CTC Meeting #26
April 8 - 9, 2013
BFP-Roof Vents

The following 2013 Group B changes have been compiled for the above noted CTC Area of Study. Code changes with an (*) indicate CTC sponsored code changes. These changes are intended to serve as the agenda for the CTC in order to establish CTC positions, if any, for the upcoming 2013 Group B Committee Action Hearings.

F195-13*
F196-13
F197-13
F198-13

F195 – 13

910 (IBC [F] 910), Table 901.6.1, Table 3206.2, 3206.7, Chapter 80 (IBC Chapter 35)

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Revise as follows:

SECTION 910 (IBC [F] 910)
SMOKE AND HEAT REMOVAL

910.1 (IBC [F] 910.1) General. Where required by this code ~~or otherwise installed~~, smoke and heat vents or mechanical smoke ~~exhaust~~ removal 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 or a mechanical smoke removal system shall be installed ~~in the roofs of buildings or portions thereof occupied for the uses set forth in~~ as required by Sections 910.2.1 and 910.2.2. In occupied portions of a building where the upper surface of the story is not a roof assembly, a mechanical smoke removal system in accordance with Section 910.4 shall be installed.

Exception~~s~~:

1. Frozen food warehouses used solely for storage of Class I and II commodities where protected by an *approved automatic sprinkler system*.
~~2. In occupied portions of a building where the upper surface of the story is not a roof assembly, mechanical smoke exhaust in accordance with Section 910.4 shall be an acceptable alternative.~~
2. Where areas of buildings are equipped with early suppression fast-response (ESFR) sprinklers, smoke and heat removal shall not be required within these areas.

910.2.1 (IBC [F] 910.2.1) Group F-1 or S-1. Smoke and heat vents installed in accordance with Section 910.3 or a mechanical smoke removal system installed in accordance with Section 910.4 shall be installed in buildings and 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. Smoke and heat removal required by Table 3206.2, for buildings and portions thereof containing high-piled combustible ~~stock or rack~~ storage shall be installed in accordance with Section 910.3 in unsprinklered buildings. In buildings and portions thereof containing high-piled combustible storage equipped throughout with an automatic sprinkler system in accordance with Section 903.3.1.1 ~~in any occupancy group when required by Section 3206.7.~~ a smoke and heat removal system shall be installed in accordance with Section 910.3 or 910.4.

910.3 (IBC [F] 910.3) Smoke and heat vents ~~Design and installation~~. The design and installation of smoke and heat vents ~~and draft curtains~~ shall be ~~as specified~~ in accordance with Sections 910.3.1 through 910.3.3 ~~910.3.5.2 and Table 910.3~~.

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

910.3.1 (IBC [F] 910.3.1) ~~Design~~ Listing and labeling. Smoke and heat vents shall be *listed* and labeled to indicate compliance with UL 793 or FM 4430.

~~**910.3.2 (IBC [F] 910.3.2) Vent operation.** 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 Sections 910.3.2.1 through 910.3.2.3.~~

~~**910.3.2.1 (IBC [F] 910.3.2.1) 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) Sprinklered buildings.** Where installed in buildings provided with an *approved automatic sprinkler system*, smoke and heat vents shall be designed to operate automatically.~~

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

~~**Exception:** Gravity-operated drop-out vents complying with Section 910.3.2.1.~~

~~**910.3.3 (IBC [F] 910.3.3) 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).~~

910.3.2 (IBC [F] 910.3.2) ~~910.3.4 (IBC [F] 910.3.4)~~ Smoke and heat 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 in the areas of the building where the vents are required to be installed by Section 910.2, with consideration given to roof pitch, ~~draft curtain location,~~ sprinkler location and structural members.

910.3.3 Smoke and heat vents area. The required aggregate area of smoke and heat vents shall be calculated as follows:

For buildings equipped throughout with an *automatic sprinkler system* in accordance with Section 903.3.1.1:

$A_{VR} = V/9000$ **(Equation 9-4)**

Where:

A_{VR} = the required aggregate vent area (ft^2)
V = volume (ft^3) of the area that requires smoke removal

For unsprinklered buildings:

$A_{VR} = A_{FA}/50$ **(Equation 9-5)**

Where:

A_{VR} = the required aggregate vent area (ft^2)
A_{FA} = the area of the floor of the area that requires smoke removal.

