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CONSUMER PRODUCT SAFETY COMMISSION
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Memorandum

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SUBJECT : The safety of portable fuel containers (gas cans).

This memorandum forwards a report about the safety of portable fuel containers (gas cans) specifically related to access by children. Incidents involving gasoline and gas cans, children's ability to access gas cans, voluntary and mandatory standards for gas cans, and the gas can market are presented.

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REPORT ON THE SAFETY OF PORTABLE FUEL CONTAINERS (GAS CANS)

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Executive Summary

The staff of the U.S. Consumer Product Safety Commission (CPSC) reviewed information about the safety of portable fuel containers (gas cans) specifically related to access by children, including incidents involving gasoline and gas cans, children's ability to access gas cans, voluntary and mandatory standards for gas cans, and the gas can market.

Gasoline from gas cans is responsible for deaths and injuries both from ignition of the volatile vapors and from direct aspiration into the lung or aspiration following vomiting of ingested gasoline. CPSC staff is aware of 33 cases that resulted in 19 deaths where children may have opened a gas can. However, information indicating that a child may have opened a *closed* gas can was documented in only three of these cases. Because specific details relating to gas cans are lacking in the reported cases, the frequency of injuries and deaths resulting from children opening closed gas cans is unknown.

Manufacturers are currently making changes to gas cans. There is a provisional ASTM voluntary standard for child-resistance of gas cans. While present conformance is low, companies are at various stages of development of child-resistance. However, not all companies plan to incorporate child-resistant features on all gas cans.

Environmental requirements that gas cans be "spill-proof" and over-fill protected, have been adopted by California and four additional states. Gas cans that are spill-proof have built-in safety features that include a self-closing overfill protection spout which could eliminate spilling when tipped over, and overfilling a fuel tank on a piece of equipment. The addition of "spill-proof" spouts and over-fill protection features on gas cans may reduce future incidents. While child-resistance[1] is designed to prevent injuries only in cases in which the closed gas can is opened by a child under 5 years of age, a spill-proof spout could possibly eliminate incidents where an uncapped or capped gas can was tipped over and gasoline is spilled.

The CPSC staff will continue to work with the ASTM subcommittee on the conversion of the provisional standard for child-resistance of gas cans to a full consensus standard and will encourage manufacturers to develop and incorporate child-resistant features on both standard and "spill-proof" gas cans.

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[1] A package is considered to be child-resistant if 80 percent of children tested according to the protocols in 16 CFR § 1700.20 are unable to gain access to the contents.

Background

In 1978, the U.S. Consumer Product Safety Commission (CPSC) was petitioned to ban certain portable containers for consumer use of gasoline and to establish a standard for gasoline containers of five gallons or less capacity. A review of the available data found that the majority of burns and other fire-related incidents involved containers other than those sold specifically for storing gasoline. In addition, consumers' storage and use of gasoline near ignition sources was documented. Based on this information, the Commission concluded that the design or performance of gas cans did not present an unreasonable risk of injury and the Commission denied the petition (45 FR 59376). However, the Commission was also concerned about the seriousness of gasoline-related burn injuries and directed the CPSC staff to participate with ASTM in a voluntary standards effort.

In 1980, a subcommittee, ASTM F15.10, was formed to look specifically at the safety of gas cans. The CPSC staff participated in the subcommittee and two voluntary standards were developed: F 839 – Standard Specification for Cautionary Labeling of Portable Gasoline Containers for Consumer Use, and F 852 - Specification for Portable Gasoline Containers for Consumer Use[1]. Since consumer storage and use of gas cans was a concern, labeling was a priority for the subcommittee. Standard F 839, which was originally approved in 1983, presents a standard practice for cautionary labeling. Standard F 852, which was originally approved in 1984, contains safety performance requirements and test methods, such as drop testing to assure a reasonable degree of safety under foreseeable use and abuse conditions. These standards apply to plastic and metal gas cans. There are also similar standards for kerosene and diesel fuel containers. Child-resistance of gas cans was not part of these early deliberations.

The CPSC staff has not been directly involved with gasoline can fire safety since the voluntary standards for gas cans were put in place in the early 1980s. The Agency directed fire prevention efforts towards education of consumers about unsafe gasoline storage and use practices and towards the development of flammable vapor ignition resistant gas water heaters. The flammable vapor ignition resistant gas water heaters are expected to be commercially available in 2003.

Over the past few years there has been a renewed interest in gas can safety specifically related to children under 5 years of age. Prompted by several serious incidents involving children who were severely burned, some of whom subsequently died, Congressman Dennis Moore of Kansas introduced a bill, which was not voted on, during the 106th and 107th Congessional sessions, called the Children's Gasoline Burn Prevention Act. This bill states that the Commission is authorized to issue a special packaging standard for portable gasoline containers under the Poison Prevention Packaging Act (PPPA).

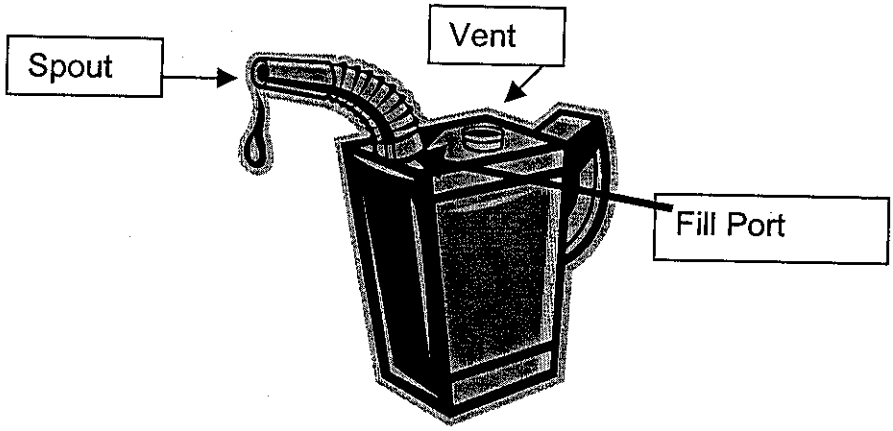
[1] A more detailed discussion of this standard can be found at Tab C.

The ASTM F15.10 subcommittee on portable fuel containers also revisited the issue of gas can safety especially related to child-resistance. The CPSC staff participated in the subcommittee, which adopted a provisional standard for child-resistant portable gasoline containers in 2001 that is discussed on page 9 of this report.

The seriousness of injuries to children from ignited gasoline vapors from gas cans, and public and Congressional interest in gas cans, prompted the CPSC staff to reexamine the safety of these products. The current focus is on child-resistance.

Description of a Gas Can

Most standard gas cans have three openings; a vent, a spout, and a fill port. The vent is used to relieve pressure and to facilitate pouring by providing a source of air. The spout aids pouring into small openings such as gas tanks on gasoline-powered equipment. The spout can be inverted and stored inside the gas can in some designs. The fill port is used to fill the gas can with gasoline.



Injuries Related To Gasoline

Gasoline is a highly volatile and flammable liquid derived from petroleum. For children, the most serious types of injuries associated with exposure to gasoline are burns following ignition of the volatile vapors, and chemical pneumonia, pulmonary damage, and possible death associated with direct aspiration into the lungs or aspiration during vomiting following ingestion. The following sections describe incidents, from various data sources, involving children less than 5 years of age and their exposure to gasoline. Due to the nature of the databases and the information collected, it is not always possible to identify the source of the gasoline. Where available, the focus will be on incidents involving access to gas cans.

TESS Database

The Toxic Exposure Surveillance System (TESS), a database maintained by the American Association of Poison Control Centers (AAPCC), is comprised of exposures that are reported to the poison control centers in the United States. The CPSC purchases TESS exposure data involving children under 5 years of age. The TESS database has a separate code for gasoline exposures.

There were 5,586 and 5,150 cases of gasoline exposure reported in TESS for 1999 and 2000 respectively. The exposure numbers have a seasonal variation. The months with the highest number of exposures are May through August. CPSC staff's primary goal in examining the TESS database was to document children's access to gasoline. These data indicate that children do have access to gasoline, especially during the late spring and summer months. However, because the database does not include detailed descriptions of exposure scenarios, we have no information about how many of the gasoline exposures are from gas cans.

It is possible to conduct a study with the AAPCC to collect additional information about gasoline exposures including whether children had access to closed or opened gas cans. The cost of a study would depend on the number of exposures, number of poison control centers needed and recruited to participate, and the complexity of the information requested. Due to the seasonal nature of the exposures, we would not recommend collecting data until late spring.

CPSC Databases

A detailed discussion of the CPSC databases is found at Tab A.

The CPSC maintains the National Electronic Injury Surveillance System (NEISS) database of product-related injuries that are treated in hospital emergency rooms. The NEISS data are collected from a probability sample of hospital emergency rooms in the United States. During 2001, there were an estimated 1,850 children under 5 years of age seen in emergency rooms following exposure to gasoline. The majority of these cases involved ingestion and aspiration, and not fire-related injury. The 1,850 estimate is based on 67 actual cases reported through NEISS hospitals. Twenty-three cases did not involve gas cans. Five cases specifically involved a child gaining access to gasoline from a gas can. This sample is too small to calculate a reliable national estimate. In the remaining 39 cases it is not known if the gasoline was in a gas can. If both the unknown container cases (39) and the known gas can cases (5) are included, the estimated number of emergency room-treated injuries to children under 5 years of age possibly involving gas cans would be about 1,270 in 2001.

A special study would be needed to provide a statistically valid national estimate of the number of children who gain access to gasoline in gas cans and to provide details about the condition of the container. However, because of the limited number of cases reported to NEISS that may involve a gas can, a data collection effort of more than one year might be necessary to generate enough cases from which to derive a statistically valid national estimate.

The CPSC staff searched three additional CPSC databases for incidents involving children less than 5 years of age and gasoline for the period 1991 through 2001. These were the In-depth Investigation File (INDP), Injury and Potential Injury Incident File (IPII), and the Death Certificate Database (DTHS). The INDP database contains cases that have been investigated by CPSC staff. The IPII database contains reports of injuries or potential injuries that may involve consumer products from newspaper clippings and consumer complaints from many different sources. The DTHS database contains product-related deaths from death certificates obtained from various states. Since these databases contain anecdotal data and are not statistical, national estimates cannot be derived from these cases.

From these databases, there were a total of 86 gasoline-related cases involving 117 victims that resulted in 48 deaths over an 11-year period. Most of the deaths were from fire-related incidents. There were 33 cases that involved children under 5 who interacted with gas cans. In 24 cases, children gained access to gasoline that was in a container other than a gas can, such as a soda can or bottle. The remaining cases either did not identify the container, or the child was a victim but did not initiate the incident.

A spreadsheet listing the 33 cases involving gas cans is at Tab A. These 33 cases resulted in 19 deaths, 20 hospitalizations, and 5 injuries that did not require hospitalization. Eighteen of the deaths resulted from fires. One death resulted from aspiration of gasoline. Most of these cases lacked information about whether the gas can was open or closed. The investigations conducted by CPSC staff over the years have focused on the source of ignition (i.e. water heaters) and not on the condition of the source of the combustible material (i.e. whether gas cans containing the gasoline were opened or closed). From the information available in the reports, we were able to identify three cases for which CPSC staff is reasonably sure that the child opened the gas can. These three cases resulted in two deaths and two hospitalizations. All three of these cases were fire-related. While these data do not provide statistical estimates, they do provide information about cases involving fires related to gas cans that is not found in TESS or NEISS.

The data from all of these sources demonstrate that children do have access to gasoline, some of which is known to be stored in gas cans. However, based on the information in the various CPSC databases, it is not possible to

quantify the deaths and injuries that result from children gaining access to closed gas cans. To better assess the scenarios involving children, it will be necessary to collect information about the condition of the gas cans involved in the cases in the future.

Children's Access to Gasoline Via Gas Cans

Even though the frequency of the injuries and deaths that result from children opening gas cans cannot be determined, it is important to understand how children access gasoline that is stored in gas cans. The staff evaluated children's access to gas cans and their ability to open closed gas cans by reviewing scenario information from incident investigations and data from child protocol testing of standard gas cans. A more detailed discussion is at Tab B.

