

FS171-15

2603.3

Proposed Change as Submitted

Proponent : Samir Mokashi (samir.mokashi@codeul.com); Avery Lindeman, Green Science Policy Institute, representing Green Science Policy Institute (avery@greensciencepolicy.org); Veena Singla, Natural Resources Defense Council, representing Natural Resources Defense Council (vsingla@nrdc.org); Vytenis Babrauskas, Fire Science & Technology Inc., representing Fire Science & Technology Inc.; Tom Lent, Healthy Building Network, representing Healthy Building Network (tlent@healthybuilding.net); Tony Stefani, representing San Francisco Firefighters Cancer Prevention Foundation (stefanit@sbcglobal.net); Bruce Hammond, Hammond & Company Inc., representing Hammond & Company Inc. (bruce@hammondandcompany.com); Nancy Hulseley, HKS, Inc., representing HKS, Inc. (nhulseley@hksinc.com); Robin Guenther, representing Perkins+Will (robin.guenther@perkinswill.com); David Eisenberg, Development Center for Appropriate Technology, representing Development Center for Appropriate Technology (strawnet@gmail.com); Marjorie Smith, Siegel & Strain Architects, representing Siegel & Strain Architects (Msmith@siegelstrain.com); Stacia Miller, International Living Future Institute, representing International Living Future Institute (stacia.miller@living-future.org); Clark Brockman, SERA Architects, Inc., representing SERA Architects, Inc. (clarkb@serapdx.com); Larry Strain, representing Siegel & Strain Architects (lstrain@siegelstrain.com); Russ Pitkin, SERA Architects, Inc., representing SERA Architects, Inc.; Kathy Gerwig, representing Kaiser Permanente; Dennis Murphy, USGBC California, representing USGBC California (dennis@usgbc-california.org); Martin Hammer, representing Martin Hammer, Architect (mfhammer@pacbell.net)

2015 International Building Code

Revise as follows:

2603.3 Surface-burning characteristics. Unless otherwise indicated in this section, foam plastic insulation and foam plastic cores of manufactured assemblies shall have a flame spread index of not more than 75 and a smoke-developed index of not more than 450 where tested in the maximum thickness intended for use in accordance with ASTM E 84 or UL 723. Loose fill-type foam plastic insulation shall be tested as board stock for the flame spread and smoke-developed indexes.

Exceptions:

1. Smoke-developed index for interior *trim* as provided for in Section 2604.2.
2. In cold storage buildings, ice plants, food plants, food processing rooms and similar areas, foam plastic insulation where tested in a thickness of 4 inches (102 mm) shall be permitted in a thickness up to 10 inches (254 mm) where the building is equipped throughout with an automatic fire sprinkler system in accordance with Section 903.3.1.1. The approved *automatic sprinkler system* shall be provided in both the room and that part of the building in which the room is located.
3. Foam plastic insulation that is a part of a Class A, B or C roof-covering assembly provided the assembly with the foam plastic insulation satisfactorily passes NFPA 276 or UL 1256. The smoke-developed index shall not be limited for roof applications.
4. Foam plastic insulation greater than 4 inches (102 mm) in thickness shall have a maximum flame spread index of 75 and a smoke-developed index of 450 where tested at a minimum thickness of 4 inches (102 mm), provided the end use is approved in accordance with Section 2603.9 using the thickness and density intended for use.
5. Flame spread and smoke-developed indexes for foam plastic interior signs in *covered and open mall buildings* provided the signs comply with Section 402.6.4.
6. Foam plastic insulation located a minimum of 6 inches (152 mm) below finished grade and separated from building interiors by a masonry or concrete wall or foundation. Such insulation shall also be exempt from the limiting oxygen index (LOI) requirements of ASTM C578.

