Fireworks Rule Review
Briefing Package

Request to conduct a full rule review of current fireworks regulations in 16 C.F.R. §§ 1500.14(b)(7); 1500.17(a)(3),(8),(9),(11), and (12); 1500.83(a)(27); 1500.85(a)(2); and part 1507

December 30, 2015

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Executive Summary

Since 1973, the U.S. Consumer Product Safety Commission ("CPSC" or "Commission") has regulated fireworks devices, initially under the Federal Hazardous Substances Act ("FHSA").[1] Under current regulations, the Commission has declared certain fireworks devices to be "banned hazardous substances."[2] Fireworks must meet various requirements to avoid being classified as "banned hazardous substances."[3] Additional regulations prescribe specific warning labels on a variety of fireworks devices.[4] Finally, the Commission also prescribes certain exemptions from labeling and from classification as "banned hazardous substances."[5] As a result of statutory revisions in the Consumer Product Safety Improvement Act of 2008, provisions of the FHSA can be enforced under the Consumer Product Safety Act ("CPSA")[6], and its provisions.

Under the direction of the Commission in the CPSC Fiscal Year 2015 Operating Plan, staff completed a rule review of the current fireworks regulations issued under the FHSA. Staff identified problems and burdens, and identified possible solutions to the problems and burdens. Additionally, staff considered the goals set forth in Executive Orders ("E.O.s") 13563 and 13579 (E.O. 12866 supplements and reaffirms E.O. 13563) and, in doing so, seeks to improve the current regulations by protecting "public health, welfare, safety, and our environment" by identifying and recommending the "best, most innovative and least burdensome tools" for compliance and enforcement.

For this rule review, staff considered CPSC staff research, current technology, market information, compliance and injury data, as well as applicable international and voluntary standards for the possible improvement of CPSC's fireworks regulations. The two main international standards used throughout the world are the European Standard EN 15947-1–15947-5: Pyrotechnic Articles—Fireworks, Categories 1, 2, and 3 ("European Standard") and The American Pyrotechnics Association Standard for Construction and Approval for Transportation of Fireworks, Novelties, and Theatrical Pyrotechnics ("APA 87-1"). The U.S. Department of Transportation ("DOT") regulates the transportation of fireworks and requires compliance with APA 87-1 when approving the certification for transportation of display and consumer fireworks. As a result of this DOT requirement, APA 87-1 is widely used by industry. The American Fireworks Standards Laboratory ("AFSL") has developed voluntary standards that incorporate both the CPSC and DOT regulations, as well as a number of standards developed by AFSL that are in addition to federal requirements. AFSL estimates that AFSL members represent 85 percent to 90 percent of all U.S. fireworks importers,[7] and each AFSL member agrees to test fireworks to the AFSL standard.

[1] 15 U.S.C. §§ 1261-1278.
[2] 16 C.F.R. §§ 1500.17(a)(3), (8), (9), (11) and (12).
[3] 16 C.F.R. part 1507.
[4] 16 C.F.R. § 1500.14(b)(7).
[5] 16 C.F.R. § 1500.83(a)(27) and 16 C.F.R. § 1500.85(a)(2).
[6] 15 U.S.C. 2051 *et seq.*
[7] http://www.afsl.org/content/about-us.

Staff recommends revisions to the current regulations as summarized in the table below. Staff believes updating the current regulations as recommended by staff would enhance safety by clarifying requirements and imposing additional requirements that in some cases are more stringent than current CPSC regulations. Updating the current regulations would provide industry with additional regulatory guidance and would assist in reducing compliance burdens by reducing testing and making administration of the regulation easier. Should the Commission determine that revision of the current CPSC fireworks regulations are warranted, staff would recommend seeking public comment on adopting certain requirements from APA 87-1 and/or the AFSL voluntary standard that are consistent with the CPSC's existing regulatory scheme, mission, and authority.

Because staff's recommended changes reflect provisions of APA 87-1 and the AFSL voluntary standard and because staff believes that industry already largely complies with these standards, staff's preliminary review indicates that most changes staff recommends to the Commission would have minimum economic impact.

If the Commission decides to proceed with staff's recommendations, the Commission could direct staff to draft a notice of proposed rulemaking ("NPR") to seek comment on updating and revising CPSC's fireworks regulations as summarized below and explained in more detail in the following discussion.

Section	Staff Recommendations
1500.14(b)(7) Labeling for fireworks devices	• Public comment on addition or deletion of devices from list • Public input on how to achieve more consistency with APA, the European Standard and AFSL in labeling and address safety issues in incident data
1500.17(a)(3) Ban on devices intended to produce audible effect with more than 2 grains pyrotechnic composition	• Replace "intent to produce audible effect" with APA burst charge requirement requiring any burst charge containing metallic powder (such as magnalium or aluminum) less than 100 mesh in particle size be limited to 130mg • Incorporate APA pyrotechnic and chemical composition limits for all fireworks devices • Obtain public input on appropriate contamination level for metal powder presence in break charges exceeding 2 grains (130mg). • Remove reference to firecrackers (move to 1500.17(a)(8). • Seek comment on aerial bombs, associated injuries, whether aerial bombs should be banned or limited to 2 grains of metallic fuel
1500.17(a)(8) firecrackers	• No change in substantive requirements for firecrackers • Seek comment on aerial bombs, associated injuries, whether aerial bombs should be banned or limited to 2 grains of metallic fuel

1500.17(a)(9) Banned fireworks devices	• No changes
1500.17(a)(11)(i) Banned reloadable tube aerial shell fireworks devices	• No changes
1500.17(a)(12)(i) Banned multiple-tube devices	• No changes
1500.83(a)(27) Exemptions for small packages, minor hazards and special circumstances	• Clarify and update to state that fireworks assortments can contain only devices designed to produce visible effects by combustion and small firecrackers with no more than 0.772 grains of pyrotechnic composition • Make references to "audible effects" consistent
1500.85(a)(2) Exemption for firecrackers less than 50 milligrams	• Delete as redundant with 1500.17(a)(8)
1507.1 Scope	• Relocate exemption for firecrackers to specific substantive provisions • Seek comment on adding a definition for firecrackers
1507.2 Prohibited chemicals	• Allow a reasonable amount of trace chemicals as impurities • Seek comment on appropriate trace contamination limit • Add lead and HCB to prohibited chemical list
1507.3 Fuses	• Seek comment on merits of adding CPSC test method for measuring side ignition (with a 5 second ignition resistance) (now in the CPSC Fireworks Testing Manual) • Seek comment on alternate test method for fuse attachment requirements for large devices
1507.4 Bases	• Seek comment on merits of requiring that base remain attached during handling and normal operation

1507.5 Pyrotechnic leakage	• No changes
1507.6 Burnout and blowout	• Seek comment on incorporating APA definition of "burnout" and "blowout"
1507.7 Handles and spikes	• No changes
1507.8 Wheel devices	• No changes
1507.9 Toy smoke devices and flitter devices	• No changes
1507.10 Rockets with sticks	• Clarify provision by specifying definitions for "straight and rigid" and "attached" (which currently are addressed in CPSC Test Manual), and seek comments
1507.11 Party poppers	• No changes
1507.12 Multiple tube fireworks devices	• No changes
Fragments	• Incorporate APA requirement (APA 87-1, Section 3.7.2) regarding fragments and solicit comments
Apex of flight	• Add APA performance requirement in APA 87-1, Section 2.6.2.8 • Solicit information regarding fires and injuries associated with APA apex of flight requirement • Seek comments on APA requirement and minimum height requirement for apex
Definitions	• Add definitions section that includes APA definitions of relevant terms (APA 87-1, Section 2.5, 2.6, 2.6.2, 2.6.2 and 2.10)

This document has been electronically approved and signed.

Briefing Memorandum

Date: December 30, 2015

TO: The Commission

Todd A. Stevenson, Secretary

THROUGH: Stephanie Tsacoumis, General Counsel
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SUBJECT: Rule review of current fireworks regulations in 16 C.F.R. §§ 1500.14(b)(7); 1500.17(a)(3),(8),(9),(11), and (12); 1500.83(a)(27); 1500.85(a)(2); and part 1507

The U.S. Consumer Product Safety Commission ("CPSC" or "Commission") regulates fireworks devices as household substances under the Federal Hazardous Substances Act ("FHSA") and the Consumer Product Safety Act ("CPSA").[8] Under its current regulations, the Commission has declared certain fireworks devices to be "banned hazardous substances."[9] There are various requirements that fireworks must meet to avoid being classified as "banned hazardous substances." These regulations prohibit the use of certain chemicals in fireworks devices, as well as specify performance and design requirements for the fuses, bases, pyrotechnic chambers, and handles and spikes.[10] Additional regulations prescribe specific warning labels for a variety of fireworks devices.[11] Finally, the Commission's regulation also provides exemptions from full labeling for special circumstances and minor hazards associated with some fireworks, and based upon meeting requirements from classification as "a banned hazardous substance."[12]

[8] 15 U.S.C. §§ 1261-1278.
[9] 16 C.F.R. §§ 1500.17(a)(3), (8), (9), (11) and (12).
[10] 16 C.F.R. part 1507.
[11] 16 C.F.R. § 1500.14(b)(7).
[12] 16 C.F.R § 1500.83(a)(27) and 16 C.F.R. § 1500.85(a)(2).

Staff completed a full rule review of the current fireworks regulations issued under the FHSA in accordance with the CPSC Fiscal Year 2015 Operating Plan. Staff considered the goals set forth in Executive Orders ("E.O.s") 13563 and 13579 (E.O. 12866 supplements and reaffirms E.O. 13563) and, in doing so, seeks to improve the current regulations for protecting "public health, welfare, safety, and our environment" by identifying and recommending the "best, most innovative and least burdensome tools" for compliance and enforcement.

I. Background

Before the formation of the CPSC, fireworks regulations were administered by the U.S. Food and Drug Administration ("FDA"). On May 14, 1973, the CPSC assumed responsibility for and administration of the FHSA, and on September 27, 1973, the Commission transferred the existing fireworks regulations under the FHSA from 21 C.F.R. parts 191 and 191b to 16 C.F.R. part 1500. Thereafter, the CPSC has promulgated additional requirements for fireworks devices, including labeling (§ 1500.14(b)(7)); pyrotechnic limits for firecrackers (§§ 1500.17(a)(8) and 1500.85(a)(2)); performance requirements for fireworks devices (part 1507), including reloadable tube aerial shell devices (§ 1500.17(a)(11)) and large multiple tube devices (§ 1500.17(a)(12)).

Since the promulgation of some of these regulations, new types of devices have been introduced into the market, and different types of explosive powders have replaced traditional black powder (charcoal, sulfur, and saltpeter) and flash powder (aluminum fueled chlorates or perchlorates).[13]

On July 12, 2006, CPSC issued an advance notice of proposed rulemaking ("ANPR"), discussing options and requesting comments regarding the fireworks regulations in 16 C.F.R. parts 1500 and 1507.[13] The ANPR presented several alternatives, including requiring mandatory certification to voluntary standards, issuing a mandatory standard specifying additional requirements fireworks devices must meet, and relying on voluntary standards or pursuing corrective actions under section 15 of the FHSA to further reduce the risk of injury associated with fireworks devices. Since then, staff researched methods to improve the fireworks regulations and published several memoranda on the work completed to date. This work included responding to public comments from the ANPR, evaluating new devices, and specific research focused on the composition and energetics of the break charge of fireworks devices intended to produce audible effects.[14,15, and 16]

For this rule review, staff considered CPSC-researched methods, current technology, market information, compliance and injury data, as well as applicable international and voluntary

[13] 71 Fed. Reg. 39249 (July 12, 2006).
[14] Christopher Musto & Andrew Lock, Consumer Product Safety Commission, "FY 2012 Fireworks Safety Standards Development Status Report" (2013).
[15]Christopher Musto, Consumer Product Safety Commission, "Fireworks Safety Standards Status Report" (2011).
[16] Christopher Musto & Andrew Lock, Consumer Product Safety Commission, "Fireworks Safety Standards Development Project FY 2013 Status Report" (2013).

standards for the possible improvement of existing mandatory fireworks regulations. The two main international standards are the European Standard, EN 15947-1–15947-5: Pyrotechnic Articles—Fireworks, Categories 1, 2, and 3 ("European Standard"), and the American Pyrotechnics Association Standard 87-1: Standard for Construction and Approval for Transportation of Fireworks, Novelties, and Theatrical Pyrotechnics ("APA 87-1"). The U.S. Department of Transportation ("DOT") regulates the transportation of fireworks and requires compliance with APA 87-1 when approving the transportation of display and consumer fireworks.

The American Fireworks Standards Laboratory ("AFSL") developed voluntary standards and a certification for consumer fireworks that incorporate the CPSC and DOT regulations. The AFSL standard has a number of requirements developed by the AFSL that are in addition to CPSC and DOT requirements. AFSL is a non-profit corporation established by members of the fireworks industry to: (i) develop and maintain voluntary safety and quality standards for fireworks, (ii) assist manufacturers in improving safety and quality in fireworks, and (iii) provide a testing and certification program to determine which fireworks comply with AFSL standards. The AFSL standards committee is appointed by the AFSL board and comprised of technical experts; representatives that manufacture, import, distribute or retail fireworks; federal and state agencies that regulate the safety of fireworks, the insurance industry; and consumers.[17] It is important to note that while CPSC attends AFSL standards committee meetings and offers input, CPSC staff does not have a vote on the board.

Staff considered APA 87-1, in particular, because the DOT incorporates this standard into its regulations, thereby requiring consumer fireworks that are to be transported in the United States legally to comply with the standard.[18] APA was established in 1948 and currently, APA membership includes nearly 85 percent of industry, which includes domestic and international importers and distributors of consumer and display fireworks.[19] APA's mission is to "encourage safety in design and use of all types of fireworks, provide industry information and support to its members, and to promote responsible regulation of the fireworks industry."[20] APA board is elected by the APA members and APA works in conjunction with the DOT, its members and code development organizations such as the National Fire Protection Association to develop their standard and ensure "standards are not overly burdensome or restrictive to the fireworks industry".[21]

Staff also considered the AFSL and the European Standards because, like APA 87-1, those standards are widely used by industry. AFSL estimates AFSL members represent 85 percent to 90 percent of all U.S. fireworks importers,[22] and each AFSL member agrees to test fireworks to the AFSL standard. Thirty-one countries around the world use the European Standard, which industry experts developed and which is based on APA 87-1.

[17] http://www.afsl.org/content/about-us.
[18] 49 C.F.R. § 173.65.
[19] http://www.americanpyro.com/assets/apamembershippresentationrev1.29.15pptx.pptx.
[20] http://www.americanpyro.com/assets/apamembershippresentationrev1.29.15pptx.pptx.
[21] https://pyro.memberclicks.net/benefits-of-membership
[22] http://www.afsl.org/content/about-us.

Executive Order ("E.O.") 13563, calls for agencies to "identify and use the best, most innovative and least burdensome tools for achieving regulatory ends." Staff has followed the Commission direction to recommend updates to the current CPSC regulations. Staff believes that aligning the CPSC regulations with the internationally recognized standards where appropriate would assist industry by clarifying applicable regulations and would assist in reducing compliance burdens by making applicable legal requirements more consistent among regulatory agencies.

II. Incident Data

Staff used primarily the 2013 Fireworks Annual Report[23] ("2013 Report") for this review and summary. According to the 2013 Report, CPSC staff received reports of eight non-occupational fireworks-related deaths during calendar year 2013. U.S. hospital emergency departments treated an estimated 11,400 fireworks-related injuries during the same year.

Staff obtained information of fireworks-related deaths from news clippings and other sources in the CPSC's Injury and Potential Injury Incident ("IPII") databases and the CPSC's Death Certificate File. Staff estimated fireworks-related injuries from the CPSC's National Electronic Injury Surveillance System ("NEISS"). To supplement the information available in these records, every year, during the month surrounding July 4th, staff conducts a special study of fireworks-related injuries. For 2013, staff completed this study between June 21, 2013 and July 21, 2013. This study provides a more detailed analysis of injuries, including the type of injury, the fireworks involved, how the injury occurred, and the medical treatment and prognosis. About 65 percent of the estimated annual fireworks-related injuries treated in emergency departments for 2013 occurred during this period.

Based on in-depth telephone investigations of some of the more severe fireworks incidents that occurred during the 1-month special study period, about half of the incidents investigated involved the misuse of fireworks devices. The other injuries resulted from malfunctioning devices. This is consistent with previous years' findings.

Additionally, according to the results from the special study of the 2013 incidents, children younger than 15 years of age accounted for approximately 40 percent of the estimated 2013 injuries.[24] Additionally the report states that an estimated 2,300 (31 percent of all injuries) injuries treated in emergency departments were associated with sparklers, consistent with previous years. The report adds that 11 percent of injuries were associated with firecrackers; reloadable shells and roman candles each accounted for 6 percent; and 4 percent of injuries were associated with bottle rockets. Additionally, similar to previous years, more than half of the

[23] Yongling Tu & Demar Granados, Consumer Product Safety Commission, "2013 Fireworks Annual Report" (2014).
[24] Yongling Tu & Demar Granados, Consumer Product Safety Commission, "2013 Fireworks Annual Report" (2014).

estimated injuries involved burns. Burns constituted the most frequent injury to all parts of the body, except the eyes, where contusions and lacerations occurred more frequently.[25]

III. Review of CPSC Fireworks Regulations

An in-depth review of the CPSC's fireworks regulations, arranged by the order in which the regulations appear in the Code of Federal Regulations ("C.F.R.") follows. The text from the C.F.R. is included before each section for discussion of the regulation and the team's recommendations to the Commission.

A. 16 C.F.R. § 1500.14 Products requiring special labeling under section 3(b) of the act

§ 1500.14(b)(7) Fireworks devices

(b) The Commission finds that the following substances present special hazards and that, for these substances, the labeling required by section 2(p)(1) of the act is not adequate for the protection of the public health. Under section 3(b) of the act, the following specific label statements are deemed necessary to supplement the labeling required by section 2(p)(1) of the act:
(7) Fireworks devices. Because of the special hazards presented by fireworks devices if not used in a certain manner, the following listed fireworks devices shall be labeled as indicated:

(i) Fountains.

WARNING (OR CAUTION)
FLAMMABLE (or EMITS SHOWERS OF SPARKS, if more descriptive).
Use only under [close] adult supervision. (Use of the word close is optional.)
For outdoor use only.
Place on level surface.
Light fuse and get away.

(ii) California candles.

WARNING (or CAUTION) EMITS SHOWERS OF SPARKS
Use only under [close] adult supervision. (Use of the word close is optional.)
For outdoor use only.
Hold in hand at bottom of tube.
Point away from body so that neither end points toward body.

(iii) Spike and handle cylindrical fountains.
(A) Spike fountains.

WARNING (OR CAUTION) EMITS SHOWERS OF SPARKS
Use only under [close] adult supervision. (Use of the word close is optional.)
For outdoor use only.
Stick firmly in ground in an upright position.

[25] Yongling Tu & Demar Granados, Consumer Product Safety Commission, "2013 Fireworks Annual Report" (2014).

Do not hold in hand.
Light fuse and get away.

(B) Handle fountains.

WARNING (OR CAUTION) EMITS SHOWERS OF SPARKS

Use only under [close] adult supervision. (Use of the word close is optional.)
For outdoor use only.
Hold in hand—point away from body.
Light fuse.

(iv) Roman Candles.

WARNING (OR CAUTION) SHOOTS FLAMING BALLS

Use only under [close] adult supervision. (Use of the word close is optional.)
For outdoor use only.
Stick butt end in ground.
Do not hold in hand.
Light fuse and get away.

(v) Rockets with sticks.

WARNING (OR CAUTION) FLAMMABLE

Use only under [close] adult supervision. (Use of the word close is optional.)
For outdoor use only.
Place in wooden trough or iron pipe at 75° angle, pointing away from people or flammable material.
Do not hold in hand.
Light fuse and get away.

(vi) Wheels.

WARNING (OR CAUTION) FLAMMABLE (OR EMITS SHOWERS OF SPARKS, IF MORE DESCRIPTIVE)

Use only under [close] adult supervision. (Use of the word close is optional.)
For outdoor use only.
Attach securely by means of a nail through the hole (or place on hard flat surface, for ground spinners).
Light fuse and get away.

(vii) Illuminating torches.

WARNING (OR CAUTION) FLAMMABLE (OR EMITS SHOWERS OF SPARKS, IF MORE DESCRIPTIVE)

Use only under [close] adult supervision. (Use of the word close is optional.)
For outdoor use only.
Hold in hand—point away from body, clothing, or other flammable material (or place upright on level ground. Do not hold in hand, if more descriptive).
Light fuse (or light fuse and get away, if more descriptive).

(viii) Sparklers.

On the front and back panels*:*

WARNING (OR CAUTION) FLAMMABLE

On the side, front, back, top, or bottom panel.

CAUTION

Use only under [close] adult supervision. (Use of the word close is optional.)
For outdoor use only.
Do not touch glowing wire (or do not touch hot plastic, wood, etc., if more descriptive).
Hold in hand with arm extended away from body.
Keep burning end or sparks away from wearing apparel or other flammable material.

(ix) Mines and shells.

WARNING (OR CAUTION) EMITS SHOWERS OF SPARKS (OR SHOOTS FLAMING BALLS, IF MORE DESCRIPTIVE)

Use only under [close] adult supervision. (Use of the word close is optional.)
For outdoor use only.
Place on hard smooth surface (or place upright on level ground, if more descriptive).
Do not hold in hand.
Light fuse and get away.

(x) Whistles without report.

WARNING (OR CAUTION) FLAMMABLE

SHOOTS WHISTLE IN AIR (if applicable)
Use only under [close] adult supervision. (Use of the word close is optional.)
For outdoor use only.
Do not hold in hand.
Light fuse and get away.

(xi) Toy smoke devices and flitter devices.

WARNING (OR CAUTION) FLAMMABLE (OR EMITS SHOWERS OF SPARKS, IF MORE DESCRIPTIVE)

Use only under [close] adult supervision. (Use of the word close is optional.)
For outdoor use only.
Do not hold in hand.
Light fuse and get away.

(xii) Helicopter-type rockets.

WARNING (OR CAUTION) FLAMMABLE (OR EMITS SHOWERS OF SPARKS, IF MORE DESCRIPTIVE)

Use only under [close] adult supervision. (Use of the word close is optional.)
For outdoor use only.
Place on hard, open surface.
Light fuse and get away.

(xiii) Party poppers.

WARNING (OR CAUTION) FLAMMABLE

Use only under [close] adult supervision. (Use of the word close is optional.)
Do not point either end toward face or other person.

Hold in hand—jerk string.

(xiv) Missile-type rockets.

WARNING (OR CAUTION) FLAMMABLE (OR EMITS SHOWERS OF SPARKS, IF MORE DESCRIPTIVE)
Use only under [close] adult supervision. (Use of the word close is optional.)
For outdoor use only.
Place on hard, open surface.
Light fuse and get away.

(xv) Labeling—General. Any fireworks device not required to have a specific label as indicated above shall carry a warning label indicating to the user where and how the item is to be used and necessary safety precautions to be observed. All labels required under this section shall comply with the requirements of § 1500.121 of these regulations. (See also § 1500.17(a) (3), (8) and (9); § 1500.83(a)(27); § 1500.85(a)(2); and part 1507).

Section 1500.14 lists the minimum labeling requirements for certain fireworks devices. Some newer fireworks devices do not appear on the list because these devices entered the market after CPSC promulgated the rule. Additionally, when the CPSC issued the regulation, the agency did not include specific labeling for firecrackers, indicating that labeling "should be the subject of further study."[26] All fireworks devices that are not specifically listed in the C.F.R. are currently covered by 16 C.F.R. § 1500.14(b)(7)(xv), which requires any consumer fireworks device not listed to indicate to the user where and how the item is to be used and necessary safety precautions that need to be observed.

Staff recognizes that listing every type of device in the regulation is not practical because there are many types of novelty devices, and the list would be too extensive. In addition, many of the devices are a combination of multiple types of devices (*e.g*., mine shells with fountain effects), which complicates labeling. Further, the types of fireworks devices are likely to continue to evolve over time.