Injury Data

The 33 incident reports involving children and gas cans discussed above provide little detail about the condition of the gas cans themselves. However, the general scenario is typical of incidents involving children and hazardous household substances. The child's interaction with the gas can was generally thought to be intentional, such as "playing" with the can or carrying it somewhere when the spill occurred. In some cases, the child was thought to have used the can in purposeful imitation of an adult. For example, children poured gasoline into a stroller and a ride-on toy. However, in a number of instances the event was thought to be accidental, as when one child inadvertently knocked over a gas can while getting a tricycle.

In the ingestion cases the gas can had been left out or had just been used. In most of the fire incidents, the children apparently obtained the gas can in the basement or garage where it was routinely kept. In most of the incidents, no information about the closures was reported. It is not known if the can was closed at the time of the incident and whether the child opened it.

In three cases, the incident report indicates that the children involved removed the caps from the gas cans. For example, in one of these, the spout cap, and fill cap were found near the lawnmower where the victim spilled gasoline. In another, the investigator's report states specifically that the cap was "not child-resistant."

While specific information about whether children opened the closure is lacking in most cases, it is reasonable to assume that children removed one of the gas can closures in at least some of the incidents in which the original status of the closures was not reported. Most of the gas cans may have been stored closed because replacing a closure is a part of the basic use of any type of container. Replacing gas can caps is easy and helps to avoid problems such as the evaporation of the gas, the generation of

fumes that are unpleasant to many people, and the increased chance of a spill. Additionally, there are existing data that also support the premise that gas cans are typically stored with the caps closed. The California Air Resources Board (CARB) conducted a survey of residential gas can usage in 1999.[2] This survey found that 66 percent of respondents reported that gas cans were stored in a "closed" condition. This may be an underestimate of the number of closed containers because of the way the survey was conducted[3]. The survey results support the hypothesis that it is likely that the gas cans in the incidents may have been capped even though it is not directly stated in the case report. It is also reasonable to assume that children may have opened the gas can caps in some incidents where these details were not documented. Both the capabilities of children in the age group of interest, and test data with standard gas cans, support that possibility.

Standard Gas Can Testing

CPSC staff reviewed four reports[4] of child panel tests conducted on plastic non-child-resistant gas cans to assess the ability of children to open these products. A videotape of three pairs of children during testing was also reviewed. The gas can closures were opened and resecured by adults before testing the gas cans with children. According to the reports, the child tests were conducted in accordance with the child test protocol detailed in 16 CFR §1700.20, however the total numbers of children tested varied. The participants consisted of pairs of children 42 to 51 months of age who were allowed five minutes to try to open the container, followed by a demonstration of how to open the container and an additional five minutes if either one of the pair of children was unsuccessful. A package was considered child-resistant if it was opened by no more than 20% of the test subjects. According to the reports, openings of the fill port caps were considered to be successful access by the children, while opening of the vent was not considered to be successful access by the children. The results of testing are listed in Table 2 on the following page.

[2] CARB contracted with California Environmental Engineering, Santa Ana, CA . Results of the survey were obtained in a CARB document entitled, "Public Meeting to Consider Approval of California's Portable Gasoline-Container Emissions Inventory, September 1999.
[3] For more detailed information about the survey refer to Tab B.
[4] Obtained from the testing laboratory with permission from its clients.

Table 2. Results of Child Testing Standard Gas Cans

Report No.	Sample Size	Container Type and Size	Number opened (CR level)
1	11	Brand A 5-gallon	11 (0%)
2	45	Brand B 5-gallon	41 (8.9%)
3	50	Brand B 5-gallon	43 (14%)
4	100	Brand A 2.5-gallon	67 (33%)*

*Per the report, 19 additional children opened only the vent cap. If this were considered to be a failure the child-resistance level would be 14%.

In each test, most children who opened the cap did so before the demonstration. In most cases, the method used to open the container was coded as "normal." Standard plastic gas cans such as those tested have simple threaded non-child-resistant screw caps at the fill port, and push-on overcaps at the vent and spout. Closures such as these are easy for children under 5 years of age to open.

Children learn by both observation and exploration, and begin imitating others during the first year of life. It is not clear at what age the association between "opening" or removing a cap and counterclockwise rotation develops. However, it may already be learned for many children in the age group specified in the test protocol because by 18 months of age a child may try to turn on a water faucet. Five of the six children (42 to 51 months of age) filmed during testing immediately gripped the fill port cap and tried to turn it in the usual counterclockwise direction.

These results further demonstrate that children under 5 years of age are able to open standard gas cans.

Standards Related to Gas Cans

CPSC Authority to Require Child-Resistant Packaging of Gas Cans

Poison Prevention Packaging Act

The Commission generally protects children under five years of age from serious injury or illness that results from handling, using, or ingesting hazardous household substances by issuing a rule requiring child-resistant packaging under the Poison Prevention Packaging Act (PPPA). Household substances include hazardous substances defined by the Federal Hazardous Substances Act (FHSA) (15 USC § 1471(2)(A)). Prepackaged gasoline and kerosene currently require child-resistant packaging under the PPPA (16 CFR 1700.14(a)(31)). However, most gas cans are sold to consumers as empty packages. The empty gas can is not a hazardous substance.

Thus, the PPPA does not provide the Commission with authority to require that empty gas cans be child-resistant. For this reason, Congressman Moore introduced the bill stating that the Commission has the authority to issue a special packaging standard for portable gas cans under the PPPA.

Consumer Product Safety Act (CPSA)

Under the Consumer Product Safety Act (CPSA), the CPSC has the authority to regulate consumer products available for use in or around the household (15 USC § 2052 (a)). This authority likely covers empty gas cans available in or around the household. Such a CPSA regulation would have to be expressed in terms of performance requirements. Before issuing a regulation under the CPSA, the Commission must find that the rule is "reasonably necessary to prevent or reduce an unreasonable risk of injury" and it is in the public's interest. The Commission must also find that the benefits of the rule bear a reasonable relationship to the costs and that it is the least burdensome way to reduce or prevent the risk of injury. If there is an applicable voluntary standard, the Commission must also find that the voluntary standard is not likely to eliminate or adequately reduce the risk of injury or that substantial compliance with the voluntary standard is unlikely (15 USC § 2058(f)(3)).

There have been two efforts in recent years that are leading to changes in gas cans, 1) the adoption of environmental emission and spill-control standards and 2) the adoption of a provisional voluntary standard for child-resistance. These efforts are described below. A more detailed description is at Tab C.

Emission and Spill-Control Standards

In September 1999, the California Air Resources Board (CARB) adopted emission and spill-control regulations for gas cans to reduce smog-forming pollution from gas cans. The regulations apply to gas cans and spouts sold in California after January 1, 2001. Major changes had to be incorporated into gas cans in order to comply with the CARB requirements. Changes included the development of spouts that shut-off automatically to prevent over-filling and that automatically seal when not in use (spill-proof). Secondary vent holes are eliminated and cans must minimize vapor permeation through the walls. There are several performance tests that a gas can must pass to ensure that the gas cans automatically shut off, do not leak, have an adequate flow rate, and do not exceed the permeation rate. These rules do not apply to safety cans,[5] fuel containers with a capacity less than or equal to one quart, or portable fuel tanks for outboard engines.

Other states and regions of the country are interested in the CARB approach to reduce air pollution. In the northeastern part of the United States, the Ozone Transport

[5] 29 CFR § 1926.155(l) definition: Safety can means an approved closed container, of not more than 5 gallons capacity, having a flash-arresting screen, spring-closing lid and spout cover and so designed that it will safely relieve internal pressure when subjected to fire exposure.

Commission (OTC), which includes states from Maine to Virginia and the District of Columbia, is promoting this option of decreasing pollution. Several states including Maryland, Pennsylvania, Delaware, and New York have adopted gas can emission regulations. Gas cans sold in these states after January 1, 2004 will have to be "spill-proof." Several other OTC states have proposed or are considering adopting similar rules.

Child-resistant Gas Cans – ASTM PS 119-01

Since changes to gas cans were being made to comply with CARB/OTC standards, gas can manufacturers began to investigate incorporating child-resistant features. In February 2001, the ASTM F15.10 subcommittee issued a child-resistance standard using the provisional standard development procedures, entitled "Provisional Standard Specifications for Child-resistant Portable Gasoline Containers for Consumer Use" (ASTM PS119-01). A provisional standard achieves limited consensus through the sponsoring subcommittee and stays in effect for two years or until it is converted to a full consensus standard, whichever comes first. PS 119-01 will cease to exist after February 1, 2003 unless the subcommittee starts it through the consensus process prior to that date. The subcommittee plans to move forward to convert PS 119-01 to a full consensus standard before February 2003. However, a meeting has not yet been scheduled. The CPSC staff will continue to participate in this subcommittee.

PS 119-01 is intended to be technically equivalent to the testing protocols and standards defined in the regulations of the Poison Prevention Packaging Act. The provisional standard includes the test methods for children and seniors described at 16 CFR § 1700.20. The child-resistance and senior-adult-use-effectiveness standards in PS 119-01 are equivalent to those in 16 CFR §1700.15. The provisional standard does not distinguish between plastic and metal gas cans. This provisional standard specifies that the child-resistant container shall continue to function at the specified effectiveness for the number of openings and closings customary for its size and contents. PS 119-01 states that technical evaluation based on factors such as wear and stress for the duration of normal use may be used to satisfy the requirement for continued function.

Conformance with ASTM PS 119-01

Representatives from six gasoline can manufacturers participate in the ASTM subcommittee. Each company has a different approach to the development of child-resistance for their gas cans. One company has a child-resistant senior-friendly standard plastic gas can on the market. It is available in three sizes, 1 gal, 2 gal, and 5 gal. Each of these gas cans has three different child-resistant features; the vent, the spout, and the fill port. The spout and the vent have a snap "line-up-the-arrow" closure (ASTM type IIIA (2)). The fill port has a ratcheted continuous threaded closure with a ratcheted fitment (ASTM type ID modified). The company supplied child and senior test data to CPSC staff. This company has put the same child-resistant fill port on their

CARB/OTC-compliant can. Another company plans to have child-resistant standard and CARB/OTC-compliant gas cans available by the spring 2003.

Several companies plan to incorporate child-resistant features only on their CARB/OTC-compliant cans. Since these cans do not have a vent, they have fewer openings to make child-resistant. The spouts are self-sealing and may be child-resistant depending on the design, the activation mechanism, and the activation force. However, CPSC staff has not seen any child-resistant data from testing "spill-proof" spouts. A child-resistant feature would have to be developed for the fill port. The companies are at various stages of development from design development to mold conversion for incorporation of the child-resistant features. Several companies are completing child and senior testing. The staff is unaware of any company that is incorporating child-resistant features on metal gas cans.

The CPSC staff is unaware of the exact percentage of the gas can market that conforms to the voluntary standard. However, conformance is relatively low.

Technical Issues Related to Child-Resistance and "Spill-Proof" Gas Cans

As described above, there is one company with a "child-resistant senior-friendly" gas can currently on the market and several other companies in various stages of development of child-resistance for standard and/or CARB/OTC-compliant gas cans. A number of factors can enhance or diminish the effectiveness of child-resistant packaging in general. In addition, there are several issues related to gas cans that are different from other child-resistant packages. These are highlighted below and detailed at Tab B.

16 CFR § 1700.20 Protocol Testing Issues

Gas cans have multiple openings. To be fully child-resistant, each of the closures (three on regular cans and two on CARB/OTC-compliant cans) must be child-resistant. The test procedures in 16 CFR § 1700.20 do not specify how to test packages with multiple openings. We are aware that in current child testing of gas cans all three closures are being tested at once during the two 5-minute time periods of the child test protocol. Children are given a gas can and told to try to open it. If not successful, the openings of the multiple closures are demonstrated to the children. Under these conditions, a child's attention and efforts may be divided, resulting in a tested child-resistance level that does not reflect the effectiveness of any one of the closures.

The reverse of the child test situation is an issue raised in the adult tests reviewed by CPSC staff. Senior adult protocol tests consist of a 5-minute time period followed by a 1-minute time period for the participant to open and properly resecure the package. The test methods in 16 CFR § 1700.20 do not specify how to conduct an adult test for a package with multiple openings. The test data

indicated that adults were given the two time periods for each of the closures on the gas can. Allowing a full 5-minute/1-minute test for each closure is unlikely to screen out cans that are unacceptable to consumers. For example, a subject taking 3 full minutes to open and resecure three closures would be counted as a success. According to Human Factors staff, in actual use, consumers are unlikely to tolerate closures that take more than a few seconds to use correctly. Thus, a container that passes testing with high "senior adult use effectiveness" may be a likely candidate for intentional defeat in the home. Closures that are difficult because they require significant strength or dexterity invite defeat, which is simple to accomplish with many designs.

