Code Technology Committee
Area of Study – Balanced Fire Protection
Roof Vents

2007/2008 Cycle
Code changes related to the CTC area of study noted above

The following are code changes related to the CTC Balanced Fire Protection – Roof vents Area of Study that will be considered at the 2007/2008 Code Development Hearings in Palm Springs, California.

F191–07/08
910.1, 910.2, 910.2.1, 910.2.2, 910.2.3 (IBC [F] 910.1, [F] 910.2, [F] 910.2.1, [F] 910.2.2, [F] 910.2.3)

Proponent: Rick Thornberry, PE, The Code Consortium, representing AAMA Smoke Vent Task Group

Revise as follows:

910.1 (IBC [F] 910.1) General. Where required by this code or otherwise installed, smoke and heat vents or mechanical smoke exhaust systems and draft curtains shall conform to the requirements of this section.

~~**Exceptions:**~~

~~1. Frozen food warehouses used solely for storage of Class I and II commodities where protected by an approved automatic sprinkler system.~~
~~2. Where areas of buildings are equipped with early suppression fast-response (ESFR) sprinklers, automatic smoke and heat vents shall not be required within these areas.~~

910.2 (IBC [F]910.2) Where required. Smoke and heat vents shall be installed in the roofs of one-story buildings or portions thereof occupied for the uses set forth in Sections 910.2.1 ~~through 910.2.3~~ <u>and 910.2.2</u>.

<u>**Exceptions:**</u>

<u>1. Frozen food warehouses used solely for storage of Class I and II commodities where protected by an approved automatic sprinkler system.</u>
<u>2. Where areas of buildings are equipped with early suppression fast-response (ESFR) sprinklers, automatic smoke and heat vents shall not be required within these areas.</u>

910.2.1 (IBC [F] 910.2.1) Group F-1 or S-1. Buildings ~~and~~ <u>or</u> portions thereof used as a Group F-1 or S-1 occupancy having more than 50,000 square feet (4645 m^2) of undivided area.

Exception: Group S-1 aircraft repair hangars.

910.2.2 (IBC [F]910.2.2) High-piled combustible storage. Buildings ~~and~~ <u>or</u> portions thereof containing high-piled combustible stock or rack storage in any occupancy group when required by Section 2306.7.

910.2.3 (IBC [F]910.2.3) Exit access travel distance increase. <u>Smoke and heat vents shall be installed in the roofs and draft curtains shall be installed on the underside of the roofs of</u> buildings ~~and~~ <u>or</u> portions thereof used as a Group F-1 or S-1 occupancy where the maximum exit access travel distance is increased in accordance with Section 1016.2.

Reason: This reformats the exceptions to the General Section 910.1 and relocates them to Section 910.2 which specifies when the smoke and heat vents are required which is the more appropriate section for the exceptions. The exceptions are also modified to apply only to Sections 910.2.1 and 910.2.2 and not 910.2.3. That is because 910.2.3 is a provision that allows for an increased travel distance when smoke and heat vents are provided so there should be no exceptions for this particular application.

Cost Impact: The code change proposal will not increase the cost of construction.

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F192–07/08

910.1.1 (New), Chapter 45 (New) [IBC [F] 910.1.1 (New), Chapter 35 (New)]

Proponent: Rick Thornberry, PE, The Code Consortium, representing AAMA Smoke Vent Task Group

1. Add new text as follows:

<u>**910.1.1 (IBC [F] 910.1.1) Approved engineered design.** Where approved, NFPA 204 shall be permitted to be used by a registered design professional for an alternative engineered design in lieu of complying with the requirements specified in Section 910 for smoke and heat vents.</u>

2. Add standard to Chapter 45 (IBC Chapter 35) as follows:

NFPA

<u>204-07</u> <u>Smoke and Heat Venting</u>

Reason: This code change provides for an approved engineering design alternative to the requirements currently in Section 910 for smoke and heat vents based on the use of NFPA 204 which is now a full standard for the design of smoke and heat vents using an engineered approach.

Cost Impact: The code change proposal will not increase the cost of construction.

Analysis: A review of the standard proposed for inclusion in the code, NFPA 204-07, for compliance with ICC criteria for referenced standards given in Section 3.6 of Council Policy #CP 28 will be posted on the ICC website on or before January 15, 2008.
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F193–07/08

910.2 (IBC [F] 910.2)

Proponent: Rick Thornberry, PE, The Code Consortium, representing AAMA Smoke Vent Task Group

Revise as follows:

910.2 (IBC [F] 910.2) Where required. Smoke and heat vents shall be installed in the roofs <u>and draft curtains shall be installed on the underside of roofs</u> of one-story buildings or portions thereof occupied for the uses set forth in Sections 910.2.1 through 910.2.3.

Reason: This is an editorial clarification to provide for a charging requirement that draft curtains are required to be installed under the provisions of this section as are smoke and heat vents.

Cost Impact: The code change proposal will not increase the cost of construction.
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F194–07/08
Table 910.3 (IBC [F] Table 910.3)

Proponent: Rick Thornberry, PE, The Code Consortium, representing AAMA Smoke Vent Task Group

Revise table footnote as follows:

TABLE 910.3 (IBC TABLE [F] 910.3)
REQUIREMENTS FOR DRAFT CURTAINS AND SMOKE AND HEAT VENTS[a]

(Portions of table not shown remain unchanged)

For SI: 1 foot = 304.8 mm, 1 square foot = 0.0929m ^{2}.

a. ~~Requirements for rack storage heights in excess of those indicated shall be in accordance with Chapter 23.~~ For solid-piled storage heights in excess of those indicated, an approved engineered design shall be used.
b. The distance specified is the maximum distance from any vent in a particular draft curtained area to walls or draft curtains which form the perimeter of the draft curtained area.
c. Where draft curtains are not required, the vent area to floor area ratio shall be calculated based on a minimum draft curtain depth of 6 feet (Option 1).
d. "H" is the height of the vent, in feet, above the floor.

Reason: Chapter 23 does not contain specific requirements for smoke and heat vents. It refers to Section 910.

Cost Impact: The code change proposal will not increase the cost of construction.
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F195–07/08
Table 910.3 (IBC [F] Table 910.3)

Proponent: Rick Thornberry, PE, The Code Consortium, representing AAMA Smoke Vent Task Group

Revise table column heading and footnote as follows:

TABLE 910.3 (IBC TABLE [F] 910.3)
REQUIREMENTS FOR DRAFT CURTAINS AND SMOKE AND HEAT VENTS[a]

OCCUPANCY GROUP AND COMMODITY CLASSIFICATION	DESIGNATED STORAGE HEIGHT (feet)	MINIMUM DRAFT CURTAIN DEPTH (feet)	MAXIMUM AREA FORMED BY DRAFT CURTAINS (square feet)	VENT-AREA-TO FLOOR-AREA RATIO[c]	MAXIMUM SPACING OF VENT CENTERS (feet)	MAXIMUM DISTANCE ~~TO~~ <u>FROM</u> VENTS ~~FROM~~ <u>TO</u> WALL OR DRAFT CURTAIN[b] (feet)

(Portions of table not shown remain unchanged)

For SI: 1 foot = 304.8 mm, 1 square foot = 0.0929m ^{2}.

a. Requirements for rack storage heights in excess of those indicated shall be in accordance with Chapter 23. For solid-piled storage heights in excess of those indicated, an approved engineered design shall be used.
b. ~~The distance specified is the maximum distance from any vent in a particular draft curtained area to walls or draft curtains which form the perimeter of the draft curtained area.~~ <u>Vents adjacent to walls or draft curtains shall be located within a horizontal distance not greater than the maximum distance specified in this column as measured perpendicular to the wall or draft curtain that forms the perimeter of the draft curtained area.</u>
c. Where draft curtains are not required, the vent area to floor area ratio shall be calculated based on a minimum draft curtain depth of 6 feet (Option 1).
d. "H" is the height of the vent, in feet, above the floor.