During the rule review, staff reviewed the internationally recognized standards (APA 87-1 and the European Standard), as well as the AFSL voluntary standard to determine if there was a better way to address labeling. Staff found differences between the CPSC regulation and the standards reviewed both in the specific warning labels and the types of devices that are listed.

The European Standard separates fireworks devices into three categories based on the hazard presented, the noise level and location of intended use. Labeling requirements and minimum age limits for use are assigned by category. The European Standard sets out detailed label requirements for over 40 specifically-identified types of fireworks; in some instances the same type of firework may have a different label depending on the category assigned making a direct comparison to the CPSC regulation difficult. Additional major differences between the CPSC regulation and the European Standard are the additional devices listed (some of which are not used in the United States), a specific distance that the spectator and/or lighter should retreat

[26] 41 Fed. Reg. 9512, 9522 (Mar. 4, 1976).

to, statements to avoid overhead obstructions, specifically listing to not use in windy conditions, and statements to avoid inhaling the smoke from devices.

APA 87-1 references the FHSA when referring to labeling. APA lists specific devices and a recommended labeling for each of those devices. The APA-recommended labeling matches the CPSC regulation. However, the APA lists additional devices that are not specifically spelled out in the CPSC regulation: firecrackers, ground spinners, chasers, snakes, snappers, booby traps (pulling fireworks), aerial shells with separate mortar tubes (with and without reports) and a few novelty devices. These devices are instead covered in the CPSC regulation by the general labeling requirement.

The AFSL has detailed labeling requirements for each device. For comparison, while the CPSC regulation specifically lists 15 different precautionary labels and the European Standard prescribes over 50 precautionary labels, the AFSL has nearly 100 different precautionary labels covering different variations of similar devices. There are some specific labeling recommendations in the AFSL standard that go above the precautions that are listed in the CPSC requirement. For example, sparklers in the AFSL standard require the additional warning statements "hold and light only one device at a time" and "after use place wire/wood in water". As another example mine and shell devices have the additional statements "never relight a fuse that fails to ignite the device" as well as "never have any part of your body over the device when lighting the fuse".

Staff needs additional information to determine if changes are needed, and if so, what precise changes should be made to the warning labels of existing devices, as well as the types of devices specifically mentioned in the current regulation. Some options for changes to the current regulatory provisions include: updating the list of devices to include the current most commonly used fireworks devices; removing references to specific devices, relying instead on the more broadly worded general labeling requirement; and/or updating the specific labels on devices known to cause injuries. Should the Commission decide to revise the labeling requirements, staff recommends public comment on how to achieve more consistency in labeling, what, if any, devices should be added to or removed from the current list, and if labeling changes could be made to address common fireworks incidents indicated in the incident data.[27]

B. 16 C.F.R. § 1500.17 Banned hazardous substances

1. § 1500.17(a)(3)

(a) Under the authority of section 2(q)(1)(B) of the act, the Commission declares as banned hazardous substances the following articles because they possess such a degree or nature of hazard that adequate cautionary labeling cannot be written and the public health and safety can be served only by keeping such articles out of interstate commerce:

[27] Yongling Tu & Demar Granados, Consumer Product Safety Commission, "2013 Fireworks Annual Report" (2014).

(3) Fireworks devices intended to produce audible effects (including but not limited to cherry bombs, M-80 salutes, silver salutes, and other large firecrackers, aerial bombs, and other fireworks designed to produce audible effects, and including kits and components intended to produce such fireworks) if the audible effect is produced by a charge of more than 2 grains of pyrotechnic composition . . ..

Discussion that follows on § 1500.17(a)(3) will be separated into three sections. First, a discussion of "fireworks devices intended to produce an audible effect…" then discussion of large banned firecrackers and, finally a discussion of "aerial bombs".

A. Devices intended to produce an audible effect

As presented above, § 1500.17(a)(3) bans a fireworks device that is "intended to produce audible effects" if the audible effect is produced by a charge of more than 2 grains (130 milligrams) of pyrotechnic composition. In upholding § 1500.17(a)(3) against legal challenge, the federal court referred to this particular test as "the amount test," reflecting the objective character of the standard.[28] In yet another legal challenge where this rule was upheld, the court stated that "[t]he limit of two grains of pyrotechnic powder in 16 C.F.R. § 1500.17(a)(3) applicable to all fireworks devices producing an audible effect provides reasonable and fair notice of what [companies] may not distribute to consumers."[29]

Fireworks devices are field tested in accordance with the "Consumer Fireworks Testing Manual."[30] Fireworks devices that are not intended to produce an audible effect have no restriction on pyrotechnic composition. Although all devices produce an audible effect, not all audible effects are intentional. For example, fireworks devices such as tube mortars and mine shells may produce visible effects and the audible effect heard is a byproduct of the explosion of the break charge required to disperse those visual effect elements. As such, determining whether an aerial device is "intended to produce an audible effect" requires years of training and expertise. CPSC possesses decades of experience in determining whether a device is intended to produce an audible effect that is subject to this regulation.

CPSC has not updated § 1500.17(a)(3) since its adoption many decades ago. Since the promulgation of this rule industry has moved away from black powder as the break charge in fireworks devices, and instead, sometimes uses hybrid powders. These hybrid powders, depending on the construction of the shell, packing density, and quantity of powder, in some cases, might produce an audible effect; while in other cases, the sound produced is incidental to the necessary function of dispersing the visual effects. In the case when the sound is incidental to the dispersion of visual effects, the requirement in §1500.17(a)(3) does not apply and no CPSC regulation regulates the quantity of explosive composition

Between October 2005 and October 2014, staff identified 495 violations regarding overload (16 C.F.R. 1500.17(a)(3)), the highest of any CPSC fireworks regulation requirement

[28] *United States v. Shelton*, 34 F. Supp.2d 1147 (W.D. Mo. 1999).
[29] *United States v. Midwest Fireworks Mfg. Co.*, 248 F.3d 563 (6th Cir. 2001).
[30] (https://www.cpsc.gov/PageFiles/121068/testfireworks.pdf).

during this same timeframe. This noncompliance resulted in the violation of more than $2 million worth of products in the past 10 years.[31] This estimated value is likely low due to the fact that the database only shows lot values indicated by the importer. Sixteen out of the 495 violations show "$0.00" as the import value. Note that $2 million does not represent retail value of product.

To determine "intent to produce an audible effect," CPSC staff listens to the device during field testing, and based on the sound, determines whether the applicable "loud report" was observed. If staff hears a "loud report," staff considers the fireworks device "intended to produce an audible effect"; and the break charge (which causes the audible effect) less than 100-mesh in particle size is limited to 2 grains (130 milligrams).[32] Staff examines the shell and weighs the break charge to determine compliance with the regulatory limits. A device only fails this requirement if the pyrotechnic material exceeds 2 grains (130mg).

Over the years, CPSC staff extensively trained the fireworks industry to help improve the consistency of this testing protocol.[33] However, because all fireworks devices produce an audible effect it is difficult to determine if that audible effect was intentional or necessary for the functioning of the device. Fireworks devices tend to be handmade, devices that are intended to be identical often don't produce the same audible effect. The amount of powder, effects, shell width and height, often vary greatly within devices from the same manufacturer and lot.

To find an alternative approach that might more effectively address all devices rather than just those "intended to produce an audible effect", over the last 4 years, CPSC staff has researched a method that would test the energetics of the break charge to see if there is a correlation between energetics and injuries. This test method involved "whole shell testing," in which the shell is detonated and the pressure created is measured. These test methods have not produced reliable results and would create a burden on CPSC and industry, due to the complex nature of the testing required and the data analysis that follows. Although staff observed differences in pressure, staff could not find a correlation between a specific pressure released and injury potential.[34]

In considering the review of "fireworks devices intended to produce an audible effect" used in 16 C.F.R. 1500.17(a)(3), staff reviewed analogous standards. The international standards (APA 87-1 and the European Standard), as well as the AFSL voluntary standard, were considered. Significantly, like the current CPSC standard, all standards address audible effects. Table 1 summarizes the major differences between the standards and the CPSC regulation.

[31] Lot values from CPSC database were used. Lot values represent what the importer declares the value of the shipment is.
[32] Consumer Product Safety Commission, "Consumer Fireworks Testing Manual" (Aug. 17, 2006).
[33] Christopher Musto & Andrew Lock, Consumer Product Safety Commission, "FY 2012 Fireworks Safety Standards Development Status Report" (2013).
[34] Christopher Musto & Andrew Lock, Consumer Product Safety Commission, "FY 2012 Fireworks Safety Standards Development Status Report" (2013).

Table 1
Audible Effect Regulations in Voluntary Standards compared to CPSC Regulations

APA 87-1	AFSL Standard	CPSC Regulation	European Standard
States that "any burst charge containing metallic powder (such as magnalium or aluminum) less than 100 mesh in particle size, is considered to be intended to produce an audible effect, and is limited to 130mg in 1.4G fireworks devices" Additionally states that "burst charge consisting of black powder or equivalent non-metallic composition is not considered to be intended to produce an audible effect when it is used to expel and ignite a secondary effect in a fireworks device."	Break charge must consist of "black powder or equivalent" (non-metallic fuel or demonstrated by empirical testing data that it is equivalent in performance to black powder.)	Limits fireworks devices intended to produce an audible effect to not more than 130mg of pyrotechnic composition. Tests for "intent to produce audible effect" during field testing by listening to the device.	For report and/or bursting charges, the net explosive content is limited to the amount of black powder or the amount of nitrate/metal-based report composition or the amount of perchlorate/metal based report composition. These limitations vary based on type of device.
Limits on total chemical and pyrotechnic material for all fireworks devices	Limits on total chemical and pyrotechnic material for all fireworks devices	Current CPSC regulations only provide pyrotechnic limits for firecrackers (50mg) and for "devices intended to produce audible effects"	Limits on total chemical and pyrotechnic material for all fireworks devices (some devices are different than what are used in the United States)
Limits the ratio of break charge to effects for mine and shell devices as well as aerial shells at "25% of the total weight of chemical composition in the component/shell"	Limits the ratio of break charge to effects for large (greater than 1 inch) mine and shell devices at "25% by weight of the chemical composition of the tube or 10	Current CPSC regulations do not provide a ratio of break charge to effects.	Limits total pyrotechnic weight for report charges containing nitrate at 40% of black powder limit or limits perchlorate based report charges at 20% of black powder limit

(respectively)	grams, whichever is less" small devices (1 inch or less) are limited to '50% by weight of the chemical composition of the tube or 10 grams, whichever is less" Aerial shells are limited to "35% by weight of the chemical composition of the shell or 10 grams, whichever is less"		

As can be seen in the chart above, CPSC is not unusual in limiting pyrotechnic material for audible effects. The particular language used in the regulation, specifically, the words "devices intended to produce an audible effect" could be updated to better address all devices currently on the market instead of just those intended to produce an audible effect. Additionally, guidance on what devices are deemed "intended to produce audible effects" could be better addressed. The European Standard, the AFSL standard and the APA standard all address audible effects through limits in the chemical composition of break charges. They not only limit the amount of pyrotechnic composition like the CPSC, but the chemical composition as well. It should be noted that "reports" are analogous to "audible effects". Staff believes the regulation could be improved by updating the language in the CPSC regulation to better align with the international consensus standard. Instead of pyrotechnic limits only applying to "devices intended to produce audible effects" as is with the current regulation, limiting the chemical composition in the break charge for report charges and the total pyrotechnic material of devices would incorporate all devices.

Except in the CPSC regulation all standards consider the use of metallic fuel in the break charge as intended to produce a report and henceforth have a stricter limit than black powder. This is likely because the addition of metallic fuels transforms the explosive from primary to secondary, meaning that the explosive with metallic fuel is more energetic per volume than the explosive without metallic fuel. Additionally, the AFSL and APA 87-1 limit the ratio of break charge to effects. This is important because if a shell consisted of too much break charge to effects the effects could disperse farther and cause flaming debris. Staff believes that by examining the shell and examining the chemical composition of the break charge, in addition to the amount of pyrotechnic composition in all devices, this would be a more reliable and repeatable method for determining "intent to produce an audible effect" than the current method of listening to the device. This is due to the fact that determining a "loud report" by listening takes more training and is less repeatable than an analytical examination if metallic fuel was used.

As noted, companies currently must adhere to APA 87-1 to transport display and consumer fireworks in the U.S. Although the AFSL standard is similar, adopting the particular language in APA 87-1 would be more appropriate since CPSC would more closely align with the DOT regulations. The European Standard language is difficult to incorporate due to the fact that the European Standard separates fireworks into different categories than the U.S. does and the types of devices are unique to Europe and do not necessarily correlate with devices common in the U.S.

To reiterate, the APA 87-1 states that "any burst charge containing metallic powder (such as magnalium or aluminum) less than 100 mesh in particle size, is considered to be intended to produce an audible effect, and is limited to 130mg in 1.4G fireworks devices." It should be noted that the 130mg limit (2 grains) is the same as the current CPSC limit. The difference is that the language in APA specifically addresses the fact that some chemical compositions of explosives (those containing metallic fuel) are more energetic per volume than those that do not contain metallic fuel. Additionally, APA 87-1 states that "burst charge consisting of black powder or equivalent non-metallic composition is not considered to be intended to produce an audible effect when it is used to expel and ignite a secondary effect in a fireworks device." APA 87-1 also limits the total pyrotechnic and chemical composition, as well as the ratio of effects to break charge to 25%.

The European Standard, the AFSL Standard and APA 87-1 all limit the total pyrotechnic weight of all fireworks devices regardless of the device producing a report. This is important since the energetic power of the device is directly related to the amount of pyrotechnic material in the device. Depending on the type of device, a different limit applies. Staff believes that a limit on the total pyrotechnic weight in all devices (not only those intended to produce an audible effect) is an important component missing in the CPSC regulation since all fireworks have the potential of creating an injury, not only those intended to produce an audible effect.

Since companies must adhere to the DOT limits of pyrotechnic composition and weights in order to transport fireworks in the Unites States, staff believes that adopting the APA 87-1 provisions would provide minimal economic burden to industry. Currently industry must comply both with the CPSC regulation and APA 87-1. Adopting these limits will make testing easier and administration of the regulation simpler (see Tab C for further analysis). Under APA 87-1, each type of device has its own pyrotechnic and chemical limit. Staff recommends the addition of these specific limits into the CPSC regulation.

The APA limits for aerial devices are listed below:[35]

A) *Sky Rockets, Bottle rockets, Missile-type rockets, Helicopter (aerial spinners), Roman Candles*: Limited to no more than 20 grams of chemical composition.
B) *Mine and Shell devices*: Total chemical composition is limited to no more than 60 grams per shell. Total chemical composition of multiple tube devices must not exceed 200 grams unless the tubes are securely attached to a wood or plastic base and the tubes are separated from each other on the base by a distance of at least

[35] Definitions of relevant terms are included in section III. F. in this briefing package.

0.50 inches (12.7mm) in which case no more than 500 grams of total chemical composition is allowed. Lift charge is limited to a maximum allowance of 20 grams per shell. Lift charge is limited to black powder (potassium nitrate, sulfur, and charcoal) or similar pyrotechnic composition without metallic fuel. The maximum amount of burst charge should not exceed 25% of the total weight of chemical composition in the component. Although not explicitly clear in the APA standard, CPSC staff considers that the 25 percent limit excludes the lift charge because it is not part of "the component" that subsequently bursts in the air.

C) *Aerial Shell with reloadable tube*: Limited to no more than 60 grams per shell. Lift charge is limited to a maximum allowance of 20 grams per shell. Lift charge is limited to black powder (potassium nitrate, sulfur, and charcoal) or similar pyrotechnic composition without metallic fuel. The maximum amount of burst charge should not exceed 25 percent of the total weight of chemical composition in the component. (Although not explicitly clear in the APA standard, CPSC staff considers that the 25 percent limit excludes the lift charge because it is not part of "the component" that subsequently bursts in the air. The total chemical composition of all the shells in the kit must not exceed 400 grams.

CPSC staff conducted research to determine whether industry is complying with the APA 87-1 definition of "intent to produce audible effect," as well as the pyrotechnic limits the standard imposes, to see if there was any correlation between the CPSC test method and the APA 87-1 test method and to see if there was substantial compliance with the standard. The results of this research are included in the LSC memorandum of this briefing package (Tab B). It is important to note that sample size was limited so definitive conclusions on industry compliance cannot be made at this time. However, due to the advance notice of any changes, sufficient time for industry compliance would be provided.

Staff tested 42 Fiscal Year ("FY") 2014 and FY 2015 compliance fireworks samples. Of the 42 devices tested, 12 were reloadable tube mortar devices and 30 were mine and shell devices. The 42 devices were selected at random. No shell contained more than the 20-gram limit of lift charge or the 60-gram limit of total pyrotechnic composition. Of the 30 multiple tube and mine and shell devices, six contained a total pyrotechnic composition limit greater than the allowed 200 grams or 500 grams (APA 87-1 section 3.1.2.5), depending on the base construction. Three of these violations were only by a small margin. Two reloadable tube aerial devices had a break charge-to-effect ratio of greater than 25 percent; eight of the 30 mine and shell devices violated of this ratio.

As mentioned previously, APA 87-1 defines "break charge containing metallic fuel less than 100 mesh" as "intended to produce an audible effect," thus limiting the break charge to 2 grains (130 milligrams). Staff further analyzed the devices for elemental composition using X-Ray Fluorescence spectroscopy ("XRF") to see if any break charges contained metallic fuel. Twenty-five of the 32 devices tested contained detectable quantities of aluminum, and all of these devices contained break charges in excess of 2 grains (130 milligrams), thus violating APA 87-1. Staff did not quantify results; therefore the extent of the violations that occurred is unknown. Staff recognizes that trace amounts of aluminum do not necessarily indicate an intention to use aluminum as a fuel; rather, trace amounts of aluminum may suggest incidental

contamination. If the APA 87-1 Standard for burst charge is adopted by CPSC, staff recommends working with the public to determine what contamination level is appropriate for metal powder presence in break charges exceeding 2 grains (130 milligrams). As explained later, creating an allowable limit for trace contamination would reduce the burden on industry and the CPSC.

To summarize, staff recommends replacing "intent to produce audible effect" with the APA burst charge requirement that any burst charge containing metallic powder (such as magnalium or aluminum) less than 100 mesh in particle size be limited to 130mg, as well as incorporate APA pyrotechnic and chemical composition limits for all fireworks devices. Additionally, staff recommends obtaining public input on appropriate contamination level for metal powder presence in break charges exceeding 2 grains (130mg).

B. Mention of cherry bombs, M-80 salutes, silver salutes and other large firecrackers

Section § 1500.17(a)(3) incudes mention of , "cherry bombs, M-80 salutes, silver salutes, and other large firecrackers". . .." These are all large firecrackers that were banned by CPSC. Firecrackers have a stricter limit of 0.772 grains of pyrotechnic composition in § 1500.17(a)(8). As explained later in the briefing package, staff does not recommend any changes to firecrackers. However, the reference to firecrackers should be removed from § 1500.17(a)(3) and moved to § 1500.17(a)(8) to avoid confusion.

C. Aerial Bombs

The term "aerial bomb" used in § 1500.17(a)(3) is not defined by the CPSC, the AFSL, the APA, or the European Standard. The language in § 1500.17(a)(8) indicates that "aerial bombs" are banned hazardous substances, without specifying a pyrotechnic limit. In § 1500.17(a)(3), the language indicates that aerial bombs have a 2-grain (130 milligram) limit. Staff needs further information to determine if § 1500.17(a)(8) or if § 1500.17(a)(3) is the appropriate location for aerial bombs. Staff recommends seeking public comment regarding these devices; what, if any, injuries are associated with them; and whether aerial bombs should be banned or limited to 2 grains of metallic fuel or continued to be included in both sections.

2. § 1500.17(a)(8)

(a) Under the authority of section 2(q)(1)(B) of the act, the Commission declares as banned hazardous substances the following articles because they possess such a degree or nature of hazard that adequate cautionary labeling cannot be written and the public health and safety can be served only by keeping such articles out of interstate commerce:
(8) Firecrackers designed to produce audible effects, if the audible effect is produced by a charge of more than 50 milligrams (.772 grains) of pyrotechnic composition (not including firecrackers included as components of a rocket), aerial bombs, and devices that may be confused with candy or other foods, such as "dragon eggs," and "cracker balls" (also known as "ball-type caps"), and including kits and components intended to produce such fireworks…

As cited above, § 1500.17(a)(8) applies a limit of 50 milligrams (.772 grains) of pyrotechnic composition to firecrackers that are "designed to produce audible effects." The

language used in this regulation differs slightly, but significantly from the language in § 1500.17(a)(3).Because firecrackers do not have any pyrotechnic effects and only produce an audible effect while functioning, all firecrackers are limited to 50 milligrams of pyrotechnic composition. However, the language, as written, is unclear because this section mentions "aerial bombs." The phrase "aerial bomb" suggests that the limit applies to aerial-type devices, when they have a less stringent limit of 2 grains, rather than 0.772 grains. As mentioned previously, the term "aerial bomb" is not defined by the CPSC, the AFSL, the APA, or the European Standard. The language in § 1500.17(a)(8) indicates that "aerial bombs" are banned hazardous substances regardless of pyrotechnic limit. In § 1500.17(a)(3), the language indicates aerial bombs have a 2-grain (130 milligram) limit. Staff needs further information to determine if § 1500.17(a)(8) or if § 1500.17(a)(3) is the appropriate location for aerial bombs. To clarify the requirements, staff recommends removing the term "aerial bomb" from either § 1507.17(a)(3) or § 1507.17(a)(8). Staff recommends seeking public comment regarding these devices to determine what, if any, injuries are associated with aerial bombs, and whether aerial bombs should be banned or limited to 2 grains of metallic fuel. Staff does not recommend any changes to the substantive requirements for firecrackers, only that the language in 16 C.F.R. § 1500.17(a)(8) be clarified.

3. § 1500.17(a)(9)

(a) Under the authority of section 2(q)(1)(B) of the act, the Commission declares as banned hazardous substances the following articles because they possess such a degree or nature of hazard that adequate cautionary labeling cannot be written and the public health and safety can be served only by keeping such articles out of interstate commerce:
(9) All fireworks devices, other than firecrackers, including kits and components intended to produce such fireworks, not otherwise banned under the act, that do not comply with the applicable requirements of part 1507 of this chapter, except fireworks devices which meet all the following conditions:
(i) The fireworks devices are distributed to farmers, ranchers, or growers through a wildlife management program administered by the U.S. Department of the Interior (or by equivalent State or local government agencies); and
(ii) Such distribution is in response to a written application describing the wildlife management problem that requires use of such devices, is of a quantity no greater than required to control the problem described, and is where other means of control is unavailable or inadequate. (See also §1500.17(a) (3) and (8)).

The FDA transferred this section of the fireworks regulations cited above to the CPSC in 1974.[36] As part of the current review, CPSC staff determined no changes are needed to this section.

4. § 1500.17(a)(11)(i)

(a) Under the authority of section 2(q)(1)(B) of the act, the Commission declares as banned hazardous substances the following articles because they possess such a degree or nature of

[36] 39 Fed. Reg. 17435 (May 16, 1974).

hazard that adequate cautionary labeling cannot be written and the public health and safety can be served only by keeping such articles out of interstate commerce:
(11)(i) Reloadable tube aerial shell fireworks devices that use shells larger than 1.75 inches in outer diameter and that are imported on or after October 8, 1991. . ..

The Commission promulgated § 1500.17(a)(11) in 1991.[37] Substantial injuries occurred with large aerial shells, which formed the basis for regulatory action. The Commission voted to prohibit these aerial shells from the market to protect consumers from the risk of serious injury. Staff has seen substantial compliance with this regulation. Violations of this section of the C.F.R. are recorded as "other violations" by compliance staff and are grouped with a number of other regulatory violations. Between October 2005 and February 2015 there have been 67 violations in this "other violations category, only some of which pertain to this regulation. This accounts for less than 5 percent of the total fireworks violations in this time period.[38]Staff believes that this regulation remains effective at reducing injuries, and staff recommends that the Commission maintain this regulation with no modifications.

