Code Administration

Proposed Code Modifications

This document created by the Florida Department of Community Affairs - 850-487-1824

TAC: Code Administration

Sub Code: Building

Total Mods for Code Administration: 34

Date Submitted	4/2/2010	**Section**	110.3	**Proponent**	Joseph Belcher
Chapter	1	**Affects HVHZ**	No	**Attachments**	No

TAC Recommendation Approved as Modified
Commission Action Pending Review

Related Modifications

Summary of Modification

The proposal extends inspections to all installations of hurricane resistant coverings or systems,.

Rationale

The hurricane protection industry estimates sales in unapproved and mostly bogus “hurricane protection devices” at a minimum of $30M to $40M a year. These products have not been tested or investigated or approved and meet no standards. The sellers of these products prey upon Florida citizens engendering a false sense of security when storms threaten. Requiring review of documents for all hurricane protection products would dramatically increase the protection provided to Florida residents.

Fiscal Impact Statement

Impact to local entity relative to enforcement of code

The change will result in an increase in inspections. Permit fees would cover additional cost so there would be little or no impact to local entity relative to enforcement of code.

Impact to building and property owners relative to cost of compliance with code

Cost of permit.

Impact to industry relative to the cost of compliance with code

Cost of permit.

Requirements

Has a reasonable and substantial connection with the health, safety, and welfare of the general public

Approval of the change would allow local jurisdictions to regulate devices, materials, and systems installed as “hurricane protection”. The products would be required to have state or local product approval. The public would benefit because sub-standard products should become less prevalent.

Strengthens or improves the code, and provides equivalent or better products, methods, or systems of construction

Approval of the change would strengthen and improve the code by closing a loop hole allowing abuse of the public in the form of sub-standard “hurricane protection” products.

Does not discriminate against materials, products, methods, or systems of construction of demonstrated capabilities

Seeks to treat all hurricane protection products equally and does not discriminate.

Does not degrade the effectiveness of the code

Improves the effectiveness of the code by closing a loop hole allowing abuse of the trust of the public in the form of sub-standard “hurricane protection” products.

110.3 Required inspections. The building official upon notification from the permit holder or his or her agent shall make the following inspections, and shall either release that portion of the construction or shall notify the permit holder or his or her agent of any violations which must be corrected in order to comply with the technical codes. The building official shall determine the timing and sequencing of when inspections occur and what elements are inspected at each inspection.

Building

9. Where impact resistant coverings or impact resistant systems are installed ~~to meet requirements of this code~~, the building official shall schedule adequate inspections of impact resistant coverings or impact resistant systems to determine the following:

The system indicated on the plans was installed.

The system is installed in accordance with the manufacturer's installation instructions and the product approval

(Other items unchanged.)

110.3 Required inspections. The building official upon notification from the permit holder or his or her agent shall make the following inspections, and shall either release that portion of the construction or shall notify the permit holder or his or her agent of any violations which must be corrected in order to comply with the technical codes. The building official shall determine the timing and sequencing of when inspections occur and what elements are inspected at each inspection.

Building

9. Where impact resistant coverings or systems are installed ~~to meet requirements of this code~~, the building official shall schedule adequate inspections of impact resistant coverings or systems to determine the following:

The system indicated on the plans was installed.

The system is installed in accordance with the manufacturer's installation instructions and the product approval

(Other items unchanged.)

Sub Code: Building

CA3894

Date Submitted	3/25/2010	**Section**	102.7, 107.3.5, 111.2, 111.3	**Proponent**	Rebecca Quinn
Chapter	1	**Affects HVHZ**	No	**Attachments**	No

TAC Recommendation Approved as Submitted
Commission Action Pending Review

Related Modifications

Summary of Modification

Florida-specific modifications to Chapter 1, related to retaining flood provisions of the I-Codes.

Rationale

Modifications recommended by FBC Flood Resistant Standards Workgroup, with concurrence by Structural TAC, to retain IBC flood provisions IBC and make Florida-specific amendments. IBC flood provisions are consistent with the NFIP. The FBC adopted the recommendation at its October 2009 meeting. Workgroup's final report is attached to the modification for 1612 and http://consensus.fsu.edu/FBC/Flood-Resistant-Standards.html

Fiscal Impact Statement

Impact to local entity relative to enforcement of code

No impact; 454 Florida communities participate in the NFIP and administer ordinance that include NFIP requirements (44 CFR 60.3).

Impact to building and property owners relative to cost of compliance with code

No impact; building and property owners already are required to comply with local floodplain management ordinances.

Impact to industry relative to the cost of compliance with code

No impact; building and property owners already are required to comply with local floodplain management ordinances.

Requirements

Has a reasonable and substantial connection with the health, safety, and welfare of the general public

Compliance with flood-resistant provisions reduces flood damage and protects life, property and general welfare.

Strengthens or improves the code, and provides equivalent or better products, methods, or systems of construction

Improves the code by having all load requirements addressed; provides equivalency with requirements of local floodplain management ordinances. The requested statutory authority will allow locally-adopted higher standards to preserve better protection and insurance discounts.

Does not discriminate against materials, products, methods, or systems of construction of demonstrated capabilities

Includes provisions for flood damage-resistant materials and methods, consistent with the NFIP and current floodplain management ordinances.

Does not degrade the effectiveness of the code

Improves effectiveness by requiring buildings to be designed and constructed with consideration of all applicable codes.

102.7 Relocation of manufactured buildings.

(1) Relocation of an existing manufactured building does not constitute an alteration.

(2) A relocated building shall comply with wind speed requirements of the new location, using the appropriate wind speed map. If the existing building was manufactured in compliance with the Standard Building Code (prior to March 1, 2002), the wind speed map of the Standard Building Code shall be applicable. If the existing building was manufactured in compliance with the Florida Building Code (after March 1, 2002), the wind speed map of the Florida Building Code shall be applicable.

(3) A relocated building shall comply with the flood hazard area requirements of the new location, if applicable.

107.3.5 Minimum plan review criteria for buildings. The examination of the documents by the building official shall include the following minimum criteria and documents: a floor plan; site plan; foundation plan; floor/roof framing plan or truss layout; and all exterior elevations:

Commercial Buildings:

Building

1. Site requirements:

Parking

Fire access

Vehicle loading

Driving/turning radius

Fire hydrant/water supply/post indicator valve (PIV)

Set back/separation (assumed property lines)

Location of specific tanks, water lines and sewer lines

Flood hazard areas, flood zones, and design flood elevations

[Remainder not shown]

8. Structural requirements shall include:

Soil conditions/analysis

Termite protection

Design loads

Wind requirements

Building envelope

Structural calculations (if required)

Foundation

Flood requirements in accordance with Section 1612, including lowest floor elevations, enclosures, flood damage-resistant materials

Wall systems

Floor systems

Roof systems

Threshold inspection plan

Stair systems

Electrical

[Items 1-7 not shown]

8. Design flood elevation

Plumbing

[Items 1-13 not shown]

14. Design flood elevation

Mechanical

[Items 1-15 not shown]

16. Design flood elevation

Gas

[Items 1-15 not shown]

10. Design flood elevation

Residential (one- and two-family)

[Items 1-15 not shown]

6. Structural requirements shall include:

Wall section from foundation through roof, including assembly and materials connector tables wind requirements structural calculations (if required)

Flood hazard areas, flood zones, design flood elevations, lowest floor elevations, enclosures, equipment, and flood damage-resistant materials

[Item 7 not shown]

111.2 Certificate issued. After the building official inspects the building or structure and finds no violations of the provisions of this code or other laws that are enforced by the department of building safety, the building official shall issue a certificate of occupancy that contains the following:

1. The building permit number.

2. The address of the structure.

3. The name and address of the owner.

4. A description of that portion of the structure for which the certificate is issued.

5. A statement that the described portion of the structure has been inspected for compliance with the requirements of this code for the occupancy and division of occupancy and the use for which the proposed occupancy is classified.

6. For buildings and structures in flood hazard areas, a statement that documentation of the as-built lowest floor elevation has been provided and is retained in the records of the department of building safety.

~~6~~ 7. The name of the building official.

~~7~~ 8. The edition of the code under which the permit was issued.

~~8~~ 9. The use and occupancy, in accordance with the provisions of Chapter 3.

~~9~~ 10. The type of construction as defined in Chapter 6.

~~10~~ 11. The design occupant load.

~~11~~ 12. If an automatic sprinkler system is provided, whether the sprinkler system is required.

111.3 Required inspections. The building official upon notification from the permit holder or his or her agent shall make the following inspections, and shall either release that portion of the construction or shall notify the permit holder or his or her agent of any violations which must be corrected in order to comply with the technical codes. The building official shall determine the timing and sequencing of when inspections occur and what elements are inspected at each inspection.

Building

1. Foundation inspection. To be made after trenches are excavated and forms erected and shall at a minimum include the following building components:

·Stem-wall

·Monolithic slab-on-grade

·Piling/pile caps

·Footers/grade beams

1.1. In flood hazard areas, upon placement of the lowest floor, including basement, and prior to further vertical construction, the elevation certification shall be submitted to the authority having jurisdiction.

[Items 2-4 not shown]

5. Final inspection. To be made after the building is completed and ready for occupancy.

5.1. In flood hazard areas, as part of the final inspection, a final certification of the lowest floor elevation shall be submitted to the authority having jurisdiction.

[Items 6-9 not shown]

CA4351

Date Submitted	4/2/2010	**Section**	105.1	**Proponent**	Joseph Belcher
Chapter	1	**Affects HVHZ**	No	**Attachments**	No

TAC Recommendation Approved as Submitted
Commission Action Pending Review

Related Modifications

Summary of Modification

Applies permitting requirements to all hurricane protection devices, materials, and systems.

Rationale

The hurricane protection industry estimates annual sales in unapproved and mostly bogus “hurricane protection devices” at $30M to $40M at the minimum. These products have not been tested or investigated by anyone and meet no standards. The sellers of these products target Florida citizens and give Florida residents a false sense of security. Requiring permits and inspections for all hurricane protection products would dramatically increase the protection provided to the residents of Florida.

Fiscal Impact Statement

Impact to local entity relative to enforcement of code

Approval of the change will result in an increase in permit applications and inspections. Permit fees would cover additional cost so there would be no impact to local entities relative to enforcement of code.

Impact to building and property owners relative to cost of compliance with code

Cost of permit.

Impact to industry relative to the cost of compliance with code

Cost of permit.

Requirements

Has a reasonable and substantial connection with the health, safety, and welfare of the general public

Approval of the change would allow local jurisdictions to regulate devices, materials, and systems installed as “hurricane protection”. The products would be required to have state or local product approval. The public would benefit because sub-standard products should become less prevalent.

Strengthens or improves the code, and provides equivalent or better products, methods, or systems of construction

Approval of the change would strengthen and improve the code by closing a loop hole allowing abuse of the public in the form of sub-standard “hurricane protection” products.

Does not discriminate against materials, products, methods, or systems of construction of demonstrated capabilities

Seeks to treat all hurricane protection products equally and does not discriminate.

Does not degrade the effectiveness of the code

Improves the effectiveness of the code by closing a loop hole allowing abuse of the trust of the public in the form of sub-standard “hurricane protection” products.

105.1 Required. Any owner or authorized agent who intends to construct, enlarge, alter, repair, move, demolish, or change the occupancy of a building or structure, or to erect, install, enlarge, alter, repair, remove, convert or replace any ~~required~~ impact resistant coverings, electrical, gas, mechanical or plumbing system, the installation of which is regulated by this code, or to cause any such work to be done, shall first make application to the building official and obtain the required permit.

CA3672

Date Submitted	3/22/2010	**Section**	105	**Proponent**	Jon Caudill
Chapter	1	**Affects HVHZ**	No	**Attachments**	Yes

TAC Recommendation Approved as Submitted
Commission Action Pending Review

Related Modifications

Summary of Modification

Staff proposes change to reflect the findings of the Florida Building Commission in Declaratory Statement DCA08-DEC-209 relative to the cut off date for constructing buildings to previously approved plans after implementation of the new codes.

Rationale

Staff proposes change to reflect the findings of the Florida Building Commission in Declaratory Statement DCA08-DEC-209 relative to the cut off date for constructing buildings to previously approved plans after implementation of the new codes. There is a difference in the permitting process between manufactured buildings and conventional construction, because the construction of a manufactured building is usually complete on the date of permit application to install the building.

Fiscal Impact Statement

Impact to local entity relative to enforcement of code

No Impact

Impact to building and property owners relative to cost of compliance with code

No Impact

Impact to industry relative to the cost of compliance with code

No Impact

Requirements

Has a reasonable and substantial connection with the health, safety, and welfare of the general public

No Impact

Strengthens or improves the code, and provides equivalent or better products, methods, or systems of construction

Provides Florida Building Commission direction for permitting the installation of State approved manufactured buildings.

Does not discriminate against materials, products, methods, or systems of construction of demonstrated capabilities

Does not discriminate

Does not degrade the effectiveness of the code

No Impact

105.3.7 Applicable Code for Manufactured Buildings. Manufacturers should be permitted to complete all buildings designed and approved prior to the effective date of a new code edition, provided a clear signed contract is in place. The contract shall provide specific data mirroring that required by an application for permit, specifically, without limitation, date of execution, building owner or dealer, and anticipated date of completion. However, the construction activity must commence within 6 months of the contract's execution. The contract is subject to verification by the Department of Community Affairs.

STATE OF FLORIDA
BUILDING COMMISSION

In the Matter of

MODULAR BUILDING INSTITUTE, Case #: DCA08-DEC-209

Petitioner.

_____/

DECLARATORY STATEMENT

The foregoing proceeding came before the Florida Building Commission (the Commission) by a Petition from Tom Hardiman of the Modular Building Institute, which was received on July 21, 2008, and subsequently amended on July 24, 2008. Based on the statements in the petition and the material subsequently submitted, it is hereby ORDERED:

Findings of Fact

1. The petition is filed pursuant to, and must conform to the requirements of Rule 28-105.002, Florida Administrative Code.

2. The Petitioner is a trade association comprised of commercial modular building manufacturers and product vendors for the modular building industry a substantial number of which manufacture buildings that are required to comply with the Florida Building Code. The Petitioner regularly represents its members before the Department and the Commission and seeking an interpretation of the Florida Building Code as it relates to the manufactured building industry is an appropriate function for a trade association.

Date Submitted	4/2/2010	**Section**	106.3.5	**Proponent**	Joseph Belcher
Chapter	1	**Affects HVHZ**	No	**Attachments**	No

TAC Recommendation Approved as Submitted
Commission Action Pending Review

Related Modifications

Summary of Modification

The proposal would require the submittal of construction documents and plan review for impact resistant coverings or system.

Rationale

The hurricane protection industry estimates sales in unapproved and mostly bogus “hurricane protection devices” at a minimum of $30M to $40M a year. These products have not been tested or investigated or approved and meet no standards. The sellers of these products prey upon Florida citizens engendering a false sense of security when storms threaten. Requiring review of documents for all hurricane protection products would dramatically increase the protection provided to Florida residents.

Fiscal Impact Statement

Impact to local entity relative to enforcement of code

The change will result in an increase in permit applications and inspections. Permit fees would cover additional cost so there would be little or no impact to local entity relative to enforcement of code.

Impact to building and property owners relative to cost of compliance with code

Cost of permit.

Impact to industry relative to the cost of compliance with code

Cost of permit.

Requirements

Has a reasonable and substantial connection with the health, safety, and welfare of the general public

Approval of the change would allow local jurisdictions to regulate devices, materials, and systems installed as “hurricane protection”. The products would be required to have state or local product approval. The public would benefit because sub-standard products should become less prevalent.

Strengthens or improves the code, and provides equivalent or better products, methods, or systems of construction

Approval of the change would strengthen and improve the code by closing a loop hole allowing abuse of the public in the form of sub-standard “hurricane protection” products.

Does not discriminate against materials, products, methods, or systems of construction of demonstrated capabilities

Seeks to treat all hurricane protection products equally and does not discriminate.

Does not degrade the effectiveness of the code

Improves the effectiveness of the code by closing a loop hole allowing abuse of the trust of the public in the form of sub-standard “hurricane protection” products.

106.3.5 Minimum plan review criteria for buildings. The examination of the documents by the building official shall include the following minimum criteria and documents: a floor plan; site plan; foundation plan; floor/roof framing plan or truss layout; and all exterior elevations:

No change to other items

Commercial Buildings:

Building

8. Structural requirements shall include:

Soil conditions/analysis

Termite protection

Design loads

Wind requirements

Building envelope

Impact resistant coverings or systems

Structural calculations (if required)

Foundation

Wall systems

Floor systems

Roof systems

Threshold inspection plan

Stair systems

Residential (one- and two-family)

8. impact resistant coverings or systems

CA3920

Date Submitted	3/26/2010	**Section**	107.3	**Proponent**	Ila Jones
Chapter	1	**Affects HVHZ**	No	**Attachments**	No

TAC Recommendation Approved as Submitted
Commission Action Pending Review

Related Modifications

Summary of Modification

Modification to allow photocopies of Department of Community Affairs approved manufactured building plans to be submitted to building departments in lieu of signed and sealed plans.

Rationale

Some building departments require signed and sealed plans for manufactured buildings during permit applications. Section 553..37(6), Florida Statutes, states “Manufactured buildings which have been issued and bear the insignia of approval shall not require an additional approval or insignia by a local government in which they are subsequently or installed.” This modification will clarify that copies of DCA approved plans are adequate for permitting.

Fiscal Impact Statement

Impact to local entity relative to enforcement of code

No impact.

Impact to building and property owners relative to cost of compliance with code

Reduce cost of obtaining up to ten signed and sealed manufactured building plans.

Impact to industry relative to the cost of compliance with code

Reduce cost of obtaining up to ten signed and sealed manufactured building plans.

Requirements

Has a reasonable and substantial connection with the health, safety, and welfare of the general public

Original signed and sealed plans are maintained by the Department of Community Affairs.

Strengthens or improves the code, and provides equivalent or better products, methods, or systems of construction

No impact to code.

Does not discriminate against materials, products, methods, or systems of construction of demonstrated capabilities

Does not descriminate.

Does not degrade the effectiveness of the code

Does not degrade effectiveness of the code.

Revise 107.3 Exception 1 to read as follows:

Exceptions:

1. Building plans approved pursuant to Section 553.77(5), Florida Statutes, and state-approved manufactured buildings are exempt from local codes enforcing agency plan reviews except for provisions of the code relating to erection, assembly or construction at the site. Erection, assembly and construction at the site are subject to local permitting and inspections. Photocopies of plans approved according to FAC 9B-1.009, F.A.C., shall be sufficient for local permit application documents of record for the modular building portion of the permitted project.

Sub Code: Residential

CA4020

Date Submitted	3/28/2010	**Section**	101.2	**Proponent**	J Glenn-BASF
Chapter	1	**Affects HVHZ**	No	**Attachments**	No

TAC Recommendation Approved as Submitted
Commission Action Pending Review

Related Modifications

Summary of Modification

Removes “multiple single-family dwellings” from the wording. Retain base code (IRC) language.

Rationale

Townhouse is included in the IRC and defined in Chapter 2. The wording, “multiple single-family dwellings, is not needed.

Fiscal Impact Statement

Impact to local entity relative to enforcement of code

No impact to local enforcement is created by this change

Impact to building and property owners relative to cost of compliance with code

None

Impact to industry relative to the cost of compliance with code

None

Requirements

Has a reasonable and substantial connection with the health, safety, and welfare of the general public

No change

Strengthens or improves the code, and provides equivalent or better products, methods, or systems of construction

Brings Florida in-line with nationally accepted practice.

Does not discriminate against materials, products, methods, or systems of construction of demonstrated capabilities

Does not discriminated against anything

Does not degrade the effectiveness of the code

Does not degrade the code.

R101.2 Scope. The provisions of the Florida Building Code, Residential, shall apply to the construction, alteration, movement, enlargement, replacement, repair, equipment, use and occupancy, location, removal and demolition of detached one– and two–family dwellings and ~~multiple single–family dwellings~~ (townhouses~~)~~ not more than three stories above grade plane in height with a separate means of egress and their accessory structures.

CA4018

Date Submitted	3/28/2010	**Section**	202 Manufactured Home	**Proponent**	J Glenn-BASF
Chapter	2	**Affects HVHZ**	No	**Attachments**	No

TAC Recommendation Approved as Submitted
Commission Action Pending Review

Related Modifications

Summary of Modification

Retain base code (IRC) language as it provides better direction.

Rationale

Retain base code (IRC) language as it provides better direction.

Fiscal Impact Statement

Impact to local entity relative to enforcement of code

No impact to local enforcement is created by this change.

Impact to building and property owners relative to cost of compliance with code

None

Impact to industry relative to the cost of compliance with code

None

Requirements

Has a reasonable and substantial connection with the health, safety, and welfare of the general public

No change

Strengthens or improves the code, and provides equivalent or better products, methods, or systems of construction

Brings Florida in-line with nationally accepted practice.

Does not discriminate against materials, products, methods, or systems of construction of demonstrated capabilities

Does not discriminate against anything.

Does not degrade the effectiveness of the code

Does not degrade the code.

MANUFACTURED HOME ~~(Mobile Home). Any residential unit, constructed to standards promulgated by the United States Department of Housing and Urban Development (HUD), away from the installation site, and which bears the HUD label.~~ Manufactured home means a structure, transportable in one or more sections, which in the traveling mode is 8 body feet (2438 body mm) or more in width or 40 body feet (12 192 body mm) or more in length, or, when erected on site, is 320 square feet (30 m^2) or more, and which is built on a permanent chassis and designed to be used as a dwelling with or without a permanent foundation when connected to the required utilities, and includes the plumbing, heating, air-conditioning and electrical systems contained therein; except that such term shall include any structure that meets all the requirements of this paragraph except the size requirements and with respect to which the manufacturer voluntarily files a certification required by the secretary (HUD) and complies with the standards established under this title. For mobile homes built prior to June 15, 1976, a label certifying compliance to the Standard for Mobile Homes, NFPA 501, in effect at the time of manufacture is required. For the purpose of these provisions, a mobile home shall be considered a manufactured home.

Sub Code: Building

Date Submitted	4/1/2010	**Section**	101.2 Exception	**Proponent**	Anthony Apfelbeck
Chapter	1	**Affects HVHZ**	No	**Attachments**	Yes

TAC Recommendation No Affirmative Recommendation with a Second

Commission Action Pending Review

Related Modifications

3871

Summary of Modification

Provides a square foot threshold for the application of the IBC to single-family dwellings and townhouses.

Rationale

There is no limit to the square footage that a SFD can be constructed under the FRC. The construction type and lack of protection of large SFDs create a significant fire protection hazard. If the Florida legislature intervenes and removes the SFD fire sprinkler requirement in the IRC, a clear Florida specific justification for this change is created. The threshold is from the SBC and does not impact affordable housing. This change is not necessary if the IRC sprinkler provisions remain.

Fiscal Impact Statement

Impact to local entity relative to enforcement of code

The impact to the local entity is minor regarding the enforcement of the code. This provision was previously within the Southern Building Code as a threshold for SFD of type VI construction.

Impact to building and property owners relative to cost of compliance with code

Approximately $1.61 per square foot for the cost of the fire sprinkler system installation. See attached report.

Impact to industry relative to the cost of compliance with code

Approximately $1.61 per square foot for the cost of the fire sprinkler system installation. See attached report.

Requirements

Has a reasonable and substantial connection with the health, safety, and welfare of the general public

Nationwide, more than 4,000 people die in fires each year. Fire sprinklers save lives, reduce property loss and can even help cut homeowner insurance premiums. The presence of fire sprinklers have a clear benefit to protecting firefighters.

Strengthens or improves the code, and provides equivalent or better products, methods, or systems of construction

Nationwide, more than 4,000 people die in fires each year. Fire sprinklers save lives, reduce property loss and can even help cut homeowner insurance premiums. The presence of fire sprinklers have a clear benefit to protecting firefighters.

Does not discriminate against materials, products, methods, or systems of construction of demonstrated capabilities

This code change does not discriminate against materials, products or systems.

Does not degrade the effectiveness of the code

This code change improvess the effectiveness of the code. Installing both smoke alarms and a fire sprinkler system reduces the risk of death in a home fire by 82%, relative to having neither.

1st Comment Period History 04/15/2010 - 06/01/2010

Proponent James Battaglia **Submitted** 6/1/2010 **Attachments** No

CA3524-G1

Comment:

Although I do sympathize with the petitioner and the request, I would disagree. Many Florida Statutes clearly give individual home/landowners many more rights than that of non-landowners, i.e. pulling homeowner permits for a new home, remodel, addition, etc. A man's home is claimed to be his castle. This would stifle these homeowner's rights to do, within reason, of their homes what they want. Also, who would further define square footage? A porch? Garage? Lanai? What is 'under roof'?

101.2 Scope. The provisions of this code shall apply to the construction, alteration, movement, enlargement, replacement, repair, equipment, use and occupancy, location, maintenance, removal and demolition of every building or structure or any appurtenances connected or attached to such buildings or structures.

Exception: Detached one- and two-family dwellings and multiple single-family dwellings (townhouses) not more than three stories above grade plane in height and less than 7,000 square feet with a separate means of egress and their accessory structures shall comply with the International Residential Code.

Home Fire Sprinkler Cost Assessment

Final Report

Prepared by:

Newport Partners

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FOREWORD

Residential fire sprinkler ordinances have been adopted by several hundred U.S. communities for use in single-family dwellings. Such systems have been shown to provide significant life safety benefits, however the installed cost of these systems remains as a point of uncertainty and a potential barrier to broader adoption. Informal estimates of typical installation costs can vary widely, and influence decision makers' views on the viability of sprinkler systems in new homes.

In order to provide information on this topic, and to understand the factors that may influence the costs and hence impede the widespread use of residential fire sprinklers, the Foundation undertook this study to provide a national perspective on the cost of home fire sprinklers by developing data on installation costs and cost savings for ten communities distributed throughout the United States. The study also explores the range of insurance premium discounts which are available to home owners with sprinkler systems in their houses.