Reason: This proposal is for editorial clarity. Not every vent is required to be within the specified maximum distance from a wall or draft curtain. That limitation is only applicable to those vents adjacent to the walls or draft curtains and not to other vents located in the middle of the draft curtained area.

Cost Impact: The code change proposal will not increase the cost of construction.

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F196–07/08

910.3.2, 910.3.2.2, 910.3.2.4 (New) [IBC [F] 910.3.2, [F] 910.3.2.2, [F] 910.3.2.4 (New)]

Proponent: Robert J. Davidson, Davidson Code Concepts, LLC, representing himself

Revise as follows:

910.3.2 (IBC [F] 910.3.2) Vent operation. Smoke and heat vents shall be capable of being operated by approved automatic ~~and~~ or manual means. Automatic or manual operation of smoke and heat vents shall conform to the provisions of Sections 910.3.2.1 through ~~910.3.2.3~~ 910.3.2.4.

910.3.2.1 (IBC [F] 910.3.2.1) Gravity-operated drop out vents. (No change to current text)

910.3.2.2 (IBC [F] 910.3.2.2) Sprinklered buildings. Where installed in buildings equipped with an approved automatic sprinkler system, smoke and heat vents shall be designed to operate ~~automatically~~ manually.

910.3.2.3 (IBC [F] 910.3.2.3) Nonsprinklered buildings. (No change to current text)

910.3.2.4 (IBC [F] 910.3.2.4) Increase in travel distance. Where installed in buildings to increase the maximum travel distance in accordance with Section 1016.2, smoke and heat vents shall be designed to operate automatically.

Reason: Since the initial drafting of the International Building and Fire Codes there have been numerous code changes submitted to eliminate the requirement for smoke and heat vents. The majority of the proposals to eliminate the requirement have argued that automatic smoke and heat vents have or may have a negative impact on the operation of automatic sprinkler systems. No definitive research has verified an overall negative effect on the operation of the sprinklers.

The key issue in the arguments appears to be the "automatic" operation of the smoke and heat vents, i.e., if they open too soon they may negatively affect sprinkler system operation. Based upon this issue, the proposals have sought to eliminate the smoke and heat vents altogether. This proposal offers a different solution. In buildings not protected with an automatic sprinkler system the smoke and heat vents shall be designed to operate automatically, in buildings protected with an automatic sprinkler system they shall be designed to operate manually unless installed for the purpose of increasing the maximum travel distance.

By making the proposed changes the basic argument against the installation of the smoke and heat vents is removed while leaving the vents in place for use by responding fire fighters. The 2006 IBC Commentary includes the following at Section 910.1:

> *"The purpose of smoke and heat vents has historically been related to the needs of fire fighters. More specifically, smoke and heat vents, when activated, have the potential effect of lifting the height of the smoke layer and providing more tenable conditions to undertake fire-fighting activities. Other potential benefits include a decrease in property damage and the creation of more tenable conditions for occupants."*

Smoke and heat vents are an important safety tool for fire fighters. They provide the opportunity to vent large buildings safely and quickly with a minimum of manpower as compared to attempting to cut large vent holes in a roof. They are a tool in the same manner as are fire hydrants required by IFC Section 508.5 or fire apparatus access roads required by IFC Section 503.1. The code does not completely eliminate the requirements for fire hydrants or fire apparatus access lanes just because a building is equipped with an automatic sprinkler system and the requirements for the smoke and heat vents should not be eliminated for that reason either.

Starting with the 2003 editions of the IBC and the IFC the following language was added:

International Building Code

> *"101.3 Intent.*
> *The purpose of this code is to establish the minimum requirements to safeguard the public health, safety and general welfare through structural strength, means of egress facilities, stability, sanitation, adequate light and ventilation, energy conservation, and safety to life and property from fire and other hazards attributed to the built environment and to provide safety to fire fighters and emergency responders during emergency operations."*

International Fire Code

> *"101.3 Intent.*
> *The purpose of this code is to establish the minimum requirements consistent with nationally recognized good practice for providing a reasonable level of life safety and property protection from the hazards of fire, explosion or dangerous conditions in new and existing buildings, structures and premises and to provide safety to fire fighters and emergency responders during emergency operations."*

Eliminating the provision for smoke and heat vents would be contrary to the stated intent of the two codes and will endanger fire fighters lives by leaving them no other option that to attempt difficult and time consuming manual roof venting operations.

Many items contained within the various I-Codes are the result of compromise, an attempt to obtain a middle ground that meets requirements for a minimum level of safety. This proposal is an example of that kind of compromise, it eliminates the potential conflict with the automatic sprinkler systems that is a concern for some but still maintains the installation of the smoke and heat vents for use by responding fire fighters.

Cost Impact: The code change proposal will not increase the cost of construction.
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F197–07/08

910.3.2.2.1 (New) [IBC [F] 910.3.2.2.1 (New)]

Proponent: Rick Thornberry, PE, The Code Consortium, representing AAMA Smoke Vent Task Group

Add new text as follows:

<u>**910.3.2.2.1 (IBC[F] 910.3.2.2.1) Ganged operation alternative.** Where approved, all smoke and heat vents located within an automatic sprinkler system zone shall be designed to open simultaneously upon activation of the water flow detection alarm device provided for the automatic sprinkler system zone. The smoke and heat vents shall also be designed to operate in accordance with Section 910.3.2.3. Where the building contains only one automatic sprinkler system, the building shall be considered to be a single automatic sprinkler system zone. Where the building contains more than one automatic sprinkler system, each system shall be designated as a separate automatic sprinkler system zone within the building. Draft curtains complying with Section 910.3.5 shall be provided to separate each automatic sprinkler system zone in the building. Any other draft curtains required by Section 910.3.5 shall be allowed to be omitted. Electrical wiring for the operation and control of the smoke and heat vents shall comply with Section 910.4.4 or the wiring shall be installed in steel conduit. Where the automatic sprinkler system water flow detection alarm device is supplied with emergency or standby power, the activation system for the simultaneous operation of the smoke and heat vents shall also be supplied in the same manner. A manual override switch for use by the fire department for simultaneously activating all of the smoke and heat vents within each automatic sprinkler system zone shall also be provided for each zone in an approved location.</u>

Reason: This code change provides for a new design alternative for sprinklered buildings using smoke and heat vents in what is called a ganged operation. This technology comes from Europe where it has been used successfully for many years. The AAMA Smoke Vent Task Group has also commissioned Hughes & Associates to conduct computer modeling studies to validate the performance of ganged operation of smoke and heat vents as prescribed in this new code section. We believe this alternate method is superior to the individual operation of smoke and heat vents, especially in sprinklered facilities.

The provisions we believe provide for a reliable operation of the gang system of smoke and heat vents and parallels the requirement for the protection of electrical wiring to that required for when mechanical smoke removal was used in lieu of smoke and heat vents. The operation of this system is triggered by the operation of the automatic sprinkler system water flow switch so that the smoke and heat vents will not open until after the sprinkler system has operated. Furthermore, the smoke and heat vents are also required to be able to be individually operated by thermally activated links as they would be under the traditional design approach. We consider this to be a fail safe approach so that should the sprinkler system not operate and trigger the water flow switch, then the smoke and heat vents will still be there to operate individually as they are triggered by heat from the growing fire.