5. § 1500.17(a)(12)(i)

(a) Under the authority of section 2(q)(1)(B) of the act, the Commission declares as banned hazardous substances the following articles because they possess such a degree or nature of hazard that adequate cautionary labeling cannot be written and the public health and safety can be served only by keeping such articles out of interstate commerce:
(12)(i) Large multiple-tube devices. Multiple-tube mine and shell fireworks devices that first enter commerce or are imported on or after March 26, 1997, that have any tube measuring 1.5 inches (3.8 cm) or more in inner diameter, and that have a minimum tip angle less than 60 degrees when tested in accordance with the procedure of §1507.12 of this part.…

The Commission promulgated section §1500.17(a)(12) in 1996.[39] At the time, staff conducted various studies to determine how to reduce the likelihood of a multiple tube mine and shell device from tipping over while functioning. Tip-overs are likely to cause substantial property damage, consumer injury, or death. In 1994 and 1995, more than 80 percent of mine and shell devices tested by staff in the field would tip over while functioning.[40] Through research, staff found that large multiple tube devices were less likely to tip over while functioning if they had a minimum tip angle of 60 degrees. Since promulgation of this rule, staff observed significantly fewer tip-overs of these devices during field testing. In 2014, less than 1 percent of these large multiple-tube devices tested on the field tipped over while functioning.[41] Additionally, most devices on the market to which this rule applies pass the 60-degree tip-over test. Between October 2005 and February 2015 there have been 65 tip-over violations. This number accounts for less than 5 percent of the total fireworks violations in this time period.[42]

[37] 56 Fed. Reg. 37831 (Aug. 9, 1991).
[38] Data supplied by CPSC Compliance staff.
[39] 61 Fed. Reg. 13084 (Mar. 26, 1996).
[40] 61 Fed. Reg. 13086 (Mar. 26, 1996).
[41] Data supplied by CPSC Compliance staff.
[42] Data supplied by CPSC Compliance staff.

This indicates substantial industry compliance with this regulation. Staff believes that this regulation remains effective at reducing the number of firework tip-over incidents. Accordingly, staff recommends that the Commission maintain this provision with no modifications.

C. 16 C.F.R. § 1500.83 Exemptions for small packages, minor hazards, and special circumstances

§ 1500.83(a)(27)

(a)The following exemptions are granted for the labeling of hazardous substances under the provisions of § 1500.82:
(27) Packaged fireworks assortments intended for retail distribution are exempt from section 2(p)(1) of the act (repeated in § 1500.3(b)(14)(i)), if:
(i) The package contains only fireworks devices suitable for use by the public and designed primarily to produce visible effects by combustion, except that small devices designed to produce audible effects may also be included if the audible effect is produced by a charge of not more than 2 grains of pyrotechnic composition;
(ii) Each individual article in the assortment is fully labeled and in conformance with the requirements of the act and regulations thereunder; and
(iii) The outer package bears on the main display panel (or panels), within the borders of a rectangle and in the type size specified in § 1500.121, the caution statement "WARNING—This assortment contains items that may be hazardous if misused and should be used only under adult supervision. IMPORTANT—Read cautions on individual items carefully." (See also § 1500.14(b)(7); § 1500.17(a) (3), (8) and (9); § 1500.85(a)(2); and part 1507).

This section of the fireworks regulations cited above was transferred to the CPSC from the FDA.[43] Section 1500.83(a)(27) provides a labeling exemption for fireworks assortments, which generally include different types of devices, such as sparklers, fountains, firecrackers, and aerial shells. This section in the regulation has not been updated to include the sections added to the C.F.R. after 1973, including the stricter limit for firecracker devices. Staff recommends that this section of the regulation, in accordance with E.O. 13563, be written in plain language so that the rule is easy to understand. Staff recommends clarifying and updating the language to be consistent with updates to the regulation.

If the recommendations to the Commission are accepted regarding the phrase "intended to produce an audible effect" versus "designed to produce an audible effect" in 16 C.F.R. § 1500.17(a)(3) and (a)(8), then staff suggests maintaining consistency and modify the language in § 1500.83(a)(27), as well, including consistently using the terms "designed" and "intended" to produce an audible effect.

The clarifications to this section of the regulation noted above would not add any additional requirements, and thus would not pose any additional burden on industry.

[43] 39 Fed. Reg. 17435 (May 16, 1974).

D. 16 C.F.R. § 1500.85 Exemptions from classification as banned hazardous substances

§ 1500.85(a)(2)

(a) The term banned hazardous substances as used in section 2(q)(1)(A) of the act shall not apply to the following articles provided that these articles bear labeling giving adequate directions and warnings for safe use:
(2) Firecrackers designed to produce audible effects, if the audible effect is produced by a charge of not more than 50 milligrams (.772 grains) of pyrotechnic composition. (See also § 1500.14(b)(7); § 1500.17(a) (3), (8) and (9); and part 1507).

This section of the regulation provides an exemption for firecrackers less than 50 milligrams. This exemption is implied by the language in 16 C.F.R. § 1500.17(a)(8). In keeping with E.O. 13563, staff recommends eliminating the redundancy by removing this provision from the C.F.R.

E. 16 C.F.R. part 1507 (Fireworks Devices)

1. § 1507.1 (Scope)

Part 1507 prescribes requirements for those fireworks devices (other than firecrackers) not otherwise banned under the act. Any fireworks device (other than firecrackers) which fails to conform to applicable requirements is a banned hazardous substance and is prohibited from the channels of interstate commerce. Any fireworks device not otherwise banned under the act shall not be a banned hazardous substance by virtue of the fact that there are no applicable requirements prescribed herein.

Section 1507.1 details the scope of the fireworks regulations. This section expressly states that firecrackers are exempt from part 1507. The Commission concluded in 1976 that the fusing requirements listed in § 1507.3 could not be applied to firecrackers without additional information to support such a requirement; hence the Commission's decision to exempt firecrackers from 1507.[44] In addition, there is an exemption for firecrackers because they generally contain a composition of chlorates and perchlorates, sulphur and aluminum powder (flash powder).[45] This would mean firecrackers violate the prohibited chemicals list in § 1507.2.

To clarify the statutory language and organize the regulations, staff recommends removing this exemption for firecrackers from all of part 1507 and instead, add the exemptions for firecrackers specifically to the sections from which they require it. For example, in the current fireworks regulations, firecrackers would require an exemption from all of § 1507.3 (Fuse Requirements), as well as an exemption from the prohibition of chlorates from § 1507.2 (Prohibited Chemicals). The remaining sections in part 1507 are not relevant to firecrackers; thus, there is no need to wholly exempt them from the part. Staff notes that this clarification of

[44] 41 Fed. Reg. 9512, 9520 (Mar. 4, 1976).
[45] 41 Fed. Reg. 9512, 9517 (Mar. 4, 1976).

the references to requirements for firecrackers will not add additional requirements for firecrackers. As such, this would pose no burden on industry.

Staff further believes that adding a specific definition for "firecrackers," as used in this section and throughout the regulation may be useful. Staff recommends that the Commission seek input from the public regarding the usefulness of defining this term, as well as the appropriateness of this example definition: Firecracker: Small, paper-wrapped or cardboard tube containing not more than 50 milligrams of explosive composition, those used in aerial devices may contain no more than 130 milligrams of explosive composition.

2. § 1507.2 (Prohibited Chemicals)

Fireworks devices shall not contain any of the following chemicals:
(a) Arsenic sulfide, arsenates, or arsenites.
(b) Boron.
(c) Chlorates, except:
(1) In colored smoke mixtures in which an equal or greater amount of sodium bicarbonate is included.
(2) In caps and party poppers.
(3) In those small items (such as ground spinners) wherein the total powder content does not exceed 4 grams of which not greater than 15 percent (or 600 milligrams) is potassium, sodium, or barium chlorate.
(d) Gallates or gallic acid.
(e) Magnesium (magnesium/aluminum alloys, called magnalium, are permitted).
(f) Mercury salts.
(g) Phosphorus (red or white). Except that red phosphorus is permissible in caps and party poppers.
(h) Picrates or picric acid.
(i) Thiocyanates.
(j) Titanium, except in particle size greater than 100-mesh.
(k) Zirconium.

Section 1507.2 contains a list of chemicals prohibited in fireworks devices. Certain chemicals in the regulation, such as arsenates and mercury salts, are classified as human carcinogens.[46] The other prohibited chemicals, boron, chlorates, gallates, magnesium, white phosphorus, magnesium, picric acid, titanium, and zirconium, were likely banned for manufacturing safety reasons due to spontaneous combustion and/or the occupational hazards associated with manufacturing and storage.[47]

[46] US EPA. 2000. Integrated Risk Information System (IRIS). Summary on Arsenic, Inorganic (7440-38-2). Available at: http://www.epa.gov/iris/.
[47] The FDA proposed the prohibition of these chemicals before the CPSC assumed responsibility for these regulations; the FDA's rationale for including these specific chemicals is not clear. See 39 Fed. Reg. 17435 (May 16, 1974).

As currently written, the regulation prohibits even trace amounts of the chemicals listed, making the testing and manufacturing of devices that comply with this requirement difficult and expensive. Instrumentation used to test for the presence of chemicals has improved greatly since 1974 when the CPSC promulgated the rule. As a result, trace amounts of chemicals that previously went undetected are now identified in tested samples. Furthermore, quantifying trace amounts of these chemicals involves substantial time and ample resources. Disproving even trace amounts of a chemical in a product becomes almost impossible because instrumentation can only quantify to parts per billion (ppb) and even parts per trillion (ppt), but not zero.

Allowing trace amounts of these chemicals would not give industry authority to add these chemicals into the manufacturing process purposely. Thus, consumer safety would not be affected by such a change. These chemicals are not intentionally introduced into the products through production methods, but are present in background levels in the environment. Complete removal of the chemicals from the end product would necessitate ensuring that they are not present in the environment during production. With additional information and public input, staff believes that setting an appropriate trace amount limit that would simultaneously protect consumers and account for the advances in technology is possible. For this reason, staff recommends allowing a reasonable amount of these chemicals as impurities. The intention is to clarify the current requirement to facilitate reasonable and cost-effective testing without posing any increase in risk.

In assessing an appropriate limit for trace contamination, staff considered the international standards (APA 87-1 and the European Standard) and the AFSL voluntary standard. The only standard that specified a level for trace contamination was APA 87-1. Although the AFSL standard considers allowance for trace contamination, the standard does not list a specific level. APA 87-1 sets the allowance for trace levels of prohibited chemicals at 0.25 percent, unless otherwise noted in the standard. Current analytical techniques, such as x-ray fluorescence ("XRF"), allow for detection at significantly lower levels. If the Commission accepts this recommendation, staff would request comments from the public to identify an appropriate limit for trace contamination that would not only protect consumer safety, but also reduce any burdens on industry.

As an example of the burdens CPSC and industry must overcome because there is no specific limit on trace allowances of prohibited chemicals, staff investigated the presence of titanium in some FY 2014 and FY 2015 compliance fireworks samples. Titanium metal that is 100-mesh or less in particle size is currently prohibited, according to 16 C.F.R. § 1507.2, APA 87-1 and the AFSL voluntary standard.

CPSC staff used x-ray fluoresce spectroscopy to test 32 devices (Tab B). Although nearly every device contained detectable quantities of titanium, only three out of the 32 devices tested (9 percent) contained titanium at greater than 2,500 ppm (0.25 percent). Most titanium levels were below 0.05 percent. The trace quantity in a vast majority of samples was likely due to contamination, not intent to use titanium as a fuel. Currently, quantifying titanium is conducted via inductively coupled plasma optical emission spectroscopy ("ICP-OES") and confirmed by a scanning electron microscope ("SEM"). With a trace limit allowance, staff would begin looking into quantifying results based on the XRF screening. A trace limit allowance would save time

and resources because XRF does not require significant sample preparation or digestion. A reasonable prohibited chemicals' limit that allows for trace contamination, rather than institute a complete ban of an element or chemical compound is recommended because the testing burden and cost to prove compliance goes up significantly as allowances for trace amounts (due to contamination) are removed and total bans are implemented.

As part of this review, staff also considered the specific chemicals that are currently prohibited under this regulation, and queried whether they should remain prohibited and whether additional chemicals should be added to the list. Many of the chemicals listed in § 1507.2 are potential carcinogens or chemicals that create a more powerful explosive. This list has not been updated since 1976 when it was adopted.[48] Staff compared the AFSL standard, APA 87-1 and the European standard to the existing regulations to see if adding or removing any chemicals in § 1507.2 had merit. Table 1 indicates the major differences between the standards, as compared to § 1507.2.

Table 1
Chemicals that are prohibited under the Voluntary Standards but are not prohibited under CPSC Regulations

APA 87-1	AFSL Standard	European Standard
Prohibits "Lead tetroxide (red lead oxide) and other lead compounds"	Prohibits "Lead and lead compounds (including red lead oxide)"	Prohibits "Lead or lead compounds"
Allowance for "small amounts (less than 0.25% by weight) as impurities, and except as specified therein"	Prohibits "Hexachlorobenzene (perchlorobenzene) at the limit of 0.01% by weight"	Prohibits "hexacholorbenzene"

The Directorate for Health Sciences evaluated the current list of prohibited chemicals and found no reason to remove any of the substances currently in the regulation. The substances have been prohibited since 1976, have safety implications, and staff recommends maintaining the current list to keep the regulations consistent with industry standards. Health Sciences staff, however, did see merit in adding two chemicals mentioned in the standards that are not currently mentioned in CPSC's fireworks regulations.

Lead and other lead compounds are prohibited in both the internationally recognized standards (APA 87-1 and the European Standard) and AFSL's voluntary standard. Currently, lead and other lead compounds are not mentioned in CPSC's fireworks regulations. Lead tetroxide and other inorganic lead compounds can be absorbed by the oral and inhalation routes and exert a variety of toxicological effects. Children are more sensitive to lead toxicity than adults, and the effect of most concern is neurological development in children. Several agencies,

[48] 39 Fed. Reg. 17435 (May 16, 1974); 41 Fed. Reg. 9512 (Mar. 4, 1976).

including CPSC, have determined that lead and lead compounds, including lead tetroxide, are probably carcinogenic to humans.

The AFSL standard and the European Standard also have hexachlorobenzene ("HCB") in their prohibited chemicals list. AFSL has a stricter limit (0.01 percent by weight) than the APA (0.25 percent by weight). HCB is a persistent organic pollutant that has been banned globally. Exposure to HCB can lead to developmental and reproductive effects, liver toxicity, and cancer. Oral inhalation or dermal exposures can lead to systemic absorption with distribution to diverse tissues, and elimination from the body is slow.

If present in fireworks, lead tetroxide and HCB can be released into the environment, upon explosion, where these substances be inhaled as particles. Lead and HCB particles may also settle onto surfaces where oral exposures could occur. Because of the human health hazards, the Directorate for Health Sciences recommends limiting lead tetroxide and other lead compounds, as well as HCB in commercially available fireworks.

CPSC staff conducted preliminary testing of FY 2014 and FY 2015 fireworks samples and found that 12 out of 32 samples (38 percent) contained lead at detectable levels. Staff recognizes that a trace level of lead does not indicate an intention to use lead as an ingredient, but a trace level of lead may signal accidental contamination. Out of the 12 samples that were found to contain lead, only one sample contained lead greater than the APA 87-1 definition of "trace amounts" of 0.25 percent. Eleven out of the 12 contained lead at less than 0.05 percent.

In 2011, the AFSL conducted small-scale testing and found HCB in 8 of 15 randomly tested fireworks. Three contained HCB at levels above the AFSL limit of 0.01 percent.[49]

The Directorate for Health Sciences has not performed detailed toxicological reviews or risk assessments of HCB or lead compounds in fireworks. No quantitative models for estimating human exposure to fireworks ingredients are known to the staff, but the actual exposure to HCB or lead from consumer fireworks is expected to be low. The toxicological hazards of these currently unregulated substances suggest that a limit on their content in consumer fireworks is reasonable. However, no specific limit can be recommended at this time. Staff recommends seeking comment from the public regarding the safety of the trace amount levels mentioned in the standards.

The addition of lead as a prohibited chemical is not expected to pose any burden on industry because DOT already incorporates APA 87-1 by reference, and the APA 87-1 standard already prohibits lead.

Prohibiting HCB could create some burden on industry. First, to the extent that HCB is currently found in fireworks, manufacturers will need to eliminate HCB. In addition, to comply with the recommended regulation changes, fireworks would have to be tested for the chemical before introduction to the market. This testing, combined with the efforts to eliminate the compounds from consumer fireworks, could create an added burden for industry.

[49] Data from AFSL memo dated July 13, 2011.

Staff recommends adding these other chemicals to the list of prohibited chemicals. Because the absence of a trace amount limit on the current list of prohibited chemicals poses a great burden on industry and CPSC, staff recommends input from the public regarding an appropriate trace contamination limit for all prohibited chemicals. One possibility is to use the APA 87-1 limit of 0.25 percent, or if deemed appropriate, a lower limit, such as 0.05 percent, because most samples tested well below that level, or 0.01 percent, which is the limit used by AFSL for HCB.

3. § 1507.3 (Fuses)

(a) Fireworks devices that require a fuse shall:
(1) Utilize only a fuse that has been treated or coated in such manner as to reduce the possibility of side ignition. Devices such as ground spinners that require a restricted orifice for proper thrust and contain less than 6 grams of pyrotechnic composition are exempted from § 1507.3(a)(1).
(2) Utilize only a fuse which will burn at least 3 seconds but not more than 9 seconds before ignition of the device.
(b) The fuse shall be securely attached so that it will support either the weight of the fireworks device plus 8 ounces of dead weight or double the weight of the device, whether is less, without separation from the fireworks device.

Section 1507.3 details fusing requirements for fireworks. The first requirement aims to reduce the possibility of side ignition of the fuse. However, the regulation does not specifically articulate a test method to explain to what extent the fuse needs to reduce side ignition, nor does the regulation specifically articulate a test method for measuring side ignition. Instead, this information is found in the CPSC Fireworks Testing Manual. The test manual indicates that the side of the fuse that protrudes from the device (including any tape or paper attached to the fuse) needs to resist ignition from a cigarette for a minimum of 5 seconds. The AFSL and APA 87-1 test method indicates a similar test method. Between October 2005 and February 2015 there have been 28 violations of the CPSC standard. This accounts for less than 2.5 percent of all fireworks violations during this same time period.[50] This indicates substantial compliance with this provision. However, in order to clarify the regulation staff recommends adding the current CPSC test method of 5 seconds of resistance to the CFR.

The second requirement aims to give the consumer an appropriate time to retreat after lighting the fireworks device before the device begins to function. CPSC and industry set this time at 3 seconds. An upper limit exists so that the consumer is not misled to believe that the fuse went out and return to the device prematurely. CPSC revised this section in 1996, after considering information on safe minimum and maximum fuse burn times.[51]

Staff considered the AFSL standard and APA 87-1 to determine whether the fuse requirement regulations needed alterations or could be improved. Staff found that the APA and

[50] Data supplied by CPSC Compliance staff.
[51] 61 Fed. Reg. 41043 (Aug. 7, 1996) (Notice of Proposed Rule); 61 Fed. Reg. 67197 (Dec. 20, 1996) (Final Rule).

the AFSL standards state that "Roman candles or similar devices requiring a longer fuse for safe functioning may burn up to 12 seconds before ignition of the device." Through field testing of many of these devices, staff found no need to increase the upper limit of the fuse requirement. Additionally, the injury data do not suggest the necessity of a time change in the current 9-second requirement.

Currently, fuse violations account for the second highest number of CPSC staff-identified violations when compared to other CPSC fireworks provisions. Between October 2005 and October 2014 there were 379 fuse violations. Three violations are included in this number: "long fuse burn time," "short fuse burn time," and "fuse attachment." The fuse violations account for 28 percent of the fireworks violations identified during that period. "Long fuse burn time" accounted for 224 out of the 379 fuse violations where in at least one instance of staff testing the device took more than 9 seconds to function. Despite a high number of violations, the economic cost of these violations should be minimal because the manufacturer simply needs to trim the fuse to remedy the regulatory noncompliance.

The data relating to violations identified by staff do not suggest that the high number of "long fuse burn time" violations is due to the inconsistency between the AFSL standard and APA 87-1. Most violations of "long fuse burn time" occurred with mine and shell devices, which have the same limit of 9 seconds in APA 87-1 and AFSL. In contrast, "Roman candles or similar devices" allow the additional 3 seconds.

Staff believes that the fuse burn time indicated in the regulation is a reasonable requirement for industry and recommends no changes.

The third requirement aims at preventing the fuse from becoming detached during transportation, normal handling, and operation. A fuse that is not secured can easily become detached, creating the possibility that the device will malfunction when lit. Consumers are likely to hold devices by the fuse. If the fuse becomes detached, this raises the possibility that the consumer will try to reattach the fuse, creating a safety hazard to the consumer that this provision eliminates. However, when this regulation was enacted, most consumer fireworks were small. In recent years very large devices (in excess of 20 pounds) entered the market. This created a problem because the regulation states that even these large devices need to withstand the weight of the entire device, plus 8 ounces of dead weight. Staff recommends that the Commission seek public comment regarding an alternate test method for fuse attachment requirements for very large devices. The regulation aims at keeping the fuse from detaching, which may negate the requirement for the entire weight, plus 8 ounces of dead weight for very large devices.

4. § 1507.4 (Bases)

The base or bottom of fireworks devices that are operated in a standing upright position shall have the minimum horizontal dimensions or the diameter of the base equal to at least one-third of the height of the device including any base or cap affixed thereto.

Section 1507.4 describes the performance requirement for the base of a fireworks device. The current regulation is aimed at minimizing the tipping hazard in a fireworks device by

addressing stability during operation. Staff does not recommend any changes to this provision because staff believes the provision reduces the possibility that a tip-over incident might occur that could cause injury to the consumer.

For this review, staff considered any additional requirements pertaining to bases that may exist in the industry standards. Staff found that both APA 87-1 and the AFSL Standard require that the base must remain attached during transportation, handling, and normal operation of the device as can be seen in Table 2. CPSC cannot regulate transportation because transportation is under the DOT's jurisdiction; however, the CPSC can require that the base remain attached during handling and normal operation.

If the base is not attached properly, injuries could occur because the device might be unstable. Specific incident data for fireworks-related injuries is limited and does not clearly reflect any injuries associated with tip-overs directly due to base detachment. Staff recommends that the Commission seek public comment on the merits of adding this provision to the regulation as well as specific incident data to support such a provision.

Staff also noted that APA 87-1 incorporates specific materials for base construction as noted in Table 2. When the CPSC rule was promulgated in 1974, the Commission considered incorporating a specific thickness for the bases of fireworks devices.[52] However, due to wanting to "promulgate performance rather than design oriented requirements," the requirement to incorporate a specific thickness was left out.[53] Staff seeks to minimize design limiting standards and therefore, does not recommend adding specific materials in the base regulation.

Table 2
Base Regulations in Voluntary Standards compared to CPSC Regulations

APA 87-1	AFSL Standard	CPSC Regulation
States that "bases must remain firmly attached to the item during transportation, handing and normal operation"	States that "bases must remain firmly attached during transportation, handing and normal operation."	Current CPSC regulations do not state a requirement for base attachment.
States that "devices that require a base shall utilize a base of wood or plastic (preferably non-brittle, medium impact polystyrene"	Requires that "bases be made of a material that will not break during transportation, handling, and normal operation."	Current CPSC regulations do not specify what materials bases need to be constructed of.

5. § 1507.5 (Pyrotechnic leakage)

The pyrotechnic chamber in fireworks devices shall be sealed in a manner that prevents leakage of the pyrotechnic composition during shipping, handling, and normal operation.

[52] 39 Fed. Reg. 17435, 17437 (May 16, 1974).
[53] 39 Fed. Reg. 17435, 17437 (May 16, 1974).

