The Case against Candle Resistant Electronics

International Electrotechnical Commission (IEC) Standard 62368 will bring hundreds of thousands of tons\(^1\) of potentially toxic fire retardant chemicals into homes, schools, hospitals, businesses—wherever electronic equipment is found. The candle flame resistance requirement in Section 7 will impede the recycling of electronics, and threaten human health and the environment worldwide. There is no valid fire safety reason for Section 7; the motivation and impetus comes from the chemical industry’s continued search for new market opportunities.

Executive Summary

The proposed IEC Standard 62368 “Audio/Video, Information and Communication Technology Equipment—Safety – Requirements” will be voted on by 25 April, 2008 by IEC representatives in the T108 committees from up to 31 countries. The majority of the standard is similar to previous rigorous standards governing the safe functioning of electronic equipment which have proved effective at preventing fires and do not have adverse health or environmental impacts. However, the proposed standard introduces a new requirement (the “candle requirement”) in Section 7 that would mandate that the plastic enclosures for nearly all consumer and business electronic products be highly resistant to external ignition from an open flame.

While on the surface the proposed provision might seem beneficial, this paper will demonstrate that this requirement is not needed for fire safety and its adoption will greatly diminish public and environmental health. Section 7 will result in the addition of high levels of flame retarding chemicals to the decorative outer housings of electronics products, although these products are currently well protected against the effects of internal heat and ignition.

The data cited as justification for Section 7 of the proposed standard do not meet the rigorous standard of proof normally expected for such a significant change. The central case used to justify the proposed requirement was an extraordinarily large number of TV fires in the 1990s in a suburb of Stockholm. Although this period was a statistical outlier, it was used to predict the expected fire rate in all of Europe, making the adoption of a proposed standard seem
necessary to prevent an increase to such a level. This study and supporting data are deeply flawed.

A review of the fire statistics reveals that an insignificant number of open flame or candle fire injuries and deaths are associated with consumer electronics. The U.S. Consumer Product Safety Commission’s (CPSC) National Electronic Injury Surveillance System (NEISS) report indicates that there are a limited number of instances where candles ignite electronics, and that according to the Consumer Electronics Association (CEA) “these incidents are so few and of such a nature that they do not appear to warrant a change in the product safety standards for electronic equipment.”

Candle ignition of electronics is very rare and there have been no reported fatalities in the U.S. in recent years. Moreover, new candle safety standards have been adopted by the candle industry in the U.S. and Europe to minimize fatalities and injuries associated with candle fires in bedding and furniture.

A fundamental principle of standards development is that changes should not be made primarily to give preference to select companies or industries. The proposed candle flame provision of IEC 62368 clearly violates this principle. The requirement was motivated and is being promoted by the fire retardant manufacturers and their representatives – companies that stand to gain financially if the standard is adopted with Section 7 included.

Proponents of the candle flame ignition section emphasize that the standard does not mandate the use of any particular chemical or technology to meet the requirements, and therefore would not in itself cause any negative health or environmental impacts as long as “safe” flame retarding materials could be identified. While technically correct, it is worth remembering that the least expensive and currently most commonly used chemicals that meet the standard are brominated flame retardants (BFRs) and chlorinated flame retardants (CFRs). Most potential replacements, such as phosphates, lack health and environmental data.

Every BFR and CFR studied to date has been found to cause serious adverse effects in experimental animals; most notable are neurological impairments in brain development and reproductive abnormalities in organ development and sperm morphology. Most BFRs also show endocrine disrupting potential. Many BFRs and CFRs have already been restricted due to their persistence, environmental mobility, and/or adverse effects on human health; others are being considered for restriction through RoHS and REACH in the EU.

Fire retardant chemicals migrate out of consumer products; they are being found in rapidly increasing levels in dust, the food chain, pets, wild animals, and human fat, body fluids, and breast milk worldwide. The United States has much higher levels of fire retardant chemicals in dust, food, and breast milk than Europe where fire retardants are much less used. The average U.S. woman’s body and breast milk contains fire retardants at levels approaching those that cause adverse reproductive and neurological health problems in animals.

The possible adverse impact of Section 7 on public health is enormous. A previous average annual production of 9,000 metric tons (20 million pounds) of the fire retardant chemical
pentaBDE, used primarily in furniture in the United States, has created a long term health and environmental hazard throughout the world. Hundreds of thousands of metric tonnes (hundreds of millions of pounds) of flame retarding chemicals are likely to be used to comply with this standard. The chemicals most likely to be used are known human and environmental toxicants or lack adequate health or toxicity information.3

Identifying effective fire retarding materials that also meet health and environmental requirements is difficult. One major BFR and CFR alternative is a class of fire retardants based on phosphorous; however, these chemicals have not been studied sufficiently to reasonably define their risks. Most phosphate fire retardants that have been studied are toxic in the environment, and the introduction of large amounts of them without sufficient study clearly violates the precautionary principle.

The addition of a variety of fire retarding chemicals into product housings also complicates plastics recycling. The recycling industry has overcome many technical challenges to become cost-effective. The rapid obsolescence of many consumer electronic products is leading to a huge expansion of the plastic waste stream. Increasing the fire retardant chemical load in this waste stream and introducing a mixture of retardants may make certain types of recycling cost prohibitive or even impossible. Section 7 would thus be likely to force much more downcycling and energy recovery (burning) to occur, amplifying the negative environmental impact. In addition, brominated and chlorinated fire retardants form highly toxic dioxins and furans during uncontrolled combustion in developing countries that are the current end-of-life fate for much of the world’s electronics.

The reality is that many common household items such as books, clothing, and bedding are made with materials such as paper, fabric, plastic that will burn if exposed to a candle flame. Treating everything in our homes and businesses with chemicals to prevent them from accidental candle ignition is not a reasonable course of action.

Fire retardant chemicals delay fires with a huge potential cost to health and environment. Other fire safety strategies such as sprinkler systems can stop fires without polluting or threatening human health. Effective ways to reduce fire deaths and injuries also include increased use of smoke detectors, child-safe lighters, and fire safety education.

The proposed IEC 62368 standard is currently out for ballot by IEC National Committee representatives from the electrotechnical standardization bodies in 31 countries, each of which has one vote. A 2/3 majority is necessary for the standard to be approved. The standard is currently available to committee members only and can be seen by those outside the committee only after it passes. If the standard were to be adopted, it would be published by IEC and potentially adopted by the European standards organization CENELEC, ANSI in the U.S., and other national standards organizations worldwide.

Usually major changes in product regulation are driven by a need to address issues and the solutions are proportional to the problem being addressed. Since there is not evidence of a significant need for protection of electronic products from candle ignition, and since the costs and adverse outcomes from this change would be so out
of proportion to the problem even using the most conservative data, this major modification to the global electronic safety standard defined in Section 7 is not justified. To defeat the IEC standard, we seek to have the voting members of IEC TC108 to submit a “No” vote with the comment to delete section 7 in its entirety.

In addition, the same document containing section 7 is currently under parallel vote in CENELEC, the electrotechnical standards body in the EU, as prEN 62368 with the same deadline of 25 April, 2008. Further more, IEC TC 108 committee has added the same requirements to the upcoming amendments to IEC 60065 and IEC 60950-1. For the reasons outlined in this paper, we ask CENELEC to vote “No” on prEN 62368 and the IEC national committees to vote "No" to the candle retardancy amendments in IEC 60065 and IEC 60950-1.
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Section I: What is the Proposed IEC Standard 62368?