Cost Impact: The code change proposal will not increase the cost of construction.
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F198–07/08

910.3.4 (IBC [F] 910.3.4)

Proponent: Rick Thornberry, PE, The Code Consortium, representing AAMA Smoke Vent Task Group

Revise as follows:

910.3.4 (IBC [F] 910.3.4) (Supp) Vent locations. Smoke and heat vents shall be located 20 feet (6096 mm) or more from adjacent lot lines and fire walls and 10 feet (3048 mm) or more from fire barriers. Vents shall be uniformly located within the roof area ~~above high-piled storage areas,~~ with consideration given to roof pitch, draft curtain location, sprinkler location and structural members.

Reason: Editorial clarification. This requirement should apply in all cases, not just for high piled storage areas.

Cost Impact: The code change proposal will not increase the cost of construction.
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F199–07/08
910.3.5 (IBC [F] 910.3.5)

Proponent: Edwin M. Berkel, CFI, Mehlville Fire Protection District, representing himself

Revise as follows:

910.3.5 (IBC [F] 910.3.5) Draft curtains. Where required, draft curtains shall be provided in accordance with this section.

> **Exception:** Where areas of buildings are equipped with ESFR sprinklers, draft curtains shall not be provided within these areas. Draft curtains shall only be provided at the separation between the ESFR sprinklers and the ~~conventional~~ standard response sprinklers

Reason: The existing code text makes use of an undefined term, "conventional sprinklers". This code change corrects that by using "standard response sprinklers" which is the correct term utilized in the reference standards.

Cost Impact: The code change proposal will not increase the cost of construction.
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F200–07/08
910 (IBC [F] 910)

Proponent: Richard Schulte, Schulte & Associates

Revise section as follows:

SECTION 910
SMOKE ~~AND HEAT VENTS~~ REMOVAL SYSTEMS

910.1 (IBC [F] 910.1) General. Where required by this code or otherwise installed, smoke ~~and heat vents, or mechanical smoke exhaust systems, and draft curtains~~ removal systems shall conform to the requirements of this section.

Exceptions:

1. Frozen food warehouses used solely for storage of Class I and II commodities where protected by an approved automatic sprinkler system.
2. Where areas of buildings are equipped with early suppression fast-response (ESFR) sprinklers, ~~automatic~~ smoke and heat ~~vents~~ removal systems shall not be required within these areas.

910.2 (IBC [F] 910.2) Where required. Smoke ~~and heat vents~~ removal systems shall be ~~installed in roofs of~~ provided for one-story buildings or portions thereof occupied for the uses set forth in Sections 910.2.1 through 910.2.3.

910.2.1 (IBC [F] 910.2.1) Group F-1 or S-1. (No change to current text)

910.2.2 (IBC [F] 910.2.2) High-piled combustible storage. (No change to current text)

910.2.3 (IBC [F] 910.2.3) Exit access travel distance increase. (No change to current text)

910.3 (IBC [F] 910.3) Smoke removal systems. Smoke removal systems shall be of a type described in Section 910.3.1 or 910.3.2.

910.3.1 (IBC [F] 910.3.1) Sprinklered buildings. Smoke removal systems in buildings protected by a sprinkler system shall be permitted to be any one of the following types of systems, or a combination thereof:

1. Automatic smoke and heat vents

2. Manually-operated smoke and heat vents
3. Manually-activated mechanical smoke exhaust system
4. Manually openable louvers in the exterior walls
5. Manually openable doors and windows in the exterior walls.

910.3.2 (IBC [F] 910.3.2) Nonsprinklered buildings. Smoke removal systems in nonsprinklered buildings shall be automatic smoke and heat vents.

~~910.3 (IBC [F] 910.3)~~ 910.4 (IBC [F] 910.4) ~~Design and installation~~ Automatic and manually-operated smoke and heat vents. The design and installation of automatic smoke and heat vents and draft curtains shall be as specified in Sections ~~910.3.1~~ 910.4.1 through ~~910.3.5.2~~ 910.4.5 and Table ~~910.3~~ 910.4. The design of manually-operated smoke and heat vents shall be as specified in Sections 910.4.1, 910.4.3 and 910.4.4 and Table 910.4.

~~910.3.1 (IBC [F] 910.3.1)~~ 910.4.1 (IBC [F] 910.4.1) Design. Automatic and manually-operated smoke and heat vents shall be listed and labeled to indicate compliance with UL 793.

~~910.3.2 (IBC [F] 910.3.2)~~ 910.4.2 (IBC [F] 910.4.2) Automatic vent operation. Automatic smoke and heat vents shall be capable of being operated by ~~approved~~ automatic and manual means. Automatic operation of smoke and heat vents shall conform to the provisions of Section ~~910.3.2.1~~ 910.4.2.1 through ~~910.3.2.3~~ 910.4.2.3.

~~910.3.2.1 (IBC [F] 910.3.2.1)~~ 910.4.2.1 (IBC [F] 910.4.2.1) Gravity-operated drop-out vents. Automatic smoke and heat vents containing heat-sensitive glazing designed to shrink and drop out of the vent opening when exposed to fire shall fully open within 5 minutes after the vent cavity is exposed to a simulated fire, represented by a time-temperature gradient that reaches an air temperature of 500°F (260°C) within 5 minutes.

~~910.3.2.2 (IBC [F] 910.3.2.2)~~ 910.4.2.2 (IBC [F] 910.4.2.2) Sprinklered buildings. Where installed in buildings provided with an approved automatic sprinkler system, smoke and heat vents shall be designed to operate automatically by activation of a heat-sensing device with a temperature rating equal to or above the temperature rating of the sprinklers.

~~910.3.2.3(IBC [F] 910.3.2.3)~~ 910.4.2.3 (IBC [F] 910.4.2.3) Nonsprinklered buildings. Where installed in buildings not provided with an approved automatic sprinkler system, smoke and heat vents shall be automatically operated by actuation of a heat-sensing device rated at between 100°F (38°C) and 220°F (104°C) above ambient.

~~910.3.3 (IBC [F] 910.3.3)~~ 910.4.3 (IBC [F] 910.4.3) Vent dimensions. The effective venting area shall not be less than 16 square feet (1.5 m^2) with no dimension less than 4 feet (1219 mm), excluding ribs or gutters having a total width not exceeding 6 inches (152 mm).

~~910.3.4 (IBC [F] 910.3.4) (Supp)~~ 910.4.4 (IBC [F] 910.4.4) Vent locations. Automatic smoke and heat vents shall be located 20 feet (6096 mm) or more from adjacent lot lines and fire walls and 10 feet (3048 mm) or more from fire barriers. Automatic and manually-operated vents shall be uniformly located within the roof area above high-piled storage areas, with consideration given to roof pitch, draft curtain location, sprinkler location and structural members.

~~910.3.5 (IBC [F] 910.3.5)~~ 910.4.5 (IBC [F] 910.4.5) Draft curtains. Where required by Table 910.3, draft curtains shall be provided in accordance with this section.

> **Exception:** Where areas of buildings are equipped with ESFR sprinklers, draft curtains shall not be provided within these areas. Draft curtains shall only be provided at the separation between the ESFR sprinklers and the conventional sprinklers.