Section 1507.5 requires that the pyrotechnic material in fireworks devices stay inside the device during shipping, handling, and normal operation. Requiring that pyrotechnic material stay within the device is intended to protect the safety of the consumer in several ways. First, leakage may prevent the device from operating as intended.For example, if the lift charge leaked out of a device during shipping, when the consumer lit the device, it is possible that the device would not rise high enough, and could injure the consumer. Second, some pyrotechnic material is highly flammable and would pose a great risk to consumers if the leaked material were to be ignited accidentally.

The current language in the C.F.R. is consistent with a performance requirement rather than a design requirement and staff recommends no changes to this provision.

6. § 1507.6 (Burnout and Blowout)

The pyrotechnic chamber in fireworks devices shall be constructed in a manner to allow functioning in a normal manner without burnout or blowout.

According to 16 C.F.R. § 1507.6, fireworks devices must be constructed to allow functioning in a normal manner without blowout or burnout. This is an important safety consideration. Blowouts often create a large explosion low to the ground where debris can injure spectators. Burnouts can cause fires, leading to property damage and injury. A similar provision in APA 87-1 section 3.6.2.5 requires that a pyrotechnic chamber be of sufficient thickness and rigidity to allow normal functioning without burnout or blowout and be constructed and sealed to prevent leakage.

Although CPSC staff believes the terms “burnout” and “blowout” are well understood by industry, staff recommends defining the terms in the regulation. Staff recommends soliciting comments on usefulness of adding the APA 87-1 definitions of these terms, provided below. Staff believes the APA definitions accurately express the CPSC’s and industry’s understanding of these terms. Additionally, because the DOT incorporates APA 87-1 by reference, by extension, the DOT also incorporates APA 87-1 definitions. The addition of definitions may clarify and streamline the regulation and would align CPSC regulations with the DOT. The APA 87-1 definitions are:

Blowout: The unintended release of a pressure effect from other than the intended orifice of a fireworks device. Examples include expulsion of the bottom plug of a roman candle, expulsion of the clay choke of a fountain, or the rupturing of the wall of a mine or shell.

Burnout: The unintended escape of flame through the wall of a pyrotechnic chamber during functioning of a fireworks device.

7. § 1507.7 (Handles and Spikes)

(a) Fireworks devices which are intended to be hand-held and are so labeled shall incorporate a handle at least 4 inches in length (see § 1500.14(b)(7)). Handles shall remain firmly attached during transportation, handling and full operation of the device, or shall consist of an integral section of the device at least four inches below the pyrotechnic chamber.
(b) Spikes provided with fireworks devices shall protrude at least 2 inches from the base of the device and shall have a blunt tip not less than 1/8-inch in diameter of 1/8-inch square.

The provisions in § 1507.7(a) require that handheld devices have at least a 4-inch handle. For this review, staff looked at injuries related to handles and spikes. The most common handheld device is a sparkler. To obtain information regarding types of devices and types of injuries, staff used the incident data obtained through in-depth telephone investigations of some of the fireworks-related injuries during the yearly one-month special study period surrounding the 4th of July. Staff considered the investigations from 2010 through 2013. Of the 131 incidents reviewed, staff found only one injury that could possibly have been prevented by a longer handle. The victim, who held a sparkler as he lit the sparkler, sustained injury when the sparkler exploded in his hand and amputated part of his index finger. This injury resulted from the device malfunctioning; a longer handle might not have prevented the consumer's injury. Due to the low number of injuries, there is no indication that the length is insufficient to protect the consumer. Importantly, the injuries considered may not be representative of all fireworks injuries. However, the injuries represent a small sample about which staff could gather detailed information on the types of devices and injuries associated with them.

The provision in § 1507.7(b) requires that devices intended to be placed in the ground have a long enough spike. The requirement keeps the device from tipping over while functioning. This is an important provision because a tip-over while a device is functioning can cause substantial injury. No injuries related to this standard were found during the period from 2010 through 2013. Based on CPSC testing experience and compliance data, tip-overs mainly occur with reloadable tube aerial shell devices and multiple-tube mine and shell devices, which do not have spikes.

Section 1507.7(b) is consistent with industry standards. Between October 2005 and February 2015 there have been 65 violations related to this provision. Violations of this section of the regulation are recorded by compliance staff as "other violations" and staff groups this provision with a number of other fireworks regulatory violations. This number accounts for less than 5 percent of the total fireworks violations in this time period.[54] This indicates substantial industry compliance with this provision. Staff recommends that the Commission maintain this section of the regulation without additional changes.

8. § 1507.8 (Wheel Devices)

Drivers in fireworks devices commonly known as "wheels" shall be securely attached to the device so that they will not come loose in transportation, handling, and normal operation. Wheel devices intended to operate in a fixed location shall be designed in such a manner that the axle remains attached to the device during normal operation.

[54] Data supplied by CPSC Compliance staff.

Section 1507.8 applies to fireworks devices known as "wheels," requiring that drivers on these devices remain intact during the operation of the device. This performance standard protects the safety of the consumer. Staff found no injuries related to this regulation. Furthermore, staff found that industry standards did not impose any additional safety provisions relating to wheel devices. Between October 2005 and February 2015 there have been 65 violations related to this provision. Violations of this section of the regulation are recorded by compliance staff as "other violations" and staff groups this provision with a number of other fireworks regulatory violations. This number accounts for less than 5 percent of the total fireworks violations in this time period.[55] This indicates substantial industry compliance with this provision. Staff recommends that the Commission maintain this section of the regulation without additional changes.

9. § 1507.9 (Toy smoke devices and flitter devices)

(a) Toy smoke devices shall be so constructed that they will neither burst nor produce external flame (excluding the fuse and first fire upon ignition) during normal operation.
(b) Toy smoke devices and flitter devices shall not be of such color and configuration so as to be confused with banned fireworks such as M-80 salutes, silver salutes, or cherry bombs.
(c) Toy smoke devices shall not incorporate plastic as an exterior material if the pyrotechnic composition comes in direct contact with the plastic.

Section 1507.9(a) requires toy smoke devices to be constructed so that they do not burst or produce an external flame. This performance standard protects the safety of the consumer. A device that bursts can cause substantial injury if the debris strikes the consumer, and the external flame can cause a fire that can lead to property loss and consumer injury. Section 1507.9(b) prohibits toy smoke and flitter devices from being a similar color and configuration as M-80 salutes, silver salutes, or cherry bombs. This is because toy smoke and flitter devices are similar in size to these banned firecracker devices. Finally, § 1507.9(c) also requires that toy smoke devices not incorporate plastic as an exterior material if the pyrotechnic composition comes in contact with the plastic. This is necessary to provide adequate safety to the consumer. The heat from the combustion of the pyrotechnic material can cause plastic fragments to be dispersed, which can injure the consumer. No additional safety provisions regarding toy smoke and flitter devices were found in the industry standards. Between October 2005 and February 2015 there have been 65 violations related to this provision. Violations of this section of the regulation are recorded by compliance staff as "other violations" and staff groups this provision with a number of other fireworks regulatory violations. This number accounts for less than 5 percent of the total fireworks violations in this time period.[56] This indicates substantial industry compliance with this provision. Therefore, staff recommends that the Commission maintain this section of the regulation without additional changes.

10. § 1507.10 (Rockets with Sticks)

[55] Data supplied by CPSC Compliance staff.
[56] Data supplied by CPSC Compliance staff.

Rockets with sticks (including skyrockets and bottle rockets) shall utilize a straight and rigid stick to provide a direct and stable flight. Such sticks shall remain straight and rigid and attached to the driver so as to prevent the stick from being damaged or detached during transportation, handling, and normal operation.

Section 1507.10 requires that rockets are constructed with straight and rigid sticks to provide a direct and stable flight. This protects consumer safety during operation with minimal design specifications. Staff believes that clarification of this provision would be useful. The regulation does not specify definitions or limits for "straight and rigid" or "attached."

The CPSC Fireworks Test Manual ("Test Manual") has a test method that defines the "attachment" of a stick rocket as "able to withstand the weight of an 8oz-weight without separation." The Test Manual also has a test method for "straightness and rigidity." The CPSC measures rigidity by clamping horizontally to a rigid surface a 1-inch section at the end of the rocket stick farthest from the motor tube. The distance that the motor end of the rocket droops downward is measured. The maximum downward droop, or arch, may not exceed ¼ of the total length of the rocket. Straightness is measured by laying the stick on a flat surface with the maximum bow up. The maximum deviation from horizontal must not exceed 1 inch. The AFSL and the APA have similar test methods for straightness, attachment, and rigidity.

CPSC sees substantial compliance with all the test methods for this regulation. Staff documented only 12 violations between October 2005 and February 2015. Staff found no additional safety provisions in industry standards. Staff recommends that the Commission seek input from the public on whether clarification of the terms "straight," "rigid," and "attached" would be useful in clarifying and streamlining the regulation.

11. § 1507.11 (Party Poppers)

Party poppers (also known by other names such as "Champagne Party Poppers," and "Party Surprise Poppers,") shall not contain more than 0.25 grains of pyrotechnic composition. Such devices may contain soft paper or cloth inserts provided any such inserts do not ignite during normal operation.

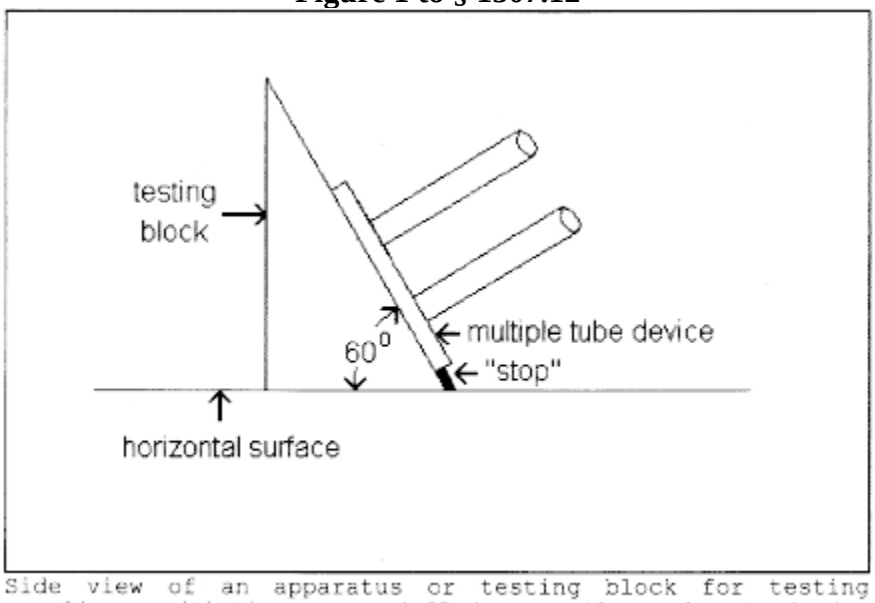
Section 1507.11 requires a limit of total pyrotechnic composition for Party Poppers. Staff sees minimal violations regarding this standard and staff found no injuries that could be tied directly to party poppers. Staff believes that the limit in the regulation is appropriate; the limit is consistent with industry standards; and as such, staff recommends the Commission maintain this section of the C.F.R. without additional changes.

12. § 1507.12 (Multiple-Tube Fireworks Devices)

(a) Application. Multiple-tube mine and shell fireworks devices with any tube measuring 1.5 inches (3.8 cm) or more in inside diameter and subject to § 1500.17(a)(12) of this part shall not tip over when subjected to the tip-angle test described in this section.
(b) Testing procedure. The device shall be placed on a smooth surface that can be inclined at 60 degrees from the horizontal, as shown in Figure 1 of this section. The height and width of the

inclined plane (not including the portion of the plane below the mechanical stop) shall be at least 1 inch (2.54 cm) greater than the largest dimension of the base of the device to be tested. The test shall be conducted on a smooth, hard surface that is horizontal as measured by a spirit level or equivalent instrument. The mechanical stop on the inclined plane shall be 1/16 inches (1.6 mm) in height and perpendicular to the inclined plane. The stop shall be positioned parallel to the bottom edge of the inclined plane and so that no portion of the device to be tested or its base touches the horizontal surface. The device shall not tip over when the plane is inclined at 60-degrees from the horizontal. The procedure shall be repeated for each edge of the device.

Figure 1 to § 1507.12



Side view of an apparatus or testing block for testing compliance with the proposed 60-degree tilt angle standard.

This test method keeps large multiple-tube mine and shell devices from tipping over while functioning. This is a much more recent fireworks regulation than the others transferred to the CPSC from the FDA. The CPSC adopted this test method in 1996, after considering information about minimizing the safety hazards associated with tip-overs.[57] In 1994 and 1995, more than 80 percent of mine and shell devices tested by staff would tip over during field testing. Tip-overs of this type of large device can cause substantial injury and have resulted in two known deaths. [58] Staff found large multiple tube devices less likely to tip over while functioning if these devices had a minimum tip angle of 60 degrees. Since promulgation of this regulation, staff witnessed a significant decline in tip-overs during field testing. For example, in 2014, less than 1 percent of devices tipped over while functioning.[59] Staff also sees substantial compliance with this regulation. Between October 2005 and February 2015, staff notes only 65 violations of this regulation identified by the Division of Compliance and Field Operations. This accounts for

[57] 60 Fed. Reg. 34922 (July 5, 1995) (Proposed Rule); 61 Fed. Reg. 13084 (Mar. 26, 1996) (Final Rule).
[58] 61 Fed. Reg. 13086 (Mar. 26, 1996).
[59] Data provided by CPSC compliance staff for FY 2014.

less than 5 percent of the total fireworks violations. To protect the safety of the consumer, staff recommends that the Commission maintain this regulation with no modifications.

F. Additional Recommendations

1. Fragments

Based on the in-depth telephone investigations that the CPSC conducted of fireworks incidents from 2005 through 2015, some incidents may be related to projected fragments from fireworks. Staff could not determine whether these injuries resulted from a fragment from inside the fireworks device, or whether the sharp fragments resulted from debris in the surrounding area of the explosion, and not necessarily from the device itself. Regardless, the possibility of injury due to projected fragments certainly exists.

APA 87-1 addresses this risk, stating: "no component of any consumer fireworks device or novelty may upon functioning, project or disperse any metal, glass, or brittle plastic fragments." To align CPSC standards with the internationally recognized standards and address this safety issue, staff recommends that the Commission consider the addition of this requirement. In particular, staff would find it helpful to solicit information regarding the appropriateness of the specific fragments listed (metal, glass, or brittle plastic); whether any additional fragments, such as wood, are appropriate to consider; and seek information regarding injuries related to this standard.

2. Apex of flight

Through CPSC field testing of hundreds of devices, components of devices designed to produce an effect high in the air often are seen exploding much closer to the ground as the shell descends. This creates a great potential for injury and property damage. When a shell bursts at the apex of its flight, the shell has the maximum amount of time to cool before touching the ground. Furthermore, the potential for a consumer to be injured when a fireworks device explodes near the ground is greater than when the device explodes at the apex of its flight.

APA 87-1 addresses this risk, stating: "devices designed to produce a visible or audible effect high in the air must be designed to produce that effect at or near the apex of its flight." The AFSL voluntary standard and the European Standard have similar requirements. The addition of this standard would promote safety and facilitate compliance action, given that tested samples cause fires when a shell does not burst at the apex of the flight. With the goal of aligning CPSC standards with the industry standards and protecting the safety of the consumer, staff recommends adding this performance requirement to the regulations, depending on public feedback. In particular, staff would find it useful to collect information from the public regarding fires and injuries associated with this provision in the standard, and the appropriateness of the language in APA 87-1. Staff also would like to seek input regarding a minimum height requirement for the apex. Staff recommends considering modifying the language to state "each component of a device designed to produce a visible or audible effect high in the air must be designed to produce that effect at or near the apex of its flight." This change would specify that devices with multiple components designed to function at different altitudes are not inadvertently

noncompliant. Staff's intent is that each component of a device does not explode on its descent, low to the ground when it was intended to explode at a much higher altitude. To add this provision to the regulations, the Commission must determine that the provision is needed to protect public health and safety and make the findings stated in section 3 of the FHSA.

3. Definitions

Staff recommends adding a definitions section in the C.F.R. to provide clarity and consistency in interpreting and applying regulatory requirements. Specifically, the term "devices intended to produce an audible effect" requires clarification of what features need to be measured. Staff recommends the addition of the APA 87-1 definitions of relevant terms. Staff believes that the APA definitions accurately express CPSC and industry understanding of these terms. Additionally, because the DOT incorporates APA 87-1 by reference, by extension, the DOT also incorporates APA 87-1 definitions. The addition of definitions would provide greater clarity in the regulation and align with the DOT requirements. Relevant APA 87-1 definitions are listed below:

Lift charge: pyrotechnic composition used to propel a component of a mine or shell device into the air. Lift charge is limited to black powder (potassium nitrate, sulfur, and charcoal) or similar pyrotechnic composition without metallic fuel.

Burst charge, Expelling charge or Break charge: Chemical composition used to break open a device after it has been propelled into the air, producing a secondary effect, such as a shower of stars. Burst charge containing metallic powder, such as aluminum or magnalium, is limited to two grains.

Chemical composition: All pyrotechnic and explosive material contained in a fireworks device. Inert materials, such as clay used for plugs, or organic matter, such as rice hulls used for density control, are not considered to be chemical composition. This does include lift charge, burst charge, and visible/audible effect materials.

Explosive composition: Any chemical compound or mixture, the primary purpose of which is to function by explosion, producing an audible effect (report) in a fireworks device.

Pyrotechnic composition: A chemical mixture that, upon burning, and without explosion, produces visible or brilliant displays or bright lights, or whistles, or motions.

IV. Summary of Recommendations

A summary of staff's recommendations in this briefing package follows. Staff lists the recommendations in four categories. The first category lists the regulations that staff recommends should be maintained without any modifications to the regulatory language. These regulations, staff maintains, provide continuity to the Commission's compliance program, are necessary to protect public health and safety, and do not need to incorporate any additional provisions from the international or voluntary standards. The second category includes recommendations that are not expected to have any net effect on industry or the public. The

recommendations simply aim to streamline or clarify the existing regulations. The third category sets forth recommendations that aim to reduce burdens on industry, by clarifying the regulation and maintaining the safety of consumers. Lastly, the fourth category provides recommendations to align CPSC's standards with industry's voluntary standards and the mandatory standards. Staff believes that these changes could also provide greater safety to the public, but may require additional support and findings.

Maintain the following sections in the C.F.R without any modifications:

- 16 C.F.R. § 1500.17(a)(9), (11), and (12); and
- 16 C.F.R. §§ 1507.7, 1507.8, 1507.9, 1507.11 and 1507.12.

Recommendations intended to clarify and streamline the regulations with no net change on industry or safety:

- Possibly define "burnout" and "blowout," as used in § 1507.6;
- Possibly define "firecracker," as used throughout the regulation;
- Specify the sections (fusing requirements and prohibited chemicals) for which firecrackers are exempt, rather than exempt firecrackers from all of part 1507;
- Remove § 1507.85(a)(2) because of its redundancy with 1500.17(a)(8);
- Clarify "reduce the possibility of side ignition," as used in § 1507.3, by using the current CPSC test method that measures this requirement;
- Possibly define "stability, rigidity and attachment," as used in § 1507.10, by using the current CPSC test method that measures compliance with these terms.

Recommendations intended to reduce burden on industry and maintain consumer safety, by clarifying current regulation:

- Revise "devices intended to produce an audible effect," as specified in §§ 1500.17(a)(3), 1500.17(a)(8), 1500.83(a)(27), and 1500.85(a)(2), by defining product classes that fall under that category for aerial devices, such as sky rockets, bottle rockets, missile-type rockets, aerial spinners, Roman candles, mine and shell devices, and aerial shell kits with reloadable tubes, which contain metallic fuels (such as magnalium or aluminum) less than 100-mesh in particle size at levels above trace;
- Adopt limits on pyrotechnic composition by firework type, as defined in DOT regulations;
- Adopt limit on ratio of break charge to effects as specified in APA 87-1;
- Add definitions of "lift charge," "burst, expelling, or break charge," "chemical composition," "pyrotechnic composition," and "explosive composition," to provide clarity in the regulation;
- Amend § 1507.2 to allow trace amounts of prohibited chemicals as impurities, unless otherwise specified;
- Clarify the term "aerial bomb," as used in § 1500.17(a)(3) and §1500.17(a)(8);
- Amend the list of warning labels for of devices that are listed in § 1500.14;

- Specify an alternate to test for "fuse attachment" as specified in §1507.3 for very large devices.

Recommendations intended to align more closely with industry best practices and that may require additional support and findings:

- Possibly adopt the requirement that any component in a fireworks device intended to produce a visible or audible effect high in the air, produce that effect at the apex of its flight;
- Possibly prohibit fireworks devices from projecting fragments upon functioning;
- Possibly amend § 1507.4 to require that the base or bottom of fireworks devices must remain attached during handling and normal operation, depending on public feedback.

V. Conclusions

Staff identified the best, and least burdensome tools after completing a full rule review of the current fireworks regulations, as directed by the Commission. In this briefing package, staff highlighted the provisions in CPSC's existing regulations that may be appropriate to update to achieve greater clarity, consistency, and reflect the current fireworks market and technology, with a goal of providing increased consumer safety. Staff recommends that the Commission revise, clarify, and update the regulations related to fireworks to address the highlighted issues. Staff believes that updating the CPSC standard with a combination of the international standards, where appropriate (*e.g*., where they reduce consumer safety risks and are consistent with CPSC's goal to allow for performance-based standards), is the least burdensome tool aimed at protecting the public.

Staff's preliminary review indicates that the changes staff is recommending to the Commission would have minimum economic impact because many simply clarify or reorganize existing requirements. Industry already must comply with APA 87-1 requirements that are relevant to transportation safety to be transported legally into the United States, and labeling changes constitute a one-time cost. Changes that go beyond clarifications of existing requirements would need to meet the requirements for rulemaking under the FHSA. If the Commission would like to pursue staff's recommendations, staff will prepare a briefing package for an NPR that would provide the Commission with information and support for regulatory changes in accordance with the FHSA.

VI. Attachment

Tab A – Health Sciences Memorandum

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

Memorandum

Date: May 13, 2015

TO : Priscilla M. Verdino, Project Manager for Fireworks, Division of Chemistry, Directorate for Laboratory Sciences

THROUGH: Alice M. Thaler, DVM, Associate Executive Director for Health Sciences
Michael A. Babich, Ph.D., Director, Division of Toxicology & Risk Assessment

FROM : Eric Hooker, M.S., D.A.B.T., Toxicologist, Division of Toxicology & Risk Assessment

SUBJECT : Toxicology of Hexachlorobenzene and Lead Compounds in Fireworks

The U.S. Consumer Product Safety Commission ("CPSC" or the "Commission") regulates fireworks devices under the Federal Hazardous Substances Act ("FHSA") (15 U.S.C. §§ 1261-1278). Under the direction of the Commission, staff has completed a rule review of the current fireworks regulations.

In particular, the Directorate for Health Sciences reviewed the regulations on prohibited chemicals in 16 C.F.R. § 1507.2 and considered applicable international and voluntary standards to possibly improve the regulations. The two main international standards are the European Standard EN 15947-1–15947-5: Pyrotechnic Articles—Fireworks, Categories 1, 2, and 3 ("European Standard"), and the American Pyrotechnics Association Standard 87-1: Standard for Construction and Approval for Transportation of Fireworks, Novelties, and Theatrical Pyrotechnics ("APA 87-1"). The U.S. Department of Transportation ("DOT") regulates the transportation of fireworks and requires compliance with APA 87-1 when approving the transportation of display and consumer fireworks. The American Fireworks Standards Laboratory ("AFSL") has developed voluntary standards that incorporate both the CPSC and DOT regulations, as well as a number of standards developed by AFSL that are in addition to federal requirements. The European Standard is used by 31 countries around the world and was developed by industry experts.

