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

This document has been electronically approved and signed.

**BALLOT VOTE SHEET**

**DATE:** March 21, 2012

**TO:** The Commission
Todd A. Stevenson, Secretary

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

**FROM:** Barbara E. Little, Office of the General Counsel, Regulatory Affairs Division

**SUBJECT:** Petition CP 11-1; Request for Standard for Gas Fireplaces with Glass Fronts

**BALLOT VOTE Due:** March 27, 2012

The U.S. Consumer Product Safety Commission ("CPSC") received a request, dated May 23, 2011, from Carol Pollack-Nelson, Ph. D, asking that the CPSC initiate rulemaking to require safeguards on the glass fronts of vented gas fireplaces to protect consumers from burns received by coming into contact with the glass front. Subsequently, the CPSC received another submission from William Lerner, asking that the CPSC initiate rulemaking to require a warning system that would alert consumers when the glass front exceeds a certain temperature. The request from Dr. Pollack-Nelson was docketed as a petition, CP 11-1, and it was published in the *Federal Register* on June 8, 2011. The *Federal Register* notice also mentioned Mr. Lerner's submission.

CPSC staff has prepared this briefing package in response to the Pollack-Nelson petition and the Lerner submission. The briefing package contains information with respect to the hazard, the behavior of young children, contact burn injuries, incident data, market information, voluntary standards, and public comments. It discusses possible options, and it makes a recommendation.

Please indicate your vote on the following options:

I. Grant the petition.

______________________ ______________
(Signature) (Date)

(a) Direct staff to draft an advance notice of proposed rulemaking.

______________________ ____________

(Signature) (Date)

(b) Direct staff to draft a notice of proposed rulemaking.

______________________ ____________

(Signature) (Date)

II. Defer the petition for 6 months, and at the end of the 6-month period, direct staff to update the Commission on the progress of standards developments in ANSI Z21.88, "ANSI Standard for Vented Gas Fireplace Heaters," and other applicable/related ANSI standards (*e.g.*, Z21.50 and those for unvented fireplaces).

______________________ ____________

(Signature) (Date)

III. Deny the petition.

______________________ ____________

(Signature) (Date)

IV. Take other action (please specify).

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____________________________________________________________

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______________________ ____________

(Signature) (Date)

Attachment: Staff briefing package: Options to Address the Petition from Carol Pollack-Nelson Requesting Mandatory Standards for Glass Fronts of Vented Gas Fireplaces

**STAFF BRIEFING PACKAGE**

OPTIONS TO ADDRESS THE PETITION FROM CAROL POLLACK-NELSON
REQUESTING MANDATORY STANDARDS
FOR GLASS FRONTS OF VENTED GAS FIREPLACES

DATE - March 21, 2012

For further information, contact:

Ronald A. Jordan, Project Manager
Directorate for Engineering Sciences
U.S. Consumer Product Safety Commission
301-987-2219
rjordan@cpsc.gov

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**ACKNOWLEDGEMENTS**

**Hot Glass Petition Team**

Phillip Chao, Office of the General Counsel
Jason Goldsmith, Directorate for Health Sciences
Ronald Jordan, Directorate for Engineering Sciences
Samantha Li, Directorate for Economic Analysis
Barbara Little, Office of the General Counsel
Tim Smith, Directorate for Engineering Sciences
John Topping, Directorate for Epidemiology
Scott Ayers, Directorate for Engineering Sciences

## EXECUTIVE SUMMARY

The U.S. Consumer Product Safety Commission (CPSC) received a request from Carol Pollack-Nelson, Ph. D., Independent Safety Consulting, to initiate rulemaking to require safeguards, including protective barriers, on glass fronts of vented gas fireplaces. Pollack-Nelson asserts that the governing voluntary standard, ANSI Z21.88, *Standard for Vented Gas Fireplace Heaters*, allows glass fronts of vented gas fireplaces to reach temperatures of 500 degrees Fahrenheit and that momentary contact with glass at that temperature causes a severe burn to the skin. She further claims that glass fronts are accessible to small children because of their positioning near floor level and that from 1999 to 2009 more than 2000 children between the ages of 0 and 5 years old received burns from contacting the glass fronts of vented gas fireplaces. On June 1, 2011, the CPSC docketed Pollack-Nelson's request as a petition. After docketing Pollack-Nelson's request as a petition, the Commission received a submission from William S. Lerner, requesting that the Commission initiate rulemaking to require a high temperature warning system that projects a visible indication onto the glass front of vented gas fireplaces, thereby warning consumers that the glass front is hot (or, when off, is still hot).

A request for comments on the Pollack-Nelson petition and the Lerner submission was published in the *Federal Register* on June 8, 2011, with the comment period ending on August 8, 2011.[1] The Commission received comments supporting and objecting to the CPSC initiating rulemaking to require mandatory standards for safeguards for glass fronts of gas vented appliance. Comments from parents or family members of victims, burn center doctors, technical entities, safety advocacy groups, inventors, and private citizens generally supported the petitioner's request. The vented gas appliance industry, represented by the Hearth, Patio, and Barbeque Association (HPBA), as well as four individual manufacturers, acknowledged the hazard and the need for action to be taken to mitigate the hazard; however, they objected to the CPSC developing mandatory standards. The HPBA and manufacturers asserted generally that the hazard should be addressed through the voluntary standards process.

Prior to submitting her petition to the Commission, Pollack-Nelson proposed that the ANSI Vented Gas Warm Air Heater Technical Advisory Group (TAG) adopt requirements for vented gas fireplaces to be equipped with barriers to protect against contact burns. In July 2010, the TAG formed a Working Group (WG) to explore the issue. At their meeting on December 13, 2011, the TAG voted to adopt the construction, performance, and related provisions developed by the WG that require vented gas fireplaces whose outside glass front temperature exceeds 78$^{o}$C (172$^{o}$F) to be shipped with mandatory protective barriers. The proposed standard's coverage includes provisions to ensure that contact with the barriers will not pose a severe burn injury hazard. Staff has reviewed the provisions and believes the provisions, if adopted, should help to reduce the risk and severity of contact burns. William Lerner, an independent inventor had also proposed that the TAG adopt a provision that required gas fireplaces whose outside glass front temperature exceeded 78$^{o}$C (172$^{o}$F) be equipped with an illuminated visual indicator contained within the viewing area to alert consumers that the viewing area was hot enough to cause a burn injury. The TAG voted to reject Mr. Lerner's proposal, citing as a reason that the visual indicator would not prevent anyone from coming into contact with the viewing area.

[1] "Petition Requesting Safeguards for Glass Fronts of Gas Vented Appliances," 76 Fed. Reg. 33179 (June 8, 2011).

Staff recommends that the Commission defer a decision on the petition from Carol Pollack-Nelson, CP 11-1, to allow the voluntary standards process to continue as planned, with the inclusion of protective barriers designed to prevent contact burns, and conclude within the 6 month timeframe estimated by the TAG. This timeframe estimates that a revised standard could be published as early as July of 2012. Staff will continue to monitor the voluntary standards process and provide an update to the Commission in 6 months (September 2012) on the progress of standards development in ANSI Z21.88, "ANSI Standard for Vented Gas Fireplace Heaters," and other applicable/related ANSI standards.

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This document has been electronically approved and signed.
Date: March 20, 2012

TO : The Commission
Todd A. Stevenson, Secretary

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

FROM : DeWane Ray, Assistant Executive Director
Office of Hazard Identification and Reduction

Ronald A. Jordan, Project Manager
Directorate for Engineering Sciences

SUBJECT: Petition from Carol Pollack-Nelson, Ph. D., requesting Mandatory Standards for Vented Gas Fireplaces with Glass Fronts

## I. Introduction

The U.S. Consumer Product Safety Commission (CPSC) received a request from Carol Pollack-Nelson, Ph. D., dated May 23, 2011, that rulemaking be initiated to require safeguards on the glass fronts of vented gas fireplaces to protect consumers from burns received by coming into contact with the glass front. Subsequently, the Commission received a submission from William S. Lerner, requesting that the Commission initiate a rulemaking to require a high temperature warning system that projects a visible indication onto the glass front of vented gas fireplaces. The request from Pollack-Nelson was docketed as a petition, CP 11-1. The Commission published a *Federal Register* notice on June 8, 2011, requesting public comments on the petition and on the submission from Lerner. (*see* TAB A).

CPSC staff has prepared this briefing package in response to the petition. The briefing package provides the Commission with information relevant to the petition, including a review of the public comments received in response to the *Federal Register* notice, a discussion of possible options, and a staff recommendation.

## II. Issue

The petition from Pollack-Nelson states that the existing voluntary standards for vented gas fireplaces allow the glass fronts to reach temperatures of 500 degrees Fahrenheit ($^{o}$F) and that momentary contact with glass fronts at these temperatures can cause severe burn injury to skin. The petition states that glass fronts on vented gas fireplaces pose a burn hazard to young children due to:

a. their high surface temperatures;
b. their accessible location and height;
c. the attraction of young children to the fire; and
d. the lack of consumer awareness about the hazard.

The petition states that the CPSC's National Electronic Injury Surveillance System (NEISS) database estimates that more than 2,000 children ages 0 to 5 years old experienced burn injuries on gas fireplaces from 1999 through March 2009. In March 2010, the petitioner proposed that the ANSI Z21.88 Technical Advisory Group (TAG) develop requirements to address the hazard.[2] At its July 21, 2010 meeting the TAG formed a working group to consider the proposal.[3] The working group met to discuss the proposal over the preceding year but did not revise the standard. Subsequently, the petitioner asked the CPSC to initiate rulemaking to require safeguards on glass fronts of vented gas fireplaces to prevent contact burn injuries. Specifically, the petition suggests that a passive barrier, such as a mesh screen, would help prevent contact burns.

## III. Product Description

There are two basic types of gas fireplaces: vented and unvented. The primary difference between vented and unvented gas fireplaces is that the combustion products from a vented gas fireplace are removed from a dwelling through a vertical vent system that extends through the roof of a dwelling or a horizontal vent system that extends through the side wall of a dwelling. The combustion products from an unvented gas fireplace (also called "vent free") are not removed from the dwelling through a vent system, but rather, they are released directly into the room in which the appliance is installed.[4]

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[2] Letter from Carol Pollack-Nelson, PH. D. to Mr. Ronnie Frazier, Atmos Energy (March 26, 2010)
[3] Minutes of May 17, 2011 meeting of the Z21/CSA Joint Technical Advisory Group for Vented Gas-Fired Warm Air Heaters.
[4] Release of combustion products into a room over time could displace the oxygen in the room, causing the oxygen concentration to drop. Potentially dangerous concentrations of carbon monoxide can be generated when the oxygen concentration in a room drops below 18 percent and an emission source (*i.e*., an operating unvented gas appliance) is present. Unvented gas fireplaces are required by their governing standard, *ANSI Z21.11.2, American National Standard for Gas-Fired Room Heaters, Volume II, Unvented Heaters*, to be equipped with a device known as an oxygen depletion safety (ODS) shutoff system. An ODS is designed to shut off the appliance before the concentration of oxygen in the room decreases to less than 18 percent of the volume of the room.

Each type of gas fireplace can be divided further into two functional categories: decorative and heating. The vented units include vented gas fireplaces and vented gas fireplace heaters. Vented gas fireplaces are more decorative in nature and provide ambiance to a room through the view of the flame through the glass front. Although capable of heating a room, vented gas fireplaces are not required to meet performance requirements for thermal efficiency.

Vented gas fireplace heaters on the other hand, are designed to heat a room and meet performance requirements for thermal efficiency. Vented gas fireplace heaters provide heat to a room through convective heat transfer of heated air from the fireplace compartment into the room through louvered openings around the perimeter of the fireplace front and through radiation of heat through the glass front. Like vented gas fireplaces, vented gas fireplace heaters also provide ambiance to a room through the view of the flame through the glass front. The same distinction exists for unvented units: unvented decorative gas fireplaces are designed for decorative purposes and not for heating a room; while unvented gas fireplace heaters are designed to heat a room. Thus, the glass fronts of a vented or unvented gas fireplaces or fireplace heaters provide the dual function of ambiance and heat transfer.

In addition to the venting and functional distinctions, these products are also manufactured and configured as gas fireplace inserts, freestanding stoves, gas fireplaces (also called factory built units), or gas log sets. Gas fireplace inserts are designed for installation in existing masonry chimneys and require conversion of the chimney for that use through the installation of a stainless steel chimney liner. Factory-built units are designed to allow installation in a home without the need for an existing masonry chimney or vented through an exterior wall (via direct vent). Freestanding gas stoves can be installed readily into almost any location in a dwelling, without the need to be built into a wall. Gas log sets are installed into existing masonry fireplaces. Vented log sets are designed for decorative use only; while "vent-free" log sets are designed to heat a room. It is not uncommon for a manufacturer to produce vented and unvented gas fireplaces in all four configurations: fireplace inserts, factory-built units, freestanding stoves, and log sets. Despite their differences, vented and unvented fireplaces share common design features relevant to this petition. In particular, both have glass fronts to allow viewing of the flame and artificial log sets, and as discussed later in this document, they have identical maximum temperature limits for glass fronts.

## IV. Incident Data (TAB B)

The Directorate for Epidemiology staff confirmed a NEISS estimate of slightly over 2,000 emergency department-treated injuries to children age 5 or younger burned on gas fireplaces (including vented and unvented) for all gas fireplace burns (regardless of glass contact) for the January 1999 to March 2009 period. However, staff finds that less than half of the cases in the sample for this estimate specifically mention glass in the NEISS comments. Staff understands the scope of the petition to be focused on cases of contact with hot glass on vented gas fireplaces rather than all contact burn cases involving gas fireplaces in general.

Of the cases treated in emergency departments from January 1, 1999 to March 31, 2009, that were reported through NEISS , staff found 37 cases involving children ages 0 to 5 years old that could be determined to involve burns from contact with hot glass on the outside of gas fireplaces. Although details are limited in some reports, staff selected these 37 cases on the basis that there was both a clear indication of contact with glass and a clear indication that the fireplace was a gas-burning type of fireplace. Staff finds that the set of data meeting these criteria is too small to report national estimates specific to contact with hot glass (on gas fireplaces). Staff believes that, given the limitations of the available data, analysis and characterization of the hazard specific to glass contact by young children is best focused on assessment of just the 37 cases identified by staff from among NEISS cases treated between January 1999 and March 2009.

Staff finds that, of the 37 cases, most involved children under the age of 3 and most of the injuries involved burns to the hands. Staff also finds that more than half of the injuries involved second degree burns or worse. Additionally, staff searched for cases involving adults and children older than 5 years, but found only 4 cases of glass contact in the January 1999 to March 2009 timeframe (victims ages 7, 10, 14, and 25). In all four of these cases, the glass contact appeared to be unintentional. Among the 37 cases involving children 5 years old or younger, some of the contact also was accidental (such as backing into or falling onto the glass); however, in many of the cases involving young children, it appears that the contact may have been intentional.

## V. Market for Fireplaces and Protective Barriers (TAB C)

The Directorate for Economic Analysis provided information on the market for vented gas fireplaces. At least 28 firms are known to be manufacturers or importers of gas fireplaces and gas inserts. Nineteen are domestic manufacturers, and nine are foreign manufacturers whose products are imported into the United States.

Some firms also manufacture or provide a device marketed as a protective barrier. These products include screens, such as folding or freestanding screens, and mesh or fire screens. These products also may be referred to as safety screens or safety guards. A screen can be freestanding, meaning it might have the ability to support itself, independent of attachment to a gas appliance. Freestanding screens may have bi- or tri-fold screens, with a large centerpiece and adjacent side screens that fold at an angle. Sizes of screens vary depending upon the dimensions of the fireplace. A few firms describe the glass front of their vented gas fireplace as “heat-resistant glass,” which may or may not have a protective purpose.

At least 14 firms manufacture or supply protective barriers. Eight are domestic and four are foreign. Most firms that manufacture a protective barrier also manufacture gas fireplaces. Two of the domestic manufacturers specialize in fireplace accessories, including screens and glass doors.

Manufacturers’ wholesale prices for protective barriers are not readily available. Protective barriers are usually sold as an accessory or as optional equipment for gas hearth appliances.

However, one retail estimate for mesh screens is $66.95, and freestanding screens range from $159.95 to $189.95.[5] See TAB C for more details.

## VI. Preliminary Estimates of Societal Costs (TAB C)

The Directorate for Economic Analysis staff provided information on the societal costs of injuries associated with vented gas fireplace burns. The CPSC Injury Cost Model (ICM) uses empirically derived relationships between emergency department-treated injuries and injuries treated in other settings (*e.g*., doctor's offices and clinics) to estimate the number of injuries treated outside hospital emergency departments. Thereafter, it estimates societal costs for all medically treated injuries, including the NEISS-estimated injuries and the ICM estimates for injuries treated in other settings. These costs include the costs of medical treatment, work loss, pain and suffering, and liability insurance and litigation costs.[6]

Based on the 37 identified cases reported through NEISS, in combination with medically attended injuries reported through the ICM, there may have been about 1,754 medically treated glass contact burn injuries with associated injury costs of $91 million over the 10.25 years from January 1999 through March 2009. Thus, there may have been approximately 171 incidents with an injury cost of $8.8 million on an annual basis. However, these estimates are subject to considerable variability, given the small sample size of the NEISS injury estimates upon which they are based.

## VII. Discussion of Burn Injuries and Incident Data (TAB D)

The Directorate for Health Sciences (HS) staff has provided a discussion on burn injuries, an analysis of the incident data related to a child coming into contact with the glass front of a gas fireplace, and the injury potential associated with this hazard scenario.

Contact burn injuries occur when the skin is brought into contact with a hot surface and sufficient thermal energy is transferred to increase the skin temperature and produce cell injury or death. Although there are built-in withdrawal reflexes to safeguard us from damage to our tissues, they may not be rapid enough to prevent injury from extremely hot surfaces; consequently, damage to the tissue can take place prior to such reflex withdrawal occurring. Our reflex withdrawal can be undermined when an individual falls onto a hot surface, which can result in additional contact time and a more severe injury.

Burn injuries are classified by the anatomic thickness of the skin involved, and they range from reversible burns that can heal spontaneously (superficial burns and partial thickness burns) to

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[5] This represents an online discount and excludes shipping costs. Retailers offer discounted prices for purchasing multiple items.

[6] For a more thorough discussion of the ICM, see Ted R. Miller, et al., *The Consumer Product Safety Commission's Revised Injury Cost Model, Final Report to the U.S. Consumer Product Safety Commission*, Public Services Research Institute, Calverton, Maryland, December 2000. It is available from the CPSC website (in 2 files) at http://www.cpsc.gov/LIBRARY/FOIA/FOIA02/os/Costmodept1.pdf and http://www.cpsc.gov/LIBRARY/FOIA/FOIA02/os/Costmodept2.pdf.

deeper irreversible burns that require surgery in order to heal (full thickness and subdermal burns). Skin surface temperatures at or above 65° Celsius (149° Fahrenheit) require less than 1 second to produce partial-thickness burns, and temperatures at or above 70° Celsius (158° Fahrenheit) require less than 1 second to produce full-thickness burns. It appears that the operating temperatures of gas fireplaces can elevate the exterior surface of the glass front to temperatures that greatly exceed these temperatures.

In children under 10 years of age, burns are considered severe and require hospitalization when they are partial thickness and cover greater than 10% of the total body surface area (% TBSA) or are full-thickness burns and cover greater than 2% TBSA. Children with burns of critical areas, such as the face and hands, or those receiving full-thickness burns, should be referred to a burn center for treatment. In addition to removing intact blisters, treatment often will consist of surgically removing dead tissues, cleaning with sterile saline solution, applying topical antibiotics and dressings, and skin grafting. The recovery process from extensive high-severity burns is long, extremely painful, and it can be complicated, often requiring multiple surgeries. Once the physical healing is complete, victims of such burns are left with deep scarring, that can permanently disfigure, functionally impair, and severely psychologically traumatize the victim.

As is evident from the NEISS incident data and at least one available research report, the glass fronts of gas fireplaces present a serious burn injury hazard to the segment of the population that may be least able to discern the potential hazard. The majority of the children receiving contact burns from the glass front of a gas fireplace were under 3 years old. Many received at least partial-thickness burn injuries; however, a small number received injuries that included full-thickness burns. The hand (usually the palmar surface) was the body part that sustained the burn injury in the majority of these incidents, with a few receiving a burn injury on their buttock. In a small number of these burn incidents, it appears that contact with the glass surface may have been accidental.

Whether deliberate or accidental contact, given the potential for such injuries to occur, and with such brief contact times, a barrier or similar mechanism that would prevent a young child from making contact with the hot surfaces of a gas fireplace seems necessary to safeguard this vulnerable population from this hazard. Given that contact with the glass surface of a gas fireplace can nearly instantaneously produce burn wounds, any requirement aimed at mitigating this hazard that requires an adult to actively police the area near the fireplace should not be expected to provide adequate protection of the youngest children.

## VIII. Human Factors Discussion of the Incident Data and Childhood Behavior (TAB E)

As discussed by staff of the CPSC's Division of Human Factors (ESHF), during the first couple of years of life, children commonly explore with their senses and directly manipulate objects in their environment to learn about the world. These initial years also represent the time over which children become increasingly mobile, and are able to explore more of their environment. Many children will be capable of some degree of locomotion by about 8 months, with some children walking soon thereafter. These developmental changes are consistent with the available incident data. The youngest children involved in incidents tend to be at about the age at which locomotion begins, and they would be capable of getting to the glass front of a fireplace on their own. Most in-scope incidents tended to involve children younger than 2 years old, an age at which children are natural explorers and when most exploratory behavior is likely to occur; while incidents among preschool-age and older children tended to be accidental contact, such as falling or backing into the hot glass.

Safety and warnings literature suggest that the warning system proposed in Lerner's submission to the Commission is unlikely to be as effective at mitigating the burn hazard posed by the glass fronts of vented gas fireplaces as an integral screen or barrier. ESHF staff believes that the proposed warning system might be effective at capturing a consumer's attention and it also almost certainly would capture the attention of at-risk children, who are unlikely to understand a warning and its implications. The proposed warning system would have the benefit of being physically and temporally close to the hazard only when the hazard is present; however, given the exploratory behavior that is common to children most at risk to the hazard, the system could inadvertently draw these children to the hazardous glass front of the fireplace.

Moreover, the effectiveness of a warning system depends on the extent to which caregivers can supervise and prevent contact from occurring to children who are in close proximity to the fireplace. Caregivers differ in how closely they are able to supervise a child and cannot be perfectly attentive all of the time even if they are able to assess correctly the child's inability to perceive hazardous situations and to deal appropriately and effectively with the hazard. The ability of a caregiver to identify child behaviors that are likely to lead to hot-glass contact might be challenging. This is especially true in cases where the child might fall or otherwise make contact with the glass accidentally. Even when a caregiver is able to identify circumstances in which contact will occur, they still may have a limited ability to prevent contact, depending on their proximity to the child or the fireplace.

## IX. Review of Existing Standards (TAB F)

The construction and performance of vented gas fireplaces and vented gas fireplace heaters sold in the United States are governed by two separate voluntary standards: *ANSI Z21.50, Standard for Vented Gas Fireplaces,* and *ANSI Z21.88, Standard for Vented Gas Fireplace Heaters*. The construction and performance of unvented decorative gas fireplaces and unvented gas fireplace heaters sold in the United States are governed by *ANSI Z21.11.2, Standard for Gas-Fired Room Heaters, Volume II, Unvented Room Heaters*.

Each standard currently includes essentially identical construction and performance provisions for glass fronts. The construction provisions for glass fronts are located in Sections 1.5 of ANSI Z21.50 and ANSI Z21.11.2, and Section 1.6 of ANSI Z21.88. Each set of construction provisions specifies minimum requirements for the heat-resistance properties of the glass; allowances for thermal expansion and distortion; clearances for the mounting frame for the glass; serviceability and cleaning; and in the case of ceramic glass, resistance to sulfur compounds found in fuel gases and other sources.

The performance provisions for glass fronts in each of the standards specify the thermal shock, impact, and temperature test conditions that glass fronts are subjected to and are required to meet. Provisions for thermal shock and mechanical impact testing of glass fronts are located in different sections of the three standards (*i.e.*, Sections 2.14, Impact Test of Glass Materials and 2.15, Water Shock Test in ANSI Z21.50; Sections 2.10.2 (impact test) and 2.10.3, Thermal Shock in ANSI Z21.11.2; and Sections 2.13.2 (impact test) and 2.13.3, Thermal Shock in ANSI Z21.88). The temperature provisions for glass fronts in each standard only specify the maximum temperature limit for the interior of a glass front; no limits for the exterior surface temperature of the glass front are provided. These internal temperature provisions are located in Sections 2.13 of ANSI Z21.50 and ANSI Z21.88, and Section 2.10 of ANSI Z21.11.2. The following maximum temperatures for the interior surfaces of the glass fronts are based on the type of material used and are specified in Tables VI, VII, and XII in ANSI Z21.88, ANSI Z21.50, and ANSI Z21.11.2, respectively:

| Maximum Temperature for Glass | Maximum Temperature | |
|---|---|---|
| Material | $^{o}$F | $^{o}$C |
| Tempered (Soda-Lime) Glass & Toughened 3.25 x $10^{-6}/^{o}$K Expansion Borosilicate Glass | 500 | 260 |
| Annealed Borosilicate Glass 3.25 x $10^{-6}/^{o}$K Expansion | 446 | 230 |
| Ceramic Glass Materials | 1328 | 720* |
| Other Glass Materials | ** | ** |

*Use lower of 1328$^{o}$F (720$^{o}$C) or the manufacturer's maximum absolute temperature
**Absolute temperature, as specified by the material supplier for normal service conditions.

Given the magnitude of these temperatures, their measurement location (*i.e.*, interior surface), and the threshold temperatures at which severe burns can occur, it is clear to staff that these provisions were not designed to prevent contact burns to consumers. According to Canadian Standards Association-International staff,[7] these temperatures represent the maximum operating temperatures for the materials. Provisions within ANSI Z21 gas appliance standards designed to prevent contact burns will typically impose limits on temperatures of components, parts, and areas of the appliance that consumers are expected to make routine contact with in order to operate the appliance or as a result of inadvertent contact while the appliance is in operation. For example, the *American National Standard for Household Cooking Gas Appliances, ANSI Z21.1*, includes the following sections that address surface temperatures and contact burn considerations: Sections 2.18, Evaluation of Burn Hazard Potential of Exterior Surfaces and 2.19, Temperatures of Handles, Knobs and Touchpads. Section 2.18 specifies a test method for measuring the temperature of various surfaces on a gas range, and Table XII of the standard specifies the maximum temperatures that those surfaces are allowed to reach. Maximum allowable surface temperatures range from 67$^{o}$C (152$^{o}$F) to 83$^{o}$C (182$^{o}$F), depending upon the type of surface material involved for surfaces 3 feet in height or less and 83$^{o}$C (182$^{o}$F) to 100$^{o}$C (212$^{o}$F) for surfaces over 3 feet in height.

[7] E-mail correspondence from S. McCarthy, CSA-International to R. Jordan, CPSC, dated November 21, 2011.

Section 2.19 specifies a test method for measuring the temperatures of door handles, valve handles, thermostat knobs, and all other knobs, touchpads, or handles used while the appliance is being used for cooking. Table XIII of *ANSI Z21.1* specifies the maximum allowable temperatures for these parts, which can range between 55$^{o}$C (131$^{o}$F) to 83$^{o}$C (182$^{o}$F), depending upon the type of material the part is made of. These temperatures are more in-line with the threshold temperatures at which reversible epidermal injury occurs, as specified in the *ASTM Standard Guide for Heated System Surface Conditions that Produce Contact Burn Injuries, ASTM 1055*. Conversely, the maximum glass temperatures listed above and in ANSI Z21.88 and ANSI Z21.50 are well above the threshold temperatures specified in ASTM 1055, at which complete transepidermal necrosis or cell death occurs. Based on these provisions, and as demonstrated by the incidents involving contact burns, the glass front temperature limits specified in ANSI Z21.88 and ANSI Z21.50 were not designed to prevent contact burns to consumers.

## X. Voluntary Standards Development (TAB F)

In May 2010, Carol Pollack-Nelson proposed that the ANSI Vented Warm Air Technical Advisory Group (TAG) require protective barriers be provided with vented gas fireplaces at the time of sale. Similar information was included in her petition CP 11-1 to the CPSC. The TAG established the Vented Heater Glass Surface Temperature Working Group (WG) on July 21, 2010, to examine Dr. Pollack-Nelson's proposal and supporting information on burns that occur to children when they come into contact with the glass fronts of vented gas fireplaces.

Subsequent to the proposal from Pollack-Nelson, William L. Lerner, an independent inventor, asked that the working group consider developing a requirement for the inclusion of a visual warning system that would notify the user that the fireplace was (still) hot. The WG has met on six separate occasions (November 16, 2010; March 3, 2011; May 17, 2011; August 3–4, 2011; September 7–8, 2011; and October 25–26, 2011), during which time they discussed the following proposals designed to address burns that occur from contacting the hot exterior surface of the glass front of a vented gas fireplace:

- Passive, protective barrier for the glass front
- Visual warning system using LED-light
- Audible warning system
- Improved warnings in the Users/Installation manual
- Improved warning labels on the fireplace, and
- Education and information campaign to reach consumers.

At their October 25-26, 2011 meeting, the WG finalized draft provisions for an optional or required protective barrier, designed to address the hazard, and submitted the draft provisions to the TAG for consideration. The WG forwarded these draft provisions to the ANSI Vented Warm Air TAG for consideration at their December 2011 meeting. At their December 13, 2011 meeting, the TAG voted to adopt draft coverage for protective barriers for vented gas fireplaces. The draft coverage was sent to TAG members and industry stakeholders for Review and Comment on December 20, 2011. The deadline for submitting comments to the TAG is February

22, 2012. If the draft coverage is approved during the review process, a revised standard could be published by approximately mid to late 2012, with an effective date of 18 months after the publish date (*e.g.*, approximately the end of 2013 to mid-2014).

The draft coverage included the following provisions:

- Gas fireplaces whose outside glass front temperature exceeds 78°C (172°F), must also include in their instructions (**Section 1.34.1 of Z21.88 and Section 1.28.1 of Z21.50)** and markings **(Section 1.35.7 of Z21.88 and Section 1.29.6)** information and text alerting consumers that the glass is hot, not to allow children to touch the glass, and that a protective barrier is provided with the fireplace.
- A protective barrier is required to be shipped **with** the fireplace if the outside temperature of the glass front exceeds 78°C (172°F).
  **(Section 1.2.7 of ANSI Z21.88 and Section 1.2.23 of ANSI Z21.50)**
- Performance provisions to determine if the outside temperature of a glass front meets or exceeds 78°C (172°F).
  **(Section 2.14.4 of ANSI Z21.88 and Section 2.13.2 of ANSI Z21.50)**
- Performance provisions to require the protective barrier to prevent contact with the glass viewing area whose outside temperatures exceeds 78°C (172°F).
  **(Section 2.15.1 of ANSI Z21.88 and Section 2.14.1 of ANSI Z21.50)**
- Performance provisions that limit the burn hazard potential of a protective barrier. **(Section 2.15.2 of ANSI Z21.88 and Section 2.14.2 of ANSI Z21.50)** to no greater than Threshold B (reversible epidermal injury), as stated in the *ASTM Guide for Heated System Surface Conditions that Produce Contact Burn Injuries, ASTM C1055*. Unlike the material surface temperature of the glass front, the burn hazard potential for the optional barrier will be based on the skin contact temperature at the hottest exterior point of the barrier, either measured using a thermesthesiometer or calculated using Method A, each found in *ASTM Practice for Determination of Skin Contact Temperature from Heated Surfaces Using a Mathematical Model and Thermesthesiometer, ASTM C1057*.

As stated earlier, William Lerner had proposed that the TAG adopt a provision that required gas fireplaces whose outside glass front temperature exceeded 78°C (172°F) be equipped with an illuminated visual indicator contained within the viewing area to alert consumers that the viewing area was hot enough to cause a burn injury. The TAG voted to reject Mr. Lerner's proposal, citing as a reason that the visual indicator would not prevent anyone from coming into contact with the glass viewing area.

Petition CP 11-1 cited only vented gas fireplaces, not unvented gas fireplaces. Despite their differences, unvented gas fireplaces have design similarities to vented gas fireplaces, and therefore, pose a similar risk of burn injury. First, they have glass fronts for viewing the flame and imitation log sets within the fireplace enclosure. Second, the interior surfaces of glass fronts of unvented fireplaces have the same maximum temperature limits as vented gas appliances. Thus, the glass fronts of unvented gas fireplaces are likely to experience similar exterior surface temperatures as vented units, well in excess of the Threshold B limits specified in ASTM C1055. To date, staff is not aware of any plans by the ANSI Z21/83 Technical Committee to direct the

TAG for unvented gas space heaters, in particular, unvented decorative gas fireplaces and unvented gas fireplace heaters, to begin considering adoption of the WG's draft standard. Staff believes that this is likely to occur once the draft standard has been voted on and finalized by the TAG, but it bears monitoring to ensure that this occurs.

## XI. Conformance to Voluntary Standards

The Hearth, Patio, and Barbeque Association (HPBA) is a trade association that represents the hearth products, patio, and barbeque industries in North America. HPBA's hearth product members manufacture, import, distribute, sell, install, and service factory built fireplaces, gas log sets, and fireplace inserts. According to HPBA, "Most manufacturers of gas fireplaces are HPBA members. . ." and account for approximately ". . . 90 percent of all hearth appliance shipments." In order to be marketed and sold in the United States, gas appliances, including gas fireplaces, must comply with local, state, regional, or national building codes. In order to comply with the building codes, gas fireplaces must be certified to national performance and safety standards, such as the ANSI Z21 set of gas appliance standards and Underwriters Laboratories standards.

Given these conditions for market entry and participation, staff believes that a framework exists that ensures conformance of these products to the voluntary standards. Therefore, if the proposed protective barrier provisions are adopted into ANSI Z21.88 and ANSI Z21.50, staff believes that manufacturers who certify to these two standards, by default, will conform to any new protective barrier requirements. In their comments on Petition CP 11-1, HPBA asserts: "There will be high levels of compliance. The ANSI standard is applicable to the entire gas fireplace industry and is incorporated in building codes and standards. Retailers and conformity assessment organizations will require compliance. Further, the violation of a voluntary standard may be relevant in product liability litigation. The existing requirements in the standards achieve virtually total, industry-wide compliance, and there is no reason to believe that anything will be different with safety guards and related requirements." See TAB G for more details.

## XII. Addressability (TAB G)

The threshold temperatures at which irreversible contact burns occur are provided in the *ASTM Standard Guide for Heated System Surface Conditions that Produce Contact Burn Injuries, ASTM C1055.* Figure 1 of ASTM C1055 provides a time-weighted scale that indicates the threshold temperatures at which complete transepidermal necrosis (*i.e.*, cell death occurs). This is noted as Threshold A in the figure, which is a plot of Exposure Time in seconds versus the contact skin temperature in degrees Celsius. According to the plot, cell death can occur when contact of the skin is made with a surface at 70$^{o}$C (158$^{o}$F) for a one second exposure time. The exposure time before cell death increases exponentially as contact skin temperature decreases. Thus, contact with a surface at approximately 46$^{o}$C (115$^{o}$F) would have to be maintained for 1,000 seconds before cell death would occur.

The governing standards for vented gas fireplaces are the *Standard for Vented Gas Fireplaces, ANSI Z21.50*, and the *Standard for Vented Gas Fireplace Heaters, ANSI Z21.88*. Each standard specifies identical construction and performance provisions for glass fronts, including maximum allowable surface temperatures. The maximum temperatures for glass fronts are specified in Table VI of ANSI Z21.88, and the methodology for calculating these temperatures is specified in the Method of Test in Section 2.13, Glass Fronts, of the standard. The Method of Test does not specify a maximum temperature for the exterior surfaces of glass fronts, where contact burns occur. Rather, it specifies limits for the maximum temperature of the interior surface of glass fronts. Depending on the type of material used and the thickness of the material, the interior surface of the glass front can reach maximum temperatures ranging from 220$^{o}$C (428$^{o}$F) for annealed borosilicate glass to 720$^{o}$C (1328$^{o}$F) for ceramic materials.

For purposes of this analysis, actual measurement of the exterior temperature ($T_{room}$) of gas fireplace glass fronts was not practical. Therefore, as discussed in TAB G, staff used a range of temperatures in the equations provided in Section 2.13 in order to calculate the interior surface temperature of a given glass front material of a specified thickness and thermal conductivity. In order to facilitate evaluation of health effects from a contact burn by Directorate for Health Sciences staff, exterior glass temperatures ranging from 44$^{o}$C (111$^{o}$F)[8] to 78$^{o}$C (172$^{o}$F)[9] were selected. The exterior surface temperatures that would occur at the maximum interior temperatures specified by ANSI Z21.88 were also included. Tables 1 through 6 of TAB G provide a range of corresponding exterior temps, $T_{room}$, for the calculated interior temps, $T_{fire}$ for sodalime, borasillicate, and ceramic glass materials at material thicknesses of 0.125 and 0.25 inches. Based on the analysis in TAB G, the maximum exterior temperatures of the various glass materials would be 209$^{o}$C (409$^{o}$F), 234$^{o}$C (454$^{o}$F), and 595$^{o}$C (1103$^{o}$F) for Annealed Borosilicate Glass, Tempered Sodalime Glass, and Ceramic Glass, respectively. These temperatures are in excess of the Threshold A temperatures specified in ASTM C1055, at which irreversible burn injury would occur.

Therefore, in order to address the hazard, an intervention would need to:

1. Prevent the glass front exterior temperature ($T_{room}$) from reaching these threshold temperatures; or

2. Provide a barrier that prevents contact with the glass front. The barrier would also need to be designed in a manner that:

    a) Prevents the barrier surface or points of contact from reaching the Threshold A limits; or

    b) Is made of a material that prevents rapid heat transfer to human skin.

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[8] The lowest temperature at which irreversible injury could occur.

[9] The proposed minimum exterior temperature that a glass front can reach before a protective barrier is required. At their December 13, 2011 meeting, the ANSI Z21 Vented Warm Air Heater Technical Advisory Group (TAG) considered draft provisions developed by their Working Group (WG), which included, among other interventions, requirements for a physical barrier. The draft performance provisions for the barrier require that an optional barrier be made available if the exterior glass front surface of the gas fireplace exceeds 78$^{o}$C (172$^{o}$F). Thus, as drafted, the proposed provisions would allow surface temperatures, 44$^{o}$C to 77$^{o}$C (111$^{o}$F to 171$^{o}$F), which would exceed the Threshold A temperatures.

The petitioner requested that the Commission initiate rulemaking to require safeguards, including a protective barrier over the glass front, to protect consumers from the contact burn hazard. Staff believes that a glass front or barrier that meets these criteria could effectively eliminate the risk of contact burns from the glass front of a gas fireplace.

## XIII. Staff Response to Public Comments (TAB H)

A request for comments on the Pollack-Nelson petition and the Lerner submission was published in the *Federal Register* on June 8, 2011, with the comment period ending on August 8, 2011. A total of 29 comments were received by the Commission (TAB H); 24 were in support of the petition (13 commenters supported the petition with the barrier option, 9 commenters supported the visible warning system option, and 2 commenters expressed support, but did not specify a preference for an approach used to address the issue). The remaining 5 comments were against the petition (4 comments from gas fireplace manufacturers and 1 from the industry trade association, the Hearth, Patio, and Barbeque Association or HPBA). The comments in support of the petition were received from parents or family members of victims, burn center doctors, technical entities, safety advocacy groups, inventors, and from private citizens with unknown backgrounds. The HPBA and manufacturers acknowledged the merits of the hot glass issue, but they objected to mandatory standards because voluntary industry standards were being developed by the ANSI Z21 gas appliance standards organization.

### 1. Comments in support of the petition

The 24 comments that supported the petition all acknowledged the hazard and expressed the opinion that the CPSC should take some action through rulemaking to mitigate the problem. However, not all of the comments were in support of the use of a barrier, as proposed in Pollack-Nelson's petition; 11 comments supported the petition with the barrier option; 11 comments supported the LED warning light option; and 2 comments expressed support but did not specify a preference for the barrier or the warning light option.

#### a. Eleven comments were in support of the petition and the barrier option.

Staff agrees with the petitioner and the supportive commenters on this issue. Staff has examined the range of temperatures that interior and exterior surfaces of various glass front materials in gas fireplaces could potentially reach (ref. Tables 2 through 7), as well as ASTM C1055-03, the Standard Guide for Heated System Surface Conditions that Produce Contact Burn Injuries, and the severity of burns sustained by children who contacted the glass fronts. The exterior surface temperatures attainable by the glass front of a gas fireplace are greatly in excess of the minimum temperatures specified in ASTM C1055 that can cause irreversible damage to skin. Therefore, the most plausible way to prevent contact with the glass front is through the use of a protective barrier. In order for a protective barrier to be effective, it would have to be designed to prevent physical contact with a glass front or other heated surfaces and not transfer heat from the glass front sufficient to cause irreversible skin damage. The design considerations of a protective barrier are discussed in Section X, Voluntary Standards Development, and Section XII, Addressability.

