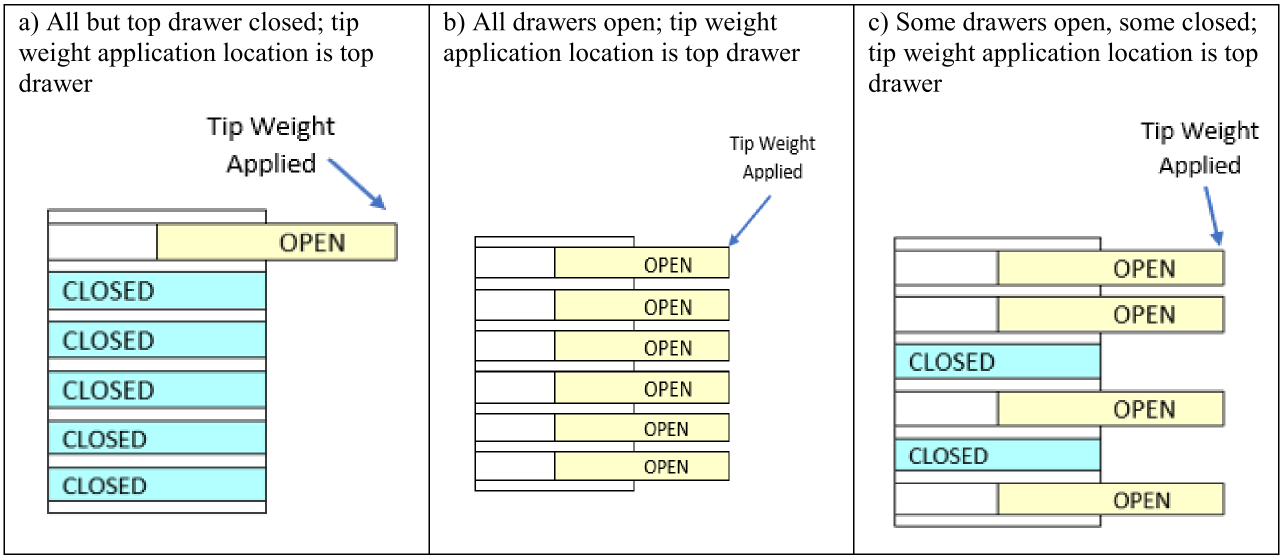


Figure 3. Illustration of potential drawer configurations in Phase I—side view.

The previous illustration provides insight into potential configurations for a 6-drawer, single column CSU, with one (the top) drawer open, all 6 drawers open, and 4 out of the 6 drawers open. In this illustration, the tip weight application location for configuration a) and b) can only be the top drawer; however, in configuration c), the tip weight application location could also have been the bottom drawer or the third drawer from the bottom.

The Phase I study confirmed that comparable tip weights existed for similar open/closed drawer configurations in the tested CSUs when considering a simple single column of drawers that are identically sized.

Patterns of Interest - Phase II Study

The primary goal of the Phase II study was an extension of the Phase I study to examine additional complexities with respect to real-world scenarios of CSUs. This included more complex CSUs and combinations of filled and/or empty drawers within the same CSU, in addition to open/closed drawers. In this memorandum, staff refers to configurations in which some drawers are filled and some drawers are empty as "partially filled" configurations. Staff also used the knowledge and experience gained within the Phase I study to modify the test method to try to decrease the test-to-test variability, for example, by adding cross hatches on the drawer and the weight bag to ensure weight bags were centered within drawers. Figure 4 illustrates a weight bag and the cross-hatch feature used to ensure the weight bags were centered within a drawer.

Weight Bag	Centering within Drawer
	

Figure 4. Picture of weight bag for filled drawers and crosshatch to center weight bag within drawer.

The increased complexity of the CSUs, plus the inclusion of filled/empty drawers by drawer increased the number of possible combinations for each unit. For example, if all combinations of a 3 row, 2 column unit were examined, 24,576 ($2^6 * 2^6 * 6$, when considering all six possibilities of the variable open/closed or filled/empty for each of the six drawers and the tip weight application location on each of the 6 drawers) different combinations are possible. Staff allowed for testing of any of the possible combinations, with one restriction: the drawer located directly above the tip weight application location always had to be closed to allow the tip weight mechanism to be applied to the drawer face. This restriction slightly reduced the total number of potential combinations. However, even with this restriction, thousands of combinations were still possible. Many of these combinations are like replicates, because most, but not all, dressers have symmetry in rows and/or columns. However, staff did not assess all of the combinations. Rather, staff identified prospectively select combinations and collected data on the tip weight for these combinations.

Figure 5 provides a diagram that illustrates three scenarios for a simple single-column, 6-drawer structure. The diagram includes three combinations that were considered within the Phase II study. Within this illustration, the three primary variables that are considered are: (1) open/closed drawer, (2) filled/empty drawer, and (3) the tip weight application location.

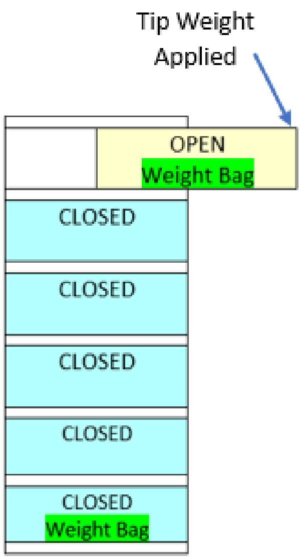
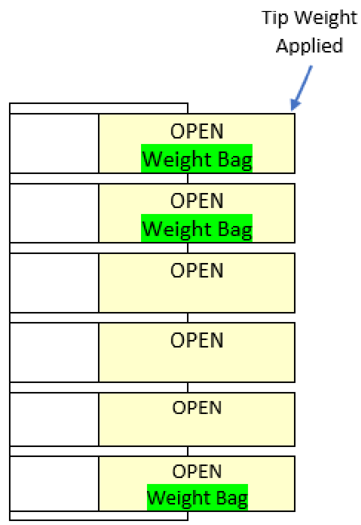
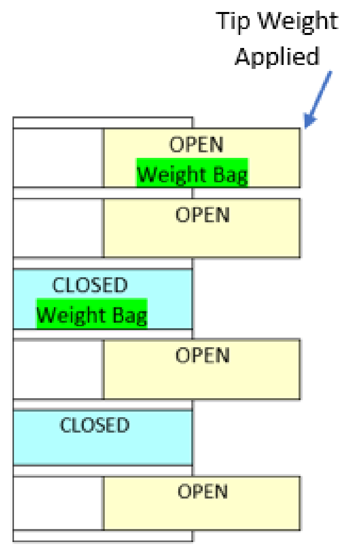
Only top drawer open, weight bags in top and lowest drawer; tip weight application location is the top drawer	All drawers open; top, 2nd level and bottom drawer filled with weight bags; tip weight application location is the top drawer	Four drawers open, two drawers closed; one open and one closed drawer filled with weight bags; tip weight application location is the top drawer
		

Figure 5. Examples (side view) of a single-column unit, showing potential combinations of drawers open/closed, drawers filled with weight bag/empty, and tip weight application location.

In the figure above, the first column illustrates a single-column, 6-drawer CSU, in which only the top drawer is open, and all others are closed; only the top and bottom drawer are filled; and the tip weight application location is the top drawer. The second column illustrates an example of the same CSU with all drawers open, but only three of the six drawers are filled. The third column illustrates a potential combination in which several drawers are open and two drawers (one open, one closed) are filled. In each of these scenarios, it is likely that the tip weight would be different because of the different scenario illustrated.

Data from testing various configurations of pre-specified open/closed, filled/empty drawers, and tip weight application location provided insight into the effect of these factors on the CSU stability. These configurations mimic how a CSU may be used in the real world.

Historical Background and Characteristics of Units Studied

Staff selected CSUs for the Phase I and Phase II testing from the approximately 200 units available from the testing described in Tab N, in addition to exemplars from incident-involved units. The selected units were a non-random sample intended to cover a range of drawer/row designs (single column to more complex), a range of stability, and to include units with and without feet.

Staff initially selected 11 CSUs for Phase I to cover a limited range of drawer/row designs (single column) and to include units with/without feet. Subsequently, staff selected an additional 15 CSUs for the Phase II study, which was intended to examine additional sources of variability in the test plan and more complex units. The units for Phase II included more complex units with multiple columns, different size rows and, like the Phase I study, units with/without feet.

In both Phase I and Phase II, CPSC staff made every attempt to gather data in a pre-specified and consistent manner. To accomplish this, staff excluded certain test results, or did not test certain configurations, because they were either not feasible, or they did not provide useful information about CSU stability. For some configurations, the unit tipped before any tip weight was applied. For example, if a 6-row, single-column CSU was to have all six drawers filled and open, but by the time the fourth drawer was open, the unit tipped over (with no weight applied), staff entered "0" for the tip weight. However, in fact, the unit tipped well before the pre-specified configuration. For these instances, the data were not included, although there is the chance that this was a functional "0" (in which the CSU tipped at precisely zero pounds), rather than an indication that the unit tipped *prior to any weight* being applied.

A tip weight was only included in the analysis, if there was a tip-over weight greater than zero pounds. In other cases, the test that was called for was not feasible because the planned tip weight application location was directly beneath an open drawer. In still other instances, the drawer broke when attempts were made to obtain the tip weight for that test. Thus, staff excluded data from specific units and specific tip weights because data were either absent, or had integrity/consistency issues. This affected roughly 5 percent of the data collected in this study.

A summary of the physical characteristics of the 26 units tested as part of the Phase I (11 units) and Phase II (15 units), and other data collected in the 2018 study, are provided in

Table 1 and Figure 6 and incorporate data from Tab N.

Table 1. Background Information Including Physical Characteristics, Phase and Previously Recorded Data

Unit #	Carpet test Unit #	Phase	Pandemic	Drawer Layout	CSU Weight (lb)	Height (in)	Width (in)	Depth (in)	Open Drawer ASTM (7.1)—Pass?
1	n/a	1	Pre	3 rows of 1 drawer	106	37.5	30.75	18	Y
2	n/a	1	Pre	3 rows of 1 drawer	45	28.125	27.625	15.625	Y
3	n/a	1	Pre	3 rows of 1 drawer	67	36	29.625	15.5	Y
4	n/a	1	Pre	4 rows of 1 drawer	47	29.75	27.75	15.75	Y
5	n/a	1	Pre	4 rows of 1 drawer	123	54.25	40	17.75	Y
6	n/a	1	Pre	4 rows of 1 drawer	75	40.375	27.625	15.5	Y
7	n/a	1	Pre	4 rows of 1 drawer	55	29.75	30	15.75	Y
8	n/a	1	Pre	5 rows of 1 drawer	141	56	38	18.25	Y
9	n/a	1	Pre	5 rows of 1 drawer	130	56.25	42	17.75	Y
10	n/a	1	Pre	5 rows of 1 drawer	148	54.625	30	19	Y
11	n/a	1	Pre	5 rows of 1 drawer	93	49.25	29.75	19.5	Y
12	n/a	2	Pre	5 rows of 1 drawer	175	53.875	40	18.375	Y
13	n/a	2	Pre	5 rows of 1 drawer	96	50	31.875	15.75	Y
14	8	2	Pre	6 rows of 1 drawer	120	52.125	37.25	17.875	Y
15	9	2	Pre	1 row of 2 drawers on top, 4 rows of 1 on bottom	148	53.625	40	18	Y
16	7	2	Pre	top row 2 drawers, 4 rows of 1	136	48.5	31.625	19	Y
17	2	2	Post	4 rows, 1 column	100	40.125	39.75	19.125	Y
18	5	2	Post	3 rows, 1 column	57	27.5	31.25	15.5	Y
19	1	2	Post	3 rows of 1 drawer	100	37.5	42.5	19.375	Y
20	4	2	Post	5 rows, 1 column	149	50.1	35	18	Y
21	11	2	Post	3 rows of 2 drawers	119	32.625	55.25	16.25	Y
22	12	2	Post	3 rows of 2 drawers	130	36.875	53.875	15.875	Y
23	10	2	Post	4 rows of 2 drawers	142	36.25	53.875	18.5	Y
24	13	2	Post	1 row of 3 drawers, 2 rows of 2 drawers	124	36.125	58	18.125	Y
25	6	2	Post	3 rows. Bottom and middle row: 2 columns. Top row: 3 columns.	194	37.2	55.3	21.6	Y
26	3	2	Post	3 rows. Bottom and middle row: 2 columns. Top row: 4 columns.	123	37.2	62.75	19.6	Y

From Figure 6, below, it can be seen that the units selected for the Phase I and Phase II studies had a range of tip weight from 21 to 114 pounds. All units met the stability requirement in ASTM F2057 – 19 Section 7.1; while nine units measured in 2018, did not meet the stability requirements in Section 7.2 (using 50 pounds as the cutoff).

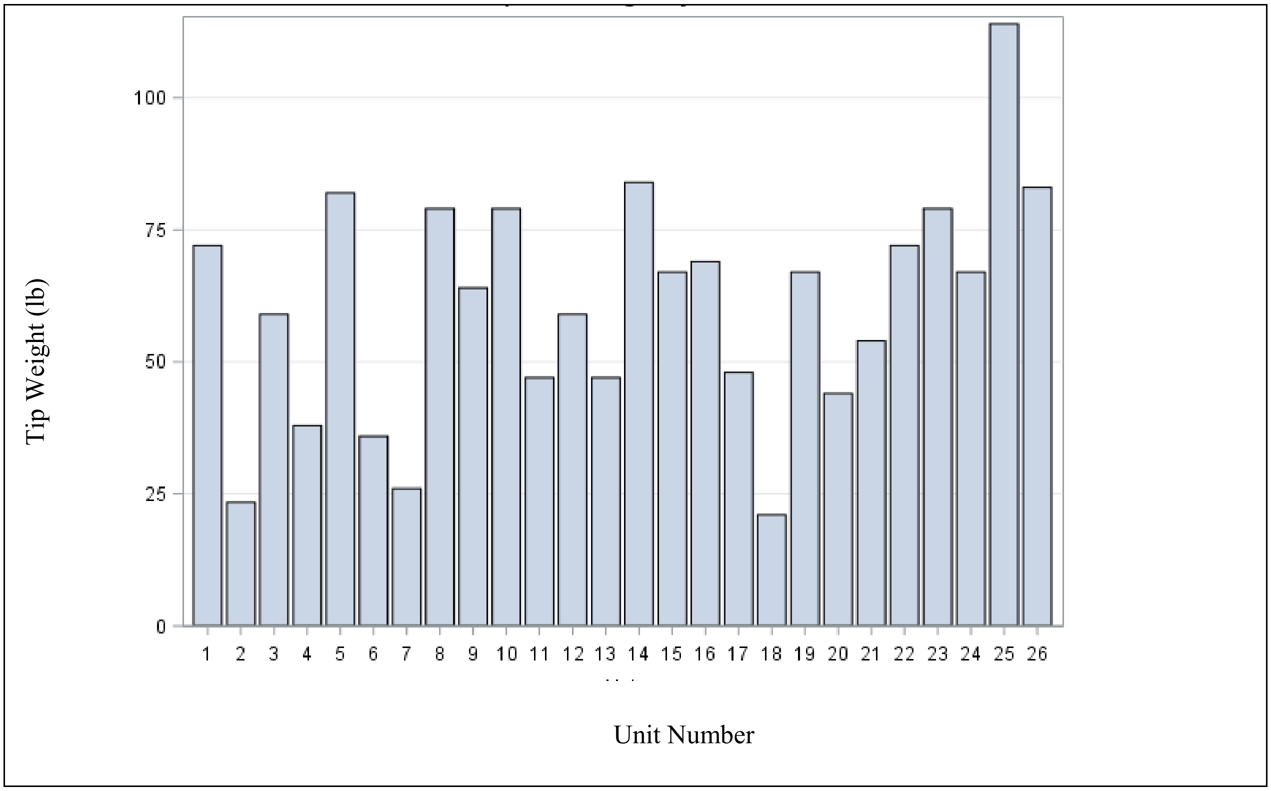


Figure 6. Previously assessed tip-over weight (single open drawer, empty unit) for the 26 units.

As Table 1 indicates, the CSUs ranged in weight from 45 pounds to 194 pounds. The height of the units varied from 27.5 inches to 56.25 inches tall. A comparison of the height and weight of the unit to the tip weight can be seen in Figure 7 and Figure 8.

Tip-Over Weight Versus Height of Unit

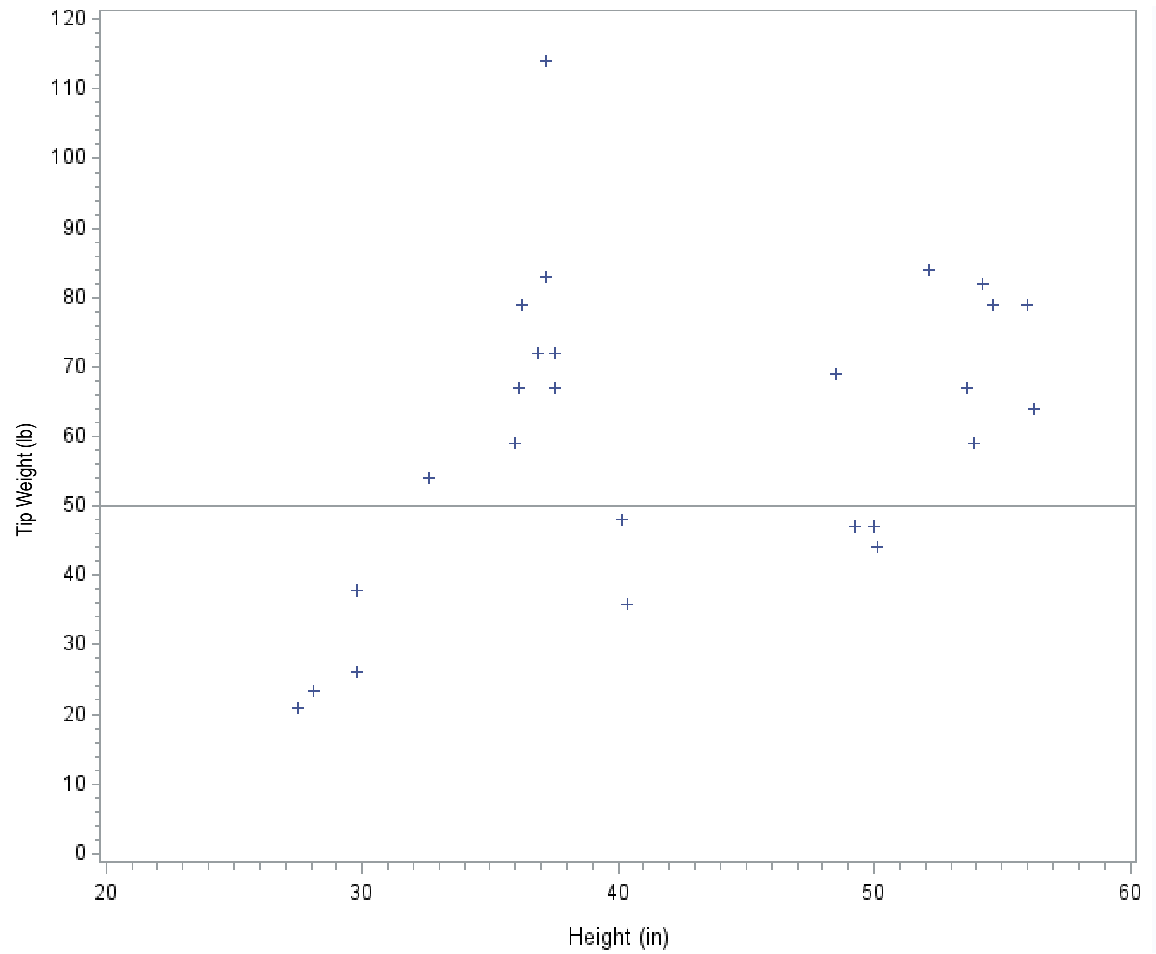


Figure 7. Tip weight considering height of unit.

Tip-Over Weight Versus Weight of Unit

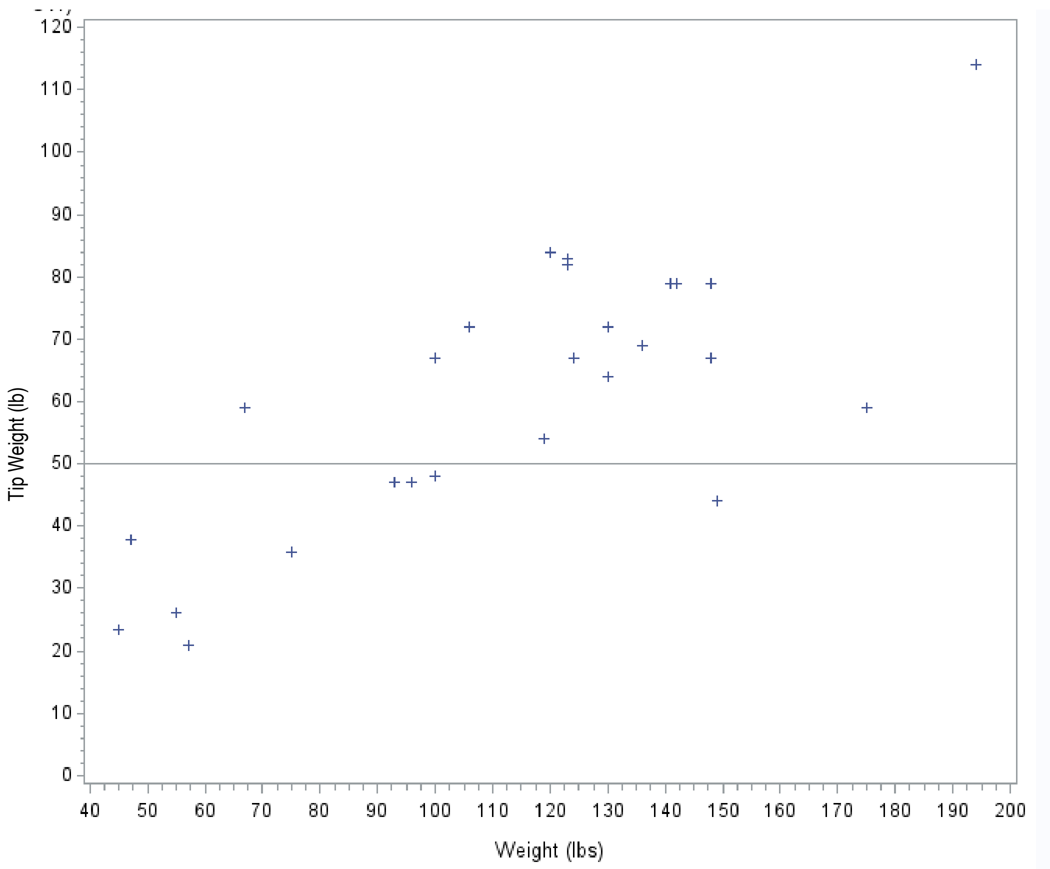


Figure 8. Tip weight considering weight of unit.

As Figure 7 and Figure 8 illustrate, based on the sample test data, there seems to be a trend that lighter and shorter units may be less stable, with eight of the nine lightest units, and the four shortest units, failing to meet ASTM F2057 – 19 Section 7.2.

Figure 9 provides insight into the height and weight of a unit and whether they meet the stability requirement in ASTM F2057 – 19 Section 7.2. From the graphic, there are some shorter, lighter units, along with a taller, heavy unit that did not meet the stability requirement in ASTM F2057 – 19 Section 7.2. Yet, there are other similar units that met the stability requirement in Section 7.2. This illustrates that there does not appear to be a relationship between specific heights and/or weights of a CSU that will lead to stability or instability based on the pass/fail of ASTM 7.2.

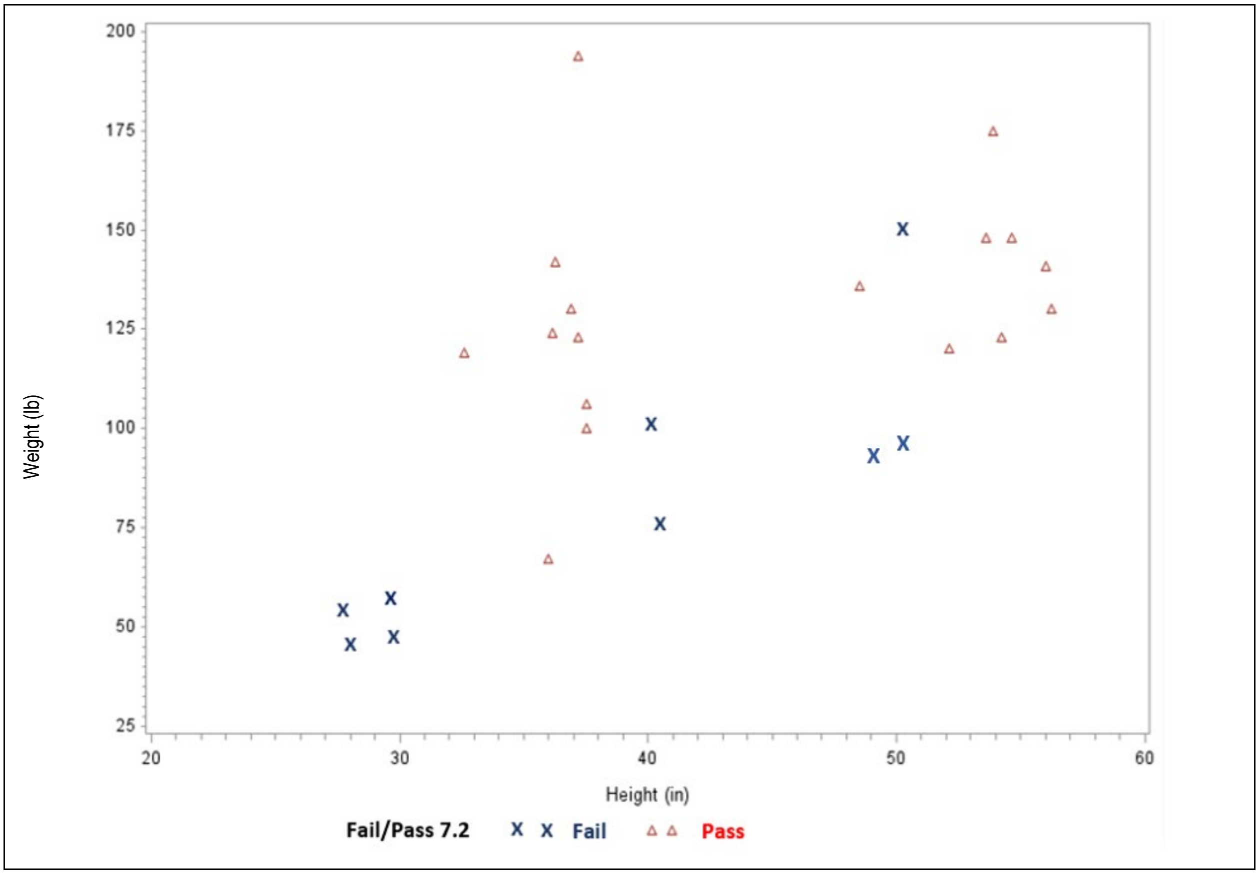


Figure 9. CSUs that meet/do not meet the stability requirement in ASTM F2057 – 19 Section 7.2 considering height and weight of unit.

Staff also looked at the CSU depth-to-width ratio (footprint ratio), compared to tip weight. Note that footprint ratio values close to 1 (0.8 or 0.9) would be nearly a square footprint, and small values (0.2 or 0.3) for this footprint ratio would be a wider, but less deep, rectangular unit. A footprint ratio greater than 1 would be associated with a very narrow unit that is deep, but for CSUs, this is not common. In addition, staff looked at two other characteristics that could influence tip weight: the footprint ratio compared to the weight of the unit, and the footprint ratio compared to the height of the unit. Figure 10 illustrates that the footprint ratio alone does not appear to directly affect tip weight. However, this is not surprising because both the height and the weight of the unit concurrently affect stability.

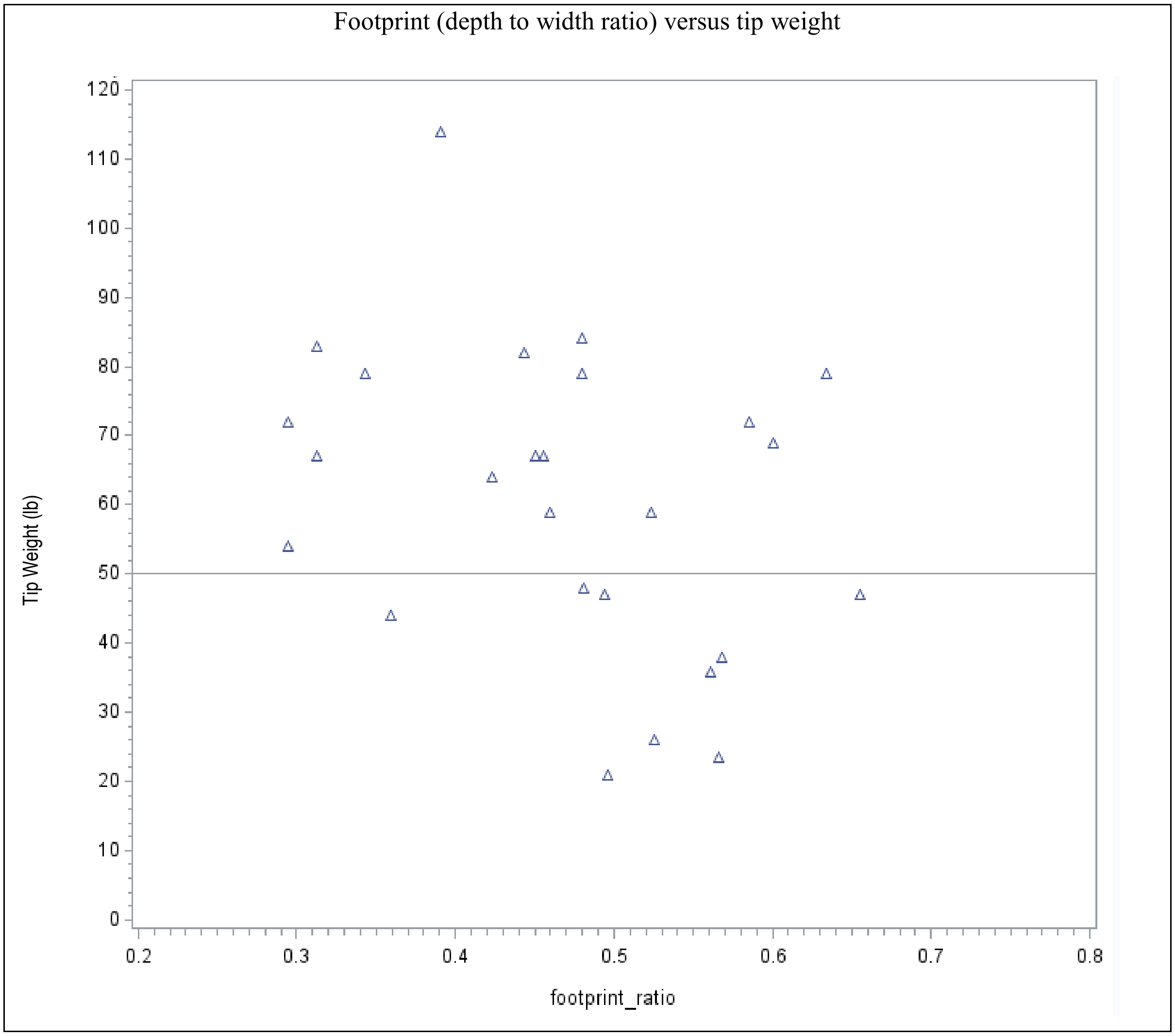


Figure 10. Dimensions of unit compared to tip weight.

The figure above provides limited information about the stability of the units. However, incorporating the height of the unit and the weight of the unit compared to the footprint ratio provides additional insight into tip weight patterns of the 26 units studied in the Phase I/II study. These additional comparisons related to the footprint ratio to weight and height of the unit are provided in Figure 11.

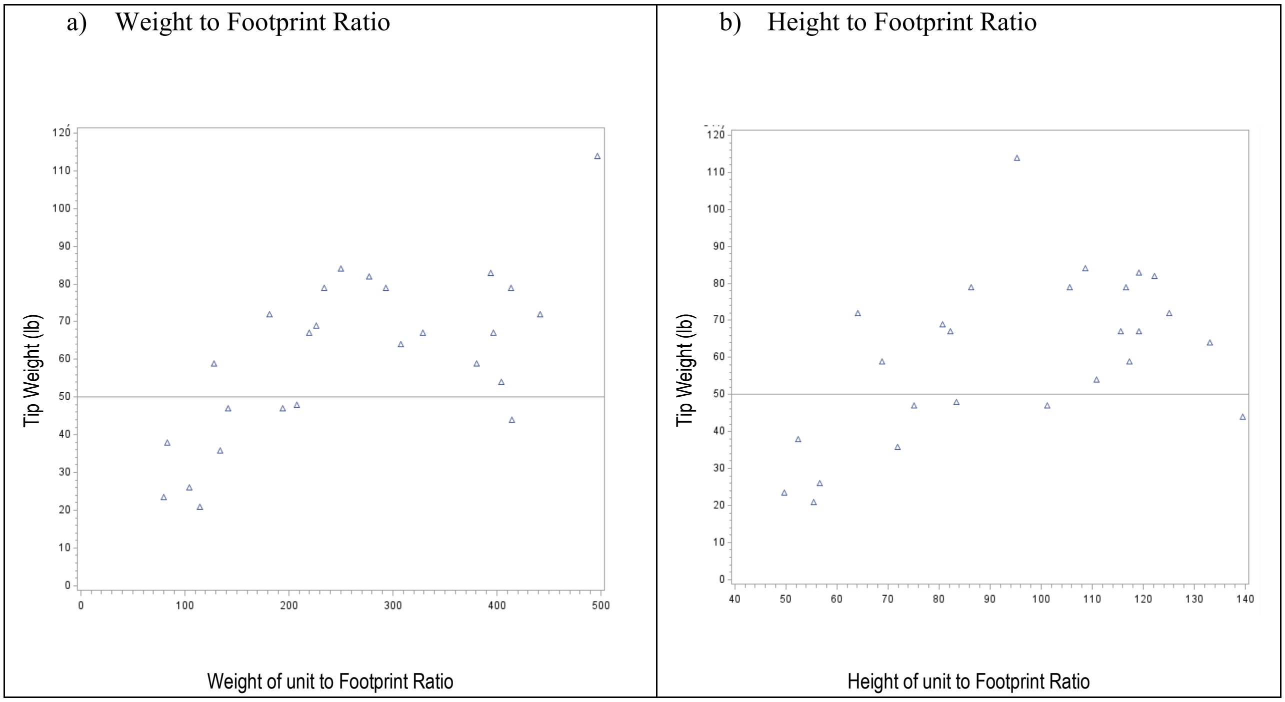


Figure 11. Tip Weight considering the footprint ratio to weight and height of the unit.

It is important to note that the 2018 results related to the dimensions of the CSU compared to the tip weight reflect the tip weight for a completely empty unit with only one drawer open. Thus, these results do not reflect tip weight when multiple drawers are opened or drawers are filled. Furthermore, these data do not provide insight into the drawer structures, presence and location of feet, and other design characteristics that may influence tip-over weight.

This exploration of the stability of CSUs based on their design characteristics demonstrates that design characteristics can influence stability of an empty unit with a single open drawer. However, there are factors beyond height, weight, and footprint that also influence this stability. In addition, a combination in which all drawers are empty and only one drawer is open does not represent all the combinations that could be present in real-world use of CSUs, which are commonly filled with clothing, and that may have multiple drawers open. The Phase I and Phase II studies were designed to examine more possible combinations indicating which drawers were open/closed and filled/empty.

PHASE I AND PHASE II RESULTS

From the 26 CSUs tested, CPSC staff was able to obtain 2,054 data points for a variety of drawer combinations (select scenarios of: filled/empty, open/closed, tip weight application location).

Staff excluded some data points, as described above, and where data points were greater than 10 pounds different than an identically open/closed, filled/empty CSU with only the tip weight drawer application location varying. This would suggest a transcription error and both values were excluded. A summary of all 2,054 data points collected within the Phase I and II studies are included in Table 2.

Table 2. Datapoints Available from Phase I and Phase II Studies

Unit	Phase	Count (*1)	Drawer Layout	Feet	Tip Weight with One Open Drawer, Empty (pounds) (*2)	Validation Replicates (*3)	Drawers Partial Filled/Empty
1	1	20	3 rows of 1 drawer	N	68	No	No
2	1	10	3 rows of 1 drawer	N	22	No	No
3	1	10	3 rows of 1 drawer	Y	58	No	No
4	1	23	4 rows of 1 drawer	N	37	No	No
5	1	23	4 rows of 1 drawer	Y	88	No	No
6	1	23	4 rows of 1 drawer	N	.	No	No
7	1	23	4 rows of 1 drawer	N	.	No	No
8	1	48	5 rows of 1 drawer	Y	42	Yes	No
9	1	48	5 rows of 1 drawer	Y	30	Yes	No
10	1	48	5 rows of 1 drawer	Y	80	Yes	No
11	1	49	5 rows of 1 drawer	Y	.	Yes	No
12	2	54	5 rows of 1 drawer	Y	64	Yes	Yes
13	2	54	5 rows of 1 drawer	N	52	Yes	Yes
14	2	148	6 rows of 1 drawer	Y	85	Yes	Yes
15	2	162	1 row of 2 drawers on top, 4 rows of 1 on bottom	Y	67	Yes	Yes
16	2	162	Top row 2 drawers, 4 rows of 1	N	65	Yes	Yes
17	2	45	4 rows, 1 column	N	42	Yes	Yes
18	2	60	3 rows, 1 column	N	21	Yes	Yes
19	2	69	3 rows of 1 drawer	Y	64	Yes	Yes
20	2	70	5 rows, 1 column	Y	46	Yes	Yes
21	2	102	3 rows of 2 drawers	Y	47	Yes	Yes
22	2	102	3 rows of 2 drawers	Y	54	Yes	Yes
23	2	131	4 rows of 2 drawers	Y	51	Yes	Yes
24	2	185	1 row of 3 drawers, 2 rows of 2 drawers	Y	50	Yes	Yes
25	2	185	3 rows. Bottom and middle row: 2 columns. Top row: 3 columns.	Y	104	Yes	Yes
26	2	200	3 rows. Bottom and middle row: 2 columns. Top row: 4 columns.	Y	.	Yes	Yes

Note: (*1): Count listed in this table is ALL data collected within this study, prior to data clean up.

(*2) For several units, staff did not collect the tip weight with "only one drawer open," as specified in ASTM 7.2. Rather, staff had all drawers open in the top row of drawers and applied the tip weights to a single one of those open drawers.

(*3) For select units to be studied in the alternate surface testing (Tab P), there was pre- and post-testing that provided additional data, specifically for the alternate surface testing. This provided multiple additional replicates of select open/closed and filled/empty configurations with the tip weight application location on the top drawer.

A graphical summary of all 2,054 tip weight datapoints for all units examined in the Phase I and Phase II study can be seen in Figure 12. The observed values associated with each of the 26 units illustrate the variability of tip weights observed and collected within both the Phase I and Phase II studies. This demonstrates the variability of tip weight with various combinations of opened/closed and filled/empty drawers.

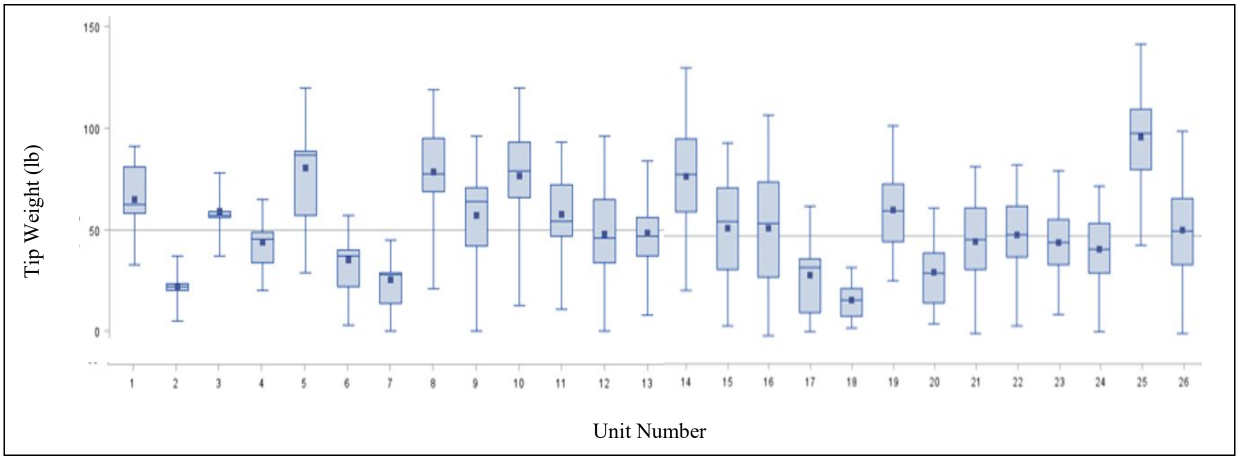


Figure 12. Plot of ALL tip weight values for ALL units examined in the Phase I and Phase II study.

Of the 2,054 tip weights collected from the 26 CSUs, staff flagged 277 tip weights as outliers, transcription errors, "0" values that may or may not be a functional zero (*i.e.*, indicate that the furniture did not tip with zero pounds applied but did tip when 1 pound was applied or if the unit tipped *prior* to any weight being applied as the drawers were being opened), and where experimental error was suspected. These data points were removed, leaving 1,777 tip weight datapoints to evaluate and analyze.

From the above figures, it can be seen that units have a variety of tip weights that were observed during the study. These data incorporate both filled and empty drawers demonstrating a variety of different open/closed drawer configurations. The histogram plots include **all** data collected during the Phase I and Phase II studies. However, as noted above, select observations were subsequently excluded, due to outliers that fell beyond the normal/expected range of variability in results and concerns such that those outliers could be unreliable data points.

To supplement this reduced dataset, staff used data obtained from Phase I and II testing and data from other CPSC staff testing ESMC/LSM performed on approximately 180 sample units (Tab N) and Product Safety Assessments (PSAs) for some incident units. From this, 108 datapoints from these historical LSM and ESMC studies were added to the Phase I and Phase II datasets. Because there were multiple replicates for select units, there were a total of 1,885 datapoints added from this historical information.

A graphical representation of all validated data for the tested units and historical supplementary data is provided within Figure 13.

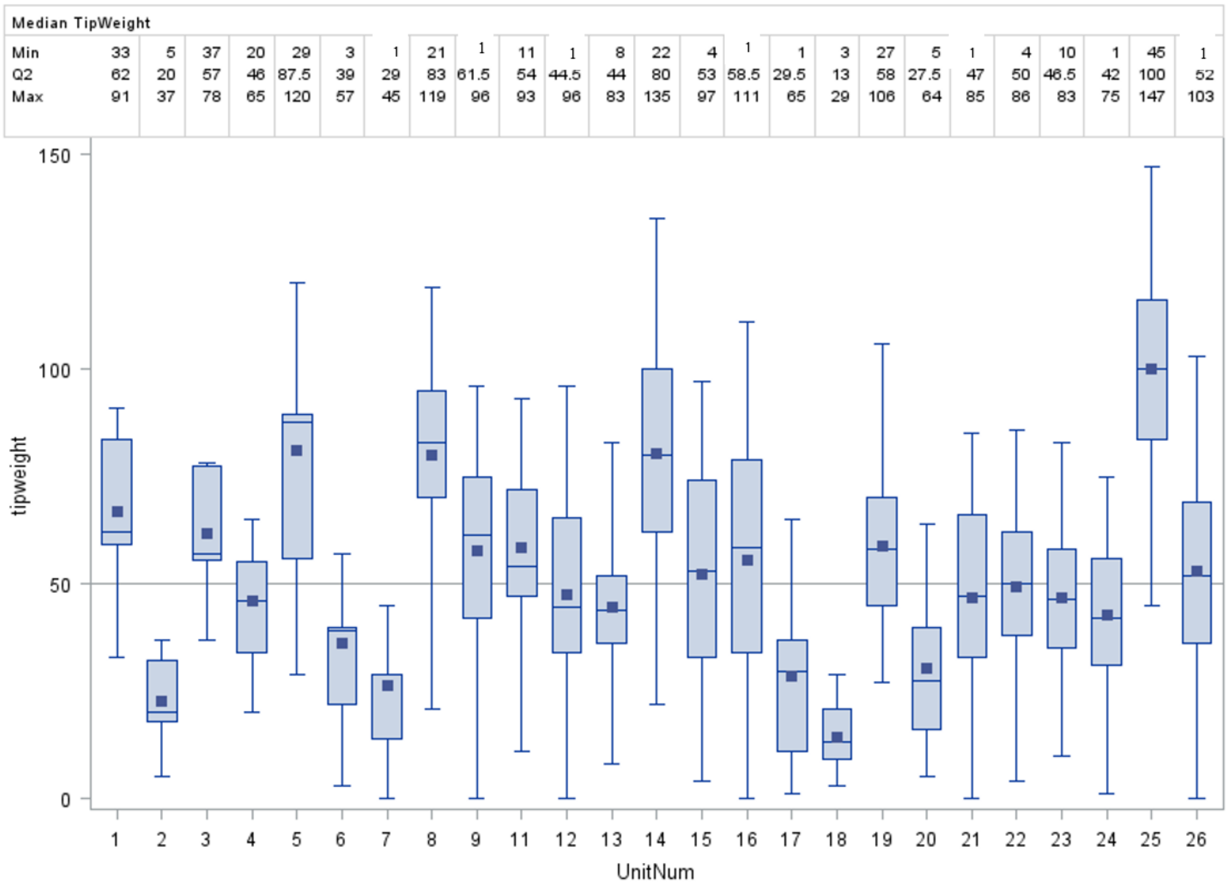


Figure 13. Plot of distributions of tip weights for all 26 units, including only validated tip weight values and supplemented with other historical data from the 2018 samples and ESMC data points.

As Figure 13 illustrates, individual CSUs vary in stability, depending on the configuration of open/closed drawers, and filled/empty drawers. Within this figure, it can be observed that some units are more stable than other units, including some units' lowest tip weight is higher than other units' highest tip weight. As an example, unit 2 is an unstable unit that did not pass ASTM F2057 – 19 Section 7.2 and tended to have tip weights well below 50 pounds for all tested configurations. In contrast, unit 25 had a range of tip weights from 45-147 pounds for the various configurations tested. The data illustrated in the previous figure include best-case configurations in terms of stability, in which most drawers are closed and filled, and worst-case configurations in which most drawers are filled and open.

In addition to the open/closed and filled/empty drawers, different CSU drawer structures have an influence on the tip weight. For example, a unit that has five identical drawers, one per row, is fundamentally different from a unit that has a different size row of drawers within the column or a unit that has three single-drawer rows with a double-drawer row at the top. See Figure 14 below for an illustration.

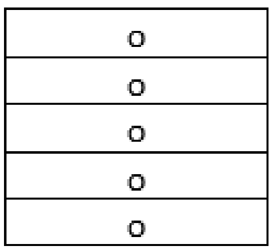
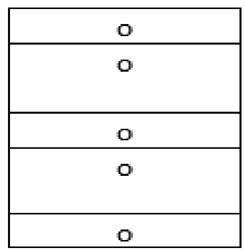
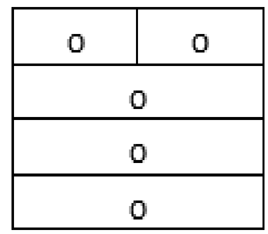
5 drawers, single column-all identical-sized drawers	5 drawers, single column-different-sized drawers	5 drawers, with 3 single rows and a double row for the top
		

Figure 14. Illustration of complexity of drawer structure.

To compare tip weights between and within units, staff uses the percent of open/closed and filled/empty drawers, calculated using the functional drawer volume in which weight bags and drawers are extended outside the CSU, rather than the number of open/closed and filled/empty drawers. Figure 15 compares the count of drawers open and filled to the more accurate percent of drawers open and filled. Although the count of drawers open/closed or filled/empty is an easy metric to consider and examine, it does not necessarily adequately reflect the reality of the configuration considered, particularly if drawers are variably sized.

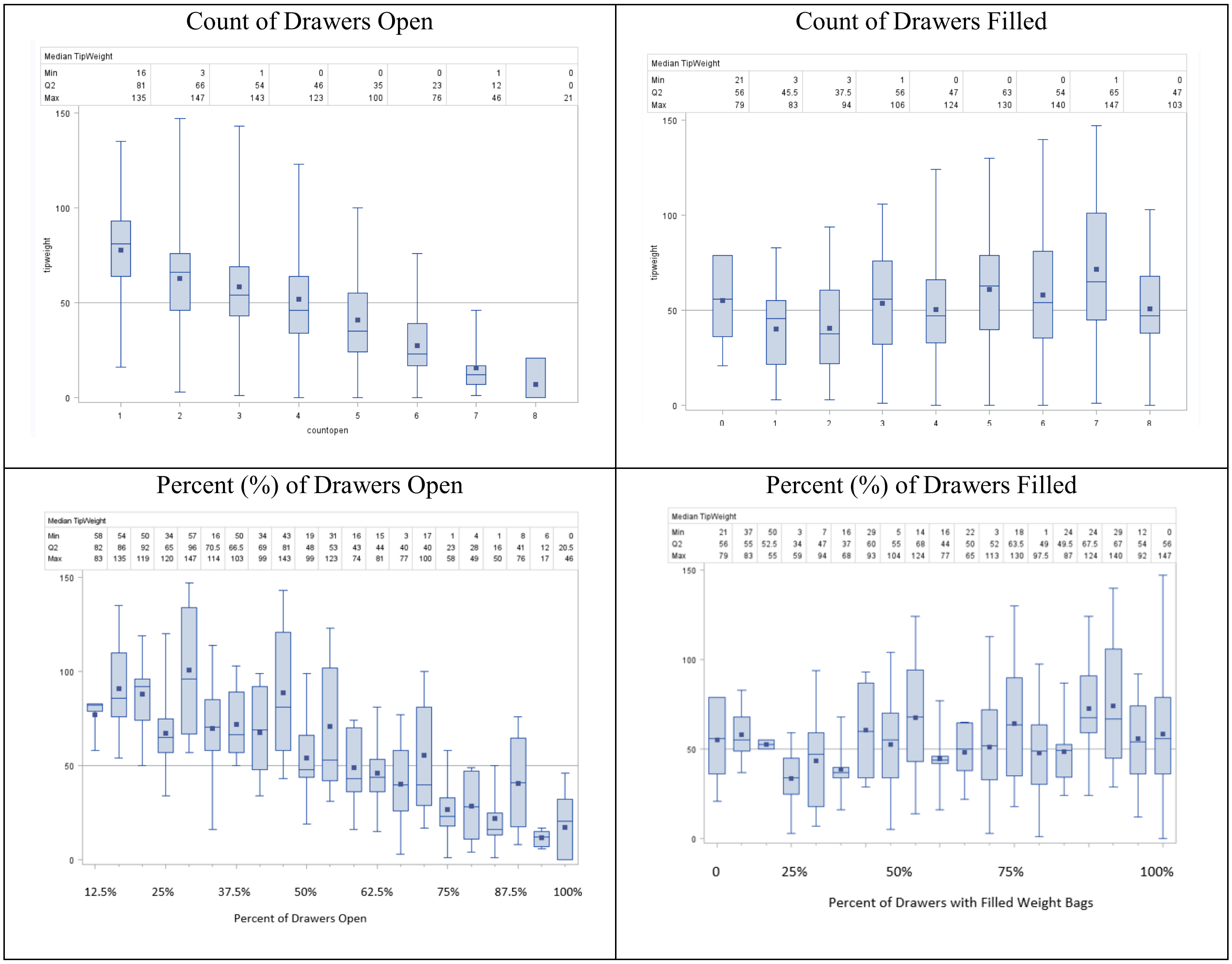


Figure 15. Comparison of count versus percent of drawers open and drawers filled.

In the remainder of this memorandum, the percent of drawers open and filled, rather than count of drawers, will be used as the metric in comparisons of various pre-specified tested configurations.

Examining the results in the previous table, it appears that filled/empty drawers is less influential on the observed tip weight than open/closed drawers. However, this is likely due to sparsity of data. Partially filled configurations were only considered in the Phase II study, and even then, only a very limited number of valid datapoints were available to analyze.

The following graphic, Figure 16, depicts tip weight by percent drawers open and percent drawers filled for an individual unit (Unit 25). This CSU was selected for convenience and due to the availability of data and that it meets the current ASTM 7.2 requirement. Furthermore, the CSU is unlikely to tip prior to 50 pounds of tip weight applied until greater than 50 percent of the drawers are concurrently opened and filled (the CSU has more drawers open that are filled with weight bags) providing a counterbalance to any drawers that are closed and filled. It should be noted that this unit is 194 pounds in weight and 37.2 inches tall. It is quite heavy, but not tall, when compared to other units in the Phase I and II study and within the CSUs available for examination by CPSC staff from both the 2018 study and PSAs examined by ESMC staff.

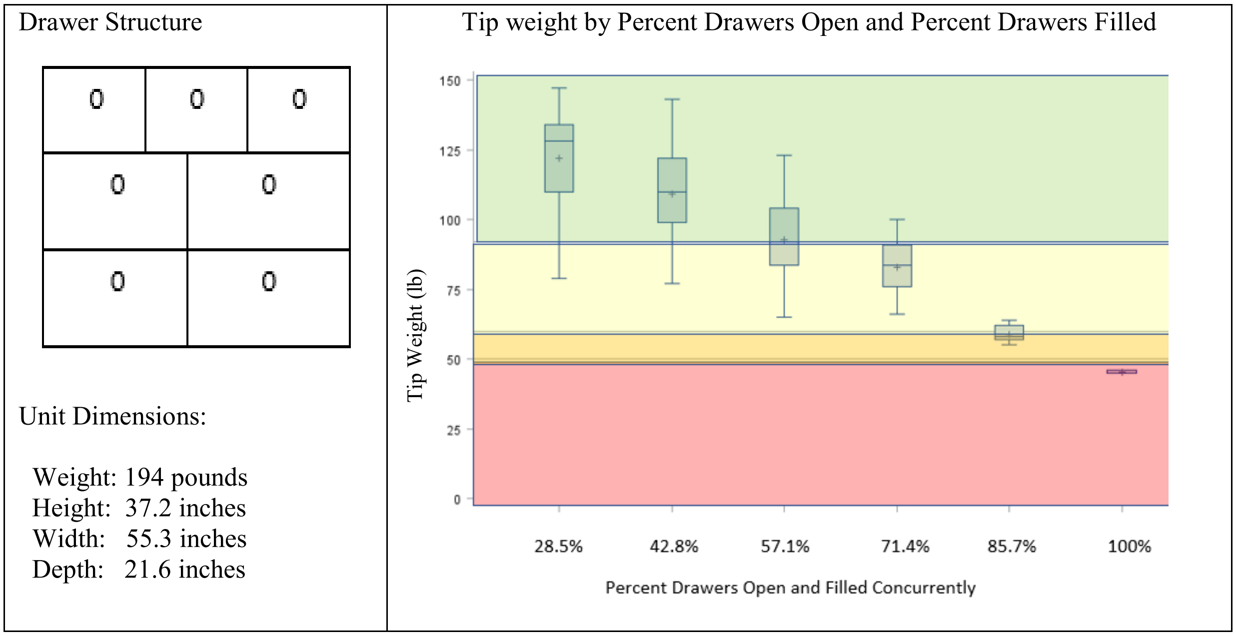


Figure 16. Plot of open/closed and filled/empty drawers.

With respect to Figure 16, Unit 25 is a 7-drawer unit with a total of 3 rows: 2 columns for the bottom two rows and 3 columns for top row. The light red highlight indicates the unit tips over at a weight below 50 pounds (the current ASTM 7.2 standard weight) in the tested configuration. The light orange highlight indicates that the unit tips over at between 50 and 60 pounds in the tested configuration.[3] The yellow highlight indicates that the unit tips over at between 60 pounds and 92 pounds, which is the static tip weight based on the equation for a 51.2-pound child ascending a CSU found in TAB D, in the tested configuration. Finally, the light green highlight indicates that the unit tips over at a weight higher than 92 pounds in the tested configuration.

The figure above provides both insight into the drawer structure, the dimensions and physical characteristics of the unit and as the tip weight observed when considering the percent of drawers

[3] Staff used a test weight of 60 pounds as a point to highlight because it has been used as a potential option for a standard in several contexts, including as an alternative that CPSC considered in the ANPR.

open and filled. This unit is relatively stable compared to the other tested units within the Phase I and Phase II study, with an observed tip weight of 104 pounds on a single open drawer when the unit is empty, which exceeds the current ASTM 7.2 by more than 50 pounds.

While the previous graphic illustrates the concurrent examination of both drawers open and filled, examining the tip weight when all drawers are filled but only select drawers are open may provide insight into the influence drawers open/closed have on the stability of the unit. Similarly, examining the tip weight of drawers open but the percent of drawers with filled weight bags provide insight regarding the influence of drawer open/closed patterns and filled/empty weight bags on the stability of this unit. Specific results for this unit can be observed in Figure 17.

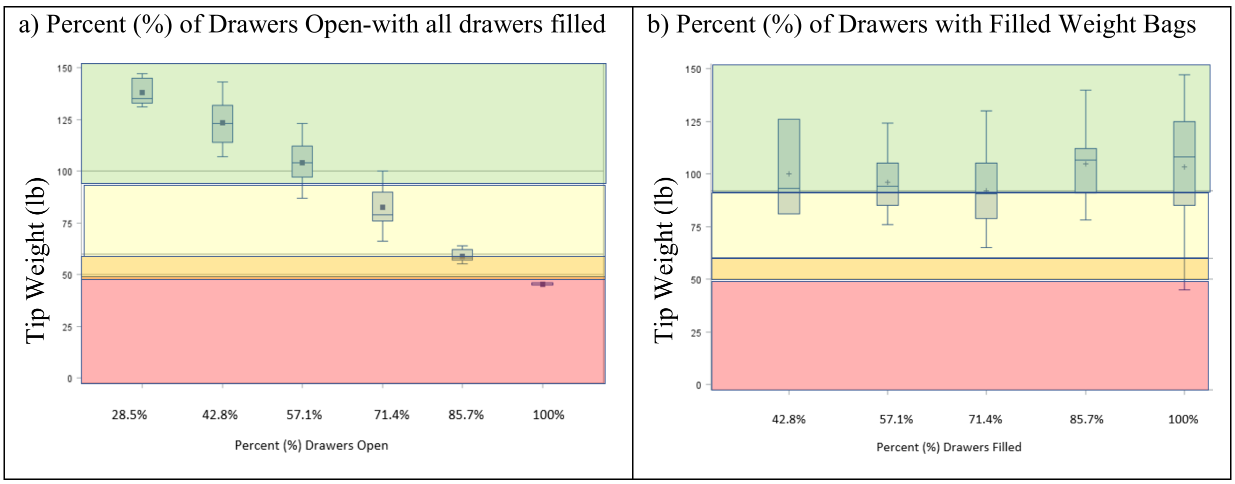


Figure 17. Boxplot of Tip weight by the percent of drawers open and percent of drawers filled: Unit 25.

Despite the sparsity of data collected within Phase II and the exclusion of certain results and outliers, the limited results here indicate that the open/closed drawers influence the tip weight of the unit. However, the inclusion of drawers with filled/empty weight bags provides additional accuracy and precision with respect to the influence of the concurrent open/closed drawers and filled/empty weight bags and thus will be presented when considering the general patterns of all units.

The goal of this study was to determine the effect of drawers open/closed and drawers filled/empty concurrently. Figure 18 illustrates the tip weight of the units with validated data[4]

[4] Validated data excluded the data points discussed above, including data that was more than 10 pounds different than an equivalent or replicated value and the problematic functional zeros.

from the Phase I and Phase II study and historical data collected by CPSC staff. From this graphic it can be observed that, depending on the percent drawers open and filled, having multiple drawers open leads to decreasing stability, demonstrated by decreasing tip weights.

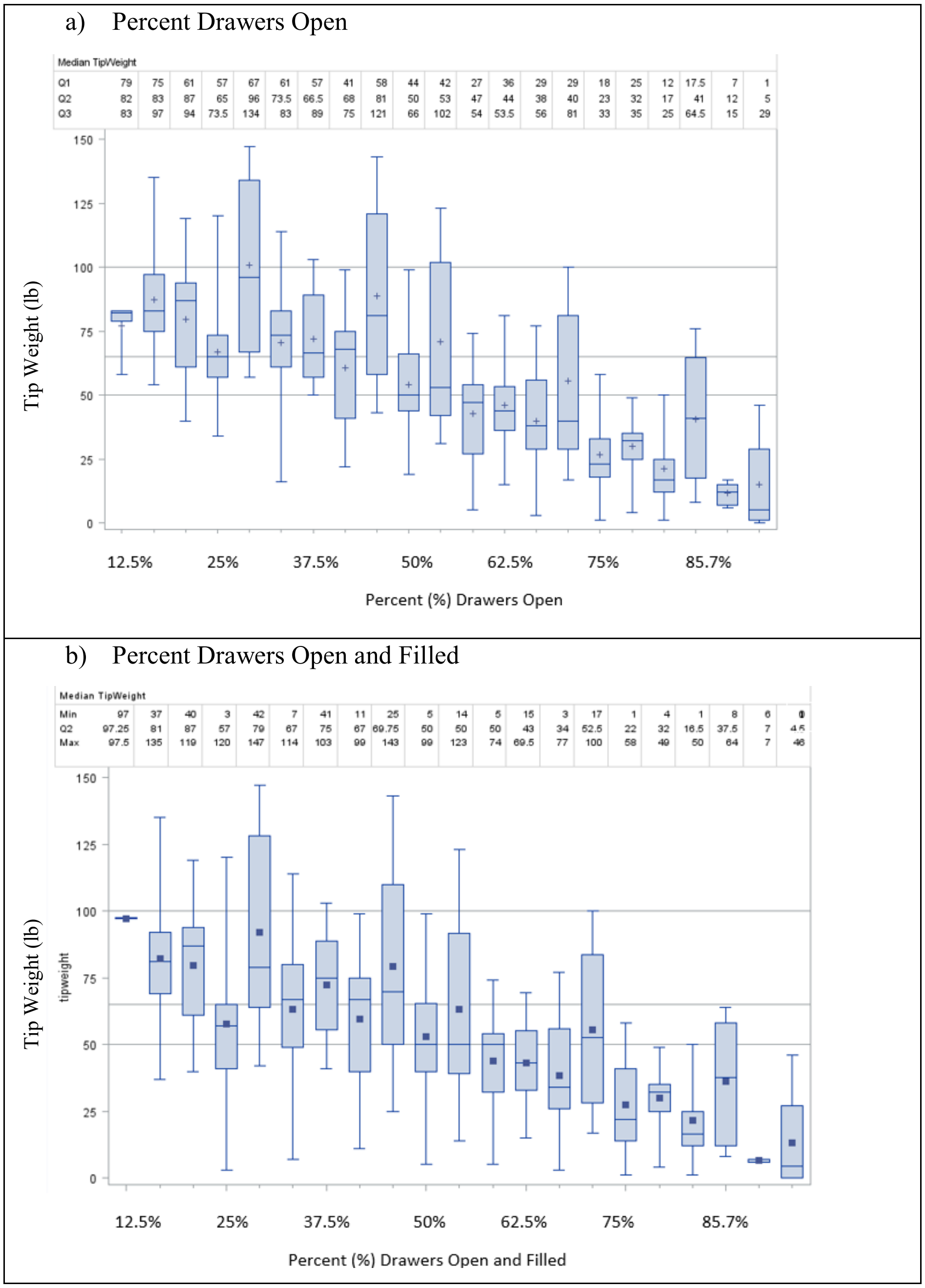


Figure 18. Observed Tip weight based on % drawers open and % drawers open and filled for all validated data from the 26 CSUs.

Select subgroup analysis was performed on data including but not limited to the presence of hardware and multi-dimensionality of different counts of rows and different counts of columns within the CSU. However, due to the sparsity of data collected within the Phase I and II studies, few factors had sufficient coverage to make any meaningful assessments with respect to the effect of open/closed and filled/empty drawers (see Limitations, below).

One additional variable that staff considered as part of these studies was the CSU had feet. Within Figure 19 a) and b) the influence of the presence/absence of feet on tip weight is presented.

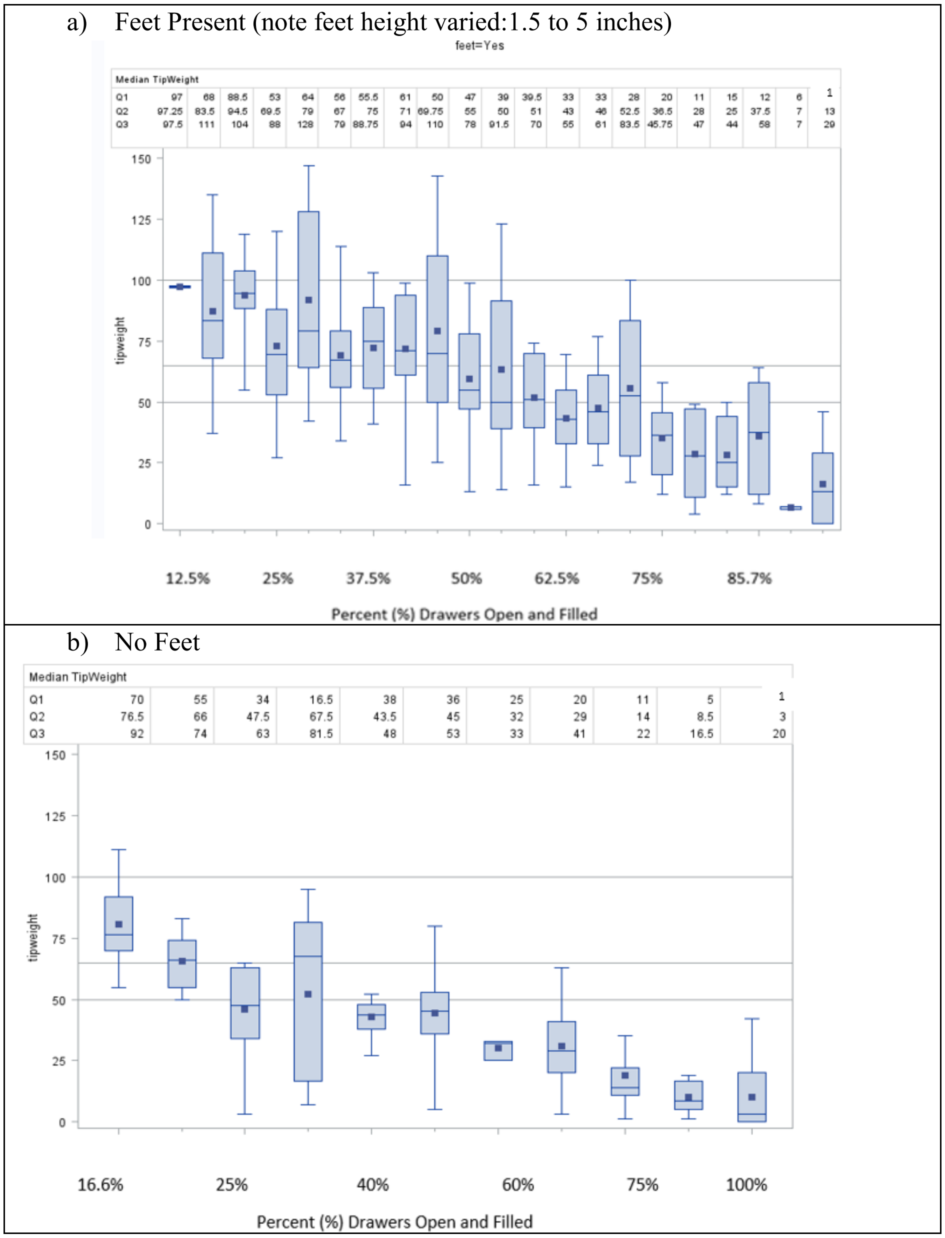


Figure 19. Comparison of tip weight stratified by presence or absence of feet.

Within this study, more of the units had feet; this may or may not reflect the market of CSUs. Similar trends in tip weight were observed with more drawers being open and filled being less stable for both footed and non-footed CSUs. However, this post-hoc examination does not account for the variations in the dimensions like weight and height; additional testing would allow staff to explore these correlations more fully if needed. Additionally, this dichotomous (presence/absence) variable related to feet did not include vital information about the feet that may have influenced stability including height of feet, location of the feet (*i.e.*, inset or extending outside the footprint of the CSU), or other feet features.

LIMITATIONS

This study provides insight into the patterns of instability based on whether CSU drawers are open/closed and filled/empty. However, there are some limitations to the study. The selection of units was not comprehensive or representative of all CSUs available commercially. In addition, this testing was limited in scope and was not designed to be comprehensive in terms of the variety of all combinations of drawers open/closed, drawers filled/empty, and the tip weight application location within the CSU. Accordingly, the conclusions based on this study are limited to the tested units and the configurations that were tested and had valid data. However, the studies described in this memorandum are supplemented by important findings in other Tabs of this briefing package, especially Tabs C, D, M and R, in order to support the draft proposed rule.