The proposed IEC Standard 62368 “Audio/Video, Information and Communication Technology Equipment—Safety – Requirements” summarizes past standards governing the safe functioning of electronic equipment and also introduces a new “candle requirement” in Section 7 that would require that the plastic enclosures for most consumer and business electronic products be highly resistant to external ignition from an open flame.

What Are The Existing Fire Safety Standards For Electronic Devices?

Electronic products today are designed according to strict safety standards, IEC 60065 and IEC 60950, which minimize the risk of fire from internal heat and ignition. Examples of the products covered are listed in Table 1. Manufacturers can use flame retardants inside their products and/or design strategies to meet these standards. For example, the power supplies for most printers are contained in boxes external to the unit to separate high voltage areas from plastics.

Table 1. Current Flammability Standards for Electronics and Affected Products

<table>
<thead>
<tr>
<th>Standard</th>
<th>Example Products Affected</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>IEC 60065: Audio, video and similar</strong></td>
<td>Televisions (TVs) including plasma TVs</td>
</tr>
<tr>
<td><strong>electronic apparatus safety standard</strong></td>
<td>Audio, CD/DVD players</td>
</tr>
<tr>
<td></td>
<td>Game machines</td>
</tr>
<tr>
<td></td>
<td>Video cameras</td>
</tr>
<tr>
<td></td>
<td>Electronic musical instruments</td>
</tr>
<tr>
<td><strong>IEC 60950: Information technology and</strong></td>
<td>Monitor, personnel computer</td>
</tr>
<tr>
<td><strong>telecommunication equipment safety</strong></td>
<td>Printer, scanner, fax machine, copier, calculator</td>
</tr>
<tr>
<td><strong>standard</strong></td>
<td>Photo-printing equipment</td>
</tr>
<tr>
<td></td>
<td>Monetary processing machines</td>
</tr>
<tr>
<td></td>
<td>Telephone sets, pager, modem</td>
</tr>
</tbody>
</table>

How Is the Candle Flame Resistance Requirement Different from Current Requirements?

The proposed standard, IEC 62368, would incorporate the existing standards as above and add a new requirement in Section 7 that candle flame external housing of electronics would have to withstand a three-minute contact with a candle flame without catching fire. Design strategies
alone would usually not be sufficient to achieve compliance with the proposed standard, which means the addition of chemical flame retardants to the housing would be most likely.

**What Level of Flame Protection Must Be Met Under the Proposed Standard?**

Table 2 below shows the Underwriters Laboratory ratings for flammability of electronic housings. Internal materials inside electronic appliances currently need to meet minimum flame rating levels (usually V-0), which means they will readily self-extinguish after contact with a vertical flame. They are designed to compensate for electrical faults which may cause thermal spikes, sparks, or flames.

**Most outer housing materials currently used are rated HB without any added chemical flame retardants**, although some product housings are also required to have higher flame ratings if they act as part of the protective enclosure in the case of an internal fault. HB stands for “horizontal burn” and the standard requires that if a flame is applied to the material it will take more than three minutes to burn four inches in a horizontal direction (see Figure 1 below). The outer decorative housings for most consumer electronics are currently not required to meet higher flame ratings if there is a fire enclosure for protection against internal ignition. The outer housings are required to meet V-ratings if they are used as fire enclosure.

The proposed candle resistance standard would require the plastic in the outer housing to be rated V1 or higher which means it will readily self-extinguish when an external vertical flame is applied. See Figure I for a more detailed explanation of the levels of flame retardancy.

**Table 2. Flame-retardancy ratings**

<table>
<thead>
<tr>
<th>UL94 Ratings for Electronics Housings</th>
<th>Flammability</th>
</tr>
</thead>
<tbody>
<tr>
<td>5VA</td>
<td>More Flame Resistant</td>
</tr>
<tr>
<td>5VB</td>
<td></td>
</tr>
<tr>
<td>V-0</td>
<td></td>
</tr>
<tr>
<td>V-1</td>
<td></td>
</tr>
<tr>
<td>V-2</td>
<td>Less Flame Resistant</td>
</tr>
<tr>
<td>HB</td>
<td></td>
</tr>
</tbody>
</table>
Figure 1: Definition of UL94 Ratings for Electronic Housings

<table>
<thead>
<tr>
<th>Surface Burn</th>
<th>Vertical Burn</th>
<th>Horizontal Burn</th>
</tr>
</thead>
</table>
| Doesn’t Ignite
Under Hotter Flame | Self Extinguishing
UL 94 V-0 (Best)
UL 94 V-1 (Good)
UL 94 V-2 (Drips) | Slow Burn Rating
Takes more than
3 min. to burn
4 inches |

**What Types of Flame Retardants Are Likely To Be Used To Meet This Standard?**

Acrylonitrile butadiene styrene (ABS), high impact polystyrene (HIPS), and blends such as HIPS/ Polyphenylene (PPE), which are used in nearly all consumer electronic housings, are naturally flame resistant to the level HB. The proposed candle flame resistance requirement in IEC 62368 requires that external housings have a flammability rating of at least V-1.

To meet the proposed standard in Section 7 of IEC 62368, manufacturers are most likely to add flame retarding chemicals to the currently used electronic housing materials, HIPS and ABS. A variety of fire retardants can and will be used to comply with the IEC standard. The most cost effective and commonly used in plastic at the present time are brominated flame retardants (BFRs) and chlorinated flame retardants (CFRs).

HIPS, the lowest cost and most widely used plastic in electronic enclosures, is currently most often flame retarded with decabromodiphenyl ether (decaBDE). ABS is most frequently flame retarded with tetrabromobisphenol A (TBBPA). These flame retardants, when used in electronics housings, are added to rather than chemically bonded with exterior plastic. Therefore they can migrate out of the plastic into the surrounding environment.

A great deal of new information is currently emerging with regard to the negative health and environmental impacts of using BFRs and CFRs in consumer products. This will be discussed in Section III of this report. Several chemicals in this class have already been restricted due to their persistence or adverse effects on health which include conditions such as neurological impairments, reproductive abnormalities, endocrine disruption and cancer.

An additional potential hazard is that Antimony Trioxide, Sb$_2$O$_3$, is usually used as a synergist along with BFRs in electronics housings. This chemical is listed as known to the state of California to cause cancer under Proposition 65 and is considered a high priority substance under the RoHS Directive.
Some of the larger computer companies like HP, Dell, and Apple have committed not to use BFRs. However, as can be seen from Table 3 below, BFRs are currently less expensive than phosphates and some other alternatives, and as such, are expected to be used at least to some extent if the proposed Section 7 candle requirement is enacted.

Currently 45% of the fire retardant usage in the U.S. is BFRs; Europe uses 11% BFRs and 17% CFRs. It is reasonable to assume that increased usage, at least for the near future, would follow a similar pattern.

Table 3. Estimated TV Flame Retardants Cost to Meet the V-0 Standard

<table>
<thead>
<tr>
<th>Fire Retardant Chemical</th>
<th>Average Cost</th>
<th>Percent of $300 TV</th>
</tr>
</thead>
<tbody>
<tr>
<td>DecaBDE (BFR)</td>
<td>$11.21</td>
<td>3.7%</td>
</tr>
<tr>
<td>Other BFRs</td>
<td>$14.55</td>
<td>4.9%</td>
</tr>
<tr>
<td>Bisphenol A diphosphate</td>
<td>$18.18</td>
<td>6.1%</td>
</tr>
<tr>
<td>Phosphate esters</td>
<td>$22.00</td>
<td>7.3%</td>
</tr>
<tr>
<td>RDP</td>
<td>$23.03</td>
<td>7.7%</td>
</tr>
</tbody>
</table>

(Source: Lowell Center for Sustainable Production)
Section II: Development of the IEC Candle Flame Resistance Portion of Standard 62368

In the early 2000s, the U.S. National Association of State Fire Marshals (NASFM) began a campaign to require major electronics manufacturers to make their product housings candle flame resistant to an extent that would require adding high levels of fire retardant chemicals. Claiming that candle fires in consumer electronics were a major hazard, they called for an open flame flammability standard for consumer electronics housings.