Staff also agrees with most of the concerns raised by commenters about an LED warning light. While a warning light could serve to remind a parent that the glass is (still) hot, given the myriad of ways in which glass could be contacted unintentionally, staff does not believe that an LED warning light is capable of preventing a contact burn, and prevention is a higher order intervention than warning. None of the commenters submitted literature or other technical documentation to substantiate the concern that young children might be attracted by a warning light. However, staff from the Division of Human Factors found that "Young children are especially attracted to bright colors and high contrast . . .;" and that a warning light incorporating these features ". . . may mistakenly attract young children to a hazard or hazardous product." See Section VIII, Human Factors discussion of the incident data and childhood behavior and TAB E for a more detailed discussion. A more detailed discussion of the comments is provided in TAB H.

**b. Eleven comments in support of the petition and the LED warning light option.**

For the reasons stated earlier under Section 1.a., staff does not agree that a visual warning is the best intervention to prevent children from sustaining contact burns. Staff believes that the concern about the temperature that a barrier can reach is a valid issue; however, the commenters did not provide any literature or other technical documentation to substantiate the claim that a metal screen will be heated to and exceed 121$^{o}$C (250$^{o}$F). The CSA Vented Heater Glass Temperature Working Group has developed draft standards provisions that address this issue by specifying that a barrier be designed to prevent a burn hazard greater than Threshold B (reversible epidermal injury) as stated in the ASTM Guide for Heated System Surface Conditions that Produce Contact Burn Injuries, ASTM C1055. See Section X, Voluntary Standards Development or TAB F and Section XII, Addressability or TAB G for additional discussion on this issue. A more detailed discussion of the comments is provided in TAB H.

**c. Two comments in support of the petition, but no preference for either option.**

These comments support the petition and rulemaking by the CPSC, but they do not indicate a preference for the barrier or LED warning light options. The commenters did not provide any technical data to support their positions.

**2. Comments against the petition**

All 5 of the comments against the petition were from the gas appliances industry; 4 from gas appliance manufacturers and 1from an industry trade association. Although they acknowledged the hazard and the need for action to be taken to mitigate the hazard, they were against the petition and rulemaking and expressed their belief that the issue should be addressed through the voluntary standards process. Three of the manufacturers expressed opinions that providing an optional barrier upon request was viable, but they indicated that this should be addressed through the voluntary standards; one manufacturer developed a protective barrier as part of a lawsuit settlement; one manufacturer was willing to consider requiring a barrier.

Staff reviewed the comments from entities opposed to the petition. All of the commenters recognized the hazard and advocated for the development of voluntary standards for the use of a protective barrier, as well as enhanced warnings and efforts to educate consumers, retailers, and the hospitality industry about the hazards associated with the glass temperature of vented gas fireplaces. The commenters indicated they do not support rulemaking as proposed in the petition.

## XIV. Discussion

After reviewing the comments and supporting references, the available incident data, the existing voluntary standards, the range of temperatures attainable by the exterior surfaces of the glass front of gas fireplaces, the behaviors of the target population (*i.e*., children 5 years old and under), and the severity of the injuries sustained by this group, staff finds that the glass fronts of gas fireplaces, vented as well as unvented, pose a risk of severe burn injury not previously addressed by any of the governing voluntary standards (ANSI Z21.88-2009, ANSI Z21.50-2007, and ANSI Z21.11.2-2011). Whether deliberate or accidental contact, given the potential for such injuries to occur, and with such brief contact times, a barrier or similar mechanism that would prevent a young child from making contact with the hot surfaces of a gas fireplace seems necessary to safeguard this vulnerable population from this hazard. Given that contact with the glass surface of a gas fireplace can nearly instantaneously produce burn wounds, any requirement aimed at mitigating this hazard that requires an adult to actively police the area near the fireplace should not be expected to provide adequate protection of the youngest children. Staff believes that an intervention to prevent contact with a glass front would provide the greatest level of protection to consumers from intentional and accidental contact.

In a little over a year, the Working Group established by the ANSI Vented Warm Air Technical Advisory Group's (TAG) to address Pollack-Nelson's proposal for a mandatory protective barrier, developed draft provisions for a mandatory protective barrier which will be required on all vented gas fireplaces whose outside glass front temperature exceeds 78$^{o}$C (172$^{o}$F). At their December 13, 2011 meeting, the TAG voted to adapt draft coverage for protective barriers for vented gas fireplaces into ANSI Z21.88 and ANSI Z21.50 and sent the draft coverage out to TAG members and industry stakeholders for Review and Comment on December 20, 2011. This draft coverage should help to prevent irreversible burn injuries from contacting the glass front of vented gas fireplaces. The TAG also voted to reject Mr. Lerner's proposal, citing as a reason that the visual indicator would not prevent anyone from coming into contact with the glass viewing area. Staff also felt that a visible, high temperature warning system would not provide the highest level of safety or prevent contact with a hot glass surface.

According to CSA staff, the best case timeline for publication of the draft coverage is as follows:[10]

[10] E-mail from L. Federspiel, Canadian Standards Association-International, to R. Jordan, CPSC, January 11, 2012, and attachment titled "R&C letter-Stoud.pdf".

- Review and Comment period ends: February 22, 2012
- TAG meeting to discuss comments: March 14, 2012
- Draft minutes sent out: March 16, 2012
- General Distribution Minutes sent out: April 16, 2012
- Z21/83 TC & CSA TC Ballots issued: April 16, 2012
- BSR-8 Public Review: April 16, 2012 through May 31, 2012
- Z21/83 TC & CSA TC Ballots close: May 17, 2012
- IGAC Ballot issued: May 21, 2012
- BSR-9 ANSI Approval: June 1, 2012 through June 29, 2012
- IGAC Ballot closed: June 21, 2012
- Publication: July 2012
- Effective date: 18 months after publication

This timeline assumes that the draft coverage will not undergo any substantive changes or negative ballot votes, which could necessitate it having to go through the Review and Comment process more than once. If deference is given to the voluntary standards process, it would be important to monitor the process closely to ensure that this tentative schedule is adhered to and that the draft standard is not subjected to unnecessary delay or abandoned.

Although Petition CP 11-1 only raises concerns about vented gas fireplaces, staff believes that a similar risk is also posed by the glass fronts of unvented gas fireplaces. The governing standard for these appliances, ANSI Z21.11.2, specifies temperature limits for the interior glass front that are identical to those found in ANSI Z21.88 and Z21.50 for the vented gas fireplaces. Therefore, the outside surface of glass fronts on unvented gas fireplaces can reach similar temperatures as the vented units and result in irreversible burn injuries, if contacted. To date, there has been no activity on the unvented heater TAG to address glass temperature issues with unvented gas fireplace heaters or unvented decorative gas fireplaces. According to a representative from the Canadian Standards Association "Once the vented heater TAG completes their work, they can make a recommendation that the coverage be sent to the TAG for unvented fireplace heaters and unvented decorative fireplaces for their consideration as well."[11] In order to reduce or eliminate the risk of irreversible burn injuries occurring from contact with the glass fronts of unvented gas fireplace heaters and unvented decorative gas fireplaces, the Z21 TAG for Unvented Gas-Fired Heating Appliances should be asked to adopt the draft coverage to the governing standard for these appliances, ANSI Z21.11.2, *Standard for Gas-Fired Room Heaters, Volume II, Unvented Room Heaters.*

## XV. Options.

1. <u>Grant petition CP 11-1</u> and issue an NPR to begin rulemaking;

[11] E-mail from S. McCarthy, Canadian Standards Association-International, to R. Jordan, CPSC, December 19, 2011.

2. Deny petition CP 11-1; or

3. Defer decision on petition CP 11-1 for 6-months to allow the voluntary standards process to continue as planned and conclude within the timeframe estimated by the TAG.

**XVI. Recommendations**

Staff recommends that the Commission defer a decision on the petition from Dr. Carol Pollack-Nelson, CP 11-1, to allow the voluntary standards process to continue as planned and conclude within the timeframe estimated by the TAG. Staff will continue to monitor the voluntary standards process and provide an update to the Commission within 6 months (September 2012) on the progress of standards development in ANSI Z21.88, "ANSI Standard for Vented Gas Fireplace Heaters," and ANSI Z21.50, "ANSI Standard for Vented Gas Fireplaces."

To reduce or eliminate the risk of irreversible burn injuries occurring from contact with the glass fronts of unvented gas fireplace heaters and unvented decorative gas fireplaces, the Z21 TAG for Unvented Gas-Fired Heating Appliances should be asked to adopt the draft coverage to ANSI Z21.11.2, *Standard for Gas-Fired Room Heaters, Volume II, Unvented Room Heaters.* Staff would also monitor developments in ANSI Z21.11.2, to ensure that these changes were made.

# TAB A

***Carol Pollack-Nelson, Ph.D.***
***Independent Safety Consulting***
***13713 Valley Drive***
***Rockville, Maryland 20850***
***301-340-2912***
***pollacknel@comcast.net***

May 23, 2011

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

*Re: Petition for a Standard for Gas Fireplaces*

Dear Mr. Stevenson:

I am filing this petition to request the Consumer Product Safety Commission (CPSC) initiate rulemaking to require safeguards on glass fronts of gas fireplaces. Presently, the ANSI voluntary standard for Gas Vented Fireplaces permits gas fireplace glass fronts to reach temperatures of 500 degrees Fahrenheit. Momentary contact with a glass of that temperature causes the skin to immediately melt onto the glass. Glass fronts are accessible, touchable surfaces, particularly for small children, due to their positioning near the ground. Thousands of young children have been burned after contacting the hot glass of a gas fireplace.

I am a Human Factors Psychologist, having worked in the field of consumer product safety since 1982. From 1988 through 1993, I was employed by the CPSC in the Human Factors Division. Since 1994, I have been working independently as a human factors consultant. I have published in the field of Human Factors, including papers on product hazards, child supervision, warning label design, and voluntary standards. I have presented my findings at professional and industry conferences.

Last year, I was retained as an expert witness in a lawsuit filed on behalf of 11-month-old Marin Montgomery who suffered painful and disfiguring third burns after contacting the glass front of a gas fireplace. Marin lived with her mother and siblings in a rental apartment that had a gas fireplace in the living room. The fireplace glass was flush with the wall and positioned near the ground. Marin had been sitting on the living room floor with her mother who had just finished wrapping holiday gifts. Marin got up and toddled in the direction of the gas fireplace, which had been on for a period of time. Unbeknownst to her mother, the fireplace glass had reached a temperature of around 400° F.

Marin, who had just started walking, tripped & fell forward. Although her mom reached to grab her, the little girl had already stumbled and fallen against the vertical surface in front of her – the glass of the gas fireplace. Her mother immediately removed Marin from the glass, but it was too late. Her daughter's injuries were immediate. She suffered 3rd degree burns to both palms and scarring burns to her nose & forehead.

Ás it turns out, Marin's experience is not uncommon. The Consumer Product Safety Commission's (CPSC, 2009) National Electronic Injury Surveillance System (NEISS) database estimates that from 1999 through March 2009, over 2000 children aged 0-5 years suffered burn injuries on gas fireplaces. All incidents reported that the child fell into, backed into, or otherwise contacted the fireplace. Most specifically mentioned contact with the glass. Hands were the part of the body most frequently injured. However, there were a number of reports of arm, finger, lower trunk and facial injuries as well.

***Product Description, Instruction & Warnings***

The gas fireplace in Marin's home is called *direct vent* because the decorative glass front is fixed and cannot be opened to allow heat to escape. This causes the glass itself to absorb enormous heat. In fact, the industry standard for Vented Gas Fireplace Heaters (ANSI, 2003) allows glass fronts to reach temperatures of 500 degrees F.

A warning in the product's Installation & Operation Manual advises consumers of the high surface temperatures and to "...stay away to avoid burns or clothing ignition." Further, parents are advised to carefully supervise young children when they are in the same room as the appliance. Optional screen guards, available for purchase, are noted in the manual.

A warning tag about this hazard was placed on the fireplace itself:

"CAUTION: Hot while in operation. Do not touch. Severe burns may result.
Keep children, clothing, furniture, gasoline and other liquids having flammable
vapors away."

This warning tag is attached to the pilot light which is located beneath the fireplace, and behind an access door.

***Burn Potential & Hot Surfaces***

Information about the burn potential of hot surfaces was published in the 1940s by Henriques and Mortiz of the Harvard Medical School. Their research showed a temperature-time relationship for burns (Mortiz and Henriques, 1947; Henriques, 1948). Through their research, they determined the following:

The level of skin damage to the duration and intensity of surface contact
can be related by the following curve (Fig. 1). Exposures below the lower

curve should not produce permanent injury in normal humans. Exposures between the curves are described as second-degree burns and have intermediate levels of cell damage. Exposures at levels above the top line are defined as third-degree burns that cause deep, permanent cell damage and scarring (ASTM C1055-03, p. 7).

The graph depicted in Figure 1, below, shows the Temperature-Time Relationship for Burns. According to this graph, complete transepidermal necrosis (cell death) occurs after 1 second at temperatures above 158 ° F (70°C).

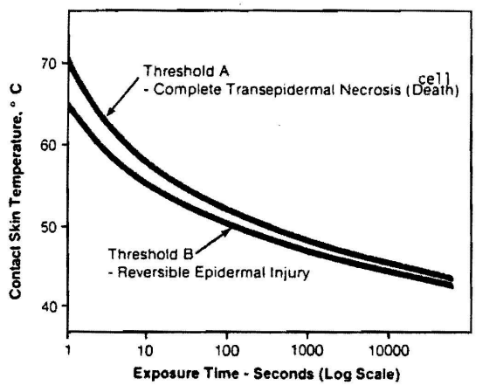


**FIG. 1 Temperature-Time Relationship for Burns**
*ASTM C1055-03, Standard Guide for Heated System Surface Conditions that Product Contact Burn Injuries, ASTM International*

***Voluntary Standards and Surface Temperature Limits***

A number of voluntary standards have incorporated the findings of Henriques & Moritz. *ASTM Standard Guide for Heated System Surface Conditions that Product Contact Burn Injuries* (C 1055-003) states that the maximum level of injury recommended is that causing first degree burns in the *average* subject. "At no time, however, are conditions that produce third degree burns recommended." The standard recommends surface temperatures below 158 degrees F.

The standard also cites the work of Stoll, Chianta and Piergallini (1979) who examined the relationship between pain, reaction times, and injury and established a minimum time to sense pain and react to it at any temperature to be a minimum of 0.3 s. Wu (1977) "...recommended that a 1-minute exposure limit be used for design purposes for persons who have slow reactions (infants, elderly, or infirmed) or who *freeze* under severe hazard conditions."

According to the Underwriters Laboratories *Standard for Household Electric Ranges* (2005), the maximum acceptable temperature of glass surfaces as measured by a probe is 172°F. Temperature limits are increased 31°F for areas that will be more than 3 feet above the floor level, as installed.

Two British Standards address hazards of hot, touchable surfaces. The British Standard EN 563 (1994), *Safety of machinery – Temperatures of Touchable Surfaces – Ergonomics Data to Establish Temperature Limit Values for Hot Surfaces* states that the burn threshold for contacting glass for a time of 0.5 seconds is between 183.2° and 194° F.

British Standard EN 13202 (2000), *Ergonomics of the Thermal Environment. Temperatures of touchable hot surfaces - Guidance for Establishing Surface Temperature Limit Values in Product Standards with the Aid of EN 563,* instructs a protocol for determining hazardous touchable surfaces and the risk they pose (pp.6-7). First, identify all accessible, touchable hot surfaces. Next, perform a task analysis that identifies the activities involved in using the product. "Particular attention shall be paid to possible intentional and unintentional contact with hot surfaces and to which persons (users of the product and others) it may occur" (p. 6). Next, hot surfaces are measured during normal operating conditions of the product. "If the surface temperature is above the burn threshold, cutaneous injury upon contact with the hot surface is to be expected" (p. 6).

The standard specifically mentions "unintentional contact" by children (p. 8), instructing that extended reaction time is expected with children, so at least 4 seconds is used to calculate the minimum contact period. For younger children, this time will be longer: "Until 24 months children do not have reflexes which are quick enough to remove their hands from what burns them. They do not always have the ability to get away from hot surfaces therefore. The contact period can be up to 15 s for very young children."

***Studies of Pediatric Burns on Glass Fronts of Gas Fireplaces***

Medical professionals who have treated children with severe contact burns resulting from contact with gas fireplaces provide insight into the hazard pattern. Becker and Cartotto (1998) reported on an 11-month-old boy who sustained burns to his hand after touching the glass front of a gas fireplace. The child's parents had turned off the fireplace approximately five minutes prior to the accident.

The authors conducted experiments whereby they measured the glass temperature of three gas fireplace models. The maximum measurable temperature for one glass front was 254 ° C (489 ° F); the temperature was still increasing, however, the adhesive metal tape melted, preventing further measurements. Within an average of 6.5 minutes, the other fireplaces reached 392° F. Further, an average of 12.3 minutes was required for the appliances to cool from 392° F to 212 ° F. One unit was cooled to 122° F, which required 27.5 minutes (p. 87).

Based on their findings, the authors reported, that a "...a partial-thickness burn could occur with less than one second of contact with the glass front of a gas fireplace that had reached a maximum steady state temperature. Additionally, less than one second would be required for a partial thickness burn five minutes after the fireplace had been extinguished."

Dunst, Scott, Kraatz, Anderson, Twomey, and Peltier (2004) reported seeing "an alarming increase in the incidence of pediatric palm burns associated with gas fireplaces." A retrospective chart review was conducted to identify patients under five years who sustained hand burns after contacting the glass of a gas fireplace. From January 1996 through December 2002, 39 patients ranging in age from seven to 23 months were identified (mean age was approximately 13 months). This represented a 15-fold increase in pediatric burns associated with gas fireplace glass contact since 1996. Furthermore, "...this increase is strongly correlated with an increase in the sales of glass-enclosed gas fireplaces during the same period" (p. 69).

Zettel, Khambalia, Barden, Murthy, and Macarthur (2004) identified 27 children who presented to The Hospital for Sick Children in Toronto between 1999 and 2002 due to gas fireplace contact burns. The children ranged in age from eight to 36 months (median age was 14 months). More than one-third of victims (37%) were injured after their lost their balance near the fireplace; another 30 percent were injured when they touched the glass front out of curiosity. Remaining injuries resulted from the child walking too close to the glass front.

Naqui, Enoch and Shah's (2005) retrospective data analysis identified 35 pediatric cases of contact burns from glass plates of gas fireplaces at a hospital in Manchester, England between 1994 and 2001. Most injuries involved the hand, palm or fingers. Other injuries affected the forearm, face, buttocks or thighs. All cases were accidental.

> Naqui, et. al. cited the study by Moritz and Henriques which indicated that: "... a temperature of 70 ° C [158° F] would cause a partial thickness burn in less than one second. Normal reaction time to a painful stimulus is .25s in a healthy adult...but this is obviously delayed in those with restricted mobility like toddlers. With glass plates of gas fires reaching temperatures of 245 ° C [473° F] within 15 min...., toddlers would have an extremely high risk of sustaining burn injury from such devices (2005, p. 74).

***Human Factors Issues relating to Burns on the Glass from Gas Fireplaces***

The hazard posed by gas fireplaces is due to a combination of factors including the high surface temperature of the fireplace glass, the accessible location of the glass front, the attractiveness of fire to young children, and the lack of consumer awareness of the hazard.

Fireplaces are situated in a family room or other communal areas of the home, approximately 6 inches from the floor. As was the case in Marin's home, they can cover an area of about 35 x 35 inches.

The low height of the fireplace glass makes it accessible to young children. Toddlers, who are unsteady on their feet, are particularly vulnerable to inadvertently falling into or contacting the glass. This bears out in pediatric data that shows that the average age of victims was about 13-14 months Dunst, et. al. (2004) and Zettel, et. al. (2004). Most children walk independently between 10 and 15 months of age and are considered to be "toddlers" for about a year as they learn to become steady on their feet. Children this age frequently lose their footing when walking or standing. A toddler who is walking near the wall where the fireplace is positioned, may, foreseeably, fall against it.

The fireplace, when built into the wall and flush with it serves as a physical substitute for the section of wall that it replaces. Toddlers range in height from about 28-29 inches. If a child were toddling near the subject fireplace, his or her hands and other parts of the body would surely contact the glass, as occurred in more than 2,000 incidents in the last 10 years.

Aside from unintentional contact with the glass, it is also foreseeable that a young child will be drawn to the fireplace and contact the glass through exploration. Young children are drawn to vivid and dynamic objects. Fire – the movement of the flames, the changes in color – is intriguing. As noted by Naqui, Enoch and Shah (2005), "... The flames of fires provide an attractive glow to toddlers who can inadvertently touch the glass plates." Out of curiosity, a young child may approach the glass and lean against it in an effort to look more closely at the fire. Or, he may put a hand out towards the fire in an effort to touch it, again resulting in contact with the glass.

Curiosity about fire is believed to be universal among children and a normal part of development (Gaynor and Hatcher, 1987). That children are attracted to fire was an important factor in the CPSC's decision to require child-resistant features on novelty and utility lighters (Meiers, 1996).

***Consumers Lack Awareness of the Hazard***

Some manufacturers include a warning about the high glass temperature on the fireplace. However, as in the case presented here, the warning is typically positioned under the base of the fireplace, behind a removable panel where the pilot light is located. Since the gas fireplace works with the flip of the switch, most consumers have no reason to lift this panel in the course of normal use. Placement of a warning in a location where it is not likely to be seen by the fireplace user demonstrates the inappropriateness of warnings as a means of addressing this hazard.

Warnings in the product's "Installation Manual" are also not likely to be seen as the average consumer does not install the gas fireplace. After it is installed, it should operate easily by turning on the wall switch, as noted. If there is a problem with the fireplace or if repairs are required, it is likely that the consumer will call a specialized technician, especially if they are renters like Marin Montgomery's mother.

Because consumers are not likely to read the any or all of the Installation Manual, they will not see the information about the option to purchase an additional safety screen. Furthermore, it is my understanding that it is too late to request an integral screen at that point since it must be installed at the factory.

Without the benefit of seeing a warning, the average consumer has no basis for knowing that the exterior glass of a fireplace can get hot enough to cause instantaneous burns. Nor does the consumer have any way of knowing how long the dangerously high temperatures persist after the product is turned off. Additionally, the average consumer does not know of pediatric injury data associated with gas fireplaces.

While one can easily recognize the hazard of an exposed flame or an open fireplace and may even suspect that the glass front will be warm or even somewhat hot, it is not "common knowledge" that the glass front of a gas fireplace can reach 500 degrees F. Not only does the average consumer not know that the glass fronts reach temperatures of this extreme, it is also not likely that s/he can even appreciate how quickly and how severely injuries will be if the glass is contacted. Five hundred degrees Fahrenheit exceeds what most consumers can appreciate as being "hot." The average consumer has no idea what will happen to skin when it contacts 500 degree F glass for even a moment.

This lack of knowledge by consumers was expressed in comments of parents whose children have been burned (Pollack-Nelson, 2009). One father noted that prior to his son's incident; he had no idea if the glass front on the gas fireplace got hot. "It had never crossed my mind." Another consumer who wrote to a gas fireplace manufacturer, stating that he had no idea how dangerous a fireplace becomes when it is on. Further, he consulted with other parents who agreed that they "...assumed the glass was of such material that it would not get hot!"

Not only are consumers not likely to realize that the glass front becomes treacherously hot, but it is quite likely that some will view the glass front as a protective barrier from the flames. In other words, the glass front may provide a false sense of security. According to one parent, "I thought the glass protected the heat from the outside... I thought the glass was heat-resistant."

The absence of any guard or barrier over the front of the glass contributes to the perception that the glass is touchable. A guard can serve not only as a barrier to a hazard, but also as an indication that the hazard exists. Consumers expect that products in their home are safe and dangers are guarded against. As one angry parent wrote in a letter to a manufacturer: "One would not assume since there is no protective screen/stop around these fireplaces that the glass would get so hot..."

Consumers perceptions of the glass as a safe-to-touch barrier are forged not only from a lack of obvious hazard (i.e., lack of a conspicuous warning and barrier, no color change), but also from experience with other household appliances, such as their oven. Oven doors serve as a barrier from the high heat inside. Some parents have stated that they believed the gas fireplace would be like other appliances in the home and that you would not get burned if you touch it.

In sum, the average consumer has no reason to suspect that the glass front of a gas fireplace presents an acute and severe burn hazard. While it is common knowledge that the interior of the fireplace gets hot, it is beyond the average consumers' ability to discern the temperature of the front of the glass.

***Supervision***

When children become injured on adult or household products, their parents are often accused of failing to supervise appropriately. However, in many cases – including those involving pediatric burns on the hot glass of a gas fireplace - the parent was in the same room as the child and supervising him or her directly (e.g., talking with the child) but still unable to prevent the injury from occurring.

The CPSC specifically addressed the issue of supervision and injuries to children in a Federal Register notice for "Requirements for the Special Packaging of Household Substances; Final Rule (Code of Federal Regulations, 1995). In this notice, the Commission called for special packaging for certain poisonous household objects to protect children:

> The Committee... believes that parental negligence is not the primary cause of poisonings. There are too many potentially hazardous products in the modern home to hope that all of them can be kept out of the reach of children. Special packaging will accomplish what previous efforts have not b[y] attempting to create positive separation between young children and hazardous substances. Special packaging is intended simply to make the environment of young children safer (p. 37723).

***Passive Intervention Needed To Protect Children***

Siekmann (1989, 1990) found that a large number of burn accidents result from a person being unaware of any danger from a hot surface or accidental contact. He suggested protective measures be added to products if the danger from a hot surface is not visible or obvious (1990).

Presently, some manufacturers provide a protective mesh screen with their gas fireplaces. Yet, many do not and the industry standard does not require this. Some manufacturers offer protective screens as an accessory, however, as noted, consumers may not see this information in the manual until after the fireplace is installed (since they are given the manual at the time of installation). Furthermore, since a screen is not required, consumers may not recognize it as a safety necessity. Also, consumers who purchase an existing home or rent their residence are not likely to know about the screen option since the fireplace is already installed in the home.

Passive interventions, like an integral safety screen, that do not require action by the parent to ensure a child's safety has been advocated in the published literature for decades (Dershewitz and Williamson, 1977; Eichelberger, Gotschall, Feely, Harstad and Bowman, 1990; Morrongiello and Dayler, 1996; Ytterstad, Smith and Coggan, 1998). In fact, this is the basis for child-resistance features found on numerous adult, household products including heater grill guards, child-resistant cigarette and utility lighters, and child-resistant caps on medicines and cleaning supplies.

Incorporating protective devices into household products that are not specifically intended for young children was addressed in a Public Hearing on Disposable Butane Lighters:

Congress took explicit action to anticipate types of problems that we run into with children getting access to these types of products, and therefore, safety problems developing. Congress did the same with respect to refrigerators. That would be another area where the refrigerator is not intended for children, but in order to prevent entrapment, Congress literally passed a standard... Similarly with respect to lead in paint, not a product intended for children... Or more recently... lead and wrapping paper... drinking glasses. But all areas where the product itself is not intended, really, for children but where hazard would manifest itself over time, with respect to children gaining access to that product.

Studies of the pediatric burn risk associated with gas fireplaces consistently recommend a barrier be employed to prevent injuries. Becker & Cortotto (1998), who studied gas fireplaces in connection with a pediatric burn case, recommended that mechanical guards be provided with all gas fireplace units. "Small children are at risk of contact burns from these units, even with short duration contacts. We propose that gas fireplace manufacturers give consideration to the installation of protective barriers..." (p. 89).

Zettel, Khambalia, Barden, Murthy, and Macarthur (2004) came to the same conclusion after studying the burns of 27 young children. "Given the etiology of these burns (loss of balance or curiosity), passive prevention, such as barriers or changes in the composition of glass panels, may be the most effective approach to combat them" (p. 512).

The British Standard EN 563:1994 (referenced earlier) recommends protective measures to prevent burns on touchable hot surfaces: "Engineering measures are preferred and should be given priority" (p. 16). These include: Reduction of surface temperature; insulation; and guards (screen or barrier). The standard identifies the following factors that make protective measures against burning all the more important:

- the higher the measured surface temperature is above the burn threshold;
- the longer the surface temperature exceeds the burn threshold;
- the less the risk of burning is known to the person liable to be burned (e.g., children);
- the smaller the chance is for counter-reaction;
- the more accessible the hot surface is;
- the higher the contact risk is in accordance with the intended use;
- the more frequently the contact is likely to occur;
- the smaller the previous knowledge of the user concerning safe handling of the machine with a hot surface is to be expected (p.14).

***Petition Request***

In May 2010, I submitted the extensive information found in this petition to the ANSI/CSA Subcommittee for Gas Vented Fireplaces, requesting that revisions be made to the standard in order to mitigate the burn risk. In the ensuing year, industry met to discuss the petition, but the standard was not revised. Furthermore, last week, I was informed by a representative of the Subcommittee that at this time, there is no plan to make any revisions.

Due to industry's failure to act, I am petitioning the CPSC to develop a mandatory standard that will adequately protect consumers, and particularly children, from this hazard. Specifically, I am asking the Commission to develop a mandatory standard for gas fireplaces that requires an integral protective barrier, guard or other device for any accessible surface (e.g., glass fronts) that, if contacted, is hot enough to cause severe burns.

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

Respectfully submitted,

Carol Pollack-Nelson, Ph.D.

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U.S. CONSUMER PRODUCT SAFETY COMMISSION
4330 EAST WEST HIGHWAY
BETHESDA, MD 20814

OFFICE OF THE GENERAL COUNSEL

Cheryl A. Falvey
General Counsel
Tel: 301-504-7642
E-Mail: cfalvey@cpsc.gov

May 20, 2011

Carol Pollack-Nelson, Ph.D.
Independent Safety Consulting
13713 Valley Drive
Rockville, Maryland 20850

Dear Dr. Pollack-Nelson:

This responds to your submission dated April 12, 2011, asking that the Consumer Product Safety Commission ("the Commission") initiate rulemaking to require safeguards on glass fronts of vented gas fireplaces. For the reasons stated below, we do not believe that your request meets the Commission's requirements for petitions as set forth in 16 C.F.R. Part 1051.

The Commission has certain requirements for petitions that are set out in our regulations. Compliance with these requirements allows the Commission to undertake a review of the petition to determine whether it merits further action.

Your request meets almost all of the petition requirements. It is in English, provides your name and address, indicates the product at issue, and sets forth facts which establish the claim that the issuance of the rule is necessary. 16 C.F.R. § 1051.5(a)(1)-(4). The Commission's petition regulations also require that a petition contain "a brief description of the proposed rule" that the Commission should issue. Id. § 1051.5(a)(5). Your letter does cite various voluntary standards which address the hazards of hot, touchable surfaces. It also discusses the ineffectiveness of warnings contained only in operation and instruction manuals or out of sight of the consumer. Your letter also points out consumers may not be aware of the option to purchase safety screens for gas fireplaces, and that it may not be possible to install an integral safety screen on a vented gas fireplace after the gas fireplace's installation. What we would need from you before docketing this as a petition is a brief summary of what a proposed rule might include to address these various issues you have identified, as required by 16 C.F.R. 1051.5(a)(1)(5)). Your resubmission should be directed to the Commission's Office of Secretary.

Sincerely,

Cheryl A. Falvey

CPSC Hotline: 1-800-638-CPSC(2772) □ CPSC's Web Site: http://www.cpsc.gov

***Carol Pollack-Nelson, Ph.D.***
***Independent Safety Consulting***
***13713 Valley Drive***
***Rockville, Maryland 20850***
***301-340-2912***
***pollacknel@comcast.net***

Received CPSC
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Office of the Secretary
FOI

April 12, 2011

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

*Re: Petition for a Standard for Gas Fireplaces*

Dear Mr. Stevenson:

I am filing this petition to request the Consumer Product Safety Commission (CPSC) initiate rulemaking to require safeguards on glass fronts of gas fireplaces. Presently, the ANSI voluntary standard for Gas Vented Fireplaces permits gas fireplace glass fronts to reach temperatures of 500 degrees Fahrenheit. Momentary contact with a glass of that temperature causes the skin to immediately melt onto the glass. Glass fronts are accessible, touchable surfaces, particularly for small children, due to their positioning near the ground. Thousands of young children have been burned after contacting the hot glass of a gas fireplace.

I am a Human Factors Psychologist, having worked in the field of consumer product safety since 1982. From 1988 through 1993, I was employed by the CPSC in the Human Factors Division. Since 1994, I have been working independently as a human factors consultant. I have published in the field of Human Factors, including papers on product hazards, child supervision, warning label design, and voluntary standards. I have presented my findings at professional and industry conferences.

Last year, I was retained as an expert witness in a lawsuit filed on behalf of 11-month-old Marin Montgomery who suffered painful and disfiguring third burns after contacting the glass front of a gas fireplace. Marin lived with her mother and siblings in a rental apartment that had a gas fireplace in the living room. The fireplace glass was flush with the wall and positioned near the ground. Marin had been sitting on the living room floor with her mother who had just finished wrapping holiday gifts. Marin got up and toddled in the direction of the gas fireplace, which had been on for a period of time. Unbeknownst to her mother, the fireplace glass had reached a temperature of around 400° F.

Marin, who had just started walking, tripped & fell forward. Although her mom reached to grab her, the little girl had already stumbled and fallen against the vertical surface in front of her – the glass of the gas fireplace. Her mother immediately removed Marin from the glass, but it was too late. Her daughter's injuries were immediate. She suffered 3rd degree burns to both palms and scarring burns to her nose & forehead.

As it turns out, Marin's experience is not uncommon. The Consumer Product Safety Commission's (CPSC, 2009) National Electronic Injury Surveillance System (NEISS) database estimates that from 1999 through March 2009, over 2000 children aged 0-5 years suffered burn injuries on gas fireplaces. All incidents reported that the child fell into, backed into, or otherwise contacted the fireplace. Most specifically mentioned contact with the glass. Hands were the part of the body most frequently injured. However, there were a number of reports of arm, finger, lower trunk and facial injuries as well.

### *Product Description, Instruction & Warnings*

The gas fireplace in Marin's home is called *direct vent* because the decorative glass front is fixed and cannot be opened to allow heat to escape. This causes the glass itself to absorb enormous heat. In fact, the industry standard for Vented Gas Fireplace Heaters (ANSI, 2003) allows glass fronts to reach temperatures of 500 degrees F.

A warning in the product's Installation & Operation Manual advises consumers of the high surface temperatures and to "...stay away to avoid burns or clothing ignition." Further, parents are advised to carefully supervise young children when they are in the same room as the appliance. Optional screen guards, available for purchase, are noted in the manual.

A warning tag about this hazard was placed on the fireplace itself:

"CAUTION: Hot while in operation. Do not touch. Severe burns may result.
Keep children, clothing, furniture, gasoline and other liquids having flammable
vapors away."

This warning tag is attached to the pilot light which is located beneath the fireplace, and behind an access door.

### *Burn Potential & Hot Surfaces*

Information about the burn potential of hot surfaces was published in the 1940s by Henriques and Mortiz of the Harvard Medical School. Their research showed a temperature-time relationship for burns (Mortiz and Henriques, 1947; Henriques, 1948). Through their research, they determined the following:

> The level of skin damage to the duration and intensity of surface contact can be related by the following curve (Fig. 1). Exposures below the lower curve should not produce permanent injury in normal humans. Exposures between the curves are described as second-degree burns and have intermediate levels of cell damage. Exposures at levels above the top line are defined as third-degree burns that cause deep, permanent cell damage and scarring (ASTM C1055-03, p. 7).

The graph depicted in Figure 1, below, shows the Temperature-Time Relationship for Burns. According to this graph, complete transepidermal necrosis (cell death) occurs after 1 second at temperatures above 158 ° F (70°C).

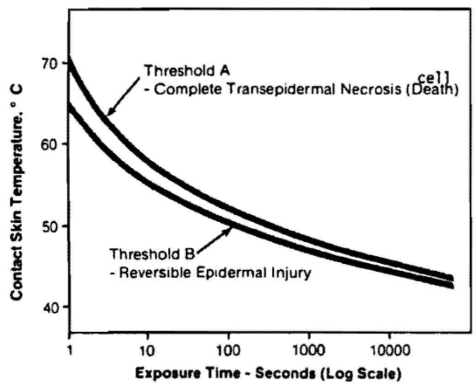


**FIG. 1 Temperature-Time Relationship for Burns**
*ASTM C1055-03, Standard Guide for Heated System Surface Conditions that Product Contact Burn Injuries, ASTM International*

***Voluntary Standards and Surface Temperature Limits***

A number of voluntary standards have incorporated the findings of Henriques & Moritz. *ASTM Standard Guide for Heated System Surface Conditions that Product Contact Burn Injuries* (C 1055-003) states that the maximum level of injury recommended is that causing first degree burns in the *average* subject. "At no time, however, are conditions that produce third degree burns recommended." The standard recommends surface temperatures below 158 degrees F.

The standard also cites the work of Stoll, Chianta and Piergallini (1979) who examined the relationship between pain, reaction times, and injury and established a minimum time to sense pain and react to it at any temperature to be a minimum of 0.3 s. Wu (1977) "...recommended that a 1-minute exposure limit be used for design purposes for persons who have slow reactions (infants, elderly, or infirmed) or who *freeze* under severe hazard conditions."

According to the Underwriters Laboratories *Standard for Household Electric Ranges* (2005), the maximum acceptable temperature of glass surfaces as measured by a probe is 172°F. Temperature limits are increased 31°F for areas that will be more than 3 feet above the floor level, as installed.

Two British Standards address hazards of hot, touchable surfaces. The British Standard EN 563 (1994), *Safety of machinery – Temperatures of Touchable Surfaces – Ergonomics Data to Establish Temperature Limit Values for Hot Surfaces* states that the burn threshold for contacting glass for a time of 0.5 seconds is between 183.2° and 194° F.

British Standard EN 13202 (2000), *Ergonomics of the Thermal Environment. Temperatures of touchable hot surfaces - Guidance for Establishing Surface Temperature Limit Values in Product Standards with the Aid of EN 563,* instructs a protocol for determining hazardous touchable surfaces and the risk they pose (pp.6-7). First, identify all accessible, touchable hot surfaces. Next, perform a task analysis that identifies the activities involved in using the product. "Particular attention shall be paid to possible intentional and unintentional contact with hot surfaces and to which persons (users of the product and others) it may occur" (p. 6). Next, hot surfaces are measured during normal operating conditions of the product. "If the surface temperature is above the bum threshold, cutaneous injury upon contact with the hot surface is to be expected" (p. 6).

The standard specifically mentions "unintentional contact" by children (p. 8), instructing that extended reaction time is expected with children, so at least 4 seconds is used to calculate the minimum contact period. For younger children, this time will be longer: "Until 24 months children do not have reflexes which are quick enough to remove their hands from what burns them. They do not always have the ability to get away from hot surfaces therefore. The contact period can be up to 15 s for very young children."

***Studies of Pediatric Burns on Glass Fronts of Gas Fireplaces***

Medical professionals who have treated children with severe contact burns resulting from contact with gas fireplaces provide insight into the hazard pattern. Becker and Cartotto (1998) reported on an 11-month-old boy who sustained burns to his hand after touching the glass front of a gas fireplace. The child's parents had turned off the fireplace approximately five minutes prior to the accident.

The authors conducted experiments whereby they measured the glass temperature of three gas fireplace models. The maximum measurable temperature for one glass front was 254 ° C (489 ° F); the temperature was still increasing, however, the adhesive metal tape melted, preventing further measurements. Within an average of 6.5 minutes, the other fireplaces reached 392° F. Further, an average of 12.3 minutes was required for the appliances to cool from 392° F to 212 ° F. One unit was cooled to 122° F, which required 27.5 minutes (p. 87).

Based on their findings, the authors reported, that a "...a partial-thickness burn could occur with less than one second of contact with the glass front of a gas fireplace that had reached a maximum steady state temperature. Additionally, less than one second would be required for a partial thickness burn five minutes after the fireplace had been extinguished."

Dunst, Scott, Kraatz, Anderson, Twomey, and Peltier (2004) reported seeing "an alarming increase in the incidence of pediatric palm burns associated with gas fireplaces." A retrospective chart review was conducted to identify patients under five years who sustained hand burns after contacting the glass of a gas fireplace. From January 1996 through December 2002, 39 patients ranging in age from seven to 23 months were identified (mean age was approximately 13 months). This represented a 15-fold increase in pediatric burns associated with gas fireplace glass contact since 1996. Furthermore, "...this increase is strongly correlated with an increase in the sales of glass-enclosed gas fireplaces during the same period" (p. 69).