CONCLUSIONS

Staff conducted tip-over testing for select CSUs on a hard, flat, level surface to learn what effect a variety of configurations with tip weight application location, drawers open/closed and drawers filled/empty *can* have on the stability of the CSUs. In general, as expected, the CSUs were less stable as more drawers were opened. The overall effect of filled or empty drawers was less pronounced because filled drawers have a variable effect on stability: a filled closed drawer would contribute to stability, while a filled open drawer would decrease stability. However, the sparsity of data and data issues expected in this limited study reduced the ability to make general statements on the effect of drawer configuration related to filled/empty drawers, particularly when different patterns of open/closed and filled/empty were examined. All units tested, under various drawer filled/empty configurations, tended to tip more easily with more drawers open. However, the answer to the question of 'how much more easily?' is not a straightforward one, because there was variation within CSUs and among CSUs. This was confounded by the variety of the dimensions of the units, including height, footprint, and overall weight of the unit.

While there were significant numbers of replicates of the various designed experiment of drawers open/closed, filled/empty and the tip weight application location, only 26 unique CSUs were tested within this study and only 12 of these units were tested in partially filled configurations. The limited number of units sampled and the limited unique drawer placement and structure examined within this limited study limits the generalizability of the stability and tip weight patterns assessed and noted above; however, it is clear the presence of open and filled drawers degrades stability of CSUs regardless of the CSU drawer pattern or design.

Based on the evidence provided within the study and analyses in other Tabs, CPSC staff suggests that the ASTM F2057 – 19 stability tests and any stability tests that do not account for the real-world use factors of multiple opened and filled drawers are insufficient to assess stability because these factors contribute to instability.

TAB P: Analysis of the Tip-Over Weight for CSUs on Carpet in Combination with Multiple Open and Filled Drawers

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

Memorandum

Date: July 14, 2021

TO: Kristen Talcott, Ph.D., Project Manager,
Division of Human Factors, Directorate for Engineering Sciences

THROUGH: Stephen Hanway, Associate Executive Director,
Directorate for Epidemiology

Risana Chowdhury, Director,
Division of Hazard Analysis, Directorate for Epidemiology

FROM: David Miller, Statistician,
Division of Hazard Analysis, Directorate for Epidemiology

SUBJECT: Analysis of the Tip-Over Weight for CSUs on Carpet in Combination with Multiple Open and Filled Drawers

BACKGROUND

In November 2017, the Consumer Product Safety Commission (CPSC) voted to approve an advance notice of proposed rulemaking (ANPR) to address the risk of death and injury, caused by clothing storage units (CSUs) tipping over. As part of the ongoing rulemaking effort, CPSC staff is examining various factors that affect the stability of CSUs. This memorandum presents the laboratory test data collected to assess the effect of a carpeted surface on the stability of a convenience sample of 13 CSUs.

CPSC is aware of 226 fatalities (an annual average of 11 deaths) in the United States between 2000 and 2020, related to CSU tip over (Tab A). Children account for 85 percent of these fatalities. According to NEISS (National Electronic Injury Surveillance System), there have been an estimated 78,200 injuries related to CSU instability or tip over, that were treated in U.S. hospital emergency departments (EDs) between 2006 and 2019. This is an annual average of 5,600 injuries. Of these injuries, an estimated 56,400 (72 percent) were to children. This is an annual average of 4,000 injuries to children over this 14-year period. As detailed in the Directorate for Engineering Sciences, Division of Human Factors (ESHF) staff memorandum (Tab C), tip-over incidents compiled in the Consumer Product Safety Risk Management System (CPSRMS) involving children and CSUs without televisions and for which the flooring type beneath the CSU was reported, carpet was the flooring type for 82 percent of the fatal incidents and 80 percent of the nonfatal incidents. From an examination of fatal incident photos, ESHF staff determined that the carpet involved in the incidents was predominantly[1] cut pile wall-to-wall carpet.

ASTM F2057 – 19, *Standard Safety Specification for Clothing Storage Units*, addresses the stability of CSUs.[2] Under this voluntary standard, there are two stability performance requirements for CSUs. The first requirement (referred to as ''7.1'' because it is section 7.1 of the standard) pertains to the stability of the unloaded unit. Under the prescribed test method, the unit is placed on a hard, flat surface, and all of the doors and drawers are opened. To meet the requirement, the unit must not tip over in this configuration. The second test requirement (referred to as ''7.2'' because it is section 7.2 of the standard) pertains to the stability of the unit with a load. When the unit is placed on a hard, flat surface, with only one drawer open and a 50-pound weight applied to that drawer, the unit must not tip over.

CPSC staff examined various factors that affect the stability of CSUs. These factors include open drawers, filled drawers (drawers with weight to simulate clothing fill), and the flooring type under the CSU, including carpet. The Directorate for Epidemiology, Division of Hazard Analysis (EPHA) staff memorandum, *Testing to Assess the Effect of Open/Closed and Filled/Empty Drawers on Clothing Storage Unit Stability*, Tab O, addresses CPSC staff's effort to assess the effect of various factors, including open drawers and weight-filled drawers on the stability of CSUs, as do Tabs D, M and R through different approaches. This memorandum focuses on the effect of carpet on stability as compared to CSU stability on the hard, flat, level lab surface (this non-carpeted surface will hereafter be referred to as the 'hard' surface). Staff assesses the effect of the carpet on tip weight for the different units and for different degrees of open/closed drawers and filled/empty drawers.

CPSC staff were aware of a previous effort to examine the possible effect of carpet on CSU tip overs. In 2016, Kids in Danger (KID) and Shane's Foundation conducted a study of CSU stability.[3] Researchers tested the stability of 19 CSUs, based on the tests described in ASTM F2057 – 19 Section 7.1 and 7.2. Researchers conducted the tests on a hard, flat surface, as specified by ASTM F2057 – 14, as well as on a section of carpeting. The results showed that some of the units that passed 7.1 on the hard surface, tipped over when tested on carpet; and some of the units that passed 7.2 on the hard surface, tipped over when tested on carpet. Conversely, none of the units failed 7.1 on the hard surface and passed on the carpet, or failed 7.2 on the hard surface and passed on the carpet. This provided some evidence that CSUs might be less stable on carpet than when on a hard surface. CPSC staff decided to conduct its own testing to evaluate this issue.

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[1] Of the 46 fatal incidents involving carpet, CPSC staff has investigations with photos for 30 of them. Of these 30 incidents, 26 were cut pile wall-to-wall carpet and four were not.
[2] See *Analysis of Voluntary Standards for Clothing Storage Units*, Tab F, for more information about ASTM 2057.
[3] *Furniture Stability: A Review of Data and Testing Results* (Kids in Danger and Shane's Foundation, August 2016).

PURPOSE

Staff tested a convenience sample of 13 CSUs from the *Testing to Assess the Effect of Open/Closed and Filled/Empty Drawers on Clothing Storage Unit Stability* (Tab O) study on a carpeted test surface to improve understanding of the degree to which a carpeted surface can affect the stability of CSUs.

CARPET SURFACE TIP-OVER TEST METHODS

For this testing, staff used a section of wall-to-wall tufted polyester carpeting with polypropylene backing that CPSC staff purchased from a major home-supply retailer. The pile height was, according to the manufacturer's specifications, 19/32 of an inch and the carpet density was 1,698 ounces per cubic yard. Staff assessed that this carpet was typical of wall-to-wall carpeting on the market. Staff cut and installed a 4- foot x 8-foot section of the carpet with a carpet pad on top of a plywood platform. The carpet pad was 6-pound bonded padding and was 10 millimeters thick. Staff used 7/8-inch-wide tack strips with 3/8-inch brads installed at the edge of the platform to secure the carpet.

Before conducting tip-over testing for each CSU, staff placed the CSU on the carpet test surface. When a CSU was placed on the carpet test surface, any leg, skirt, or vertical member of the CSU was placed at least 2 inches from any edge of the test surface and at least 2 inches from where any leg, skirt, or vertical member from a previous CSU had been placed for testing. Staff then conditioned the CSU by placing 200 pounds on top of the unit (using barbell weights on top of a plywood platform) for 15 minutes. During this conditioning, all CSU drawers were closed and unfilled. After the 15 minutes of conditioning, LSM staff conducted the tip-over testing of the unit using the same methods and CSU configurations (*i.e.*, number and position of open and filled drawers) as used with these units in the Multiple Open and Filled Drawers testing that was conducted on the hard surface (Tab O).

Staff conducted tip-over testing on 13 CSUs on the carpeting. After testing the first 10 units, there was no longer space on the carpet test surface to place units without placing legs within 2 inches of where previous units' legs had been placed. As a result, staff installed a new 4-foot x 8-foot section of the same tufted polyester carpeting and carpet pad on the test surface and followed the same procedure used for the original carpeted test surface. This new carpet test surface was used to test the final three CSUs.

CARPET SURFACE TIP-OVER TEST PROCEDURE

Of the 26 units for which tip-over testing was conducted on the hard surface for the Multiple Open and Filled Drawers testing (Tab O), EPHA staff selected 13 to be tested on the carpet sample. These units were selected to cover a range of drawer/row designs (single column to more complex), a range of stability, and to include units with feet and those without.

For the 13 selected units, staff conducted tip-over tests on the carpet for all of the same combinations of open and closed drawers, filled and empty drawers, and test weight drawers[4] that were done for that unit on the hard surface. This was done to provide comparable data between the hard surface and the carpet. Staff used the pairs of tip weights, the tip weight on the hard surface, and tip weight on the carpet for any given combination of unit and open/closed drawers, filled/empty drawers, and test weight drawer to isolate the effect of carpet on stability. As with the hard surface testing, the units with more drawers had more tests conducted on carpet, because there were more possible combinations of open/closed drawers, filled/empty drawers, and test weight application locations for those units. For more specific information about the tests conducted for the selected CSUs, see Tab O. The 13 selected units are detailed below in Table 1.

[4] In the test, staff applied increasing weight to one open drawer until the unit tipped over, to determine the weight needed to tip the unit over.

Table 1. CSUs Involved in Tip-Over Testing on Carpet

Unit #[5]	# Tip Weight Pairs	Drawer Layout	Feet?	Tip Weight (lb)[6]
1	58	3 rows of one drawer each	yes	67
2	36	4 rows of one drawer each	yes	44
3	168	3 rows; the bottom and middle rows have two drawers, the top row has four drawers	yes	83
4	54	5 rows of one drawer each	yes	49
5	47	3 rows of one drawer each	no	19
6	157	3 rows; the bottom and middle rows have two drawers, the top row has three drawers	yes	114
7	73	5 rows; the bottom four rows have one drawer and the top row has two drawers	no	69
8	67	6 rows of one drawer each	yes	84
9	73	5 rows; the bottom four rows have one drawer and the top row has two drawers	yes	67
10	124	4 rows of two drawers each	yes	79
11	90	3 rows of two drawers each	yes	54
12	101	3 rows of two drawers each	yes	72
13	173	3 rows; the bottom two rows have two drawers and the top row has four drawers[7]	yes	67

ANALYSIS

From the 13 CSUs tested on both the flat surface and on the carpet, CPSC staff was able to obtain 1,233 pairs of tip weights (tip weight on the flat surface and a comparable tip weight on the carpet). The paired-weight data were only included in the analysis if there was a tip weight greater than zero pounds on both the flat surface and on the carpet, so that a valid comparison could be made. Some data points were not attainable for various reasons. For example, in some cases, either on the hard surface, the carpet, or both, the unit tipped before any tip weight was applied. For these instances, the data were not included. In other cases, the test that was specified was not feasible because the drawer assigned to be the tip weight application location was directly beneath a drawer designated to be open.[8] In other instances, the drawer broke when trying to obtain the tip weight for that test.

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[5] This unit number is specific to the Alternate Surface Testing in this memorandum, see Appendix XX for the link between these unit numbers and the other units in the other memos.

[6] Tip weight was determined using the test method described in ASTM F2057 – 19, Section 7.2, except that weights other than the 50 pounds specified in 7.2 were used to determine the weight at which the unit tipped over.

[7] For the top row of this unit, there are four drawers, but the middle two are one above the other and are treated as one drawer because one cannot be opened without opening the other.

[8] There is no room to apply the tip weight to a drawer if the drawer above that drawer is open.

Of the 1,233 pairs[9] of tip weights, staff flagged 12 pairs as outliers where experimental error is suspected.[10] EPHA staff defined an outlier as a pair in which either the hard surface tip weight was larger than the corresponding carpet tip weight by 30 pounds or more, or the carpet tip weight was greater than the hard surface tip weight by 10 pounds or more. These 12 outliers were removed, leaving 1,221 pairs of tip weights to evaluate and analyze.

For each of these 1,221 corresponding tip weight pairs, a tip weight difference was calculated as:

wt_diff = Hard Surface Tip Weight – Carpet Tip Weight

As such, the tip weight difference (wt_diff) is positive if the tip weight on the hard surface is higher than the one on the carpet. Accordingly, positive tip weight differences would suggest that CSUs are less stable when on carpet.

Overall and Unit-by-Unit Tip Weight Differences

The testing showed the CSUs tended to be more stable on the hard surface than they were on carpet. Of the 1,221 tip weight differences, wt_diff is positive for 1,149 (94.1 percent) of them. The weight difference is negative for 33 (2.7 percent) of testing pairs and wt_diff = 0 (the tip weights were equal) for 39 (3.2 percent) of pairs. Table 2 provides descriptive statistics about these tip weight differences overall and by unit.

[9] These 1,233 pairs do not include the 59 pairs of tip weights that were excluded because one or both of the tip weights was zero.
[10] For each of these 12 instances, either the flat surface tip weight, or the carpet tip weight, was found to be far out of line with what would be expected for that unit and that number of drawers open/closed and filled/empty, in light of the tip weight on the alternate surface (flat or carpet). CPSC staff conducted analyses of the full set of data (all 1,233 pairs), as well as the subset (1,221 pairs), and staff found little difference in the overall findings. Staff considered it prudent to exclude these data points.

Table 2. Tip Weight Differences (in pounds) – Mean, Median, Standard Deviation

Unit	# Tip Weight Differences	Mean	Standard Deviation	Median
All	**1,221**	**7.6**	**5.1**	**7**
1	58	11.8	3.9	11
2	36	5.6	2.0	5
3	168	10.3	3.6	11
4	54	6.0	2.3	6
5	47	7.2	1.8	7
6	157	9.8	4.7	10
7	73	4.3	3.0	4
8	67	9.2	4.4	9
9	73	7.5	2.5	7
10	124	2.9	3.3	2
11	90	16.0	3.3	16
12	101	4.1	4.5	3
13	173	4.2	2.7	4

It is clear that there are large differences between the CSUs in the measured effect of the carpet (compared to the hard surface) on the stability of the unit. Unit 10 has a median tip weight difference (wt_diff) of 2 pounds, and Unit 11 has a median wt_diff of 16 pounds. It is worth noting that the standard deviation for the entire data set of 1,221 wt_diffs (5.1) is quite a bit higher than the standard deviations for the individual units. Most of the variability in the wt_diff data is between units, as opposed to within units. Figure 1 has boxplots of the wt_diff for each tested CSU.

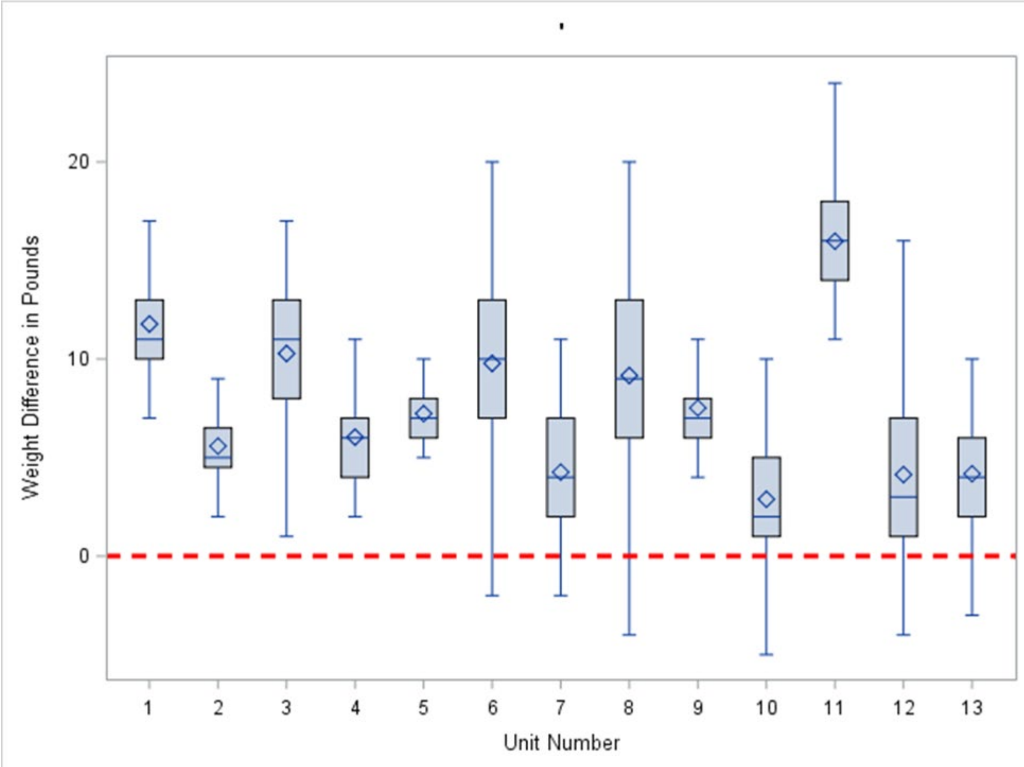

Figure 1. Boxplot of tip weight difference by CSU.

Note: The boxplots show the mean, denoted by the diamond, the median, the 25th Percentile, the 75th Percentile, and the highest observation below 1.5 X IQR[11] above the 75th Percentile and the lowest observation above 1.5 X IQR below the 25th Percentile. Each box is between 36 and 168 pairs of tip weights (table 2, column N). Positive weight differences mean the unit required a higher weight application to tip on the hard surface than carpet.

Tip Weight Differences by Various Criteria

CPSC staff also analyzed the relationship between tip weight difference and open/closed drawers and filled/empty drawers. Staff compared the wt_diffs for tip-over tests, where most of the drawers were open, to those where most of the drawers were closed. Similarly, staff compared the wt_diffs for the tests where most of the drawers were filled, with weight bags to those where most of the drawers were empty.

To account for the variations in the number of drawers in each row, staff used the term drawer-rows in their determination of whether or not most drawers were open (or similarly, whether most drawers were filled) for a particular tip-over test configuration. For a simple unit such as Unit 1, which has three rows of one drawer each, this is straightforward. Each drawer counts as one drawer-row. If two or three drawers were open for a test, then that is considered a test where

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[11] Interquartile range; the difference between the 25th and 75th percentiles.

most drawers were open. However, for Unit 3, the bottom and middle rows have two drawers and the top row has four drawers. So, for Unit 3, a drawer in the bottom or middle row counts as half a drawer-row, but a drawer in the top row, counts as one fourth of a drawer-row. Because Unit 3 has three rows, if more than 1.5 drawer-rows were open for a particular test, then that is considered a test where most drawers were open.

CPSC staff also analyzed the tip weight differences for CSUs with feet as opposed to those without feet. Two of the 13 units, Unit 5 and Unit 7, did not have feet. Table 3 provides information about the tip weight differences (mean, median, and standard deviation) for the 1,221 tip weight pairs. It also provides this information separately for the tests with mostly open vs. mostly closed drawers, mostly filled vs. mostly empty drawers, and units with feet vs. units without feet.

Table 3. Tip Weight Differences – Mean, Median, and Standard Deviation, by Various Criterion

	# Tip Weight Differences	**Mean**	**Standard Deviation**	**Median**
All	**1,221**	**7.6**	**5.1**	**7**
Mostly Open[12]	533	7.1	4.7	7
Mostly Closed	475	8.5	5.3	8
Mostly Empty	153	7.2	3.8	6
Mostly Filled	1,011	7.7	5.2	7
Feet	1,101	7.8	5.2	7
No Feet	120	5.4	2.9	6

Figures 2, 3, and 4 show the boxplots for the wt_diffs by open/closed drawers, filled/empty drawers, and units with feet versus units without feet, respectively. Although the testing was not designed to generate statistical inferences on possible differences in tip weight by open/closed drawers, filled/empty drawers, and units with feet/units without feet, we can look at the tip weight differences for these groups. Both from Table 3 and from the boxplots in Figures 2, 3, and 4, it can be seen that there was not much difference in the measured effect of carpet (on tip weight) among these different groups. It is not clear that factors such as open versus closed drawers or filled versus empty drawers made much difference on the size of the carpet effect. The big differences appear to be between the different CSUs.

[12] The number of wt_diffs for "Mostly Open" and "Mostly Closed" do not add to 1,221 because wt_diffs from tests where exactly half of the drawer-rows were open, are excluded from both groups. The same is true for "Mostly Empty" and "Mostly Filled."

Figure 2. shows a boxplot for the tip weight differences separately for the tests where most of the drawer-rows were open and those where most of the drawer-rows were closed. The tests where exactly half of the drawer-rows were open are excluded. The tip weight differences between these two groups appear to be similar.

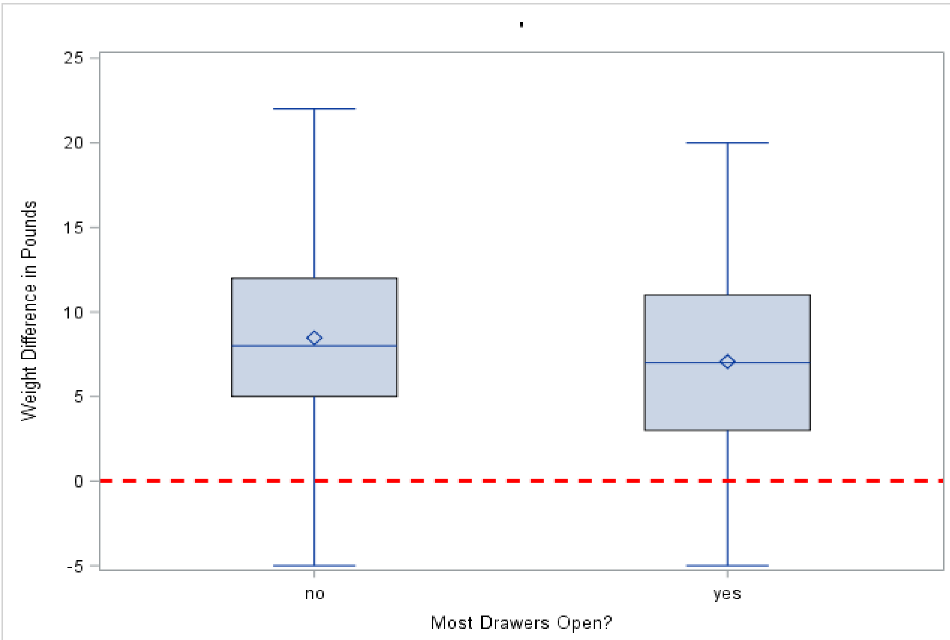

Figure 2. Boxplot of tip weight difference by mostly open vs. mostly closed drawers.

Figure 3 shows a boxplot for the tip weight differences separately for the tests where most of the drawer-rows were filled with weight bags and those where most of the drawer-rows were empty. The tests where exactly half of the drawer-rows were filled are excluded. The tip weight differences between these two groups appear similar with slightly larger spread in the weight differences for the tests where the drawers were mostly filled.

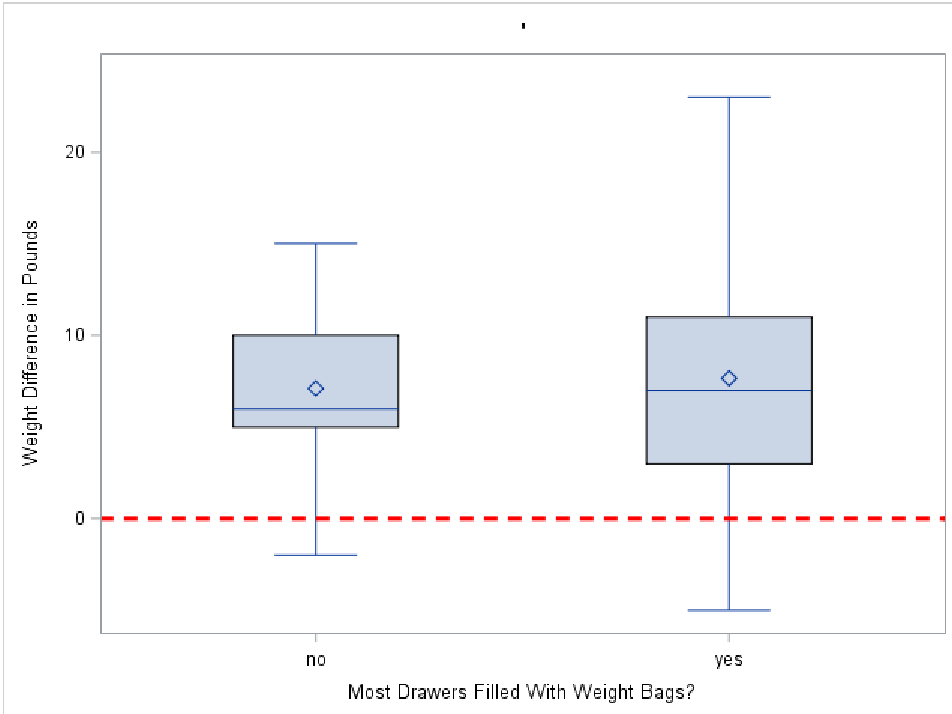

Figure 3. Boxplot of tip weight difference by mostly open vs. mostly closed drawers.

Figure 4 shows a boxplot for the tip weight differences separately for the tests from the 11 units that had feet and the two units without feet. The tip weight differences appear to be a bit higher for the units with feet, and there was more spread in the weight differences for these units with feet. Staff cannot determine from this, however, that these slightly larger weight differences are a function of the units' having feet.

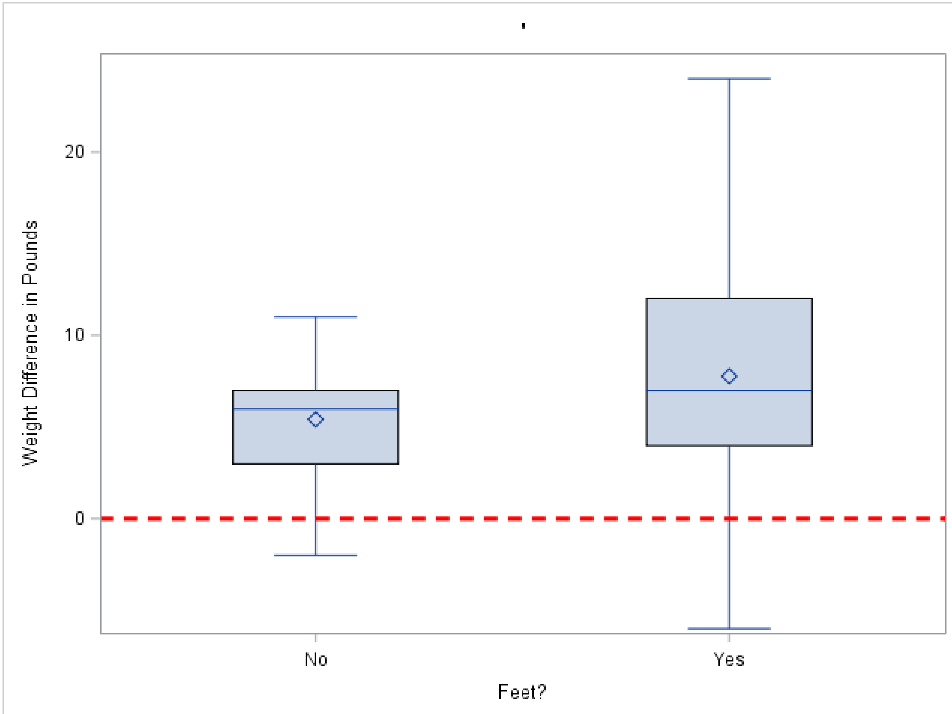

Figure 4. Boxplot of tip weight difference by units with feet versus units without feet.

Weight Difference vs. Percent Weight Difference

The previous analyses in this report used straight tip weight differences (Hard Surface Tip Weight – Carpet Tip Weight). To explore whether the effect of carpet changed based on the CSU's stability, staff compared both weight difference and Percent (relative) Tip Weight Difference of the hard surface and carpet tip weights. Percent Tip Weight Difference (%wt_diff) is calculated as:

%wt_diff = (Hard Surface Tip Weight – Carpet Tip- Weight)/Hard Surface Tip Weight

To compare these two measures, staff looked at scatterplots and the correlations between each measure (wt_diff and %wt_diff) and the tip weights.

For the 1,221 pairs of tip weights, the estimated correlation coefficient[13] between wt_diff and Flat Surface Tip Weight is 0.325 and the estimated correlation coefficient between wt_diff and Carpet Tip Weight is 0.155. These positive correlation coefficients indicate that wt_diffs are higher when the tip weights are higher. But these coefficients are not high.

[13] The Pearson correlation coefficient is a measure of the strength and direction of the linear relationship between two continuous variables. A correlation of +1 means a perfectly positive linear relationship, a correlation of -1 means a perfectly negative linear relationship, and a correlation of 0 means the lack of a linear relationship.

Figure 5 shows a scatter plot of the 1,221 data points of wt_diff vs. Hard Surface Tip Weight. A regression line (the black dashed line) was fit to the data. It can be seen that there is a good deal of deviation between the line and the wt_diff data points, illustrating the low degree of correlation.

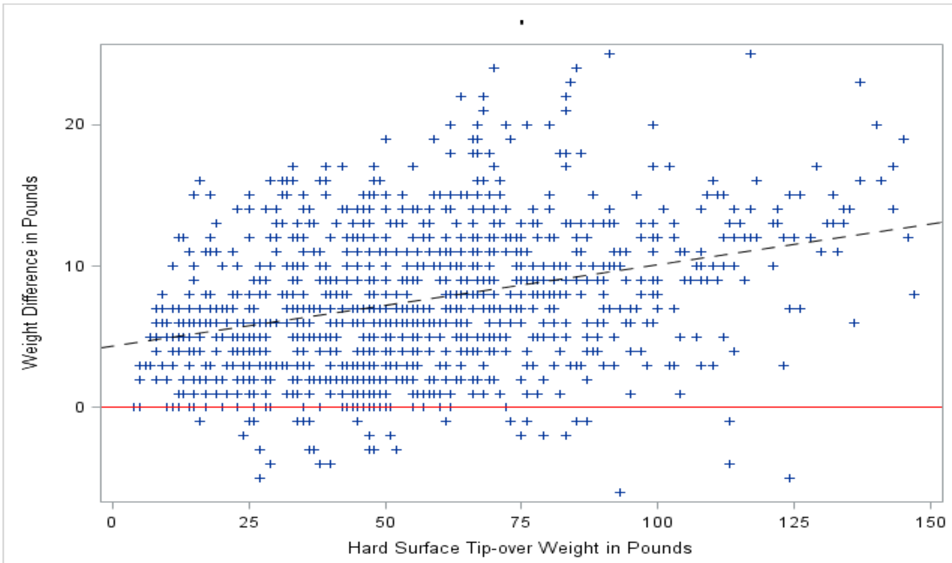

Figure 5. Scatterplot of tip weight difference by flat surface tip weight.

The estimated correlation coefficient between %wt_diff and Hard Surface Tip Weight is -0.431. This is a stronger linear relationship than with the straight difference (wt_diff), but is a negative relationship, meaning that the %wt_diff decreases as the Hard Surface Tip Weight increases. Put into functional terms, as weight to tip the unit on a hard surface increased, shifting to a carpeted surface had less of an impact in terms of the percentage of the tip weight.

Figure 6 is a scatterplot of the 1,221 tip weight pairs with the %wt_diff as the y-coordinate and the hard surface tip weight as the x-coordinate. A stronger relationship is apparent here between %wt_diff and the Hard Surface Tip Weight. It appears to be a curvilinear relationship between the two variables where the slope of the line becomes less steep as the Hard Surface Tip Weight increases. The %wt_diffs vary greatly, including many very large ones, when the Hard Surface Tip Weight was low. This makes intuitive sense – when the Hard Surface Tip Weight is quite low, even a couple of pounds change in the Tip Weight Difference means a big change in the Percent Tip Weight Difference.

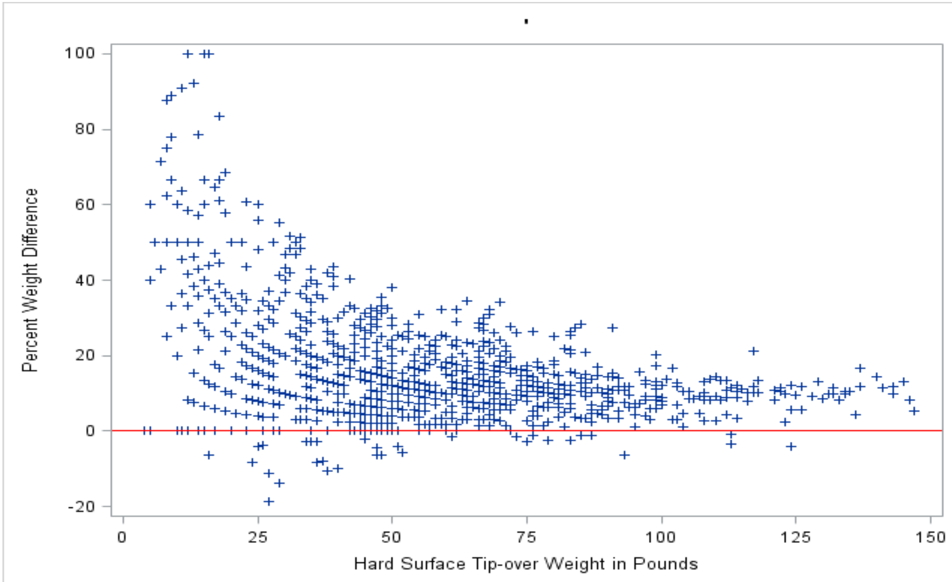

Figure 6. Scatterplot of percent tip weight difference by flat surface tip weight.

On a unit-by-unit basis, the %wt_diff tended to be more correlated (than wt_diff) with the Flat Surface Tip Weight for the individual units. The goal of the analysis is to assess the effect of carpet on CSU stability, so staff want the observed differences to be, as much as possible, a function of the carpet, as opposed to a function of the overall stability of the unit. For these reasons, staff decided to use the straight difference as the measure to focus on for the analysis. However, it is worth noting that there does appear to be some positive relationship between wt_diff and the tip weights.

CONCLUSION

Staff conducted tip-over testing for some CSUs on an alternate surface (carpet) to learn what effect a surface can have on the stability of the CSUs under different conditions. In general, the CSUs were less stable on the carpet. All units tested, under various conditions, tended to tip with less weight on the carpet than on the hard surface. A determination of how much less weight is not a straightforward one. For the data collected in this testing, the mean difference in tip weight, when comparing a hard surface with carpet, was 7.6 pounds, and the median was 7 pounds. However, that comparison, by itself, is incomplete, because it does not reflect the fact that most of the variability in the wt_diff data was between units, as opposed to within them. For example, the 90th percentile wt_diff across all units was 14 pounds, but the median for Unit 11 was 16 pounds (and the 90th percentile for Unit 11 was 21 pounds). This example illustrates the large unit-to-unit differences in the size of the carpet effect on stability.

Relationships between the difference in hard surface and carpet tip weights (wt_diff) and open/closed drawers and filled/empty drawers were examined, and some differences were noted; but these differences were small, compared to the unit-to-unit differences in wt_diff. A relationship does appear to exist, for the units tested, between wt_diff and the hard surface tip weight (as well as the carpet tip weight), but this relationship does not appear to be a strong one and does not explain well the unit-to-unit variability in wt_diffs.

Although it is currently not clear which design characteristics of a CSU cause it to be more or less affected by being placed on carpet, the large differences in the average tip weight differences from unit to unit, suggest that some units are affected more than others. This testing was conducted on a limited set of 13 different CSUs, and on only one type of carpet surface. Therefore, this testing does not provide information on the effect of different flooring surfaces, such as thicker or thinner carpets, thicker or thinner carpet pads, or different types of flooring on the stability of CSUs, in general.

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TAB Q: Consumer Product Safety Commission (CPSC): Furniture Tipover Report

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CPSC Staff Statement on Fors Marsh Group (FMG) Report "Consumer Product Safety Commission (CPSC): Furniture Tipover Report"[1]

March 29, 2020

The report titled, "Consumer Product Safety Commission (CPSC): Furniture Tipover Report," presents the results of six in-home interviews (ethnographies) and six 90-minute focus groups

with consumers in November and December 2019. The interview participants had children between 1-5 years old in the home. The focus group participants included parents of a child age 1-5 years old, people who are regularly visited by children ages 1-5 years old, and people who plan to have children in the next five years. Participants included people who rent their home and people who own their home. The interviews and focus groups assessed factors that influence consumers' perceptions and interactions with clothing storage units (CSUs) and their associated warning information, factors that influence consumers' decisions to select and use certain products, as well as their knowledge, awareness, and behaviors associated with furniture tip over. Work was completed under CPSC contract CPSC-D-16-0002, Task Order: 61320619F1103.

[1] This statement was prepared by the CPSC staff, and the attached report was produced by Fors Marsh Group for CPSC staff. The statement and report have not been reviewed or approved by, and do not necessarily represent the views of, the Commission.

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FORS MARSH GROUP

Consumer Product Safety Commission (CPSC): Furniture Tipover Report

March 13, 2020

Executive Summary

Background

Between 2000 and 2016, Consumer Product Safety Commission (CPSC) staff estimated 65,200 injuries resulting from clothing storage unit (CSU; including but not limited to chests, chests of drawers, drawer chests, armoires, chifferobes, bureaus, door chests, and dressers) tipovers. Of these tipovers, 195 resulted in fatalities, with the most prominently affected age group being children under 18 years old (86%).[2] As such, it is important to understand how consumers process information related to CSUs and their associated warnings in order to update the standards around CSUs. The CPSC contracted with Fors Marsh Group (FMG) to conduct research with caregivers to better understand their attitudes, behaviors, and beliefs regarding CSUs. The first phase of research entailed conducting six 90-minute in-home ethnographies. Participants were segmented based on the age of their child (three participants had at least one child between the ages of 18–35 months old in the home, and three participants had at least one child between the ages of 36–72 months old in the home). The ethnographies assessed family interactions with and their use of CSUs and similar furniture items in the home.

For the next phase of the project, FMG conducted six 90-minute focus groups. Participants were segmented into groups based on their caregiver status (parent of a child ages 12–72 months, individual without young children in the home who is planning to have children in the next five years, or individual without young children in the home who is visited regularly by children ages 12–72 months). The focus groups assessed consumers' perceptions and interactions with CSUs and the associated warning information, as well as factors that influence their decisions on product selection, classification, and placement.

Overview of the Findings

In both the ethnographies and focus groups, participants reported features they believe distinguish CSUs from other types of products. These features included anything that holds or organizes clothes. During the ethnographies, the most common CSU in the participants' homes was a freestanding unit with drawers (usually referenced as a "dresser" by participants). Four participants in the ethnographies had more than one dresser in their home. In terms of the placement of these CSUs in the home, participants mostly placed CSUs in their bedrooms and/or their children's bedrooms. Several ethnography participants mentioned that their children climb on and jump off of nightstands (none of which were anchored). Alternatively, during the focus groups, participants shared that children in the home sometimes try to climb or pull on CSUs. However, some participants expressed that they do

[2] Advance Notice of Proposed Rulemaking Regarding Clothing Storage Unit Tip Overs. (2017). *U.S. Consumer Product Safety Commission.*

not perceive tipover risks as very high, because they said they monitor their children frequently. In other cases, some participants minimalized the risk because they had experienced a tipover and were unharmed by it.

The focus groups also explored the influence of product marketing on their purchasing decisions. Participants generally reported that they typically have a specific piece of furniture in mind when they decide to purchase a product. They reported that they typically analyze a unit's overall size, drawer depth, and number of drawers when making purchasing decisions. Participants mentioned perceiving furniture displays as suggestions or recommendations for a product's use and placement within the home; however, they ultimately purchase units that are the most functional for their space and layout constraints.

In both the ethnographies and focus groups, participants seemed to be unaware of and uninterested in warning label placement and content. They reported perceiving warning labels as all saying the same thing, as manufacturers protecting themselves from liability, and only necessary for units that are of low quality. Additionally, participants who were not parents typically mentioned that warning labels apply more to people who have children. It was apparent, across both the ethnographies and the focus groups, that participants do not fully read the warning labels or adhere to the messaging. Most of the participants in the ethnographies had not noticed the warning labels on the products in their homes (even when the research staff noted that about five were visible). In the focus groups, when presented with a warning label to read line by line, several participants expressed that they would disregard the instructions regarding not putting a TV on top of the unit. They voiced that the warning labels should include more information regarding the "why" behind instructions, as it would make them more likely to adhere to the information (e.g., Why should they refrain from putting a TV on top of the unit?).

Conclusions

The number of drawers, the drawer depth, and the size of the CSU were all salient factors that impacted participants' classifications of CSUs. Although participants did not consider certain items, such as nightstands or units with removable shelves, to be traditional CSUs, several participants said they use them for small clothing items. Additionally, several participants expressed that they perceive that shorter, smaller, and lighter units pose less of a tipover risk, and therefore, they are more likely to put these units in children's rooms.

Several focus group participants reported that they do not believe they are largely influenced by product marketing and displays in regard to their classifications of CSUs. Although product marketing can provide ideas or suggestions for them as to how they might use a product, participants commonly reported that they are more likely to purchase a product based on an established need. Participants reported that they generally like units that are multi-functional and that they often have a product already in mind when they begin their search.

Additionally, the majority of participants in both the focus groups and ethnographies reported that they do not notice, read, or adhere to warning labels because they already know the information included on them, they do not think the information is relevant to them, or they think the warning labels are a way for manufacturers to protect themselves from liability. Several focus group participants expressed that they would like to know the "why" behind certain warnings. For example, participants reported that including the reason why a TV should not be placed on top of a unit or why heavier items should go in the bottom drawers would be helpful to them. Participants also reported wanting to see additional information regarding weight limits of CSUs, as well as information regarding how to anchor a unit. Two focus group participants mentioned that they believe CSUs on the market have already been tested and have passed certain safety standards, and other participants mentioned that they would like to know this kind of safety information up front before purchasing items.

Table of Contents

Introduction

Between 2000 and 2016, Consumer Product Safety Commission (CPSC) staff estimated 65,200 injuries resulting from clothing storage unit (CSU; including but not limited to chests, chests of drawers, drawer chests, armoires, chifferobes, bureaus, door chests, and dressers) tipovers. Of these tipovers, 195 resulted in fatalities, with the most prominently affected age group being children under 18 years old (86%).[3] As such, it is important to understand how consumers process information related to CSUs and their associated warnings in order to update the standards around CSUs and to reduce the incidence of tipover-related injury and death in the future. As such, Fors Marsh Group (FMG) was contracted by the CPSC to gather information from consumers regarding how they process information related to CSUs and their associated warning information.

FMG conducted six in-home ethnographies and six focus groups with consumers to assess factors that influence consumers' perceptions and interactions with CSUs and their associated warning information, factors that influence consumers' decisions to select and use certain products, as well as their knowledge, awareness, and behaviors associated with furniture tipover.

[3] Advance Notice of Proposed Rulemaking Regarding Clothing Storage Unit Tip Overs. (2017). *U.S. Consumer Product Safety Commission.*

Chapter 1: Ethnographies

Methodology

FMG conducted six in-home ethnographies with caregivers in Richmond, VA, to gather information regarding caregiver interaction with and use of clothing storage units (CSU) and similar furniture items in the home. Ethnographies lasted approximately 90 minutes and were fielded from November 6 to November 7, 2019. Ethnography recruitment procedures were designed to ensure a diverse mix of qualified participants. Ethnographies were segmented by the participants' child's age: three participants had at least one child between the ages of 18–35 months old in their home, and three participants had at least one child between the ages of 36–72 months old in their home. Good Run Research, a research facility in Richmond, VA, with which Fors Marsh Group (FMG) has an existing relationship, carried out recruitment procedures for the ethnographies. First, the facility searched their panel and targeted individuals that identified as having a child in their home. Next, a brief online questionnaire was sent to the individuals to obtain a list of respondents who would potentially qualify for the ethnography. Once the list was compiled, in-depth screening using the screener was conducted over the phone to obtain a final list of qualifiers. Qualifiers were then scheduled to participate in the ethnographies based on the screening requirements and based on their availability to participate in the study.[4] Due to the specificity of the recruit and the research methodology (conducting research in homes), participants received a $175 incentive for participating.

Demographic data can be found in Table 1.

Table 1: Ethnography Demographics

Age Group of Children*	*n*	%
18 months–Under 3 years old	3	33%
Ages 3–5 years old	4	44%
Ages 6–17 years old	2	22%
Relationship to Child	*n*	%
Parent	6	100%
Responsible for Purchasing Furniture	*n*	%
Yes	5	83%
No	1	17%
Responsible for Assembling Furniture	*n*	%

[4] See screener in Appendix A.

Yes	4	67%
No	2	33%
Responsible for Arranging Furniture	*n*	%
Yes	6	100%
Age of the Caregiver	*n*	%
30–34 years old	4	67%
35–40 years old	2	33%
Race/Ethnicity	*n*	%
White	4	66%
Black	1	17%
Hispanic/Latino	1	17%

Some categories may not sum up to 100% due to rounding.
*Some participants had more than one child.

Materials Design and Procedure

The discussion guide for the ethnographies (see Appendix B) was developed to assess the following research questions:

1. How many clothing storage units are located in the home? Where are they located? What type (e.g., dressers, chests, door chests, armoires)? What is the size and design of the unit?
2. When were the clothing storage units purchased or obtained? How old are the units?
3. Are there other pieces of furniture in the home that are used to store clothing?
4. Are there any pieces of furniture in the home that look like clothing storage units, but are not used to store clothing (e.g., a dresser that is used in the foyer or dining room)? What is stored in these items?
5. Are there any nightstands used in the home? What are the dimensions? How many drawers do they have? Are they used to store clothing?
6. What is stored in the drawers of the clothing storage units?
7. What flooring is the clothing storage unit placed on? And Is the clothing storage unit tilted?
8. Are there warning labels on the clothing storage units? Where are they? Are they visible to the consumer? Are they obscured by other items? Is the consumer aware of the content of the warning labels?
9. Which clothing storage units or similar items in the home does the child or children interact with? How do(es) the child(ren) interact with these items (e.g., puts items in/out of drawers, interacts with objects on top of the unit, climbs on the dresser, steps in/on the drawers, sits in the drawers, sits on the unit, uses nearby furniture to facilitate interactions)?

Participants were asked about conventional CSUs used for clothing storage in their home, conventional CSUs used for something other than clothing storage in their home, and unconventional units used for clothing storage in their home. Definitions of conventional and unconventional CSUs were left up to each participant to determine. Participants were then asked to show the research team each unit. The research team used a checklist (see Appendix C) to record the dimensions (using a measuring tape) and the features of each unit. Next, participants were asked how their children interact with each of the units. The research team used a doll, provided by CPSC, to mimic a child's interactions with the unit. The research team also took photographs of the units' placement in the participants' homes and their contents. The research team documented the design (e.g., number of drawers, size of drawers), make, and model of the CSU—when that information was available—to supplement analysis. The sessions were audio recorded. To ensure participants' privacy and comfort within their homes, video streaming and recording were not conducted. Thematic analysis was conducted on the ethnography transcripts, meaning researchers analyzed the transcripts for common themes and prominent patterns. Throughout this chapter, participants' quotes are used to supplement the most dominant themes of these ethnographies. These quotes are not an exhaustive list of thoughts expressed by the participants.

Ethnography Findings

Definitions of CSUs

Participants were first asked to explain what the term "clothing storage unit" means to them in order to assess how they define and classify CSUs. During the ethnography and throughout this report, researchers used the participants' definition of CSU and their classification of a unit to discuss the units. When answering this question, two participants defined CSUs as a product used to store clothing. Five participants also listed types of CSUs either to elaborate their definition or as their definition. The most common classifications included "dressers," "wardrobes," "cabinets," "armoires," and "closets." Two participants noted that they perceive "shelves" to be a key feature of CSUs—typically emphasizing this feature by saying that CSUs have shelves or places that are used to store folded clothing. Two participants said that they considered storage bins to be a CSU as well. These types of bins were frequently cited as useful ways for saving space (such as under beds or in attics).

- *"A freestanding, not closet storage for clothing. That might be like a dresser or an armoire or a wardrobe thing." —Participant 1*
- *"So, to me, that would be anything that clothing is stored in like a dresser, or wardrobe, something like that." —Participant 4*
- *"So, I was telling you, we just moved into this house a year… almost a year and half ago. And so, we've had to really adapt what that means to us because we*

have less space. So, for ourselves, we have different storage bins that we rotate in seasonally" –Participant 3

- *"Under dresser or just a closet area with shelving or things like that." –Participant 5*

Purchasing Behaviors

Common methods that participants cited for acquiring CSUs were from furniture stores, antique stores, consignment stores, general merchandise stores, and online shopping sites. Participants also had custom-built units or were given units as hand-me-downs. General merchandise stores (such as Target and Walmart) were frequently mentioned for purchasing items such as units with removable shelves, baskets, and storage bins.

- *"So, the bed and the nightstand and the dresser were a set. This I got from actually a friend in the neighborhood who was like, 'Hey, I got this desk, it might go with your daughter's stuff, do you want it?'" –Participant 6*
- *"They made it out of wood… So, in our old house, we didn't have a closet, so we needed something to hang his clothes… his room was much smaller… So, they made this." –Participant 4*
- *"We got [unit with removable shelves] either at Target or Walmart… One of them was from Target and one's Walmart." –Participant 3*

Some key factors that participants mentioned considering when purchasing CSUs were affordability, functionality, design/style, and size. Four participants noted that the price of the unit is also an important factor when purchasing a CSU. They want something that is reasonably affordable (e.g., one participant noted that saving money was one of their main reasons for accepting a hand-me-down item versus a store-bought item). Similarly, four participants noted that they consider the functionality of the unit when purchasing a CSU, contemplating whether the unit could be used for multiple purposes to help maximize space in their homes. Examples of functionality that participants noted appreciating included having rods to hang clothing, having shelves for folded clothing, and/or having shelves deep enough to store accessories or shoes. Participants also mentioned keeping appearance and design preferences in mind when purchasing a CSU. They reported that they want to like the style of the unit and want the unit to match the existing décor and furniture in their home. Participants said that the perception of sturdiness also influences their purchasing decisions, as well as whether a unit appears solid and high quality.

- *"Ikea is pretty much our go-to because it's affordable. It's not like they're going to last forever." –Participant 1*
- *"So, it's like we're really trying to utilize the space as best we can, but also keep things a little bit hidden and out of our area as much as possible." –Participant 3*

- *"Just the most space. So, for that particular unit I wanted a place to put the TV, and then I wanted a place for both of us to be able to have a place for our socks and underwear and things like that. I basically hang everything up. He likes to fold a lot of things. So that's why I wanted the space that was open, so he could like stack his sweaters and things like that." –Participant 5*
- *"Well, this house is pretty small, so everything basically has a purpose. So, we try to minimize as much as we can." –Participant 2*
- *"So, I had something in mind, it had to be white. I was more concerned about color: All of her other pieces are white. So, that was another thing that I knew that I wanted it to be." –Participant 3*

Number and Types of CSUs in the Home

The number of conventional CSUs that participants owned varied (participants were asked to use their own definition of a CSU). Participants had between two to four CSUs in their homes. The most common CSU was a freestanding unit with drawers (usually referred to as a "dresser" by participants). Four participants in the ethnographies had more than one dresser in their home. Furthermore, three participants had some type of freestanding unit with doors that opened and drawers, typically called an "armoire" or "wardrobe" by participants. In terms of the placement of these CSUs in the home, participants mostly placed CSUs in their bedrooms and/or their children's bedrooms. The ethnography participants did not generally have any CSUs in the main living areas, with the exception of one participant who had acquired a large, vintage dresser to put in a living room. The participant reported that this piece was used to store "junk" and had items such as sunglasses on the top of it. At least three participants stored clothing in unconventional units, such as nightstands or freestanding units with removable shelves (typically made of canvas or a basket material). Similarly, about half of participants also mentioned storing clothing in storage bins under their bed in their own bedrooms and in their children's rooms.

- *"So, they were giving it away and I was like, 'Well, we don't have any…dressers or anything, so maybe this is something we could use.' So, it was just sitting there for a while. I was like, 'I don't know [what] I'm going to do with it.' But my tights and, I forgot what's in the top one. Oh yeah, my scarves and my lingerie. I think the original purpose of this is a nightstand…it looks like one." –Participant 5*
- *"So, we have, in [NAME]'s closet alone, we probably have, I would say, nine [bins]. And then, we have others throughout the house. So, we have an office space, but we also have a bookshelf for her. And in there, we have pullout bins that have winter boots and winter hats, and rain boots." –Participant 3*
- *"We have (laundry) baskets everywhere holding clean clothes, socks that are matched or whatever. Luckily, there is a closet and the Ikea dresser in my daughter's room. But for all of her little things, because everything's so little*

that you need a better system (baskets) than that giant closet that doesn't have good drawers." –Participant 1

Most ethnography participants noted that they have always used the CSUs in their home for clothing storage. However, one participant noted that their dresser was once used as a changing station and held items such as diapers, wipes, creams, and medical supplies but is now used to store clothes. Another participant noted that the dresser in their child's room was originally used to store dishes; however, after re-painting it, they started using it to store their child's clothing.

- *"Well, we've used it in this function [store clothing]." –Participant 4*
- *"It was a diaper changing… I had the changing mat on the top and then the wipe warmer, so it was my baby changing station. Now, it's just a dresser." –Participant 1*
- *"No, no, it was originally for… I mean, I think it was actually first for dishes, a very old one. And then we just painted it and made it for clothing." –Participant 2*

Placement of CSUs in the Home

Participants were also probed on their motivations behind their CSU placement. Some of the commonly reported motivations were space maximization, necessity, and organization. Participants interpreted this question as either why they had placed the unit in a particular room, or why they had placed it in a particular position within the room. Participants who interpreted this question as asking for their motivation behind placing the unit in a particular room said they placed the unit there because the unit either fulfilled a specific purpose, helped organize their belongings, or they had space constraints that limited their ability to put it elsewhere in their home. Somewhat similar answers came up among participants who interpreted the question as referring to the position of the unit in the room. Participants also noted that space or layout constraints limited their ability to put the unit elsewhere in the room. For instance, one participant mentioned that they selected a unit with bins rather than a dresser, because they needed a unit to organize their child's toys and books in addition to clothing, and they did not want to deal with anchoring a dresser at this time. Additionally, five participants mentioned that they had recently moved and had either moved specific units with them because the units were in good condition and fit the space in their homes, or they had donated or disposed of certain units, because the units did not meet either of these requirements.

- *"We put the dresser [here in the room], because this is where the largest open wall in the room is and is the only [wall] one without a window. We've tried putting the bed this way and then putting it over there, but it just made the most sense on this wall to be able to fit the rocker in as well… but I also like a really open space. I feel like big furniture that's going to take over the room, I don't really want to have a whole bunch of it around. At some point, I'm hoping to get* *rid of the big dresser in my daughter's room, because she has so many toys and she has a nice closet, so a smaller one would be better because it's huge." —Participant 1*

- *"Honestly, it was the only place. When I got it, I was like, 'Oh, it can be like next to the bed.' But then I realized the space isn't big enough for that. So, I just put it there for now.... The ottoman could possibly be moved. I don't really want anything to be in front of the window, like something that tall to be in front of the window. So, I don't really see another place it can go." —Participant 5*
- *"Some things work really well, and then some things don't. Or they just don't fit your space, or they don't fit whatever. And this was one of the pieces that transitioned over with us from our last house to this house, and I just made it work." —Participant 3*
- *"[NAME] doesn't have a dresser yet… Like it wasn't necessary. We thought about it, and it just wasn't necessary for her to have that extra piece of furniture and for us to anchor it, really. What she has access to right now is like a ton of books and a ton of toys, that are all at her level. And there are even bins for that. But we were like, 'Clothes bins…' this just made more sense. We hang 90% of her clothes. The things that get put in a bin are pants, underwear, socks, shoes, pajamas, things like that. That we can just really grab and go…" —Participant 3*

Anchoring Behavior

In general, two participants reported taking precautions to make the units in their homes safer. One participant had anchored an armoire and dresser, and another had anchored a unit with removable shelves. The participant who had anchored the armoire and dresser reported anchoring several items in their house once their child transitioned out of the crib because they were afraid their child would start climbing on things. None of the participants appeared to anchor nightstands or other items under 30 inches. Comparatively, three participants reported anchoring bookshelves in their children's room versus units for clothing storage. Participants who had anchored units in their homes had done so based on their own perceptions of the safety of the units (e.g., bookshelves that are tall and skinny and, therefore, at a greater risk for tipover). Participants also noted that they had specifically chosen CSUs for their children's rooms that they thought would not need to be anchored because they were smaller and lighter weight. Additionally, two participants noted that they remembered seeing a warning label about anchoring or receiving anchoring brackets, but still chose not to anchor the CSU.

- *"[Because bookshelf is heavy], we did put this little safety thing. [We anchored it] as soon as we got it from Ikea." —Participant 2*
- *"This [bookshelf] is skinnier, you know… So, we anchored." —Participant 3*
- *"She doesn't have a dresser yet…Like it wasn't necessary. We thought about it, and it just wasn't necessary for her to have that extra piece of furniture and for us to anchor it, really." —Participant 3*
- *"Yes, there was [a warning label] on the box…because it came with brackets and such." —Participant 4*

- *"I don't know if it's fixed to the wall in here because I really don't let my daughter... I've never let her wander around by herself. It comes, when you first buy it, with the things that attach it to the wall, so there's no tip risk. But we co-sleep, and so she's with me at night, and then in the daytime she's never." –Participant 1*

Flooring

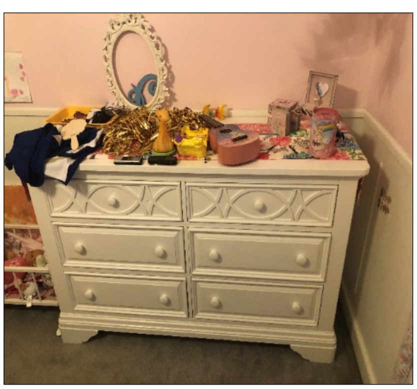
Through observation, it was noted that although participants placed CSUs on both carpet and hardwood, none of the units were ever on a split floor (e.g., half on wood and half on rug). Units were either on one surface or another. It was noted that units in four households were on hardwood floors, with only units in two households on carpet. Additionally, none of the units appeared to be tilted.

Product Analyses

The ethnographies were structured to prioritize assessment of units that children had greatest access to and interacted with the most on a regular basis. The following section details findings from in-depth observations of these units. Participants generally reported that their children interact with furniture in their own rooms the most, but in a few instances, children also have interacted with furniture in parents' rooms. Findings from these discussions are illustrated below. The units depicted below are not an exhaustive list of those observed in homes. Additional photographs and descriptions can be found in Appendix H.

Dressers

Four participants had a unit that they described as a "dresser" in their children's bedrooms. These units were freestanding units with drawers.



Unit in child's room
Participant 6
Approximate dimensions: 63"L x 20"W x 38"H

Unit in child's room
Participant 1
Approximate dimensions: 50"L x 22"W x 44"H

Participants noted that the dresser in their child's room was specifically placed there for the purpose of storing clothes. Although some participants had acquired their dressers as hand-me-downs, other participants noted that that they had purchased their unit from a store (e.g., Target, consignment store, Ikea, Hanes), or in the case of one participant, the unit had been built specifically for them. Two participants mentioned that their dressers were once used for other purposes in the past (e.g., it was once used for storing dishes but is now used for clothing storage in their child's bedroom, it was once used as a diaper-changing station and now is just a dresser in their child's room).

Previously used for dish storage in child's room
Participant 4
Approximate dimensions: 32"L X 18"W X 43"H

Previously used as changing station in child's room
Participant 2
Approximate dimensions: 50"L x 18"W x 37"H

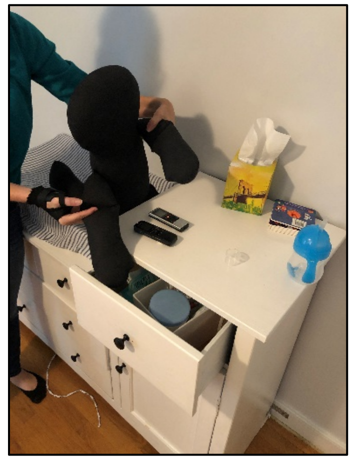
Some items that were commonly found on top of the dressers in children's rooms included lamps, arts and crafts, and additional toys. In parents' rooms, items on top of the dresser included picture frames, jewelry, and in one instance, a TV. Additionally, dressers in children's rooms were typically lower and wider to the ground. The few dressers observed in parents' rooms were taller and skinnier than the ones in children's rooms.

Product Interactions

All participants reported that that their children regularly interact with the dressers in their rooms, with the frequency of these interactions ranging from five times a week to multiple times a day. Since dressers in the children's rooms were used for storing clothes, reaching for clothes was reported as their children's main interaction with the unit. Participants also mentioned that their children interact with the dressers in parents' rooms as well. One participant (parent) had a TV on top of the dresser in their own room (note that this dresser was anchored). The perceived nature of these interactions was fairly similar across participants. Participants noted that their children open the drawers of the dresser either with both hands or with one hand only. Although some participants indicated that their children often pull drawers from one side (partially open), others said that their children pull open the drawers from both sides (fully open). The participant with the diaper-changing station/dresser combination in their child's room mentioned that their child had begun climbing across various components of the unit. This unit was anchored with brackets (and had been anchored before their child started to climb on it). The research team had participants mimic with a doll their children's interaction so that the research team could photograph how their children typically interact with the units. Pictures of staged interactions can be found below. Additionally, participants noted that their children are either too young to remember to close the drawers/doors of the dresser or are just learning to open and close drawers/doors of the dresser after they are finished grabbing clothing items. For the most part, drawers were generally between 70–80% full of folded clothing, meaning there was still some room between the clothing and the edge of the drawer. For the most part, clothing was loosely folded and did not appear to be stuffed or tightly packed. Participants also said that because their children mostly open the bottom drawers of their dresser, they make sure to keep all of their children's clothing in the bottom drawers. They also mentioned that children are usually only opening one drawer at a time.

- *"She'll keep [the drawers] a little ajar…not fully open, but a little open. She'll mainly keep them shut." –Participant 6*
- *"When she first started using it, she would only pull from one side of the drawer. She's pretty good about it now. She gets the concept now, so she'll pull it out and put it back in, and we're just constantly repeating to her like, [inaudible]." –Participant 2*
- *"[Her clothes] are in the bottom two. I always keep anything she would want in the bottom. She never really [reaches for things on the top of the dresser]. If she does, they end up on my floor, but she can reach it pretty well now." –Participant 1*

Staged interaction of child with unit in parent's room (Anchored with flat screen TV on top)
Participant 4
Approximate dimensions: 40"L x 18"W x 46"H



Staged interaction of child with unit in child's room (Anchored)
Participant 4
Approximate dimensions: 50"L x 18"W x 37"H

Apart from the interactions with clothing in the children's drawers, participants mentioned that their children also interact with units in the parents' rooms. For instance, three participants noted that their children may lean against the dresser or try to reach for things on top of the units. Participants also reported that they are not worried about their children reaching out for items on top of the units, because their child is either tall enough to safely reach the top or because the top of the dresser is not visible to the child. On the other hand, two participants said that they are not comfortable with their children reaching to the top of the dresser and actively dissuade their child from doing so. None of the six participants reported that their children sit on or attempt to climb any dressers.

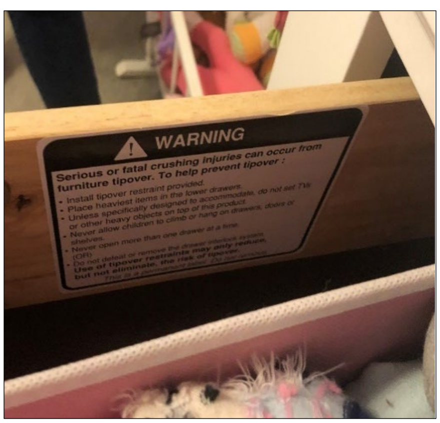
- *"He doesn't … I've seen him come here and stand up against it, but he's never opening it or climbing on it really. Mostly leaning against it, or if he's having a tantrum, he'll put his hands here and… No. He hasn't really [tried to reach anything on the top of dresser in parent's room]. I think mostly because he can't see it, but he hasn't … I've never seen him try to climb up it."*
  —Participant 4
- *"And she does not try to climb on to anything luckily, knock on wood. Everything's been easy with my children that way." —Participant 1*

Warning Labels

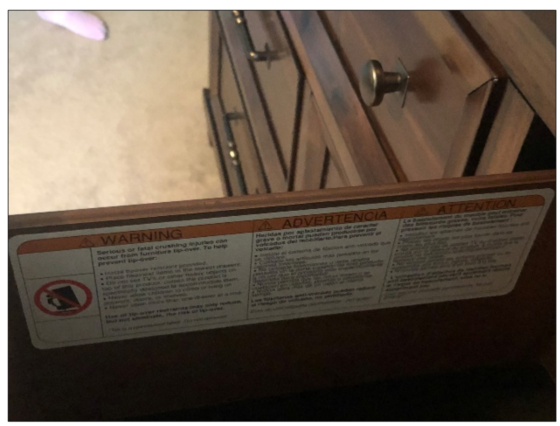
Participants generally said that they had not paid attention or noticed warning labels on the units in their children's rooms, regardless of the manner in which they had acquired the unit (in-store purchase or a hand-me-down). Of note, three dressers had visible warning labels—

inside the top drawer of the unit. However, participants mentioned that they had never really noticed the label before. Participants who had purchased the unit in a store mentioned that they had not actively looked for warning labels or safety information when purchasing the product. Additionally, even if there had been a warning label, they had no memory of seeing or reading it. Participants who had received the unit as a hand-me-down from family, friends, or online sources offered varied reasons for the lack of the warning labels. Participants who had obtained their dressers from an antique store said that warning labels were missing because the units had been manufactured in an era when regulations on furniture were not common. Participants mentioned that their hand-me-down units may have had labels on them originally, but that by the time they received the units, the labels were no longer there. One participant expressed that they perceive that older units are heavier, and therefore, better quality. As a result, they said they believe that older products do not need warning labels, whereas products made today are perceived as lightweight and of poorer quality, so they need warning labels.

- *"It does not have warning labels. It looks like it's from the 60s or 70s." —Participant 4*
- *"Anything from Ikea comes with a warning label, like children being crushed or whatever. They're very cautious, I think, about the recalls. Obviously, the antiques don't. Like, that bookcase is an antique, and it's very heavy. There's something nice about the older stuff is so heavy that it's less of a tipping issue I feel like." —Participant 1*



Warning label inside unit's drawer in child's room
Participant 6
Approximate dimensions: 50"L x 22"W x 44"H



Warning label inside unit's drawer in parent's room
Participant 6
Approximate dimensions: 66"L x 18"W x 40"H

Participants recognized that the warning labels for CSUs might include warnings about tipover, sliding doors (*e.g.*, sliding over fingers), or suffocation hazards. When asked where they thought warning labels would be placed, participants noted that the warning labels are most likely inside of the first drawer because most people open that drawer first, on the back of the dresser, or in the construction manual of a unit that requires assembly. It is worth noting that in instances where the research team found warning labels after posing these questions, the warning labels were all inside of the first drawer (and participants seemed to be unaware that the labels were there). A few of the warning labels observed on the dressers also had information in multiple languages (e.g., Spanish or French). Participants did not appear to be aware of these labels.

- *"Probably in the first drawer on the inside, which would make the most sense." —Participant 2*
- *"They all start off with the most scary things, 'Your child will die.' Probably tipping hazard, suffocation hazards. I would guess on the back or in the drawer." —Participant 4*
- *Yeah, I probably have seen [the warning label], but it's probably also like the tags that you have on lamps that are like, 'Warning. Don't remove.' And you just don't think about it I guess… Probably any kind of disclaimer so that they couldn't sue later or we couldn't sue later if something happened…. No, I don't pay attention to it. To me, a warning label should be not even on the furniture but as part of the purchase or part of the original choice in the furniture." —Participant 6*

Armoires/Wardrobes

Unit in child's room
(Anchored)
Participant 4
Approximate dimensions: 43"L x 23"W x 60"H

Unit in parent's room
(Unanchored)
Participant 3
Approximate dimensions: 33"L x 18"W x 42"H

Two participants had at least one unit in their home that was freestanding with drawers and doors, typically referred to as an "armoire" or "wardrobe." Some units were located in children's rooms, whereas others were located in parents' bedrooms. Of the participants who had armoires, most noted that the armoires were either purchased from a thrift store or were handmade. All of the armoires were used for clothing storage, and the drawers were 70–80% full of clothing.