The Research Foundation expresses gratitude to the National Fire Protection Association for its sponsorship of the project, and to the project technical panelists listed on the following page.

The content, opinions and conclusions contained in this report are solely those of the authors.

Home Fire Sprinkler Cost Assessment Research Project

Technical Panel

David Butry, National Institute of Standards & Technology

Mike Chapman, Chapman Homes

Keith Covington, Third Coast Design Studio, LLC

Paul Emrath, National Association of Home Builders

Jeff Feid, State Farm Insurance

Tony Fleming, Metropolitan Fire Protection

J. Dennis Gentzel, Office of the State Fire Marshal (MD)

Michael Kebles, Las Vegas Valley Water District

Ron Murray, UA Local 290, Portland, OR

Peg Paul, Home Fire Sprinkler Coalition

James Tidwell, International Code Council

Paul Valentine, Mt. Prospect (IL) Fire Department

Keith Zaccard, Hanover Park (IL) Fire Department

Gary Keith, NFPA liaison

Principal Sponsor

National Fire Protection Association

THE
FIRE PROTECTION
RESEARCH FOUNDATION
Research in support of the NFPA mission

Home Fire Sprinkler Cost Assessment

Prepared by:
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Fire Protection Research Foundation

Home Fire Sprinkler Cost Assessment

Final Report

September 10, 2008

Acknowledgements

This research project was performed for the Fire Protection Research Foundation (FPRF) under the direction of Kathleen Almand, by Newport Partners LLC of Davidsonville, MD. While these two groups oversaw and conducted the research, respectively, many of the project's findings were made possible only through the cooperation of homebuilders, sprinkler contractors, local fire bureaus, and city officials. The design of this work called for a great deal of information gathering on the state of fire sprinklers in residential construction, and these groups helped to provide that information in the form of extensive documentation and responding to many requests for additional data. The authors of this report wish to gratefully acknowledge the contributions of dozens of individuals for their assistance.

This project was also guided by the FPRF's technical review panel, which provided valuable direction and feedback throughout the course of the project. The project authors wish to recognize this group and thank them for their participation and input:

David Butry, National Institute of Standards and Technology
Mike Chapman, Chapman Homes
Keith Covington, Third Coast Design Studio
Paul Emrath, National Association of Home Builders
Jeff Feid, State Farm Insurance
Tony Fleming, Metropolitan Fire Protection
Dennis Gentzel, Maryland State Fire Marshal's Office
Michael Kebles, Las Vegas Valley Water District
Ron Murray, UA Local 290
James Tidwell, International Code Council
Paul Valentine, Mt. Prospect Fire Department
Kenneth Zaccard, Hanover Park Fire Dept, Representing IAFC

Liaison
Peg Paul, Home Fire Sprinkler Coalition
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Executive Summary

Residential fire sprinkler ordinances have been adopted by several hundred United States communities for use in single-family dwellings. Such systems have been shown to provide significant life safety benefits, however the installed cost of these systems remains as a point of uncertainty and a potential barrier to broader adoption. Informal estimates of typical installation costs can vary widely and influence decision makers' views on the viability of sprinkler systems in new homes. Accordingly, the purpose of this study is to provide a national perspective on the cost of home fire sprinklers by developing data on installation costs and cost savings for ten communities distributed throughout the United States. The study also explores the range of insurance premium discounts which are available to homeowners with sprinkler systems in their houses.

To obtain information on the cost of installing residential sprinkler systems, ten case study communities were selected: nine in the United States, and one in Canada. The ten communities offer diversity in terms of sprinkler ordinance status, geographic location, housing style, and sprinkler system variables such as the type of piping material and the water supply source (municipal or on-site). For each of these communities, three building plans were collected from builders and sprinkler installers, along with sprinkler system cost data and other related cost and system information.

The term "sprinklered square feet" (sprinklered SF) reflects the total area of sprinklered spaces, including basements, garages, and attics when applicable. This term is used to better characterize the cost of sprinklers per unit of space which is covered by the system, especially since many of the homes have sprinklers in spaces beyond the normal living space, such as a garage. In terms of absolute costs, the total sprinkler system costs to the homebuilder ranged from $2,386 to $16,061 for the 30 houses.

The cost of sprinkler systems to the homebuilder, in dollars per sprinklered SF, ranged from $0.38 to $3.66. This range represents the 30 different house plans, with the average cost being $1.61 per sprinklered SF. The low end of this range

($0.38/sprinklered SF) represents a California house in a community with a long-standing ordinance, sprinklers in the attic and the garage (in addition to the living space), and some potential pricing benefits from a volume relationship with the sprinkler contractor. The high end of this cost range ($3.66/sprinklered SF) represents a Colorado house on well water and a system constructed with copper piping which utilized anti-freeze for freeze protection during the winter. These costs include all costs to the builder associated with the sprinkler system including design, installation, and other costs such as permits, additional equipment, and increased tap and water meter fees – to the extent that they apply. When accounting for any available credits given for the use of residential sprinklers (as was the case in Wilsonville, OR), the total sprinkler system costs to the builder averaged $1.49 per sprinklered SF.

Variables associated with higher cost systems included extensive use of copper piping (instead of CPVC or PEX), an on-site water supply (instead of municipal water), local requirements to sprinkler additional areas like garages or attics, and higher local sprinkler permit fees. The cost data also support the concept that communities with sprinkler ordinances in effect for more than five years tend to experience market acceptance and increased competition leading to lower system costs.

Credits or "trade-offs," which could include incentives like greater fire hydrant spacing in a community with sprinklers, were also investigated in each of the ten communities. While trade-offs may be used in communities as part of the zoning approval process for specific developments, just one of the ten communities had a credit or trade-off that applied to the houses which were analyzed. Wilsonville, OR, offers a credit of $1.21 per square foot of living space in an effort to partially offset the costs of sprinklers.

As complementary data to the cost analysis, a survey of available insurance premium discounts for homeowners with sprinkler systems was conducted. For each of the ten communities where sprinkler cost data was analyzed, the average insurance premium discount (as a percentage) was obtained from five insurers with significant market share

in the state. Discount savings percentages ranged from 0 to 10% among all companies and agencies surveyed, with an average premium discount of 7%. Related issues such as limits on the overall discount allowed for protective devices, sprinkler system requirements, and any potential insurance penalties for sprinklers were also explored. There were no instances discovered of insurance penalties or extra fees associated with the use of residential sprinkler systems due to concerns such as system leakage.

Insurance quotes for a theoretical prototype house were also obtained for the nine United States communities and one Canadian community. Quotes were obtained with and without a sprinkler system in an effort to estimate the discount that may result from having a sprinkler system. Annual discount savings averaged $22, or 3.42% of the annual premium. The difference in this discount compared to the average percentage discount found in the survey is likely due to the disconnect between generally quoted ranges and the real discounts allowed on real policies. As sprinkler systems become more common in given areas and this discount becomes a more common topic in the consumer-insurance agent dialogue, it is anticipated that actual discounts would more closely track with general ranges.

Table of Contents

I. Introduction

In 1975 the National Fire Protection Association (NFPA) introduced Standard 13D: Standard for the Installation of Sprinkler Systems in One- and Two-Family Dwellings and Mobile Homes.[1] Since that time there have been approximately ten updates to the standard to reflect practical experience and to accommodate such things as nonmetallic piping and multipurpose systems. NFPA Standard 13D and related standard NFPA 13R[2] have evolved and been balanced to optimize system costs and fire safety for specific types of residential occupancy buildings.

Although residential sprinklers have been adopted by many communities, only 2% of all existing one- and two-family homes included a sprinkler system as of 2003.[3] Although the life safety benefit of home fire sprinklers is well validated, installed cost remains a major barrier to their acceptance by homebuilders and local regulators. In 1986, the City of Scottsdale commissioned an independent study of the cost to install an NFPA 13D compliant system in an average single-family residence in that city. The study reviewed installation and related costs associated with sprinklers, as well as where sprinklers would result in cost savings.

In September 2007, the National Institute of Standards and Technology (NIST) released a cost benefit analysis that concluded the multipurpose residential sprinkler systems are economical across three housing types: townhouse, colonial style two-story, and a ranch design. Multipurpose systems (a system integrated with the home plumbing system) are allowed in some locations but were not used as the basis of the Scottsdale study, as it was completed prior to the updates in the 13D standard which permitted multipurpose systems.

Since 1986, the number of communities in the United States with sprinkler ordinances has increased, resulting in increased efficiencies in design, manufacturing and installation, as well as greater regulatory, insurance and builder acceptance. Further, the more widespread installation of these

[1] "Mobile Homes" was replaced with "Manufactured Homes" in the 1994 edition.
[2] Standard for the Installation of Sprinkler Systems in Residential Occupancies up to and Including Four Stories in Height, NFPA 13R.
[3] www.usfa.fema.gov/downloads/pdf/nrfsi-03report.pdf

systems provides the opportunity to take a broader look at the costs and cost savings associated with home fire sprinklers in today's housing industry. A broader range of cost data will be of value to local communities considering sprinkler ordinances, homebuilders and homeowners considering the installation of sprinklers, and other industry stakeholders.

The purpose of this study is to provide a national perspective on the cost of home fire sprinklers by developing data on installation costs and cost savings for ten communities, distributed throughout the United States.

II. Cost Analysis of Residential Sprinkler Systems

A. Criteria for Community Selection

To obtain information on the cost of installing residential sprinkler systems, ten case study communities were selected. The selection of the communities was based on the status of a local sprinkler ordinance, geography, availability of data, and other factors. In an effort to obtain a cross-section of jurisdictions with varied experiences, the communities selected include five that have had an ordinance in effect for more than five years, two that have had an ordinance in effect for five years or less, two that have never had an ordinance, and one that had an ordinance which has subsequently been repealed. The basis for these criteria was to capture potential cost differences that exist between regions with high rates of sprinkler regulation and those with lower rates of regulation (and presumably lower frequency of installations).

The broad geographic spread of the case study communities, as seen in the following section, provides variation which reflects different local circumstances. Such differences may include the type of installer, materials used, and specific system requirements – which all contribute to the cost of the system. The geographic spread also allowed for a variety of housing types to be analyzed. For example, while basement foundations are typical in the Northeast, slab foundations are more typical in places like California.

While the status of the local sprinkler ordinance and the geographic location of communities were the primary selection criteria, several other factors were evaluated with the intent of gaining a diverse set of data. For instance, communities which allow the use of multipurpose systems were sought to be included in the sample. And in fact, two communities that commonly install multipurpose systems were included in the cost analysis. Likewise, the selected communities cover a range of sprinkler piping materials, with CPVC (most common), copper, and PEX.

An effort was also made to select communities which would provide a mix of housing types in terms of the number of stories and foundation system. These housing features can significantly impact the extent and cost of a sprinkler system. The selection process also took into consideration the typical sprinkler installer in a community (sprinkler contractor or plumber), in an effort to include communities with both models.

As a result of the varied technical requirements between sprinkler systems installed in areas with and without a municipal water supply, building plans connected to non-municipal (on-site) water supplies were also captured in the selection. The study includes two communities where the building plans analyzed were on well water systems, allowing the characterization of the associated costs.

B. Community Overview

The ten communities selected for the cost analysis are shown below:

The selection of communities satisfies the various criteria and overall provides a diverse mix of sprinkler systems in terms of type of system, house, piping material, installer, water supply, etc. A Canadian community with a well established ordinance was also included to add more diversity to the community mix.

C. Selection of House Plans and Obtaining Cost Data

Within each case study community, the selection of house plans for obtaining cost data was typically based on builder or sprinkler contractor recommendations from local fire departments or local homebuilder associations. Nearly all builder and contractor participants were generally quite willing to share house plans and cost data documentation on sprinkler systems, as well as responding to a wide range of related questions.

All of the house plans and associated cost data obtained for this study were for homes that have been built since 2005, allowing for the analysis of recent cost figures. Three house plans were requested from each builder in an effort to obtain a broader sample. Actual house plans were obtained from the builder or sprinkler contractor with sprinkler system information, installation costs to the builder, and any additional costs to the builder not included in the installation cost. In cases where the builder could not provide additional cost information, local government offices were consulted on items such as permit fees or increased tap fee charges.

Overall, the thirty house plans reflect a cross-section of housing types nationwide, including one- and two-story homes; basement, slab, and crawl space foundations; and custom, semi-custom, and production homes. House sizes, measured in terms of "sprinklered square feet", averaged 4,118 sprinklered SF, ranging from 1,913 to 6,542 sprinklered SF. Throughout this report, the term "sprinklered SF" is frequently used, and reflects the total area of sprinklered spaces, including basements, garages, and attics when applicable. This term is used to better characterize the cost of sprinklers per unit of space, especially since many of the homes have sprinklers in spaces beyond the normal living space, such as a garage. For the sake of comparison, the thirty houses averaged 3,660 square feet living space, ranging from 1,723 to 6,360 sf. For the houses with basement

foundations, the area of the basement (unfinished or finished) was included in calculating the house's living space square footage.

House Size for 30-Home Sample

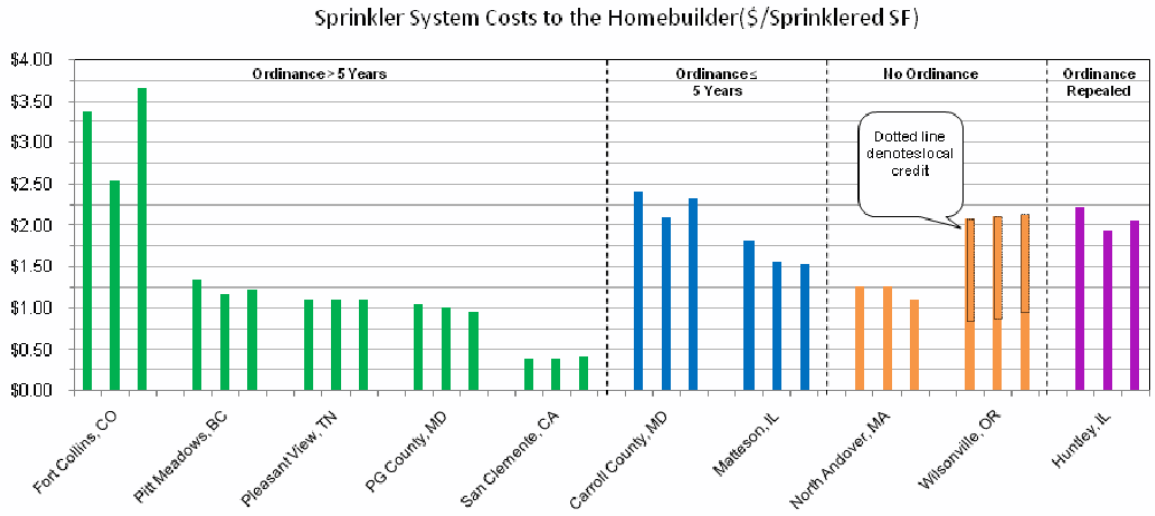
(Square feet)

	Sprinklered Area*	Living Area**
Mean	4,118	3,660
Median	4,124	3,441
Minimum	1,913	1,723
Maximum	6,542	6,360

* Sprinklered SF includes all spaces with sprinkler coverage
**Living area SF includes all livings spaces including basements (unfinished or finished)

D. Sprinkler System Costs

The cost of sprinkler systems to the homebuilder, in dollars per sprinklered SF, ranged from $0.38 to $3.66. This range represents the thirty different house plans, with the average cost being $1.61 per sprinklered SF. This figure includes all costs associated with the sprinkler system including design, installation, and other costs such as permits, additional equipment, increased tap and water meter fees – to the extent they apply. When accounting for any additional costs and any available credits (Wilsonville, OR), the total sprinkler system costs to the builder averaged $1.49 per sprinklered SF. Sprinkler system costs to the homebuilder are shown in the graph and table below, with more detailed cost data included in Appendix A.

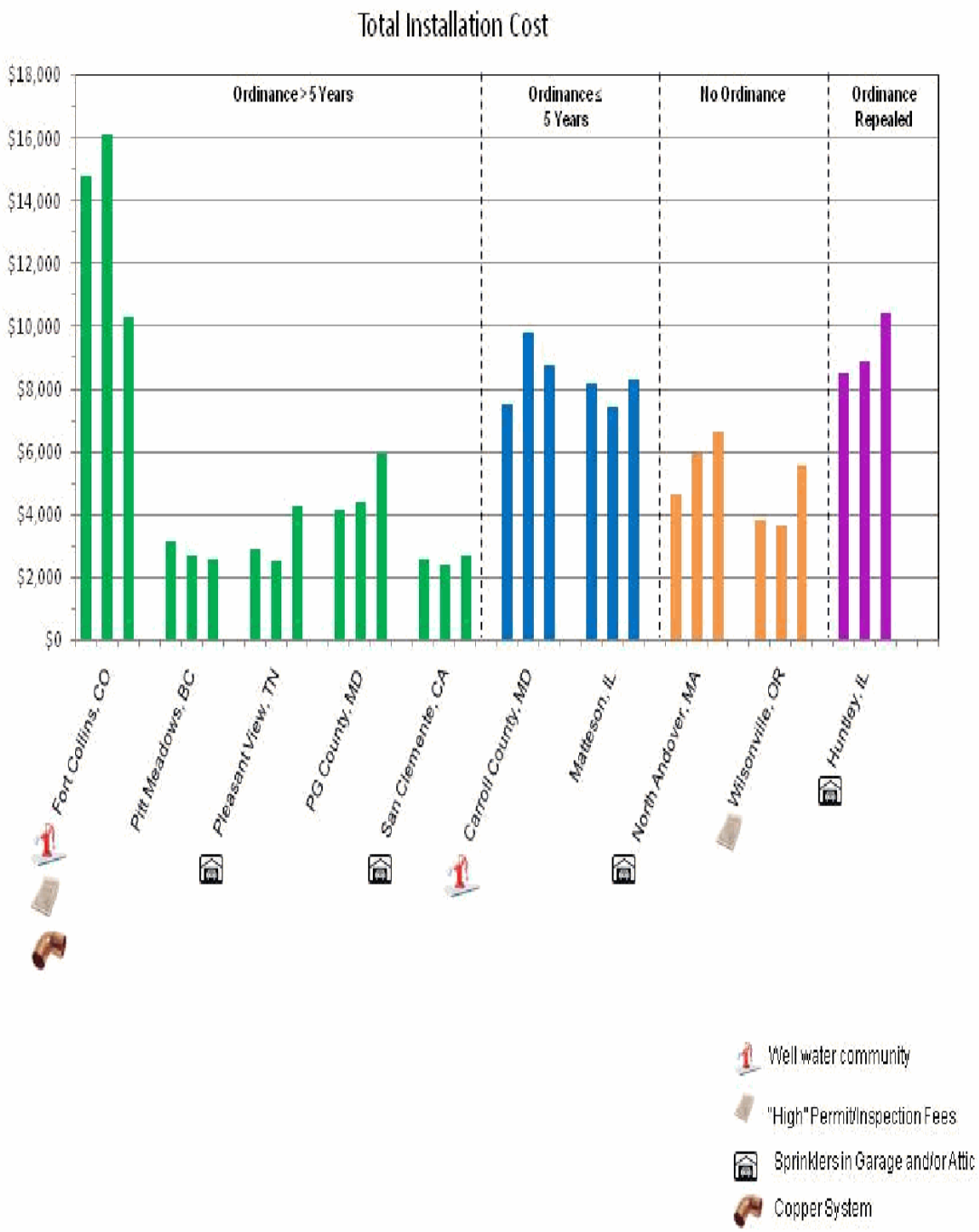


Sprinkler System Costs to the Homebuilder

	Cost ($/sprinklered SF)	Cost ($/living space SF)	Cost With Available Credits ($/sprinklered SF)	Cost with Available Credits ($/living space SF)
Mean	$1.61	$1.72	$1.49	$1.60
Median	$1.42	$1.49	$1.23	$1.38
Minimum	$0.38	$0.74	$0.38	$0.74
Maximum	$3.66	$3.66	$3.66	$3.66

The data above reflects the sprinkler system bid price plus all associated costs for the system which were not included in the bid (e.g. permit fee, increase in water service line, increase in tap fee). In several of the case study communities, these additional costs were already included in the contractor's bid price (like a permit fee) or these cost impacts did not apply (like an increased tap fee). One case study community, Wilsonville, OR, offers a $1.21 per square foot credit in an effort to partially offset the costs of sprinklers. When accounting for this credit across the entire 30-home sample, the total sprinkler system costs to the builder averaged $1.49 per sprinklered SF.

In addition to the cost of sprinklers per unit of space, the total cost per house is also an important metric. The following graph relates the total cost of the sprinkler system to the builder for all thirty house plans, with price-influencing variables noted for each community.



It should be noted that the variables identified in the graph above, such as the use of copper piping, were identified as significant factors in the overall price of the sprinkler system through discussions with the builder or contractor, and more detailed cost data in some cases. However, given the small size of the data set and other limitations, this research did not attempt to specifically quantify the pricing influence of variables like copper piping or well water systems for use on a broader basis. Several system variables, including those identified on the graph, are discussed and summarized below. Many of these factors are discussed further in the Individual Community Analysis section of this report.

E. Sprinkler System Variables

Sprinkler System Requirements and Extent of Coverage

Sprinkler systems provisions which go beyond NFPA 13D minimum requirements are sometimes found in local ordinances. Such modifications may require additional types of spaces to be sprinklered, such as garages. In the ten communities analyzed, local modifications include requiring all bathrooms (regardless of size) to have fire sprinklers (Matteson, IL); requiring fire sprinklers in garages (Huntley, IL, North Andover, MA, Pleasant View, TN, and San Clemente, CA); and requiring fire sprinklers in attics (San Clemente, CA).

Since adding sprinkler coverage to spaces like garages necessitates additional piping, sprinkler heads, and in some cases systems which can be used in areas reaching freezing temperatures, this factor is significant to note when assessing system costs.

Type of Pipe Used

Systems in the study used a mix of metallic (copper) and nonmetallic (CPVC or PEX) pipe. In communities using solely nonmetallic pipe, installation costs averaged $1.18 per sprinklered square foot. Several communities used CPVC piping in unexposed areas and copper in exposed areas like unfinished basements. In such cases, installation costs averaged $1.56 per sprinklered square foot. The houses analyzed in Fort Collins, CO, used exclusively copper piping, with an average installation cost of $3.19 per sprinklered square foot. This suggests that the type of piping used in systems can substantially impact the overall job cost.

Sprinkler System Costs by Type of Pipe

	CPVC	CPVC/ Copper	Copper	CPVC	CPVC/ Copper	Copper
	$/Sprinklered SF			$/Living Space SF		
Mean	$1.18	$1.56	$3.19	$1.30	$1.65	$3.19
Median	$1.10	$1.56	$3.37	$1.24	$1.56	$3.37
Minimum	$0.38	$0.95	$2.53	$0.74	$0.95	$2.53
Maximum	$2.40	$2.21	$3.66	$2.40	$2.49	$3.66

Water Source

While most of the houses assessed rely on municipal water sources, two of the communities (Carroll County, MD, and Fort Collins, CO) included homes reliant on well water. Sprinkler systems of this type require a booster pump, which according to estimates from sprinkler contractors, can add roughly $2,000 to $3,600 to the overall system cost. Installation costs in dollars per sprinklered square foot for these two communities ranged from $2.09 to $3.66. This results in an average of $2.73 per sprinklered square foot, compared to the $1.18 average for houses in those communities with a municipal water supply. Consequently, it is evident that a home's water supply source can be a significant factor in increasing price.

Sprinkler System Costs by Water Source

	Municipal	Non-Municipal	Municipal	Non-Municipal
	$/Sprinklered SF		$/Living Space SF	
Mean	$1.18	$2.73	$1.31	$2.73
Median	$1.10	$2.47	$1.24	$2.47
Minimum	$0.38	$2.09	$0.74	$2.09
Maximum	$2.21	$3.66	$2.49	$3.66

Permit and Inspection Fees

Communities often have a combined permit and inspection fee for the installation of sprinkler systems. While two of the case study communities do not have any fee for sprinkler permit and

inspection (Pleasant View, TN, and San Clemente, CA), the other eight communities do have such fees. In these communities, those permit and inspection fees which were identified ranged from $50 to just under $800, although in some of the case studies the permit fees were layered into the overall system bid and were not identifiable as single line item costs. While some of the ten communities have a flat fee, others calculate permit and inspection fees based on the size of the house or valuation of the construction. In determining which communities should be classified as having "high" permit and inspection fees, a threshold amount of $350 was set as a "high" based on the limited data available on the range of fees.

System Design Type

Multipurpose systems combine plumbing and sprinklers into one system and piping network, resulting in continuous flow of water circulating in the system. Conversely, a standalone sprinkler system uses dedicated sprinkler piping supply, with water flowing only when a sprinkler is activated. In analyzing the system type used, data was obtained for multipurpose systems (six homes) and standalone sprinkler systems (twenty-four homes). In communities where multipurpose systems are used, installation costs in dollars per sprinklered square foot averaged $1.04. In communities where standalone systems were used, installation costs averaged $1.61 per sprinklered SF.

Sprinkler System Costs by Design Type

	Multipurpose (6 Homes)	Standalone (24 Homes)	Multipurpose (6 Homes)	Standalone (24 Homes)
	$/Sprinklered SF		$/Living Space SF	
Mean	$1.04	$1.61	$1.04	$1.73
Median	$1.02	$1.39	$1.02	$1.49
Minimum	$0.81	$0.38	$0.81	$0.74
Maximum	$1.32	$3.66	$1.32	$3.66

Type of Foundation

House foundation types in the study varied depending on geographic location. While basement foundations were the prevalent foundation type in the eastern communities, slab or crawl space

foundations were more common in the western communities of the study. The following table depicts house foundation types by region, based on U.S. Census Bureau data:

2007 Foundation Type Market Shares

	Nationwide (U.S.)	Northeast	Midwest	South	West
Full/Partial Basement	27.7%	73.6%	73.7%	10.6%	18.6%
Crawl Space	18.4%	10.5%	6.2%	19.2%	27.3%
Slab	52.7%	14.0%	19.7%	68.7%	53.5%
Other	0.6%	0.7%	0.1%	0.9%	0.4%
Not Reported	0.5%	1.2%	0.3%	0.6%	0.2%

For houses in the study with basement foundations, sprinkler system costs averaged $1.81 per sprinklered square foot. System costs for houses with slab foundations averaged $0.81 per sprinklered square foot, while houses with crawl spaces had an average cost of $0.92 per sprinklered square foot.