~~**910.3.5 (IBC [F] 910.3.5) Draft curtains.** Where required by Table 910.3, draft curtains shall be installed on the underside of the roof 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 non-ESFR sprinklers.~~

~~**910.3.5.1 (IBC [F] 910.3.5.1) Construction.** Draft curtains shall be constructed of sheet metal, lath and plaster, gypsum board or other *approved* materials that 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) 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) Mechanical smoke removal systems ~~exhaust~~. ~~Where *approved* by the *fire code official,* engineered~~ mechanical smoke removal systems ~~exhaust~~ shall be designed and installed in accordance with Sections 910.4.1 through 910.4.7 ~~an acceptable alternative to smoke and heat vents~~.

910.4.1 Automatic sprinklers required. The building shall be equipped throughout with an approved automatic sprinkler system in accordance with Section 903.3.1.1.

910.4.2 (IBC [F] 910.4.2) Exhaust fan construction. Exhaust fans that are part of a mechanical smoke removal system shall be rated for operation at 105 deg. C. Exhaust fan motors shall be located outside of the exhaust fan air stream.

910.4.3 (IBC [F] 910.4.3) System design criteria. The mechanical smoke removal system shall be sized to exhaust the building at a minimum rate of two air changes per hour based upon the volume of the building or portion thereof without contents. The capacity of each exhaust fan shall not exceed 30,000 cubic feet per minute.

910.4.3.1 Make-up air. Make-up air openings shall be provided within six feet (add metric) of the floor level. Operation of makeup air openings shall be manual or automatic. The minimum gross area of make-up air inlets shall be 8 ft^2 per 1000 cfm of smoke exhaust.

910.4.4 (IBC [F] 910.4.4) Activation. The mechanical smoke removal system shall be activated by manual controls only.

910.4.5 (IBC [F] 910.4.5) Manual control location. Manual controls shall be located so as to be accessible to the fire service from an exterior door of the building and be protected against interior fire exposure by not less than 1-hour fire barriers constructed in accordance with Section 707 of the *International Building Code* or horizontal assemblies constructed in accordance with Section 712 of the *International Building Code*, or both.

~~**910.4.1 (IBC [F] 910.4.1) Location.** Exhaust fans shall be uniformly spaced within each draft-curtained area and the maximum distance between fans shall not be greater than 100 feet (30 480 mm).~~

~~**910.4.2 (IBC [F] 910.4.2) 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 equation:~~

~~$C = A \times 300$ **(Equation 9-4)**~~

~~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) 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 in Section 910.3.2. Individual manual controls for each fan unit shall also be provided.~~

910.4.6 (IBC [F] 910.4.6) ~~**910.4.4 (IBC [F] 910.4.4)**~~ **Control wiring** ~~**and control.**~~ Wiring for operation and control of mechanical smoke removal systems ~~exhaust fans~~ shall be connected ahead of the main disconnect in accordance with Section 701.12E of NFPA 70 and be protected against interior fire exposure to temperatures in excess of 1,000°F (538°C) for a period of not less than 15 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 707 of the *International Building Code* or *horizontal assemblies* constructed in accordance with Section 711 of the *International Building Code*, or both.~~

~~**910.4.5 (IBC [F] 910.4.5) 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 required exhaust. Openings for supply air shall be uniformly distributed around the periphery of the area served.~~

910.4.7 (IBC [F] 910.4.7) ~~**910.4.6 (IBC [F] 910.4.6) Interlocks**~~ **Controls.** ~~On 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.~~ Where building air handling and mechanical smoke removal systems are combined or where independent building air-handling systems are provided, fans shall automatically shut down in accordance with the *International Mechanical Code*. The manual controls provided for the smoke removal system shall have the capability to override the automatic shutdown of fans that are part of the smoke removal system.

910.5 Maintenance. Smoke and heat vents and mechanical smoke removal ~~exhaust~~ systems shall be maintained in an operative condition in accordance with Section 910.5.1 or 910.5.2, respectively ~~NFPA 204~~.

910.5.1 Smoke and heat vents. Smoke and heat vents shall be maintained ~~in an operative condition~~ in accordance with NFPA 204 and Section 910.5.1.1

910.5.1.1 Fusible links. Fusible links for smoke and heat vents shall be ~~promptly~~ replaced whenever fused, damaged or painted. ~~Smoke and heat vents and mechanical smoke exhaust systems shall not be modified.~~

910.5.2 Mechanical smoke removal systems. Mechanical smoke removal systems shall be maintained in accordance with the equipment manufacturer's maintenance instructions and Sections 910.5.2.1 through 910.5.2.4.