In 2002, Robert Polk of the U.S. NASFM submitted a proposal to the IEC recommending a candle flame standard for electronics equipment. This proposal was the origin of the IEC TS 62441 which is now Section 7 in the proposed IEC 62368. The impetus and momentum motivating the candle standard has continued to come from NASFM. Four documents, cited by NASFM as justifying the standard in its proposal, are discussed in Appendix I.

As discussed in Section IV, the founder of the NASFM and their liaison to the government and the CPSC is Peter Sparber, a paid lobbyist for the fire retardant chemical industry. This means the NASFM is not an impartial party. They are linked to the industry that will gain a substantial financial benefit from the adoption of Section 7.

The literature, when reviewed, does not demonstrate a need for a candle flame resistance requirement for consumer electronics. NASFM based their claim of the need for an open-flame standard on misinterpretation of studies, flawed studies, and ignoring studies not favorable to their case.

Do Candle Fires in Consumer Electronics Present a Clear and Present Danger?

In response to the NASFM proposal, John Hall of the National Fire Protection Association (NFPA), America’s leading fire statistician, presented data in 2002 showing there were an insignificant number of candle fires in consumer electronics. His paper entitled, “Fires involving appliance housings – is there a clear and present danger?” concluded there was not a hazard.

Hall documented one death annually between 1993-1997 in the U.S. attributable to candle ignition of appliance housings including washers, dryers and stoves. Consumer electronics were only a part of this total. This implies an annual death rate of less than one from fires initiated by open flames -- a statistically insignificant number. Hall wrote that fires ignited by open flames in appliance housings were primarily very small fires that did not spread beyond the appliance.

This situation has not subsequently changed in the U.S. as documented in a 2007 NFPA report on the number of candle-ignited appliance fires. The NFPA report estimates 400 candle fires annually associated with all appliances, averaging less than one death per year in the U.S., and
equivalent to 7% of the total appliance fires. One estimate, based on appliance waste measurements, is that approximately 20% of appliance waste is consumer electronics. Thus, one could estimate that approximately 80 candle-ignited electronics fires occur per year, resulting in well below one death per year in the United States.

Both NFPA reports lead to the same conclusion: Candles (or any other external small open flame) account for a small share of the appliance housing fires and appliance housings as first items ignited account for a small share of the candle fires.

**IEC Special Fire Research Group Report**

After receiving the NASFM proposal for an open flame standard for electronic housings, the IEC created a Special Fire Research Group (SFRG) to assess:

1) the probability of fires caused by open flames external to consumer electronics housing;
2) conditions that might cause these fires;
3) the environmental implications of suggested precautions/safeguards (e.g., addition of flame retardant chemicals to electronics housing) over the intended lifecycle of the product.

The membership of the SFRG included representatives from the electronics industry as well as Great Lakes Chemical Corporation (now Chemtura) and Albemarle Corporation, two major manufacturers of flame retardant chemicals.

The summary conclusions of the SFRG report, quoted in Appendix 2, were not supportive of the need for the proposed IEC open-flame standard, but instead concluded that more study was needed.

**NASFM Justification on the Need for a Candle Standard is based on a Projected Future Hazard**

NASFM’s call for a candle standard rests not on a current documented problem of fires in consumer electronics, but on a potential future problem. This claim is based on a comparison of television fires in the U.S. with those in one suburb of Stockholm that had an extraordinarily high fire rate in the 1990s.

Margaret Simonson et al is the primary reference for the high frequency of fire in Europe. Her estimate comes from a paper by de Poortere et al. that purports to show that Europe, which uses UL-rated HB plastics with no additive flame retardants, has a much higher TV fire frequency than does the U.S., which uses plastics with flame retardants, or UL-rated V0 plastics. The research was funded by the European Brominated Flame Retardants Industry.
To begin with, this use of TV fire data as a basis for a regulation covering all consumer electronics is highly questionable. TVs are only one product in the greater category of “consumer electronics.” In this study, internally caused fires are not separated out from those caused by external open flames in the home. The vast majority of TV and consumer electronics fires result from internal electrical malfunction; these should not have been included.

Ignoring this issue, de Poortere proceed to argue that the HB plastics used in Europe caused more open flame fires in electronics housing than the VO plastics used in the U.S. However, instead of compiling statistics on fires from various European countries, de Poortere extrapolated the rate of TV fires per million TV sets in one suburb in Stockholm, reported in a study called the Vallingby project. De Poortere states, “The Vallingby project results, because of the thoroughness of the methodology are more representative of a wider European reality”. The Vallingby study is not referenced, nor is its methodology explained.

The Stockholm suburb in the Vallingby study had a much higher rate of fires per million TVs than the numbers given for the Netherlands, previous reports for Sweden, and the numbers in the 2001 UK Department of Trade and Industry report “Causes of fire involving television sets in dwellings”. (See Figure I below comparing the data used by the NASFM, Simonson, and de Poortere documenting the frequency of European TV fires with data from England, the Netherlands, and Norway.) With this artificially high number of “European” TV fires, de Poortere et al. 2002 conclude that Europe has many more TV fires than the U.S., due to the use of HB plastics.

Further undermining the Simonson, de Poortere argument is that the current rate of TV fires in Sweden is 6 per million, not dissimilar from the US. The 1991 to 1995 fire occurrence they cite cites appears to be an anomalous spike.

The relevant number is the number of externally caused fires for all consumer electronics. Relevant numbers showing a low level of such fires can be found in John Hall’s 2002 paper, as cited above. The NASFM proposal does not acknowledge the Hall data and its conclusions.

**Figure 2. TV Fires/ million TVs**
Figure 2 demonstrates that TV fires in the single report from Sweden cited by the NASFM and Simonson, are not representative of the rest of Europe. (Data for the USA, England, and Norway are from the DTI study and Sweden and the Netherlands are from Poortere)

**What Is The Risk Of Candle Ignition For Consumer Electronics?**

Noting that only five incidents involving the ignition by candles of appliances had been reported to the US Consumer Product Safety Commission over 11 years on a hotline set up for consumer product-related fire and burn injuries, the CEA concluded “that these incidents are so few and of such a nature that they do not appear to warrant a change in the product safety standards for electronic equipment.”

The Consumer Electronics Association states that, in 11 years of reporting, the National Electronics Injury Surveillance System saw only five cases of candle-ignited appliance injuries. Only one of these injuries was serious.

According to a Telecommunications Industry Association report in 2005: “It is the conclusion of subcommittee TR41.7 that the proposal as it currently stands is without merit and should be rejected. …it does not seem prudent to add arbitrary requirements that may increase the use flame retardants without a demonstrated need.” The TIA wrote again in 2007, “The new rationale does not offer any additional information or substantiation that there is a problem to be solved specific to this kind of equipment…. In addition, no data has ever been presented that the proposed requirements would address the stated (but so far unsubstantiated) concerns.”

It should be noted that four sources—Hall (2002), the CPSC, Consumer Electronics Association (CEA), the Telecommunications Industry Association (TIA)—have concluded that the risk of candles igniting consumer electronics is low.
It is not clear why the IEC standard setting group seemingly chose to disregard these four sources in favor of the bromine industry-sponsored study concluding that candle ignition of consumer electronics poses a serious fire safety threat. The Vallingby study upon which the proposal is based is not peer reviewed, does not provide sources, and is out of line with other published and peer reviewed data.