Gas cans contain a spout to facilitate pouring. In some designs, the spout can be stored inside the gas can. In some new CARB/OTC designs, the spout cannot be stored in the gas can and must be out for proper closing of the gas can. The staff received test data from one company, whose gas can was child-protocol tested with the spout inside the can. The closure passed the child test demonstrating that the fill port was child-resistant but the spout itself was not tested. It seems more likely that for convenience, a potent factor in product use, consumers may use and store the containers with the spout installed. In order for any can to be "child-resistant," all closures and potential access ports for gasoline need to be tested.

These issues related to the test protocols would need to be addressed in any consideration of a mandatory child-resistant packaging standard for gas cans.

Wear and Durability

Durability is an important factor to consider when discussing the integrity of child-resistant packages. Unlike packages for medicine or household cleaners, which are thrown away when they are empty, gas cans can be refilled many times. While gas cans are not typically used on a daily basis, they are kept for long periods of time. The useful life of gas cans is estimated to be about 5 years (see section below on Gas Can Market). Gas can closures may be subject to more wear than the typical child-resistant closure. The provisional standard, ASTM PS 119-01 specifies that the child-resistant containers shall continue to function at the specified effectiveness for the number of openings and closings customary for their size and contents. According to the provisional standard, this can be accomplished by using technical evaluations based on factors such as wear and stress for the duration of normal use. This would need to be addressed in any consideration of a mandatory child-resistant packaging standard for gas cans.

CARB/OTC Compliant Gas Can Issues

The CARB/OTC gas cans have many potential safety benefits even though that was not the intent of the environmental regulations. Because they are "spill-

proof," the spouts do not have to be resecured to prevent fumes from escaping. In addition, these gas cans have fewer closures since vent caps are eliminated.

However, because CARB/OTC-compliant cans do not contain separate vent caps, lack of venting of these gas cans has been raised as a possible safety issue. Venting the container prior to refueling is necessary to prevent splashing and spills from the fuel tank.

The limited information available suggests that venting is not a serious obstacle to safe use. First, to use the spout one places the nozzle inside the gas tank. On the gas cans evaluated, the flange used to retract the spout is well above the opening. Although testing would be required for confirmation, it appears that splashing may be largely confined within the gas tank itself. Second, CARB staff contacted with a firm that has sold containers of this type for several years, and the firm reported that it had not received any complaints or comments on this issue. CARB staff suggested this indicates that instructions may be adequate to address the issue. Human Factors staff adds that on the containers reviewed, venting is relatively easy to perform. Since splash-back is both annoying and potentially dangerous, the experience would help influence most consumers to vent the container before using it. Third, although cost information is not currently available, one firm has developed a nozzle that does not require venting prior to use.

Gas Can Market

A review of the gas can market is at Tab D.

Discussions with members of ASTM F15.10 subcommittee on portable fuel containers revealed that there are six significant manufacturers of gas cans which are believed to account for most of the gas can sales in the United States. There is little or no importing of gas cans to the United States, except from Canada, which may account for approximately 10 percent of U.S. gas can sales.

In the U.S., an estimated 20 million gas cans are sold annually. The most common gas cans produced are made of molded plastic in one- and two-gallon sizes. Industry sources report that plastic cans represent 95 percent or more of all gas cans sold with one gallon cans accounting for about 60 percent of all gas cans sold in the US. The remaining approximately 1 million gas cans are metal cans which can be either standard gas cans or "safety cans."

Plastic one-gallon gas cans typically retail for about $2, and 2-gallon plastic cans retail for $3 to $3.50 each. Consumers are likely to purchase a smaller sized gas can at the same time they purchase a new gasoline-powered tool, such as a lawn trimmer or snow blower that may require a mix of gasoline and oil (i.e. 2-stroke engine).

Metal safety cans typically retail for $25 in the 1-gallon size, while the metal 5-gallon safety cans retail for about $30 each. Metal standard gas cans retail for about $15 because they do not incorporate the safety features that are the major cost associated with safety cans.

Industry sources indicate that plastic gas cans experience an average useful life of about 3-5 years based on sales, while metal cans have an average useful life of 25 years or more. The CARB sponsored a residential gas can survey in 1999 to assess the extent of gas can usage in California[6]. The survey found that the average age of gas cans in California was 5.5 years.

The survey results indicate that 46 percent of all households surveyed had at least one gas can. The average number of residential gas cans was approximately 2 per household surveyed. If national consumption of gas cans were similar to that of California, there would be about 85 million gas cans in household use in the U.S.

Costs of Making Gas Cans Child-Resistant

There is limited information available about the cost of developing child-resistant closures for plastic gas cans. Since many of the companies are developing child-resistance in conjunction with the changes to make gas cans CARB/OTC-compliant, the costs of child-resistance alone are difficult to assess.

One firm currently markets a non-CARB plastic gas can with child-resistant closures in 3 locations; the spout, the fill port, and the vent. This style of can retails for about 75 cents more than similar non-child-resistant cans. However, it is not clear whether the increased cost is only related to the addition of the child-resistant features. Another manufacturer is studying designs to incorporate child-resistant features in cans while eliminating the vent port. The firm's marketing director stated that adding the child-resistant feature may be accomplished with "little or no extra cost" because of savings derived from eliminating the vent. However, the extent of additional costs will not be known until the cans are in production.

Industry sources were unable to estimate the cost of adding child-resistant features to a metal can, but some modification may be needed for even metal "safety cans" in order to comply with child-resistant requirements.

CARB/OTC- Compliant Gas Cans

As described above in the section on *Emission and Spill-Control Standards,* gas cans currently sold in California have "spill-proof" and over-fill protective spouts as well as other changes to limit emission of gasoline vapor. CARB estimated that the average

[6] CARB contracted with California Environmental Engineering, Santa Ana, CA. Results of the survey were obtained in a CARB document entitled, "Public Meeting to Consider Approval of California's Portable Gasoline-Container Emissions Inventory," September 1999.

cost of a gas can would increase $6 to $11 to comply with these changes. Three current manufacturers estimate that the changes to the cans to comply with CARB standards add $4 to $7 to the retail price of the gas cans. After January 2004, every gas can sold in Pennsylvania, Maryland, New York, and Delaware will also be spill-proof. Together, these five states (including California) represent about 25 percent of the population of the United States. The costs of "spill-proof" cans may change as the market expands.

Discussion

The available data demonstrate that children have access to gasoline in gas cans. Gasoline from gas cans is responsible for deaths and injuries both from ignition of the volatile vapors and from direct aspiration into the lung or aspiration following vomiting of ingested gasoline. Child protocol data from testing standard gas cans confirm Human Factors staff's assessments that children under 5 years of age are able to open closed standard gas cans. CPSC staff is aware of 33 cases that resulted in 19 deaths where children may have opened a gas can. However, information indicating that a child may have opened a *closed* gas can was documented in only three of these cases. Because specific details relating to gas cans are lacking in the reported cases, the frequency of injuries and deaths resulting from children opening closed gas cans is unknown. This lack of information is important since child-resistance would address only those injuries where a child under 5 years of age was able to open the closed gas can. More information is necessary to assess the impact that child-resistance would have in preventing deaths and injuries of children. More information is also necessary to assess the role that gas cans play in the approximately 5,000 exposures to gasoline reported to poison control centers and the estimated 1,300 children treated in emergency rooms annually.

Manufacturers are currently making changes to gas cans that may impact the ability of a child to access gasoline stored in them. There is currently a provisional voluntary standard for child-resistance of gas cans. While present conformance is low, companies are at various stages of development of child-resistance. However, not all companies plan to incorporate child-resistant features on all gas cans.

The environmental requirements that gas cans be "spill-proof" and over-fill protected, adopted by California and four additional states, may increase safety of gas cans by two mechanisms. First, it is spurring the development of child-resistant features on gas cans since major changes to standard cans had to be adopted. However, some companies as described above have limited the child-resistant features to their CARB/OTC-compliant cans. Second, gas cans that are CARB/OTC-compliant have built in safety features that eliminate closing the spout, spilling when tipped over, and overfilling a fuel tank on a piece of equipment.

The addition of "spill-proof" spouts and over-fill protection features on gas cans may affect future incidents. While child-resistance will prevent injuries only in cases in which the closed gas can would otherwise have been opened by a child under 5 years of age, a spill-proof spout could possibly eliminate incidents where an uncapped or capped gas can was tipped over and gasoline is spilled. It should be noted that since the staff focused on child-resistance, we specifically limited the review of incident data to those cases that involve children under 5 years of age who interacted with gas cans. Other incidents involving adults and overfilling of equipment fuel tanks were excluded. The staff would have to broaden the examination of data and information collection to study the potential safety impact of the spill-proof spout.

Conclusion

The CPSC staff will continue to work with the ASTM subcommittee on the conversion of the provisional standard for child-resistance of gas cans to a full consensus standard and will encourage manufacturers to develop and incorporate child-resistant features.

TAB A

UNITED STATES
CONSUMER PRODUCT SAFETY COMMISSION
WASHINGTON, DC 20207

Memorandum

Date: December 9, 2002

TO : Suzanne Barone, HS

THROUGH: Susan Ahmed
Associate Executive Director
Directorate for Epidemiology
Russell Roegner, Director EPHA

FROM : George Rutherford, EPHA

SUBJECT : Gasoline Cans

As requested, Epidemiology staff searched the available databases for injury and incident reports related to the hazard to children associated with gasoline, and specifically to gasoline stored in gasoline containers. The following discussion presents the results of this search of the data.

The available data were also evaluated to determine what, if any, additional data collection or studies might be necessary or appropriate in order to adequately describe the hazards which would be addressed by child resistant gasoline containers.

Emergency Room-Treated Injuries (NEISS)

Epidemiology staff searched the data on emergency room-treated injuries in the National Electronic Injury Surveillance System (NEISS) for the most recent full year, 2001. Data retrieval was limited to injuries to children less than 5 years-of-age. During 2001 there were an estimated 1,850 emergency room-treated injuries to children less than 5 years-of-age associated with gasoline or gasoline containers. This estimate is based on a sample of 67 cases reported through NEISS hospitals. Of these cases, 5 (sample size too small to give an estimate) involved a child getting access to gasoline which was in a gas can. In 39 cases (estimated 1,160 injuries) it was not known if the gasoline was in a gasoline container when the child gained access to it. Six cases involved gasoline stored in a container other than a gas can. Seventeen cases which were associated with gasoline were completely irrelevant to gas cans, involving such things as gas pumps at a gas station, and gasoline being used by an adult.

If both the 39 unknown container cases and the 5 gas can cases are included, the maximum estimated number of emergency room-treated injuries to children under 5 years-of-age possibly involving gas cans in 2001 would be 1,270.

Burns were infrequent among these injuries. There were three cases involving burns included in the total number of possible gas can-related injuries (sample size too small to give an estimate). Ingestion and aspiration of the gasoline were the most common injuries.

Incident Reports, Investigations, Death Certificates (IPII, INDP, DTHS)

These data sources were searched for the period 1991 through 2001 for incidents involving children and gasoline. Please note that these are reports which CPSC has received. They are not a statistical sample nor are they a universe of all incidents involving gasoline cans. Many of these cases were assigned for investigation to evaluate the involvement of the ignition source (e.g. water heater), and do not contain any detail about the container used for the gasoline. Sorting of these data into categories is done primarily to illustrate this absence of detail from the available cases and to identify those cases found most likely to be relevant to the issue of child resistance. No quantitative conclusions should be drawn from these data. These incidents also tend to be more dramatic catastrophic incidents than the emergency room treated injuries identified in NEISS.

The search was limited to children less than five years-of-age. A total of 86 reports was found. The reports were reviewed to identify cases in which children gained access to gasoline from a closed gas can. From the information available in the reports, staff was able to identify 3 cases for which we are reasonably sure that the container was opened by the child. These three cases resulted in two deaths and two hospitalizations. All three of these cases were fires. There are another 30 cases, for which we know only that the gasoline was in a gasoline container and a child under five years old was involved. Some of these cases could have involved children opening the container, but we do not have this information. These cases resulted in 17 deaths, 18 hospitalizations, and 5 injuries which did not require hospitalization. All but one of the deaths and two of the non hospitalized injuries resulted from fires. One death resulted from ingestion of gasoline. The other two injuries were an ingestion and a case of dermatitis. A spreadsheet listing these 33 cases is attached.