- *"So, in our old house, he didn't have a closet, so we needed something to hang his clothes." —Participant 4*

- *"More so with [NAME]'s, and it's really to pull out the bottom [drawers] because I think she's really curious about it." –Participant 3*

Product Interactions

Participants said that their children's interactions with the armoires are similar to their interactions with dressers, mainly because the armoires have drawers as well. Specifically, participants reported that the main interaction that their children have with armoires is taking out clothing items. In terms of the nature of these interactions, participants reported that their children open and close doors and drawers with either one hand or both hands, as seen in the pictures below. One participant also noted that their child tugs at the clothes that are hung from a rod inside the armoire. Participants who had armoires in their own rooms did not voice any concerns regarding their children's interactions with the unit. In contrast, participants with armoires in their children's bedrooms reported concerns. Specifically, they mentioned that their children sometimes reach on top of the armoire, and they said they worry that their children might attempt to climb the armoire. As a result, one participant had decided to anchor the unit.

Staged interaction of child with unit in child's room (Anchored)
Participant 4
Approximate dimensions: 43"L x 23"W x 60"H

Staged interaction of child with unit in parent's room (Unanchored)
Participant 3
Approximate dimensions: 33"L x 18"W x 42"H

- *"He just tries to pull them out. He does tug on the clothes above his head... He has not attempted recently to climb up but that was a concern of ours for a while... hang on, this one we had the locks to keep these open, but then we just worked on, don't do that." –Participant 4*
- *"She tries to pull one side and then she'll realize it won't pull all the way out. She'll try to reach her hand in if she can get it open enough and then will try to muscle the rest of it open." –Participant 3*

Warning Labels

The participant who had anchored the armoire had also anchored several other items throughout their household, noting this was a step they took as soon as their child transitioned out of the crib, because they were afraid that their child would climb on the armoire.

Nightstands

Unit in in child's room
Participant 6
Approximate dimensions: 20"L x 15"W x 28"H

Unit in parents' room
Participant 3
Approximate dimensions: 24"L x 16"W x 27"H

Most participants had multiple units they referred to as "nightstands" in their homes, often located in the children's and parents' bedrooms. Most of the time, there were lamps or books on top of the nightstands. Among these participants, nightstands were hand-me-downs obtained from online sites or groups, thrift stores, or through people they know. In contrast, fewer participants reported that they had purchased these units from furniture stores. In terms of placement, the nightstands were always placed near the bed. Although the majority of the participants did not store clothes in their nightstands, a few did. Participants who stored clothes in the nightstands stored smaller/lighter items (such as tights, scarves, or nightwear) or holiday-related seasonal items. Participants who did not store clothes in their nightstands stored miscellaneous, junk-like items such as chargers and lotion. Nightstands were generally 50–60% full.

Product Interactions

The majority of participants noted that their children regularly interact with nightstands, although none of the participants had taken steps to anchor the nightstands. The most common interactions were opening a drawer to store items or, more surprisingly, climbing, standing, or jumping off of the unit. Participants did not mention that their children climb or step on open drawers, rather they step on the bottom (nightstands with an open bottom) or on top of the nightstands. The majority of the parents did not note any concerns with these interactions, except two participants. Specifically, one participant seemed concerned by the possibility of cords being pulled while climbing, and the other participant was concerned about the possibility of the sharp corner of the nightstand hurting their children when they jump on the bed. One participant recognized that although the nightstand in the parents' room is the most "tippable" unit in their home, they were not concerned about it causing harm to their children. They justified this reasoning by noting that the nightstand is on the side of the bed that their children do not interact with.

Staged interaction of child with unit in parent's room
Participant 4
Approximate dimensions: 26"L x 19"W x 29"H

Staged interaction of child with unit in parent's room
Participant 3
Approximate dimensions: 24"L x 16"W x 27"H

- *"Yes, she'll get on the bed and then stand on the table—then I have to tell her to be careful of the lamp and we don't stand on tables…She does climb on the top, and it's really easy because she'll go from the big bed to the table. She hasn't done it in a while." –Participant 3*
- *"Yes. He has climbed on it and opened it. He will usually use this as a way to get on the bed. He'll put one hand on there and then get on the bed." –Participant 4*
- *"Daughter does put books on stop of the nightstand, but she doesn't play with it." –Participant 2*
- *"But this, the pointy, this bothers me when they jump on the bed…I don't think this was intended for a child to use." –Participant 1*

Warning Labels

Among those who owned a nightstand, two participants recalled noticing or reading the warning label. Others noted that although they expect every unit from furniture stores (e.g., Ikea) to have warning labels because they assume that all of the recently manufactured units would have them, they did not remember seeing the warning labels on the unit they had purchased. A few participants indicated that because the unit had to be assembled, they imagined that if the warning label was not on the unit itself, it might be in the instruction manual. Of note, the research team did not observe any warning labels on the nightstands.

- *"It's probably on the back and on the [in]struction manual." –Participant 1*
- *"Not sure if it had a warning label. It probably did." –Participant 4*

Shelving Units with Removable Bins

Unit in basement
Participant 4
Approximate dimensions: 24"L x 12"W x 36"H

Unit in child's room
Participant 3
Approximate dimensions: 23"L x 12"W x 35"H

All participants had at least one unit with removable shelves in their homes, although this type of unit is not considered a conventional CSU. Participants referenced these units in various ways, but generally mentioned storage and shelving when describing them. These units were used either with or without removable bins. In the majority of the cases, the bins did not come with the shelving units and were purchased separately. Most of these bins were lightweight; were made of plastic, cloth, or straw; and were generally 70–80% full (usually of toys or other similar items). Participants had acquired these shelving units either from department, furniture, or online stores or received them as hand-me-downs. The majority of these shelving units were located in children's rooms or play areas and were usually placed against a wall. Many of these units had been purchased to store children's toys, books, and in a few instances, children's clothing. Although these shelving units are not intended to store children's day-to-day clothing, three participants noted that the units hold seasonal items (e.g., jackets) or some clothing items (e.g., scarves, gloves, socks, shoes, hats, underwear, pajamas, pants).

- *"Stores toys. Always intended it to store toys." –Participant 1*
- *"The things that get put in a bin are pants, underwear, socks, shoes, pajamas, things like that. That we can just really grab and go…" –Participant 3*
- *"That'll probably be [where] it stays until they don't [use it for toys]. You know what? I could probably convert this to use it for socks and all that. It would probably be good for winter gloves, winter hats, socks, and just keep it downstairs by the back door or whatever." –Participant 2*

Product Interactions

Given that most of these units were placed in the children's rooms or playrooms and mostly contained toys, participants noted that their children interact with these units quite frequently. Frequency ranged from at least one time a day up to several times a day. The majority of the participants reported that the nature of the interaction between their children and these units is primarily pulling out the bins entirely or partially, using either one or both hands. Additionally, they reported that their children might pull out books or toys without pulling out the bins and also reach for items on top of the unit (such as coloring books or other toys). Although none of the participants noted that their children climb on the shelves of these units, one participant mentioned that their child sits in the lower shelves when playing hide-and-seek. One participant mentioned that they either chose to anchor the units or to place them horizontally because they were concerned about their children's potential interactions with the unit.

Staged interaction of child with unit in family room
Participant 5
Approximate dimensions: 44"L x 16"W x 45"H

Staged interaction of child with unit in basement
Participant 4
Approximate dimensions: 24"L x 12"W x 36"H

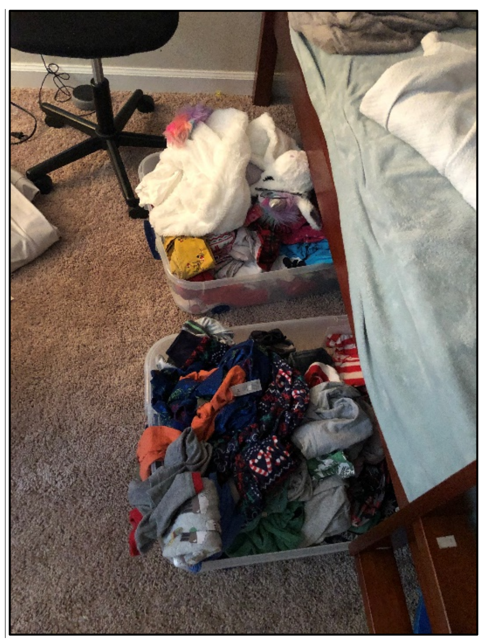
- *"She doesn't sit on it, but again, it's just basically for the books or whatever we tell her to pick up…She'll grab a book and just put it there, but there's no…I wouldn't say she plays with that. A few times just when she's playing hide and seek. She'll go in there or she'll go in here and just move all that stuff and try and get in there."–Participant 2*
- *"So, we have a bookshelf that's lower, and then I can turn it on its side if I need to make it so that she has more access to it to pull the bins in and out. We can anchor it either way." –Participant 3*

Warning Labels

Among the participants who owned a unit with removable bins, more participants reported seeing warning labels on these units compared to other units in their homes. This warning label observation was especially salient among individuals who had purchased the unit from a store and assembled it themselves. The participants who remembered seeing warning labels also noted that the unit came with equipment to anchor the unit to the wall. Some of these participants recalled seeing warning labels and mentioned that the warning labels likely included information about the risks of tipover, instructions on how to anchor the unit, or just general cautionary information. However, no warning labels were visible to the research team for these units, as most participants recalled that the warning labels were more visible during the assembly stage.

- *“[It had a] warning label on the box, because it came with brackets.” —Participant 4*
- *“Yes. It came with hooks. I didn’t use them, but it came with a warning on them. And actually, I know that there was a warning about anchoring and safety, and making sure...” —Participant 3*
- *“I have no idea [if it had a warning label]. I got it off of Amazon.” —Participant 5*
- *“May have been. I don’t remember or not—don’t know if this had hooks or not either...It would say be careful of tipping.” —Participant 6*

Storage Bins



Unit in child’s room
Participant 5
Approximate dimensions: 27”L x 13”W x 6”H

Participants used what they generally called “storage bins” to store clothing. In terms of placement, storage bins were located in the children’s rooms or parents’ rooms. In these rooms, the storage bins were either placed in the closets or were placed under the beds to maximize space in the rooms. In some cases, these units were stacked on top of each other to further maximize space. These units were mainly used for storing clothes and were typically 90% full of clothing. Participants indicated that although these units often store seasonal or smaller clothing items, they are also used to store more day-to-day clothing like pajamas.

Product Interactions

Of those participants who mentioned that the bins are used for storing more day-to-day items, the frequency of their children's interactions typically ranged from once a day to several times a week. Interactions included pulling out bins to get clothing items out of the bins. One participant noted that their children often forget to push the bins back under the bed.

- *"So, here's our closet. And so, their socks, we use these little bins, so they can pick it out. And then this is his clothes and her clothes. This is the dirty clothes bag. So these are the bins I was talking about where their play clothes are." –Participant 5*
- *"I did put her spring stuff that I'm pretty sure she'll still be able to wear next year under here [in a storage bin]." –Participant 6*

Storage Chests

Unit in parent's bedroom
Participant 3
Approximate dimensions: 63"L x 20"W x 38"H

Unit in living area
Participant 1
Approximate dimensions: 42"L x 17"W x 22"H

Four participants had units in their homes that were considered storage chests with a hinged lid (two was the maximum number of chests observed in one home). Four out of five of these units were placed in living areas or dens, one storage chest was found by the foot of the bed in the parents' bedroom. These units were mainly used to store blankets, toys, or seasonal clothing. For example, one participant noted that although the chest had once been used to store seasonal clothing (e.g., sweaters, warmer clothes), it is now used to store wool blankets to prevent moth damage. Although three participants reported storage as the main purpose of the unit, one participant had placed their chest in the living area in lieu of a center or side table and used it to keep trays or cups. Participants often commented that their children sit on, lie inside of, or step or jump off of the chest onto other nearby furniture (such as a couch).

Emergent Theme

Perceived Susceptibility of Risk

Perceptions of tipover susceptibility appeared to impact participants' anchoring behavior. Low susceptibility to tipover came up several times throughout the ethnographies. At least three participants reported that they do not worry about the risks of units tipping over, either because their children do not climb on the furniture or because they had internal justifications for why a unit is safe. These justifications included the unit being solid, heavy, or low to the ground.

- *[The door of the chest] doesn't slide or anything when they're doing that kind of activity because it's nice heavy wood." –Participant 1*
- *"But I also feel like I'm actually glad this [nightstand is] on this side because it's not as tall as that one [nightstand]. From afar, they look pretty similar, but this one is definitely shorter. And if she were going to jump off of this one, which is going to happen one of these days, I feel like not as worried about it. Whereas, if she's jumping off of that one..." –Participant 3*
- *"I liked this dresser. It's not very easy to tip, so I didn't really have to worry about much." –Participant 1*

Although two participants mentioned that they chose to anchor their furniture as a precaution, most participants provided reasons for why they did not anchor their furniture. Participants' perceptions that their children are unlikely to climb on furniture was the main factor in their decision to not anchor units. Participants often reported that their children "are good" and do not climb on furniture, or that they are able to monitor the types of units that the children actually climb on and interact with.

- *"Not even. No, she's never been a climber, so that's something that ... yeah, she's never tried to do." –Participant 6*
- *"I don't know if it's fixed to the wall in here because I really don't let my daughter... I've never let her wander around by herself. It comes, when you first buy it, with the things that attach it to the wall, so there's no tip risk... My kids like to be with me. She doesn't climb, thank god. I know a lot of kids are crazy, and they do that." –Participant 1*

Participants seemed confident in their decisions not to anchor their furniture because they believe that their units are safe or that their children do not climb on them. There appeared to be a belief among participants that as long as their children are careful with the units or as long as units are "safe," there are minimal risks associated with the units.

Chapter 2: Focus Groups

Methodology

FMG, on behalf of CPSC, conducted six 90-minute focus groups in Richmond, VA, from December 3 to December 4, 2019, with a total of 48 participants. Focus group recruitment procedures were designed to ensure a diverse mix of qualified participants. The participants were segmented by (1) caregiver status: parents of a child 12–72 months old, non-parent individuals planning to have children in the next five years, non-parent individuals who are visited at least once a week by children ages 12–72 months old (e.g., grandparents, aunts, uncles, close family friends, etc. with priority given to those who had children staying overnight) and (2) by homeowner status (own vs. rent home). Focus groups were held at Good Run Research, a research facility in Richmond, VA, with which FMG has an existing relationship. The facility searched their panel and targeted individuals that identified as parents or non-parents. Next, a brief online questionnaire was sent to these individuals to obtain a list of respondents who would potentially qualify for the focus group. Once the list was compiled, in-depth screening using the screener was conducted over the phone to obtain a final list of qualifiers. If available, the qualifiers were scheduled to participate in the focus group that they qualified for, based on the screening materials.[5] Focus groups were overrecruited (12 participants recruited to seat up to eight per group), and participants received a $75 incentive for participating in the focus group.

The demographic data of parents of a child 12–72 months old can be found in Table 2 (total of two focus groups), and the demographic data of the non-parents (individuals planning to have children in the next five years and individuals who are visited at least once a week by children ages 12–72 months old) can be found in Table 3 (total of four focus groups).

Table 2. Focus Group Demographics: Parents

Responsible for Purchasing Furniture	*n*	%
Yes	16	100%
No	0	0%
Responsible for Assembling Furniture	***n***	**%**
Yes	15	94%
No	1	6%
Gender	***n***	**%**
Male	8	50%
Female	8	50%
Participant Age	***n***	**%**

[5] See screener in Appendix D.

21–30 years old	4	25%
31–40 years old	8	50%
41–50 years old	2	13%
51–60 years old	2	13%
Age of Child*	*n*	%
Under 1 year old	3	19%
Ages 1–3	11	69%
Ages 4–5	9	56%
Ages 6–17	8	50%
Race/Ethnicity*	*n*	%
White	9	56%
Black	5	31%
Hispanic/Latino	1	6%
American Indian or Alaska Native	1	6%
Asian	1	6%

Total: 16 parents
Some categories may not sum up to 100% due to rounding.
*Participants could select more than one answer.

Table 3. Focus Groups Demographics: Non-Parents

Responsible for Purchasing Furniture	*n*	%
Yes	31	97%
No	1	3%
Responsible for Assembling Furniture	*n*	%
Yes	22	69%
No	10	31%
Gender	*n*	%
Male	13	41%
Female	19	59%
Participant Age	*n*	%
21–30 years old	12	38%
31–40 years old	11	34%
41–50 years old	2	6%
51–60 years old	4	13%
61–70 years old	3	9%
Age of Children Visiting the Home*	*n*	%
Under 1 year old	2	6%
Ages 1–3	12	37%
Ages 4–5	13	40%
Ages 6–17	6	18%
None of the above	12	37%
Race/Ethnicity*	*n*	%

White	14	44%
Black	11	34%
Hispanic/Latino	6	19%
American Indian or Alaska Native	1	3%
Asian	2	6%
Some Other Race	1	3%

Total: 32 non-parents
Some categories may not sum up to 100% due to rounding.
*Participants could select more than one answer.

Materials Design and Procedure

The focus group discussion guide (see Appendix E) was created to investigate the following research questions:

1. How does product information (i.e., product name, marketing) and design (e.g., unit size, number of drawers, size of drawers) influence a consumer's determination of whether a product is or can be a clothing storage unit?
2. How does a consumer's determination of whether a product is a clothing storage unit influence the placement of the product in their home, use of the product (e.g., what they store in the unit), and perception of tipover risk?
3. Which warning label placement locations on clothing storage units (including armoires and other units with doors) are the most conspicuous and what locations are unacceptable to the consumer?
4. How do consumers react to warning hang tags or removable stickers that provide additional information about tipover risk and anchoring furniture?
5. Do consumers understand the information provided in the warnings regarding tipovers and the use of a television on the unit? Do consumers believe that these warnings will be effective?
6. Would additional information about stability (e.g., certification or verification that a product meets standard) have an effect on consumers' buying decisions?

The product categories of interest for the research questions included dressers, nightstands, armoires, occasional furniture, accent furniture, and lightweight storage units. The moderator kicked off the conversation by assessing participants' general definitions of a CSU. Discussions then progressed to assess behaviors associated with CSUs, including the influence of product marketing and a worksheet activity on classifications of CSUs (see Appendix F), and concluded with assessing awareness and behaviors associated with CSU warning labels.

During the worksheet activity, participants were shown eight pictures of units and were asked to label the piece of furniture, note what types of items they would store in it, and report where they would place it within the home. The moderator followed up on participants' responses to better understand the thought process behind their decisions.

Warning label discussions included assessing participants' past experiences with CSU warning labels, their perceptions of acceptable versus unacceptable placement of warning labels, their attitudes toward warning hang tags and removable stickers, and how the addition of stability information would impact their perceptions of warning labels. Participants were then shown a warning label and were asked to further discuss how often they pay attention to warning labels, the extent to which they understand and adhere to the messages/instructions, their opinions on the content included in the label, and their perception of the overall effectiveness of the warning labels. Finally, participants were asked for recommendations that would help increase their engagement with warning labels.

After conducting all six focus groups, trained qualitative analysts reviewed the notes from the focus group discussions and identified key themes. Each of the focus groups was transcribed for analysis purposes. A coding manual was developed to guide the coding of the focus group transcript data using NVivo software. In addition to coding the specific sections of the discussion guide (e.g., introduction, definition of a CSU), coders highlighted emergent themes. Throughout this chapter, participant quotes are used to supplement the most prominent themes of the focus groups. These quotes are not an exhaustive list of thoughts expressed by participants.

Focus Group Findings

Definition of a CSU

Focus group discussions began by assessing how participants define CSUs. When prompted with this question, a few participants said a CSU is anything that can hold clothing. However, several other participants responded with examples of units. Dressers, closets, and armoires were the most common examples that participants provided. Participants reported that these units have features that allow for organization and the protection of clothing (e.g., drawers of various sizes, dividers to help with organization, and doors to keep clothing out of sight). Cloth baskets on shelving units were also reported to be a unit used for clothing storage.

- *"Dividers within either the closet or the dresser, armoire, things like that. So, a place where you can, I like to be organized, but to keep things organized. So, it's not just one place where you throw something and then just, you shut the door, it's visually pleasing when you open it." —Planning to have children, Renter*
- *"I guess the different size drawers. Like the big drawers at the bottom are, in my mind at least, for like shorts, tee shirts, and the top drawers are smaller for socks, stuff like that."*

— Planning to have children, Renter

- *"So, I guess anything that keeps your clothing out of sight…" —Visited by children, Renter*
- *"It's like a three-by-three, and they're cloth bins, so I store clothing in some. The open ones, I'll put some ornament or something decorative to kind of…" —Visited by children, Renter*

The discussion progressed to determine how the size of a unit influences participants' definitions of a CSU. The majority of participants noted that if a unit is too small, they will not store clothing in it, because the clothing will not fit. The definition of too small varied across participants, but some agreed that "too small" meant that it was shorter than about 3 feet or had drawers that were too small to fit items like a shirt. Overall, participants' responses for their preferred CSU height varied from 2 to 5 feet. On the other hand, a few participants noted that CSUs in their children's room are smaller than their typical definitions. The units are shorter so that their children can more easily access drawers, and drawers are smaller to fit smaller clothing.

Drawers were also a prominent distinguishing factor that came up during focus groups. Although there was not a consensus on size, the preference was to have drawers that are large enough (e.g., bigger than a shirt) and deep enough to hold clothing. One participant mentioned that there is a difference between what they would ideally like in terms of drawer size and what they will accept. They would ideally like drawers deep enough to easily store clothing; however, participants noted that the current dresser they have requires them to shove or stuff their clothing inside. Further, the specific size of the drawers was reported to vary based on the needs of each person and the size of the home.

A few participants also expressed that CSUs tend to have drawers of varying sizes—usually the bottom drawers are larger and are meant for storing bigger clothing (such as pants), and the top drawers are smaller and are meant for items such as undergarments and socks. Additionally, the majority of participants reported that they generally think of a CSU as having at least three drawers. However, a few participants noted that a CSU could have four drawers, whereas others mentioned that to be considered a CSU, a unit only needed one drawer. Participants often considered a unit with two drawers or fewer to be a nightstand. They also emphasized that nightstands often have narrow drawers (i.e., cannot fit multiple clothing items next to each other).

- *"Three or more [is a dresser]. [The size of drawers in a CSU depends] upon the size of your house and your needs I think." —Visited by children, Owner*
- *"It needs to at least be a foot, or at least over 6 inches when you're pulling a [drawer] out." —Visited by children, Renter*
- *"I would think it's got to be wide enough drawer to have two folded articles of clothing side by side…if it's only narrow enough for one, then I'm going to call it a nightstand." —Parent, Renter*

- *"I guess deeper [drawers]? Like looking down into them? If that makes sense. So… I'd rather have one big one that has long, deeper drawers, so I can stack like four pairs of jeans instead of two or stack sweatshirts." —Planning to have children, Owner*
- *"I think that's dependent on the space or the person. Because in my household, like what she was saying, the dresser in my room is enough space for my stuff. But and the baby's room he has several different little storage units that we have to put some stuff in just because he has different sizes as he grows." —Parent, Owner*
- *[Moderator: "And how many drawers does the nightstand have?"]*
  "Two." —Visited by children, Renter

Participants reported the room in which a unit is placed is another factor in classifying CSUs. A few participants mentioned that units in their living room (such as a side table or entertainment cabinet) have drawers that could theoretically be used to store clothing. However, they reported that because they use the side table and entertainment cabinets in their living room, they are unlikely to put clothing items in it. Participants commonly reported that depending on where the unit is within the home, the purpose of the unit may change (e.g., units that were originally used in a living room have been moved to a bathroom.).

- *"In the living room, we have two…side tables, but they're very deep, and they're not terribly wide…And for intents and purposes, a junk drawer." —Planning to have children, Renter*
- *"I think again, like depending on what room it's in. I've definitely had things that, say, I originally had in the living room and then they moved to the bathroom when I moved or whatever the cabinet space was, and that changed how I used it."—Planning to have children, Renter*
- *"It's big and it's wood [entertainment cabinet]. My daughter can't touch the TV screen, and it's easy to put things in the drawers. If I have guests coming over I can just… Legos, puzzles, just stuff like that." —Parent, Owner*

Although most participants agreed that nightstands are mainly used to store junk (e.g., Chapstick, chargers, books, bills), a few participants reported storing clothing items in their nightstands (e.g., shirts, socks, pajamas, slippers, underwear, hats, mittens). Participants who reported storing clothing in their nightstands said that they do so because of space limitations or simply out of convenience.

- "[On] my husband's side, we [put] his socks… pajamas, swim wear [in the nightstand]."
  —Planning to have children, Renter
- *"Slippers. Things to keep your feet nice and toasty and warm. Top one would be like a night shirt, pajamas, those, kind of things. And the upper one [above the top] one would be just the catchall stuff." —Planning to have children, Renter*
- *"I mean, I store underwear and socks, stuff like that, in the nightstand." —Visited by children, Renter*
- *"Actually, [I] keep like lotion, little Chapstick, and just stuff to use before bed, or a book, maybe something like that. Chargers." —Parent, Renter*
- *"[I store clothes in my nightstand because] I have too much clothes." —Parent, Renter*

- *"Stuff you may want to be able to reach from the bed." —Parent, Renter*

Product Marketing

Perceptions of Furniture Displays

The focus groups progressed to assess how furniture displays (both in store and online) affect participants' perceptions of CSUs. The majority of participants reported that furniture displays often appear as staged bedrooms that are not realistically replicable in their homes. Additionally, a few participants expressed frustration that these displays typically attempt to sell an entire furniture set, but they are usually only interested in buying one item. Participants also provided additional details regarding their perceptions of furniture displays, which included that the displays (1) focus on design, (2) appear well organized, (3) look visually appealing, and (4) show the scale of what the piece would look like in a room.

- *"Usually by a bed or like in a make-believe room." —Planning to have children, Renter*
- *"Everything matches—the drapes, the bed spread, the furniture—like you said, they've got the nightstand, the bed, the dresser and maybe if you all can remember, they used to be called High Boys, the tall dresser, so it all matches." —Visited by children, Owner*
- *"Yeah, staged. Staged bedroom." —Visited by children, Renter*
- *"They're showing you how it could be used in your room, I mean, usually displays are trying to show you the functionality of it." —Parent, Renter*
- *"[They] try to sell you three pieces when you only need the one!" —Parent, Renter*
- *"[The display is] more focused on design… Because if you're walking in an Ikea, they have it all set up with bedroom, carpet, dresser, all that." —Parent, Owner*

Participants noted that online displays of CSUs are typically the same as in-store displays but are just an image. A few participants also reported that online displays can be more elaborate (e.g., show an entire house set up around a CSU) and showcase size comparisons (e.g., if a unit comes in multiple sizes). Additionally, participants mentioned that they appreciate seeing dimensions online so that they can measure in their home before purchasing.

- *"Kind of the same. It's just pictures." —Visited by children, Renter*
- *"But even more elaborately staged…It'll be, like, a full home, I feel like." —Visited by children, Renter*
- *"Usually the pictures of it in someone's house…kind of like show scale of size. Usually, we'll look at that if it looks like it's the same size as the chair, a little bit bigger than the chair, they usually throw random props in there." —Planning to have children, Owner*

CSU Display Influence

Next, discussions focused on how CSU displays influence CSU placement in participants' homes. The majority of participants reported that they do not perceive the display to affect where they place the CSU in their home. A few participants noted that the display sometimes provides them with ideas or suggestions regarding where they could place the CSU in their home (e.g., if a unit is depicted in a bedroom set, they would be more likely to assume it is meant for a bedroom). However, participants kept reiterating that they usually already have a need for a specific item and a place in mind for it when they begin shopping.

- *"Because I mean, I'm looking at a piece of furniture, I'm still, I mean, I'm looking at it in the ad, but I'm still envisioning my house and where it's going to go and stuff, so…" —Planning to have children, Renter*
- *"I don't think it does at all for me, because obviously, those pictures online are meant to be show pieces, they're meant to exaggerate it, the most perfect scenario of that being placed. I don't have a perfect home… I have to think mentally where it's going to go in my home and completely not rule out where it's fitting in the picture." —Planning to have children, Renter*
- *"They kind of tell, marketing tells a story and kind of encourages you again to utilize a product in a particular way. So, it's like, 'Hey, this is what we've decided you should use the product for and hopefully it works for you.'" —Visited by children, Owner*
- *"Oh, I would think that most particularly if you go and look at a bedroom set, you would think that most of those pieces are going to be specifically for a bedroom." —Visited by children, Owner*
- *"Usually, when you see it in a demonstration bedroom, you're going to associate that item with a bedroom item, so I would think if it's displayed in a living room, you probably wouldn't look at the product and first associate it with being something that you put in your bedroom." —Visited by children, Renter*
- *"Yeah, I like to rearrange really often, just because I feel like it just helps keep things fresh in the house, just rearranging, keeping it new. So, for me, I might put bedroom furniture in the living room. It all just matters if it works. I like versatile furniture. I like things that it could be anywhere." —Visited by children, Renter*

It is important to note that although participants did not generally perceive marketing to influence their perceptions, during the subsequent worksheet activity in which participants were asked to classify CSUs, the way the units were displayed appeared to affect participants' classification of the unit. Participants were more likely to classify a unit with a TV on top as a dresser or media cabinet, whereas a unit with a vase on top was more likely to be classified as an accent piece that would be in an entryway.

- *"I think if there had been a TV next to it or like, I could totally see that as a bedroom, like the clothing, dresser as well. But because it's set that way, like I pictured it in my house as an entryway table." —Planning to have children, Renter*
- *"I was just influenced by the fact that there was a television on it. I could have made it a cabinet." —Visited by children, Owner*
- *"The fact that there was a TV on it kind of accentuated [crosstalk] the fact that it was a dresser and makes it feel like it's in someone's bedroom." —Visited by children, Renter*

Manufacturer Name

Next, discussion shifted to assess how the manufacturer's name of a product influences participants' classification and perceived use of a unit. Initially, participants reported that they are unaware of how the manufacturer's name of a product affects their thought process.

When probed further, participants reported that they visualize an item when they see the word "dresser," and therefore, they mentioned that they believe the name impacts their classifications. Again, participants reported that although the product name might influence their thinking of how they could use the product, they will ultimately purchase and use a product based on its function and ability to meet their established need. For example, a participant reported using a dresser in a hallway because they had a need for a unit and the dresser best fit that need in that part of their home.

- *"I'm sure we're primed, right? We might not even realize that just because it's called that, we're going to use it that way, but we see it surrounded by clothes or we just assume that it's for clothing, so…" —Planning to have children, Renter*
- *"Well, I think if you think about a dresser and a buffet, for example. They can look almost exactly the same, but by the name, you're like, 'Okay, dresser is going to go in the bedroom and buffet is going to go in the dining room.'" —Planning to have children, Renter*
- *[Moderator: "So to what extent, if at all, does the way the manufacturer names the product affect whether you classify that as a clothing storage unit?"] "Like you know a dresser is a dresser." —Visited by children, Owner*
- *"We've got the coffee table, but we also had a dresser that we kind of keep up by the front door… kind of like knickknacks and accoutrements and stuff." —Visited by children, Owner*
- *"I'm thinking with this generation that we have now where people tend to be multitask items in your house, that would be something where you might have in the middle of a dining room, you might have a piece that actually has maybe pajamas or whatever for whatever reason you need downstairs simply because it works in that room. But not many people are going to open the drawer and see what you've got in your drawers." —Visited by children, Owner*
- *"None to me. If it has a drawer, if it has a three-dimensional space that clothes can be put in, it has the potential to be a clothing storage unit. It's just a matter of if it's visually appealing and fits in the space that's needed." —Visited by children, Renter*
- *"It'd probably change my thinking, but it probably wouldn't change what I would put in it. Depend on what I was needing it for." —Parent, Renter*
- *"Yeah, but otherwise for me, it wouldn't matter. But, like you said, searching-wise, it makes sense to call it that but otherwise for me it's just whatever the use of space is." —Parent, Renter*
- *"I don't listen to any rules. It works better as my TV stand right now [and it] is actually a dresser. So, we didn't like the drawers, I just use it as a TV stand, and it looks like a TV stand when you put a TV on it. So." —Planning to have children, Owner*
- "*Well, if you look at maple furniture or cherry furniture or whatever, when you go in, you see a piece, you go, 'Oh that's a really neat way of using that chest of drawers.' But it's still a chest of drawers. And it's a chest of drawers whether you put clothes in it or what"—Visited by children, Owner*

Accent Pieces

When participants were asked how the name "accent piece" affects their definition and use of a unit, participants reported that an accent piece is typically used for storage and can be found anywhere in the home. Participants noted that furniture displays for accent pieces typically highlight its versatility and showcase numerous ways to use the piece in the home.

A few participants also reported storing clothing in an accent piece due to the need for more storage (e.g., storing pajamas and undergarments in an accent piece in the bathroom).

- *"Well in the bathroom, you put pajamas, underwear, all kinds of stuff." —Visited by children, Owner*
- *"Like an overflow because we have an accent piece in our family room that's a clothing storage unit and it has, we keep batteries and extra things. So, it's easy to get to." —Visited by children, Owner*
- *"I would think an accent piece could be utilized in almost any room of your house. It's one of those ones. This is an add on piece. I've seen people put it in a large bathroom and put linens in it. I've seen them put it in a foyer, I've seen in the living room and even a dining room or bedroom. It's one of those multipurpose. It doesn't say specifically where it has to go. I think that makes me think of Ikea. Yeah. Because Ikea is probably the one manufacturer that I've seen that it can be a kitchen, a dining room, a bedroom, a bathroom or whatever, and they will show pieces. When you go to their stores, they show it in several different venues to give you the idea that it's not just for one thing because the average shopper only sees it for where it's displayed." —Visited by children, Owner*
- *"Oh! Those little cube things, kind of like ottomans?... Yeah, those are really convenient. Those are technically accent pieces. Because, again, it's functional. You can use it as a storage unit, but you can sit on it, you can kick your feet up on it, you can [crosstalk] clothing, you know. Those are great..." —Visited by children, Renter*

Purchasing Behaviors

Factors Influencing Purchasing Decisions

Nearly all of the participants reported that they are responsible for making purchasing decisions. Across parents and non-parents, the most commonly mentioned factors that influence purchasing decisions were (1) cost (e.g., wanting to remain within a specific budget), (2) quality (e.g., wanting furniture that will last a long time), and (3) functionality (e.g., wanting furniture that meets their needs, but can also be maximized for multiple uses). These three factors were especially emphasized by non-parents who rented their homes: They reported that furniture that can withstand multiple moves is important. Size and style were two other factors participants mentioned as influencing their purchasing decisions as well—wanting items that fit their space and match their decor. These two factors of size and space were particularly salient among non-parents, who often reported being less constrained by safety concerns and focused more on aesthetics and function.

- *"Durability. Is it going to last more than one or two moves?" —Visited by children, Renter*
- *"And probably not as likely to invest big dollars in a piece of furniture that is going to get beat up in the process moving from place to place." —Visited by children, Renter*
- *"Durability, especially for the kids, making sure it's not going to fall apart in a year just from opening and shutting it, you know daily use." —Parent, Renter*

- *"Making sure it actually fits in your house you know where you want it." —Planning to have children, Owner*
- *"Depends what you're looking for there. I mean, if you need it for storage, that's one thing. If you need it for everyday use, that would be another thing. And if it matches." —Planning to have children, Owner*
- *"Older heavier wood stuff? So, most of our stuff was built in the 40s. I think eventually we're going to transition over into more modern stuff. But for right now we've just been looking for something that can take a beating." —Parent, Owner*

Children-Specific Factors

During the groups with parents, participants reported specific factors that they look for when purchasing units for their children. Size, weight, and durability (e.g., Can it withstand everyday use without getting damaged or falling apart?) were three of the most prominent factors that parents noted. Participants reported that the size of the drawers is important due to the large amount of clothing that requires storage, yet participants said they would like drawers that will not injure their child if the drawer were to come out of the unit. Participants reported that they also prefer CSUs for children to have rounded edges to prevent injury if the child runs into the unit. Further, the height of the unit was also cited as an important factor, because participants would like a unit that is an appropriate height (i.e., short enough) for their children to easily access their clothes. Participants also reported wanting units that are heavy and durable enough to withstand regular usage (e.g., withstand wear and tear, withstand children coloring on it).

- *"Well, I have ours under dresser. The dresser that we have in that room, though, is shorter so it's easier for them to get to." —Visited by children, Owner*
- *"It's small drawers. So, if it happened to pull out, it's not going to be something that's going to take a foot off or something. It really is, it is a younger child size piece that they could handle pretty easily." —Visited by children, Owner*
- *"Kids color and mark on everything, so we transitioned out of all wood. Anything pretty much of aesthetic value, we got … We have no more white in the house, and no more surfaces that are easily marked, basically. So, kind of like plastic, like imitation wood almost, where they combine wood pulp, where it's not actual grain…" —Visited by children, Renter*
- *"Yeah, I wouldn't get a child a storage container that had too much that they couldn't use it themselves. So, if I was looking in terms of what draws me to furniture for children: something that's safe, but also that they can use independently. They don't need me to come open it or…" —Visited by children, Renter*
- *"Well, my nine-year-old has a lot of clothes because his dad really likes clothes. So, his T-shirts are just coming out of the drawer, so he actually has two drawers. So, definitely the deepness is important." —Parent, Renter*
- *"Will it grow with the kids?…Yeah, if I'm going to invest in furniture, I'd like it to ideally grow in the space." —Parent, Renter*

- *"Well, they're hard on things and you have to be able to pull stickers off of it. And I, I don't want it collapsing on them while they're using it, so I just wanted it to be solid enough that they can use it." —Parent, Owner*
- *"Or how it shuts? That was important for my sons… so his fingers wouldn't get squished." —Parent, Owner*
- *[Moderator: "Have you all ever bought something specifically for the kids to store their clothing in?"] "Well, it's something really simple. It's like this plastic stackable, the drawers, and in fact you can add on extra drawers to it if you need to. The top comes off. You can add extra drawers. It's pretty utilitarian. It's got wheels, you can move it around." —Visited by children, Owner*

Children's Interactions with CSUs

After discussing what factors participants take into consideration when purchasing a unit for a child, participants discussed how children interact with units in the home. It was widely reported that children within the home mainly interact with the bottom drawer of a unit, since it is easiest for them to reach and safely interact with. A few participants reported that their child climbs on units (e.g., uses the drawers as steps) within their home to reach something within a drawer or on top of the unit. Participants reported that their children (or children who visit) typically open one or two drawers at a time, and it always tends to be the bottom drawer of a unit. Further, a few participants reported that they had experienced tip-over incidents as the result of children climbing on units. Their solution was to replace units with heavier furniture to prevent the furniture from tipping over.

- *"For me it's a lot, because I keep Nerf guns in the bottom drawer. So, my roommates, they have kids, so they're there pretty frequently, so when I'm not busy doing anything they'll come in my room, pick out a gun, and the whole house is a mess within 10 minutes." —Planning to have children, Renter*
- *"[The lower drawers are] easy access for them to create. I've always [allowed] a level of independence for them to be able to get what they need or put it back or whatever. So…" —Visited by children, Owner*
- *"My nephew likes to climb the dresser, anything that can pull out, that's his height, that he can grab onto. But I have a tall wardrobe that he doesn't really mess with, but I guess because it's bigger than him, it's probably intimidating, so he probably just ignores it…" —Visited by children, Renter*
- *"That heavy furniture, for one. I prefer heavy furniture when the kids are around because we had an incident with my niece with a TV falling on her, so that's one of the reasons why… [My niece was] trying to turn the TV, but she opened the drawer to get to it." —Visited by children, Renter*
- *"I was going to say, that's exactly why we transitioned! Because they were using the drawers as steps to try to climb, and if the furniture isn't heavy enough, it will just topple right over, and then…" —Visited by children, Renter*
- *"I've seen kids use drawers as steps more times than I can count." —Visited by children, Renter*
- *"My two-year-old will climb on anything. He's actually opened the bottom drawer and stepped into it to get the Xbox controller off the top." —Parent, Renter*

CSU Features of Interest

Participants were asked about the specific features they look for when purchasing a CSU. Drawers were the most commonly reported feature that participants reported looking for when purchasing a CSU. They said they want drawers that are deep enough to fit clothing, drawers that slide in and out well, drawers with varying sizes that can hold different types of clothing, and drawers that are sturdy (i.e., hold the weight of clothes and do not break easily).

- *"I like different size drawers or organizers that, I know we were talking about that before, but I, this is not what I have right now, but I would love it if my first drawer had separators for things, and then maybe the bottom ones were bigger for more T-shirts and things like that." —Planning to have children, Renter*
- *Bigger drawers so that I had more space, because it's my boyfriend and I, so it was important to have enough space that we could fit most of our things in there together." —Visited by children, Renter*
- *"Drawers that they slide well." —Planning to have children, Owner*
- *"I would actually push. This is weird, but I would open it up and push inside the drawer, because I've had a lot of my drawers buckle under and they never fit back in that lip again. They can't be closed… So, I would probably check that out." —Planning to have children, Owner*
- *"How the drawers come out or how it slides." —Parent, Owner*

Furthermore, a few participants reported that functionality and durability are also factors they seek out when purchasing a CSU. Specifically, these participants mentioned that they want a CSU that easily opens and allows them to see all of their clothes. Participants also noted that the CSU must be durable enough to hold the weight of their clothes and last for more than a few months.

- *"My issue too with dressers is the drawers, because if they get stuck at all, it's such a pain. And especially with the cheaper stuff you're trying to shove things in, and I won't [shove] them, so that's why I get the heavier stuff because that would usually last a lot longer." —Planning to have children, Owner*
- *"I like being able to see it, everything." —Planning to have children, Owner*
- *"It makes it functional if it's not in my everyday space, and I can put it away." —Planning to have children, Owner*
- *"Like even if I put a whole bunch of stuff in it, it's not going to break in six months." —Parent, Owner*

Online Versus In-Store Shopping Behavior

The majority of participants reported that they like to shop for products online. They reported that conducting searches online is efficient, convenient (e.g., they can browse a large quantity of products in a short amount of time), and allows them to filter their search.

- *"I'm busy, and I can't go to multiple stores, so I feel like it just gives me a really good variety of prices, styles, and it's fast." —Planning to have children, Renter*

- *"It's cheaper. I can look at a lot more options than I could I feel like I went to one store. Then there's certain stores like* Ikea*. I kind of know I'm going to be getting something functional that I'll probably like online for a good price." —Participant Focus Group 1*
- *"Starting online go and check stuff out. Once I see something, I may like to see like [it's] status [in store]." —Planning to have children, Owner*
- *"When I go look for furniture online, I look for like a certain… I type in like a certain style that I want." —Parent, Owner*
- *"Nowadays online…10, 12 years ago, in the store." —Parent, Owner*

A few participants, however, expressed that they prefer shopping for products in store versus online. They like being able to see the units in person to assess the quality and size of the unit and drawers. A few participants specified that they like to do initial furniture searches online and then follow up in the store before ultimately making a purchasing decision.

- *"For me, just growing up, my mother used to always go to the store, so I guess maybe now I just like going and touching it and feeling the quality of the wood, that it's durable, and all that." —Planning to have children, Renter*
- *"I feel like it's a lot easier to judge size in person, too. I can read dimensions online, but I'm not going to pull out a tape measure. [crosstalk]" —Planning to have children, Renter*
- *"If it's something I'm in the market for and considering purchasing, yeah, [I go in store]." —Visited by children, Renter*
- *"I like starting the research online, but furniture I rather buy in store." —Planning to have children, Owner*

Additional Stability Information

Next, the conversation shifted to assess whether additional information to verify that a unit meets a certain stability standard would be useful to participants when purchasing a CSU. Some participants reported that they thought this additional information would provide peace of mind and give them confidence in their decision to purchase a specific unit, whereas others said they thought units already go through these kinds of certifications. However, participants without children mentioned that they would only perceive this as useful if they had children to worry about, emphasizing that safety is not particularly important to them at this point in their lives.

- *"I would be more happy to buy it." —Visited by children, Renter*
- *"It's peace of mind."—Visited by children, Owner*
- *"But it also implies quality control [and] that it's been tested in." —Visited by children, Owner*
- *"Yeah, I think I've, I've taken that for granted too, that I'm assuming that it's [already] been tested…" —Parent, Owner*
- *"Yeah, I was going to say, I do because I don't know, I am five-nine, but I also buy tall things because I am tall, and so I'll still have to reach up on things. And I am super prone to climbing on my counters, climbing on everything to get to the top shelves of things, so that would make me feel good even without kids. And then having kids would make that super important."*

—Planning to have children, Renter

- *"I mean, if you have kids it might, but if you don't have kids, I at least don't really care how safe it is. It's not going to hurt me." —Planning to have children, Renter*
- *"But I don't know for me personally if that would make a difference. I don't have kids that stay at my house very often, so when I purchase, I just think about myself." —Visited by children, Renter*

Some parents and non-parents reported that this additional stability information would not affect their purchasing decisions because they would still want to go "test" out the unit in the store for themselves (e.g., test how the drawers open). Further, a few participants reported perceiving that this additional stability information would come from the manufacturer, and they reported that they would not trust the information as a result.

- *"The second part of that is if I'm buying a piece of furniture and I have any worries about that, you can put all the manufacturer details on it you want, I'm still going to open up the drawers and make sure that it's easy opening and it's not going to be rumbling around. You go back to that marketing part." —Visited by children, Owner*
- *"It would depend on who's certifying it. I mean, I subscribe to Consumer Reports and I know they're not the tell-all, but I'm a lot more confident from what they're saying than if it's coming from the manufacturer themselves. And then, even though, as you said, a consumer advocacy or … yeah, whatever you just mentioned. I didn't know that existed, but …" —Parent, Renter*

Participants were asked where they would prefer this additional stability information to be located. Several participants mentioned that they thought that stability information would be best displayed in the direct eyesight of the consumer (such as on the box or on a product display sign). Participants reported that locations such as in direct eyesight of the consumer would be most effective at drawing attention.

- *"Right on the box." —Visited by children, Renter*
- *"I would say if it's in store, then probably note that somewhere on display…A sign or something." —Visited by children, Renter*

Hazards and Risks

Discussion shifted to assess participants' awareness of the general hazards and risks associated with CSUs. The majority of participants reported furniture tipover as the primary risk. Previous experience with tipover, knowing someone who has had a tipover incident, and hearing about tipover-related recalls were all factors influencing this awareness of risk.

- *"So, when we were talking about the kids, I had always thought, I thought that I had learned when I was a kid or something that if the unit is pretty tall and not heavily weighted on the back, if the kid is reaching for an upper drawer or climbing it or something it has the possibility of falling on them." —Planning to have children, Renter*

- *"Ikea had a huge recall on all that stuff. They sent me a whole bunch of mounting units…So they sent people mounting things to mount your dressers to the wall. I was like, 'What is this? I didn't even put this dresser together.'" —Visited by children, Renter*
- *"I know there have been issues, especially with kids that, like, dressers falling over and now I know Ikea tells you have to put all of your furniture to the wall, so they don't get sued. So yeah, that's a consideration." —Planning to have children, Owner*

Hazards or risks that could result in other accidents aside from tipover were frequently mentioned as well. A few participants reported being very aware of sharp edges on CSUs, as well as the risk of shutting fingers in doors and drawers.

- *"Also, shutting your finger in the drawer. You're not paying attention. It's too quick or something." —Planning to have children, Renter*
- *"Sharp corners, glass on the top. I think about my grandchildren, pinching fingers, furniture falling over them snagging their foot or something on like a foot claw or a piece at the bottom, so it's got to be safe." —Visited by children, Owner*
- *"I'm not going to buy something that looks like it could be harmful. I don't know why I keep going back to that, but that sharp edge thing is a big deal to me."
—Visited by children, Renter*

The moderator probed to understand if the hazards and risks that participants mentioned are the ones they take into consideration when purchasing a CSU and placing it in their home. Overall, participants noted that they consider factors such as their perception of unit stability (e.g., test drawers to see how durable they are) and the balance of the unit (e.g., test unit balance to ensure that the unit will not tip over) when assessing risk. Participants noted that these factors are important to consider for their safety and (if applicable) the safety of their children.

- *"You know, they're very heavy drawers and the unit itself is not very heavy, so that's why they fall out. But in the store, I would test the drawer, open it and see what does it look like when they're all out? The one that we have, the drawers are only about that deep, so the drawer is very heavy." —Parent, Renter*
- *"Certainly. You check for the balance, and if it seems like it closes too hard, and there's too much of a danger getting smashed fingers for littles in there… then if there's super sharp corners on it for if the drawers get left open and the kid's running around, that sort of thing. That's a consideration. I mean, there's going to be a drawer that gets left open that someone is going to hit at some point." —Parent, Renter*
- *"And I usually think about hazards, I guess, more it's like sturdiness."
— Planning to have children, Owner*

Being a parent seemed to influence awareness and interpretation of risk. A few non-parent participants reported that they do not really consider hazards and risks regarding CSUs, although some mentioned that they take safety precautions when children come to visit their home. Instead, they are more likely to consider how the product will look, fit, and function in their space. These precautions included shutting doors to rooms with large, heavy furniture, or adding zip ties to drawers of units that might present a risk if pulled.

- *"It could if a child lived there…but I don't think that way just yet because I don't have kids." —Planning to have children, Renter*
- *"Lighter ones and kids are going to be involved it stays in my bedroom or the door stays closed." —Planning to have children, Owner*
- *"All of my furniture and the kid area has handles that I can actually put little zip ties through if I want to close something off for whatever reason. If I'm storing china, or something, they'll have handles that I could easily zip tie, so the kids can get in." —Planning to have children, Owner*

Beliefs Toward Anchoring CSUs

Discussions progressed from hazards and risks to beliefs about anchoring CSUs. Of the few participants who reported anchoring their CSUs, reasons for anchoring included awareness of tipover tragedies and the products used in high-traffic areas. Other participants reported not anchoring CSUs because they do not think the unit is likely to tip over, they rent their home (i.e., do not want to damage the walls), or because it is not required to anchor.

- *"Because [the units are] high use, and they're right in the middle of an area, or accessible. My nephew might come over and come around the corner, and just pull on it or something. But for the ones that are in my closet, I'm not doing it." —Visited by children, Renter*
- *"The stories about the Ikea [recall]… I think it ended up being six cases total. In which, I know there were two fatalities, at least. So, when I saw those, it made me be like, 'Maybe I should look into this.' Because before that, people would send me… The stuff had been there, but I didn't really know, but once I saw those stories about that, like, 'A dresser, even with clothes in it, could fully tip over, or could tip a TV over or something like that.' I was like, 'Okay, we need to…" —Visited by children, Renter*
- *"Yeah. Like the weight of what's in the drawers opening could very well just tip it." —Visited by children, Renter*
- *"My experience was that they weren't encouraged, either. It was like, 'If you want to mount these to the wall, you can.' It wasn't like, 'Hey, if you don't mount this to the wall…' —Visited by children, Renter*
- *"Won't tip over." —Parent, Renter*
- *"I'm a little less… I'm probably not more prone to anchor something into a wall, so that's why I have the dressers that, anything that does store their clothes, or the dresser is in a different room. And in their room, we don't have anything that could fall over, because I just don't want to have to deal with repair the damage of anchoring it in." —Parent, Renter*
- *"I don't anchor it because that way I don't have to worry about repairing damage." —Parent, Renter*

Experience with CSU Tipover

A few participants mentioned that tipover is something they take into consideration when purchasing a CSU. They expressed that they want units that are safe and sturdy in their home (elaborating that these are often shorter, wider units). A participant also reported that they assess the type of flooring that they put the unit on to help determine the tipover risk, reporting that carpeting seems less stable than hard flooring.

- *"It's not coming in the house if it's not safe." —Visited by children, Owner*
- *"Well, I think what she was talking earlier, I think the lower the unit a lower wider unit is much more safe than a tall thin unit. If you've got the chance to have space to do it. They used to call them a single dresser, they were like, and I think to me that is, if I were doing children's rooms now and buying it from scratch, I'd be looking at pieces like that."*
  —Visited by children, Owner
- *"For like a room that has carpeting maybe but other than that I wouldn't."*
  —Planning to have children, Owner

Caregiver status influenced perceptions of tipover risk. Participants in the non-parent groups, mainly non-parents that are planning to have children in the next five years, reported that they would be more likely to take tipover into consideration once they have kids in their home. Tipover risk is not top of mind for them because they are not worried about children interacting with the furniture on a regular basis.

- *"Not until the kids came. Not until things went awry, and then it was like, 'Oh, okay.'" —Parent, Renter*
- *"It's not me. I don't have kids coming over, anything like that. It's just my dog. Mostly adults coming in, so it's not something I really worried about."—Planning to have children, Owner*
- *"I don't really think about that yet, but I would consider it more …because when the doors are open, it can tip."*
  —Planning to have children, Owner

The moderator continued the discussion to assess how participants determine tipover risk and what makes them decide a unit is likely to tip. Participants mentioned that several factors influence their perception of tipover risk. Participants reported physically attempting to tipover a unit in a store, testing the leg structure of a unit to see how stable it seems, adding weight to a unit to see how it reacts, and assessing the drawers and dimensions of a unit to determine if a CSU might be at risk for tipover.

- *"Just checking to see the legs, the leg structure, if it's profile is flush with the floor.... So I don't know what the specifications cut off is, but I think it also just depends on how front heavy, because again, I've had this one before and when I was changing drawers and cleaning things up one time it actually fell forward." —Planning to have children, Renter*
- *"If there's a store display, you try and tip it." —Visited by children, Renter*
- *"The weight of it." —Visited by children, Renter*

- *"Open multiple drawers." —Parent, Renter*
- *"Even like put a little weight on there. I mean, obviously if you open all the drawers, if they're empty, but you can't push too hard, but just a little bit of weight in addition." —Parent, Renter*
- *"Dimensionally, if it's narrow or small, one way and then tall, then it's more likely to tip. But it seems kids can figure out how to go over anything." —Planning to have children, Owner*
- *"Pull on it… lean and then see what it does." —Parent, Owner*

Participants also discussed personal experiences with CSU tipover. More than 20 participants reported that they had some type of experience with tipover, either firsthand or secondhand. Tipover experiences were generally a result of participants (either as adults or children) or their own children climbing or standing on drawers. A few participants also reported instances of hearing about family or friends experiencing tipover due to children climbing or standing on drawers as well. Please see Appendix G for a full list of quotes regarding tipover experiences.

- *"I mean a ball got thrown on top, a friend and I were playing with, and I tried to put a foot on the first shelf and climb up. And I put my hand on the top, and it started to come back." —Planning to have children, Renter*
- *"It was just a giant entertainment system. When I was like 10 or 11, a ball got thrown up there, so I tried to climb and got to the top and got a hand on it. And I was always a big kid, and it started to come down, but then I was tall enough I could drop and hold it." —Planning to have children, Renter*
- *"I had an Ikea piece, again I don't know if it's Ikea, and I was doing the thing you weren't supposed to do. I had two drawers open. I had the bottom…no, I had the middle and the top open. Because I was, I think, sorting my clothes and moving them and cleaning them out, and it actually did tip over and forward and think it either hit my arm or knee or something. So, that did happen, that was as an adult, so." —Planning to have children, Renter*
- *"I was young. I was three or four and I guess at my Grandma's chest of drawers, so it was tall, and I was trying to get to the top and it fell on me. That's where I got this scar right here from it." —Planning to have children, Renter*
- *"So, I told him to grab something from his room, and he opened… I think he must have opened the bottom drawer, and then not found what he needed, and then opened the next one. Then maybe, I don't know if he climbed on it or what, but he came running and I heard a huge bang. He came running out, and he was like, 'Mommy, I couldn't hold it. I couldn't hold it up anymore.' I'm like, 'Oh my gosh, you were holding the dresser up?'… It's a pretty decently tall. It would've hurt him really badly if it hadn't fallen on him, if he hadn't caught it. Really heavy." —Parent, Renter*
- *"When both drawers [of the nightstand] were open, it had … I can't remember what was in it. Something heavy was in it, in the top drawer, and it tipped over. Thankfully it didn't break and nobody was hurt." —Parent, Renter*

Items on Top of Furniture

Discussion then shifted to assess the types of items that participants place on top of furniture and the reasoning behind that decision. Participants commonly reported putting jewelry, lotion, perfumes, picture frames, and TVs on top of furniture. Participants were asked to elaborate on what factors they take into consideration for TV placement. Participants mentioned that they look at the surface of the unit (e.g., Is the surface flat?), the size of the unit (e.g., Is the unit large enough to hold a TV?), and the height of the unit (e.g., Is the TV able to be easily seen?).

- *"Flat surface. Large enough to hold a TV." —Planning to have children, Renter*
- *"Can you see the TV from the bed, too." —Planning to have children, Renter*
- *"I guess one of the high boys… [must be] at least five drawers up [to place a TV on a CSU]." —Visited by children, Owner*
- *"We used to have like just a regular TV stand, but after my one year old was born. It was switched to…I don't know what this is. I guess it's something like that a dresser with a bunch of drawers, but it's really tall so he can't touch the TV and get his little fingerprints all over the screen." —Parent, Owner*

Space and functionality were frequently reported as factors behind why participants decide to place items (especially TVs) on top of CSUs in their home. Participants mentioned that if they have to work with space and layout constraints, placing items such as TVs on top of the CSU (versus having to purchase another item like a TV stand) allows them to maximize space and functionality.

- *"I think it also depends on space. Because the apartment I'm in now is, well I don't. It's, it's not really that small, we just have a lot of stuff. So, a lot of the spaces where I would have made it strictly for decorating is now, it has to be utilized and decorative. So, if I was in a bigger place, then I would just put picture frames or flowers, but instead I'm like, 'Oh, I got to put this thing and this thing and…'" —Planning to have children, Renter*
- *"Functional, instead of having a separate stand or something to put the TV on. Utilizing that piece that holds clothing as well as the TV on top of it." —Visited by children, Owner*
- *"For me, it's all about kind of what is [necessary] in the room. We have a TV in our bedroom, and the only logical place to put it is kind of on top of the dresser, so that's where it goes. The stereo and speakers as well. Then, beyond that, it's more about just … kind of what [NAME] was saying about, it's a workspace, it's a flat horizontal surface. If I'm stacking clean clothes there, I'll do it. If there's space there to be used, I'm using it for something, typically." —Visited by children, Renter*
- *"My daughter has her TV on top of hers, and we talked about putting it on the wall, but she likes to rearrange her room too much, and so it makes more sense to keep it on top." —Parent, Renter*
- "It's functionality. Because at the time our room was pretty small, we [weren't] going to buy another piece of furniture just to hold the TV when the dresser is perfectly fine and stable." *—Planning to have children, Owner*

Participants disclosed that the TVs on their units range from 32 to 60 inches. All participants reported that their TVs are flat screens versus CRT-TVs, and all participants reported that the TVs are on legs or a stand versus leaning against a wall.

CSU Worksheet Activity

After establishing an understanding of the participants' purchasing behavior and how participants define a CSU, participants were given a worksheet that contained eight pictures of pieces of furniture and associated dimensions with each unit. Although the dimensions were provided to help participants understand comparative product size, many participants reported they did not really notice or take the dimensions into consideration when completing the worksheet. As a result, some participants said they perceived these units to be larger or smaller than they actually were because they only looked at the picture. Participants were directed to fill in what they would call the unit, what they would store in the unit, and where they would potentially place the unit within their home. They were then asked to explain their reasoning behind their choices. Results for each product are detailed below.

Unit 1 (62" W x 20" D x 36" H)

Participants typically categorized this unit as a buffet, dresser, and entry/side/hall table. Other participants categorized this unit as an accent piece, chest of drawers, kitchen storage unit, soft table, bureau, and china cabinet. Participants reported that they would place it in their bedroom, front hall, dining room, entryway, hallway, or living room. The legs of the unit, the scalloped bottom, and the items pictured on top of the unit made participants view it more as a decorative piece than a CSU. A few participants reported that if the unit did not have a space between the floor and the bottom drawer, did not have a scalloped bottom, and did not have the decorative legs, they would consider it a dresser. Some participants also said that they perceived that the drawers are too small for the unit to be a CSU. With the notion that this is not a CSU, participants claimed that they would store dishes, silverware, tablecloths, blankets, keys, and candles in this unit. There were various opinions on how to categorize this unit, what to store in this unit, and where to place the unit. This was mainly due to the aesthetics of the unit and the size of its drawers.

- *"So, I put, if you have a dining room, I don't, but if you have a dining room, dining room, and eat-in kitchen, and I also envision that for some reason as an entryway. Sometimes you have that wasted space right next to a door when you open it. I've seen that... I used to see that as an entryway. It was like what people put silverware, serving pieces, tablecloths, games for game night, junk drawers, kid's toys. It could be just a catch-all." —Planning to have children, Renter*
- *"Like I said, I have a very wide dresser, that actually looks a lot like that one. It's got two long drawers and the bottom is where I put tee shirts, shorts, stuff like that. And I mean, I think, the*

setting in the picture has a lot to do with what everyone said. Just my opinion." —Planning to have children, Renter

- *"I think if there had been a TV next to it or like, I could totally see that as a bedroom, like the clothing, dresser as well. But because it's set that way, like I pictured it in my house as an entryway table." —Planning to have children, Renter*

Unit 1 Worksheet Findings

Labels	Items Stored Inside	Locations
Accent Piece (4)	Remotes, paper, toys, keys, batteries, umbrella, knick-knacks, miscellaneous	Living room (2), hallway (3), entryway (1), foyer (1)
Buffet/sideboard (15)	Dishes, silverware, napkins, tablecloths, linens, placemats, candles	Dining room (7), bedroom (4), kitchen (4), living room (4), entryway (3), foyer (1)
Dresser (24)	Clothes, socks, underwear, linens, wash cloths blankets, throws, small jewelry, candles, miscellaneous items, keys	Bedroom (17), living room (6), dining room (4), kitchen (4), hallway (4), office (1)
Entry/hall/side table (6)	Keys, blankets, junk, linen, board games, mittens, scarves, stationary, chargers, dishes, placemats	Entryway (2), hallway (2), living room (3), dining room (1), foyer (1)
Chest/chest of drawers (2)	Clothes, dining room articles	Bedroom (2), dining room (1)
Kitchen storage unit/cabinet (2)	Dishes, linens for table, items for living room or kitchen	Kitchen (2), living room (1), dining area (1)
Other mentions: Sofa table (1), bureau (1), china cabinet (1)	China cabinet: silverware, tablecloths; sofa table: junk; bureau: kids' clothes, pet assortments	China cabinet: dining room; sofa table: behind sofa or hallway; bureau: front hall

Unit 2 (19" W x 15" D x 25" H)

Participants characterized this unit as a nightstand, side/bedside/end table, commode,

kitchen storage, and a small dresser. The participants that identified Unit 2 as a small dresser or nightstand reported that they would store undergarments/socks in this unit. Other participants did not identify this as a CSU because the dimensions of the unit are much smaller than a typical CSU and the drawers are not large enough to store clothing. The small size of this unit made a few participants report this as an appropriate unit for a child's bedroom. Additionally, some participants echoed the sentiments from Unit 1—that the scalloped bottom and skinny legs of the unit make it look like it is more decorative and not as durable for storing large, heavy clothing items. Participants that categorized this unit as a non-CSU reported that they would store chargers, medicines, junk items, jewelry, books, and kitchen supplies in this unit. The participants that identified this unit as a CSU reported that they would place it in their bedroom. Other participants noted that they would place this unit in their front hall, dining room, entryway, hallway, or living room.

- *"I put miscellaneous items in there just things I want to have on my bed. Book, glasses…" —Visited by children, Owner*
- *"And that little one on the front that we couldn't decide on whether it was a bedside table. If you have young children, and they don't stay there long periods of time, that's kind of a child size version of a piece of furniture, so it kind of be like he was saying earlier, you could always put that in closet in a way." —Visited by children, Owner*
- *"I put nightstand/kitchen stand [crosstalk] because I wasn't sure." —Visited by children, Renter*
- *"Maybe double the size [and it could be a CSU]." —Visited by children, Renter*

Unit 2 Worksheet Findings

Labels	Items Stored Inside	Locations
Nightstand (37)	Books, cords, chargers, remotes, electronics, lotion, medication, socks, underwear, batteries, personal items, jewelry	Bedroom (35), bathroom (4)
Side/hallway/entryway/end table (15)	Chargers, batteries, remotes, books, small clothing items, miscellaneous items, wallet, glasses, socks, underwear,	Bedroom (10), living room (7), hallway/entryway (2), kitchen (1)
Kitchen storage/cupboard/table (5)	Small items, kitchen supplies, utensils, household items	Kitchen (4), living room (1), closet (1)
Small dresser (1)	Undergarments	N/A

Unit 3 (52" W x 16" D x 35" H)

Participants categorized Unit 3 as a dresser, entertainment unit, TV stand, media cabinet, armoire, and buffet. In contrast to units 1 and 2, when reviewing Unit 3, participants reported that the solid bottom makes it appear sturdier than the ones with scalloped bottoms and skinny legs. As a result, participants said they would be more likely to classify this as a CSU and store heavier clothing items in this unit. Participants further elaborated that since there is a TV pictured on top of the unit, they would most likely place this unit in their bedroom, children's room, living room, or den. Participants reported that the TV in the picture also led them to believe that this unit could be used to store clothes, toys, crafts, cables, cords, video games/DVDs, and electronics.

- *"The double dresser was an original probably, but they're also using them for buffets now. The fact that it's been painted means that it's been refurbished…It's been repurposed for something else cause it looks exactly like the unit that my son bought and then one thing they did is they took one of those sets of drawers out and put baskets in it and they have that in their family room with all the kids gaming systems fit in the drawers and all that stuff." —Visited by children, Owner*
- *"I was just influenced by the fact that there was a television on it. I could have made it a cabinet." —Visited by children, Owner*

- *"The fact that there was a TV on it kind of accentuated [crosstalk] the fact that it was a dresser and makes it feel like it's in someone's bedroom." —Visited by children, Renter*

Unit 3 Worksheet Findings

Labels	Items Stored Inside	Locations
Dresser (40)	Clothes, undergarments, linens, socks, pajamas, everyday clothes, shirts, pants	Bedroom (34), kid's room (2)
TV stand/media cabinet/entertainment stand (14)	Movies, games, cables, CDs, toys, remotes, gaming consoles, electronics, TV accessories, remotes	Living room (9), family room (1), den (3)
Armoire (2)	Sweater, pants, clothes	Bedroom (2), den (1)
Chest of drawers (2)	Clothes, jewelry	Bedroom (2)
Accent piece (1)	Miscellaneous items (not clothes)	Den (1)
Buffet (1)	Dishes, linens	Family room (1)

Unit 4 (32" W x 16" D x 30" H)

The next unit on the worksheet was collectively categorized as a nightstand or a side/end

table, although a few participants reported it as a dresser, bureau, buffet, or lingerie chest. The small size of the unit and the few shallow drawers were two factors that led participants to report that they would place this unit in their bedroom and only store socks and undergarments in this unit. As expressed with many other units, the legs of this piece also impacted perceptions. Participants noted that the decorative, skinny legs make the unit feel as if it is not made to store clothing. A few participants reported that they would place this unit in their living room and specified that they would store books, junk, or miscellaneous items in this unit. Other participants noted that they would place this unit in their dining room, kitchen, or children's bedroom.

- *"And, I was thinking almost the buffet in the dining room…" —Visited by children, Owner*
- *"In my home, I don't have a formal dining room, but if I did, that would probably go there for me. Because that's what first popped in my head when I saw it." —Visited by children, Owner*
- *"[This belongs] next to your bed." —Parent, Owner*

Unit 4 Worksheet Findings

Labels	Items Stored Inside	Locations
Nightstand/beside table (39)	Clothes, underwear, socks, lotion, junk, medicines, cosmetic	Bedroom (38), living room (3), bathroom (1), hallway (1)

	products, chargers, books, knick-knacks	
End table (4)	Small items, remotes, electronics junk, makeup	Bedroom (4), living room (2)
Dresser (2)	Anything, kids' clothes	Bathroom (1), bedroom (1) kid's room (1)
Others: Bureau (1) lingerie chest (1)	Bureau: Batteries, cords, kitchenware; lingerie chest: lingerie	Bureau: Dining room or kitchen; Lingerie chest: bedroom

Unit 5 (17.75" W x 12" D x 35" H)

All of the participants labeled Unit 5 as some form of a storage unit. The various storage labels

included storage shelves, storage unit, storage basket, cubby storage, storage bins, and storage drawers. With this unit categorized as some form of storage, participants reported that they would store toiletries, towels, washcloths, laundry, food, linens, toys, and lightweight clothes (e.g., socks, gym clothes). Since this unit is narrow and lightweight, participants reported that they would only store small, lightweight clothing items in it. Overall, participants reported that they would place this unit in their bathroom, kitchen, pantry, laundry room, kid's room, or playroom for storage.