**Fire Retard Chemicals Slow Fires; Alternatives Prevent or Stop Fires**

Fire retardant chemicals can slow the ignition of plastic electronics housings from a small, open flame, such as a candle, but such products will nonetheless ignite in a larger fire scenario. The slight benefit in slowing combustion comes at an enormous potential cost to health and the environment. Fire safety strategies such as sprinkler systems stop fires without polluting or threatening human health. Other effective ways to reduce fire deaths and injuries include increased use of smoke detectors, child-safe lighters, and fire safety education.

The overall leading cause of fire deaths is cigarettes. The most effective fire safety strategies are campaigns to reduce smoking and the introduction of reduced ignition propensity (RIP) or fire safe cigarettes. In the last 25 years, annual cigarette-related deaths in the U.S. have declined dramatically from 2,000 to 700. U.S. legislation requiring reduced ignition propensity (“fire safe”) cigarettes and the recent adoption of similar regulations in Europe will likely reduce such deaths even further. Meanwhile, smoking rates for Germany, France and the United Kingdom had declined to slightly over 26% by 2003, and in the United States to just 21% by 2004. This greatly diminishing fire death rate should eliminate a large part of the rationale for increasing the level of hazardous fire retardant chemicals in consumer products.

**New Standards for Fire-Safe Candles Will Reduce Candle Fires**

In addition to the already low incidence of candle ignition of electronics, new candle safety standards have been adopted by the candle industries in the U.S. and Europe to minimize fatalities and injuries associated with candle fires in bedding and furniture.

During the period from 1990 to 1998, U.S. candle consumption increased 350%. Although candle-related fire injuries and deaths increased at much slower rates of 13% and 42% respectively, improving candle fire safety became the objective of the candle industry and the Consumer Product Safety Commission (CPSC). Working through the American Society for Testing and Materials (ASTM) organization, standards were developed to address candle fire safety issues, using the following approach:

- Research and understand the root causes of candle fires
- Create manufacturing standards to reduce and/or eliminate root causes
- Work with retailers to require these standards in their candle specifications.
As a result, ASTM has instituted candle manufacturing standards that address public education of candle hazards through labeling, glass container material requirements to eliminate shattering due to candle heat, and improved candle design to minimize the four most prevalent causes of candle fires: excessive flame height, secondary ignition, end of useful life, and stability. Complying with these standards requires a manufacturer to design and produce candles with warning labels, with a maximum wick length, without combustible decorative materials, that will self extinguish without incident when they have burned down, and be proportioned to not tip over up to an angle of 10 degrees.

Ninety percent of US candle manufactures have pledged to comply with these standards. The ASTM is actively working with major retailers and distributors to ensure that their specifications for candles and accessories will include these standards regardless of where they are sourced. As a result, the ASTM estimates that the majority of all candle and candle accessory products sold in the U.S. are in compliance.

There are similar candle standards initiatives in Europe. A European committee for standardization (CEN) task force for candles in Europe is in place to define standards and work with European candle producers to improve the safety of candle use.

The widespread implementation of these standards designed to address the root causes of candle fires has improved candle fire safety and is ultimately reducing candle fire injuries and deaths in ignitions of furniture and bed clothing.

**Section III: Adverse Impacts of Implementing the Candle Flame Resistance Standard in Section 7 of IEC 62368**

**Effect of the Section 7 Candle Requirement on Electronics Recycling**

The proposed candle flame resistance requirement in IEC 62368 to protect housings from external ignition by small, open flame would essentially mandate that external product housings have a flammability rating of at least V-1.

Materials with a flame rating of HB are commonly used for the external housings of many consumer products. The existing requirement to contain fires from internal sources allows for the widespread use of HB-rated plastic materials (ABS, HIPS, and PP blends) for most external housings, without adding flame retardants. These materials account for 87% of recycled electronics plastics. Alternately, more expensive materials, such as a polycarbonate (PC)/ABS blend, could be used.

After many years of effort, electronics recycling is becoming more common. The negative impacts of the proposed candle requirement on recycling are described below:
(1) Less recycled material would be available for use in new products

By far the preferred method for disposing of plastics at end-of-life is mechanical recycling because it closes the loop and reduces the need for additional virgin material to be extracted and produced. Mechanical recycling requires plastics to be shredded and sorted by resin type in order to provide homogenous plastic waste, which can then be put through a melt reprocessing step, and combined with new material to produce a blend that is (ideally) comparable to virgin material. If the properties of recycled material are not comparable to virgin material, it must then be “downcycled” into less demanding applications. It is currently possible to recover high-purity ABS through a variety of recycling approaches, and there is an active market for the recycled material.

Several BFRs are known to degrade the mechanical properties of recycled engineering plastics,\(^1^8\) although many of these problems are solved by using more chemical additives. More importantly, after bromine-containing plastics have passed through the basic recycling process, the additional thermal stresses from the new product manufacturing processes, such as extrusion, compounding and molding, can lead to an increase in PBDD/F concentrations (dioxins and furans) above legal limits. Therefore, mechanical recycling of bromine-containing electronics waste is often not recommended.\(^1^9\)

BFRs, as previously discussed, will be used to meet the flammability requirements by some manufacturers for reasons of cost and familiarity. Some major electronics producers have made public commitments to eliminate BFRs from product housings, which would mean that other flame retardant chemistries would be introduced to meet the proposed requirement. There has been little research on the effects of non-BFR flame retardants on the mechanical properties of recycled resins. Based on the negative impact that these chemicals have on the properties of virgin materials (poor mechanical properties, thermal stability, and molten rheology, etc.), residual non-BFR flame retardants will almost certainly degrade the properties of recycled ABS and HIPS.

Using commercially available ABS and HIPS (with no added flame retardants) in the housings of electronics whenever possible greatly improves the probability that recycled plastic can be introduced into equivalent products because the mechanical properties are maintained after recycling. The introduction of flame retardant chemicals to all ABS and HIPS housing in order to meet the candle flame resistance requirement will result in degraded mechanical properties of material recovered from electronics housings when it is recycled, making it harder to incorporate recycled content into equivalent products, and forcing more “downcycling.”

(2) Recycling of plastics containing a mixture of flame retardants would cost more, forcing more energy recovery or burning of plastic.

The EU directive on Waste from Electrical and Electronic Equipment (WEEE) which was enacted in 2003 aims to increase the re-use, recycling and recovery of waste from a wide range
of consumer products. Annex II of the WEEE Directive requires the “selective treatment of plastics containing BFRs,” so plastics containing BFRs are separated prior to recycling or energy recovery. However, it is unlikely that most recyclers would be able to cost effectively separate plastics containing a variety of fire retardant chemicals. It would be labor intensive and the analytical tools available for identifying chemicals in materials are limited to elemental detection of a number of substances. For example, handheld x-ray fluorescence (XRF) equipment would be able to detect elemental phosphorous in non-BFR plastics, but would not be able to differentiate between the various phosphorous compounds. Different phosphorous compounds exhibit different chemical behaviors and would produce a variety of combustion byproducts. Gravity separation, often used to refine the waste stream, would not differentiate between different fire retardants.

Since all non-BFR plastics would be shredded together, the resulting regrind from mixed flame retarded plastics could have unpredictable and undesirable qualities, even within the same base resin. If mixed, untreated regrind is “downcycled,” the reduced market value of the lower grade of material could threaten the economic viability of the recycling industry, as would any additional post-processing treatments needed to homogenize, purify, or otherwise improve the material.