It is also worth noting that there were 24 cases in which the gasoline was being stored or used in a container other than a gasoline container, such as a soda can or bottle, when the child got access to the gasoline.

To summarize, we were able to identify three cases from our non-statistical databases for which we can be reasonably certain that a child gained access to gasoline from a closed gasoline container. There may be additional cases of this among the other 30 cases, but we do not have enough information on these cases to conclude that they are relevant.

Poison Control Center Data

The American Association of Poison Control Centers maintains the Toxic Exposure Surveillance System (TESS). This system contains reports of exposures to chemicals that are reported to participating poison control centers. The CPSC purchases TESS data involving children under 5 years of age. The TESS database has a separate code for gasoline exposures. There were over 5,000 gasoline exposures reported in TESS in both 1999 and 2000. There is seasonal variation in when gasoline exposures occur. Over half of the exposures in 2000 were between May and

August. The TESS system is not based on a statistical sample of poison control centers, nor is it a complete universe of all exposures reported to poison control centers. It is, however, a large database, which provides an indication of the size of the exposure problem.

Possible Special Study

A special study to provide statistically valid estimates of the number of children who gained access to a closed gasoline container and to provide details about the containers involved is desirable, but may not be feasible. With only 44 cases reported through NEISS in a full year, which *might* involve children getting access to gasoline from a gasoline container, a study which ran for a full year could expect to get about 25 completed investigations after more than a year of collecting data. While these investigations could provide insight into the mechanisms of how the children got access to the gasoline, the study results would be of little use in statistically quantifying the hazard. In addition, most of the NEISS cases involve ingestion or contact with gasoline. With only three burns in the 44 cases in 2001, a NEISS based study would not tell us much about burns from access to gasoline in containers.

The NEISS study would be useful as a case finding mechanism, but would not provide statistical answers and would not quantify the size of the problem very well, other than to show that the problem is not very large in terms of frequency of injury. Instead of a NEISS study, investigations could be assigned over the next year for any gasoline associated cases identified, either through NEISS, or through any of the other data bases that CPSC routinely reviews. The data obtained from this data collection effort could be added to the data already available to help determine what action the Commission may choose. Because these cases would be focused on collecting information about the gasoline cans, we could expect to get much more useful information than is contained in the data reviewed for this memo.

A special study using the TESS system could be more useful. This study would contain data on poisoning and gasoline exposures, but not on burns. This study would involve a contract with the AAPCC to collect and use the data. The cost of such a study would depend on the number of centers recruited to participate, the complexity of the information requested, and whether the results needed to be projected to estimate the national proportions for each of the questions answered.

Gas Can Incidents 1/1/1991 - 12/31/2001 Product Codes 910, 980, 981 Ages 0 - 4

#	lkno	docno	dtacc	city	state	age	sex	disp	prod1	prod2	narrative	Pattern
1	920817HCN2434	G9280033A	8/1/92	WARREN	MI	2	1	8	910	118	A 2 YEAR OLD MALE DIED DUE TO 2ND & 3RD DEGREE BURNS TO OVER 40%OF HIS BODY AFTER GASOLINE FUMES WERE IGNITED BY THE WATER HEATER'S PILOT LIGHT IN THE BASEMENT OF HIS HOME. THE VICTIM WAS PLAYING WITH THE GASOLINE, AND SPILLED SOME OF IT ON HIMSELF AND ON THE BASEMENT FLOOR. WHEN THE GASOLINE WAS IGNITED, THE VICTIM BECAME ENGULFED IN THE FLAMES.	Child opened closed container
2		H0080020A	5/16/97	KANSAS CITY	MO	3	2	4	910	118	A FEMALE AND A MALE, AGE 3, RECEIVED BURNS AND WERE HOSPITALIZED WHEN THEY SPILLED GASOLINE FROM A GASOLINE CONTAINER WHICH WAS IGNITED BYA GAS WATER HEATER IN A GARAGE.. THE CONTAINER WAS WITHOUT A CHILD RESISTANT CAP.	Child opened closed container
3	000518HCN0238	G0050132A	5/16/00	NORTH PEKIN	IL	2	1	8	118	910	A 2-YEAR OLD MALE VICTIM DIED IN A FIRE. THE FIRE WAS CAUSED BY A VAPOR IGNITION . IT IS UNCERTAIN BUT FIRE DEPARTMENT PERSONNEL ASSUME THE VICTIM DROPPED A GASOLINE CONTAINER CONTAINING SOME GASOLINE ONTO AN ENCLOSED GARAGE FLOOR. THE SPILLED GASOLINE WAS ABOUT TWO FEET IN DISTANCE FROM A FUNCTIONING NATURAL GAS WATER HEATER.	Child opened closed container
4	910212CWE7014	F9127001A	2/6/91	GALVESTON	TX	3	1	8	981	118	A YOUNG BOY POURED PART OF A CONTAINER OF GASOLINE ON THE GARAGE FLOOR AT A HOUSE. THE GASOLINE WAS IGNITED BY A GAS WATER HEATER NEARBY. THE EXPLOSION CAUSED 95% BURN INJURIES. THE BOY DIED FROM THE EXTENSIVE BURN INJURIES.	Involved a child and a gas can
5	910329HWE5021	F9135021A	2/16/91	TEMPE	AZ	2	1	4	118	981	A 2 YEAR OLD MALE KNOCKED ON OPENED CAN OF GASOLINE ON THE FLOOR OFA STORAGE/LAUNDRY ROOM. THE VAPOR FROM THE GAS WAS IGNITED BY A NATURAL GAS HOT WATER HEATER LOCATED ABOUT 2 FEET AWAY. THE CHILD SUFFERED 2ND DEGREE BURNS OVER ABOUT 17% OF HIS BODY.	Involved a child and a gas can
6	910605HCC0242	X9155437A	5/15/91	PALA	CA	2	1	8	118	981	A 2 YEAR OLD BOY DIED FROM BURNS RECEIVED WHEN THE GASOLINE HE WAS PLAYING WITH IN THE WASHROOM OF HIS HOME CAUGHT FIRE. THE VICTIM'S FATHER HAD LEFT A PLASTIC CONTAINER OF GASOLINE IN THE WASHROOM AND CLOSED AND LOCKED THE DOOR. IT IS NOT KNOWN HOW THE VICTIM WAS ABLE TO ENTER THE ROOM. THE PILOT ON THE LP GAS FIRED WATER HEATER APPARENTLY IGNITED THE GAS FUMES. UNCAPPED 6 GALLON CAN	Involved a child and a gas can
7	910708HCC1316	N9160163A	5/15/91	WOODBRIDGE	NJ	2	1	4	910	118	A 2 YEAR OLD MALE SUSTAINED SECOND AND THIRD DEGREE BURNS OVER 60% OF HIS BODY WHEN HE TIPPED OVER A CAN OF GASOLINE IN A BASEMENT ENTRANCEWAY AND THE FUMES WERE SUBSEQUENTLY IGNITED BY A GAS HOT WATER HEATER IN THE BASEMENT. THE VICTIM'S 5 YEAR OLD BROTHER ATTEMPTED TO PULL THE VICTIM FROM THE FLAMES BUT HE WAS UNSUCCESSFUL AND SUSTAINED FIRST AND SECOND DEGREE BURNS. THE VICTIM'S MOTHER PULLED HIM FROM THE FLAMES. THE VICTIM WAS MEDIVAC TO A BURN HOSPITAL FOR TREATMENT.	Involved a child and a gas can
8	911209HCC1500	X91C0559A	10/18/91	E. STROUDSBURG	PA	4	1	8	910	118	A 4 YEAR OLD MALE, PLAYING IN THE HALLWAY OF HIS HOME, KICKED OVER AN OPENED PLASTIC CAN OF GASOLINE. THE VAPORS FROM THE SPILLED CONTENTS, TRAVELING ACROSS TO A GAS WATER HEATER, WERE IGNITED BY THE PILOT LIGHT. THE VICTIM SUSTAINED FATAL BURNS IN THE ENSUING FIRE.	Involved a child and a gas can
9	911108HCC1467	N91B0104A	10/25/91	ORLANDO	FL	2	1	4	910	118	A 2 YEAR OLD MALE SUSTAINED 2ND AND 3RD DEGREE BURNS ON HIS LEGS, FACE AND HANDS WHEN HE POURED GASOLINE FROM A 1 GALLON CONTAINER INTO A LAWN MOWER STORED IN A 5'X8' UTILITY ROOM OF HIS RENTED HOUSE. THE PILOT LIGHT ON THE LP GAS FIRED HOT WATER IN THEUTILITY ROOM APPARENTLY IGNITED THE GASOLINE VAPORS.	Involved a child and a gas can
10	920409HCC1649	N9230359A	3/10/92	DELRAY BEACH	FL	213	1	8	910	0	A 2 YEAR OLD MALE AND 13 MONTH OLD FEMALE WERE CRITICALLY BURNED AFTER THEY KNOCKED OVER A PLASTIC CONTAINER OF GASOLINE IN A GARAGE AND THE GAS VAPORS WERE IGNITED BY A WATER HEATER PILOT LIGHT, THE 13 MONTH OLD FEMALE LATER DIED.	Involved a child and a gas can
11		X92C1262A	4/21/92	BAYBORO	NC	4	1	8	981	389	A 4 YEAR OLD MALE DIED IN A MOBILE HOME FIRE STARTED WHEN A GAS CAN WAS KNOCKED OVER NEAR A GAS SPACE HEATER.	Involved a child and a gas can
12	920814HWE5009	F9285009A	7/3/92	PRINEVILLE	OR	2	1	8	118	981	A TWO YEAR OLD MALE DIED OF SMOKE AND CARBON MONOXIDE ASPHYXIA AS A RESULT OF A FIRE IN THE GARAGE OF HIS GRANDPARENTS HOME. THE VICTIM APPARENTLY SPILLED GASOLINE ON A STROLLER AFTER WATCHING HIS OLDER BROTHER REFUEL A LAWN MOWER. THE PILOT LIGHT IN A GAS WATER HEATER IGNITED VAPOR FROM THE SPILLED GASOLINE CAUSING AN INTENSE FIRE WHICH ENTRAPPED THE VICTIM.	Involved a child and a gas can
13	930812CCC3491	F9370160A	7/10/93	PALESTINE	TX	2	1	8	118	910	THIS INVESTIGATION INVOLVES THE DEATH OF A TWO YEAR OLD MALE. THE VICTIM DIED AS A RESULT OF THERMAL BURNS HE SUSTAINED DURING A FIRE AT HIS RESIDENCE. THE REPORT STATES THAT HE WAS PLAYING INSIDE THE UTILITY ROOM WITH A CAN OF GASOLINE. A LIT GAS WATER HEATER WAS NEARBY. THE DOOR WAS CLOSED AND THERE WAS NO VENTILATION.	Involved a child and a gas can
14		X9485621A	4/20/94	MOBILE	AL	217	1	8	1123	910	A 17 MONTH OLD MALE DIED OF BURNS RECEIVED WHEN HE LIFTED AND SPILLED A PLASTIC CONTAINER OF GASOLINE NEAR A WATER HEATER.	Involved a child and a gas can
15		G9470137B	5/1/94	DETROIT	MI	3	1	4	981	322	A 3 YEAR OLD MALE WAS BADLY BURNED WHEN HE KNOCKED OVER A GAS CAN GETTING HIS BICYCLE AND A FURNACE IGNITED THE GAS FUMES.	Involved a child and a gas can
16	940802HCC2187	G9460116A	6/5/94	LEAVENWORTH	KS	4	1	8	1604	910	A HOUSE FIRE WHICH RESULTED IN THE DEATH OF A FOUR YEAR OLD CHILD, SEVERE BURNS TO A THREE YEAR OLD CHILD AND MINOR BURNS TO BOTH PARENTS. THE CITY'S CHIEF FIRE INVESTIGATOR DETERMINED THE PROBABLE CAUSE WAS THE FOUR YEAR OLD CHILD IGNITING, WITH A DISPOSABLE LIGHTER, GASOLINE WHICH HAD BEEN POURED FROM A FIVE GALLON CONTAINER AT HIS HOME. THE FOUR YEAR OLD HAD A HISTORY OF FIRE SETTING. OTHER SOURCES OF IGNITION WERE ELIMINATED INCLUDING A WATER HEATER PILOT LIGHT.	Involved a child and a gas can
17	960223HCC6032	X9621384A	6/3/95	EDINBURG	TX	2	1	8	118	910	THIS CASE INVOLVED A 2-YEAR -OLD MALE VICTIM WHO WHILE PLAYING IN A STORAGE AREA, SPILLED GASOLINE ON THE FLOOR. THE GAS WATER HEATER PILOT IGNITED THE GASOLINE FUMES AND THE TODDLER WAS CAUGHT IN THE FIRE THAT RESULTED. THE VICTIM DIED OF COMPLICATIONS DUE TO THERMAL BURNS IN THE HOSPITAL A MONTH FOLLOWING THE INCIDENT.	Involved a child and a gas can