910.5.2.1 Frequency. Systems shall be operationally tested not less than once per year. Testing shall include the operation of all system components including control elements.

910.5.2.2 Testing. Operational testing of the mechanical smoke removal system shall include all equipment such as fans, controls and make-up air openings.

910.5.2.3 Schedule. A routine maintenance and operational testing program shall be initiated and a written schedule for routine maintenance and operational testing shall be established.

910.5.2.4 Written record. A written record of mechanical smoke exhaust system testing and maintenance shall be maintained on the premises. The written record shall include the date of the maintenance, identification of the servicing personnel and notification of any unsatisfactory condition and the corrective action taken, including parts replaced.

901.6.1 Standards. *Fire protection systems* shall be inspected, tested and maintained in accordance with the referenced standards *listed* in Table 901.6.1.

TABLE 901.6.1
FIRE PROTECTION SYSTEM MAINTENANCE STANDARDS

SYSTEM	STANDARD
Portable fire extinguishers	NFPA 10
Carbon dioxide fire-extinguishing system	NFPA 12
Halon 1301 fire-extinguishing systems	NFPA 12A
Dry-chemical extinguishing systems	NFPA 17
Wet-chemical extinguishing systems	NFPA 17A
Water-based fire protection systems	NFPA 25
Fire alarm systems	NFPA 72
~~Mechanical smoke exhaust systems~~	~~NFPA 204~~
Smoke and heat vents	NFPA 204
Water-mist systems	NFPA 750
Clean-agent extinguishing systems	NFPA 2001

Revise as follows:

TABLE 3206.2
GENERAL FIRE PROTECTION AND LIFE SAFETY REQUIREMENTS

COMMODITY CLASS	SIZE OF HIGH-PILED STORAGE AREA[a] (square feet) (see Sections 3206.2 and 3206.4)	ALL STORAGE AREAS (See Sections 3206, 3207 and 3208)[b]					SOLID-PILED STORAGE, SHELF STORAGE AND PALLETIZED STORAGE (see Section 3207.3)		
		Automatic fire-extinguishing system (see Section	Fire detection system (see Section	Building access (see Section 3206.6)	Smoke and heat removal (see Section	~~Draft curtains (see Section 3206.7)~~	Maximum pile dimension[c] (feet)	Maximum permissible storage height[d] (feet)	Maximum pile volume (cubic feet)

		3206.4)	**3206.5)**		**3206.7)**				

(Portions of table not shown remain unchanged)

3206.7 Smoke and heat removal. Where smoke and heat removal is ~~are~~ required by Table 3206.2, ~~smoke and heat vents~~ it shall be provided in accordance with Section 910. ~~Where draft curtains are required by Table 3206.2, they shall be provided in accordance with Section 910.3.5.~~

Add new standard to Chapter 80 (IBC Chapter 35) as follows:

FM
4430-12 Approval Standard for Heat and Smoke Vents 910.3.1

Reason: The ICC Board established the ICC Code Technology Committee (CTC) as the venue to discuss contemporary code issues in a committee setting which provides the necessary time and flexibility to allow for full participation and input by any interested party. The code issues are assigned to the CTC by the ICC Board as "areas of study". Information on the CTC, including: meeting agendas; minutes; reports; resource documents; presentations; and all other materials developed in conjunction with the CTC effort can be downloaded from the following website: http://www.iccsafe.org/cs/CTC/Pages/default.aspx. Since its inception in April/2005, the CTC has held twenty-five meetings - all open to the public.

This proposed code change is a result of the CTC's investigation of smoke and heat removal through the Roof Vent Study Group (RVSG), which is part of the area of CTC study entitled "Balanced Fire Protection" the scope of which is: *"To investigate what constitutes an acceptable balance between active fire protection and passive fire protection measures with respect to meeting the fire and life safety objectives of the IBC."* As part of the CTC's review of the "balanced" fire protection issue, the CTC formed the RVSG to study the issue of smoke and heat vents with specific emphasis on: building area; sprinkler versus non sprinkler operation; impact on fire-fighting operations; relationship to the on-going updating of NFPA 204; the need for smoke and heat vent design requirements, regardless if smoke and heat vents are mandated by the code. The RVSG was formed in October 2006 and has been working on this issue since January 2007 and developed code change proposal F144-09/10 which was disapproved by the ICC membership. This subsequent code change proposal is a result of continued RVSG study on the issue.