- *"I said bathroom storage too, because I would see this because I always see that as bathroom storage, and I've seen children's clothes stored like this." —Planning to have children, Renter*
- *"[I did report storing clothing in this] because if you look at this if you got a tall enough closet, you could almost put this in your closet and put your clothes in there, that will help utilize your space." —Visited by children, Owner*

Unit 5 Worksheet Findings

Labels	Items Stored Inside	Locations
Bathroom storage/bathroom shelves (7)	Makeup, washcloths, soap, towels, toiletries	Bathroom (7)
Variations of generic storage labels: Storage bins/storage shelves/storage unit/storage baskets/cubby storage, etc. (30)	Clothes, toiletries, towels, linens, anything lightweight, laundry, pantry items, food, games, junk, knick-knacks, toys, crafts	Bathroom (12), kitchen (7), closet (6) laundry room (4), living room (3), kid's room (2)
Laundry/linen/towel storage (5)	Towels, blankets, toiletries, laundry, linens, health and beauty products	Bathroom (4), closet (2), laundry room (2)

Unit 6 58.2" W x 21" D x 82" H

Participants came to a general consensus that this unit would not be categorized as a CSU due to the glass doors. Because participants said that glass doors are typically used to display items, participants instead categorized this unit as a china cabinet, chest, or armoire. Participants reported that they would not store clothes in this unit even if the glass were frosted. After completing the worksheet, participants were asked if they would store clothes in this unit if the glass were replaced with wood doors. Participants responded that they would be more likely to categorize this unit as an armoire or wardrobe if the doors were wood. China, glassware, dishes, plates, tablecloths, cases, and alcohol were items that participants said they would ideally store in this unit. Participants reported that they would put this unit in the dining room, living room, or kitchen.

- *"The whole point of having glass is to be able to see through it. If you frost it, you might as well just have wood there. It's like, you don't want people seeing your clothes, so if you're using it as a clothing storage unit, you've just got eight panels of giant glass in your room that you don't necessarily need…" —Visited by children, Renter*
- *"[If the glass was wood] it'd be like a…armoire." —Parent, Renter*

Unit 6 Worksheet Findings

Labels	Items Stored Inside	Locations
China cabinet (32)	China, glassware, plates, serving platters/pieces, dishes, vases, delicate/fancy/antique items, tablecloths, books, pictures	Dining room (25), living room (3), den (3) kitchen (2), bedroom (1)
China hutch/hutch (4)	Dishes, glasses, serving pieces, knick-knacks, china	Dining room (4), kitchen (1)
Cabinet (4)	Plates, decorative items, china, crystal to display, pictures, teacups	Dining room (4)
Armoire (2)	Plates, bowls, kitchen stuff, china, glassware	Dining room (2)
Buffet (1)	Dishes, plates	Dining room (1)

Unit 7 (34" W x 12" D x 33.25" H)

Participants categorized this unit in various ways, but the majority of participants did not

categorize this as a CSU. However, a few participants viewed this as an appropriate unit to store bulky clothing items (e.g., sweaters and sweatshirts). The general perception was that this could be a cabinet, TV stand, accent piece, chest, or vanity. A few participants said this could be categorized as a dresser wardrobe or armoire. However, they did not indicate that they would store clothing in it even if categorized this way. Since the unit only has two drawers and two bigger cabinet-like doors, participants reported that they would store TV/electronic items (e.g., cable box, DVDs), kitchen items (e.g., silverware, servicing pieces, cookbooks), and bathroom items (e.g., towels, washcloths) in it. The few participants that reported the unit as a dresser noted that they would store clothing in it. Participants noted the ideal placement of this unit in their home would be in the kitchen, bathroom, and bedroom (if using for media purposes).

- *"Well, I've seen that done with a microwave oven sitting on top of it. Years ago they would've done that for it, but I'm assuming that when you open those, cabinet their shelves, which that piece would be great to put sweaters, sweatshirts, those kinds of bulky things that take up way too much room in a drawer." —Visited by children, Owner*
- *"I put nightstand or vanity because it looked like a vanity missing a sink." —Parent, Owner*

Unit 7 Worksheet Findings

Labels	Items Stored Inside	Locations
Cabinet (11)	Tupperware, kitchen utensils, cleaning supplies, towels, makeup, dishes, games, electronics, movies	Living room (4), dining room (3), kitchen (3), bathroom (1), den (1), game room (1)
TV stand/cabinet (8)	Games, cables, movies, DVDs, keys, remotes	Living room (4), bedroom (2), den (1)
Accent/occasional/entryway piece or table (6)	Books, games, dishes, keys, miscellaneous items (not clothes)	Dining room (2), hallway/doorway (2), study/office (1), kitchen (1)
Side table/sideboard (4)	Remotes, games, party supplies, wine/liquor/alcohol	Living room (2), dining room (1), kitchen (1), bar (1)
Nightstand (4)	Books, games	Bedroom (1), living room (1)
Storage (3)	Bathroom supplies, TV stuff, glasses	Living room (1), bathroom (1)
Kitchen storage/hutch/drawer (3)	Serving pieces, silverware, utensils	Kitchen (3), dining room (1), entry way (1)
Dresser (2)	Cable box, TV items, clothes, towels	Living room (10), bathroom (1), bedroom (1), family room (1)

Vanity (2)	Towels, clothes, cleaning products	Bathroom (2), bedroom (2)
Others: Wardrobe (1); Armoire (1)	Wardrobe: media; armoire: blank	Wardrobe: Den (1) Armoire: Dining room (1);

Unit 8 (26" W x 20" D x 30" H)

The final unit on the worksheet was identified among participants as some sort of CSU.

Participants reported that because of the smaller size of the unit, it would be used as a unit for a child, as the height of the unit makes it easier for children to access drawers independently. Further, participants labeled the unit as a dresser, kid's dresser, bedside storage, and nightstand. However, only two participants reported this unit as a nightstand, whereas the rest of the participants viewed it as a dresser mainly due to the number of drawers. Participants reported that they would store clothes, socks, undergarments, pajamas, and kid's clothes in this unit. Lastly, participants noted that they would place this unit in a bedroom, kid's bedroom, guest room, or a closet.

- *"I'm thinking more than two or three drawers is a dresser. That's what I'd say." —Planning to have children, Renter*
- *"That could work for kid's clothes…The size. It's small." —Visited by children, Renter*
- *"[I would store kid's clothes, because the unit is] small enough for it." —Parent, Renter*

Unit 8 Worksheet Findings

Labels	Items Stored Inside	Locations
Dresser (25)	Clothes, undergarments, socks, underwear, pajamas, books, small things, kid's stuff	Bedroom (19), kid's bedroom (2), guest room (1)
Kid's dresser (4)	Kid's clothes, toys, small clothing, socks	Kid's room (2), guestroom (1), office (1), garage (1)
Small dresser (4)	Clothes, socks, underwear, gym clothes	Bedroom (3), closet (1)
Chest of drawers (3)	Clothes	Bedroom (3), closet (1)
Nightstand (2)	Miscellaneous items (not clothes), pens, paper, socks	Bedroom (2)
Others: Jewelry box (1); organizer (1); small bedside storage hutch (1)	Jewelry box: Jewelry; Organizer: jewelry; Storage hutch: socks, chargers, knick-knacks	Jewelry box: bedroom; Organizer: closet; Storage Hutch: bedroom

Warning Labels

Noticing Warning Labels

Next, focus group conversations shifted to warning labels. About half of the participants reported that they had never noticed a warning label on a CSU, often mentioning that even if they had seen one, they probably had not paid attention to it. Of the participants who had mentioned seeing a warning label, only a few actually reported that they had read it. Several participants said they did not recall reading it fully or perhaps looked at it once and never again after that.

- *"Don't think I've ever paid attention to it, but I've probably seen it."* *—Parent, Renter*
- *"[I] literally [do] not [read the warning label]." —Planning to have children, Owner*
- *"I think if I had kids, I'd be more prone to it. But I literally don't [look at] warning [labels]." —Planning to have children, Owner*

Many participants described the purpose of warning labels as a way for manufacturers to protect themselves from liability or as an additional assembly step that consumers must take once they purchase a piece of furniture (e.g., installing anchors).

- *"But when the hang tag, the purpose of the hang tag [is to] tell the consumer that's purchasing a piece of furniture, there's going to be an additional step required. So, before I even think about purchasing that piece of furniture, the hang tags let me know this is going to require a tipover restrain." —Visited by children, Owner*
- *"I feel more like the company's trying to cover themselves. So, I'm going to use it for whatever purpose I want to use it for, and I may just not have it in my kid's room, though we do have one in my child's room but he's fairly… I mean, he's five, but he's like a mature five, kind of. Like if I tell him not to touch it…and also it has fallen, so he knows what's going to happen, so he won't mess with it now. He knows, I don't touch the dresser, and then he tells his friends, 'Don't touch the dresser.'" —Parent, Renter*
- *"Yeah. I've seen it on a long one, but then that's when you feel like the company's just trying to cover themselves. You feel like [it] doesn't really mean anything because they just don't want to get in trouble for something falling and hurting somebody."* *—Parent, Renter*

Participants were asked to describe the content of the warning labels they remembered seeing. Participants reported that common warning label content includes potential choking hazards for small pieces, anchoring furniture to prevent tipover, minimizing child play around furniture to prevent an accident, and discouraging climbing on furniture to prevent tipover.

- *"I've seen choking hazards, in case there's some, like you have little screws or little pieces you need to assemble it with. Don't allow children near this, in terms of choking hazard. Stuff like that." —Planning to have children, Renter*

- *"Well, different chest of drawers, items like Ikea indicate you should anchor this to the wall to prevent injuries." —Visited by children, Owner*
- *"It's usually about not letting kids play with it because it's dangerous." —Visited by children, Renter*
- *"Caution, tipping. Tipping hazard, something like that." —Parent, Renter*
- *"Yeah, at the end of the instructions, it would say anchor it." —Parent, Renter*
- *"I think it was, I think it was like a sticker that had like a kid and like a picture of the unit falling down on them." —Parent, Owner*

Location of Warning Labels

Participants were also asked to discuss the most prominent locations where they have seen warning labels. The most commonly mentioned locations were the back of furniture, the top drawer of a unit, the unit packaging/box, or the unit's instruction manual.

- *"I always feel like I saw it on the back, but maybe I'm thinking another piece, but I always feel like I saw warning labels or any information on a piece on the back." —Planning to have children, Renter*
- *"It was on the right side of the top drawer." —Planning to have children, Renter*
- *"Or on the box. Or the underside." —Planning to have children, Renter*
- *"Stickers on the backs of cabinets often do." —Visited by children, Owner*
- *"Sometimes the back panel that you attach afterwards already has the stickers on it." —Visited by children, Owner*
- *"I've seen one inside a drawer before." —Parent, Renter*
- *"In the instructions themselves for insurance." —Parent, Renter*

Warning Label Placement

Discussions progressed to assessing participants' perceptions of acceptable and unacceptable places to put warning labels. Top of the unit in the corner, on the handle of a unit, inside the top drawer of a unit, or in the instruction manual were all mentioned as acceptable places for warning labels. These label locations were deemed acceptable locations because they can be easily seen and are more likely to grab one's attention.

- *"Yeah, I think that if it's this, like the corner right here. Because then you can still see the full piece without the sticker on it from the front, but then on the top it's clearly visible to you. Unless it's a really tall, like taller than the average person because then you can't see it." —Planning to have children, Renter*
- *"On the handle, like on a plastic tie thingy…Well, it's right in your face and then you can just cut it off when you get home, and then it's up to you whether you keep it somewhere or just trash it." —Planning to have children, Renter*
- *"I would think on [the] outside [of] the drawer or maybe something that's got a lot of color right there where you're walking up to the furniture and seeing it not behind it or in a drawer." —Visited by children, Owner*
- *"And if you are going to put it in the box, separate it from the instructions."*

—Visited by children, Renter

- *"Top drawer…It's the drawer most likely to be opened." —Visited by children, Renter*
- *"I think the drawer made sense because I mean, one of the warnings is specifically about how you load the drawers." —Planning to have children, Owner*
- *"Some type of removable sticker on the item or a major part of the item that you're going to see that you're going to have to remove that. So, you're going to have to look at it." —Parent, Owner*

Next, participants discussed unacceptable places for warning labels. Participants expressed that putting label stickers on the outside of a unit (particularly on the top) that leave a residue when it is peeled off is unacceptable. Additionally, they said that the back of a unit is also unacceptable for sticker placement because it will not be visible.

- *"Well. Not on a sticker that's going to be a pain to get off and then it leaves a residue and you're upset. I know that sounds wrong, but…" —Planning to have children, Renter*
- *"I think some are, some aren't. Some people said they've seen them on the back or under and that's completely useless. They're facing towards the wall. You're not really looking under it. In my case, when I saw it on the inside, I think if someone really wants to pay attention to the warning label then it's a really good place because, like I said, you're eventually going to have to open that top drawer." —Planning to have children, Renter*
- *"On the bottom or back of dressers." —Visited by children, Renter*
- *"The top, the front, or even the bottom…Because then you have to take it off and it gets stuck." —Parent, Renter*

Warning Label Activity

To assess perceptions, attitudes, and behaviors toward warning labels specific to CSUs, participants were given an example CSU warning label to examine. A few participants noted that they had seen a label like this before. Additionally, several participants mentioned that they would assume that the piece of furniture was of low quality after reading all of these warnings. They said it seems like the piece of furniture would not be able to sustain day-to-day use and could fall apart easily. Lastly, a few participants reported that they firmly believe that warning labels only exist so that furniture manufacturers can protect themselves from liability.

- *"To me this label just says this product is unsafe, don't buy it." —Visited by children, Owner*
- *"I've seen it before." —Parent, Renter*

- *"Honestly, also, this label makes me think that this is really low-quality furniture, because, no, but hear me out. Because the only things in my apartment that I have placed the heaviest on the bottom is literally bookcases where the shelves are falling apart or units, I have these units that are super wobbly, so I place the heavy things on the bottom. I don't do it for the quality furniture I have." —Planning to have children, Renter*
- *"It almost makes you feel like you are buying a subpar product that is not going to stand up to the rigors of everyday use." —Visited by children, Renter*
- *"Like if they're having to put the disclaimer on it, it's obviously not the sturdiest piece of furniture that's out there, because not all dressers have this." —Visited by children, Renter*
- *"I feel more like the company's trying to cover themselves. So, I'm going to use it for whatever purpose I want to use it for, and I may just not have it in my kid's room, though we do have one in my child's room but he's fairly … I mean, he's five, but he's like a mature five, kind of. Like if I tell him not to touch it … and also it has fallen, so he knows what's going to happen, so he won't mess with it now. He knows, I don't touch the dresser, and then he tells his friends, 'Don't touch the dresser.'" —Parent, Renter*

Similar to behaviors related to anchoring furniture, a few non-parents who plan on having children in the future and a few non-parents who are regularly visited by children ages 12–72 months reported that they thought they would be more likely to pay attention to the warning label if they were to have children in their home.

- *"I say I wouldn't [pay attention to this label] unless I was buying children's furniture." —Planning to have children, Renter*
- *"It depends if you have kids or not." —Visited by children, Renter*
- *"Well it all depends. If it's a piece of thing going in my bedroom and nobody else is going to be doing it, I might glance at it and peruse it. But if it's one that's going to go in a child's room and I see, 'Oh there's a child,' then I might spend more time on it." —Visited by children, Owner*

Line-by-Line Assessment

Participants read through the warning label line by line and were asked for their perspectives and opinions on the content. The following sections detail the results from this activity.

"Children Have Died from Furniture Tipover"

The first line that participants read was, "Children have died from furniture tipover." There were mixed reactions to this line. Some participants said that the idea of a piece of furniture potentially killing a child would deter them from wanting to read the label further or to buy the piece of furniture. A few participants expressed that this line was overly dramatic. Alternatively, a few other participants said they appreciated the harsh statistic and reported that this information would make them want to adhere to the label.

- *"I also think that the placement of the first sentence. If there was somehow a way to place it where furniture tipover completed that sentence, because right now the top four words are 'Warning, people have died from' or 'Children have died from,' so you're instantly like, 'Oh my*

God, they died.' And I think that is the most deterring part about it." —Planning to have children, Renter

- *"Well it is a red warning. So, it's not going to sugar coat it. It's going to tell you the good, the bad, and the ugly right away, because they don't want to write a whole journal or just want to tell you short." —Visited by children, Owner*
- *"Oh, I would definitely comply with the warning label when I saw that." —Visited by children, Owner*
- *"I mean, it makes sense that it's the very top and it's in bold letters." —Planning to have children, Owner*

"ALWAYS Install Tipover Restraint Provided"

The next line "ALWAYS install tipover restraint provided" resulted in similar responses among participants. The majority of participants reported that they do not usually adhere to this instruction. If the tipover restraint is not already included, motivation to install it would be low. Furthermore, a few participants noted that installing a restraint to prevent tipover is another line the manufacturer added to protect themselves from liability.

- *"[People are] never [adhering to this warning]." —Parent, Renter*
- *"I think [people are] probably not [adhering to this warning] very much if it's not included with the product." —Parent, Renter*
- *"And again, I think if it's saying that it requires tipover restraint, I think that's something on the manufacturers side that has changed, not on our side. I feel like it should be designed heavy enough on the thing itself that you shouldn't have to restrain it to the wall."*
  —Parent, Renter
- *"The line about installing it to pull a restraint. Like I've personally never done anything like that. But if it was maybe a different color or I probably would've zoned into it a little bit more and think, 'Oh, this might be something I need that I could do. Can I do this on my own or is it something that I'll need some help?' You know, I would want to know, like you said, maybe being able to see a video. Is this something I'd be able to do on my own or am I going to have to get someone else to help me do this? Will I do it right." —Parent, Owner*

"NEVER Put a TV on This Product"

The next line of the warning label, "NEVER put a TV on this product," elicited a range of feedback from participants. Several participants expressed that they would want to know the reason they should not put a TV on top of the product, although a few participants mentioned that they would adhere to the label to prevent injury. Additionally, a few participants mentioned that people will likely disregard this warning if putting a TV on top of a CSU fits their space and layout needs. Similar to other sentiments expressed in the non-parent groups, a few non-parent participants who plan on having children and a few non-parent participants who are regularly visited by a child reported that the warning is something that is irrelevant to them, since they do not have children.

- *"I'm little bit more concerned about, I mean at this point in my life... I want to put a TV there, why can't I? I don't know, [if] that's what... would make me not buy it."*
  —Planning to have children, Renter
- *"Nobody I know would follow that." —Planning to have children, Renter*
- *"I would follow it. I don't have a TV in my room either, but even if I wanted to, I would just follow it because I also have anxiety and I'd be like, 'Well, is it going to like fall over in the middle of the night?'" —Planning to have children, Renter*
- *"If they need a TV in the room, they're going to put it where they want it. They're not going to do that." —Visited by children, Owner*
- *"Don't do it if there's more impact. You're saying, 'Never put a TV on it.' People are like, 'All right, well why? What's going to happen?' You were spelling it out, TV may fall on a person."*
  —Visited by children, Owner
- *"I'm going to say people are probably going to disobey that. Because again, I think you spoke about people have a vision for what they want to use the product for. And they'll say, 'Well, that's okay. Yeah, it'll be fine.'" —Visited by children, Owner*
- *"Especially, if you don't have children in the house. I think nowadays people with children and grandchildren. Probably spend a little bit more attention. Well, opposed to when my children [were] growing up, we put TVs on top of dressers and like I said earlier, now if I ever get a grandchild or something I wouldn't." —Visited by children, Owner*

"NEVER Allow Children to Stand, Climb, or Hang on Drawers, Doors, or Shelves"

Participants reviewed the line, "NEVER allow children to stand, climb, or hang on drawers, doors, or shelves." The majority of participants reported that this line seems like common sense, but they figured it is something that is required to be included. Most participants (parents and non-parents) reported they do not condone this behavior because of its obvious safety implications.

- *"Because you wouldn't allow them, but that doesn't mean that they wouldn't do it."*
  —Visited by children, Owner
- *"If you've ever had a kid, you can't [crosstalk]. No one is allowing them to use the furniture as a jungle gym." —Visited by children, Renter*
- *"I think, as a consumer, we know this is jargon that has to be said because of liabilities."*
  —Visited by children, Renter
- *"Right, but we know, to an extent ... obviously ... not to let children climb on furniture, so this verbiage doesn't do anything for me, but I do know as a consumer, they have to do this. So, it doesn't bother me anyway." —Visited by children, Renter*

"NEVER Open More Than One Drawer at a Time"

The next line that the participants reviewed was, "NEVER open more than one drawer at a time." The majority of participants mentioned that they have a habit of opening multiple drawers at a time when using a unit because they are often grabbing multiple items. Participants also reported that a child within the home typically opens one or two drawers at a time and it always tends to be the bottom drawer of a unit. Similar to reactions from the first line of the warning label, many participants noted that this line suggests that the unit must be low quality. They reported that, if a unit cannot withstand having two drawers open, then that is a fault of the manufacturing versus unsafe usage.

- *"I think it's a subconscious thing to open multiple drawers." —Planning to have children, Renter*
- *"Pretty easy, but I mean I also feel like if you can't open more than one drawer, that's kind of pretty [expletive] craftsmanship." —Parent, Renter*
- *"[The child usually opens] one or two [drawers at a time]." —Parent, Renter*
- *"It's going to tipover. It's not very sturdy." —Parent, Owner*
- *"It doesn't really add the benefit of the product. Because what if I had to open all the [drawers] because I'm looking for something." —Parent, Owner*

"Place Heaviest Items in the Lowest Drawers"

The last bullet of the warning label that participants analyzed was, "Place heaviest items in the lowest drawers." Once again, participants mentioned this line was common sense. The majority of participants noted that putting larger items in the bottom of the CSU and lighter items in the top is a habit that they have been practicing since they were young. In addition, there was consensus among participants that since this is perceived as common sense, most consumers would adhere to this warning.

- *"That's what I was going to say. Reading that would make me, because it's not something I'm cognizant of all the time. I'm just storing things." —Visited by children, Renter*
- *"I currently do, just … I think it's just habit, because my parents used to put all the jeans in the bottom drawer, so now I put all the jeans in the bottom drawer." —Visited by children, Renter*
- *"Yeah, that was just common sense." —Parent, Renter*
- *"Top heavy things fall over. Bottom heavy things stay up." —Parent, Renter*
- *"I think a lot of people will do that." —Planning to have children, Owner*

"This is a Permanent Label. Do Not Remove!"

The final line of the warning label reads, "This is a permanent label. Do no remove!" Several participants mentioned that if the label were in a less obvious spot, they would be agreeable to leaving it on the unit. However, some participants mentioned that they would want to remove the label if it were located somewhere that is easily visible, thus detracting from the visual appeal of the unit.

- *"If it's hard to get them off and they're completely out of sight [crosstalk] then I'll leave them." —Visited by children, Renter*
- *"If it's not easily visible, it's not usually an issue, but for me, it's also … if it's really stuck on there and it looks like it's not going anywhere, don't mess with it. If it looks like it's barely hanging on and has already come half unstuck, you might as well finish unsticking it." —Visited by children, Renter*
- *"[I will remove the warning label if it is in a place] where I don't want to see it." —Visited by children, Renter*
- *"I don't take it off unless it's like where you can see it all the time." —Parent, Renter*

Additional Information and Formatting Changes

Participants reported various recommendations, including additional content and formatting changes that would be effective. The suggested recommendations ranged from wording changes to make the warning less aggressive and reformatting the label to increase the spacing to adding additional images for easier comprehension. Additionally, participants reported that although they often receive anchoring kits with products, they are not always sure how to install them. As a result, participants expressed this would be helpful to include in labels as well. Participant recommendations included:

- Replace "NEVER" with either "Do not" or "We recommend."
- Put the pictures on the bottom of the warning label to increase space between the bullets.
- Increase the size of the warning label to make it more eye-catching.
- Add a picture that shows the unit anchored to the wall.
- Highlight "ALWAYS install tipover restraint provided" to increase the likelihood that consumers will read that line and carry out that action.
- Include information about how to install anchors.
- Use different colors to make it stand out.

Hang Tags and/or Removable Stickers

When prompted with the idea of a hang tag or a removable sticker to feature the additional information noted above, more than half of the participants reported that they would prefer a hang tag. They reported that a hang tag would be easier to remove and would not leave residue on the unit. However, a few participants noted that they would prefer a removable sticker instead of a hang tag. Participants noted that a removable sticker is a good option to place in spots where a potentially risk behavior might take place (e.g., put a removable sticker on top of a unit where a consumer may put a TV).

- *"A hang tag or I just don't like the stickers on the furniture." —Visited by children, Owner*
- *"Yeah, especially as a removable sticker. I think that's a good option. Put it somewhere where … Like, if it says don't put a TV on it, put it right where the people would have to put the TV, but it's easy to take off. Don't make me have to scrape through your paper to get it off. Good plastic stickers that come right off." —Visited by children, Renter*
- *"Hang tag, because I can just cut it right off." —Parent, Renter*
- *"If it was a removable label, it could just be like right on top."*
  —Planning to have children, Owner

In addition to the formatting and wording changes, participants reported an assortment of additional information they would like to see included on the warning label. Recommended additional information included:

- Cleaning instructions for the unit.

- Weight of the unit, the max weight that the top of the unit can hold, and the max weight that each shelf can sustain.
- Dimensions of an acceptable TV that can be placed on top of the unit.
- Reasoning behind why it is recommended that TVs should not be placed on top of the unit.
- Additional references at the bottom of the warning label for consumers to use (e.g., link, QR code) that show how to install the anchors.
- Unit material (e.g., wood, plastic).

Overall Effectiveness of the Warning Label

Finally, participants discussed whether they thought the CSU warning label would be effective in preventing furniture tipover. Participants reported that if a consumer were to actually read the entire warning label, it would be effective, yet about half of participants expressed that they had never come across a warning label previously, and only a few participants reported ever reading an entire warning label. By reading the entire warning label, participants reported that the consumer would have enough information to know that if they do not adhere to the warning, then the consumer is taking their own risk. Additionally, a few participants reported that labels are not attention-grabbing and that consumers are not reading the labels, and, therefore, they would not be effective no matter the content.

- *"Pretty effective…I think it grabs you with the first sentence saying, 'Children have died from furniture tipover.' You want to make sure that, within your control, that it never happens while you own it." —Planning to have children, Renter*
- *"Nobody reads the terms and conditions, you know?" —Visited by children, Renter*
- *"Very preventable because it tells you, like, 'Don't put a TV on this,' so if you put a TV on it …you're taking your own risk." —Parent, Renter*
- *"I think that's kind of on the purchaser. It's on you, how do you use it and how do you prevent it from tipping over." —Parent, Renter*
- *"Pretty effective if people read it." —Planning to have children, Owner*

Emergent Theme

Perceived Susceptibility of Risk

Participants in the focus groups also had varying perceptions of susceptibility in regard to tipover risk. Many participants (both parents and non-parents) reported believing that because they have purchased units they perceive as "durable," "high quality," or "child friendly," they are less susceptible to furniture tipover. Participants reported perceiving units with solid bottoms as more stable for storing clothing (compared to unit with skinny legs). As a result of taking these factors into consideration to determine whether the furniture is safe, participants are less likely to read and adhere to warning labels and take steps to anchor their furniture.

Looking into the differences between parents and non-parents, it is apparent that non-parents who are regularly visited by children and non-parents who are planning to have children disassociate themselves with tipover risk, since they do not have children in their homes. When asked questions about their perceptions of tipover risk, they almost exclusively deferred to discussing how risks are more existent when children are in the home.

- *"For me… I don't have kids coming over anything like that. It's just my dog. Mostly adults coming in, so it's not something I really worried about." —Visited by children, Renter*
- *"I don't really think about that yet…." —Planning to have children, Owner*
- *"I think if I had kids, I'd be more prone to it. But I literally don't pass the warning [label]." —Planning to have children, Owner*

Although there was a higher proportion of parents who reported anchoring their furniture, their overall perception of risk appeared low. Many parent participants reported that they know items should be anchored, but they either never got around to actually installing the anchoring kits, they did not know how to, or they felt it was unnecessary, because they monitor their children.

- *"Not until the kids came. Not until things went awry, and then it was like, 'Oh, okay.'" —Parent, Renter*
- *"My wife had bought it. A couple of those, like… Where you put the baskets in? I mean, I wouldn't call them clothing storage units. We picked the baskets for like toys and stuff in it, but it came with a bracket and I never installed it." —Parent, Owner*
- *"Yeah. There's almost always somebody, there's always somebody watching the kids, like the ways that our house is, it's just, yeah." —Parent, Owner*
- *"I didn't think it was necessary." —Parent, Owner*

Most interesting to note was that several participants in the focus groups reported that they had experienced tipover (either themselves or their children), yet they did not report taking tipover hazards and anchoring into serious consideration. It is important to recognize that participants did not perceive tipover as a pertinent risk, leading them to pay less attention to instructions and warning labels.

Chapter 3: Conclusions and Discussion

Conclusions

Overall, participants considered items such as dressers, armoires, closets, and storage bins to be clothing storage unites (CSU). Distinguishing features that participants identified for CSUs included anything that holds clothes, organizes clothes, or has drawers. Additionally, during focus group discussions, the number of drawers also came up as a distinguishing feature of a CSU. Responses regarding the number of drawers to be considered a CSU varied across groups. Some participants reported that three or more drawers would be considered a CSU, whereas others said that to be considered a CSU, a unit only needed to have one drawer. Several other participants also mentioned that they generally consider two or fewer drawers a nightstand. Additionally, the size of the drawers was mentioned as a distinguishing factor as well. Larger, deeper drawers were included in discussions of CSUs, whereas narrower, more shallow drawers were often included in nightstand discussions. For the focus group worksheet activity, features such as the legs and the bottom of a product also came up as features participants often consider when classifying something as a CSU. For several of the eight products listed on the worksheet, participants were more likely to classify something with a solid bottom as a CSU. There were mixed opinions in regard to the leg style of other units, including some participants who said they thought that skinny legs disqualified units from being a CSU and others who said they thought that the skinny legs might make the piece more multi-functional (e.g., could be used as a dresser or accent piece). However, in these instances, there were still subsets of participants who disregarded the legs and classified the product as a CSU.

Additionally, several participants reported storing small clothing items in nightstands, although they would not formally consider a nightstand to be a CSU. During the ethnographies, although participants reported that their children do not climb on CSUs in the home, several participants reported that their children stand on or jump off of nightstands. Interestingly, none of the participants in the ethnographies had anchored their nightstands. They reported that since the nightstands are short and light, they pose less of a risk. This sentiment was echoed for other small units as well. Participants often mentioned that shorter, smaller, and lighter units pose less of a risk; therefore, they are likely to put them in children’s rooms. On the other hand, a few participants had anchored dressers and armoires instead, citing that they know these units can pose tipover risk. Overall, the majority of participants did not anchor any of their furniture. During the focus groups, a larger proportion of participants reported that their children have climbed on CSUs in their homes (typically including stepping on drawers). This difference could be attributed to sampling a larger number of participants during focus groups, thus increasing the chance of someone’s child interacting with CSUs. Both focus group and ethnography participants minimized tipover risk by mentioning that they monitor their children on a regular basis and, therefore, can stop risky behavior before it begins.

Also of note, several participants in the focus groups reported having experienced some type of tipover—either on themselves, loved ones, or on their children. Participants who experienced tipover generally reported that there were no major injuries associated with it, aside from one participant who knew of a tipover death that occurred. Participants' overall perceptions of susceptibility to tipover hazards and risks were low. As a result, several participants mentioned that they are unlikely to read and/or adhere to warning labels. This finding was fairly consistent across both ethnographies and focus groups: only one or two participants during the ethnographies had taken steps to anchor their furniture, and hardly any participants were aware of warning labels on their products.

Many participants, particularly in the focus groups, reported that they believe the main purpose of a warning label is to protect the manufacturer from liability, or participants said they already know what information is included in them. As a result, participants reported not perceiving the label as a priority to notice, read, or adhere to. When probed further during the warning label activity, participants mentioned that they think labels could be effective if consumers were to read and follow the instructions. However, several participants during this activity also expressed that they would like to know the "why" behind certain warnings. Participants said they thought that if they understood the reasoning for doing or not doing something, the label would be more effective at increasing compliance.

Additionally, during the focus groups, non-parent participants reported that they would be more likely to take safety precautions into consideration if they were parents (i.e., they would be more likely to read and adhere to a warning label). However, participants in the parent groups did not appear significantly more likely to adhere to warning labels. Although parent participants reported being aware of the hazards and risks associated with tipover, they reported that they are still unlikely to anchor their furniture. Overall, participants tended to say that they are more reliant on their own opinions to decide whether a product is safe: They like to test units in stores and assess how "durable" or "stable" a product seems. If they purchase a product that meets their internal standard of safety, participants expressed using that standard as a justification for why they chose not to anchor their furniture.

Regarding the influence of product marketing and displays on CSU classifications, several focus group participants reported that they are largely not impacted by product marketing. They mentioned that although the marketing might provide them with ideas or suggestions for how to use a particular product, they are more likely to purchase a product based on their established needs. However, during the subsequent worksheet activity, it was apparent that participants were implicitly affected by displays when categorizing CSUs. When describing the reasoning behind why they categorized a product a certain way, several participants mentioned the items depicted on top of the units.

Discussion, Limitations, and Future Research

Qualitative research, such as focus groups and ethnographies, provides invaluable insight into a target audience's range of behavior and perceptions.[6] Collecting rich qualitative data from a small sample of relevant participants allows for detailed insights into their reasoning and actions, providing a layer of depth to data that is not attainable with just quantitative research.[7] By nature, qualitative sampling is purposive—participants are selected to ensure that they will meet the criteria relevant to the research question.[8] Therefore, this research effort was conducted with a small number of parents of young children in Richmond, VA. Richmond was selected due to a strong existing relationship with Good Run Research, who has access to individuals who fit the criteria of this study and were confident in their ability to fulfill the recruit. Conducting research in one location with a small sample of individuals limits the generalizability of responses; however, the goal of qualitative research is not to produce findings that are generalizable to the entire population. Rather, the goal is to learn as much about the study participants and their attitudes, beliefs, and behaviors as possible. The insights gained from qualitative research, and any policy or programmatic decisions based on those insights, can then be confirmed through additional quantitative analyses using probability sampling methods.[9]

Conducting in-home observations (ethnographies) with consumers provides a nuanced understanding of consumer behavior, allowing researchers to meet the consumer at their point of product usage and interaction. By observing behavior in participants' homes, researchers were able to physically assess how consumers store clothing. Researchers were also able to obtain results that highlighted participants' non-compliance to safety guidelines (i.e., anchoring furniture). This methodology allowed for measurements, child interaction reenactments, and photographs—elements that could not be obtained through interviews conducted in a traditional facility or remotely. Access to CSUs in ethnographies was limited to the furniture in the six tested homes (i.e., this furniture ultimately does not represent the full range of products that might be found in the home of a parent or caregiver). However, without direct observations, the research would have been reliant on self-report data only, and gathering the full contextual data needed to answer the research questions (i.e., about product usage, child interactions, and anchoring behavior) would not have been possible. Additionally, counts were reported in ethnographies in order to distinguish variability in responses. However, it should be noted that with qualitative research and small sample sizes, counts should not hold weight in decision-making (e.g., three out six vs. four out of six)

[6] Fors Marsh Group. (2017). *Fors Marsh Group qualitative research methods brief* [Unpublished brief].
[7] Ibid.
[8] Ibid.
[9] Ibid.

because, although variability in responses is valuable and meaningful, the differences are not statistically significant.

Conducting focus groups for this research effort provided insight into attitudes, awareness, and beliefs associated with CSUs (in particular, definitions and classifications of CSUs, the influence of product marketing, and associations with warning labels). Focus groups are a methodology that allows researchers to gather a wide variety of responses and experiences and that provides in-depth, rich information, as participants can often discuss topics with one another and build upon each other's sentiments.[10] Focus groups for this effort were also conducted in Richmond, VA, so responses should not be generalized nationwide. However, the purpose of the focus groups was to collect detailed responses and valuable insights regarding the "why" and "how" behind consumer selection, usage, and interaction. This research presents initial findings that can be further translated into actionable recommendations. Future research can then be conducted in different U.S. regions and among more diverse samples to test if results would be replicated and if further insights can be identified.

Expanding the Current Research Effort: Additional Ethnographies and Focus Groups

It would be beneficial to further investigate and obtain additional data on how the subpopulations of interest (parents, non-parents, individuals who are planning to have or are visited by young children, renters, homeowners) use and classify CSUs. In order to obtain a more diverse, geographic sample, it would be advantageous to expand this research into various areas across the country. Conducting additional focus groups and ethnographies across the country, particularly in areas with frequent natural disasters (e.g., earthquakes in California, tornados in Oklahoma) or areas with more moderate, coastal climates (prone to outdoor living) would provide important data on attitudes, beliefs, and behaviors of individuals across the country. Additionally, it could provide CPSC with additional information on CSU classification, interaction, and usage.

Warning Label Improvement

In the ethnographies and focus groups, researchers found that consumers experience difficulty in noticing, reading, and adhering to warning labels. Participants reported believing that all warning labels are the same, are largely irrelevant, and are mainly just the manufacturers' way of protecting themselves from liability. As such, it would be beneficial to conduct a follow-up study that focuses on understanding the best messaging strategies and communications channels for increasing consumer adherence to warning labels. Developing frames to address determinants of behavior is considered a best practice in communication research. Message frames reflect the audiences' values, needs, and motivations—the most likely touchpoints for triggering action. It is important to test message frames in regard to warning labels before refining the labels in order to have a full understanding of what is

[10] Fors Marsh Group. (2017). *Fors Marsh Group qualitative research methods brief* [Unpublished brief].

working and not working. This research could present potential solutions for improving and enhancing warning label content and identifying additional promising communications channels and approaches and, ultimately, increasing adherence behavior. Using the results of the message frame testing and past research, the next recommended phase would be to develop a series of suggested options for refining and enhancing CSU warning label copy. Once labels have been refined, they would then be tested in an online copy testing survey. Conducting an online survey allows for obtaining geographically and demographically diverse data. Additionally, it is an efficient way to gather insight from a large proportion of the population in a short amount of time. Survey respondents would be presented with a warning label copy condition (or control) to test for hypothesized differences in determinants (e.g., risk perception), as well as to assess for language, formatting, and presentation preferences. Results from the survey would inform recommendations for improving warning labels in the future, with the ultimate goal of increasing consumer attention and adherence.

Appendices

Appendix A: Ethnography Screener

Section 1: Introduction

Hello, my name is ____________, and I am calling on behalf of Fors Marsh Group, an independent research firm. We will be conducting in-home interviews about furniture used to store clothing in for a federal public safety agency. Each interview will be 90 minutes and led by a trained moderator and the goal will be to gather your thoughts and opinions on certain furniture items in your home. You will receive $175 as a thank you for taking part in the study.

[REPEAT INTRO IF CALL WAS TRANSFERRED]

May I ask you a few questions to see if you are qualified to participate in the study?

Yes	[ ]	Continue
No	[ ]	TERMINATE

IF YES, READ: Great! Before we begin, you should know that there are no wrong answers to the questions I'm going to ask you. You also don't have to answer any questions if you don't want to. If an answer leads to me ending the call, that is because we are looking for a diverse group and we may already have enough similar candidates for this study. Any questions before we begin?

PLEASE USE THE TERMINATION LANGUAGE BELOW FOR ANY RESPONSE THAT LEADS TO THE ANSWER OPTION "THANK AND END."

Thank you for taking the time to answer these questions. Unfortunately, based on the responses you provided, you do not meet the specifications we are looking for in this study. I appreciate your time and hope you have a good morning/afternoon/evening.

Section 2: Screener and Demographic Questions

Q1A. Do any children 17 and under live in your household?

Yes	[ ]	Continue to Q2A
No	[ ]	THANK AND END
Refused	[ ]	THANK AND END

Q2A. Which of the following age groups are living in your household? **Mark all that apply.**

Under 18 months old	[ ]	THANK AND END
18 months to under 3 years old	[ ]	Continue to Q2B
Ages 3–5 years old	[ ]	Continue to Q2B
Ages 6–17 years old	[ ]	THANK AND END
Refused	[ ]	THANK AND END

Q2B. What are their ages? (Please separate ages with a comma if more than one child).

[ ] Years old

Q2C. What are their genders? (Please separate genders with a comma if more than one child).

[ ]

Q3. Which from the list below best describes your relationship to the child/(children)?

Parent	[ ]	Continue to Q4
Grandparent	[ ]	
Legal Guardian	[ ]	
Aunt or uncle	[ ]	
Close family friend	[ ]	
Daycare Provider	[ ]	THANK AND END
Other	[ ]	THANK AND END
Refused	[ ]	THANK AND END

Q4. Do the children at your home have access to furniture that you use to store clothing in?

Yes	[ ]	Continue to Q5
No	[ ]	THANK AND END
Refused	[ ]	THANK AND END

Q5. Are you the primary person responsible for <u>purchasing</u> furniture in your home?

Yes	[ ]	Continue to Q6
No	[ ]	

Q6. Are you the primary person responsible for <u>assembling</u> furniture in your home?

Yes	[ ]	Continue to Q7
No	[ ]	

Q7. Are you the primary person responsible for arranging furniture in your home?

Yes	[ ]	Continue to Q8
No	[ ]	

Q8. When, if ever, was the last time you participated in marketing research or focus group research?

Within the past 3 months	[ ]	THANK AND END
More than three months ago	[ ]	Continue to Q9
Never	[ ]	Continue to Q9
Refused	[ ]	THANK AND END

Q9. What is your gender?

Male	[ ]	Continue to Q10
Female	[ ]	
Refused	[ ]	

Q10. Are you Hispanic or Latino?

Yes	[ ]	Continue to Q11
No	[ ]	
Refused	[ ]	

Q11. What is your race? Mark all that apply.

American Indian or Alaska Native	[ ]	
Asian	[ ]	
Black or African American	[ ]	
Native Hawaiian or other Pacific Islander	[ ]	
White	[ ]	
Some other race, Specify __________	[ ]	
Refused	[ ]	

Q12. What is your age?

[ ] Years old

INTERVIEW BREAKDOWN

- 3 participants will have at least one child 18–35 months living in their household
- 3 participants will have at least one child 36–72 months living in their household

Section 3: Invitation to Participate in Interview

Thank you for taking the time to speak with me today. We would like to invite you to participate in an in-home interview. The interviews are being conducted on [DATE] and will last **approximately 90 minutes.** Between the time frames of [X] and [X] on these dates, what time works best for you?

Your opinions are very important to us. You will be paid **$175** in the form of a Visa gift card.

People who have been invited previously to participate in this type of project have found the experience to be enjoyable and informative.

Are you interested in participating in this study?

Yes	[ ]	Continue
No	[ ]	THANK AND END

We would like to conduct this interview when we can access all rooms in your house (for example, not during a child's naptime). Can you confirm that we can schedule a time when this would be possible?

Yes	[ ]	Continue
No	[ ]	THANK AND END

IF YES, READ: Great! PLEASE do not do <u>anything</u> special or out of the ordinary to prepare for this interview (in other words, don't clean on our account!). It is **<u>most helpful</u>** to see things as they typically are. The interview will be audio recorded so the interviewer can concentrate and not worry about taking notes. The research team may also take photographs of furniture in your home, but there will be no personally identifying information in the photographs, nor will any individuals be in the photographs. Other family members can be at home like usual…it will be most helpful if this is like a "normal" day for you, except that the researcher will be there to talk with you. If you could please provide your home address, that would be great. If you would like to provide your email address, I can send you a confirmation?

Email address

[   ] Open ended

ADDRESS FOR IN-HOME:

EXACT ADDRESS	
Cross-Streets	
Directions/land marks?	

We will provide you with the CELL phone # of a member of the research team prior to the interview. He or she will call and introduce herself to you a couple days before the interview. If you have any questions or concerns in the meantime, please feel free to contact [GOOD RUN CONTACT INFO]

Before we go, do you have any other questions for me?

[THANK AND END]

Appendix B: Ethnography Guide

CPSC Furniture Tipover

In-home Ethnography – Discussion Guide

Research Objective: To conduct in-home interviews (ethnographies) with adults to understand how consumers interact with clothing storage units in their home. These interviews will specifically focus on assessing clothing storage unit placement, size, und usage in the home. Additionally, a primary goal of these interviews is to investigate how children interact with these units. The findings from this research will ultimately inform CPSC on ways to improve voluntary standards in the future.

NOTES TO REVIEWER:
This discussion guide is not a script and therefore will not be read verbatim. The moderator will use these questions as a roadmap and probe as needed to maintain the natural flow of conversation.
Moderator instructions are highlighted in yellow.

Overview: Total time—90 minutes

SECTION A: Introduction and Icebreaker (5 min.)
The moderator will explain the purpose of the research, present the ground rules, and allow participants to ask any questions.
SECTION B: Clothing Storage Unit Usage in the Home (80 min) This section will assess where and how clothing storage units are being used in the home, as well as warning label visibility and awareness. Participants will be asked to show the research team each unit. Subsection 1 will assess clothing storage units used to store clothing; Subsection 2 will assess clothing storage units that are not used to store clothing; and Subsection 3 will assess non-clothing storage units used to store clothing, including probes to understand nightstand usage. The researchers will use a checklist document to record the dimensions and features of each unit. The team will probe on how the children in the home interact with each unit.
SECTION C: Conclusion (5 min.)

Moderator ensures that all questions are answered and all comments have been heard.

Section A. Introduction and Icebreaker (5 minutes)

Thank you for taking the time to talk with us today and welcoming us into your home. Your time is greatly appreciated. My name is _____, and I work for Fors Marsh Group, which is an independent research company. I am very eager to listen to you and what you have to tell me, and I have no stake in how you respond. Today, we would like to hear from you about the furniture or units where you store your clothing. I will be asking you to show me where you keep such units and how you use them.

We will have about 90 minutes for our discussion. Before we get started, I want to go over a few general guidelines for today:

- First, there are no wrong answers and we are not here to evaluate or judge you. Our whole purpose is to hear your perspectives, opinions, and experiences.
- What we talk about here is confidential. That means your name will not be associated with anything you say in our reports and your responses will not be linked to your identity in any way.
- Your participation is voluntary and you have the right to withdraw from the study at any time. You don't have to answer every question, but I am eager to hear what you have to say.
- We are audio-recording this session to make sure we don't miss anything you share with us. I will be speaking with a lot of people for this project, and it will be impossible for me to remember everything that is said in these conversations. The audio files will be transcribed, but any information that could identify you will be removed from the transcripts. At the end of our discussion, we will use the recordings and transcripts to write a report with our findings.

Do you have any questions before we begin?

Ok great. Before we get started, I'd just like to get to know you a little better. Can you tell me something you like to do with your child/children in your free time?

Section B. Clothing Storage Unit Usage in the Home (80 min)

Thank you again for welcoming us into your home today and telling me about your child. I would like to now start talking about clothing storage units in your home.

- What do you think a clothing storage unit is?
- What types of clothing storage units do you have in your home?
- We will talk about individual pieces of furniture more in-depth in a couple of minutes, but first I was wondering if you could estimate about how many clothing storage units would you have in your home?
  - In general, where are they?
- Generally speaking, how did you obtain the majority of these units?
      - [If purchased:] When did you purchase these units? Where did you purchase them from?
      - What motivated you to purchase them?
      - Do they still serve the same purpose as they did when you originally made the purchase?
    - [If gift/hand me down/donated:] When did you receive them? Who gave them to you?
      - For what reason did you receive them?
      - Do they still serve the same purpose as they did when you received them?

Ok, great. That information is very helpful to have for context as we're going through the rest of today's discussion. I would now like us to walk through your house and have you show me what some of these units look like, particularly the ones that your child/(children) have access to. If you could walk me to one of those units to show me where they are located. [Go to first unit]

For context, do you all rent this home or do you own it? Ok, thanks.

Subsection 1: Clothing Storage Units Used to Store Clothing

Second researcher uses checklist to record features of the clothing storage unit. For each piece of furniture, researcher will measure dimensions and drawer size with a tape measure, as well as take photographs of the unit. The checklist will additionally capture the type of flooring the unit is on as well as if the unit is tilted.

- What motivated you to purchase/obtain this particular unit?
  - [If purchased] Who in your family purchased it? Who put it together? Who decided where to place it?
- Do you know the make and/or model of this unit? Where is it from?
- Who uses this unit most frequently?
  - How do they use it? Can you show me?

- What motivated you to place this item here?
- Who in your family most frequently uses the clothing or items stored in this unit?
    - In an average week, how often do these individuals access the items stored inside?
- What is stored in the drawers of the clothing storage units? Can you open them for me? [Researcher takes measurements]
- Are there any items on top of the unit or inside the unit that your child uses or interacts with?
    - [IF YES] What are these items?
        - How often do they use each of these items in an average week?
        - How often do they ask for your help in retrieving these items?
        - To what extent are they responsible putting the item back in the unit?
            - How would they go about doing that? Can you show me?
        - How many drawers do they open at one time? How far out do they pull the drawers? [Researcher takes note] What is the highest number of drawers that they have opened at one time?
- How does your child/children interact with the clothing storage units?
    - Are they putting any items inside the unit or taking any items out of the unit?
        - What types of items?
        - How often would they do this in an average week?
        - How do they typically put items in?
        - How do they typically take the items out?
        - [Probe to understand how forceful interactions are – e.g., are they throwing items or placing them]
    - How often do they sit on the unit?
        - Use it for balance?
        - Climb on it?
            - Step on drawers?
            - Are they using it to reach other things?
        - Play on it?

- I have a doll here that I would like you to use to show me how your child uses this unit most frequently. [X] on our research team is going to take a photograph of the doll for our records to show how your child would interact with the unit.

Moderator will present the doll they have. The researcher will take photographs once participant has placed doll on/near furniture.

- Is there a warning label on this unit? [Check front, back, and inside unit]
    - [IF YES] Where is it?
        - Are you aware of the content on the warning label?
        - Did you read the warning label when you saw it? Why or why not?
        - What do you recall from reading the warning label?

Researcher will take photograph of warning label

- Were you familiar with the information presented in this warning label? Have you seen it before?
- [IF NO] Was there ever a warning label on it?
  - [If yes} What happened to it? [Probe to understand if removed/fell off]
  - [If unaware] What would you expect to be on the warning label for this product?

Great, thank you so much for your insight here. Could you take us to another piece of furniture in your home that you would also classify as a clothing storage unit that your child has access to?

Moderator will go through probes in Subsection 1 for each different piece of furniture that the participant classifies as a clothing storage units, moderator will stop this exercise after 40 minutes.

Subsection 2: Clothing Storage Units Not Used for Clothing

Are there any pieces of furniture in the home that look like clothing storage units, but are not used to store clothing (for example, a dresser that is used in the foyer or dining room)?

Can you show me what these look like and where they are? [Walk to unit]

Second researcher uses checklist to record features of the unit. For each piece of furniture, researcher will measure dimensions as well as drawer size, with a tape measure. The checklist will additionally capture the type of flooring the unit is on as well as if the unit is tilted.

- What is stored in this item?
  - What motivated you to purchase/obtain this particular unit?
    - [If purchased] Who in your family purchased it? Who put it together? Who decided where to place it?
- How long has this piece of furniture been in this location?
  - What motivated you to place this item here?
  - What was the original intent of this purchase?
    - Has the purpose of this piece of furniture remained the same or changed over time?
  - Do you know the make and/or model of this unit? Where is it from?
- Who uses this unit most frequently?
  - How do they use it? Can you show me?
- Who in your family most frequently uses the items stored in this unit?

- In an average week, how often do these individuals access the items stored inside?
- What is stored in the drawers of these units? Can you open them for me? [Researcher takes measurements]
- Are there any items on top of or inside the unit the unit that your child uses or interacts with?
  - [IF YES] What are these items?
    - How often do they use each of these items in an average week?
    - How often do they ask for your help in retrieving these items?
    - To what extent are they responsible putting the item back in the unit?
      - How would they go about doing that? Can you show me?
    - How many drawers do they open at one time? How far out do they pull the drawers? [Researcher takes note] What is the highest number of drawers that they have opened at one time?
- How does your child/children interact with the clothing storage units?
  - Are they putting any items inside the unit or taking any items out of the unit?
    - What types of items?
    - How often would they do this in an average week?
    - How do they typically put items in?
    - How do they typically take the items out?
    - [Probe to understand how forceful interactions are – e.g., are they throwing items or placing them]
  - How often do they sit on the unit?
    - Use it for balance?
    - Climb on it?
      - Step on drawers?
      - Are they using it to reach other things?
    - Play on it?

- I have a doll here that I would like you to use to show me how your child uses this unit most frequently. [X] on our research team is going to take a photograph of the doll for our records to show how your child would interact with the unit.
- ***Moderator will present the doll they have. The researcher will take photographs once participant has placed doll on/near furniture.***

- Is there a warning label on this unit? [Check front, back, and inside unit]
  - [IF YES] Where is it?
    - Are you aware of the content on the warning label?
    - Did you read the warning label when you saw it? Why or why not?
    - What do you recall from reading the warning label?

Researcher will take photograph of warning label

        - Were you familiar with the information presented in this warning label? Have you seen it before?
        - [IF NO] Was there ever a warning label on it?
            - [If yes} What happened to it? [Probe to understand if removed/fell off]
            - [If unaware] What would you expect to be on the warning label for this product?

Moderator will go through probes in Subsection 2 for each piece of furniture that the participant classifies as a clothing storage unit but does not store clothing in, stopping after 20 minutes.

Subsection 3. Non-Clothing Storage Units Used to Store Clothing

Alright, so the last type of furniture I would like to talk about is furniture that you wouldn't necessarily classify as a clothing storage unit, but you store clothing in it anyways. Could you show me this piece of furniture? Same as with the last pieces, I'd like to first look at ones that your child/(children) has access to.

Second researcher uses checklist to record features of the unit. For each piece of furniture, researcher will measure dimensions as well as drawer size, with a tape measure. The checklist will additionally capture the type of flooring the unit is on as well as if the unit is tilted.

- How long has this piece of furniture been in this location?
    - What motivated you to place this item here?
    - What motivated you to purchase/obtain this particular unit?
        - [If purchased] Who in your family purchased it? Who put it together? Who decided where to place it?
    - What was the original intent of this purchase?
        - Has the purpose of this piece of furniture remained the same or changed over time?
    - Do you know the make and/or model of this unit? Where is it from?
- Who uses this unit most frequently?
    - How do they use it? Can you show me?
- Who in your family most frequently uses the items stored in this unit?
    - In an average week, how often do these individuals access the items stored inside?
- What is stored in the drawers of these units? Can you open them for me? [Researcher takes measurements]
- Are there any items on top of or inside the unit that your child uses or interacts with?
    - [IF YES] What are these items?

            - How often do they use each of these items in an average week?
            - How often do they ask for your help in retrieving these items?
            - To what extent are they responsible putting the item back in the unit?
                - How would they go about doing that? Can you show me?
- How does your child/children interact with the clothing storage units?
    - Are they putting any items inside the unit or taking any items out of the unit?
        - What types of items?
        - How often would they do this in an average week?
        - How do they typically put items in?
        - How do they typically take the items out?
    - How often do they sit on the unit?
        - Use it for balance?
        - Climb on it?
            - Step on drawers?
            - Are they using it to reach other things?
        - Play on it?
- I have a doll here that I would like you to use to show me how your child uses this unit most frequently. [X] on our research team is going to take a photograph of the doll for our records to show how your child would interact with the unit.
- ***Moderator will present the doll they have. The researcher will take photographs once participant has placed doll on/near furniture.***
- Is there a warning label on this unit? [Check front, back, and inside unit]
    - [IF YES] Where is it?
        - Are you aware of the content on the warning label?
        - Did you read the warning label when you saw it? Why or why not?
        - What do you recall from reading the warning label?

Researcher will take photograph of warning label

        - Were you familiar with the information presented in this warning label? Have you seen it before?
        - [IF NO] Was there ever a warning label on it?
            - [If yes} What happened to it? [Probe to understand if removed/fell off]
            - [If unaware] What would you expect to be on the warning label for this product?

Moderator will go through probes in Subsection 3 for each piece of furniture that the participant does not classify as a clothing storage unit but puts clothing in, stopping after 15 minutes.

- [If participant does not organically bring up nightstand]: **(5 minutes)**
    - Do you or anyone in your family store clothing in any of these nightstands?

  - [If no] Have you ever stored clothing in it? For what reasons?
    - Have you ever thought about storing clothing in it? For what reasons?
  - [If yes] Where are those located? Can you show us? [Walk with participant to nightstand].
- What motivated you to purchase/obtain this particular unit?
- Do you know the make and/or model of this unit? Where is it from?
- Who uses this unit most frequently?
  - How do they use it? Can you show me?
- Who in your family most frequently uses the clothing or items stored in this unit?
  - In an average week, how often do these individuals access the items stored inside?
- What is stored in the drawers of the clothing storage units?
- Are there any items on top of the unit that your child uses or interacts with?
  - [IF YES] What are these items?
    - How often do they use each of these items in an average week?
    - How often do they ask for your help in retrieving these items?
    - To what extent are they responsible putting the item back in the unit?
      - How would they go about doing that? Can you show me?
    - How many drawers do they open at one time? How far out do they pull the drawers? [Researcher takes note] What is the highest number of drawers that they have opened at one time?
- How does your child/children interact with the clothing storage units?

  - Are they putting any items inside the unit or taking any items out of the unit?
    - What types of items?
    - How often would they do this in an average week?
    - How do they typically put items in?
    - How do they typically take the items out?
    - [Probe to understand how forceful interactions are – e.g., are they throwing items or placing them]
  - How often do they sit on the unit?
    - Use it for balance?
    - Climb on it?
      - Step on drawers?
      - Are they using it to reach other things?
    - Play on it?

- I have a doll here that I would like you to use to show me how your child uses this unit most frequently. [X] on our research team is going to take a photograph of the doll for our records to show how your child would interact with the unit.
- ***Moderator will present the doll they have. The researcher will take photographs once participant has placed doll on/near furniture.***

- Is there a warning label on this unit? [Check front, back, and inside unit]
    - [IF YES] Where is it?
        - Are you aware of the content on the warning label?
        - Did you read the warning label when you saw it? Why or why not?
        - What do you recall from reading the warning label?

Researcher will take photograph of warning label

- Were you familiar with the information presented in this warning label? Have you seen it before?
- [IF NO] Was there ever a warning label on it?
    - [If yes} What happened to it? [Probe to understand if removed/fell off]
    - [If unaware] What would you expect to be on the warning label for this product?

Section C. Conclusion (5 min.)

This has been a very helpful session. Thank you so much for taking time out of your day to have us visit your lovely home and share your space and experiences. Before we wrap up, is there anything else that you would like to share or that we might have missed?

Please let us know if you have any questions and I hope you have a great rest of your day.

Appendix C: Ethnography Checklist

Participant #: ______
Date: _________
Number of children: _______
Age of child/children (months): ________

Rent or Own Home:_________

Unit #: _______

Type: ________________

Age of item: ______

Make and model: _______(N/A if not available)

Design: ______ Material:______

Photo taken? Y/N

Size (L, W, H): ______________ inches

Location in home: ___________

Number of drawers: _________

Size of drawers: ____________

Inside the unit:Clothes/Other:_____________________

Approximate fill amount: 25% 50% 75% 100% ______________

On carpet or floor[hard surface]?

C / F

Unit tilted? Y / N

Unit anchored? Y / N

Doll photo taken for this unit? Y / N

Does the child interact with unit? Y / N

How often? _______ (days per week)

Climb on unit?

Y / N

Step on drawers?

Y/N

Are drawers open when interacting?

Y/N

How far open? 25% 50% 75% 100% _____

Stand on unit?

Y / N

Are there items on top the unit?

Y / N

If yes, size (L, W, H): ______________

Does the child interact with the items?

Y / N

Warning label visible?

Y / N

Where is it?____________

If no, what's covering it? ___________

Warning Label Picture? Y/N

Appendix D: Focus Group Screener

Section 1: Introduction

Hello, my name is ____________, and I am calling on behalf of Fors Marsh Group, an independent research firm. We will be conducting focus groups about furniture used to store clothing. We are conducting the focus groups for a federal public safety agency. Each focus group will be led by a moderator and will include up to eight participants, who will be asked to share their opinions about furniture usage. Focus groups will be held at Good Run Research on **x** for about 90 minutes. Those who participate will receive **$75** as a thank you for taking part in the study.

[REPEAT INTRO IF CALL WAS TRANSFERRED]

May I ask you a few questions to see if you are qualified to participate in the study?

Yes	[ ]	Continue
No	[ ]	THANK AND END

IF YES, READ: Great! Before we begin, you should know that there are no wrong answers to the questions I'm going to ask you. You also don't have to answer any questions if you don't want to. If an answer leads to me ending the call, that is because we are looking for a diverse group, and we may already have enough similar candidates for this study. Any questions before we begin?

PLEASE USE THE TERMINATION LANGUAGE BELOW FOR ANY RESPONSE THAT LEADS TO THE ANSWER OPTION "THANK AND END."

Thank you for taking the time to answer these questions. Unfortunately, based on the responses you provided, you do not meet the specifications we are looking for in this study. I appreciate your time and hope you have a good morning/afternoon/evening.

Section 2: Screener and Demographic Questions

Q1. Are you a parent of any children under the age of 17 who live in your household?

Yes	[ ]	Continue to Q2A
No	[ ]	Continue to Q3A
Refused	[ ]	THANK AND END

Q2A. Which of the following age groups are living in your household? **(Mark all that apply.)**

Under 1 year old	[ ]	Continue to Q3B
Ages 1–3	[ ]	Continue to Q2B
Ages 4–5	[ ]	Continue to Q2B
Ages 6–17	[ ]	Continue to Q3B
Refused	[ ]	THANK AND END

Q2B What are their ages? **(Please separate ages with a comma if more than one child.)**

[ ] Years old

Q2C. What are their genders? **(Please separate genders with a comma if more than one child.)**

[ ]

Continue to Q6 **(If they are the parent of a child who lives in their household they would qualify for the segment with children, they can skip Q3–Q5.)**

Q3A. Which statement best describes your future plans regarding having children? **(Choose one option.)**

I plan to have children within the next five years	[ ]	Continue to Q3B
I may have children in the future, but am not sure	[ ]	
I do not plan to have children	[ ]	

Q3B. Do any children from the following age groups come to your home at least once a week? **(Mark all that apply.)**

Under 1 year old	[ ]	THANK AND END
Ages 1–3	[ ]	GO TO Q3C
Ages 4–5	[ ]	GO TO Q3C
Ages 6–17	[ ]	THANK AND END
None of the above	[ ]	THANK AND END
Refused	[ ]	THANK AND END

Q3C What are their ages? **(Please separate ages with a comma if more than one child.)**

[ ] Years old

Q3D. What are their genders? **(Please separate genders with a comma if more than one child.)**

[ ]

Q4. Which of the following options best represent how often and to what extent the child (/children) come(s) to your house?

Visits and stays overnight 2 or more days per week	[ ]	Continue to Q5
Visits 2 or more days per week but does not stay overnight	[ ]	
Visits once a week and stays overnight	[ ]	
Visits once a week and does not stay overnight	[ ]	
Refused	[ ]	

Q5. Which from the list below best describes your relationship to the child/(children)?

Parent	[ ]	Continue to Q6
Grandparent	[ ]	
Legal guardian	[ ]	
Aunt or uncle	[ ]	
Close family friend	[ ]	
Daycare provider	[ ]	THANK AND END
Other	[ ]	THANK AND END
Refused	[ ]	THANK AND END

Q6. Do the children at your home have access to furniture that you use to store clothing in?

Yes	[ ]	Continue to Q7
No	[ ]	THANK AND END
Refused	[ ]	THANK AND END

Q7. Which of these statements best describe your home ownership status?

I rent my home.	[ ]	Continue to Q8
I own or mortgage my home.	[ ]	
I neither own nor rent my home.	[ ]	THANK AND END

Q8. Are you the primary person responsible for <u>purchasing</u> furniture in your home?

Yes	[ ]	Continue to Q9
No	[ ]	

Q9. Are you the primary person responsible for <u>assembling</u> furniture in your home?

Yes	[ ]	Continue to Q10
No	[ ]	

Q10. Are you the primary person responsible for <u>arranging</u> furniture in your home?

Yes	[ ]	Continue to Q11
No	[ ]	

Q11. When, if ever, was the last time you participated in marketing research or focus group research?

Within the past 3 months	[ ]	THANK AND END
More than three months ago	[ ]	Continue to Q12
Never	[ ]	Continue to Q12
Refused	[ ]	THANK AND END

Q12. What is your gender?

Male	[ ]	Continue to Q13
Female	[ ]	
Other	[ ]	
Refused	[ ]	

Q13. Are you Hispanic or Latino?

Yes	[ ]	Continue to Q14
No	[ ]	
Refused	[ ]	

Q14. What is your race? **(Mark all that apply.)**

American Indian or Alaska Native	[ ]	Continue to Q15
Asian	[ ]	

Black or African American	[ ]	
Native Hawaiian or other Pacific Islander	[ ]	
White	[ ]	
Some other race, Specify __________	[ ]	
Refused	[ ]	

Q15. What is your age?

[ ] Years old

GROUP BREAKDOWN

Group	**Q2A.** Which of the following age groups are living in your household?	**Q3A.** Which statement best describes your future plans regarding having children?	**Q3B.** Do any children from the following age groups come to your home at least once a week?	**Q.7** Which of these statements best describe your home ownership status?	**Date/Time**
1	Parents of children age 1– 5 living in home	N/A	N/A	Own	
2	Parents of children age 1–5 living in home	N/A	N/A	Rent	

3	No children age 1–5	Plan to have children in next 5 years	N/A	Own	
4	No children age 1–5	Plan to have children in next 5 years	N/A	Rent	
5	No children age 1–5	Unsure or not planning	Children age 1–5 come to home at least once a week	Own	
6	No children age 1–5	Unsure or not planning	Children age 1–5 come to home at least once a week	Rent	

Section 3: Invitation to Participate in Focus Group

Thank you for taking the time to speak with me today. We would like to invite you to participate in a focus group. The focus group will take place at Good Run Research, a focus group facility, where we will be discussing furniture used to store clothing. The focus group will be audio/visual-recorded. You may not participate in this study if you are not willing to be recorded. A light dinner will be provided.

The focus group is being held on [DATE] , at Good Run Research and will last **approximately 90 minutes.**

Your opinions are very important to us. You will be paid **$75** in the form of a Visa gift card.

People who have been invited previously to participate in this type of project have found the experience to be enjoyable and informative.

Are you interested in participating in this study?

Yes	[ ]	Continue
No	[ ]	THANK AND END

IF YES, READ: Great! I am going to give you the address and contact information for the facility. Please be sure to be there 15 minutes before the scheduled start time to ensure that the group starts on time. Additionally, please bring a government issued photo ID with you to the study. Do you have a pen and paper? If you would like to provide your email address, I can send you a confirmation with address and time?

Email address

[ ] Open ended

GIVE NAME AND ADDRESS OF FACILITY:

Good Run Research and Recreation

4116 W Broad St, Richmond, VA 23230

Appendix E: Focus Group Discussion Guide

CPSC Furniture Usage:

Focus Group Discussion Guide

Research Objective: Conduct focus groups with adults to discuss their perceptions of clothing storage units and associated warning information, as well as the factors influencing their decisions on product selection and use. Results of these focus groups will help inform CPSC on ways to improve voluntary standards in the future.

NOTES TO REVIEWER:
This discussion guide is not a script and therefore will not be read verbatim. The moderator will use these questions as a roadmap and probe as needed to maintain the natural flow of conversation.
Moderator instructions are highlighted in yellow.

Session Overview: Total time—90 minutes

SECTION A: Introduction and Icebreaker (5 min.) The moderator will explain the purpose of the research, present the ground rules, and allow participants to ask any questions.
SECTION B: Perceptions Associated with Clothing Storage Units (50 min.) This section will assess participant perceptions of what classifies as a clothing storage unit, what factors influence this classification, as well as associated risks with this type of furniture. A worksheet activity will facilitate this discussion by asking participants to label certain products, to share what they would store in them, and to share where they would place them in their homes. The moderator will also probe on additional information that may affect the participants' decisions to buy a product.
SECTION C: Awareness and Behaviors Associated with Clothing Storage Unit Warning Labels (30 min.) The next section will assess participant perceptions of and behaviors related to clothing warning unit labels. Participants will be asked to view a sample warning label to examine their comprehension of warning label content and perception of warning label effectiveness.
SECTION D: Conclusion (5 min.) Moderator ensures that all questions are answered, and all comments have been heard.

Section A. Introduction and Icebreaker (5 minutes)

Thank you all for coming to talk to us today, your time is greatly appreciated. My name is _____, and I work for Fors Marsh Group, which is an independent research company. This means that I'm here to listen to you and what you have to tell me, and I have no stake in how you respond. Today, we would like to hear from you about some of the factors that influence your decisions when purchasing and arranging furniture.

We will have about 90 minutes for our discussion. Before we get started, I want to go over a few general rules for our discussion today:

- First, there are no wrong answers and we are not here to evaluate or judge each other. Our whole purpose is to hear your perspectives, opinions, and experiences.
- What we talk about here is confidential. That means that none of your personal identifiable information such as your name or your address, will be associated with anything you say in our reports and your responses will not be linked to your identity in any way.
- Likewise, we want to respect everyone's privacy in this room and not share any of our discussion from today with others who were not here.
- Your participation is voluntary and you have the right to withdraw from the study at any time.
- You don't have to answer every question, but I do want to hear from everyone, so I might call on you at some point. Please speak one at a time and clearly so I may hear you.
- You might have already noticed the glass behind me. There are some people from the research team who are observing and taking notes so I can be present in our discussion. Even though people are observing, please speak openly about your opinions and experiences. We want to learn from you, so it is important that you share your honest opinions.
- We are also video and audio-recording this session. I will be speaking with a lot of people for this project, and it will be impossible for me to remember everything that is said in these groups. The audio files will be transcribed, but any information that could identify you will be removed from the transcripts. At the end of our discussion, I have to write a report and will refer to the recordings and transcripts when writing the report.
- Please turn your cellphone off or switch to silent mode.
- If you need to go to the restroom during the discussion, please feel free to do so.