Zettel, Khambalia, Barden, Murthy, and Macarthur (2004) identified 27 children who presented to The Hospital for Sick Children in Toronto between 1999 and 2002 due to gas fireplace contact burns. The children ranged in age from eight to 36 months (median age was 14 months). More than one-third of victims (37%) were injured after their lost their balance near the fireplace; another 30 percent were injured when they touched the glass front out of curiosity. Remaining injuries resulted from the child walking too close to the glass front.

Naqui, Enoch and Shah's (2005) retrospective data analysis identified 35 pediatric cases of contact burns from glass plates of gas fireplaces at a hospital in Manchester, England between 1994 and 2001. Most injuries involved the hand, palm or fingers. Other injuries affected the forearm, face, buttocks or thighs. All cases were accidental.

> Naqui, et. al. cited the study by Moritz and Henriques which indicated that: "... a temperature of 70 ° C [158° F] would cause a partial thickness burn in less than one second. Normal reaction time to a painful stimulus is .25s in a healthy adult...but this is obviously delayed in those with restricted mobility like toddlers. With glass plates of gas fires reaching temperatures of 245 ° C [473° F] within 15 min...., toddlers would have an extremely high risk of sustaining burn injury from such devices (2005, p. 74).

***Human Factors Issues relating to Burns on the Glass from Gas Fireplaces***

The hazard posed by gas fireplaces is due to a combination of factors including the high surface temperature of the fireplace glass, the accessible location of the glass front, the attractiveness of fire to young children, and the lack of consumer awareness of the hazard.

Fireplaces are situated in a family room or other communal areas of the home, approximately 6 inches from the floor. As was the case in Marin's home, they can cover an area of about 35 x 35 inches.

The low height of the fireplace glass makes it accessible to young children. Toddlers, who are unsteady on their feet, are particularly vulnerable to inadvertently falling into or contacting the glass. This bears out in pediatric data that shows that the average age of victims was about 13-14 months Dunst, et. al. (2004) and Zettel, et. al. (2004). Most children walk independently between 10 and 15 months of age and are considered to be "toddlers" for about a year as they learn to become steady on their feet. Children this age frequently lose their footing when walking or standing. A toddler who is walking near the wall where the fireplace is positioned, may, foreseeably, fall against it.

The fireplace, when built into the wall and flush with it serves as a physical substitute for the section of wall that it replaces. Toddlers range in height from about 28-29 inches. If a child were toddling near the subject fireplace, his or her hands and other parts of the body would surely contact the glass, as occurred in more than 2,000 incidents in the last 10 years.

Aside from unintentional contact with the glass, it is also foreseeable that a young child will be drawn to the fireplace and contact the glass through exploration. Young children are drawn to vivid and dynamic objects. Fire – the movement of the flames, the changes in color – is intriguing. As noted by Naqui, Enoch and Shah (2005), "... The flames of fires provide an attractive glow to toddlers who can inadvertently touch the glass plates." Out of curiosity, a young child may approach the glass and lean against it in an effort to look more closely at the fire. Or, he may put a hand out towards the fire in an effort to touch it, again resulting in contact with the glass.

Curiosity about fire is believed to be universal among children and a normal part of development (Gaynor and Hatcher, 1987). That children are attracted to fire was an important factor in the CPSC's decision to require child-resistant features on novelty and utility lighters (Meiers, 1996).

***Consumers Lack Awareness of the Hazard***

Some manufacturers include a warning about the high glass temperature on the fireplace. However, as in the case presented here, the warning is typically positioned under the base of the fireplace, behind a removable panel where the pilot light is located. Since the gas fireplace works with the flip of the switch, most consumers have no reason to lift this panel in the course of normal use. Placement of a warning in a location where it is not likely to be seen by the fireplace user demonstrates the inappropriateness of warnings as a means of addressing this hazard.

Warnings in the product's "Installation Manual" are also not likely to be seen as the average consumer does not install the gas fireplace. After it is installed, it should operate easily by turning on the wall switch, as noted. If there is a problem with the fireplace or if repairs are required, it is likely that the consumer will call a specialized technician, especially if they are renters like Marin Montgomery's mother.

Because consumers are not likely to read the any or all of the Installation Manual, they will not see the information about the option to purchase an additional safety screen. Furthermore, it is my understanding that it is too late to request an integral screen at that point since it must be installed at the factory.

Without the benefit of seeing a warning, the average consumer has no basis for knowing that the exterior glass of a fireplace can get hot enough to cause instantaneous burns. Nor does the consumer have any way of knowing how long the dangerously high temperatures persist after the product is turned off. Additionally, the average consumer does not know of pediatric injury data associated with gas fireplaces.

While one can easily recognize the hazard of an exposed flame or an open fireplace and may even suspect that the glass front will be warm or even somewhat hot, it is not "common knowledge" that the glass front of a gas fireplace can reach 500 degrees F. Not only does the average consumer not know that the glass fronts reach temperatures of this extreme, it is also not likely that s/he can even appreciate how quickly and how severely injuries will be if the glass is contacted. Five hundred degrees Fahrenheit exceeds what most consumers can appreciate as being "hot." The average consumer has no idea what will happen to skin when it contacts 500 degree F glass for even a moment.

This lack of knowledge by consumers was expressed in comments of parents whose children have been burned (Pollack-Nelson, 2009). One father noted that prior to his son's incident; he had no idea if the glass front on the gas fireplace got hot. "It had never crossed my mind." Another consumer who wrote to a gas fireplace manufacturer, stating that he had no idea how dangerous a fireplace becomes when it is on. Further, he consulted with other parents who agreed that they "...assumed the glass was of such material that it would not get hot!"

Not only are consumers not likely to realize that the glass front becomes treacherously hot, but it is quite likely that some will view the glass front as a protective barrier from the flames. In other words, the glass front may provide a false sense of security. According to one parent, "I thought the glass protected the heat from the outside... I thought the glass was heat-resistant."

The absence of any guard or barrier over the front of the glass contributes to the perception that the glass is touchable. A guard can serve not only as a barrier to a hazard, but also as an indication that the hazard exists. Consumers expect that products in their home are safe and dangers are guarded against. As one angry parent wrote in a letter to a manufacturer: "One would not assume since there is no protective screen/stop around these fireplaces that the glass would get so hot..."

Consumers perceptions of the glass as a safe-to-touch barrier are forged not only from a lack of obvious hazard (i.e., lack of a conspicuous warning and barrier, no color change), but also from experience with other household appliances, such as their oven. Oven doors serve as a barrier from the high heat inside. Some parents have stated that they believed the gas fireplace would be like other appliances in the home and that you would not get burned if you touch it.

In sum, the average consumer has no reason to suspect that the glass front of a gas fireplace presents an acute and severe burn hazard. While it is common knowledge that the interior of the fireplace gets hot, it is beyond the average consumers' ability to discern the temperature of the front of the glass.

***Supervision***

When children become injured on adult or household products, their parents are often accused of failing to supervise appropriately. However, in many cases – including those involving pediatric burns on the hot glass of a gas fireplace - the parent was in the same room as the child and supervising him or her directly (e.g., talking with the child) but still unable to prevent the injury from occurring.

The CPSC specifically addressed the issue of supervision and injuries to children in a Federal Register notice for "Requirements for the Special Packaging of Household Substances; Final Rule (Code of Federal Regulations, 1995). In this notice, the Commission called for special packaging for certain poisonous household objects to protect children:

> The Committee... believes that parental negligence is not the primary cause of poisonings. There are too many potentially hazardous products in the modern home to hope that all of them can be kept out of the reach of children. Special packaging will accomplish what previous efforts have not b[y] attempting to create positive separation between young children and hazardous substances. Special packaging is intended simply to make the environment of young children safer (p. 37723).

***Passive Intervention Needed To Protect Children***

Siekmann (1989, 1990) found that a large number of burn accidents result from a person being unaware of any danger from a hot surface or accidental contact. He suggested protective measures be added to products if the danger from a hot surface is not visible or obvious (1990).

Presently, some manufacturers provide a protective mesh screen with their gas fireplaces. Yet, many do not and the industry standard does not require this. Some manufacturers offer protective screens as an accessory, however, as noted, consumers may not see this information in the manual until after the fireplace is installed (since they are given the manual at the time of installation). Furthermore, since a screen is not required, consumers may not recognize it as a safety necessity. Also, consumers who purchase an existing home or rent their residence are not likely to know about the screen option since the fireplace is already installed in the home.

Passive interventions, like an integral safety screen, that do not require action by the parent to ensure a child's safety has been advocated in the published literature for decades (Dershewitz and Williamson, 1977; Eichelberger, Gotschall, Feely, Harstad and Bowman, 1990; Morrongiello and Dayler, 1996; Ytterstad, Smith and Coggan, 1998). In fact, this is the basis for child-resistance features found on numerous adult, household products including heater grill guards, child-resistant cigarette and utility lighters, and child-resistant caps on medicines and cleaning supplies.

Incorporating protective devices into household products that are not specifically intended for young children was addressed in a Public Hearing on Disposable Butane Lighters:

> Congress took explicit action to anticipate types of problems that we run into with children getting access to these types of products, and therefore, safety problems developing. Congress did the same with respect to refrigerators. That would be another area where the refrigerator is not intended for children, but in order to prevent entrapment, Congress literally passed a standard... Similarly with respect to lead in paint, not a product intended for children... Or more recently... lead and wrapping paper... drinking glasses. But all areas where the product itself is not intended, really, for children but where hazard would manifest itself over time, with respect to children gaining access to that product.

Studies of the pediatric burn risk associated with gas fireplaces consistently recommend a barrier be employed to prevent injuries. Becker & Cortotto (1998), who studied gas fireplaces in connection with a pediatric burn case, recommended that mechanical guards be provided with all gas fireplace units. "Small children are at risk of contact burns from these units, even with short duration contacts. We propose that gas fireplace manufacturers give consideration to the installation of protective barriers..." (p. 89).

Zettel, Khambalia, Barden, Murthy, and Macarthur (2004) came to the same conclusion after studying the burns of 27 young children. "Given the etiology of these burns (loss of balance or curiosity), passive prevention, such as barriers or changes in the composition of glass panels, may be the most effective approach to combat them" (p. 512).

The British Standard EN 563:1994 (referenced earlier) recommends protective measures to prevent burns on touchable hot surfaces: "Engineering measures are preferred and should be given priority" (p. 16). These include: Reduction of surface temperature; insulation; and guards (screen or barrier). The standard identifies the following factors that make protective measures against burning all the more important:

- the higher the measured surface temperature is above the burn threshold;
- the longer the surface temperature exceeds the burn threshold;
- the less the risk of burning is known to the person liable to be burned (e.g., children);
- the smaller the chance is for counter-reaction;
- the more accessible the hot surface is;
- the higher the contact risk is in accordance with the intended use;
- the more frequently the contact is likely to occur;
- the smaller the previous knowledge of the user concerning safe handling of the machine with a hot surface is to be expected (p.14).

***Petition Request***

In May 2010, I submitted the extensive information found in this petition to the ANSI/CSA Subcommittee for Gas Vented Fireplaces, requesting that revisions be made to the standard in order to mitigate the burn risk. In the ensuing year, industry met to discuss the petition, but the standard was not revised. Furthermore, last week, I was informed by a representative of the Subcommittee that at this time, there is no plan to make any revisions.

Due to industry's failure to act, I am petitioning the CPSC to develop a mandatory standard that will adequately protect consumers, and particularly children, from this hazard.

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

Respectfully submitted,

Carol Pollack-Nelson, Ph.D.

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in accordance with the Accomplishment Instructions of Airbus Mandatory Service Bulletin A300–32–0450, Revision 02, dated July 28, 2009. Parts removed from an airplane as required by this paragraph must be returned to Messier-Dowty within 30 days after removing the part from the airplane.

(k) As of the effective date of this AD, any MLG retraction actuator sliding rod having P/N C69029–2 or C69029–3 that has accumulated less than 32,000 total flight cycles, may be installed on any airplane, provided that the inspections required by paragraphs (g) and (h) of this AD are accomplished at the compliance times specified in paragraphs (g) and (h) of this AD and all applicable replacements required by paragraphs (i) and (j) of this AD are done.

**Lubrication of the MLG Assembly**

(l) Within 1,500 flight hours after the effective date of this AD: Clean and lubricate the MLG assembly, in accordance with Task 321112–0505–1 of the Airbus A300 Maintenance Planning Document, Revision 30, dated April 1, 2010. Repeat the cleaning and lubrication thereafter at intervals not to exceed 1,500 flight hours.

**Credit for Actions Accomplished in Accordance With Previous Service Information**

(m) Inspections accomplished before the effective date of this AD, in accordance with Airbus Service Bulletin A300–32–0450, dated December 1, 2005; or Airbus Mandatory Service Bulletin A300–32–0450, Revision 01, dated May 10, 2006; are acceptable for compliance with the corresponding requirements of this AD.

**FAA AD Differences**

**Note 1** : This AD differs from the MCAI and/or service information as follows: No differences.

**Other FAA AD Provisions**

(n) The following provisions also apply to this AD:

(1) *Alternative Methods of Compliance (AMOCs):* The Manager, International Branch, ANM–116, Transport Airplane Directorate, FAA, has the authority to approve AMOCs for this AD, if requested using the procedures found in 14 CFR 39.19. In accordance with 14 CFR 39.19, send your request to your principal inspector or local Flight Standards District Office, as appropriate. If sending information directly to the International Branch, send it to ATTN: Dan Rodina, Aerospace Engineer, International Branch, ANM–116, Transport Airplane Directorate, FAA, 1601 Lind Avenue SW., Renton, Washington 98057–3356; telephone (425) 227–2125; fax (425) 227–1149. Information may be e-mailed to: *9-ANM-116-AMOC-REQUESTS@faa.gov.* Before using any approved AMOC, notify your appropriate principal inspector, or lacking a principal inspector, the manager of the local flight standards district office/certificate holding district office. The AMOC approval letter must specifically reference this AD. AMOCs approved previously in accordance with AD 2007–25–15, amendment 39–15297, are approved as AMOCs for the corresponding provisions of this AD.

(2) *Airworthy Product:* For any requirement in this AD to obtain corrective actions from a manufacturer or other source, use these actions if they are FAA-approved. Corrective actions are considered FAA-approved if they are approved by the State of Design Authority (or their delegated agent). You are required to assure the product is airworthy before it is returned to service.

**Related Information**

(o) Refer to MCAI European Aviation Safety Agency Airworthiness Directive 2010–0102, dated June 8, 2010; Airbus Mandatory Service Bulletin A300–32–0450, Revision 02, dated July 28, 2009; Messier-Dowty Special Inspection Service Bulletin 470–32–806, dated October 27, 2005; and Task 321112–0505–1 of the Airbus A300 Maintenance Planning Document, Revision 30, dated April 1, 2010; for related information.

Issued in Renton, Washington, on May 27, 2011.

**Ali Bahrami,**

*Manager, Transport Airplane Directorate, Aircraft Certification Service.*

[FR Doc. 2011–14094 Filed 6–7–11; 8:45 am]

BILLING CODE 4910–13–P

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## CONSUMER PRODUCT SAFETY COMMISSION

## 16 CFR 1460

## Petition Requesting Safeguards for Glass Fronts of Gas Vented Fireplaces

**AGENCY:** U.S. Consumer Product Safety Commission.

**ACTION:** Notice.

**SUMMARY:** The U.S. Consumer Product Safety Commission ("Commission" or "we") has received a petition (CP 11–1) requesting that the Commission initiate rulemaking to require safeguards for glass fronts of gas vented fireplaces. We invite written comments concerning the petition.

**DATES:** The Office of the Secretary must receive comments on the petition by August 8, 2011.

**ADDRESSES:** You may submit comments, identified by Docket No. CPSC–2011–0028, by any of the following methods:

**Electronic Submissions**

Submit electronic comments in the following way:

*Federal eRulemaking Portal: http://www.regulations.gov.* Follow the instructions for submitting comments.

To ensure timely processing of comments, the Commission is no longer accepting comments submitted by electronic mail (e-mail), except through *http://www.regulations.gov.*

**Written Submissions**

Submit written submissions in the following way:

*Mail/Hand delivery/Courier (for paper, disk, or CD–ROM submissions), preferably in five copies, to:* Office of the Secretary, U.S. Consumer Product Safety Commission, Room 820, 4330 East West Highway, Bethesda, MD 20814; telephone (301) 504–7923.

*Instructions:* All submissions received must include the agency name and petition number for this rulemaking. All comments received may be posted without change, including any personal identifiers, contact information, or other personal information provided, to: *http://www.regulations.gov.* Do not submit confidential business information, trade secret information, or other sensitive or protected information electronically. Such information should be submitted in writing.

*Docket:* For access to the docket to read background documents or comments received, go to: *http://www.regulations.gov.*

**FOR FURTHER INFORMATION CONTACT:** Rockelle Hammond, Office of the Secretary, U.S. Consumer Product Safety Commission, Room 820, 4330 East West Highway, Bethesda, MD 20814; telephone (301) 504–6833.

**SUPPLEMENTARY INFORMATION:** The Commission has received correspondence from Carol Pollack-Nelson, Ph.D. ("petitioner"), dated May 23, 2011, requesting that we initiate rulemaking to require safeguards for glass fronts of gas vented fireplaces. We are docketing this request as a petition under the Consumer Product Safety Act. 15 U.S.C. 2056 and 2058. Petitioner notes that the industry standard for gas vented fireplace heaters allows glass fronts to reach temperatures of 500 degrees Fahrenheit, and that these glass fronts are accessible to children. Petitioner claims that, according to the U.S. Consumer Product Safety Commission's National Electronic Injury Surveillance System database (NEISS), more than 2,000 children ages 0–5 years suffered burn injuries on gas fireplaces in the period between 1999 and March 2009. Petitioner believes the hazard posed by gas fireplaces is due to a combination of factors, "including the high surface temperature of the fireplace glass, the accessible location of the glass front, the attractiveness of fire to young children, and the lack of consumer awareness of the hazard." Petitioner states that passive interventions, such as an "integral safety screen," are needed to protect children. Petitioner asks the Commission to develop a mandatory standard for gas fireplaces that requires a protective barrier, guard or other device for any accessible surface that, if contacted, is hot enough to cause severe burns.

Subsequent to the receipt of this petition, the Commission received a submission from Mr. William S. Lerner, also requesting that the Commission initiate rulemaking regarding glass fronts of gas fireplaces. Mr. Lerner asks the Commission to require a "high temperature warning system," which will "project a clear high temperature alert onto the glass front of the fireplace that will remain visible from the time the fireplace is lit until the glass is cool enough to touch safely." We also seek comment on his proposal.

Interested parties may obtain a copy of the petition and subsequent submission by writing or calling the Office of the Secretary, U.S. Consumer Product Safety Commission, Room 820, 4330 East West Highway, Bethesda, MD 20814; telephone (301) 504–7923. Copies of these documents are also available for inspection from 8:30 a.m. to 5 p.m., Monday through Friday, in the Commission's Public Reading Room, Room 419, 4330 East West Highway, Bethesda, MD, or from the Commission's Web site at: *http://www.cpsc.gov.*

**Todd A. Stevenson,**

*Secretary, U.S. Consumer Product Safety Commission.*

[FR Doc. 2011–14020 Filed 6–7–11; 8:45 am]

BILLING CODE 6355–01–P

**DEPARTMENT OF THE INTERIOR**

**Bureau of Indian Affairs**

**25 CFR Chapter I**

## Tribal Consultation on No Child Left Behind School Facilities and Construction Negotiated Rulemaking Committee—Draft Report

**AGENCY:** Bureau of Indian Affairs, Interior.

**ACTION:** Notice of tribal consultation meetings.

**SUMMARY:** The Bureau of Indian Affairs is announcing that it will conduct five consultation meetings with Indian tribes to obtain oral and written comments concerning a draft report to provide Congress and the Secretary of the Interior comprehensive information about the conditions and funding needs for facilities at Bureau-funded schools, as required by the No Child Left Behind Act of 2001. See the **SUPPLEMENTARY INFORMATION** section of this notice for details.

**DATES:** The tribal consultation meetings will take place on Wednesday, June 15, 2011; Thursday, June 16, 2011; Thursday, June 30, 2011; Wednesday, July 13, 2011; and Tuesday, July 19, 2011.

**FOR FURTHER INFORMATION CONTACT:** The Designated Federal Officer Michele F. Singer, Director, Office of Regulatory Affairs and Collaborative Action, Office of the Assistant Secretary—Indian Affairs, 1001 Indian School Road, NW., Suite 312, Albuquerque, NM 87104; telephone (505) 563–3805; fax (505) 563–3811.

**SUPPLEMENTARY INFORMATION:**

### I. Background

Pursuant to the Congressional mandate set out in the No Child Left Behind Act of 2001, at 25 U.S.C. 2005(a)(5), the Secretary of the Interior established the No Child Left Behind School Facilities and Construction Negotiated Rulemaking Committee in accordance with the Federal Advisory Committee Act (5 U.S.C. Appx. 1–16) and the Negotiated Rulemaking Act (5 U.S.C. 561–570a). The Committee is chartered to prepare and submit to the Secretary a catalog of the conditions at Bureau-funded schools, and to prepare reports covering: the school replacement and new construction needs at Bureau-funded school facilities; a formula for the equitable distribution of funds to address those needs; a list of major and minor renovation needs at those facilities; and a formula for equitable distribution of funds to address those needs. The reports are to be submitted to Congress and to the Secretary. All Committee documents that are available to the public can be viewed at *http://www.bia.gov/WhoWeAre/AS-IA/ORM/Rulemaking/index.htm* in accordance with the Federal Advisory Committee Act.

The purpose of the consultation, as required by 25 U.S.C. 2011(b), is to provide Indian tribes, Indian school boards, Indian organizations, parents, student organizations, school employees, Bureau employees, and other interested parties with an opportunity to comment on the draft report prepared by the Committee.

### II. Report Details

The public may download and print a copy of the report, located at *http://www.bia.gov/WhoWeAre/AS-IA/Consultation/index.htm* or *http://www.bia.gov/WhoWeAre/AS-IA/ORM/Rulemaking/index.htm.*

### III. Meeting Details

The Bureau of Indian Affairs will hold tribal consultation meetings on the following schedule:

| Date | Time | Location |
|---|---|---|
| Wednesday, June 15, 2011 | 9 a.m.–4 p.m | Navajo Nation, Department of Diné Education, Education Center (Auditorium), Morgan Blvd.-Building 2556, Window Rock, AZ 86515. |
| Thursday, June 16, 2011 | 9 a.m.–4 p.m | Muckleshoot Tribal School, Cafeteria, 15209 SE 376th Street, Auburn, WA 98092. |
| Thursday, June 30, 2011 | 9 a.m.–4 p.m | Wild Horse Pass Hotel and Casino, Acacia C–D Room, 5040 Wild Horse Pass Blvd., Chandler, AZ 85226. |
| Wednesday, July 13, 2011 | 9 a.m.–4 p.m | Rushmore Plaza Civic Center, Alpine-Ponderosa Room, 444 N. Mt. Rushmore Road, Rapid City, SD 57701. |
| Tuesday, July 19, 2011 | 9 a.m.–4 p.m | Miccosukee Resort and Gaming, Ballroom C, 500 SW 177th Avenue, Miami, FL 33194. |

# TAB B

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

TO : Ronald A. Jordan
Project Manager, Petition CP 11-1
Division of Combustion and Fire Sciences
Directorate for Engineering Science

THROUGH: Kathleen Stralka, Associate Executive Director,
Directorate for Epidemiology
Stephen Hanway, Division Director
Division of Hazard Analysis

FROM : John Topping, M.S., Mathematical Statistician,
Division of Hazard Analysis

SUBJECT : Injuries Pertaining to Glass Fronts of Gas Fireplaces and Contact Burns with Hot Glass – Petition CP 11-1

This memorandum presents incident data in response to Petition CP 11-1. The petitioner asks the Commission to engage in rulemaking to mitigate the hazard of burns from contact with hot glass in the front of vented gas fireplaces. The petitioner considers the current voluntary standard inadequate and urges the Commission to develop its own requirements for protective devices, such as barriers, to reduce or eliminate the likelihood of direct glass contact by persons (particularly young children) near the fireplace. After receipt of this petition, an additional submission requested that the Commission mandate a warning light to indicate the presence of a burn injury hazard whenever the glass is detected to be hot, regardless of whether the fireplace is turned on or off.

BACKGROUND:

Carol Pollack-Nelson, Ph.D. is the petitioner asking the Commission to make rules requiring some sort of barrier or safeguard to restrict or reduce opportunities for direct skin contact with glass whenever it may be hot. The petitioner is concerned primarily with the hazard to young children and states that CPSC's National Electronic Injury Surveillance System (NEISS) estimates that during the period between 1999 and March 2009, more than 2,000 children ages 0–5 years old suffered burn injuries on gas fireplaces. The petitioner not only asserts that the victims contacted the fireplace (with hands being the most frequently injured body part), but she also claims that most of the NEISS cases specifically mentioned glass. The petitioner notes that the hands were the body part most frequently injured, and she also notes that there were additional cases of burn injury to the arm, finger, lower trunk, and face.

Following receipt of this petition, the Commission received a submission from William Lerner, suggesting that a warning light be mandatory. The warning light, as suggested by Mr. Lerner, would remain active so long as the glass is dangerously hot. This light is intended to communicate the presence of danger to the observer, and in that way, reduce the risk of burns from contact with hot glass. Lerner's submission does not make statistical assertions regarding injuries, nor does it limit the focus to any particular age group, such as children. The requests made in this submission from William Lerner are being evaluated concurrently with the requests made in the petition received from Carol Pollack-Nelson.

DISCUSSION:

CPSC staff is able to validate only some of the assertions made by the petitioner. Staff can confirm that when the scope is not limited to cases of glass contact, CPSC's NEISS gives a point estimate of slightly more than 2,000 emergency room-treated injuries to children age 5 or younger burned on gas fireplaces (assumed to include both vented and unvented) for all gas fireplace burns (regardless of glass contact) for the January 1999 to March 2009 period. Note that this is an estimate of injuries spanning the entire 10¼ year period and is not an annual average. Staff finds that less than half of the cases in the sample for this estimate specifically mention glass in the NEISS comments.[12] Staff understands the scope of the petition to be focused specifically on cases of contact with hot glass on gas fireplaces, rather than on all contact burn cases involving gas fireplaces, in general.

Of the cases treated from January 1, 1999 to March 31, 2009, that were reported through NEISS to CPSC, staff found 37 cases involving children ages 0 to 5 years old that could be determined to involve burns from contact with hot glass on the outside of gas fireplaces. Although details are limited in some reports, staff selected these 37 cases because there was a clear indication of contact with glass and that the fireplace was a gas-burning type of fireplace. [Cases with insufficient information on record, such as those in which the type of fireplace was unspecified (could not be ruled out as wood, electric) and/or for which it was not indicated what components and/or materials were contacted (*i.e.*, glass, metal), are not included in these 37 cases.] There were also several cases excluded—despite mentioning glass—due to other

[12] Under the product code for "Gas burning fireplaces, factory built," there are 79 records in NEISS that indicate thermal burns for children 5 and younger treated 1/1/1999–3/31/2009. These cases all involve burns but do not necessarily involve contact with hot glass. Staff found only 32 of these cases to clearly indicate glass contact (in one case the word "glass" was not mentioned but rather, window). Six other cases mentioned the word "glass" but had other ambiguities on the basis of which these were set aside as being of questionable relevance to the scope of this petition. From further analysis of records in other fireplace-related product codes, CPSC staff found four additional records indicative of gas burning fireplaces (only two clearly involving hot glass contact). This increased the size of the thermal burns set to 83 (out of which staff only considered 34 to involve clearly hot glass contact). Additionally, assessment of surveys conducted as a byproduct of a July 2002 to December 2004 NEISS Fire Injury Study added another three cases involving thermal burns with gas fireplaces (all three indicate glass contact). Combining information from these sources, staff's assessment is that only 37 cases can be determined to clearly indicate glass contact out of the expanded set of 86 thermal burns on gas fireplaces for children 0 to 5 years old treated in NEISS emergency departments from January 1, 1999 to March 31, 2009.

ambiguities; most of these described screens or covers and are addressed in detail later within this memorandum.

Staff finds that the set of data meeting these criteria (the 37 cases with clear indication of gas fireplace and burn from glass contact) is too small to report national estimates.[13] While staff may have been conservative in its selection of relevant cases, staff did consider records from not only the product code for gas burning fireplace, but also screened records from among all other fireplace product codes and from a NEISS fire injury study. The search within the other product codes for information indicative of gas burning models revealed two of the relevant cases. Further, staff identified another three of the cases on the basis of information collected via telephone as a byproduct of a NEISS fire injury follow-up survey that was conducted during the years 2002 to 2004. Regardless of whether the more inclusive or the less inclusive set of gas fireplace thermal burn injuries are used, staff finds an explicit indication of glass in fewer than half the cases; therefore, staff is unable to validate the petitioner's assertion that most of the gas fireplace thermal burn cases mention or involve hot glass.

Of the 37 cases identified by staff, 4 were subject to in-depth investigation via telephone interviews as part of the NEISS Fire Injury Study conducted from July 1, 2002 to December 31, 2004. Three of those four investigated cases did not indicate gas burning fireplaces in the initial NEISS record and only were determined relevant to this assessment on the basis of the information collected during phone interviews conducted as a byproduct of this study. Two of these NEISS reports mentioned glass contact, but they indicated a fireplace of unspecified type. One of the NEISS reports made no mention of glass and also indicated the fireplace to be of an unspecified type. Thirty-four of the 37 cases reported a gas burning fireplace and glass contact related to burns in the original NEISS record, and 3 were added on the basis of supplemental information collected from the fire study. The majority of fireplace injury cases reported through NEISS do not result in follow-up interviews. While these three cases seem to suggest that some proportion of the other NEISS cases with limited information also may have involved contact with glass on the exteriors of gas fireplaces, the data is insufficient to estimate reliably such proportions and/or report an adjusted estimate.

Staff examined dates to correspond with statistics cited in Carol Pollack-Nelson's petition (ages 0–5, treatment dates from January 1, 1999 to March 31, 2009). While expansion to include all ages and/or cases treated through December 31, 2010, adds several additional cases, the sample size remains too small for staff to project national estimates based on the available data. Note that for victims older than 5 in the January 1999 to March 2009 timeframe, staff finds an additional 4 NEISS cases specifically reporting burns from accidental contact with hot glass on the outside of gas fireplaces (ages 7, 10, 14, and 25, respectively).

[13] Attempts at expansion of the sample size of hot glass contact with gas fireplaces, still fail to project an estimate that would be considered reliable. All possible variations or combinations of the following failed to produce a reliable estimate:

- including all the cases mentioning the word "glass" that CPSC staff considered to be of questionable relevance;
- expanding the date range through the end of calendar year 2009 or through 2010; and
- removing the age restriction to include hot glass burns suffered by victims of all ages including adults.

Table 1 shows that three of the cases determined relevant within the years 2003 and 2004 were detected only on the basis of information collected as a byproduct of the NEISS Fire Injury Study. Table 1 also shows that for children 5 and under, the 3 years with the highest number of cases specifying gas fireplaces with burns on hot glass are 2005 (6 cases), 2006 (10 cases), and 2008 (5 cases). Table 2a and 2b show that most of the children were under the age of 3 (84%) and that the majority of the children are male (62%).

**Table 1. Number of Cases of Hot Glass Contact Burns on Gas Fireplaces Treated in NEISS Emergency Departments 1999–March 2009 By Year and Basis for Determination for Children Ages 5 and Younger**

| | 1999 | 2000 | 2001 | 2002 | 2003 | 2004 | 2005 | 2006 | 2007 | 2008 | First 3 Months of 2009 | Total |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Determined Relevant from NEISS Record | 1 | 2 | 1 | 1 | 1 | 1 | 6 | 10 | 3 | 5 | 3 | 34 |
| Determined Relevant Only from Fire Study Data | | | | | 2 | 1 | | | | | | 3 |
| Total | 1 | 2 | 1 | 1 | 3 | 2 | 6 | 10 | 3 | 5 | 3 | 37 |

**Table 2a. Number of Cases of Hot Glass Contact Burns on Gas Fireplaces Treated in NEISS Emergency Departments By Age and Gender for Children Ages 5 and Younger**

| | 8 months | 9 months | 10 months | 11 months | 12 months | 13 months | 14 months | 15 months | 16 months | 17 months | 18 months | 19 months | 20 months | 21 months | 22 months | 23 months | 2 Years | 3 Years | 4 Years | 5 Years | All Ages Under 6 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Male | 1 | 4 | 2 | 3 | 1 | 1 | | | 1 | | 1 | | | | 1 | 1 | 3 | 1 | 2 | 1 | 23 |
| Female | 1 | | 4 | 1 | | | | 1 | 1 | | | | 1 | | 1 | | 2 | 1 | | 1 | 14 |
| Total | 2 | 4 | 6 | 4 | 1 | 1 | 0 | 1 | 2 | 0 | 1 | 0 | 1 | 0 | 2 | 1 | 5 | 2 | 2 | 2 | 37 |

**Table 2b. Number of Cases of Hot Glass Contact Burns on Gas Fireplaces Treated in NEISS Emergency Departments By Age and Gender for Children Ages 5 and Younger**

| Gender | Younger than 3 | Ages 3-5 | Total For All Ages 5 and Under |
|---|---|---|---|
| Male | 19 | 4 | 23 (62%) |
| Female | 12 | 2 | 14 (38%) |

| Total | 31 (84%) | 6 (16%) | 37 |
|---|---|---|---|

Table 3 shows that hands were the body part injured most frequently (86%) and that the remaining injuries were to the fingers and lower trunk. Table 4 shows that more than half of the 37 cases involved second-degree burns, and at least 2 involved third- degree or worse burns (for 14 out of the 37 cases the severity of the burn was not specified).

**Table 3. Number of Cases of Hot Glass Contact Burns on Gas Fireplaces Treated in NEISS Emergency Departments By Body Part for Children Ages 5 and Younger**

| Most Affected Body Part | Cases in Sample |
|---|---|
| Hand | 32 (86%) |
| Finger | 1 (3%) |
| Trunk, lower | 4 (11%) |
| Total | 37 |

**Table 4. Number of Cases of Hot Glass Contact Burns on Gas Fireplaces Treated in NEISS Emergency Departments By Severity of Burn (or Worst Burn in the Case of Multiple Burns)**

| Severity of Burn | Cases in Sample |
|---|---|
| First Degree | 2 |
| Second Degree | 19 |
| Third Degree | 2 |
| Degree Not Specified | 14 |
| Total | 37 |

CONCLUSION:

CPSC staff finds that the majority of cases reported through NEISS associated with gas fireplaces and burns from contact with hot glass involve young children. CPSC staff can confirm that the point estimate for all gas fireplace burns is more than 2,000 for the 10¼ year period, but staff finds that the data is not sufficient to project a national estimate specific to hot glass contact burns on gas fireplaces. Even if staff extends beyond the 37 cases of clear hot glass contact to include the set of glass mentions of questionable relevance and/or the set of victims of ages greater than 5 and/or the set of victims treated more recently (*i.e.* from April 2009 to December

2010), none of the resulting combined data sets would allow us to generate a reliable national estimate. Staff finds that the only way to come up with a large enough sample size to support a national estimate from 1999 through some recent year, would be to make inferences about the proportion of cases of hot glass contact and gas burning among the cases for which at least one of those factors is not specified. Staff does not find the available data sufficient to support such inferences reliably. Staff believes that, given the limitations of the available data, analysis and characterization of the hazard specific to glass contact by young children is focused best on assessment of just the 37 cases identified by staff from among NEISS cases treated January 1999 to March 2009.

APPENDIX:

**Table A1. Product Codes Screened* for this Assessment (prod1 or prod2)**

| Product Code | Title |
|---|---|
| 0316 | Wood-burning fireplaces, factory built |
| **0334** | **Gas-burning fireplaces, factory built** |
| 0336 | Built-in fireplaces |
| 0342 | Fireplaces, not specified |
| 0346 | Electric fireplaces, factory built |
| 0663 | Fireplace equipment |

*To ensure thoroughness, records listing any of the above product codes in either the prod1 or prod2 fields were screened for this assessment; however the product code of greatest relevance is 0334 "Gas-burning fireplaces, factory built."

**Table A2. Body Part Codes Observed* (bdpt)**

| bdpt | Description |
|---|---|
| 82 | Hand |
| 92 | Finger |
| 79 | Trunk, lower |
| 80 | Arm, upper |
| 33 | Arm, lower (not including elbow or wrist) |
| 83 | Foot |
| 76 | Face (including eyelid, eye area, and nose) |

*Of the 37 cases staff established as contact with hot glass on gas fireplaces, only the first three body part codes were observed.