The purpose of this code change proposal is to update the provisions which mandate roof smoke and heat removal systems in industrial and storage buildings based upon technical information on the operation of roof vents which has been developed in the United States over the last 20 years. The RVSG has developed its proposed revisions to the roof vent provisions based upon the following:

❖ Research on the interaction of sprinklers, roof vents and draft curtains funded by the National Fire Protection Research Foundation (NFPRF) and conducted at Underwriters Laboratories (UL) in 1997/1998. This research is summarized in a document referred to as National Institute of Science and Technology Interagency Report (NISTIR) 6196-1 dated September,1998.

❖ Provisions for the use of roof vents in sprinklered buildings included in the 2010 and 2013 edition of NFPA 13, including the substantiation statement for the NFPA 13 roof vent provisions.

❖ The capability of standard spray sprinklers to both control and/or extinguish a fire within 30 minutes of sprinkler operation, without supplemental fire department activity has been documented.

❖ Recommendations contained in National Institute for Occupational Safety and Health (NIOSH) 2005-132, *Preventing Injuries and Deaths of Fire Fighters Due to Truss Systems*, and NIOSH 2010-153, *Preventing Deaths and Injuries of Fire Fighters using Risk Management Principles at Structure Fires*.

❖ Recommendations contained in the Initial Report of the Federal Emergency Management Agency (FEMA)/National Fallen Firefighter Foundation (NFFF®) Firefighter Life Safety Summit held on April 14, 2004 in Tampa, Florida.

The RVSG determined that the primary purpose of smoke and heat removal from the perspective of the building code requirement is to assist fire-fighting operations after control of the fire has been achieved by the automatic sprinkler system.. Automatic smoke and heat vents and automatic sprinkler systems were developed independently

of one another and their interaction has been a concern for many years. Even today, there is no accepted method of analyzing their interaction and, therefore, the installation standards for each (NFPA 204 and NFPA 13, respectively) give cautions to the designers of buildings having both systems.

The RVSG also determined that a manually-activated mechanical smoke removal system could perform the same function as roof vents. This code change increases the emphasis and acceptability of mechanical smoke removal systems as an acceptable alternative to smoke and heat vents. Mechanical smoke removal systems as prescribed in this code change provide fire-rated, grade-level enclosures for the control of the mechanical smoke removal system. This provides greater control of the system for the fire incident commander and reduces the need to place fire fighters on roofs or in other hazardous situations to operate smoke and heat venting systems. This methodology is consistent with the latest recommendations from NIOSH and NFFF for fire fighter safety, risk management and recommended fire- fighting tactics.

Summary of general provisions of the proposal:

- Either automatic roof vents or a manually-activated mechanical smoke removal system are permitted to be provided in industrial and storage buildings protected by a sprinkler system (in buildings where these provisions are applicable).
- Only roof vents should be permitted to be provided in storage buildings with high-piled storage which are not protected by a sprinkler system (i.e., buildings which contain high-piled storage with an area between 2,500 and 12,000 square feet). The rationale for this provision is that a mechanical smoke removal system capable of handling temperatures between 1,000^{o} F and 2,000^{o} F cannot be practically provided at a reasonable cost.
- Provisions for the design of a manually-activated mechanical smoke removal system have been included. These provisions require that the mechanical smoke removal system be sized to provide a minimum exhaust rate of 2 air changes per hour based upon the enclosed volume of the building space to be exhausted, without any deductions for the space occupied by storage or equipment. An exhaust rate of 2 air changes per hour is based on an analysis assuming a conservative approach using a Factory Mutual Research Corporation (FMRC) Standard Plastic Commodity (polystyrene cups in compartmented cartons). This commodity is recognized to represent a severe fire hazard of high density plastics. In a calculation based on this commodity , a maximum of 68,960 cfm of smoke was generated by the design fire. Based upon an empty building volume of 2.659 million cubic feet, the exhaust rate required to achieve two air changes per hour is 88,633 cfm. Because no single fan can exceed 30,000 cfm, this building required five fans, each exhausting 25,570 cfm for a total of 127,850 cfm. This exceeds the minimum two air changes per hour by more than 40 percent. Even at the minimum required rate of two air changes per hour, the calculation results show that the mechanical smoke removal system proposed will be capable of removing the smoke from the building faster than it will be generated, ultimately removing smoke from the building once the fire is extinguished. A degree of conservatism is added to this by the calculation using an empty building volume.
- Provisions for the design of roof vents in buildings protected by a sprinkler system have been modified to require that the area of roof vents provide equivalent venting to that required for the mechanical smoke removal system (2 air changes per hour) based upon an assumption that each square foot of vent area will provide 300 cubic feet per minute (cfm) of ventilation. The reason for this requirement is that the roof vents should at least provide venting equivalent to the minimum venting provided by the mechanical smoke removal system. A factor of 300 cfm of venting per square foot of vent area is presently included in the 2012 edition of the *International Building Code*, although the use of this conversion factor is questionable at best. The actual ventilation provided by each square foot of vent area will depend upon the temperature differential between ambient conditions and the smoke layer under the roof deck or the pressure achieved if positive pressure ventilation is utilized. If the prescribed value is not practical for a given building design, designers have the option of demonstrating other values which provide the same performance under the alternate method of design provisions in the code.
- Provisions for the design of roof vents in buildings not protected by a sprinkler system have been revised (simplified) to require that the ratio of the area of the vents to the floor area be a minimum of 1:50. The rationale for this revision is that the case where roof vents will be provided without sprinkler protection will be rare: buildings which contain high-piled storage with an area between 2,500 and 12,000 square feet. Given that this situation will be rare, a complex analysis to determine the required area of roof vents is unnecessary. The ratio of vent area to floor area of 1:50 is conservative based upon the present requirements included in the International Building and Fire Codes.
- Provisions for the mechanical smoke removal system permit the system to be designed to handle air at ambient temperature provided that the fan motors are located outside the air stream. The basis for this provision is the thermocouple temperature data for the large-scale fire tests conducted at UL in 1997/1998, specifically Tests P-1 and P-4. (In Tests P-1 and P-4, no vents opened so the ceiling temperatures recorded would be unaffected by the activation of vents. See Pages 40 and 52 of the NISTIR 6196-1 report dated September 1998 (on the CTC web site) for the thermocouple temperature data recorded as a function of time.)
- The exposing temperatures and time periods were reviewed and not considered to pose a threat to the building structure, fans or power wiring.
- The sprinkler activation times and ceiling temperature data for the five large-scale fire tests summarized in NISTIR 6196-1 indicate that the exposure of mechanical exhaust fans and ducts located at the ceiling to high temperatures will be relatively short. Since it is anticipated that the exhaust system will only be activated after the arrival of fire fighters at the scene (estimated to be 7 minutes or longer after ignition), ceiling temperatures should be

reduced sufficiently to allow fans rated for only ambient temperatures to be used for the exhaust system.

- The existing provisions for the design of a mechanical exhaust system indicate that the electrical power supply for the system is to be wired ahead of the main building disconnect for increased reliability and to facilitate fire-fighting operations. This existing provision will remain as no adverse experience has been cited.
- The provisions for the design of a mechanical smoke removal system indicate that wiring providing power to exhaust fans located in the interior of the building is to be protected by materials which will provide a 15 minute finish rating protection. The ceiling temperature data collected in the five large-scale fire tests summarized in NISTIR 6196-1 (cited above) show that temperatures at the ceiling will be far less than the exposure temperatures defined by the ASTM E119 time-temperature curve and that the ceiling temperatures will rapidly decrease once sprinklers activate. The ceiling temperature data included in NISTIR 6196-1 indicates that providing 15 minute finish rating protection for the interior electrical power supply is more than adequate to prevent damage to the power supply wiring for the exhaust system.
- The provisions pertaining to draft curtains included in the code have been removed. The rationale for removing the provisions for draft curtains is that research conducted by Factory Mutual Research Corporation (FMRC) in 1994 and the research conducted at UL in 1997/1998 demonstrated that draft curtains affect the sequence of operation of sprinklers and may have an adverse effect on sprinkler operation.

Although the mechanical smoke removal system or roof vent system outlined above are intended to be utilized to assist fire fighters after fire control has been achieved, either one of these systems can be utilized to assist interior manual fire-fighting operations. In order to utilize the roof vent system to assist with manual interior fire-fighting, it will likely be necessary that the vents will have to be opened manually by sending fire fighters to the roof if this is within the responding fire department's operating procedures.

It should be noted that the effectiveness of manually-opened roof vents will be marginal at best once sprinklers have operated and the ceiling temperatures drop to near ambient. Hence, in order for roof vents to be of assistance for interior manual fire-fighting, fire fighters will likely either need to pressurize the building using positive pressure ventilation (PPV) or exhaust the building with supplemental equipment.