Does anyone have any questions before we begin?

[Introductions and Icebreaker]

Okay, great. First, I'm going to have everyone introduce themselves so I can get to know you a little better. Please tell us your first name and your favorite room in your home.

It's wonderful to meet you all—let's get started with our discussion.

Section B. Perceptions Associated with Clothing Storage Units (50 min)

[Subsection B1. Brainstorming Activity: Clothing Storage]

So, to start off our discussion, I'd like to do a brainstorming activity with you using this flip chart. I would like to hear from you about where you and your family typically store clothes in your home. What are some places or areas that come to mind? We are going make to make a list as a group, so feel free to share as many ideas as you can think of. I will write down your responses and then we can talk about them.

[Participants list the items and moderator writes on chart. Allow brainstorming for 2 minutes or until group has exhausted options. Moderator then focuses on selection of items and uses prompts as needed to fully understand idea.]

Great, thank you! Now let's talk about the items and/or places that you've noted you and your family use to store your clothes.

- What makes you store your clothes in [X]?
- What items other than clothing would you store in [X]?

Great, thank you for starting the conversation off. This is going to set up the rest of our discussion today about clothing storage units.

[Subsection B2. Definition of Clothing Storage Unit]

Ok, so I would now like to ask you all a question. How would you define what a clothing storage unit is? As a reminder, there are no wrong answers here. We're just looking for feedback on this topic.

- What are some features that would lead you to think that a piece of furniture is a clothing storage unit? [Or, what would make something NOT classified as a clothing storage unit?]
    - How does X feature influence your decision in determining whether an item is a clothing storage unit? [Probe for each feature mentioned]
        - [If needed: what do they typically look like? How large are they (height, depth or width in inches? Where are they located in your home?]
    - **[Homeowner group:]** How, if at all, does owning your home impact where you place these units in your home?
    - **[Renter group:]** How, if at all, does renting your home impact where you place these units in your home?
- How does the size of a piece of furniture impact whether or not you would store clothing in it? [Probe to understand if there is a specific size that would make them more or less likely to store clothes in it, e.g., if something is smaller are they less likely?]
- What about number of drawers? To what extent does the number of drawers impact your decision to store clothing? [Probe to understand how the number of drawers influences their decision to store clothing in the piece of furniture or not]

- How does the size of the drawers impact your decision? [Probe to understand if depth, width, etc. impact their likelihood of storing clothes]
- What specific factors influence your decision on what items to put inside pieces of furniture?
- When do you make the decision of what to put inside a piece of furniture?
    - [If needed for clarification] Before you buy it? After you have already put it in your home?

[Children living in home]: To what extent do your children interact with clothing storage units?

- How do they interact with them? [Probe for sitting, functional climbing (e.g., stepping on the bottom drawer to reach things or using the piece of furniture to pull themselves up), playing on them]

[Children visiting home]: When children come visit or stay at your house, to what extent do they interact with clothing storage units?

- How do they interact with them? [Probe for sitting, functional climbing (e.g., stepping on the bottom drawer to reach things or using the piece of furniture to pull themselves up), playing on them]

[Subsection B3. Marketing of Product]

- Switching gears a little bit, I'd like you to think about clothing storage units you have bought and/or seen displayed for sale in a store.
    - What does the setting or display look like for that item typically in advertisements or in the store?
    -
    - How do these displays influence where you place the product in your home?
    - How do these displays influence how you use the product in your home?
    - [Probe to understand if they mimic placement/use based on what they see]
- What about catalogues or other advertisements? How do depictions of furniture in these ads influence where you place the furniture or how you use it? [Probe to understand if they mimic placement/use based on what they see]
    - To what extent does a manufacturer's name of the product (e.g. nightstand or dresser) impact where you place the product in your home? What about how you use the product in your home? [Probe to understand if the manufacturer's name of the product (e.g. nightstand) is how they use it in home. Why or why not?]
    - To what extent does the name influence whether you classify a product as a clothing storage unit?

[Subsection B4. Behaviors related to purchasing and safety]

- Who in your household usually makes the decision when it comes to purchasing a clothing storage unit?

- When you are looking to purchase a clothing storage unit, what factors are considered before purchasing?
- What hazards or risks are you aware of that are associated with clothing storage units?
  - How do you take these into consideration when deciding whether or not to purchase a piece of furniture?
  - What about when deciding where to place the product in your house? How do hazards and risks impact your decision?
  - [If tipover does not come up] As you may or may not be aware, some of these units can potentially tip over if not secured. How, if at all, does or would tipover risk influence your decision to purchase?
  - What about your decision where to place the item?
  - Have you ever experienced a piece of furniture, whether it's a clothing storage unit or not, tilting or tipping over in your home?
    - Did you report it to the CPSC? The manufacturer? If not, for what reasons?
  - [IMPORTANT QUESTION] How would additional information about stability (for example, a certification or verification that a product meets a certain safety standard) have an effect on your buying decision? [Probe to understand if having this type of information available would have an effect on whether they would purchase it.]
  - What types of things do you typically put on top of these products?
    - How big are they? [General sense of height, weight]
  - What factors do you take into consideration when you decide whether or not to put something on top of one of these products?
    - What size or weight limits do you take into consideration, if at all?
    - Are TVs ever included in items that you might put on top?
      - [If yes] What type of TV is it? (e.g. CRT or flat screen)
      - How big is the TV?
      - Is the TV on a stand or on the piece of furniture leaning against the wall?

Great, thank you for that discussion. You all have provided very helpful feedback so far.

[Subsection B5. Worksheet Activity]

We are now going to do a worksheet activity. Once I pass you this worksheet, you will see that there is a grid showing a bunch of different pieces of furniture. Please note that it has a front and back. What I would like you to do is look at these pieces of furniture, and in the first column, write what you would call this piece of furniture. In the second column, write what you would store in that piece of furniture. In the third, please write where you would potentially put that piece of furniture in your home. For example, what room would you put it in? When you are done, we will discuss your answers. Alright, it looks like everyone is wrapping up. Before we discuss, I'd like you to go through and put a little x next to the items you think are clothing storage units.

Okay, now let's talk through how you filled this out.

- Looking at the first piece of furniture listed, what would you call this piece of furniture?

- What would you store in it?
- For what reasons would you put [X] in it?
- Where would you place it in your home?
  - For what reasons would you put it in [X] location?
- Did anyone classify this as a clothing storage unit? What factors led you to do so?
  - For those who didn't, for what reasons did you not classify this as a clothing storage unit?

[Repeat for each item]

- Are there any items on this worksheet that you didn't mark as a clothing storage unit but you still might put clothing in?
  - If so, what are they? For what reasons? [Probe to understand if size, number of drawers, material, etc. impact decision].
- What clothing storage units listed on this worksheet do you prefer over the others? [If participant answers in terms of how the item looks (e.g. color or how chic it is), probe to understand what specific features (e.g. size, height, number of drawers) about the preferred CSU makes the participant prefer this CSU over another CSU. Want to understand function.]
  - For what reasons?
- [Glass cabinet]: How does the glass on this item influence your decision whether it's a clothing storage unit or not? Would wood doors or frosted glass change your mind?
- [Dark brown cabinet under glass: Ensure discussion touches on CSU versus accent piece and reasons for this classification].
- Looking at the pieces of furniture on this worksheet, which products would a child be most likely to interact with in your home?
- What does that interaction look like [or what could it look like]?
- For the products you didn't mention a child would interact with, for what reasons would they not?

Great, thank you for that discussion.

Section C. Awareness and Behaviors Associated with Clothing Storage Unit Warning Labels (30 minutes)

Now I would like to shift topics a little bit to talk more specifically about warning labels that you might see on clothing storage units.

- How often do you notice warning labels on clothing storage units?
- Where on that piece of furniture did you find the warning label?
- What is typically on the warning labels that you've seen on clothing storage units? Is the purpose of the warning label clear? [If unclear, probe to understand what isn't clear on the warning label.]

- Which placement of the warning label did you find to be the most eye-catching location on the clothing storage unit? [Probe to understand what specific location (e.g., bottom of drawer, side of drawer, upper/lower drawer, on the door) on a clothing storage unit was most eye catching.]
- How often have you seen labels that you thought were in an unacceptable place?
  - [If yes], For what reasons did you think that was an unacceptable place to have a warning label on a clothing storage unit?

Ok, now I'm going to pass around another piece of paper. You'll see that there is an example of a warning label that might be seen on a clothing storage unit, I'd like you to take a minute to look at and read over the warning label.

- What is your first reaction when you see a label like this?
- How much attention do you typically pay to warning labels like this?
  - How much of the warning label do you typically read, if at all? [Probe to understand if participant reads the entire label]
  - What do you think is the intent of the warning label? How easy or difficult is the warning label to understand?
  - What, if anything, is confusing or unclear about this label?
  - What catches your attention at first about this label?
- To what extent does the opening line, "Children have died from furniture tipover" catch your attention? [Probe to understand why]
  - How does that line impact your decision to comply with the warning label?
- Looking at the line that says "always install tipover restraint provided," can you tell me what that means in your own words?
- What steps have you previously taken, if any, to anchor or restrain clothing storage units? What made you decide to/not to?

- How often do you think consumers read this warning label and follow the instructions to not put a TV on the product? What makes you say that?
  - What type of additional information about TVs would be beneficial to add to the warning label, if at all? [Probe to see if adding what type of TV (e.g., CRT or flat screen) would be helpful or not.]

- The next line of the warning label reads, "NEVER allow children to stand, climb or hang on drawers, doors, or shelves."
    - What do you believe the purpose of this line is?
    - To what extent do you follow these instructions within your home? [Probe to understand why or not why]
        - If you haven't seen this line before, how would reading it impact your behavior? [Probe to understand if they would comply with the instructions]
- The next line says to "NEVER open more than one drawer at a time."
    - What do you believe is the purpose of this line?
    - To what extent do you avoid opening more than one drawer at a time?
- The last bullet notes that you should place the heaviest items in the lowest drawers.
    - What do you believe the purpose of this line is?
    - Is this something that you currently do within your home? Why or why not?
- In addition to a permanent warning label, there is potential that a hang tag or removeable sticker providing additional risk information could be added to products like these in the future.
    - What type of additional information would be useful for you to have on the additional warning tag or sticker, if any?
    - What formatting changes would you like to see on the hang tag or removable sticker compared to the permanent warning label? [Probe to understand if more graphics, less verbiage, a different color scheme, or size of warning label would help make the consumer more likely to read the label]

  Would you rather this information be presented in a hang tag or as a removable sticker? For example, a hang tag could be a tag hanging off the back of a dresser, and a removable sticker could be a sticker placed at the bottom of a drawer.
    - The bottom line of the warning label says, "This is a permanent label. Do not remove!" Thinking about clothing storage units in your home, do you typically leave the warning labels or remove them? Does this behavior vary by type of furniture? [Probe to understand if only take off of clothing storage units, only other items, etc.]
- How effective do you think this warning label would be in preventing furniture tipover?
    - What do you think would make it more effective?

Thank you! That was all very helpful information.

Section D. Conclusion (5 min.)

This has been a very helpful session. Thank you so much for taking time out of your day to be with me and share your perspectives and experiences. Before we wrap up, is there anything else that you would like to share or that we might have missed?

[TIME PERMITTING] If you don't mind, I am going to step out for just a moment to see if my team has any additional follow up questions for you all. [Ask any additional questions.]

Ok, thank you again for your time. Are there any final questions? If not, you are free to go. Please leave behind your worksheets and writing utensils. Have a wonderful evening!

Appendix F: Focus Group Worksheet

	Product label:	What would you store in this piece of furniture?	Where would you put this piece of furniture in your home?
 62" W x 20" D x 36" H			
 19" W x 15" D x 25" H			
 52" W x 16" D x 35" H			

	Product label:	What would you store in this piece of furniture?	Where would you put this piece of furniture in your home?
 32” W x 16” D x 30” H			
 17.75” W x 12” D x 35” H			
 58.2” W x 21” D x 82” H			

	Product label:	What would you store in this piece of furniture?	Where would you put this piece of furniture in your home?
 34” W x 12” D x 33.25” H			
 26” W x 20” D x 30” H			

Appendix G: Tipover Experiences

- *"I mean a ball got thrown on top, a friend and I were playing with, and I tried to put a foot on the first shelf and climb up. And I put my hand on the top and it started to come back…I put my foot back down and I was able to brace it…. I was nine or ten." —Planning to have children, Renter*
- *"I've had this one before and when I was changing drawers and cleaning things up one time it actually fell forward. So, this height, this did. Because the face of this, because it's MBF, or whatever wood, pressboard, the actual front, the one that I had, was very heavy. So, it actually did fall forward, and it actually did hurt me one time. So, that one specifically, which is kind of funny." —Planning to have children, Renter*
- *"It was just a giant entertainment system. When I was like 10 or 11, a ball got thrown up there, so I tried to climb and got to the top and got a hand on it. And I was always a big kid, and it started to come down, but then I was tall enough I could drop and hold it." —Planning to have children, Renter*
- *"I had an Ikea piece, again I don't know if it's Ikea, and I was doing the thing you weren't supposed to do. I had two drawers open. I had the bottom…no, I had the middle and the top open. Because I was, I think, sorting my clothes and moving them and cleaning them out, and it actually did tip over and forward and think it either hit my arm or knee or something. So, that did happen, that was as an adult, so." —Planning to have children, Renter*
- *"I was young. I was three or four and I guess at my Grandma's chest of drawers, so it was tall, and I was trying to get to the top and it fell on me. That's where I got this scar right here from it…Well, I fell back, because the bed was right there, so it didn't fall on me all the way, thank God, so the bed kind of saved it, saved me." —Planning to have children, Renter*
- *"Even the beds have to be lower. I remember my kids slept in the kind of higher beds, [inaudible] you know what I'm saying? If I had to do it today, maybe one day I get blessed with grandchildren, I can set them up a room. It would be so much different from when I set up my children's room. It would be different. I would be more aware of their safety cause that tipping over with the dressers and stuff. Anybody be on social media? You see that stuff nowadays kids get killed from that. Oh, another thing I didn't know any better when the girls were growing up. Is the TV on top of the dresser? You couldn't pay me to put a television on top of a dresser." —Visited by children, Owner*
- *"I didn't even think to [report the incidents to the manufacturer or the CPSC]." —Visited by children, Renter*
- *"That heavy furniture, for one. I prefer heavy furniture when the kids is around because we had an incident with my niece with a TV falling on her, so that's one of the reasons why…[She was] trying to turn the TV, but she opened the drawer to get to it…" —Visited by children, Renter*

- *"My little niece fell through the drawer once, playing in it, because she's very small and she likes to...The drawer is to an armoire, like you mentioned, the type that opens up or something, and there's drawers under it. But it opens up. So, she's in the lower one, and she likes to play with dolls and stuff in it, but the wood under it fell out, so she actually scraped herself because she fell through the drawer, if that makes sense...Yeah. The bottom fell through. I think she is a little traumatized, because she kind of got stuck. It was one of those, 'This is why you don't go playing in these...'" —Visited by children, Renter*
- *"You mention that ... I actually have my little niece, her shirt got caught on the knob of the drawer and it pulled out, and there was nothing in it but just the weight of that, and it tipped over. Our solution was to put heavier stuff on ... It sounds bad ... but putting heavier stuff on top, further back, to offset the weight...She was running around, had a loose article of clothing, and it got caught on the knob. So, as she's moving, it pulls the knob out, and the whole dresser came with her. She got scratched from the side of the drawers, too, so that' why...I think she was three or four... [It was a kid's dresser that was] like two-and-a-half feet...just two little drawers." —Visited by children, Renter*
- *"So, I told him to grab something from his room, and he opened... I think he must have opened the bottom drawer, and then not found what he needed, and then opened the next one. Then maybe, I don't know if he climbed on it or what, but he came running and I heard a huge bang. He came running out, and he was like, 'Mommy, I couldn't hold it. I couldn't hold it up anymore.' I'm like, 'Oh my gosh, you were holding the dresser up?'...So I went in, and the dresser was on his face because my husband's grandfather made the dresser, so we don't want to...It's a pretty decently tall. It would've hurt him really badly if it hadn't fallen on him, if he hadn't caught it. Really heavy...He was four I believe." —Parent, Renter*
- *"My mom always tells the story. She [doesn't] know how it happened. I was in my room playing, and she just hears a scream, and she runs in and I'm just lying on the floor, holding up the dresser like this. I guess I was probably climbing on it or something or another, but yeah. I think she said I was like five, so... [The dresser was] probably four-and-a-half, five-feet-tall with five drawers." —Parent, Renter*
- *"When both drawers [of the nightstand] were open, it had ... I can't remember what was in it. Something heavy was in it, in the top drawer, and it tipped over. Thankfully it didn't break, and nobody was hurt." —Parent, Renter*
- *"Bedrooms. When I was pregnant with my first son, my mom was determined to have me put the changing table, like secure it to the wall, and I thought she was crazy. But it actually made sense because my brother liked to climb on things when I was pregnant, and he was only [AGE]. He actually fell off of it, and I fell on top of him. But it was just the changing table, there was nothing on it, and he was fine. But so, I did that, and it was definitely irritating." —Parent, Renter*
- *"When both drawers [of the nightstand] were open, it had ... I can't remember what was in it. Something heavy was in it, in the top drawer, and it tipped over. Thankfully it didn't break and nobody was hurt...I can't remember [what was stored inside of the*

nightstand]... there was something heavy in it at the time, but typically it's just extra stuff that needs to be out of sight, so just throw it in that drawer, and then it's being a junk drawer sometimes." —Parent, Renter

- *"I feel more like the company's trying to cover themselves. So, I'm going to use it for whatever purpose I want to use it for, and I may just not have it in my kid's room, though we do have one in my child's room but he's fairly ... I mean, he's [AGE], but he's like a mature [AGE], kind of. Like if I tell him not to touch it ... and also it has fallen, so he knows what's going to happen, so he won't mess with it now. He knows, I don't touch the dresser, and then he tells his friends, 'Don't touch the dresser." —Parent, Renter*
- *"I've actually had a cabinet fall on me before...Well, I just opened it. But he was he was really bad at stuff he wouldn't hang pacing. One time I was playing the piano and this huge painting, crashed down on my head. I was I didn't have to nail it though. And I was like, yeah." —Planning to have children, Owner*
- *"I mean, there's been times where I'll sit with my God baby in my bedroom, and I'll be folding laundry or what have you and putting it away. And she'll usually just perched up on my bed and play with socks or whatever she's not normally, she's not at the age yet where she's going through and opening stuff and digging through stuff. Ours did happen. That's how we started closing our doors because we have a lot of friends who have kids, they're starting to walk and once they start walking...this little girl took a turn went down our hallway and went to our bedroom and just a magnet to our drawers. I just are ripping them open they think about strengths, so she ripped basically fell over and just fell back... [she used] both hands [to open the drawers]... [she pulled on] my dresser the bottom one, which is of course has the heavy jeans in it... [the dresser is] like four feet [with] four drawers... [she was] 18 months maybe... She's okay. Yeah, we have carpet, so it fell back she shocked herself, and it just wasn't something I was expecting." —Planning to have children, Owner*
- *"There was a child in writing my class that did that that climb the drawers and the TV fell on them and they died... I was in kindergarten... Yeah, this is kindergarten first grade. And I remember it was like my one of my like classmates' brothers. And I think it was because obviously the TVs were heavy glass back then. But they didn't have it bolted to the wall or anything." —Planning to have children, Owner*
- *"I've had like similar like lingerie drawer that was tall like that and the pulling it out, it came all the way out and hit my toe, you know the bottom drawer. So, like just even low stuff can hurt...And the drawer came out and just trying to pull it out. Like the lower drawers, if you pull it all the way out by mistake and it slips, the edges from the corners of the drawers still can be... It was.... That one was like the tall lingerie one that had like one, two, three. I think it has like four maybe five. It's a taller one, but it's a smaller, thinner piece. But yeah, I had some issues with that one." —Parent, Owner*
- *"I think about my brother-in-law. He had two brothers, and they rambunctious, and so, they pulled the dresser over on top of one of the brothers, so the mom would walk in and find the kid looking like he was dead.... Those are boys, it's like three*

boys. And so, they were kids was, yeah, they were fine. They did it on purpose, in order to... This is would be in the 60's or 70's and that's what I think about... Now they did this intentionally, so they were like eight, nine, and ten." —Parent, Owner

- *"Just being careless. I was careless and I left the drawer in my dresser open just a little bit. And the one-year-old of course just comes along and bumps his head on the corner. So, he bumps his head on a lot of stuff. Yeah, just the risk of injuries, carelessness." —Parent, Owner*

Appendix H: Additional Ethnography Pictures

Participant 1

In Scope:


Dimensions: 63''L x 20"W x 38"H
Location: Child's room
Warning Label Visible: No
Where Purchased: Ikea
Inside Drawers: Clothes
Drawers: 75-100% full, items fairly close to top, drawer organizers inside drawers
Interactions: 5x a week, 1x a day, mom dresses her so child has limited interaction with the unit

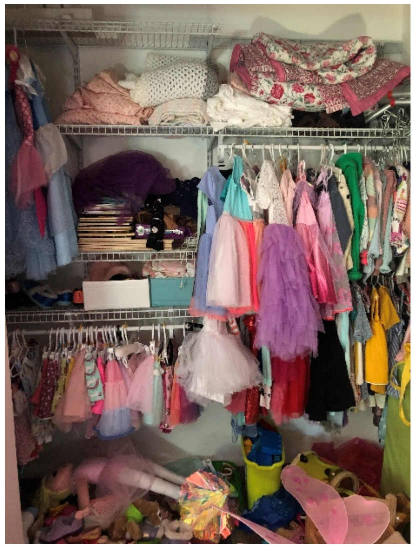
Nightstands:

Dimensions: 20"L x 15"W x 28"H
Location: Child's room
Warning Label Visible: No

Where Purchased: Ikea
Inside Drawers: Not many items (a couple dollar bills)
Interactions: Participant reported child does not really interact with unit

Out of Scope:

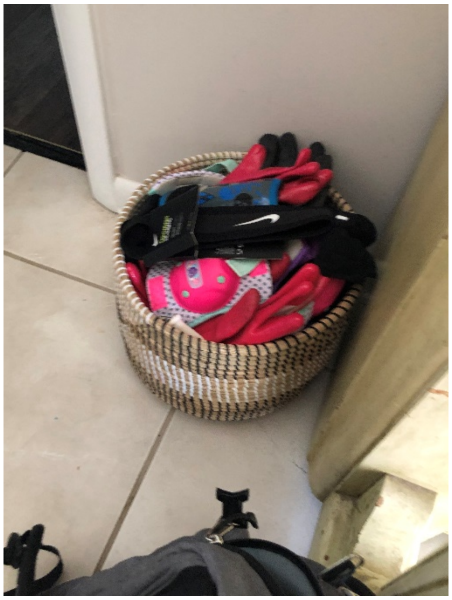
Location: Child's room
Purpose: Toy storage



Location: Child's Room
Purpose: Clothing storage

Location: Living area
Purpose: Clothing storage

Location: Storage closet
Purpose: Toy and junk storage



Location: Hallway
Purpose: Glove/seasonal storage

Location: Parent's room
Purpose: Clothing storage

Location: Living area
Purpose: Blanket storage
Interactions: Kids climb inside or jump off of

Participant 2

In Scope:

Dimensions: 32''L x 18"W x 43" H
Location: Child's room
Warning Label Visible: No
Where Purchased: Hand-me-down (originally used to store dishes)
Inside Drawers: Clothes
Drawers: 75% full, clothes were not right up against top of drawer
Interactions: Child starting to interact with unit (2x a day) to get clothes. Used to only pull from one side but now pulls from both (see picture above). Does not climb, step, or stand on unit. Opens and closes drawers when interacting with unit but only one drawer at time.

Dimensions: 39''L x 18"W x 43" H
Location: Child's room
Warning Label Visible: No
Where Purchased: Could not remember, maybe Hanes
Inside Drawers: Clothes
Drawers: 90-100% full, clothes were full to top of drawer
Interactions: Child interacts with unit every day to get clothes out. Pulls from both sides of drawer. One drawer open when interacting Does not climb, step, or stand on unit.

Nightstands:

Dimensions: 15''L x 14"W x273" H
Location: Child's room

Warning Label Visible: No
Where Purchased: Hand-me-down
Inside Drawers: Junk
Interactions: Child only interacts with items on top of the unit.

Dimensions: N/A
Location: Child's room
Warning Label Visible: No
Where Purchased: Hand-me-down

Out of Scope:

Location: Child's room
Purpose: Costume storage

Location: Child's room
Purpose: Book and toy storage

Location: Hallway
Purpose: Toy and game storage

Location: Hallway
Purpose: Craft and toy storage

Location: Living area
Purpose: Book, toy, miscellaneous storage
Unit was anchored

Location: Family room
Purpose: Media storage

Location: Living area
Purpose: Toys, blankets
Interactions: Kids step/jump on

Location: Entryway
Purpose: Miscellaneous storage (sunglasses, etc.)

Participant 3

In Scope:

Dimensions: 42''L x 20"W x 38" H
Location: Parent's room
Warning Label Visible: No
Where Purchased: Consignment store
Inside Drawers: Clothes
Drawers: 90% full, items were not stuffed in drawers, but drawers were full almost to top
Interactions: Child interacts with drawers in morning while parents are getting ready. Does not climb, step, or stand on drawers or unit. Pulls out drawer from one side and reaches in (see above picture)

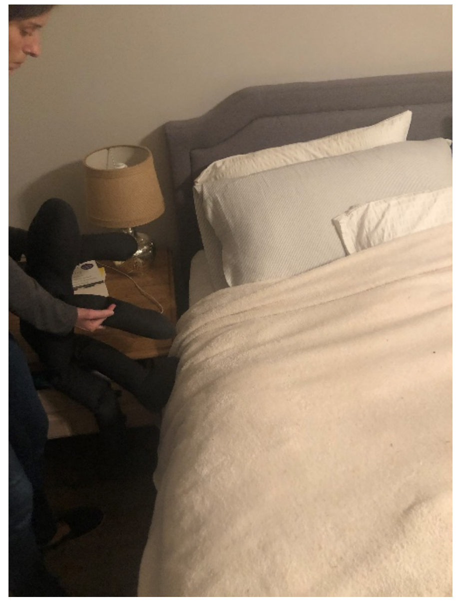
Dimensions: 33''L x 18"W x 42" H
Location: Parent's room
Warning Label Visible: No
Where Purchased: Consignment store
Inside Drawers: Clothes
Drawers: 90% full, items were not stuffed in drawers, but drawers were full almost to top
Interactions: Child does not interact with this unit

Questionable and of Interest:

Dimensions: 23’’L x 12”W x 35” H
Location: Child’s closet
Warning Label Visible: No, but participant remembered information about anchoring and safety on the box/instructions
Where Purchased: Unsure – Target or Walmart
Inside Drawers: Clothes and shoes
Drawers: 80 – 90% full, items were not tightly packed in bins, but bins were full almost to top
Interactions: Child interacts with unit often to get shoes out of bins but does not climb, step, or stand on unit
Unit was anchored

Nightstands:

Dimensions: 24''L x 16"W x 27" H
Location: Parent's room
Warning Label Visible: No
Where Purchased: Thrift store
Inside Drawers: Clothing in bottom (holiday/seasonal items), top drawer holds miscellaneous items
Drawers: 75% full, not packed tightly or full to top
Interactions: Child does not interact with unit. Participant called this unit a nightstand.



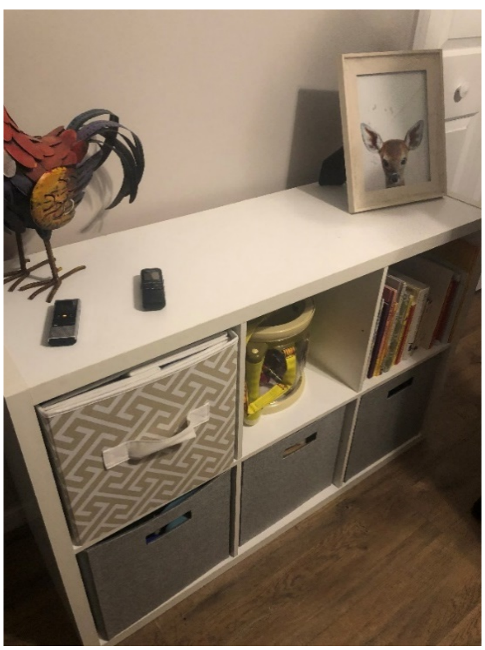
Dimensions: N/A (but shorter and wider than the other nightstand)
Location: Parent's room
Warning Label Visible: No
Where Purchased: Thrift store
Inside Drawers: Books, other miscellaneous items
Drawers: 75% full, not packed tightly or full to top
Interactions: Child interacts with unit frequently, will climb on unit and jump from unit to bed. Drawers are open (25–50% of the way) when interacting.


Dimensions: 36''L x 18"W x 22" H
Location: Parent's room
Warning Label Visible: Yes, inside unit. Participant had not noticed prior to research team noting.
Where Purchased: Consignment store
Inside Drawers: Clothing (sweatshirts, etc.)
Drawers: 75–80 % full, not packed tightly or full to top
Interactions: Child interacts with unit a couple days a week – opens and closes lid.

Out of Scope:

Location: Child's room
Purpose: Books/miscellaneous storage

Location: Parent's room
Purpose: Vanity – fairly empty
Interactions: Child interacts with unit in mornings, opens drawers 25–50% of the way open when interacting. Pulls drawers from one side (see picture above)

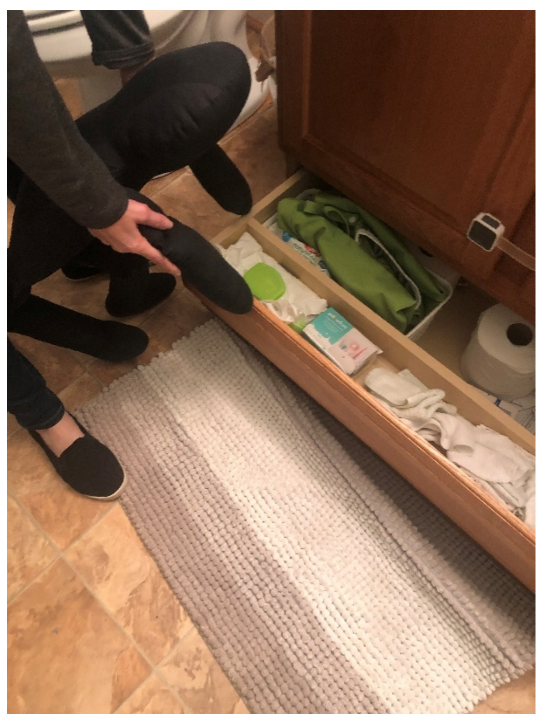


Location: Den/office
Purpose: Books, toys, shoes, miscellaneous

Interactions: Child interacts with units sometimes to get books but does not interact with it frequently. Does not climb or stand on unit, but will pull out bins

Location: Office/den
Purpose: Sewing desk, miscellaneous storage
Interactions: Child does not interact with unit

Location: Office/den
Purpose: Bookshelf
Interactions: Child does not interact with unit



Location: Bathroom
Purpose: Attached bathroom storage
Interactions: Child pulls out bottom drawer (the rest are locked), pulls drawer from one side (see picture above)


Location: Hallway
Purpose: Attached wall unit (from Ikea) – storage for shoes, etc.
Interactions: Child interacts with unit frequently – hangs on drawers (drawers are open 100% when hanging on them)


Location: Office/den
Purpose: Blankets/towels
Interactions: Child interacts with unit frequently – sits in and stands on unit. Warning label was visible to research team, but participant had not noticed before

Participant 4

In Scope:

Dimensions: 43''L x 23"W x 60" H
Location: Child's room
Warning Label Visible: No
Where Purchased: Participant's parents built it, new unit
Inside Drawers: Clothes and toys
Drawers: 75–80 % full, clothes were not tightly packed
Interactions: Child interacts with unit frequently – opens and closes drawers, pulls drawers from one side. Pulls drawer open partially when interacting
Unit was anchored

Dimensions: 50''L x 18"W x 37" H
Location: Child's room
Warning Label Visible: No
Where Purchased: Someone made it, ~2 years old (used to be changing table now just used for clothing and miscellaneous storage)
Inside Drawers: Clothes
Drawers: 75–80 % full, clothes were not tightly packed
Interactions: Child interacts with unit frequently – climbs from changing table piece to open drawers. The top drawer was broken from this interaction – second drawer is now locked
Unit was anchored


Dimensions: 40''L x 18"W x 46" H
Location: Parent's room
Warning Label Visible: No
Where Purchased: 60's vintage store
Inside Drawers: Clothes
Drawers: 75% full of clothes, clothes were not tightly packed
Interactions: Child does not interact with frequently but sometimes leans on it or tries to open drawers (see picture above), pulls from one side with both hands
Unit was anchored

Questionable and of Interest

Dimensions: 66''L x 19"W x 33" H
Location: Living room
Warning Label Visible: No
Where Purchased: 60's vintage store
Inside Drawers: Linens and other miscellaneous items, described by participant as "junk"
Drawers: 50 – 75% full, some drawers had no items in them, others were somewhat full
Interactions: Child interacts with this unit somewhat frequently, pulls open drawers with both hands – only pulls drawers open about 25%
Unit was anchored

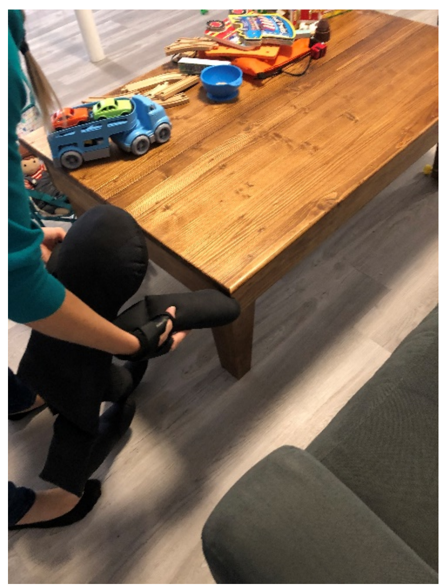
Nightstands:

Dimensions: 26’’L x 19”W x 29” H
Location: Parent’s room
Warning Label Visible: No
Where Purchased: Ikea
Inside Drawers: Books, socks, hairbrush, other miscellaneous items
Drawers: 75% full – items were not packed tightly to top, but drawers were full
Interactions: Child interacts with this unit to step onto bed – places on hand on nightstand and places foot on bottom (more on bottom lip of unit and not on bottom drawer). Also tries to pull items off the top of the nightstand (monitor, lamp).
Unit was not anchored.

Out of Scope:

Location: Basement
Purpose: Toy storage
Interactions: Child interacts with unit everyday – pulls out bins. Bins were 50% full (not stuff tightly).
Unit was anchored.



Location: Basement
Purpose: Toy storage
Interactions: Child interacts with unit frequently – opens top to play with train set.

Location: Dining room
Purpose: Bar cart/ glassware storage
Interactions: Child does not interact with unit.

Location: Family room
Purpose: TV stand/media storage/blanket storage
Interactions: Child does not interact with unit but does try to turn TV on.

Participant 5

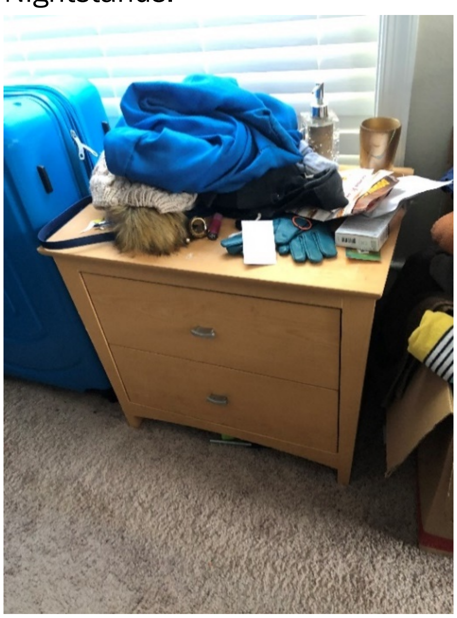
In Scope:
None

Questionable and of Interest:

Dimensions: 28''L x 17"W x 44" H
Location: Kids' room (2 kids share room)
Warning Label Visible: No
Where Purchased: Amazon
Inside Drawers: Shorts, socks, underwear, toys
Drawers: 80 – 90% full – items were not packed tightly to top, but drawers were full
Interactions: Children reach in to pull out clothing or toys – only pull the drawers open about 25% when interacting.

Dimensions: N/A
Location: Kids' room (2 kids share room)
Warning Label Visible: No
Where Purchased: N/A
Inside Drawers: Socks, clothes
Drawers: 90% full – items were not packed tightly to top, but drawers were full
Interactions: Children reach in to pull out clothing – "grab and go" – not interacting with unit for extended period of time.

Nightstands:

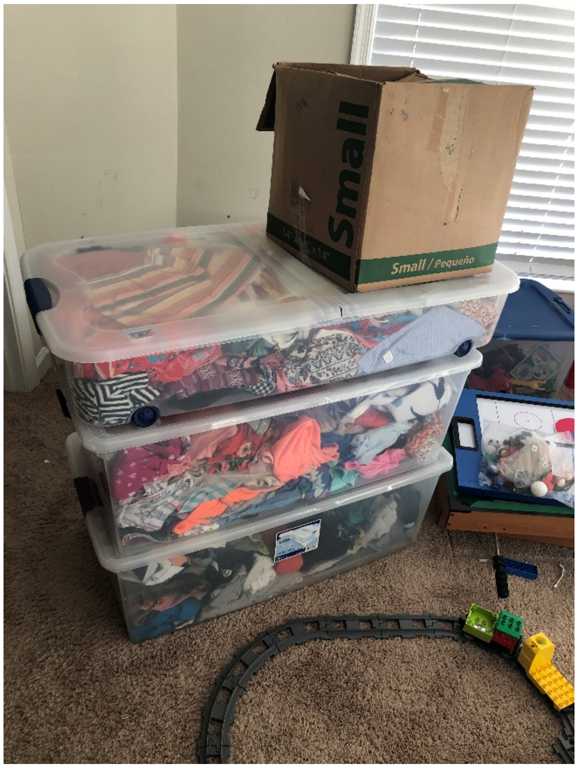


Dimensions: 22''L x 16"W x 21" H
Location: Parent's room
Warning Label Visible: No
Where Purchased: Obtained for free
Inside Drawers: Tights, scarves, lingerie
Drawers: Participant did not show research team inside of drawers
Interactions: Children do not interact with this unit.
Unit was not next to bed because of space constraints – moved to other wall in room for the time being (participant had just moved so item placement was still evolving).

Out of Scope:

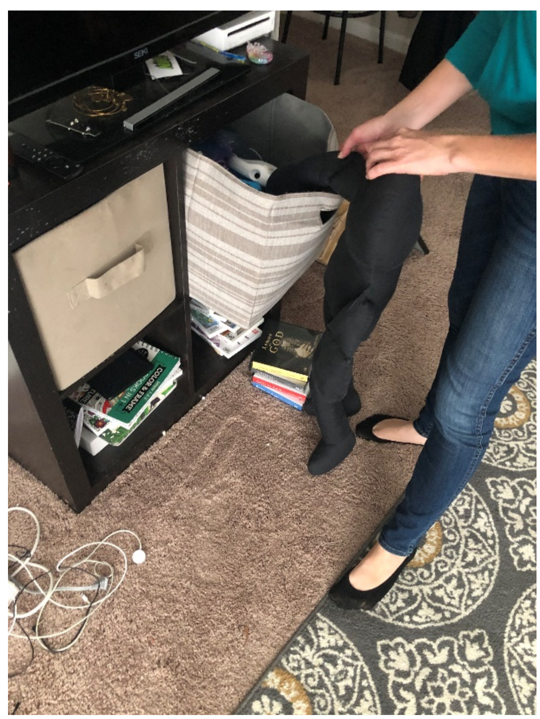
Location: Kids' room
Purpose: Clothing storage
Interactions: Children interact with storage bins frequently – pull out from under bed and grab clothing items

Location: Kids' room
Purpose: Book storage
Interactions: Children interact with bookcase regularly as they pull out their books



Location: Family room
Purpose: Non-seasonal clothing storage
Interactions: Minimal interactions as these are used to store non-seasonal clothing items

Location: Family room
Purpose: Toy storage
Interactions: Children interact with unit regularly – reach into baskets for items (see picture above) or take games off shelves

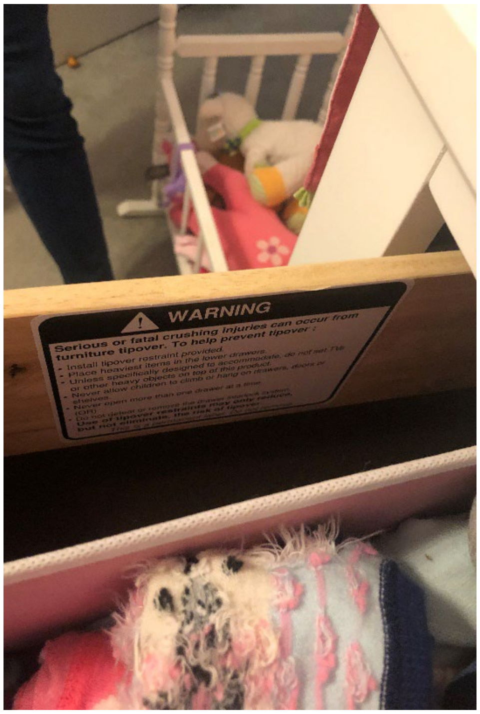


Location: Family room
Purpose: DVD/video game storage

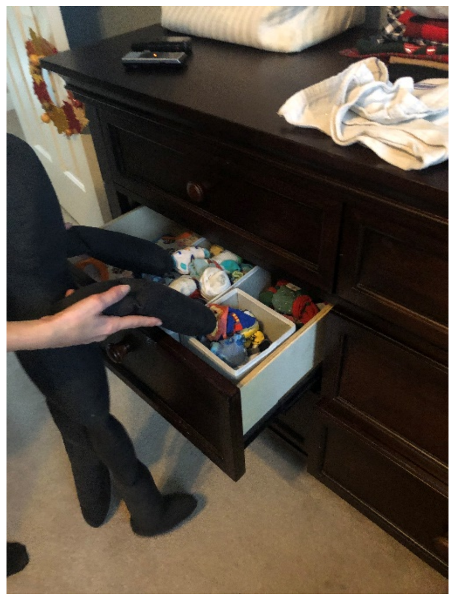
Interactions: Children interact with unit regularly – reach into baskets for items (see picture above) to take items out.

Participant 6

In Scope:



Dimensions: 50''L x 22"W x 44" H
Location: Kid's room
Warning Label Visible: Research team found label inside top drawer – participant was unaware it was there, and it was covered by clothing items
Where Purchased: Pottery Barn Kids
Inside Drawers: Kid's clothes
Drawers: 80 – 90% full – drawers had organizers in them so not too tightly packed but still full
Interactions: Child interacts with this unit regularly – opens drawers all the way when interacting. Usually pulls one drawer at a time (see picture above) and reaches into drawer



Dimensions: 50''L x 22"W x 44" H
Location: Kid's room
Warning Label Visible: Research team found label inside top drawer – participant was unaware it was there, and it was covered by clothing items
Where Purchased: Babies R' Us – have had unit for about 5 years

Inside Drawers: Kid's clothes
Drawers: 80 – 90% full – drawers had organizers in them so not too tightly packed but still full
Interactions: Child interacts with this unit to get socks – opens drawers about halfway when interacting. Usually pulls one drawer at a time with both hands (see picture above) and reaches into drawer

Questionable and of Interest:

Dimensions: 35''L x 12"W x 36" H
Location: Kid's room
Warning Label Visible: No
Where Purchased: N/A
Inside Drawers: Toys, doll clothes
Drawers: 75% full – most drawers were not filled to top
Interactions: Child interacts with this unit to get toys and doll clothes, usually interacts with bottom drawers the most (see picture above). Drawers are typically 50 – 75% open when reaching into them.

Nightstands:


Dimensions: 23''L x 16"W x 24" H
Location: Kid's room
Warning Label Visible: No
Where Purchased: N/A
Inside Drawers: Miscellaneous items
Drawers: 50% full, not many items inside small top drawer
Interactions: Child does not interact with this unit regularly

Dimensions: N/A
Location: Parent's room
Warning Label Visible: No
Where Purchased: Ashley Furniture (brand new)
Inside Drawers: Miscellaneous items (not clothing)
Drawers: N/A
Interactions: Child does not interact with this unit regularly

Out of Scope:

Location: Kid's room
Purpose: Desk – toy/miscellaneous storage
Interactions: Child climbs on chair sometimes to reach things that are high up

Location: Kid's room
Purpose: Toy/blanket/miscellaneous storage
Interactions: N/A

Location: Dining room
Purpose: Miscellaneous storage (pens, craft items)
Interactions: Child sometimes tries to open top drawers to get pens

Location: Family room/living area
Purpose: Miscellaneous storage (games, crafts, etc.)
Interactions: Children sometimes open doors to reach for toys or craft bin

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TAB R: Forces and Postures During Child Climbing Activities

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CPSC Staff Statement on University of Michigan Transportation Research Institute (UMTRI) "Forces and Postures During Child Climbing Activities: Technical Report"[1]

March 29, 2021

The report titled, "Forces and Postures During Child Climbing Activities: Technical Report," presents the results of an in-lab human subjects study of 40 children ages 20 to 65 months. Children and their caregivers participated in a group discussion with the researchers that focused on the child's climbing behaviors. Researchers also directed the children through a set of climbing behaviors on an instrumented test fixture with parallel bars representing the upper and lower handholds of a clothing storage unit. Researchers measured the forces and postures exerted by the children and calculated the tip-over moment around a virtual fulcrum for five climbing behaviors: ascend, bounce, lean, yank, and leaning back while supported with one hand and one foot. Researchers also gathered data for child interactions with a simulated drawer and table top. Work was completed under CPSC contract 61320618D0004, Task Order 61320619F1015.

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[1] This statement was prepared by the CPSC staff, and the attached report was produced by the University of Michigan Transportation Research Institute for CPSC staff. The statement and report have not been reviewed or approved by, and do not necessarily represent the views of, the Commission.

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Forces and Postures During Child Climbing Activities

Technical Report

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July 2020

Technical Report Documentation Page

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16. Abstract

Many children are injured every year due to furniture and appliances tipping over and displacement of objects on furniture. Injuries are due to the furniture unit falling onto the child as well as falling objects supported by the furniture, particularly televisions. Clothing storage units, such as dressers, are a common type of furniture to tip over onto children. The current U.S. voluntary standard addressing the stability of clothing storage units, ASTM F2057-19, mandates a test procedure that involves applying a 50-lb weight at the edge of an opened drawer. No studies have previously assessed the forces that children exert when climbing under conditions similar to those associated with furniture tip overs. To address this need, a laboratory study was conducted with a convenience sample of 40 children ages 20 to 65 months from Southeast Michigan. Children were directed through a set of climbing behaviors on two instrumented bars (handles) to simulate a dresser, and with a simulated drawer and tabletop. Forces and moments gathered from load cells in the test apparatus were analyzed for 1173 behavior instances. The primary dependent measure was the tip-over moment calculated around a virtual fulcrum simulating the contact point between the floor and the front of the dresser. Five climbing behaviors — ascend, bounce, lean, yank, and leaning back while supported with one hand and one foot — were extracted from trials with a range of handle positions, and the maximum tip-over moment was computed from the handle force data. For the simulated drawer and table conditions, the moments at the time of ascent and descent were computed, as well as the peak moment during ascent.

Tip-over moments in all of the handle-trial behaviors exceeded the moment associated with body weight located one foot from the fulcrum. On average, the moments generated in the ascend, bounce, lean, and yank behaviors were equivalent to exerting 1.8, 2.7, 2.7, and 3.9 times body weight, respectively, at a distance of one foot from the fulcrum. The location of the child's center of mass (CM) was estimated in side-view images from the times of maximum moment. The results demonstrate that climbing, with vertically separated contacts for the hands and feet, enables children to exert tip-over moments that exceed those associated with the action of their body weight under their feet. Dynamic behaviors, such as stepping up, bouncing, or yanking can greatly increase the tip-over moment. In contrast, children climbing into or out of a simulated drawer tend to place their CM more inboard and thereby generate less tip-over moment than when climbing with vertically separated hand and foot placements.

These data provide the first available information on forces and moments associated with child climbing behavior and may be used to inform the design of furniture and the development of associated performance standards.

17. Key Words Child strength, furniture tip over, child anthropometry, child strength, child climbing			18. Distribution Statement
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We thank our collaborators at the CPSC for their substantial contributions to this work, in particular Kristen Talcott and Rana Balci-Sinha. Michael Taylor and Daniel Taxier also provided valuable input.

At UMTRI, a large number of people contributed to the success of this project including Carl Miller, Brian Eby, Jennifer Bishop, Laura Malik, Emma Cheyne, and Justin Vellend.

ABSTRACT

Many children are injured every year due to furniture and appliances tipping over and displacement of objects on furniture. Injuries are due to the furniture unit falling onto the child as well as falling objects supported by the furniture, particularly televisions. Clothing storage units, such as dressers, are a common type of furniture to tip over onto children. The current U.S. voluntary standard addressing the stability of clothing storage units, ASTM F2057-19, mandates a test procedure that involves applying a 50-lb weight at the edge of an opened drawer. No studies have previously assessed the forces that children exert when climbing under conditions similar to those associated with furniture tip overs. To address this need, a laboratory study was conducted with a convenience sample of 40 children ages 20 to 65 months from Southeast Michigan. Children were directed through a set of climbing behaviors on two instrumented bars (handles) to simulate a dresser and with a simulated drawer and tabletop. Forces and moments gathered from load cells in the test apparatus were analyzed for 1173 behavior instances. The primary dependent measure was the tip-over moment (i.e., the torque that tends to tip the unit over) calculated around a virtual fulcrum simulating the contact point between the floor and the front of the dresser. Five climbing behaviors — ascend, bounce, lean, yank, and leaning back while supported with one hand and one foot — were extracted from trials with a range of handle positions, and the maximum tip-over moment was computed from the handle force data. For the simulated drawer and table conditions, the moments at the time of ascent and descent were computed, as well as the peak moment during ascent.

Tip-over moments in all of the handle-trial behaviors exceeded the moment associated with body weight located one foot from the fulcrum. On average, the moments generated in the ascend, bounce, lean, and yank behaviors were equivalent to exerting 1.8, 2.7, 2.7, and 3.9 times body weight, respectively, at a distance of one foot from the fulcrum. The location of the child's center of mass (CM) was estimated in side-view images from the times of maximum moment. The average estimated CM (ECM) location was outboard of the hands and feet in all handle configurations and behaviors, with the largest distances observed in the lean and yank conditions. The ECM locations were close to the edge of the simulated drawer and table in the associated trials, and the associated moments were equivalent to 0.8, 0.7, and 1.1 times body weight for the ascent, descent, and maximum moment points, respectively. The results demonstrate that climbing, with vertically separated contacts for the hands and feet, enables children to exert tip-over moments that exceed those associated with the action of their body weight under their feet. Dynamic behaviors, such as stepping up, bouncing, or yanking can greatly increase the tip-over moment. In contrast, children climbing into or out of a simulated drawer tend to place their CM more inboard and thereby generate less tip-over moment than when climbing with vertically separated hand and foot placements.

A comparison of the postures observed in the study with publicly available videos of children climbing dressers and other furniture suggests that the behaviors, particularly the ascent behaviors in both the handle and drawer trials, represent common movement patterns. Leaning and yanking are also observed in interactions with other household items, such as gates. These data provide the first available information on forces and moments associated with child

climbing behavior and may be used to inform the design of furniture and the development of associated performance standards.

INTRODUCTION

Many children are injured due to furniture and appliances tipping over and displacement of objects on furniture, particularly televisions. Gottesman et al. (2009) reviewed 18 years of hospital trauma data to characterize injuries to children due to tip overs. They documented an average of 14,700 injuries per year in the United States, about half of which were due to televisions falling on children. They noted that pulling and climbing on furniture accounted for more than 25% of the injuries. Wolf and Harding (2011) reviewed case reports of child fatalities due to furniture and television tip overs, documenting the role of climbing or other interactions in each case. Cusimano and Parker (2016) conducted a systematic literature review focused on falling televisions as a source of injury to children. Among the papers they surveyed, 19 of 29 identified climbing as the most significant cause of injury.

Recently, Suchy (2019) reported that the U.S. Consumer Product Safety Commission was aware of 459 fatalities among children, ranging in age from under 1 years of age to 14 years of age due to incidents of product instability or tip overs between 2000 and 2018. Data from hospital emergency departments indicates that, between 2016 and 2018, an estimated annual average of 12,500 children in the United States were treated for injuries due to product instability or tip-over. When children are injured, case reports suggest that these injury events commonly result from children climbing on or otherwise interacting physically with the product. Approximately 78% of estimated injuries to children occur in children six years old or younger; a majority of fatalities involve children between 1 and 3 ½ years old.

A majority of fatalities among children from tip overs involving only furniture are due to dressers, bureaus, and chests. ASTM F2057-19, Standard Safety Specification for Clothing Storage Units, defines a clothing storage unit is a "furniture item with drawers and/or hinged doors intended for the storage of clothing typical with bedroom furniture," such as chests, door chests and dressers. F2057 is a voluntary standard that has two stability-related requirements. The first evaluates whether an empty unit tips when all extension elements (drawers and doors) are open, with no additional weights or forces applied. The second is a static test with a weight to assess tip-over risk. Starting with an empty unit, a single drawer or door is opened to a specified position and a 50-lb weight is "gradually" placed on the edge. The unit meets the requirement if it does not tip over when all extension elements are tested individually. F2057 states that the 50-lb test weight is "equal to the 95th percentile five-year-old child." According to a nationally-representative study for the United States, published in 2016, the mean body weight of a five-year-old child (i.e., age 60 to 71 months) is 47 lb for boys and 45 lb for girls; the 95th-percentile body weight is 64 lb for boys and 61 lb for girls (Fryar et al. 2016).

Currently, minimal quantitative information is available on the forces exerted by children when performing climbing behaviors that may result in tip overs. Nose et al. (2018) reported on a research program aimed at characterizing child climbing activities, but forces were not measured. The test procedure in F2057 is based explicitly on a statically applied body weight, but information is needed on whether climbing behaviors could result in applied forces that exceed body weight, and whether a child could climb in such a way that the tip-over moment (that is, the torque that tends to tip the unit over) is greater than that produced by the child's body weight resting on the front edge of the drawer.

The objective of the current study was to examine the forces and postures associated with child climbing activities that might be among those associated with tip-over events. The study was not designed to obtain normative data for a population on the distribution of forces children can exert. Rather, the goal was to obtain data on the *possible* interactions that could be used to inform the design of furniture and related standards development.

To accomplish this objective, a convenience sample of 40 children, ages 20 to 65 months, from Southeast Michigan who were identified by their caregivers as showing interest in climbing in the household were recruited to participate in data collection sessions. The study had two major components. First, the children and their caregivers participated in a group discussion with the investigators that focused on the child's climbing behaviors. Second, a laboratory study was conducted to measure forces and postures exerted by the children in a range of climbing behaviors.

The children's size and body shape were quantified using traditional manual and three-dimensional anthropometry. The child participants were directed through a set of scripted behaviors on a laboratory apparatus, including climbing, leaning, and bouncing. Force and moment data were gathered from all interaction surfaces and video and three-dimensional point-cloud data were obtained from several angles.

The focus group data were analyzed to document the range of climbing behaviors the children exhibited, including the locations and types of furniture that they climbed. The data from the laboratory data collection were analyzed to quantify the maximum forces and tip-over moments generated by the children during the scripted behaviors across the various fixture configurations, along with the estimated center of mass locations at the time of peak force or moment. Data from a total of 1173 behavior instances were analyzed. The effects of the behavior type, fixture configuration, and child anthropometric characteristics were assessed.

METHODS

Reporting Units

The data in this study were gathered and calculations were performed using SI units: Newtons (N), meters (m), and Newton-meters (Nm). To improve interpretation for individuals more familiar with U.S. customary units, the plots and tables in this report show dimensions in inches and feet, force in pounds force (lb), and moments in pounds-feet (lb ft). These values were converted from the SI values using 4.45 N/lb, 0.0254 m/inch, and 1.355 Nm/lb-ft. Generally, the displayed unit was converted, rather than the preceding values. For example, moment calculations were performed using N and m, then converted to lb-ft. Calculations were performed at the available data resolution, typically 10 digits. The displayed values are rounded to three significant digits, which corresponds approximately to measurement precision for forces and moments.

Relevant Furniture Dimensions

CPSC staff provided dimension data from over 180 clothing storage units. Of particular interest for the current study was the height of the upper front edge of the lowest drawer relative to the floor, since this would be a likely point of force application for a climbing child. The drawer extension, i.e., how far the drawer could be pulled out before hitting a stop, was also a consideration, since this affects the tip-over moment a child can generate. In general, when vertical forces are applied at the upper edge of the drawer front, larger values for extension create greater tip-over moments. Similarly, rearward forces exerted at a greater height are associated with larger tip-over moments. Table 1 shows summary data for these two values. Based on this analysis, the values for 16 inches height and 12 inches for extension were used in the analysis to estimate the potential effects of the measured forces and moments on tip-over moment. The moment calculations were performed using the SI equivalents of 406 and 305 mm, respectively, and the results converted to U.S. customary units for reporting. These calculations are explained in detail below and the effects of choosing different values for these dimensions are quantified.

Table 1
Summary Statistics for the Lowest Drawer of Clothing Storage Units (inches)

Dimension	N	Mean	SD	10^{th}%ile	50^{th}%ile	90^{th}%ile
Height	175	13.5	2.4	11.1	13.4	16.1
Extension	182	10	1.6	8.4	9.8	11.9

Laboratory Apparatus

Laboratory Space

The test fixtures and laboratory space used in this study were purpose-built for this and related studies with children. Figure 1 shows a schematic of the laboratory space, and Figure 2 shows photos of the space while testing was in progress. A column with linear tracks on four sides was located in the center of the laboratory. The column was bolted to the cement floor and braced by beams that extended to the walls near the ceiling (Figure 3). Reconfigurable fixtures were mounted on bearings attached to the linear tracks on the sides of the column. A force plate was bolted to a concrete pad on the floor in front of the column, and a raised platform floor was built so that the floor of the testing area was level with the top of the force plate.

The raised floor area was flanked on two sides by half-walls with doors. A transparent wall on the side of the laboratory where participants entered created a space where participants and their families could sit and see all of the testing activities. An opaque wall on the opposite side of the laboratory separated the raised testing area from the data acquisition system and test fixtures not being used during a trial.

Edges and surfaces accessible to children were covered or padded. The floor under and around the test fixtures was padded with large pieces of ArmaSport ALC (Armacell) foam, a polyvinyl chloride/ acrylonitrile butadiene rubber blend. The manufacturer states that it has a 25% compression resistance at 4.0-6.0 psi, a 50% compression set at 25% of maximum, and density of 6.0-8.5 lb/ft^3 (ASTM D 1056). It has a minimum tensile strength of 90 psi and elongation of 125% minimum (ASTM D 412). The padding on top of the floor force plate was cut so that it did not touch the surrounding floor or padding. Padding that covered the other load cells was constructed so that it would not rest on the load cell.

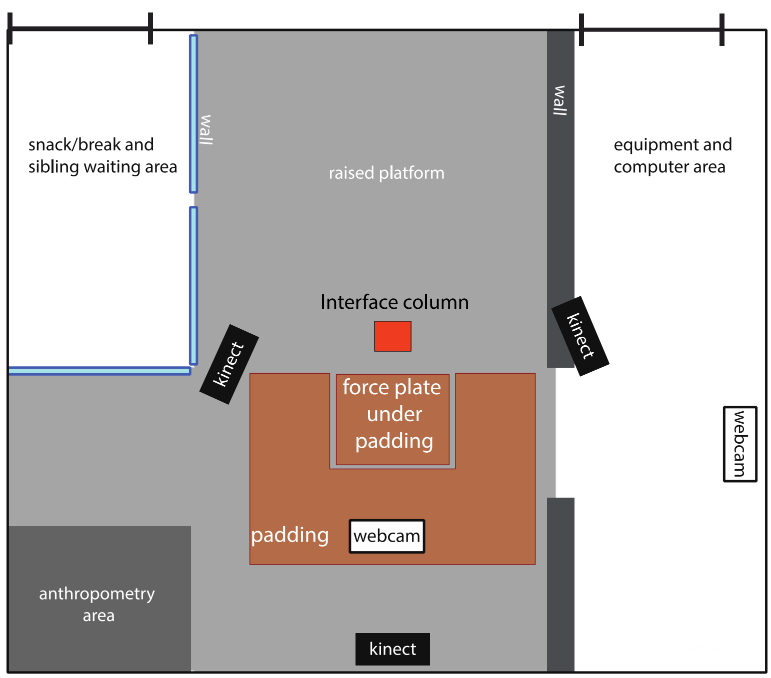


Figure 1. Floor plan of laboratory where climbing study was performed showing testing area in grey and waiting and storage areas in white.

Figure 2. Photos show the laboratory space in use. The photos on the top shows a child approaching a representation of a dresser front with instrumented handles and an investigator giving encouragement, along with a side view of a child on the apparatus. The photos on the bottom show the waiting/break area for children (bottom left), a child participant climbing down from a table condition in the center of the lab while a parent crouches alongside (bottom middle), and an investigator running the data acquisition system while a child participant sits in the open drawer (bottom right).

Figure 3. The photo on the left shows the beams bracing the center column. The photo on the right shows the data collection equipment (Kinect Azure and webcam) attached to the beams.

Handle (Bar) Fixtures

A laboratory apparatus was constructed to provide children with the opportunity to perform a set of scripted climbing behaviors. The apparatus was intended to facilitate the climbing behaviors rather than being typical of any type of furniture. Figure 4 shows a child on the apparatus.

Figure 4. Child on the climbing apparatus. The positions of the two bars (red) could be adjusted vertically and horizontally.

A set of two bars that could be moved and then locked into different horizontal and vertical positions was used to simulate a climbing surface. Figure 5 shows both bars (handles). The handles were designed to provide advantageous grip surfaces so that the children's force exertions were not limited by discomfort due to sharp edges. The upper bar that the children grabbed with their hands was a 460-mm-long rod with a diameter 19 mm mounted to a load cell at the middle of its length. The diameter was chosen as a comfortable diameter for children to grip based on pilot testing. The lower bar, which supported the child's feet during most behaviors, was 610 mm long with a diameter of 25.2 mm. The lower bar was mounted along its length to a flat piece of angled aluminum that was attached to a load cell at middle of the bar length. The purpose of the flat metal adjacent to the bar was to keep the child from falling to the floor if the child's foot slipped forward. The lower bar was round so that the interface between the child's foot and the surface was the same regardless of the angle of the child's foot while on the bar.

The bars were covered in a Durabak brand polyurethane marine coating. This material provided a smooth surface with high friction that could be sanitized easily. The color red was chosen to contrast the colors in the lab, make the bar visually appealing, and enhance oral instruction to the children.

The bars and load cells were attached to movable arms constructed from two pieces of extruded aluminum. The arms straddled the central column and traveled fore-aft along two linear bearings. The arms could also be moved vertically with two additional linear bearings on the column. Each of the four bearings had two locks used to keep the bars securely in place once positioned.

Figure 5. Interaction bars used in the climbing trials. The children grasped the thinner upper bar (top) with their hands and interacted with the thicker lower bar with their feet. The edge of the flat aluminum safety surface on the lower bar was covered with foam padding.

Drawer and Table

In addition to the bars used for climbing behaviors, a separate fixture was constructed to simulate a drawer and table-top (see Figure 6). The drawer was made in two parts. The main part of the drawer was an aluminum box, bolted to a six-axis force plate. The box was open in the front and at the top and had transparent plexiglass windows on two sides. The inside of the box was 24 inches wide by 16 inches deep by 8 inches high. The inside bottom surface was padded with the same material as the floor, decreasing the interior height to 6.75 inches. The front surface of the drawer was a separate piece of aluminum 24 inches wide by 12 inches high. This piece did not touch the main part of the drawer and was supported separately by a six-axis load cell. The top edges of both parts of the drawer were covered in lengths of foam padding for protection. Figure 7 shows the two parts of the drawer. The box and its force plate were bolted to the top of the support arm used for the handle trials, and the front of the drawer with its load cell were attached to the front of the support arm. As the box was being set to the height needed for a trial, wood supports were placed under the arm so that the weight of the box would be supported by the floor instead of the central column and the bearings on linear tracks were locked, providing greater rigidity.

A vertical surface extending the width of the drawer was placed behind the drawer, extending from a couple of millimeters above the top edge of the back of the drawer to a height well above the child when in the box (Figure 8). This surface was also supported by the central column and instrumented with a 6-axis load cell. However, interaction with the back surface was infrequent and the data were not analyzed.

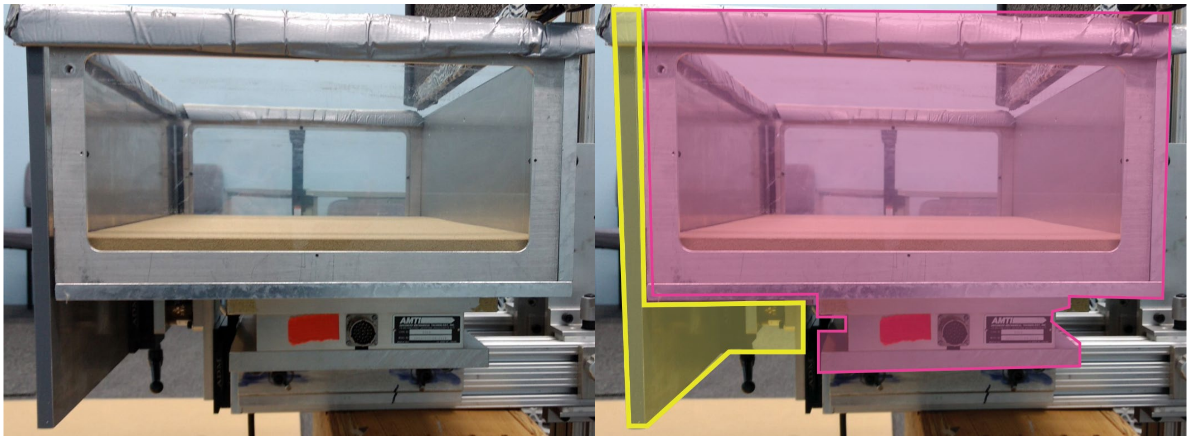


Figure 6. The image on the left shows a closer view of the force instrumentation for the drawer conditions. The front side of the drawer was mounted separately from the rest of the box. The image on the right highlights the separate pieces.

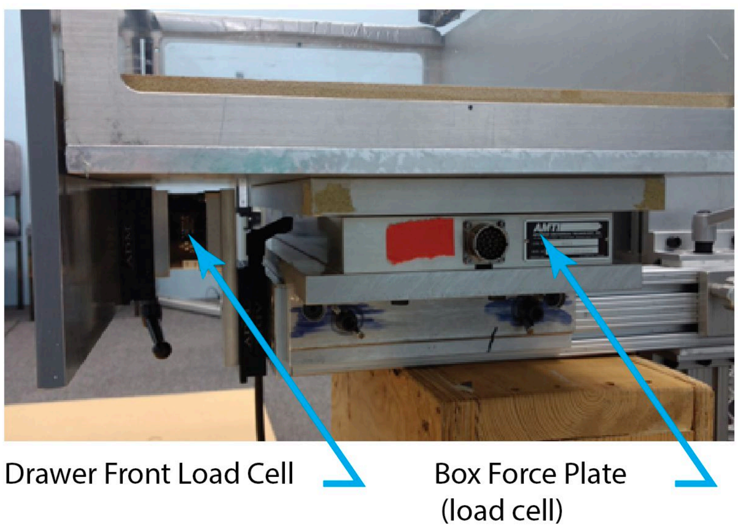


Figure 7. Close-up view of the underside of the drawer fixture, showing the two load cells that were used to measure forces and moments on the drawer front and the main part of the drawer (box).

A flat "table" was created by bolting a 28-x-16-inch wooden board to the back and sides of the drawer box. This set up was intended to simulate a tabletop or the top of a dresser or other furniture unit. The forces the child exerted on the table were only measured by the force plate under the box. The front of the drawer was still in place, and the load cell behind it measured forces the child applied to the front surface only. Because the top surface of the drawer front was covered by the tabletop, forces on the drawer front in this condition were limited to being predominantly horizontal. Figure 8 shows a table condition. The vertical surface behind the table was raised a few millimeters above the table to avoid force transfer between the components.

Figure 8. Photos of the table condition from two perspectives, showing the flat wood tabletop added to the box frame.

Instrumentation

The force plate under the main part of the drawer was an AMTI model BP250500-6-2000, and the force plate under the floor was an AMTI model OR6-7-1000. The load cells used for the front of the drawer, the vertical surface behind the drawer, and both handles were Denton model 3300. Data from the force plates and load cells were acquired using custom software interfacing with a National Instruments CompactDAQ with NI-9237 modules. Data were recorded at 2000 Hz with the forces in N and the moments in Nm. Force and moment data were initially low-pass filtered for anti-aliasing at 900 Hz. A 200 Hz, 4^{th}-order, phaseless low-pass filter was applied prior to analysis. As noted above, the calculated values were converted to lb and lb ft for tables and figures in this report.