Reason: This proposal exempts foam plastic insulation used below grade and separated from the building interior from the flame spread index (FSI) and smoke-developed index (SDI) requirements of Section 2603.3 and from the limiting oxygen index (LOI) criteria of ASTM C578. This will maintain building fire safety while reducing the health and environmental impacts of toxic or potentially toxic flame retardant chemicals, and it will increase consumer choice.

Ignition and propagation of fire requires three elements: fuel, an ignition source, and oxygen. The proposed exemption from FSI, SDI, and LOI requirements applies only to foam plastic insulation that is at least 6 inches below finish grade, where there is no significant exposure to ignition sources or oxygen. Since the foam plastic insulation will not burn under these conditions, the provisions of Section 2603.3, that limit surface burning characteristics (FSI and SDI) of foam plastic insulation, are not relevant and provide no fire safety benefit. Similarly, there is no fire safety benefit from meeting the limiting oxygen index (LOI) criteria in ASTM C578. FSI, SDI, and LOI requirements are unnecessary for below-grade uses of foam plastic insulation, where the elements required for a fire do not exist. However, the flame retardants used in foam plastic insulation to meet these requirements pose a significant hazard to human health and ecosystems.

The proposed change does not require additional protection at below-grade wall penetrations beyond those required by other applicable code provisions. At these locations it is highly unlikely that foam plastic insulation on the exterior side of the wall will be exposed to an ignition source, and if a portion of the insulation were somehow exposed, there would not be sufficient oxygen to propagate fire.

Satisfying the FSI, SDI, and LOI criteria typically requires the addition of flame retardants to foam plastic insulation. During manufacture and installation, workers are likely to be exposed to these flame retardants, which have been associated with

neurological and reproductive impairments, hormonal and immune problems, and cancer. These flame retardants are released into the environment during manufacture, demolition, and disposal, and they will eventually migrate out of landfills and other repositories. When thermally processed or burned (for instance, in an incinerator or a landfill), insulation containing halogenated flame retardants can generate highly persistent and toxic halogenated dioxins and furans and other toxic combustion byproducts. Exposure to these dioxins and furans has been associated with cancer and other human health and ecological harm.

HBCD (hexabromocyclododecane) is the flame retardant used most commonly in polystyrene insulation, a typical variety of foam plastic insulation used below-grade. In 2013 under the Stockholm Convention, over 150 countries agreed to eliminate HBCD from the global marketplace due to its persistence and toxicity. The chemical alternatives to HBCD are also highly persistent halogenated flame retardants and are expected to have some comparable adverse health and ecological impacts. Reducing the unnecessary use of harmful flame retardants will reduce exposure and harm to construction workers, emergency responders, the general public, and ecosystems.

The proposed change does not prohibit the use of flame retardants in foam plastic insulation. Instead, it describes conditions under which foam plastic insulation without flame retardants can be used safely in buildings. This change would include below-grade insulation placed horizontally for frost-protected shallow foundations per Section 1809.5(2); such insulation must also comply with the insulation protection requirements of this section and the referenced standard ASCE 32.

It is envisioned that insulation without flame retardants for use as described in this proposed exception would require labeling that complies with Section 2603.2. This labeling would be the responsibility of the insulation manufacturer, in the same way that it is currently the manufacturer's responsibility to properly label foam plastic insulation for the end uses described in Exceptions 1 through 5 of Section 2603.3.

This code change will maintain fire safety, reduce the adverse health and environmental impacts of toxic flame retardants used in foam plastic insulation, and expand consumer choice.

Cost Impact: Will not increase the cost of construction

The proposed code change will not require any action that increases construction costs since it does not mandate any change from current practice. Utilizing the proposed code change would not require any alteration to design or construction practices. The proposed change would enable voluntary manufacture and use of alternative foam plastic insulation products that do not contain flame retardant chemicals. The cost of using these alternative insulation products may be higher, lower, or the same as the cost of using currently available insulation depending on formulation costs, production volumes, consumer demand, and level of competition.