Sprinkler System Costs by Foundation Type

	Basement (20 homes)	Slab (6 homes)	Crawl Space (4 homes)	Basement (20 homes)	Slab (6 homes)	Crawl Space (4 homes)
	$/Sprinklered SF			$/Living Space SF		
Mean	$1.81	$0.81	$0.92	$1.90	$0.99	$1.00
Median	$1.68	$0.78	$0.88	$1.68	$0.97	$0.88
Minimum	$0.95	$0.38	$0.81	$0.95	$0.74	$0.81
Maximum	$3.66	$1.12	$1.10	$3.66	$1.32	$1.44

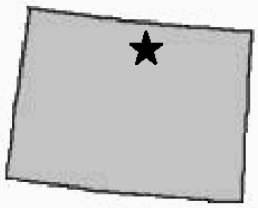
It should be noted that these costs, when presented in terms of dollars per sprinklered square foot, reflect the cost impacts of the foundation system but simultaneously incorporate the impacts of installing sprinklers in garages and attics in some cases. In other words, the limited data set and number of variables involved with each particular data point do not allow a more thorough analysis of this issue within this research.

F. Individual Community Analysis

The following table summarizes the communities, research houses, and sprinkler systems analyzed within each of the ten communities, followed by more detailed summaries of each jurisdiction. Note that for information such as pipe type, system type, and several other categories, the data in the table refers specifically to the 30 homes analyzed in the study, not community requirements.

Community	Sprinkler Ordinance Information	Year of Ordinance Adopted	Local Modifications to 13D	System Type	Pipe Type	Sprinkler Head Type	Water Supply	Foundation Type
Fort Collins, CO	13D > 5 years	1986	None	standalone	Copper	concealed; semi-recessed in exposed areas	Well water	Basement
Pitt Meadows, BC	13D > 5 years	1998	None	multipurpose	CPVC	semi-recessed	Municipal	Slab
Pleasant View, TN	13D > 5 years	2002	Sprinklers or a 1-hour rated assembly required in garage	standalone	CPVC	concealed	Municipal	2 Basement 1 Crawl Space
Prince George's County, MD	13D > 5 years	1992	None	standalone	CPVC; copper in basements	concealed; semi-recessed in exposed areas	Municipal	Basement
San Clemente, CA	13D > 5 years	1980	Sprinklers required in garages and attics	standalone	CPVC	concealed	Municipal	Slab
Carroll County, MD	13D < 5 years	2006	None	standalone	CPVC	concealed; semi-recessed in exposed areas	Well water	Basement
Matteson, IL	13D < 5 years	2004	All bathrooms must have sprinklers, regardless of size	standalone	CPVC; copper in basements	concealed; semi-recessed in exposed areas	Municipal	Basement
North Andover, MA	no ordinance	N/A	Sprinklers in garages	standalone	CPVC	concealed	Municipal	Basement
Wilsonville, OR	no ordinance	N/A	None	multipurpose	PEX	semi-recessed	Municipal	Crawl Space
Huntley, IL	13D repealed	2005	2 Sprinkler heads required in garages	standalone	CPVC; copper in basements	concealed; semi-recessed in exposed areas	Municipal	Basement

Fort Collins, Colorado



Fort Collins, Colorado has mandated NFPA 13D since 1986. The community is served by the Poudre Fire Authority. Residential sprinkler systems are typically installed by sprinkler contractors, but the installation may also be done by a plumber. Both standalone and multipurpose systems have been installed in homes in Fort Collins, and pipe type is typically plastic (CPVC or PEX), but may also be metallic (copper). The housing styles in Fort Collins range from manufactured housing to custom homes larger than 5,000 square feet, typically with basement foundations.

In the case study of Fort Collins, three house floor plans were obtained from a local sprinkler contractor. All three homes were built on a basement foundation, thus requiring sprinkler heads in the basement in addition to the main living areas per NFPA 13D. Including the basement area, the three homes had living space ranging from 2,797 to 6,360 square feet. In sprinklered square footage, the three homes ranged from 2,797 to 6,360 square feet (sprinklered area = living space area). The cost of the systems to the builder ranged from $10,250 to $16,061. The cost of the systems ranged from $2.53 to $3.66 per sprinklered SF.

Fort Collins – Sprinkler System Costs

	System Cost	*Sprinklered Space*		*Living Space*	
		Size	*$/SF*	*Size*	*$/SF*
House 1	$14,745	4,373	$3.37	4,373	$3.37
House 2	$16,061	6,360	$2.53	6,360	$2.53
House 3	$10,250	2,797	$3.66	2,797	$3.66

In each home, the sprinkler contractor installed a standalone system using copper piping.[4] Concealed sprinkler heads were used in the main living area, while semi-recessed sprinkler heads

[4] The sprinkler contractor has traditionally used only copper for sprinkler systems, believing it to be superior to plastic both in performance and longevity. The contractor is considering switching to plastic on their larger projects to remain competitive in the local market.

were used in areas where piping is exposed. Design fee, inspection fee, and permit fee were included in the sprinkler contractor's installation price. It is important to note, however, that the permit fee varies depending on the valuation of the individual home. Thus, permit fees for the three case study homes ranged from $510.46 to $799.83. The contractor's installation price also included an anti-freeze system, a system flow switch and alarm, and a backflow preventer. Because all three homes rely on well water, a booster pump and tank was required for the sprinkler system, which was also included in the contractor's installation price.

A supplemental bid for the sprinkler system installations in Fort Collins may help to characterize the relatively high system costs which were obtained for the homes. A second residential sprinkler contractor in the Fort Collins area quoted the system installations on the same three homes with a range of $8,000 to $12,500. This difference from the actual contractor bid range ($10,250 to $16,061) may be heavily influenced by the type of pipe used for the systems. PEX was used in the supplemental system bid design, while copper was used in the actual plans. PEX pipe is flexible tubing that is significantly less expensive than copper.

Pitt Meadows, British Columbia

Pitt Meadows, British Columbia has mandated NFPA 13D since 1998. The community is served by the Pitt Meadows Fire Department. There are no specific requirements for residential sprinkler systems beyond those of NFPA 13D. Residential sprinkler systems are typically installed by sprinkler contractors. Both standalone and multipurpose systems have been installed in homes in Pitt Meadows, and pipe is typically CPVC. Typical housing type in Pitt Meadows is two-story, 2,500 square feet in living space, with a crawl space or slab foundation.

In the case study of Pitt Meadows, three house floor plans were obtained from a semi-custom builder. All three homes were built on a slab foundation. The three homes had living space (and sprinkler square footage space) ranging from 2,109 to 2,342 square feet. The cost of the systems to the

builder ranged from $2,560 to $3,090.[5] When considered in terms of dollars per unit of space, the cost of the systems ranged from $1.15 to $1.32 per sprinklered SF (U.S. dollars).

Pitt Meadows – System Costs

	System Cost	*Sprinklered Space*		*Living Space*	
		Size	*$/SF*	*Size*	*$/SF*
House 1	$3,090	2,342	$1.32	2,342	$1.32
House 2	$2,690	2,336	$1.15	2,336	$1.15
House 3	$2,560	2,109	$1.21	2,109	$1.21

The sprinkler contractor installed a standalone system using CPVC piping and standard white semi-recessed sprinkler heads were used. Design fee, inspection fee, and permit fee were included in the sprinkler contractor's installation price. It is important to note, however, that the permit fee is calculated as 0.95% of the sprinkler system construction value. Thus, permit fees for the three case study homes ranged from $24.32 to $29.35. The contractor's installation price also included a system flow switch and alarm, and a backflow preventer.

Pleasant View, Tennessee

Pleasant View, Tennessee has mandated NFPA 13D since 2002. The community is served by the Pleasant View Volunteer Fire Department. In addition to the requirements of NFPA 13D, Pleasant View requires sprinkler coverage in the garage of homes. Standalone systems are the more common system used in Pleasant View, with CPVC pipe typically used. Typical housing type in Pleasant View ranges from 1,200 to 4,000 square feet of living space, both one- and two-story homes, with differing foundation types.

[5] The original prices were in Canadian dollars (CAN). Amounts were converted to USD (U.S. dollars) based on currency exchange rates of $1.00 CAN to $1.0099 USD as of March 2008 (when the costs were incurred).

In the case study of Pleasant View, three house floor plans were obtained from a semi-custom builder. Two of the homes were built with a basement foundation; the other home had a crawl space. The three homes had living space ranging from 1,723 to 3,326 square feet. In addition to sprinkler coverage in the living space, sprinklers were also installed in the garages. Thus, total sprinklered space in the three homes ranged from 2,612 to 3,826 sprinklered SF. The total cost of the sprinkler systems to the builder ranged from $2,489 to $4,208. When considered in terms of dollars per unit space, the cost of the system for each of the three homes was $1.10 per sprinklered SF.

Pleasant View – System Costs

	System Cost	*Sprinklered Space*		*Living Space*	
		Size	*$/SF*	*Size*	*$/SF*
House 1	$2,872	2,612	$1.10	2,112	$1.36
House 2	$2,489	2,273	$1.10	1,723	$1.44
House 3	$4,208	3,826	$1.10	3,326	$1.27

The sprinkler contractor installed a standalone system using CPVC piping and concealed sprinkler heads. The design fee for the sprinkler system was included in the sprinkler contractor's installation price. Pleasant View does not charge an inspection fee or permit fee for residential sprinkler systems. The contractor's installation price also included a system flow switch and alarm, and a backflow preventer.

All three homes use a municipal water source. An increased water service line size is needed in Pleasant View to allow for the potential increase in water flow associated with the sprinkler system. This increase from ¾" to 1" does not result in an increase in price for the sprinkler system installation, as all building lots now come with this increased line size. Increases in water meter size or water tap fee were not required or incurred.

Prince George's County, Maryland

Prince George's County, Maryland phased in the requirement of NFPA 13D beginning in 1987, when county council approved the mandate of residential sprinklers. On January 1, 1992, the final stage of the law went into effect stating that from that point on all residential structures, including single-family homes, must be fully protected by a NFPA Approved 13-D residential sprinkler.[6] The county is served by the Prince George's County Fire Department. There are no specific requirements for residential sprinkler systems beyond those of NFPA 13D. Residential sprinkler systems are typically installed by sprinkler contractors. Standalone systems are the common system used in Prince George's County, and pipe type is typically CPVC. Typical housing type in Prince George's County is two-story, roughly 3,000 square feet in living space, with a basement foundation.

In the case study of Prince George's County, three house floor plans were obtained from a regional production builder. All three homes were built on basement foundations. Including the basement area, the three homes had living space ranging from 3,903 to 6,170 square feet. The amount of sprinklered square footage ranged from 3,903 to 6,170 square feet. The cost of the systems to the builder ranged from $4,100 to $5,886. When considered as dollars per square foot of sprinkler coverage, the cost of the system ranged from $0.95 to $1.05 per square foot.

[6] Ronald Jon Siamicki, "*Residential Sprinklers: One Community's Experience Twelve Years after Mandatory Implementation*," January 2001.

Prince George's County – System Costs

	System Cost	*Sprinklered Space*		*Living Space*	
		Size	*$/SF*	*Size*	*$/SF*
House 1	$4,100	3,903	$1.05	3,903	$1.05
House 2	$4,332	4,345	$1.00	4,345	$1.00
House 3	$5,886	6,170	$0.95	6,170	$0.95

The sprinkler contractor installed a standalone system using CPVC piping, using both concealed and standard white semi-recessed sprinkler heads. Design fee, inspection fee, and permit fee were included in the sprinkler contractor's installation price. The contractor's installation price also included a system flow switch and alarm, and a backflow preventer.

San Clemente, California

San Clemente, California has mandated NFPA 13D since 1980. The community is served by the Orange County Fire Authority. In addition to the requirements for residential sprinkler systems stated by NFPA 13D, the community also requires sprinkler coverage in the garage and attic space of homes. Standalone systems are the common system used in San Clemente, with CPVC pipe typically used. Typical housing type in San Clemente ranges from 2,500 to 5,000 square feet with slab foundations.

In the case study of San Clemente, three house floor plans were obtained from a production builder. All of the homes were built on slab foundations with living space ranging from 3,214 to 3,482 square feet. With garage and attic space considered, sprinklered space ranged from 6,329 to 6,542 square feet. The cost of the systems to the builder ranged from $2,386 to $2,655. When considered in terms of dollars per square foot of sprinkler coverage, the cost of the systems ranged from $0.38 to $0.41 per square foot. These low costs for the sprinkler system are likely the result of volume pricing

(the builder indicated that the contractor does a large volume of work with them) and the competitive market as a result of the length of the ordinance's existence.

San Clemente – System Costs

	System Cost	*Sprinklered Space*		*Living Space*	
		Size	*$/SF*	*Size*	*$/SF*
House 1	$2,565	6,542	$0.39	3,482	$0.74
House 2	$2,386	6,329	$0.38	3,214	$0.74
House 3	$2,655	6,448	$0.41	3,358	$0.79

The sprinkler contractor installed a standalone system using CPVC piping and concealed sprinkler heads. The design fee and inspection fee for the sprinkler system was included in the sprinkler contractor's installation price. San Clemente does not charge a permit fee for residential sprinkler systems—the city promotes the use of residential sprinkler systems by eliminating such a fee. The contractor's installation price also included a system flow switch and alarm, and a backflow preventer.

All three homes use a municipal water source. There is no need for an increased water service line size, water meter size, or tap fee as a result of the sprinkler system installation.

Carroll County, Maryland

Carroll County, Maryland has mandated NFPA 13D since 2006. The county is served by local paid and volunteer fire departments. There are no specific requirements for residential sprinkler systems above and beyond those of NFPA 13D. Standalone systems are the common system used in Carroll County, although multipurpose systems may also be used. CPVC pipe is typically used in finished areas of homes, with copper used in unfinished areas. Typical housing in Carroll County is about 1,800 square feet for one-story ranches, and 3,500 square feet for two-story homes, with basement foundations.

In the case study of Carroll County, three house floor plans were obtained from a semi-custom builder. All three homes were built with a basement foundation, with living space (including basement) ranging from 3,131 to 4,686 square feet. The cost of the systems to the builder ranged from $7,499 to $9,800. When considered in terms of dollars per square foot of sprinkler coverage, the cost of the systems ranged from $2.09 to $2.40 per sprinklered square foot.

Carroll County – System Costs

	System Cost	*Sprinklered Space*		*Living Space*	
		Size	*$/SF*	*Size*	*$/SF*
House 1	$7,499	3,131	$2.40	3,131	$2.40
House 2	$9,800	4,686	$2.09	4,686	$2.09
House 3	$8,750	3,772	$2.32	3,772	$2.32

Because all three homes rely on well water, a booster pump and tank was required for the sprinkler system, which was included in the contractor's installation price. The sprinkler contractor installed a standalone system using CPVC piping. Concealed sprinkler heads were used in unexposed areas and semi-recessed sprinkler heads were used in exposed areas. The design fee, inspection fee, and permit fee for the systems were included in the sprinkler contractor's installation price. The contractor's installation price also included a system flow switch and alarm, and a backflow preventer.

Matteson, Illinois

Matteson, Illinois has mandated NFPA 13D since 2004. The community is served by the Matteson Fire Department. There are no specific requirements for residential sprinkler systems beyond those of NFPA 13D. Standalone systems are the more common system used in Matteson, with CPVC pipe typically used. Typical housing type in Matteson is about 3,000 square feet, both one- and two-story homes, usually with basement foundations.

In the case study of Matteson, three house floor plans were obtained from a semi-custom builder. All three homes were built with a basement foundation, with living space (including the basement area) and sprinklered space ranging from 4,562 to 5,478 square feet. The cost of the systems to the builder ranged from $7,407 to $8,329, or $1.52 to $1.80 per sprinklered square foot.

Matteson – System Costs

	System Cost	*Sprinklered Space*		*Living Space*	
		Size	*$/SF*	*Size*	*$/SF*
House 1	$8,198	4,562	$1.80	4,562	$1.80
House 2	$7,407	4,740	$1.56	4,740	$1.56
House 3	$8,329	5,478	$1.52	5,478	$1.52

The sprinkler contractor installed a standalone system using CPVC piping. Concealed sprinkler heads were used in unexposed areas and semi-recessed sprinkler heads were used in exposed areas. The design fee for the sprinkler system was $50, and the inspection fee and permit fee were a combined $150. The contractor's installation price also included a system flow switch and alarm, and a backflow preventer.

All three homes use a municipal water source. An increase in water service line size is needed in Matteson to accommodate the potential increase in water flow associated with the sprinkler system. This increased service line cost the builder an additional $700. Increase costs for a larger water meter or water tap fee were not incurred.

North Andover, Massachusetts

North Andover, Massachusetts does not require residential sprinklers by law, but instead has implemented NFPA 13D through local zoning. Sprinklers are a part of the zoning approval process, as discussed in a later section of the report. The community is served by the North Andover Fire Department. In addition to the requirements for residential

sprinkler systems stated by NFPA 13D, the North Andover Fire Department requires sprinkler coverage in the garage. Standalone systems are the common system used in North Andover, with CPVC pipe typically used. Typical housing type in North Andover is about 2,000 to 3,500 square feet, both one- and two-story homes, usually with basement foundations.

In the case study of North Andover, three house floor plans were obtained from a local developer in the community. All three homes were built with a basement foundation, with living space (including the basement area) ranging from 3,084 to 5,422 square feet. With garage square footage considered, the three homes ranged from 3,568 to 5,906 sprinklered square feet. The cost of the sprinkler systems to the builder ranged from $4,500 to $6,500, or $1.10 to $1.26 per sprinklered square foot.

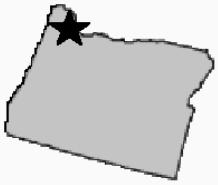
North Andover – System Costs

	System Cost	*Sprinklered Space*		*Living Space*	
		Size	*$/SF*	*Size*	*$/SF*
House 1	$4,500	3,568	$1.26	3,084	$1.46
House 2	$5,800	4,632	$1.25	4,148	$1.40
House 3	$6,500	5,906	$1.10	5,422	$1.20

The sprinkler contractor installed a standalone system using CPVC piping. Concealed sprinkler heads were used in unexposed areas and semi-recessed sprinkler heads were used in exposed areas of the home. The design fee and inspection fee were included in the cost to the builder, while the permit fee was a separate cost at $50 per home. The contractor's installation price also included a system flow switch and alarm, and a backflow preventer.

All three homes use a municipal water source. An increase in water service line size was needed to accommodate the potential increased water flow associated with the sprinkler system. This increase cost the builder an additional $450. An increase in tap fee at a cost of $500 was also incurred. There was no additional cost incurred related to the water meter size.

Wilsonville, Oregon



Wilsonville, Oregon does not require residential sprinklers by law, but has required NFPA 13D in the planned community of Villebois. The community is served by Tualatin Valley Fire and Rescue. There are no specific requirements for residential sprinkler systems beyond those of NFPA 13D. System installations are typically done by a plumber; thus a multipurpose system is the most common system used in the area. Typical housing type in Wilsonville is between 2,000 to 3,000 square feet, often with a crawl space foundation.

In the case study of Wilsonville, three house floor plans were obtained from a developer in the region. All three homes were on a crawl space, with living space (and sprinklered square footage) ranging from 1,913 to 2,917 square feet. The total cost of the systems to the builder (before any credit is applied) ranged from $4,014 to $5,892, or $2.02 to $2.10 per sprinklered square foot

The City of Wilsonville offers a $1.21 per square foot of living space credit to the builder to offset the costs associated with sprinklers. This is a one-time credit, offered at the time of system installation. The credit cannot be any greater than the water meter system development charge for a 3/4" meter, which is currently $4,436 – regardless of the size of the home. In rare situations, a large home requiring a 1" water meter may receive a greater credit, but only if proof is shown that this increased water meter size is directly a result of water flow requirements for the sprinkler system.

When accounting for the impact of this credit, the sprinkler system costs for the three Wilsonville homes range from $0.81 to $0.89 per sprinklered square foot, as shown in the table below.

Wilsonville – System Costs

	System Cost	*Sprinklered Space*			*Living Space*		
		Size	*Credit ($/SF)*	*$/SF*	*Size*	*Credit ($/SF)*	*$/SF*
House 1	$4,178	2,005	$1.21	$0.87	2,005	$1.21	$0.87
House 2	$4,014	1,913	$1.21	$0.89	1,913	$1.21	$0.89
House 3	$5,892	2,917	$1.21	$0.81	2,917	$1.21	$0.81

The plumber installed a multipurpose system using PEX piping and standard white semi-recessed sprinkler heads. The design fee was included in the cost to the builder, while the inspection and permit fee was a separate cost to the builder, at $360 per home. The system did not feature a flow switch and alarm, but a required backflow preventer was included in the installation cost. All three homes use a municipal water source. An increase in water service meter size from 5/8" to 3/4" was needed to accommodate the increased water flow associated with the sprinkler system.

Huntley, Illinois

Huntley, Illinois mandated NFPA 13D in 2005, and the mandate was repealed by the Village of Huntley in 2007. Residential sprinkler systems are currently a "mandatory option" in the Village of Huntley—builders must offer homeowners the option to install a residential sprinkler system. While 13D is not required in the village itself, sprinkler systems are still required in the county portion of the fire district. When NFPA 13D was required, sprinkler coverage was also required in the garages of homes. System installations are typically done by a sprinkler contractor, using CPVC pipe. Typical housing in Huntley ranges from 2,000 to 4,500 square feet, usually with basement foundations.

In the case study of Huntley, three house floor plans were obtained from a local sprinkler contractor. All three homes were built with a basement foundation, with living space (including the basement area) ranging from 3,400 to 4,560 square feet. With garage areas considered, the three homes ranged from 3,835 to 5,045 sprinklered square feet. The cost of the sprinkler systems to the builder ranged from $8,476 to $10,406, or $1.93 to $2.21 per sprinklered square foot.

Huntley – System Costs

	System Cost	*Sprinklered Space*		*Living Space*	
		Size	*$/SF*	*Size*	*$/SF*
House 1	$8,476	3,835	$2.21	3,400	$2.49
House 2	$8,851	4,575	$1.93	4,030	$2.20
House 3	$10,406	5,045	$2.06	4,560	$2.28

The sprinkler contractor installed a standalone system using CPVC pipe in all areas except the basement, where copper was used. Concealed sprinkler heads were used in unexposed areas and semi-recessed sprinkler heads were used in exposed areas. The design fee for the system was included in the sprinkler contractor's installation price, while the inspection fee and permit fee were a combined $300, an additional cost outside of the sprinkler contractor's installation price. The contractor's installation price also included a system flow switch and alarm, and a backflow preventer.

All three homes use a municipal water source. An increase in water service line size from 1" to 1 ½" was required to accommodate the increased water flow associated with the sprinkler system. This increase in water line size cost the builder an additional $821.

G. Credits and Trade-Offs

Trade-offs is a general term for allowances that can be made in the building construction or the development planning when sprinkler systems will be used in the houses. At the house level, a trade-

off could be a waiver of using fire-rated drywall in attached garages when the garage will be sprinklered. At the development level, trade-offs can include greater spacing of fire hydrants, narrower road widths, reduced water main sizes, relaxed requirements for the number of neighborhood exits, and others.

Arial View of North Andover Subdivision Illustrating Cluster Zoning

Potential trade-offs at the development level and the house level were investigated for all ten communities. Possible trade-offs were particularly scrutinized in North Andover, Massachusetts and Wilsonville, Oregon. Neither community has a mandated residential sprinkler ordinance, so incentives of some type could be reasonable tools to encourage the use of sprinklers.

North Andover has experienced tremendous growth in the past thirty-five years and has implemented cluster zoning as a way to preserve open space in the community. In subdivisions such as Hickory Hills, several additional building lots have been made available through cluster zoning, while still allowing for a large amount of open space in the development. Cluster zoning involves smaller lots and tighter setbacks, with larger parcels of dedicated open space nearby. The former North Andover Fire Chief viewed cluster zoning as a potentially greater fire risk (as homes are built closer together), resulting in a requirement for residential sprinklers for such developments as an additional safety measure. Additionally, because North Andover lacks the manpower for a new fire station, residential sprinkler systems can buy the fire department time in the event of an emergency. As a result, the town planning board created cluster-zoned subdivisions in North Andover as specially permitted lots, where developers and builders are required to install residential sprinkler systems in homes. Although the planning board does sometimes offer a decrease in the width of streets, increased spacing between fire hydrants, and the elimination of a turnaround for cluster developments, none of these trade-offs were offered in Hickory Hills.

Wilsonville, OR provides a per-house credit intended to help cover the cost to install a residential sprinkler system. The credit is limited to the current water meter system development charge. Thus, the one-time credit changes as the system development charge changes. Beyond this credit offered

by the City of Wilsonville, there were no documented development-level or house-level trade-offs in the ten communities.

For communities where garages are sprinklered, there were no trade-offs identified related to drywall specifications. For each of the four communities in the study with sprinklered garages, the additional coverage is treated as an added safety measure, to be implemented in addition to the traditional fire-rated drywall required by building codes. In many cases, local jurisdictions will require sprinkler coverage in the garage when there are bedrooms and/or other living areas above the garage.

Although evidence of trade-offs was not found in the case study communities, there is a general knowledge in the industry that trade-offs may be implemented on more of a case-by-case basis integrated with the zoning approval process for developments, rather than as a standard community policy. Negotiations are often made between a developer and the Authority Having Jurisdiction (AHJ). Such agreements may be made in order for a developer to avoid penalty for not installing sprinklers.