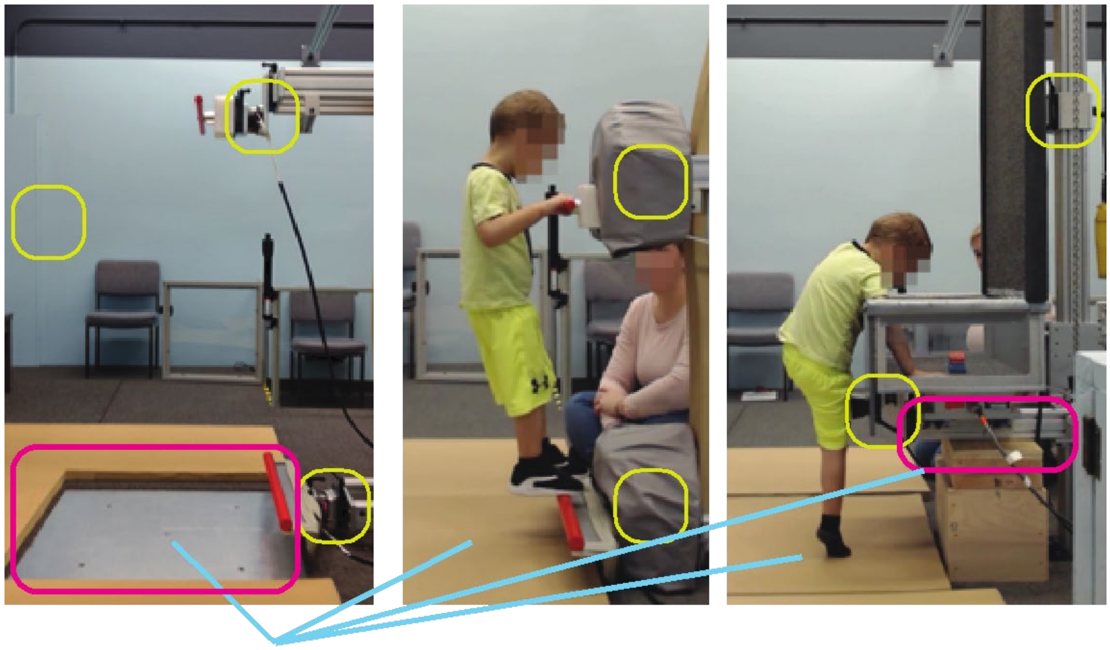


Figure 9. The image on the left shows the laboratory set up for a handle condition with the padding removed to show the force instrumentation behind the bars and on the floor. The image in the center shows the same type of condition but with the instrumentation covered with padding. The image on the right shows the set up for the drawer condition with the force instrumentation for the drawer, the drawer front, and the front surface of the furniture behind the drawer.

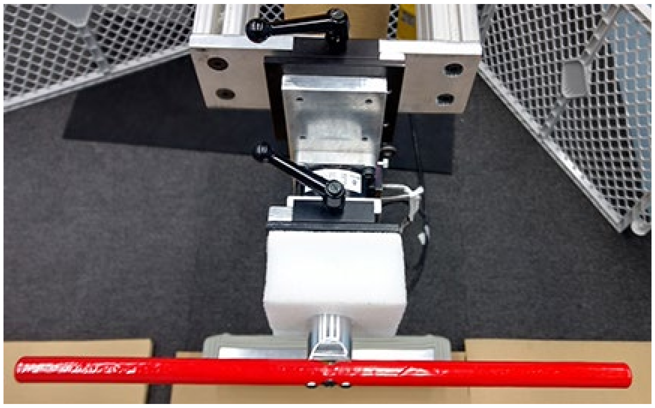


Figure 10. The handles were mounted on the 6-axis load cells via a quick release locking system. The photo shows the handle with the load cell behind it.

Video and Posture Measurement

Two Logitech C920 cameras were used to record the participants' movements. The cameras collected 640-x-480-pixel images at a rate of 15 Hz. Figure 11 shows the fields of view for the cameras. One camera was mounted on an overhead track and was moved between trials to get the best field of view possible for the trial. The other camera was mounted on the wall to the right of the test fixture and was not moved during testing.

The side-view camera was calibrated for making quantitative measurements using a checkered grid (Figure 12). Images were recorded with the grid at the far side of the drawer, at the middle of the fixture, and at the near side (closest to the camera). The images were digitized to establish calibration factors relating the image dimensions (pixels) to physical dimensions in the laboratory space. The calibration value for the middle position was used for the calculations in this report, with the far and near calibrations serving as approximate error bounds for these measurements. Based on the calibration data, the measurements from the webcam images are estimated to be accurate ±15 percent. On average, distances between landmarks are probably slightly overestimated, since the measured points on the right side of the child's body usually lay somewhat closer to the camera than the center of the fixture.

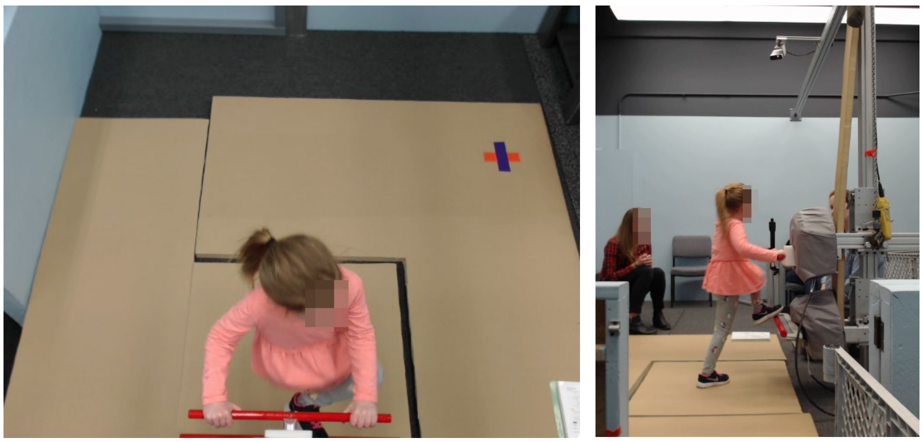


Figure 11. Example of camera fields of view: top (left) and side (right).

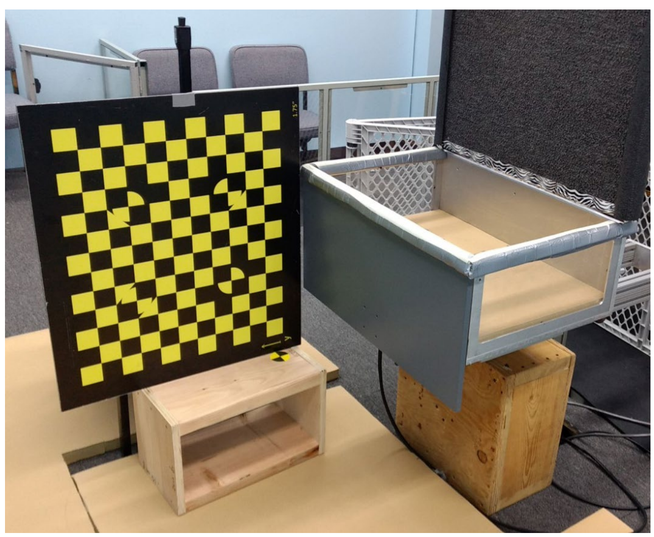


Figure 12. Camera calibration grid set up for the side-view webcam.

3D Posture Measurement

A 3D human motion tracking system based on Microsoft Azure Kinect sensors was used to capture the 3D posture of the participants (Figure 13). Placement of the sensors was constrained by the test fixtures and possible occlusion by the additional people in the room. Three sensors were placed in a triangular shape above the test fixture area. Two were located on either side of and to the front of the participant, and the third was placed directly behind the participant. Figure 14 shows an image from the 2D RGB camera on each Kinect sensor. The data from the Kinect sensors were not analyzed for this report.

Figure 13. One of the Azure Kinect sensors mounted in the laboratory.

Figure 14. Examples of the RGB camera fields of view from the three Azure Kinects during data collection.

Study Population

Recruitment

Caregivers of 189 children in the desired age range responded to an online advertisement on the University of Michigan portal for participation in research studies. In a phone interview, caregivers were asked the following questions:

How old is your child? [require 18 to 71 months]

What is your child's gender? [recorded to consider girl/boy balance]

Does your child have normal physical development? [require yes]

Can he/she participate in normal physical activities, such as running and playing on playground equipment? [require yes]

Has your child shown an interest in climbing on a household item (not on a playground)? [require yes]

In this study, we will ask your child to push and pull very hard with his/her hands and feet, and climb up on laboratory equipment above a padded floor. Does that sound like something your child would be able to do? [require yes]

Does he/she currently have any illness or injury that would make it difficult for your child to participate? [require no]

Is your child able to follow spoken instructions in English at a level appropriate for his/her age? [require yes]

Is it OK for us to record video of your child? [require yes]

Equal numbers of boys and girls were selected from among those who answered these questions in the manner required. Consequently, all participants were children whose caregivers indicated that they have "shown an interest in climbing a household item" and all had typical motor development. From among those eligible, children were chosen to fill the sex/age bins in Table 2. Availability for open test times was also a consideration in choosing participants.

Forty children participated in this study. Table 2 shows the age bins targeted and the age distribution of the participating children. Because some of the children were not able to complete all of the testing conditions, more participants than originally planned were recruited to ensure the number of completed trials across conditions was reasonable.

Table 2
Participant Age Distribution

Age Range	Original Target Number	Number of Female Participants	Number of Male Participants	Total Participants
18 – 23 months	4	2	4	6
24 – 47 months	12	11	10	21
48 – 71 months	8	7	6	13
Total	24	20	20	40

Standard Anthropometry

Standard anthropometric dimensions, including stature, body weight, and linear breadths and depths were gathered from each participant to characterize the overall body size and shape. Table 3 lists the anthropometric measures collected, and Table 4 lists a summary of these measures for the children tested. Appendix A explains the anthropometric methods and Appendix B lists all of the values. Figure 15 shows a plot of stature and body weight, demonstrating the range of both variables.

Table 3
List of Standard Anthropometric Measures

Weight	Erect Sitting Height
Stature	Hip Breadth
Axilla Height	Buttock-Popliteal Length
Omphalion Height	Buttock-Knee Length
Max Step Height	Bi-acromial Breadth
Upward Grip Reach	Waist Circumference at Omphalion Height
Span	

Table 4
Summary of Participant Anthropometry (US Customary Units)

Measurement	Minimum	Maximum	Mean	Median	SD
Age (mo)	20	65	40	38	13
BMI (kg/m^2)	13.7	20.7	16.7	16.4	1.6
Weight (lb)	22.7	50.1	34.4	34.2	6.2
Stature (in)	29.3	44.1	37.9	37.5	3.7
Axilla Height (in)	21.5	31.7	27.0	27.1	3.0
Omphalion Height (in)	15.4	25.3	20.9	20.3	2.8
Upward Grip Reach (in)	32.4	52.0	43.1	42.1	4.7
Max Step Height (in)	6.9	15.8	10.5	10.3	2.4
Waist Circumference at Omphalion (in)	18.0	25.7	20.7	20.5	1.3
Erect Sitting Height (in)	18.4	25.6	21.9	21.6	1.7
Hip Breadth (in)	6.7	10.6	8.0	8.0	0.8
Buttock-Popliteal Length (in)	7.4	13.8	9.9	9.3	1.4
Buttock-Knee Length (in)	7.2	14.3	11.9	11.8	1.6
Biacromial Breadth (in)	7.5	10.7	8.8	8.7	0.7
Reach Span (in)	28.1	43.5	36.6	36.6	4.1

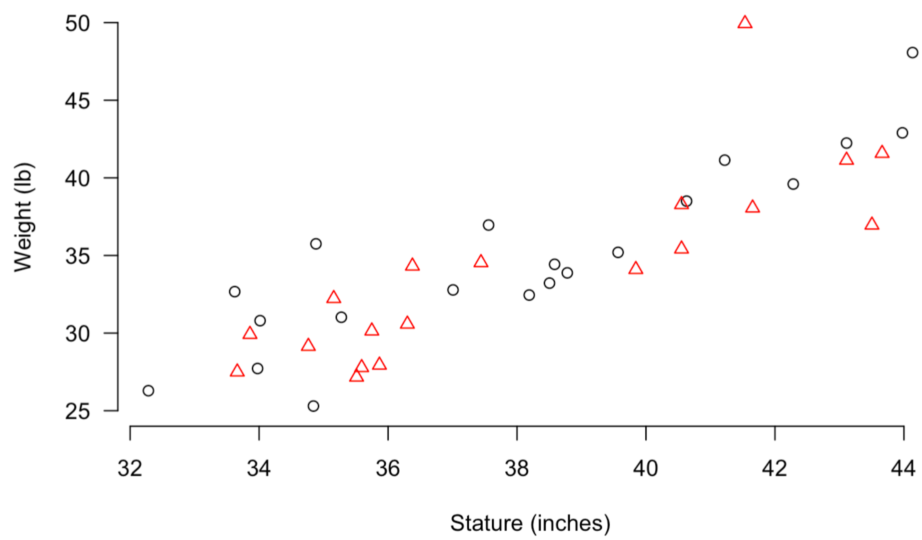


Figure 15. Participant weight versus stature for boys (circles) and girls (triangles).

Three-Dimensional Anthropometry

In addition to standard anthropometric data, body shape and surface contours were recorded using a Vitronic Vitus XXL full-body laser scanner and Scanworx software by HumanSolutions.

The VITUS XXL records hundreds of thousands of data points on the surface of the body in about 12 seconds by sweeping four lasers vertically. The two cameras on each of the four scanning heads pick up the laser light contour projected on the participant and translate the images into accurate three-dimensional data. The participants were scanned in a standing and an unsupported seated posture.

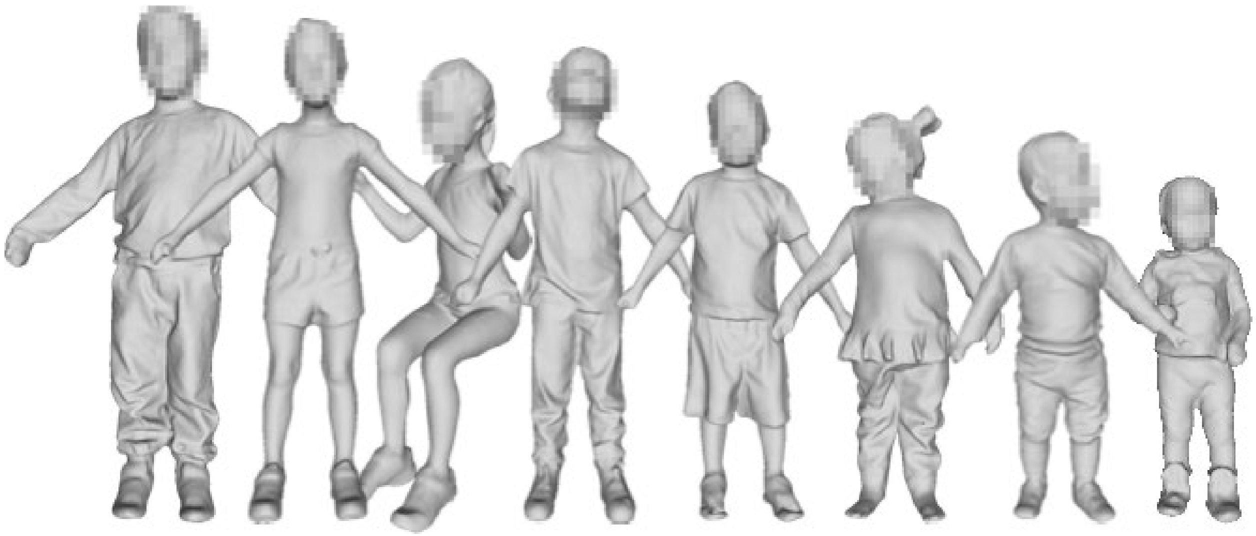


Figure 16. Examples of child 3D scans, from left to right: 5YO (1117 mm), 5YO standing and seated (1105 mm), 5YO (1021 mm), 2YO (970 mm), 2YO (904 mm), 21MO (864 mm), and 21MO (743 mm)

Focus-Group Questions

The participant and caregiver were asked questions during the testing session about the participant's typical climbing behaviors at home and in other settings (Appendix C). The questionnaire was administered orally, and participants were encouraged to expand upon any answers given. Typically, the investigators began the questions early in the testing session and returned to them throughout the session as breaks were needed for the child.

Child Activities and Instructions

The study protocol was approved by an institutional review board for human-subject research at the University of Michigan (HUM00158177). Caregivers were required to stay with their children at all times during the testing session, which was limited to 2 hours. Children and caregivers were offered breaks throughout the testing session and caregivers were encouraged to request breaks if they thought their child needed them.

Prior to arrival, caregivers were requested to dress their children in shorts or leggings, a tight shirt, and shoes with firm, grippy soles (tennis shoes given as a good choice). Upon arrival, an investigator read an introductory script to the caregiver and child. After obtaining written consent from the caregiver and oral consent from the child, participants were asked to remove their shoes and anthropometrical measurements were collected. The introduction script and other scripted instructions are in Appendix D.

The order of climbing trials was drawer, table, and handles. After the drawer and table trials, the participant and caregiver were taken to another laboratory for the scanning portion of testing. While the participant was in the scanning laboratory, an investigator exchanged the drawer/table fixture for the handles so that they would be ready when the participant returned. When all trials were completed, the caregivers were paid, and the child was offered a choice of a small toy from a prize chest. Caregivers were also given a tip-over safety handout (Appendix F).

Drawer and Table Test Conditions

Instructions were given to the participant and caretaker while an investigator set up the apparatus relative to the participant's anthropometric measurements. Participants were asked to climb into the drawer, sit down for a moment, and then climb out (see Appendix D for the specific instructions to the children). This task was performed at two or three heights. The first time the child climbed into the drawer, the top edge was set to the height of the child's omphalion (navel). In pilot testing, all children were physically capable of climbing into a drawer set to this height. Having the child easily succeed and receive praise for the first testing condition was important in setting the tone of testing and making the experience enjoyable for the child. For the next trial the drawer was set to a higher position. If the child easily climbed into the drawer set to omphalion height, the drawer was raised to the height of the child's axilla (armpit). If the child had some difficulty climbing into the drawer at omphalion height, the drawer was raised to only halfway between the child's omphalion and axilla. If the child could climb in at this height, the drawer would then be raised to the height of the child's axilla. If a child went from omphalion height directly to axilla height, but found axilla height too difficult, the drawer was then lowered to the location midway between omphalion and axilla. Figure 17 illustrates this process of setting the drawer heights.

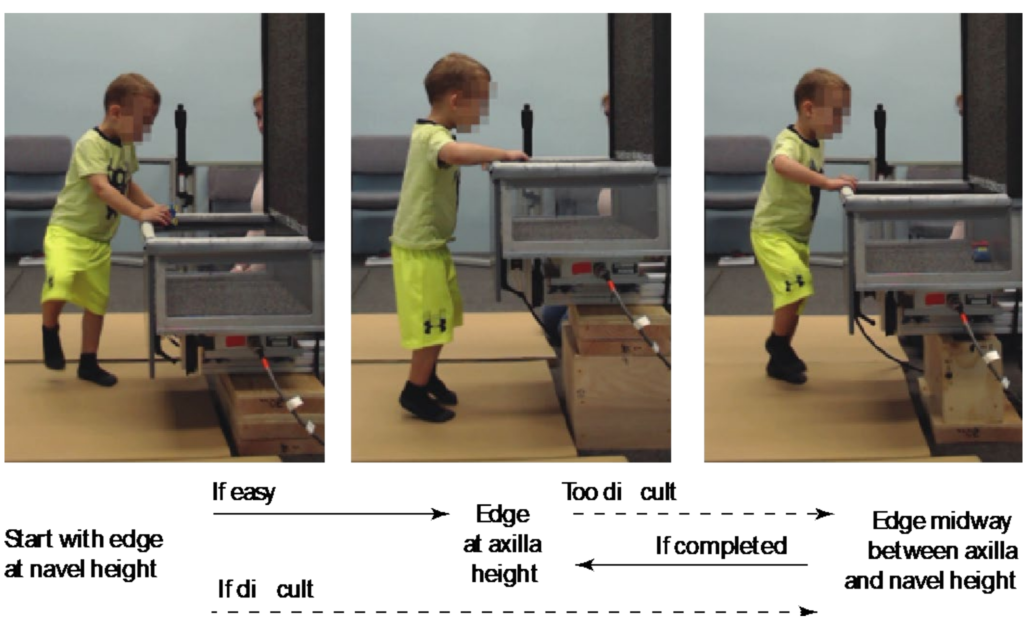


Figure 17. Illustrated flow chart showing how the different heights of the drawer were presented to the participant.

After the drawer trials, the drawer was left at the highest position the child was able to successfully climb into and a solid wood board was placed on top of the drawer to simulate a tabletop or the top of a dresser or other furniture unit. The board was rigidly attached to the sides and back of the drawer so that it only loaded on the force plate under the bottom of the drawer (see Figure 8). Participants were placed on top of the fixture and asked to climb down to the front. If the child did not land on the floor force plate, the trial was repeated if possible. Figure 18 shows frames from a table trial.

Figure 18. Photos of a child placed on the table by her caregiver and then climbing down on her own.

Handle Test Conditions

The locations of the upper and lower bars in the handle trials were reconfigured relative to the size of the child to achieve a range of child interactions with the apparatus listed in Table 5. The lower bar the child stepped up on was set to two positions. The “high” position was the height of the child’s maximum step height above the padded floor. The mean value of maximum step height was 10.5 (sd 2.4) inches (see Appendix B). The low height of 4.7 inches was chosen to be as low as possible for safety while also allowing the children’s feet to interact with the bar from various angles without contacting the floor. Because the spacing between the bars was expected to alter posture and force generation, the vertical and horizontal position of the upper bar were varied based on the child’s upward grip reach height. The height of the upper bar was set to three different positions relative to the padded floor surface: 100%, 75% and 50% of the child’s upward grip reach. These are referred to as “high,” “mid,” and “low,” respectively, in Table 5. The horizontal position of the upper bar was set so that it was either “aligned” with the lower bar, or “offset” from the lower bar to be closer to the child approaching the handles. The offset was 20% of the upward grip reach height.

Table 5
Handle Trial Test Conditions and Actions Requested

	Bar Locations			Behaviors Requested					
Order	Lower Bar Height	Upper Bar Vertical Height	Upper Bar Horizontal Position	Climb Up (Ascent)	Bounce	Lean Back & Yank	1 hand & 1 foot	Other	Climb Down (Descent)
1	High	Mid	Aligned	X					X
2	High	High	Aligned	X					X
3	High	Low	Aligned	X					X
4	Low	Mid	Aligned	X	X	X	X		X
5	Low	Mid	Offset	X	X	X			X
6	Low	Mid	Offset					Hop up	
7	Low	Low	Offset					Hop up	
8	Low	Low	Offset	X	X	X			X
9	Low	Low	Aligned	X	X	X	X		X
10	Low	High	Aligned	X	X	X	X		X
11	Low	High	Offset	X	X	X			X
12	Low	High	Offset					Hop up	
13	Low	High	Offset					Hang	

For each configuration of the handles, the participants were asked to perform a set of actions. The actions usually started with climbing up (ascent), standing with both feet and hands on the bars, and then climbing down (descent). If the child did something other than a standard climbing motion, for example jumping up or falling down, the trial was repeated requesting the child to also perform a climbing action. Both standard and non-standard climbing actions were recorded, and the child was praised following their attempts. In conditions where the lower bar was set to the higher position as shown in Figure 19, the upper bar was always aligned horizontally with the lower bar and only the climbing up, standing, and then climbing down actions were requested. The higher bar presented a greater risk of injury if the child fell, therefore more complex actions were only requested when the lower bar height was set to the low height.

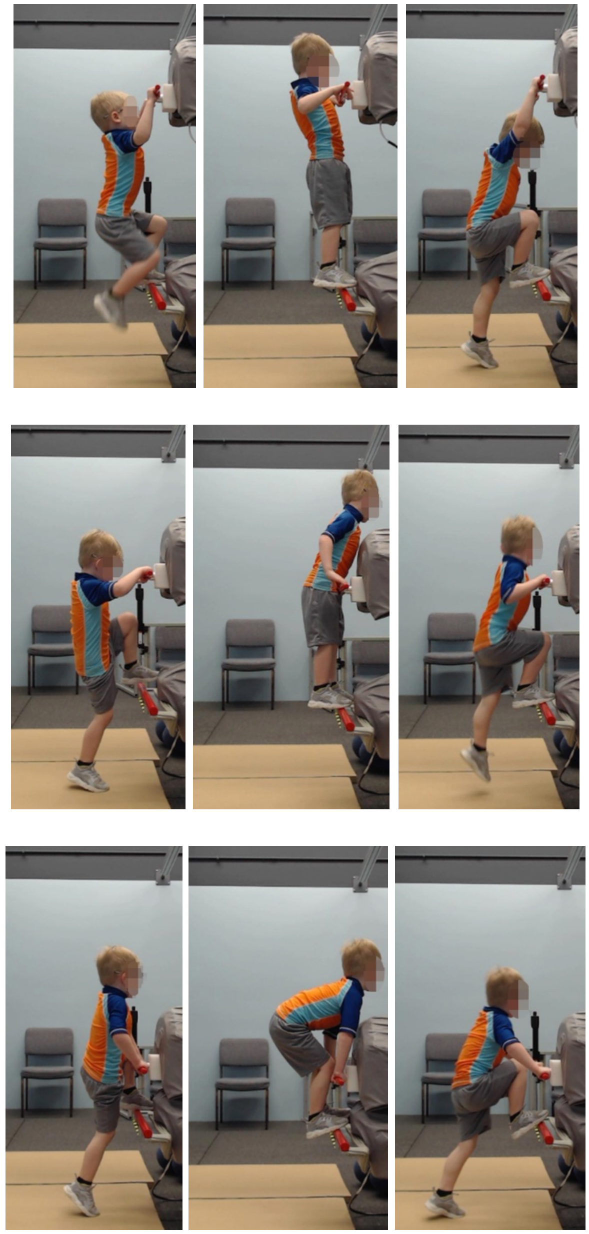


Figure 19. This series of photos show a child climbing up and down with the lower bar set to "high" maximum step height position and the upper bar set to the "high," "mid," and "low" bar heights (top to bottom) which were 100%, 75% and 50% of upward grip reach height, respectively.

For the configuration with the lower bar at the low height, the child was asked to climb up and then 1) bounce vigorously without leaving the bar, 2) lean back as far as they could while keeping both hands and feet on the bars, 3) stay in this leaned-back position and then pull on the bar as hard as they could and 4) to take one hand and foot (ipsilateral) off the bars and then lean as far away from the bars as possible. These actions are shown in Figures 20-24. The one-hand and one-foot action was not possible for most children to do without falling when the upper bar was low and offset, therefore it was not requested in that handle configuration. Figures 25 and 26 show two additional actions requested in a subset of handle configurations. A request to "hop-up" meant the child would hold the upper bar and try to jump from the floor to a position where their arms were straight and their hips were in front of the upper bar, an action similar to hoisting oneself out of a swimming pool. This was only requested when the upper bar was offset from the lower bar, so that the child could land on the padded floor instead of a metal bar. A request to "hang" was only made when the upper bar was at the high, offset position. The child would be asked to hold onto the upper bar, lift their feet off the floor by bending their knees, hang still for a few seconds, and then straighten their legs to return to the floor.

The words used to request the child to perform these actions were kept very simple. Scripts of these instructions are in Appendix D. Instructions usually were kept to three-word sentences, for example, "Please climb up" or "Hands go here" and then augmented by hand signals such as pointing to the upper bar. The illustrations in Figures 20-26 were printed on a laminated sheet and shown to the child and caregiver as needed to help in comprehension. Caregivers also helped direct the children.

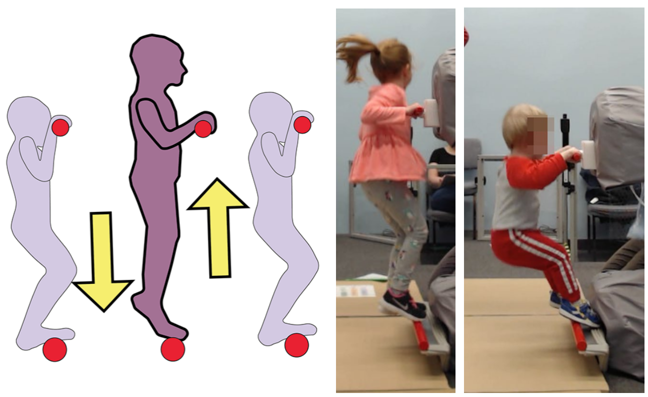


Figure 20. Illustrated instruction (left) of and children performing (center and right) the Bounce behavior.

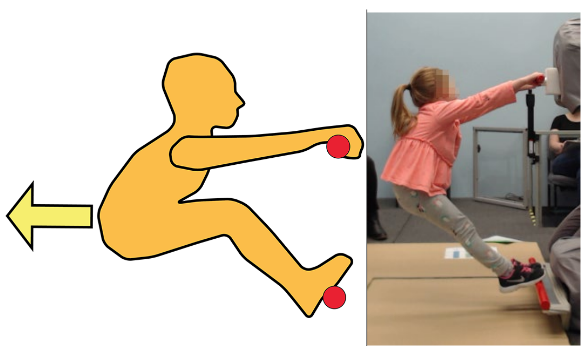


Figure 21. Illustrated instruction (left) of and child performing (right) the Lean behavior.

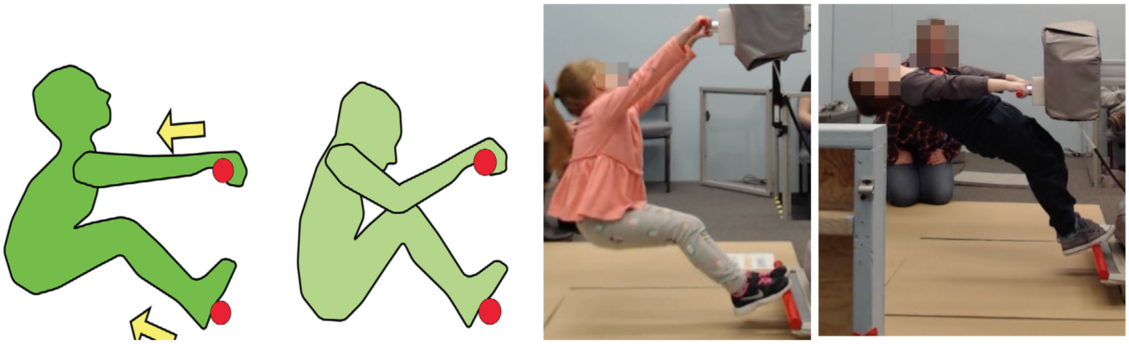


Figure 22. Illustrated instruction (left) of and children performing (center and right) the Yank behavior after leaning back.

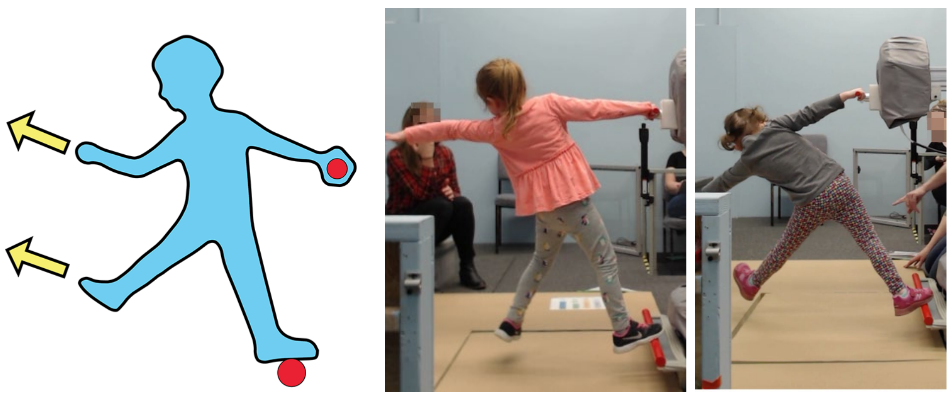


Figure 23. Illustrated instruction (left) of and children performing (right) the One-Hand/One-Foot behavior.

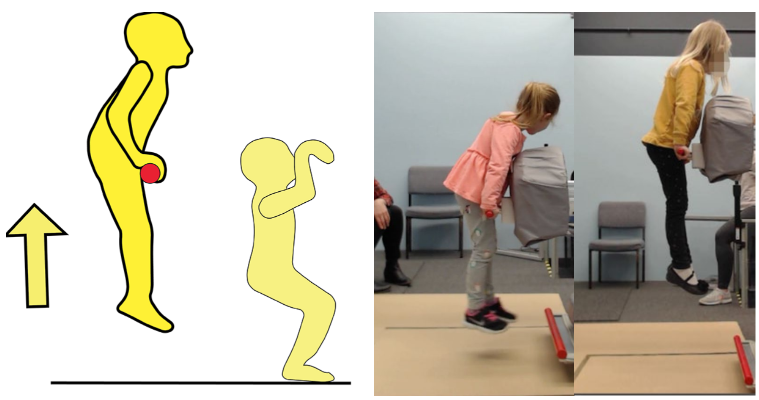


Figure 24. Illustrated instruction (left) of and children performing (center and right) the Hop Up behavior.

Figure 25. A child attempting the Hop Up behavior with the handle at high, mid and low heights (left to right).

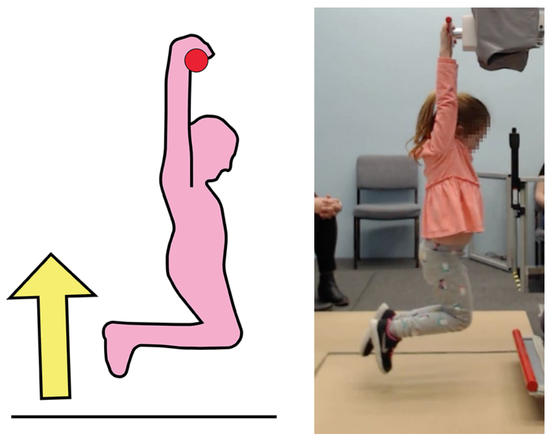


Figure 26. Illustrated instruction (left) of and child performing (right) the Hang behavior.

Data Reduction and Event Extraction

Video from each trial was reviewed to isolate the frames containing target behaviors and characterize them. The investigator recorded the start and end frame for each event. The investigator also noted if the child was applying force to something that was not instrumented during the event, such as being off the force plate or stepping on the padding over the structure, or the parent was exerting a force. These events were excluded from subsequent analysis. Tables 6–9 show the subtype categories used to identify the manner in which the child performed the tasks. Most subtypes were uncommon, qualitatively different behaviors and were not included in the analysis.

Force and moment data for each trial were reviewed for plausibility and force anomalies, with reference to still images and videos of the events. For example, in some cases the child was partially in contact with the padding behind the load cells. Some trials (<1%) were excluded due to anomalous force or moment data, generally due to behaviors that were inconsistent with the instructions. Note that the inclusion and exclusion of data was substantially subjective and biased toward inclusion of a wider range of behavior rather than a narrow interpretation of the instructions.

Table 6
Subtype Categories Used to Describe Ascent and Descent in Handle Trials

Ascent Categories		Descent Categories	
Assisted	Hop Down	1 Foot	Fall Down Posterior
Assisted Failed Attempt	Hop Up	Assisted	Foot Off
Climb Down	Knees On Bar	Assisted Failed Attempt	Hop Down
Climb Up*	Lower Bar	Climb Down*	Hop Up Landing
Climb Up 1 Hand or 1 Foot	On Bars	Climb Down 1 Hand or 1 Foot	Lower Down
Failed Attempt	Run Up Bounce Up	Climb Down Sideways	Slip Down
Fall Down Posterior	Seated	Climb Up 1 Hand or 1 Foot	Spin Down
Foot On	Swing Up	Fall	Step Down 1 Hand 1 Foot
Grey Padding	Upper Bar	Fall Down Anterior	Swing Down
		Fall Down Lateral	Swing Down 1 Hand 1Foot

* Used in analysis.

Table 7
Subtype Categories Used to Describe Bounce, Lean Back, and Yank Events in Handle Trials

Bounce Categories	Lean Back Categories	Yank Categories
Assisted	Assisted	Bent Arms or Legs*
Attempt	Bent Arms or Legs*	Failed Attempt
Bounce*	Bent at Waist*	On Ground
Climb Up	Bent Legs*	Swing Up
Failed Attempt	Failed Attempt	Yank
Hang	Lateral	Yank Assisted
Hop	Lean Back*	Yank Bent Arms or Legs*
On Floor	Null	Yank Straight Arms and Legs*
Straight Legs	On Floor	
Swing		
Tapping Feet		

* Used in analysis.

Table 8
Subtype Categories Used to Describe One-Hand/One-Foot, Hop-Up and Hang Events in Handle Trials

One-Hand /One-Foot Categories	Hop Up Categories	Hang Categories
1 Foot	Hop Up*	Face at or above bars
1 Hand 1Foot*	Hop Up On Bars*	Feet On Bars Swing
1 Hand No Feet	Hop Up On Ground*	Hang*
Anterior	On Ground	Swing*
Failed Attempt	On Ground Bar Above Waist*	
Null	On Ground Posture Not Held	
Touching Other		

* Used in analysis.

Table 9
Subtype Categories Used to Describe Ascending and Descending in the Drawer and Table Trials

Ascent Categories	Descent Categories	
Attempt	Climb Down Facing Away*	Jump Down Facing Away†
Climb In*	Climb Down Facing Box*	Jump Down Facing Box†
Failed Attempt	Climb Out*	Jump Down Facing Side†
High Step In*	Fall Out	Jump Down Facing Table†
Hop In	High Step Out*	Placed Out by Adult
No Attempt		Slide Down Facing Away*
		Slide Down Facing Table*

* Used in analysis.
† Analyzed separately.

Force and Moment Data Analysis

Handle Trials — The force data for each extracted behavior were analyzed to identify the peak forces and moments. Specifically, the peak forces in the X (fore-aft) and Z (vertical) directions were calculated along with the peak tip-over moment (hereafter moment). The moment was calculated to estimate the combined contributions of the hand and foot forces to a potential furniture tip over. Figure 27 illustrates the calculations for the handle trials. The X and Z forces from the load cells on the top and bottom handles were used. The test conditions and behaviors were essentially planar in side-view (XZ), so the Y-axis (lateral) forces were generally small and were not analyzed.

For safety reasons, most trials were conducted with the lower bar as close to the padded floor as possible and the structure was effectively rigid so that no tip over could occur. However, the effect of the child-exerted forces on the likelihood of tip over is affected by the location of the points of application of these forces relative to the effective fulcrum about which the furniture would tip (generally the front edge of the base of support). Consequently, the effects of the child-exerted forces on the likelihood of tip over were estimated by calculating moments (torques) around a virtual fulcrum, as illustrated in Figure 27.

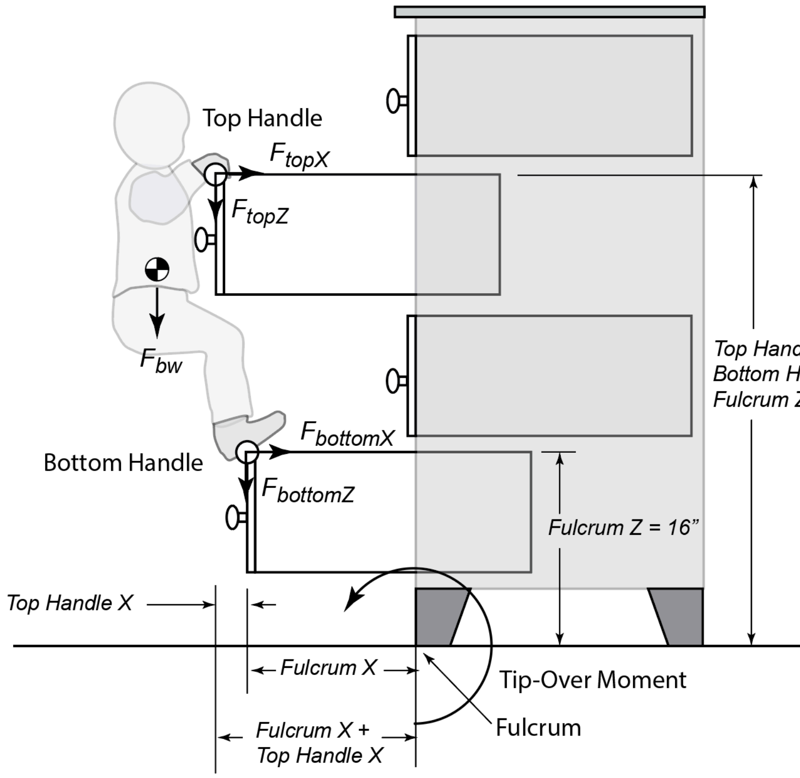


Figure 27. Schematic of moment calculations around the virtual fulcrum. Forces are positive as shown. Note that the sign of the tip-over moment is inverted for clarity, so that positive moments indicate moments that tend to tip the unit toward the child.

Based on the furniture dimension data summarized above, calculations were conducted with the fore-aft distance from the lower bar to the virtual fulcrum set to 305 mm (12 inches) and a vertical distance from the lower bar to the fulcrum of 406 mm (16 inches). These values are intended to simulate an open drawer with 90^{th}-percentile opening extent and 90^{th}-percentile height above the floor for the lowest drawer of a unit. Additional calculations were performed with various fore-aft distances (Fulcrum X values) between 0 and 16 inches to demonstrate the effects of this parameter. The tip-over moment is the instantaneous moment about the virtual fulcrum created by the X and Z forces on both bars. Note that the sign is inverted for clarity: a positive moment represents a moment that would tip a furniture unit toward the child. Considering all distances as positive and the forces positive as illustrated in Figure 27, the calculation is performed as

$$\textit{Tip-Over Moment} = F_{bottomZ} * (\textit{Fulcrum X}) - F_{bottomX} * (\textit{Fulcrum Z}) + F_{topZ} * (\textit{TopHandleX} + \textit{FulcrumX}) - F_{topX} * (\textit{TopHandleZ-BottomHandleZ} + \textit{Fulcrum Z})$$

For dimensions in feet and forces in lb, the units of the moment are lb-ft.

Figure 27 shows that the child's body weight will generally be distributed between the two bars, but that the child's center-of-mass (CM) location will also typically be outboard of the bars (farther from the fulcrum than the bars). Hence, the quasi-static moment is approximately equal to the child's CM location times the horizontal distance of the CM to the fulcrum. However, dynamic forces generated by the child during the activities in this study often produce much higher moments through the combination of horizontal and vertical forces. When a child leans back with her feet on the bottom bar and hands on the top, the horizontal forces on the bars would be equal and opposite in a quasi-static situation. In a dynamic situation, such as the Yank behavior, the horizontal forces on the top bar can be higher, resulting in a larger tip-over moment. Similarly, the Bounce behavior produces vertical forces on the bottom bar exceeding body weight, and hence higher moments than would be generated statically when Fulcrum X is greater than zero.

In some cases, the dependent measures were divided by body weight to enable the effects of the behaviors to be examined independent of child size. In these cases, the body weight normalization was applied after calculation of the moment. Calculations were performed using custom software written in the Mathematica environment (version 12.0). Unit conversions and plotting were performed in R (version 4.0.1).

Drawer and Table Trials — Tip-over moments were computed in a similar manner for the drawer and table trials. In this case, the load cells were offset from the various points of force application, so both forces and moments were included in the calculation. Figure 28 shows a schematic of the calculations. Forces and moments on the drawer front and the box of the drawer were measured separately, as described above. The moment above the virtual fulcrum was computed by adding the contributions of the forces measured at the load cell centers and the Y moments measured at each location. The virtual fulcrum location was computed relative to the front upper edge of the drawer (toward the child).

Calculating the tip-over moment from the force and moment data requires information about the locations of the load cells relative to the virtual fulcrum. Figure 28 shows the locations of the load cells relative to the front upper edge of the drawer front. Subtracting these from the virtual fulcrum X and Z dimensions (12 inches and 16 inches, respectively) gives the location of each load cell from the fulcrum. The tip-over moment attributed to each load cell is obtained by adding the measured moment about the Y axis to the moments about the fulcrum generated by the X and Z forces measured at that location.

Considering distances as positive, the moment was calculated as

$$\text{Tip-over Moment} = F_{fz}*LCFX - F_{fx}*LCFZ + M_{fy} + F_{bz}*LCBX - F_{bx}*LCFZ + M_{by}$$

where *LCFX* = Fulcrum X – 2.75 (inches), *LCFZ* = Fulcrum Z – 10.0, *LCBX* = Fulcrum X – 10.3, and *LCBZ* = Fulcrum Z – 10.3 inches.

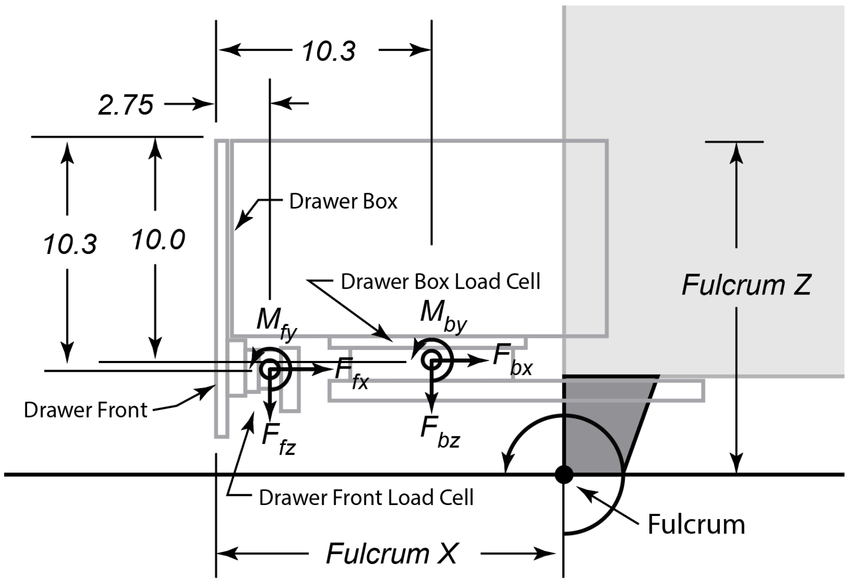


Figure 28. Schematic of dimensions (inches), forces, and moments used to compute tip-over moments for drawer and table trials.

Image-Based Posture Analysis

The video frames at time points of interest were extracted and an investigator manually digitized the series of landmarks on the image of the child. The landmarks are listed in Tables 10 and 11. Landmarks on the right side of the body were digitized for postures from the handle trials; landmarks on both sides of the body were digitized for postures from the drawer and table trials. From these landmarks, the CM location was estimated based on data from Snyder et al. (1977). In that large-scale anthropometric study, the location of the whole-body center of mass (CM) was calculated in conditions in which the child was supine with the hips and knees flexed 90 degrees. The height (inferior-superior location) of the CM with respect to the buttocks was reported as a function of erect sitting height. For children in the age range of the current study, the mean value was approximately 33%. Using this average value, the CM location was estimated as 33% of the way from the buttock landmark to the top-of-head landmark. Note that the postures of the children often deviated from the measurement posture used in the Snyder study, so this is, at best, an approximation. However, the estimated CM (ECM) location is a useful posture measure that describes the location of the lower torso (approximately the center of the abdomen).

Table 10
Landmarks Digitized on Handle Trial Video Frames

Foot Contact Right	Hand Contact Right	Top of Head
Ankle Right	Shoulder Right	Ear
Knee Right	Elbow Right	
Hip Right	Wrist Right	
Bottom of Buttocks		

Table 11
Landmarks Digitized on Drawer and Table Trial Video Frames

Ball of Foot Right	Ball of Foot Left	Top of Head
Ankle Right	Ankle Left	Nose
Knee Right	Knee Left	Ear Left
Hip Right	Hip Left	Ear Right
Hand Contact Right	Hand Contact Left	Bottom of Buttocks
Wrist Right	Wrist Left	
Elbow Right	Elbow Left	
Shoulder Right	Shoulder Left	

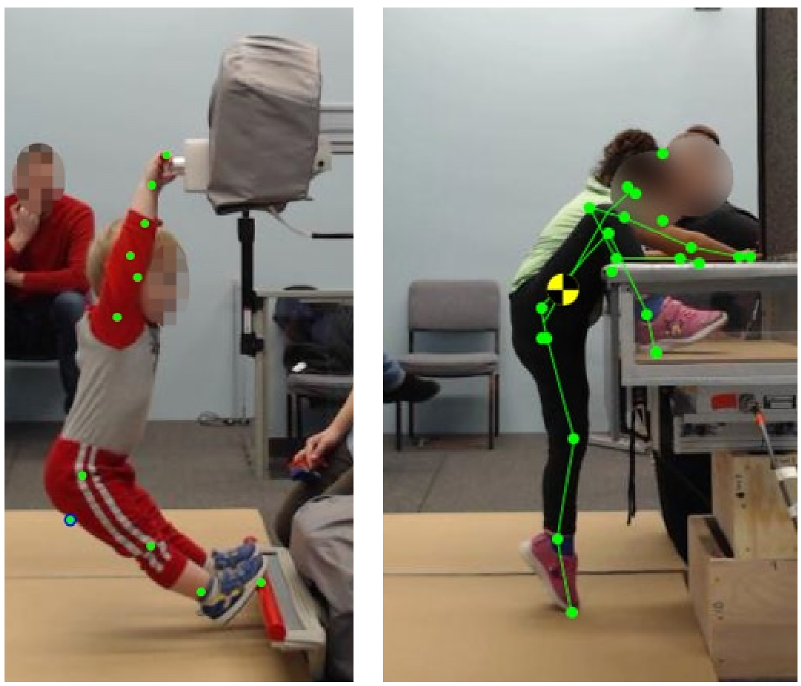


Figure 29. The photo on the left shows the right side of the body as it is digitized. The photo on the right shows the resulting body segments and the estimated center of mass locations for a different child and test condition.

RESULTS: FOCUS GROUP

Appendix G presents the full set of focus group responses. Table 12 summarizes the responses from the first two questions:

> Q1: Has your child shown an interest in climbing on a household item (not on a playground)?
>
> Q2: What was the item, where was it located and how did he/she climb?

All responded affirmatively to the first question. The reported location of climbing was most often the bedroom, followed closely by the living or family room and kitchen. The most common furniture types that children were reported to climb were tables, beds, and chairs or benches. Six of the children were reported to have climbed dressers.

When asked as part of Q2 "How does your child interact with the furniture?," caregivers mentioned climbing tactics that included "jumped up," "hands and feet," "ladder style," and "grab and pull up," among others. Many caregivers mentioned children using chairs, stools, and other objects to facilitate their climbing, including pulling out dresser drawers.

Nearly all (95%) of children had dressers in their rooms (Q3) and 87% of caregivers had observed their children interacting with the dressers (Q4). A total of 29 children reportedly opened and closed drawers, and 16 pulled items out (only 3 put items in); 6 were reported to have climbed in or on the dresser (Q5). One caregiver reported that the child had tipped a dresser over by climbing on it. Among the climbing strategies mentioned (Q6), the most common (6 responses) was stepping into or onto the lowest drawer. Ten caregivers reported that their child climbed down from furniture, six said they jumped, and three said their child asked for help (Q7).

About half of caregivers indicated that children interact similarly with other furniture, with a range of items identified, including bookshelves, chairs, and coffee tables (Q8). Climbing and pulling up were the most common tactics.

Caregivers responded to the open question (Q9) in a variety of ways. Fifteen caregivers mentioned general tendencies to climb (monkey bars, couches, etc.); one said that they had "bolted" a TV to the wall because "6-yr-old nephew pulled dresser over on himself." (This was a different dyad than had earlier mentioned the participant pulling over a dresser.) Given the recruitment questions, it was interesting that four caregivers mentioned that their child "doesn't climb very much" or similar.

The subsequent questions were directed to the child (Q10-Q14). Of 32 children who responded to the initial question "do you like climbing," 31 said yes. Asked what they climb (Q11), 23 mentioned playground equipment, 7 mentioned tables, chairs, or counters in the kitchen, 6 said bunkbeds, and 8 said couch. With respect to climbing tactics (Q12, "How do you climb?"), 15 said hands and feet, and seven had a variety of responses, including "stepping" and "by myself." Children were asked how they interacted with a furniture item mentioned by the caregiver as something that their child had climbed (Q13). In five cases in which the caregiver mentioned a dresser, the children responded to the question "what do you do with the dresser" with opening drawers and getting clothes out. None volunteered climbing. When asked how they would get something that was hard to reach (Q14), nine mentioned chairs or stools, seven said ask for help or climb/jump, and three said "tippy toes."

Table 12
Frequency of Caregiver or Child Mentions of Climbing by Location and Object

Item Climbed	Bed-room	Living or family room	Kit-chen or pantry	Dining room	Base-ment	Bath-room	Entry or hall	Com-puter room or office	Play-room	Any-where	Total
Table	0	2	10	5	0	0	0	0	0	0	17
Bed	16	0	0	0	0	0	0	0	0	0	16
Chair, bench and stool	0	2	5	3	0	0	1	1	1	0	13
Counter	0	0	10	0	0	0	0	0	0	0	10
Coffee table	0	8	0	0	1	0	0	0	0	0	9
Dresser	6	0	0	0	0	0	0	0	0	0	6
Shelves	0	3	2	0	1	0	0	0	0	0	6
Bunkbed	5	0	0	0	0	0	0	0	0	0	5
Crib	4	0	0	0	0	0	0	0	0	0	4
Bathtub, toilet, or towel rod	0	0	0	0	0	4	0	0	0	0	4
Desk	0	2	0	0	0	0	0	1	0	0	3
Window	0	2	0	0	0	0	0	0	0	1	3
Fireplace	0	3	0	0	0	0	0	0	0	0	3
Ottoman	0	3	0	0	0	0	0	0	0	0	3
Stairs	0	0	0	0	2	0	0	0	0	0	2
Changing table	1	0	0	0	0	0	1	0	0	0	2
Light fixture	0	0	0	1	0	0	0	0	0	0	1
Fridge	0	0	1	0	0	0	0	0	0	0	1
Baby gate	0	0	0	0	0	0	1	0	0	0	1
Other*	1	3	0	0	1	0	0	0	0	0	5
Total	33	28	28	9	5	4	3	2	1	1	114

* Toy bins or cubes, train table, pool table, play kitchen

RESULTS: HANDLE TRIALS

Qualitative Results

Figure 30 shows side-view images of examples of children's behavior on the handle fixture. The frames were taken at the time of peak tip-over moment. Forces exerted by the child at the hands and feet are illustrated using scaled vectors (red arrows). Digitized landmarks (green dots) and estimated center of mass (yellow/black circle) locations are shown. The images demonstrate that forces at both the hands and feet often have substantially horizontal components, and usually, but not always, the foot forces are larger than the hand forces. The horizontal components at the hands and feet are also in opposite directions: the horizontal foot forces are forward (toward the test fixture) while the hand forces are rearward (toward the child).

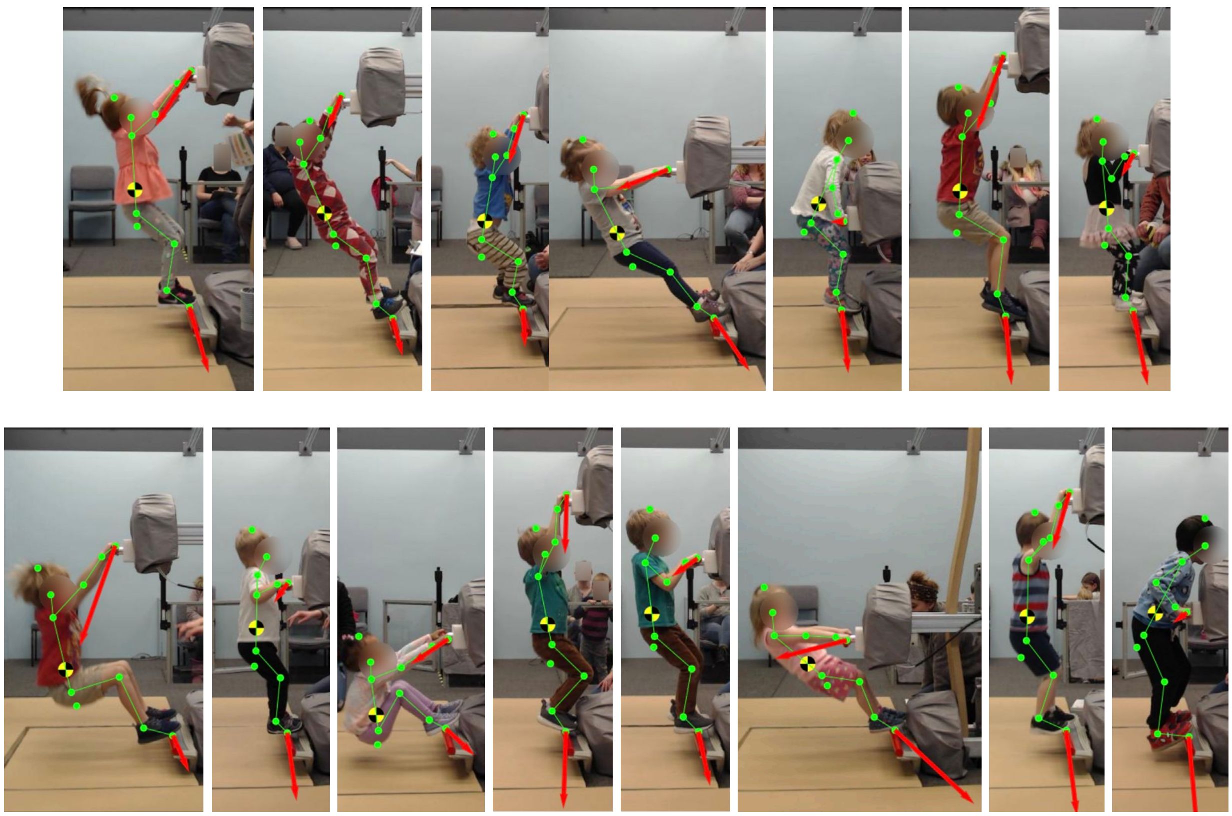


Figure 30. Examples of behaviors. Arrows illustrate the directions and relative magnitudes of forces at the hands and feet.

Overview of Forces

Figures 31– 40 show example time-history plots of the horizontal and vertical forces for each behavior. Horizontal (X) forces are positive forward, away from the child. Vertical (Z) forces are positive downward (refer to Figure 27). Figure 21 shows an Ascent behavior. In this trial, the child's body weight transitions from the force plate to the bars, with the lower bar bearing nearly all of the weight. Note that the horizontal forces on the upper and lower bars are approximately equal in magnitude and opposite in direction, consistent with the posture being approximately static toward the end of the sample. Under these conditions, the vertical forces sum to body weight.

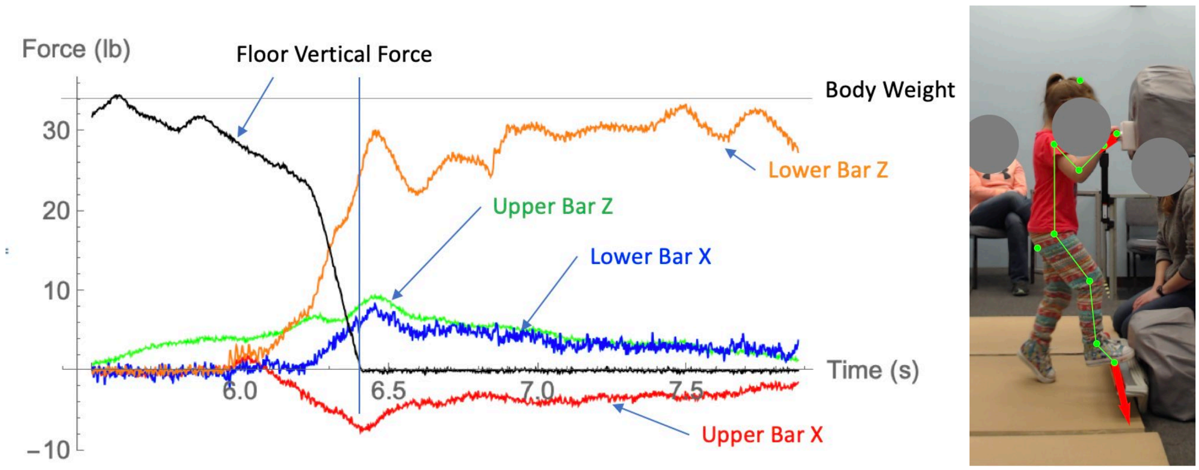


Figure 31. Example forces for the **Ascend** behavior in the handle trials. The image at the right shows the child at the time indicated by the vertical line in the figure.

Figure 32 shows data from a Bounce behavior. Here, the vertical force on the lower bar exceeds body weight even with a downward force on the upper bar, demonstrating the substantial vertical acceleration the child is producing. Again, the upper and lower bar X forces are approximately opposite. The relatively large horizontal force is necessary for the child to accelerate vertically given that the center of mass is outboard of the bars.

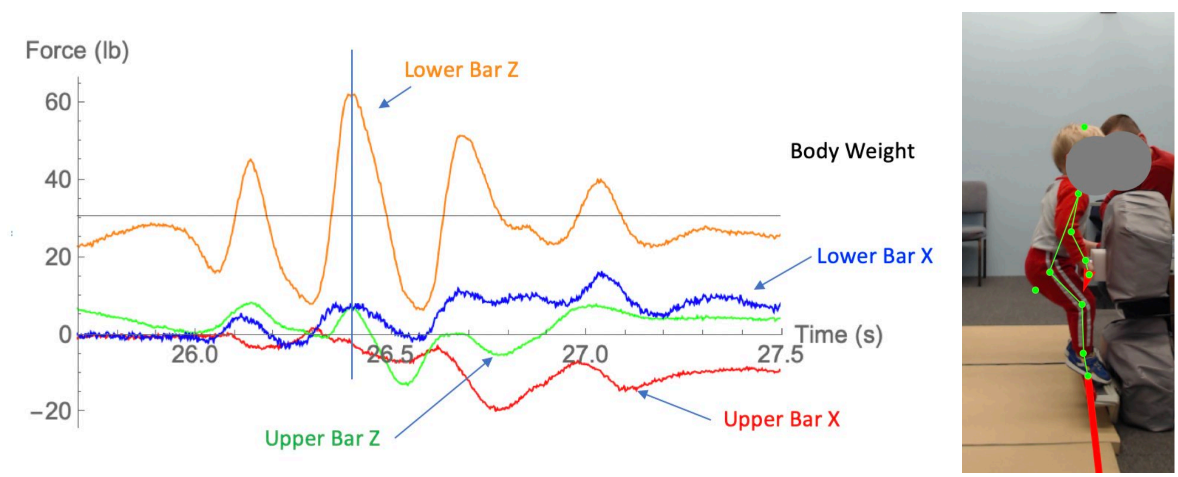


Figure 32. Example forces for the **Bounce** behavior in the handle trials. The image at the right shows the child at the time indicated by the vertical line in the figure.

Figure 33 shows data from a Lean behavior. The vertical force on the lower bar is reduced, and the upper bar vertical force increased, as the child leans back. The approximate opposite upper and lower X forces indicate that the posture is approximately static.

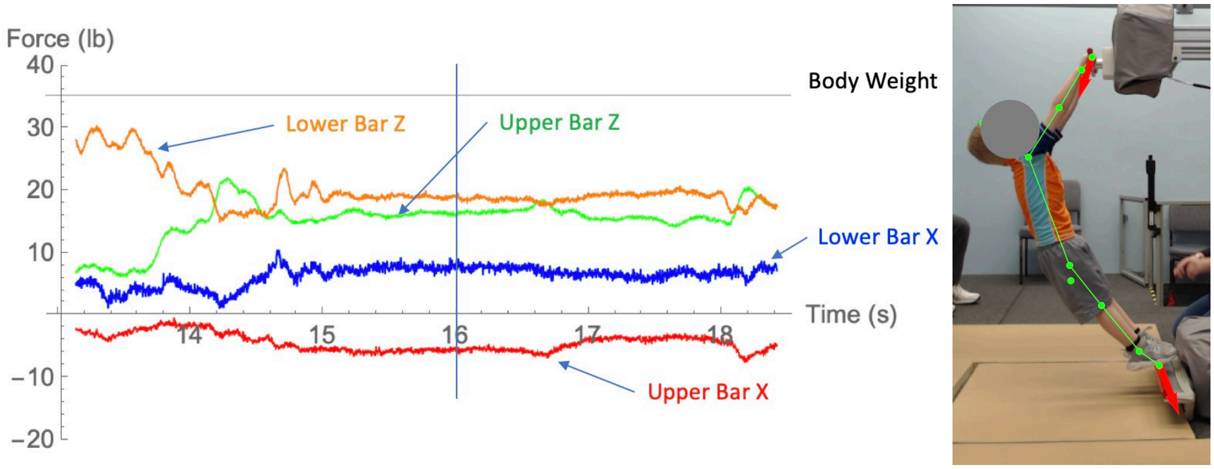


Figure 33. Example forces for the **Lean** behavior in the handle trials. The image at the right shows the child at the time indicated by the vertical line in the figure.

Figure 34 shows data from a Yank behavior. Two Yank cycles are shown, characterized by negative (rearward) peaks in the upper bar X force. Note the peak absolute magnitude of the horizontal forces on the upper and lower bars approaches or exceeds body weight. The vertical forces remain fairly constant, with most of the body weight borne by the lower bar.

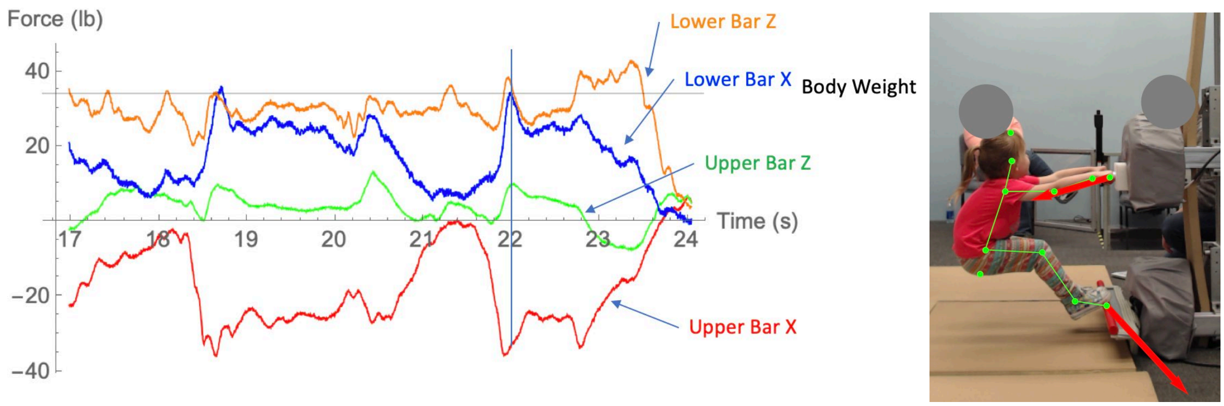


Figure 34. Example forces for the **Yank** behavior in the handle trials. The image at the right shows the child at the time indicated by the vertical line in the figure.

Figure 35 shows data from a One Hand behavior. As the child leans back, the total vertical force of approximately body weight is shared by the upper and lower bars, while the magnitudes of the horizontal forces move in parallel. The data show that this posture was approximately static for about three seconds.

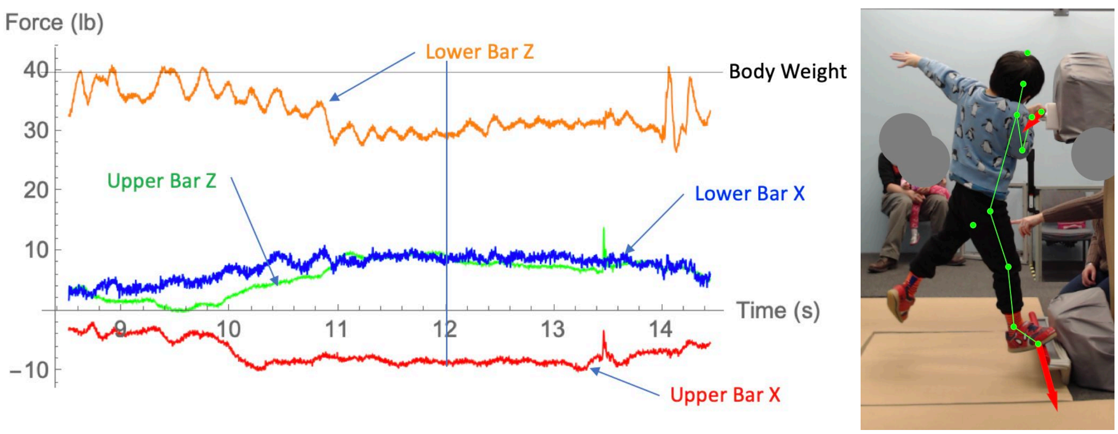


Figure 35. Example forces for the **One Hand** behavior in the handle trials. The image at the right shows the child at the time indicated by the vertical line in the figure.