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Public Hearing Results

Committee Action:

Disapproved

Committee Reason: The committee disapproved this change based on the following: no fire test data has been submitted on the product used in this application – fire can get below ground and protection by the masonry or concrete wall or foundation may not always be enough; this is a more susceptible location than that proposed in FS170; and the 6 inch dimension is arbitrary and may not always be there after occupancy causing an exposure issue, which could then increase flame spread to other portions of the exterior of the building.

Individual Consideration Agenda***Public Comment 1:***

Proponent : Avery Lindeman, Green Science Policy Institute, representing Green Science Policy Institute (avery@greensciencepolicy.org); Veena Singla, representing Natural Resources Defense Council; Bruce Hammond, Hammond & Company Inc., representing Hammond & Company Inc.; Tom Lent, Healthy Building Network, representing Healthy Building Network (tlent@healthybuilding.net); Vytenis Babrauskas, Fire Science and Technology Inc., representing Fire Science and Technology Inc.; Marjorie Smith, representing Siegel & Strain Architects (Msmith@siegelstrain.com); Stacia Miller, International Living Future Institute, representing International Living Future Institute (stacia.miller@living-future.org); Russ Pitkin, SERA Architects, Inc., representing SERA Architects, Inc (russsp@serapdx.com); Dennis Murphy, representing USGBC California (dennis@usgbc-california.org); David Eisenberg, Development Center for Appropriate Technology, representing Development Center for Appropriate Technology (strawnet@gmail.com); Tony Stefani, representing San Francisco Firefighters Cancer Prevention Foundation (stefanit@sbcglobal.net); Martin Hammer, representing Martin Hammer, Architect (mfhammer@pacbell.net); Nancy Hulsey, representing HKS, Inc. (nhulsey@hksinc.com); Larry Strain, representing Siegel & Strain Architects (lstrain@siegelstrain.com); Samir Mokashi, Code Unlimited, representing Green Science Policy Institute (samir.mokashi@codeul.com); Amanda Kaminsky, representing The Durst Organization (akaminsky@durst.org); Kathy Gerwig, representing Kaiser Permanente; Suzanne Drake, representing Perkins+Will (suzanne.drake@perkinswill.com); Ernest Pacheco, representing Communications Workers of America - District 9 (erniepacheco@cwa9412.org); Karen Burbano, representing REWS [e] team, Design & Construction Integrator (kburbano@google.com); Donald Lucas (d_lucas@lbl.gov); Charlotte Brody, representing BlueGreen Alliance (cbrody@bluegreenalliance.org); Jen Jackson, representing San Francisco Dept of the Environment and San Francisco Fire Dept (cynthia.jackson@sfgov.org) requests Approve as Modified by this Public Comment.

Modify as Follows:

2015 International Building Code

2603.3 Surface-burning characteristics. ~~Unless~~ Except as provided for in Section 2603.3.1 or otherwise indicated in this section, foam plastic insulation and foam plastic cores of manufactured assemblies shall have a flame spread index of not more than 75 and a smoke-developed index of not more than 450 where tested in the maximum thickness intended for use

in accordance with ASTM E 84 or UL 723. Loose fill-type foam plastic insulation shall be tested as board stock for the flame spread and smoke-developed indexes.

Exceptions:

1. Smoke-developed index for interior *trim* as provided for in Section 2604.2.
2. In cold storage buildings, ice plants, food plants, food processing rooms and similar areas, foam plastic insulation where tested in a thickness of 4 inches (102 mm) shall be permitted in a thickness up to 10 inches (254 mm) where the building is equipped throughout with an automatic fire sprinkler system in accordance with Section 903.3.1.1. The approved *automatic sprinkler system* shall be provided in both the room and that part of the building in which the room is located.
3. Foam plastic insulation that is a part of a Class A, B or C roof-covering assembly provided the assembly with the foam plastic insulation satisfactorily passes NFPA 276 or UL 1256. The smoke-developed index shall not be limited for roof applications.
4. Foam plastic insulation greater than 4 inches (102 mm) in thickness shall have a maximum flame spread index of 75 and a smoke-developed index of 450 where tested at a minimum thickness of 4 inches (102 mm), provided the end use is approved in accordance with Section 2603.9 using the thickness and density intended for use.
5. Flame spread and smoke-developed indexes for foam plastic interior signs in *covered and open mall buildings* provided the signs comply with Section 402.6.4.
6. ~~Foam plastic insulation located a minimum of 6 inches (152 mm) below finished grade and separated from building interiors by a masonry or concrete wall or foundation. Such insulation shall also be exempt from the limiting oxygen index (LOI) requirements of ASTM C578.~~

2603.3.1 Exterior below-grade wall or foundation insulation.

Flame spread index and smoke-developed index as specified in Section 2603.3 shall not be required for foam plastic insulation separated from the building interior by a masonry or concrete wall or foundation in the following locations:

1. Vertical insulation installed a minimum of 6 inches (152 mm) below finished exterior grade.
2. Horizontal insulation installed a minimum of 12 inches (304 mm) below finished exterior grade and extending no more than 24 inches outward from the foundation edge.
3. Horizontal insulation installed below finished exterior grade and protected by a concrete slab on the ground surface directly above the insulation.

Oxygen index shall not be limited for such insulation.

Commenter's Reason: This Public Comment modifies the original proposal to

address feedback from the 2015 IBC - Fire Safety Code Committee and stakeholders. It creates a sub-section under 2603.3 that specifies below-grade uses of foam plastic insulation for which there are no flame spread, smoke-developed, and oxygen index requirements. Use of this proposed change would be optional; the proposed change would not mandate any alteration to current building practice. It would maintain fire safety and increase consumer choice of insulation products for safe use below-grade.

This proposed change covers exterior insulation for basement and foundation walls and frost-protected shallow foundations. **Figure 1** and **Figure 2** below depict examples of insulation where the proposed change could be used. Uses covered by this proposed change are different from those covered by FS 170-15.