It should also be noted that this proposed code change does not make reference to NFPA 204 for the design of roof vent systems in either buildings protected by a sprinkler system or unsprinklered buildings. The rationale for this is that NFPA 204 does not address the use of roof vents in sprinklered buildings and the design provisions for roof vents presently included in NFPA 204 are too complex for application to relatively small buildings were vents would be permitted without sprinkler protection (i.e., buildings with high-piled storage less than 12,000 square feet in floor area).

The proposed code change developed by the RVSG is intended to incorporate the latest technology and research available on the interaction of sprinklers, roof vents and draft curtains, as well as the evolving thinking on fire fighter safety promoted by NIOSH and the NFFF into the code provisions.

The information on which this code change proposal is based did not exist when the provisions for roof vents were first included in the building and fire codes in the 1970s and 1980s. This proposal is a much needed update in the fire protection provisions for large industrial and storage buildings. A section-by-section summary follows:

910.1: The phrase "…or otherwise installed…" has been removed to clarify that these provisions are specific to required systems. None of the requirements in the section must be mandatory for non-required systems. Terminology was changed from "exhaust" to "removal" for consistency of terminology. This section is a general section but the exceptions are specific to when a smoke and heat removal system is required; therefore, the exceptions have been relocated to Section 910.2.

910.2: Exceptions 1 and 3 in this section have been relocated here from Section 910.1 as they are specific to when a smoke and heat removal system is required. In Exception 2, terminology has been changed from "exhaust" to "removal" for consistency of terminology. Additionally, the use of a mechanical smoke removal system is made mandatory instead of optional since it is the only practical way to provide smoke and heat removal in multi-story buildings.

910.2.1: This section has been editorially reworded into a complete sentence and mechanical smoke removal has been made an option for smoke and heat removal without requiring specific approval. Companion changes to the remainder of Section 910 have been made to move mechanical smoke removal as an option to smoke and heat venting.

910.2.2: This section has had a reference to IFC Table 3206.2 added and the reference to Section 3206.7 removed because Section 3206.2 sends the code user to the table first and then the table sends the user to Section 3206.7. The phrase "…stock or rack…" were removed because high-piled storage is not limited to stock or rack storage. The intent of the overall code change is to require smoke and heat vents as the method for protecting unsprinklered buildings and provide the option of vents or mechanical smoke removal for sprinklered buildings. This section was

revised to accomplish that goal by referencing Section 910.3 for design of roof vents in non-sprinklered buildings and either Section 910.3 or 910.4 for sprinklered buildings.

910.3: This section has been revised to remove the reference to draft curtains as explained in the general reason statement. Additionally, the section and table references were updated to address section format changes.

Table 910.3: The table has been deleted and replaced with new Section 910.3.3 for calculation of required roof vent area.

910.3.1: The option to use FM Standard 4430 as an alternative to UL 793 has been added. Some manufacturers of roof vents only maintain an FM approval of their product, not a UL listing. Hence, making the UL standard the sole standard would require vents with only a FM approval to have their products tested by UL. FM 4430 and UL 793 are very similar in content. Permissive language contained in previous FM standards has been replaced with mandatory language in the most recent edition of the FM standard.

Current 910.3.2: Specific requirements for vent operation have been deleted. In (storage) buildings protected by a sprinkler system, the roof vent provisions contained in NFPA 13 dictate the temperature rating of the fusible element. Hence, there is no need to specify the temperature rating of the fusible element of the vent. With respect to the use of vents in unsprinklered high-piled storage areas, the temperature rating of the fusible element is not all that important. A listed fusible link or listed drop-out vent will operate when exposed to temperatures in excess of 1,000 degrees F. This issue is addressed in both the UL and FM standards for roof vents.

Proposed 910.3.2: This section has been relocated as indicated and revised to remove the reference to draft curtains as previously explained in the general reason statement.

Current 910.3.3: This section is to be deleted and replaced with new Section 910.3.3 that provides a simplified calculation for vent area. With respect to the minimum size of the vents, installing vents with dimensions less than 4 feet is not practical or economical. The more holes put in the roof, the more likely there is to be roof leakage problems. Hence, the minimum size of vents is “self-policing” from a practical and economic standpoint.