**Table A3. Dispositions Codes Observed (disp)**

| bdpt | Description |
|---|---|
| 1 | Treated and released, or examined and released without treatment. |
| 2 | Treated and transferred to another hospital |
| 4 | Treated and admitted for hospitalization (within the same facility) |
| 6 | Left without being seen/Left against medical advice |

**Table A4. Definitions of headers used in the tables that follow**

| | |
|---|---|
| **nek** | This is a unique identifier for each record in NEISS |
| **dt_trmt** | Date of treatment of injury in the NEISS emergency department.<br>The tables below are presented in month/date/year format. |

| | |
|---|---|
| **prod1** | Indicates Product Code in NEISS associated with incident |
| **prod2** | Also indicates Product code in NEISS associated with the incident in the event that two products are involved |
| **age** | Indicates age of victim. Children ages 2 or older are recorded as the number of years. Children under the age of 2 are recorded in the number of months, plus 200. So for example "208" refers to an 8-month-old, and "223" refers to a 23-month-old. |
| **sex** | Indicates the gender of the injured person or child.<br>M for male and F for female. |
| **narrative** | These comments are the only textual description of the incident or injury as recorded in NEISS. |
| **bdpt** | This refers to the body part most severely injured. For example "82" indicates the hands were injured (or most injured) body part. |
| **disp** | This refers to the disposition of the victim, for example, "1" indicates the victim was treated and released, and "4" indicates hospitalization. |

## Table A5. NEISS Records Specifying Gas Fireplaces with Glass Contact Burns for Children 5 or Younger

## Treatment Dates: 1/1/1999–3/31/2009

**(34 Cases – Includes two cases that were listed under product code "Fireplaces, not specified" but the Comments indicate gas.)**

| | nek | dt_trmt | prod1 | prod2 | age | sex | verbatim narrative | bdpt | disp |
|---|---|---|---|---|---|---|---|---|---|
| 1 | 991212927 | 12/3/1999 | 334 | | 210 | M | PT PUT HANDS ON HOT GAS FIREPLACE **GLASS** D:THERMAL BURNS | 82 | 1 |
| 2 | 627750 | 6/11/2000 | 334 | | 216 | M | PT. TOUCHED CLASS DOOR OF GAS FIREPLACE. DX: PALM BURN | 82 | 1 |
| 3 | 1025374 | 10/8/2000 | 334 | | 2 | M | PT FELL AGAINST **GLASS** DOORS OF GAS FIREPLACE DX: 1ST DEGREE BURN TO BUTTACK | 79 | 1 |
| 4 | 11007261 | 9/25/2001 | 334 | | 210 | F | PT PUT HANDS ON HOT GAS FIREPLACE **GLASS**. DX: SECOND DEG BURNS BOTH PALMS. | 82 | 1 |
| 5 | 20345217 | 3/11/2002 | 334 | | 4 | M | PT BURNED BUTTOCKS ON **GLASS** OF GAS FIREPLACE **GLASS**. DX: BURN SECOND DEG L | 79 | 1 |

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | BUTTOCKS 1% TBSA. | | |
| 6 | 30451796 | 4/24/2003 | 334 | | 210 | F | DX LEFT PALM BURN: TOUCHED **GLASS** OF GAS FIREPLACE AT HOME. | 82 | 1 |
| 7 | 40959583 | 9/22/2004 | 334 | | 3 | M | PT. BURNED HAND ON GAS FIREPLACE **GLASS** DX: 2ND DEGREE PALMAR BURN | 82 | 1 |
| 8 | 50138119 | 1/15/2005 | 334 | | 211 | F | PT PUT HANDS ON GAS FIRPLACE **GLASS**. DX: R HAND COMPLETE PALMAR BURN 3RD DEG, L HAND MEDIAL PALMAR BURN 2ND/3RD DEG. | 82 | 2 |
| 9 | 50518429 | 4/8/2005 | 334 | | 209 | M | PT PUT HAND ON GAS FIREPLACE **GLASS**. DX: L PALM BURN. | 82 | 4 |
| 10 | 50444835 | 4/22/2005 | **342** | | 5 | M | PT'S FATHER STATES CHILD BACKED UP AGAINST HOT **GLASS** DOOR OF A GAS FIREPLACE AND BURNT BUTTOCK NO FIRE DEPT PRESENT | 79 | 1 |
| 11 | 51014051 | 9/5/2005 | 334 | | 210 | F | PT BURNED HAND ON GAS FIREPLACE **GLASS**. DX: PARTIAL THICKNESS BURNS L PALM & FOREHEAD. | 82 | 1 |
| 12 | 51104535 | 10/15/2005 | 334 | | 2 | F | PT PUT HAND ON **GLASS** FRONT OF GAS FIREPLACE. DX: L HAND BURN. | 82 | 1 |
| 13 | 51247301 | 12/12/2005 | 334 | | 210 | M | DX BURNS TO RIGHT HAND: TOUCHED GAS FIREPLACE **GLASS** AT HOME NO FIRE DEPT INVOLVEMENT. | 82 | 1 |
| 14 | 60308591 | 2/27/2006 | 334 | | 211 | M | AT BABYSITTER'S HOUSE TOUCHED **GLASS** ON GAS FIRE PLACE AND BURNED HAND DX: 2ND DEGREE THERMAL BURN TO R HAND; FIRE NOT INVOLVED | 82 | 1 |
| 15 | 60335287 | 3/16/2006 | 334 | | 2 | M | PATIENT TOUCHED HAND TO **GLASS** PLATE OF GAS FIREPLACE AT HOME LAST NIGHT ; PALMAR SURFACE WITH FINGER BURNS | 82 | 1 |
| 16 | 60417373 | 3/18/2006 | 334 | | 218 | M | PT PUT HANDS ON GAS FIREPLACE **GLASS**. DX: PARTIAL THICKNESS BURNS 2.5% TBSA BILAT | 82 | 4 |

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | PALMS & FOREHEAD. | | |
| 17 | 60416734 | 3/29/2006 | 334 | 4050 | 5 | F | DX BOTH HANDS BURNED: TRIPPED OVER PILLOW AND LANDED WITH BOTH HANDS ON **GLASS** COVER TO GAS FIREPLACE. | 82 | 1 |
| 18 | 60546234 | 4/29/2006 | 334 | | 209 | M | PT PUT HAND ON **GLASS** OF PROPANE FIREPLACE. DX: L HAND FULL THICKNESS BURN. | 82 | 2 |
| 19 | 61101687 | 10/28/2006 | 334 | | 215 | F | PT WAS PLAYING NEAR GAS FIREPLACE THAT HAD **GLASS** DOOR ON IT, AT HOME, FELL & PUT LT HAND ON HOT DOOR.NO FIRE DEPT. DX: BURNS TO RT HAND | 82 | 1 |
| 20 | 61121208 | 10/30/2006 | 334 | | 210 | F | DX PARTIAL THICKNESS BURNS TO BOTH HANDS: PLACED HANDS ON **GLASS** DOOR OF GAS FIREPLACE AT HOME. NO MENTION OF FIRE DEPT | 82 | 1 |
| 21 | 61205356 | 11/23/2006 | 334 | | 213 | M | PT BURNED LEFT HAND AFTER TOUCHING GAS FIREPLACE **GLASS** WINDOW. DX LEFT HAND BURN. | 82 | 1 |
| 22 | 70131370 | 12/24/2006 | 334 | | 211 | M | PT TOUCHED GAS FIREPLACE **GLASS**. DX: R PALM BURN FULL TO PARTIAL THICKNESS, OM. | 82 | 4 |
| 23 | 70113911 | 12/29/2006 | 334 | | 222 | F | PT TOUCHED THE **GLASS** ON A PROPANE FIREPLACE AT HER GRANDPARENTS HOME. NO FIRE DEPARTMENT. DX: 1ST AND 2ND DEGREE BURNS LEFT HAND, PALMAR | 82 | 1 |
| 24 | 70141404 | 1/20/2007 | 334 | | 4 | M | PT WAS @ HOME PT PLACED RIGHT HAND ON GAS FIREPLACE WINDOW NOW HAS3 SM ALL BLISTERS TO PALM OF HAND. DX 1ST AND 2ND DEGREE BURN. | 82 | 1 |
| 25 | 70450871 | 4/1/2007 | 334 | | 3 | F | PT FELL AGAINST GAS FIREPLACE **GLASS** WHILE DANCING. DX: FIRST/SECOND DEG BURN L HAND/WRIST. | 82 | 1 |

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| 26 | 71057116 | 10/3/2007 | 334 | | 211 | M | PT PLACED HANDS ON HOT GAS FIREPLACE **GLASS**. DX: 2.25% TBSA INTERMEDIATE THICKNESS BURNS BILAT HANDS. | 82 | 4 |
| 27 | 80213580 | 1/30/2008 | 334 | | 212 | M | PT FELL PLACING HAND ON GAS FIREPLACE **GLASS**. DX: 2ND DEG BURN ENTIRE L PALM. | 82 | 1 |
| 28 | 80317712 | 2/27/2008 | **342** | | 209 | M | PT PUT HAND ON GAS FIREPLACE **GLASS** DOOR. DX: SECOND DEG BURN L PALM. | 82 | 1 |
| 29 | 80347518 | 3/18/2008 | 334 | | 216 | F | PT WAS @ DAYCARE TOUCH **GLASS** FIREPLACE WITH PALMS NOW BURNS TO HANDS DX 1ST AND 2ND DEGREE BURNS TO HANDS. | 82 | 1 |
| 30 | 81202848 | 11/27/2008 | 334 | | 208 | F | DX 2ND DEGREE BURNS: W PLAY'G AROUND GAS FIREPLACE, W SHE PLACED HER L PALM ON THE **GLASS** FRONT RESULT'G IN IMMED PAIN & BLISTER'G, | 82 | 1 |
| 31 | 90149627 | 12/29/2008 | 334 | | 2 | F | PT PUT HAND AGAINST HOT **GLASS** ON GAS FIREPLACE. DX: L PALM BURN. | 82 | 4 |
| 32 | 90428149 | 3/17/2009 | 334 | | 2 | M | PT BACKED INTO A GAS FIREPLACE ENCLOSED BY **GLASS**. DX: SUPERFICIAL BURN L BUTTOCK. | 79 | 1 |
| 33 | 90352780 | 3/26/2009 | 334 | | 222 | M | DX PARTIAL THICKNESS BURNS (FINGERS) BIB PARENTS C/O BURN TO BACK OF L HAND THIS A.M. W WALK NEAR GAS FIREPLACE, PLACED HAND AGAINST **GLASS** | 92 | 1 |
| 34 | 90409801 | 3/28/2009 | 1807 | 334 | 208 | M | PT WAS CRAWLING ON THE FLOOR WHEN HE PUT HANDS ON A **GLASS** GAS FIREPLACE BLISTERS TO BOTH HANDS. DX PARTIAL THICKNESS BURNS TO PALMS. | 82 | 1 |

## Table A6. INDP Records Specifying Gas Fireplaces with Glass Contact Burns for Children 5 or Younger that Were Collected as Part of a Fire-Related Injury Study. Treatment Dates: 1/1/1999-3/31/2009

**(**The first 3 cases are additional to the set of 34 determined from NEISS records alone;
the last record in the list below refers to the an incident that was already counted on the basis of information from NEISS)

| tkno | nek | dt_acc | age | sex | verbatim narrative | bdpt | disp | notes |
|---|---|---|---|---|---|---|---|---|

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| 1 | 030324HEP5601 | 30336729 | 3/17/2003 | 223 | M | THE 23 MONTH OLD MALE VICTIM SUSTAINED BURNS TO HIS RIGHT HAND WHEN HE TOUCHED THE GLASS DOOR OFA FIRE PLACE AT A DAYCARE CENTER. HE WAS TAKEN TO THE HOSPITAL WHERE HE WAS TREATED AND RELEASED. THERE WAS NO CARBON MONOXIDE TESTING OR POISONING. | 82 | 1 | NEISS Record Indicated Glass, contact but not gas type fireplace NEISS product code was 342 - "Fireplaces, not specified" |
| 2 | 031118HEP8942 | 31131587 | 11/14/2003 | 220 | F | THE 20 MONTH OLD FEMALE VICTIM WAS DIAGNOSED WITH 2ND DEGREE BURNS TO BOTH HANDS WHEN SHE PUT HER HANDS ON THE GLASS DOOR OF A GAS FIREPLACE AND LEFT HAND PRINTS ON THE GLASS. THE FIREPLACE HAND BEEN OPERATIN FOR 5 OR 6 HOURS. SHE WAS TAKEN TO THE ED WHERE SHE WAS TREATED AND RELEASED. NO F.D. INVOLVED. | 82 | 1 | NEISS Record Indicated Glass, contact but not gas type fireplace NEISS product code was 342 - "Fireplaces, not specified |
| 3 | 040119HEP5601 | 40131292 | 12/25/2003 | 209 | M | THE 9 MONTHS OLD MALE VICTIM SUSTIANED A 2ND DEGREE BURN TO HIS RIGHT PALM WHEN HE PRESSED HIS HAND AGAINST THE HOT GLASS PANEL ON A GAS LOG FIREPLACE AT HIS GARANDFATHER'S HOUSE. HE WAS DRIVEN TO THE HOSPITAL WHERE HE WAS TREATED AND RELEASED. NO UNINTENDED SPREAD OF FLAMES OR FIRE WAS INVOLVED IN THE INCIDENT. | 82 | 1 | NEISS Record gave no indication of glass and NEISS product code was 342 - Fireplaces, not specified and "DX Right Palm Burn: Touched Fireplace at home," |
| 4 | 051228HEP5601 | 51247301 | 12/12/2005 | 210 | M | THE 10 MONTH OLD MALE VICTIM SUSTAINED 2ND DEGREE BURNS TO HIS RIGHT HAND WHEN HE TOUCHED THE HOT GLASS AROUND A GAS FIREPLACE. THE VICTIM WAS TAKEN TO THE HOSPITAL WHERE HE WAS TREATED AND RELEASED. FIRE DEPT. DID NOT ATTEND. | 82 | 1 | Already included based on NEISS record that indicated glass contact and product code 334 - "Gas-burning fireplaces, factory built" |

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | | | | | THERE WAS NO FIRE. | | | |

**Observe that this last record in the list above below refers to an incident that was already counted on the basis of information initially provided in NEISS; and therefore, this extra information does not add to the incident count.**

## Table A7. NEISS Records that Were Excluded from Focus of Assessment Due to Ambiguities, Despite Mentioning Glass, Gas Fireplaces, and Contact Burns for Children 0–5

## Treatment Dates: 1/1/1999–3/31/2009

**(7 Cases)**

| | Nek | dt_trmt | prod1 | prod2 | Age | sex | verbatim narrative | bdpt | disp | Reason for Exclusion |
|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 90241794 | 2/14/2009 | 334 | | 211 | M | PT PUT HANDS ON **GLASS** COVER FOR GAS FIREPLACE. DX: PARTIAL THICKNESS BURNS BILAT PALMS. | 82 | 1 | Glass Cover |
| 2 | 81121510 | 11/4/2008 | **663** | | 3 | F | DX LWOBS: BURN TO L TRICEP X 1.5HRS F GAS FIREPLACE GLASS COVER'G. NOTED BROKEN BLISTER TO CENTER OF 1 DEGREE BURN. NON-CIRCRUMFRENCIAL | 80 | 6 | Glass Cover |
| 3 | 30209202 | 12/26/2002 | 334 | | 213 | M | PATIENT PUT HANDS ON **GLASS** SCREEN TO GAS FIREPLACE AT HOME; 2ND DEGREE HAND BURNS | 82 | 1 | Glass Screen |
| 4 | 80307671 | 2/27/2008 | 663 | 334 | 2 | F | PATIENT TOUCHED HAND ON **GLASS** FIREPLACE SCREEN IN FRONT OF GAS FIREPLAC E, LARGE BLISTERS ON PALM; 2ND DEGREE BURN TO HAND, 1-5 FINGERS, | 82 | 4 | Glass Screen |
| 5 | 90152946 | 1/24/2009 | 334 | 4050 | 207 | F | DX 2ND DEGREE BURNS-R HAND: MOP REPORTS CHILD CRAWLED OVER PILLOWS IN FRONT OF **GLASS**ED FACED GAS FIREPLACE TOUCH SCREEN W R HAND | 82 | 1 | Glass Screen |
| 6 | 41243434 | 11/11/2004 | 334 | 663 | 207 | M | CRAWLED UP AND PUT HANDS ON **GLASS** ENCLOSURE TO GAS IGNITED FIREPLACE OR ELECTRIC FIREPLAC AT HOME, BURNS TO PALMS OF HANDS, BLISTERS; 2ND DG BU | 82 | 4 | Lack of clarity as to whether fireplace is gas burning or electric |

| | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| 7 | 50229103 | 2/12/2005 | 334 | | 210 | M | BURN HAND - CHILD BURNED RIGHT HAND ON HOT **GLASS** FRONT OF STOVE - BURN TO RIGHT HAND PALM GAS FIREPLACE - 2ND DEGREE BURN AT HOME | 82 | 1 | Stove, unclear whether this product is of the type being addressed in petition |

## Table A8. NEISS Records Specifying Gas Fireplaces with Glass Contact Burns for Persons Older than 5 Years Old

## Treatment Dates: 1/1/1999–3/31/2009

**(4 Cases)**

| | nek | dt_trmt | prod1 | prod2 | age | sex | verbatim narrative | bdpt | disp |
|---|---|---|---|---|---|---|---|---|---|
| 1 | 90141522 | 1/4/2009 | **334** | | 7 | M | PT WAS PLAYING AND FELL AGAINST GLASS ON GAS FIREPLACE. DX: R FOREARM/HAND BURN FIRST/SECOND DEG. | 33 | 1 |
| 2 | 80203128 | 1/19/2008 | **334** | | 14 | M | PT WAS SPENDING NIGHT AT FRIENDS HOUSE SLEEPING ON FLOOR AND ACCIDENTLY TOUCHED HEELS OF FOOT ON GLASS OF PROPANE FIREPLACE, NO FIRE DX;BURN | 83 | 1 |
| 3 | 90352722 | 3/24/2009 | **334** | | 25 | F | DX 2ND DEG BURNS: W SIT'G IN FRONT OF FIREPLACE & W STARTLED & FELL BACKWARDS HIT'G LOWER BACK ON GLASS OF GAS FIREPLACE. NO FD | 79 | 1 |
| 4 | 91207863 | 11/18/2009 | **334** | | 10 | M | PT PUT FOOT ON HOT GLASS FROM GAS FIREPLACE. DX: L FOOT BURN. | 83 | 1 |

## Table A9. NEISS Records Specifying Gas Fireplaces and Burn Injuries, but No Indication of Glass - for Children 5 or Younger

## Treatment Dates: 1/1/1999–3/31/2009

**(42 Cases)**

| | nek | dt_trmt | prod1 | prod2 | age | sex | verbatim narrative | bdpt | disp |
|---|---|---|---|---|---|---|---|---|---|
| 1 | 990109137 | 1/7/1999 | 334 | | 3 | M | 3 YOM PRESSED HAND DOWN ON GAS FIREPLACE. DX- 2ND DEGREE BURN R HAND. MANDOTA FIREPLACE | 82 | 1 |
| 2 | 991023079 | 10/17/1999 | 334 | | 215 | M | DX 2ND DEGREE BURN TO RIGHT HAND: BURNED HAND ON GAS | 82 | 1 |

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | FIREPLACE AT HOME. | | |
| 3 | 991127430 | 11/11/1999 | 334 | | 218 | M | PT PUT HAND ON GAS FIREPLACE. DX: FIRST DEG BURN R PALM. | 82 | 1 |
| 4 | 991210543 | 12/1/1999 | 334 | | 212 | M | PT. BURNED ARM ON GAS FIREPLACE. DX: FOREARM BURN UNKNOWN IF FD ATTENDED | 33 | 4 |
| 5 | 11127756 | 11/4/2001 | 334 | | 219 | F | PT PUT HAND ON FRONT OF GAS FIREPLACE. DX: SECOND DEG BURN L HAND. | 82 | 1 |
| 6 | 11127834 | 11/11/2001 | 334 | | 210 | M | PT BURNED HAND ON GAS FIREPLACE. DX: FIRST AND SECOND DEG BURN R HAND. | 82 | 1 |
| 7 | 20136207 | 1/10/2002 | 334 | | 211 | F | 11-MONTH OLD FEMALE SUSTAINED A BURN OF HER FINGER AS A RESULT OF TOUCHING A GAS FIREPLACE. | 92 | 1 |
| 8 | 20228608 | 2/7/2002 | 334 | | 211 | M | DX RIGHT HAND BURN: TOUCHED HOT GAS FIREPLACE AT HOME. | 82 | 1 |
| 9 | 20304831 | 3/2/2002 | 334 | | 214 | M | BURN HAND - CHILD TOUCHED GAS FIREPLACE INJURING RIGHT HAND, SMALL ABRA SION TO BACK OF HAND NOTICED ALSO | 82 | 1 |
| 10 | 20332036 | 3/10/2002 | 334 | | 213 | F | PT FELL ON GAS FIREPLACE. DX: FIRST AND SECOND DEG BURNS R HAND. | 82 | 1 |
| 11 | 21110837 | 11/2/2002 | 334 | | 211 | M | BURNED HAND ON GAS FIREPLACE. DX SUPERFICIAL 2ND DEGREE BURN LEFT HAND. | 82 | 1 |
| 12 | 21224437 | 12/2/2002 | 334 | | 208 | M | PT CRAWLED UP TO GAS FIREPLACE. DX: FIRST/SECOND DEG BURNS NOSE/L HAND. | 76 | 1 |
| 13 | 21237778 | 12/20/2002 | 334 | 1930 | 3 | M | MOM THINKS HE MAY HAVE TOUCHED A GAS FIREPLACE IN THEIR HOUSE WITH HIS LEFT HAND AT 0930, HAD 1 TSP MOTRIN. DX 2ND DEGREE BURNS PALM LT HAND. | 82 | 1 |
| 14 | 30223610 | 2/13/2003 | 334 | | 2 | M | PT.INJ.RT.HAND AT HOME WHEN TOUCHED HOT GAS FIREPLACE. DX; RT.HAND 2DEG .BURN. | 82 | 1 |

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| 15 | 30404048 | 3/30/2003 | 334 | | 212 | M | BURN FINGERS - 12 MOM BURNED HIS LEFT INDEX AND MIDDLE FINGERS WHEN HE TOUCHED METAL OF GAS FIREPLACE, BLISTERING NOTED AND ALSO RING FINGER | 92 | 1 |
| 16 | 40841947 | 8/16/2004 | 334 | | 209 | F | PT. BURNED BOTH HANDS AFTER TOUCHING A GAS FIREPLACE TODAYDX: BILATERAL PALMAR BURNS | 82 | 1 |
| 17 | 50132749 | 12/29/2004 | 334 | | 207 | M | PT TOUCHED GAS FIREPLACE. DX: R HAND/NOSE/FINGERS BURN PARTIAL/FULL THICKNESS. | 82 | 1 |
| 18 | 50141780 | 1/24/2005 | 334 | | 217 | M | 1 YOM BURNED R HAND ON GAS FIREPLACE AT HOME. FIRE DEPARTMENT DID NOT ATTEND. | 82 | 1 |
| 19 | 50301552 | 2/15/2005 | 334 | | 2 | F | PT BACKED UP INTO GAS FIREPLACE. DX: FIRST/SECOND DEG SUPERFICIAL BURNS BUTTOCKS/BACK. | 79 | 1 |
| 20 | 50436999 | 4/19/2005 | 334 | | 2 | F | FOREARM BURN-FELL INTO GAS FIREPLACE- @ HOME | 33 | 1 |
| 21 | 50832389 | 7/22/2005 | 334 | | 3 | M | PT FELL ONTO GAS FIREPLACE. DX: BILAT BUTTOCK BURN SECOND DEG. | 79 | 1 |
| 22 | 51038454 | 9/24/2005 | 334 | | 211 | M | PT TOUCHED PROPANE FIREPLACE. DX: PARTIAL THICKNESS BURNS BILAT PALMS. | 82 | 4 |
| 23 | 60312533 | 3/4/2006 | 334 | | 219 | M | TRIPPED AND FELL AGAINST GAS BURNING FIREPLACE DX: BURN TO HAND | 82 | 1 |
| 24 | 61238950 | 12/19/2006 | 334 | | 210 | F | BURN FACE - 10 MOF FOUND PLAYING NEAR GAS FIREPLACE HAVING SUSTAINED 2N D DEGREE BURNS TO LEFT CHEEK, NOSE, RIGHT HAND, NO FIRE DEPT | 76 | 1 |
| 25 | 70215838 | 1/28/2007 | 334 | | 214 | F | PT TOUCHED GAS FIREPLACE. DX: PARTIAL THICKNESS BURN R HAND. | 82 | 1 |
| 26 | 70212103 | 2/5/2007 | 334 | | 223 | F | 23 MOF TOUCHED OUTSIDE OF GAS FIREPLACE THAT WAS HOT SUSTAINING BURNS T O BOTH HANDS | 82 | 1 |

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| 27 | 71106851 | 11/1/2007 | 334 | | 2 | M | PT BURNED HAND ON GAS FIREPLACE LAST NIGHT DX// RIGHT HAND BURN | 82 | 1 |
| 28 | 71137783 | 11/19/2007 | 334 | | 217 | M | BURNED FINGERS ON GAS FIREPLACE/ THERMAL BURNS RIF, RMF | 92 | 1 |
| 29 | 80250544 | 2/17/2008 | 334 | | 223 | M | PT BURNED HAND ON GAS FIREPLACE. DX: R HAND SECOND DEG BURN. | 82 | 1 |
| 30 | 81240221 | 12/18/2008 | 334 | | 2 | F | 2 YO F 1ST AND 2ND DEGREE BURNS TO HAND AFTER TOUCHING GAS FIREPLACE AT FRIENDS HOUSE* | 82 | 1 |
| 31 | 90147396 | 1/24/2009 | 334 | | 213 | F | HAND BURNS- TOUCHED HOT GAS FIREPLACE-@ HOME | 82 | 5 |
| 32 | 90322487 | 2/8/2009 | 334 | | 2 | M | PT TOUCHED GAS FIRPLACE INSERT. DX: L HAND BURN 4% TBSA. | 82 | 4 |
| 33 | 90250172 | 2/20/2009 | 334 | | 3 | F | PT TOUCHED GAS FIREPLACE. DX: L HAND BURN 2ND DEG. | 82 | 1 |
| 35 | 10439823 | 4/18/2001 | 334 | | 216 | F | 16 M/O FEMALE WAS AT A MOTEL WHEN SHE TOUCHED THE OUTSIDE OF A MET AL GAS FIREPLACE BURNING HER LT HAND. | 82 | 1 |
| 36 | 30132916 | 1/9/2003 | 334 | | 5 | F | DX: PARTIAL THICKNESS BURN L FOREARM. TRIPPED AN FELL AGAINST HOT SCREEN ON GAS BURNING FIREPLACE. | 33 | 1 |
| 37 | 40323841 | 3/12/2004 | 663 | 334 | 212 | M | 12-MONTH-OLD M CRAWLED UP TO GAS FIREPLACE AND TOUCHED THE FIREPLACE SC REEN WITH BOTH HANDS NO FIRE INVOLVED. | 82 | 4 |
| 38 | 50143581 | 1/19/2005 | 334 | | 5 | M | TRIPPED & TOUCHED METAL SURROUNDING GAS FIREPLACE. DX: BURN 2 OR MORE DIGITS 2ND DEGREE. | 92 | 1 |
| 39 | 51122875 | 11/10/2005 | 334 | | 221 | F | BURN HANDS - 21 MOF TRIPPED AND FELL LANDING WITH BOTH HANDS ON HOT GRI LL OF GAS FIREPLACE, BURNS TO PALMS | 82 | 1 |
| 40 | 80221878 | 12/22/2007 | 334 | 663 | 208 | M | DAD WATCHING PT IN LIVING ROOM WITH GAS FIREPLACE ON, HAS MESH SCREEN, PT CRUISING FELL INTO MESH BURNING FACE/HANDS;2ND | 76 | 1 |

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | BURNS FACE/HANDS | | |
| 41 | 81047833 | 10/7/2008 | 334 | | 209 | M | BURN TO RT HAND AFTER TOUCHING THE TILE AROUND GAS FIREPLACE- NO FD ATTENDANCE. DX; 1ST DEGREE BURNS TO FINGERTIPS & FOREARM | 92 | 4 |
| 42 | 50223149 | 2/7/2005 | **663** | | 4 | M | PT BURNED R HAND LAST NIGHT WHEN TOUCHED A **GAS** FIREPLACE SCREEN. 2ND DEGREE BURN. | 82 | 1 |

# TAB C

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

**Memorandum**

Date: December 16, 2011

TO : Ronald A. Jordan, Project Manager
Petition CP11-1 Safeguards for Glass Fronts of Vented Gas Fireplaces

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 : Samantha Li, Economist
Directorate for Economic Analysis

SUBJECT : Petition to Require Safeguards on Vented Gas Fireplaces: Market Information and Economic Considerations

## Background

The Commission received and docketed a petition (Petition CP 11-1), requesting that it initiate rulemaking to require safeguards for glass fronts of vented gas fireplaces. The petitioner asserts that: (1) warning labels are inappropriate as a means of addressing this hazard; and (2) consumers are unaware that the temperature of the exterior glass of a fireplace can become hot enough to cause instantaneous burns. The petitioner urges the Commission to adopt a mandatory standard for gas fireplaces that requires an integral protective barrier, guard, or other device for any accessible surface (*i.e.*, glass fronts). A subsequent submission requests that the CPSC initiate rulemaking to require a warning system that would alert consumers when the glass front exceeds a certain temperature.

This memorandum provides information on the market for vented gas fireplaces and the societal cost of injuries associated with vented gas fireplace burns. The discussion is based on information that was readily available, including information provided by the petitioner and public comments.

## The Product

The petitioner requests that CPSC initiate rulemaking on vented gas fireplaces. A vented gas fireplace heater can be configured as either a freestanding gas fireplace or as a gas fireplace insert. An existing fireplace (e.g., wood burning) can be converted to gas burning by placing an insert into the hearth of a fireplace, either masonry or factory-built, and using the existing chimney fitted with a flue liner or other modification. Size varies depending upon the type of fireplace.

Glass fronts are integral components of gas fireplaces. Glass fronts, also referred to as viewing glass fronts, provide a viewing area of the interior hearth appliance and radiate heat into the room. The glass surface may be provided in clear or tinted shades. Most glass fronts are composed of 5mm ceramic or tempered glass; however, borosilicate glass may also be used. Glass fronts have heat-resistant properties and are tested to ensure against breaking or cracking under impact of thermal shock.

Access doors (or operable glass doors) may be used in place of, or in conjunction with, glass fronts. Operable glass doors are designed to keep gas components from entering into a room and may have a decorative front. Firms that supply glass fronts also may supply screens and surrounds designed to enhance aesthetic value (decorative screens).

These fireplaces serve aesthetic as well as functional purposes. Most are designed to provide heat to a room. It is important to note that the barriers mentioned in the petitioner's request could interfere with heat transmission. A barrier may also reduce the aesthetic value of the fireplace because it blocks the glass front. Thus, a mandatory barrier could reduce the utility associated with fireplaces for consumers.

Prices of fireplaces are difficult to obtain because most fireplaces are sold in the wholesale market. The price of a fireplace is embodied in the price of a house, or as part of the cost of a home renovation project.

**Market for Fireplaces and Protective Barriers**

At least 28 firms are known to manufacture or import gas fireplaces and gas inserts. Nineteen are domestic manufacturers and nine are foreign manufacturers whose products are imported into the United States. This includes firms that supply glass enclosures.[14]

Publicly available information is insufficient to identify the size of most firms. The North American Industry Classification System (NAICS) lists product codes for U.S. firms. Manufacturing of heating equipment is listed under the NAICS product code *333414 Heating Equipment (Except Warm Furnaces) Manufacturing*. However, in addition to gas fireplaces, this encompasses various heating equipment, including boilers, burners, furnaces, heating units, and wood stoves, which are beyond the scope of the petition.

Some firms list their businesses under categories other than manufacturing of heating equipment and often under more than one product code. Domestic firms may list their business as home furniture (*44229930 All Other Home Furnishings Stores*), heating equipment (*42373018 HVAC Equipment Merchant Wholesale*, *23822002 Plumbing & HVAC Contractors*), construction and other manufacturing (*32739004 Other Concrete Products Manufacturing*, *33312008 Construction Machinery Manufacturing*, or *33231210 Fabricated Structural Metal Manufacturing*), or a product code unrelated to manufacturing and heating equipment (*54161303 Marketing Consulting Services*).

*Industry Dollar Sales*

[14] A glass enclosure includes a frame, mounting hardware, glass front, and operable doors.

The Hearth, Patio, and Barbecue Association (HPBA) represents manufacturers, retailers, distributors, manufacturers' representatives, service and installation firms, and other companies and individuals having business interests in, and related to, the hearth, patio, and barbecue products industries. According to HPBA, in 2000, approximately 1.8 million gas hearth products (fireplaces, stoves, inserts, fireboxes, and gas logs) were shipped. Of the 1.8 million gas hearth products, 717,900 were gas fireplaces. Net dollar sales for gas fireplaces were $330.6 million. In 2010, 651,000 gas hearth appliances were shipped; 304,500 of these appliances were gas fireplaces. Net dollar sales of gas fireplaces totaled $186.4 million. HPBA estimates that in 2010, 28 percent of all fireplaces, stoves, and fireplace inserts produced for the U.S. marketplace were produced for the builder market (new homes), and 72 percent were produced for the remodeling market.[15]

*Protective Barriers*

Protective barriers include screens, such as folding or freestanding screens, and mesh or fire screens. They may also be referred to as safety screens or safety guards. A screen can be freestanding or capable of supporting itself, independent of attachment to a gas appliance (freestanding screens). Freestanding screens may have bi- or three-fold screens, with a large centerpiece and adjacent side screens that fold at an angle. Sizes of screens vary, depending upon the dimensions of the fireplace. A few firms ambiguously describe their glass front to have "heat resistant glass," which may or may not have a protective purpose.

At least 14 firms manufacture or supply protective barriers. Eight are domestic and four are foreign. Most firms that manufacture a protective barrier also manufacture gas fireplaces. Two of the domestic manufacturers specialize in fireplace accessories, including screens and glass doors. Publicly available information is insufficient to determine the size and dollar sales of most firms.[16] Firms often produce multiple brands and list their businesses under more than one product code.

Manufacturers' wholesale prices of protective barriers are not readily available. Protective barriers are usually sold as an accessory or optional equipment for gas hearth appliances. However, one retail estimate for mesh screens is $66.95 and freestanding screens range from $159.95 to $189.95.[17]

**Voluntary Standards**

Gas fireplaces and gas inserts are covered by the voluntary standards ANSI Z21.88, *Vented Gas Fireplace Heaters,* and ANSI Z21.50, *Vented Gas Fireplaces,* which apply to direct vent gas appliances. Unvented decorative gas fireplaces and unvented gas fireplace heaters are covered by

[15] Public Comment from Hearth, Patio, Barbeque Association (August 8, 2011).
[16] Financial information is available for the two publicly held firms. These firms manufacture gas fireplaces, as well.
[17] This represents an online discount and excludes shipping costs. Retailers offer discounted prices for purchasing multiple items.

a separate standard; however, the glass front performance and construction requirements are identical to the other two standards.[18]

The construction and performance requirements of glass fronts in all three standards are similar. They include requirements for heat-resistant properties; testing to ensure against breakage or cracking under impact of thermal shock; clearances for the mounting frame for the glass; instructions for serviceability and cleaning; and in the case of ceramic glass, resistance to sulfur compounds found in fuel gases and other sources. The performance provisions specify the maximum interior temperatures that glass fronts are required to comply with, depending on the material used.[19]

The ANSI Working Group may modify the existing voluntary standards, by requiring manufacturers, at the time of purchase, to provide a barrier to protect against burn hazards as a result of direct contact with the glass viewing area surface. The proposed industry requirement limits the external temperature of the barrier.[20]

Warning labels may also be revised. Currently, warning labels refer to safety screens and guards as "any safety screen or guard removed for servicing the appliance must be replaced prior to operating the appliance" and "provide a means by which the consumer can identify the listed barrier (such as graphic representation, clear description or reference marking)." The revised statements may inform users that a barrier is available for the gas appliance and should provide additional information regarding the barrier (*e.g*., safe use, proper assembly and installation and service).

**Industry Safety Programs**

According to HPBA, most manufacturers of gas fireplaces are HPBA members. HPBA estimates that members ship approximately 90 percent of all hearth appliance shipments. Although ANSI Z21.88 and ANSI Z21.50 standards are nominally "voluntary," as a practical matter, they are mandatory because of their incorporation into building codes and standards.[21]

In 2007, HPBA created a hot glass warning label with a graphical representation and warning statements indicating that fireplaces and flames are hot. The image depicts a hand reaching toward the fireplace with symbols indicating heat; the background color is red. The warning statements specify: (1) Hot glass will cause burns; (2) Do not touch glass until cool; and (3) Never allow children to touch the glass. The warning label has been used widely by

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[18] Unvented decorative gas fireplaces and unvented gas heaters are covered by ANSI Z21.11.2, *Standard for Gas-Fired Room Heaters, Volume II, Unvented Room Heaters*. Memorandum from Ronald Jordan, dated November 21, 2011, Subject: Existing Voluntary Standards and Voluntary Standards Development Associated with Glass Fronts of Gas Fireplaces. The ANSI Working Group may propose coverage to ANSI ZI21.88, and once coverage is accepted, the information will be included in other standards.
[19] Memorandum from Ronald Jordan, Directorate for Engineering Sciences, dated November 21, 2011, Subject: Existing Voluntary Standards and Voluntary Standards Development Associated with the Glass Fronts of Gas Fireplaces- Petition CP 11-1.
[20] Based on communication and e-mails from Ronald Jordan.
[21] Public Comment from Hearth, Patio & Barbeque Association (August 8, 2011).

manufacturers in their operating manuals and installation literature. In addition to individual company communications and education efforts, HPBA distributed a safety pamphlet to its member companies for show rooms and customers, as well as to pediatric offices, hospitals, and specialty medicine organizations.[22] Similarly, one manufacturer provides a mesh barrier at no additional cost for all of its brands.[23]

Lennox Hearth Products provides a "Safety Guard," a barrier designed to provide more protection than an ordinary panel screen, both in terms of its ability to prevent a nonreversible burn injury if touched, and its rigidity, which helps to prevent inadvertent contact with the glass, particularly by young children. The "Safety Guard" is available free of charge, upon request, on the firm's website. New customers also learn of the Safety Guard's availability through product literature accompanying each new fireplace unit.[24]

**Preliminary Estimate of Societal Costs**

National estimates of thermal burn product-related injuries are not available because the National Electronic Injury Surveillance System (NEISS) data does not allow for clear identification of gas fireplaces and glass fronts. The petitioner refers to NEISS estimates from 1999 through 2009, where more than 2,000 children, ages 0 to 5 years, suffered burn injuries on gas fireplaces. Upon inspection of the data, CPSC staff found 37 cases from January 1999 through March 2009, which were clearly identifiable as thermal burns related to contact with the glass front of a gas fireplace.[25]

The CPSC Injury Cost Model (ICM) uses empirically derived relationships between emergency department-treated injuries and injuries treated in other settings (*e.g.*, doctor's offices and clinics) to estimate the number of injuries treated outside of hospital emergency departments. It then estimates societal costs for all medically treated injuries, including the NEISS-estimated injuries and the ICM estimates for injuries treated in other settings. These costs include the costs of medical treatment, work loss, pain and suffering, and liability insurance and litigation costs.[26] Based on the 37 identified cases reported through NEISS, in combination with medically attended injuries reported through the ICM, there may have been about 1,754 medically treated glass contact burn injuries with associated injury costs of $91 million over the 10.25 years, from

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[22] Public Comment (August 8, 2011). See HPBA's website for additional information on the safety symbol (http://www.hpba.org/safety-information/fireplace-and-stove-glass-safety) and safety pamphlet (http://static.hpba.org/fileadmin/Glass_Safety/HPBA_GasBrochure_web.pdf).
[23] Public Comment from Home and Hearth Technologies (August 5, 2010).
[24] Public Comment from Mike Pennington, Director of Engineering at Lennox Hearth Products (August 8, 2011). Lennox Hearth Products agreed to provide the "Safety guard" in the settlement of class action lawsuit, *Keilhotz, et al. v. Lennox Hearth Products, et al.*
[25] Memorandum from John Topping, Division of Hazard Analysis, dated November 18, 2011, Subject: Injuries Pertaining to Glass Fronts of Gas Fireplaces and Contact Burns with Hot Glass – Petition CP 11-1.
[26] For a more thorough discussion of the ICM, see Ted R. Miller, et al., *The Consumer Product Safety Commission's Revised Injury Cost Model, Final Report to the U.S. Consumer Product Safety Commission*, Public Services Research Institute, Calverton, Maryland, December 2000. It is available from the CPSC's website (in 2 files) at http://www.cpsc.gov/LIBRARY/FOIA/FOIA02/os/Costmodept1.pdf and http://www.cpsc.gov/LIBRARY/FOIA/FOIA02/os/Costmodept2.pdf.

January 1999 through March 2009. Thus, there may have been approximately 171 incidents and an associated injury cost of $8.8 million on an annual basis. However, these estimates are subject to considerable variability, given the small sample size of the NEISS cases upon which they are based.

**References**

American National Standards Institute. http://www.ansi.org.

ANSI Z21.88 Vented Gas Fireplace Heaters.

ANSI Z21.50 Vented Gas Fireplaces.

ANSI Z21.11.2 Gas-Fired Room Heaters, Volume II, Unvented Room Heaters.

Hearth, Patio & Barbecue Association. http://www.hpba.org.

Miller, et al (2000). The Consumer Product Safety Commission's Revised Injury Cost Model, Public Services Research Institute, Calverton, MD 20705.

National Fireplace Institute. http://www.nficertified.org.

North American Industry Classification System (NAICS) 2007 Product Codes. Census Bureau. 2011. http://www.census.gov.

# TAB D

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

**Memorandum**

Date: December 9, 2011

TO : Ronald A. Jordan, Project Manager, Petition CP 11-1
Division of Combustion and Fire Sciences,
Directorate for Engineering Sciences

THROUGH: Mary Ann Danello, Ph.D., Associate Executive Director,
Directorate for Health Sciences
Lori E. Saltzman, M.S., Director,
Division of Health Sciences,
Directorate for Health Sciences

FROM : Jason R. Goldsmith, Ph.D., Physiologist,
Division of Health Sciences,
Directorate for Health Sciences

SUBJECT : Petition CP 11-1

This memorandum has been prepared in response to Petition CP 11-1, which requests that the Commission address burn injuries that result from contact with the glass fronts of vented gas fireplaces. Specifically, the petitioner requests that the Commission develop a mandatory standard for vented gas fireplaces that requires a protective barrier, guard, or other device to safeguard against severe burns due to contact with hot surfaces.

BACKGROUND:

The petition was brought by Carol Pollack-Nelson, Ph.D. ("petitioner"). The petitioner states that the voluntary standard for vented gas fireplaces permits glass fronts to reach temperatures of 500° Fahrenheit and that these surfaces are accessible to children. Using data from the U.S. Consumer Product Safety Commission (CPSC) National Electronic Injury Surveillance System database (NEISS), the petitioner asserts that during the period between 1999 and March 2009, more than 2,000 children 0 to 5 years of age suffered burn injuries from touching gas fireplaces; further, the petitioner claims that these injuries resulted from accidental or other contact with the fireplace, and that most incidents specifically mention contact with the glass. The petitioner notes that hands were the body part injured most frequently, and that there were also reports of burn injury to the arm, finger, lower trunk, and face. Finally, the petitioner asserts that gas fireplaces are hazardous, due to the high surface temperature of the glass front, combined with the accessibility of this surface, the affinity young children have for fire, and the lack of awareness consumers have of the hazard.

Subsequent to receipt of the petition, the Commission received a submission from William Lerner, who also requested initiation of a rulemaking to address the burn injury hazard associated with the glass fronts of vented and unvented gas fireplaces. Mr. Lerner's submission requested that the Commission require a warning system to alert consumers when the glass front exceeds a certain temperature. Mr. Lerner's request is being considered concurrently with Pollack-Nelson's petition.

The Division of Hazard Analysis (HA) staff (J. Topping, December 9, 2011 Hazard Analysis memorandum) examined NEISS for contact burn injuries to children 0 to 5 years of age that resulted from gas fireplaces during the time period specified by the petitioner. Of the 83 incidents found that described burn injuries from a gas fireplace, 34 reportedly resulted from contact with the glass front surface. Three additional NEISS incidents were the subject of in-depth investigations, which allowed the determination that they also involved contact with the glass front of a gas fireplace, bringing the incident total to 37.

Based on a review of the materials provided by the petitioners, the public comments received, the HA analysis, and the medical literature involving burn injuries, Health Sciences (HS) staff has provided a discussion on burn injuries, an analysis of the incident data related to a child coming into contact with the glass front of a gas fireplace, and the injury potential associated with this hazard scenario.