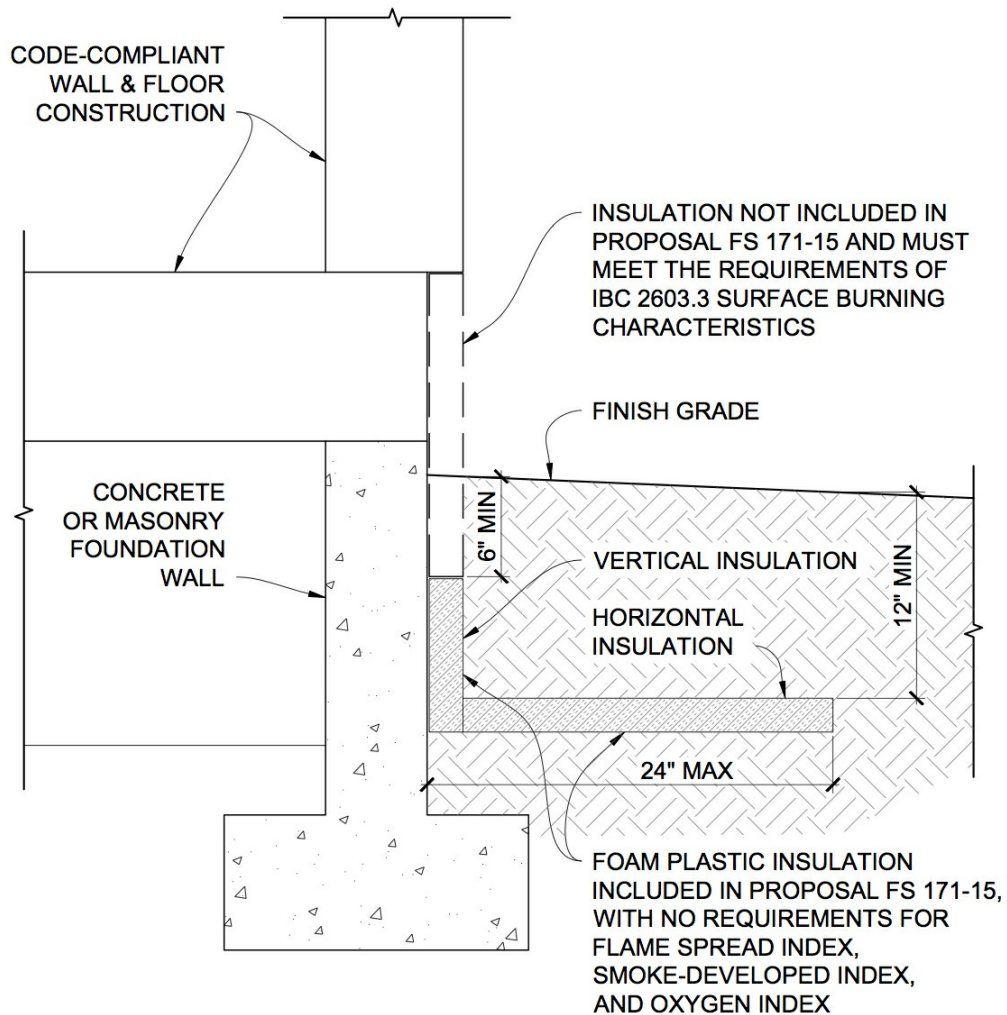


Figure 1: EXTERIOR BELOW-GRADE INSULATION
Proposed Code Section 2603.3.1 (1) and 2603.3.1 (2)