~~910.3.5.1 (IBC [F] 910.3.5.1)~~ 910.4.5.1 (IBC [F] 910.4.5.1) Construction. Draft curtains shall be constructed of sheet metal, lath and plaster, gypsum board or other approved materials which provide equivalent performance to resist the passage of smoke. Joints and connections shall be smoke tight.

~~910.3.5.2 (IBC [F] 910.3.5.2)~~ 910.4.5.2 (IBC [F] 910.4.5.2) Location and depth. The location and minimum depth of draft curtains shall be in accordance with Table 910.3.

~~**910.4 (IBC [F] 910.4)**~~ **910.5** **(IBC [F] 910.5)** **Manually-activated mechanical smoke exhaust system.** ~~Where approved by the fire code official, engineered mechanical smoke exhaust shall be an acceptable alternate to smoke and heat vents.~~ The design and installation of a mechanical smoke exhaust system shall be as specified in Sections 910.5.1 through 910.5.6.

~~**910.4.1 (IBC [F] 910.4.1)**~~ **910.5.1** **(IBC [F] 910.5.1)** **Location.** Exhaust fans shall be uniformly spaced ~~within each draft-curtained area~~ within the floor area served by the exhaust system and the maximum distance between fans shall not be greater than ~~100~~ 200 feet (~~30280~~ 60560 mm).

~~**910.4.2 (IBC [F] 910.4.2)**~~ **910.5.2 (IBC [F] 910.5.2)** **Size.** Fans shall have a maximum individual capacity of 30,000 cfm (14.2 m^3/s). The aggregate capacity of smoke exhaust fans shall be determined by the following equation:

C = A x ~~300~~ 100

where:

C = Capacity of mechanical ventilation required, in cubic feet per minute (m^3/s).
A = Area of roof vents provided in square feet (m^2) in accordance with Table 910.3.

~~**910.4.3 (IBC [F] 910.4.3)**~~ **910.5.3** **(IBC [F] 910.5.3)** **Operation.** Mechanical smoke exhaust fans shall be ~~automatically~~ activated by ~~the automatic sprinkler system or by heat detectors having operating characteristics equivalent to those described 901.3.2~~ manual controls only. Individual manual controls for each fan shall also be provided. Automatic activation of the mechanical smoke exhaust system shall not be permitted.

~~**910.4.4 (IBC [F] 910.4.4)**~~ **(Supp)** **910.5.4** **(IBC [F] 910.5.4)** **Wiring and control.** Wiring for operation and control of smoke exhaust fans shall be connected ahead of the main disconnect and protected against exposure to temperatures in excess of 1,000°F (538°F) for a period of not less than ~~15~~ 5 minutes. Controls shall be located so as to be immediately accessible to the fire service from the exterior of the building and protected against interior fire exposure by not less than 1-hour fire barriers constructed in accordance with Section 706 or horizontal assemblies constructed in accordance with Section 711, or both.

~~**910.4.5 (IBC [F] 910.4.5)**~~ **910.5.5** **(IBC [F] 910.5.5)** **Supply air.** Supply air for exhaust fans shall be provided at or near the floor level and shall be sized to provide a minimum of 50 percent of the required exhaust. Openings for supply air shall be uniformly distributed around the periphery of the area served.

~~**910.4.6 (IBC [F] 910.4.6)**~~ **910.5.6** **(IBC [F] 910.5.6)** **Interlocks.** In combination comfort air-handling/smoke removal systems or independent comfort air-handling systems, fans shall be controlled to shut down in accordance with the approved smoke control sequence.

910.6 (IBC [F] 910.6) Manually openable louvers in the exterior walls. Manually openable louvers in the exterior walls shall provide 100 square feet of clear opening for each 100 feet (30.5 m) of building perimeter.

910.6.1 (IBC [F] 910.6.1) Spacing. The spacing between louvers shall not exceed 200 feet (61 m).

910.7 (IBC [F] 910.7) Manually openable doors and windows in the exterior walls. Manually openable doors and windows in the exterior walls shall provide 100 square feet of opening for each 100 feet of building perimeter.

910.7.1 (IBC [F] 910.7.1) Spacing. The spacing between doors and windows shall not exceed 200 feet (61 m).

TABLE 910.3 (IBC [F] TABLE 910.3)
REQUIREMENTS FOR DRAFT CURTAINS AND SMOKE AND HEAT VENTS[a,b]

OCCUPANCY GROUP AND	DESIGNATED STORAGE	MINIMUM	MAXIMUM AREA FORMED BY DRAFT	VENT-AREA-T0	MAXIMUM SPACING OF	MAXIMUM DISTANCETO VENTS FROM WALL OR DRAFT

COMMODITY CLASSIFICATION	HEIGHT (feet)	DRAFT CURTAIN DEPTH (feet)	CURTAINS (square feet)	FLOOR-AREA RATIO[c]	VENT CENTERS (feet)	CURTAIN[~~b~~ c] (feet)
Group F-1 and S-1	___	0.2 x H[~~d~~ e] but ≥ 4	50,000	1:100	120	60

a. (No change to existing text)

b. Draft curtains are not required where manually-operated smoke and heat vents are provided.

~~b~~ c. (No change to existing text)

~~c~~ d. (No change to existing text)

~~d~~ e. (No change to existing text)

(Portions of table and footnotes not shown remain unchanged)

Reason: The purpose of this code change proposal is two-fold. First, this proposal incorporates the results of fire testing on the interaction of standard spray sprinklers and automatic smoke and heat (roof) vents conducted at Underwriters Laboratories (UL) in 1997 and 1998 into the provisions of this code section. Second, this proposal reflects changes in fire fighting operations recommended by the National Institute of Occupational Safety and Health (NIOSH) and also by FEMA Firefighter Life Safety Summit (held on April 14, 2004).

Special provisions which addressed the hazard of high-piled storage originated in the Uniform Building Code (UBC) and Uniform Fire Code (UFC). The requirements for high-piled storage contained in the 1979 edition of the UFC required that a manually-activated mechanical smoke removal system be provided in sprinklered buildings which contained high-piled storage. Further, the high-piled storage provisions contained in the 1979 UFC specifically prohibited the installation of smoke and heat vents in sprinklered buildings (due to concerns that the opening of automatic smoke and heat vents could adversely impact the operation of sprinklers and could cause the failure of the sprinkler system).

In the early 1980's, a UFC ad hoc committee on high-piled storage was formed. (The proponent of this proposal represented the Northern California Fire Prevention Officers (NCFPO) on the ad hoc committee until August, 1982.) This ad hoc committee recommended that the high-piled storage provisions contained in the UFC be modified to reverse the code provisions which prohibited the use of smoke and heat (roof) vents in sprinklered buildings and proposed that automatic smoke and heat vents be specifically required in sprinklered buildings containing high-piled storage.

The UFC ad hoc committee recommended that automatic smoke and heat vents be provided in sprinklered buildings for two basic reasons (and only two reasons). The first reason was to assist interior manual fire fighting operations and the second reason was to reduce property damage caused by smoke and heat. In effect, the committee decision to require roof vents in sprinklered buildings brushed aside the concern that the opening of roof vents could adversely affect the operation of the sprinkler system, however, the one issue that the ad hoc committee most certainly did not address (because it was not known at the time) was whether or not the operation of the sprinkler system would have an adverse impact on the opening of roof vents.