Although mechanical recycling is increasing, only about 16% of plastics are mechanically recycled today in Europe, with lower rates in other regions. Electronic materials already pose a challenge for mechanical recycling because separating the plastics is difficult due to the complexity of the products. Introducing a wide range of flame retarding chemicals into product housings to meet the proposed standard would make mechanical recycling even less profitable, or perhaps impossible in some cases, so that much of the waste material currently being mechanical recycled will be diverted to energy recovery (burning), with negative impacts for the environment and public health.

(3) Emissions from energy recovery exhaust could have unknown and potentially toxic composition.

Energy recovery involves the combustion of plastic materials in order to recover energy for producing electricity, steam, or heat. It is a common way of treating mixed and soiled plastics in the waste stream, and about 30% of post-consumer plastic waste is treated through energy recovery in municipal incinerators in Europe.

Energy recovery is vastly inferior to mechanical recycling in that it destroys material that could be incorporated into new products; however, properly controlled incineration is still preferred to land filling in most cases. Significant research has been done to ensure the complete thermal destruction of brominated dioxins and furans in state-of-the-art solid waste treatment facilities. While there has been extensive research on the incineration of BFRs, little is known about the effects of alternate flame retardant chemistries on combustion in incinerators and smelters. In particular, many phosphorous compounds are known to exhibit acute ecotoxicity, and the composition of the combustion byproducts of plastics containing these flame retardants is unknown.
Since the formulators would be using a wide variety of chemical approaches to achieve fire resistance, it is likely that there would be a wide variety of combustion byproducts in incinerator exhaust. Incinerator operators wouldn’t know what chemicals are in incoming waste, making it difficult to anticipate which scrubbing and sequestering techniques should be used on exhausts and effluents.

It took many years for European incinerators to be properly equipped to reliably destroy halogenated dioxins and furans in exhausts, and they will need to invest in equipment and technology to appropriately sequester and scrub combustion byproducts from alternate chemistries which may include phosphorous, antimony, and other materials. Complying with the proposed candle flame resistance requirement could set in motion an environmental crisis with a time delay because it takes time for most electronic products to reach the waste stream. It could be many years before the full impact of the additional flame retardant byproducts is known for energy recovery exhaust.

**4) Outdoor burning of electronics and unplanned fires could result in uncontrolled emissions possibly containing dioxins, furans, and other toxic compounds**

Much of the concern about BFRs in electronics is due to combustion byproducts, including dioxins, furans, their brominated analogs and other toxic compounds, produced in uncontrolled, open pit burning of waste that occurs in the informal recycling network and in unplanned fires in locations such as landfills. There are numerous reports documenting the risks to workers, surrounding communities, and ecosystems near electronic waste dismantling and burning sites.23 24

Although an eventual goal is to eliminate dangerous practices, the reality is that uncontrolled incineration is still the end-of-life fate of a significant portion of electronic products. Many product housings will end up in the informal recycling system or be burned in an unplanned fire in an uncontrolled way. In addition, with the reduced financial viability of legitimate recycling, additional consumer electronic waste that cannot be otherwise economically recycled may be added to the more than one million tons of electronic product waste shipped to China from the U.S. and EU each year.25

Even within the legitimate solid waste treatment system, not every incinerator and smelter has been modified to incorporate state-of-the-art technology, so exhaust with toxic combustion byproducts of flame retarding chemicals will be released in many areas. Also, equipment with sub-optimal exhaust treatment is more likely to be found in poor areas and to continue to emit harmful exhaust for longer periods due to a lack of environmental regulation and enforcement in these areas.

The burden of the additional hundreds of million pounds of flame retarding chemicals and the resulting dioxins, furans, and other toxic pollutants from V-1 housings to meet the candle flame requirements will fall disproportionately on communities already affected by uncontrolled or sub-optimal incineration of electronic waste.
**Human and Environmental Health Impacts of the Candle Resistance Requirement**

If the IEC candle standard were adopted today, hundreds of thousands of tons (hundreds of millions of pounds)\(^1\) of fire retardant chemicals would be added to consumer electronics. The least expensive chemicals that could currently be used to meet the standard are BFRs and CFRs. These chemicals, which have been in use in furniture, draperies, carpets and some electronics for as long as three decades, are known to migrate out of these products into dust; they are being found in increasing levels in human fat, body fluids, and breast milk worldwide. They have entered the food chain and are most noticeably found in fish and meat.

The U.S. has the highest levels of fire retardants in consumer products and has much higher levels of BFRs in dust, food, and breast milk than the rest of the world. California, the only state in the U.S. with an open flame standard for furniture, has 3 to 8 times the levels of toxic BFRs in house dust compared to other parts of the nation. U.S. levels are ten times higher than European levels.\(^4\) Preliminary studies indicate that Californians also have higher levels measured of BFRs in their body fluids. In animal experiments, BFRs have been reported to cause thyroid disruption, reproductive, neurological and developmental problems, and cancer.\(^{26,27,28}\)

At present decaBDE and TBBPA are the BFRs primarily used in plastic electronics housings and their usage could considerably increase, possibly by as much as two or three-fold. Both are known to persist in humans, wildlife, and the environment and have the potential to cause adverse health and environmental effects. They, like most other fire retardant chemicals, continue to be used in consumer products without adequate knowledge of potential health and environmental effects.

In 2003, California enacted legislation banning decabromodiphenyl ether (pentaBDE) and octabromodiphenyl ether (octaBDE), BFRs closely related to decaBDE, used in high volumes in draperies, consumer electronics, and small appliances. Eight other states and the European Union (EU) followed suit. In 2004, the U.S. manufacturer voluntarily ceased production.

The phase-out of pentaBDE and octaBDE was due to a number of studies demonstrating bioaccumulation and adverse health effects in experimental animals, notably disruption of thyroid hormone balance and neurological and developmental effects. Exposures early in life caused irreversible changes in spontaneous behavior and learning and memory deficits that were permanent and increased in later life.\(^{29}\) Other studies have found that polybrominated diphenyl ethers (PBDEs) actually change certain brain receptors.\(^{30}\) The fire-retardant decaBDE, which continues in common use, has been found to cause the same changes in spontaneous behavior, learning, and memory as the less brominated BDEs.\(^{34}\)

PBDEs are similar in structure to thyroid hormone, and exposures cause decreased thyroid hormone levels (serum T4) in mice, rats, kestrals, and frogs.\(^{31,32}\) Disruption of thyroid
hormone balance may well contribute to the neurobehavioral effects and changes in brain functioning observed after PBDE exposures. The National Toxicology Program (NTP) has found that there is some evidence of carcinogenicity of decaBDE in experimental animals.33

DecaBDE was recently banned in Sweden, Washington State, and Maine based on extensive research showing that it is accumulating and debrominating to form the more toxic less brominated BDEs.34 Ten or more other U.S. states are considering legislation to ban decaBDE. The European Court of Justice will hand down its judgment on the DecaBDE exemption from RoHS on 2 April 2008.

TBBPA is the most highly used brominated flame retardant worldwide and has been marketed as a safe, non-toxic flame retardant. However, its long-term toxicity has not been adequately evaluated. The NTP is currently conducting a two-year cancer bioassay in mice and rats.35 In vitro studies have established that TBBPA is cytotoxic, immunotoxic, and disrupts thyroid hormone homeostasis.36 TBBPA is also a potent inhibitor of estradiol sulfotransferase in vitro37,38 suggesting that TBBPA exposure may lead to elevated estrogen levels if inhibition of this enzyme occurs in vivo. A recent in vivo study has found high estrogenic activity in ovariectomized mice after TBBPA exposure.39 A decrease in circulating thyroxine has also been shown in vivo after TBBPA exposure in a reproduction study in rats.40 That study also found increased testes and pituitary (male) weights and correlations with other developmental parameters.