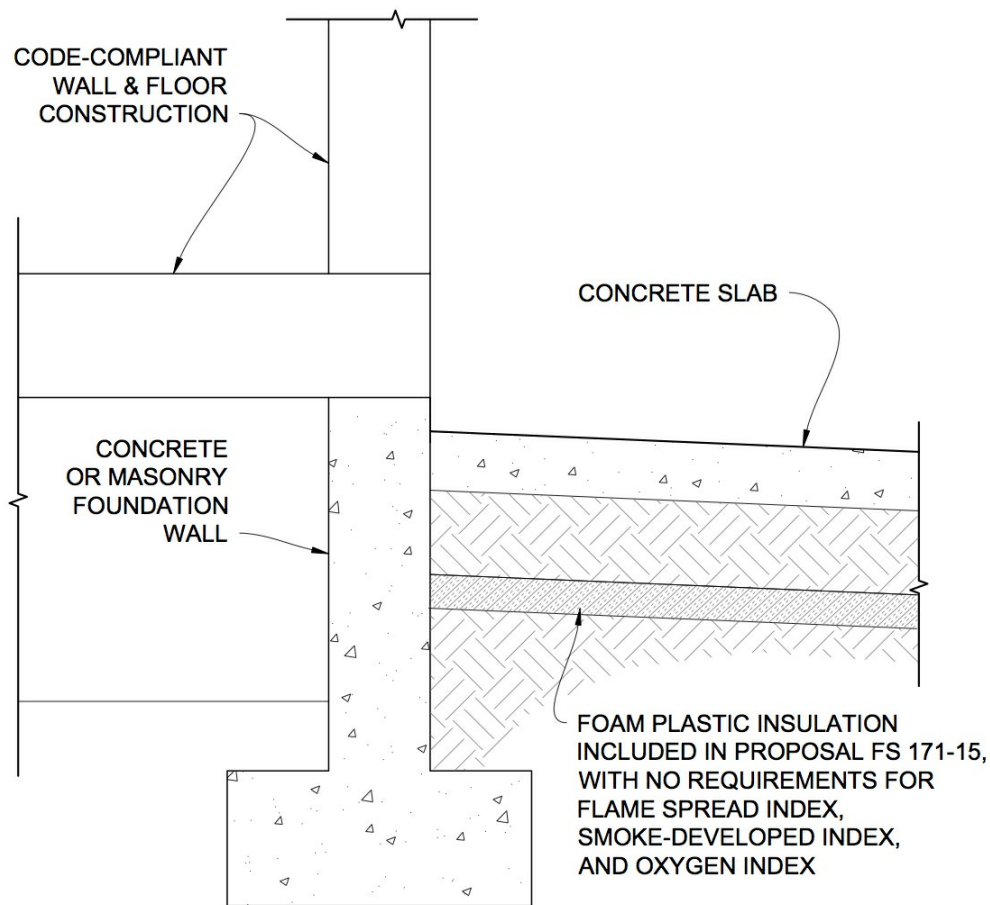


Figure 2: EXTERIOR BELOW-GRADE INSULATION WITH CONCRETE SLAB PROTECTION
 Proposed Code Section 2603.3.1 (3)

This proposed change would maintain fire safety in the following ways:

- Insulation installed in accordance with this proposed code change would be completely separated from the building interior.
- Insulation installed in accordance with this proposed code change would not have access to a realistic source of ignition because it is completely protected by concrete, masonry, or soil. Due to concerns that insulation covered by this proposal might become exposed during the course of use, the following publications provided precedent for establishing adequate protection. All four references establish protection requirements for insulation installed below finished exterior grade. Insulation installed in accordance with these codes and standards is considered sufficiently protected from possible damage or exposure. Where requirements differed between these documents, the most

conservative protection requirements were used. See **Table 1** for further detail.

- The 2015 International Building Code (IBC) Section **1809.5 Frost protection**
 - ASCE 32-01: Design and Construction of Frost Protected Shallow Foundations
 - The 2015 International Energy Conservation Code (IECC), Sections **C303.2.1 Protection of exposed foundation insulation** and **C402.2.6 Slabs on grade**
 - The 2015 International Residential Code (IRC) **Section 403.3.2 Protection of horizontal insulation below ground**
- Insulation installed in accordance with this proposed code change would not have access to adequate oxygen to sustain a fire, as demonstrated by results from preliminary fire tests of below-grade foam plastic insulation. These tests are described below.

Description of Tests: There is no established fire test method for the configurations covered by this proposed code change, and the co-commenters are unaware of data on flame spread or smoke-developed between concrete and sub-grade material for foams of various material properties. Therefore, in response to requests for testing data of the assemblies included under this proposed code change, Dr. David Rich at Reax Engineering Inc., and Dr. Donald Lucas (Lawrence Berkeley National Laboratory) and Avery Lindeman (Green Science Policy Institute), conducted preliminary tests to evaluate how different foam plastic insulation materials installed below grade would react when subjected to a range of reasonably foreseeable fire spread scenarios.

The insulation materials were sandwiched between concrete pavers (2 inches thick) and earth or other non-combustible surface and ignited at an opening in the pavers to observe fire spread beneath the simulated concrete slab. Tests were conducted with and without an externally applied radiant heat flux comparable to a post-flashover fire condition. Two types of insulation were tested: one that complied with the requirements of International Building Code (IBC) Section **2603.3 Surface burning characteristics**; and a similar below-grade insulation material that did not comply with Section 2603.3 requirements. When there were no openings between the concrete pavers, neither sample of insulation ignited, even at conditions where melting occurred. When there were significant openings (16 square inches) or gaps (2.5 inches) between the concrete pavers, and insulation was subjected to an open flame ignition source and an external heat flux, both samples ignited and burned comparably; however, without an external heat flux, ignition of insulation was followed by limited flame spread, and flames self-extinguished due to restricted access to oxygen as the flame burned away from the opening in the pavers.