III. Insurance Discounts for Residential Sprinkler Systems

A. Methodology for Estimating Insurance Premium Reductions

A 2007 study conducted by the National Association of Home Builders (NAHB) economics department showed that insurers do offer meaningful discounts for residential sprinkler systems, but that the discounts varied from state to state. For this study, an insurance survey was created to examine insurance companies and local agencies in the nine states where case study communities were located. This survey was both quantitative and qualitative, gathering not only average insurance premium discounts, but also information on insurance company categorization and/or requirements for discounts, and the familiarity of consumers with such discounts. This information is intended to help round out the case studies and provide meaningful data on actual insurance incentives and policies.

For each community, the average insurance premium discount (as a percentage) was obtained from five insurance companies. The National Association of Insurance Commissioners (NAIC) 2007 Market Share Reports for Property/Casualty Insurance Groups and Companies were used to identify the top five insurance companies in each state. In cases where insurance discounts could not be obtained from a top-five company, discounts were obtained from subsequent companies from the NAIC report list. In cases where information could not be obtained directly from an insurance company, local insurance agencies were contacted.

B. Insurance Premium Discounts for Residential Sprinkler Systems

Discount savings percentages are derived from the whole annual homeowner's insurance premium (rather than just a portion of the premium). Discount savings percentages ranged from 0 to 10% among all companies and agencies surveyed, with an average discount savings percentage premium of 7%.

In California, annual homeowner's insurance premium discount percentages were obtained from Allstate, State Farm, Farmers, Auto Club Enterprises, and Nationwide. Discounts ranged from 0 to 10%.

In Colorado, annual homeowner's insurance premium discount percentages were obtained from State Farm, Farmers, American Family, Allstate, and Travelers. Discounts ranged from 3 to 10%.

In Illinois, annual homeowner's insurance premium discount percentages were obtained from Allstate, State Farm, Country Financial, Farmers, and American Family. Discounts ranged from 5 to 10%.

In Maryland, annual homeowner's insurance premium discount percentages were obtained from Allstate, State Farm, Travelers, Nationwide, and Erie. Discounts ranged from 4 to 10%.

In Massachusetts, annual homeowner's insurance premium discount percentages were obtained from Commerce, Andover, Chubb & Son, Travelers, and Liberty Mutual. Discounts ranged from 5 to 10%.

In Oregon, annual homeowner's insurance premium discount percentages were obtained from State Farm, Farmers, Allstate, Country Financial, and American Family. Discounts ranged from 5 to 10%.

In Tennessee, annual homeowner's insurance premium discount percentages were obtained from State Farm, Tennessee Farmers, Allstate, Travelers, and Nationwide. Discounts ranged from 0 to 10%.

In British Columbia, annual homeowner's insurance premium discount percentages were obtained from Aviva, Canadian Northern Shield, Economical Insurance, Dominion of Canada, and Gore Mutual. Discounts ranged from 0 to 12%.

These findings are summarized in the table below.

State	Insurance Company	Market Share in State/Province	Percentage Discount for Residential Sprinklers
Maryland	Allstate	21.06%	4%
	State Farm	16.61%	10%
	Travelers	13.01%	10%
	Nationwide	11.12%	5%
	Erie	8.38%	5%
Tennessee	State Farm	26.54%	10%
	Tennessee Farmers	18.30%	5%
	Allstate	11.43%	10%
	Travelers	5.58%	10%
	Nationwide	5.24%	0%
Illinois	State Farm	32.66%	10%
	Allstate	16.29%	10%
	Country Insurance	8.09%	5%
	Farmers	6.60%	6%
	American Family	5.28%	10%
Massachusetts	Commerce	10.02%	5%
	Andover Companies	8.45%	5%
	Chubb & Son Inc.	7.98%	10%
	Travelers	7.65%	7%
	Liberty Mutual	7.08%	8%
Colorado	State Farm	23.82%	10%
	Farmers	15.45%	5%
	American Family	12.42%	10%
	Allstate	10.28%	5%
	Travelers	3.96%	3%
California	State Farm	20.23%	10%
	Farmers	17.03%	10%
	Allstate	13.33%	10%
	Auto Club Enterprises	4.33%	0%
	Nationwide	3.58%	6%
Oregon	State Farm	25.26%	10%
	Farmers	19.09%	5%
	Allstate	10.66%	10%
	American Family	4.17%	10%
	Country Insurance	4.07%	5%
British Columbia	Aviva	8.05%	5%
	Canadian Northern Shield	6.23%	13%
	Economical Insurance	6.10%	0%
	Dominion of Canada	3.11%	0%
	Gore Mutual	1.96%	0%

Categorization of Sprinkler Systems

Many insurance companies classify the discount offered for residential sprinkler systems by the extent of sprinkler coverage in the home. While these exact categories and their specific requirements differ between companies, most insurers typically classify system types into "partial" or "full" systems. A partial system generally means sprinkler coverage in the main living area only. In a few instances, partial may be defined as sprinkler coverage in the utility room only. A full system often means sprinkler coverage in all areas of the home, including the basement or crawl space, all bathrooms, closets, and hallways. In some instances, a full system classification may also require sprinkler coverage in garages. Furthermore, several companies required the sprinkler system to be monitored with an alarm. For the purposes of this insurance survey, the discount percentage offered by an insurer that most closely aligned with the fire sprinkler ordinance requirements for the particular case study community being assessed was used.

Most insurance companies consider a residential sprinkler system to be a protective device. Other protective devices warranting homeowner's insurance discounts include a monitored fire alarm connected to the sprinkler system (which may range from a 3 to 5% discount based on limited feedback from insurance agents), smoke detector, fire extinguisher, security system, deadbolt locks, and home location in a gated community. The majority of insurance companies place a cap on the maximum discount percentage offered for all protective devices. This cap ranged from 10 to 20% in the survey, with an average protective device discount cap of 14%.

Penalties/Fees as a result of System Leakage

The presence of a residential sprinkler system can raise concern about the risk of accidental water leakage from the system. According to the Insurance Services Office, Inc. (ISO) standard "Homeowners 3—Special Form" policy provides for coverage due to damages from residential fire sprinkler system leakage provided that reasonable care has been taken to maintain heat in the building to prevent freezing of the residential fire sprinkler system. Essentially residential fire sprinkler piping is treated the same as regular household plumbing as far as coverage and pricing for ISO's

standard Homeowners program. Thus, there is no extra charge for the coverage of the peril of fire sprinkler leakage.[7]

This issue was probed in the insurance survey to see if the homeowner's insurance policy typically covers sprinkler system leakage. Insurers interviewed in the study echoed the preceding ISO recommendations. Insurance companies routinely treat sprinkler system piping the same as a plumbing system. Sprinkler system leakage is reported as a loss. Accidental sprinkler system leakage is most likely covered under the homeowner's insurance policy, whereas sprinkler system leakage as a result of a maintenance issue may not be covered by the policy. Claims adjusters determine whether or not sprinkler system leakage is covered under the homeowner's policy, often on a case by case basis.

Document Requirements for Discounts

For those insurance companies offering premium discounts for residential sprinkler systems, many require proof of the system's installation or existence. Methods of providing proof to insurance company underwriters vary among companies. However, the most common include an interior inspection of the home, a copy of the installation certificate and/or receipt, submitting pictures of the actual system, and providing the name of the sprinkler contractor. In some instances, one or more of these may be required by an insurer. In other cases, an insurer may not require any proof at all—the homeowner would simply be required to notify the insurer of the system installation upon application. It is important to note that misrepresentation in the application could put the homeowner in breach and possibly void parts or all of the policy.

Homeowner Awareness of Discounts

Homeowners are often informed of possible insurance savings for sprinklers by their insurance agent. An insurance agent typically gathers fact-finding information about the homeowner and the property in an initial or renewal appointment with the homeowner purchasing insurance. It is common for an insurance agent to ask the homeowner at this time if the property being insured has certain protective devices, including a residential sprinkler system.

[7] Fire Sprinkler System Leakage in ISO Homeowners Policy, Insurance Services Office, 2008.

C. Related Issues Affecting the Magnitude and Availability of Discounts

The level of insurance discount knowledge varied greatly, which was particularly evident in comparing a region where residential sprinkler systems are very common to a region where residential sprinkler systems are not common. This often resulted in varying levels of an agent's familiarity with residential sprinkler systems and the insurance premium discount offered by their insurance company. Insurance agents with modest familiarity with residential sprinkler systems typically referred to the insurance company manual to obtain insurance premium discount information.

In obtaining information on possible penalties as a result of sprinkler system leakage, many agents were unsure of or unfamiliar with such penalties. Agents explained that insurance company underwriters deal with the claims process that would result if a sprinkler system were to accidentally leak.

D. Home Insurance Quotes for a Sample Home

As a separate part of the insurance study to complement the information obtained from the insurance survey, insurance policy quotes were obtained for the nine United States communities and one Canadian community using a theoretical prototype house. For the United States communities, the prototype house was a two-story 2,500 square foot colonial with an unfinished basement and one-car attached garage. Quotes were obtained with and without a sprinkler system in an effort to estimate the discount that may result from having a sprinkler system. Discount savings in dollars ranged from $5 in Huntley, IL to $53 in North Andover, MA, with an average savings of $22. As a percentage from the quoted price without a sprinkler system, savings ranged from 1.14% to 6.68%, with an average of 3.42%.

For the Canadian community, the prototype house was a two-story 2,300 square foot home with crawl space, located in Pitt Meadows, British Columbia. Similar to the United States communities, quotes were obtained with and without a sprinkler system. Discount savings in dollars was $55, and the percentage discount from the quoted price without a sprinkler system was 4.83%.

Community	Actual Residence Value	Quoted Residence Value	Premium without Sprinklers	Premium with Sprinklers (all areas)	Discount Savings($)	Discount Savings (%)
PG County (Bowie), MD	$244,836	$245,000	$970	$919	$51	5.26%
Pleasant View, TN	$223,612	$224,000	$600	$588	$12	2.00%
Matteson, IL	$294,414	$294,000	$455	$443	$12	2.64%
Huntley, IL	$282,051	$282,000	$438	$433	$5	1.14%
San Clemente, CA	$316,172	$316,000	$674	$661	$13	1.93%
Fort Collins, CO	$228,639	$229,000	$411	$404	$7	1.70%
Carroll County (Finksburg), MD	$243,361	$243,000	$519	$485	$34	6.55%
Wilsonville, OR	$274,138	$274,000	$342	$332	$10	2.92%
North Andover, MA	$285,162	$285,000	$794	$741	$53	6.68%
Pitt Meadows, BC	--	$305,000	$1,139	$1,084	$55	4.83%

As noted in the above table, the average discount in all the communities when using a prototype home to get actual bids was less than the percentage range found in the insurance survey. This shows that there is variance in the discount percentage offered which can be best attributed to competitive market pricing.

Appendix A – Sprinkler System Costs by Community

Community and House Plan	Area of Sprinklered Spaces (SF)	Living Space (SF)	TOTAL COST	Local Sprinkler Credit	Net Cost (contractor + additional + credits) in $/SF of Sprinklered SF	Net Cost (contractor + additional + credit) in $/SF of Living Space
Fort Collins, CO - House 1	4,373	4,373	$14,745	0	$3.37	$3.37
Fort Collins, CO - House 2	6,360	6,360	$16,060	0	$2.53	$2.53
Fort Collins, CO - House 3	2,797	2,797	$10,250	0	$3.66	$3.66
Pitt Meadows, BC - House 1	2,342	2,342	$3,090	0	$1.32	$1.32
Pitt Meadows, BC - House 2	2,336	2,336	$2,690	0	$1.15	$1.15
Pitt Meadows, BC - House 3	2,109	2,109	$2,5600	0	$1.21	$1.21
Pleasant View, TN - House 1	2,612	2,112	$2,872	0	$1.10	$1.36
Pleasant View, TN - House 2	2,273	1,723	$2,489	0	$1.10	$1.44
Pleasant View, TN - House 3	3,826	3,326	$4,208	0	$1.10	$1.27
Prince George's County, MD - House 1	3,903	3,903	$4,100	0	$1.05	$1.05
Prince George's County, MD - House 2	4,345	4,345	$4,332	0	$1.00	$1.00
Prince George's County, MD - House 3	6,170	6,170	$5,886	0	$0.95	$0.95
San Clemente, CA - House 1	6,542	3,482	$2,565	0	$0.39	$0.74
San Clemente, CA - House 2	6,329	3,214	$2,386	0	$0.38	$0.74
San Clemente, CA - House 3	6448	3,358	$2,655	0	$0.41	$0.79
Carroll County, MD - House 1	3,131	3,131	$7,499	0	$2.40	$2.40
Carroll County, MD - House 2	4,686	4,686	$9,800	0	$2.09	$2.09
Carroll County, MD - House 3	3,772	3,772	$8,750	0	$2.32	$2.32
Matteson, IL - House 1	4,562	4,562	$8,198	0	$1.80	$1.80
Matteson, IL - House 2	4,740	4,740	$7,407	0	$1.56	$1.56
Matteson, IL - House 3	5,478	5,478	$8,329	0	$1.52	$1.52
North Andover, MA - House 1	3,568	3,084	$4,500	0	$1.26	$1.46
North Andover, MA - House 2	4,632	4,148	$5,800	0	$1.25	$1.40
North Andover, MA - House 3	5,906	5,422	$6,500	0	$1.10	$1.20
Wilsonville, OR - House 1	2,005	2,005	$4,178	($1.21)	$0.87	$0.87
Wilsonville, OR - House 2	1,913	1,913	$4,014	($1.21)	$0.89	$0.89
Wilsonville, OR - House 3	2,917	2,917	$5,892	($1.21)	$0.81	$0.81
Huntley, IL - House 1	3,835	3,400	$8,476	0	$2.21	$2.49
Huntley, IL - House 2	4,575	4,030	$8,851	0	$1.93	$2.20
Huntley, IL - House 3	5,045	4,560	$10,406	0	$2.06	$2.28

U.S. EXPERIENCE WITH SPRINKLERS AND OTHER AUTOMATIC FIRE EXTINGUISHING EQUIPMENT

John R. Hall, Jr.

February 2010

National Fire Protection Association
Fire Analysis and Research Division

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Abstract

Automatic sprinklers are highly effective elements of total system designs for fire protection in buildings. They save lives and property, producing large reductions in the number of deaths per thousand fires, in average direct property damage per fire, and especially in the likelihood of a fire with large loss of life or large property loss. When sprinklers are present in the fire area, they operate in 93% of all reported structure fires large enough to activate sprinklers, excluding buildings under construction. When they operate, they are effective 97% of the time, resulting in a combined performance of operating effectively in 91% of reported fires where sprinklers were present in the fire area and fire was large enough to activate sprinklers. In homes (including apartments), wet-pipe sprinklers operated effectively 96% of the time. When wet-pipe sprinklers are present in structures that are not under construction and excluding cases of failure or ineffectiveness because of a lack of sprinklers in the fire area, the fire death rate per 1,000 reported structure fires is lower by 83% for home fires, where most structure fire deaths occur, and the rate of property damage per reported structure fire is lower by 40-70% for most property uses. In homes (including apartments), wet-pipe sprinklers were associated with a 74% lower average loss per fire. Also, when sprinklers are present in structures that are not under construction and excluding cases of failure or ineffectiveness because of a lack of sprinklers in the fire area, 95% of reported structure fires have flame damage confined to the room of origin compared to 74% when no automatic extinguishing equipment is present. When sprinklers fail to operate, the reason most often given (53% of failures) is shutoff of the system before fire began. (All statistics are based on 2003-2007 fires reported to U.S. fire departments, excluding buildings under construction.)

Keywords: fire sprinklers; fire statistics; automatic extinguishing systems; automatic suppression systems

Acknowledgements

The National Fire Protection Association thanks all the fire departments and state fire authorities who participate in the National Fire Incident Reporting System (NFIRS) and the annual NFPA fire experience survey. These firefighters are the original sources of the detailed data that make this analysis possible. Their contributions allow us to estimate the size of the fire problem. We are also grateful to the U.S. Fire Administration for its work in developing, coordinating and maintaining NFIRS. For more information about the National Fire Protection Association, visit www.nfpa.org or call 617-770-3000. To learn more about the One-Stop Data Shop go to www.nfpa.org/osds or call 617-984-7443.

Copies of this report are available from:

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NFPA No. USS14

Executive Summary

Automatic sprinklers are highly effective and reliable elements of total system designs for fire protection in buildings. In 2003-2007, sprinklers operated in 93% of all reported structure fires large enough to activate sprinklers, excluding buildings under construction and buildings without sprinklers in the fire area. When sprinklers operate, they are effective 97% of the time, resulting in a combined performance of operating effectively in 91% of all reported fires where sprinklers were present in the fire area and fire was large enough to activate them. The combined performance for the more widely used wet pipe sprinklers is 92%, while for dry pipe sprinklers, the combined performance is only 79%. In homes (including apartments), wet-pipe sprinklers operated effectively 96% of the time. By comparison, combined performance is 60% for dry chemical systems, 79% for carbon dioxide systems, 81% for foam systems, and 88% for halogen systems. (Wet chemical systems may be included with dry chemical systems or with other special hazard systems.) These most current statistics are based on 2003-2007 fires reported to U.S. fire departments, excluding buildings under construction and cases of failure or ineffectiveness because of a lack of sprinklers in the fire area and after some recoding between failure and ineffectiveness based on reasons given.

When wet-pipe sprinklers are present in structures that are not under construction and excluding cases of failure or ineffectiveness because of a lack of sprinklers in the fire area, the fire death rate per 1,000 reported home structure fires is lower by 83% and the rate of property damage per reported structure fire is lower by 40-70% for most property uses. In homes (including apartments), wet-pipe sprinklers were associated with a 74% lower average loss per fire. Also, when sprinklers are present in structures that are not under construction and excluding cases of failure or ineffectiveness because of a lack of sprinklers in the fire area, 95% of reported structure fires have flame damage confined to the room of origin compared to 74% when no automatic extinguishing equipment is present.

Of reported 2003-2007 structure fires in health care properties, an estimated 57% showed sprinklers present, with higher percentages for hospitals (71%) and nursing homes (65%) and a much lower percentage for clinics and doctor's offices (28%). Sprinklers were also reported as present in half or more of all reported fires in laboratories (60%), manufacturing facilities (52%), theaters (50%), and prisons and jails (50%). In every other property use, more than half of all reported fires had no sprinklers.

The few surveys that have been done of sprinkler presence in general, not limited to fires, have found that in any property group, the percentage of buildings with sprinklers is much higher than the percentage of reported fires with sprinklers present. Sprinklers apparently are still rare in many of the places where people are most exposed to fire, including educational properties, offices, most stores, and especially homes, where most fire deaths occur. There is considerable potential for expanded use of sprinklers to reduce the loss of life and property to fire.

When sprinklers fail to operate, the reason most often given (53% of failures) was shutoff of the system before fire began, as may occur in the course of routine inspection maintenance. Other leading reasons were inappropriate system for the type of fire (20%), lack of maintenance (15%), and manual intervention that defeated the system (9%). Only 2% of sprinkler failures were attributed to component damage.

When sprinklers operate but are ineffective, the reason usually had to do with an insufficiency of water applied to the fire, either because water did not reach the fire (43% of cases of ineffective performance) or because not enough water was released (31%). Other leading reasons were inappropriate system for the type of fire (12%), manual intervention that defeated the system (5%), and lack of maintenance (4%). Only 4% of cases of sprinkler ineffectiveness were attributed to component damage.

When people are fatally injured in spite of the operation of wet-pipe sprinklers, the victims often had special vulnerabilities that are less often found with fatal victims of home fires in general. For example,

- 93% of fatal victims in home fires with wet-pipe sprinkler operation were located in the area of fire origin, where they could have suffered fatal injuries before sprinkler activation, compared to 53% of fatal home fire victims in general;
- 30% of fatal victims in home fires with wet-pipe sprinkler operation had their clothing on fire, compared to 7% of fatal home fire victims in general;
- 50% of fatal victims in home fires with wet-pipe sprinkler operation were age 65 or older, compared to 28% of fatal home fire victims in general; and
- 37% of fatal victims in home fires with wet-pipe sprinkler operation returned to the fire after escaping, compared to 19% of fatal home fire victims in general.

Table of Contents

List of Tables

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U.S. Experience with Sprinklers

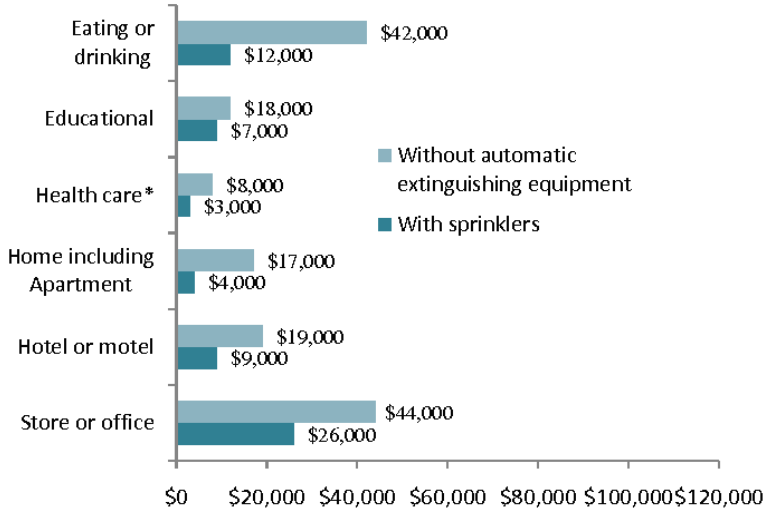
Sprinklers save lives and protect property from fires.

Compared to properties without automatic extinguishing equipment

- The death rate per fire in sprinklered homes is lower by 83%.
- For most property uses, damage per fire is lower by 40-70% in sprinklered properties.

Flame damage was confined to the room of origin in 95% of fires in sprinklered properties vs. 74% in fires with no automatic extinguishing equipment.

Damage per Fire With and Without Sprinklers, 2003-2007



*Health care refers to hospitals, nursing homes, clinics, doctor's offices, and mental retardation facilities.

Sprinklers are reliable and effective.

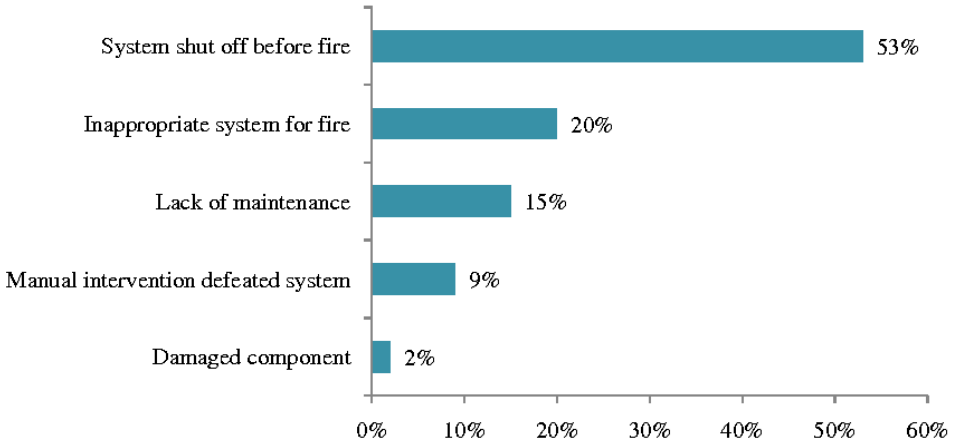
- In reported structure fires large enough to activate them, sprinklers operated in 93% of fires in sprinklered properties.
- Wet pipe sprinklers operated in 95% of these fires vs. 83% for dry pipe sprinklers.
- In reported structure fires large enough to activate them, sprinklers operated and were effective in 91% of fires in sprinklered properties.
- Wet pipe sprinklers operated and were effective in 92% of fires vs. 79% for dry pipe sprinklers.

NOTE: NFPA's Fire Sprinkler Initiative: Bringing Safety Home is a nationwide effort to encourage the use of home fire sprinklers and the adoption of fire sprinkler requirements for new construction. See www.firesprinklerinitiative.org.

Statistics are based on 2003-2007 U.S. reported fires excluding buildings under construction. Sprinklered properties exclude properties with no sprinklers in fire area.

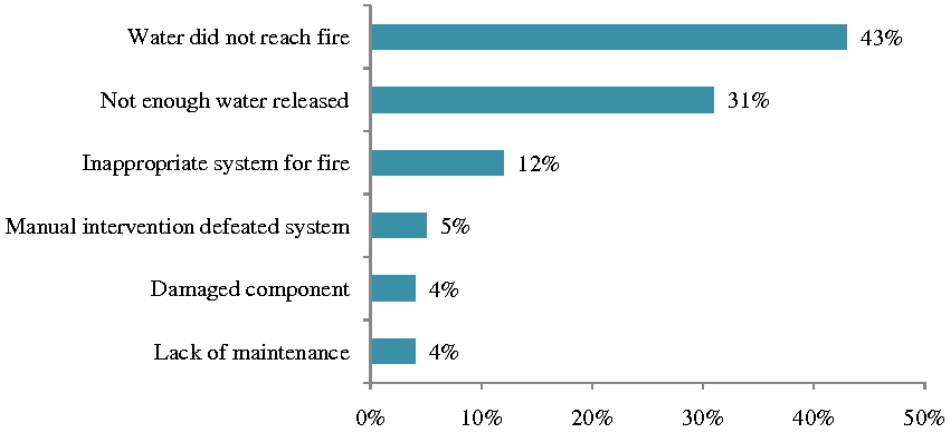
The graph below is based on the 7% of fires in sprinklered properties (roughly 1,000 fires per year) in which the sprinkler should have operated but did not.

Reasons When Sprinklers Fail to Operate
2003-2007



In fires where sprinklers operated, they were effective in 97% of the cases. The graph below is based on the other 3% (roughly 400 fires per year), in which the sprinkler was ineffective.