Gas Can Incidents 1/1/1991 - 12/31/2001 Product Codes 910, 980, 981 Ages 0 - 4

#	ikno	docno	dtacc	city	state	age	sex	disp	prod1	prod2	narrative	Pattern
18	950807HWE5005	F9585005A	6/14/95	PUEBLO	CO	215	1	4	118	981	A 15 MONTH OLD BOY SUFFERED BURNS TO 17% OF HIS UPPER BODY WHEN HE KNOCKED OVER 2 GASOLINE CANS IN A ROOM WITH A WATER HEATER. THE FUMES FROM THE LEAKING CONTAINERS WERE LIT BY THE PILOT LIGHT ON THE HOME WATER HEATER.	Involved a child and a gas can
19	970513HCC2159	G9720094A	1/20/97	CINCINNATI	OH	3	1	4	981	310	A 3 YEAR OLD MALE RECEIVED SECOND AND THIRD DEGREE BURNS TO APPROXIMATELY 25% OF HIS BODY WHEN HE WAS PLAYING IN THE BASEMENT WITH A CAN OF GASOLINE. IT IS ASSUMED THAT HE SPILLED GASOLINE ON HIS CLOTHING, WENT NEAR THE GAS FURNACE AND HIS CLOTHING IGNITED. HIS FATHER RECEIVED SECOND AND THIRD DEGREE BURNS ON HIS HANDS AND ARMS WHILE TRYING TO PUT OUT THE FIRE ON THE CHILD'S CLOTHING.	Involved a child and a gas can
20	970519HCC2193	G9750060A	5/1/97	LENOIR CITY	TN	3	2	8	118	910	A 3 YEAR OLD FEMALE WAS KILLED AND A 4 YEAR OLD FEMALE SUSTAINED SERIOUS BURN INJURIES AFTER THE HOT WATER HEATER IN HER BASEMENT EXPLODED. REPORTEDLY, THE FEMALE VICTIMS WERE IN THE BASEMENT PLAYING WITH GASOLINE, AND THE VAPORS IGNITED AFTER SPREADING TO THE PILOT LIGHT.	Involved a child and a gas can
21		X0052145A	8/2/97	ST. JOSEPH	MO	4	1	8	1731	981	A BOY, AGE 4, DIED OF SMOKE INHALATION & HIS BROTHER WAS HOSPITALIZED FOR BURNS IN A HOUSE FIRE STARTED WHEN THEY PLAYED WITH MATCHES ADJACENT TO A GAS CAN AND THE GAS CAN EXPLODED AND CAUGHT ON FIRE.	Involved a child and a gas can
22		G97C0019A	11/9/97	STARKVILLE	MS	3	1	4	1141	910	A 3 YR OLD MALE WAS SEVERELY BURNED WHEN A CONTAINER OF GASOLINE HE FOUND EXPLODED AFTER HE WANDERED NEAR A FIRE. HE WAS BURNED AROUND HIS FEET AND FACE.	Involved a child and a gas can
23		G9860122A	6/1/98	EL DORADO	KS	4	1	8	981	118	A BOY, AGE 4, DIED FROM BURNS RECEIVED IN A HOME GARAGE FIRE. A PLASTIC GAS CAN WAS FOUND TIPPED OVER AND A GAS HOT WATER HEATER LOCATED IN THE GARAGE MAY HAVE IGNITED THE FIRE. THE MOTHER WAS BURNED ON HER HAND AND FACE.	Involved a child and a gas can
24		N9880152A	7/12/98	RED BANK	NJ	221	1	4	127	981	A 21 MONTH OLD MALE WAS BURNED OVER 92% OF HIS BODY AS A RESULT OF A FIRE BELIEVED STARTED WHEN HE KNOCKED OVER A GASOLINE CONTAINER AND THE FUMES WERE IGNITED BY A RUNNING CLOTHES DRYER. HIS GRANDFATHER WAS BURNED ON HIS FACE AND HANDS.	Involved a child and a gas can
25		G9940210A	4/18/99	DEFIANCE	OH	3	2	4	1687	981	A GIRL, AGE 3, AND A BOY, AGE 5, BOTH WERE HOSPITALIZED FOR SERIOUS INJURY IN A FIRE IN A PARKED CAR. THE FIRE STARTED BY CHILDREN PLAYING WITH A LIGHTER IN THE BACK SEAT OF THE CAR WHERE A PLASTIC GASOLINE CANISTER WAS LOCATED. WHICH CAUSED $2,000. DAMAGE.	Involved a child and a gas can
26	990922HBB2668	I9990131A	7/24/99	JACKSON	MI	4	1	4	118	910	ONE 3 YEAR OLD AND TWO 4 YEAR OLD MALES RECEIVED THIRD DEGREE BURNS TO OVER 35% OF THEIR BODIES WHEN A FIRE ORIGINATED WHILE THEY WERE PLAYING IN THE CARPORT STORAGE ROOM. IT IS BELIEVED THAT WHILE THEY WERE PLAYING A PLASTIC GASOLINE CONTAINER WITH GASOLINE INSIDE WAS ACCIDENTALLY TURNED OVER AND THE GASOLINE VAPORS WERE IGNITED BY A NATURAL GAS WATER HEATER THAT WAS MOUNTED AT FLOOR LEVEL IN THE STORAGE ROOM.	Involved a child and a gas can
27	000815HCN0420	G0080148A	8/12/00	ROUND LAKE BEACH	IL	4	1	4	1330	910	A FOUR-YEAR-OLD MALE WAS SEVERLY BURNED WHEN HE POURED GASOLINE FROM A GAS CAN ONTO A BATTERY-POWERED RIDING TOY CAR AND THEN ATTEMPTED TO OPERATE IT. THE GASOLINE APPARENTLY INFILTRATED THE ELECTRIC DRIVE MOTORS ON THE REAR WHEELS AND THE ELECTRICAL CURRENT / SPARK IGNITED THE FUEL. THE CHILD WAS BURNED OVER 50% OF HIS BODY. THE TOY CAR WAS ALMOST COMPLETELY CONSUMED BY THE FIRE.	Involved a child and a gas can
28	010531HCN0589	G0150342A	5/30/01	KANSAS CITY	KS	4	1	4	118	910	A FOUR-YEAR-OLD MALE WAS RIDING HIS TRICYCLE IN THE BASEMENT OF THE HOUSE WHEN HE SUSTAINED SERIOUS BURNS ON HIS HANDS AND TORSO. THE FIRE INVESTIGATING OFFICIAL STATED THAT IT APPEARS THAT SOMEONE KNOCKED OVER THE GAS CONTAINER OR WAS PLAYING WITH THE GAS CONTAINER, I.E. FILLING UP THE TRICYCLE LIKE A CAR, WHEN THE GAS SPILLED AND WAS IGNITED BY A GAS WATER HEATER ON THE BASEMENT FLOOR. THE CHILD WAS TAKEN TO THE HOSPITAL WHERE HE REMAINED UNTIL JULY 2001. NO ONE ELSE WAS INJURED IN THE FIRE AND ESTIMATE OF DAMAGE WAS NOT AVAILABLE.	Involved a child and a gas can
29	011022HCN0055	G01A0115A	10/10/01	SPRINGFIELD	OH	212	1	8	981	0	AN EIGHT-MONTH-OLD FEMALE AND A ONE-YEAR-OLD MALE DIED WHEN VAPORS FROM A PLASTIC GASOLINE CONTAINER WERE IGNITED BY PILOT LIGHTS IN THE KITCHEN OF THEIR APARTMENT. THE FIRE MARSHAL SAID THAT THE GAS STOVE, WATER HEATER AND FURNACE ALL HAD PILOT LIGHTS THAT COULD HAVE STARTED THE BLAZE.	Involved a child and a gas can
30	931103CCC2078	C93A5015A		DETROIT	MI	222	1	8	981	118	A 22 MONTH OLD CHILD WAS BURNED AND SUBSEQUENTLY DIED AS A RESULT OFA GAS CAN TIPPING OVER AND THE FLAME FROM THE WATER HEATER IGNITING THE FUMES	Involved a child and a gas can
31	941110HCC3008	9348047161	5/27/93	KILLEEN	TX	3	1	8	910	981	THE 3 YEAR OLD MALE VICTIM DIED FROM ASPIRATION FROM INGESTION OF GASOLINE WHEN HE INGESTED GASOLINE FROM A 2 GALLON PLASTIC GAS CAN WHICH WAS SITTING NEXT TO A LAWN MOWER ON GRASS IN HIS BACKYARD WHILE HIS FATHER LEFT TO THROW OUT GRASS CLIPPINGS. THE VICTIM WAS TAKEN TO THE EMERGENCY ROOM AND PRONOUNCED DEAD ON ARRIVAL.	Involved a child and a gas can
32	961018HEP9007		10/5/96	HEMINGFORD	NE	212	1	1	910	0	A 12 MONTH OLD MALE VICTIM APPARENTLY INGESTED GASOLINE WHILE PLAYING OUTSIDE IN THE YARD OF HIS HOME, NEAR THE GARAGE. THE VICTIM WAS FOUND SITTING NEXT TO AN OPEN GAS CAN. THE VICTIM'S MOTHER FOUND THAT THE VICTIMS HANDS AND BREATH SMELLED OF GASOLINE AND THAT HIS EYES WERE WATERY. SHE UNSUCCESSFULLY, TRIED TO CONTACT THE POISON CONTROL CENTER FOR SOME GUIDANCE. CONCERNED THAT THE VICTIM HAD INGESTED GASOLINE, THE VICTIM'S PARENTS TRANSPORTED THE VICTIM TO THE NEAREST HOSPITAL, WHICH WAS ABOUT 45 MINUTES FROM HOME. AT THE HOSPITAL, THE VICTIM WAS EXAMINED WHICH INCLUDED X-RAYS OF HIS LUNGS, EXAMINATION OF HIS EYES, AND OBSERVATION FOR ADDITIONAL SYMPTOMS. THE X-RAYS SHOWED NO LIQUID IN HIS LUNGS, THE VICTIMS EYES WERE WATERY DUE TO THE GASOLINE FUMES, AND NO FURTHER SYMPTOMS	Involved a child and a gas can
33	910410HEP9002		4/6/91	PHOENIX	AZ	219	1	1	1448	981	THE 19 MONTH OLD MALE VICTIM INCURRED DERMATITIS AFTER HE SPILLED GASOLINE FROM A PLASTIC CAN 1/4 FULL ONTO HIS CHEST, GROIN AND BUTTOCK AREAS. THE 11 YEAR OLD BROTHER OF THE VICTIM HAD PREVIOUSLY BEEN MOWING AND LEFT THE VICTIM WITH THE CAN AND NON-RUNNING WALK-BEHIND MOWER, UNSUPERVISED IN THE YARD. THE VICTIM WAS TAKEN TO HOSPITAL FOR TREATMENT AND RELEASED.	Involved a child and a gas can

TAB B

UNITED STATES
CONSUMER PRODUCT SAFETY COMMISSION
WASHINGTON, DC 20207

Memorandum **Date:** January 7, 2003

TO: Suzanne Barone, Ph.D., Project Manager for Poison Prevention
Directorate for Health Sciences

Through: Hugh McLaurin, Associate Executive Director
Directorate for Engineering Sciences

Robert B. Ochsman, Ph.D., Director,
Division of Human Factors

FROM: Catherine A. Sedney, ESHF (1282)

SUBJECT: Gasoline Cans

Background

The Poison Prevention Packaging Act (PPPA) requires that hazardous household products be sold in packaging that is difficult for children under five to open. Gasoline cans are empty when sold. The cans themselves cannot be considered hazardous, and are not subject to these requirements. Congressman Dennis Moore (Third District, KS) contacted the Commission on this issue following a fire in his district caused by young children playing with a can of gasoline. A four-year-old died and a three-year-old was severely burned in the incident. Commission staff reviewed available incident data and other information to explore the need to require child-resistant (CR) closures for these containers.