- Insulation installed in accordance with this proposed code change would still be subject to the labeling and identification requirements of Section **2603.2 Labeling and identification**, ensuring that foam plastic insulation would be labeled with the product identification and sufficient information to determine that the end use complies with the code requirements.

Table 1: Comparison of Proposed Provisions with Existing Codes and Standards

Proposed Code Section	Proposed Code Language	Summary of Relevant Existing Codes and Sta
	<u>Vertical insulation installed a minimum</u>	IECC Section C303.2.1 and ASCE 32 require that a

2603.3.1 (1)	<u>of 6 inches (152 mm) below finished exterior grade.</u>	foundation wall insulation extend at least 6 inches against "ultraviolet radiation, physical damage, or protective covering is required.
2603.3.1 (2)	<u>Horizontal insulation installed a minimum of 12 inches (304 mm) below finished exterior grade and extending no more than 24 inches outward from the foundation edge.</u>	IBC Section 1809.5 allows for frost protection of sl require additional protection of insulation when in does not extend outward more than 24 inches fro to be protected by a minimum of 10 inches of soil. change.
2603.3.1 (3)	<u>Horizontal insulation installed below finished exterior grade and protected by a concrete slab on the ground surface directly above the insulation.</u>	ASCE 32 requires that horizontal insulation install portion "extending outward more than 24 inches f or asphalt pavement on the ground surface direct on the top surface of the insulation. IRC Section R concrete slab" subject to requirements of IBC Sec thickness of 3.5 inches (89 mm). IECC Section C4C protected by pavement or by a minimum of 10 incl conservative of these requirements, which is prot thick.

Oxygen index is not currently limited in Chapter 26 of the IBC. However, the acceptance criteria for certain types of foam plastic insulation (AC12: Acceptance Criteria for Foam Plastic Insulation) require testing to ASTM C578, which limits the permitted oxygen index of polystyrene insulation materials. The purpose of this index is to measure the percent of oxygen in air needed to sustain combustion in a candle-like fire. This is not relevant for the proposed uses of below-grade foam plastic insulation, as demonstrated by the preliminary fire tests discussed above. Oxygen Index would therefore not be limited for insulation covered by this proposed code change.

We are aware of concerns that this proposed code change may increase the fire hazard of foam plastic insulation materials during the transportation, storage, and installation stages of the product lifecycle. If this proposal is approved, we feel that current practices will maintain the current level of fire safety throughout these stages as described below:

- **Transportation:** the U.S. Department of Transportation does not differentiate between foam plastic materials based on surface burning characteristics. Special safety measures are not required for the bulk shipment of foam plastics, including food-grade materials and other foam plastics with varying material properties.
- **Storage and Installation:** As stated in a 2003 Technical Bulletin from the Alliance for the Polyurethanes Industry, "All organic foam insulations, regardless of whether they contain fire retardants, should be considered combustible and handled accordingly. Certain precautions must be taken to minimize any potential for fire through accidental ignition in handling, storage, and use." Therefore the surface burning characteristics required in Section 2603.3 are not sufficient to provide fire safety, and the following practices should be followed regardless of the Flame Spread and Smoke Developed Indexes of the materials present:
 - In accordance with OSHA Regulations for Occupational Safety and Health and Construction, worksite storage of foam plastics and other flammable materials should be done safely and in a way that does not block exits. The Alliance for the Polyurethane Industry recommends that foam boardstock be stored "in limited quantities, in an accessible location, and free from ignition hazards."
 - OSHA regulations also require that hot work adhere to NFPA 51B, which

stipulates that activities like welding and cutting should only be performed when appropriate precautions are taken. These include removal or proper protection from sparks, heat, or hot metal of any flammable materials in the vicinity of the work.

The proposed change does not prohibit the use of foam plastic insulation that meets the requirements of Section 2603.3. Instead, it describes uses in construction where foam plastic insulation may be used safely without requiring the surface burning characteristics specified in Section 2603.3. Use of this proposed change would be optional and would maintain fire safety.

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