Figure 36 shows data from a Hop Up behavior. No lower bar forces are observed, since this behavior was performed with the upper bar only. The upper bar vertical force approaches and briefly exceeds body weight, while the horizontal force oscillates slightly as the child tries to balance on the bar.

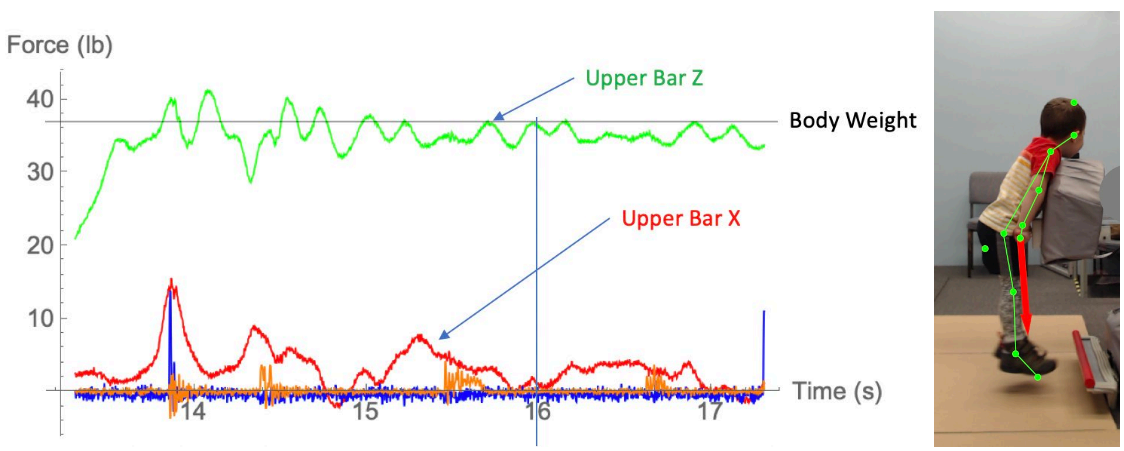


Figure 36. Example forces for the **Hop Up** behavior in the handle trials. The image at the right shows the child at the time indicated by the vertical line in the figure.

Figure 37 shows data from a Hang behavior. As with the Hop Up behavior, no lower bar forces are observed. The upper bar vertical force oscillates around body weight as the horizontal force shows some swinging back and forth. This child was able to hang for about four seconds.

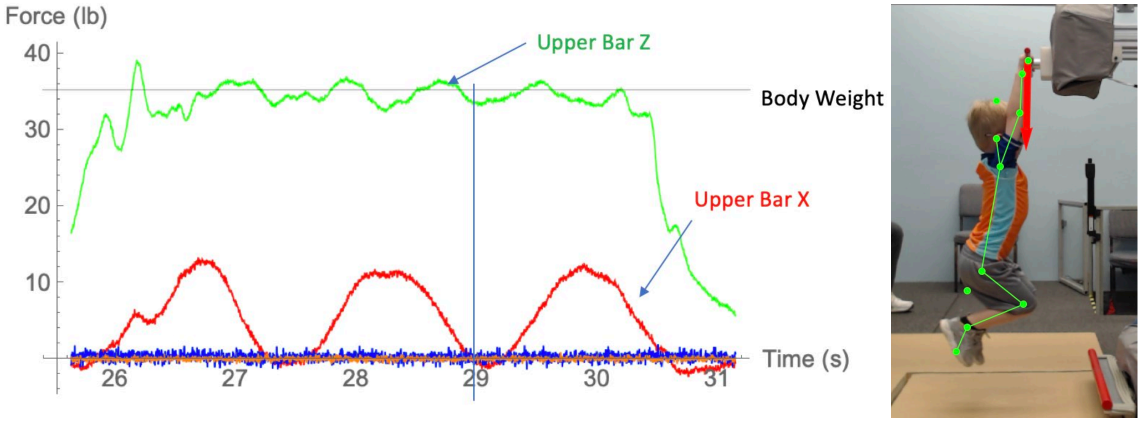


Figure 37. Example forces for the **Hang** behavior in the handle trials. The image at the right shows the child at the time indicated by the vertical line in the figure.

Figure 38 shows data from a child climbing into the drawer (ascending). The floor vertical force begins to dip below body weight as the vertical force on the front of the drawer increases. The child steps into the drawer and then, over a period of about one second, the child transfers her weight from the floor to the drawer. In this example, the child's body weight is borne by both the drawer front (note the position of the right hand) and drawer box.

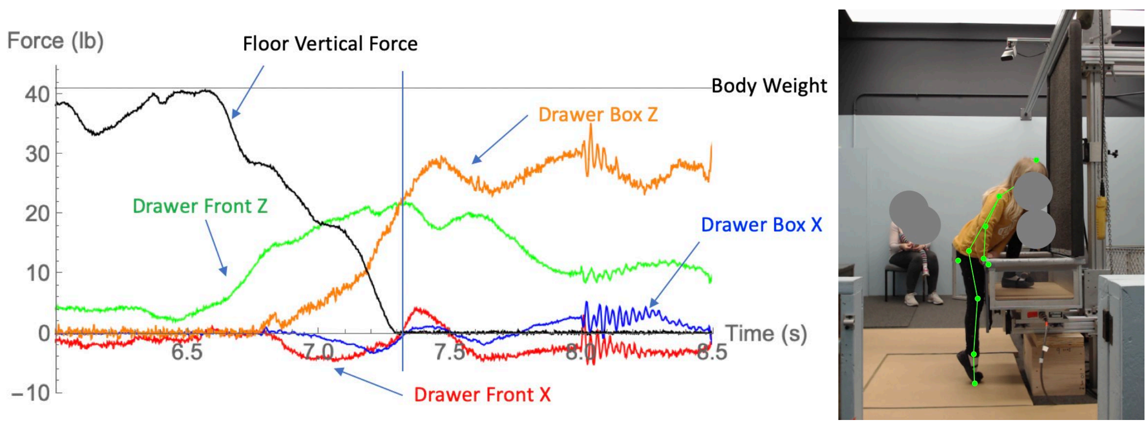


Figure 38. Example forces for the **Ascent** behavior in the drawer trials. The image at the right shows the child at the time indicated by the vertical line in the figure.

Figure 39 shows data from a child climbing out of the drawer (descending). The vertical force in the box drops initially as the child bears weight on the front of the drawer. A large amount of force, nearly up to body weight, is transferred to the front of the drawer just before the first foot touches down and the floor force increases.

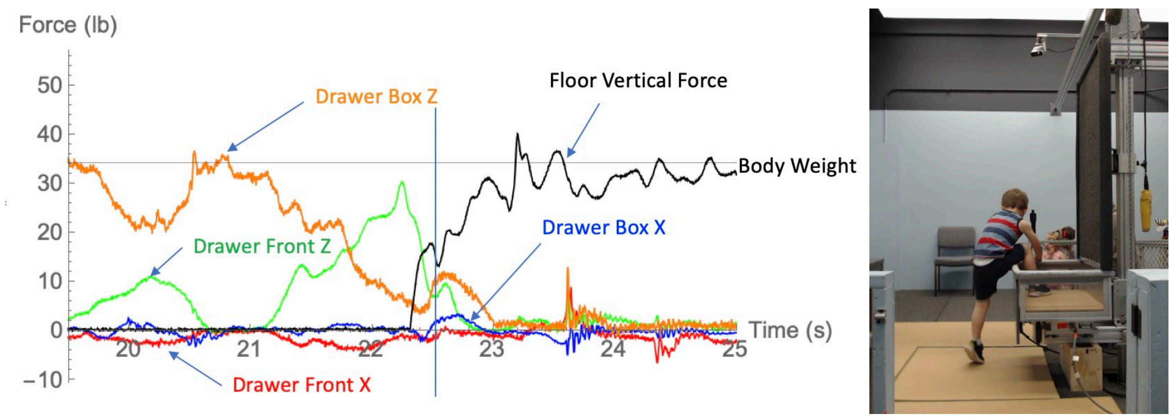


Figure 39. Example forces for the **Descend** behavior in the drawer trials. The image at the right shows the child at the time indicated by the vertical line in the figure.

Figure 40 shows data from an uncontrolled (jump) descent from the drawer. (Jump descents were not requested, but some children jumped when asked to climb down.) Note the vertical scale. The child's body weight is initially fully supported by the drawer box, then transitions to fully supported on the front of the drawer. The drawer front force drops rapidly to zero as the child begins to drop. The floor vertical force briefly exceeds more than four times body weight on landing.

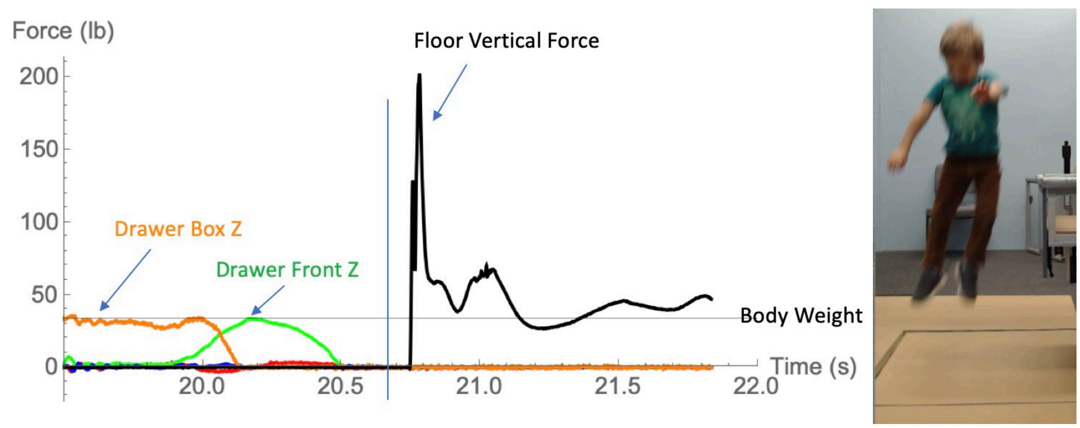


Figure 40. Example forces for a jump descent behavior in the drawer trials. The image at the right shows the child at the time indicated by the vertical line in the figure.

Maximum Moments

Figure 41 and Table 13 show box plots of the maximum moments calculated for handle trial behaviors for the 12-inch fulcrum X distance. Note that these plots consider all handle configurations, except that Ascent is only for aligned trials (upper bar over lower bar). In all cases, the median value is greater than the value that would be obtained by applying body weight at the fulcrum distance. Table 14 shows the values for aligned handle trials only (upper bar directly above lower bar). Figure 42 and Tables 15 and 16 show the values normalized by body weight. For moments in lb ft, dividing by body weight in lb yields values with units of ft. Two interpretations are useful: (1) the values are the distance from the fulcrum in feet that the body weight would need to be placed to obtain the same moment, or (2) the multiple of body weight that would need to be placed at the 1-foot distance from the fulcrum to obtain the same moment. For example, Table 13 shows that the Ascent behavior across all trials produced a mean normalized moment of 1.75, meaning that the dynamic effects produced an increase in effective body weight of 75%. Consistent with qualitative trends in Figures 41 and 42, the largest mean normalized moment was observed for the Yank behavior, with a mean value equivalent to 3.85 times body weight applied vertically to the lower bar.

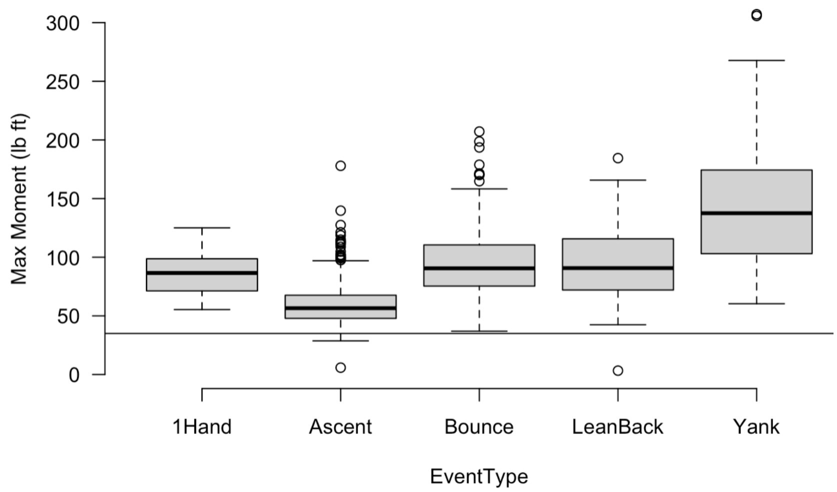


Figure 41. Box plot of maximum moment (lb ft) during behaviors calculated using a 12-inch fulcrum X distance. Horizontal line is mean body weight (34 lb) at 12 inches. In the boxplots, the dark line is the sample median, and the box shows the interquartile range (25th to 75th percentile). The whiskers (vertical lines) extend to the most extreme data point that is no more than 1.5 times the interquartile range from the box. Data points that are more extreme (generally considered outliers) are shown with circles.

Table 13
Summary of Maximum Moment Values for **All** Handle Trials (lb ft)

Behavior	N Subjects	N Trials	Mean	SD	10th%ile	50th%ile	90th%ile
1Hand	19	47	86.2	20.0	60.5	86.6	114.4
Ascend	36	436	59.6	18.5	40.3	56.6	80.8
Bounce	32	138	96.3	32.3	59.2	90.5	138.2
LeanBack	34	163	94.3	28.4	62.0	90.7	131.7
Yank	27	95	145.5	54.2	82.4	137.5	215.8

Table 14
Summary of Maximum Moment Values for **Aligned** Handle Trials (lb ft)

Behavior	N Subjects	N	Mean	SD	10th%ile	50th%ile	90th%ile
1Hand	18	32	81.3	18.5	57.0	78.9	112.4
Ascend	36	276	54.0	15.2	38.3	51.2	71.5
Bounce	32	82	91.9	29.7	58.6	87.8	133.7
LeanBack	30	83	90.7	28.5	61.2	89.3	122.9
Yank	25	53	142.4	55.1	76.2	136.6	216.2

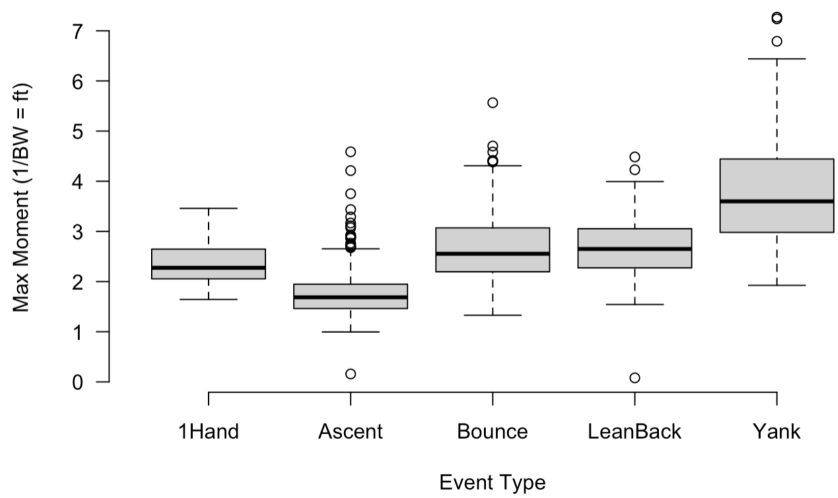


Figure 42. Box plot of maximum moment during behaviors normalized by body weight (ft).

Table 15
Maximum Moment Values (lb ft) Normalized by Body Weight (lb) for **All** Handle Trials (units: ft)

Behavior	N Subjects	N Trials	Mean	SD	10^{th} %ile	50^{th} %ile	90^{th} %ile
1Hand	19	47	2.35	0.43	1.77	2.27	2.90
Ascent	36	436	1.75	0.46	1.24	1.69	2.28
Bounce	32	138	2.69	0.72	1.90	2.55	3.57
LeanBack	34	163	2.66	0.58	2.00	2.65	3.31
Yank	27	95	3.85	1.17	2.62	3.60	5.53

Table 16
Maximum Moment Values (lb ft) Normalized by Body Weight (lb) for **Aligned** Handle Trials (units: ft)

Behavior	N Subjects	N Trials	Mean	SD	10^{th} %ile	50^{th} %ile	90^{th} %ile
1Hand	18	32	2.18	0.36	1.72	2.16	2.74
Ascent	36	276	1.60	0.39	1.21	1.54	2.00
Bounce	32	82	2.60	0.72	1.88	2.50	3.30
LeanBack	30	83	2.54	0.58	1.95	2.60	3.13
Yank	25	53	3.73	1.19	2.51	3.43	5.40

Analysis of Trends

Least-squares linear fits were conducted to examine trends in the relationship between moments and body weight. A heavier child would be expected to produce larger moments, but aspects of behavior could be more important than body weight. Note that the statistical significance of these trends is not reported due to limitations of the dataset. R^2 values are reported that quantify the fraction of variance in the moments that is accounted for by body weight. The root-mean-square deviation (RMS) from the trend line is also reported.

Table 17 lists the intercepts and slopes shown in Figures 43 and 44 showing relationships between maximum moment from child body weight for aligned trials. The R^2 values were modest, demonstrating that child behavior has more important effect on maximum moment than body weight. Even for the Yank behavior, only about 38% of the variance in maximum moment is attributable to body weight.

Table 18 and Figures 45 and 46 show trends for normalized maximum moment as a function of body weight. For Ascend and Bounce, the slopes are close to zero, but weak positive relationships are seen for Lean and Yank. This suggests a difference in behavior for larger children that is not accounted for by body weight. For example, this is consistent with the heavier children also having longer arms and legs that would allow them to shift their centers of mass further away from the handles (see section below on center-of-mass estimates) as well as being relatively stronger.

Table 17
Least-Square Fit Results relating Maximum Moment (lb ft) to Body Weight (lb) for **Aligned** Handle Trials
(see Figures 43 and 44)

Behavior	Intercept	Body Weight Slope*	R^2	RMS**
1Hand	-7.1	2.38	0.48	13.6
Ascent	8.0	1.36	0.26	13.1
Bounce	-7.7	2.82	0.30	25.0
Lean	-33.3	3.51	0.43	21.6
Yank	-79.3	5.90	0.38	43.8

* For body weight in lb
** Root mean square deviation for linear fit

Table 18
Least-Square Fit Results relating Maximum Moment Normalized by Body Weight (ft) to Body Weight (lb) for **Aligned** Handle Trials
(see Figures 45 and 46)

Behavior	Intercept	Body Weight Slope *	R^2	RMS**
1Hand	1.94	0.006	0.00	0.36
Ascent	1.80	-0.006	0.00	0.39
Bounce	2.37	0.006	0.00	0.72
Lean	1.47	0.030	0.07	0.56
Yank	1.19	0.068	0.09	1.12

* For body weight in lb
** Root mean square deviation for linear fit

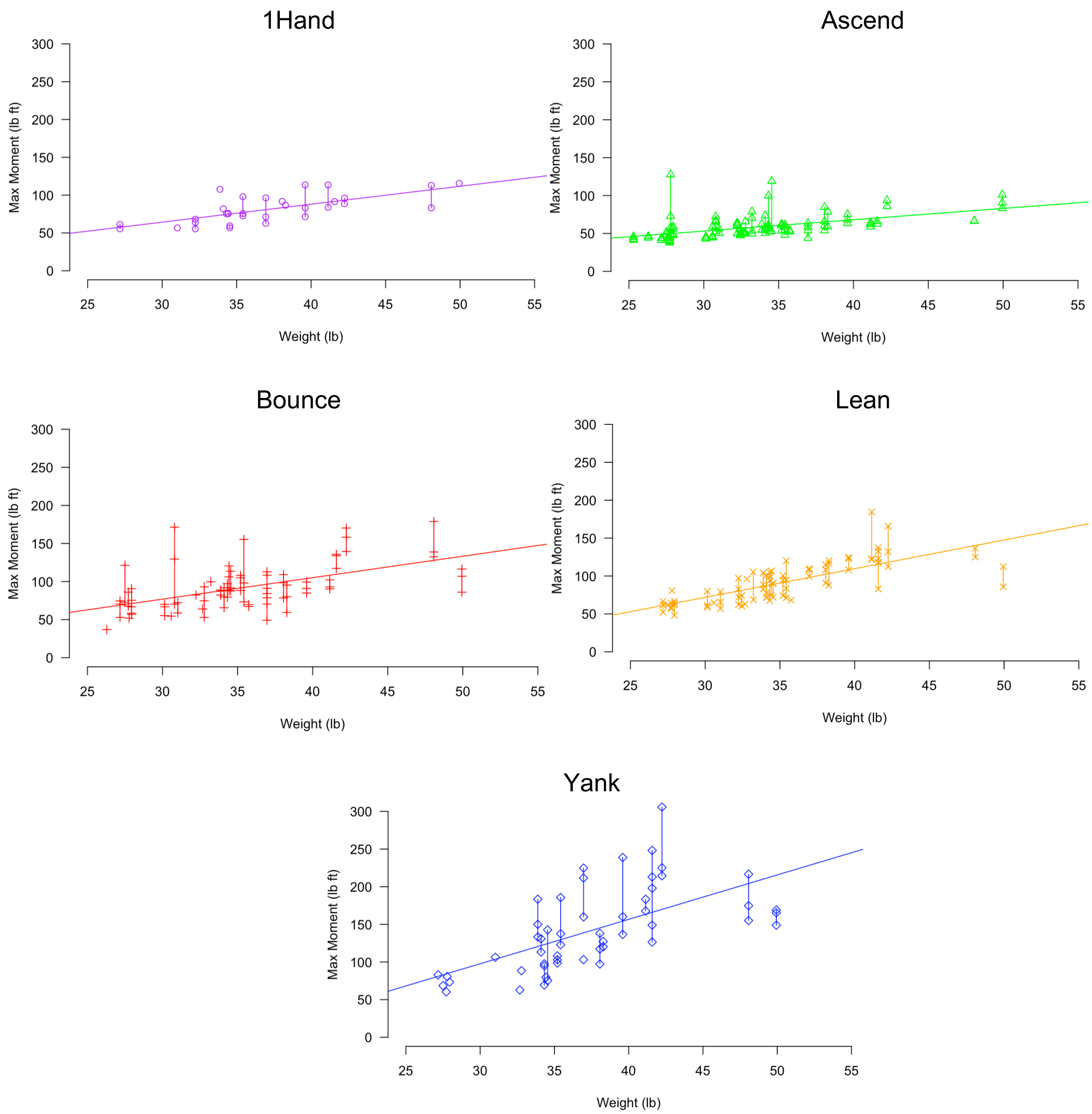


Figure 43. Maximum moment (lb ft) as a function of body weight (lb) for **aligned** handle trials. Vertical lines connect data from the same subject. Trend lines are shown for each behavior.

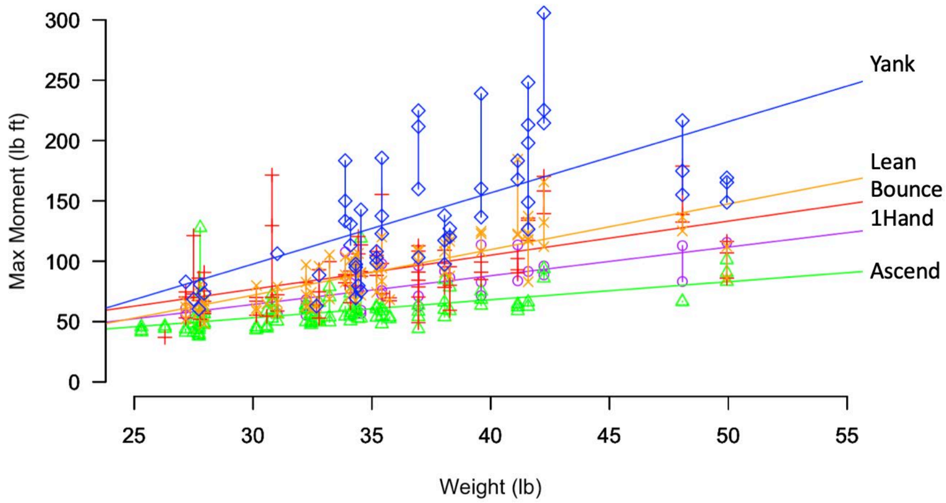


Figure 44. Plots from Figure 43 combined.

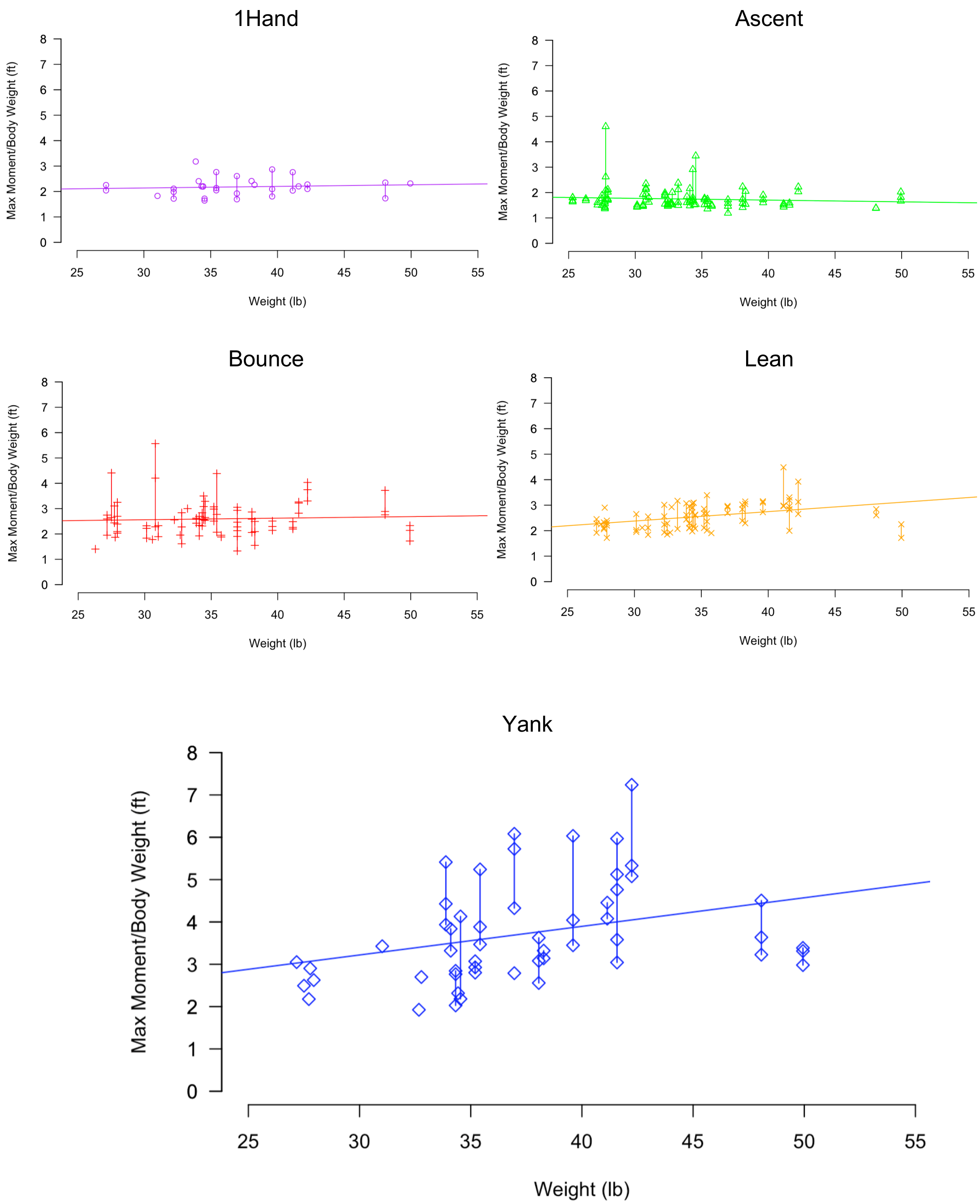


Figure 45. Scatter plots of maximum moment (lb ft) normalized by body weight (normalized units: ft) as a function of body weight (lb) for **aligned** handle trials. Vertical lines connect data from the same subject. Trend lines are shown for each behavior.

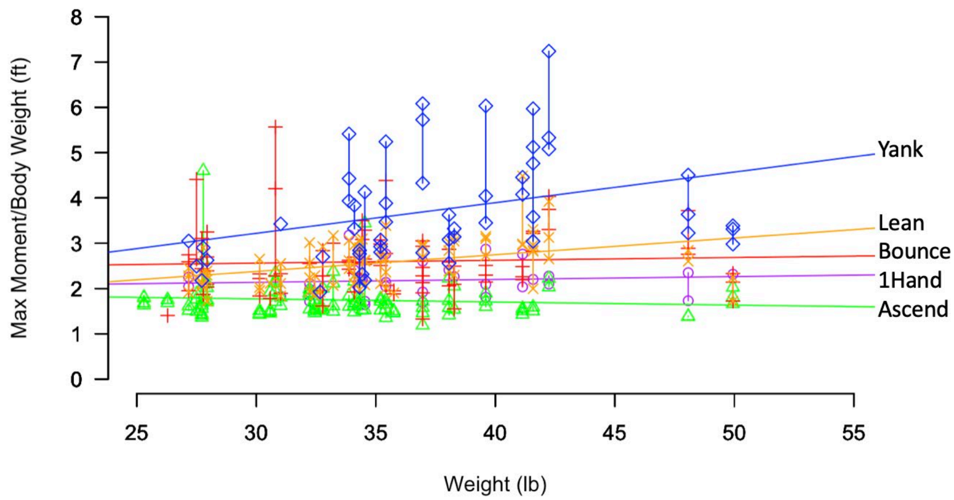


Figure 46. Plots from Figure R6 combined. Vertical lines connect data from the same subject. Trend lines are shown for each behavior.

Hop Up and Hang

The Hop Up and Hang behaviors were designed to use the upper handle only and were performed only in the trials in which the upper handle was offset toward the child. Because the fore-aft location of the upper handle was scaled based on body size (see Methods), the tip-over moment was calculated differently for these behaviors. The vertical force on the upper bar was assumed to be the only relevant force and the virtual fulcrum was set at 12 inches forward of the upper bar. Effectively, this means the vertical force in lb is equal to the value of the tip-over moment in lb ft.

Figure 47 shows these normalized moment values, which show minimal trends with body weight. The mean values (standard deviations) for Hop Up and Hang were 0.91 (0.35) and 1.14 (0.12) ft. The 62 available hop-up trials included a variety of tactics and both successful and unsuccessful tries (that is, where the child was not able to hold the posture). The 22 hang trials are only successful efforts (held for at least one second).

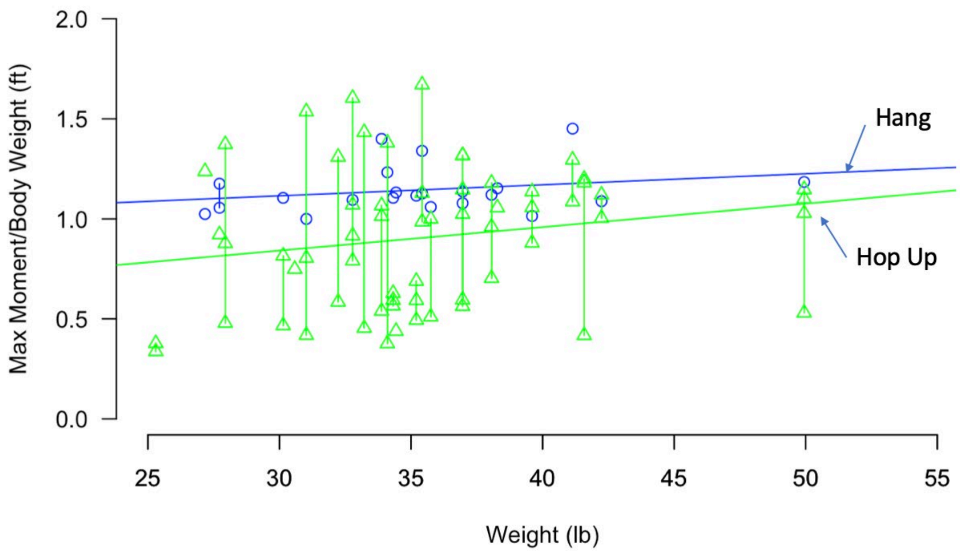


Figure 47. Maximum moment (lb ft) normalized by body weight (normalized units: ft) as a function of body weight for Hop Up and Hang behaviors. Vertical lines connect data from the same subject. Trend lines are shown for each behavior.

Vertical Forces

Examining the vertical forces on the handles at the time of maximum tip-over moment provides insight into the factors that produce the moments. Figure 48 shows the sum of the vertical forces on the upper and lower handles at the time of peak moment normalized by body weight. Conceptually, a stationary child will produce vertical forces equal to body weight, and indeed the figure shows that median forces for the quasi-static behaviors (1Hand, Hang, and Lean) are very close to one body weight. The highest normalized vertical forces are observed for the bounce behavior, with a mean of 1.7 times body weight. However, the values are lower for the lean and yank behaviors that produced higher tip-over moments. These findings show the importance of center of mass location for generating tip-over moment. Whereas the high tip-over moment for the Bounce behavior is generated predominantly by dynamic vertical acceleration of the child's mass, the high moments for Lean and Yank are due primarily to the outward offset of the child's CM from the handles, rather than vertical forces higher than body weight. (Note that the Yank behavior also results in differential horizontal forces that contribute to the tip-over moment, but the dominant factor is the CM location.) This analysis also makes clear that the child's weight, by itself, does not completely determine tip-over moment, nor does the vertical force. Both the CM location and dynamic behaviors are also important.

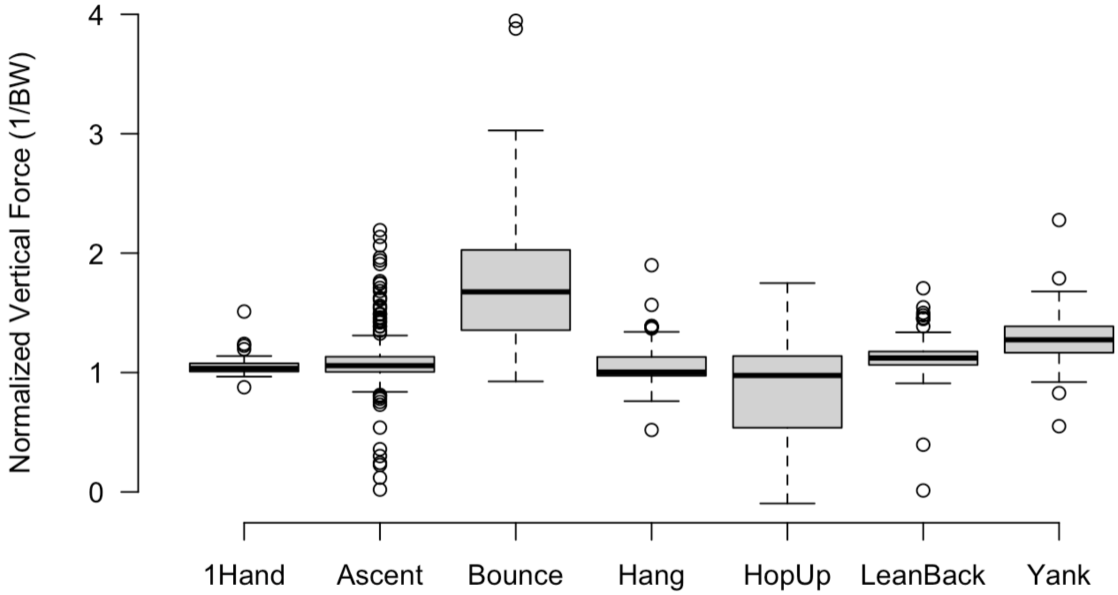


Figure 48. Normalized vertical forces (sum of upper and lower handles) at time of peak moment.

Effects of Vertical Handle Placement

The spacing between the upper and lower handles was varied based on participant anthropometry to ensure that all participants produced a wide range of postures independent of body size (see Figure 19). The effects of the nominal upper handle height (high, medium, low) on the mean tip-over moment was examined within behavior. Figure 49 shows boxplots of the differences in moment distribution across upper bar height in the aligned conditions. Table 19 lists the mean values and standard deviations within conditions. Apparent differences are observed only for the Ascent and Lean behaviors. For Ascent, the mean moment was higher in the mid and high bar positions than in the lower bar position. For Lean, the mean moment was higher in the lower bar position, which allowed the participants to extend their bodies fully rearward than in the higher handle positions. A comparison of the moments for all ascent conditions with those for the high step (lower bar) height did not show meaningful differences. In all cases, the variability within conditions was large relative to the differences between conditions.

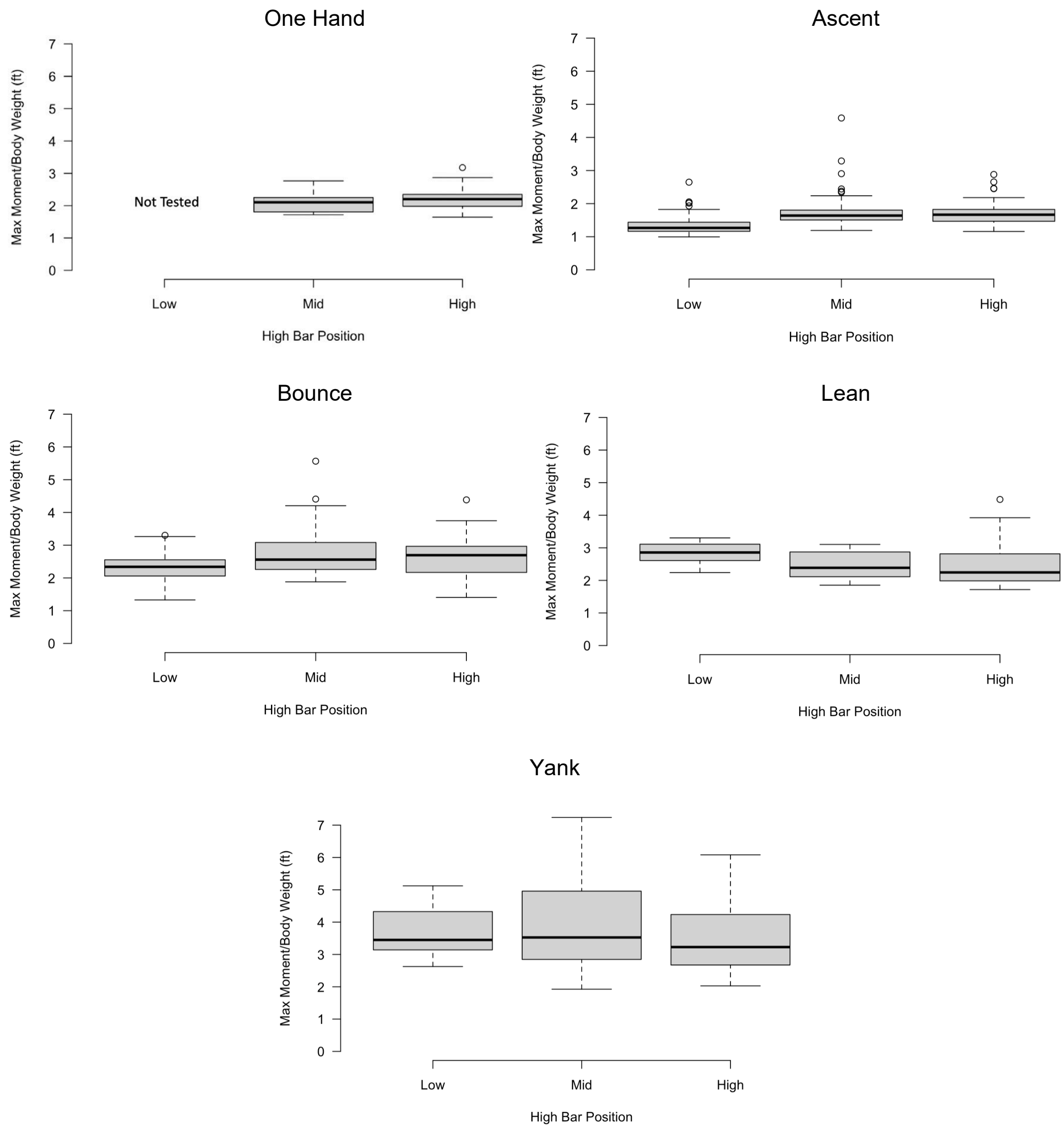


Figure 49. Effects of upper bar height on normalized moment in aligned trials.

Table 19
Effects of Upper Handle Placement on Mean Normalized Moment in Aligned Trials (ft)

Behavior	Low		Mid		High	
	Mean	SD	Mean	SD	Mean	SD
1Hand	N/A	N/A	2.12	0.32	2.23	0.41
Ascent	1.36	0.29	1.73	0.41	1.67	0.31
Ascent High*	1.39	0.25	1.70	0.34	1.67	0.21
Bounce	2.30	0.49	2.78	0.85	2.67	0.66
Lean	2.83	0.32	2.47	0.40	2.48	0.71
Yank	3.68	0.79	3.93	1.46	3.55	1.21

* Bottom bar in high position.

Effects of Virtual Fulcrum Placement

The distance that forces are exerted from the fulcrum affect the moment. In particular, the horizontal (X) fulcrum position has a strong effect, since downward forces are generally highest in these activities. The preceding analysis was based on a 12-inch (one foot) horizontal distance between the location of force exertion and the fulcrum, chosen because it is the 90th percentile value for drawer extension in a large dataset of clothing storage unit dimensions. Because this dimension varies across furniture designs, the effect of this dimension on the moment is important to examine.

In the static case, where the sum of the vertical forces is equal to body weight, the moment is equal to body weight times the horizontal distance from the child's center of mass to the fulcrum. Because the center of mass is always outboard of the hands and feet in these scenarios, reducing the fulcrum X to zero reduces, but does not eliminate, the moment. Under static conditions, the fore-aft forces at the hands and feet will be equal and opposite; the moment caused by the CM lying outward of the hands and feet is observed in the data as the magnitude of the force at the hands multiplied by the distance between the hands and feet.

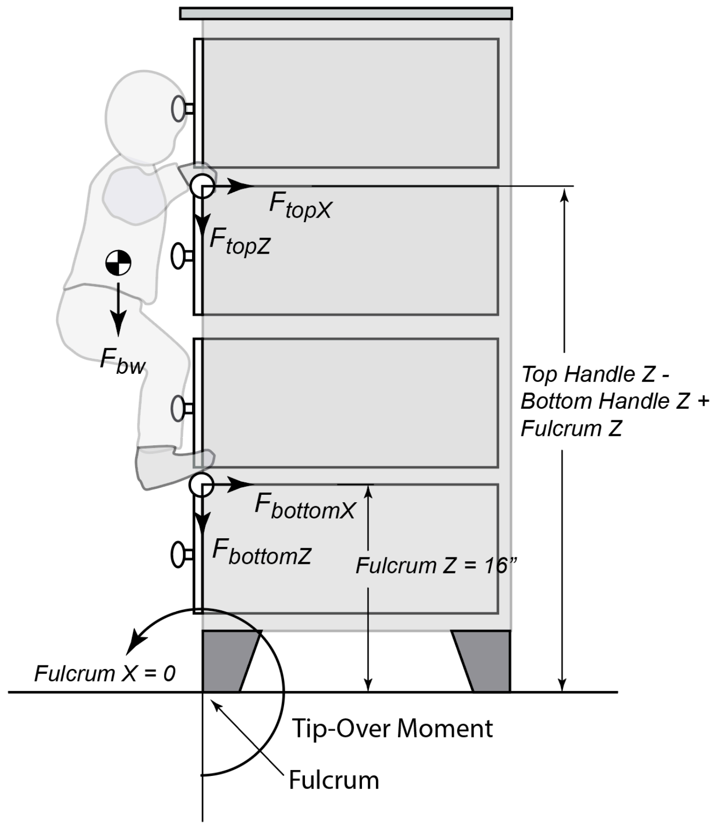


Figure 50. Schematic of effects of reducing fulcrum X to zero (compare with Figure 27).

Because the behaviors of interest are dynamic, the quasistatic calculations do not necessarily hold. However, the net moment can be calculated using a zero fulcrum X position to bound the effects of drawer extension. Placing the virtual fulcrum directly under the hands and feet in the aligned conditions eliminates the effects of vertical forces on moment while amplifying the relative effects of horizontal forces.

Table 20 compares the mean peak moments for fulcrum X values of 0 and 12 inches across behaviors for aligned conditions. The time of peak moment can differ depending on the fulcrum position used. However, to facilitate comparison, the moments for X=0 inches were calculated using the forces measured at the time of peak moment calculated using X=12 inches. Figure 51 shows the effects across the range of fulcrum X values. The trends are linear because the calculation is in effect scaling the moment created by the vertical forces to zero. Hence, the moment that remains with X=0 is due entirely to horizontal forces.

Placing the fulcrum directly under the aligned handles (X=0) reduces but does not eliminate the moment. The normalized values can be interpreted as the effective CM location outboard of the front of the clothing storage unit, in feet. The mean value is about 0.5 feet for the Ascent behavior and about 2.5 feet for the Yank behavior, where the horizontal forces exerted at the hands create substantial moments even when the effects of vertical forces are eliminated.

Table 20 also shows the effects of reducing Fulcrum Z to zero. The effect is much smaller than the effect of Fulcrum X, since the vertical forces (due to body weight) are generally much larger than the horizontal forces. The largest effect is seen for the Yank behavior, which has the highest horizontal forces. Figure 52 shows the trends across Fulcrum Z values.

Table 20
Effects of Virtual Fulcrum X Position on Mean Values of Maximum Moment (Aligned Trials)†

Behavior	X = 12” Z = 16” (Reference)	X = 0” Z = 16”	X Difference Relative to Reference*	X % Difference*	X = 12” Z = 0”	Z Difference Relative to Reference*	Z % Difference*
1Hand	81.3	42.0	-39.3	-48.3%	74.4	-6.9	-8.5%
Ascend	54.1	17.5	-36.6	-67.7%	49.9	-4.2	-7.8%
Bounce	91.9	26.8	-65.1	-70.8%	87.7	-4.2	-4.6%
LeanBack	91.7	51.9	-39.8	-43.4%	82.2	-9.5	-10.4%
Yank	142.4	94.1	-48.3	-33.9%	118.2	-24.2	-17.0%

† Moments for X=0 calculated using the force values measured at the time of peak moment calculated with X=12 inches. Fulcrum Z = 16 inches for both Fulcrum X columns; Fulcrum X = 12 inches for Fulcrum Z column.
* Difference in moment going from 12 inches or 16 inches to 0 inches.

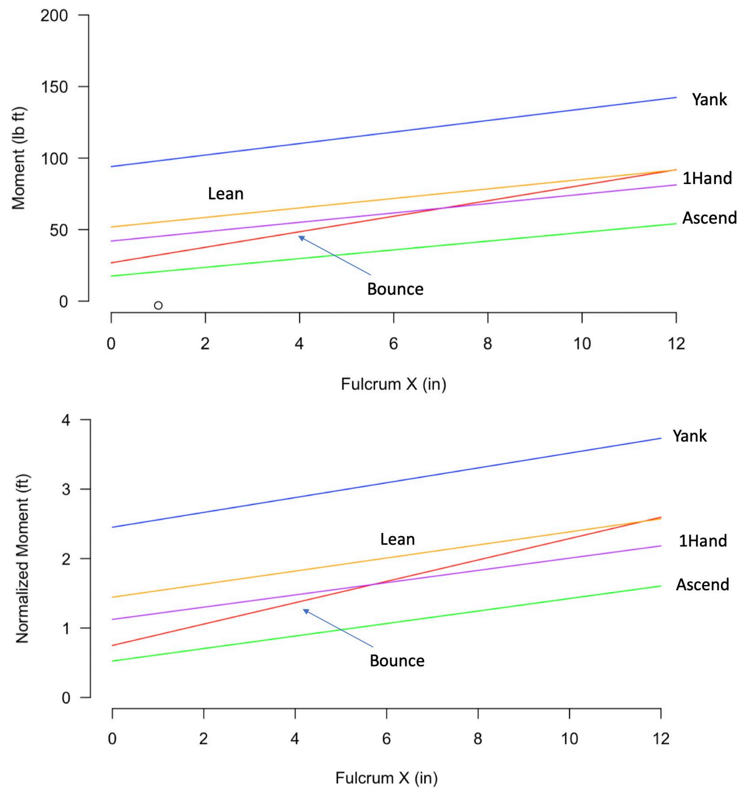


Figure 51. Effects of varying the horizontal distance to the virtual fulcrum from zero (directly under the bars) to 12 inches on moment (top) and moment normalized by body weight (bottom) for aligned trials.

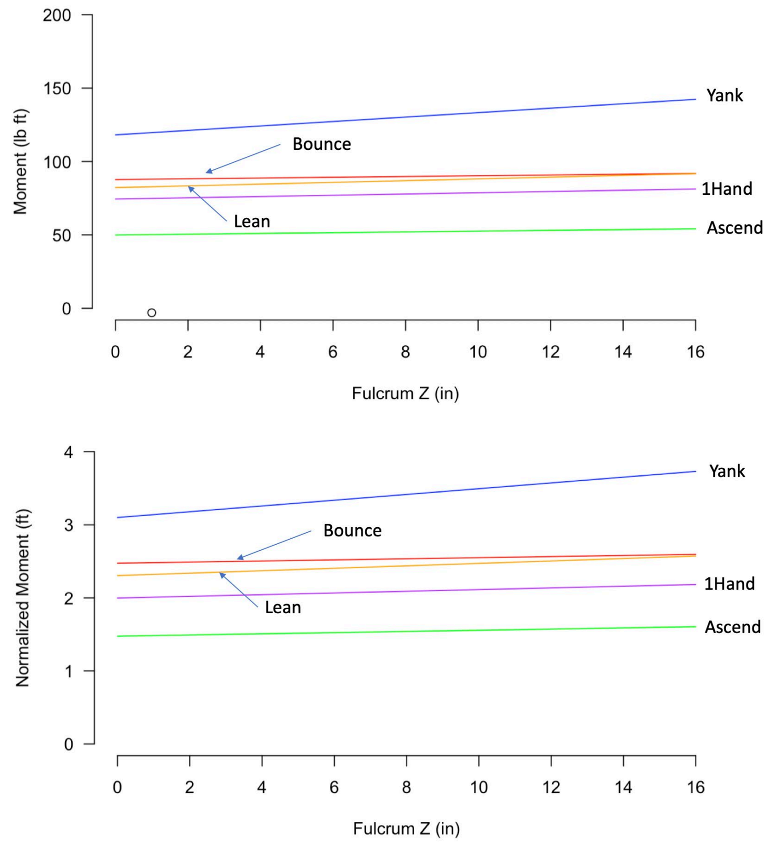


Figure 52. Effects of varying the vertical distance to the virtual fulcrum from zero (bottom bar at ground level) to 16 inches on moment (top) and moment normalized by body weight (bottom) for aligned trials.

Posture Results: Center of Mass Location

Participant postures have strong effects on the forces exerted and the calculated moments, because most of the force magnitude results from the action of gravity on the participant's mass. Consequently, the location of the center of mass (CM) during the behavior is the most useful posture variable. If the postures were static, the CM location could be calculated from the measured forces. However, due to the dynamic nature of the behaviors, the CM location is best estimated from video images. Note that due to resource limitations CM location was estimated for only a subset of trials.

The calibrated point locations digitized images were analyzed to quantify the estimated CM (ECM) location relative to the fore-aft position of the handles for a subset of the aligned-condition trials (see Methods section for digitizing and CM estimation procedures). For each trial, the frame from the sideview video at the time closest to the time of maximum moment was digitized (Figure 53)

Table 21 lists summary statistics for the ECM offset. Figures 54 and 55 show the ECM offset as a function of child body size for four behaviors. The results show that the results can be summarized as two postures: one for Ascent and Bounce behaviors with the ECM about 6 inches from the handles, and another for the Lean and Yank behaviors with the mean ECM of about 11 inches. Note that the variance is much larger for the latter two behaviors, consistent with the greater postural flexibility afforded by these behaviors. Figures 54 and 55 show that the ECM is related to body size, as expected, with larger children having their CM further away from the handles. The effect is stronger for the Lean and Yank behaviors. However, the variance around the mean trend is fairly large, indicating substantial posture variability. Note that the correlation between stature and body weight in this sample is 0.84, so the similar relationships with ECM are expected.

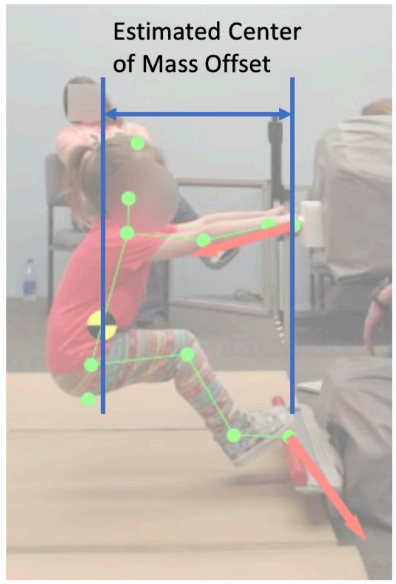


Figure 53. Example of digitized frame with estimated center of mass location and offset from upper handle. Forces at the hands and feet are shown with scaled arrows.

Table 21
Estimated Center of Mass Horizontal Offset from the Handles for Aligned Trials (inches)

Behavior	N Subjects	N Trials	Mean	SD	10th %ile	50th %ile	90th %ile
Ascent	36	109	6.1	2.0	4.3	6.1	8.6
Bounce	32	80	6.0	2.5	4.0	5.8	9.1
LeanBack	30	81	11.3	3.4	8.5	11.6	15.9
Yank	25	53	10.9	3.4	7.3	11.5	15.9

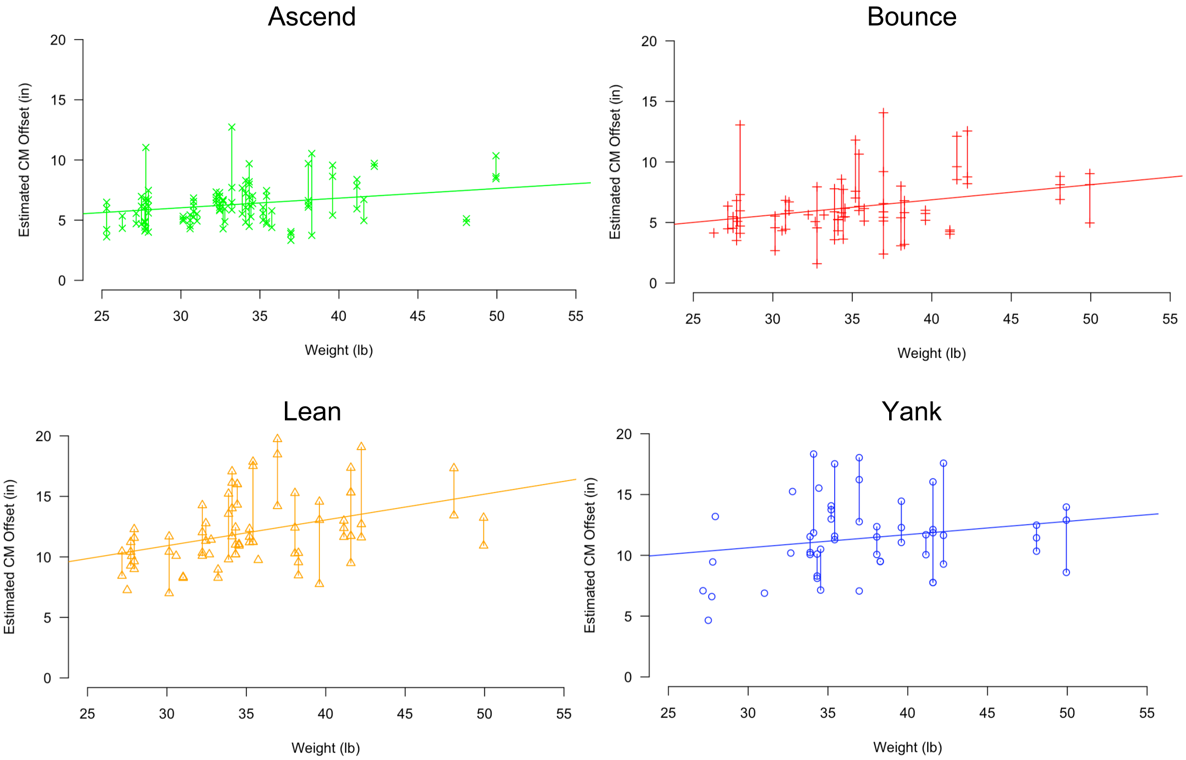


Figure 54. Relationship between estimated CM offset and **body weight** for aligned trials for which posture was analyzed.

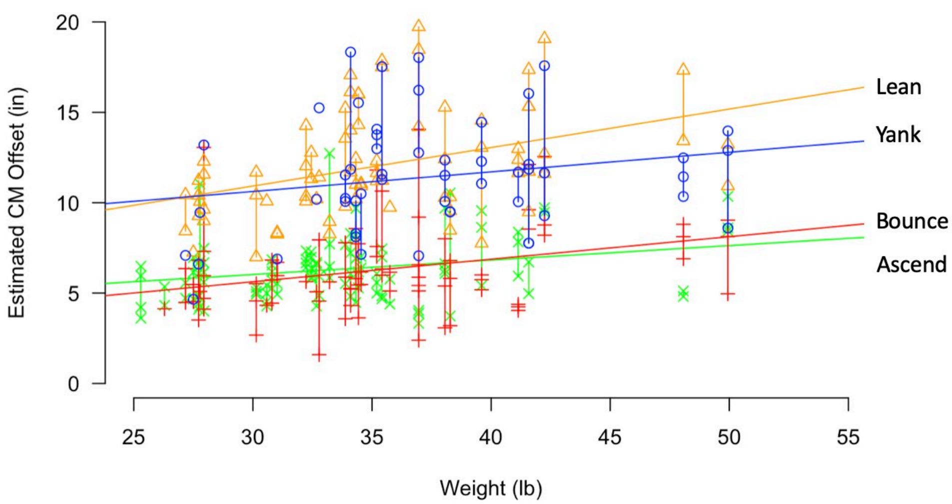


Figure 55. Relationship between estimated CM offset and **body weight** for aligned trials for which posture was analyzed (summary across behaviors).

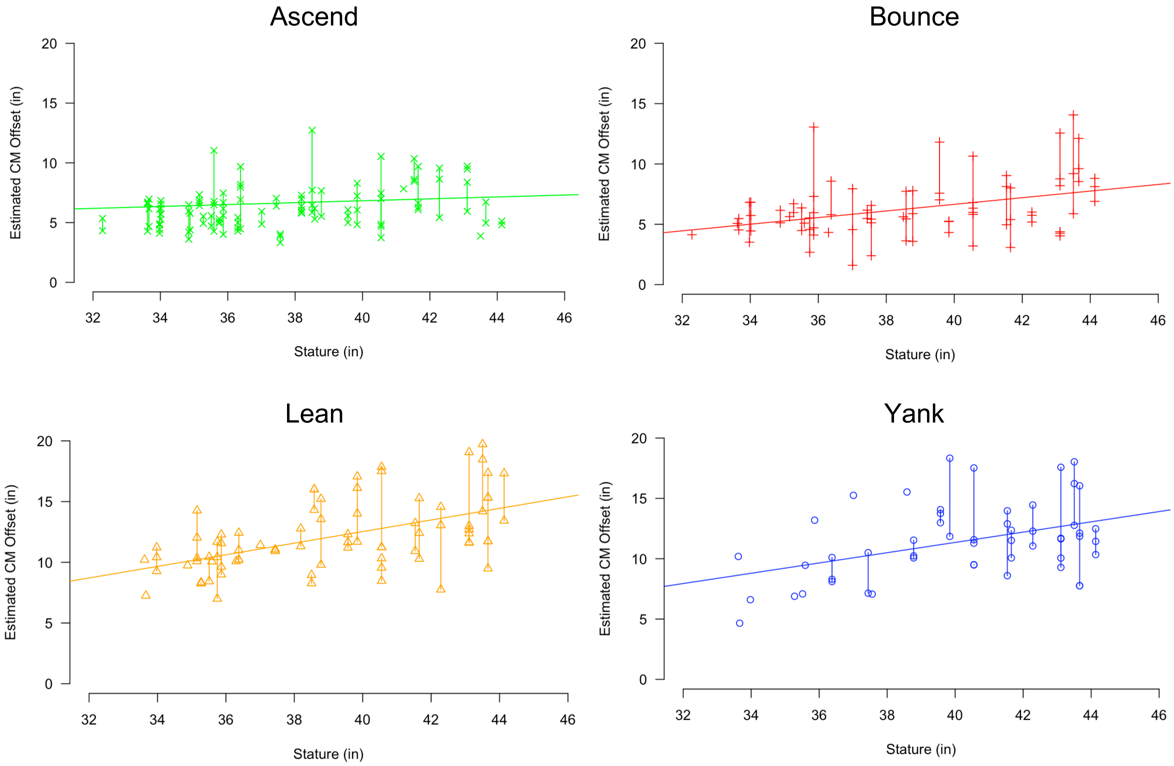


Figure 56. Relationship between estimated CM offset and **stature** for aligned trials for which posture was analyzed.

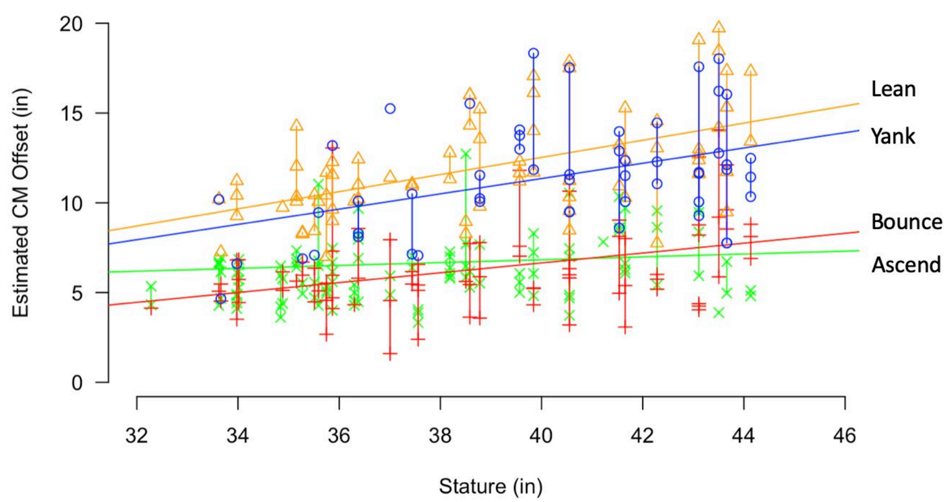


Figure 57. Relationship between estimated CM offset and **stature** for aligned trials for which posture was analyzed (summary across behaviors).

RESULTS: DRAWER AND TABLE TRIALS

Tip-over Moments

The tip-over moment was calculated at three time points in the trials: when the floor vertical force first dropped below 5 N (Ascent), at the point of maximum moment during the trial (Maximum), and at the point where the floor vertical force first rose above 5 N (Descent). Because the child was placed on the simulated table, only descent data are presented for table trials. The maximum moment was generally observed when the child sat or kneeled in the simulated drawer, rather than during ascent. Figure 58 shows sample images from trials at the ascent, peak moment, and descent frames.

Table 22 shows summary statistics for maximum moments calculated for the same virtual fulcrum conditions used for the handle trials, namely fulcrum X = 12 inches and fulcrum Z = 16 inches. Fulcrum X is measured from the front, upper lip (edge) of the simulated drawer or table (see Figure 28).

Figure 58. Example images from ascent, peak moment, and descent frames.

Table 23 shows that normalized moments were generally much lower than for the handle trials. On average, the normalized values were below 1 ft, indicating that the effective center of mass location was inboard of the drawer edge. This is consistent with the design of the fixtures, which necessitated the children to bring their CMs inside the drawer in order to have sufficient stability to leave the floor. On descent, the children controlled their descent to the ground, which again necessitated maintaining the CM over the drawer or table area. Figures 59 and 60 show the relationships with body weight.

Table 22
Summary of Moment Values† for **Drawer and Table*** Trials (lb ft)

Behavior	N	Mean	SD	10th%ile	50th%ile	90th%ile
Ascent	72	28.4	7.5	19.0	28.5	36.6
Maximum	72	37.7	9.3	26.8	36.5	48.7
Descent	89	23.6	9.6	9.4	24.9	35.3

†Moment calculated for 12-inch horizontal virtual fulcrum distance divided by body weight.
* Table trials are included in Descent only

Table 23
Summary of Normalized Moment Values† for **Drawer and Table*** Trials (ft)

Behavior	N	Mean	SD	10th%ile	50th%ile	90th%ile
Ascent	72	0.82	0.16	0.64	0.86	0.98
Maximum	72	1.10	0.26	0.87	1.09	1.29
Descent	89	0.71	0.28	0.30	0.81	0.99

†Moment calculated for 12-inch horizontal virtual fulcrum distance divided by body weight.
* Table trials are included in Descent only

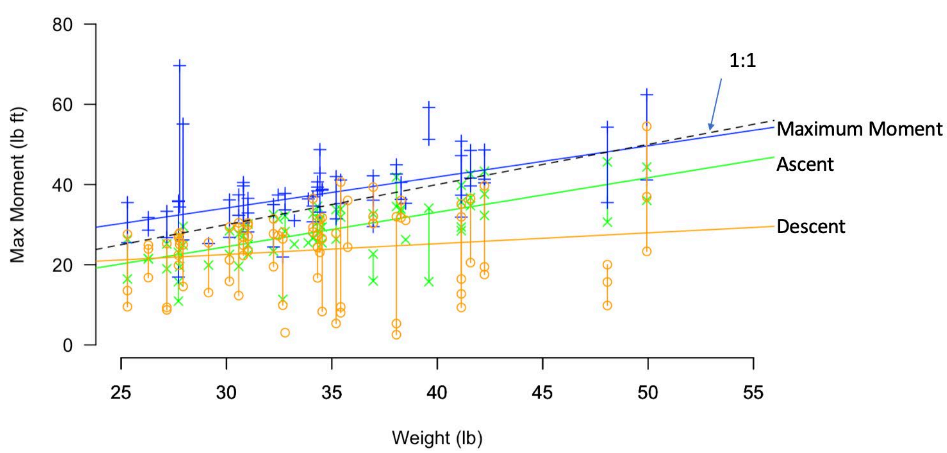


Figure 59. Moment values for drawer and table trials as a function of body weight. Vertical lines connect data from the same subject. Trend lines are shown for each behavior.

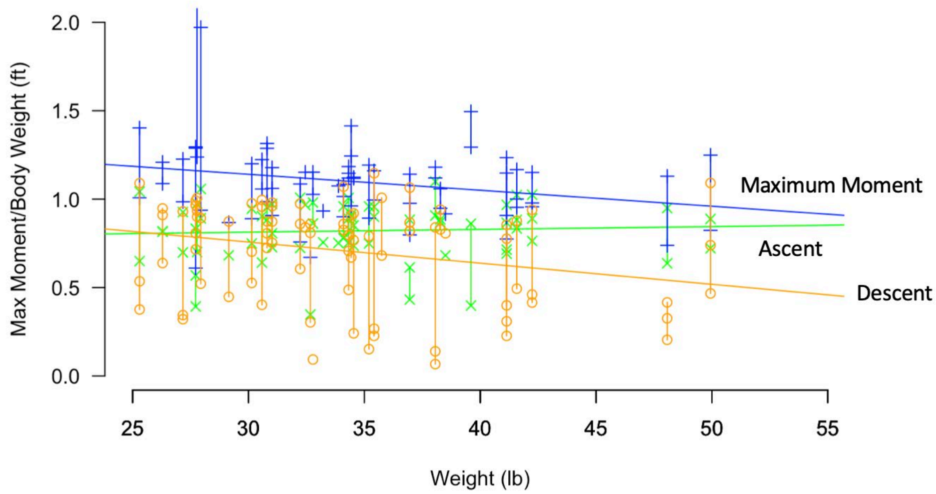


Figure 60. Normalized moment values for drawer and table trials as a function of body weight. Vertical lines connect data from the same subject. Trend lines are shown for each behavior.

Effects of Drawer/Table Height

The height of the drawer affected the moments measured on ascent and descent as well as the peak moment. Figures 61 – 63 show the boxplots of the distributions for each height category. When the drawer was at navel height, the children were able to pivot their torsos over the drawer to a greater extent on ascent, resulting in a smaller moment than when the drawer was higher. The normalized peak moment was also higher when the drawer was at axilla (armpit) height. Figure 64 shows comparative photos illustrating the differences in child posture. The findings for descent were somewhat different. When descending from the highest drawer or table position, most children were conservative and descended backward (facing the drawer/table), leaving their center of mass more centered on the fixture until their first foot touched the ground. Consequently, the normalized moment was larger on average for the lower drawer/table height.