Incident Data

Staff from the Directorate for Epidemiology searched the Commission databases for incidents involving gasoline and children less than five years of age (G. Rutherford; memorandum to S. Barone, dated December 4, 2002). For the year 2001, the National Electronic Injury Surveillance System (NEISS) yielded five cases that involved a child gaining access to gasoline that was in a gas can. In 39 additional cases, it was not known if the gasoline was in a container when the child gained access to it. Most of the NEISS cases were ingestions, and incidents resulting in burns were rare.

For the period 1991 through 2001 there were a total of 86 incidents involving gasoline and children under five reported in the Injury and Potential Injury Incident (IPII), Incident Investigations (INDP), and Death Certificate (DTHS) databases. Of these, 33 cases were identified in which the gasoline was in a container and a child under five was involved. The incidents resulted in a total of 19 deaths, 20 hospitalizations, and five injuries that did not require hospitalization.

HF reviewed summaries, and where available, in-depth reports, of these incidents. Note that product-related incidents reported in the IPII, INDP, and DTHS databases consist only of those cases reported to the CPSC, and do not include all such cases. The following discussion is intended to characterize the details relevant to the issue of child-resistance in the cases available for review. However, these cases do not form a statistical sample, and they may not be representative of such incidents as a whole. Additionally, the majority of the incidents were investigated for a study of fires involving natural gas-fueled appliances. Little information on the container and its closures, that is, information relevant to the possible effectiveness of a requirement for child-resistant gas cans, was collected in these investigations, as will be discussed further below.

Children ranging in age from 12 months to four years initiated the incidents. This age group included all of the deaths, and a majority of the injuries. Eighteen of the fatalities were due to fire, and one child died due to aspiration of gasoline. Each of the survivors of the fire incidents suffered burn injuries of varying seriousness and extent. In a few cases the initial ignition source was thought to be a lighter or matches, and in one case, sparks from a battery-powered ride-on car. The majority, however, resulted when the child spilled or poured gasoline near a natural gas appliance. The child frequently had gasoline on his clothes or was standing in or near a pool of it when the appliance pilot light ignited the vapors resulting in a flash fire.

The general scenario reported is typical of most incidents involving children and hazardous household substances. The victims, predominantly male, were typically playing in or near the home. Although adults were nearby, there was a lapse of direct visual contact with the child. The child's behavior can be described as exploratory or imitative play, and interaction with the gas can was generally thought to be intentional. In some instances this was described simply as "playing" with the can or carrying it somewhere when the spill occurred. In other cases the child was thought to have used the can in purposeful imitation of an adult. Examples include a child pouring gasoline into a stroller in one case, and a ride-on toy in another. A departure from the usual is that in a number of instances the event was thought to be accidental, as when one child inadvertently knocked over a gas can while getting a tricycle.

In each of the ingestion incidents the container had been left out, and in one, had just been used. In the fire incidents, it appears that the cans had been used recently in a few instances, but more often children apparently obtained the can in the basement or garage where it was routinely kept.

In three cases the report suggests that the children involved removed the caps. For example, in one of these, the spout cap and fill cap were found near the lawnmower where the victim spilled gasoline. In another, the investigator's report states specifically that the cap was "not child-resistant." In the majority of the incidents, no information about the closures was reported. It is not known if the can was closed at the time of the incident, and if so, whether the child opened it.

The lack of details notwithstanding, it is reasonable to assume that the caps may have been in place in at least some instances in which the can was stored indoors. Despite occasional errors, omissions, and exceptions, replacing a cap is a part of the basic use of any type of container. Further, leaving a gas can open allows the gas to evaporate, generates fumes that are unpleasant to many people, and increases the chance of a

spill to be cleaned up. Additionally, at least some users may be familiar with the dangers of an open container. Replacing the caps is easy, and helps avoid these negative consequences.

A survey conducted by California Environmental Engineering (Santa Ana, CA) for the California Air Resources Board (CARB) lends support to the premise that gas cans are typically stored with the caps in place (Air Resources Board, Mobile Source Control Division; September, 1999). As part of a study of fuel emissions, consumers were surveyed on their ownership and storage of gasoline cans. At the time of the survey, 66% of respondents reported that their containers were stored in a "closed" condition. The survey very likely underestimates the number of closed containers, however.[1] The definition of "closed" in the report logically included the condition in which the spout was left out, and both the spout and vent were capped. However this configuration was not included as an option in the survey itself. The survey asked respondents to choose "which figure below best describes your gas container." The figures with spouts included one with an open vent cap, and one with a closed vent cap, but neither spout was capped. Only one choice, which showed a closed fill port (i.e., without a spout) and a closed vent cap, was counted as closed. It seems likely that, based on physical similarity alone, a respondent whose gas can had spout and vent caps in place would have chosen the figure showing a spout and a closed vent cap rather than the one "closed" can pictured without a spout. Thus the number of "open" responses may have been inflated. Further confounding the survey results on this point is that 30% of respondents reported storing cans empty of gasoline. The denominator for the proportion of consumers storing cans "open" is the combination of cans stored empty and cans stored with fuel. Thus, it is possible that the proportion of gas cans stored open was lower than that reported, and that some proportion of those contained no fuel. In either case, the survey lends credence to the hypothesis that although it was not specified in the investigation reports, the gas cans in the incidents may have been capped.

It is also reasonable to speculate that children may have removed the caps in some incidents where these details were not documented. Both the capabilities of children in the age group of interest, and test data with standard (i.e., non-CR) gas cans, support that possibility. The following section addresses these points.

Available Test Data and Child Capabilities

The Project Manager (S. Barone, Directorate for Health Sciences) provided four reports of child panel tests conducted on typical plastic non-CR gasoline containers, and a videotape of three pairs of children during testing. Based on the reports, the child panel tests were conducted in accordance with the procedures for testing special packaging that are detailed in the PPPA regulations (16 CFR Ch. II §1700.20), however the number of children in each panel varied. The subject samples consist of pairs of children 42 to 51 months of age. The protocol allows the children five minutes to try to open the container, followed by a demonstration and an additional five minutes if either one of the pair is unsuccessful. A package is considered child-resistant if it is opened by no more

[1] Treatment and interpretation of the survey data was confirmed with Archana Agrawal, Manager, Off-Road Inventory and Assessments Section, California Air Resources Board (personal discussion, 12/4/02).

than 20% of the test subjects. In these tests only the fill port caps were tested. The reports are summarized below.

Report No.	Sample Size	Container Type and Size	Number opened (CR level)	Conditions
1	11	Brand A 5-gallon	11 (0%)	Test personnel secured caps.
2	45	Brand B 5-gallon	41 (8.9%)	Caps secured by panel of adults 50 to 70 years of age.
3	50	Brand B 5-gallon	43 (14%)	Caps secured by panel of adults 18 to 45 years of age.
4	100	Brand A 2.5-gallon	67 (33%)*	Containers partially filled with water. Given to a panel of adults 18 to 45 years of age who were asked to remove the cap, pour out a small amount of water, and then secure the container as if it had gasoline.

*Per the report, 19 additional children opened only the vent cap. This would constitute a failure under the test protocol, so that the correct CR level is 14%.

In each test, among those children who opened the cap, all but a few did so before the demonstration. The elapsed time between the start of the test and the point at which a child opened the cap varied widely, with a few children accomplishing the task in five to ten seconds. In most cases, the method the children used to open the container was coded as "normal," with occasional elaborations that a given child used "just his fingers," or used one versus both hands. A few children were noted to support or stabilize the can, for example, by throwing a leg over it. In Test 4, in which the cans contained water, several spills were noted.

These results are not surprising. Typical plastic gas cans[2] such as those tested have simple threaded screw caps at the fill port, and push-on caps at the vent and spout. Force requirements aside, closures such as these are easy for children under five years of age to open. Children learn by both observation and exploration, and begin imitating others during the first year of life. Between 12 and 18 months, they can manipulate toys and other objects that require simple twisting and turning actions (Therrell, Brown, Sutterby & Thornton, 2002; pp. 15-16). By 18 months of age a child may try to turn a doorknob or turn on a water faucet (Caplan & Caplan, 1977; p. 219). It is not clear at what age the association between "opening" or removing a cap and counterclockwise rotation develops, however, it may be already be ingrained for many children in the age group specified in the test protocol. Five of the six children (42 to 51 months of age) filmed during testing immediately gripped the fill port cap and tried to turn it in the usual counterclockwise direction.

Available CR Cans and Test Data

Should further data collection efforts substantiate that the incidence of children accessing properly closed gas cans is a significant hazard, two issues may affect the

[2] The Directorate for Economics estimates that 95% of gas containers in use are made of plastic; the remaining 5% are metal (T. Karels; memorandum to S. Barone dated December 10, 2002).

need for a mandatory standard. First, industry has developed a provisional voluntary standard for CR gas containers (S. Barone; memorandum to M.A. Danello, dated January 7, 2003). The standard incorporates the child and adult PPPA protocols and criteria for CR packaging. The second issue is standards developed by the state of California and a coalition of East Coast states. The California Environmental Protection Agency Air Resources Board (CARB) adopted emission and spill prevention requirements for gas cans and spouts sold in the state starting January 1, 2001. The Ozone Transport Commission (OTC), an organization of eleven states in the Northeast and Mid-Atlantic regions, has developed a model rule similar to that of California. Four states have adopted the requirements, which will take effect after January, 2004. These measures do not include a requirement for child-resistance; however, their design may influence the likelihood of incidents, and a number of firms plan to incorporate CR features in their CARB/OTC-compliant products.

Brand D CR Can

Staff is aware of one firm (Brand D) that has developed and tested a CR gas can unrelated to emissions and spill control. The container has CR closures at the fill port, vent, and spout. In addition to the child panel test described in a previous section, the container was subjected to testing by a panel of 100 adults 50 to 70 years of age, as required by the PPPA. The adult test consists of a five-minute period during which the subject is asked to open and secure the container according to the instructions. If successful, the subject is asked to open and secure an identical closure during a second test period of one minute. The Senior Adult Use Effectiveness (SAUE) level is the percentage of successful openings for the two periods, and the minimum acceptable SAUE is 90%.

The Brand D container, partially filled with water, and with the spout installed, met the criteria for both the child and the adult panels. Each closure, rather than the can itself, was tested in independent five-minute/one-minute periods. The closures were opened by 94% of the adult panel (N=100) during the first period, and were opened and secured by 90% during the second period. During the child-panel test five children (10%) were able to open the container, all following the demonstration.

CARB- and OTC-Compliant Cans

Three CARB/OTC gas cans, including the one tested, were available for evaluation. Because these containers are designed to reduce emission and spills, they do not have vent caps, and the spouts are self-closing. The spout consists of a spring-operated sleeve surrounding the opening. The sleeve is designed with a tab or flange that one must position against the fuel tank opening. Pressing down on the tab retracts the sleeve to open the spout. When force against the tab is withdrawn, the sleeve returns automatically to the closed position.

The self-closing spout design may provide a significantly greater level of child-resistance than ordinary cans. Because the can must be held nearly upside down while the spout is retracted, it would be more difficult for children under five to pour out gasoline with containers of this type. Additionally, the incidents of inadvertent spills would be prevented, presuming the fill port closures are adequately tightened.

Venting of these cans has been raised as a possible safety issue. Because they do not have a separate vent cap, venting the container prior to refueling is necessary to prevent "blow-back" (splashing and spills) from the fuel tank. Although information on this topic is limited, what is available suggests that venting is not a serious obstacle to safe use. First, to use the spout one places the nozzle inside the tank, and the flange against the lip of the opening. On the containers evaluated the flange used to retract the spout is well above the opening. Although testing would be required to confirm it, it appears that splashing may be largely confined within the tank. Second, this concern was raised in a report prepared by the CARB staff (Boudoff, Coon, Fitzgibbon & Mahdavi, 1999). They contacted a firm that has sold containers of this type for several years, and reported that it has received no complaints or comments on this issue. CARB staff suggested this indicates that instructions may be adequate to address the issue. HF adds that on the containers reviewed, venting is relatively easy to perform. Since splash-back is both annoying and potentially dangerous, the experience would help influence most consumers to vent the container before using it. Third, although cost information is not available currently, one firm has developed a nozzle that requires no venting prior to use.