Proposed 910.3.3: The design of roof vent area has been simplified with two equations, one for sprinklered buildings and one for non-sprinklered buildings. A detailed explanation of the derivation of the equations is provided in the general reason statement.

910.3.5: The section on draft curtains has been removed. As detailed in the general reason statement, draft curtains can interfere with sprinkler operation and the RVSG found no evidence that they provided a valuable enhancement to roof vent performance.

910.4: This section has been revised to remove the qualification that a fire code official must approve the use of mechanical smoke removal systems. This code change changes mechanical smoke removal from an optional method that requires additional approval to an equally recognized, ~~if not superior~~, method of smoke removal that can be chosen without additional approval required. To address the qualifications for mechanical system use, additional prescriptive conditions were added to replace the case-by-case approval method.

910.4.1: This condition of mechanical system use requires that the building be sprinklered to protect the mechanical equipment from excessive heat.

Current 910.4.2: This section is deleted and replaced by new Section 910.4.3.

Proposed 910.4.2: This section requires exhaust fan motors be located out of the exhaust stream to protect the mechanical equipment from excessive heat.

Current 910.4.3: This section was deleted and replaced with **Section 910.4.4** and requires that mechanical systems are to be activated manually so that the fire department is in control of the system. In some situations, automatic operation could cause a fire to grow or spread, opening an excessive number of sprinklers. Automatic operation of the mechanical smoke removal system could be detrimental to the operation of the sprinkler system in a manner similar to draft curtains. The effect of the automatic mechanical smoke removal system on sprinkler operation would depend upon when the system was activated. The sooner the system is automatically activated, the greater the detrimental effect. The fire department will retain the option to shut down the exhaust system, as well.

Proposed 910.4.3. and 910.4.3.1: These sections specify the design requirement for the minimum number of air changes, maximum fan capacity, and requirements for the provision of make-up air. Based on NFPA 92-2012, Annex

Section A-4.4.4.1, the maximum air velocity through the make-up air inlet is 1 m/sec or 200 ft/min. The area requirement is then derived as follows:

- Effective Vent Area = (1000 ft^3/min)/(200 ft/min) = 5 ft^2 per 1000 cfm
- Assume an orifice coefficient of 0.6
- Gross Vent Area = 5 ft^2/(0.6) = 8.33 ft^2 per 1000 cfm, which is rounded down due to the conservative nature of the requirement

The reason for this limitation is to prevent significant deflection of the plume, which will cause more air entrainment into the plume and more smoke production. This criteria is conservative as the requirement above assumes an active fire and the design philosophy for this code proposal is to provide post-fire smoke exhaust.

Current 910.4.5: This section has been deleted and replaced with more specific make-up air requirements in Section 910.4.3.

Proposed 910.4.5: This section establishes the required placement, access and protection of the manual controls to ensure the fire fighters will have quick and protected access to the controls.

910.4.6: This current section has been renumbered from 906.4.4 and addresses wiring and control. New Section 910.4.5 addresses the control system so the control provisions were removed from this section. The remaining text is unchanged.

910.4.7: This section has been revised to require that if a mechanical smoke removal system is integrated with a standard HVAC system, then the system must shut down upon detection of smoke as required by the IMC. This is a companion change to the new requirement in proposed Section 910.4.4 that mechanical smoke removal systems shall be manually operated only.

910.5 and Table 901.6.1. The reference to NFPA 204 for the maintenance of smoke and heat vents was retained; however, the reference to NFPA 204 for mechanical systems was removed and replaced with prescriptive testing and maintenance requirements placed in proposed Section 910.5.2. The RVSG determined that the maintenance requirements in NFPA 204 were not specific enough to ensure the necessary maintenance. In Section 910.5.1.1, the statement that vents cannot be modified was removed because it is not a maintenance issue. Modification of vents can be accomplished in a code compliant manner and such modification would require a building permit.

Table 3206.2: As previously noted, draft curtain requirements have been deleted and as a companion change, the column in IFC Table 3206.2 that prescribes draft curtain installation has been deleted.

Cost Impact: This proposal will not increase the cost of constructing industrial and storage buildings, and, in many cases, will reduce the cost of constructing these types of buildings.

Analysis: A review of the standard proposed for inclusion in the code, FM 4430-12, with regard to the ICC criteria for referenced standards (Section 3.6 of CP#28), will be posted on the ICC website on or before April 1, 2013.