DISCUSSION:

Burn Injuries

Contact burn injuries occur when the skin is brought into contact with a hot surface and sufficient thermal energy is transferred to increase the skin temperature and produce cell injury or death. The degree to which the skin temperature is increased by contact with a hot surface is determined by the rate at which the heat is added (a function of the properties of the surface and the temperature of the surface); the duration of the exposure; the heat capacity of the tissue; the amount of blood flow through the tissue; the rate at which heat is transferred to deeper tissues; and the rate at which heat is lost back out through the skin (Ahrenholz et al., 1995).

Although there are built-in mechanisms to safeguard us from damage to our tissues, they may not be rapid enough to prevent injury from extremely hot surfaces. The withdrawal of one's limb or other body part from a hot surface is mediated by a spinal reflex, which results not only in the movement of the affected body part away from the heat source, but also the activation of other muscle groups to counterbalance that movement. Detection of a noxious heat stimulus is dependent upon the receptive field of heat nociceptors (injury receptors) reaching temperatures in excess of 45° Celsius (113° Fahrenheit), which is the heat pain threshold in humans. That is, the activation of heat nociceptors is dependent upon both the necessary heat transfer through the tissue occurring, and a temperature threshold being reached before the noxious nature of the hot surface is sensed by the heat nociceptors and the withdrawal reflex is initiated.

The conduction velocity of the nerve fibers that mediate this response can be as slow as 0.5 m/sec (1.6 ft/sec). At that velocity, it can take 1 second before the signal from an activated heat nociceptor located in the hand reaches the central nervous system. Therefore, if the temperature is great enough, damage to the tissue can take place prior to the central nervous system receiving the information and signaling the appropriate muscle groups to withdraw from the hot surface.

This protective defensive reflex can be undermined when an individual falls onto a hot surface. Under such circumstances, if some or all of the body weight is pressing the skin against the surface before the imbalance is corrected, it may be impossible for the reflex withdrawal of the affected body part(s) from the surface to occur, which can result in additional contact time and a more severe injury.

The lowest temperature that is of concern is 44° Celsius (111° Fahrenheit), which is just below the heat pain threshold. At this temperature, cutaneous burning (irreversible cellular damage and protein denaturation [breakdown]) occur with continuous exposure duration of 6 hours (Moritz and Henriques, 1947). As the skin temperature increases as a result of exposure to the heat source, the rate at which burn injuries occur increases rapidly.

For each degree that the temperature of the skin is increased above 44° Celsius (up to and including 51° Celsius [124° Fahrenheit]), the time required to produce irreversible cellular injury is reduced by approximately one half; at temperatures above 51° Celsius, the changes in exposure time needed to produce partial- and full-thickness burns become increasingly smaller for each degree rise in temperature (Moritz and Henriques, 1947). Surface temperatures at or above 65° Celsius (149° Fahrenheit) require 1 second or less to produce partial-thickness burns, and temperatures at or above 70° Celsius (158° Fahrenheit) require 1 second or less to produce full-thickness burns.

The determination of burn injury severity requires physical examination of the patient in order to establish the depth of the burn (a measure of the heat that has been transferred from the heat source to the tissues) and the extent and location of the burn, and is influenced by other factors as well, including age, other medical circumstances, and the heat source of the burn (Moritz and Henriques, 1947; Richard, 1999; Ripple et al., 1990).

*Depth of Burn Injury*

Burn injuries are classified by the anatomic thickness of the skin involved. Burn depth is described as superficial, partial thickness, full thickness, or subdermal (Richard, 1999; see also Table 1). Previously, burn wounds have been described by degree, from first to fourth, respectively; however, that classification system can be confusing.

Superficial burns affect only the outer epidermal layer of skin, the epidermis, and the skin is erythematous (flush) due to irritation of the underlying network of blood vessels that project upward from the dermis (Richard, 1999). The burn produced by ultraviolet radiation from the sun (sunburn) is a representative example of this type of burn. Mild edema (swelling) may be present, and pain and tenderness of the affected areas will usually be delayed for several hours after the exposure. Burn wounds of this depth will lack blisters and be dry. Healing will occur spontaneously without scarring in 3 to 5 days (Richard, 1999; Upshaw et al., 2004); during this time, dead tissue sloughs off, as new epithelium begins to cover the injured area (Merck, 1987).

Table 1 Classification of Burn Wound Depth

| Depth of Burn: | **Superficial** | **Partial Thickness** Superficial | **Partial Thickness** Deep | **Full Thickness** | **Subdermal** |
|---|---|---|---|---|---|
| Classification by Degree: | First-degree | Second-degree | | Third-degree | Fourth-degree |
| Tissues Involved: | Epidermis | Epidermis and upper dermal layer | Epidermis and deep dermal layer | Epidermis and dermis | Epidermis, dermis, and subcutaneous tissues |
| Wound Color and Vascularity: | Erythematous; pink or red; blanches with pressure | Erythematous; bright pink or red, mottled red; blanches with brisk capillary refill | Mixed red, waxy white; blanches with slow capillary refill | White, black, cherry red, tan; thrombosed vessels; poor distal circulation; no blanching | Charred |
| Surface Appearance: | No blisters, dry | Intact blisters, moist surface if blisters removed, elastic | Broken blisters, moist surface, dry, less elastic | Dry, leathery, rigid | Devitalized, subcutaneous tissue may be evident |
| Sensation: | Delayed mild to moderate pain, tender | Severe pain when blisters removed | Sensitive to pressure only | Anesthetic, hairs pull out easily | Anesthetic |
| Swelling: | Slight edema | Moderate edema | Marked edema | None, dehydration | None, dehydration |
| Healing: | Spontaneous - within 3-5 days | Spontaneous – within 7 to 10 days | Spontaneous – greater than 3 weeks, can require skin grafts | Does not heal, requires skin grafts | Does not heal, requires skin grafts |
| Scarring: | No scarring | Scarring unusual | Scarring and contractures likely | Severe contractures and scarring | Severe contractures and scarring |

Table adapted, in part, from Richard, 1999, and Singer, 2000.

Partial-thickness burns involve the upper two layers of the skin, the epidermis and dermis, and can be divided into two subcategories, superficial and deep, depending on wound characteristics and the depth of dermal injury. Superficial partial-thickness wounds extend down into the most superficial layer of the dermis, the papillary layer, whereas deep partial-thickness wounds extend into the reticular, or deeper, layer of the dermis.

Superficial partial-thickness wounds are erythematous, due to the inflammation of the vascularized dermis, and elastic, and moderate edema is present. The mottled red skin will blanch for as long as pressure is applied, and will return quickly to red when it is relieved, due to rapid capillary refill; this is a hallmark property of the superficial partial-thickness burn and can be useful in the differentiation of such burns from deep partial-thickness burns (Richard, 1999). Blisters are present and remain intact, but when broken or removed, the absence of the epidermis will allow body fluid to leak onto the surface of the wound; once in that state, these burns will be extremely painful, due to the exposed nerve endings (Richard, 1999; Upshaw et al., 2004). Most specialists in the treatment of burn wounds now advocate the removal of all blisters, except for those occurring on the palms or soles (Upshaw et al., 2004).

Healing will occur spontaneously within 7 to 10 days; uninjured epidermal elements, hair follicles, and sweat glands allow for rapid regeneration (Merck, 1987; Richard, 1999). Although scar formation is unlikely, unless infection occurs, some patients may be left with alterations in skin tone due to the destruction of the melanocyte (pigment)-producing cells of the epidermis (Merck, 1987; Richard, 1999).

Deep partial-thickness wounds appear as mixed red or waxy white; are less elastic than superficial partial-thickness burns; and are characterized by marked edema. Although blanching will occur when pressure is applied, restoration of color will be delayed, due to slow capillary refill. Blisters are normally absent, and the surface of the wound is moist, similar to superficial partial-thickness wounds after blister removal. Sensation is altered in deep partial-thickness wounds due to the destruction of superficial nerve endings and preservation of deeper sensory receptors (Richard, 1999); whereas, pain from a pin prick or light pressure may not be sensed, more intense pressure may be detected.

Healing will occur spontaneously but will require at least 3 weeks and as many as 6 weeks; reepithelialization will start from the edges of the wound or from any remaining dermal or epidermal tissue. The healing process is slow and often involves the formation of excessive granulation tissue (vascularized fibrous connective tissue) prior to being covered by epithelium. Such wounds generally contract and can develop into disfiguring and disabling dense hypertrophic scarring, unless they are treated promptly by skin grafting (Merck, 1987; Richard, 1999; Singer, 2000).

Full-thickness burns are irreversible wounds that extend down through the entire thickness of the skin to the level of subcutaneous tissue and may reveal part of the adipose layer. Wounds of this type generally require prolonged exposure to the heat source (Singer, 2000). The appearance of these wounds may vary from black to white. Blackened areas indicate necrotic (dead) tissue; whereas, areas that appear white or red are devoid of vasculature; any red coloration that may be present is owing to the entrapment of hemoglobin subsequent to the destruction of red blood cells. If pale in color, wounds of this depth may be mistaken for normal skin; however, blanching will not occur when pressure is applied (Merck, 1987). Superficial blood vessels are likely thrombosed (clotted) and distal circulation may be compromised. The surface of these wounds may be that of an eschar (scab), which is dry, rigid, and leathery to the touch (Richard, 1999). Due to the destruction of the cutaneous nerves and dermal follicles, the wound area is anesthetic (without sensation), and body hairs can be pulled out easily, respectively (Richard, 1999). The wound area will appear dehydrated (depressed compared to surrounding tissue) due to the evaporation of all fluid from the tissue.

Given the involvement of all layers of the skin and possibly subcutaneous tissues as well, full-thickness burns will not heal spontaneously. For all but the smallest wound areas, excision of dead tissue, followed by skin grafting, is usually required to heal this injury; and even then, scar formation can occur around the margin of the wound or between the seams of the graft. Additionally, scar contractures can develop subsequent to graft contraction (Richard, 1999).

Subdermal burns extend below the dermal layer into the subcutaneous tissue levels of fat, muscle, or bone. The involved areas have a charred appearance; and, in the case of a hand or foot, they may appear devitalized or mummified (Richard, 1999). As with full-thickness burns, subdermal burn areas are dehydrated, anesthetic, and require skin grafts or flaps to close the wound, and scarring is common.

Removing the child from a hot surface, such as the glass front of a gas fireplace, as quickly as possible can help mitigate the wound. Similarly, cooling may decrease the depth of the burn if it is done within the first hour of the injury (Singer, 2000).

In children, even after debriding the wounds (surgically removing dead tissue) and fully assessing them, it may be very difficult to determine wound depth, and such determinations are often initially underestimated (Upshaw et al., 2004). Due to their thinner skin, younger children can have deeper burns (*e.g.*, scald burns) than adults (Upshaw et al., 2004).

Determination of burn wound depth is also complicated by the fact that most injuries fail to fit into the distinct categories described above (Richard, 1999). It is usually the case that the burn wound is not of uniform depth throughout the field of the wound, but rather contains zones of tissue damage. The area receiving the greatest amount of heat will be the area with the deepest injury. If contact with the heat source is prolonged to the point of tissue damage, the area is referred to as the "zone of coagulation" and will involve full-thickness injury. The area on the periphery of the zone of coagulation is termed the "zone of stasis." In this area, circulation is still present, but is slow and variable, allowing for the perfusion of the tissue; this burn depth is indicative of partial-thickness injury. The outermost area of the burn is referred to as the "zone of hyperemia" and appears red from the vascular dilatation that results (Richard, 1999; Singer, 2000).

Burn injuries are dynamic, and their appearance can change rapidly, particularly in the first few days after the injury. Improper fluid resuscitation, excessive pressure from bandages, and infection can cause partial-thickness burns in the zone of stasis to become full-thickness burns.

*Location of Burn Injury*

The location of the burn injury can have a significant effect on the severity of the burn injury and its treatment (Singer, 2000). Amongst the most difficult to treat are burn injuries of the hand; such wounds require hospitalization to treat the wound properly and ensure the maintenance of function.

*Extent of Burn Injury*

The extent of the burn injury is generally expressed as a percentage of the total body surface area (% TBSA) that has partial-thickness or full-thickness burns; for this purpose, superficial burns are ignored. Referring physicians often miscalculate the extent of burn, overestimating smaller burns and underestimating larger wounds (Singer, 2000). For children younger than 10 years old, the most accurate estimate of the % TBSA that is injured is obtained by using the Lund-Browder chart, which gives, for various ages, the % TBSA associated with different parts of the body, thereby preventing errors of overestimation (Richard, 1999; Singer, 2000; Upshaw et al., 2004). For example, each surface of a child's hand is considered to represent 1.25% TBSA, and each buttock is considered to represent 2.5% TBSA (Merck, 1987).

*Burn Severity and Treatment*

Patients can be treated on an outpatient basis for mild burns—superficial burns and those that involve small surface areas. These include superficial and superficial partial-thickness burns involving less than 10% TBSA. Generally, patients are admitted if their wounds are not expected to heal spontaneously within 3 weeks and may be admitted if certain critical areas of the body, such as the face or hands, are involved with the deepest burns; if the patient is less than 2 years old; or if poor compliance with treatment is expected.

In children under 10 years of age, burns are considered severe and require hospitalization when they are partial thickness and cover greater than 10 percent TBSA or are full-thickness burns and cover greater than 2% TBSA. Additionally, burns of critical areas, such as the face, hands, feet, and perineum may also require hospitalization (Singer, 2000). The American Burn Association has specific criteria to follow for when patients should be transferred to a burn unit: they include partial thickness burns greater than 10% TBSA; burns involving the hands, feet face, perineum, genitalia, or major joints; full-thickness burns in any age group; and children in hospitals lacking qualified personnel or equipment required to care for children (Upshaw et al., 2004).

Children with burns covering more than 15–20% TBSA will require fluid resuscitation and also a urinary catheter to monitor urinary output (Upshaw et al., 2004). In addition to removing intact blisters, treatment will often consist of debriding the wound, cleaning with sterile saline solution, and the application of topical antibiotics and dressings. Dressings are typically changed twice daily, although biologic dressings containing antibiotics can be used for partial-thickness burns or moderate full-thickness burns; in addition to decreasing the chance of infection and the amount of pain experienced, such dressings may also increase the rate at which healing takes place (Upshaw et al., 2004).

The recovery process from extensive high-severity burns is long; extremely painful, due to the need to remove necrotic tissue repeatedly; and it can be complicated, often requiring multiple surgeries to replace skin grafts and relieve contractures where coagulated scar tissues disrupt tissue blood and fluid supply. Once the physical healing is complete, victims of such burns are left with extensive deep scarring, which can permanently disfigure and functionally impair the victim, as well as cause severe psychological trauma, especially if the face is involved.

As is evident from both the NEISS incident data and at least one available research report (Dunst et al., 2004), the glass fronts of gas fireplaces present a serious burn injury hazard to the segment of the population that may be least able to discern the potential hazard that these surfaces represent.

Incident Data

In 37 of the 86 incidents involving contact burns from gas fireplaces that were originally reported in NEISS, staff was able to conclude reasonably that contact was made with the glass front (including glass doors) of the fireplace. A review of those NEISS incidents and, in three cases, follow-up in-depth investigations, indicates that 84 percent of the children were under 3 years of age (31/37) and 62 percent were male (23/37). The extent of burn injury was discernible in 26 of the cases. Of these, the majority received at least partial-thickness burn injuries; 2 received superficial burns, 21 received injuries that included partial-thickness burns, and 3 received injuries that included full-thickness burns.

Two children were treated and transferred to another facility; both children reportedly received full-thickness burns, suggesting that they may have been transferred to a burn treatment center. Five children were treated and hospitalized; at least one reportedly received full-thickness burns and two received partial-thickness burns. The remaining 30 children were all treated and released.

The hand (usually the palmar surface) is the body part that sustained the burn injury in the majority of these incidents. Twenty-three children received burns to one hand. Of the 23, one reportedly also received burn injuries to the forehead; two also received burn injuries to the fingers (the fingers were likely involved in the majority of incidents in which burn injuries of the hand were sustained); one reportedly received burn injuries to the wrist; and one reportedly burned the back of the hand. Ten children reportedly received burn injuries to both hands; one of the 10 children reportedly received burn injuries to the forehead. The remaining four children all received a burn injury to the buttock.

Although few of the narrative descriptions in the NEISS incidents provided sufficient detail to determine the circumstances that led to contact with the glass, at least seven suggest that contact with the glass surface may have been accidental. Five children reportedly fell or tripped, resulting in contact with the hot glass surface with one hand, (2) both hands, (2) or the buttock (1). Two children reportedly backed into the glass surface, suffering burns to the buttock.

Case Review from Medical Literature

The injuries described in the NEISS incident data are generally consistent with those reported in a case review examined by HS staff, in which contact palm burns from glass-enclosed gas fireplaces are discussed. In the report by Dunst et al. (2004), a review is provided of the records for the period 1996 through 2002, for 39 patients under the age of 5 years old who suffered burns of the palm after contact with the glass front of a gas fireplace; all were treated at one county burn center in Minneapolis, MN.

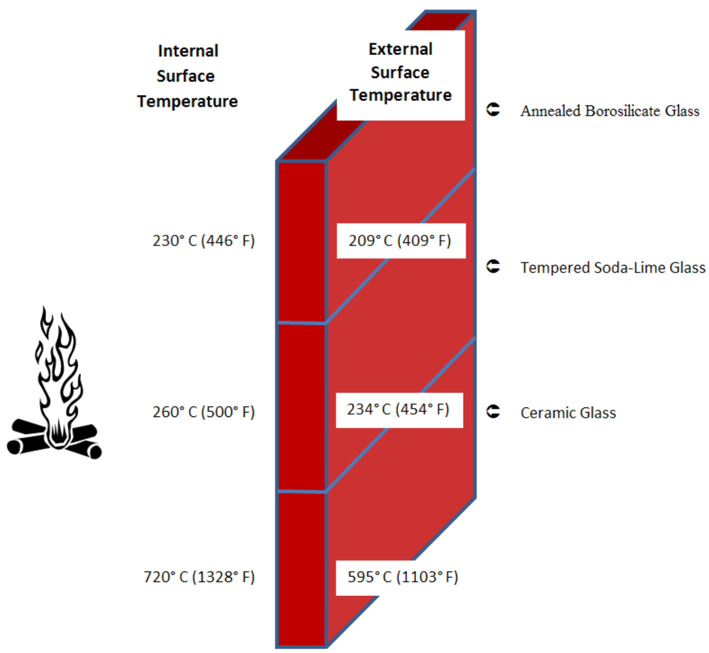
Each of the children was under 24 months old. One child received a full-thickness burn; whereas, the others received partial-thickness burns. More than half of the patients (56%) received burns to both palms. Thirty-three children with superficial partial-thickness burns were treated and released and had their injuries heal without complications. Two children with partial-thickness burns suffered mild wound contractures that required treatment with extension splints. Three children underwent skin grafting; these included the one child with full-thickness burns and two children with partial-thickness burns, who required grafting subsequent to wound contractures.

The authors of this paper discuss the care that contact burn injuries from gas fireplaces require, the likelihood of contractures and scarring, and the need for surgery. Of significance, the authors also state that such burns may be avoided by educating parents, displaying warnings, and by manufacturers providing protective screens.

Voluntary Standards and Comments to the Petition

Whereas the temperatures of the glass surfaces of the gas fireplaces involved in the above incidents are unknown, the maximum temperatures that the internal surface of the glass fronts are permitted to reach are specified in the applicable voluntary standards, ANSI Z21.50 and Z21.88, for glass of three different compositions: annealed borosilicate glass, tempered soda-lime glass, and ceramic. These temperatures are shown on the left-hand side of Figure 1. For a glass thickness of 6.35 mm (0.25 inches), the temperatures expected at the external surface for each glass composition at the maximum internal surface temperature allowed can be calculated and are shown on the right-hand side of Figure 1. (Data from Ronald Jordan, personal communication of November 1, 2011.)

Figure 1. Surface Temperatures of Glass Fronts
(6.35 mm thick) of Different Compositions



The temperature mentioned by the petitioner, 500° Fahrenheit (260° Celsius), appears to be the maximum internal glass surface temperature for fronts composed of tempered soda-lime glass. Annealed borosilicate glass fronts have a slightly lower maximum temperature; whereas, glass fronts composed of ceramic glass are permitted to reach a maximum temperature that is more than 275 percent hotter.

Assuming that the operating temperatures of gas fireplaces allow the internal surface of the glass front to approach the maximum temperature specified in the standards, momentary contact (at or under 1 second[27]) with the external surface of the glass front made from any of the three glass compositions (at or near the calculated maximum temperature) would elevate the skin temperature far above that which is necessary to produce partial-thickness burns or full-thickness burns (65° Celsius [149° Fahrenheit] and 70° Celsius [158° Fahrenheit], respectively).

Additionally, once turned off, the glass surface of gas fireplaces may take many minutes to cool to a temperature that does not pose a contact burn hazard. The incident narratives provided by the petitioner and commenters indicate that not everyone may be aware of the temperatures that the glass front of gas fireplaces may reach and/or the potential that exists for contact burn injuries to occur; the pattern of injuries described above seems to suggest strongly that children under 5 years of age are chief amongst those who may be unaware.

Whether through deliberate or accidental contact, given the potential for such injuries to occur, and with such brief contact times, a barrier or similar mechanism that would prevent a young child from making contact with the hot surfaces of a gas fireplace seems an appropriate way to manage the hazard. It is unclear how many of the children involved in the incidents described above were supervised, and in some incidents, where accidental contact was described, contact may have occurred despite supervision. Given that contact with the glass surface of a gas fireplace can produce burn wounds nearly instantaneously, any requirement to mitigate this hazard requiring an adult to police the area near the fireplace actively should not be expected to provide adequate protection to the youngest children.

CONCLUSION:

Brief contact with the glass front of a gas fireplace can produce severe burn injuries that require immediate medical attention. Such wounds can involve all layers of the skin and require extensive, long-term, complicated wound management, including multiple surgeries. These wounds are extremely painful to receive and to undergo treatment for, and they may leave the victim badly scarred, disfigured, functionally impaired and psychologically traumatized. The addition of a barrier or similar mechanism that can prevent contact with surfaces capable of producing burn injuries would appear to appropriately manage the hazard.

[27] Longer contact times can be expected to increase the depth and extent of the wound, and, therefore, increase the injury severity.

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# TAB E

UNITED STATES
CONSUMER PRODUCT SAFETY COMMISSION
BETHESDA, MD 20814

MEMORANDUM

DATE: January 10, 2012

TO: Ronald A. Jordan, Project Manager, CP 11-1
Division of Combustion and Fire Sciences, Directorate for Engineering Sciences

THROUGH: George A. Borlase, Ph.D., P.E., Associate Executive Director,
Directorate for Engineering Sciences

Robert B. Ochsman, Ph.D., CPE, Director,
Division of Human Factors, Directorate for Engineering Sciences

FROM: Timothy P. Smith, Engineering Psychologist,
Division of Human Factors, Directorate for Engineering Sciences

SUBJECT: Human Factors Assessment for Petition CP 11-1, Petition Requesting Safeguards for Glass Fronts of Vented Gas Fireplaces

## BACKGROUND

In correspondence dated May 23, 2011, Carol Pollack-Nelson, Ph.D., of Independent Safety Consulting (the "petitioner"), requested that the Commission initiate rulemaking to require safeguards for the glass fronts of vented gas fireplaces. The CPSC's Office of the General Counsel docketed the request for rulemaking as Petition CP 11-1 under provisions of the Consumer Product Safety Act (CPSA). The petitioner claimed that the industry standard for vented gas fireplaces allows the glass fronts, which are accessible to children, to reach temperatures of 500 degrees Fahrenheit, and that passive interventions, such as an "integral safety screen," are needed to protect children. The petition identified the primary age range of concern as children 5 years old and younger.

Subsequently, the Commission received a submission from William S. Lerner, a safety consultant. Mr. Lerner expressed reservations about the use of screens such as that proposed by the Petitioner, and he requested that the Commission initiate rulemaking to require an integrated high-temperature warning system that would project a clear "high temperature" alert onto the glass fronts of gas fireplaces "from the time the fireplace is lit until the glass is cool enough to touch safely." Mr. Lerner's "warning system," therefore, refers to a specific technology or type of warning—not to the more common use of the phrase in warnings literature to refer to multiple sources of warnings and hazard information intended to communicate a safety message. For this reason, all references to a "warning system" in this memorandum by staff of the CPSC's Directorate for Engineering Sciences, Division of Human Factors (ESHF), refer to Mr. Lerner's proposed technology, unless otherwise specified.

## DISCUSSION

### INCIDENT DATA REVIEW

### INCIDENT AND INJURY DATA

In its search of CPSC data sources for incidents relevant to the petition, staff of the CPSC's Directorate for Epidemiology, Division of Hazard Analysis (EPHA), identified 37 incidents in the National Electronic Injury Surveillance System (NEISS) database with treatment dates from 1999 through March 2009 that would be considered within the scope of the petition, in that they were determined to have involved hot glass contact on a gas fireplace by a child 5 years old or younger. The youngest victim was 8 months old, and the available incidents appeared to involve younger children more often than older children. For example, more than two-thirds (26, or roughly 70 percent) of the 37 in-scope incidents involved a child younger than 2 years; and more than three-quarters of the incidents (31, or roughly 84 percent) involved a child younger than 3 years. Only 6 of the 37 in-scope incidents involved a child 3 years old or older. Additionally, when the search for incidents was expanded to include victims older than 5 years, EPHA staff could find only 4 additional NEISS cases, with victim ages ranging from 7 to 25 years.

Incident details in the NEISS data are sparse and, in most cases, tend to include only enough information to know that the child contacted the hot glass on the fireplace with the skin, most commonly on the hand or hands. Five cases indicated that contact was the result of the child falling against the fireplace; two cases indicated that contact was the result of the child backing into the fireplace; and one case could have involved the child either falling or backing into the fireplace.[28] Although the limited number of cases makes it difficult to draw any firm conclusions, contact among older children tended to involve scenarios that clearly were more "accidental" contact, such as backing into or falling against the fireplace, rather than deliberate contact. For example, four of the six incidents to children 3 years old or older are known to have involved the child backing into or falling against the fireplace.

### RELEVANT CHILD DEVELOPMENT ISSUES

During the first couple years of life, commonly identified as the sensorimotor stage of development, children explore with their senses and directly manipulate objects in their environment (Brown & Beran, 2008; Hourcade, 2006). This exploratory behavior is the primary method by which these children learn about the world. Toddlers, in particular, are very curious and are commonly recognized as "explorers," who will touch, probe, poke, and otherwise explore nearly everything that attracts them and that they can access (Caplan & Caplan, 1983; Hourcade, 2006; Rubin, Fisher, & Doering, 1980; Therrell, Brown, Sutterby, & Thornton, 2002).

As the term "toddler" implies, these initial years also represent the time during which children develop the gross motor skills required to move voluntarily from place to place. With increasing mobility, children are able to explore more of their environment so that they are no longer limited to exploring only those objects that are brought to them. Generally, the first types of true locomotion that children will exhibit are crawling, or moving on the hands and stomach, and creeping, or moving on the hands and knees. On average, infants begin to crawl at 8 months, and

[28] This last case involved contact with the buttocks.

they begin to creep shortly thereafter (Brown & Beran, 2008; Haywood & Getchell, 2001). However, some children may reach these motor milestones slightly earlier, and a substantial number of children may never crawl or creep prior to walking (Haywood & Getchell, 2001). Children generally can walk alone at about 12 months old, but some may reach this milestone as early as 9 months (Bayley, 1969). Thus, many children will be capable of some degree of locomotion by about 8 months, with some children walking soon thereafter.

The developmental changes described above are consistent with the available incident data. The youngest children involved in incidents tend to be at about the age at which locomotion begins and would be capable of getting to a glass-front fireplace on their own. Although the available incident data do not include sufficient details to determine why the glass-front fireplace was touched, most in-scope incidents tended to involve children younger than 2 years old, an age at which children are natural explorers and most exploratory behavior is likely to occur. Incidents among preschool-aged and older children tended to be limited to accidental contact, such as falling or backing into the hot glass, rather than deliberate exploratory-type contact.

### POTENTIAL EFFECTIVENESS OF A HIGH-TEMPERATURE WARNING LIGHT SYSTEM

#### WARNINGS VERSUS OTHER HAZARD-CONTROL EFFORTS

Safety and warnings literature consistently identify a classic hierarchy of approaches that one should follow to control hazards, based primarily on the effectiveness of each approach in eliminating or reducing exposure to the hazard. The use of warning systems, such as that proposed in Mr. Lerner's submission to the Commission, is universally viewed as less effective than either designing the hazard out of the product or guarding the consumer from the hazard, and, therefore, is lower in the hazard control hierarchy than these other two approaches (Vredenburgh & Zackowitz, 2005; Wogalter, 2006; Wogalter & Laughery, 2005). Warning systems are less effective, primarily because they do not prevent consumer exposure to the hazard, and instead rely on persuading consumers to alter their behavior in some way to avoid the hazard.

Controlling hazards through design or guarding is especially important when children are the at-risk population, because children—especially those who are very young—may not have the cognitive ability to appraise a hazard or to appreciate the consequences of their own actions, and they may not understand how to avoid hazards effectively (Kalsher & Wogalter, 2008; Rice & Lueder, 2008). Additionally, literature on warning design commonly recommends that the text of warnings intended for the general public be written at no higher than the 6$^{th}$ grade reading level (Leonard, Otani, & Wogalter, 1999), which is about age 11. Based on the experience of ESHF staff, many warnings fail to meet this guideline, and even a warning that did meet this guideline presumably would not be understandable to many children younger than 11 years old. Consequently, any warning intended to address a hazard to young children most likely would have to be targeted at parents or other caregivers, who then must diligently supervise the children to prevent exposure to the hazard. However, caregivers differ in the extent to which they are able to supervise a child, and they may misjudge their child's ability to perceive hazardous situations and to deal appropriately and effectively with those situations (Kalsher & Wogalter, 2008).

For the reasons stated above, warnings should be viewed as "last resort" measures that supplement, rather than replace, redesign or guarding, unless these higher level hazard-control efforts are not feasible. Thus, to the extent that the hazard posed by the glass fronts of gas fireplaces rises to the level of requiring mandatory federal rulemaking, the need for a high-temperature warning system similar to that proposed by Mr. Lerner depends largely on the feasibility and effectiveness of guarding children from the hazard. For example, if an integral safety screen such as that proposed by the petitioner could effectively address the available burn incidents, a high-temperature warning system may not be necessary. On the other hand, a high-temperature warning system might be useful as a supplemental safety measure if the risk is not eliminated by guarding and the system could be designed in a way that would not lure children to the hazardous surface.

WARNING SYSTEM ATTRIBUTES

The warning system proposed by Mr. Lerner offers certain advantages over a typical warning label. For example, an illuminated phrase or symbol most likely would be more detectable and better at capturing a consumer's attention than an identically sized warning label whose visibility is dependent on external reflected light. Research shows that visual attention is drawn to display items that are bright and colorful, and abrupt stimulus onsets, such as a light switching on, tends to be especially attention-grabbing (Wickens & Hollands, 2000; Wickens & Carswell, 2006). Warnings literature even suggests illuminating a warning, such as through the use of directed artificial lighting or back lighting, as a possible solution to addressing warning visibility issues in low-illumination environments (Wogalter & Vigilante, 2006); and it is foreseeable that consumers may reduce interior lighting levels when fireplaces are in use or after such use, when the consumer has left the room but the glass front of the fireplace remains hot. Illuminated warnings also may be more legible than non-illuminated warnings in dim environments.

The dynamic nature of Mr. Lerner's proposed warning system is yet another advantage. Most warning labels and signs are static and would remain visible even when the hazard is not present, and repeated and long-term exposure to such a warning can lead to habituation, in which the warning no longer attracts one's attention (Wogalter & Vigilante, 2006). Static warning labels might even be viewed as a false alarm when warning about hazardous conditions or events that are intermittent. In contrast, Mr. Lerner's proposed warning system would display the relevant warning only when the hazard is present so consumers would be alerted to the hazard only when needed. Moreover, once a fireplace has been shut off, consumers have little way of knowing when the glass front of the fireplace is no longer hot enough to pose a hazard. The proposed warning system would provide this information to consumers, and avoid the possibility of consumers touching the glass front to test its temperature. Because the warning would appear on the hazardous surface only when the hazard is present, it would be physically and temporally close to the hazard; this attribute is commonly recommended in warnings literature to improve a warning's attention-grabbing power (*e.g.*, see Wogalter & Vigilante, 2006).

A potential downside to Mr. Lerner's proposed warning system is that its increased attention-capturing ability, relative to a static warning label, would affect its noticeability among *all* people, children included. Young children are especially attracted to bright colors and high contrast, and this is reflected in the design of their toys and other products (*cf.* Therrell, Brown, Sutterby, & Thornton, 2002). Thus, although an illuminated warning might improve the likelihood that adults would notice and attend to the warning; this means that it also almost certainly would capture the attention of a child.[29] These are the same children who, as discussed earlier, are driven to explore everything that captures their attention, and warnings literature recognizes that the characteristics of a warning, such as its coloring or symbols, may mistakenly attract young children to a hazard or hazardous product (Kalsher & Wogalter, 2008). Given that the proposed warning would be located on the hot glass, at-risk children may be drawn to explore the warning on the glass, thereby resulting in the unintended consequence of placing these children at greater risk of burns. Another issue to consider for a dynamic warning system such as that proposed by Mr. Lerner is that, depending on how it is designed, a failure of the warning system could result in no warning being presented to consumers even when the glass is hot. This could be particularly dangerous if consumers come to rely upon the lack of a warning as an indicator that the hazard is not present (Meyer, 2006), especially when the fireplace is not active and there is no other visual indication that the glass front might be hot.

Mr. Lerner does not specify the content of the proposed warning, but a simple illuminated red light is unlikely to be adequate. Red lights are often used in other contexts to indicate hazardous situations or hot surfaces, but this use is not standardized and such lights are sometimes used to communicate very different messages (*cf.* Woodson, Tillman, & Tillman, 1992). Furthermore, those exposed to the hazard may not be the owners of the product and, therefore, may not understand the meaning of a red light in the context of a fireplace without having read an accompanying owner's manual. Given the potential severity of the hazard, the intended message should be understandable without having to refer to a manual.[30]

Research suggests that symbols may be the best way of conveying hazard information to very young children (Kalsher & Wogalter, 2008), but the true effectiveness of symbols in communicating to children is unknown and, depending on its design, a symbol might lead children to act out any unsafe behavior that is portrayed (Frantz, Rhoades, & Lehto, 1999). Additionally, symbols that may seem to have obvious meanings to adults may have little real impact on childhood injuries. For example, research has found that adding a "Mr. Yuk" or a skull-and-crossbones symbol to a hazardous container did not significantly reduce the number of preliterate children who opened such a container (Schneider, 1977 as cited in Wogalter, Silver, Leonard, & Zaikina, 2006). All of this suggests that any symbolic warnings that are located on the hazardous surface and that are visible and accessible to at-risk children should undergo thorough testing before finalizing the design.

#### WARNINGS AND CHILD SUPERVISION

The ultimate effectiveness of any warning is determined by the extent to which it is likely to address relevant incidents and injuries. As noted earlier, staff's search for incidents within the scope of the petition identified 4 cases involving victims older than 5 years and 37 cases involving victims 5 years old and younger, most of whom were younger than 2 years old. Thus,

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[29] One might be able to design the warning so that it could be seen or read only at an "adult" height. However, this would eliminate its usefulness to smaller adults or to adults who are seated on or near the floor.

[30] Warnings literature and the U.S. voluntary consensus standard on product safety signs and labels, ANSI Z535.4, *American National Standard for Product Safety Signs and Labels* (*e.g.*, ANSI Z535.4 – 2007), state that warnings should identify the hazard, consequences of exposure to the hazard, and appropriate hazard-avoidance behavior, unless the consumer can readily infer this information.

hardly any of the available incidents involved victims old enough to read and understand a warning even if it were readily visible. Moreover, incidents involving older children tended to involve falling or backing into the glass front of the fireplace rather than deliberately placing the hands onto the glass. A warning is unlikely to have prevented these incidents unless the presence of the warning alerted the caregiver and the caregiver was effective at keeping the child away from the hot glass.

The ability of Mr. Lerner's proposed warning system to address injuries resulting from contact with the hot glass, therefore, depends on the ability of parents or other caregivers who receive the warning message to be able to limit a child's access to the hot glass. Because incidents can occur quickly, caregivers who cannot prevent child access to a room containing a fireplace that is in use must maintain continuous focused attention on children who are in proximity to the fireplace to detect when they are about to contact the glass front, either deliberately or accidentally. However, research has found that people cannot be perfectly attentive regardless of their desire to do so (Wickens & Hollands, 2000). Caregivers are likely to be distracted at least occasionally because they must perform other tasks, are responsible for supervising more than one child, are exposed to other salient but irrelevant stimuli, or are subject to other stressors.

Furthermore, continuous focused attention is only part of what is needed to prevent child contact with the hot glass front of a fireplace. Caregivers must be able to distinguish child behaviors that are likely to lead to contact with the glass from those that will not, which may be challenging, especially in those cases in which contact is accidental (*e.g.*, falling) rather than deliberate. Even if a caregiver is able to identify circumstances in which contact might occur, they may have a limited ability to prevent contact depending on their proximity to the child or fireplace and on the degree of control they have over the child. Two-year-olds, for example, have a strong drive for independence and autonomy and may exhibit defiant behavior (Caplan & Caplan, 1983). Thus, depending on the caregiver's proximity to the child, this behavior could make it especially difficult to prevent contact between the child and the hot glass.

## CONCLUSIONS

Safety and warnings literature suggest that the warning system proposed in Mr. Lerner's submission to the Commission is unlikely to be as effective as an integral screen or barrier at mitigating the burn hazard posed by the glass fronts of vented gas fireplaces. The proposed warning system might be effective at capturing a consumer's attention, but such a system also almost certainly would capture the attention of at-risk children, who are unlikely to understand a warning and its implications. The proposed warning system would have the benefit of being physically and temporally close to the hazard only when the hazard is present, but given the exploratory behavior that is common to those children most at risk from the hazard, the system could inadvertently draw these children to the hazardous glass front of the fireplace.

The effectiveness of the warning system, therefore, depends on the extent to which caregivers can effectively supervise children in proximity to the fireplace and prevent contact from occurring. Yet caregivers differ in the extent to which they are able to supervise a child, and cannot be perfectly attentive even if they correctly assess their child's inability to perceive hazardous situations and to appropriately and effectively deal with those situations. Furthermore, distinguishing child behaviors that are likely to lead to contact with the glass from similar behaviors that will not lead to contact might be challenging, especially in cases of falls or other accidental contact. Even if a caregiver is able to identify circumstances in which contact might occur, they may have a limited ability to prevent contact depending on their proximity to the child or fireplace.

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# TAB F

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

**Memorandum**

**Date:** November 21, 2011

| | | |
|---|---|---|
| **TO** | **:** | Petition CP 11-1 File |
| **THROUGH:** | | George A. Borlase, Associate Executive Director,<br>Directorate for Engineering Sciences<br>Patricia K. Adair, Director<br>Division of Combustion and Fire Sciences |
| **FROM** | **:** | Ronald A. Jordan, Mechanical Engineer<br>Project Manager, Petition CP 11-1<br>Division of Combustion and Fire Sciences,<br>Directorate for Engineering Sciences |
| **SUBJECT** | **:** | Existing Voluntary Standards and Voluntary Standards Development Associated with the Glass Fronts of Gas Fireplaces – Petition CP 11-1 |

## Review of Existing Voluntary Standards

The construction and performance of vented gas fireplaces and vented gas fireplace heaters sold in the U.S. are governed by two separate voluntary standards: *ANSI Z21.50, Standard for Vented Gas Fireplaces* for *Vented Gas Fireplaces* and *ANSI Z21.88, Standard for Vented Gas Fireplace Heaters*. The construction and performance of unvented decorative gas fireplaces and unvented gas fireplace heaters sold in the U.S. are governed by *ANSI Z21.11.2, Standard for Gas-Fired Room Heaters, Volume II, Unvented Room Heaters*.

Each standard currently includes essentially identical construction and performance provisions for glass fronts. The construction provisions for glass fronts are located in Sections 1.5 of ANSI Z21.50 and ANSI Z21.11.2, and Section 1.6 of ANSI Z21.88. Each set of construction provisions specify minimum requirements for the heat resistance properties of the glass; allowances for thermal expansion and distortion; clearances for the mounting frame for the glass; serviceability and cleaning; and in the case of ceramic glass, resistance to sulfur compounds found in fuel gases and other sources.