Reasons When Sprinklers Are Ineffective
2003-2007



Usually only 1 or 2 sprinklers are required to control the fire.

- When wet pipe sprinklers operated, 89% of reported fires involved only 1 or 2 sprinklers.
- For dry pipe sprinklers, 74% involved only 1 or 2 sprinklers.

Statistics are based on 2003-2007 U.S. reported fires excluding buildings under construction. Sprinklered properties exclude properties with no sprinklers in fire area.

U.S. Experience With Sprinklers, 2/10 viii NFPA Fire Analysis And Research, Quincy, MA

Before You Read the Report:
Some Introductory Notes on Incident Coding and Analysis

See Appendix A for general information on the statistical methodology and see Appendix B for a detailed overview of data elements related to automatic extinguishing equipment.

Here are some important points on incident coding and analysis that apply to this report:

Fires excluded from analysis

- Fires in buildings with reported structure status of under construction are excluded. No fire protection systems or features can be expected to perform as designed in a building that is under construction.

- Statistics on reliability, effectiveness, and performance exclude partial systems as identified by reason for failure and ineffectiveness equal to equipment not in area of fire. Not all partial systems will be so identified, and the codes and standards for this equipment do not require coverage in all areas. For example, concealed spaces and exterior locations may not be required to have coverage.

Missing choices and misleading labels when coding presence or type of automatic extinguishing report

- The established generic name of "automatic extinguishing equipment" is misleading, because many if not most such equipment is designed to control fires and not to fully extinguish them.

- There is no code for wet chemical system, which was mandated as the type of non-water-based system to be used in eating and drinking establishments shortly after the coding rules were set for NFIRS Version 5.0, the current version of the U.S. Administration's National Fire Incident Reporting System.[1] Wet chemical systems may be coded as dry chemical systems, foam systems, or other special hazard systems and are probably more common than all of these other systems.

- Fire extinguishers are not automatic equipment and should not be coded but sometimes are reported under any of several types of automatic extinguishing equipment.

- There was no way to code automatic extinquishing equipment as unknown during 1999 to 2003, although there was the option of leaving the field blank. During that period, the U.S. Fire Administration advised that unknowns should be reported as no equipment present.[2] This arrangement had the potential to severely understate the presence of automatic extinguishing equipment. However, the estimates for 2002 and 2003 are not substantially lower than either the pre-1999 estimates or the three years of estimates from 2004 and later. Therefore, this potential problem seems to have had little effect in practice.

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[1] NFIRS compiles fire incident and casualty reports from participating U.S. local fire departments. NFPA's national estimates are based on NFIRS data and estimated totals from the annual NFPA fire experience survey of U.S. fire departments.
[2] U.S. Fire Administration, *NFIRS Coding Questions*, revised January 2, 2002, p.13.

Recoding of sprinkler performance based on reasons for failure or ineffectiveness.
The coding of reasons for failure or ineffectiveness has been used in this analysis to recode system performance entries. Unknown reasons have been proportionally allocated to avoid the dubious alternative assumption that the coded performance is correct if no reason is given for the performance.

If Performance =	Not Effective And Reason =	Then Change to:
	System shut off	Performance = Failed to operate
	Not in area of fire	Presence = No; Performance not applicable

If Performance =	Failed to Operate And Reason =	Then Change to:
	Not enough agent	Performance = Not effective
	Agent didn't reach fire	Performance = Not effective
	Not in area of fire	Presence = No; Performance not applicable

Note that this recoding will not address partial sprinkler systems where there were sprinklers in part or all of the fire area unless the system is ineffective because of fire spread to or from uncovered areas.

Presence of Sprinklers and Other Automatic Extinguishing Equipment

Of reported 2003-2007 structure fires in health care properties, an estimated 57% showed sprinklers present, with higher percentages for hospitals (71%) and nursing homes (65%) and a much lower percentage for clinics and doctor's offices (28%). Sprinklers were also reported as present in half or more of all reported fires in laboratories (60%), manufacturing facilities (52%), theaters (50%), and prisons and jails (50%). In every other property use, more than half of all reported fires had no sprinklers.

In 1994-1998, only 7% of reported structure fires had any type of automatic extinguishing equipment present. By 2003-2007, this percentage had risen by about half, to 10%. Before 1999, the type of automatic extinguishing equipment was not reported, and so it is not possible to show the trend in sprinkler presence. It is possible to show the trend in presence of automatic extinguishing equipment generally and to show how sprinkler presence compares to automatic extinguishing equipment presence in the most recent years. See Table 1 for percentage of reported structure fires, excluding buildings under construction, in which automatic extinguishing equipment was present for the year groups of 1994-1998 and 2003-2007.[3] Table 1 also shows percentage of fires with any type of sprinkler reported present for 2003 to 2007.

The following properties where large numbers of people routinely are present show less than one-third of reported fires in properties with sprinklers present in 2003-2007:

- Every type of public assembly property except theaters
- Educational properties
- Clinics and doctor's offices
- Homes including apartments
- Every type of store or office except department stores

Most fires in storage properties are not in warehouses but are in garages, barns, silos, and small outbuildings. It is these types of buildings that drive the very low percentage of reported fires with automatic extinguishing equipment in all storage properties combined.

In 2003-2007, sprinklers were reported in only 5% of fires in homes (including apartments). Clearly, there is great potential for expanded installation.

The 2007 American Housing Survey included a question about sprinkler presence in homes.[4] The survey indicated 3.9% of occupied year-round housing units had sprinklers. A much smaller percentage of single family homes had sprinklers as compared to multi-unit housing. Sprinklers were present in:

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[3] Some fires after 1999 are coded as confined fires, which are fires confined to cooking vessel, chimney or flue, furnace or boiler, incinerator, commercial compactor, or trash receptacle. Confined fires permit limited reporting with most data fields not required and usually left blank. Confined fires permit limited reporting with most data fields not required and usually left blank. Confined fires combine with very low sprinkler usage to make estimates for one- and two-family dwellings too volatile and uncertain to list separately, and so estimates are provided only for all homes combined

[4] *American Housing Survey 2007*, U.S. Department of Commerce and U.S. Department of Housing and Urban Development, September 2008, Table 1C-4, 2-4, and 2-25.

- 1.5% of single family detached homes,
- 1.9% of single family homes, whether detached or attached,
- 10.6% of all housing units in multi-unit buildings,
- 2.9% of housing units in buildings with 2-4 units,
- 5.8% of housing units in buildings with 5-9 units,
- 12.1% of housing units in buildings with 10-19 units,
- 16.3% of housing units in buildings with 20-49 units, and
- 27.3% of housing units in buildings with 50 or more units.

Sprinklers are installed in 13.0% of housing units in buildings that were constructed no more than four years ago. This is more than triple the percentage for all housing units. No statistics are provided on sprinkler installation specifically in recently constructed single family homes, but detached single-family homes are a larger share of recently built housing units than of total housing units (70% vs. 63%). This strongly suggests that single family homes are part of the recent jump in sprinkler installation.

Sprinkler presence percentages are higher in the West region than in other regions and lower in rural areas than in non-rural areas.

To underscore the principal finding, more than 1 million single family detached dwellings now have fire sprinklers.

The Home Fire Sprinkler Coalition, formed in 1996, developed a variety of educational materials about the benefits of home fire sprinklers. These materials address common questions and misconceptions. They may be accessed through their web site http://www.homefiresprinkler.org.

Because sprinkler systems are so demonstrably effective, they can make a major contribution to fire protection in any property. NFPA 101®, *Life Safety Code*; NFPA 1, *Fire Code*; and NFPA 5000®, *Building Construction and Safety Code*, have required sprinklers in all new one- and two-family dwellings, all nursing homes, and many nightclubs since the 2006 editions. The 2009 edition of the *International Residential Code*, also added requirements for sprinklers in one- and two-family dwellings, effective January 2011. This protection can be expected to increase in areas that adopt and follow these codes. NFPA is supporting adoption of these requirements through its Fire Sprinkler Initiative (see http://www.firesprinkler.initiative.org).

The few surveys that have been done of sprinkler presence in general, not limited to fires, have found that in any property group, the percentage of buildings with sprinklers is much higher than the percentage of reported fires with sprinklers present. Sprinklers apparently are still rare in many of the places where people are most exposed to fire, including educational properties, offices, most stores, and especially homes, where most fire deaths occur. There is considerable potential for expanded use of sprinklers to reduce the loss of life and property to fire.

As with detection/alarm systems and all other fire protection features, in property classes where sprinklers are not required, they will tend to go first into the properties that can afford them most, not the high-risk fire-prone properties that would benefit most from their presence.

Table 1. Presence of Sprinklers and Other Automatic Extinguishing Equipment in Structure Fires, 1994-1998 vs. 2003-2007

Property Use	Number of Structure Fires With Equipment Present and Percentage of Total Structure Fires in Property Use					
	Any Automatic Extinguishing Equipment 1994-1998		Any Automatic Extinguishing Equipment 2003-2007		Any Sprinkler 2003-2007	
All public assembly	4,380	(26%)	7,650	(49%)	3,040	(19%)
Fixed-use amusement place	150	(18%)	170	(29%)	150	(24%)
Variable-use amusement place	140	(16%)	270	(22%)	260	(22%)
Religious property	90	(5%)	280	(15%)	270	(14%)
Library or museum	110	(28%)	190	(28%)	180	(28%)
Eating or drinking establishment	3,240	(29%)	4,730	(58%)	1,380	(17%)
Passenger terminal	60	(35%)	180	(28%)	110	(16%)
Theater	110	(35%)	140	(51%)	140	(50%)
Educational property	1,820	(24%)	2,250	(34%)	2,010	(31%)
Health care property	4,400	(68%)	4,010	(61%)	3,770	(57%)
Nursing home	2,060	(76%)	2,060	(70%)	1,910	(65%)
Hospital	1,650	(74%)	1,210	(77%)	1,110	(71%)
Clinic or doctor's office	70	(29%)	200	(28%)	200	(28%)
Prison or jail	430	(19%)	290	(51%)	290	(50%)
All residential	11,110	(3%)	26,980	(8%)	25,820	(7%)
Home (including apartment)	8,440	(2%)	21,110	(5%)	20,130	(5%)
Hotel or motel	1,690	(35%)	1,900	(48%)	1,790	(45%)
Dormitory or barracks	620	(29%)	1,670	(46%)	1,550	(42%)
Rooming or boarding home	230	(17%)	970	(33%)	950	(32%)
Board and care home	NA	(NA)	900	(43%)	790	(38%)
Store or office	5,230	(21%)	6,090	(30%)	4,660	(23%)
Grocery or convenience store	1,190	(27%)	2,030	(44%)	1,010	(22%)
Laundry or dry cleaning or other professional service	310	(13%)	350	(19%)	340	(18%)
Service station or motor vehicle sales or service	230	(6%)	230	(10%)	170	(7%)
Department store	1,100	(52%)	610	(43%)	560	(39%)
Office	1,470	(25%)	1,210	(32%)	1,170	(31%)
Laboratory	120	(48%)	110	(65%)	100	(60%)
Manufacturing facility	6,400	(50%)	4,070	(57%)	3,740	(52%)
All storage	1,090	(3%)	950	(4%)	920	(4%)
Warehouse excluding cold storage**	740	(22%)	510	(38%)	510	(38%)
All structures	37,100	(7%)	53,940	(10%)	44,310	(9%)

NA – Category not defined in fire incident data prior to 1999.
*Also includes development disability facilities. In 1994-98, this category also includes care of physically inconvenienced and excludes doctor's office and care of aged facilities without nursing staff.
**In 1994-1998, includes general warehouse, textile storage, processed food storage except cold storage and storage of wood, paper, plastics chemicals, and metals.

Notes: These are structure fires reported to U.S. municipal fire departments and so exclude fire reported only to Federal or state agencies or industrial fire brigades. Post-1998 estimates are based only on fires reported in Version 5.0 of NFIRS and include fires reported as confined fires. Estimates are not shown for 1999-2002 because of lower participation in NFIRS Version 5.0 in those years. After 1998, buildings under construction are excluded.
Source: NFIRS and NFPA survey.

Automatic Extinguishing Equipment Type

In reported fires, most automatic extinguishing equipment is recorded as sprinklers, and most sprinklers are wet pipe sprinklers.
Table 2 shows the percentage of non-confined and confined fires, excluding buildings under construction, by type of automatic extinguishing equipment for each of the major property groups and some subgroups.[5] Percentage calculations are based only on fires where automatic extinguishing equipment presence and type were known and reported. In Version 5.0 of NFIRS, if multiple systems are present, the system coded is supposed to be the one system designed to protect the hazard where the fire started.

Some type of sprinklers were present in 82% of 2003-2007 fires where automatic extinguishing equipment was present. Wet pipe sprinklers accounted for 73% of all systems and so out-numbered dry pipe sprinklers by roughly 10-to-1.

The major property class with the largest share for dry pipe sprinklers was storage, where dry pipe sprinklers accounted for 20% of the systems cited. Cold storage was the only property class for which dry pipe sprinklers constituted a majority (in this case, 53%) of systems cited.

For public assembly properties, there was a 40% to 60% split between sprinklers and other types of automatic extinguishing equipment, respectively. Dry chemical systems accounted for 40% of the systems present. Eating or drinking establishments (the dominant part of public assembly) had a 29% to 71% split between sprinkler systems and other types of automatic extinguishing equipment, respectively. Dry chemical systems accounted for 47% of total systems in eating or drinking establishments, compared to a 29% share for all sprinklers combined. Note that wet chemical systems have no clearly identified equipment type category but have been the mandated type of system for eating and drinking establishments for roughly a decade. It seems likely that most of the dry chemical systems reported are either wet chemical systems or dry chemical extinguishers, which should not be reported as any type of automatic equipment.

Public assembly properties, especially eating and drinking establishments, have the highest percentages for both dry chemical systems (40% and 47%, respectively) and other special hazard systems (11% and 12%, respectively), both of which probably are dominated by wet chemical systems, for which there is no labeled category. Roughly ten years ago, the applicable standards for eating and drinking establishments required that dry chemical systems be replaced by wet chemical systems. It seems likely that some wet chemical systems will be coded as other special hazard systems and some will be coded as dry chemical systems, the latter being the well-defined equipment type closest to a wet chemical system.

It would be useful to have a better sense of what kind of equipment is coded as "other special hazard systems." There are some types of automatic extinguishing equipment that do not fit exactly into any of the defined categories, such as equipment using wet chemicals. It is also

[5] Some fires after 1999 are coded as confined fires, which are fires confined to cooking vessel, chimney or flue, furnace or boiler, incinerator, commercial compactor, or trash receptacle. Confined fires permit limited reporting with most data fields not required and usually left blank. Confined fires combine with very low sprinkler usage to make estimates for one- and two-family dwellings too volatile and uncertain to list separately, and so estimates are provided only for all homes combined

possible that some fires will be coded as other special hazard system when they really involved automatic extinguishing equipment of one of the defined types. The category also could be used for some devices that are not automatic and so should not be coded as automatic extinguishing equipment present, such as portable extinguishers.

Some insight into what is being coded under "other special hazard systems" comes from a check of uncoded narratives for the three restaurant fires in recent years in Minnesota where such equipment was reported. (The narratives on these fires were part of a data set provided for a special analysis described on p. 49.) One fire involved a wet chemical system, and another involved an undefined hood system, which could have involved wet or dry chemical agents. The third fire involved use of portable extinguisher and should not have been coded as automatic extinguishing equipment present.

Table 2.
Type of Automatic Extinguishing Equipment Reported as Percentage of All Fires Where Equipment Was Present and of Known Type, by Property Use
2003-2007 Structure Fires Reported to U.S. Fire Departments

Property Use	Fires per year with any automatic extinguishing equipment	All sprinklers	Wet pipe sprinklers	Dry pipe sprinklers	Other sprinklers*
All public assembly	7,650	40%	34%	2%	4%
Fixed-use amusement place	170	85%	82%	3%	1%
Variable-use amusement place	270	97%	84%	13%	0%
Religious property	280	97%	86%	4%	7%
Library or museum	190	99%	92%	5%	2%
Eating or drinking establishment	4,730	29%	23%	2%	4%
Passenger terminal	180	58%	35%	22%	1%
Theater	140	99%	95%	3%	1%
Educational property	2,250	89%	80%	6%	3%
Health care property**	4,010	94%	81%	12%	1%
Nursing home	2,060	93%	78%	15%	1%
Hospital	1,210	92%	85%	6%	1%
Clinic or doctor's office	200	98%	95%	3%	1%
Prison or jail	290	98%	87%	10%	2%
All residential	26,980	96%	87%	7%	2%
Home (including apartment)	21,110	95%	86%	6%	3%
Hotel or motel	1,900	94%	85%	6%	3%
Dormitory or barracks	1,670	93%	77%	14%	1%
Rooming or boarding house	970	98%	88%	11%	0%
Board and care home	900	89%	82%	7%	0%
Store or office	6,090	77%	67%	7%	3%
Grocery or convenience store	2,030	50%	44%	3%	3%
Laundry or dry cleaning or other professional service	350	95%	85%	9%	1%
Service station or motor vehicle sales or service	230	76%	70%	5%	1%
Department store	610	91%	78%	12%	1%
Office	1,210	97%	85%	7%	4%
Laboratory	110	92%	69%	2%	21%
Manufacturing facility	4,070	92%	79%	10%	3%
All storage	950	97%	75%	20%	2%
Warehouse excluding cold storage	510	99%	82%	15%	1%
All structures***	53,940	82%	73%	7%	3%

* Includes deluge and pre-action sprinkler systems and may include sprinklers of unknown or unreported type.
** Nursing home, hospital, clinic, doctor's office, or development disability facility
*** Includes some property uses that are not shown separately.

Note: These are based on structure fires reported to U.S. municipal fire departments in NFIRS Version 5.0 and so exclude fires reported only to Federal or state agencies or industrial fire brigades. Row totals are shown in the leftmost column of percentages, and sums may not equal totals because of rounding error. In Version 5.0 of NFIRS, if multiple systems are present, the system coded is supposed to be the one system designed to protect the hazard where the fire started. This field is not required if the fire did not begin within the designed range of the system. Buildings under construction are excluded.

Source: NFIRS and NFPA survey.

Table 2. (Continued)
Type of Automatic Extinguishing Equipment Reported as Percentage of All Fires Where Equipment Was Present and of Known Type, by Property Use
2003-2007 Structure Fires Reported to U.S. Fire Departments

Property Use	All systems other than sprinklers	Dry chemical system*	Carbon dioxide (CO2) system	Halogen type system*	Foam system	Other special hazard system*
All public assembly	60%	40%	3%	3%	4%	11%
Fixed-use amusement place	15%	14%	0%	0%	0%	1%
Variable-use amusement place	3%	2%	0%	0%	0%	1%
Religious property	3%	2%	0%	0%	0%	1%
Library or museum	1%	1%	0%	0%	0%	0%
Eating or drinking establishment	71%	47%	3%	3%	5%	12%
Passenger terminal	42%	41%	0%	0%	0%	1%
Theater	1%	1%	0%	0%	0%	0%
Educational property	11%	8%	0%	0%	1%	2%
Health care property**	6%	4%	1%	0%	0%	1%
Nursing home	7%	5%	1%	0%	0%	0%
Hospital	8%	5%	0%	0%	0%	3%
Clinic or doctor's office	2%	0%	0%	0%	0%	1%
Prison or jail	2%	1%	0%	0%	0%	0%
All residential	4%	2%	0%	0%	0%	2%
Home (including apartment)	5%	2%	0%	0%	0%	2%
Hotel or motel	6%	2%	0%	0%	0%	4%
Dormitory or barracks	7%	5%	0%	0%	1%	1%
Rooming or boarding home	2%	1%	0%	0%	0%	0%
Board and care home	11%	4%	0%	0%	4%	3%
Store or office	23%	15%	2%	1%	2%	4%
Grocery or convenience store	50%	31%	4%	1%	6%	7%
Laundry or dry cleaning	5%	0%	0%	0%	0%	4%
Service station or motor vehicle sales or service	24%	20%	0%	1%	0%	2%
Department store	9%	8%	0%	0%	0%	0%
Office	3%	1%	1%	0%	0%	0%
Laboratory	8%	2%	4%	1%	0%	1%
Manufacturing facility	8%	2%	4%	0%	0%	1%
All storage	3%	1%	0%	0%	0%	2%
Warehouse excluding cold storage	1%	0%	0%	0%	0%	0%
Cold storage	0%	0%	0%	0%	0%	0%
All structures***	18%	11%	1%	1%	1%	4%

* "Dry chemical system" may include wet chemical systems, because there is no category designated for wet chemical systems. "Halogen type system" includes non-halogenated suppression systems that operate on the same principle. "Other special hazard system" may include automatic extinguishing systems that are known not to be sprinklers but otherwise are of unknown or unreported type.

** Nursing home, hospital, clinic, doctor's office, or development disability facility.

*** Includes some property uses that are not shown separately.

Note: These are based on structure fires reported to U.S. municipal fire departments in NFIRS Version 5.0 and so exclude fires reported only to Federal or state agencies or industrial fire brigades. Row totals are shown in the leftmost column of percentages, and sums may not equal totals because of rounding error. In Version 5.0 of NFIRS, if multiple systems are present, the system coded is supposed to be the one system designed to protect the hazard where the fire started. This field is not required if the fire did not begin within the designed range of the system. Building under construction are excluded.

Source: NFIRS and NFPA survey.

Automatic Extinguishing Equipment Reliability and Effectiveness

In order to estimate the reliability and effectiveness of any type of automatic extinguishing equipment, the database must first be edited to remove fires, buildings, and systems where operation cannot be expected, such as small fires, buildings under construction, and partial installations. Table 3 shows the percentage of non-confined and confined structure fires, excluding buildings under construction and incidents with partial systems not in area of fire, where fires were too small to activate operational automatic extinguishing equipment. Table 3 also shows, for fires large enough to activate equipment, the percentage of fires where equipment operated, the percentage of operating equipment cases where equipment was effective, and the percentage of fires where equipment operated effectively. This is shown for:

- All sprinklers
- Wet pipe sprinklers
- Dry pipe sprinklers
- Dry chemical systems (which probably includes and may be dominated by wet chemical systems and may include some miscoded portable extinguishers),
- Carbon dioxide systems (which may include some wet chemical systems and some miscoded portable extinguishers),
- Foam systems (which may include some wet chemical systems and some miscoded portable extinguishers), and
- Halogen systems (which may include some wet chemical systems and some miscoded portable extinguishers).

Property use classes are shown only if they accounted for at least 100 projected fires per year with the specific type of automatic extinguishing equipment present.

For most property use groups and most types of automatic extinguishing equipment, the majority of reported fires were too small to activate operational equipment.
When automatic extinguishing equipment was present, the percentages of fires too small to activate operating equipment, based on overall reported structure fires, were as follows:

- 65% for all sprinklers,
- 65% for wet pipe sprinklers,
- 70% for dry pipe sprinklers,
- 61% for dry (or possibly wet) chemical systems,
- 43% for carbon dioxide systems,
- 66% for foam systems, and
- 59% for halogen systems.

Sprinklers in the area of fire failed to operate in only 7% of reported structure fires large enough to activate sprinklers.
Failure rates are equal to 100% minus the percentage of systems that operated, which is the percentage shown in Table 3A. The other estimated failure rates corresponding to percentage operating rates shown in Table 3A are:

- 5% for wet pipe sprinklers,

- 17% for dry pipe sprinklers,
- 26% for dry (or possibly wet) chemical systems,
- 17% for carbon dioxide systems,
- 3% for foam systems, and
- 4% for halogen systems.

For major property classes and sprinklers, the estimated failure rates range from a low of 4% for residential properties, public assembly properties and stores and offices to a high of 32% for educational properties and 29% for storage properties. The estimated failure rates for wet pipe sprinklers specifically were 25% for educational properties and 16% for storage properties.

For sprinklers that operated, their performance was deemed effective in 97% of the cases. For all confined or non-confined fires large enough to activate sprinklers, excluding buildings under construction, sprinklers operated effectively 91% of the time.
The percentages of effective operation for all structures were as follows for other types of automatic extinguishing equipment:

- 92% for wet pipe sprinklers,
- 79% for dry pipe sprinklers,
- 60% for dry (or possibly wet) chemical systems,
- 79% for carbon dioxide systems,
- 81% for foam systems, and
- 88% for halogen systems.

Wet pipe sprinklers are both much more reliable than dry pipe sprinklers (95% vs. 83%) and slightly more effective when they operate (98% vs. 95%), resulting in a much higher percentage of effective operation (92% vs. 79%). Operating effectiveness is much lower for dry (or possibly wet) chemical systems than for any other type of automatic extinguishing equipment (60% vs. 79-92%) and is especially low (51%) for eating or drinking establishments, which account for most of the fires reported with this type of equipment. Eating or drinking establishments also account for most fires reported with carbon dioxide, foam, or halogen systems. These installations may all include a high proportion of misclassified wet chemical systems or portable extinguishers, because carbon dioxide, foam, and halogen systems are rarely appropriate for eating or drinking establishments.

A disadvantage of measuring automatic extinguishing equipment effectiveness by judgments made in incident reports is the ambiguity and subjectivity of the criterion of "effective," which has never been precisely defined, let alone supported by an operational assessment protocol that could be executed consistently by different people. Also, confined fires usually have these details unreported, and so their few fires with details reported will be weighted far more heavily, after allocation of unknowns, than will non-confined fires.

The majority of sprinkler failures occurred because the system was shut off.
Table 4 provides the percentages of reasons for failure, after recoding, by type of automatic extinguishing system and property use. Other or unclassified reason for failure is treated as an unknown and allocated.

For all types of sprinklers combined:

- 53% of failures to operate were attributed to the equipment being shut off,
- 20% were because the equipment was inappropriate for the type of fire,
- 15% were because of lack of maintenance,
- 9% were because manual intervention defeated the equipment, and
- 2% were because a component was damaged.