In the early 1990's, fire testing by Factory Mutual Research Corporation (FMRC) determined that draft curtains required to be utilized with smoke and heat vents could adversely affect the number and location of sprinklers which operated in a fire (depending upon where the fire was located with respect to the draft curtains). Based upon this finding, the requirements for draft curtains contained in the Uniform Fire Code were modified and, in most cases, the requirement for draft curtains were removed, when the International Fire Code was developed. (Since automatic roof vents and draft curtains are a “team”, the removal of the requirement for draft curtains has a detrimental effect on the operation of roof vents.)

In 1997 and 1998, the National Fire Protection Research Foundation (NFPRF) sponsored testing on the interaction of sprinklers and smoke and heat vents at Underwriters Laboratories in an attempt to finally resolve the issue of whether or not open smoke and heat vents adversely affected the operation of sprinklers. While the NFPRF testing did not conclusively resolve this issue, the NFPRF tests supported FMRC’s conclusion that draft curtains could negatively impact the operation of sprinklers and also determined that the operation of standard spray sprinklers negatively impacted the operation of roof vents. In fact, the NFPRF tests determined that automatic roof vents are unlikely to automatically open in buildings where the sprinkler system successfully or marginally controls a fire.

Excerpts from the report on the NFPRF tests (NISTIR 6196-1) addressing the impact of operating sprinklers on the opening of automatic roof vents include the following:

> “*It had become clear by this time in the project that the vents were unlikely to open when the fire was ignited more than about 4.6 m (15 ft) away.*” (Page 54, NISTIR 6196-1)

> “*. . . .it appears from the data below that the sprinkler spray influenced the thermal response characteristics of this particular vent, and it is believed that sprinklers could have a similar influence on similar vent designs.*” (Page 64, NISTIR 6196-1)

> “*Six other tests were performed with the fire at this distance from the vent when the vent was equipped with a fusible link, and in none of these tests did the vent open. . . .Examination of the near-ceiling temperatures from all the tests indicates that sprinklers of this type* [standard spray sprinklers] *have a significant cooling effect, and this will certainly have an effect on thermally-responsive, independently-controlled vents.*” (Page 64, NISTIR 6196-1)

> “*In Plastic Test P-2, the fire was ignited directly under a vent. In the experiment, flames reached the top of the central array at about 65 s and the vent cavity at about 70 s. The first sprinkler activated at 100 s. The vent did not open at any time during the 30 min test even though another vent 6 m (20 ft) to the west of the unopened vent opened at 6:04.*” (Page 64, NISTIR 6196-1)

> “*This data, along with the plunge tunnel measurements reported in Section 3.1.4, suggests that the fusible link reached its activation temperature before or at about the same time as the first sprinkler activated, but the link did not fuse. It is not clear whether the link did not fuse because it was cooled directly by water drawn upwards into the vent cavity, or whether the sprinkler spray simply cooled the rising smoke plume enough to prevent the link from fusing. In any event, this phenomenon deserves further study.*” (Page 64, NISTIR 6196-1)

"*The mass flow rates* [through the vents] *for Test I-10 and P-5 are relatively low compared with the theoretical maximum because the near-ceiling gas temperatures are greatly reduced by the sprinklers.*" (Page 100, NISTIR 6196-1)

"*The significant cooling effect of sprinkler sprays on the near-ceiling gas flow often prevented the automatic operation of vents. This conclusion is based on thermocouple measurements within the vent cavity, the presence of drips of solder on the fusible links recovered from unopened vents, and several tests where vents remote from the fire and the sprinkler spray activated. In one cartoned plastic commodity experiment, a vent did not open when the fire was ignited directly beneath it.*" (Page 101, NISTIR 6196-1)

In addition to the excerpts from NISTIR 6196-1, Dr. Craig Beyler of Hughes Associates, Inc. (a consultant to the AAMA Smoke Vent Task Group) has also addressed the issue of the opening of roof vents in sprinklered buildings. The following are excerpts from Dr. Beyler's work:

"*The experimental studies have shown that . . . . .current design practices are likely to limit the number of vents operated to one and vents may in fact not operate at all in very successful sprinkler operations.*" (Page 1, "Interaction of Sprinklers with Smoke and Heat Vents")

"*Eliminates Need for Manual Venting?* *No*" (Page 42, "Sprinkler/Vent Interactions-What people think, what we know, and what we don't.")

"*Not only is the fear of early operation not founded, current design practice will likely lead to 0-1 vents operating*" (Page 61, "Sprinkler/Vent Interactions-What people think, what we know, and what we don't.")

"*Revised design methods for early operation of vents are needed*" (Page 61, "Sprinkler/Vent Interactions-What people think, what we know, and what we don't.")

Obviously, if automatic roof vents do not operate automatically in sprinklered buildings where the sprinkler system is operative and effective, or marginally effective, then the roof vents do little to assist interior manual fire fighting operations and will do little to reduce heat and smoke damage caused by a fire. These points were clearly demonstrated in a fire in a bulk merchandise retail store in Tempe, Arizona on March 19, 1998.

In the bulk merchandise retail store fire in Tempe, the sprinkler system operated, but was inadequate for the hazard being protected and was failing. (A total of 66 large orifice sprinklers operated in the fire. The hydraulic calculations for the sprinkler system assumed that only 29 sprinklers would operate.) Even though the building was provided with smoke and heat vents per the UFC requirements, the building was filled with smoke from floor to the underside of the roof (with zero visibility at the floor) by the time the Phoenix Fire Department arrived at the building. Based upon the NFPA fire report, only 3 of the 29 roof vents (and one skylight) opened automatically and a ladder company had to be sent to the roof to open the other vents.

The NFPA report on this fire in Tempe indicates that the smoke and heat vents had been disabled (although 3 vents did operate automatically), however, this fire clearly shows that smoke and heat vents can be completely ineffective in providing visibility for fire fighters where too few vents open. This finding, coupled with the finding from the NFPRF tests that sprinkler operation will limit the maximum number of vents opening to one, if any vents open at all, indicates that the performance of automatic roof vents is essentially the same as manually-opened vents, except where the sprinkler protection is impaired and fails to discharge water (i.e. closed water supply control valve, broken piping or a pump fails to start).

Where a sprinkler system protecting a large single-story building is impaired and fails to discharge water, the recommendations contained in NIOSH 2005-132, "Preventing Injuries and Deaths of Fire Fighters due to Truss System Failures" are applicable. NIOSH 2005-132 contains the following recommendations regarding interior manual fire fighting operations in buildings constructed with trusses (and other light-weight roof construction typically used in large single-story storage and industrial buildings):

"*Fire fighters should be discouraged from risking their lives solely for property protection activities.*" (Page 7)

"*Lives will continue to be lost unless fire departments make appropriate fundamental changes in fire-fighting tactics involving trusses.*" (Page 8)
"*NIOSH recommends that fire departments, fire fighters, building owners, and managers take steps to minimize the risk of injury and death to fire fighters during fire fighting operations involving structures with truss floor and roof systems. . . .*" (Page 8)

"*Use defensive strategies whenever trusses have been exposed to fire or structural integrity cannot be verified. Unless life-saving operations are under way, evacuate fire fighters and use an exterior attack.*" (Page 9)

Comments contained in the initial report from the FEMA Firefighter Life Safety Summit held in Tampa on April 14, 2004 also address interior manual fire fighting in buildings both large and small. The following is an excerpt from the report:

"*The willingness of firefighters to risk their own lives to save others must never be used as an excuse to take unnecessary risks. Firefighters are highly respected for being willing to risk their own lives to save others, but that cannot justify taking unnecessary risks in situations where there is no one to save and nothing to be gained. In too many cases firefighters lose their lives while trying to save property that is already lost or to rescue victims who are already dead. While these efforts are valiant, they are also futile. Individual firefighters who take unnecessary risks, or fail to follow standard safety practices, endanger their own lives as well as the lives of other fire fighters who are depending on them or who might have to try to rescue them.*"

Based upon the excerpts from NIOSH 2005-132 and the FEMA Firefighter Life Safety Summit above, it can be concluded that interior manual firefighting operations are no longer recommended in buildings with unprotected (non-rated) roof construction in the event the sprinkler system protecting the building is impaired and fails to discharge water. It can also be concluded that sending firefighters to the roof to open unopened automatic roof vents in buildings with unprotected (non-rated) roof construction is not recommended.