The Directorate for Health Sciences supports the continued prohibition of the chemicals currently listed in 16 C.F.R. § 1507.2. Certain chemicals listed in the regulation, such as arsenates and mercury salts, are classified as human carcinogens (EPA, 2000). The other prohibited chemicals, namely boron, chlorates, gallates, magnesium, white phosphorus, magnesium, picric acid, titanium, and zirconium, were likely banned for manufacturing safety

reasons, due to spontaneous combustion and/or the occupational hazards associated with manufacturing and storage. These chemicals have been banned from consumer fireworks since June 8, 1976 (41 Fed. Reg. 22931 (June 8, 1976)) and are consistent with the chemicals banned in both of the international standards (APA 87-1 and European Standard) and the AFSL voluntary standard.

Lead and other lead compounds are prohibited in both the internationally recognized standards APA 87-1 and the European Standard), as well as in AFSL's voluntary standard. APA 87-1 bans lead and other lead compounds at a level of .25 percent by weight. Currently, lead is not mentioned in CPSC's fireworks regulations.

The AFSL Standard and the European Standard also have hexachlorobenzene ("HCB") in their prohibited chemicals list. AFSL has a stricter limit than the APA of 0.01 percent by weight, versus 0.25 percent.

The following provides CPSC's Directorate for Health Sciences staff's review of the potential health effects of hexachlorobenzene ("HCB," also known as perchlorobenzene) and lead tetroxide and other inorganic lead compounds in commercial fireworks. This memorandum presents summaries of the known toxicological issues regarding these substances and supports prohibiting or limiting HCB and lead tetroxide in consumer fireworks.

The Directorate for Health Sciences has not performed detailed toxicological reviews or risk assessments of HCB or lead compounds in fireworks. Information discussed below indicates that these chemicals are present in consumer fireworks; however, CPSC does not have specific information on the extent to which they are present. No quantitative models for estimating human exposure to fireworks ingredients are known to the staff; but the actual exposure to HCB or lead from consumer fireworks is expected to be low. There is no indication that there are incidents in which children have put consumer fireworks in their mouths. Therefore, the concern with human exposure stems from residue dispersed during explosion of the fireworks. Residue from fireworks may be inhaled or may settle onto surfaces that humans contact and lead to potential hand-to-mouth transfer. It may be possible to model or estimate these exposures, but additional information would be needed regarding the devices containing the contaminants and descriptions of the typical use patterns of consumer fireworks (*e.g.*, number of devices of each type used in a session; distance of the spectators from the activation/explosion of the device; frequency of use). Because of the lack of exposure data, the Directorate for Health Sciences cannot confirm what limits on HCB and lead tetroxide in consumer fireworks would be safe or pose no human health risk. However, the toxicological hazards of these currently unregulated substances suggest that a limit on their content in consumer fireworks is reasonable.

Hexachlorobenzene

HCB (Chemical Abstract Service Number 118-74-1; also known as perchlorobenzene) has the chemical symbol C_6Cl_6. HCB is described as a white crystalline solid that is not water soluble. It is moderately volatile and is very persistent and bioaccumulative in the environment (ATSDR 2013).

HCB was formerly used as a fungicide and in the manufacture of fireworks, ammunition, and synthetic rubber. Its function in fireworks is to improve illumination effects (Schmid et al. 2014). Former uses of HCB as a pesticide ended in the United States in 1965, and there are no known current commercial uses in the United States. There are no known natural occurrences of HCB, but it can be produced as a byproduct in the manufacture of other chemicals and by burning of municipal waste. Katz et al. (1980) reported that HCB was a combustion product of hexachloroethane-based smoke generators (smoke bombs) used by the United States Army. Production and use of HCB have been prohibited globally under the Stockholm Convention on Persistent Organic Pollutants (http://chm.pops.int/), adopted in 2001, and effective in 2004. However, the United States did not ratify the Stockholm Convention.

The limit of 0.01 percent HCB in consumer fireworks is the industry standard limit for consumer fireworks, as provided in the American Fireworks Standards Laboratory standard ("AFSL" 2014); no explanation is available for how this value was determined. The European Standard also prohibits HCB in consumer fireworks. Limited information is available on the levels of potential human exposure to HCB from consumer use of fireworks. However, there are recent reports of the presence of HCB in commercial and professional fireworks in the United States and Europe.

The AFSL (2011) reported that eight of 15 randomly sampled mine and shell pyrotechnic devices manufactured in China contained detectable HCB at concentrations of 0.00014 to 0.27 percent by weight, and three of the samples exceeded the 0.01 percent limit. Fleischer et al. (1999) reported that remains of fireworks contained HCB up to 0.14 percent. A program named Chemical Legislation European Enforcement Network ("CLEEN") tested the HCB contents of samples of fireworks in several European countries where HCB is prohibited under the Stockholm Convention. Of 439 samples tested, 317 had a HCB content below the quantification limit of 0.00005 percent; 77 samples showed a content between the quantification limit and 0.0005 percent; and 45 samples (~10%) showed HCB content of more than 0.0005 percent. The highest HCB content tested was 27,000 mg/kg (2.7%). Before the CLEEN project, samples of fireworks imported from China into Denmark (2008-2010) and Austria (2009-2010) were tested for HCB content. In total, 82 samples were analyzed and 25 percent of the products tested contained HCB at concentrations of 0.005 percent to 4.4 percent (CLEEN 2012).

A study by Schmid et al. (2014) reported that 297 pg/m^3 HCB was detected in air samples at 3 hours after numerous small-scale fireworks were used by inhabitants of Zurich, Switzerland, during a Swiss National Day celebration on August 1, 2011; this concentration was approximately 10 times higher than ambient HCB levels measured 1 week before and 2 weeks after the event. The report clarified that the fireworks were not large-scale public displays by municipalities. Thus, presumably the fireworks that were used were consumer grade and not professional. A total emission of 23 g HCB was released into the environment from the single night of fireworks throughout Zurich. Human exposure to HCB was not measured in this study. It is not known what proportions of the HCB released were added firework ingredients versus a product of combustion of other chlorinated hydrocarbons (Schmid et al. 2014).

The adverse human health effects of HCB exposure have been described recently by the U.S. Environmental Protection Agency ("US EPA" 2013) and the Agency for Toxic Substances and Disease Registry ("ATSDR" 2013). HCB is readily absorbed into the human body by oral

ingestion, and although there are no specific data, presumably HCB is readily absorbed into systemic circulation with inhalation exposure. HCB may also be absorbed with contact to the skin, mucous membranes, and the eyes. HCB accumulates in lipid-rich tissues, such as adipose tissue, adrenal cortex, bone marrow, skin, and some endocrine tissues. Additionally, HCB can be transferred to offspring across the placenta and via mother's milk. It undergoes limited metabolism, yielding pentachlorophenol, tetrachlorohydroquinone, and pentachlorothiophenol as the major metabolites excreted in urine. However, HCB is excreted primarily unchanged in the feces. There are no data describing the timing of excretion in humans, but the elimination half-lives for HCB range from approximately 1 month in rats and rabbits, to 2 or 3 years in monkeys (ATSDR 2013).

Acute and intermediate oral exposures to HCB have been associated with developmental and reproductive toxicity in laboratory animals. Chronic oral exposures have produced liver toxicity, including cancer (hepatocellular carcinoma), in laboratory animals (ATSDR 2013; US EPA 2013). There are no data describing toxicological effects of inhalation or dermal exposure to HCB. A summary of the toxicological reference values by ATSDR and US EPA are provided below in Table 1.

Table 1. Summary of Toxicological Reference Values for Hexachlorobenzene

Reviewing Agency (year of Review)	Toxicological Reference Value Type	Value	Critical Toxicity Endpoint
Non-Cancer			
ATSDR (2013)	Acute oral Minimal Risk Level ("MRL")	0.008 mg/kg-d	Developmental (hyperactivity in offspring, rats)
	Intermediate oral MRL	0.0001 mg/kg-d	Reproductive (degenerative lesions in ovarian follicles)
	Chronic oral MRL	0.00007 mg/kg-d	Liver toxicity
US EPA (1991)	Chronic oral Reference Dose ("RfD")	0.0008 mg/kg-d	Liver toxicity
Cancer			
US EPA (1996)	Oral Cancer Slope factor ("CSF")	1.6 $(mg/kg\text{-}d)^{-1}$	Hepatocellular carcinoma
	Drinking Water Unit Risk	0.000046 $(mg/kg\text{-}d)^{-1}$	Hepatocellular carcinoma
	Inhalation Unit Risk ("IUR")	0.00046 $(\mu g/m^3)^{-1}$	Hepatocellular carcinoma (based on oral exposure data)

As noted above, exposure to HCB has been shown to cause liver cancer in laboratory animals. The US EPA (1996) describes HCB as a "probable human carcinogen" (Classification B2). The International Agency for Research on Cancer ("IARC") determined that HCB is "possibly carcinogenic to humans" (Group 2B). The National Toxicology Program ("NTP") describes HCB as "reasonably anticipated to be a human carcinogen" in its 13th Report on Carcinogens (NTP 2014). The California Environmental Protection Agency ("Cal EPA" 2015) includes HCB in its current Proposition 65 list of "chemicals known to the state to cause cancer or reproductive toxicity." The American Conference of Governmental Industrial Hygienists ("ACGIH" 2012) has listed HCB as a confirmed animal carcinogen with unknown relevance to humans (A3 Classification).

In summary, HCB is a persistent organic pollutant that has been banned globally but has recently been detected in fireworks. HCB, upon explosion of fireworks, can be released into the environment, where it may be inhaled as a vapor or adsorbed to inhalable particles. Particles containing HCB may also settle onto surfaces where dermal or oral exposures could occur. Oral, inhalation, or dermal exposures can lead to systemic absorption with distribution to diverse tissues, and elimination from the body is slow. Exposure to HCB can lead to developmental and reproductive effects and liver toxicity, including cancer. Because of the human health hazards and the environmental concerns (persistence and bioaccumulation), the Directorate for Health Sciences supports a limitation of HCB in consumer fireworks, but the staff cannot currently comment on how protective of human health the proposed limit value of 0.01 percent would be.

Lead Tetroxide

Lead tetroxide (Chemical Abstract Service Number 1314-41-6) is an inorganic lead compound. It is also known as minium, red lead, and triplumbic tetroxide. Lead tetroxide has the chemical symbol Pb_3O_4. It is described as a red or orange crystalline solid or powder that is not water soluble. There is limited information on lead tetroxide, but the toxicological information available for other inorganic lead compounds is generally expected to be relevant to lead tetroxide.

Lead tetroxide is reportedly used as a delay charge in commercial fireworks to make "crackling microstars" (PyroData). Use of lead tetroxide as a paint pigment is limited under prohibitions of lead-containing paints. There might be uses of lead tetroxide in the manufacture of stained glass windows.

The limit of 0.25 percent (2,500 ppm) lead in consumer fireworks is the industry standard limit of prohibited chemicals for consumer fireworks in APA 87-1; no explanation is available for how this value was determined. The AFSL standard (2014) and European Standard also prohibit lead and lead compounds in consumer fireworks but do not recommend an acceptable concentration. Section 101 of the Consumer Product Safety Improvement Act of 2008 ("CPSIA;" Pub. L. No. 110-314 (Aug. 14, 2008)) limits the lead content of most component parts of most children's products, including toys, to 100 ppm by weight, except for inaccessible component parts, certain electronic devices, and certain other products or component parts. The lead content is limited to 90 ppm in paint and similar surface coatings of children's products and some furniture. These limits are based on the oral route of exposure to children by mouthing objects. There is no indication of incidents of children have put consumer fireworks in their mouths.

Exposure to lead from consumer fireworks is likely to be low compared to children's products or exposure to paints in the household that contain lead. A literature search revealed very little information on which to base an exposure model for lead compounds from consumer fireworks. The AFSL (2008) reported that 9 percent of 400 firework samples tested in 2007 contained excess lead (*i.e.*, more than 0.06% concentration) and 11 percent of 200 samples tested in 2006 contained excess lead. The report did not state how many samples exceeded the APA 87-1 limit of 0.25 percent.

When released into the environment, lead tetroxide binds to organic materials in soil and precipitates in water. In the air, as when exploded in fireworks, particulate matter containing lead tetroxide is subject to gravitational settling, creating the potential of inhalation, oral exposure, and dermal contact.

Inhalation or oral ingestion of lead results in high systemic absorption. However, absorption through intact skin is low. Once absorbed, lead is distributed to several tissues but is primarily stored in bones and teeth, where it can remain for decades. Systemically absorbed lead can be passed from mother to offspring via the placenta and in milk. The elimination kinetics of lead in blood is slow, and most lead is eliminated from the body in urine and feces (ATSDR 2007a).

Exposure to lead can affect many systems and tissues in the human body, in particular, the nervous system. Children are more sensitive to lead toxicity than adults. For this reason, most lead regulations are based on effects in children. Lead toxicity occurs by multiple mechanisms, including binding to sulfhydryl groups, which can affect the structure and function of various enzymes, receptors, and other proteins. Lead may also compete with other ions, such as calcium, iron, and zinc that have important metabolic and homeostatic functions.

The US EPA (2004) and ATSDR (2007a) have not derived any toxicological reference values (*e.g.*, RfD, RfC, MRL) for inorganic lead compounds, because a clear exposure threshold for the more sensitive effects in humans has not been identified. The total body burden of lead depends on the individual's history of exposure; so a metric of external exposure is not a reliable predictor of absorbed dose. Instead of an MRL approach, ATSDR (2007 a,b) recommends a hazard dose-response approach, based on internal doses, as measured by blood lead levels. Table 2 summarizes the ranges of blood lead levels at which specific health effects have been reported. ATSDR (2007b) recently revised its reference level of 10 µg/dL to 5 µg/dL of lead in blood for children and recommends chelation therapy if a child's blood lead level is ≥ 45 µg/dL.

Table 2. Summary of Health Effects Associated with Blood Lead Levels (ATSDR 2007)

System	Health Effect	Blood Lead Level Range
Hematological	Decreased activity of several heme biosynthesis enzymes	<10 µg/dL
Gastrointestinal	Colic in children	60–100 µg/dL
Cardiovascular	Elevated blood pressure	<10 µg/dL
Renal	Decreased glomerular filtration rate	<20 µg/dL
Neurological	Encephalopathy	100–120 µg/dL (adults) 70–100 µg/dL (children)
	Peripheral neuropathy	40 µg/dL
	Neurobehavioral and neuropsychological effects in adults	40–80 µg/dL
	Cognitive and neurobehavioral effects in children	<10 µg/dL
Reproductive	Reduced fertility	>40 µg/dL

NTP determined that lead and lead compounds are "reasonably anticipated to be a human carcinogen" in its 13th Report on Carcinogens (NTP 2014). The US EPA (1993) has determined that inorganic lead is a "probable human carcinogen" (Classification B2). IARC has determined that inorganic lead (including lead tetroxide) is "probably carcinogenic to humans" (Group 2A). The ACGIH (2008) has listed inorganic lead as a confirmed animal carcinogen with unknown relevance to humans (A3 Classification). Cal EPA (2015) includes lead and lead compounds in

its current Proposition 65 list of "chemicals known to the state to cause cancer or reproductive toxicity." The US EPA (1993) has not derived a quantitative cancer potency value for inorganic lead compounds. However, Cal EPA (2009) reports an oral CSF of 0.0085 $(mg/kg\text{-}day)^{-1}$, an inhalation slope factor of 0.042 $(mg/kg\text{-}day)^{-1}$, and an inhalation unit risk of 0.000012 $\mu g/m^3$ (staff could not locate a technical document describing the derivation of these values).

In summary, as an ingredient in fireworks, lead tetroxide can be released into the environment upon explosion, where it may be inhaled as particles. Lead particles may also settle onto surfaces where oral exposures could occur. Lead tetroxide and other inorganic lead compounds can be absorbed by the oral and inhalation routes and exert a variety of toxicological effects. Children are more sensitive to lead toxicity than adults, and the effect of most concern is neurological development in children. The guidance values for preventing lead toxicity are based on body burden (*i.e.*, children's blood lead levels), rather than on typical toxicological reference values (*e.g.*, RfD, MRL). Several agencies have determined that lead and lead compounds (including lead tetroxide) are probably carcinogenic to humans. Because of the human health hazards, the Directorate for Health Sciences supports a limitation of lead tetroxide and other lead compounds in consumer fireworks, but the staff cannot currently comment on how protective of human health the limit value of 0.25 percent would be.

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Tab B – LSC Memorandum

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

Memorandum

Date: April 17, 2015

TO : Priscilla M. Verdino, Project Manager

THROUGH: Andrew G. Stadnik, Associate Executive Director for Laboratory Sciences
Aaron Orland, Division Director, Laboratory Sciences – Chemistry

FROM : Jason E. Howe, Chemist

SUBJECT : APA 87-1 Harmonization Investigation

Introduction

The U.S. Consumer Product Safety Commission ("CPSC" or "Commission") regulates fireworks devices under the Federal Hazardous Substances Act ("FHSA").[60] The division of Laboratory Sciences-Chemistry ("LSC") tests consumer fireworks under CPSC's compliance testing program. CPSC has developed a testing manual to facilitate industry compliance with the various fireworks regulations.[61] Under the direction of the Commission, staff has completed a rule review of the current fireworks regulations.

In particular, LSC staff focused on the regulations that pertain to the testing, design, and chemical composition of fireworks and evaluated them from a scientific perspective. These regulations include the requirements in §1500.17(a)(3) and (8), which limit the pyrotechnic material in aerial devices and in firecrackers, and part 1507, which specifies certain prohibited chemicals fireworks devices must not contain, in addition to performance and design requirements for the fuses, bases, pyrotechnic chambers, handles, spikes, wheel devices, toy smoke devices, flitter devices, stick rockets, party poppers, and multiple tube fireworks devices.

Staff considered CPSC researched methods, current technology, and applicable international and voluntary standards for possible improvement of the fireworks regulations. The two main international standards are the European Standard EN 15947-1–15947-5: Pyrotechnic Articles—Fireworks, Categories 1, 2, and 3 ("European Standard"), and the American Pyrotechnics Association Standard 87-1: Standard for Construction and Approval for Transportation of Fireworks, Novelties, and Theatrical Pyrotechnics ("APA 87-1"). The U.S. Department of Transportation ("DOT") regulates the transportation of fireworks and requires

[60] 15 U.S.C. §§ 1261-1278.
[61] CPSC Fireworks Testing Manual.

compliance with APA 87-1 when approving the transportation of display and consumer fireworks. The American Fireworks Standards Laboratory ("AFSL") has developed voluntary standards that incorporate both the CPSC and DOT regulations, as well as a number of standards developed by AFSL that are in addition to the federal requirements.

1. Review of 16 C.F.R. § 1500.17(a)(3) and (8)

Discussion that follows on § 1500.17(a)(3) will be separated into three sections. First, a discussion of "fireworks devices intended to produce an audible effect…" then discussion of large banned firecrackers and, finally a discussion of "aerial bombs".

A. Devices intended to produce an audible effect

Section § 1500.17(a)(3) bans a fireworks device that is "intended to produce audible effects" if the audible effect is produced by a charge of more than 2 grains (130 milligrams) of pyrotechnic composition. In upholding § 1500.17(a)(3) against legal challenge, the federal court referred to this particular test as "the amount test," reflecting the objective character of the standard.[62] In yet another legal challenge where this rule was upheld, the court stated that "[t]he limit of two grains of pyrotechnic powder in 16 C.F.R. § 1500.17(a)(3) applicable to all fireworks devices producing an audible effect provides reasonable and fair notice of what [companies] may not distribute to consumers."[63]

Fireworks devices are field tested in accordance with the "Consumer Fireworks Testing Manual."[64] Fireworks devices that are not intended to produce an audible effect have no restriction on pyrotechnic composition. Although all devices produce an audible effect, not all audible effects are intentional. For example, fireworks devices such as tube mortars and mine shells may produce visible effects and the audible effect heard is a byproduct of the explosion of the break charge required to disperse those visual effect elements. As such, determining whether an aerial device is "intended to produce an audible effect" requires years of training and expertise. CPSC possesses decades of experience in determining whether a device is intended to produce an audible effect that is subject to this regulation.

CPSC has not updated § 1500.17(a)(3) since its adoption many decades ago. Since the promulgation of this rule industry has moved away from black powder as the break charge in fireworks devices, and instead, sometimes uses hybrid powders. These hybrid powders, depending on the construction of the shell, packing density, and quantity of powder, in some cases, might produce an audible effect; while in other cases, the sound produced is incidental to the necessary function of dispersing the visual effects. In the case when the sound is incidental to the dispersion of visual effects, the requirement in §1500.17(a)(3) does not apply and no CPSC regulation regulates the quantity of explosive composition.

[62] *United States v. Shelton*, 34 F. Supp.2d 1147 (W.D. Mo. 1999).
[63] *United States v. Midwest Fireworks Mfg. Co.*, 248 F.3d 563 (6th Cir. 2001).
[64] (https://www.cpsc.gov/PageFiles/121068/testfireworks.pdf).

To determine "intent to produce an audible effect," CPSC staff listens to the device during field testing, and based on the sound, determines whether the applicable "loud report" was observed. If staff hears a "loud report," staff considers the fireworks device "intended to produce an audible effect"; and the break charge (which causes the audible effect) less than 100-mesh in particle size is limited to 2 grains (130 milligrams).[65] Staff examines the shell and weighs the break charge to determine compliance with the regulatory limits. A device only fails this requirement if the pyrotechnic material exceeds 2 grains (130mg).

Over the years, CPSC staff extensively trained the fireworks industry to help improve the consistency of this testing protocol.[66] However, because all fireworks devices produce an audible effect it is difficult to determine if that audible effect was intentional or necessary for the functioning of the device. Fireworks devices tend to be handmade, devices that are intended to be identical often don't produce the same audible effect. The amount of powder, effects, shell width and height, often vary greatly within devices from the same manufacturer and lot.

To find an alternative approach that might more effectively address all devices rather than just those "intended to produce an audible effect", over the last 4 years, CPSC staff has researched a method that would test the energetics of the break charge to see if there is a correlation between energetics and injuries. This test method involved "whole shell testing," in which the shell is detonated and the pressure created is measured. These test methods have not produced reliable results and would create a burden on CPSC and industry, due to the complex nature of the testing required and the data analysis that follows. Although staff observed differences in pressure, staff could not find a correlation between a specific pressure released and injury potential.[67]

In considering the review of "fireworks devices intended to produce an audible effect" used in 16 C.F.R. 1500.17(a)(3), staff reviewed analogous standards. The international standards (APA 87-1 and the European Standard), as well as the AFSL voluntary standard, were considered. Significantly, like the current CPSC standard, all standards address audible effects Table 1 summarizes the major differences between the standards and the CPSC regulation.

Table 1
Audible Effect Regulations in Voluntary Standards compared to CPSC Regulations

APA 87-1	AFSL Standard	CPSC Regulation	European Standard
States that "any burst charge containing metallic powder (such as magnalium or aluminum) less than	Break charge must consist of "black powder or equivalent" (non-metallic fuel or demonstrated by	Limits fireworks devices intended to produce an audible effect to not more than 130mg of	For report and/or bursting charges, the net explosive content is limited to the amount of black

[65] Consumer Product Safety Commission, "Consumer Fireworks Testing Manual" (Aug. 17, 2006).
[66] Christopher Musto & Andrew Lock, Consumer Product Safety Commission, "FY 2012 Fireworks Safety Standards Development Status Report" (2013).
[67] Christopher Musto & Andrew Lock, Consumer Product Safety Commission, "FY 2012 Fireworks Safety Standards Development Status Report" (2013).