If manual intervention occurs before fire begins, one would expect that to be coded as system shut off before fire. If manual intervention occurs after sprinklers operate, one would expect that to constitute ineffective performance, not failure to operate. What is left is manual intervention after fire begins but before sprinklers operate, but we do not know whether that is the only condition associated with this coding.

Only 2% were because of a failing of the equipment rather than a failing of the people who designed, selected, maintained, and operated the equipment. If these human failings could be eliminated, the overall sprinkler failure rate would drop from the estimated 7% of reported fires to less than 0.2%. That is the kind of sprinkler failure rate reported by Marryatt[6] for Australia and New Zealand, where high standards of maintenance are reportedly commonplace.

Training can sharply reduce the likelihood of three other causes of failure – system defeating due to manual intervention, lack of maintenance, and installation of the wrong system for the hazard.

Most cases of sprinkler ineffectiveness were because water did not reach the fire (43%) or because not enough water was released (31%).
Table 5 provides distributions of reasons for ineffectiveness, by property class and type of automatic extinguishing equipment. In Table 5, two of the reasons for ineffectiveness are (extinguishing) agent did not reach the fire and not enough (extinguishing) agent was released. For sprinklers, the agent is water. In addition to the two reasons cited, other reasons for sprinkler ineffectiveness for all structures were inappropriate equipment for the type of fire (12%), defeating due to manual intervention (5%), damage to a system component (4%), and lack of maintenance (4%).

There are a number of different ways in which water may not reach the fire. One is shielded fires such as rack storage in a property with ceiling sprinklers only. Another is fire spread above exposed sprinklers, through unsprinklered concealed spaces, or via exterior surfaces. Another reason would be a deep-seated fire in bulk storage. A different kind of problem would be droplet sizes that are too small to penetrate the buoyant fire plume and reach the seat of the fire.

Insufficient water can be released if there are problems with the system's water supply. This reason for ineffectiveness can also overlap with other reasons, such as inappropriate equipment (if, for example, the hazard has changed under the equipment and now requires a higher water flow density than is provided by the now inappropriate equipment) and defeating by manual intervention (if, for example, the sprinklers are turned off prematurely so that insufficient water reaches the fire). Insufficient water also could be one of the reasons that could be cited if a flash

[6] H.W. Marryatt, Fire: *A Century of Automatic Sprinkler Protection in Australia and New Zealand*, 1886-1986, 2nd edition, Victoria, Australia: Australian Fire Protection Association, 1988.

fire or a fire with several points of origin overwhelms the system or if an explosion reduces the water flow but does not cause complete system failure.

Reasons for ineffectiveness are different for wet pipe sprinklers and dry pipe sprinklers, with dry pipe sprinklers having 60% of cases attributed to not enough water released compared to 25% for wet pipe sprinklers. Because the design of dry pipe sprinklers assures a delayed release of water, it is not surprising that when such systems are ineffective, an insufficiency of water is usually involved.

Even a well-maintained, complete, appropriate system requires the support of a well-considered integrated design for all the other elements of the building's fire protection. Unsatisfactory sprinkler performance can result from an inadequate water supply or faulty building construction. More broadly, unsatisfactory fire protection performance can occur if the building's design does not address all five elements of an integrated system – slowing the growth of fire, automatic detection, automatic suppression, confining the fire, and occupant evacuation.

Effectiveness should be measured relative to the design objectives for a particular system. For most rooms in most properties, sprinklers are designed to confine fire to the room of origin.

Table A. Non-Confined Fires With Areas of Origin That Could Be Room Larger Than the Sprinkler Design Area for the Space, as Percent of Total Non-Confined and Confined Structure Fires for Buildings Not Under Construction and With Sprinklers in Fire Area Percentage of 2003-2007 Structure Fires Reported to U.S. Fire Departments

Property Use	Large Assembly Area (At Least 100 People)	Sales, Showroom or Performance Area	Storage Room, Area, Tank or Bin	Shipping, Receiving or Loading Area	Unclassified Storage Area	All Areas Combined
Eating or drinking establishment	1.0%	0.2%	1.7%	0.2%	1.2%	4.3%
Public assembly excluding eating or drinking establishment	2.4%	0.7%	0.9%	0.2%	0.8%	5.0%
Educational	1.3%	0.3%	0.6%	0.0%	0.7%	2.9%
Health care property*	0.1%	0.0%	0.5%	0.0%	0.3%	0.9%
Home (including apartment)	0.0%	0.0%	0.2%	0.0%	0.2%	0.4%
Hotel or motel	1.6%	0.0%	0.3%	0.0%	0.5%	1.4%
Store or office	0.1%	5.7%	2.2%	2.1%	2.2%	12.2%
Manufacturing facility	0.1%	0.0%	2.5%	2.1%	1.7%	6.4%
Warehouse excluding cold storage	0.1%	0.3%	5.0%	12.4%	9.9%	27.7%

* Hospital, clinic, doctor's office, nursing home and development disability facility.

Note: Percentages are defined as non-confined fires with indicated area of origin divided by total non-confined and confined fires with any area of origin. Percentages sum left to right and may not equal totals in last column because of rounding. Fires reported as confined fires are excluded from the numerator because such fires could not be large enough to exceed the sprinkler design area. Statistics are based on structure fires reported to U.S. municipal fire departments and so exclude fires reported only to Federal or state agencies or industrial fire brigades. Statistics exclude buildings under construction and fires with sprinklers not in fire area reported as reason for failure or ineffectiveness of automatic extinguishing equipment.

Source: NFIRS and NFPA survey.

Some properties have some very large rooms in which the sprinkler installation is designed to confine fire to a design area that is much smaller than the entire room. These rooms could include large assembly areas; sales, showroom, or performance areas; and storage areas.

Table A shows the percentage of fires, by property use, that begin in five types of rooms that *could* be large enough to have a design area smaller than the entire room. Many of these rooms will not be that large. All these rooms combined do not account for a majority of fires in any type of property, and only warehouses have more than about one-eighth of their fires in such rooms.

Sprinklers are designed to confine a fire to the room of origin or the design fire area, whichever is smaller.
Therefore, the benefits of sprinklers will tend to come in the following scenarios:

- A fire that would otherwise have spread beyond the room of fire origin will be confined to the room of origin, resulting in a smaller fire-damaged area and less property damage.
- A fire that would otherwise have grown larger than the design fire area in a room larger than that area will be confined to the design fire area, resulting in a smaller fire-damaged area and less property damage.
- A fire will be confined to an area smaller than the room or the design fire area, even though that degree of success goes beyond the performance assured by the design, resulting in a smaller fire-damaged area and less property damage.

Table 6 provides direct measurement of sprinkler effect involving the first scenario. For all structures combined, 74% have flame damage confined to room of origin when there is no automatic extinguishing equipment present. This rises to 95% of fires with flame damage confined to room of origin when any type of sprinkler is present.

As noted, for most rooms in most properties, effective performance is indicated by confinement of fire to the room of origin. For the few rooms where the design area is smaller than the room, a sprinkler system can be ineffective in terms of confining fire to the design area but still be successful in confining fire to the larger room of origin. Therefore, one might expect the percentage of fires with flame confined to room of origin to be slightly larger than the combined performance (operating effectively) for any given property use. Table B shows this is usually the case.

Dry pipe sprinklers tend to have more sprinklers operating than wet pipe sprinklers.
Table 7A shows the number of sprinklers operating by type of sprinkler system. Five or fewer heads operated in 97% of the wet pipe system activations and 89% of the dry pipe system activations.

Dry-pipe systems are much more likely to open more than one sprinkler than wet pipe systems (39% vs. 23% of fires). The likely reason is the designed time delay in tripping the dry pipe valve and passing water through the piping to the opened sprinklers. The delay permits fire to spread, which can mean a larger fire, requiring and causing more sprinklers to activate.

**Table B. Combined Sprinkler Performance vs.
Sprinkler Success in Confining Fire to Room of Origin, by Property Use Group
2003-2007 Structure Fires Reported to U.S. Fire Departments Where Sprinklers Were Present in Fire Area,
Fire Was Large Enough to Activate Sprinklers, and Building Was Not Under Construction**

Property Use	Percentage of Fires Where Sprinklers Operated Effectively (from Table 3A)	Percentage of Fires with Flame Damage Confined to Room of Origin
Public assembly	90%	95%
Eating or drinking establishment	90%	93%
Educational	68%	98%
Health care property*	87%	99%
Residential	95%	96%
Home (including apartment)	94%	97%
Hotel or motel	91%	97%
Dormitory or barracks	99%	97%
Store or office	94%	93%
Grocery or convenience store	94%	96%
Laundry or dry cleaning or other professional supply or service	92%	92%
Service station or motor vehicle sales or service	92%	85%
Department store	95%	92%
Office building	95%	94%
Manufacturing facility	86%	87%
Storage	77%	80%
Warehouse excluding cold storage	77%	79%
All structures**	91%	95%

* Nursing home, hospital, clinic, doctor's office, or development disability facility.

** Includes some properties not separately listed above.

Wet pipe sprinkler systems tend to have more sprinklers operating in fires in manufacturing facilities or warehouses than in other properties.

Table 7B shows the number of wet pipe sprinklers operating by property use group. In warehouses or manufacturing facilities respectively, 69-70% of the fires in properties where wet pipe sprinklers operated had two or fewer sprinklers operating, which means 30-31% of the fires in properties had at least three sprinklers operating. Similarly, 89-90% had five or fewer sprinklers operating, which means 10-11% had at least six sprinklers operating. By contrast, in public assembly properties and stores and offices where wet pipe sprinklers operated, 87-90% of fires in properties had two or fewer sprinklers operating, which means only 10-13% of fires in properties had at least three sprinklers operating. Similarly, 95-96% had five or fewer sprinklers operating, which means only 4-5% had at least six sprinklers operating.

In homes (including apartments), 97% of fires in properties had two or fewer sprinklers operating.

Effectiveness declines when more sprinklers operate.
When more than 1-2 sprinklers have to operate, this may be taken as an indication of less than ideal performance. Table 8 shows that the percentage of fires where performance is deemed effective decreases as the number of wet pipe sprinklers operating decreases, falling from 97% of fires when one sprinkler opens to 79% when more than 10 sprinklers open. At the same time, the number of sprinklers operating should not be used as an independent indicator of effectiveness because sprinklers are deemed effective in most fires where sprinklers operate, no matter how many sprinklers operate. Furthermore, most sprinkler installations are designed for control, not extinguishment, and anticipate that multiple sprinklers will be needed for control in some fire scenarios.

Table C. Reasons for Failure or Ineffectiveness as Percentages of All Cases of Failure or Ineffectiveness, for All Structures and All Sprinklers

Reason	Failure		Ineffectiveness		Combined	
System shut off	521	(38%)	0	(0%)	521	(38%)
Wrong type of (inappropriate) system for type of fire	197	(14%)	47	(3%)	244	(18%)
Water discharged but did not reach fire	0	(0%)	169	(12%)	169	(12%)
Lack of maintenance	148	(11%)	16	(1%)	163	(12%)
Not enough water discharged	0	(0%)	121	(9%)	121	(9%)
Manual interruption defeated system	89	(7%)	20	(1%)	108	(8%)
System component damaged	20	(1%)	16	(1%)	35	(3%)
Total	974	(72%)	388	(28%)	1,362	(100%)

Source: Based on Tables 4A and 5A.

Details on reasons for failure or ineffectiveness and how to address them.
The following potential reasons for failure or ineffectiveness are defined in the statistical database:

- System shut off (a reason for failure but not for ineffectiveness),
- Wrong type of (inappropriate) system for the type of fire,
- Agent discharged but did not reach fire (a reason for ineffectiveness but not for failure),
- Lack of maintenance [including corrosion or heads painted],
- Not enough agent discharged (a reason for ineffectiveness but not for failure),
- Manual intervention [defeated the system] (8%)
- System component damaged,
- Fire not in area protected [by the system] (excluded from analysis of failure and ineffectiveness)

NFPA has compiled published incidents (see Appendix D) that illustrate the different types of reasons for sprinkler failure or ineffectiveness, and NFPA 25, *Standard for the Inspection, Testing, and Maintenance of Water-Based Fire Protection Systems*, describes procedures to

address most of these reasons that involve maintenance of an existing sprinkler system. An exception is systems designed to NFPA 13D (the home sprinkler standard), for which maintenance, inspection, and testing requirements are much fewer, reflecting the greater inherent reliability of the simpler design, and are included in the NFPA 13D standard. When the reasons involve a need to modify the sprinkler system, procedures to trigger those changes are found in NFPA 1, *Fire Code*, and NFPA 1620, *Standard for Pre-Incident Planning*.

System shut off

The NFPA incident compilation includes cases of systems shut off because of building status (e.g., vacant, being remodeled, still under construction) and cases of systems shut off because of system problems (e.g., leak in system, dirt in water supply for both building and system, damage from earlier forklift collision). NFPA 25 addresses all these circumstances under rules for dealing with impairments (Chapter 14). When the system is shut off or otherwise impaired, NFPA 25 requires use of a tag to provide a visible reminder that the system is out of service, close oversight of the schedule and steps required to correct the impairment, and appropriate practices to assure safety in the building while the impairment exists. NFPA 25 also addresses valve supervision using a tamper switch connected to a central alarm monitoring system.

Inappropriate system

Statistically, this is the second leading reason for failure or ineffectiveness, after system shut off.

"Inappropriate" system can refer to the wrong type of agent (e.g., water vs. chemical agent or carbon dioxide), the wrong type of system for the same agent (e.g., wet pipe vs. dry pipe), or the wrong design for the same system and agent (e.g., a design adequate only for Class I commodities vs. a design adequate for any class of commodities). The NFPA compilation identifies cases where the system was inadequate for the hazard or where the fire overwhelmed the system with no further details available.

The NFPA 13, NFPA 13D and NFPA 13R standards for installation of automatic extinguishing equipment provide detailed requirements for selecting the right agent, the right system, and the right design, but this is all relative to conditions at the initial installation. The need for a change in system design can be identified during routine, periodic inspections in support of the local fire code or pre-incident planning. Section 13.3.3 of NFPA 1 requires the property owner or occupant to maintain the design level of performance and protection of the sprinkler system and to evaluate the adequacy of the installed system if there are any changes in occupancy, use, process, or materials. NFPA 1620 requires periodic review, testing, updating and refinement of the pre-incident plan. NFPA 1620 also states that a mismatch of sprinkler system with type or arrangement of protected commodities is a sprinkler system design deficiency that should be noted on the pre-incident plan.

Agent did not reach fire

A number of conditions can result in this problem, but the most obvious one is a shielded fire. An incident identified in the NFPA compilation involved a convention center where a covering,

operating like a temporary ceiling, blocked the sprinklers from reaching the fire. Shielding can also occur if fire grows under furniture (as in a residential property or an office) or under equipment (as in a manufacturing facility) or in the lower portions of an array of objects (as in a store or warehouse).

An engineered solution to the problem is to place sprinklers under the shielding, as with in-rack sprinklers. The other principal alternative is to avoid arrangements where shielding and blocking are likely to occur. The periodic inspections needed to identify shielding and blocking situations and to correct such problems if discovered can be conducted as part of fire code inspections (e.g., in support of NFPA 1) or pre-incident planning (e.g., in accord with NFPA 1620.)

Lack of maintenance

The NFPA compilation identifies an incident where a sprinkler was coated with cotton dust in a textile manufacturing plant and an incident where sediment built up in the system. NFPA 13 and NFPA 25 include requirements for special protection in settings or during activities with a high vulnerability to accumulation of dust, paint, or other substances, and NFPA 25 uses inspections to detect such accumulations when they occur.

Not enough agent discharged

The NFPA incident compilation identifies several cases of fire overwhelming the sprinklers, but for most of these incidents, it was not reported whether the sprinkler system had problems affecting the flow or whether the system design was no longer adequate for the hazard being protected or whether some other problem was involved.

NFPA 25 uses inspections and testing to address all sources of problems affecting water flow or delivered density, including standpipes, hose systems, fire service mains, fire pumps, and water storage tanks. If the problem is a system no longer appropriate for the hazard below it, NFPA 1 and NFPA 1620 are relevant, as discussed above under "inappropriate system".

NFPA 25 also provides a procedure for periodic investigation of pipes for obstructions (Chapter 13). Such obstructions can reduce water flow and result in a problem of not enough agent discharged.

Manual intervention

NFPA standards for specific occupancies or for fire service operations provide guidance for fire protection and firefighting in a sprinklered building. These rules address the best use of fire suppression equipment in combination with fire sprinklers and the need to confirm that fire conditions no longer pose a threat before shutting off sprinklers.

System component damaged

In the NFPA compilation of incidents of failure or ineffectiveness, the incidents involving component damage consist entirely of fires where automatic extinguishing equipment was

damaged by explosions or by ceiling, roof, or building collapse, nearly always as a consequence of fire. System component damage is the least frequently cited reason for sprinkler failure or ineffectiveness, which is consistent with the idea that the components are very reliable, absent a severe external cause like an explosion. Explosions are more severe than the design fires considered by NFPA 13, NFPA 13D, and NFPA 13R. NFPA 25 uses inspections and tests to detect less severe component damage.

Fire not in area protected

Under fire incident coding rules, automatic extinguishing equipment is deemed to be present in a building only if it is present in the area of fire. Therefore, fires are removed from the operationality and effectiveness analysis in the report if equipment was deemed to have failed or been ineffective because of fire outside area protected.

However, some areas may be unprotected even in a system that is described as having complete coverage. NFPA 13 has provisions for sprinkler protection of concealed spaces and exterior locations, but coverage of these areas is required only in certain defined situations. The NFPA compilation includes several incidents involving partial coverage by any definition but also several incidents where coverage was described as complete but was not provided for areas of fire origin or of early fire growth in concealed or void spaces, on balconies or other outside locations, or above sprinklers in manufacturing or storage facilities.

Table D. Leading Areas of Origin for Fires in One- or Two-Family Homes Excluding Buildings Under Construction 2003-2007 Structure Fires Reported to U.S. Fire Departments

Area of Origin	Percent of Fires Where Wet-Pipe Sprinklers Were Present But Not Present in Fire Area	Percent of All Fires
Kitchen	32%	32%
Wall assembly or concealed space	9%	3%
Attic or concealed space above top story	8%	3%
Crawl space or substructure space	6%	2%
Garage**	6%	3%
Exterior balcony or unenclosed porch	5%	2%
Courtyard, terrace or patio	5%	1%
Laundry room or area	4%	4%
Exterior wall surface	4%	3%
Other area of origin	21%	47%
Total	100%	100%

* These are only fires where the absence of sprinklers in the fire area was identified because that absence was cited as a reason for failure or ineffectiveness.

** Excludes garages coded as separate building.

Source: NFIRS and NFPA survey.

This long-standing dilemma over how to describe a lack of coverage in concealed spaces and exterior locations has become more complicated with the emergence of specialized installation standards, such as NFPA 13D and NFPA 13R, that also exempt certain rooms from coverage.

Table D shows the leading areas of fire origin for one- and two-family home fires coded as sprinklers present but failed or ineffective because of no sprinkler in the fire area. In other words, sprinklers were present somewhere in the home but not in the area of origin. Percentage shares for all these areas of origin for one- and two-family home fires, regardless of sprinkler status, are also included for comparison.

One-third of fires with no sprinklers in the fire area were fires that began in the kitchen, an area that should be covered by sprinklers in any standard installation. However, concealed spaces and other structural areas, external areas, garages, and attics account for nearly half (43%) of the fires where sprinklers are present but not in the fire area. These same areas accounted for less than one-fifth (18%) of fires in dwellings in general.

Table 3.
Automatic Extinguishing Equipment Reliability and Effectiveness, by Property Use
2003-2007 Structure Fires

A. All Sprinklers

			When equipment is present, fire is large enough to activate equipment, and sprinklers were present in fire area			
Property Use	**Number of fires per year where extinguishing equipment was present**	**Percent of fires too small to activate equipment**	**Number of fires per year**	**Percent where equipment operated (A)**	**Percent effective of those that operated (B)**	**Percent where equipment operated effectively (A x B)**
All public assembly	3,040	68%	910	96%	94%	90%
Eating or drinking establishment	1,380	54%	580	97%	93%	90%
Educational property	2,010	83%	320	68%	100%	68%
Health care property*	3,770	83%	620	88%	98%	87%
Nursing home	1,910	80%	380	83%	99%	82%
Residential	25,820	66%	8,440	96%	99%	95%
Home (including apartment	20,130	62%	7,290	95%	99%	94%
Hotel or motel	1,790	69%	520	92%	99%	91%
Dormitory or barracks	1,550	81%	290	99%	100%	99%
Rooming or boarding house	950	82%	150	97%	99%	96%
Board and care home	790	85%	110	98%	100%	98%
Store or office	4,660	64%	1,580	96%	99%	94%
Grocery or convenience store	1,010	64%	340	97%	97%	94%
Laundry or dry cleaning	340	59%	130	96%	96%	92%
Service station or motor vehicle sales or service	170	40%	100	97%	95%	92%
Department store	560	68%	170	95%	99%	95%
Office	1,170	75%	280	95%	100%	95%
Manufacturing facility	3,740	48%	1,850	93%	93%	86%
All storage	920	48%	470	79%	97%	77%
Warehouse excluding cold storage	510	43%	280	80%	97%	77%
All structures**	44,310	65%	14,630	93%	97%	91%

* Nursing home, hospital, clinic, doctor's office, or development disability facility.
** Includes some properties not listed separately above.

Note: These are percentages of fires reported to U.S. municipal fire departments and so exclude fires reported only to Federal or state agencies or industrial fire brigades. In Version 5.0 of NFIRS, if multiple systems are present, the system coded is supposed to be the one system designed to protect the hazard where the fire started. This field is not required if the fire did not begin within the designed range of the system. Buildings under construction are excluded. Percentages are based on estimated total fires reported in NFIRS Version 5.0 with the indicated type of automatic extinguishing system and system performance not coded as fire too small to activate systems. Fires are excluded if the reason for failure or ineffectiveness is system not present in area of fire. Fires are recoded from operated but ineffective to fail if the reason for failure or ineffectiveness was system shut off. Fires are recoded from failed to operated but ineffective if the reason for failure or ineffectiveness was not enough agent or agent did not reach fire. Property use classes are shown only if they accounted for at least 100 projected fires per year with the specific type of automatic extinguishing equipment present.

Source: NFIRS and NFPA survey.

Table 3. (Continued)
Automatic Extinguishing Equipment Reliability and Effectiveness, by Property Use
2003-2007 Structure Fires

B. Wet Pipe Sprinklers Only

Property Use	Number of fires per year where extinguishing equipment was present	Percent of fires too small to activate equipment	When equipment is present, fire is large enough to activate equipment, and sprinklers were present in fire area: Number of fires per year	Percent where equipment operated (A)	Percent effective of those that operated (B)	Percent where equipment operated effectively (A x B)
All public assembly	2,570	70%	730	97%	97%	94%
Eating or drinking establishment	1,110	57%	460	97%	97%	94%
Educational property	1,800	85%	250	75%	100%	75%
Health care property*	3,270	83%	520	90%	99%	89%
Nursing home	1,600	81%	300	85%	99%	84%
Residential	23,370	64%	7,920	96%	100%	96%
Home (including apartment	18,220	61%	6,840	96%	99%	96%
Hotel or motel	1,620	70%	470	88%	99%	87%
Dormitory or barracks	1,290	77%	290	99%	100%	99%
Rooming or boarding home	850	79%	150	97%	99%	96%
Store or office	4,070	64%	1,390	96%	99%	95%
Grocery or convenience store	880	64%	300	97%	97%	95%
Laundry or dry cleaning	300	57%	130	96%	96%	92%
Service station or motor vehicle sales or service	160	40%	90	97%	95%	92%
Department store	480	69%	140	95%	99%	94%
Office	1,030	74%	260	96%	99%	96%
Manufacturing facility	3,210	49%	1,540	96%	92%	89%
All storage	710	48%	360	84%	98%	82%
Warehouse excluding cold storage	420	45%	230	85%	97%	83%
All structures**	39,110	65%	13,000	95%	98%	92%

* Nursing home, hospital, clinic, doctor's office, or development disability facility.
** Includes some properties not listed separately above.

Note: These are percentages of fires reported to U.S. municipal fire departments and so exclude fires reported only to Federal or state agencies or industrial fire brigades. In Version 5.0 of NFIRS, if multiple systems are present, the system coded is supposed to be the one system designed to protect the hazard where the fire started. This field is not required if the fire did not begin within the designed range of the system. Buildings under construction are excluded. Percentages are based on estimated total fires reported in NFIRS Version 5.0 with the indicated type of automatic extinguishing system and system performance not coded as fire too small to activate systems. Fires are excluded if the reason for failure or ineffectiveness is system not present in area of fire. Fires are recoded from operated but ineffective to fail if the reason for failure or ineffectiveness was system shut off. Fires are recoded from failed to operated but ineffective if the reason for failure or ineffectiveness was not enough agent or agent did not reach fire. Property use classes are shown only if they accounted for at least 100 projected fires per year with the specific type of automatic extinguishing equipment present.

Source: NFIRS and NFPA survey.

Table 3. (Continued)
Automatic Extinguishing Equipment Reliability and Effectiveness, by Property Use
2003-2007 Structure Fires

C. Dry Pipe Sprinklers Only

			When equipment is present, fire is large enough to activate equipment, and sprinklers were present in fire area			
Property Use	**Number of fires per year where extinguishing equipment was present**	**Percent of fires too small to activate equipment**	**Number of fires per year**	**Percent where equipment operated (A)**	**Percent effective of those that operated (B)**	**Percent where equipment operated effectively (A x B)**
All public assembly	190	60%	70	94%	76%	71%
Eating or drinking establishment	90	46%	40	100%	69%	69%
Residential	1,880	82%	320	92%	98%	90%
Home (including apartment)	1,350	81%	250	89%	98%	88%
Store or office	420	65%	140	91%	99%	90%
Manufacturing facility	410	45%	210	90%	95%	86%
All storage	190	49%	90	57%	97%	55%
Warehouse excluding cold storage	80	26%	60	43%	96%	41%
All structures*	3,810	70%	1,100	83%	95%	79%

* Includes some properties not listed separately above.