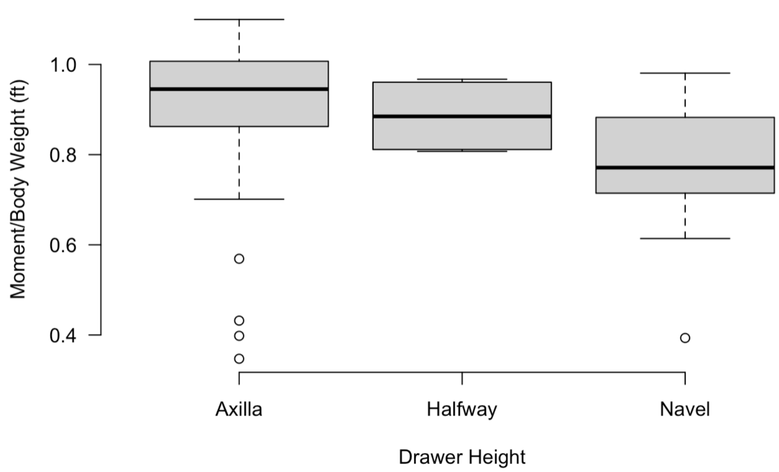


Figure 61. Effect of drawer height on normalized moment on **ascent**.

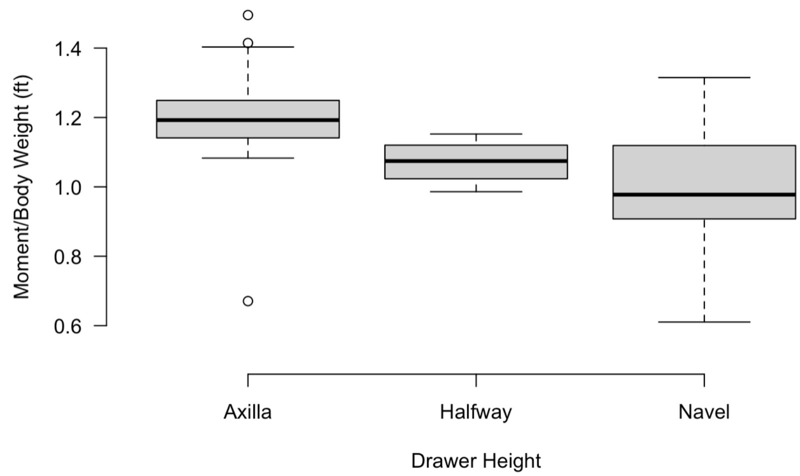


Figure 62. Effect of drawer height on normalized moment at **peak moment**.

Figure 63. Effect of drawer/table height on normalized moment at **descent**.

Ascent
Navel Height

Ascent
Axilla Height

Descent
Navel Height

Descent
Axilla Height

Figure 64. Comparative photos illustrating differences in tactics depending on drawer height.

Jump Descents

In a small number of trials, the child jumped down from the simulated drawer or table. The subset of 33 trials in which the child jumped and apparently landed with both feet on the force plate were extracted for analysis. The mean peak vertical force on the floor was 166 lb (standard deviation 75 lb), an average of 4.7 times body weight. Figure 65 shows the relationship between the peak force and body weight. As expected, children exerted ground reaction forces approximately proportional to body weight, on average, but the effect was weak relative to the variance. All jump landings resulted in forces exceeding two times body weight and some children exerted peak forces exceeding eight times body weight on jump landing. Note that these results are influenced by the foam padding on the floor over the force plate and the children's footwear. Bare feet and thinner or firmer padding would be expected to increase the peak force, as would jump descents from greater height.

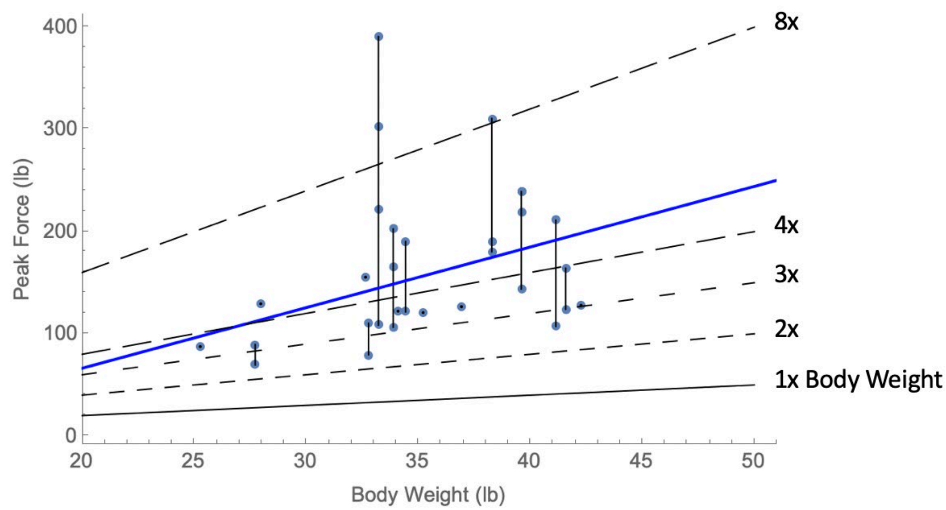


Figure 65. Peak vertical ground reaction force for jump landings as a function of body weight.

Posture Results: Estimated Center of Mass Location

Images from ascent and peak moment frames were manually landmarked as described in the methods section to locate the estimated center of mass (ECM) location. Figure 66 shows sample frames from one trial. For the drawer and table trials, the ECM offset was quantified as the distance outboard (toward the child) from the front upper edge of the fixture. Due to the complexity of the postures relative to the handle-trial postures, the ECM estimates for these trials are considered to be less accurate.

Figure 66. Example digitized frames with estimated center of mass location.

Table 24 lists summary statistics for the ECM offset. Negative values indicate that the ECM was within the drawer or footprint of the tabletop. On average, the ECM was about one inch outboard of the edge when the trailing foot left the floor on ascent and about 2.5 inches outboard when the leading foot reached the floor on descent. This is consistent with the biomechanical considerations.

Figures 67 and 68 show the ECM offset as a function of child body size for the three extracted frames, demonstrating that ECM location is not related to body size in these trials. In general, the tasks are sufficiently constrained geometrically that large body size does not result in differences in average torso location at the selected frames.

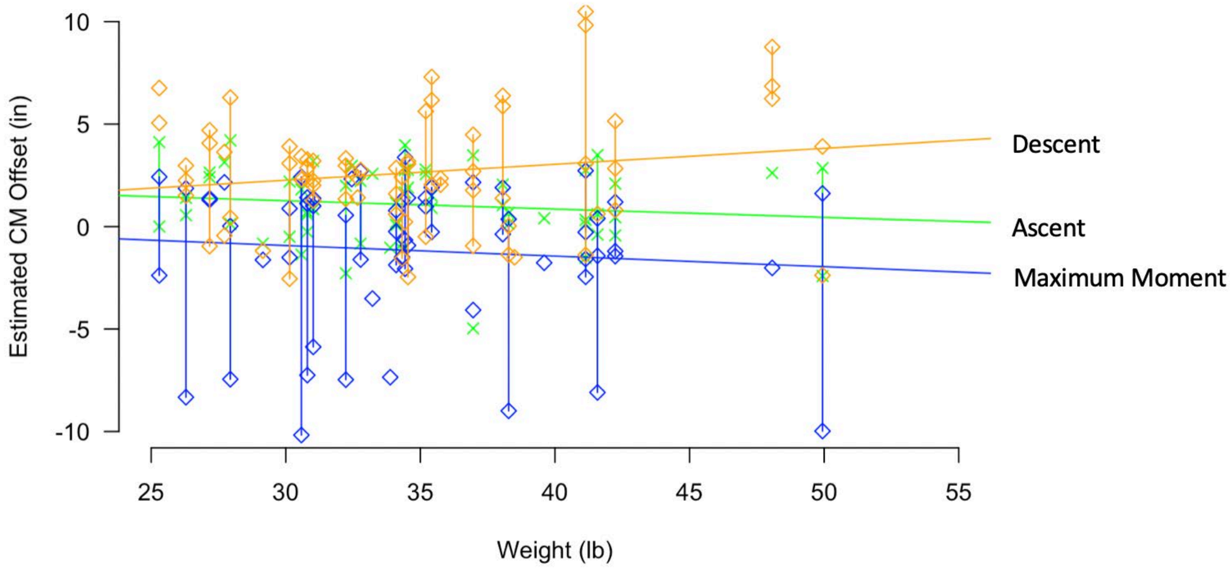


Figure 67. Relationship between estimated CM offset and **body weight** for drawer and table trials for which posture was analyzed.

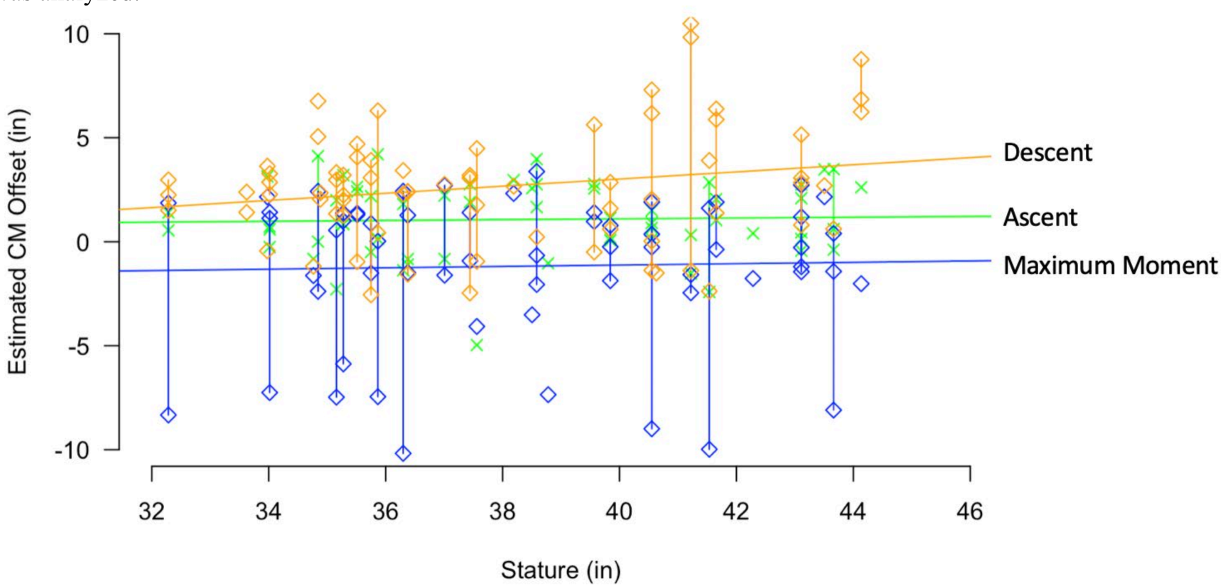


Figure 68. Relationship between estimated CM offset and **stature** for drawer and table trials for which posture was analyzed (summary across behaviors).

The mean ECM values in Table 24 can be compared with the normalized moment values from Table 23 for the same trials and frames. The normalized moment values suggest that the children's CM was in fact inboard of the drawer/table edge on both ascent and descent. The discrepancy with the image-based results is likely due to the fact that the estimated CM location is not valid across all postures and the measurement procedure was based on a single camera view that did not necessarily capture oblique torso postures well. The normalized peak moment values greater than 1 reflect the dynamics of the child dropping into the drawer; the ECM locations for these frames are also within the drawer (negative offset).

Table 24
Estimated Center of Mass Horizontal Offset Outboard of the Front Edge of the Drawer or Table (inches)

Behavior	N Subjects	N Trials	Mean	SD	10th%ile	50th%ile	90th%ile
Ascent	32	61	1.1	1.8	-1.0	0.9	3.1
Maximum	32	61	-1.2	3.5	-7.5	-0.3	2.2
Descent	33	76	2.6	2.7	-1.1	2.4	6.3

Larger CM offsets would be expected to be associated with higher horizontal forces. Figure 69 shows a plot of the upper handle horizontal force (Fx) as a function of ECM offset at the time of peak tip-over moment. The lean and yank behaviors were in some trials associated with horizontal forces nearing or exceeding body weight. These were also generally trials with relatively high ECM offsets, although the scatter in the plot is consistent with the dynamic and variable nature of in these behaviors.

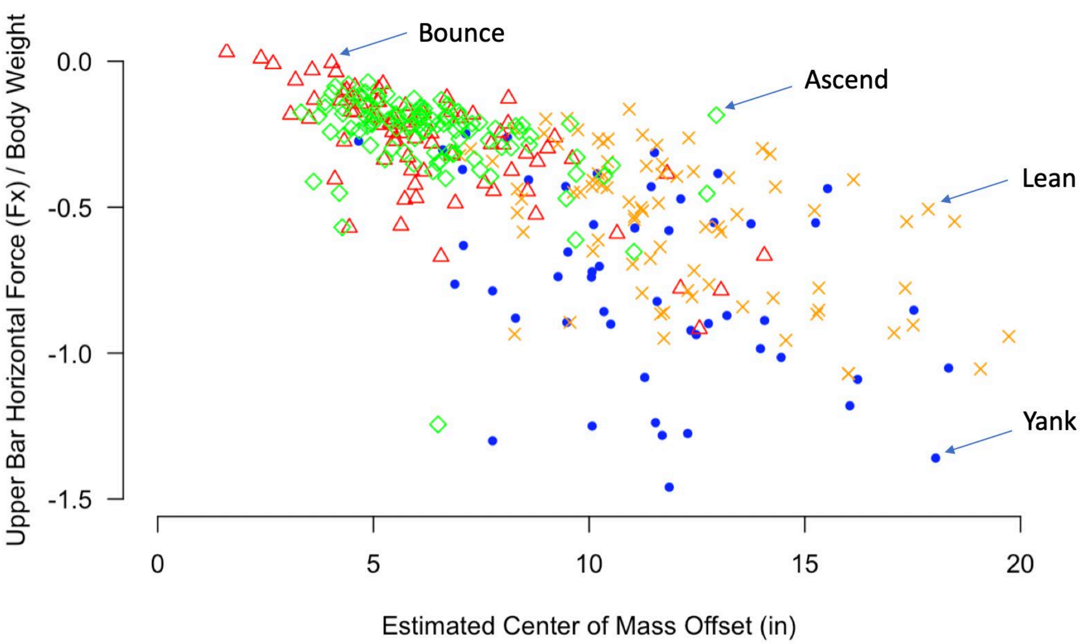


Figure 69. Horizontal force on the upper bar (Fx) normalized by body weight as a function of ECM offset for four behaviors.

RESULTS: SUMMARY

Table 25 and Figure 70 summarize the mean normalized tip-over moments associated with the various child behaviors. When the children were asked to climb in and out of a realistic drawer mockup set to a range of heights, without any reaction surface below it, they produced markedly lower moments than when interacting with separate contact points above the ground during the handle trials. That is, having separate contact points for the hands and feet, with good affordance for exerting force, enabled much greater moment generation. This is due in large part to the ability to support the center of mass outboard of the hands and feet by generating outward horizontal force at the hands and inboard force at the feet. In simple terms, this is the difference between climbing “into” (drawer trials) and climbing “on” (handle trials). To put it another way, the drawer and table trials correspond to interactions of a child negotiating the distance between a single furniture surface and the floor, whereas the handle trials correspond to children who have both hands and feet off of the floor and at different heights.

The results show that a child stepping up (for example, onto an open drawer) while able to grip a surface higher up can exert tip-over moments exceeding body weight by 60% (handle Ascent behavior). In contrast, climbing into a drawer without the ability to hold onto something higher for stability produced lower moments. With good affordance for hand and foot forces, as provided by the handles, children are able to exert moments equivalent to over 3.7 times body weight, on average. Bouncing, without leaning back, can produce average moments over 2.5 times body weight.

Table 25
Mean Normalized Tip-Over Moments Across Conditions (ft)

Behavior – Handle Trials	N	Mean*
Yank	53	3.73
Bounce	82	2.60
LeanBack	83	2.54
1Hand	32	2.18
Ascent	276	1.60
Behavior Frame – Drawer and Table Trials		
Maximum Moment	72	1.10
Ascent	72	0.82
Descent	89	0.71

* Units of ft; may also be interpreted as multiple of body weight exerted one foot from the fulcrum.

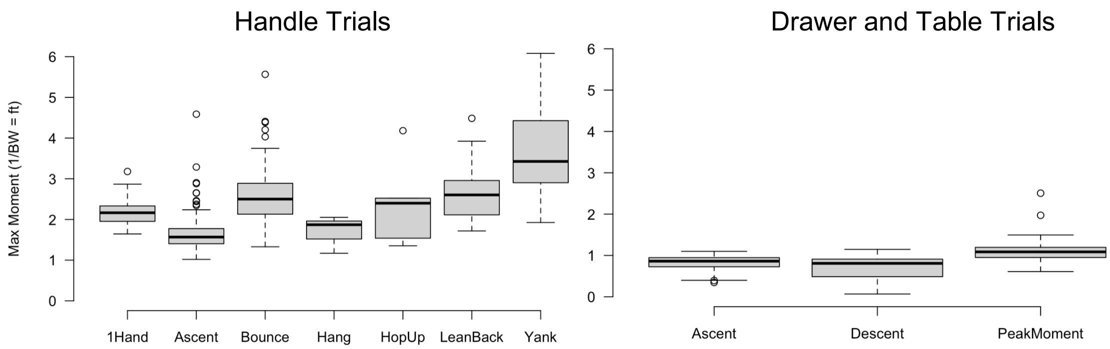


Figure 70. Comparison of the effects of behaviors on tip-over moment across test configurations.

DISCUSSION

Effects of Behavior, Apparatus Configuration, and Child Characteristics on Tip-Over Moments

Child behavior had much stronger effects on tip-over moments than child body size, and behavior influenced the effects of body size. All children were able to perform the Ascent and Bounce behaviors in aligned handle conditions and to climb into the drawer (and descend from the drawer and table) at navel height. Most children were also able to perform the Lean, Yank, and One-hand behaviors, which moved the child's center of mass outward and increased the moments substantially. The apparatus configuration (height of the handles and drawer) had smaller effects than anticipated, in part due to the wide variability among children in their behaviors.

Larger children (heavier or taller) are generally able to exert higher forces and moments, but the effects are generally small relative to the variance among children. The variance is particularly high for the more dynamic activities and those most influenced by body posture (Bounce, Lean, and Yank). The anthropometric effects are larger for behaviors with larger mean responses, indicating that the older, larger, more physically capable children are able to magnify the effects of their body weight through these behaviors (notably Lean and Yank). Given the large residual variance in posture and behavior, further analysis of anthropometric effects is unlikely to be useful; either stature or body weight is a sufficient surrogate for child size and age.

Comparison of Postures and Behaviors with Naturalistic Child Climbing Behavior

Most incidents of furniture tip-over are unwitnessed by anyone other than the child, and far fewer are caught on video. However, online searches readily retrieve videos of children climbing, including some that result in furniture tip overs. Figure 71 shows some images of children climbing to illustrate several characteristics that are similar to the current study:

- Children pull open drawers and use them as steps and handholds.
- Children use other features, such as drawer handles, as affordances for both the hands and feet when climbing.
- Children grasp upper drawers, furniture tops, or other features while stepping on lower drawers.
- When climbing, the children's bodies can be postured such that the center of mass is outboard of the hand and foot locations.

These scenarios demonstrate children exerting both horizontal and vertical forces with their hands and feet, just as they did in the laboratory study. Children are often seen in online videos sitting in drawers into which they've climbed, or on top of dressers and other furniture after climbing.

Limitations

This study has important limitations that should be considered when interpreting the results. The data were gathered in a laboratory environment using fixtures that were specifically constructed to produce idealized boundary conditions. The surfaces the participants interacted with were padded and equipped with high-friction interfaces to ensure that discomfort at the interface would not limit the children's behavior. The fixtures were rigidly mounted, so that no actual tip-over or instability perceptible to the children occurred. The fixtures were not designed to measure the dynamic events during incipient dresser tip overs, such as shifting drawers and a change in the dresser center of mass location with respect to the fulcrum. In general terms, these dynamic changes would be expected to reduce the moment required to continue to move the unit toward tip over.

The analysis focused on peak values of tip-over moment. Peak values of time-series force data are affected by the sampling and filter frequencies. In this case, the low-pass filter frequency of 200 Hz allowed short-duration peaks to be identified. A lower filter frequency would tend to reduce the peak moment. In the complex dynamics of a tip-over event, the mass moment of inertia of the furniture unit would influence the effect of the force exertion time history. The angular impulse generated by the child-exerted forces would impart momentum to the furniture unit. Conceptually, the impulses observed in the current study could be applied to computational models of furniture to estimate the change in momentum. However, the current study was focused on quantification of the child behavior, not the analysis of interactions with actual furniture.

Because the goal of the study was to gather subjective and objective data from children about their climbing behavior, children were recruited who were reported by their caregivers as liking to climb. The extent to which they represent the climbing disposition or tendencies of the general population is unknown. However, all children were reported by their caregivers as within the normal developmental range for their age.

The participants were directed to perform a set of behaviors chosen based on a review of videos of children climbing on clothing storage units and other furniture. These behaviors were within the behavioral repertoire of these normally developing children, except that some children lacked the grip and upper-body strength needed to perform the Hang and HopUp behaviors. The laboratory setting and encouragement from their caregivers may have led the children to engage in riskier behaviors than they would on their own.

Figure 71. Images from publicly available videos of children climbing household items (see Appendix H for a description of search terms). NOTE: visible faces have been blurred.

Further Analysis and Data Gathering

The data from this study could support a variety of further analyses. As noted above, the time histories of force and moments could be used to conduct dynamic simulations of potential tip-over events using realistic furniture characteristics. These calculations could be aided by analyses of the 3D anthropometric and posture data gathered in the study. The body scan data could be used to create 3D, articulated avatars of each child that could be used with the Microsoft Kinect data to track the posture of children more accurately and completely than was done using 2D video in the current project. The center of mass location could be more accurately determined as a function of time from these data.

Additional data could be gathered using similar techniques but more realistic interfaces. The idealized interfaces in the current study were chosen to ensure that they did not create discomfort that might limit child behavior. However, furniture often provides different types of affordances, such as narrow drawer edges and small protruding handles. Future research could investigate the extent to which these features of furniture design influence child climbing behaviors.

REFERENCES

Cusimano, M.D. and Parker, N. (2016). Toppled television sets and head injuries in the pediatric population: a framework for prevention**.** *Journal of Neurosurgery Pediatrics*, 17:3–12

Fryar, C., Gu, Q., Ogden, C., Flegal, K., (2016). *Anthropometric reference data for children and adults: United States, 2011–2014*. National Center for Health Statistics. Vital Health Stat 3.

Gottesman, B.L, McKenzie, L.B., Conner, K.A., and Smith, G.A. (2009). Injuries from furniture tip-overs among children and adolescents in the United States, 1990-2007. *Clinical Pediatrics*. 48(8):851-858.

Nose, T., Kitamura, K., Oono, M., Nishida, Y., and Ohkura, M. (2018). Automatic Learning of Climbing Configuration Space for Digital Human Children Model. In D. N. Cassenti (Ed.): *Proceedings Applied Human Factors and Ergonomics Conference*, AISC 780, pp. 483–490.

Snyder, R.G., Schneider, L.W., Owings, C.L., Reynolds, H.M., Golumb, D.H., and Schork, M.A. (1977). *Anthropometry of Infants, Children, and Youths to Age 18 for Product Safety Design*. Final Report UM-HSRI-77-17. University of Michigan Transportation Research Institute, Ann Arbor, MI.

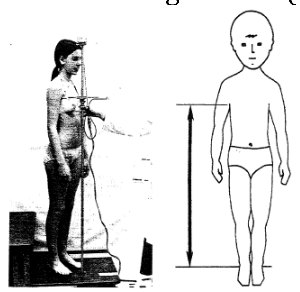
Suchy, A. (2019). *Product Instability or Tip-Over Injuries and Fatalities Associated with Televisions, Furniture, and Appliances: 2019 Report*. U.S. Consumer Product Safety Commission, Bethesda, MD.

Wolf, B.C. and Harding, B.E. (2011). Household Furniture Tip-Over Deaths of Young Children. *Forensic Sciences*, 56(4):918-921.

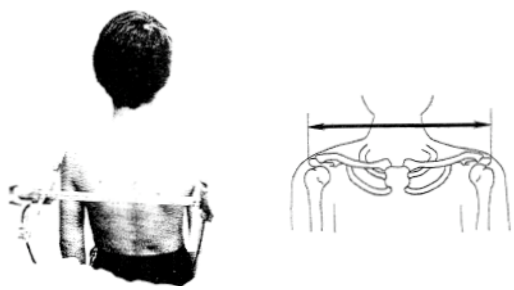
APPENDIX A

Standard Anthropometric Methods

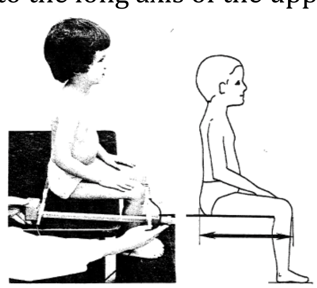
Axilla Height (Snyder 1977)
Subject stands erect, with feet together, weight evenly distributed, arms initially raised then lowered when instrument is in place. With the pointed blade of an anthropometer, measure the vertical distance from the standing surface to the right axilla (armpit).



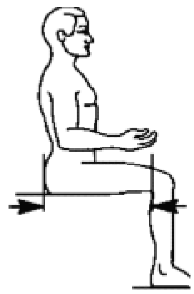
Bi-acromial Breadth (Snyder 1977)
Subject stands erect, arms hanging at sides. With the pointed blades of the anthropometer, measure the horizontal distance between the most lateral edges of the right and left acromion landmarks. (*Make sure shoulders are in widest position)*



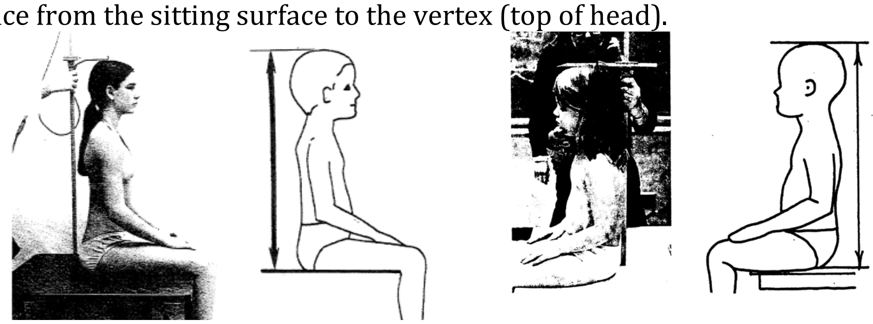
Buttock-Knee Length (Snyder 1977)
Subject sits erect, feet resting on a platform adjusted for 90° knee flexion. With the paddle blades of an anthropometer, measure the distance from the posterior surface of the right buttock to the anterior surface of the knee parallel to the long axis of the upper leg.



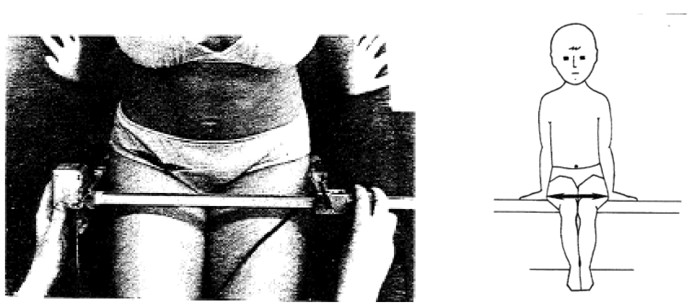
Buttock-Popliteal Length (ANSUR II)
The horizontal distance between a buttock plate placed at the most posterior point on either buttock and the back of the right knee (the popliteal fossa at the dorsal juncture of the calf and thigh) is measured with an anthropometer. The subject sits erect. The thighs are parallel and the knees flexed 90° with the feet in line with the thighs.



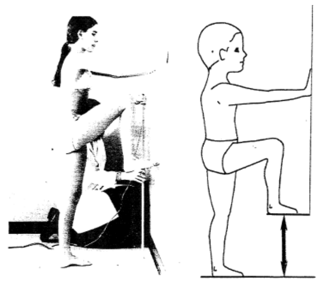
Erect Sitting Height (Snyder 1977)
Subject sits erect with head oriented in the Frankfort Plane (tragion to infraorbitale level), arms hanging at sides, hands resting on thigh. With the paddle blade of the anthropometer, measure the vertical distance from the sitting surface to the vertex (top of head).



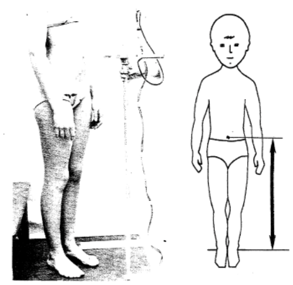
Hip Breadth (Snyder 1977)
Subject sits erect with knees together, feet resting on a platform adjusted for 90° knee flexion. With the paddle blades of an anthropometer, measure the maximum breadth across the hips parallel to the seated surface.



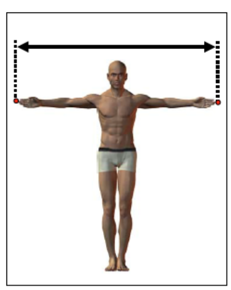
Max Step Height (Snyder 1977)
Subject stands erect facing wall with palms of hands resting lightly against wall at shoulder level for balance. Subject raises right foot to maximum height from floor. With the paddle blade of an anthropometer, measure the vertical distance from the floor to the ball of the foot.



Omphalion Height (Snyder 1977)
Subject stands erect with feet together and weight evenly distributed. With the pointed blade of an anthropometer, measure the vertical distance from the standing surface to the umbilicus (navel).

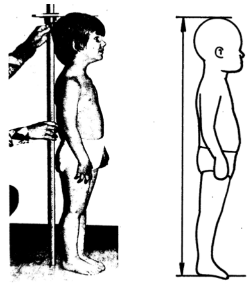


Span (Reach) (ANSUR II)
The distance between the tips of the middle fingers of the horizontally outstretched arms is measured on a wall chart. The participant stands erect with the back against a wall-mounted scale and the heels together. Both arms and hands are stretched horizontally along the wall with the tip of the middle finger of one hand just touching a side wall. A block is placed at the tip of the middle finger of the other hand to establish the measurement on the scale. The measurement is taken at the maximum point of quiet respiration.

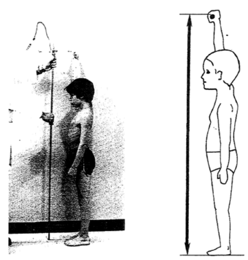


Stature (Snyder 1975)
Subject stands erect with head oriented in the Frankfort Plane (tragion to infraorbitale level), arms hanging at sides. With an anthropometer, measure the vertical distance from the standing surface

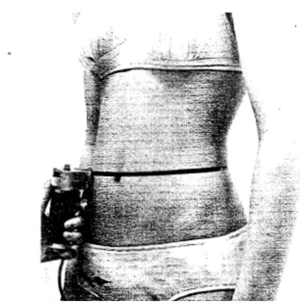
to vertex (top of the head).



Upward Grip Reach (Snyder 1977)
Subject stands erect with feet together, left shoulder against wall, grasping the handle of the grip device in right hand, and abducts extended right arm to maximum horizontal grip reach. With the pointed blade of an anthropometer, measure the horizontal distance from the wall to the most distal point on the handle of the grip device.



Waist Circumference, Omphalion (Snyder 1977)
Subject stands erect with feet together, weight evenly distributed, and arms hanging at sides. With a tape device, measure the horizontal circumference of the waist during normal breathing at the level of the umbilicus (navel).



APPENDIX B
Standard Anthropometric Data

Participant Number	Gender	Age (mo)	BMI (kg/m^2)	Weight (kg)	Stature (mm)	Axilla Height (mm)	Omphalion Height (mm)	Upward Grip Reach (mm)	Max. Step Height (mm)
CP05	F	31	15.4	12.6	904	595	477	983	235
CP06	M	65	15.6	19.5	1117	768	635	1310	316
CP07	F	50	15.1	16.1	1030	755	592	1154	332
C001	F	60	13.7	16.8	1105	782	635	1256	376
C002	F	54	15.3	18.9	1109	800	642	1322	321
C003	M	29	15.6	14.75	970	667	516	1054	208
C004	F	51	15.1	15.5	1012	734	589	1172	356
C005	F	47	20.3	22.7	1055	777	601	1255	304
C006	M	21	18.7	14	864	566	446	921	259
C007	F	58	15.4	17.3	1058	769	622	1200	289
C008	F	35	18.2	15.6	924	659	507	1037	215
C009	M	42	15.8	16	1005	711	564	1160	391
C010	M	36	18.4	16.8	954	635	487	1078	240
C011	M	46	16.4	17.5	1032	715	575	1158	293
C012	F	30	17.1	12.5	855	595	459	1050	209
C013	M	23	17.7	11.95	820	567	424	963	230
C014	M	32	14.6	11.5	885	705	526	1025	256
C015	M	65	15.6	18	1074	773	618	1262	240
C016	F	27	16.9	13.25	883	587	463	998	221
C017	M	41	16.2	15.65	980	724	529	1125	283
C018	F	28	18.3	14.65	893	629	472	1022	231
C019	F	42	16.6	13.7	908	638	476	1020	225
C020	M	48	17.0	18.7	1047	749	580	1200	320
C021	M	54	15.8	15.4	985	702	555	1130	221
C022	M	22	20.3	14.85	854	602	431	953	183
C023	F	29	15.3	12.7	911	675	513	1060	201
C024	F	20	18.3	13.6	860	603	438	965	175
C025	M	28	17.5	14.1	896	637	473	996	186
C026	F	56	15.5	18.7	1095	802	622	1256	402
C027	F	35	15.1	12.35	902	627	483	978	300
C028	M	57	16.0	19.2	1095	805	637	1211	365
C029	F	38	16.3	13.9	922	671	516	1027	291
C030	F	33	17.3	15.7	951	701	506	1126	278
C031	M	29	16.9	12.6	863	594	450	971	213
C032	F	21	18.6	10.3	743	546	391	823	190
C033	M	42	15.7	15.1	978	735	544	1117	275
C034	F	57	16.4	17.4	1030	743	586	1165	272
C035	M	38	16.8	14.9	940	660	504	1035	225
C036	M	52	17.3	21.85	1121	800	628	1282	305
C037	M	23	20.7	16.25	886	623	481	1006	262

Participant Number	Gender	Age (mo)	Waist Circumference at Omphalion (mm)	Erect Sitting Height (mm)	Hip Breadth (mm)	Buttock-Popliteal Length (mm)	Buttock-Knee Length (mm)	Biacromial Breadth (mm)	Reach Span (mm)
CP05	F	31	555	511	190	219	292	215	Null
CP06	M	65	555	608	233	312	363	253	1092
CP07	F	50	565	566	206	275	334	228	1004
C001	F	60	498	612	212	290	351	230	1028
C002	F	54	565	604	217	284	356	252	1060
C003	M	29	578	548	190	237	333	225	971
C004	F	51	503	560	200	251	326	231	986
C005	F	47	652	578	243	293	360	252	1104
C006	M	21	509	512	204	222	264	223	851
C007	F	58	540	589	210	274	339	243	1000
C008	F	35	520	543	207	230	301	214	890
C009	M	42	515	585	207	311	259	219	973
C010	M	36	561	548	213	237	309	225	900
C011	M	46	Null	Null	Null	Null	Null	Null	1016
C012	F	30	480	521	182	221	277	213	768
C013	M	23	510	510	188	189	260	204	762
C014	M	32	458	511	171	Null	284	212	Null
C015	M	65	524	591	199	351	307	233	1014
C016	F	27	512	481	200	278	231	210	820
C017	M	41	502	577	185	224	303	224	964
C018	F	28	535	536	188	221	286	225	857
C019	F	42	530	515	195	230	297	198	807
C020	M	48	532	618	212	260	320	239	1021
C021	M	54	512	542	207	274	321	233	990
C022	M	22	534	505	198	223	265	221	Null
C023	F	29	495	514	181	229	289	219	885
C024	F	20	532	515	233	234	284	190	844
C025	M	28	529	546	190	226	277	206	825
C026	F	56	557	604	223	293	357	245	1060
C027	F	35	500	535	188	221	278	216	859
C028	M	57	515	615	220	277	357	256	1050
C029	F	38	490	556	183	229	289	208	861
C030	F	33	516	584	207	234	296	212	863
C031	M	29	510	527	268	226	184	204	848
C032	F	21	490	468	170	196	249	193	714
C033	M	42	475	550	180	254	307	215	929
C034	F	57	562	601	213	284	342	222	942
C035	M	38	517	550	202	253	300	214	867
C036	M	52	540	650	234	270	354	271	1100
C037	M	23	551	545	224	213	277	228	851

APPENDIX C

Focus Group Structured Protocol

Furniture Questionnaire CPSC Dresser
Revision 2019-10-02 Participant Number__________________

PARENT QUESTIONS

[Administered orally by research assistant, responses recorded by hand. Parent questions are administered while the child is being measured (standard anthropometry) in the same room.]

1. Has your child shown an interest in climbing on a household item (not on a playground)? **Y N**
2. What was the item, where was it located and how did he/she climb?
   What:
   Where:
   How:
3. Does the child have furniture for clothing storage (for example a dresser) in their room? **Y N**
   a. If no: Do they have access to furniture like that in the house?
4. Have you observed your child interacting with the dresser [or whatever word the caregiver uses]? **Y N**
5. How does/did your child interact with the furniture (e.g. climbs, opens drawers, pulls items out of drawers, sits in drawers)?
6. If the child climbs/climbed on the furniture, what strategy is used (e.g. all drawers closed, drawers opened in a staggered pattern, uses other objects or furniture)?
7. How does/did the child get down from the furniture?
8. Does/did the child interact similarly with other furniture items (e.g. nightstands, media units, accent/occasional furniture, office furniture, bookcases)? **Y N**
9. Do you have anything else that you would like to mention? Are there any issues that we have not raised?

CHILD QUESTIONS

[Administered orally by research assistant, responses recorded by hand. Child questions are administered with the parent in the same room.]

10. Do you like climbing? **Y** **N**

11. What types of things do you climb?

12. How do you climb?

13. For the items identified by the parent: What do you do with the [furniture item]? (e.g. open the drawers, get things out, stand/sit/climb on the item) NOTE: Do not prompt for sit/standing/climbing unless raised by the parent or child.

14. If there is something in or on the item that is hard to reach, how would you try to get it?

APPENDIX D

Scripted Instructions

Consent Scripts

Research Assistant to Adult:

Thank you for volunteering today. Before we start I would like to go over what we are doing today and answer any questions you may have. We will measure your child's body dimensions and record his or her weight. We will use special rulers called anthropometers to take these measurements and will need to touch your child's head, chest, pelvis, arms and legs. We will also record your child's body shape using a whole-body surface measurement system. This system uses a red laser light similar to the light used in a supermarket checkout scanner. This system is in a laboratory down the hall.

Most of the time during this session we will ask your child to climb onto a low bar while pulling on a handle, as if climbing on playground equipment. We will ask him/her to lean back and pull as hard as he/she can. We will start with asking your child to climb into and out of this box that simulates a piece of furniture.

We will record three-dimensional video of your child as he or she is participating in the study. We need the video to understand how your child performs the tasks. Video recording is required to participate in the study.

You will stay with your child at all times during the study. You are free to leave the study at any time. We will take little breaks during this session. Please let us know if you think your child needs a break, or if you have any questions during testing.

Research Assistant to Child:

We want to know how you are. We want you to push and pull (*demonstrates*) on handles as hard as you can. We want you to climb. We will show you how. Your (dad or mom) has said that it is OK.

Do you want to do this?

[Require oral yes.]

Anthropometry Script

We are going to do some measurements with rulers now and some later.

To child: I am going to see how big you are now.

<u>*Weight*</u>

To Child: Please take off your shoes.
Step on this scale. Hands at your sides.

<u>*Stature*</u>

To parent: Please stand in front of your child.

To Child: Stand here (*2 feet in front of parent*). Look at your mom/dad. I am going to touch the top of your head.

<u>*Omphalion Ht*</u>

To Both: We are going to do that again. Except I will measure to your belly button.

<u>*Axilla Ht*</u>

To Both: We are going to do that again. Except I will measure to your armpit.

To Both: I am going to take some arm and leg measurements.

<u>***Max Step Height***</u>

To Child: Stand facing this corner. Right hand on this wall. Arm straight. Stand straight.

To Parent: We are measuring maximum step height. Please keep your child standing straight. His/her hand is on the wall for support. He/she will lift the right leg. Please help your child hold the knee bent and foot flat at the highest point.

(show illustration if needed)

<u>***Overhead reach***</u>

To Child: Stand in this corner. Face this way. Back and legs against this wall. Hold this piece of wood.

To Parent: We are measuring overhead reach. Please keep your child standing straight. His/her back and heels against the wall. Feet flat on floor. Please help your child bring his/her arm up so that the wood is flat on the wall.

(show illustration if needed)

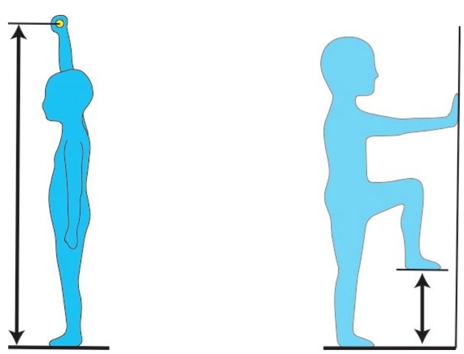


Figure D1: Illustration shown to parent before overhead reach and maximum step height measurements

General Instruction Script

I am going to set up the equipment in different ways. NN (*name of investigator*) is at the computer and will check that the equipment is working properly (*zeroing)* each time I make a change. It is important that while NN is checking --- no one stand on this square or touch this equipment. When I make changes, I may ask both of you (*parent and child*) to stand in the lower area with the door closed. This will ensure that your child is not around the equipment while it is moving.

Drawer Conditions Script

To Parent:

This box represents a furniture drawer. I am setting the top edge of the drawer at your child's belly button height. I will ask him/her to crawl in, wait a moment, and then crawl out.

Please watch your child while you stand here *(show spot not in way of Kinects or camera – near "X" on floor)*. We would like to get his/her behavior without your help. However, if you think that 1) your child is stuck and can't go up or down or 2) is about to fall from a height that you do not feel comfortable with, please step in and take your child off of the equipment.

To Child:

Sit here on this tape.

(Start Recording)

I am putting this silly toy in here. (*if needed with younger child)*

Please climb into the box. *Alternates:* Go sit in the box. Go sit next to toy.

(*When they are inside)*

Sit down.

Please hand me the toy. (*if needed with younger child)*

Now climb out of the box. *Alternates:* Go sit on "X"/next to parent. I will hold your toy.

Go sit on the tape. *Alternates:* Go by mom/dad/toy.

To Parent:

I am going to raise the height of the edge to be half way between your child's belly button and armpit height (*or at armpit height, or lower)*. And he/she will crawl in, wait a moment, and then crawl out. If this is too hard for your child I will lower it a bit. If this is very easy for your child I will raise it a bit.

Table Conditions Script

To Parent:

This represents the top of a table or dresser. We are going to measure your child as he/she gets themselves down from the top. I would like you to place your child so he/she is sitting on top of it. Your child should **not** stand up on the top. Please do not stand on the square on the floor after you have placed your child on the table top.

Please watch your child while you stand here *(show spot)*. We would like to get his/her behavior without your help. However, if you think that 1) your child is stuck and can't go up or down or 2) is about to fall from a height that you do not feel comfortable with, please step in and take your child off of the equipment.

To Child:

Sit here on this tape. *(Start Recording)*

To Parent:

Please place your child on the top

To Child: (*When they are on top)*

(If they look like they are going to stand) ... Sit down on your bottom.

Climb down. *Alternates:* Go by mom/dad/toy.

Go sit on the tape. *Alternates:* Go by mom/dad/toy.

Note: The initial position of their legs might be different: over the edge versus cross legged. If you have time and the child is willing, do a second trial with whichever they did not do the first time.

Dresser Conditions Script

To Parent:

These two bars represent the front of a piece of furniture a child might climb. We are going to move the bars to two different heights and in and out. Each time we move them, we will need to make sure they are working properly, so we need to stand away from the square.

We will then ask your child to step onto the lower bar and hang onto the top bar with their hands. We have a list of things we would like your child to do while standing on the lower bar. We may not ask him/her to do all of them every time.

To Child:

Sit here on this tape.

See definitions of actions below

Climb up: Climb up on the step. Hand on handle.

(Both hands and feet should be on the bar after completion)

Al*ternate:*

1) Feet here. Hands here. (point to each bar)
2) *Use hands to show up stepping motion*
3) *Practice when not collecting, guiding hands and feet.*

Bounce: Practice on floor before going on the step.

Keep feet touching lower step. Bounce up and down. Use your arms and legs to bounce.

(feet should stay on the step)

Al*ternate:*

1) Jump high! Jump again! Now keep your feet on floor. *(hold feet with hands)*
2) Squish down low. Jump up. *(hold feet with hands)*
3) Down, down, down! >>> Up, up, up! *Other pairs:* tiny/big!
4) Boing-y! Boing-y!
5) *When demonstrating emphasize being tiny and then rocketing up. Explosive!*

Lean Back: Lean back as far as you can. Straight arms and legs. *(pause ... then go to "Yank")*

(after they are in the position for a moment)

Al*ternate:*

1) *Practice while on the bar, but not recording - help them lean backwards while on bar.*
2) Hang on! Feet stay. Body away.

Yank: Yank/Pull as hard as you can on the handle.

Al*ternate:*

1) *Practice while on the floor: take child's hands and do a push-me, pull-you type of game*
2) Shake the handle. Shake, shake, shake! *Other word:* Rattle

1 Hand and 1 Foot: Take one hand off the handle. Take one foot off the step.
(correct if not the same side of body by saying …)
Now switch legs.
A*lternate:*
1) *Stand behind child and ask them to touch your hand with their hand. Then their foot.*
    a. Hang on. One hand here / high five. This foot (point to same side foot) here.
2) *Practice while on the bar, but not recording - help them let go of bar and move foot*
3) Hang on … *(touch hand)* ... Hand please … *(touch foot with other hand)* ... Foot please.

Hop Up: Stand on the floor here (point to spot). Do not use the step (shake head).
(pause) Hands on handle.
(if low or mid bar) Hop up so your tummy touches handle. Keep tummy on handle.
(if highest bar) Do a pull up.
Drop down to the floor (point to floor). *If needed*>> No landing on step!

A*lternate:*
1) Hop up like you are getting out of a pool.
2) Super jump! Use handle to help you get higher.
3) Jump high. Handle helps you get higher!

Hang: Stand on floor … (point to spot) … Hands on handle … ***(pause)***
Hang. Feet off floor. Drop to the floor.
(ONLY hang in WR -- offset conditions)

Climb down: (*Make sure they are back in a "standard" 2-foot, 2-hand posture before starting).*
Please climb down.
A*lternate:*
1) Feet here. (point to floor)
2) *Use hands to show down stepping motion.*

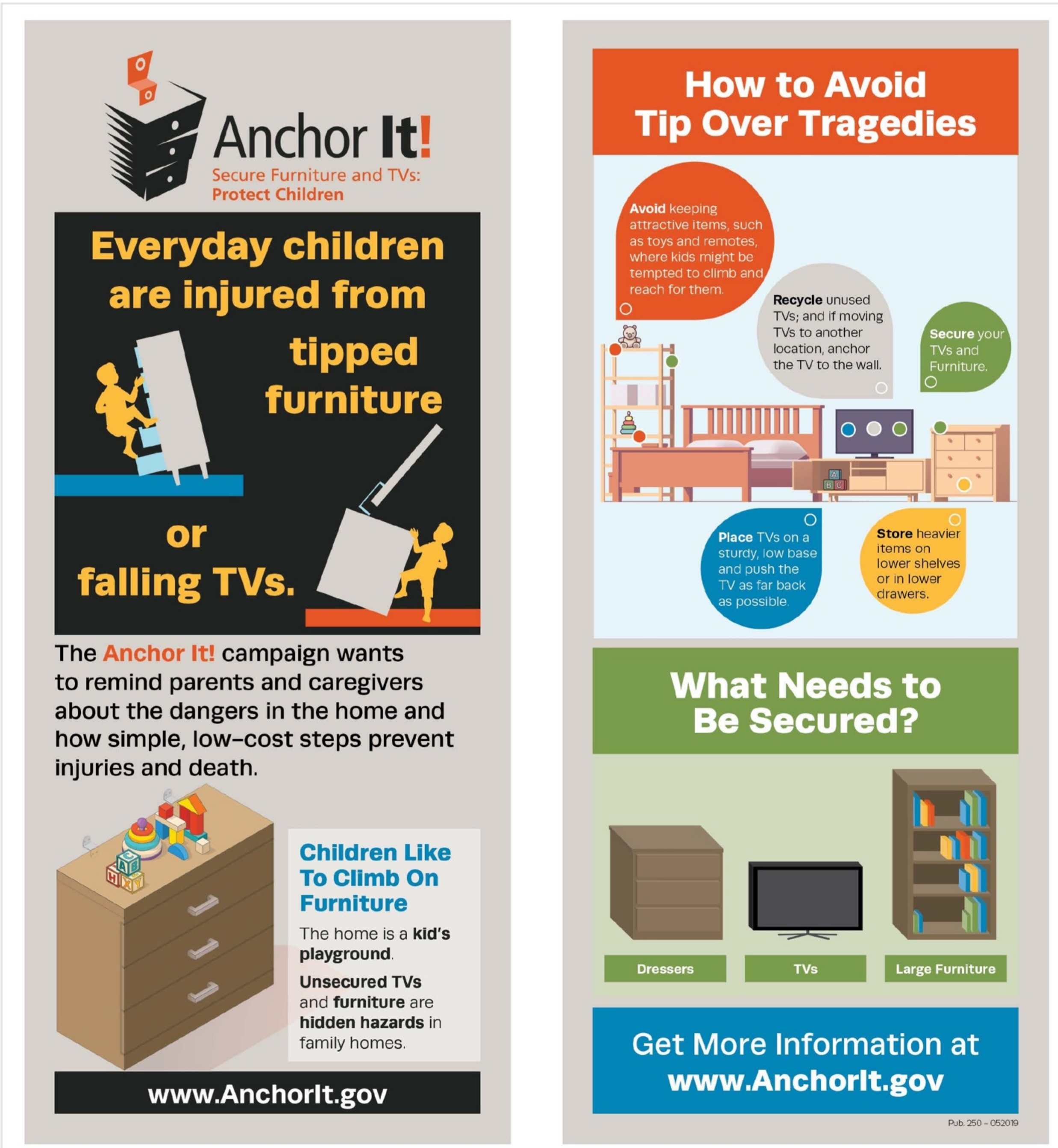
If you need to act it out, stand on the child's left side. Sometimes standing beside the child is helpful when showing a fore-aft motion such as lean or yank as it is hard to mirror that.

APPENDIX E

Illustrated Instructions for Handle Conditions

APPENDIX F

Tip-Over Safety Handout



APPENDIX G

Focus Group Responses

Table 1
Caregiver Answers, Part 1

Participant Number	Age at Testing (mo)	Has your child shown an interest in climbing on a household item?	What was the item?	Where was it located?	How did he/she climb?
CP05	31	Yes	table; fridge; tub; dresser; couch; play kitchen; computer desk; metal drawers in pantry	kitchen; living room; bathroom	move to chair; climb on back of couch
CP06	65	(no response)	stair rails; window ledges; trees	(no response)	(no response)
CP07	50	Yes	coffee tables; couch back; kitchen table	living room; kitchen	hands to pull up, knee on couch; gets on chair
C001	60	Yes	couch; bathroom towel rod	family room; bathroom	jumping on/off; hanging (broke); uses stepstool
C002	54	Yes	couch	living room	jumped up
C003	29	Yes	chairs; bar stool chair; sofa	kitchen; living room	elbows/knees; jumps off
C004	51	Yes	window	living room	small child chair into window sill standing
C005	47	Yes	stairwell; dresser; desk; counters	bannister; parents' room; computer room; kitchen	pulling; used chair; barstool
C006	21	Yes	couch; coffee table; kitchen table; stairs	(no response)	couches at first, then becomes daredevil
C007	58	Yes	couch; ladders; stairs; counter top; dressers	mom's room	object sitting near dresser that she used to climb up there
C008	35	Yes	couch (no furniture except couches)	living room	climb
C009	42	Yes	chair; bed; couch	living room; bedroom	hands & knees
C010	36	Yes	couch; countertop; crib (in & out); beds	living room; kitchen; bedroom; parents' room	standard; step stool; leg up; pulls sheets & blankets
C011	46	Yes	table; desk; bookshelf; bed; couch	living room; basement; bedroom	hands & feet
C012	30	Yes	table; hang from chandelier/light	dining room	chair to table
C013	23	Yes	train table; end table; stool; couches; bed; bench	basement; kitchen; living room; parents' room; entry	hands and feet; with plastic stool
C014	32	Yes	everything; stairs; shelves; dressers; couch; bed	(no response)	hands & feet
C015	65	Yes	sofa; parents' bed; bathtub	living room; bedroom; bathroom	hands & feet
C016	27	Yes	sofa; parents' bed; stairs	living room; bedroom	climbs hands & feet; uses step stool for sink to hold onto the counter
C017	41	Yes	beds; couches; chairs; tables; cubes; baby gates; brick hearth; stairs	bedrooms; living room; kitchen; coffee table; hall	uses objects to step up - whatever is there
C018	28	Yes	beds; couch; brick fireplace; chairs; basement stairs	bedroom; living room; kitchen	grab and pull up

C019	42	Yes	couches; tables; bed; coffee table; kitchen/office chairs	living room; kitchen; bedroom; office	leg over; chair to table; step on frame, leg over, pulled up; climbs from floor; pull up from belly, leg over
C020	48	Yes	dressers; couch back (sectional); coffee table; bunkbed ladder	bedroom; living room	hands & feet (handles) or from bed to dresser; flip over back of arm, floor to cushions to back
C021	54	Yes	counters; dressers; couch; coffee table; bunkbed ladder	kitchen; bedroom; living room	stool/chair; climbs handles or from bed to dresser; flip over back of arm or floor to cushions to back; hands & feet
C022	22	Yes	couch (back); coffee tables; chairs; crib	living room; dining room; bedroom	flop; pull up; hanging on bar
C023	29	Yes	dresser; bunk beds; pantry shelves; cabinets; window; table	bedroom; pantry; kitchen; living room; dining room	pulling out drawers; rail; swing up
C024	20	Yes	couch; chair; bench seat	living room; dining room	knee up; reaches across and pulls herself up
C025	28	Yes	bed; crib; changing table; desk; coffee table; table; book case	bedroom; parents' room; living room; kitchen	steps on trundle, pulls up; base of crib; nightstand; chair; arms
C026	56	Yes	couch; bed; counter; tables; window sill; toilet	living room; bedroom; kitchen; anywhere; bathroom	hands, feet; kid chair; kitchen chair; step up, pulls up
C027	35	Yes	counter; table; couches; beds	kitchen; living room; bedroom	(no response)
C028	57	Yes	toy organizer; dresser; cabinet; table; counter	living room; parents' room; kitchen	ladder style
C029	38	Yes	table; ladder; playground	kitchen	chair
C030	33	Yes	couch; table; crib; beds	living room; dining room; bedrooms	knees up - hands & knees
C031	29	Yes	coffee table; couch; dining table; beds (can't get down)	living room; dining room; bedroom	hands & feet; chair to table; shimmies up
C032	21	Yes	stool; table; ottoman (high)	play room; living room	front first, flop & scoot
C033	42	Yes	couch; changing table; mantle; chairs; dining table; counter	living room; entryway; dining room; kitchen	sit/walk across back; swing leg up boxes, bin; step up; chair
C034	57	Yes	counter; bunk bed ladder; couch; bed	kitchen; bedrooms; living room	stool, props herself up and jumps; hands & feet; puts leg up & pulls up; pulls up & swings leg over
C035	38	Yes	counter; bunk bed ladder; couch; bed	kitchen; sister's room; living room; bedroom	hands & feet; leg up & pull; pulls up & swings leg over
C036	52	Yes	couch; ottoman; pool table; chairs	living room; family room	leg up; hop up
C037	23	Yes	couch; chair; ottoman; book shelf; coffee table	living room	leg up; elbows, feet

Table 2
Caregiver Answers, Part 2

Participant Number	Age at Testing (mo)	Does the child have furniture for clothing storage in their room?	If no, do they have access to furniture like that in the house?	Have you observed your child interacting with the dresser?	How does/did your child interact with the furniture?
CP05	31	Yes	N/A	Yes	Dump out, stool, move chair
CP06	65	(no response)	(no response)	(no response)	(no response)
CP07	50	Yes	N/A	Yes	opens drawers, pulls clothes out
C001	60	Yes	N/A	Yes	opens/closes to get clothes out
C002	54	Yes	N/A	Yes	opens & closes
C003	29	Yes	N/A	Yes	opens drawers, empties
C004	51	Yes	N/A	Yes	opens drawers, pulls items out, when she was little
C005	47	Yes	N/A	No	N/A
C006	21	Yes	N/A	Yes	open & close drawers; does not climb
C007	58	Yes	N/A	Yes	appropriately
C008	35	Yes	N/A	Yes	opens drawers, gets clothes out
C009	42	No	Yes - parents' room	No	N/A
C010	36	Yes	N/A	Yes	opens & closes drawers; clothes in bottom & top drawer - used to climb on bed and lean over to get stuff out of top drawer
C011	46	Yes	N/A	Yes	opening
C012	30	No	No	No	not interested
C013	23	Yes	N/A	No	opens bottom drawer
C014	32	Yes	N/A	Yes	opens drawers, takes clothes out
C015	65	Yes	N/A	Yes	opens drawers, takes clothes out, closes drawers
C016	27	Yes	N/A	No	ignores it
C017	41	Yes	plastic 3-tiered	Yes	takes drawers, dumps clothes - no climbing, sits in drawers under bed
C018	28	Yes	plastic 3-drawer	Yes	pull out drawers and dump things
C019	42	Yes	N/A	Yes	opens drawers for clothes - doesn't sit in, hasn't recently climbed on/in it
C020	48	Yes	N/A	Yes	climbs, opens drawers to take clothes out
C021	54	Yes	N/A	Yes	climbs; opens drawers to get clothes out
C022	22	Yes	N/A	Yes	getting things from top (no climbing)
C023	29	Yes	N/A	Yes	opens drawers, stands in bottom, climbs to middle
C024	20	Yes	N/A	No	Yes - opens drawers on dresser
C025	28	Yes	N/A	Yes	opens & shuts drawers; pulls stuff out
C026	56	Yes - 5-drawer square cubby	N/A	Yes	only allowed to open and close; foot on cubby, dresser bolted to wall; uses step stool
C027	35	Yes	N/A	Yes	Yes - 2-tier dresser in closet - on top are clothes hung. Climbed onto storage box and then onto dresser to get the dress she wanted
C028	57	Yes	N/A	Yes	since 18 months
C029	38	Yes	N/A	Yes	clothes in & out; opens & closes doors
C030	33	Yes	N/A	Yes	opens drawers - gets out clothes
C031	29	Yes	N/A	Yes	opens/shuts, fills with books, takes out clothes
C032	21	Yes	N/A	Yes	tries to put things in drawers
C033	42	Yes	N/A	Yes	opens drawers; climbed - stepping into drawer
C034	57	Yes	N/A	Yes	climbed once - tipped over (didn't see); opens & shuts drawers

C035	38	Yes	N/A	Yes	opens & closes drawers
C036	52	Yes	N/A	Yes	opens drawers; pulls items out of drawers
C037	23	Yes	N/A	Yes	opens drawers pulls items out of drawers

Table 3
Caregiver Answers, Part 3

Participant Number	Age at Testing (mo)	If the child climbs/climbed on the furniture, what strategy is used?	How does/did the child get down from the furniture?	Does/did the child interact similarly with other furniture items?	Do you have anything else that you would like to mention?	Are there any issues that we have not raised?
CP05	31	Use chairs	Call for help, tried to climb down herself	(no response)	(no response)	(no response)
CP06	65	Pulls a chair, opens cupboard, uses sink	(no response)	(no response)	(no response)	(no response)
CP07	50	N/A	Jump, climbs down to chair from kitchen table; flops onto seated part of couch	No	No	No
C001	60	N/A	N/A	Yes - TV console, table; jumping/pull up	Sitting, tipping chair, almost fell	(no response)
C002	54	N/A	jumps off couch	No	just couches	(no response)
C003	29	N/A	N/A	Yes - nightstands, bathtub	(no response)	(no response)
C004	51	sat in lower drawer, grabbed upper ones	feet out, step down	Yes - coffee table, side table	climbing couch, falling and jumping	(no response)
C005	47	N/A	N/A	N/A	No	(no response)
C006	21	opens more than one	crawls (tummy); daredevil will throw himself down	No	(no response)	(no response)
C007	58	N/A	N/A	No	bolted TV to wall; no more than 3-high dresser	6-yr-old nephew pulled dresser over on himself - old, heavy furniture. We are very safety conscious
C008	35	N/A	N/A	No	playgrounds, couches	(no response)
C009	42	N/A	climbs off bed, chair	No	dining table - climbs from chair; bookshelf - no climbing	sometimes helps with dishes - gets stool so he can reach
C010	36	N/A	slides off, belly to furniture front	N/A	None - not a huge climber	(no response)
C011	46	N/A	N/A	No	will jump off furniture onto cushions on floor	(no response)

C012	30	N/A	N/A	Yes - barstools, climb over back of couch/chairs	climb/jump on parents' bed	(no response)
C013	23	N/A	(no response)	book shelf - hasn't tried climbing, tries reaching stuff up high - "mama help, need help"	gymnastics - triangle foam, toddler slide	(no response)
C014	32	N/A	N/A	Yes	No	(no response)
C015	65	N/A	N/A	No	cereal on top of fridge - step stool, onto counter; also things from upper cabinets	(no response)
C016	27	N/A	N/A	Just the couch; high chair - tries to climb in	she doesn't like doing dangerous things	(no response)
C017	41	N/A	N/A	Yes - book case - cool stuff on top	(no response)	He does love climbing, husband has bolted everything to the wall
C018	28	N/A	N/A	Yes - pull out drawers in kitchen	none - not quite as adventurous as Matthew	(no response)
C019	42	lowest drawer - stepped in, tried to stand	ask for help, crawl out	Yes - used to climb on book shelf - hold & lean back	Used to crawl out of crib. Will find chair or step stool if she's really determined.	Rope climb at playground
C020	48	from bed to dresser	climbs down handles; climbs onto bed from top of dresser	No	No	(no response)
C021	54	from bed to dresser or climbs handles	jumps; climbs down handles; jumps onto bed	Yes	No	(no response)
C022	22	N/A	N/A	Yes - reaches to get things	No	(no response)
C023	29	lift leg up into other	catch her, brother lets know	(no response)	stacks stuff if she can't reach	(no response)
C024	20	(no response)	couch - flip on belly & slide down; whines to get off of bench	(blank)	(no response)	(no response)
C025	28	N/A	N/A	Yes	No	(no response)
C026	56	N/A	N/A	No	Good climber, rock wall, hoops at gymnastics for monkey bars; limited fear, advanced climber	(no response)
C027	35	N/A	N/A	No	No	Window sill
C028	57	pulls drawers out, uses cubbies as step; knobs	jumps	No	been climbing since he could	(no response)
C029	38	N/A	N/A	Yes - climbs in & out of bathtub	doesn't climb very much	(no response)

C030	33	N/A	N/A	No	climbs on arm of couch to reach top of Ikea cube	(no response)
C031	29	N/A	N/A	No	No	(no response)
C032	21	N/A	N/A	No	tries to climb in washing machine, car	(no response)
C033	42	step in, doesn't go past bottom	step/jump	Yes - end table drawer	No	(no response)
C034	57	don't know	fell	No	No	(no response)
C035	38	N/A	N/A	Yes - nightstands, pushes up	(no response)	(no response)
C036	52	(no response)	(no response)	No	outside - playground equipment	(no response)
C037	23	(no response)	(no response)	Yes - gets down by climbing	more interested in climbing	(no response)

Table 4
Child Participant Answers

Subject Number	Age at Testing (in months)	Do you like climbing?	What types of things do you climb?	How do you climb?	What do you do with the [furniture item mentioned by parent]?	If there is something in or on the item that is hard to reach, how would you try to get it?
CP05	31	(no response)	(no response)	(no response)	(no response)	(no response)
CP06	65	Yes	Monkey bars, play structure, kitchen counter, bunk bed ladder	Jump up on the counter	Couch, back left off the	(no response)
CP07	50	Yes	Stairs/steps; bridge	Hands & feet	(no response)	(no response)
C001	60	Yes	Jungle gym, rock wall, couch, monkey bars	hands/feet, jump off	climb behind couch, jump down (recliner pockets)	tippy toes, step stool
C002	54	Yes	bed, couch, monkey bars	climb straight, climb up the side	pick clothes; open drawers one at a time	ask mama or dada
C003	29	Yes	slide stairs, chairs	(no response)	(no response)	(no response)
C004	51	Yes	treehouses, ladders, monkey bars, slide	hands and feet	(no response)	hands, climb ladder
C005	47	Yes	handles, trampolines, stairs	frontways	desk: play on it - stand with a stool to climb on	use a stool; jump up
C006	21	(no response)	(no response)	(no response)	(no response)	(no response)
C007	58	Yes	everything! Big blocks, couch. Gymnastics - I love the bars to swing on - no flips	I personally just climb like a human does	N/A	stool, pillow on stool to make it taller
C008	35	Yes	playground	N/A	N/A	get dad to help me
C009	42	Yes	chairs; monkey bars	hands & knees - pulls himself up	bed - jump, play; bunk bed - climb up stairs/ladder; couch - sit on back, jump, play	asks parents for help
C010	36	Yes	Boxes, roofs	like a monkey, step stool, hands and feet	climb on kitchen counter to reach stuff	(no comment)
C011	46	Yes	ladder	(no response)	(no response)	(no response)
C012	30	Yes	(no response)	(no response)	(no response)	(no response)
C013	23	(no response)	(no response)	(no response)	(no response)	(no response)
C014	32	(no response)	(no response)	(no response)	(no response)	(no response)
C015	65	Yes	gym - room with play structure, 3 floors, stairs	couch - hands and feet	get clothes out of dresser	step stool
C016	27	child wouldn't respond	(no response)	(no response)	(no response)	(no response)
C017	41	Yes	climbing walls, ropes	Hands & feet	get clothes out of dresser	climb up with branches
C018	28	Yes	couches	climb it	open drawers, close drawers, put clothes in and out of	ask mama

					drawers; climb the slide with feet	
C019	42	Yes	Mom & dad's bed; climb stairs at playground; ladders - little ones, handles; slide on slides	stepping; hands on sheets of bed, step	climbing up	handles; hands; tiptoes; mommy could help
C020	48	Yes	ladders, slides	feet on ladder; hands & feet on stairs	get clothes out of dresser	use stool
C021	54	Yes	bars; ladder - bunk bed; paddles on playground	hands & feet (ladder); bars - only two hands, stepping	Kitchen counter - hands and feet	Kitchen counter - hands on top of counter, use feet to push body up and get it
C022	22	Yes	(no response)	(no response)	(no response)	(no response)
C023	29	(no response)	(no response)	(no response)	(no response)	(no response)
C024	20	(no response)	(no response)	(no response)	(no response)	(no response)
C025	28	Yes	I don't know	Hands	I don't know	(no response)
C026	56	Yes	window sills (do splits in the window); tables when I can't reach stuff out of the cupboards, climb on counters	table, chairs	(no response)	find little chair to get candy; with dinner chair
C027	35	Yes	Monkey bars	(no response)	(no response)	with a chair
C028	57	Yes - really high	playground - everything	(no response)	(no response)	(no response)
C029	38	No	(no response)	(no response)	(no response)	(no response)
C030	33	Yes	(showed climbing on chair)	hands & knees	don't jump on the couch!	jump! Mom says she'll use stool - bring something to counter to reach
C031	29	Yes	table; chairs; ladder at playground	hands & feet/knees	coffee table - elbows/knees - shimmy	don't know
C032	21	(no response)	(no response)	(no response)	(no response)	(no response)
C033	42	Yes	monkey bars like Arthur	hands and hands	rocks at home - TV remote - the regular one to turn the show off	(no response)
C034	57	Yes	couch; ladder (bed); kitchen (counters); playground - twirly, rock wall	hands & feet	climb on chair - can reach all the windows	tippy toes; jump up hIgh & grab it; stool/ladder
C035	38	Yes	couch, counters	(no response)	(no response)	climb hands & feet
C036	52	Yes	couch, slide, tire, bed, treehouse	hands and feet	(no response)	mom
C037	23	Yes	slide, chairs, brother	by myself	(no response)	reach, mom, brother

APPENDIX H

As part of the study, CSPC staff provided UMRTI researchers with list of publicly available videos of children interacting with CSUs and other similar furniture items in the home. Staff found these videos by using combinations of keywords to search YouTube. Keywords included, but were not limited to: child, toddler, baby, dresser, chest, drawer, cabinet, armoire, furniture, climb, open, jump, empty, fall, tip, and tip-over. Combinations of keywords included, but were not limited to: "climb dresser," "child climb," "child drawer," "open drawer," and "child dresser." Staff also viewed related videos that were recommended by YouTube, allowing staff to follow a chain of videos of interest that weren't necessarily included in the original search results. Search results included videos uploaded by consumers as well as segments of news reports and other media. Still images from some of these videos are shown in this report.

UMTRI researchers supplemented these videos with additional videos that they located.