To summarize, fire testing conducted at Underwriters Laboratories in 1997 and 1998 determined that automatic roof vents will not automatically open in sprinklered buildings (if the sprinkler protection is effective or marginally effective in controlling the fire) and NIOSH 2005-132 recommends against interior manual firefighting in buildings with unprotected (non-rated) roof construction where the sprinkler protection is impaired and fails to discharge water. In other words, the two basic reasons why the UFC ad hoc committee on high-piled storage recommended that the installation of roof vents be mandated, to assist interior manual firefighting operations and to reduce heat and smoke damage, are no longer valid. Given this, the need to continue to mandate the installation of automatic roof vents is certainly questionable.

Two other issues which the code changes committee for the Fire Code requested to be addressed in the last code change cycle are fire extinguishment and occupant safety in large single-story buildings. The issue of fire extinguishment in large single-story buildings is addressed in two excerpts from NFPA 13:

> **"*Sprinkler protection installed as required in this standard is expected to protect the building occupancy without supplemental fire department activity.*"**
>
> **"*During the testing program, the installed automatic extinguishing system was capable of controlling the fire and reducing all temperatures to ambient within 30 minutes of ignition.*"**

Given the above, sprinkler protection which is properly designed, installed and maintained is capable of doing the firefighting in large manufacturing and storage buildings in 30 minutes or less. Fire fighters only need to support the sprinkler system by supplying the fire department connection. (It should be noted that no fire fighter fatalities occurred in buildings which were protected throughout by a sprinkler system in either 2005 or 2006.)

With respect to the occupant fire safety issue, large single-story storage and industrial buildings protected by a sprinkler system are extremely "safe" buildings. While fire fatalities have occurred in these types of facilities, the fatalities are typically due to either occupants being intimate with the fire source or due to explosions. Once again, the admonition from the Firefighter Life Safety Summit quoted above should be considered.

The code change proposal substantially modifies the provisions contained in Section 910. In buildings protected by a sprinkler system, five design options for providing (post-fire) ventilation for use by the fire service are provided. It is specifically intended that all five of these options be used after fire control and extinguishment by the sprinkler system. This proposal retains the requirement to provide automatic roof vents as previously required for buildings which are not protected by a sprinkler system.

The proposal for four new design options to provide ventilation for the building is based upon the fact that it is highly unlikely that automatic smoke and heat vents will operate in a building provided with sprinkler protection. Hence, automatic smoke and heat vents will actually function in the same manner as manually-operated roof vents.

The option to provide a mechanical smoke exhaust system is based upon the present provisions for such systems already included in section 910, however, the exhaust rate required has been reduced by two-thirds and the protection of the electrical power supply has been reduced from 15 minutes to 5 minutes. The required exhaust rate has been reduced because the efficiency of roof vents after the fire has been extinguished will be reduced (due to the reduced temperature differential at the vent). The requirements for protection of the power supply for the exhaust fans from high temperatures has been reduced to 5 minutes because sprinkler operation should provide more than adequate protection for the power supply. If the operation of sprinklers can prevent automatic smoke and heat vents from opening, then the operation of sprinklers should provide more than adequate protection for a minimally protected power supply.

The other two options to provide post-fire ventilation consist of exterior wall openings. Again, the standard by which the effectiveness of exterior wall openings should be measured is the effectiveness of roof vents after the fire has been controlled and extinguished. Given that the entire building will be cooled to ambient temperatures after the operation of the sprinkler system, roof venting will not be a very efficient method of ventilating the building. The effectiveness of exterior wall openings to provide ventilation should be judged based upon the level of effectiveness provided by roof vents.

For over 20 years, owners of large warehouses and industrial buildings in the United States have been required by building and fire codes to provide a highly ineffective means of providing fire protection. Adoption of this code change will finally allow building owners to provide building fire protection based upon good fire protection practice, rather than fire protection practice based on myth. It is unfortunate that previous proposals to delete the requirement for roof vents and draft curtains were not approved due to a lack of understanding by the fire service on how roof vents function in sprinklered buildings. Over the years, billions of dollars have been wasted on providing automatic roof vents and draft curtains in sprinklered buildings. This is an excellent example of what can happen when code provisions are developed based upon emotion, rather than utilizing an engineering approach to building fire protection.

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6. Standard on Sprinkler Systems (NFPA 13), National Fire Protection Association.

Cost Impact: The code change proposal will not increase the cost of construction.
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E112–07/08

1016.2 [IFC [B] 1016.2)

Proponent: Rick Thornberry, PE, The Code Consortium, Inc., representing AAMA Smoke Vent Task Group

Revise as follows:

1016.2 (IFC [B] 1016.2) ~~Roof~~ Smoke and heat vent increase. In buildings ~~that are~~ one story in height, equipped with automatic ~~heat and~~ smoke and heat ~~roof~~ vents complying with Section 910 and equipped throughout with an automatic sprinkler system in accordance with Section 903.3.1.1, the maximum exit access travel distance shall be 400 feet (122 m) for occupancies in Group F-1 or S-1.

Reason: Editorial.

Cost Impact: The code change proposal will not increase the cost of construction.
++

E113–07/08

1016.2 (IFC [B] 1016.2)

Proponent: Richard Schulte, Schulte & Associates

Revise as follows:

1016.2 (IFC [B] 1016.2) Roof vent increase. In buildings that are one story in height, ~~equipped with automatic heat and smoke roof vents complying with Section 910 and~~ equipped throughout with an automatic sprinkler system in accordance with Section 903.3.1.1, the maximum exit access travel distance shall be 400 feet (122 m) for occupancies in Group F-1 or S-1.

Reason: The purpose of this proposal is to allow an increase in travel distance to 400 feet (from 250 feet) in single story sprinklered buildings which contain Group F-1 and S-1 occupancies without automatic smoke and heat vents being provided.

For more than 20 years, an exception has been included in the model building codes used in the United States which permits an increase in travel distance to 400 feet in single-story Group F-1 and S-1 occupancies protected by a sprinkler system and provided with automatic smoke and heat vents. This exception has been based upon the assumption that the automatic smoke and heat vents would operate and vent heat and smoke from the building, thus increasing the time that occupants have to evacuate the building. Since the allowable travel distance is the means by which the code limits evacuation time, an increase in the time available for evacuation translates into an increase in the distance which can be safely traveled during an evacuation. Hence, an increased travel distance is permitted when a building containing a Group F-1 or S-1 occupancy is provided with automatic smoke and heat vents and sprinkler protection.

While the provision which permits an increase in allowable travel distance when automatic smoke and heat vents are provided appears to be logical, fire tests utilizing a combination of standard spray sprinklers and fusible link-activated smoke and heat (roof) vents conducted at Underwriters Laboratories (UL) in 1997 and 1998 clearly demonstrated that operating sprinklers interfere with the opening of roof vents. The following are quotes from the report of the tests at UL, "Sprinkler, Smoke & Heat Vent, Draft Curtain Interaction -- Large Scale Experiments and Model Development", dated September 1998. (The report is referred to as NISTIR 6196-1.)