Note: These are percentages of fires reported to U.S. municipal fire departments and so exclude fires reported only to federal or state agencies or industrial fire brigades. In Version 5.0 of NFIRS, if multiple systems are present, the system coded is supposed to be the one system designed to protect the hazard where the fire started. This field is not required if the fire did not begin within the designed range of the system. Buildings under construction are excluded. Percentages are based on estimated total fires reported in NFIRS Version 5.0 with the indicated type of automatic extinguishing system and system performance not coded as fire too small to activate systems. Fires are excluded if the reason for failure or ineffectiveness is system not present in area of fire. Fires are recoded from operated but ineffective to failed if the reason for failure or ineffectiveness was system shut off. Fires are recoded from failed to operated but ineffective if the reason for failure or ineffectiveness was not enough agent or agent did not reach fire. Property use classes are shown only if they accounted for at least 100 projected fires per year with the specific type of automatic extinguishing equipment present.

Source: NFIRS and NFPA survey.

Table 3. (Continued)
Automatic Extinguishing Equipment Reliability and Effectiveness, by Property Use
2003-2007 Structure Fires

D. Dry Chemical Systems Only

			When equipment is present, fire is large enough to activate equipment, and sprinklers were present in fire area			
Property Use	**Number of fires per year where extinguishing equipment was present**	**Percent of fires too small to activate equipment**	**Number of fires per year**	**Percent where equipment operated (A)**	**Percent effective of those that operated (B)**	**Percent where equipment operated effectively (A x B)**
All public assembly	3,060	63%	1,020	69%	75%	51%
Eating or drinking establishment	2,230	63%	730	68%	75%	51%
Residential	570	50%	300	94%	95%	89%
Store or office	890	56%	330	82%	75%	61%
Grocery or convenience store	630	66%	170	92%	73%	67%
All structures*	5,930	61%	2,060	74%	81%	60%

* Includes some properties not listed above.

Note: "Dry chemical systems" may include some wet chemical systems, because there is no category designated for wet chemical systems. These are percentages of fires reported to U.S. municipal fire departments and so exclude fires reported only to Federal or state agencies or industrial fire brigades. In Version 5.0 of NFIRS, if multiple systems are present, the system coded is supposed to be the one system designed to protect the hazard where the fire started. This field is not required if the fire did not begin within the designed range of the system. Buildings under construction are excluded. Percentages are based on estimated total fires reported in NFIRS Version 5.0 with the indicated type of automatic extinguishing system and system performance not coded as fire too small to activate systems. Fires are excluded if the reason for failure or ineffectiveness is system not present in area of fire. Fires are recoded from operated but ineffective to fail if the reason for failure or ineffectiveness was system shut off. Fires are recoded from failed to operated but ineffective if the reason for failure or ineffectiveness was not enough agent or agent did not reach fire. Property use classes are shown only if they accounted for at least 100 projected fires per year with the specific type of automatic extinguishing equipment present.

Source: NFIRS and NFPA survey.

Table 3. (Continued)
Automatic Extinguishing Equipment Reliability, by Property Use
2003-2007 Structure Fires

E. Carbon Dioxide Systems Only

Property Use	Number of fires per year where extinguishing equipment was present	Percent of fires too small to activate equipment	When equipment is present, fire is large enough to activate equipment, and sprinklers were present in fire area: Number of fires per year	Percent where equipment operated (A)	Percent effective of those that operated (B)	Percent where equipment operated effectively (A x B)
All public assembly	220	50%	100	37%	93%	34%
Eating or drinking establishment	160	52%	70	39%	91%	35%
Manufacturing facility	180	3%	160	99%	93%	93%
All structures*	710	43%	360	83%	94%	79%

F. Foam Systems Only

Property Use	Number of fires per year where extinguishing equipment was present	Percent of fires too small to activate equipment	When equipment is present, fire is large enough to activate equipment, and sprinklers were present in fire area: Number of fires per year	Percent where equipment operated (A)	Percent effective of those that operated (B)	Percent where equipment operated effectively (A x B)
All public assembly	320	66%	70	96%	69%	66%
Eating or drinking establishment	230	63%	50	95%	69%	66%
All structures*	670	66%	160	97%	84%	81%

* Includes some properties not listed separately above.

Note: These are percentages of fires reported to U.S. municipal fire departments and so exclude fires reported only to Federal or state agencies or industrial fire brigades. In Version 5.0 of NFIRS, if multiple systems are present, the system coded is supposed to be the one system designed to protect the hazard where the fire started. This field is not required if the fire did not begin within the designed range of the system. Buildings under construction are excluded. Percentages are based on estimated total fires reported in NFIRS Version 5.0 with the indicated type of automatic extinguishing system and system performance not coded as fire too small to activate systems. Fires are excluded if the reason for failure or ineffectiveness is system not present in area of fire. Fires are recoded from operated but ineffective to fail if the reason for failure or ineffectiveness was system shut off. Fires are recoded from failed to operated but ineffective if the reason for failure or ineffectiveness was not enough agent or agent did not reach fire. Property use classes are shown only if they accounted for at least 100 projected fires per year with the specific type of automatic extinguishing equipment present.

Source: NFIRS and NFPA survey.

Table 3. (Continued)
Automatic Extinguishing Equipment Reliability, by Property Use
2003-2007 Structure Fires

G. Halogen Systems Only

Property Use	Number of fires per year where extinguishing equipment was present	Percent of fires too small to activate equipment	When equipment is present, fire is large enough to activate equipment, and sprinklers were present in fire area: Number of fires per year	Percent where equipment operated (A)	Percent effective of those that operated (B)	Percent where equipment operated effectively (A x B)
All public assembly	210	65%	50	100%	93%	93%
Eating or drinking establishment	150	65%	40	100%	91%	91%
All structures*	380	59%	110	96%	92%	88%

* Includes some properties not listed separately above.

Note: These are percentages of fires reported to U.S. municipal fire departments and so exclude fires reported only to Federal or state agencies or industrial fire brigades. In Version 5.0 of NFIRS, if multiple systems are present, the system coded is supposed to be the one system designed to protect the hazard where the fire started. This field is not required if the fire did not begin within the designed range of the system. Buildings under construction are excluded. Percentages are based on estimated total fires reported in NFIRS Version 5.0 with the indicated type of automatic extinguishing system and system performance not coded as fire too small to activate systems. Fires are excluded if the reason for failure or ineffectiveness is system not present in area of fire. Fires are recoded from operated but ineffective to fail if the reason for failure or ineffectiveness was system shut off. Fires are recoded from failed to operated but ineffective if the reason for failure or ineffectiveness was not enough agent or agent did not reach fire. Property use classes are shown only if they accounted for at least 100 projected fires per year with the specific type of automatic extinguishing equipment present.

Source: NFIRS and NFPA survey.

Table 4.
Reasons for Failure to Operate When Fire Was Large Enough to Activate Equipment and Equipment Was Present in Area of Fire, by Property Use
Based on Indicated Estimated Number of 2003-2007 Structure Fires per Year

A. All Sprinklers

Property Use	System shut off	Inappropriate system for type of fire	Lack of maintenance	Manual intervention defeated system	System component damaged	Total fires per year
All public assembly	61%	6%	9%	21%	3%	32
Eating or drinking establishment	60%	0%	17%	23%	0%	17
Residential	35%	43%	3%	16%	2%	377
Home (including apartment)	46%	34%	2%	14%	5%	357
Store or office	64%	7%	17%	10%	1%	70
Manufacturing facility	62%	4%	13%	18%	4%	123
Storage	83%	2%	4%	5%	5%	96
All structures*	53%	20%	15%	9%	2%	974

* Includes some properties not listed separately above.

Note: Percentages are based on structure fires reported in NFIRS Version 5.0 to U.S. municipal fire departments and so exclude fires reported only to Federal or state agencies or industrial fire brigades. Figures reflect recodings explained in Introduction: Fires are excluded if the reason for failure or ineffectiveness is system not present in area of fire, unclassified or unknown. Fires are recoded from operated but ineffective to failed if the reason for failure or ineffectiveness was system shut off. Fires are recoded from failed to operated but ineffective if the reason for failure or ineffectiveness was not enough agent or agent did not reach fire. In Version 5.0 of NFIRS, if multiple systems are present, the system coded is supposed to be the one system designed to protect the hazard where the fire started. This field is not required if the fire did not begin within the designed range of the system. Buildings under construction are excluded. Property use groups are shown only if there were at least 10 fires per year involving failure to operate and 10 fires per year involving operation not effective.

Source: NFIRS and NFPA survey.

Table 4. (Continued)
Reasons for Failure to Operate When Fire Was Large Enough to Activate Equipment and Equipment Was Present in Area of Fire, by Property Use
2003-2007 Non-Confined and Confined Structure Fires

B. Wet Pipe Sprinklers Only

Property Use	System shut off	Inappropriate system for type of fire	Lack of maintenance	Manual intervention defeated system	System component damaged	Total fires per year
Public assembly	67%	4%	8%	20%	0%	23
Eating or drinking establishment	67%	0%	13%	20%	0%	14
Residential	43%	30%	4%	21%	2%	297
Home (including apartment)	57%	18%	3%	19%	5%	264
Store or office	70%	5%	8%	17%	0%	54
Manufacturing facility	57%	7%	11%	19%	6%	60
All structures*	52%	17%	10%	18%	2%	704

C. Dry Pipe Sprinklers Only

Property Use	System shut off	Inappropriate system for type of fire	Lack of maintenance	Manual intervention defeated system	System component damaged	Total fires per year
All structures	65%	19%	5%	6%	5%	185

* Includes some properties not listed separately above.

Note: Percentages are based on structure fires reported in NFIRS Version 5.0 to U.S. municipal fire departments and so exclude fires reported only to Federal or state agencies or industrial fire brigades. Figures reflect recodings explained in Introduction: Fires are excluded if the reason for failure or ineffectiveness is system not present in area of fire, unclassified or unknown. Fires are recoded from operated but ineffective to failed if the reason for failure or ineffectiveness was system shut off. Fires are recoded from failed to operated but ineffective if the reason for failure or ineffectiveness was not enough agent or agent did not reach fire. In Version 5.0 of NFIRS, if multiple systems are present, the system coded is supposed to be the one system designed to protect the hazard where the fire started. This field is not required if the fire did not begin within the designed range of the system. Buildings under construction are excluded. Property use groups are shown only if there were at least 10 fires per year involving failure to operate and 10 fires per year involving operation not effective.

Source: NFIRS and NFPA survey.

Table 4. (Continued)
Reasons for Failure to Operate When Fire Was Large Enough to Activate Equipment and Equipment Was Present in Area of Fire, by Property Use
Based on Indicated Estimated Number of 2003-2007 Structure Fires per Year

D. Dry Chemical Systems Only

Property Use	System shut off	Inappropriate system for type of fire	Lack of maintenance	Manual intervention defeated system	System component damaged	Total fires per year
Public assembly	13%	2%	80%	3%	1%	320
Eating or drinking establishment	14%	2%	78%	5%	1%	235
Residential	0%	0%	100%	0%	0%	14
Store or office	5%	5%	79%	4%	7%	59
Grocery or convenience store	9%	20%	22%	18%	32%	13
All structures*	11%	2%	76%	10%	2%	542

E. Carbon Dioxide Systems Only

Property Use	System shut off	Inappropriate system for type of fire	Lack of maintenance	Manual intervention defeated system	System component damaged	Total fires per year
All structures	4%	0%	90%	0%	6%	60

* Includes some properties not listed above.

Note: Percentages are based on structure fires reported in NFIRS Version 5.0 to U.S. municipal fire departments and so exclude fires reported only to Federal or state agencies or industrial fire brigades. Figures reflect recodings explained in Introduction: Fires are excluded if the reason for failure or ineffectiveness is system not present in area of fire, unclassified or unknown. Fires are recoded from operated but ineffective to failed if the reason for failure or ineffectiveness was system shut off. Fires are recoded from failed to operated but ineffective if the reason for failure or ineffectiveness was not enough agent or agent did not reach fire. In Version 5.0 of NFIRS, if multiple systems are present, the system coded is supposed to be the one system designed to protect the hazard where the fire started. This field is not required if the fire did not begin within the designed range of the system. Buildings under construction are excluded. Property use groups are shown only if there were at least 10 fires per year involving failure to operate and 10 fires per year involving operation not effective.

Source: NFIRS and NFPA survey.

Table 5.
Reasons for Ineffectiveness When Fire Was Large Enough to Activate Equipment and Equipment Was Present in Area of Fire, by Property Use
Based on Indicated Estimated Number of 2003-2007 Structure Fires per Year

A. All Sprinklers

Property Use	Agent did not reach fire	Not enough agent released	Inappropriate system for type of fire	Manual intervention defeated system	System component damaged	Lack of maintenance	Fires per year
All public assembly	45%	48%	4%	3%	0%	0%	55
Eating or drinking establishment	49%	46%	5%	0%	0%	0%	41
Residential	31%	12%	21%	4%	16%	15%	54
Home (including apartment)	35%	8%	14%	2%	23%	16%	50
Store or office	50%	16%	10%	16%	0%	8%	20
Manufacturing facility	46%	35%	4%	9%	1%	5%	127
Storage	38%	13%	0%	25%	24%	0%	12
All structures*	43%	31%	12%	5%	4%	4%	388

* Includes some properties not listed separately above.

Note: Percentages are based on structure fires reported in NFIRS Version 5.0 to U.S. municipal fire departments and so exclude fires reported only to Federal or state agencies or industrial fire brigades. Figures reflect recodings explained in Introduction: Fires are excluded if the reason for failure or ineffectiveness is system not present in area of fire. Fires are recoded from operated but ineffective to failed if the reason for failure or ineffectiveness was system shut off. Fires are recoded from failed to operated but ineffective if the reason for failure or ineffectiveness was not enough agent or agent did not reach fire. In Version 5.0 of NFIRS, if multiple systems are present, the system coded is supposed to be the one system designed to protect the hazard where the fire started. This field is not required if the fire did not begin within the designed range of the system. Buildings under construction are excluded. Property use groups are shown only if there were at least 10 fires per year involving failure to operate and 10 fires per year involving operation not effective.

Source: NFIRS and NFPA survey.

Table 5. (Continued)
Reasons for Ineffectiveness When Fire Was Large Enough to Activate Equipment and Equipment Was Present in Area of Fire, by Property Use
Based on Indicated Estimated Number of 2003-2007 Structure Fires per Year

B. Wet Pipe Sprinklers Only

Property Use	Agent did not reach fire	Not enough agent released	Inappropriate system for type of fire	Manual intervention defeated system	System component damaged	Lack of maintenance	Total fires per year
Public assembly	60%	20%	11%	9%	0%	0%	18
Eating or drinking establishment	62%	24%	14%	0%	0%	0%	13
Residential	39%	4%	22%	4%	20%	9%	48
Home (including apartment)	39%	3%	14%	3%	26%	15%	43
Store or office	55%	10%	14%	21%	0%	0%	15
Manufacturing facility	49%	33%	5%	9%	0%	4%	114
All structures*	47%	25%	15%	6%	4%	3%	303

C. Dry Pipe Sprinklers Only

Property Use	Agent did not reach fire	Not enough agent released	Inappropriate system for type of fire	Manual intervention defeated system	System component damaged	Lack of maintenance	Total fires per year
All structures	16%	60%	3%	3%	3%	14%	45

* Includes some properties not listed above.

Note: Percentages are based on structure fires reported in NFIRS Version 5.0 to U.S. municipal fire departments and so exclude fires reported only to Federal or state agencies or industrial fire brigades. Figures reflect recodings explained in Introduction: Fires are excluded if the reason for failure or ineffectiveness is system not present in area of fire. Fires are recoded from operated but ineffective to failed if the reason for failure or ineffectiveness was system shut off. Fires are recoded from failed to operated but ineffective if the reason for failure or ineffectiveness was not enough agent or agent did not reach fire. In Version 5.0 of NFIRS, if multiple systems are present, the system coded is supposed to be the one system designed to protect the hazard where the fire started. This field is not required if the fire did not begin within the designed range of the system. Buildings under construction are excluded. Property use groups are shown only if there were at least 10 fires per year involving failure to operate and 10 fires per year involving operation not effective.

Source: NFIRS and NFPA survey.

Table 5. (Continued)
Reasons for Ineffectiveness When Fire Was Large Enough to Activate Equipment and Equipment Was Present in Area of Fire, by Property Use
Based on Indicated Estimated Number of 2003-2007 Structure Fires per Year

D. Dry Chemical Systems Only

Property Use	Agent did not reach fire	Not enough agent released	Inappropriate system for type of fire	Manual intervention defeated system	System component damaged	Lack of maintenance	Total fires per year
Public assembly	72%	19%	2%	2%	0%	5%	178
Eating or drinking establishment	72%	19%	2%	2%	0%	4%	122
Residential	21%	69%	0%	10%	0%	0%	17
Store or office	44%	45%	6%	0%	2%	3%	68
Grocery or convenience store	81%	10%	10%	0%	0%	0%	43
All structures*	57%	34%	2%	2%	0%	3%	291

E. Carbon Dioxide Systems Only

Property Use	Agent did not reach fire	Not enough agent released	Inappropriate system for type of fire	Manual intervention defeated system	System component damaged	Lack of maintenance	Total fires per year
All structures	49%	51%	0%	0%	0%	0%	17

* Includes some properties not listed separately above.

Note: Percentages are based on structure fires reported in NFIRS Version 5.0 to U.S. municipal fire departments and so exclude fires reported only to Federal or state agencies or industrial fire brigades. Figures reflect recodings explained in Introduction: Fires are excluded if the reason for failure or ineffectiveness is system not present in area of fire, unclassified or unknown. Fires are recoded from operated but ineffective to failed if the reason for failure or ineffectiveness was system shut off. Fires are recoded from failed to operated but ineffective if the reason for failure or ineffectiveness was not enough agent or agent did not reach fire. In Version 5.0 of NFIRS, if multiple systems are present, the system coded is supposed to be the one system designed to protect the hazard where the fire started. This field is not required if the fire did not begin within the designed range of the system. Buildings under construction are excluded. Property use groups are shown only if there were at least 10 fires per year involving failure to operate and 10 fires per year involving operation not effective.

Source: NFIRS and NFPA survey.

Table 6.
Extent of Flame Damage,
for Sprinklers Present vs. Automatic Extinguishing Equipment Absent
2003-2007 Structure Fires

Property Use	Percentage of fires confined to room of origin excluding structures under construction and sprinklers not in fire area: With no automatic extinguishing equipment	With sprinklers of any type
Public assembly	77%	95%
Fixed-use amusement or recreation place	74%	96%
Variable-use amusement or recreation place	84%	97%
Religious property	74%	96%
Library or museum	85%	97%
Eating or drinking establishment	76%	93%
Educational	90%	98%
Health care property*	92%	99%
Residential	76%	96%
Home (including apartment)	76%	97%
Hotel or motel	87%	97%
Dormitory or barracks	94%	97%
Store or office	71%	93%
Grocery or convenience store	77%	96%
Laundry or dry cleaning or other professional supply or service	81%	92%
Service station or motor vehicle sales or service	62%	85%
Department store	75%	92%
Office building	77%	94%
Manufacturing facility	69%	87%
Storage	32%	80%
Warehouse excluding cold storage	50%	79%
All structures**	74%	95%

* Nursing home, hospital, clinic, doctor's office, or development disability facility.
** Includes some properties not listed separately above.

Note: Percentages are based on structure fires reported in NFIRS Version 5.0 to U.S. municipal fire departments and so exclude fires reported only to Federal or state agencies or industrial fire brigades. Calculations exclude fires with unknown or unreported extent of flame damage. In Version 5.0 of NFIRS, if multiple systems are present, the system coded is supposed to be the one system designed to protect the hazard where the fire started. This field is not required if the fire did not begin within the designed range of the system.

Source: NFIRS and NFPA survey.

Table 7.
Number of Sprinklers Operating
2003-2007 Structure Fires

A. By Type of Sprinkler

Number of Sprinklers Operating	Percentage of structure fires where that many sprinklers operated: Wet pipe	Dry pipe	Other type sprinkler	All sprinklers
1	77%	61%	39%	75%
2 or fewer	89%	74%	53%	87%
3 or fewer	92%	79%	65%	91%
4 or fewer	95%	86%	88%	94%
5 or fewer	97%	89%	90%	96%
6 or fewer	98%	90%	95%	97%
7 or fewer	98%	90%	96%	97%
8 or fewer	98%	90%	96%	98%
9 or fewer	98%	90%	96%	98%
10 or fewer	99%	92%	98%	98%
20 or fewer	99%	96%	99%	99%

Note: Percentages are based on structure fires reported in NFIRS Version 5.0 to U.S. municipal fire departments and so exclude fires reported only to Federal or state agencies or industrial fire brigades. Percentages are based on fires where sprinklers were reported present and operating and there was reported information on number of sprinklers operating. Figures reflect recodings explained in Introduction: Fires are excluded if the reason for failure or ineffectiveness is system not present in area of fire. Fires are recoded from operated but ineffective to failed if the reason for failure or ineffectiveness was system shut off. Fires are recoded from failed to operated but ineffective if the reason for failure or ineffectiveness was not enough agent or agent did not reach fire. In Version 5.0 of NFIRS, if multiple systems are present, the system coded is supposed to be the one system designed to protect the hazard where the fire started. This field is not required if the fire did not begin within the designed range of the system. Buildings under construction are excluded.

Source: NFIRS and NFPA survey.

Table 7. (Continued)
Number of Sprinklers Operating
2003-2007 Structure Fires

B. Wet Pipe Sprinklers, by Property Use Group

Number of Sprinklers Operating	Percentage of structure fires where that many wet pipe sprinklers operated					
	Public assembly	Home	Hotel or motel	Store or office	Manufacturing facility	Warehouse excluding cold storage
1	72%	90%	87%	67%	49%	47%
2 or fewer	90%	97%	94%	87%	69%	70%
3 or fewer	92%	98%	96%	91%	79%	76%
4 or fewer	95%	99%	99%	94%	86%	78%
5 or fewer	96%	99%	100%	95%	89%	90%
6 or fewer	97%	99%	100%	97%	92%	93%
7 or fewer	97%	99%	100%	97%	93%	94%
8 or fewer	99%	100%	100%	97%	94%	94%
9 or fewer	99%	100%	100%	98%	94%	95%
10 or fewer	99%	100%	100%	98%	96%	95%
20 or fewer	100%	100%	100%	98%	98%	97%

Note: Percentages are based on structure fires reported in NFIRS Version 5.0 to U.S. municipal fire departments and so exclude fires reported only to Federal or state agencies or industrial fire brigades. Percentages are based on fires where sprinklers were reported present and operating and there was reported information on number of sprinklers operating. Figures reflect recodings explained in Introduction: Fires are excluded if the reason for failure or ineffectiveness is system not present in area of fire. Fires are recoded from operated but ineffective to failed if the reason for failure or ineffectiveness was system shut off. Fires are recoded from failed to operated but ineffective if the reason for failure or ineffectiveness was not enough agent or agent did not reach fire. In Version 5.0 of NFIRS, if multiple systems are present, the system coded is supposed to be the one system designed to protect the hazard where the fire started. This field is not required if the fire did not begin within the designed range of the system. Buildings under construction are excluded.

Source: NFIRS and NFPA survey.

Table 8.
Sprinkler Effectiveness Related to
Number of Sprinklers Operating
2003-2007 Structure Fires

	Percent of structure fires where sprinklers are effective			
		Wet pipe sprinklers		
Number of Sprinklers Operating	All sprinklers All structures	All structures	Manufacturing facility	Warehouse excluding cold storage
1	97%	98%	93%	95%
2	94%	96%	93%	100%
3 to 5	91%	93%	92%	99%
6 to 10	87%	86%	85%	88%
More than 10	79%	74%	75%	90%
Total	96%	96%	91%	96%

Note: Percentages are based on structure fires reported in NFIRS Version 5.0 to U.S. municipal fire departments and so exclude fires reported only to Federal or state agencies or industrial fire brigades. Percentages are based on fires where sprinklers were reported present and operating and there was reported information on number of sprinklers operating. Figures reflect recodings explained in Introduction: Fires are excluded if the reason for failure or ineffectiveness is system not present in area of fire. Fires are recoded from operated but ineffective to failed if the reason for failure or ineffectiveness was system shut off. Fires are recoded from failed to operated but ineffective if the reason for failure or ineffectiveness was not enough agent or agent did not reach fire. In Version 5.0 of NFIRS, if multiple systems are present, the system coded is supposed to be the one system designed to protect the hazard where the fire started. This field is not required if the fire did not begin within the designed range of the system. Buildings under construction are excluded.

Source: NFIRS and NFPA survey.

Automatic Extinguishing Equipment Impact

A number of approaches can be and have been used to quantify the impact and value of sprinklers and other automatic extinguishing systems. These approaches may be grouped into the following three types:

- Reduction in life loss per fire or property loss per fire;
- Reduction in the likelihood of large fire size or severity, such as fire spread beyond room of origin, multiple deaths, or large property loss; and
- Qualitative judgments as "effective" or "satisfactory" by fire investigators or others completing incident reports, already discussed in the previous section.

Sprinkler Reduction in Loss of Life in Fire

For 2003-2007 home fires, the death rate per 100 fires was 83% lower with wet pipe sprinklers than with no automatic extinguishing equipment.
Table 9 shows fire death rate reductions for various property use groups. Only the statistics for homes (including apartments) are based on enough fatal fires, both with and without sprinklers, for reasonable confidence in the results. Even the home fire statistics are volatile because of the influence of confined fires, where details on sprinkler presence and performance are not required and rarely provided.