One brand (Brand C) container that meets the CARB and OTC requirements has undergone child and adult protocol testing, and testing for others is in progress. As is typical of many plastic gas cans, the tested model has a fill cap and spout that are separate, and the spout can be reversed for storage. For the adult test, the cans were filled with water and closed; the position of the spout was not specified in the report received. The container did not meet the SAUE criterion. The child-panel test was conducted with the spout within the can, and none of the children opened it (100%CR).

Factors Influencing the Effectiveness of CR Gas Cans

A number of factors can enhance or diminish the effectiveness of CR devices. In this instance, the baseline level of closure use is an important first factor; if a significant proportion of incidents occur when closures are not in use, requiring the closures to be child-resistant would obviously have little effect. Insufficient data are available at this time to assess the level of closure use.

Note that to be fully child-resistant, each of the closures (three on regular cans and two on CARB/OTC-compliant cans) must be child-resistant. With the partial exception of the self-closing spout, the effectiveness of each of the closures depends on consistently correct use. On a per-use basis, there is a greater opportunity for errors, of both commission and omission, than with the typical CR package.

The likelihood of foreseeable misuse and intentional defeat of safety devices is linked to design. Inadvertent misuse can occur when it is not obvious how to use the device correctly. Defeat (e.g., intentionally altering a product to avoid use of safety features) is more typical when a device is too hard for a consumer to use, or when its use is perceived as inconvenient. The CR gas cans reviewed raise concerns on both counts. Casual tightening in some cases was insufficient to engage the CR feature even though the cap appeared to be in place, and did not leak. Only one of the closures was easy to use. The rest varied from annoying to difficult because they required significant strength or dexterity. These are characteristics that invite defeat, which is simple to accomplish with the designs used. With the exception of the self-closing spouts, the containers evaluated can be altered with little effort to permanently bypass the CR features.

Durability is likely to be a particularly important factor affecting the integrity of gas can closures. Unlike packages for medicine or household cleaners, which are thrown away when they are empty, gas cans are estimated by the industry to have useful life of three to five years, and the average age reported in the CARB survey was over five years (T. Karels; memorandum to S. Barone dated December 10, 2002). Gas can caps are likely to be subject to considerably more wear than the typical CR closure. On this point the containers evaluated warrant improvement. Some of the closures failed to function, or could be overridden, after the limited use required for evaluation.

The test protocol itself, as it has been applied to gas containers, raises concerns for effectiveness. As defined in the regulation, the protocol is specific to packaging that has one opening, and the entire test period focuses on a single closure. Gas cans have multiple openings and multiple configurations. In some of the studies reviewed, gas cans were tested with the spout inside the can. It seems more likely that for convenience, a potent factor in product use, consumers would use and store the containers with the spout installed. The tests, in effect, were of a different container than the one children might interact with in the home environment. In one test only the fill port cap was tested, thus the CR level of the other closures is unknown. In another, all three closures were demonstrated to the children. Under these conditions, a child's attention and efforts may be divided, and result in a tested CR level that does not reflect the effectiveness of any one of the closures. The reverse is an issue raised in one of the adult tests reviewed. Allowing a full five-minute/one-minute test for each closure is unlikely to screen out cans that are unacceptable to consumers. For example, in the test data reviewed, a subject taking three full minutes to open and resecure three closures would be counted as a success. In actual use, however, consumers are unlikely to tolerate closures which take more than a few seconds to use correctly. Thus, a container that receives high marks for usability during testing may be a likely candidate for intentional defeat in the home. Because these containers differ from the types of packaging the protocol was designed to test, the procedures used highlight issues that would need to be addressed in any consideration of a mandatory standard for gas cans.

Summary

The incident data indicate that gas cans are at times easily accessible to young children, and may be stored in proximity to appliances fueled by natural gas. The incidents that result from spills near the appliances often involve multiple victims, and their injuries are typically severe or fatal. Although test data confirm that children under five are able to open non-CR gasoline cans, in only three cases reported to the Commission is there sufficient information to indicate that the incident occurred because a child did open a closed can. A reasonable possibility is that this was a causal factor in more incidents, but was not documented as such because the appliance, rather than the container, was the focus of the investigation. More data are needed to determine the frequency of such incidents, and thus, if requirements for child-resistant closures are warranted. Due to the development of a voluntary standard on child-resistance, and state regulations regarding emissions and spill control, some gasoline cans that offer greater child-resistance are now available. The overall effectiveness of these products may be limited by factors related to user acceptance of the designs, long-term durability of the CR features, and the procedures used to test their level of child-resistance.

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TAB C

UNITED STATES
CONSUMER PRODUCT SAFETY COMMISSION
WASHINGTON, DC 20207

Memorandum

Date: JAN - 7 2003

TO : Mary Ann Danello, Ph.D. Associate Executive Director for Health Sciences

THROUGH: Lori Saltzman, M.S., Director, Division of Health Sciences

FROM : Suzanne Barone, Ph.D., Project Manager for Poison Prevention, Directorate for Health Sciences

SUBJECT : Standards for portable gasoline containers.

This memorandum describes existing standards for portable gasoline containers (gas cans). The California Air Resources Board (CARB) regulations for spill and emission reduction from gas cans are discussed. ASTM voluntary standards for gas cans including the status of and conformance to the ASTM provisional standard for child-resistant gasoline cans, are also described.

Historical Background

In 1978, the U.S. Consumer Product Safety Commission (CPSC) was petitioned to ban certain hazardous portable containers for consumer use of gasoline and to establish a standard for gasoline containers of five gallons or less capacity. The Commission denied the petition noting that the available data did not support rulemaking and directed the CPSC staff to participate with ASTM to define the scope of a voluntary standards effort. In 1980, a subcommittee, ASTM F15.10, was formed to look specifically at the safety of portable gasoline containers (gas cans). The CPSC staff participated in the subcommittee and two voluntary standards were developed: F 839 – Standard Specification for Cautionary Labeling of Portable Gasoline Containers for Consumer Use, and F 852 - Specification for Portable Gasoline Containers for Consumer Use. Standard F 839 contains cautionary labeling for the safe use of gasoline. Standard F 852 contains safety performance requirements for gas cans such as drop testing. These standards apply to standard plastic and metal gas. Child-resistance of gas cans was not part of these early deliberations.

Description of ASTM F 839

As described above, ASTM F 839 contains cautionary labeling language. This standard was the first standard developed by the ASTM F15.10 subcommittee because consumer misuse of gasoline was a major safety concern. This voluntary standard contains cautionary warnings about use and storage of gasoline. The standard requires

that the language and block-style lettering be consistent with the requirements of the CPSC's Federal Hazardous Substances Act (FHSA). Gas can manufacturers are complying with this standard and gas cans have incorporated cautionary labeling on their gas cans during manufacture. This standard was reapproved in 1998 and is up for renewal in 2003. The CPSC staff will reexamine the labeling standard to determine if any changes should be suggested.

Emission and Spill-Control Standards

In September 1999, the California Air Resources Board (CARB) adopted emission and spill-control regulations for gas cans to reduce smog-forming pollution from gas cans. A summary of these regulations is at Attachment A. The regulations apply to gas cans and spouts sold in California after January 1, 2001. The available gasoline cans did not meet the new regulations and major changes had to be incorporated in order to comply with the CARB requirements. Changes included the development of spouts that shut-off automatically to prevent over-filling and that automatically seal when not in use. Secondary vent holes are eliminated and cans must minimize vapor permeation through the walls. There are several performance tests that a gas can must pass to ensure that the spill-proof systems automatically shut off, do not leak, have an adequate flow rate, and do not exceed the permeation rate. These rules do not apply to safety cans,[1] fuel containers with a capacity less than or equal to one quart, or portable fuel tanks for outboard engines.

Other states and regions of the country are interested in the CARB approach to reduce air pollution. In the northeastern part of the United States, the Ozone Transport Commission (OTC), which includes states from Maine to Virginia and the District of Columbia, is promoting this option of decreasing pollution. The OTC was formed to combat ground-level ozone in the region. The OTC developed a model rule based on the CARB standards. This model rule is not binding but states in the OTC can use the model rule to develop state-specific regulations. Several states including Maryland, Pennsylvania, Delaware, and New York have adopted gas can emission regulations. Gas cans sold in these states after January 1, 2004 will have to be "spill-proof." Other states have proposed, or are considering adoption of the model rule.

The ASTM F15.10 subcommittee developed and approved a provisional standard (PS 91-00) for portable gasoline and kerosene spill-resistant fueling systems for consumer use in July 2000. A provisional standard achieves limited consensus through the sponsoring subcommittee and stays in effect for two years or until it is converted to a full consensus standard, whichever comes first. This provisional standard incorporates technical parameters for the reliability of the spill-proof spout such as the durability of the closing mechanism. These parameters were not included in the CARB standards. The subcommittee has been working to convert this standard

[1] 29 CFR § 1926.155(l) definition: Safety can is an approved closed container, of not more than 5 gallons capacity, having a flash-arresting screen, spring-closing lid and spout cover and so designed that it will safely relieve internal pressure when subjected to fire exposure.

to a full consensus standard. It has been through subcommittee balloting and is out for Committee balloting in January 2003.

Child-resistant Gas Cans

Since changes to gas cans were being made to comply with CARB standards, gas can manufacturers began to investigate incorporating child-resistance. In 1999, ASTM subcommittee F15.10 formed a task group to explore the possibility of child-resistant packaging for gas cans. The task group met with CPSC staff in July of 1999 to discuss child-resistance. A copy of the meeting log is at Attachment B. The ASTM F15.10 subcommittee issued a child-resistance standard using the provisional standard development procedures in February 2001 entitled, "Provisional Standard Specifications for Child-resistant Portable Gasoline containers for Consumer Use." PS 119-01 will cease to exist after February 1, 2003 unless the subcommittee starts it through the consensus process prior to that date.

Description of ASTM PS 119-01

ASTM PS 119-01 is intended to be technically equivalent to the testing protocols and standards defined in the regulations of the Poison Prevention Packaging Act. The provisional standard includes the test methods for children and seniors described at 16 CFR § 1700.20. The child-resistance and senior-adult-use-effectiveness standards in PS 119-01 are equivalent to those in 16 CFR §1700.15. The provisional standard does not distinguish between plastic and metal gas cans and does not cite or apply the younger-adult test method to any gas can type. The standard does not specifically address procedures for testing multiple openings on gas cans.

This standard specifies that the child-resistant containers shall continue to function at the specified effectiveness for the number of openings and closings customary for its size and contents. PS 119-01 states that technical evaluation based on factors such as wear and stress for the duration of normal use may be used to satisfy the requirement for continued function.

Conformance to PS 119-01

Representatives from six gasoline can manufacturers participate in the ASTM subcommittee. These six companies are believed to account for almost all gas can sales in the United States. The market share of each company is unknown. Most gas cans sold are made of plastic.

Each company has a different approach to the development of child-resistance for their gas cans. While current conformance with the standard is low, companies are working on child-resistance for gas cans. One company has a child-resistant standard plastic gas can on the market. It is available in three sizes, 1 gal, 2 gal, and 5 gal. Each of these gas cans has three different child-resistant features; the vent, the spout tip, and the fill port. This company has put the same child-resistant fill port on their

CARB/OTC-compliant can. Another company plans to have child-resistant standard and CARB/OTC-compliant gas cans available by the spring 2003.

Several companies plan to incorporate child-resistant features only on their CARB/OTC-compliant cans. Since these cans do not have a vent, they have fewer openings to make child-resistant. The spouts are self-sealing and may be child-resistant depending on the design, the activation mechanism, and the activation force. However, CPSC staff has not seen any child-resistant data from testing "spill-proof" spouts. A child-resistant feature would have to be developed for the fill port. The companies are at various stages of development from design development to mold conversion for incorporation of the child-resistant features. Several companies are completing child and senior testing.

The staff is unaware of any company that is incorporating child-resistant features on metal gas cans.

Status of PS 119-01

The subcommittee plans to move forward to convert PS 119-01 to a full consensus standard before February 2003. However, a meeting has not yet been scheduled. The CPSC staff will continue to participate in this subcommittee.

Discussion

The gas can industry has been making changes to gas cans, both to comply with environmental standards adopted by the states of California, Pennsylvania, Delaware, Maryland and New York and to make cans child-resistant.