Other brominated flame retardants might also be used to meet a new IEC standard. These might include bis(tribromophenoxy) ethane or decabromodiphenylethane, flame retardants for which little or no toxicity data are available.

Phosphates are the other major class of fire retardants that could be used to meet the IEC candle standard. Currently they are more expensive and not yet available in large enough quantities to replace BFRs and CFRs, should the latter be phased out. The phosphates that have been studied are highly ecotoxic; data about long term health and environmental effects is not available.

An important question is whether fire-retardant chemicals cause the same adverse health effects in humans as they do in multiple species of animals. The most data is available for PBDEs, which are found in high levels in house dust and dryer lint41 as well as in the food supply, especially in meat and fish.42

A recent review relating BFR body levels in humans to those measured in animals that were fed BFRs allows for quantitative comparison between animal and human exposures.43 The most probable health impacts from PBDE exposure are reproductive and neurodevelopmental changes. For US women, the highest five percent have PBDE tissue concentrations equal to those that cause reproductive changes in experimental animals and within a factor of ten of the level that causes neurological changes.44,43 This is especially problematic during pregnancy when exposure to very low levels of endocrine disrupting chemicals can increase neurological, reproductive, and developmental problems in the unborn child as well as cancer.45 Many brominated and chlorinated
chemicals are known or suspected endocrine disruptors. This suggests a small margin of safety for developmental toxicity of BFRs for children born to U.S. women.

At the same time, developmental conditions such as are listed in Table 4 are increasing in our populations. Brominated and chlorinated fire retardants, which are associated with similar conditions in experimental animals, could be contributing to the increased prevalence of some or all of these conditions.

Table 4. Recent increases in health problems that could be related to early exposures to environmental pollutants such as halogenated fire retardant chemicals.

<table>
<thead>
<tr>
<th>Condition</th>
<th>Increase</th>
</tr>
</thead>
<tbody>
<tr>
<td>Autism</td>
<td>10X</td>
</tr>
<tr>
<td>Male Birth Defects</td>
<td>2X</td>
</tr>
<tr>
<td>Childhood Asthma</td>
<td>2X</td>
</tr>
<tr>
<td>Acute Lymphocytic Leukemia</td>
<td>62%</td>
</tr>
<tr>
<td>Childhood Brain Cancer</td>
<td>40%</td>
</tr>
<tr>
<td>Preterm Birth</td>
<td>23%</td>
</tr>
<tr>
<td>Infertility</td>
<td>5-10%</td>
</tr>
<tr>
<td>Birth Defects</td>
<td>3-5%</td>
</tr>
<tr>
<td>Sperm Counts</td>
<td>1%</td>
</tr>
</tbody>
</table>

Fetal and early life exposures are linked to a range of adult health problems such as Alzheimer’s disease and other neurological disorders and diabetes. Some chemical exposures can lead to heritable changes that continue into future generations.

House cats share our indoor environment and have high levels of PBDEs. Hyperthyroidism is a new disease that emerged in cats in the 1980s as PBDEs began to be used in significant quantities and is now the second most common disease in cats. Noting that pentaBDE is structurally similar to thyroid hormone, researchers have suggested an association of the high levels of PBDEs in cats and hyperthyroidism.
Another factor to consider is occupational exposures that may occur during the production of BFRs and CFRs; during the manufacture of products containing these chemicals; and during waste disposal of such products.

Unlike many other pollutants BFR exposures come primarily from contact with consumer products containing BFRs, such as electronic appliances, furniture in the home and office, rather than from diet. The major route of exposure is ingestion of dust with BFRs attached to dust particles. Dust is also the major source of exposure for young children. Children have greater body burden do adults. Homes and work environments with several consumer electronic devices have been shown to have higher concentrations of BFRs in indoor air than those without electronics.

Dozens of scientific studies are under way looking at the relationship of other fire retardant chemicals to birth defects, autism, hyperactivity, reduced fertility and sperm counts and other neurological and reproductive conditions. A study at Copenhagen University Hospital associated cryptorchidism, a condition in which one or both testicles fail to descend into the scrotum, with higher concentrations of PBDEs in breast milk. In 2006, Swedish researchers linked early-onset testicular cancer with higher levels of maternal PBDEs. The PBDE-autism connection is being studied by Irva Hertz-Picciotto at the Mind Institute at UC Davis.

The continued failure to adequately evaluate the health and environmental hazards of a series of fire retardant chemicals prior to their entering the environment demonstrates the need for a more systematic approach to chemical regulation.

The benefits of additional requirements leading to fire retardant chemicals in consumer products should be weighed against the health costs before proceeding.
Section IV: Chemical Industry Involvement in the IEC Process

The proposed candle requirement, while protecting against a minuscule number of fires, would lead to a massive infusion of fire retardant chemicals into consumer electronics, as well as substantial profits for the fire retardant chemical manufacturers. Most of the impetus for Section 7 of IEC 62368 and other open flame standards in consumer products comes from the chemical manufacturers, their lobbyist Peter Sparber, the NASFM, and other individuals and organizations associated with the chemical industry or Sparber.60 61 62 63

According to a recent article in the Washington Post64, “Peter Sparber…a vice president of the Tobacco Institute, the industry's lobbying arm, in the 1980s….built a national network of tobacco-friendly fire marshals to call on in the fight against fire-safe cigarettes. ….By the late 1980s, Sparber …was a volunteer lobbyist for the National Association of State Fire Marshals….Sparber was still on the tobacco industry payroll.”

Starting in 1999, lobbying registration records show, Sparber went to work for the producers of BFRs, which include Chemtura, based in Middlebury, CT, and Albemarle, based in Richmond, VA. Their industry stands to greatly benefit if a candle requirement is implemented for consumer electronics.

Statistics developed by individuals associated with Peter Sparber and the NASFM have provided much of the justification for the IEC standard proposed by the NASFM. For example, Margaret Simonson, whose research on the high level of TV fires in Europe was based on one fire-prone suburb of Stockholm was cited, is chair of the Science Advisory Committee for the NASFM. Along with Karen Suhr, who works in Peter Sparber’s Washington, DC, lobbying firm, Simonson is the contact person for International Consortium for Fire Safety, Health and the Environment (ICFSHE). See http://clean-and-safe.org/contact.htm

Peter Sparber continues to serve as the pro bono legislative representative for the NASFM and to coordinate their aggressive campaigns for open flame standards and fire retardant chemicals in a wide range of consumer products. For example, the NASFM is currently campaigning to remove sprinkler exclusions and require high levels of fire retardant chemicals in furniture in nursing homes, hospitals, college dorms, and other residential facilities in the United States.

Another NASFM effort to strong-arm business to use flame retardant chemicals is to try to persuade the National Transportation Safety Board (NTSB) to classify furniture without a high level of chemicals as a hazardous material. Trucks delivering such furniture would be required to display an orange hazardous materials decal, the drivers would need Hazmat certification, and stores with such furniture would be classified as “hazardous occupancies.”