100 mesh in particle size, is considered to be intended to produce an audible effect, and is limited to 130mg in 1.4G fireworks devices" Additionally states that "burst charge consisting of black powder or equivalent non-metallic composition is not considered to be intended to produce an audible effect when it is used to expel and ignite a secondary effect in a fireworks device."	empirical testing data that it is equivalent in performance to black powder.)	pyrotechnic composition. Tests for "intent to produce audible effect" during field testing by listening to the device.	powder or the amount of nitrate/metal-based report composition or the amount of perchlorate/metal based report composition. These limitations vary based on type of device.
Limits on total chemical and pyrotechnic material for all fireworks devices	Limits on total chemical and pyrotechnic material for all fireworks devices	Current CPSC regulations only provide pyrotechnic limits for firecrackers (50mg) and for "devices intended to produce audible effects"	Limits on total chemical and pyrotechnic material for all fireworks devices (some devices are different than what are used in the United States)
Limits the ratio of break charge to effects for mine and shell devices as well as aerial shells at "25% of the total weight of chemical composition in the component/shell" (respectively)	Limits the ratio of break charge to effects for large (greater than 1 inch) mine and shell devices at "25% by weight of the chemical composition of the tube or 10 grams, whichever is less" small devices (1 inch or less) are limited to '50% by weight of the chemical composition of the tube or 10 grams, whichever is less" Aerial shells are	Current CPSC regulations do not provide a ratio of break charge to effects.	Limits total pyrotechnic weight for report charges containing nitrate at 40% of black powder limit or limits perchlorate based report charges at 20% of black powder limit

	limited to “35% by weight of the chemical composition of the shell or 10 grams, whichever is less”		

As can be seen in the chart above, CPSC is not unusual in limiting pyrotechnic material for audible effects. The particular language used in the regulation, specifically, the words “devices intended to produce an audible effect” could be updated to better address all devices currently on the market instead of just those intended to produce an audible effect. Additionally, guidance on what devices are deemed “intended to produce audible effects” could be better addressed. The European Standard, the AFSL standard and the APA standard all address audible effects through limits in the chemical composition of break charges. They not only limit the amount of pyrotechnic composition like the CPSC, but the chemical composition as well. It should be noted that “reports” are analogous to “audible effects”. Staff believes the regulation could be improved by updating the language in the CPSC regulation to better align with the international consensus standard. Instead of pyrotechnic limits only applying to “devices intended to produce audible effects” as is with the current regulation, limiting the chemical composition in the break charge for report charges and the total pyrotechnic material of all devices would incorporate all devices.

Except in the CPSC regulation all standards consider the use of metallic fuel in the break charge as intended to produce a report and henceforth have a stricter limit than black powder. This is likely because the addition of metallic fuels transforms the explosive from primary to secondary meaning that the explosive with metallic fuel is more energetic per volume than the explosive without metallic fuel. Additionally the AFSL and APA 87-1 limit the ratio of break charge to effects. This is important because if a shell consisted of too much break charge to effects the effects could disperse farther and cause flaming debris. Staff believes that by examining the shell and examining the chemical composition of the break charge in addition to the amount of pyrotechnic composition in all devices would be a more reliable and repeatable method for determining “intent to produce an audible effect” than the current method of listening to the device. This is due to the fact that determining a “loud report” by listening takes more training and is less repeatable than an analytical examination if metallic fuel was used.

As noted, companies currently must adhere to APA 87-1 to transport, display and consumer fireworks in the US. Although the AFSL standard is similar, adopting the particular language in APA 87-1 would be more appropriate since CPSC would more closely align with the DOT regulations making administration of regulations easier. The European Standard language is difficult to incorporate due to the fact that the European Standard separates fireworks into different categories than the U.S. does and the types of devises are unique to Europe and do not necessarily correlate with devices common in the U.S.

To reiterate, the APA 87-1 states that “any burst charge containing metallic powder (such as magnalium or aluminum) less than 100 mesh in particle size, is considered to be intended to

produce an audible effect, and is limited to 130mg in 1.4G fireworks devices". It should be noted that the 130mg limit (2 grains) is the same as the current CPSC limit, the difference is that the language in APA specifically addresses the fact that some chemical compositions of explosives (those containing metallic fuel) are more energetic per volume than those that do not contain metallic fuel. Additionally APA 87-1 states that "burst charge consisting of black powder or equivalent non-metallic composition is not considered to be intended to produce an audible effect when it is used to expel and ignite a secondary effect in a fireworks device." APA 87-1 also limits the total pyrotechnic and chemical composition, as well as the ratio of effects to break charge to 25%.

The European Standard, the AFSL Standard and APA 87-1 all limit the total pyrotechnic weight of all fireworks devices regardless of the device producing a report. This is important since the energetic power of the device is directly related to the amount of pyrotechnic material in the device. Depending on the type of device, a different limit applies. Staff believes that a limit on the total pyrotechnic weight in all devices (not only those intended to produce an audible effect) is an important component missing in the CPSC regulation since all fireworks have the potential of creating an injury, not only those intended to produce an audible effect.

Since companies must adhere to the DOT limits of pyrotechnic composition and weights in order to transport fireworks in the Unites States, staff believes that adopting the APA 87-1 provisions would provide minimal economic burden to industry. Currently industry must comply both with the CPSC regulation and APA 87-1. Adopting these limits will make testing easier and administration of the regulation simpler (see Tab C for further analysis). Under APA 87-1, each type of device has its own pyrotechnic and chemical limit. Staff recommends the addition of these specific limits into the CPSC regulation.

The APA limits for aerial devices are listed below:[68]

A) *Sky Rockets, Bottle rockets, Missile-type rockets, Helicopter (aerial spinners), Roman Candles*: Limited to no more than 20 grams of chemical composition.
B) *Mine and Shell devices*: Total chemical composition is limited to no more than 60 grams per shell. Total chemical composition of multiple tube devices must not exceed 200 grams unless the tubes are securely attached to a wood or plastic base and the tubes are separated from each other on the base by a distance of at least 0.50 inches (12.7mm) in which case no more than 500 grams of total chemical composition is allowed. Lift charge is limited to a maximum allowance of 20 grams per shell. Lift charge is limited to black powder (potassium nitrate, sulfur, and charcoal) or similar pyrotechnic composition without metallic fuel. The maximum amount of burst charge should not exceed 25% of the total weight of chemical composition in the component. Although not explicitly clear in the APA standard, CPSC staff considers that the 25 percent limit excludes the lift charge because it is not part of "the component" that subsequently bursts in the air.
C) *Aerial Shell with reloadable tube*: Limited to no more than 60 grams per shell. Lift charge is limited to a maximum allowance of 20 grams per shell. Lift charge

[68] Definitions of relevant terms are included in section III. F. in this briefing package.

is limited to black powder (potassium nitrate, sulfur, and charcoal) or similar pyrotechnic composition without metallic fuel. The maximum amount of burst charge should not exceed 25 percent of the total weight of chemical composition in the component. (Although not explicitly clear in the APA standard, CPSC staff considers that the 25 percent limit excludes the lift charge because it is not part of "the component" that subsequently bursts in the air. The total chemical composition of all the shells in the kit must not exceed 400 grams.

To summarize, staff recommends replacing "intent to produce audible effect" with APA burst charge requirement requiring any burst charge containing metallic powder (such as magnalium or aluminum) less than 100 mesh in particle size be limited to 130mg as well as incorporate APA pyrotechnic and chemical composition limits for all fireworks devices. Additionally, staff recommends obtaining public input on appropriate contamination level for metal powder presence in break charges exceeding 2 grains (130mg).

B. Mention of cherry bombs, M-80 salutes, silver salutes and other large firecrackers

Section § 1500.17(a)(3) incudes mention of , "cherry bombs, M-80 salutes, silver salutes, and other large firecrackers". . .." These are all large firecrackers that were banned by CPSC. Firecrackers have a stricter limit of 0.772 grains of pyrotechnic composition in § 1500.17(a)(8). As explained later in the briefing package, staff does not recommend any changes to firecrackers. However, the reference to firecrackers should be removed from § 1500.17(a)(3) and moved to § 1500.17(a)(8) to avoid confusion.

C. Aerial Bombs

The term "aerial bomb" used in § 1500.17(a)(3) is not defined by the CPSC, the AFSL, the APA, or the European Standard. The language in § 1500.17(a)(8) indicates that "aerial bombs" are banned hazardous substances, without specifying a pyrotechnic limit. In § 1500.17(a)(3), the language indicates that aerial bombs have a 2-grain (130 milligram) limit. Staff needs further information to determine if § 1500.17(a)(8) or if § 1500.17(a)(3) is the appropriate location for aerial bombs. Staff recommends seeking public comment regarding these devices; what, if any, injuries are associated with them; and whether aerial bombs should be banned or limited to 2 grains of metallic fuel or continued to be included in both sections.

APA 87-1 Test method for "intent to produce audible effect"

Currently, CPSC regulations only limit the total pyrotechnic composition for devices intended to produce an audible effect (§ 1500.17(a)(3)) and firecrackers (§ 1500.17(a)(8)). As mentioned previously, the DOT, through APA 87-1, limits the total pyrotechnic composition of all fireworks devices, the total lift charge a device or part of a device may contain, and the mass distribution of break charge to effects. APA 87-1 sections 3.1.2.5 and 3.1.2.6 state that consumer fireworks may have a maximum break charge of 25 percent (by weight) per component, of the device's total chemical composition per component, if the break charge is composed of black powder, or equivalent non-metallic composition. Under APA 87-1, metal fuel indicates intent to produce an audible effect and the standard limits the amount to 130 milligrams.

Staff recommends considering the addition of the following pyrotechnic composition mass and composition limits from APA 87-1 to CPSC's regulations to improve safety by limiting the power of fireworks devices, and consequently, the injury potential for consumers:

A) Sky Rockets, Bottle rockets, Missile-type rockets, Helicopter (aerial spinners), Roman Candles: Limited to no more than 20 grams of chemical composition.

B) Mine and Shell devices: Total chemical composition is limited to no more than 60 grams per shell. Total chemical composition of multiple tube devices must not exceed 200 grams unless the tubes are securely attached to a wood or plastic base, and the tubes are separated from each other on the base by a distance of at least 0.50 inches (12.7 millimeters) in which case no more than 500 grams of total chemical composition is allowed. Lift charge is limited to a maximum allowance of 20 grams per shell. Lift charge is limited to black powder (potassium nitrate, sulfur, and charcoal) or similar pyrotechnic composition without metallic fuel. The maximum amount of burst charge should not exceed 25 percent of the total weight of chemical composition in the component (25% excludes lift charge since it is not part of the component that subsequently bursts in the air).

C) Aerial Shell with reloadable tube: Limited to no more than 60 grams per shell. Lift charge is limited to a maximum allowance of 20 grams per shell. Lift charge is limited to black powder (potassium nitrate, sulfur, and charcoal) or similar pyrotechnic composition without metallic fuel. The maximum amount of burst charge should not exceed 25 percent of the total weight of chemical composition in the component. (25 percent excludes lift charge since it is not part of the component that subsequently bursts in the air). The total chemical composition of all the shells in the kit must not exceed 400 grams.

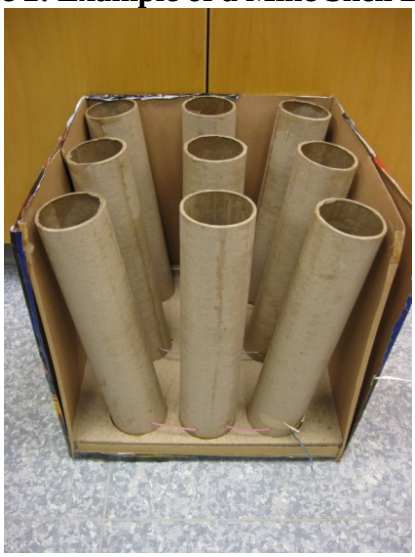
To assess the process, LSC performed some random testing of fiscal year ("FY") 2014 and FY 2015 compliance fireworks samples. This random testing included determination of the total pyrotechnic weight in devices and the break charge chemical composition. The process and test results are described below.

a. Description of Samples

Fireworks samples of various sizes and types from various manufacturers were chosen due to availability from existing CPSC compliance testing. The two main devices that were chosen were reloadable tube mortar devices (Figure 1) and multiple-tube mine and shell devices (Figure 2). These two types represent the majority of fireworks devices sampled for Compliance purposes. Currently, when CPSC receives a fireworks sample, multiple devices of the same sample are received so that staff can conduct testing on more than one device. Each device is designated a specific "sub" number. For this process, one sub from each sample was chosen at random. For reloadable tube mortar devices, often, multiple shells are received for each device. Of these, one shell was selected, at random, from the chosen sample sub. For the multiple-tube mine or shell device, three of the devices' multiple tubes were chosen randomly. Staff analyzed the individual devices for powder weights and saved the break charge chemical composition for subsequent elemental analysis.

Figure 1: Example of a Reloadable Tube Mortar Device

Figure 2: Example of a Mine Shell Device



b. Analysis of Pyrotechnic Composition Mass for Individual Components

APA 87-1 section 3.1.2.5 states that if the break charge is composed of black powder or equivalent non-metallic composition, consumer fireworks may have a maximum break charge of 25 percent by weight of the device's total pyrotechnic composition in each component. If the break charge contains a metal fuel (for example, aluminum or the aluminum-magnesium alloy called magnalium), the limit for the break charge is 130 mg. This is part of the APA 87-1's effort to test repeatedly and reliably for "intent to produce an audible effect," based on having more break charge than reasonably necessary to disperse and initiate visual effects.

APA 87-1 limits the mass of the lift charge to a maximum allowance of 20 grams per shell in both reloadable aerial shells (APA 87-1 section 3.1.2.5) and multiple-tube mine and shell devices (APA 87-1 section 3.1.2.6). For reloadable aerial shell devices, the maximum amount of pyrotechnic composition allowed in a single shell is 60 grams. For multiple-tube mine or shell devices, the maximum amount of pyrotechnic material is 200 grams total, unless the tubes are securely attached to a wood or plastic base and the tubes are separated from each other on the

base by a distance of at least 0.50 inches (12.7mm). In this case, no more than 500 grams of total chemical composition are allowed.

Staff carefully dissected and subsequently analyzed 42 (12 reloadable aerial shell devices and 30 multiple-tube mine or shell devices) uniquely labeled "sample devices" to obtain the lift charge, break charge, and effect weights. Following CPSC's testing methods, [69] staff separated the break charge from the effects by passing the pyrotechnic contents of the shell through a 100-mesh sieve. Tables 1 and 2 show the results of the pyrotechnic components analysis. Highlighted values show violations, which are subsequently discussed.

Table 1: Mass of Pyrotechnic Composition for Reloadable Aerial Shells

Sample Number	Lift Charge (g)	Break Charge (g)	Effect Mass (g)	Total Pyrotechnic Composition (g)	Ratio	CPSC Pass/Fail (Report weight only)*
30	4.881	2.995	19.256	27.132	13.5%	Pass
31A	5.437	2.626	17.520	25.583	13.0%	Pass
31B	5.691	4.823	30.237	40.751	13.8%	Pass
15-800-0765	3.826	8.222	24.829	36.877	24.9%	Pass
15-304-0961	4.226	1.951	19.884	26.061	8.9%	Pass
14-304-4508	7.826	6.380	18.211	32.417	26.0%	Fail
14-304-3853	6.437	10.225	34.552	51.214	22.8%	Fail
14-810-5751	8.721	9.369	29.396	47.486	24.2%	Fail
14-810-5837	8.780	11.592	26.372	46.744	30.5%	Fail
14-810-5841	6.470	9.477	33.110	49.057	22.3%	Pass
14-840-7473	8.159	6.428	28.340	42.927	18.5%	Fail
14-840-7779	7.641	7.732	28.995	44.368	21.1%	Fail

* A report weight was determined only if an audible effect was found in even one trial for a particular sample during Field testing. A pyrotechnic composition mass for material passing through a 100-mesh sieve greater than 130 mg (2 grains) was deemed a Fail for that sample.

[69] Consumer Product Safety Commission, "Consumer Fireworks Testing Manual" (Aug. 17, 2006).

Table 2: Mass of Pyrotechnic Composition for Mine Shell Devices*

Sample Number	Max Pyro Comp (g)	Number of Tubes per device	Lift Charge Average (g)	Break Charge Average (g)	Effect Mass Average (g)	Total Pyro Comp (g)**	Ratio	CPSC Pass/Fail (Report weight only)***
15-800-2396	200	10	2.938	3.348	8.009	142.953	29.5%	Pass
15-800-2402	500	28	3.494	2.576	11.341	487.508	18.5%	Pass
15-800-2728	500	36	1.613	1.754	7.606	395.028	18.7%	Pass
15-800-2660	500	15	3.394	3.341	12.467	288.020	21.1%	Pass
14-304-3824	500	9	8.159	1.271	30.769	361.788	4.0%	Pass
15-800-3240	500	30	3.189	3.684	8.948	474.660	29.2%	Pass
15-800-3239	200	19	2.157	2.298	6.979	217.240	24.8%	Pass
15-800-2400	500	25	3.337	1.881	11.605	420.567	13.9%	Pass
15-800-3238	200	16	2.312	2.042	6.948	180.843	22.7%	Pass
15-304-0960	200	25	2.692	2.732	4.097	238.025	40.0%	Pass
15-800-2598	500	18	5.009	3.525	17.293	464.892	16.9%	Pass
15-800-2399	500	16	3.859	2.228	12.267	293.669	15.4%	Pass
15-800-2398	500	24	3.844	3.103	2.905	236.448	51.6%	Pass
15-800-2661	200	9	3.334	3.540	13.390	182.376	20.9%	Pass
15-304-0997	500	30	3.841	3.631	9.420	506.760	27.8%	Pass
12-810-5761	500	16	10.472	3.031	20.522	544.395	12.9%	Pass
15-800-0706	200	20	2.168	0.000	5.093	145.220	0.0%	Pass
15-800-4569	200	24	2.161	2.835	6.709	280.912	29.7%	Pass
15-800-4570	500	47	2.643	0.000	6.233	417.156	0.0%	Pass
15-800-2403	500	30	3.340	2.741	8.509	437.700	24.4%	Pass
15-304-0996	500	30	3.465	3.846	8.547	475.760	31.0%	Pass
15-800-4568	200	25	2.071	2.407	5.851	258.225	29.1%	Pass
15-800-2404	500	30	3.835	0.906	8.821	406.850	9.3%	Pass
12-304-3668	500	10	7.081	2.335	31.234	406.493	7.0%	Fail
15-800-0325	500	9	7.320	0.744	29.646	339.384	2.4%	Pass
13-810-5744	500	12	3.224	3.232	10.470	203.112	23.6%	Pass
15-800-2397A	500	110	0.780	0.000	2.363	409.175	0.0%	Pass
15-800-2397B		5	3.191	1.965	7.544		20.7%	Pass
13-840-8301A	500	12	4.375	1.762	19.826	461.994	8.2%	Pass
13-840-8301B		3	7.299	1.612	41.241		3.8%	Pass

* Averages were obtained from three random shells per sample sub. Individual weights of shells (lift, break, and effects) are listed in Appendix 1.

** Total Pyrotechnic weight was obtained by multiplying the sum of the average lift, break, and effect masses by the respective total number of tubes in the shell. The letter designations "A" and "B" indicate the presence of different diameter tubes in a single device. Three measurements were made of each diameter, and the total pyrotechnic composition was still calculated as one device.
*** A report weight was determined only if an audible effect was found in even one trial for a particular sample during Field testing. A pyrotechnic composition mass for material passing through a 100-mesh sieve greater than 130 mg (2 grains) was deemed a Fail for that sample.

c. Break Charge Chemical Analysis

Staff used X-Ray Fluorescence spectroscopy ("XRF") to test the break charge for elemental analysis. This was done to verify if any of the break charge masses contained metallic fuel, and thus, according to APA 87-1, were intended to produce an audible effect (report) and are further limited to 130 milligrams (2 grains). Highlighted values show violations that are subsequently discussed.

Table 3: Elemental Composition of Break Charge via X-Ray Fluorescence (XRF)

Sample Number	Aluminum Content (ppm Al)	Titanium Content (ppm Ti)	CPSC Pass/Fail (Report weight only)*
1	3883 ± 956	170 ± 38	Pass
2	ND	258 ± 34	Pass
3	31300 ± 1700	293 ± 36	Pass
4	29300 ± 1400	148 ± 50	Pass
5	2052 ± 1065	157 ± 39	Pass
6	6766 ± 1287	231 ± 62	Pass
7	19800 ± 1400	ND	Pass
8	ND	298 ± 38	Pass
9	17500 ± 1200	ND	Pass
10	34600 ± 1600	244 ± 44	Pass
29	5654 ± 1078	133 ± 39	Pass
11	6905 ± 583	222 ± 19	Pass
12	ND	292 ± 19	Pass
13	6089 ± 1151	123 ± 41	Pass
14	27800 ± 1500	175 ± 40	Pass
30	ND	89 ± 33	Pass
31A	5339 ± 1395	92200 ± 600	Pass
31B	5165 ± 1444	89400 ± 600	Pass
32	ND	441 ± 35	Pass
33	41600 ± 1200	7108 ± 78	Pass
22	ND	276 ± 54	Pass
23	12400 ± 1400	248 ± 39	Pass
24	17100 ± 1300	121 ± 58	Fail
25	ND	121 ± 37	Pass
26	17600 ± 1400	481 ± 40	Pass

34	51600 ± 2100	536 ± 48	Fail
18	26800 ± 1600	ND	Pass
20	16000 ± 1500	155 ± 50	Pass
21	23000 ± 1400	315 ± 56	Pass
15	28500 ± 1500	191 ± 53	Pass
16	29000 ± 1500	274 ± 49	Pass
28B	1808 ± 1204	119 ± 41	Pass

Note: "ND" indicates "None Detected"
* A report weight was determined only if an audible effect was found in even one trial for a particular sample during Field testing. A pyrotechnic composition mass for material passing through a 100-mesh sieve greater than 130 mg (2 grains) was deemed a Fail for that sample.

d. Discussion of Results

Two reloadable aerial shell devices that staff analyzed (Table 1) had a break charge-to-affect ratio above the 25 percent mass ratio allowable under APA 87-1. None of the analyzed reloadable aerial shells contained greater than the allowable 20 grams of lift charge or 60 grams of total pyrotechnic composition.

Eight out of the 30 (27%) analyzed multiple-tube mine and shell devices (Table 2) had a break charge-to-effects ratio above the 25 percent mass ratio allowable under APA 87-1. None of the 30 analyzed multiple-tube mine and shell devices had a lift charge in excess of the allowed 20 grams. Six of the 30 (20%) analyzed multiple-tube mine and shell devices had a total pyrotechnic composition greater than the allowed 200 grams or 500 grams (APA 87-1 section 3.1.2.5), depending on the base construction. Four of these six violations also overlapped with the 25 percent mass ratio violations.

According to APA 87-1 section 2.5, any break charge containing metallic powder (such as aluminum) less than 100-mesh in particle size is considered to be intended to produce an audible effect. Of the 32 break charge pyrotechnic materials available and further examined by XRF (Table 3), 25 contained detectable quantities of aluminum. Exact aluminum levels, however, were not quantified. All aluminum rich break charges exceeded the 130-mg limit specified in APA 87-1. The absence of an allowable limit for impurities creates a large burden from a scientific perspective. This burden is further discussed in the "Prohibited Chemicals" section below. At small amounts, it is clear that metal is not being used as a fuel; its presence is likely due to contamination in the manufacturing process.

Both the CPSC regulation and APA 87-1 are intended to address the same hazard. Both APA 87-1 and the CPSC test method would keep M-80s and silver salutes out of the public's hands. However, they do so through different means. Both devices that failed the CPSC's determination of audible effects during field trials and subsequent report weight in excess of 2 grains (130 mg), also contained metallic fuel, thus failing the APA 87-1 test. Although the means of testing for these illegal devices are different, both the CPSC's and the APA's approach protect against the hazards in M-80s and similar devices. By analytically examining fireworks devices that contain metallic fuel and limiting the amount of break charge to effects, dangerous devices would be kept out of the market. Given that the same regulatory intent is intended to be

addressed by both CPSC and APA 87-1, CPSC staff feels that adopting the repeatable and reliable APA 87-1 standard (which is also mandatory through DOT regulation) can lead to a more cost-effective way for industry to attain a higher rate of compliance, and maintain the same safety standard the CPSC strives to achieve. Staff would like to work with the public to find an appropriate contamination level for metal powder.

e. Conclusion

This survey of samples collected for routine CPSC compliance investigation shows that CPSC can test the masses of individual pyrotechnic device components (lift charge, break charge, effects) and determine the elemental composition of the break charge. This testing is already required by DOT for the transportation of consumer fireworks and is detailed by APA 87-1.