The performance provisions for glass fronts in each of the standards specify the thermal shock, impact, and temperature test conditions that glass fronts are subjected to and required to comply with. Provisions for thermal shock and mechanical impact testing of glass fronts are located in different sections of the three standards (i.e., Sections 2.14, Impact Test of Glass Materials and 2.15, Water Shock Test in ANSI Z21.50; Sections 2.10.2 (impact test) and 2.10.3, Thermal Shock in ANSI Z21.11.2; and Sections 2.13.2 (impact test) and 2.13.3, Thermal Shock in ANSI Z21.88). The temperature provisions for glass fronts in each standard only specify the maximum temperature limit for the interior of a glass front; no limits for the exterior surface temperature of the glass front are provided. These provisions are located in Sections 2.13 of ANSI Z21.50 and ANSI Z21.88, and Section 2.10 of ANSI Z21.11.2. The following maximum temperatures for the interior surfaces of the glass fronts are based on the type of material used and are specified in Tables VI, VII, and XII in ANSI Z21.88, ANSI Z21.50, and ANSI Z21.11.2, respectively:

| Maximum Temperature for Glass | Maximum Temperature | |
|---|---|---|
| Material | $^{o}$F | $^{o}$C |
| Tempered (Soda-Lime) Glass & Toughened 3.25 x $10^{-6}/^{o}$K Expansion Borosilicate Glass | 500 | 260 |
| Annealed Borosilicate Glass 3.25 x $10^{-6}/^{o}$K Expansion | 446 | 230 |
| Ceramic Glass Materials | 1328 | 720* |
| Other Glass Materials | ** | ** |

*Use lower of 1328$^{o}$F (720$^{o}$C) or the manufacturer's maximum absolute temperature
**Absolute temperature as specified by the material supplier for normal service conditions.

Given the magnitude of these temperatures, their measurement location (*i.e.*, interior surface), and the threshold temperatures at which severe burns can occur, it is clear to staff that these provisions were not designed to prevent contact burns to consumers. According to Canadian Standards Association-International staff,[31] these temperatures represent the maximum operating temperatures for the materials. Provisions within ANSI Z21 gas appliance standards designed to prevent contact burns will typically impose limits on temperatures of components, parts, and areas of the appliance that consumers are expected to make routine contact with in order to operate the appliance or as a result of inadvertent contact while the appliance is in operation. For example, the *American National Standard for Household Cooking Gas Appliance, ANSI Z21.1*, includes the following sections that address surface temperatures and contact burn considerations: Sections 2.18, Evaluation of Burn Hazard Potential of Exterior Surfaces and 2.19, Temperatures of Handles, Knobs and Touchpads. Section 2.18 specifies a test method for measuring the temperature of various surfaces on a gas range and Table XII of the standard specifies the maximum temperatures that those surfaces are allowed to reach. Maximum allowable surface temperatures range from 152$^{o}$F to 182$^{o}$F, depending upon the type of surface material involved for surfaces 3 feet in height or less and 182$^{o}$F to 212$^{o}$F for surfaces over 3 feet in height.

Section 2.19 specifies a test method for measuring the temperatures of door handles, valve handles, thermostat knobs and all other knobs, touchpads, or handles used while the appliance is being used for cooking. Table XIII of *ANSI Z21.1* specifies the maximum allowable temperatures for these parts, which can range between 131$^{o}$F to 182$^{o}$F depending upon the type of material the part is made of. Contact with materials at these temperatures can elevate skin temperatures sufficiently to produce reversible epidermal injury, as specified in the *ASTM Standard Guide for Heated System Surface Conditions that Produce Contact Burn Injuries, ASTM 1055*. Conversely, contact with glass at the maximum glass temperatures listed above and in ANSI Z21.88 and ANSI Z21.50 can elevate skin temperatures well above the threshold temperatures specified in ASTM 1055 at which complete

[31] Email correspondence from S. McCarthy, CSA-International to R. Jordan, CPSC, dated November 21, 2011.

transepidermal necrosis or cell death occurs. Based on these provisions and as demonstrated, by the incidents involving contact burns, the glass front temperature limits specified in ANSI Z21.88 and ANSI Z21.50 were not designed to prevent contact burns to consumers.

**Voluntary Standards Development**

In May 2010, Carol Pollack-Nelson presented the same information that would later be contained in her petition CP 11-1 to the ANSI Vented Warm Air Technical Advisory Group (TAG) and proposed that they require that protective barriers be provided with vented gas fireplaces at the time of sale. The TAG established the Vented Heater Glass Surface Temperature Working Group (WG) on July 21, 2010 to examine Pollack-Nelson's proposal and supporting information on burns that occur to children when they come into contact with the glass fronts of gas fireplaces. The WG has met on six separate occasions (November 16, 2010; March 3, 2011; May 17, 2011; August 3-4, 2011; September 7-8, 2011; and October 25-26, 2011) during which time, they discussed the following proposals designed to address burns that occur from contacting the hot exterior surface of the glass front of a gas fireplace:

- Passive, protective barrier for the glass front
- Visual warning system using LED-light
- Audible warning system
- Improved warnings in the Users/Installation manual
- Improved warning labels on the fireplace, and
- Education and information campaign to reach consumers

The WG has drafted passive barrier provisions to be included in the Construction, Performance, Definitions, and Exhibit parts of ANSI Z21.88 and ANSI Z21.50. The standards development is summarized as follows:

- Developing "Construction" and "Performance" provisions for an Optional Barrier to be made available at the time of purchase.

- Exempting installations in which the glass viewing surface is four (4) feet or higher since children 0-5 years would not be able to access the surface.

- According to the Secretariat for the organization, to-date William Lerner[32] has not provided the WG or the TAG proposed standards text for the TAG to consider. Therefore, neither the WG nor the TAG is developing any standards coverage for the warning light concept. They have asked Mr. Lerner a number of times to provide proposed standards text for the TAG to consider.

- The WG sent the draft provisions for the Barrier to the TAG for consideration at their December 2011 meeting.

[32] William Lerner made a submission to CP 11-1, requesting the Commission to develop a mandatory standard that required a visual warning light be projected onto the glass front of a gas fireplace to warn consumer that the glass was still hot.

- The TAG approved the draft provisions for the Barrier to the TAG for consideration at their December 2011 meeting and sent it out for a 60-day Review and Comment period that began on December 20, 2011 and ended on February 22, 2012.

- If there are no delays during the Review and Comment period, a published standard could be available by mid to the end of 2012.

- Effective date for compliance with a new standard would be approximately 18 months from the publication date.

- The crux of the standard would be making an optional barrier[33] available at the time of purchase of vented gas fireplaces:

    - with an outside glass viewing area temperature that exceeds 172 ºF (78 ºC)

    - installed at a height less than 4 feet above the floor

- The barrier will be required to:

    - Prevent contact with the glass front of a gas fireplace

    - Prevent a burn hazard greater than Threshold B (reversible epidermal injury) as stated in the *ASTM Guide for Heated System Surface Conditions that Produce Contact Burn Injuries, ASTM C1055*

    - Unlike the material surface temperature of the glass front, the burn hazard potential for the optional barrier will be based on the skin contact temperature at the hottest exterior point of the barrier, either measured using a thermesthesiometer or calculated using Method A, each found in *ASTM Practice for Determination of Skin Contact Temperature from Heated Surfaces Using a Mathematical Model and Thermesthesiometer, ASTM C1057*

The WG forwarded the draft proposals to the TAG for consideration at the TAG's December 13, 2011 meeting. If the TAG votes to approve the proposal, a revised standard could be published by approximately mid to the end of 2012, with an effective date of 18 months after the publish date (*e.g.*, approximately the end of 2013 to mid-2014). The draft provisions are provided in Table 1.

Petition CP 11-1 cited only vented gas fireplaces, not unvented gas fireplaces. Despite their differences, unvented gas fireplaces have design similarities comparable to vented gas fireplaces and therefore pose a similar risk of burn injury. First, they can be equipped with glass fronts for viewing the flame and imitation log sets within the fireplace enclosure. Second, the governing standard for unvented gas fireplaces, ANSI Z21.11.2, *Standard for Gas-Fired Room Heaters, Volume II, Unvented Room Heaters*, includes provisions that allow the interior surfaces of glass fronts of

[33] As presented in the draft coverage, if a gas fireplace meets the height and glass temperature criteria, a manufacturer would be required to make a barrier available to the consumer upon the consumer's request at the time of purchase of the fireplace.

unvented gas fireplaces to reach the same maximum temperature limits as those specified for vented gas fireplaces in ANSI Z21.88 and ANSI Z21.50. Thus, the glass fronts of unvented gas fireplaces are likely to experience similar exterior surface temperatures as vented units, well in excess of the Threshold B limits specified in ASTM C1055. To date, staff is not aware of any plans by the ANSI Z21/83 Technical Committee to direct the TAG for unvented gas space heaters, in particular, unvented decorative gas fireplaces and unvented gas fireplace heaters, to begin considering adoption of the WG's draft standard. Staff believes that this is likely to occur once the draft standard has been voted on and finalized by the TAG, but it bears monitoring to ensure that this occurs.

**Conformance to Voluntary Standards**

The Hearth, Patio, and Barbeque Association (HPBA) is a trade association that represents the hearth products, patio, and barbeque industries in North America. HPBA's hearth product members manufacture, import, distribute, sell, install and service factory built fireplaces, gas log sets, and fireplace inserts. According to HPBA "Most manufacturers of gas fireplaces are HPBA members…" and account for approximately "…90 percent of all hearth appliance shipments." In order to be marketed and sold in the U.S., gas appliances, including gas fireplaces, must comply with local, state, regional, or national building codes. In order to comply with the building codes, gas fireplaces must be certified to national performance and safety standards, such as the ANSI Z21 set of gas appliance standards and Underwriters Laboratories standards.

Given these conditions for market entry and participation, staff believes that a framework exists that ensures conformance of these products to the voluntary standards. Therefore, if the proposed protective barrier provisions are adopted into ANSI Z21.88 and ANSI Z21.50, staff believes that manufacturers that certify to these two standards will, by default, conform to the any new protective barrier requirements. In their comments on Petition CP 11-1, HPBA asserts: *"There will be high levels of compliance. The ANSI standard is applicable to the entire gas fireplace industry and is incorporated in building codes and standards. Retailers and conformity assessment organizations will require compliance. Further, the violation of a voluntary standard may be relevant in product liability litigation. The existing requirements in the standards achieve virtually total, industry-wide compliance and there is no reason to believe that anything will be different with safety guards and related requirements."*

# TAB G

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

**Memorandum**

**Date: December 15, 2011**

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| **TO :** | Petition CP 11-1 File |
| **THROUGH:** | George A. Borlase, Associate Executive Director,<br>Directorate for Engineering Sciences<br><br>Patricia K. Adair, Director<br>Division of Combustion and Fire Sciences |
| **FROM :** | Ronald A. Jordan, Mechanical Engineer<br>Project Manager, Petition CP 11-1<br>Division of Combustion and Fire Sciences,<br>Directorate for Engineering Sciences |
| **SUBJECT :** | Addressability of Hazard Associated with Elevated Surface Temperatures of the Glass Fronts of Gas Fireplaces – CP 11-1 |

Petition CP 11-1 raises concerns about the risk and incidence of burns associated with consumers, especially children, coming into contact with the hot glass front of a vented gas fireplace. The petitioner requested that the Commission initiate rulemaking to require safeguards, including a protective barrier over the glass front, to protect consumers from the contact burn hazard. In order to understand whether the hazard is addressable, it is important first to know the threshold temperatures at which irreversible contact burns occur and the range of temperatures that the exterior surface of glass fronts can reach. The type of material, material thickness and the thermophysical properties of the material, such as the thermal conductivity and emissivity, are variables that must be accounted for when determining the exterior surface temperatures of glass fronts on gas fireplaces. It is also helpful to understand the maximum temperature limits specified by the governing standard for the application the material is used in.

The threshold temperatures at which irreversible contact burns occur are provided in the *ASTM Standard Guide for Heated System Surface Conditions that Produce Contact Burn Injuries, ASTM C1055*. Figure 1 of ASTM C1055 provides a time-weighted scale that indicates the threshold temperatures at which complete transepidermal necrosis (i.e., cell death occurs). This is noted as Threshold A in the figure, which is a plot of Exposure Time in seconds versus the contact skin temperature in degrees Celsius. According to the plot, cell death can occur when contact of the skin is made with a surface that elevates skin temperature to 70°C (158°F) for a one second exposure time. The exposure time before cell death occurs increases logarithmically as the contact skin temperature decreases. Thus, contact with a surface at approximately 46°C (115°F) would have to be maintained for 1,000 seconds before cell death would occur.

The governing standards for vented gas fireplaces are the *Standard for Vented Gas Fireplaces, ANSI Z21.50,* and the *Standard for Vented Gas Fireplace Heaters, ANSI Z21.88*. Each standard includes identical construction and performance provisions for glass fronts.[34] The range of temperatures that the exterior surfaces of various glass front materials can reach were determined through the use of the Method of Test found in Section 2.13, Glass Fronts, of *ANSI Z21.88*. This Method of Test does not specify a maximum temperature limit for the exterior surfaces of glass fronts of vented gas fireplace heaters, where contact burns occur. Rather, it specifies limits for the maximum temperature of the interior surface of glass fronts. Depending on the type of material used and the material thickness, the interior surface of the glass front can reach maximum temperatures ranging from 220°C (428°F) for annealed borosilicate glass to 720°C (1328°F) for ceramic materials. The Method of Test requires that the exterior temperature of the glass front ($T_{room}$) be measured and the interior surface temperatures ($T_{fire}$) calculated using the following heat transfer equations:

$$q_{cond\ glass} = k_{glass} * (T_{fire} - T_{room})/t \qquad \text{eq. 1}$$

Solving for $T_{fire}$:

$$T_{fire} = (q_{cond\ glass} * t)/ k_{glass} + T_{room} \qquad \text{eq. 2}$$

$$q_{cond\ glass} = q_{conv\ room} + q_{emitted\ rad\ room} \qquad \text{eq. 3}$$

$$q_{conv\ room} = 10.32*(T_{room} - T_{ambient}) \qquad \text{eq. 4}$$

$$q_{emitted\ rad\ room} = 5.103 \times 10^{-8}*(T_{room}^4 - T_{ambient}^4) \qquad \text{eq. 5}$$

Therefore, $T_{fire}$ is also:

$$T_{fire} = (q_{conv\ room} + q_{emitted\ rad\ room})* t/ k_{glass} + T_{room} \qquad \text{eq. 6}$$

Where:

$q_{conv\ room}$ = convective heat transfer from the glass material into the room
$q_{emitted\ rad\ room}$ = radiation heat transfer from the glass material into the room
$q_{cond\ glass}$ = conductive heat transfer through the glass material
$T_{room}$ = temperature of the exterior surface (room side) of the glass material
$T_{ambient}$ = temperature of the ambient air in the room
$T_{fire}$ = temperature of the interior surface (fire side) of the glass material
$k_{glass}$ = thermal conductivity of the glass material
t = thickness of the glass material

[34] Because the two standards have identical construction and performance requirements for glass fronts, only one standard (ANSI Z21.88) will be referenced throughout the remainder of this memorandum.

For the purposes of this analysis, actual measurement of the exterior temperature ($T_{room}$ ) of gas fireplace glass fronts was not practical. Therefore, staff used a range of temperatures in the above equations in order to calculate the interior surface temperature of a given glass front material of a specified thickness and thermal conductivity. In order to facilitate evaluation of health effects from a contact burn by Directorate for Health Sciences, exterior glass temperatures ranging from 44$^{o}$C (111$^{o}$F)[35] to 78$^{o}$C (172$^{o}$F)[36] were selected. The exterior surface temperatures that would occur at the maximum interior temperatures specified by ANSI Z21.88 were also included. Because the above equations describe the relationship between the interior and exterior temperatures, the selected range of exterior temperatures represent valid, corresponding values that would be expected to occur on the exterior surface of a glass front when interior temperatures reach the calculated values. Using equations 4 and 5 above, the convective and radiation heat transfer at each exterior temperature ($T_{room}$) level was calculated, allowing the conductive heat transfer through the glass material to be determined using Eq. 3 and finally, using the range of exterior glass front temperatures, $T_{room}$, the interior glass front temperatures, $T_{fire}$, were calculated. Tables 1 through 6 provide a range of corresponding exterior temps, $T_{room}$, for the calculated interior temps, $T_{fire}$ for sodalime, borasillicate, and ceramic glass materials at material thicknesses of 0.125 and 0.25 inches two glass thicknesses that are representative of the glass used in most units.

Therefore, in order to address the hazard, an intervention would need to either:

1. Prevent the glass front exterior temperature ($T_{room}$) from reaching these threshold temperatures;

2. Provide a barrier that prevents contact with the glass front. The barrier would also need to be designed in a manner that either:

    a. Prevents the barrier surface or points of contact from reaching the Threshold A limits; or

    b. Is made of a material that prevents rapid heat transfer to human skin.

Staff believes that a glass front or barrier that meets these criteria could effectively manage the risk of contact burns from the glass front of a gas fireplace.

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[35] The lowest temperature at which irreversible injury could occur.

[36] The proposed minimum exterior temperature that a glass front can reach before a protective barrier is required. At their December 13, 2011 meeting, the ANSI Z21 Vented Warm Air Heater Technical Advisory Group (TAG) considered draft provisions developed by their Working Group (WG) which included, among other interventions, requirements for a physical barrier. The draft performance provisions for the barrier require that an optional barrier be made available if the exterior glass front surface of the gas fireplace exceeds 78$^{o}$C (172$^{o}$F). Thus, as drafted, the proposed provisions would allow surface temperatures, 44$^{o}$C to 77$^{o}$C (111$^{o}$F to 171$^{o}$F), that would exceed the Threshold A temperatures.

**Table 1. Calculation of Sodalime Glass Temperatures, when material thickness, t = 0.125 inches**

| $T_{room}$ | | | $T_{ambient}$ | | | $t_{glass}$ | q - conv room | q - emitted rad room | k - sodalime glass | $q_{cond}$ glass | $T_{fire}$ | | | Δ $T_{fire}$_$T_{room}$ |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| °F | °K | °C | °F | °K | °C | m | Watts/ $m^2$ | Watts/ $m^2$ | Watts/ °K*m | Watts/ $m^2$ | °K | °F | °C | °F |
| 111 | 317.0 | 43.9 | 80.0 | 299.8 | 26.7 | 0.003175 | 177.7 | 103.2 | 0.864 | 280.9 | 318.0 | 112.9 | 44.9 | 1.9 |
| 112 | 317.5 | 44.4 | 80.0 | 299.8 | 26.7 | 0.003175 | 183.5 | 106.8 | 0.865 | 290.3 | 318.6 | 113.9 | 45.5 | 1.9 |
| 113 | 318.1 | 45.0 | 80.0 | 299.8 | 26.7 | 0.003175 | 189.2 | 110.4 | 0.866 | 299.6 | 319.2 | 115.0 | 46.1 | 2.0 |
| 114 | 318.7 | 45.6 | 80.0 | 299.8 | 26.7 | 0.003175 | 194.9 | 114.1 | 0.868 | 309.0 | 319.8 | 116.0 | 46.7 | 2.0 |
| 115 | 319.2 | 46.1 | 80.0 | 299.8 | 26.7 | 0.003175 | 200.7 | 117.8 | 0.869 | 318.4 | 320.4 | 117.1 | 47.3 | 2.1 |
| 116 | 319.8 | 46.7 | 80.0 | 299.8 | 26.7 | 0.003175 | 206.4 | 121.5 | 0.870 | 327.9 | 321.0 | 118.2 | 47.9 | 2.2 |
| 117 | 320.3 | 47.2 | 80.0 | 299.8 | 26.7 | 0.003175 | 212.1 | 125.2 | 0.871 | 337.3 | 321.6 | 119.2 | 48.5 | 2.2 |
| 118 | 320.9 | 47.8 | 80.0 | 299.8 | 26.7 | 0.003175 | 217.9 | 128.9 | 0.873 | 346.8 | 322.1 | 120.3 | 49.0 | 2.3 |
| 119 | 321.4 | 48.3 | 80.0 | 299.8 | 26.7 | 0.003175 | 223.6 | 132.7 | 0.874 | 356.3 | 322.7 | 121.3 | 49.6 | 2.3 |
| 120 | 322.0 | 48.9 | 80.0 | 299.8 | 26.7 | 0.003175 | 229.3 | 136.5 | 0.875 | 365.8 | 323.3 | 122.4 | 50.2 | 2.4 |
| 121 | 322.5 | 49.4 | 80.0 | 299.8 | 26.7 | 0.003175 | 235.1 | 140.3 | 0.876 | 375.3 | 323.9 | 123.4 | 50.8 | 2.4 |
| 122 | 323.1 | 50.0 | 80.0 | 299.8 | 26.7 | 0.003175 | 240.8 | 144.1 | 0.877 | 384.9 | 324.5 | 124.5 | 51.4 | 2.5 |
| 123 | 323.7 | 50.6 | 80.0 | 299.8 | 26.7 | 0.003175 | 246.5 | 147.9 | 0.879 | 394.4 | 325.1 | 125.6 | 52.0 | 2.6 |
| 124 | 324.2 | 51.1 | 80.0 | 299.8 | 26.7 | 0.003175 | 252.3 | 151.8 | 0.880 | 404.0 | 325.7 | 126.6 | 52.6 | 2.6 |
| 125 | 324.8 | 51.7 | 80.0 | 299.8 | 26.7 | 0.003175 | 258.0 | 155.6 | 0.881 | 413.6 | 326.3 | 127.7 | 53.2 | 2.7 |
| 126 | 325.3 | 52.2 | 80.0 | 299.8 | 26.7 | 0.003175 | 263.7 | 159.5 | 0.882 | 423.3 | 326.8 | 128.7 | 53.7 | 2.7 |
| 127 | 325.9 | 52.8 | 80.0 | 299.8 | 26.7 | 0.003175 | 269.5 | 163.4 | 0.884 | 432.9 | 327.4 | 129.8 | 54.3 | 2.8 |
| 128 | 326.4 | 53.3 | 80.0 | 299.8 | 26.7 | 0.003175 | 275.2 | 167.4 | 0.885 | 442.6 | 328.0 | 130.9 | 54.9 | 2.9 |
| 129 | 327.0 | 53.9 | 80.0 | 299.8 | 26.7 | 0.003175 | 280.9 | 171.3 | 0.886 | 452.3 | 328.6 | 131.9 | 55.5 | 2.9 |
| 130 | 327.5 | 54.4 | 80.0 | 299.8 | 26.7 | 0.003175 | 286.7 | 175.3 | 0.887 | 462.0 | 329.2 | 133.0 | 56.1 | 3.0 |
| 131 | 328.1 | 55.0 | 80.0 | 299.8 | 26.7 | 0.003175 | 292.4 | 179.3 | 0.888 | 471.7 | 329.8 | 134.0 | 56.7 | 3.0 |
| 132 | 328.7 | 55.6 | 80.0 | 299.8 | 26.7 | 0.003175 | 298.1 | 183.3 | 0.890 | 481.4 | 330.4 | 135.1 | 57.3 | 3.1 |
| 133 | 329.2 | 56.1 | 80.0 | 299.8 | 26.7 | 0.003175 | 303.9 | 187.4 | 0.891 | 491.2 | 331.0 | 136.2 | 57.9 | 3.2 |

**Table 1. Calculation of Sodalime Glass Temperatures, when material thickness, t = 0.125 inches**

| $T_{room}$ | | | $T_{ambient}$ | | | $t_{glass}$ | q - conv room | q - emitted rad room | k - sodalime glass | $q_{cond}$ glass | $T_{fire}$ | | | Δ $T_{fire}$_$T_{room}$ |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| °F | °K | °C | °F | °K | °C | m | Watts/m² | Watts/m² | Watts/°K*m | Watts/m² | °K | °F | °C | °F |
| 134 | 329.8 | 56.7 | 80.0 | 299.8 | 26.7 | 0.003175 | 309.6 | 191.4 | 0.892 | 501.0 | 331.5 | 137.2 | 58.4 | 3.2 |
| 135 | 330.3 | 57.2 | 80.0 | 299.8 | 26.7 | 0.003175 | 315.3 | 195.5 | 0.893 | 510.8 | 332.1 | 138.3 | 59.0 | 3.3 |
| 136 | 330.9 | 57.8 | 80.0 | 299.8 | 26.7 | 0.003175 | 321.1 | 199.6 | 0.895 | 520.6 | 332.7 | 139.3 | 59.6 | 3.3 |
| 137 | 331.4 | 58.3 | 80.0 | 299.8 | 26.7 | 0.003175 | 326.8 | 203.7 | 0.896 | 530.5 | 333.3 | 140.4 | 60.2 | 3.4 |
| 138 | 332.0 | 58.9 | 80.0 | 299.8 | 26.7 | 0.003175 | 332.5 | 207.8 | 0.897 | 540.4 | 333.9 | 141.4 | 60.8 | 3.4 |
| 139 | 332.5 | 59.4 | 80.0 | 299.8 | 26.7 | 0.003175 | 338.3 | 212.0 | 0.898 | 550.3 | 334.5 | 142.5 | 61.4 | 3.5 |
| 140 | 333.1 | 60.0 | 80.0 | 299.8 | 26.7 | 0.003175 | 344.0 | 216.2 | 0.899 | 560.2 | 335.1 | 143.6 | 62.0 | 3.6 |
| 141 | 333.7 | 60.6 | 80.0 | 299.8 | 26.7 | 0.003175 | 349.7 | 220.4 | 0.901 | 570.1 | 335.7 | 144.6 | 62.6 | 3.6 |
| 142 | 334.2 | 61.1 | 80.0 | 299.8 | 26.7 | 0.003175 | 355.5 | 224.6 | 0.902 | 580.1 | 336.3 | 145.7 | 63.2 | 3.7 |
| 143 | 334.8 | 61.7 | 80.0 | 299.8 | 26.7 | 0.003175 | 361.2 | 228.8 | 0.903 | 590.0 | 336.8 | 146.7 | 63.7 | 3.7 |
| 144 | 335.3 | 62.2 | 80.0 | 299.8 | 26.7 | 0.003175 | 366.9 | 233.1 | 0.904 | 600.0 | 337.4 | 147.8 | 64.3 | 3.8 |
| 145 | 335.9 | 62.8 | 80.0 | 299.8 | 26.7 | 0.003175 | 372.7 | 237.4 | 0.906 | 610.1 | 338.0 | 148.9 | 64.9 | 3.9 |
| 146 | 336.4 | 63.3 | 80.0 | 299.8 | 26.7 | 0.003175 | 378.4 | 241.7 | 0.907 | 620.1 | 338.6 | 149.9 | 65.5 | 3.9 |
| 147 | 337.0 | 63.9 | 80.0 | 299.8 | 26.7 | 0.003175 | 384.1 | 246.0 | 0.908 | 630.2 | 339.2 | 151.0 | 66.1 | 4.0 |
| 148 | 337.5 | 64.4 | 80.0 | 299.8 | 26.7 | 0.003175 | 389.9 | 250.4 | 0.909 | 640.3 | 339.8 | 152.0 | 66.7 | 4.0 |
| 149 | 338.1 | 65.0 | 80.0 | 299.8 | 26.7 | 0.003175 | 395.6 | 254.8 | 0.910 | 650.4 | 340.4 | 153.1 | 67.3 | 4.1 |
| 150 | 338.7 | 65.6 | 80.0 | 299.8 | 26.7 | 0.003175 | 401.3 | 259.2 | 0.912 | 660.5 | 341.0 | 154.1 | 67.9 | 4.1 |
| 151 | 339.2 | 66.1 | 80.0 | 299.8 | 26.7 | 0.003175 | 407.1 | 263.6 | 0.913 | 670.6 | 341.5 | 155.2 | 68.4 | 4.2 |
| 152 | 339.8 | 66.7 | 80.0 | 299.8 | 26.7 | 0.003175 | 412.8 | 268.0 | 0.914 | 680.8 | 342.1 | 156.3 | 69.0 | 4.3 |
| 153 | 340.3 | 67.2 | 80.0 | 299.8 | 26.7 | 0.003175 | 418.5 | 272.5 | 0.915 | 691.0 | 342.7 | 157.3 | 69.6 | 4.3 |
| 154 | 340.9 | 67.8 | 80.0 | 299.8 | 26.7 | 0.003175 | 424.3 | 276.9 | 0.917 | 701.2 | 343.3 | 158.4 | 70.2 | 4.4 |
| 155 | 341.4 | 68.3 | 80.0 | 299.8 | 26.7 | 0.003175 | 430.0 | 281.4 | 0.918 | 711.4 | 343.9 | 159.4 | 70.8 | 4.4 |
| 156 | 342.0 | 68.9 | 80.0 | 299.8 | 26.7 | 0.003175 | 435.7 | 286.0 | 0.919 | 721.7 | 344.5 | 160.5 | 71.4 | 4.5 |

**Table 1. Calculation of Sodalime Glass Temperatures, when material thickness, t = 0.125 inches**

| $T_{room}$ | | | $T_{ambient}$ | | | $t_{glass}$ | q - conv room | q - emitted rad room | k - sodalime glass | $q_{cond}$ glass | $T_{fire}$ | | | Δ $T_{fire}$_$T_{room}$ |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| °F | °K | °C | °F | °K | °C | m | Watts/ m² | Watts/ m² | Watts/ °K*m | Watts/ m² | °K | °F | °C | °F |
| 157 | 342.5 | 69.4 | 80.0 | 299.8 | 26.7 | 0.003175 | 441.5 | 290.5 | 0.920 | 732.0 | 345.1 | 161.5 | 72.0 | 4.5 |
| 158 | 343.1 | 70.0 | 80.0 | 299.8 | 26.7 | 0.003175 | 447.2 | 295.1 | 0.921 | 742.3 | 345.7 | 162.6 | 72.6 | 4.6 |
| 159 | 343.7 | 70.6 | 80.0 | 299.8 | 26.7 | 0.003175 | 452.9 | 299.7 | 0.923 | 752.6 | 346.2 | 163.7 | 73.1 | 4.7 |
| 160 | 344.2 | 71.1 | 80.0 | 299.8 | 26.7 | 0.003175 | 458.7 | 304.3 | 0.924 | 763.0 | 346.8 | 164.7 | 73.7 | 4.7 |
| 161 | 344.8 | 71.7 | 80.0 | 299.8 | 26.7 | 0.003175 | 464.4 | 308.9 | 0.925 | 773.3 | 347.4 | 165.8 | 74.3 | 4.8 |
| 162 | 345.3 | 72.2 | 80.0 | 299.8 | 26.7 | 0.003175 | 470.1 | 313.6 | 0.926 | 783.7 | 348.0 | 166.8 | 74.9 | 4.8 |
| 163 | 345.9 | 72.8 | 80.0 | 299.8 | 26.7 | 0.003175 | 475.9 | 318.3 | 0.928 | 794.1 | 348.6 | 167.9 | 75.5 | 4.9 |
| 164 | 346.4 | 73.3 | 80.0 | 299.8 | 26.7 | 0.003175 | 481.6 | 323.0 | 0.929 | 804.6 | 349.2 | 169.0 | 76.1 | 5.0 |
| 165 | 347.0 | 73.9 | 80.0 | 299.8 | 26.7 | 0.003175 | 487.3 | 327.7 | 0.930 | 815.0 | 349.8 | 170.0 | 76.7 | 5.0 |
| 166 | 347.5 | 74.4 | 80.0 | 299.8 | 26.7 | 0.003175 | 493.1 | 332.4 | 0.931 | 825.5 | 350.4 | 171.1 | 77.3 | 5.1 |
| 167 | 348.1 | 75.0 | 80.0 | 299.8 | 26.7 | 0.003175 | 498.8 | 337.2 | 0.932 | 836.0 | 350.9 | 172.1 | 77.8 | 5.1 |
| 168 | 348.7 | 75.6 | 80.0 | 299.8 | 26.7 | 0.003175 | 504.5 | 342.0 | 0.934 | 846.5 | 351.5 | 173.2 | 78.4 | 5.2 |
| 169 | 349.2 | 76.1 | 80.0 | 299.8 | 26.7 | 0.003175 | 510.3 | 346.8 | 0.935 | 857.1 | 352.1 | 174.2 | 79.0 | 5.2 |
| 170 | 349.8 | 76.7 | 80.0 | 299.8 | 26.7 | 0.003175 | 516.0 | 351.7 | 0.936 | 867.7 | 352.7 | 175.3 | 79.6 | 5.3 |
| 171 | 350.3 | 77.2 | 80.0 | 299.8 | 26.7 | 0.003175 | 521.7 | 356.5 | 0.937 | 878.3 | 353.3 | 176.4 | 80.2 | 5.4 |
| 172 | 350.9 | 77.8 | 80.0 | 299.8 | 26.7 | 0.003175 | 527.5 | 361.4 | 0.939 | 888.9 | 353.9 | 177.4 | 80.8 | 5.4 |
| 454 | 507.5 | 234.4 | 80.0 | 299.8 | 26.7 | 0.003175 | 2144.3 | 2974.2 | 1.283 | 5118.5 | 520.2 | 476.8 | 247.1 | 22.8 |

| Table 2. Calculation of Sodalime Glass Temperatures, when material thickness, t = 0.250 inches | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| $T_{room}$ | | | $T_{ambient}$ | | | $t_{glass}$ | q - conv room | q - emitted rad room | k - sodalime glass | $q_{cond}$ glass | $T_{fire}$ | | | Δ $T_{fire}$_$T_{room}$ |
| °F | °K | °C | °F | °K | °C | m | Watts/ $m^2$ | Watts/ $m^2$ | Watts /°K*m | Watts/ $m^2$ | °K | °F | °C | °F |
| 111 | 317.0 | 43.9 | 80.0 | 299.8 | 26.7 | 0.006350 | 177.7 | 103.2 | 0.864 | 280.9 | 319.1 | 114.7 | 46.0 | 3.7 |
| 112 | 317.5 | 44.4 | 80.0 | 299.8 | 26.7 | 0.006350 | 183.5 | 106.8 | 0.865 | 290.3 | 319.7 | 115.8 | 46.6 | 3.8 |
| 113 | 318.1 | 45.0 | 80.0 | 299.8 | 26.7 | 0.006350 | 189.2 | 110.4 | 0.866 | 299.6 | 320.3 | 117.0 | 47.2 | 4.0 |
| 114 | 318.7 | 45.6 | 80.0 | 299.8 | 26.7 | 0.006350 | 194.9 | 114.1 | 0.868 | 309.0 | 320.9 | 118.1 | 47.8 | 4.1 |
| 115 | 319.2 | 46.1 | 80.0 | 299.8 | 26.7 | 0.006350 | 200.7 | 117.8 | 0.869 | 318.4 | 321.5 | 119.2 | 48.4 | 4.2 |
| 116 | 319.8 | 46.7 | 80.0 | 299.8 | 26.7 | 0.006350 | 206.4 | 121.5 | 0.870 | 327.9 | 322.2 | 120.3 | 49.1 | 4.3 |
| 117 | 320.3 | 47.2 | 80.0 | 299.8 | 26.7 | 0.006350 | 212.1 | 125.2 | 0.871 | 337.3 | 322.8 | 121.4 | 49.7 | 4.4 |
| 118 | 320.9 | 47.8 | 80.0 | 299.8 | 26.7 | 0.006350 | 217.9 | 128.9 | 0.873 | 346.8 | 323.4 | 122.5 | 50.3 | 4.5 |
| 119 | 321.4 | 48.3 | 80.0 | 299.8 | 26.7 | 0.006350 | 223.6 | 132.7 | 0.874 | 356.3 | 324.0 | 123.7 | 50.9 | 4.7 |
| 120 | 322.0 | 48.9 | 80.0 | 299.8 | 26.7 | 0.006350 | 229.3 | 136.5 | 0.875 | 365.8 | 324.6 | 124.8 | 51.5 | 4.8 |
| 121 | 322.5 | 49.4 | 80.0 | 299.8 | 26.7 | 0.006350 | 235.1 | 140.3 | 0.876 | 375.3 | 325.3 | 125.9 | 52.2 | 4.9 |
| 122 | 323.1 | 50.0 | 80.0 | 299.8 | 26.7 | 0.006350 | 240.8 | 144.1 | 0.877 | 384.9 | 325.9 | 127.0 | 52.8 | 5.0 |
| 123 | 323.7 | 50.6 | 80.0 | 299.8 | 26.7 | 0.006350 | 246.5 | 147.9 | 0.879 | 394.4 | 326.5 | 128.1 | 53.4 | 5.1 |
| 124 | 324.2 | 51.1 | 80.0 | 299.8 | 26.7 | 0.006350 | 252.3 | 151.8 | 0.880 | 404.0 | 327.1 | 129.2 | 54.0 | 5.2 |
| 125 | 324.8 | 51.7 | 80.0 | 299.8 | 26.7 | 0.006350 | 258.0 | 155.6 | 0.881 | 413.6 | 327.7 | 130.4 | 54.6 | 5.4 |
| 126 | 325.3 | 52.2 | 80.0 | 299.8 | 26.7 | 0.006350 | 263.7 | 159.5 | 0.882 | 423.3 | 328.4 | 131.5 | 55.3 | 5.5 |
| 127 | 325.9 | 52.8 | 80.0 | 299.8 | 26.7 | 0.006350 | 269.5 | 163.4 | 0.884 | 432.9 | 329.0 | 132.6 | 55.9 | 5.6 |
| 128 | 326.4 | 53.3 | 80.0 | 299.8 | 26.7 | 0.006350 | 275.2 | 167.4 | 0.885 | 442.6 | 329.6 | 133.7 | 56.5 | 5.7 |
| 129 | 327.0 | 53.9 | 80.0 | 299.8 | 26.7 | 0.006350 | 280.9 | 171.3 | 0.886 | 452.3 | 330.2 | 134.8 | 57.1 | 5.8 |
| 130 | 327.5 | 54.4 | 80.0 | 299.8 | 26.7 | 0.006350 | 286.7 | 175.3 | 0.887 | 462.0 | 330.9 | 136.0 | 57.8 | 6.0 |
| 131 | 328.1 | 55.0 | 80.0 | 299.8 | 26.7 | 0.006350 | 292.4 | 179.3 | 0.888 | 471.7 | 331.5 | 137.1 | 58.4 | 6.1 |
| 132 | 328.7 | 55.6 | 80.0 | 299.8 | 26.7 | 0.006350 | 298.1 | 183.3 | 0.890 | 481.4 | 332.1 | 138.2 | 59.0 | 6.2 |