Consumer product companies report that NASFM uses aggressive tactics to encourage their use of flame-retardant chemicals. Companies that balk are threatened by the prospect of adverse media campaigns showing their products catching fire and burning.
It seems that the fire retardant chemical companies acting through the NASFM have similarly been exerting undue influence in preventing the IEC from taking a balanced approach to fire safety. Such an approach would weigh the miniscule possible future fire benefit to be gained from making plastic electronics housings resistant to candle flames against an enormous likely negative impact on human health and the global environment. The winners from the approval of Section 7 of the IEC standard are the manufacturers of fire retardant chemicals and their lobbyist; the losers are public health and the global environment.

**Conclusion**

When the IEC candle fire resistance standard development process began, there were an insignificant number of candle ignitions in consumer electronics. The standard was introduced to stop possible future fires. However since that time, the number of fire deaths from candles igniting consumer electronics has remained statistically insignificant.

Adopting the requirement that all electronic housings be resistant to a three-minute exposure to a candle flame as defined in Section 7 of IEC 62368 is not aligned with current larger issues of public health and the environmental goals of increasing recycling and reducing pollution.

Although the developers of the candle flame resistance requirement point out that the standard does not dictate the method for meeting the requirement, the most likely approach would be to add flame retarding chemicals to current materials. Including a variety of fire retardant chemicals in plastic housings will increase the cost and complexity of recycling, and potentially shift waste material into energy recovery (burning), where unknown and potentially dangerous combustion byproducts will be released into the environment for years to come.

The possible adverse impact on public health is enormous. The chemicals likely to be used are known human and environmental toxicants or lack adequate health or toxicity information. The previous average annual use of 9,000 metric tons (20 million pounds) of the fire retardant pentaBDE, primarily in the U.S., has polluted the world. The hundreds of thousands of metric tonnes (hundreds of millions of pounds) of a variety of flame retarding chemicals, often without adequate health data, that would be likely to be used to comply with this standard pose potentially catastrophic consequences to human health and the environment globally.

These chemical fire retardants only delay plastic ignition from a small open flame; they have no impact on a fire the size of a wastebasket. Sprinkler systems stop nearly all fires without imperiling human heath and the environment. Other effective strategies to reduce fire deaths and injuries include fire safe cigarettes, candles, and the increased use of smoke detectors, sprinkler systems, child-safe lighters, and fire safety education. The most effective way to reduce fire deaths is through campaigns to reduce smoking.

This paper demonstrates the lack of a documented past, present, or future fire safety reason for Section 7 of IEC 62368 and enormous negative consequences to the health of humans, animals, and the environment.
Sales of the fire retardant chemicals to meet this standard will provide billions of dollars of revenues to the chemical industry which is directing the IEC process to its own profit. The cost to the world in adverse impacts on human health and the environment is likely to be orders of magnitude greater.

Polybrominated biphenyls (PBBs), polychlorinated biphenyls (PCBs), Tris, Halon, asbestos, and PBDEs are all fire retardant materials which have turned out to have serious long-term negative effects on our health and/or environment. Once millions of pounds of toxic fire retardant materials such as these enter the global environment, it is impossible to recall them. Bioaccumulation and adverse health impacts of most of these fire retardant materials in multiple animal species are well documented. Similar outcomes are beginning to be seen in humans.

Due to ineffectiveness of toxics regulation in the U.S., neither the federal nor state environmental protection agencies or other governmental organizations have the authority to require manufacturers to provide the necessary health and safety information or to regulate the chemicals themselves.

Whether the fire retardants to be used are BFRs, CFRs, phosphates, or other alternatives, adding hundreds of millions pounds of such chemicals to consumer products without adequate health information represents an enormous gamble with human and environmental health worldwide. Adding these chemicals this without a strong fire safety rationale is irresponsible.

Fire-retardant chemicals in our homes should not pose a much greater hazard to our health and environment than the risk of the fires they are supposed to prevent. It is critical that 1/3 or more of the national bodies who belong to the IEC TC 108 committee vote “No” on IEC standard 62368 with the added comment to delete Section 7 in its entirety.

In addition, the IEC TC 108 committee is considering requirements for candle flame ignition resistance for the two current flammability standards, IEC 60950 and IEC 60065. For the reasons outlined in this paper, the national IEC bodies should vote "No" on adding a candle resistance requirement to IEC 60950 and in IEC 60065.

Also, the same document containing section 7 is currently under parallel vote in CENELEC, the standards body in the EU, as prEN 62368 with the same deadline of 25 April, 2008. We ask CENELEC to vote “No” on prEN 62368 to protect human health and the environment.
Appendices

Appendix 1: Major Documents used in Support of the Candle Standard, Section 7 of IEC 62368

NASFM based the need for IEC 62368 primarily on four documents. 10, 65, 66, 67

In order to justify the IEC proposal, NASFM should show that there are enough electronics fires, of enough severity, to constitute a real danger to the consumer. Two basic questions should be answered:

1. How many destructive fires occur each year due to candle igniting the external housing of electronics?
2. Would less flammable enclosures reduce fire deaths, injuries, and/or losses?

These answers are necessary given the toxicity and high economic costs (compliance costs, health costs, environmental costs, and cost of losing the opportunity to recycle) of implementing Section 7 of the proposed IEC standard.

Neither of these questions has been adequately answered in these documents.

Document 1 is a website with links to sub-documents associated with NASFM meetings in 2002. Few of the sub-documents are original reports or are well referenced. There are three Powerpoint presentations, a set of meeting notes, a letter against the IEC standard from the CEA, and a call for information regarding the standard.

Document 2 attempts to answer questions about the prevalence and severity of electronics fires in the United States and Europe. Based on equivocal information, the report concludes that there is a significant need for higher fire safety in Europe, and a somewhat lesser need in the US. However the thoroughness of the report and the conclusions drawn from data are open to question.

Document 3 compares the flammability of four types of resins (ABS, HIPS high, PC, and PP) and three categories of flame retardancy (inherent in the plastic with no additives, with halogen free additives, and with brominated/antimony flame retardants). The report scientifically details heat outputs of the various materials. The report concludes that, with flame retardants (halogenated or otherwise), there is little chance of a candle ignited electronics fire that would spread throughout a structure. However, without flame retardants, electronics have the capacity to ignite and spread fire.

Document 4 is a study by John Hoffman of the Safety Engineers Laboratory in Michigan. It finds that V0 plastics are less flammable than HB plastics and that it is difficult to tell whether a TV fire starts internally or externally based on the burn pattern of the room. Although it is not the main thrust of the paper, the author suggests that V0 plastics are the reason for the decline of TV fires in the US from 1980 to 1997. However, the paper makes this claim without discussing other possible reasons for the decrease in fires (better internal electronics, better
open flame safety in the home, etc.), nor does it give a quantitative estimate of the increase in V0 plastics in the American market.

**Appendix 2: Response of the IEC Special Fire Research Group to Proposal for a Candle Standard Report**

After receiving the NASFM proposal for an open flame standard for electronic housings, the IEC created a Special Fire Research Group (SFRG) to assess the probability of fires caused by open flames external to consumer electronics housing; conditions that might cause these fires; and also the environmental implications of addition of flame retardant chemicals to electronics housing over the intended lifecycle of the product.

The summary conclusions of the SFRG report, as quoted below, concluded that more study was needed.

- **a. How large is the fire problem associated with the equipment of interest?**
  There is sufficient historical evidence of fire experience involving entertainment and electronic equipment to justify a more detailed examination. The TV fire rate in Europe is significantly higher than the U.S. rate. It is less clear how the fire death rates compare, and it is not clear how the fire incidence rates compare for equipment of interest other than TVs.

- **b. How much of the fire problem involving the equipment of interest arises from external ignition?**
  Internal ignition accounts for most fires and should be the primary concern of any fire safety initiative, but external ignition contributes a sufficient share to justify further examination.