CPSC staff recommends aligning the CPSC regulations with the DOT in order to provide industry with one regulation. This would reduce the burden of having to comply with two different tests. Additionally, administration of a single regulation would be easier for industry.

2. Review of 16 C.F.R. part 1507

A. § 1507.2

Part 1507 specifies certain prohibited chemicals that fireworks devices must not contain, as well as performance and design requirements for the fuses, bases and pyrotechnic chambers. It also specifies requirements for specific devices such handles, spikes, wheel devices, toy smoke devise, flitter devices, stick rockets, party poppers and multiple tube fireworks devices.

Section 1507.2 lists various chemicals that are prohibited in fireworks devices. Health Sciences reviewed the merits of these chemicals and also recommended the addition of lead and hexachlorobenzene (HCB). Adding these chemicals would not place a large burden on CPSC. Lead can be quickly detected via XRF, and HCB would require detection by Gas Chromatography – Mass Spectroscopy (GC-MS), which the CPSC already possesses. As currently written, the regulation prohibits even trace amounts of the chemicals listed, making the testing and manufacturing of devices that comply with this requirement difficult and expensive. Instrumentation used to test for the presence of chemicals has improved greatly since 1974 when the CPSC promulgated the rule. As a result, trace amounts of chemicals that previously went undetected are now identified in tested samples. Furthermore, quantifying trace amounts of these chemicals involves substantial time and ample resources. Disproving even trace amounts of a chemical in a product becomes almost impossible because instrumentation can only quantify to parts per billion (ppb) and even parts per trillion (ppt) but not zero. For this reason, staff recommends allowing a reasonable amount as impurities.

Staff believes that trace amounts of these chemicals may not pose a safety risk to consumers and would allow for reasonable production and test methods and costs. The intention of allowing trace amounts of these chemicals would not be to give industry authority to add these chemicals intentionally into the manufacturing process. There would be no added benefit to them

in doing so. These chemicals are not intentionally introduced into the products through production methods, but are present in background levels in the environment. Complete removal of the chemicals from the end product would necessitate ensuring that they are not present in the environment during production. The intention is not to change any current practice, but to facilitate reasonable and cost effective testing. Many of these chemicals are listed in the regulation due to their instability in the manufacturing process and storage. Therefore, it is in industries best interest to avoid the use of the listed chemicals.

Allowing trace amounts of these chemicals would not give industry authority to add these chemicals into the manufacturing process purposely. Thus, consumer safety would not be affected by such a change. These chemicals are not intentionally introduced into the products through production methods, but are present in background levels in the environment. Complete removal of the chemicals from the end product would necessitate ensuring that they are not present in the environment during production. With additional information and public input, staff believes that setting an appropriate trace amount limit that would simultaneously protect consumers and account for the advances in technology is possible. For this reason, staff recommends allowing a reasonable amount of these chemicals as impurities. The intention is to clarify the current requirement to facilitate reasonable and cost-effective testing without posing any increase in risk.

As an example of the burdens that CPSC as well as industry must overcome due to the lack of a trace allowances, staff investigated the presence of titanium metal (Ti) content in some FY14 and FY15 compliance fireworks samples. Titanium metal that is 100-mesh or less in particle size is currently prohibited according to 16 C.F.R. § 1507.2, APA 87-1 and the AFSL voluntary standard. Staff tested lead simultaneously due to the nature of the instrumentation and the ease in doing so.

a. Test Method

After staff removed the break charge pyrotechnic composition from the device and passed it through a No. 100-mesh sieve, they used XRF to test the break charge for elemental composition. The benefits of XRF testing include a lack of further sample preparation and simultaneous testing of all elements of the periodic table above magnesium in atomic number. The initial sample preparation of removing the pyrotechnic composition and sieving is already required for determining the mass ratio. This means that the XRF testing is very cost effective for routine elemental analysis screening.

b. Results

Table 4 lists the quantity of lead and titanium detected in the samples.

Table 4: Elemental Composition of Break Charge via X-Ray Fluorescence (XRF)

Sample	Titanium Content (ppm Ti)	Lead (ppm Pb)
1	170 ± 38	ND
2	258 ± 34	ND

3	293 ± 36	ND
4	148 ± 50	ND
5	157 ± 39	27 ± 3
6	231 ± 62	7369 ± 59
7	ND	ND
8	298 ± 38	ND
9	ND	ND
10	244 ± 44	452 ± 11
29	133 ± 39	ND
11	222 ± 19	38 ± 2
12	292 ± 19	ND
13	123 ± 41	ND
14	175 ± 40	ND
30	89 ± 33	ND
31A	92200 ± 600	66 ± 5
31B	89400 ± 600	72 ± 5
32	441 ± 35	ND
33	7108 ± 78	ND
22	276 ± 54	276 ± 6
23	248 ± 39	ND
24	121 ± 58	ND
25	121 ± 37	ND
26	481 ± 40	ND
34	536 ± 48	30 ± 4
18	ND	32 ± 5
20	155 ± 50	ND
21	315 ± 56	417 ± 10
15	191 ± 53	432 ± 11
16	274 ± 49	427 ± 11
28A	119 ± 41	ND

Note: “ND” indicates “None Detected”

c. Discussion of Results

Although almost every device CPSC tested contained detectable quantities of titanium, only three out of the 32 devices (9%) contained greater than 2,500 ppm (0.25%), which is the current APA 87-1 definition of trace amounts. Additionally, 12 out of 32 samples (38 percent) contained lead at detectable levels, but only one contained it at levels greater than 0.25 percent. The trace quantity in a vast majority of samples was likely due to incidental contamination.

Staff recognizes that a trace level of lead or titanium does not indicate intention to use that material as an ingredient, but possible accidental contamination.

Without a recognized allowable trace contamination limit, chemical composition testing may involve Inductively Coupled Plasma (“ICP”) for parts per million (ppm) or parts per billion

(ppb) elemental analysis, Scanning Electron Microscopy – Energy Dispersive X-Ray Spectroscopy ("SEM-EDS") for particle size and elemental identity confirmation, Gas-Chromatography-Mass Spectroscopy ("GC-MS") for organic compound identification and quantification, or Ion Chromatography ("IC") for ionic species recognition and quantification. There is often significant sample preparation required for each of these techniques. Allowing trace contamination leaves room for a screening tool, such as XRF, that has minimal sample preparation necessary, which represents significant time and cost savings to confirm compliance.

Although APA 87-1 currently defines trace amounts at 0.25 percent, the majority of the samples tested contained amounts much lower than 0.25 percent. Staff recognizes that a risk assessment of all the chemicals currently prohibited by the C.F.R., as well as those being recommended to align with the international standards would be costly and time consuming.

d. Conclusions

LSC recognizes that trace quantities of some chemicals may be present due to contamination or impurities. Although a risk assessment has not been performed and would be difficult and costly to complete, it is reasonable to assume that there is a trace amount that provides safety for the consumer and facilitates reasonable and cost-effective testing. These chemical elements and compounds are regulated in 16 C.F.R. § 1507.2 for various valid and important reasons. Often pyrotechnic composition involving these regulated materials is more energetic or easy to initiate accidentally. Additionally, some of these chemicals are known carcinogens and environmental contaminants. However, there are significant additional burdens placed on industry and the CPSC by the absence of a trace allowance limit that would not impact safety. Staff recommends considering the industry interpretation of trace amounts (0.25%) or a lower limit such as 0.05 percent or 0.01 percent. Nearly all of the devices tested contained less than 0.05 percent of titanium or lead. Staff recommends working the public to identify an appropriate limit that protects safety.

The addition of lead and HCB to the prohibited chemical list would not place a large burden on CPSC as staff already maintains and operates the equipment necessary for these tests. Additionally, the results indicate that lead is not present at quantities greater than trace amount.

B. § 1507.3 (Fuses)

Section 1507.3 details fusing requirements for fireworks. The first requirement aims to reduce the possibility of side ignition of the fuse. However, the regulation does not specifically articulate a test method to explain to what extent the fuse needs to reduce side ignition., nor does the regulation specifically articulate a test method for measuring side ignition. Instead, this information is found in the CPSC Fireworks Testing Manual. The test manual indicates that the side of the fuse that protrudes from the device (including any tape or paper attached to the fuse) needs to resist ignition from a cigarette for a minimum of 5 seconds. The AFSL and APA 87-1 test method indicates a similar test method. Between October 2005 and February 2015 there have been 28 violations of the CPSC standard. This accounts for less than 2.5 percent of all fireworks

violations during this same time period.[70] This indicates substantial compliance with this provision. However, in order to clarify the regulation staff recommends adding the current CPSC test method of 5 seconds of resistance to the CFR.

The second requirement aims to give the consumer an appropriate time to retreat after lighting the fireworks device before the device begins to function. CPSC and industry set this time at 3 seconds. An upper limit exists so that the consumer is not misled to believe that the fuse went out and return to the device prematurely. CPSC revised this section in 1996, after considering information on safe minimum and maximum fuse burn times.[71]

Staff considered the AFSL standard and APA 87-1 to determine whether the fuse requirement regulations needed alterations or could be improved. Staff found that the APA and the AFSL standards state that "Roman candles or similar devices requiring a longer fuse for safe functioning may burn up to 12 seconds before ignition of the device." Through field testing of many of these devices, staff found no need to increase the upper limit of the fuse requirement. Additionally, the injury data do not suggest the necessity of a time change in the current 9 second requirement.

Currently, fuse violations account for the second highest number of CPSC staff-identified violations when compared to other CPSC fireworks provisions. Between October 2005 and February 2015 there were 362 fuse violations. Three violations are included in this number, "long fuse burn time", "short fuse burn time" and "fuse attachment". This accounts for 28 percent of the fireworks violations. "Long fuse burn time," accounted for 212 out of the 362 fuse violations where in at least one instance of staff testing the device took more than 9 seconds to function. Despite a high number of violations, the economic cost of these violations should be minimal because the manufacturer simply needs to trim the fuse to remedy the regulatory noncompliance.

The data relating to violations identified by staff do not suggest that the high number of long fuse burn time violations is due to the inconsistency between the AFSL standard and APA 87-1. Most violations of long fuse burn time occurred with mine and shell devices, which have the same limit of 9 seconds in APA 87-1 and AFSL. In contrast, "Roman candles or similar devices" allow the additional 3 seconds.

Staff believes that the fuse burn time indicated in the regulation is a reasonable requirement for industry and recommends no changes.

The third requirement aims at preventing the fuse from becoming detached during transportation, normal handling, and operation. A fuse that is not secured can easily become detached, creating the possibility that the device will malfunction when lit. Consumers are likely to hold devices by the fuse. If the fuse becomes detached, this raises the possibility that the consumer will try to reattach the fuse, creating a safety hazard to the consumer that this provision eliminates. However, when this regulation was enacted, most consumer fireworks were small. In

[70] Data supplied by CPSC Compliance staff.
[71] 61 Fed. Reg. 41043 (Aug. 7, 1996) (Notice of Proposed Rule); 61 Fed. Reg. 67197 (Dec. 20, 1996) (Final Rule).

recent years very large devices (in excess of 20 pounds) entered the market. This created a problem because the regulation states that even these large devices need to withstand the weight of the entire device, plus 8 ounces of dead weight. Staff recommends that the Commission seek public comment regarding an alternate test method for fuse attachment requirements for very large devices. The regulation aims at keeping the fuse from detaching, which may negate the requirement for the entire weight plus 8 ounces of dead weight for very large devices.

C. § 1507.4 (Bases)

Section 1507.4 describes the performance requirement for the base of a fireworks device. The current regulation is aimed at minimizing the tipping hazard in a fireworks device by addressing stability during operation. Staff does not recommend any changes to this provision because staff believes the provision reduces the possibility that a tip-over incident might occur that could cause injury to the consumer.

For this review, staff considered any additional requirements pertaining to bases that may exist in the industry standards. Staff found that both APA 87-1 and the AFSL Standard require that the base must remain attached during transportation, handling, and normal operation of the device as can be seen in Table 2. CPSC cannot regulate transportation because transportation is under the DOT's jurisdiction; however, the CPSC can require that the base remain attached during handling and normal operation.

If the base is not attached properly, injuries could occur because the device might be unstable. Specific incident data for fireworks-related injuries is limited and does not clearly reflect any injuries associated with tip-overs directly due to base detachment.. Staff recommends that the Commission seek public comment on the merits of adding this provision to the regulation as well as specific incident data to support such a provision.

Staff also found that APA 87-1 incorporates specific materials for base construction as noted in Table 2 When the CPSC rule was promulgated in 1974, the Commission considered incorporating a specific thickness for the bases of fireworks devices.[72] However, due to wanting to "promulgate performance rather than design oriented requirements," the requirement to incorporate a specific thickness was left out.[73] Staff seeks to minimize design limiting standards and therefore, does not recommend adding specific materials in the base regulation.

Table 2
Base Regulations in Voluntary Standards compared to CPSC Regulations

APA 87-1	AFSL Standard	CPSC Regulation
States that "bases must remain firmly attached to the item during transportation, handing and normal operation"	States that "bases must remain firmly attached during transportation, handing and normal operation."	Current CPSC regulations do not state a requirement for base attachment.

[72] 39 Fed. Reg. 17435, 17437 (May 16, 1974).
[73] 39 Fed. Reg. 17435, 17437 (May 16, 1974).

States that "devices that require a base shall utilize a base of wood or plastic (preferably non-brittle, medium impact polystyrene"	Requires that "bases be made of a material that will not break during transportation, handling, and normal operation."	Current CPSC regulations do not specify what materials bases need to be constructed of.

D. § 1507.5 (Pyrotechnic leakage)

Section 1507.5 requires that the pyrotechnic material in fireworks devices stay inside the device during shipping, handling, and normal operation. Requiring that pyrotechnic material stay within the device is intended to protect the safety of the consumer in several ways. First, leakage may prevent the device from operating as intended. For example, if the lift charge leaked out of a device during shipping, when the consumer lit the device, it is possible that the device would not rise high enough, and could injure the consumer. Second, some pyrotechnic material is highly flammable and would pose a great risk to consumers if the leaked material were to be ignited accidentally.

The current language in the C.F.R. is consistent with a performance requirement rather than a design requirement and staff recommends no changes to this provision.

E. § 1507.6 (Burnout and Blowout)

According to 16 C.F.R. § 1507.6, fireworks devices must be constructed to allow functioning in a normal manner without blowout or burnout. This is an important safety consideration. Blowouts often create a large explosion low to the ground where debris can injure spectators. Burnouts can cause fires, leading to property damage and injury. A similar provision in APA 87-1 section 3.6.2.5 requires that a pyrotechnic chamber be of sufficient thickness and rigidity to allow normal functioning without burnout or blowout and be constructed and sealed to prevent leakage.

Although CPSC staff believes the terms "burnout" and "blowout" are well understood by industry, staff recommends defining the terms in the regulation. Staff recommends soliciting comments on usefulness of adding the APA 87-1 definitions of these terms, provided below. Staff believes the APA definitions accurately express the CPSC's and industry's understanding of these terms. Additionally, because the DOT incorporates APA 87-1 by reference, by extension, the DOT also incorporates APA 87-1 definitions. The addition of definitions may clarify and streamline the regulation and would align CPSC regulations with the DOT. The APA 87-1 definitions are:

Blowout: The unintended release of a pressure effect from other than the intended orifice of a fireworks device. Examples include expulsion of the bottom plug of a roman candle, expulsion of the clay choke of a fountain, or the rupturing of the wall of a mine or shell.

Burnout: The unintended escape of flame through the wall of a pyrotechnic chamber during functioning of a fireworks device.

F. § 1507.7 (Handles and Spikes)

The provisions in § 1507.7(a) require that handheld devices have a handle of at least 4 inches. This provides the consumer with enough room to grasp the device without being burned or injured by the pyrotechnic effects. The provision in § 1507.7(b) requires that devices intended to be placed in the ground have a spike of sufficient length to do so. This keeps the device from tipping over while functioning. This is an important provision because a tip-over during the functioning of a device can cause substantial injury. This regulation is consistent with industry standards, and staff recommends the Commission maintain this section of the C.F.R. without additional changes.

G. § 1507.8 (Wheel Devices)

Section 1507.8 applies to fireworks devices known as "wheels," requiring that drivers on these devices remain attached during the operation of the device. This performance standard protects the safety of the consumer, and no additional safety provisions were found in the industry standards. Staff recommends the Commission maintain this section of the C.F.R. without additional changes.

H. § 1507.9 (Toy smoke devices and flitter devices)

Section 1507.9(a) requires toy smoke devices to be constructed so that they do not burst or produce an external flame. This performance standard protects the safety of the consumer. A device that bursts can cause substantial injury if the debris strikes the consumer, and external flame can cause a fire which can lead to property loss and consumer injury. Section 1507.9(b) prohibits toy smoke and flitter devices from being a color and configuration similar to M-80 salutes, silver salutes, or cherry bombs. This is because toy smoke and flitter devices are similar in size to these banned firecracker devices. Finally, § 1507.9(c) also requires that toy smoke devices not incorporate plastic as an exterior material if the pyrotechnic composition comes in contact with the plastic. This is necessary to provide adequate safety to the consumer. The heat from the combustion of the pyrotechnic material can cause plastic fragments to be dispersed, which can injure the consumer. No additional safety provisions regarding toy smoke and flitter devices were found in the industry standards. Staff recommends that the Commission maintain this section of the C.F.R. without additional changes.

I. § 1507.10 (Rockets with Sticks)

Section 1507.10 requires that rockets are constructed with straight and rigid sticks to provide a direct and stable flight. This protects consumer safety during operation with minimal design specifications. Staff believes that clarification of this provision would be useful. The regulation does not specify definitions or limits for "straight and rigid" or "attached."

The CPSC Fireworks Test Manual ("Test Manual") has a test method that defines the "attachment" of a stick rocket as "able to withstand the weight of an 8oz-weight without separation." The Test Manual also has a test method for "straightness and rigidity." The CPSC

measures rigidity by clamping horizontally to a rigid surface a 1-inch section at the end of the rocket stick farthest from the motor tube. The distance that the motor end of the rocket droops downward is measured. The maximum downward droop, or arch, may not exceed ¼ of the total length of the rocket. Straightness is measured by laying the stick on a flat surface with the maximum bow up. The maximum deviation from horizontal must not exceed 1 inch. The AFSL and the APA have similar test methods for straightness, attachment, and rigidity.

Staff recommends that the Commission seek input from the public on whether clarification of the terms "straight," "rigid," and "attached" would be useful in clarifying and streamlining the regulation.

I. § 1507.11 (Party Poppers)

Section 1507.11 requires a limit of total pyrotechnic composition for Party Poppers. Staff sees minimal violations regarding this standard and staff found no injuries that could be tied directly to party poppers. Staff believes that the limit in the regulation is appropriate; the limit is consistent with industry standards; and as such, staff recommends the Commission maintain this section of the C.F.R. without additional changes.

J. § 1507.12 (Multiple-Tube Fireworks Devices)

The test method in Section 1507.12 keeps large multiple-tube mine and shell devices from tipping over while functioning. This is a much more recent fireworks regulation than the others transferred to the CPSC from the FDA. The CPSC adopted this test method in 1996, after considering information about minimizing the safety hazards associated with tip-overs.[74] In 1994 and 1995, more than 80 percent of mine and shell devices tested by staff would tip over during field testing. Tip-overs of this type of large device can cause substantial injury and have resulted in two known deaths. [75] Staff found large multiple tube devices less likely to tip over while functioning if these devices had a minimum tip angle of 60 degrees. Since promulgation of this regulation, staff witnessed a significant decline in tip-overs during field testing. For example, in 2014, less than 1 percent of devices tipped over while functioning.[76] Staff also sees substantial compliance with this regulation. Between October 2005 and February 2015, staff notes only 65 violations of this regulation identified by the Division of Compliance and Field Operations. This accounts for less than 5 percent of the total fireworks violations. To protect the safety of the consumer, staff recommends that the Commission maintain this regulation with no modifications.

K. Additional Recommendations

1. ***Fragments***

[74] 60 Fed. Reg. 34922 (July 5, 1995) (Proposed Rule); 61 Fed. Reg. 13084 (Mar. 26, 1996) (Final Rule).
[75] 61 Fed. Reg. 13086 (Mar. 26, 1996).
[76] Data provided by CPSC compliance staff for FY 2014.

Based on the in-depth telephone investigations that the CPSC conducted of fireworks incidents from 2005 through 2015, some incidents may be related to projected fragments from fireworks. Staff could not determine whether these injuries resulted from a fragment from inside the fireworks device, or whether the sharp fragments resulted from debris in the surrounding area of the explosion, and not necessarily from the device itself. Regardless, the possibility of injury due to projected fragments certainly exists.

APA 87-1 addresses this risk, stating: "no component of any consumer fireworks device or novelty may upon functioning, project or disperse any metal, glass, or brittle plastic fragments." To align CPSC standards with the internationally recognized standards and address this safety issue, staff recommends that the Commission consider the addition of this requirement. In particular, staff would find it helpful to solicit information regarding the appropriateness of the specific fragments listed (metal, glass, or brittle plastic); whether any additional fragments, such as wood, are appropriate to consider; and seek information regarding injuries related to this standard.

2. **Apex of flight**

Through CPSC field testing of hundreds of devices, components of devices designed to produce an effect high in the air often are seen exploding much closer to the ground as the shell descends. This creates a great potential for injury and property damage. When a shell bursts at the apex of its flight, the shell has the maximum amount of time to cool before touching the ground. Furthermore, the potential for a consumer to be injured when a fireworks device explodes near the ground is greater than when the device explodes at the apex of its flight.

APA 87-1 addresses this risk, stating: "devices designed to produce a visible or audible effect high in the air must be designed to produce that effect at or near the apex of its flight." The AFSL voluntary standard and the European Standard have similar requirements. The addition of this standard would promote safety and facilitate compliance action, given that tested samples cause fires when a shell does not burst at the apex of the flight. With the goal of aligning CPSC standards with the industry standards and protecting the safety of the consumer, staff recommends adding this performance requirement to the regulations, depending on public feedback. In particular, staff would find it useful to collect information from the public regarding fires and injuries associated with this provision in the standard, and the appropriateness of the language in APA 87-1. Staff also would like to seek input regarding a minimum height requirement for the apex. Staff recommends considering modifying the language to state "each component of a device designed to produce a visible or audible effect high in the air must be designed to produce that effect at or near the apex of its flight." This change would specify that devices with multiple components designed to function at different altitudes are not inadvertently noncompliant. Staff's intent is that each component of a device does not explode on its descent, low to the ground when it was intended to explode at a much higher altitude. To add this provision to the regulations, the Commission must determine that the provision is needed to protect public health and safety and make the findings stated in section 3 of the FHSA.

3. **Definitions**

Staff recommends adding a definition section into the C.F.R. to provide clarity and consistency in interpreting and applying regulatory requirements. In particular, the clarifications and changes that staff is recommending for requirements for devices "intended to product an audible effect," involve specific terms that require precise definitions to be clear about how to test devices. Staff recommends adding the APA 87-1 definitions of relevant terms. Staff believes that the APA definitions accurately express CPSC and industry understanding of these terms. Additionally, because the DOT incorporates by reference APA 87-1, by extension, the DOT also incorporates APA 87-1 definitions. Adding the definitions would clarify the regulation and harmonize with the DOT. The APA 87-1 definitions are listed below:

Lift charge: pyrotechnic composition used to propel a component of a mine or shell device into the air. Lift charge is limited to black powder (potassium nitrate, sulfur, and charcoal) or similar pyrotechnic composition without metallic fuel.

Burst charge, Expelling charge or Break charge: Chemical composition used to break open a device after it has been propelled into the air, producing a secondary effect, such as a shower of stars. Burst charge containing metallic powder, such as aluminum or magnalium, is limited to 2 grains.

Chemical composition: All pyrotechnic and explosive material contained in a fireworks device. Inert materials, such as clay used for plugs, or organic matter, such as rice hulls used for density control, are not considered to be chemical composition. This includes lift charge, burst charge, and visible/audible effect materials.