"*It had become clear by this time in the project that the vents were unlikely to open when the fire was ignited more than about 4.6 m (15 ft) away.*" (Page 54, NISTIR 6196-1)

"*. . . .it appears from the data below that the sprinkler spray influenced the thermal response characteristics of this particular vent, and it is believed that sprinklers could have a similar influence on similar vent designs.*" (Page 64, NISTIR 6196-1)

"*Six other tests were performed with the fire at this distance from the vent when the vent was equipped with a fusible link, and in none of these tests did the vent open. . . .Examination of the near-ceiling temperatures from all the tests indicates that sprinklers of this type* [standard spray sprinklers] *have a significant cooling effect, and this will certainly have an effect on thermally-responsive, independently-controlled vents.*" (Page 64, NISTIR 6196-1)

"*In Plastic Test P-2, the fire was ignited directly under a vent. In the experiment, flames reached the top of the central array at about 65 s and the vent cavity at about 70 s. The first sprinkler activated at 100 s. The vent did not open at any time during the 30 min test even though another vent 6 m (20 ft) to the west of the unopened vent opened at 6:04.*" Page 64, NISTIR 6196-1)

"*This data, along with the plunge tunnel measurements reported in Section 3.1.4, suggests that the fusible link reached its activation temperature before or at about the same time as the first sprinkler activated, but the link did not fuse. It is not clear whether the link did not fuse because it was cooled directly by water drawn upwards into the vent cavity, or whether the sprinkler spray simply cooled the rising smoke plume enough to prevent the link from fusing. In any event, this phenomenon deserves further study.*" (Page 64, NISTIR 6196-1)

"*The mass flow rates* [through the vents] *for Test I-10 and P-5 are relatively low compared with the theoretical maximum because the near-ceiling gas temperatures are greatly reduced by the sprinklers.*" (Page 100, NISTIR 6196-1)

"*The significant cooling effect of sprinkler sprays on the near-ceiling gas flow often prevented the automatic operation of vents. This* *conclusion is based on thermocouple measurements within the vent cavity, the presence of drips of solder on the fusible links recovered from unopened vents, and several tests where vents remote from the fire and the sprinkler spray activated. In one cartoned plastic commodity experiment, a vent did not open when the fire was ignited directly beneath it.*" (Page 101, NISTIR 6196-1)

The following are quotes from Dr. Craig Beyler, Hughes Associates, Inc. (a consultant to the AAMA Smoke Vent Task Group) regarding the operation of smoke and heat (roof) vents in buildings protected by a sprinkler system:

"*The experimental studies have shown that . . . . .current design practices are likely to limit the number of vents operated to one and vents may in fact not operate at all in very successful sprinkler operations.*" (Page 1, "Interaction of Sprinklers with Smoke and Heat Vents")

"*Not only is the fear of early operation not founded, current design practice will likely lead to 0-1 vents operating*" (Page 61, "Sprinkler/Vent Interactions-What people think, what we know, and what we don't.")

Given the above, it can be concluded that smoke and heat (roof) vents do not actually operate as expected in buildings protected by a sprinkler system. Hence, the logic behind the increase in travel distance to 400 feet is flawed.

For the last 20 years (or more), the increase in travel distance to 400 feet has been considered acceptable when sprinkler protection and automatic roof vents are provided. If automatic smoke and heat vents will not operate in sprinklered buildings, then it can be concluded that it is actually the sprinkler protection provided in the building that makes this increase in the travel distance limitation acceptable. Hence, it is logical that an increase in travel distance should be permitted in one story buildings containing Group F-1 or S-1 occupancies solely based upon the protection provided by sprinklers.

In other words, automatic smoke and heat vents provide no additional protection for occupants evacuating a storage or industrial building and it is the sprinkler protection (along with the size of the building) which is providing all of the protection necessary to permit an extended egress travel distance.

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Cost Impact: The code change proposal will not increase the cost of construction.
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E114–07/08

Table 1016.1, 1016.2 (IFC [B] Table 1016.1, [B] 1016.2); IFC 910.2.3 (IBC [F] 910.2.3)

Proponent: Richard Schulte, Schulte & Associates

1. Revise IBC as follows:

TABLE 1016.1 (IFC [B] TABLE 1016.1)
EXIT ACCESS TRAVEL DISTANCE

(No change to table entries)

For SI: 1 foot = 304.8 mm.

a. See the following sections for modifications to exit access travel distance requirements:
   Section 402: For the distance limitation in malls.
   Section 404: For the distance limitation through an atrium space.
   ~~Section 1016.2 For increased limitations in Groups F-1 and S-1.~~
   Section 1025.7: For increased limitation in assembly seating.
   Section 1025.7: For increased limitation for assembly open-air seating.
   Section 1019.2: For buildings with one exit.
   Chapter 31: For the limitation in temporary structures.
b. Buildings equipped throughout with an automatic sprinkler system in accordance with Section 903.3.1.1 or 903.3.1.2. See Section 903 for occupancies where automatic sprinkler systems in accordance with Section 903.3.1.2 are permitted.
c. Buildings equipped throughout with an automatic sprinkler system in accordance with Section 903.3.1.1.

~~**1016.2 (IFC [B] 1016.2) Roof vent increase.** In buildings that are one story in height, equipped with automatic heat and smoke roof vents complying with Section 910 and equipped throughout with an automatic sprinkler system in accordance with Section 903.1.1, the maximum exit access travel distance shall be 400 feet (122 m) for~~

~~occupancies in Group F-1 or S-1.~~

2. Revise IFC as follows:

~~**IFC 910.2.3 (IBC [F] 910.2.3 Exit access travel distance increase.** Buildings and portions thereof used as a Group F-1 or S-1 occupancy where the maximum exit access travel distance is increased in accordance with Section 1016.2.~~

Reason: The purpose of this code change proposal is to delete the provision which allows an increase in travel distance to 400 feet in one story Group F-1 and S-1 occupancies protected by a sprinkler system and provided with smoke and heat (roof) vents.

At present, the IBC permits travel distance to be increased from 200 feet to 250 feet in Group F-1 and S-1 occupancies when sprinkler protection is provided. Section 1016.2 allows an additional 150 feet of travel distance in Group F-1 and S-1 occupancies above and beyond that permitted when sprinkler protection is provided when smoke and heat (roof) vents are also provided.

While smoke and heat (roof) vents by themselves will automatically vent smoke and heat generated by a fire in an unsprinklered one story building, there is serious doubt whether or not smoke and heat (roof) vents actually perform their intended function in buildings protected throughout by a sprinkler system.

Fire tests utilizing a combination of standard spray sprinklers and fusible link-activated smoke and heat (roof) vents conducted at Underwriters Laboratories (UL) in 1997 and 1998 clearly demonstrated that operating sprinklers interfere with the opening of roof vents. The following are quotes from the report of the tests at UL, "Sprinkler, Smoke & Heat Vent, Draft Curtain Interaction -- Large Scale Experiments and Model Development", dated September 1998. (The report is referred to as NISTIR 6196-1.)