- **c. What is the severity of the fires involving the equipment of interest?**
  Fires involving this equipment tend to be smaller than typical structure fires in both Europe and the U.S.

- **d. What are the sources of external ignitions?**
  For the particular types of equipment of interest, open flame is the principal type of external ignition, and most open flame ignitions that are not the result of a fire started somewhere else in a room or building are due to candles.

- **e. What is the role of intentional fire setting and fire play by children in the open flame ignitions of appliance housings?**
  For the dominant open-flame source (i.e., candles), intentional and child-play fires is not an issue. For match and lighter ignitions of appliance housings, intentional fire setting accounts for the majority of fires, while child-playing is much less an issue.

- **f. What does the fire record of the U.S. vs. Europe imply about the fire performance of V0 plastic?**
The greater use of V0 plastic may explain the large difference in TV fire incidence rates between Europe and the U.S. There is no clear, comparable difference in average fire severity, which is low for these fires in both regions.”
Endnotes

1 Approximately 1/3 of electronic housings are currently treated with fire retardant chemicals. The annual increase with the IEC candle resistance requirement is estimated to be twice the current usage. Estimates of the increase if Section 7 of the IEC standard were to be enacted range from a low of 250,000 metric tons (550 million pounds) of BFRs to a high of 790,000 metric tons (1.7 billion pounds) in total.

2 Dave Wilson, October 1 2002, Electronic Equipment Ignition By Candle – Recent Incident Reports, Consumer Electronics Association

3 Furniture Flame Retardancy Partnership: Environmental Profiles of Chemical Flame-Retardant Alternatives for Low-Density Polyurethane Foam, EPA 742-R-05-002A, September 2005

4 Zota AR, Rudel RA, Morello-Frosch RA, Camann DE, Brody JG. 2007. Regional variation in levels of indoor polybrominated diphenyl ethers may reflect differences in fire safety regulations for consumer products. 17th Annual Conference of the International Society of Exposure Analysis, Research Triangle Park, NC.


6 See the proposal on the archived NASFM web site at: http://66.151.177.220/issues/home/computer_fires.html, under “NASFM Proposals to Underwriters Laboratories Standards Technical Panels for Audio, Video, and Similar Electronic Apparatus (UL 60065) and Information Technology Equipment (UL 60950)”


9 Conference of the Parties to the Basel Convention on the Control of Transboundary Movements of Hazardous Wastes and Their Disposal, Eighth meeting, Nairobi, 27 November–1 December 2006 Item 4 of the provisional agenda, Organization of the meeting Creating innovative solutions through the Basel Convention.


14 TR41.7 Comments on the Proposal for Adding Candle Flame Test to UL 60950-1, March 31, 2005.

15 TR41.7 letter to UL Objecting to the Preliminary Proposal for Candle Flame Requirements UL 60950-1, December 14, 2007.
16 ASTM F2417-04 in the U.S. and EN 15493 of 2007 in the EU are the standards for candle safety.


20 APME, Plastics Market 2004


36 LS Birnbaum, DF Staskal, JJ Diliberto, September 2003, Health effects of polybrominated dibenzo-p-dioxins (PBDDs) and dibenzofurans (PBDFs) - Environment International, Volume 29, Number 6, pp. 855-860(6)


42 Arnold Schecter, Olaf Päpke, T. Robert Harris, K.C. Tung, Alice Musumba, James Olson, and Linda Birnbaum, Polybrominated Diphenyl Ether (PBDE) Levels in an Expanded Market Basket Survey of U.S. Food and Estimated PBDE Dietary Intake by Age and Sex, Environmental Health Perspectives Vol. 114, Number 10(October 2006)

43 Thomas A. McDonald, Polybrominated Diphenylether Levels among United States Residents: Daily Intake and Risk of Harm to the Developing Brain and Reproductive Organs, Integrated Environmental Assessment and Management, Volume 1, Number 4, pp. 343–354


Main, Katharina M, et al. 2007. Flame Retardants in Placenta and Breast Milk and Cryptorchidism in Newborn Boys, In: Environmental Health Perspectives, ehponline.org
60 http://web.archive.org/web/19990420072056/www.firemarshals.org/advocate.htm

61 Conversation with Andrew McGuire, Executive Director, Trauma Foundation, San Francisco General Hospital

Big Tobacco's Dollars Douse Push for Fire-Safe Cigarettes; Lobbying: Firms bankroll experts, alliances with safety groups to resist product changes, papers show. By: Myron Levine, Times Staff Writer

63 E.M. Barbeau, G. Kelder, S. Ahmed, V. Mantuefel and E.D. Balbach, From strange bedfellows to natural allies: the shifting allegiance of fire service organizations in the push for federal fire-safe cigarette legislation, Tobacco Control;14:338-345(2005) and many other articles at http://legacy.library.ucsf.edu

64 “Fighting for Safety: Your Couch Is Caught in a Flammable Regulatory Battle Between the Chemical and Furniture Industries” By Annys Shin, Washington Post, Saturday, January 26, 2008; Page D01


CONTACT INFORMATION:

Arlene Blum, PhD., Institute for Green Science Policy, Visiting Scholar, UC Berkeley
arlene@arleneblum.com  510 644-3164
Box 5455, Berkeley, CA, 94708, USA
http://greensciencepolicy.org/

Sara Schedler, Friends of the Earth
SSchedler@foe.org  415.544.0790, ext. 17 (office)
311 California St., Suite 510, San Francisco, CA 94104, USA
www.foe.org

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Center for Environmental Health
Center for Environmental Oncology of the University of Pittsburgh Cancer Institute
Clean Production Action
Department of the Environment, City of San Francisco
European Environmental Bureau
Friends of the Earth
Healthy Building Networks
Institute of Green Oxidation Chemistry, Carnegie Mellon University
MOMS(Making Our Milk Safe)
Moms Rising
Public Trust Alliance

Co-signers:

Joan Blades, Co-founder, Mom's Rising and MoveOn.org
Arlene Blum, PhD, Visiting Scholar, University of California at Berkeley
Jared Blumenfeld, Director, Department of the Environment, City of San Francisco
Kathleen Collins, Professor, Dept. of Molecular and Cell Biology, University of California at Berkeley
Terry Collins, PhD, Thomas Lord Professor of Chemistry, Carnegie Mellon University, and Director, Institute of Green Oxidation Chemistry

Devra Davis, PHD, Director, Center for Environmental Oncology of the University of Pittsburgh Cancer Institute
Anne M. Dranginis, Ph.D. Associate Professor of Biological Sciences, St. John's University

Maryann Donovan, MPH, PhD, Scientific Director, Center for Environmental Oncology of the University of Pittsburgh Cancer Institute

Stephen A. Gardner, DVM, DABVP, Albany Animal Hospital

Ronald B. Herberman, M.D., Director, UPCI, Chief, Division of Hematology-Oncology, Hillman Professor of Oncology, Associate Vice Chancellor for Cancer Research

Alastair Iles, Assistant Professor of Science, Technology & Environment, Department of Environmental Science, Policy and Management, University of California at Berkeley

Tom Lent - Policy Director, Healthy Building Network


Ruthann Rudel, Senior Scientist, Silent Spring Institute

Sara Schedler, Friends of the Earth

David Seaborg, World Rainforest Fund

Professor Allen Silverstone, Dept. of Microbiology & Immunology, SUNY Upstate Medical University

Tony Stefani, Board Chair, San Francisco Firefighters Cancer Prevention Foundation

Michael Warburton, Executive Director, Public Trust Alliance