Explosive composition: Any chemical compound or mixture, whose primary purpose is to function by explosion, producing an audible effect (report) in a fireworks device.

Pyrotechnic composition: A chemical mixture, which upon burning, and without explosion, produces visible or brilliant displays or bright lights, or whistles, or motions.

Summary of Recommendations to the Commission

After reviewing the fireworks regulations, staff recommends that the Commission consider the following changes to the C.F.R. These changes are intended to clarify existing regulations and update requirements to reflect the best available science.

Recommendations intended to clarify and streamline the regulations with no net change on industry or safety:

- Possibly define "burnout" and "blowout," as used in § 1507.6;
- Possibly define "firecracker," as used throughout the regulation;
- Specify the sections (fusing requirements and prohibited chemicals) for which firecrackers are exempt, rather than exempt firecrackers from all of part 1507;
- Remove § 1507.85(a)(2) because of its redundancy with 1500.17(a)(8);
- Clarify "reduce the possibility of side ignition," as used in § 1507.3, by using the current CPSC test method that measures this requirement;

- Possibly define "stability, rigidity and attachment," as used in § 1507.10, by using the current CPSC test method that measures compliance with these terms.

Recommendations intended to reduce burden on industry and maintain consumer safety, by clarifying current regulation:

- Revise "devices intended to produce an audible effect," as specified in §§ 1500.17(a)(3), 1500.17(a)(8), 1500.83(a)(27), and 1500.85(a)(2), by defining product classes that fall under that category for aerial devices, such as sky rockets, bottle rockets, missile-type rockets, aerial spinners, Roman candles, mine and shell devices, and aerial shell kits with reloadable tubes, which contain metallic fuels (such as magnalium or aluminum) less than 100-mesh in particle size at levels above trace;
- Adopt limits on pyrotechnic composition by firework type, as defined in DOT regulations;
- Adopt limit on ratio of break charge to effects as specified in APA 87-1;
- Add definitions of "lift charge," "burst, expelling, or break charge," "chemical composition," "pyrotechnic composition," and "explosive composition," to provide clarity in the regulation;
- Amend § 1507.2 to allow trace amounts of prohibited chemicals as impurities, unless otherwise specified;
- Clarify the term "aerial bomb," as used in § 1500.17(a)(3) and §1500.17(a)(8);
- Amend the list of warning labels for of devices that are listed in § 1500.14;
- Specify an alternate to test for "fuse attachment" as specified in §1507.3 for very large devices.

Recommendations intended to align more closely with industry best practices and that may require additional support and findings:

- Possibly adopt the requirement that any component in a fireworks device intended to produce a visible or audible effect high in the air, produce that effect at the apex of its flight;
- Possibly prohibit fireworks devices from projecting fragments upon functioning;
- Possibly amend § 1507.4 to require that the base or bottom of fireworks devices must remain attached during handling and normal operation, depending on public feedback.

Appendix 1: Pyrotechnic weights

Sample	Lift Charge 1 (g)	Lift Charge 2 (g)	Lift Charge 3 (g)	Break Charge 1 (g)	Break Charge 2 (g)	Break Charge 3 (g)	Effect Mass 1 (g)	Effect Mass 2 (g)	Effect Mass 3 (g)
1	3.005	2.892	2.917	3.120	2.922	4.002	6.776	7.465	9.787
2	3.390	3.454	3.637	2.653	2.656	2.420	10.702	10.519	12.802
3	1.258	1.825	1.756	1.715	1.732	1.816	7.487	7.764	7.566
4	3.476	3.544	3.161	3.206	3.242	3.574	12.266	12.673	12.462
5	8.745	8.453	7.278	1.021	1.057	1.736	30.845	31.785	29.676
6	3.434	3.131	3.003	3.915	3.331	3.807	10.467	10.051	6.327
7	1.981	2.153	2.338	2.310	2.276	2.307	5.055	7.825	8.056
8	3.140	3.673	3.197	1.942	2.017	1.683	11.593	12.518	10.705
9	2.372	2.322	2.242	2.052	2.012	2.063	6.956	6.566	7.323
10	2.124	2.954	2.999	2.651	2.724	2.820	4.189	4.044	4.058
11	5.055	5.198	4.775	2.379	4.073	4.123	15.747	17.577	18.555
12	3.752	3.848	3.978	2.374	1.953	2.357	12.619	12.232	11.950
13	3.957	4.056	3.519	3.451	2.464	3.395	0.000	0.000	8.714
14	3.735	3.473	2.795	3.589	3.530	3.501	13.290	13.425	13.454
15	3.879	3.874	3.771	3.596	3.690	3.606	9.792	8.739	9.729
16	10.495	10.463	10.457	2.556	3.196	3.342	20.257	20.437	20.871
17	2.093	2.483	1.927	0.000	0.000	0.000	5.758	5.130	4.392
18	2.215	2.226	2.041	2.839	2.807	2.859	6.890	6.546	6.691
19	2.442	2.758	2.728	0.000	0.000	0.000	5.934	6.189	6.576
20	3.449	3.114	3.456	3.505	2.380	2.338	7.303	9.793	8.432
21	3.835	3.251	3.309	3.753	3.809	3.977	8.954	7.809	8.879
22	2.017	2.164	2.033	2.161	2.769	2.291	5.925	5.789	5.838
23	3.966	3.966	3.573	0.000	0.000	2.718	10.319	7.644	8.499
24	6.674	7.439	7.130	2.950	2.722	1.332	29.441	30.315	33.945
25	7.111	7.451	7.398	0.546	0.744	0.941	28.349	28.043	32.545
26	3.156	3.067	3.448	3.495	2.532	3.670	8.779	10.100	12.531
27A	0.749	0.81		0	0		2.308	2.418	
27B	3.191			1.965			7.544		
28A	4.651	4.098		2.336	1.187		20.25	19.401	
28B	7.299			1.612			41.241		

*Sample contained 110 small tubes (15-800-2397A) and 5 larger tubes (15-800-2397B).
**Sample contained 12 small tubes (13-840-8301A) and 3 larger tubes (13-840-8301B).

Tab C – Econ Memorandum

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

Memorandum

Date: May 18, 2015

TO : Priscilla Verdino, Chemist, Lab Sciences

THROUGH : Gregory B. Rodgers, Ph.D., Associate Executive Director, Directorate for Economic Analysis

Deborah V. Aiken, Ph.D., Senior Staff Coordinator, Directorate for Economic Analysis

FROM : Robert Squibb, Directorate for Economic Analysis

SUBJECT : Fireworks Rule Review: Economic Considerations

Background

The Consumer Product Safety Commission ("CPSC" or "Commission") directed staff to conduct a review of the regulations on consumer fireworks in 16 C.F.R. §§ 1500.14, 1500.17, 1500.83, 1500.85, and Part 1507. This memorandum provides background on the current market for consumer fireworks, discusses the burdens associated with existing regulations, describes inconsistencies between current CPSC rules and other standards pertaining to consumer fireworks, and provides a preliminary discussion of the expected effects of the changes that staff recommends for CPSC's fireworks regulations.

Product

Consumer fireworks are fireworks intended to be used by consumers. According to the American Pyrotechnics Association ("APA"), an industry trade group, consumer fireworks are distinct from display fireworks, based on intended use and amount of chemical composition. The import, sale, and manufacturing of display fireworks are under the jurisdiction of the Bureau of Alcohol, Tobacco, Firearms, and Explosives. Consumer fireworks have many different varieties, including firecrackers, bottle rockets, sparklers, fountains, Roman candles, wheels, and several others. Fireworks and firecrackers that create an audible effect are limited by how much pyrotechnic material they can contain. The Federal Hazardous Substances Act ("FHSA") bans any fireworks that exceed the limits on pyrotechnic composition or do not comply with the regulations in 16 C.F.R. part 1507.

The Market for Consumer Fireworks

According to data from the APA, revenue from sales of consumer fireworks has grown relatively steadily from 1998 to 2013.[77] Sales of consumer fireworks have increased from roughly $284 million in 1998, to roughly $662 million in 2013.[78] Imported fireworks make up a substantial majority of consumer fireworks sales in the United States.

One difficulty in obtaining additional information regarding the market for consumer fireworks is that industry classification codes are not specific and do not distinguish between consumer and display fireworks or between fireworks and other products. For example, the U.S. International Trade Commission ("ITC") does not differentiate between consumer and display fireworks in its reports. However, total imports reported for 2012 and 2013 for all fireworks were $227 million and $214 million, respectively.[79]

Domestic fireworks manufacturing is covered under North American Industry Classification System ("NAICS") code 325998, "All Other Miscellaneous Chemical Product and Preparation Manufacturing." Fireworks manufacturing is also captured under Standard Industrial Classification ("SIC") code 50920303. Importers and retail sales firms are counted under NAICS codes 423920 and 453998, "Toy and Hobby Goods and Supplies Merchant Wholesalers" and "All Other Miscellaneous Store Retailers," respectively. According to the 2012 Economic Census of the United States, there were 985 manufacturers, 2,218 wholesalers, and 15,438 retailers as categorized by NAICS code, a small proportion of which are in the fireworks market.

The U.S. Small Business Administration ("SBA") size guidelines define manufacturers categorized under this code as "small" if they have fewer than 500 employees. The SBA defines importers as small if they have fewer than 100 employees (wholesalers) or less than $7.5 million sales (retailers). The American Fireworks Standards Laboratory ("AFSL"), which conducts testing and certification for a substantial portion of the industry, maintains a public list of U.S. importers and Chinese manufacturers that participate in its programs. Its list includes 176 importers, of which 111 are small; two are large; and the remaining 63 are of indeterminate size, although likely small.[80]

CPSC Fireworks Regulations

The CPSC regulations for consumer fireworks stem from the FHSA and include 16 C.F.R. §§ 1500.14, 1500.17, 1500.83, 1500.85, and part 1507. The FHSA began under the jurisdiction of the U.S. Food and Drug Administration, and was transferred to CPSC upon the founding of

[77] APA Facts and Figures. *American Pyrotechnics Association.* Accessed on April 21, 2015. http://www.americanpyro.com/assets/docs/FactsandFigures/fireworks%20revenue%20by%20industry%20segment%201998-13.pdf.

[78] Sales of display fireworks increased from $141 million in 1998 to $328 million in 2013.

[79] The ITC data report import value as "value of first sale" and are not comparable to APA sales data. The concept of "value of first sale" allows importers to report the value of goods as the first sale price recorded for those goods in a series of sales from manufacturer to middleman to importer.

[80] CPSC staff made these determinations using information from Dun & Bradstreet and ReferenceUSA, as well as firm websites.

the Commission. The FHSA bans any fireworks that do not meet the requirements listed in the Act. The regulations promulgated under the FHSA include restrictions on the composition of fireworks, warning label requirements, and limits on the amount of pyrotechnic material, if the device was intended to produce an audible effect[81] or designed to produce an audible effect.[82] Part 1507, adopted in 1976, adds a list of banned chemicals, fuse burn requirements, restrictions on pyrotechnic leakage during transport and operation, restrictions on burnout and blowout during normal use, requirements regarding components (*e.g.*, bases and handles), and design for specific types of fireworks (*e.g.*, rockets with sticks, party poppers).

Other Standards

In addition to the mandatory CPSC requirements, the APA maintains a voluntary standard for consumer fireworks, APA standard 87-1. The APA standard is incorporated by reference into U.S. Department of Transportation ("DOT") regulations for transporting explosives in the United States. Because of the DOT regulations, all fireworks must comply with the APA standard to be transported into the United States. APA standard 87-1 contains requirements that pertain to a broader set of fireworks products outside CPSC's jurisdiction. Thus, the APA standard and DOT regulations differ slightly from CPSC regulations. However, with some exceptions discussed below, the APA voluntary standard, the DOT regulations, and the CPSC regulations are largely consistent where they apply to consumer fireworks.

The AFSL also maintains a voluntary standard for consumer fireworks. The AFSL standard incorporates CPSC and DOT regulations, and also adds some provisions. The AFSL also conducts testing for manufacturers and importers to the requirements of the AFSL voluntary standard. As of 2011, the AFSL reports that 94 percent of the 7.45 million consumer fireworks cases it tested were compliant with its standards.[83] This indicates substantial compliance with current CPSC and DOT regulations.

There is also a consumer fireworks standard used by the European Commission. This standard also is similar and largely consistent with the CPSC and DOT regulations, as well as the AFSL voluntary standard.

The APA and AFSL have updated their standards since the latest revision of the CPSC regulations. The recommendations to the Commission from this briefing package constitute an effort, in part, to harmonize the requirements.

Retrospective Evaluation of Current CPSC Regulations

Ideally, a complete retrospective analysis of CPSC's fireworks regulations would include evaluating the benefits (*e.g.*, the reduction in deaths and injuries) and compliance costs attributable to the rule. Conceptually, to conduct such an analysis, we first need to construct a

[81] § 1500.17(a)(3).
[82] § 1500.17(a)(8).
[83] Consumer Fireworks Testing Results. *American Fireworks Safety Laboratory*. Accessed April 21, 2015. http://www.afsl.org/content/consumer-fireworks-testing-results.

baseline scenario that assumes CPSC's rules were never promulgated and then compute production costs, as well as the number of injuries and deaths that would have occurred in the absence of CPSC regulation. The difference in costs and injuries and deaths between the baseline scenario and the status quo, if measurable, constitutes the retrospective costs and benefits of current CPSC regulations.

Formal retrospective evaluation of the costs and benefits of CPSC's fireworks regulations, as suggested above, is not possible for several reasons. The bulk of CPSC regulations for fireworks are based on design and composition requirements. Given that most of the regulations have been in effect for approximately 40 years, manufacturing techniques have evolved to incorporate these requirements. In other words, compliance costs, to a large degree, are inherent in the production function for fireworks; thus, they are indistinguishable from the production costs associated with producing a viable and marketable product in the absence of the requirements.[84] The primary exception would be any costs associated with testing, labeling, reporting, or recordkeeping requirements because these costs accrue post-production and can be viewed as an increment to the costs of producing fireworks. However, the only testing explicitly mandated in the CPSC regulations is a tip-over test for multiple-shell reloadable tube devices, requiring that they remain upright when placed on an incline under specific conditions. The burden of this test is minimal, because it requires little time and no specialized equipment. Additionally, there are no Paperwork Reduction Act burdens associated with the rules because §§ 1500.17(a)(3), 1500.17(a)(8), 1500.83(a)(27), and 1500.85(a)(2) and part 1507 do not include requirements for reporting, record keeping, or third party disclosure of any information. CPSC's regulation adds labeling requirements, which are discussed below.

Regarding retrospective benefits measurement, staff would need to estimate the effectiveness of CPSC's regulation to estimate the death and injuries that would have occurred in the absence of CPSC's rule.Given existing data and the length of time that the regulations have been in effect, estimation of an effectiveness rate is not possible.

Additionally, the key obstacle to constructing the appropriate baseline for evaluating the impact of revisions to the CPSC rule is that CPSC's regulations overlap to a significant degree with APA standard 87-1 and DOT's regulations (because DOT incorporates by reference the APA standard) for consumer fireworks. In the absence of CPSC rules, manufacturers and importers would still need to comply with DOT regulations, and consequently, the APA standard as well.

However, describing the incremental burden of CPSC's regulations is possible by examining the areas where CPSC's and DOT's rules (and the APA standard) do or do not overlap. When there is "perfect" overlap, CPSC rules do not add any incremental regulatory burden to manufacturers and importers of fireworks beyond that created by the APA and DOT standards. The "perfect" overlap areas represent aspects of consumer fireworks regulations that producers would still need to comply with, even in the complete absence of CPSC regulation. In cases

[84] As a practical matter, even if it were possible to separate production and regulatory compliance cost, most consumer fireworks products purchased in the United States are manufactured in China (and often "by hand"), which presents other difficulties in collecting data.

where CPSC regulations add requirements beyond DOT rules (and the APA standard), beyond DOT's jurisdictional authority, or are otherwise more stringent, or where differences in language between analogous sections in the different rules lead to inconsistent interpretation, CPSC rules create an additional burden.[85]

CPSC regulations that do create an incremental burden include the labeling and marking requirements in 16 C.F.R. § 1500.14.[86] These provisions are not part of the DOT regulations since they cover consumer use and potential injuries that could arise from product misuse rather than transport. In previous burden analyses, staff has estimated the burden for creating labels to be around one hour for labels which require some modification.[87] Fireworks labels include only mandatory language, so the design requirements should be less burdensome.

CPSC requirements for the elimination of banned chemicals are also more stringent than the APA standard (and DOT regulations). As testing equipment has become more sensitive to chemical composition, trace amounts of chemicals that were previously undetectable are now identified in tested samples. CPSC requirements include no written tolerance level for trace amounts of banned chemicals, amounts that may not pose a safety hazard, but are very costly to eliminate completely. These chemicals are not intentionally introduced to the products through production methods, but are present in background levels in the environment. APA standard 87-1 includes a tolerance of 0.25 percent by weight for banned substances, which serves to reduce the burden on industry of eliminating these trace amounts. These trace amounts were undetectable by testing equipment and procedures that existed when the CPSC regulations were originally written.

Other sections of CPSC's regulations align in topic area with APA 87-1 as incorporated into DOT regulations but use different testing criteria. One key example is "devices intended to produce an audible effect," as specified in §§ 1500.17(a)(3), 1500.17(a)(8), 1500.83(a)(27), and 1500.85(a)(2), under which CPSC classifies products based on a test in which staff listens for an audible effect and then measures the amount of pyrotechnic composition if the device is deemed to contain a "loud report".[88] APA standard 87-1 determines a product's "intent to produce an audible effect" in terms of metallic fuel composition. Pyrotechnic materials overload represents the largest class of violations in CPSC compliance data for the last 10 years. Because industry may classify these products using different criteria (*i.e.*, fuel composition rather than CPSC's

[85] It is important to note that CPSC's regulations provide continuity in enforcement of the various fireworks rules. Although all fireworks manufactured or imported first pass under DOT's authority as they are transported for commerce, once fireworks are purchased by consumers, DOT's authority no longer applies; and instead, CPSC's authority applies. However, this alone does not represent an "increment" to the regulatory burden. For APA standard 87-1 requirements that are directly relevant to both transportation safety and consumer safety, fireworks should comply with CPSC's regulations before reaching the consumer because they had to comply with the DOT rule to be transported to the consumer.

[86] The incremental burden related to the creation and maintenance of General Conformity Certificates ("GCCs") by fireworks suppliers has not been included in this analysis. GCCs are required for all regulated consumer products under 16 C.F.R. part 1110. Any burden related to GCCs is due to 16 C.F.R. part 1110 but is triggered by the existence of a consumer fireworks rule. Changes to the underlying consumer fireworks regulation (other than its complete elimination) have no implication for the burden associated with GCCs.

[87] See Final Rule for Safety Standards for Frame Child Carriers, 80 Fed. Reg. 11113 (Mar. 2, 2015).

[88] CPSC Fireworks Testing Manual.

field testing), some violations of the CPSC rule were not violations of APA standard 87-1. This discrepancy can result in a burden to industry when products CPSC staff classifies as violations (but the APA/DOT would not) need to be destroyed. Reconciling the differences in classification criteria could possibly assist in reducing this burden.

Revisions designed to harmonize the language of the CPSC rule and the APA Standard 87-1 can also reduce the regulatory burden to manufacturers by clarifying the requirements of the rules.

Recommended Changes to CPSC Regulations

Staff is recommending changes to the regulations for consumer fireworks based on its review of the current regulations.

Recommendations intended to reduce burden due to inconsistencies across standards:

- Revise "devices intended to produce an audible effect," as specified in §§ 1500.17(a)(3), 1500.17(a)(8), 1500.83(a)(27), and 1500.85(a)(2), by defining product classes that fall under that category for aerial devices as sky rockets, bottle rockets, missile-type rockets, aerial spinners, Roman candles, mine and shell devices, and aerial shell kits with reloadable tubes, which contain metallic fuels (such as magnalium or aluminum) less than 100-mesh in particle size above trace amounts
- Amend § 1507.2 to allow trace amounts of prohibited chemicals as impurities, unless otherwise specified.

Recommendations intended to better harmonize language with APA Standard 87-1:

- Clarify language in § 1500.17(a)(8) to indicate that the listed pyrotechnic composition limit applies only to firecrackers
- Clarify if aerial bombs belong in § 1500.17(a)(8), which prohibits them or in § 1500.17(a)(3), which limits them to 2 grains of pyrotechnic material
- Eliminate the general exemption for firecrackers from part 1507 requirements under § 1507.1, and institute the exemption for firecrackers only in sections for which firecrackers require it (*e.g.*, § 1507.2 for chlorates and perchlorates, and § 1507.3 for fuse requirements)
- Amend § 1507.2 to include lead, lead tetroxide (red lead oxide), and other lead compounds in the list of prohibited chemicals
- Amend § 1507.4 to require that the base or bottom of fireworks devices must remain attached during transportation, handling, and normal operation
- Define "burnout" and "blowout," as used in § 1507.6
- Adopt the requirement that any firework device intended to produce a visible or audible effect high in the air produce that effect at the apex of its flight
- Adopt limits on chemical composition by firework type as defined in DOT regulations
- Add definitions of "lift charge," "burst, expelling, or break charge," "chemical composition," "pyrotechnic composition," "firecracker," and "explosive composition"

- Prohibit fireworks devices from projecting metal, glass, or brittle plastic fragments upon functioning.

Other Recommendations:

- Consider adding labeling requirements for additional fireworks devices in § 1500.14, or amend the labeling to existing devices listed to address common injuries
- Clarify § 1500.83(a)(27) to state that the labeling exemption for assortments applies to small devices
- Delete § 1500.85(a)(2), due to redundancy with § 1500.17(a)(8)
- Amend § 1507.2 to include hexachlorobenzene (perchlorobenzene) in the list of prohibited chemicals
- Define "straightness, rigidity and attachment," as used in § 1507.10
- Define a minimum exemption for "pyrotechnic leakage," as used in § 1507.5
- Define "reduce the possibility of side ignition," as used in § 1507.3
- Consider an alternate test method for "fuse attachment," as used in § 1507.3 for very large devices.

Descriptive Analysis of Recommended Changes

To the extent that violations of CPSC regulations are from products that conform to DOT regulations, but fail due to CPSC requirements, burdens to industry should be reduced by eliminating inconsistencies across the regulations. For APA standard 87-1 requirements that are directly relevant to both transportation safety and consumer safety, the changes recommended to harmonize the requirements of CPSC regulations with APA standard 87-1, which are incorporated by reference into DOT regulations, will create no incremental burden because industry compliance with those regulations is already mandatory. If anything, staff expects the burden to be slightly reduced because understanding and compliance with one consistent set of rules is necessary.

The suggested revisions to § 1500.14, to amend labeling on current devices or add additional devices to the list, are likely to pose limited, if any, burden to firms because those products already are required to display a label. The recommended changes would require only modifications to existing labels and would not create a new labeling requirement for sparklers.

The recommended changes to amend the list of prohibited chemicals in § 1507.2 to include hexachlorobenzene could create some burden. First, to the extent that hexachlorobenzene is currently found in fireworks, manufacturers will need to eliminate this chemical from the fireworks device. In 2011, the AFSL conducted small-scale testing and found hexachlorobenzene in eight of 15 random samples tested, although only three were above the recommended limit.[89] Second, fireworks would have to be tested for the chemical before introducing the fireworks device into the market. This testing, combined with the efforts to eliminate the compounds from consumer fireworks, would create an added burden for industry.

[89] Data from AFSL memorandum, *Suggest Perchlorobenzene screen test in QIP*, dated July 13, 2011.

The recommendations for revising § 1500.83(a)(27), which exempts assortments of small devices from labeling, are designed to clarify the requirements. The changes are intended to eliminate contradictions in the labeling exemption about the limits for small devices' pyrotechnic composition. In addition, the changes would clarify what devices can be included in assortments not subject to labeling requirements. There should be no burden associated with these recommended changes, because devices that fit the requirements of the current composition limits in § 1500.17 could continue to be used in assortments.