| Table 2. Calculation of Sodalime Glass Temperatures, when material thickness, t = 0.250 inches | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| $T_{room}$ | | | $T_{ambient}$ | | | $t_{glass}$ | q - conv room | q - emitted rad room | k - sodalime glass | $q_{cond}$ glass | $T_{fire}$ | | | Δ $T_{fire}$_$T_{room}$ |
| °F | °K | °C | °F | °K | °C | m | Watts/ $m^2$ | Watts/ $m^2$ | Watts /°K*m | Watts/ $m^2$ | °K | °F | °C | °F |
| 133 | 329.2 | 56.1 | 80.0 | 299.8 | 26.7 | 0.006350 | 303.9 | 187.4 | 0.891 | 491.2 | 332.7 | 139.3 | 59.6 | 6.3 |
| 134 | 329.8 | 56.7 | 80.0 | 299.8 | 26.7 | 0.006350 | 309.6 | 191.4 | 0.892 | 501.0 | 333.3 | 140.4 | 60.2 | 6.4 |
| 135 | 330.3 | 57.2 | 80.0 | 299.8 | 26.7 | 0.006350 | 315.3 | 195.5 | 0.893 | 510.8 | 334.0 | 141.5 | 60.9 | 6.5 |
| 136 | 330.9 | 57.8 | 80.0 | 299.8 | 26.7 | 0.006350 | 321.1 | 199.6 | 0.895 | 520.6 | 334.6 | 142.7 | 61.5 | 6.7 |
| 137 | 331.4 | 58.3 | 80.0 | 299.8 | 26.7 | 0.006350 | 326.8 | 203.7 | 0.896 | 530.5 | 335.2 | 143.8 | 62.1 | 6.8 |
| 138 | 332.0 | 58.9 | 80.0 | 299.8 | 26.7 | 0.006350 | 332.5 | 207.8 | 0.897 | 540.4 | 335.8 | 144.9 | 62.7 | 6.9 |
| 139 | 332.5 | 59.4 | 80.0 | 299.8 | 26.7 | 0.006350 | 338.3 | 212.0 | 0.898 | 550.3 | 336.4 | 146.0 | 63.3 | 7.0 |
| 140 | 333.1 | 60.0 | 80.0 | 299.8 | 26.7 | 0.006350 | 344.0 | 216.2 | 0.899 | 560.2 | 337.1 | 147.1 | 64.0 | 7.1 |
| 141 | 333.7 | 60.6 | 80.0 | 299.8 | 26.7 | 0.006350 | 349.7 | 220.4 | 0.901 | 570.1 | 337.7 | 148.2 | 64.6 | 7.2 |
| 142 | 334.2 | 61.1 | 80.0 | 299.8 | 26.7 | 0.006350 | 355.5 | 224.6 | 0.902 | 580.1 | 338.3 | 149.4 | 65.2 | 7.4 |
| 143 | 334.8 | 61.7 | 80.0 | 299.8 | 26.7 | 0.006350 | 361.2 | 228.8 | 0.903 | 590.0 | 338.9 | 150.5 | 65.8 | 7.5 |
| 144 | 335.3 | 62.2 | 80.0 | 299.8 | 26.7 | 0.006350 | 366.9 | 233.1 | 0.904 | 600.0 | 339.5 | 151.6 | 66.4 | 7.6 |
| 145 | 335.9 | 62.8 | 80.0 | 299.8 | 26.7 | 0.006350 | 372.7 | 237.4 | 0.906 | 610.1 | 340.2 | 152.7 | 67.1 | 7.7 |
| 146 | 336.4 | 63.3 | 80.0 | 299.8 | 26.7 | 0.006350 | 378.4 | 241.7 | 0.907 | 620.1 | 340.8 | 153.8 | 67.7 | 7.8 |
| 147 | 337.0 | 63.9 | 80.0 | 299.8 | 26.7 | 0.006350 | 384.1 | 246.0 | 0.908 | 630.2 | 341.4 | 154.9 | 68.3 | 7.9 |
| 148 | 337.5 | 64.4 | 80.0 | 299.8 | 26.7 | 0.006350 | 389.9 | 250.4 | 0.909 | 640.3 | 342.0 | 156.0 | 68.9 | 8.0 |
| 149 | 338.1 | 65.0 | 80.0 | 299.8 | 26.7 | 0.006350 | 395.6 | 254.8 | 0.910 | 650.4 | 342.6 | 157.2 | 69.5 | 8.2 |
| 150 | 338.7 | 65.6 | 80.0 | 299.8 | 26.7 | 0.006350 | 401.3 | 259.2 | 0.912 | 660.5 | 343.3 | 158.3 | 70.2 | 8.3 |
| 151 | 339.2 | 66.1 | 80.0 | 299.8 | 26.7 | 0.006350 | 407.1 | 263.6 | 0.913 | 670.6 | 343.9 | 159.4 | 70.8 | 8.4 |
| 152 | 339.8 | 66.7 | 80.0 | 299.8 | 26.7 | 0.006350 | 412.8 | 268.0 | 0.914 | 680.8 | 344.5 | 160.5 | 71.4 | 8.5 |
| 153 | 340.3 | 67.2 | 80.0 | 299.8 | 26.7 | 0.006350 | 418.5 | 272.5 | 0.915 | 691.0 | 345.1 | 161.6 | 72.0 | 8.6 |
| 154 | 340.9 | 67.8 | 80.0 | 299.8 | 26.7 | 0.006350 | 424.3 | 276.9 | 0.917 | 701.2 | 345.7 | 162.7 | 72.6 | 8.7 |
| 155 | 341.4 | 68.3 | 80.0 | 299.8 | 26.7 | 0.006350 | 430.0 | 281.4 | 0.918 | 711.4 | 346.4 | 163.9 | 73.3 | 8.9 |

| Table 2. Calculation of Sodalime Glass Temperatures, when material thickness, t = 0.250 inches | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| $T_{room}$ | | | $T_{ambient}$ | | | $t_{glass}$ | q - conv room | q - emitted rad room | k - sodalime glass | $q_{cond}$ glass | $T_{fire}$ | | | Δ $T_{fire}$_$T_{room}$ |
| °F | °K | °C | °F | °K | °C | m | Watts/ $m^2$ | Watts/ $m^2$ | Watts /°K*m | Watts/ $m^2$ | °K | °F | °C | °F |
| 156 | 342.0 | 68.9 | 80.0 | 299.8 | 26.7 | 0.006350 | 435.7 | 286.0 | 0.919 | 721.7 | 347.0 | 165.0 | 73.9 | 9.0 |
| 157 | 342.5 | 69.4 | 80.0 | 299.8 | 26.7 | 0.006350 | 441.5 | 290.5 | 0.920 | 732.0 | 347.6 | 166.1 | 74.5 | 9.1 |
| 158 | 343.1 | 70.0 | 80.0 | 299.8 | 26.7 | 0.006350 | 447.2 | 295.1 | 0.921 | 742.3 | 348.2 | 167.2 | 75.1 | 9.2 |
| 159 | 343.7 | 70.6 | 80.0 | 299.8 | 26.7 | 0.006350 | 452.9 | 299.7 | 0.923 | 752.6 | 348.8 | 168.3 | 75.7 | 9.3 |
| 160 | 344.2 | 71.1 | 80.0 | 299.8 | 26.7 | 0.006350 | 458.7 | 304.3 | 0.924 | 763.0 | 349.5 | 169.4 | 76.4 | 9.4 |
| 161 | 344.8 | 71.7 | 80.0 | 299.8 | 26.7 | 0.006350 | 464.4 | 308.9 | 0.925 | 773.3 | 350.1 | 170.6 | 77.0 | 9.6 |
| 162 | 345.3 | 72.2 | 80.0 | 299.8 | 26.7 | 0.006350 | 470.1 | 313.6 | 0.926 | 783.7 | 350.7 | 171.7 | 77.6 | 9.7 |
| 163 | 345.9 | 72.8 | 80.0 | 299.8 | 26.7 | 0.006350 | 475.9 | 318.3 | 0.928 | 794.1 | 351.3 | 172.8 | 78.2 | 9.8 |
| 164 | 346.4 | 73.3 | 80.0 | 299.8 | 26.7 | 0.006350 | 481.6 | 323.0 | 0.929 | 804.6 | 351.9 | 173.9 | 78.8 | 9.9 |
| 165 | 347.0 | 73.9 | 80.0 | 299.8 | 26.7 | 0.006350 | 487.3 | 327.7 | 0.930 | 815.0 | 352.6 | 175.0 | 79.5 | 10.0 |
| 166 | 347.5 | 74.4 | 80.0 | 299.8 | 26.7 | 0.006350 | 493.1 | 332.4 | 0.931 | 825.5 | 353.2 | 176.1 | 80.1 | 10.1 |
| 167 | 348.1 | 75.0 | 80.0 | 299.8 | 26.7 | 0.006350 | 498.8 | 337.2 | 0.932 | 836.0 | 353.8 | 177.2 | 80.7 | 10.2 |
| 168 | 348.7 | 75.6 | 80.0 | 299.8 | 26.7 | 0.006350 | 504.5 | 342.0 | 0.934 | 846.5 | 354.4 | 178.4 | 81.3 | 10.4 |
| 169 | 349.2 | 76.1 | 80.0 | 299.8 | 26.7 | 0.006350 | 510.3 | 346.8 | 0.935 | 857.1 | 355.0 | 179.5 | 81.9 | 10.5 |
| 170 | 349.8 | 76.7 | 80.0 | 299.8 | 26.7 | 0.006350 | 516.0 | 351.7 | 0.936 | 867.7 | 355.7 | 180.6 | 82.6 | 10.6 |
| 171 | 350.3 | 77.2 | 80.0 | 299.8 | 26.7 | 0.006350 | 521.7 | 356.5 | 0.937 | 878.3 | 356.3 | 181.7 | 83.2 | 10.7 |
| 172 | 350.9 | 77.8 | 80.0 | 299.8 | 26.7 | 0.006350 | 527.5 | 361.4 | 0.939 | 888.9 | 356.9 | 182.8 | 83.8 | 10.8 |
| 454 | 507.5 | 234.4 | 80.0 | 299.8 | 26.7 | 0.006350 | 2144.3 | 2974.2 | 1.283 | 5118.5 | 532.9 | 499.6 | 259.8 | 45.6 |

| Table 3. Calculation of Borasillicate Glass Temperatures, when material thickness, t = 0.125 inches | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| $T_{room}$ | | | $T_{ambient}$ | | | $t_{glass}$ | q - conv room | q - emitted rad room | k - Borasillicate glass | $q_{cond}$ glass | $T_{fire}$ | | | Δ $T_{fire}$_$T_{room}$ |
| $^oF$ | $^oK$ | $^oC$ | $^oF$ | $^oK$ | $^oC$ | m | Watts/ $m^2$ | Watts/ $m^2$ | Watts /$^oK$*m | Watts/ $m^2$ | $^oK$ | $^oF$ | $^oC$ | $^oF$ |
| 111 | 317.0 | 43.9 | 80.0 | 299.8 | 26.7 | 0.003175 | 177.7 | 103.2 | 1.310 | 280.9 | 317.7 | 112.2 | 44.6 | 1.2 |
| 112 | 317.5 | 44.4 | 80.0 | 299.8 | 26.7 | 0.003175 | 183.5 | 106.8 | 1.310 | 290.3 | 318.2 | 113.3 | 45.1 | 1.3 |
| 113 | 318.1 | 45.0 | 80.0 | 299.8 | 26.7 | 0.003175 | 189.2 | 110.4 | 1.310 | 299.6 | 318.8 | 114.3 | 45.7 | 1.3 |
| 114 | 318.7 | 45.6 | 80.0 | 299.8 | 26.7 | 0.003175 | 194.9 | 114.1 | 1.310 | 309.0 | 319.4 | 115.3 | 46.3 | 1.3 |
| 115 | 319.2 | 46.1 | 80.0 | 299.8 | 26.7 | 0.003175 | 200.7 | 117.8 | 1.310 | 318.4 | 320.0 | 116.4 | 46.9 | 1.4 |
| 116 | 319.8 | 46.7 | 80.0 | 299.8 | 26.7 | 0.003175 | 206.4 | 121.5 | 1.310 | 327.9 | 320.6 | 117.4 | 47.5 | 1.4 |
| 117 | 320.3 | 47.2 | 80.0 | 299.8 | 26.7 | 0.003175 | 212.1 | 125.2 | 1.310 | 337.3 | 321.1 | 118.5 | 48.0 | 1.5 |
| 118 | 320.9 | 47.8 | 80.0 | 299.8 | 26.7 | 0.003175 | 217.9 | 128.9 | 1.310 | 346.8 | 321.7 | 119.5 | 48.6 | 1.5 |
| 119 | 321.4 | 48.3 | 80.0 | 299.8 | 26.7 | 0.003175 | 223.6 | 132.7 | 1.310 | 356.3 | 322.3 | 120.6 | 49.2 | 1.6 |
| 120 | 322.0 | 48.9 | 80.0 | 299.8 | 26.7 | 0.003175 | 229.3 | 136.5 | 1.310 | 365.8 | 322.9 | 121.6 | 49.8 | 1.6 |
| 121 | 322.5 | 49.4 | 80.0 | 299.8 | 26.7 | 0.003175 | 235.1 | 140.3 | 1.310 | 375.3 | 323.5 | 122.6 | 50.4 | 1.6 |
| 122 | 323.1 | 50.0 | 80.0 | 299.8 | 26.7 | 0.003175 | 240.8 | 144.1 | 1.310 | 384.9 | 324.0 | 123.7 | 50.9 | 1.7 |
| 123 | 323.7 | 50.6 | 80.0 | 299.8 | 26.7 | 0.003175 | 246.5 | 147.9 | 1.310 | 394.4 | 324.6 | 124.7 | 51.5 | 1.7 |
| 124 | 324.2 | 51.1 | 80.0 | 299.8 | 26.7 | 0.003175 | 252.3 | 151.8 | 1.310 | 404.0 | 325.2 | 125.8 | 52.1 | 1.8 |
| 125 | 324.8 | 51.7 | 80.0 | 299.8 | 26.7 | 0.003175 | 258.0 | 155.6 | 1.310 | 413.6 | 325.8 | 126.8 | 52.7 | 1.8 |
| 126 | 325.3 | 52.2 | 80.0 | 299.8 | 26.7 | 0.003175 | 263.7 | 159.5 | 1.310 | 423.3 | 326.3 | 127.8 | 53.2 | 1.8 |
| 127 | 325.9 | 52.8 | 80.0 | 299.8 | 26.7 | 0.003175 | 269.5 | 163.4 | 1.310 | 432.9 | 326.9 | 128.9 | 53.8 | 1.9 |
| 128 | 326.4 | 53.3 | 80.0 | 299.8 | 26.7 | 0.003175 | 275.2 | 167.4 | 1.310 | 442.6 | 327.5 | 129.9 | 54.4 | 1.9 |
| 129 | 327.0 | 53.9 | 80.0 | 299.8 | 26.7 | 0.003175 | 280.9 | 171.3 | 1.310 | 452.3 | 328.1 | 131.0 | 55.0 | 2.0 |
| 130 | 327.5 | 54.4 | 80.0 | 299.8 | 26.7 | 0.003175 | 286.7 | 175.3 | 1.310 | 462.0 | 328.7 | 132.0 | 55.6 | 2.0 |
| 131 | 328.1 | 55.0 | 80.0 | 299.8 | 26.7 | 0.003175 | 292.4 | 179.3 | 1.310 | 471.7 | 329.2 | 133.1 | 56.1 | 2.1 |
| 132 | 328.7 | 55.6 | 80.0 | 299.8 | 26.7 | 0.003175 | 298.1 | 183.3 | 1.310 | 481.4 | 329.8 | 134.1 | 56.7 | 2.1 |
| 133 | 329.2 | 56.1 | 80.0 | 299.8 | 26.7 | 0.003175 | 303.9 | 187.4 | 1.310 | 491.2 | 330.4 | 135.1 | 57.3 | 2.1 |

**Table 3. Calculation of Borasillicate Glass Temperatures, when material thickness, t = 0.125 inches**

| $T_{room}$ | | | $T_{ambient}$ | | | $t_{glass}$ | q - conv room | q - emitted rad room | k - Borasillicate glass | $q_{cond}$ glass | $T_{fire}$ | | | Δ $T_{fire}$_$T_{room}$ |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| °F | °K | °C | °F | °K | °C | m | Watts/m² | Watts/m² | Watts/°K*m | Watts/m² | °K | °F | °C | °F |
| 134 | 329.8 | 56.7 | 80.0 | 299.8 | 26.7 | 0.003175 | 309.6 | 191.4 | 1.310 | 501.0 | 331.0 | 136.2 | 57.9 | 2.2 |
| 135 | 330.3 | 57.2 | 80.0 | 299.8 | 26.7 | 0.003175 | 315.3 | 195.5 | 1.310 | 510.8 | 331.6 | 137.2 | 58.5 | 2.2 |
| 136 | 330.9 | 57.8 | 80.0 | 299.8 | 26.7 | 0.003175 | 321.1 | 199.6 | 1.310 | 520.6 | 332.1 | 138.3 | 59.0 | 2.3 |
| 137 | 331.4 | 58.3 | 80.0 | 299.8 | 26.7 | 0.003175 | 326.8 | 203.7 | 1.310 | 530.5 | 332.7 | 139.3 | 59.6 | 2.3 |
| 138 | 332.0 | 58.9 | 80.0 | 299.8 | 26.7 | 0.003175 | 332.5 | 207.8 | 1.310 | 540.4 | 333.3 | 140.4 | 60.2 | 2.4 |
| 139 | 332.5 | 59.4 | 80.0 | 299.8 | 26.7 | 0.003175 | 338.3 | 212.0 | 1.310 | 550.3 | 333.9 | 141.4 | 60.8 | 2.4 |
| 140 | 333.1 | 60.0 | 80.0 | 299.8 | 26.7 | 0.003175 | 344.0 | 216.2 | 1.310 | 560.2 | 334.5 | 142.4 | 61.4 | 2.4 |
| 141 | 333.7 | 60.6 | 80.0 | 299.8 | 26.7 | 0.003175 | 349.7 | 220.4 | 1.310 | 570.1 | 335.0 | 143.5 | 61.9 | 2.5 |
| 142 | 334.2 | 61.1 | 80.0 | 299.8 | 26.7 | 0.003175 | 355.5 | 224.6 | 1.310 | 580.1 | 335.6 | 144.5 | 62.5 | 2.5 |
| 143 | 334.8 | 61.7 | 80.0 | 299.8 | 26.7 | 0.003175 | 361.2 | 228.8 | 1.310 | 590.0 | 336.2 | 145.6 | 63.1 | 2.6 |
| 144 | 335.3 | 62.2 | 80.0 | 299.8 | 26.7 | 0.003175 | 366.9 | 233.1 | 1.310 | 600.0 | 336.8 | 146.6 | 63.7 | 2.6 |
| 145 | 335.9 | 62.8 | 80.0 | 299.8 | 26.7 | 0.003175 | 372.7 | 237.4 | 1.310 | 610.1 | 337.4 | 147.7 | 64.3 | 2.7 |
| 146 | 336.4 | 63.3 | 80.0 | 299.8 | 26.7 | 0.003175 | 378.4 | 241.7 | 1.310 | 620.1 | 337.9 | 148.7 | 64.8 | 2.7 |
| 147 | 337.0 | 63.9 | 80.0 | 299.8 | 26.7 | 0.003175 | 384.1 | 246.0 | 1.310 | 630.2 | 338.5 | 149.7 | 65.4 | 2.7 |
| 148 | 337.5 | 64.4 | 80.0 | 299.8 | 26.7 | 0.003175 | 389.9 | 250.4 | 1.310 | 640.3 | 339.1 | 150.8 | 66.0 | 2.8 |
| 149 | 338.1 | 65.0 | 80.0 | 299.8 | 26.7 | 0.003175 | 395.6 | 254.8 | 1.310 | 650.4 | 339.7 | 151.8 | 66.6 | 2.8 |
| 150 | 338.7 | 65.6 | 80.0 | 299.8 | 26.7 | 0.003175 | 401.3 | 259.2 | 1.310 | 660.5 | 340.3 | 152.9 | 67.2 | 2.9 |
| 151 | 339.2 | 66.1 | 80.0 | 299.8 | 26.7 | 0.003175 | 407.1 | 263.6 | 1.310 | 670.6 | 340.8 | 153.9 | 67.7 | 2.9 |
| 152 | 339.8 | 66.7 | 80.0 | 299.8 | 26.7 | 0.003175 | 412.8 | 268.0 | 1.310 | 680.8 | 341.4 | 155.0 | 68.3 | 3.0 |
| 153 | 340.3 | 67.2 | 80.0 | 299.8 | 26.7 | 0.003175 | 418.5 | 272.5 | 1.310 | 691.0 | 342.0 | 156.0 | 68.9 | 3.0 |
| 154 | 340.9 | 67.8 | 80.0 | 299.8 | 26.7 | 0.003175 | 424.3 | 276.9 | 1.310 | 701.2 | 342.6 | 157.1 | 69.5 | 3.1 |
| 155 | 341.4 | 68.3 | 80.0 | 299.8 | 26.7 | 0.003175 | 430.0 | 281.4 | 1.310 | 711.4 | 343.2 | 158.1 | 70.1 | 3.1 |
| 156 | 342.0 | 68.9 | 80.0 | 299.8 | 26.7 | 0.003175 | 435.7 | 286.0 | 1.310 | 721.7 | 343.7 | 159.1 | 70.6 | 3.1 |

**Table 3. Calculation of Borasillicate Glass Temperatures, when material thickness, t = 0.125 inches**

| $T_{room}$ | | | $T_{ambient}$ | | | $t_{glass}$ | q - conv room | q - emitted rad room | k - Borasillicate glass | $q_{cond}$ glass | $T_{fire}$ | | | Δ $T_{fire}$_$T_{room}$ |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| °F | °K | °C | °F | °K | °C | m | Watts/ $m^2$ | Watts/ $m^2$ | Watts /°K*m | Watts/ $m^2$ | °K | °F | °C | °F |
| 157 | 342.5 | 69.4 | 80.0 | 299.8 | 26.7 | 0.003175 | 441.5 | 290.5 | 1.310 | 732.0 | 344.3 | 160.2 | 71.2 | 3.2 |
| 158 | 343.1 | 70.0 | 80.0 | 299.8 | 26.7 | 0.003175 | 447.2 | 295.1 | 1.310 | 742.3 | 344.9 | 161.2 | 71.8 | 3.2 |
| 159 | 343.7 | 70.6 | 80.0 | 299.8 | 26.7 | 0.003175 | 452.9 | 299.7 | 1.310 | 752.6 | 345.5 | 162.3 | 72.4 | 3.3 |
| 160 | 344.2 | 71.1 | 80.0 | 299.8 | 26.7 | 0.003175 | 458.7 | 304.3 | 1.310 | 763.0 | 346.1 | 163.3 | 73.0 | 3.3 |
| 161 | 344.8 | 71.7 | 80.0 | 299.8 | 26.7 | 0.003175 | 464.4 | 308.9 | 1.310 | 773.3 | 346.6 | 164.4 | 73.5 | 3.4 |
| 162 | 345.3 | 72.2 | 80.0 | 299.8 | 26.7 | 0.003175 | 470.1 | 313.6 | 1.310 | 783.7 | 347.2 | 165.4 | 74.1 | 3.4 |
| 163 | 345.9 | 72.8 | 80.0 | 299.8 | 26.7 | 0.003175 | 475.9 | 318.3 | 1.310 | 794.1 | 347.8 | 166.5 | 74.7 | 3.5 |
| 164 | 346.4 | 73.3 | 80.0 | 299.8 | 26.7 | 0.003175 | 481.6 | 323.0 | 1.310 | 804.6 | 348.4 | 167.5 | 75.3 | 3.5 |
| 165 | 347.0 | 73.9 | 80.0 | 299.8 | 26.7 | 0.003175 | 487.3 | 327.7 | 1.310 | 815.0 | 349.0 | 168.6 | 75.9 | 3.6 |
| 166 | 347.5 | 74.4 | 80.0 | 299.8 | 26.7 | 0.003175 | 493.1 | 332.4 | 1.310 | 825.5 | 349.5 | 169.6 | 76.4 | 3.6 |
| 167 | 348.1 | 75.0 | 80.0 | 299.8 | 26.7 | 0.003175 | 498.8 | 337.2 | 1.310 | 836.0 | 350.1 | 170.6 | 77.0 | 3.6 |
| 168 | 348.7 | 75.6 | 80.0 | 299.8 | 26.7 | 0.003175 | 504.5 | 342.0 | 1.310 | 846.5 | 350.7 | 171.7 | 77.6 | 3.7 |
| 169 | 349.2 | 76.1 | 80.0 | 299.8 | 26.7 | 0.003175 | 510.3 | 346.8 | 1.310 | 857.1 | 351.3 | 172.7 | 78.2 | 3.7 |
| 170 | 349.8 | 76.7 | 80.0 | 299.8 | 26.7 | 0.003175 | 516.0 | 351.7 | 1.310 | 867.7 | 351.9 | 173.8 | 78.8 | 3.8 |
| 171 | 350.3 | 77.2 | 80.0 | 299.8 | 26.7 | 0.003175 | 521.7 | 356.5 | 1.310 | 878.3 | 352.5 | 174.8 | 79.4 | 3.8 |
| 172 | 350.9 | 77.8 | 80.0 | 299.8 | 26.7 | 0.003175 | 527.5 | 361.4 | 1.310 | 888.9 | 353.0 | 175.9 | 79.9 | 3.9 |
| 409 | 482.5 | 209.4 | 80.0 | 299.8 | 26.7 | 0.003175 | 1886.3 | 2354.7 | 1.310 | 4241.0 | 492.8 | 427.5 | 219.7 | 18.5 |

| Table 4. Calculation of Borasillicate Glass Temperatures, when material thickness, t = 0. 250 inches | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| $T_{room}$ | | | $T_{ambient}$ | | | $t_{glass}$ | q - conv room | q - emitted rad room | k - Borasillicate glass | $q_{cond}$ glass | $T_{fire}$ | | | Δ $T_{fire}$_$T_{room}$ |
| °F | °K | °C | °F | °K | °C | m | Watts/ m² | Watts/ m² | Watts /°K*m | Watts/ m² | °K | °F | °C | °F |
| 111 | 317.0 | 43.9 | 80.0 | 299.8 | 26.7 | 0.006350 | 177.7 | 103.2 | 1.310 | 280.9 | 318.4 | 113.5 | 45.3 | 2.5 |
| 112 | 317.5 | 44.4 | 80.0 | 299.8 | 26.7 | 0.006350 | 183.5 | 106.8 | 1.310 | 290.3 | 319.0 | 114.5 | 45.9 | 2.5 |
| 113 | 318.1 | 45.0 | 80.0 | 299.8 | 26.7 | 0.006350 | 189.2 | 110.4 | 1.310 | 299.6 | 319.6 | 115.6 | 46.5 | 2.6 |
| 114 | 318.7 | 45.6 | 80.0 | 299.8 | 26.7 | 0.006350 | 194.9 | 114.1 | 1.310 | 309.0 | 320.2 | 116.7 | 47.1 | 2.7 |
| 115 | 319.2 | 46.1 | 80.0 | 299.8 | 26.7 | 0.006350 | 200.7 | 117.8 | 1.310 | 318.4 | 320.8 | 117.8 | 47.7 | 2.8 |
| 116 | 319.8 | 46.7 | 80.0 | 299.8 | 26.7 | 0.006350 | 206.4 | 121.5 | 1.310 | 327.9 | 321.4 | 118.9 | 48.3 | 2.9 |
| 117 | 320.3 | 47.2 | 80.0 | 299.8 | 26.7 | 0.006350 | 212.1 | 125.2 | 1.310 | 337.3 | 322.0 | 119.9 | 48.9 | 2.9 |
| 118 | 320.9 | 47.8 | 80.0 | 299.8 | 26.7 | 0.006350 | 217.9 | 128.9 | 1.310 | 346.8 | 322.6 | 121.0 | 49.5 | 3.0 |
| 119 | 321.4 | 48.3 | 80.0 | 299.8 | 26.7 | 0.006350 | 223.6 | 132.7 | 1.310 | 356.3 | 323.2 | 122.1 | 50.1 | 3.1 |
| 120 | 322.0 | 48.9 | 80.0 | 299.8 | 26.7 | 0.006350 | 229.3 | 136.5 | 1.310 | 365.8 | 323.8 | 123.2 | 50.7 | 3.2 |
| 121 | 322.5 | 49.4 | 80.0 | 299.8 | 26.7 | 0.006350 | 235.1 | 140.3 | 1.310 | 375.3 | 324.4 | 124.3 | 51.3 | 3.3 |
| 122 | 323.1 | 50.0 | 80.0 | 299.8 | 26.7 | 0.006350 | 240.8 | 144.1 | 1.310 | 384.9 | 325.0 | 125.4 | 51.9 | 3.4 |
| 123 | 323.7 | 50.6 | 80.0 | 299.8 | 26.7 | 0.006350 | 246.5 | 147.9 | 1.310 | 394.4 | 325.6 | 126.4 | 52.5 | 3.4 |
| 124 | 324.2 | 51.1 | 80.0 | 299.8 | 26.7 | 0.006350 | 252.3 | 151.8 | 1.310 | 404.0 | 326.2 | 127.5 | 53.1 | 3.5 |
| 125 | 324.8 | 51.7 | 80.0 | 299.8 | 26.7 | 0.006350 | 258.0 | 155.6 | 1.310 | 413.6 | 326.8 | 128.6 | 53.7 | 3.6 |
| 126 | 325.3 | 52.2 | 80.0 | 299.8 | 26.7 | 0.006350 | 263.7 | 159.5 | 1.310 | 423.3 | 327.4 | 129.7 | 54.3 | 3.7 |
| 127 | 325.9 | 52.8 | 80.0 | 299.8 | 26.7 | 0.006350 | 269.5 | 163.4 | 1.310 | 432.9 | 328.0 | 130.8 | 54.9 | 3.8 |
| 128 | 326.4 | 53.3 | 80.0 | 299.8 | 26.7 | 0.006350 | 275.2 | 167.4 | 1.310 | 442.6 | 328.6 | 131.9 | 55.5 | 3.9 |
| 129 | 327.0 | 53.9 | 80.0 | 299.8 | 26.7 | 0.006350 | 280.9 | 171.3 | 1.310 | 452.3 | 329.2 | 132.9 | 56.1 | 3.9 |
| 130 | 327.5 | 54.4 | 80.0 | 299.8 | 26.7 | 0.006350 | 286.7 | 175.3 | 1.310 | 462.0 | 329.8 | 134.0 | 56.7 | 4.0 |
| 131 | 328.1 | 55.0 | 80.0 | 299.8 | 26.7 | 0.006350 | 292.4 | 179.3 | 1.310 | 471.7 | 330.4 | 135.1 | 57.3 | 4.1 |
| 132 | 328.7 | 55.6 | 80.0 | 299.8 | 26.7 | 0.006350 | 298.1 | 183.3 | 1.310 | 481.4 | 331.0 | 136.2 | 57.9 | 4.2 |

| Table 4. Calculation of Borasillicate Glass Temperatures, when material thickness, t = 0. 250 inches | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| $T_{room}$ | | | $T_{ambient}$ | | | $t_{glass}$ | q - conv room | q - emitted rad room | k - Borasillicate glass | $q_{cond}$ glass | $T_{fire}$ | | | Δ $T_{fire}$_$T_{room}$ |
| °F | °K | °C | °F | °K | °C | m | Watts/ m² | Watts/ m² | Watts /°K*m | Watts/ m² | °K | °F | °C | °F |
| 133 | 329.2 | 56.1 | 80.0 | 299.8 | 26.7 | 0.006350 | 303.9 | 187.4 | 1.310 | 491.2 | 331.6 | 137.3 | 58.5 | 4.3 |
| 134 | 329.8 | 56.7 | 80.0 | 299.8 | 26.7 | 0.006350 | 309.6 | 191.4 | 1.310 | 501.0 | 332.2 | 138.4 | 59.1 | 4.4 |
| 135 | 330.3 | 57.2 | 80.0 | 299.8 | 26.7 | 0.006350 | 315.3 | 195.5 | 1.310 | 510.8 | 332.8 | 139.5 | 59.7 | 4.5 |
| 136 | 330.9 | 57.8 | 80.0 | 299.8 | 26.7 | 0.006350 | 321.1 | 199.6 | 1.310 | 520.6 | 333.4 | 140.5 | 60.3 | 4.5 |
| 137 | 331.4 | 58.3 | 80.0 | 299.8 | 26.7 | 0.006350 | 326.8 | 203.7 | 1.310 | 530.5 | 334.0 | 141.6 | 60.9 | 4.6 |
| 138 | 332.0 | 58.9 | 80.0 | 299.8 | 26.7 | 0.006350 | 332.5 | 207.8 | 1.310 | 540.4 | 334.6 | 142.7 | 61.5 | 4.7 |
| 139 | 332.5 | 59.4 | 80.0 | 299.8 | 26.7 | 0.006350 | 338.3 | 212.0 | 1.310 | 550.3 | 335.2 | 143.8 | 62.1 | 4.8 |
| 140 | 333.1 | 60.0 | 80.0 | 299.8 | 26.7 | 0.006350 | 344.0 | 216.2 | 1.310 | 560.2 | 335.8 | 144.9 | 62.7 | 4.9 |
| 141 | 333.7 | 60.6 | 80.0 | 299.8 | 26.7 | 0.006350 | 349.7 | 220.4 | 1.310 | 570.1 | 336.4 | 146.0 | 63.3 | 5.0 |
| 142 | 334.2 | 61.1 | 80.0 | 299.8 | 26.7 | 0.006350 | 355.5 | 224.6 | 1.310 | 580.1 | 337.0 | 147.1 | 63.9 | 5.1 |
| 143 | 334.8 | 61.7 | 80.0 | 299.8 | 26.7 | 0.006350 | 361.2 | 228.8 | 1.310 | 590.0 | 337.6 | 148.1 | 64.5 | 5.1 |
| 144 | 335.3 | 62.2 | 80.0 | 299.8 | 26.7 | 0.006350 | 366.9 | 233.1 | 1.310 | 600.0 | 338.2 | 149.2 | 65.1 | 5.2 |
| 145 | 335.9 | 62.8 | 80.0 | 299.8 | 26.7 | 0.006350 | 372.7 | 237.4 | 1.310 | 610.1 | 338.8 | 150.3 | 65.7 | 5.3 |
| 146 | 336.4 | 63.3 | 80.0 | 299.8 | 26.7 | 0.006350 | 378.4 | 241.7 | 1.310 | 620.1 | 339.4 | 151.4 | 66.3 | 5.4 |
| 147 | 337.0 | 63.9 | 80.0 | 299.8 | 26.7 | 0.006350 | 384.1 | 246.0 | 1.310 | 630.2 | 340.0 | 152.5 | 66.9 | 5.5 |
| 148 | 337.5 | 64.4 | 80.0 | 299.8 | 26.7 | 0.006350 | 389.9 | 250.4 | 1.310 | 640.3 | 340.6 | 153.6 | 67.5 | 5.6 |
| 149 | 338.1 | 65.0 | 80.0 | 299.8 | 26.7 | 0.006350 | 395.6 | 254.8 | 1.310 | 650.4 | 341.3 | 154.7 | 68.2 | 5.7 |
| 150 | 338.7 | 65.6 | 80.0 | 299.8 | 26.7 | 0.006350 | 401.3 | 259.2 | 1.310 | 660.5 | 341.9 | 155.8 | 68.8 | 5.8 |
| 151 | 339.2 | 66.1 | 80.0 | 299.8 | 26.7 | 0.006350 | 407.1 | 263.6 | 1.310 | 670.6 | 342.5 | 156.9 | 69.4 | 5.9 |
| 152 | 339.8 | 66.7 | 80.0 | 299.8 | 26.7 | 0.006350 | 412.8 | 268.0 | 1.310 | 680.8 | 343.1 | 157.9 | 70.0 | 5.9 |
| 153 | 340.3 | 67.2 | 80.0 | 299.8 | 26.7 | 0.006350 | 418.5 | 272.5 | 1.310 | 691.0 | 343.7 | 159.0 | 70.6 | 6.0 |
| 154 | 340.9 | 67.8 | 80.0 | 299.8 | 26.7 | 0.006350 | 424.3 | 276.9 | 1.310 | 701.2 | 344.3 | 160.1 | 71.2 | 6.1 |
| 155 | 341.4 | 68.3 | 80.0 | 299.8 | 26.7 | 0.006350 | 430.0 | 281.4 | 1.310 | 711.4 | 344.9 | 161.2 | 71.8 | 6.2 |

| Table 4. Calculation of Borasillicate Glass Temperatures, when material thickness, t = 0. 250 inches | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| $T_{room}$ | | | $T_{ambient}$ | | | $t_{glass}$ | q - conv room | q - emitted rad room | k - Borasillicate glass | $q_{cond}$ glass | $T_{fire}$ | | | Δ $T_{fire}$_$T_{room}$ |
| °F | °K | °C | °F | °K | °C | m | Watts/ $m^2$ | Watts/ $m^2$ | Watts /°K*m | Watts/ $m^2$ | °K | °F | °C | °F |
| 156 | 342.0 | 68.9 | 80.0 | 299.8 | 26.7 | 0.006350 | 435.7 | 286.0 | 1.310 | 721.7 | 345.5 | 162.3 | 72.4 | 6.3 |
| 157 | 342.5 | 69.4 | 80.0 | 299.8 | 26.7 | 0.006350 | 441.5 | 290.5 | 1.310 | 732.0 | 346.1 | 163.4 | 73.0 | 6.4 |
| 158 | 343.1 | 70.0 | 80.0 | 299.8 | 26.7 | 0.006350 | 447.2 | 295.1 | 1.310 | 742.3 | 346.7 | 164.5 | 73.6 | 6.5 |
| 159 | 343.7 | 70.6 | 80.0 | 299.8 | 26.7 | 0.006350 | 452.9 | 299.7 | 1.310 | 752.6 | 347.3 | 165.6 | 74.2 | 6.6 |
| 160 | 344.2 | 71.1 | 80.0 | 299.8 | 26.7 | 0.006350 | 458.7 | 304.3 | 1.310 | 763.0 | 347.9 | 166.7 | 74.8 | 6.7 |
| 161 | 344.8 | 71.7 | 80.0 | 299.8 | 26.7 | 0.006350 | 464.4 | 308.9 | 1.310 | 773.3 | 348.5 | 167.7 | 75.4 | 6.7 |
| 162 | 345.3 | 72.2 | 80.0 | 299.8 | 26.7 | 0.006350 | 470.1 | 313.6 | 1.310 | 783.7 | 349.1 | 168.8 | 76.0 | 6.8 |
| 163 | 345.9 | 72.8 | 80.0 | 299.8 | 26.7 | 0.006350 | 475.9 | 318.3 | 1.310 | 794.1 | 349.7 | 169.9 | 76.6 | 6.9 |
| 164 | 346.4 | 73.3 | 80.0 | 299.8 | 26.7 | 0.006350 | 481.6 | 323.0 | 1.310 | 804.6 | 350.3 | 171.0 | 77.2 | 7.0 |
| 165 | 347.0 | 73.9 | 80.0 | 299.8 | 26.7 | 0.006350 | 487.3 | 327.7 | 1.310 | 815.0 | 350.9 | 172.1 | 77.8 | 7.1 |
| 166 | 347.5 | 74.4 | 80.0 | 299.8 | 26.7 | 0.006350 | 493.1 | 332.4 | 1.310 | 825.5 | 351.5 | 173.2 | 78.4 | 7.2 |
| 167 | 348.1 | 75.0 | 80.0 | 299.8 | 26.7 | 0.006350 | 498.8 | 337.2 | 1.310 | 836.0 | 352.2 | 174.3 | 79.1 | 7.3 |
| 168 | 348.7 | 75.6 | 80.0 | 299.8 | 26.7 | 0.006350 | 504.5 | 342.0 | 1.310 | 846.5 | 352.8 | 175.4 | 79.7 | 7.4 |
| 169 | 349.2 | 76.1 | 80.0 | 299.8 | 26.7 | 0.006350 | 510.3 | 346.8 | 1.310 | 857.1 | 353.4 | 176.5 | 80.3 | 7.5 |
| 170 | 349.8 | 76.7 | 80.0 | 299.8 | 26.7 | 0.006350 | 516.0 | 351.7 | 1.310 | 867.7 | 354.0 | 177.6 | 80.9 | 7.6 |
| 171 | 350.3 | 77.2 | 80.0 | 299.8 | 26.7 | 0.006350 | 521.7 | 356.5 | 1.310 | 878.3 | 354.6 | 178.7 | 81.5 | 7.7 |
| 172 | 350.9 | 77.8 | 80.0 | 299.8 | 26.7 | 0.006350 | 527.5 | 361.4 | 1.310 | 888.9 | 355.2 | 179.8 | 82.1 | 7.8 |
| 409 | 482.5 | 209.4 | 80.0 | 299.8 | 26.7 | 0.006350 | 1886.3 | 2354.7 | 1.310 | 4241.0 | 503.1 | 446.0 | 230.0 | 37.0 |