The provisional ASTM standard for child-resistance has been in place for less than two years. Gas can manufacturers are working to develop child-resistance. However, current compliance with the voluntary standard is low. Most companies are in the process of incorporating child-resistant features on CARB/OTC-compliant cans. Companies are marketing standard gas cans in states that have not adopted the emission and spill-resistant regulations. Several companies either have or will have standard cans with child-resistant features. It is unknown what proportion of the market this will represent.

Since several companies are only putting child-resistant features on the CARB/OTC-compliant cans, full compliance with the child-resistant voluntary standard is unlikely unless CARB/OTC-type standards are enacted in more regions of the country and standard gas cans are no longer available for sale. This could also occur if the burden of making two different types of gas cans (standard and CARB/OTC-compliant) becomes too great.

Attachment A

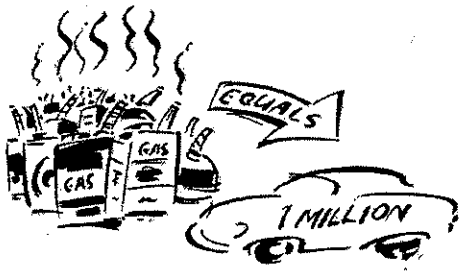
New regulations for portable gas cans and gas can spouts

This page updated October 12, 1999

At its September 23, 1999, meeting, the California Air Resources Board (ARB) adopted new emission and spill-control regulations for portable fuel containers, commonly known as "gas cans," and gas can spouts. The regulations apply to new gas cans and spouts sold in California starting January 1, 2001. There is no requirement for owners of gas cans or spouts sold before that date to modify their gas cans or to scrap them and buy new ones.

A major source of smog-forming pollution

While the air emissions from a single portable gas can appear to be small, the total number of such containers means they contribute significantly to smog-forming emissions in California. Based on industry and government data, it is estimated that there are 9.2 million residential gas cans and almost 600,000 commercial gas cans in California. About 1.9 million new gas cans are sold each year in the state.



Gas cans account for about 87 tons a day of smog-forming pollution. That's equal to emissions from about 1 million cars.

These cans contribute smog-forming emissions to California's air in several ways, including:

- permeation of vapors through walls in containers made from a plastic known as high density polyethylene (seventy-five percent of residential gas cans are made from this plastic);
- escaping fumes while fuel is being dispensed;
- spillage and/or over-filling as fuel is being poured into equipment;
- spillage and evaporation through secondary vent holes; and
- evaporation through inadequately capped spouts.

Portable gas cans account for about 87 tons per day (TPD) of smog-forming reactive organic gasses (ROG) escaping into California's air. Without the ARB's

action to reduce gas can emissions, that number will grow to 96 TPD by 2010. However, adoption of the regulations will mean a 73 percent reduction in ROG emissions from gas cans by 2010, cutting the amount of smog-forming emissions to 26 TPD. An added benefit to the consumer is a significant reduction in exposure to harmful fuel vapors while using portable gas cans.

How will the new standards work?

All containers and spouts will have an automatic shut-off feature preventing overfilling of power equipment fuel tanks. Several gas can manufacturers already have products on the market with this feature. The spouts will also have an automatic closing feature so the can will be sealed when it is not being used to fill an equipment fuel tank. This feature prevents leaking vapors when the can is not in use. Again, several manufacturers already have products on the market that comply with this requirement. Secondary venting holes will be eliminated under the new standards since these openings allow venting of fumes to the air. The new standards require manufacturers to reduce vapor permeation through a container's walls to no more than 0.4 grams per gallon per day.

The gas can regulations will prevent spills during equipment fueling and evaporation during fuel storage.

The new standards are cost-effective

ARB estimates that the average cost of a gas can, in sizes ranging from one gallon to six gallons, will increase approximately $6 to $11 per can. Looking at costs another way, the regulation will cost $2.01 for each pound of smog-forming ROG reduced. This is a cost-effective amount for ROG reduction, considering the typical $5 per pound cost of recent emission control strategies to reduce smog-forming hydrocarbons and oxides of nitrogen.

Needed for clean air

The gas can and gas can spout regulations will bring the state cleaner air and help meet federally-mandated requirements to reduce harmful air emissions. Existing ARB regulations reduce smog-forming emissions from automobiles, heavy-duty trucks, watercraft engines, lawn and garden equipment, gasoline and diesel fuels, consumer products such as hair spray and auto polishes, and other equipment and products. The ARB will continue to look for other ways to reduce harmful emissions.

For more information

Technical reports about the new standards can be found on the ARB's Internet site by going to http://www.arb.ca.gov/msprog/spillcon/spillcon.htm. Copies of the

technical reports may also be ordered through ARB's Public Information Office, 2020 L Street, Sacramento, CA 95814 (916) 322-2990. The ARB's ADA Coordinator can be reached at (916) 322-4505, TDD (916) 324-9531.

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Spillage Control Measure Main Page

A department of the California Environmental Protection Agency

Attachment B

LOG OF MEETING

SUBJECT: ASTM F15.10 CR Closure Task Group of Standards for Flammable Liquid Containers

DATE OF MEETING: July 20, 1999

PLACE: CPSC Headquarters, Bethesda, MD

LOG ENTRY SOURCE: Suzanne Barone, Ph.D., Pharmacologist, HS

COMMISSION REPRESENTATIVES: See attachment.

NON-COMMISSION REPRESENTATIVES: See attachment.

SUMMARY OF MEETING:

The ASTM subcommittee F15.10 on flammable liquid containers formed a task group to explore the possibility of child-resistant packaging for portable gasoline cans if found to be appropriate. This was the introductory meeting of the task group. The CPSC staff presented information on the child-resistant packaging standards and test methods under the Poison Prevention Packaging Act (PPPA). The discussion of packaging included the types of closures that are currently available on the market and the ASTM D10.31 subcommittee on child-resistant packaging as a resource. CPSC staff also discussed the regulatory process at CPSC and the differences between mandatory and voluntary standards.

The task group briefed the CPSC staff on California environmental standards and the development of an ASTM standard for gas cans to decrease emissions from overflow and permeation. The task group will evaluate the information presented and hold another meeting in a few months.

Meeting of ASTM F15.10 CR Closures Task Group
July 20, 1999
At the CPSC Headquarters, Room 715

Name	Company Name	Telephone Number
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TAB D

UNITED STATES
CONSUMER PRODUCT SAFETY COMMISSION
WASHINGTON, DC 20207

Memorandum

Date: January 3, 2003

TO : Suzanne Barone, HS
Project Manager, Gasoline Cans

THROUGH: Warren J. Prunella, Associate Executive Director for Economic Analysis

FROM : Terrance R. Karels, EC TRK

SUBJECT : Market Information --- Gasoline Cans wp

This memo provides preliminary information on the US residential market for gasoline cans, and information on the potential costs of adding child-resistance (CR) features to these products. This information is to be used in the CPSC staff's preliminary work regarding child-resistance for gasoline cans. The following information was developed through contacts with gasoline can manufacturers, public information available through the Internet, the "Portable Fuel Container Spillage Report" (California Environmental Protection Agency, 1999), and follow-up contacts with California state sources.

Types of Gasoline Cans

In 1978, the Commission was petitioned to develop a mandatory safety standard for portable gasoline cans. The staff's briefing package differentiated between a broad category, "gasoline container" (a portable container that may or may not be marketed specifically for gasoline use and storage), a more specific category of "gas can" (a portable container expressly for gasoline use), and "safety can" (a non-CR gasoline can with additional features, such as a spring-loaded cap, pressure release vent, and non-sparking and non-spill features), which is a subgroup of "gas cans." While the types of gas cans in common use at that time were significantly different than today, these general categories of containers are still pertinent.

In the 1970s and early 1980s, the most common types of gas cans were flat-sided thin-gauge steel "tins," most typically in the one- and two-gallon sizes. In the early 1980s, plastic gas cans were introduced. Plastic gas cans dominated the market by the early 1990s. A residential survey conducted in 1999 for the California Environmental Protection Agency found that 76% of all gas cans in residential use in California were plastic.

There is a substantial number of other volatile liquids, such as varnish removers, turpentine, camp stove white gas, and paint strippers, that are sold in older-design "tins." Some of these tins may see subsequent use as gas containers after they are empty of the purchased liquids.

Virtually all gas cans currently being marketed are of molded plastic design, in one- and two-gallon sizes. Except for a small number of thin gauge steel cans, the remaining gas cans are "safety cans" of much heavier gauge metal (24 gauge steel). Industry sources report that plastic cans now represent 95% or more of all gas cans sold. An estimated 20 million gas cans are sold annually; thus, perhaps 1 million are of steel. One-gallon cans are estimated to account for about 60% of all gas cans sold in the US. There are reportedly little or no imports of gas cans (except from Canada, which may account for as much as 10% of US gas can sales); the cost of freight is said to limit imports.

Manufacturers

The **Thomas Register**, an industry information source, lists over 200 US and Canadian manufacturers of products that may be considered "gas cans." They are listed as gas cans, gas containers, gasoline cans, gasoline containers, fuel cans, and fuel containers. A review of individual manufacturers' websites reveals that many of these manufacturers are marketing to commercial and industrial users. Contacts with members of the ASTM subcommittee for portable fuel containers indicate that there are six significant manufacturers of gas cans for consumer use in the US and Canada. Of these, one firm is considered the market leader, accounting for over ½ of total US sales; industry contacts stated that these six firms account for virtually all gas can sales in the US.

Retail Prices

Plastic one-gallon gas cans typically retail for about $2, and two-gallon plastic cans retail for $3 to $3.50 each. A consumer is likely to purchase a smaller-sized gas can at the same time as purchasing a new gas-powered tool, such as a lawn trimmer or snow blower that may require a mix of gasoline and oil (such as with a 2-stroke engine).

Metal "safety cans" typically retail for $25 in the one-gallon size, while the metal five-gallon metal safety cans retail for about $30 each. There is also a limited number of "jerry cans" on the market, retailing for about $15. Jerry cans derive their name from the British military (describing a German gas can design), and contain 4.5 imperial gallons, which is equivalent to 5.4 US gallons. Jerry cans are made of heavy gauge steel like safety cans, but do not typically incorporate the safety features that are the major cost difference associated with safety cans.

Useful Life

Industry sources indicate that plastic gas cans experience an average useful life of perhaps 3-5 years, while metal safety cans have an average useful life of 25 years or more. The substantially longer useful life of metal cans tends to support the California EPA survey (referenced earlier) that found that 24% of gas cans in use were of metal. The CA residential survey conducted in 1999 found that the average age of gas cans in that state was 5.5 years.

Number in Use

The California survey found that 46% (or 5.2 million) of all 11.4 million California households had at least one gas can, and that there were .8 gas cans per household (or 9.1 million cans); this indicates that as many as 3.9 million households had more than one can. If national use of gas cans were similar to that of California, about 48 million households would have at least one gas can, and there would be about 80.5 million gas cans in household use.

Child-Resistance

Staff have estimated the cost of applying child-resistant (CR) closures on plastic gas cans. One firm currently markets a one-gallon plastic gas can with CR closures in 3 locations --- the spout, the fill port, and the vent port. As shown on the manufacturer's website, this style of can

retails for about 75 cents more than apparently similar cans; it is not clear, however, whether the increased cost is solely related to the addition of the CR feature. Another manufacturer is studying designs to incorporate the CR feature in cans while eliminating the vent port; the firm's marketing director stated that adding the CR feature may be accomplished with "little or no extra cost" because of savings derived from eliminating the vent. However, the extent of additional costs will not be known until the cans are in production.

Industry sources were unable to estimate the cost of adding CR features to a metal can, but some modification may be needed for even metal "safety cans" in order to comply with any CR requirement.

In 2001, emissions regulations regarding gasoline cans went into effect in California. (Although the California regulations use the word "container," the subject products are specifically intended for gasoline storage and would be more closely identified with the definition of gas cans used in this paper.) The resulting changes in gasoline can designs may provide some level of child-resistance. Four other states, Pennsylvania, New York, Maryland, and Delaware have also passed state laws similar to California's gasoline container law. Together, these five states represent about 25% of the US population. Three current manufacturers estimate that the California emissions regulation added $4-7 to the retail price of each complying gasoline container.

The California survey uncovered issues that may have an impact on the potential effectiveness of any CR feature. The survey found that 30% of gas cans in residential settings were stored empty, and some proportion of surveyed gas cans were stored without a cap or with something else acting as a cap.