> "*It had become clear by this time in the project that the vents were unlikely to open when the fire was ignited more than about 4.6 m (15 ft) away.*" (Page 54, NISTIR 6196-1)
>
> "*. . . .it appears from the data below that the sprinkler spray influenced the thermal response characteristics of this particular vent, and it is believed that sprinklers could have a similar influence on similar vent designs.*" (Page 64, NISTIR 6196-1)
>
> "*Six other tests were performed with the fire at this distance from the vent when the vent was equipped with a fusible link, and in none of these tests did the vent open. . . Examination of the near-ceiling temperatures from all the tests indicates that sprinklers of this type* [standard spray sprinklers] *have a significant cooling effect, and this will certainly have an effect on thermally-responsive, independently-controlled vents.*" (Page 64, NISTIR 6196-1)
>
> "*In Plastic Test P-2, the fire was ignited directly under a vent. In the experiment, flames reached the top of the central array at about 65 s and the vent cavity at about 70 s. The first sprinkler activated at 100 s. The vent did not open at any time during the 30 min test even though another vent 6 m (20 ft) to the west of the unopened vent opened at 6:04.*" Page 64, NISTIR 6196-1)
>
> "*This data, along with the plunge tunnel measurements reported in Section 3.1.4, suggests that the fusible link reached its activation temperature before or at about the same time as the first sprinkler activated, but the link did not fuse. It is not clear whether the link did not fuse because it was cooled directly by water drawn upwards into the vent cavity, or whether the sprinkler spray simply cooled the rising smoke plume enough to prevent the link from fusing. In any event, this phenomenon deserves further study.*" (Page 64, NISTIR 6196-1)
>
> "*The mass flow rates* [through the vents] *for Test I-10 and P-5 are relatively low compared with the theoretical maximum because the near-ceiling gas temperatures are greatly reduced by the sprinklers.*" (Page 100, NISTIR 6196-1)
>
> *"The significant cooling effect of sprinkler sprays on the near-ceiling gas flow often prevented the automatic operation of vents. This conclusion is based on thermocouple measurements within the vent cavity, the presence of drips of solder on the fusible links recovered from unopened vents, and several tests where vents remote from the fire and the sprinkler spray activated. In one cartoned plastic commodity experiment, a vent did not open when the fire was ignited directly beneath it.*" (Page 101, NISTIR 6196-1)

NFPA 204 also clearly indicates that operating sprinklers will reduce the venting rate through any vents which do open due to the reduction of temperature in the vicinity of the vent caused by operating sprinklers. The following is an excerpt from the 2002 edition of NFPA 204:

> "**A.4.4.3** *Mass flow through a vent is governed mainly by the vent area and the depth of the smoke layer and its temperature. Venting becomes more effective with smoke temperature differentials between ambient temperature and an upper layer of approximately 110°C* [198°F] *or higher. Where temperature differences of less than 110°C* [198°F] *are expected, vent flows might be reduced significantly*. . . ."

The following are quotes from Dr. Craig Beyler, Hughes Associates, Inc. regarding the operation of smoke and heat (roof) vents in buildings protected by a sprinkler system:

> "*The experimental studies have shown that . . . . .current design practices are likely to limit the number of vents operated to one and vents may in fact not operate at all in very successful sprinkler operations.*" (Page 1, "Interaction of Sprinklers with Smoke and Heat Vents")
>
> *Not only is the fear of early operation not founded, current design practice will likely lead to 0-1 vents operating*" ("Page 61," "Sprinkler/Vent Interactions-What people think, what we know, and what we don't.")
>
> "*Eliminates Need for Manual Venting?* *No*" (Page 42, ""Sprinkler/Vent Interactions-What people think, what we know, and what we don't.")
>
> "*Revised design methods for early operation of vents are needed*" (Page 61, "Sprinkler/Vent Interactions-What people think, what we know, and what we don't.")

Given the above, it can be concluded that smoke and heat (roof) vents do not actually operate as expected in buildings protected by a sprinkler system. Based upon this, it can be concluded that there is no technical basis for permitting an increase in travel distance of 150 feet beyond the travel distance permitted for Group F-1 and S-1 occupancies protected by a sprinkler system when smoke and heat (roof) vents are provided.

Bibliography

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2. "Interaction of Sprinklers with Smoke and Heat Vents", Craig L. Beyler and Leonard Y. Cooper, February 1999.
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3. “Sprinkler/Vent Interactions-What people think, what we know, and what we don’t.”, Dr. Craig Beyler, Hughes Associates, Inc. (undated (presentation).
http://www.haifire.com/presentations/Sprinkler%20Vent%20Interactions%20-%20NFPA%202000.pdf
4. NFPA 204, Standard for Smoke and Heat Venting (2002 edition).

Cost Impact: The code change proposal will increase the cost of construction.
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E115–07/08

1016.3 (New) (IFC [B] 1016.3 (New))

Proponent: Robert J. Davidson, Davidson Code Concepts, LLC, representing himself

Add new text as follows:

1016.3 (IFC [B] 1016.3) Early suppression fast-response (ESFR) sprinklers increase. In buildings equipped with an automatic sprinkler system in accordance with Section 903.3.1.1, for areas not required to have smoke and heat vents as provided by section 910.1, Exception 2, the maximum exit access travel distance shall be 400 feet (122 m) for occupancies in Group F-1 or S provided:

1. The building is provided with a fire alarm signaling system activated by sprinkler water-flow devices installed in accordance with Section 907; and,
2. An engineering analysis is provided that documents that the intended occupants will have safely exited the building before the height of the lowest horizontal surface of the accumulating smoke layer is less than 6 feet (1829 mm) above any walking surface that forms a portion of a required egress system within the ESFR protected area based upon the configuration of the fuel load expected to be present.

(Renumber subsequent section)

Reason: In the 2003 editions of the IBC and the IFC recognition was provided for the effectiveness of early suppression fast-response (ESFR) sprinklers by eliminating the requirement for smoke and heat vents for areas protected by those systems. The change was made to the 2003 editions of both codes for the purpose of balancing the application of the newer ESFR technology against the existing requirement for the smoke and heat vents together with the IFC committees concern with providing for firefighter safety.

This proposal provides correlation between the ESFR exception to Section 910.1 concerning smoke and heat vents and the increased travel distance allowance of Section 1016.2.

The configuration of fuel loads and the egress capabilities of the intended occupants varies from occupancy to occupancy and cannot be addressed by a one size fits all exception. By requiring an engineering analysis to be submitted life safety needs will be met by balancing the egress capabilities, (time needed to exit), of the intended occupants against the smoke layer generation of the fuel load and fuel configuration expected to be present. The language relating to the 6 foot height of the smoke layer correlates with existing Section 909.8.1 which is the level chosen to meet the tenable environment for evacuation requirements found in existing Section 909.1 concerning smoke control systems.

When using engineering analysis to model egress times of occupants and how long occupant egress takes, the model is based upon the occupants knowing they are supposed to be moving towards an exit at a defined reference point in time. The only effective way to provide for this ‘knowledge’ on the part of the occupants is to require the installation of alarm notification appliances in accordance with Chapter 9, Fire Protection Systems and its’ referenced standard, NFPA 72, The National Fire Alarm Code.

This proposal also meets the intent of the IBC and IFC to provide for “…safety to firefighters…” by tying the exception to the use of the ESFR sprinklers. The IFC committee stated that they accepted ESFR systems as an exception to the installation of smoke and heat vents because the capability of the ESFR systems to quickly suppress and possibly extinguish fires will greatly reduce the amount of smoke and heat generated. This is important since the lengthening of the travel distance allowed for egress of occupants will correlate directly with the lengthening of the distance firefighters might have to travel in entering the fire structure for the purpose of search and rescue and fire extinguishment, i.e., increases their exposure to risk.

Cost Impact: The code change proposal will not increase the cost of construction.