**Table 5. Calculation of Ceramic Glass Temperatures, when material thickness, t = 0.125 inches**

| $T_{room}$ | | | $T_{ambient}$ | | | $t_{glass}$ | q - conv room | q - emitted rad room | k - ceramic glass | $q_{cond}$ glass | $T_{fire}$ | | | $\Delta T_{fire}$_T room |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| °F | °K | °C | °F | °K | °C | m | Watts/m² | Watts/m² | Watts/°K*m | Watts/m² | °K | °F | °C | °F |
| 111 | 317.0 | 43.9 | 80.0 | 299.8 | 26.7 | 0.003175 | 177.7 | 103.2 | 1.750 | 280.9 | 317.5 | 111.9 | 44.4 | 0.9 |
| 112 | 317.5 | 44.4 | 80.0 | 299.8 | 26.7 | 0.003175 | 183.5 | 106.8 | 1.750 | 290.3 | 318.1 | 112.9 | 45.0 | 0.9 |
| 113 | 318.1 | 45.0 | 80.0 | 299.8 | 26.7 | 0.003175 | 189.2 | 110.4 | 1.750 | 299.6 | 318.6 | 114.0 | 45.5 | 1.0 |
| 114 | 318.7 | 45.6 | 80.0 | 299.8 | 26.7 | 0.003175 | 194.9 | 114.1 | 1.750 | 309.0 | 319.2 | 115.0 | 46.1 | 1.0 |
| 115 | 319.2 | 46.1 | 80.0 | 299.8 | 26.7 | 0.003175 | 200.7 | 117.8 | 1.750 | 318.4 | 319.8 | 116.0 | 46.7 | 1.0 |
| 116 | 319.8 | 46.7 | 80.0 | 299.8 | 26.7 | 0.003175 | 206.4 | 121.5 | 1.750 | 327.9 | 320.4 | 117.1 | 47.3 | 1.1 |
| 117 | 320.3 | 47.2 | 80.0 | 299.8 | 26.7 | 0.003175 | 212.1 | 125.2 | 1.750 | 337.3 | 320.9 | 118.1 | 47.8 | 1.1 |
| 118 | 320.9 | 47.8 | 80.0 | 299.8 | 26.7 | 0.003175 | 217.9 | 128.9 | 1.750 | 346.8 | 321.5 | 119.1 | 48.4 | 1.1 |
| 119 | 321.4 | 48.3 | 80.0 | 299.8 | 26.7 | 0.003175 | 223.6 | 132.7 | 1.750 | 356.3 | 322.1 | 120.2 | 49.0 | 1.2 |
| 120 | 322.0 | 48.9 | 80.0 | 299.8 | 26.7 | 0.003175 | 229.3 | 136.5 | 1.750 | 365.8 | 322.7 | 121.2 | 49.6 | 1.2 |
| 121 | 322.5 | 49.4 | 80.0 | 299.8 | 26.7 | 0.003175 | 235.1 | 140.3 | 1.750 | 375.3 | 323.2 | 122.2 | 50.1 | 1.2 |
| 122 | 323.1 | 50.0 | 80.0 | 299.8 | 26.7 | 0.003175 | 240.8 | 144.1 | 1.750 | 384.9 | 323.8 | 123.3 | 50.7 | 1.3 |
| 123 | 323.7 | 50.6 | 80.0 | 299.8 | 26.7 | 0.003175 | 246.5 | 147.9 | 1.750 | 394.4 | 324.4 | 124.3 | 51.3 | 1.3 |
| 124 | 324.2 | 51.1 | 80.0 | 299.8 | 26.7 | 0.003175 | 252.3 | 151.8 | 1.750 | 404.0 | 324.9 | 125.3 | 51.8 | 1.3 |
| 125 | 324.8 | 51.7 | 80.0 | 299.8 | 26.7 | 0.003175 | 258.0 | 155.6 | 1.750 | 413.6 | 325.5 | 126.4 | 52.4 | 1.4 |
| 126 | 325.3 | 52.2 | 80.0 | 299.8 | 26.7 | 0.003175 | 263.7 | 159.5 | 1.750 | 423.3 | 326.1 | 127.4 | 53.0 | 1.4 |
| 127 | 325.9 | 52.8 | 80.0 | 299.8 | 26.7 | 0.003175 | 269.5 | 163.4 | 1.750 | 432.9 | 326.7 | 128.4 | 53.6 | 1.4 |
| 128 | 326.4 | 53.3 | 80.0 | 299.8 | 26.7 | 0.003175 | 275.2 | 167.4 | 1.750 | 442.6 | 327.2 | 129.4 | 54.1 | 1.4 |
| 129 | 327.0 | 53.9 | 80.0 | 299.8 | 26.7 | 0.003175 | 280.9 | 171.3 | 1.750 | 452.3 | 327.8 | 130.5 | 54.7 | 1.5 |
| 130 | 327.5 | 54.4 | 80.0 | 299.8 | 26.7 | 0.003175 | 286.7 | 175.3 | 1.750 | 462.0 | 328.4 | 131.5 | 55.3 | 1.5 |
| 131 | 328.1 | 55.0 | 80.0 | 299.8 | 26.7 | 0.003175 | 292.4 | 179.3 | 1.750 | 471.7 | 329.0 | 132.5 | 55.9 | 1.5 |
| 132 | 328.7 | 55.6 | 80.0 | 299.8 | 26.7 | 0.003175 | 298.1 | 183.3 | 1.750 | 481.4 | 329.5 | 133.6 | 56.4 | 1.6 |
| 133 | 329.2 | 56.1 | 80.0 | 299.8 | 26.7 | 0.003175 | 303.9 | 187.4 | 1.750 | 491.2 | 330.1 | 134.6 | 57.0 | 1.6 |
| 134 | 329.8 | 56.7 | 80.0 | 299.8 | 26.7 | 0.003175 | 309.6 | 191.4 | 1.750 | 501.0 | 330.7 | 135.6 | 57.6 | 1.6 |

**Table 5. Calculation of Ceramic Glass Temperatures, when material thickness, t = 0.125 inches**

| $T_{room}$ | | | $T_{ambient}$ | | | $t_{glass}$ | q - conv room | q - emitted rad room | k - ceramic glass | $q_{cond}$ glass | $T_{fire}$ | | | $\Delta T_{fire}$_$T_{room}$ |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| °F | °K | °C | °F | °K | °C | m | Watts/m² | Watts/m2 | Watts /°K*m | Watts/m2 | °K | °F | °C | °F |
| 135 | 330.3 | 57.2 | 80.0 | 299.8 | 26.7 | 0.003175 | 315.3 | 195.5 | 1.750 | 510.8 | 331.2 | 136.7 | 58.1 | 1.7 |
| 136 | 330.9 | 57.8 | 80.0 | 299.8 | 26.7 | 0.003175 | 321.1 | 199.6 | 1.750 | 520.6 | 331.8 | 137.7 | 58.7 | 1.7 |
| 137 | 331.4 | 58.3 | 80.0 | 299.8 | 26.7 | 0.003175 | 326.8 | 203.7 | 1.750 | 530.5 | 332.4 | 138.7 | 59.3 | 1.7 |
| 138 | 332.0 | 58.9 | 80.0 | 299.8 | 26.7 | 0.003175 | 332.5 | 207.8 | 1.750 | 540.4 | 333.0 | 139.8 | 59.9 | 1.8 |
| 139 | 332.5 | 59.4 | 80.0 | 299.8 | 26.7 | 0.003175 | 338.3 | 212.0 | 1.750 | 550.3 | 333.5 | 140.8 | 60.4 | 1.8 |
| 140 | 333.1 | 60.0 | 80.0 | 299.8 | 26.7 | 0.003175 | 344.0 | 216.2 | 1.750 | 560.2 | 334.1 | 141.8 | 61.0 | 1.8 |
| 141 | 333.7 | 60.6 | 80.0 | 299.8 | 26.7 | 0.003175 | 349.7 | 220.4 | 1.750 | 570.1 | 334.7 | 142.9 | 61.6 | 1.9 |
| 142 | 334.2 | 61.1 | 80.0 | 299.8 | 26.7 | 0.003175 | 355.5 | 224.6 | 1.750 | 580.1 | 335.3 | 143.9 | 62.2 | 1.9 |
| 143 | 334.8 | 61.7 | 80.0 | 299.8 | 26.7 | 0.003175 | 361.2 | 228.8 | 1.750 | 590.0 | 335.8 | 144.9 | 62.7 | 1.9 |
| 144 | 335.3 | 62.2 | 80.0 | 299.8 | 26.7 | 0.003175 | 366.9 | 233.1 | 1.750 | 600.0 | 336.4 | 146.0 | 63.3 | 2.0 |
| 145 | 335.9 | 62.8 | 80.0 | 299.8 | 26.7 | 0.003175 | 372.7 | 237.4 | 1.750 | 610.1 | 337.0 | 147.0 | 63.9 | 2.0 |
| 146 | 336.4 | 63.3 | 80.0 | 299.8 | 26.7 | 0.003175 | 378.4 | 241.7 | 1.750 | 620.1 | 337.6 | 148.0 | 64.5 | 2.0 |
| 147 | 337.0 | 63.9 | 80.0 | 299.8 | 26.7 | 0.003175 | 384.1 | 246.0 | 1.750 | 630.2 | 338.1 | 149.1 | 65.0 | 2.1 |
| 148 | 337.5 | 64.4 | 80.0 | 299.8 | 26.7 | 0.003175 | 389.9 | 250.4 | 1.750 | 640.3 | 338.7 | 150.1 | 65.6 | 2.1 |
| 149 | 338.1 | 65.0 | 80.0 | 299.8 | 26.7 | 0.003175 | 395.6 | 254.8 | 1.750 | 650.4 | 339.3 | 151.1 | 66.2 | 2.1 |
| 150 | 338.7 | 65.6 | 80.0 | 299.8 | 26.7 | 0.003175 | 401.3 | 259.2 | 1.750 | 660.5 | 339.9 | 152.2 | 66.8 | 2.2 |
| 151 | 339.2 | 66.1 | 80.0 | 299.8 | 26.7 | 0.003175 | 407.1 | 263.6 | 1.750 | 670.6 | 340.4 | 153.2 | 67.3 | 2.2 |
| 152 | 339.8 | 66.7 | 80.0 | 299.8 | 26.7 | 0.003175 | 412.8 | 268.0 | 1.750 | 680.8 | 341.0 | 154.2 | 67.9 | 2.2 |
| 153 | 340.3 | 67.2 | 80.0 | 299.8 | 26.7 | 0.003175 | 418.5 | 272.5 | 1.750 | 691.0 | 341.6 | 155.3 | 68.5 | 2.3 |
| 154 | 340.9 | 67.8 | 80.0 | 299.8 | 26.7 | 0.003175 | 424.3 | 276.9 | 1.750 | 701.2 | 342.1 | 156.3 | 69.0 | 2.3 |
| 155 | 341.4 | 68.3 | 80.0 | 299.8 | 26.7 | 0.003175 | 430.0 | 281.4 | 1.750 | 711.4 | 342.7 | 157.3 | 69.6 | 2.3 |
| 156 | 342.0 | 68.9 | 80.0 | 299.8 | 26.7 | 0.003175 | 435.7 | 286.0 | 1.750 | 721.7 | 343.3 | 158.4 | 70.2 | 2.4 |
| 157 | 342.5 | 69.4 | 80.0 | 299.8 | 26.7 | 0.003175 | 441.5 | 290.5 | 1.750 | 732.0 | 343.9 | 159.4 | 70.8 | 2.4 |
| 158 | 343.1 | 70.0 | 80.0 | 299.8 | 26.7 | 0.003175 | 447.2 | 295.1 | 1.750 | 742.3 | 344.4 | 160.4 | 71.3 | 2.4 |

| Table 5. Calculation of Ceramic Glass Temperatures, when material thickness, t = 0.125 inches | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| $T_{room}$ | | | $T_{ambient}$ | | | $t_{glass}$ | q - conv room | q - emitted rad room | k - ceramic glass | $q_{cond}$ glass | $T_{fire}$ | | | $\Delta T_{fire}$_T room |
| $^oF$ | $^oK$ | $^oC$ | $^oF$ | $^oK$ | $^oC$ | m | Watts/ $m^2$ | Watts/$m^2$ | Watts /$^oK$*m | Watts/$m^2$ | $^oK$ | $^oF$ | $^oC$ | $^oF$ |
| 159 | 343.7 | 70.6 | 80.0 | 299.8 | 26.7 | 0.003175 | 452.9 | 299.7 | 1.750 | 752.6 | 345.0 | 161.5 | 71.9 | 2.5 |
| 160 | 344.2 | 71.1 | 80.0 | 299.8 | 26.7 | 0.003175 | 458.7 | 304.3 | 1.750 | 763.0 | 345.6 | 162.5 | 72.5 | 2.5 |
| 161 | 344.8 | 71.7 | 80.0 | 299.8 | 26.7 | 0.003175 | 464.4 | 308.9 | 1.750 | 773.3 | 346.2 | 163.5 | 73.1 | 2.5 |
| 162 | 345.3 | 72.2 | 80.0 | 299.8 | 26.7 | 0.003175 | 470.1 | 313.6 | 1.750 | 783.7 | 346.7 | 164.6 | 73.6 | 2.6 |
| 163 | 345.9 | 72.8 | 80.0 | 299.8 | 26.7 | 0.003175 | 475.9 | 318.3 | 1.750 | 794.1 | 347.3 | 165.6 | 74.2 | 2.6 |
| 164 | 346.4 | 73.3 | 80.0 | 299.8 | 26.7 | 0.003175 | 481.6 | 323.0 | 1.750 | 804.6 | 347.9 | 166.6 | 74.8 | 2.6 |
| 165 | 347.0 | 73.9 | 80.0 | 299.8 | 26.7 | 0.003175 | 487.3 | 327.7 | 1.750 | 815.0 | 348.5 | 167.7 | 75.4 | 2.7 |
| 166 | 347.5 | 74.4 | 80.0 | 299.8 | 26.7 | 0.003175 | 493.1 | 332.4 | 1.750 | 825.5 | 349.0 | 168.7 | 75.9 | 2.7 |
| 167 | 348.1 | 75.0 | 80.0 | 299.8 | 26.7 | 0.003175 | 498.8 | 337.2 | 1.750 | 836.0 | 349.6 | 169.7 | 76.5 | 2.7 |
| 168 | 348.7 | 75.6 | 80.0 | 299.8 | 26.7 | 0.003175 | 504.5 | 342.0 | 1.750 | 846.5 | 350.2 | 170.8 | 77.1 | 2.8 |
| 169 | 349.2 | 76.1 | 80.0 | 299.8 | 26.7 | 0.003175 | 510.3 | 346.8 | 1.750 | 857.1 | 350.8 | 171.8 | 77.7 | 2.8 |
| 170 | 349.8 | 76.7 | 80.0 | 299.8 | 26.7 | 0.003175 | 516.0 | 351.7 | 1.750 | 867.7 | 351.3 | 172.8 | 78.2 | 2.8 |
| 171 | 350.3 | 77.2 | 80.0 | 299.8 | 26.7 | 0.003175 | 521.7 | 356.5 | 1.750 | 878.3 | 351.9 | 173.9 | 78.8 | 2.9 |
| 172 | 350.9 | 77.8 | 80.0 | 299.8 | 26.7 | 0.003175 | 527.5 | 361.4 | 1.750 | 888.9 | 352.5 | 174.9 | 79.4 | 2.9 |
| 1103 | 868.1 | 595.0 | 80.0 | 299.8 | 26.7 | 0.003175 | 5865.2 | 28568.4 | 1.750 | 34433.6 | 930.6 | 1215.5 | 657.5 | 112.5 |

| Table 6. Calculation of Ceramic Glass Temperatures, when material thickness, t = 0. 250 inches | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| $T_{room}$ | | | $T_{ambient}$ | | | $t_{glass}$ | q - conv room | q - emitted rad room | k - ceramic glass | $q_{cond}$ glass | $T_{fire}$ | | | Δ $T_{fire}$_$T_{room}$ |
| °F | °K | °C | °F | °K | °C | m | Watts /m² | Watts/m² | Watts /°K*m | Watts/m² | °K | °F | °C | °F |
| 111 | 317.0 | 43.9 | 80.0 | 299.8 | 26.7 | 0.006350 | 177.7 | 103.2 | 1.750 | 280.9 | 318.0 | 112.8 | 44.9 | 1.8 |
| 112 | 317.5 | 44.4 | 80.0 | 299.8 | 26.7 | 0.006350 | 183.5 | 106.8 | 1.750 | 290.3 | 318.6 | 113.9 | 45.5 | 1.9 |
| 113 | 318.1 | 45.0 | 80.0 | 299.8 | 26.7 | 0.006350 | 189.2 | 110.4 | 1.750 | 299.6 | 319.2 | 115.0 | 46.1 | 2.0 |
| 114 | 318.7 | 45.6 | 80.0 | 299.8 | 26.7 | 0.006350 | 194.9 | 114.1 | 1.750 | 309.0 | 319.8 | 116.0 | 46.7 | 2.0 |
| 115 | 319.2 | 46.1 | 80.0 | 299.8 | 26.7 | 0.006350 | 200.7 | 117.8 | 1.750 | 318.4 | 320.4 | 117.1 | 47.3 | 2.1 |
| 116 | 319.8 | 46.7 | 80.0 | 299.8 | 26.7 | 0.006350 | 206.4 | 121.5 | 1.750 | 327.9 | 321.0 | 118.1 | 47.9 | 2.1 |
| 117 | 320.3 | 47.2 | 80.0 | 299.8 | 26.7 | 0.006350 | 212.1 | 125.2 | 1.750 | 337.3 | 321.5 | 119.2 | 48.4 | 2.2 |
| 118 | 320.9 | 47.8 | 80.0 | 299.8 | 26.7 | 0.006350 | 217.9 | 128.9 | 1.750 | 346.8 | 322.1 | 120.3 | 49.0 | 2.3 |
| 119 | 321.4 | 48.3 | 80.0 | 299.8 | 26.7 | 0.006350 | 223.6 | 132.7 | 1.750 | 356.3 | 322.7 | 121.3 | 49.6 | 2.3 |
| 120 | 322.0 | 48.9 | 80.0 | 299.8 | 26.7 | 0.006350 | 229.3 | 136.5 | 1.750 | 365.8 | 323.3 | 122.4 | 50.2 | 2.4 |
| 121 | 322.5 | 49.4 | 80.0 | 299.8 | 26.7 | 0.006350 | 235.1 | 140.3 | 1.750 | 375.3 | 323.9 | 123.5 | 50.8 | 2.5 |
| 122 | 323.1 | 50.0 | 80.0 | 299.8 | 26.7 | 0.006350 | 240.8 | 144.1 | 1.750 | 384.9 | 324.5 | 124.5 | 51.4 | 2.5 |
| 123 | 323.7 | 50.6 | 80.0 | 299.8 | 26.7 | 0.006350 | 246.5 | 147.9 | 1.750 | 394.4 | 325.1 | 125.6 | 52.0 | 2.6 |
| 124 | 324.2 | 51.1 | 80.0 | 299.8 | 26.7 | 0.006350 | 252.3 | 151.8 | 1.750 | 404.0 | 325.7 | 126.6 | 52.6 | 2.6 |
| 125 | 324.8 | 51.7 | 80.0 | 299.8 | 26.7 | 0.006350 | 258.0 | 155.6 | 1.750 | 413.6 | 326.3 | 127.7 | 53.2 | 2.7 |
| 126 | 325.3 | 52.2 | 80.0 | 299.8 | 26.7 | 0.006350 | 263.7 | 159.5 | 1.750 | 423.3 | 326.9 | 128.8 | 53.8 | 2.8 |
| 127 | 325.9 | 52.8 | 80.0 | 299.8 | 26.7 | 0.006350 | 269.5 | 163.4 | 1.750 | 432.9 | 327.4 | 129.8 | 54.3 | 2.8 |
| 128 | 326.4 | 53.3 | 80.0 | 299.8 | 26.7 | 0.006350 | 275.2 | 167.4 | 1.750 | 442.6 | 328.0 | 130.9 | 54.9 | 2.9 |
| 129 | 327.0 | 53.9 | 80.0 | 299.8 | 26.7 | 0.006350 | 280.9 | 171.3 | 1.750 | 452.3 | 328.6 | 132.0 | 55.5 | 3.0 |
| 130 | 327.5 | 54.4 | 80.0 | 299.8 | 26.7 | 0.006350 | 286.7 | 175.3 | 1.750 | 462.0 | 329.2 | 133.0 | 56.1 | 3.0 |
| 131 | 328.1 | 55.0 | 80.0 | 299.8 | 26.7 | 0.006350 | 292.4 | 179.3 | 1.750 | 471.7 | 329.8 | 134.1 | 56.7 | 3.1 |
| 132 | 328.7 | 55.6 | 80.0 | 299.8 | 26.7 | 0.006350 | 298.1 | 183.3 | 1.750 | 481.4 | 330.4 | 135.1 | 57.3 | 3.1 |
| 133 | 329.2 | 56.1 | 80.0 | 299.8 | 26.7 | 0.006350 | 303.9 | 187.4 | 1.750 | 491.2 | 331.0 | 136.2 | 57.9 | 3.2 |

| Table 6. Calculation of Ceramic Glass Temperatures, when material thickness, t = 0. 250 inches | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| $T_{room}$ | | | $T_{ambient}$ | | | $t_{glass}$ | q - conv room | q - emitted rad room | k - ceramic glass | $q_{cond}$ glass | $T_{fire}$ | | | Δ $T_{fire}$_$T_{room}$ |
| 134 | 329.8 | 56.7 | 80.0 | 299.8 | 26.7 | 0.006350 | 309.6 | 191.4 | 1.750 | 501.0 | 331.6 | 137.3 | 58.5 | 3.3 |
| 135 | 330.3 | 57.2 | 80.0 | 299.8 | 26.7 | 0.006350 | 315.3 | 195.5 | 1.750 | 510.8 | 332.2 | 138.3 | 59.1 | 3.3 |
| 136 | 330.9 | 57.8 | 80.0 | 299.8 | 26.7 | 0.006350 | 321.1 | 199.6 | 1.750 | 520.6 | 332.8 | 139.4 | 59.7 | 3.4 |
| 137 | 331.4 | 58.3 | 80.0 | 299.8 | 26.7 | 0.006350 | 326.8 | 203.7 | 1.750 | 530.5 | 333.4 | 140.5 | 60.3 | 3.5 |
| 138 | 332.0 | 58.9 | 80.0 | 299.8 | 26.7 | 0.006350 | 332.5 | 207.8 | 1.750 | 540.4 | 333.9 | 141.5 | 60.8 | 3.5 |
| 139 | 332.5 | 59.4 | 80.0 | 299.8 | 26.7 | 0.006350 | 338.3 | 212.0 | 1.750 | 550.3 | 334.5 | 142.6 | 61.4 | 3.6 |
| 140 | 333.1 | 60.0 | 80.0 | 299.8 | 26.7 | 0.006350 | 344.0 | 216.2 | 1.750 | 560.2 | 335.1 | 143.7 | 62.0 | 3.7 |
| 141 | 333.7 | 60.6 | 80.0 | 299.8 | 26.7 | 0.006350 | 349.7 | 220.4 | 1.750 | 570.1 | 335.7 | 144.7 | 62.6 | 3.7 |
| 142 | 334.2 | 61.1 | 80.0 | 299.8 | 26.7 | 0.006350 | 355.5 | 224.6 | 1.750 | 580.1 | 336.3 | 145.8 | 63.2 | 3.8 |
| 143 | 334.8 | 61.7 | 80.0 | 299.8 | 26.7 | 0.006350 | 361.2 | 228.8 | 1.750 | 590.0 | 336.9 | 146.9 | 63.8 | 3.9 |
| 144 | 335.3 | 62.2 | 80.0 | 299.8 | 26.7 | 0.006350 | 366.9 | 233.1 | 1.750 | 600.0 | 337.5 | 147.9 | 64.4 | 3.9 |
| 145 | 335.9 | 62.8 | 80.0 | 299.8 | 26.7 | 0.006350 | 372.7 | 237.4 | 1.750 | 610.1 | 338.1 | 149.0 | 65.0 | 4.0 |
| 146 | 336.4 | 63.3 | 80.0 | 299.8 | 26.7 | 0.006350 | 378.4 | 241.7 | 1.750 | 620.1 | 338.7 | 150.1 | 65.6 | 4.1 |
| 147 | 337.0 | 63.9 | 80.0 | 299.8 | 26.7 | 0.006350 | 384.1 | 246.0 | 1.750 | 630.2 | 339.3 | 151.1 | 66.2 | 4.1 |
| 148 | 337.5 | 64.4 | 80.0 | 299.8 | 26.7 | 0.006350 | 389.9 | 250.4 | 1.750 | 640.3 | 339.9 | 152.2 | 66.8 | 4.2 |
| 149 | 338.1 | 65.0 | 80.0 | 299.8 | 26.7 | 0.006350 | 395.6 | 254.8 | 1.750 | 650.4 | 340.5 | 153.2 | 67.4 | 4.2 |
| 150 | 338.7 | 65.6 | 80.0 | 299.8 | 26.7 | 0.006350 | 401.3 | 259.2 | 1.750 | 660.5 | 341.1 | 154.3 | 68.0 | 4.3 |
| 151 | 339.2 | 66.1 | 80.0 | 299.8 | 26.7 | 0.006350 | 407.1 | 263.6 | 1.750 | 670.6 | 341.6 | 155.4 | 68.5 | 4.4 |
| 152 | 339.8 | 66.7 | 80.0 | 299.8 | 26.7 | 0.006350 | 412.8 | 268.0 | 1.750 | 680.8 | 342.2 | 156.4 | 69.1 | 4.4 |
| 153 | 340.3 | 67.2 | 80.0 | 299.8 | 26.7 | 0.006350 | 418.5 | 272.5 | 1.750 | 691.0 | 342.8 | 157.5 | 69.7 | 4.5 |
| 154 | 340.9 | 67.8 | 80.0 | 299.8 | 26.7 | 0.006350 | 424.3 | 276.9 | 1.750 | 701.2 | 343.4 | 158.6 | 70.3 | 4.6 |
| 155 | 341.4 | 68.3 | 80.0 | 299.8 | 26.7 | 0.006350 | 430.0 | 281.4 | 1.750 | 711.4 | 344.0 | 159.6 | 70.9 | 4.6 |
| 156 | 342.0 | 68.9 | 80.0 | 299.8 | 26.7 | 0.006350 | 435.7 | 286.0 | 1.750 | 721.7 | 344.6 | 160.7 | 71.5 | 4.7 |
| 157 | 342.5 | 69.4 | 80.0 | 299.8 | 26.7 | 0.006350 | 441.5 | 290.5 | 1.750 | 732.0 | 345.2 | 161.8 | 72.1 | 4.8 |
| 158 | 343.1 | 70.0 | 80.0 | 299.8 | 26.7 | 0.006350 | 447.2 | 295.1 | 1.750 | 742.3 | 345.8 | 162.8 | 72.7 | 4.8 |

| Table 6. Calculation of Ceramic Glass Temperatures, when material thickness, t = 0. 250 inches | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| $T_{room}$ | | | $T_{ambient}$ | | | $t_{glass}$ | q - conv room | q - emitted rad room | k - ceramic glass | $q_{cond}$ glass | $T_{fire}$ | | | Δ $T_{fire}$_$T_{room}$ |
| 159 | 343.7 | 70.6 | 80.0 | 299.8 | 26.7 | 0.006350 | 452.9 | 299.7 | 1.750 | 752.6 | 346.4 | 163.9 | 73.3 | 4.9 |
| 160 | 344.2 | 71.1 | 80.0 | 299.8 | 26.7 | 0.006350 | 458.7 | 304.3 | 1.750 | 763.0 | 347.0 | 165.0 | 73.9 | 5.0 |
| 161 | 344.8 | 71.7 | 80.0 | 299.8 | 26.7 | 0.006350 | 464.4 | 308.9 | 1.750 | 773.3 | 347.6 | 166.1 | 74.5 | 5.1 |
| 162 | 345.3 | 72.2 | 80.0 | 299.8 | 26.7 | 0.006350 | 470.1 | 313.6 | 1.750 | 783.7 | 348.2 | 167.1 | 75.1 | 5.1 |
| 163 | 345.9 | 72.8 | 80.0 | 299.8 | 26.7 | 0.006350 | 475.9 | 318.3 | 1.750 | 794.1 | 348.8 | 168.2 | 75.7 | 5.2 |
| 164 | 346.4 | 73.3 | 80.0 | 299.8 | 26.7 | 0.006350 | 481.6 | 323.0 | 1.750 | 804.6 | 349.4 | 169.3 | 76.3 | 5.3 |
| 165 | 347.0 | 73.9 | 80.0 | 299.8 | 26.7 | 0.006350 | 487.3 | 327.7 | 1.750 | 815.0 | 349.9 | 170.3 | 76.8 | 5.3 |
| 166 | 347.5 | 74.4 | 80.0 | 299.8 | 26.7 | 0.006350 | 493.1 | 332.4 | 1.750 | 825.5 | 350.5 | 171.4 | 77.4 | 5.4 |
| 167 | 348.1 | 75.0 | 80.0 | 299.8 | 26.7 | 0.006350 | 498.8 | 337.2 | 1.750 | 836.0 | 351.1 | 172.5 | 78.0 | 5.5 |
| 168 | 348.7 | 75.6 | 80.0 | 299.8 | 26.7 | 0.006350 | 504.5 | 342.0 | 1.750 | 846.5 | 351.7 | 173.5 | 78.6 | 5.5 |
| 169 | 349.2 | 76.1 | 80.0 | 299.8 | 26.7 | 0.006350 | 510.3 | 346.8 | 1.750 | 857.1 | 352.3 | 174.6 | 79.2 | 5.6 |
| 170 | 349.8 | 76.7 | 80.0 | 299.8 | 26.7 | 0.006350 | 516.0 | 351.7 | 1.750 | 867.7 | 352.9 | 175.7 | 79.8 | 5.7 |
| 171 | 350.3 | 77.2 | 80.0 | 299.8 | 26.7 | 0.006350 | 521.7 | 356.5 | 1.750 | 878.3 | 353.5 | 176.7 | 80.4 | 5.7 |
| 172 | 350.9 | 77.8 | 80.0 | 299.8 | 26.7 | 0.006350 | 527.5 | 361.4 | 1.750 | 888.9 | 354.1 | 177.8 | 81.0 | 5.8 |
| 1103 | 868.1 | 595.0 | 80.0 | 299.8 | 26.7 | 0.006350 | 5865.2 | 28568.4 | 1.750 | 34433.6 | 993.0 | 1327.9 | 719.9 | 224.9 |

# TAB H

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

**Memorandum**

**Date: November 21, 2011**

**TO** : Hot Glass Petition File

**THROUGH:** George S. Borlase, Associate Executive Director,
Directorate for Engineering Sciences
Patricia K. Adair, Division Director
Division of Combustion and Fire Sciences

**FROM** : Ronald A. Jordan, Mechanical Engineer
Project Manager, Petition CP 11-1
Division of Combustion and Fire Sciences,
Directorate for Engineering Sciences

**SUBJECT:** CPSC Staff Response to Public Comments – CP 11-1

The Commission received correspondence from Carol Pollack-Nelson, Ph.D. ("petitioner"), requesting that the Commission initiate rulemaking to require safeguards for glass fronts of gas vented fireplaces. The Commission published a request for public comment on this petition (petition CP 11-1) in the Federal Register on June 8, 2011 (69 Fed. Reg. 18059). Subsequent to the receipt of Carol Pollack-Nelson's petition, the Commission received a submission from Mr. William S. Lerner, also requesting that the Commission initiate rulemaking regarding glass fronts of gas fireplaces. Mr. Lerner's submission asks the Commission to require a "high temperature warning system," which will "project a clear high temperature alert on the glass front of the fireplace that will remain visible from the time the fireplace is lit until the glass is cool enough to touch safely." The Commission also sought comments on Mr. Lerner's proposal.

A total of 29 comments were received by the Commission; 24 were in support of the petition and 5 against the petition. The comments in support of the petition were received from parents or family members of victims, burn center doctors, technical entities, safety advocacy groups, inventors, and from private citizens with unknown backgrounds. All 5 of the comments against the petition were from the gas appliance industry (including 4 from manufacturers and 1 from an industry trade association).

### 1. Comments in support of the petition

The 24 comments that supported the petition all acknowledged the hazard and expressed the opinion that the CPSC should take some action through rulemaking to mitigate the problem. However, not all of the comments were in support of the use of a barrier, as proposed in Pollack-

Nelson's petition: 11 comments supported the petition with the barrier option; 11 comments supported the LED warning light option; and 2 comments expressed support, but did not specify a preference for the barrier or the warning light option.

**a. Eleven comments in support of the petition and the barrier option. (Documents: CPSC-2011-028-0005, 0006, 0007, 0010, 0011, 0015, 0017, 0018, 0019, 0020, and 0028). Eleven comments supported Carroll Pollack-Nelson's petition and the need for a barrier over the glass front of a gas fireplace to prevent individuals from coming into contact with hot glass. Of the 11 comments that supported the petition with the barrier option, 3 commenters expressed concerns about the efficacy of the LED warning light option. The concerns raised were that a LED warning light option would not be effective because: (1) children 5 years old and under cannot read or understand a warning symbol; (2) children 5 years and under might actually be attracted to the warning light and touch the glass surface; (3) the warning light would not protect from accidental contact with a glass front (*e.g.*, falling or backing into the glass front); and (4) although alerted to the hazard, parents still might not be able to prevent a fast moving child from contacting the glass front. One commenter expressed concern that a barrier may be "physically disruptive" and "diminish the ascetics of the fireplace or room."**

Staff agrees with the petitioner and the supportive commenters on this issue. Staff has examined the range of temperatures that interior and exterior surfaces of various glass front materials in gas fireplaces could potentially reach (ref. Tables 1 through 6 in Appendix H), as well as ASTM C1055-03, Standard Guide for Heated System Surface Conditions that Produce Contact Burn Injuries, and the severity of burns sustained by children who contacted the glass fronts. The exterior surface temperatures attainable by the glass front of a gas fireplace are greatly in excess of the minimum temperatures specified in ASTM C1055 that can cause reversible and irreversible damage to skin. Therefore, the most plausible way to prevent contact with the glass front is through the use of a protective barrier. In order for a protective barrier to be effective, it would have to be designed to prevent physical contact with a glass front or other heated surfaces and not transfer heat from the glass front sufficient to cause contact burn injuries. The design considerations of a protective barrier are addressed in Section X, Voluntary Standards Development, and Section XII, Addressability of the briefing memorandum.

Staff also agrees with most of the concerns raised by commenters about an LED warning light. While a warning light would serve to remind a parent that the glass is still hot, given the myriad of ways in which glass could be contacted unintentionally, staff does not believe that an LED warning light is capable of preventing a contact burn and prevention is a higher order intervention than warning. None of the commenters submitted literature or other technical documentation to substantiate the concern that young children might be attracted by a warning light. However, staff from the Division of Human Factors found that "Young children are especially attracted to bright colors and high contrast . . .;" and that a warning light incorporating these features ". . . may mistakenly attract young children to a hazard or hazardous product."

**b. Eleven comments in support of the petition and the LED warning light option. (Documents: CPSC-2011-028-0002, 0004, 0008, 0021, 0022, 0023, 0025, 0026, 0027, 0029, and 0030)**

**Of the 11 comments that supported the LED warning light option, 3 commenters expressed concerns about the efficacy of the barrier option. The concerns raised about the barrier option were that: (1) metal screens placed in front of a fireplace glass front will be heated and reach and exceed 121°C (250°F) and thus still pose a burn hazard; (2) metal screens do not provide any indication or warning that they are hot enough to cause severe burns; (3) a metal screen creates a false sense of security that it will shield and protect individuals from a burn injury when in fact, it could cause equally severe burn injuries; (4) it is unclear how screens can be provided to conform to the varying shapes and sizes of glass fronted fireplaces; and (5) screens can be removed, thereby eliminating protection. None of the commenters provided technical documentation to support their positions.**

For the reasons stated earlier, staff does not agree that a visual warning is the best intervention to prevent children from sustaining contact burns. Staff believes that the concern about the temperature that a barrier can reach is a valid issue; however, the commenters did not provide any literature or other technical documentation to substantiate the claim that a metal screen will be heated to and exceed 121°C (250°F). The CSA Vented Heater Glass Temperature Working Group has developed draft standards provisions that address this issue by specifying that a barrier be designed to prevent a burn hazard greater than Threshold B (reversible epidermal injury) as stated in the ASTM Guide for Heated System Surface Conditions that Produce Contact Burn Injuries, ASTM C1055. See Section X, Voluntary Standards Development of the briefing memorandum and Tab F, and Section XII, Addressability of the briefing memorandum for additional discussion on this issue.

**c. Two comments expressed support of the petition, but did not prefer either option. (Documents: CPSC-2011-028-0003 and 0013)**

These comments support the petition and rulemaking by CPSC, but do not indicate a preference for the barrier or LED warning light options. The commenters did not provide any technical data to support their positions.

**2. Comments against the petition**

All 5 of the comments against the petition were from the gas appliances industry; 4 from gas appliance manufacturers and 1 from an industry trade association. Although they acknowledged the hazard and the need for action to be taken to mitigate the hazard, they were against the petition and rulemaking and expressed their belief that the issue should be addressed through the voluntary standards process. Three of the manufacturers expressed opinions that providing an optional barrier upon request was viable, but that this should be addressed through the voluntary standards; one manufacturer developed a protective barrier as part of a lawsuit settlement; one manufacturer was willing to consider requiring a barrier.

**a. Comment from manufacturer that developed a protective barrier as part of a lawsuit settlement (Document: CPSC-2011-028-0014)**

**This manufacturer opposes the petition and rulemaking. The commenter believes that the issue should be addressed through development of voluntary standards for a protective barrier that:**

**(1) Prevents non-reversible burn injury;**

**(2) Prevents inadvertent contact;**
**(3) Can be easily removed or attached by consumers;**
**(4) Has sufficient rigidity and fastens securely enough to prevent being easily dislodged during incidental contact;**
**(5) Is available to consumers at no charge upon request through company website and through accompanying product literature at time of sale.**

**This manufacturer also stated that the surface temperature of an object is not the only consideration when determining whether a thermal burn hazard exists; that the potential for a thermal burn injury is also based on:**

**(1) Body's response to heat;**
**(2) Heat transfer, including variables for:**
- **Material type**
- **Mass**
- **Texture**
- **Configuration**
- **Temperature of the hot surface/object**

**This manufacturer further states that the following criteria/considerations are needed to develop performance criteria for a safety barrier to reduce thermal burns:**

**(1) Heat transfer properties of each type of material**
**(2) Configuration of each type of material**
**(3) Expected duration of skin contact**
**(4) Associated skin contact temperatures**

**This manufacturer specified the following performance criterion that a safety barrier should meet:**

**(1) The hottest area of the safety barrier facing the occupants should not produce a skin contact temperature that exceeds the limit for a first degree burn in an average person after a reasonable contact period. This criterion should be met for each type and configuration of material (i.e., exhibiting different thermal mass, thermal conductivity or contact heat transfer efficiency) employed integral to the physical guard, such as seen on screen materials and frames.**
**(2) The safety barrier prevents toddlers putting their fingers through the screen surface where the finger could contact heated glass.**
**(3) The safety barrier should exhibit adequate structural integrity to prevent its contact with the glass when a reasonable force is applied.**
**(4) The mounting of the safety barrier must be adequate to withstand a reasonable degree of force applied in a positive and negative direction, and along three degrees of freedom (i.e., up-down, side-side, back-forth) without unintentionally dislodging or being permanently deformed with reasonable force applied.**
**(5) The safety barrier does not require a special ability or tools to install or remove so the owner/user may consciously use or cease to use the solution at will.**

**This manufacturer believes that safety barriers should be:**

**(1) Made available as an option to consumers who need or want them.**

**(2) Are not needed in every application or use.**

**(3) Will be used by consumers only for a certain period of time or at set times (similar to the use of safety gates for children).**

**This manufacturer:**

**(1) does not provide the safety barriers with every unit sold, but only to those customers who request them**

**(2) does not charge for the safety barriers, but would have to raise prices if required to provide a safety barrier with every unit sold**

**b. Comments from three manufacturers (Documents: CPSC-2011-028-0009, 0012, and 0024)**

**These three manufacturers:**

**(1) Oppose the petition and rulemaking**

**(2) Endorse working through the voluntary standards process to resolve the issue**

**(3) One manufacturer already offers a protective screen as option**

**(4) One manufacturer has included a protective screen as a standard feature for more than 7 years**

**Concerning the LED Warning light option, the manufacturers are concerned:**

**(1) It may attract young children**

**(2) Does not protect against an accidental fall into the glass front,**

**(3) Would not be effective since young children cannot read or understand warning symbols**

**c. Comment from industry trade association (Document: CPSC-2011-028-0016)**

**This trade association opposes the petition and rulemaking, and believes instead that the issue should be addressed through development of voluntary standards. Their basis for opposing the petition is that the ANSI Z21/CSA Vented Heater Glass Surface Temperature Working Group is already developing standards provisions to address the hazard and that a revised standard could be published in mid-2012 with effective date of approximately 18-months after the publication date.**

**The draft standards provisions would require that physical barriers be made available for all gas fireplaces that are installed less than 4 feet above the floor. The draft standard for a physical barrier will:**

**(1) Ensure that the physical barrier not become hot enough to cause a severe burn,**

**(2) Allow a person to remove their hand from the surface, if contact were made,**

**(3) Remain reasonably rigid,**

**(4) Be easily removable for fireplace cleaning or maintenance or if guard were no longer needed or desired (e.g., when children were no longer present)**

**The ANSI Z21/CSA Vented Heater Glass Surface Temperature Working Group also considered auditory and visual warning systems. The gas fireplace industry also plans to engage in consumer education and outreach to educate and warn consumers about the hazards associated with glass fronts. The industry seeks CPSC input and partnership on the effort, which will include:**

- **(1) Enhanced product and literature markings and information**
- **(2) Improved training of retailers, builders and distributors**
- **(3) Incorporation into the literature distributed to parents by pediatricians, educators, and others**
- **(4) Enhanced liaison with first responders, emergency, and fire service groups, and**
- **(5) Outreach to the hospitality industry**

**Concerning William Lerner's petition request to require an LED high temperature warning light, the trade association raised the following concerns:**

- **(1) The LED warning light will not prevent children from touching the hot glass**
- **(2) It is not appropriate public policy to base a standard on what appears to be the petitioner's proprietary intellectual property and economic interests**
- **(3) Children may actually be attracted to a red warning light**

Staff reviewed the comments summarized under sections 2a, b, and c above. All of the commenters recognize the hazard and advocate the development of voluntary standards for the use of protective barrier, as well as enhanced warnings and efforts to educate consumers, retailers, and the hospitality industry about the hazards associated with the glass temperature of gas fireplaces. The commenters do not support rulemaking as proposed in the petition. Staff agrees with the commenters' positions on the existence of a hazard and their approach of addressing the hazard through the development a voluntary standards requirement for a protective barrier and enhanced warnings and consumer education. Given that the industry has developed draft voluntary standards provisions that require protective barriers and enhanced warnings, staff agrees with the petitioners that rulemaking is not warranted, as long as the industry publishes a revised standard with the content and within the timeframe discussed in Section X, Voluntary Standards Development, and Tab F of the briefing memorandum.