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910.1 (IBC [F] 910.1), 910.3.5 (IBC [F] 910.3.5), 202, 3202, Table 3206.2

Proponent: Jeffrey M. Shapiro, International Institute of Ammonia Refrigeration (jeff.shapiro@intlcodeconsultants.com)

Revise as follows:

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) or quick-response storage (QRS) sprinklers, automatic smoke and heat vents shall not be required within these areas.

910.3.5 (IBC [F] 910.3.5) Draft curtains. Where required by Table 910.3, draft curtains shall be installed on the underside of the roof in accordance with this section.

Exception: Where areas of buildings are equipped with ESFR or QRS 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 non-ESFR sprinklers, and between QRS and the non-QRS sprinklers.

Add new definition as follows:

SECTION 202
GENERAL DEFINITIONS

QUICK RESPONSE STORAGE (QRS) SPRINKLER. A sprinkler with a response time index of 50 or less that is listed to control a specified fire in stored commodities with 12 or fewer sprinklers.

Revise as follows:

SECTION 3202
DEFINITIONS

QUICK RESPONSE STORAGE (QRS) SPRINKLER.

TABLE 3206.2
GENERAL FIRE PROTECTION AND LIFE SAFETY REQUIREMENTS

COMMODITY CLASS	SIZE OF HIGH-PILED STORAGE AREA[a] (square feet) (see Sections 3206.2 and 3206.4)	ALL STORAGE AREAS (See Sections 3206, 3207 and 3208)[b]					SOLID-PILED STORAGE, SHELF STORAGE AND PALLETIZED STORAGE (see Section 3207.3)		
		Automatic fire-extinguishing system (see Section 3206.4)	Fire detection system (see Section 3206.5)	Building access (see Section 3206.6)	Smoke and heat removal (see Section 3206.7)	Draft curtains (see Section 3206.7)	Maximum pile dimension[c] (feet)	Maximum permissible storage height[d] (feet)	Maximum pile volume (cubic feet)

(Portions of table not shown remain unchanged)

a through i *(No change to current text*

j. Not required when storage areas are protected by early suppression fast response (ESFR) or quick-response storage (QRS) sprinkler systems installed in accordance with NFPA 13.

Reason: Factory Mutual data sheets no longer reference special sprinkler classifications, such as ESFR. Instead, FM now classifies sprinklers as “storage” and “non-storage” and provides appropriate installation parameters. Storage sprinklers now encompass a new category of quick-response sprinklers that share the key characteristics of ESFR sprinklers, i.e. fast response thermal elements and design areas that involve 12 or fewer sprinklers, but are not designated as ESFR. These quick-response storage sprinklers require similar precautions to ESFR sprinklers with respect to not introducing unknowns that were not represented in full-scale fire tests conducted to determine listing parameters. Thereby, it is important to extend the current provisions in Chapters 9 and 32 that are applicable to ESFR sprinklers to include quick-response storage sprinklers.

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

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910.2.1 (IBC [F] 910.2.1)

Proponent: Randall R. Dahmen, P.E., Wisconsin licensed Commercial Building Inspector, representing self

Revise as follows:

910.2.1 (IBC [F] 910.2.1) Group F-1 or S-1. Buildings and portions thereof used as a Group F-1 or S-1 occupancy having more than 50,000 square feet (4645 m^2) ~~in~~ that is undivided ~~area~~ by full height walls having smoke resisting characteristics as required for draft curtains in Section 910.3.5.1.

Reason: The proposed modification of the wording clearly identifies the expectations of the assembly enclosing the Group F-1 or S-1 occupancies.

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

F198 – 13
910.3.5 (IBC [F] 910.3.5)

Proponent: Stephen DiGiovanni, Clark County, NV Fire Department, representing self

Revise as follows:

910.3.5 (IBC [F] 910.3.5) Draft curtains. Where required by Table 910.3, draft curtains shall be installed only in non-sprinklered buildings on the underside of the roof in accordance with this section.

> ~~**Exception:** Where areas of the building 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 non-ESFR sprinklers.~~

Reason: The purpose of this amendment is to not require draft curtains in buildings protected with fire sprinklers. The basis of this amendment is from Section 12.1.1 of NFPA 13. Since NFPA 13 does not provide sprinkler design criteria that encompass the use of draft curtains, then the requirement for draft curtains needs to be exempted for buildings protected in accordance with NFPA 13

Cost Impact: The cost impact for this is actual a savings, by not requiring the installation of draft curtains in sprinklered buildings.