Manufacturing facilities show a small reduction in an already low death rate, while warehouses show no reduction. Warehouses illustrate the statistical problem of analyzing impact when there are very few fatal fires. Total fire deaths in sprinklered warehouses in 2003-2007 are estimated from projections based on only four fatal incidents. The most severe was an explosion in a fireworks warehouse that killed three people. When an initial explosion precedes the fire, sprinklers cannot save people even if the explosion does not knock out the sprinklers, as can easily happen. The second most severe was an intentional fire using flammable liquids as accelerants. That fire killed two people, and there were few details. In particular, we cannot tell from the coded records whether either or both of the victims might have been the arsonists, killed early in the fire before sprinklers could activate, or whether the area of origin – an unclassified storage area – might have been outside the range of the sprinklers, which if true should have excluded the incident as no sprinklers in initial fire area. The third fatal fire was in a building under major renovation. The analysis excludes buildings under construction, but buildings under major renovation can present the same challenge to fire protection, depending on the scale of the renovation and the location of the fire origin. The fourth fatal fire was a three-story facility, with a fourth level below grade, storing agricultural products, which suggests the possibility of a dust explosion. A total of 75 sprinklers opened but sprinklers were said to have failed to operate due to manual intervention; this indicates some confusion on incident details or how to code them.

The factors that make fatal injury possible even when sprinklers are present and operate would include the following, including those shown in Table 10:

1. Victims whose actions or lack of action add to their risk by prolonging their exposure to fire conditions, such as victims who (a) act irrationally; (b) return back into the building after safely escaping; (c) are unable to act to save themselves, such as people who are bedridden or under restraint; or (d) are engaged in firefighting or rescue;

2. Victims of fires that are beyond the design limits of the system, such as fires that were (a) so close that the victim is deemed "intimate with ignition" (a victim condition no longer shown in the data but most closely approximated by "victim in area of fire origin"; they constituted 93% of fatal victims when sprinklers operated vs. 53% of total victims, in Table 10); (b) very fast, such as explosions or flash fires; or (c) outside the sprinkler-protected area, such as fires originating on exterior areas of the building; and

3. Victims who are or may be unusually vulnerable to fire effects, such as (a) older adults, age 65 or older (who constituted 50% of fatal victims when sprinklers operated vs. 28% of total victims, in Table 10), or (b) people who are in poor health before fire begins.

Absent these conditions, NFPA has no record of a fire killing 3 or more people in a completely sprinklered building where the system was properly operating.
Appendix C lists fires after 1970 with three or more deaths in a completely sprinklered building where the system was properly operating and the fire began in the sprinkler-protected interior of the building. Each is marked by the condition that accounted for the large life loss, either explosion or flash fire, which is the most common condition, or firefighting.

The statement says it excludes systems that were not "properly operating." Nearly all the systems that were present in multiple-death fires but not properly operating have been systems damaged by explosions. An exception, where poor installation or maintenance was involved, was a 1990 Alabama board and care facility fire where the water supply was insufficient to support the sprinklers.

The 2010 edition of NFPA 13 adds a clarifying sentence to the scope section of the standards: "This standard is written with the assumption that the sprinkler system shall be designed to protect against a single fire originating within the building."

There are dangers in statements that rely on all-or-nothing statistics. Until 1981, NFPA had no record of a fatal fire involving *any* number of deaths in fully sprinklered hotels or motels. In fact, though, sprinklers cannot be expected to exclude all deaths under these circumstances.

Sprinkler Reduction in Loss of Property in Fire

For most property uses, the property damage rate per reported structure fire is 40-70% lower than in properties with no automatic extinguishing equipment when wet pipe sprinklers are present in structures that are not under construction, after excluding cases of failure or ineffectiveness because of a lack of sprinklers in the fire area.
Table 11 shows smaller reductions for manufacturing facilities (22%) and warehouses (7%).

Estimates exclude a reported $100 million loss in one California single family home fire, which appears to be a badly miscoded fire loss, based on other available details on the property.

The warehouse situation is a fairer indication of the limitations of sprinklers but also of the limitations of these statistical comparisons. Roughly half of the 2003-2007 estimate of total direct property damage in warehouses with wet pipe sprinklers, excluding buildings under construction and sprinklers not in fire area, comes from projections from six fires, each involving $5.2-$8.5 million in direct property damage. All six incidents are also included in NFPA's Fire Incident Data Organization (FIDO) database, which provides some additional details not included in NFIRS. Between the NFIRS coding and the FIDO data, we can say that in two of the six fires, sprinklers failed to operate because they had been shut off before fire began. Another two fires showed sprinklers operating effectively to contain and control fire, but high loss still resulting because of the inaccessible location of the fire, either inside rack storage where the racks blocked sprinklers or deep seated in palletized storage, where the stored goods blocked sprinklers. Of the other two fires, one was in a facility with no recent maintenance and an impaired sprinkler system. The other involved a large fire load and, according to news accounts, water problems that delayed firefighting operations for roughly an hour. This last incident also involved by far the largest warehouse of the six, with a footprint of 600,000 square feet in a 4-story building.

Focusing on the first two incidents, Table 3B showed that warehouses excluding cold storage have a lower operational percentage than nearly all other property uses – operation in 85% of fires where sprinklers were present in fire area and fire was large enough to activate equipment, compared to 95% for all structures combined. While not shown in Table 4B because there were too few incidents of ineffective operation to display, the reasons for sprinkler failure in warehouses excluding cold storage were dominated by system shut off, which accounted for 90% of failures.

With respect to the last four incidents, there is reason to believe that sprinklers are more common in warehouses that are larger and have higher values per square foot. It takes a substantial warehouse to permit a fire location too deep in storage to be reached by sprinklers that are operating effectively to contain fire, and the last incident involved a warehouse with 2.4 million square feet. This can mean that the average loss per fire in a sprinklered warehouse will not be a good estimate of the predicted average loss per fire if sprinklers were added to the unsprinklered warehouses, as our calculations implicitly assume. The use of average loss in unsprinklered warehouses as a proxy for average loss in sprinklered warehouses in the absence of sprinklers, as is done in this analysis, will produce a misleadingly low baseline for comparison and so a misleadingly low estimated reduction.

Generalizing from the warehouse analysis and the long-standing NFPA statement about sprinkler effectiveness in preventing catastrophic multiple death fires, one can say that *sprinklers cannot be expected to prevent large loss if the large loss was attributable to partial coverage, explosion or flash fire, system shutoff, or the loss of the system before or early in the fire to collapse or collision.* However, there are other circumstances that also can lead to a large loss:

- Sprinkler design may not be appropriate to the hazard being protected. In the simplest form, the contents may be capable of supporting a larger, more intense fire than the sprinkler system can handle. The problem may be insufficient sprinkler density or insufficient water flow, which in turn may reflect the system's design, its age and maintenance, or its supporting water supply. Unlike explosions and flash fires, fire loads can be addressed by appropriate design, installation, maintenance, and operation. And although the effectiveness statement could be phrased to require a fully code-compliant installation, fire incident reports rarely have enough detail to confirm code compliance, and large property-loss fires are less likely than large life-loss fires to receive the detailed fire investigations that could confirm such details.

- The nature or configuration of contents may be sufficient to create a large loss even when sprinkler performance is deemed successful. Some bulk goods can shield a deep-seated fire from sprinklers. Rack storage may shield fires from ceiling sprinklers, although in-rack sprinklers should be sufficient to address such problems. High-piled stock may block sprinklers or even permit fire spread on the tops of contents above the sprinklers. And some areas – such as clean rooms – have contents so sensitive and valuable that even a small fire can produce a large financial loss.

- A fire with a sufficient number of different points of origin can overwhelm any sprinkler system. This could also be an exception to the life-saving effectiveness statement, although it has not been found to be the deciding factor in any multiple-death fire to date. It has been the deciding factor for at least one large-loss fire. Multiple points of origin can occur deliberately in an arson fire, but they can occur unintentionally or naturally, as when an outside fire spreads to numerous entry points in and on a building.

Table 9.
Estimated Reduction in Civilian Deaths per Thousand Fires
Associated With Wet Pipe Sprinklers, by Property Use
2003-2007 Structure Fires

Property Use	Without automatic extinguishing equipment	With wet pipe sprinklers	Percent reduction
All public assembly	0.6*	0.0	100%
Eating or drinking establishment	0.5*	0.0	100%
Educational	0.0	0.0	NA
Health care property**	4.6	1.3	72%
Residential	7.7	1.5	80%
Home (including apartment)	7.8	1.3	83%
Hotel or motel	4.3	0.9	79%
Dormitory or barracks	3.0	0.5	83%
Rooming or boarding house	7.8	1.6	80%
Board and care home	7.5	2.4	68%
Store or office	0.9	0.2	75%
Manufacturing facility	1.0	0.7	25%
Warehouse excluding cold storage	1.2	9.8	No reduction

NA – Not applicable because both death rates are estimated as zero.

* The Station nightclub fire is not included in the NFIRS database. If it were, the estimates for public assembly without automatic extinguishing equipment and for eating or drinking establishments without automatic extinguishing equipment would be much higher.

**Nursing home, hospital, clinic, doctor's office, or development disability facility.

Note: These are national estimates of structure fires reported to U.S. municipal fire departments, based on fires reported in NFIRS Version 5.0, and so exclude fires reported only to Federal or state agencies or industrial fire brigades. Figures exclude fires with sprinkler status unknown or unreported, partial sprinkler systems not in fire area, and structures under construction; and reflect recodings explained in Introduction: Fires are excluded if the reason for failure or ineffectiveness is system not present in area of fire. Fires are recoded from operated but ineffective to failed if the reason for failure or ineffectiveness was system shut off. Fires are recoded from failed to operated but ineffective if the reason for failure or ineffectiveness was not enough agent or agent did not reach fire. In Version 5.0 of NFIRS, if multiple systems are present, the system coded is supposed to be the one system designed to protect the hazard where the fire started. This field is not required if the fire did not begin within the designed range of the system.

Source: NFIRS and NFPA survey.

Table 10.
Characteristics of Fatal Victims
When Wet Pipe Sprinklers Operate vs. All Conditions
2003-2007 Structure Fires

	Percent of fire fatalities	
Victim Characteristic	**When wet pipe sprinklers operate, excluding sprinklers not in fire area**	**No automatic extinguishing equipment**
Victim in area of fire origin, whether or not involved in fire origin	93%	53%
Clothing on fire, whether or not while escaping	30%	7%
Victim age 65 or older	50%	28%
Victim returned to fire, unable to act, or acted irrationally	37%	19%

Note: Percentages are based on structure fires reported in NFIRS Version 5.0 to U.S. municipal fire departments and so exclude fire reported only to Federal or state agencies or industrial fire brigades. In Version 5.0 of NFIRS, if multiple systems are present, the system coded is supposed to be the one system designed to protect the hazard where the fire started. This field is not required if the fire did not begin within the designed range of the system. Buildings under construction are excluded.

Source: NFIRS and NFPA survey.

Table 11.
Estimated Reduction in Average Direct Property Damage per Fire Associated With Wet Pipe Sprinklers, by Property Use
2003-2007 Structure Fires

Property Use	Without automatic extinguishing equipment	With wet pipe sprinklers	Percent reduction
All public assembly	$37,000	$16,000	56%
Eating or drinking establishment	$42,000	$12,000	71%
Educational	$18,000	$7,000	63%
Health care property*	$8,000	$3,000	63%
Residential	$16,000	$5,000	68%
Home (including apartment)	$17,000	$4,000	74%
Hotel or motel	$19,000	$9,000	54%
Dormitory or barracks	$6,000	$1,000	81%
Rooming or boarding house	$15,000	$8,000	50%
Board and care home	$5,000	$2,000	54%
Store or office	$44,000	$26,000	40%
Manufacturing	$76,000	$59,000	22%
Warehouse excluding cold storage	$101,000	$95,000	7%

*Nursing home, hospital, clinic, doctor's office, or development disability facility.

Note: These are national estimates of structure fires reported to U.S. municipal fire departments, based on fires reported in NFIRS Version 5.0, and so exclude fires reported only to Federal or state agencies or industrial fire brigades. Figures exclude fires with sprinkler status unknown or unreported, partial sprinkler systems not in fire area, and structures under construction; and reflect recodings explained in Introduction: Fires are excluded if the reason for failure or ineffectiveness is system not present in area of fire. Fires are recoded from operated but ineffective to failed if the reason for failure or ineffectiveness was system shut off. Fires are recoded from failed to operated but ineffective if the reason for failure or ineffectiveness was not enough agent or agent did not reach fire. Direct property damage is estimated to the nearest thousand dollars and has not been adjusted for inflation. In Version 5.0 of NFIRS, if multiple systems are present, the system coded is supposed to be the one system designed to protect the hazard where the fire started. This field is not required if the fire did not begin within the designed range of the system.

Source: NFIRS and NFPA survey.

Other Issues

Much of the resistance to wider use of sprinklers stems from a cluster of concerns that are not so much issues as myths. Most Americans have had little contact with sprinkler systems outside of their portrayal in movies and television shows, where sprinklers all too often are portrayed inaccurately. For instance, activation by common heat sources, activation of all sprinklers if any one is activated, even drowning or swimming in the water released by sprinklers, all have been portrayed in film versions of sprinkler activation.

Water Damage from Sprinklers in the Absence of Fire

Sprinkler systems can release water in the absence of fire, but the best available evidence indicates that this is a small source of loss compared to fire losses. For home sprinklers in particular, the threat from non-fire water damage is negligible.

Sprinkler systems are carefully designed to activate early in a real fire but not to activate in a non-fire situation. Each sprinkler reacts only to the fire conditions in its area. Water release in a fire is generally much less than would occur if the fire department had to suppress the fire, because later action means more fire, which means more water is needed. According to a 15-year study done in Scottsdale, Arizona, on average, a fire sprinkler will use 25 gallons of water per minute to control a home fire as compared to the estimated 250 gallons used by firefighters.[7]

Unintentional release of water in a non-fire activation of a sprinkler appears to be less likely and much less damaging, according to the best available evidence, than is unintentional water release involving other parts of a building's plumbing and water supply, which tend to be both more frequent and more costly per incident.[8] Maryatt's study of sprinklers in Australia and New Zealand found water damage from non-fire accidental discharges added only 25% to the fire losses suffered by sprinklered buildings.[9] If sprinklers reduced average fire loss by only 20%, then combined fire and water damage in fire and non-fire incidents would be unchanged. (A 20% reduction means the sprinklered fire loss is 80% of the unsprinklered fire loss. Adding 25% for water damage adds 25% of 80%, which is 20%. 80%+20%=100%.) As previously noted, however, sprinklers reduce average fire loss by much more than 20%.

Another set of estimates based on recent U.S. experience can be developed from more recent data on water damage from sprinkler systems in the absence of fire. These estimates generally agree with the earlier estimates cited above.

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[7] Home Fire Sprinkler Coalition, *Automatic Sprinklers, A 15-Year Study, Scottsdale, Arizona*, available at http://www.homefiresprinkler.org/hfsc.html.

[8] Walter W. Maybee, "a Brief History of fire Protection in the United States, Atomic Energy Commission, 1947-1975", paper presented to the NFPA Fall Meeting, 1978. Paper is not limited to or focused on power plants and like facilities.

[9] H.W. Maryatt, Fire: *A Century of Automatic Sprinkler Protection in Australia and New Zealand, 1886-1986*, 2nd edition, Victoria, Australia: Australian Fire Protection Association, 1988, p. 435.

Table E. Non-Fire Sprinkler Activations by Major Property Use Group, 2003

Property Use	Reported incidents	
Commercial properties (public assembly, stores and offices)	15,900	(36%)
Manufacturing facilities	6,800	(15%)
Homes (one- or two-family dwellings, apartments)	4,700	(11%)
Warehouses excluding cold storage	4,100	(9%)
Other property use groups	12,500	(28%)
Total	44,000	(100%)

Note: Projections from NFIRS to national estimates are based on non-fire emergency responses estimated by Michael Karter from the 2003 Fire Loss Experience Survey.

Source: Unpublished analysis by Jennifer D. Flynn, NFPA Fire Analysis and Research Division, January 2008.

Table F. Non-Fire Sprinkler Activations by Likelihood of Water Release and Major Property Use Group

Type of Activation (Based on:)	Commercial properties (726 incidents)	Manufacturing facilities (206 incidents)	Homes (292 incidents)	Warehouses excluding cold storage (165 incidents)
No Water Released	50%	55%	50%	50%
Definitely no water released except dry pipe system charging or release to drain or outside	(45%)	(48%)	(46%)	(44%)
Activation with no mention of water flow outside system	(5%)	(7%)	(4%)	(6%)
Possibly Water Released	50%	45%	50%	50%
Break or damage to component	(29%)	(30%)	(27%)	(38%)
Activation with mention of water flow release outside system	(8%)	(4%)	(14%)	(5%)
Leak	(5%)	(2%)	(2%)	(1%)
Freezing	(7%)	(6%)	(6%)	(6%)
Nearby heat	(2%)	(2%)	(1%)	(1%)
Total	100%	100%	100%	100%
Confirmed water release outside system	16%	7%	21%	12%

Source: Analysis of uncoded narratives from reported incidents in Austin (TX), Minnesota, and Massachusetts.

Jennifer Flynn analyzed the number of reported emergency responses in 2003 by U.S. fire department where the reason for the response was either (a) non-fire unintentional sprinkler activation or (b) non-fire sprinkler activation from a malfunction or failure of the system. The year 2003 was the last one for which the public release file of NFIRS included non-fire incidents (because the complete file grew too large for practical storage for release in and after 2004), and earlier years involved less participation in NFIRS Version 5.0 and so a narrower base for statistical analysis. Four property use groups accounted for nearly three-fourths of the reported non-fire sprinkler incidents. See Table E.

A sprinkler system can "activate" with no damaging release of water outside the sprinkler system. The most common example is a dry-pipe system that activates by flowing water into the pipes but does not release water outside the system. Such an activation would register as an activation in a centrally monitored system and could result in a fire department response.

To estimate the fraction of incidents where water is released, an exploratory data analysis was conducted on the uncoded narratives for one year of non-fire sprinkler incidents from Austin, TX (thanks to Karyl Kinsey) and the states of Minnesota and Massachusetts (thanks to Nora Gierok and Derryl Dion). Table F shows the results, separating incidents confirmed as no water outside the system and, among incidents where water release was possible, those with water release outside the system confirmed.

If the confirmed water release percentages shown in Table F are applied to the non-fire sprinkler incidents in Table E, and the resulting water-damage incidents are compared to the 2003-2006 annual average number of fires where sprinklers were present in the same properties, then one can obtain a basis for comparison. Non-fire sprinkler incidents with confirmed water release outside the system, as a percentage of fire incidents where sprinklers operated, were as follows:

- 34% for commercial properties,
- 13% for manufacturing facilities,
- 5% for homes, and
- 25% for warehouses excluding cold storage.

While the NFIRS reports do not include any estimates of dollar damage, only a handful of incidents mentioned extensive water damage. It seems likely that the average damage per non-fire sprinkler incident is considerably less than the average damage per fire incident in sprinklered properties. Even without any such adjustment, the percentages above are comparable to the estimates from Marryatt cited earlier.

Also, the Minnesota and Massachusetts incidents that dominate the combined data base probably reflect a bigger problem with freezing conditions than is true for the country as a whole. Roughly half of the commercial property confirmed water release incidents and roughly half of the warehouse incidents involved either freezing as a cited factor or a month of occurrence during December to February. Therefore, these two percentages would probably be somewhat lower if data with representative weather conditions were available.

Whatever the actual rate for these incidents, many of them can be readily prevented by better design or safer practices. Common factors in component breaks are:

- Exposure to freezing conditions,
- Damage from forklifts or other large vehicles,
- Misuse of sprinklers, notably their use as hangers or as a base for anchoring hangers,
- Damage by construction or similar workers,
- Vandalism or horseplay in the vicinity of sprinklers, and
- Damage from impact by large doors.

Non-fire activations can also be prevented by better design or safer practices. Common factors in such activations are:

- Proximity to very high levels of ambient heat, like that produced by certain manufacturing processes,
- Testing or maintenance not conducted according to standard, resulting in water surge or alarm activation.

Do People Want Sprinklers?

In surveys, many people say they do not want sprinklers. The question is why. The answer is often some type of misinformation, like the ones related to water damage, already discussed.

One myth has to do with aesthetics. Again, when people outside the fire community think of sprinklers, they may think of the exposed pipe and sprinkler arrays that are common in some large manufacturing facilities. Inconspicuously mounted sprinklers, which are already common in offices and hotels and are available for homes, need to be better publicized.

A second myth has to do with the risk of death, serious injury or significant property damage in fire. This was the principal reason cited by people without smoke alarms 30 years ago, when most people still did not have smoke alarms, to explain why they did not have smoke alarms. If sprinklers are an excellent solution to a problem you (wrongly) think you do not have, then that would naturally reduce your interest in sprinklers and your sense of their value.

A third myth has to do with the affordability of sprinklers. Sprinklers are not inexpensive, although their effectiveness, documented earlier, means most people will find them cost-effective. This often can be incorporated into reduced insurance costs and incentives applied by community planners in new developments.

A 2008 study, conducted by Newport Partners under sponsorship of the Fire Protection Research Foundation, developed comprehensive and all-inclusive cost estimates for 30 diverse house plans in 10 communities.[10] Cost per sprinklered square foot ranged from

[10] Newport Partners, *Home Fire Sprinkler Cost Assessment – Final Report*, Fire Protection Research Foundation, Quincy, MA, September 2008, pp. iv and 6.

$0.38 to $3.66, with an average (mean) of $1.61 and a median of $1.42. Variables associated with higher cost systems included:

- Extension use of copper piping instead of CPVC or PEX plastic;
- On-site water supply (such as well water) instead of municipal water supply;
- Local requirements to sprinkler areas, like garages or attics, where coverage is not required under NFPA 13D;
- Local sprinkler ordinances in effect for less than five years, or too brief a time for market acceptance, increased competition, and resulting lower prices to take hold; and
- Local sprinkler permit fees that are higher than the norm.

Many people are not aware how much the cost of sprinkler systems and the cost of installing them have been reduced in recent years as a result of continued innovationin the industry. When people say they are not interested in sprinklers for cost reasons, they may well be reacting to an inflated notion of those costs.

A 1977 survey done for the U.S. Fire Administration, back when only 22% of U.S. homes had smoke alarms, found that 74% of households with smoke alarms were very concerned about fire compared to only 45% of households that had no smoke alarms and no intention of obtaining smoke alarms. For households without smoke alarms, whether or not they intended to obtain smoke alarms, the leading reason cited for not having obtained one was no perception of need (don't need one – 16%; no interest in one – 16%) and the second leading reason was cost (too expensive – 23%; not worth the money – 1%). These are the same reasons, in the same order, cited today by people not intending to obtain home fire sprinklers today.[11]

In survey after survey, we find that people's perceptions and reasoning align for consistency with their actions. It is impossible today to believe that a large segment of the public once objected to smoke alarms on the basis of cost, but early in their adoption, it was true. The more people learn about home fire sprinklers, the more they are attracted to them, and there is no reason to expect this trend to stop.

In fact, there is evidence that many homeowners are getting past these dated perceptions and moving on to more fact-based and positive views of home fire sprinklers. The Home Fire Sprinkler Coalition sponsored a December 2005 survey by Harris Interactive®.[12] Among the findings were that 45% of homeowners considered a sprinklered home more desirable than an unsprinklered home, that 69% believe a fire sprinkler system increases the value of a home, that 38% say they would be more likely to purchase a new home with sprinklers than one without, and that 43% would be more likely to have home fire sprinklers installed if the cost could be included in the mortgage. These read like the emerging perceptions of a nation that sees value for the cost of home fire sprinklers and sees ways to handle that cost within their home-buying budget.

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[11] Based on 2007 slide presentation of results of NAHB National Survey, conducted August 14-15, 2006, by Public Opinion Strategies, #06811.

[12] See a summary of findings in a press release at http://www.homefiresprinkler.org/release/HarrisPoll.html.

Concluding Points

Fire sprinklers are highly reliable and effective elements of total system designs for fire protection in buildings. They save lives and property, producing large reductions in the number of deaths per thousand fires, in average direct property damage per fire, and especially in the likelihood of a fire with large loss of life or large property loss.

Excluding fires too small to activate a sprinkler and cases of failure or ineffectiveness because of a lack of sprinklers in the fire area, sprinklers operated in 93% of reported structure fires and operated effectively in 91% of fires. More than half (53%) of the failures occurred because the system had been shut off.

There are certain fire situations where even a complete sprinkler system will have limited impact: (a) Explosions and flash fires that may overpower the system; (b) Fires that begin very close to a person (e.g., clothing ignition) or unusually sensitive and expensive property (e.g., an art gallery) where fatal injury or substantial property loss can occur before sprinklers can react; and (c) Fires that originate in unsprinklered areas (e.g., concealed wall spaces) or adjacent properties (e.g., exposure fires), which may grow to unmanageable size outside the range of the sprinkler system. These situations can arise when (a) sprinkler standards are based on design fires less severe than explosions or flash fires, as is the case for explosions in the NFPA 13, NFPA 13D, and NFPA 13R standards; (b) sprinkler objectives are defined in terms of a design fire area larger than the distance implied by a victim intimate with ignition; or (c) sprinkler standards exclude certain potential areas of fire origin from their definition of complete coverage, which is typically but not always the case.

Sprinkler systems are so effective that it can be tempting to overstate just how effective they are. For example, some sprinkler proponents have focused too narrowly on the reliability of the components of the sprinkler system itself. If this were the only concern in sprinkler performance, then there would be little reason for concern at all, but human error is a relevant problem.

On the other hand, human error is not a problem unique to sprinklers. In fact, all forms of active and passive fire protection tend to show more problems with human error than with intrinsic mechanical or electrical reliability.

It is important for all concerned parties to (a) distinguish between human and mechanical problems because they require different strategies; (b) include both as concerns to be addressed when deciding when and how to install, maintain, and rely on sprinklers and other automatic extinguishing systems; (c) strive to use performance analysis in assessing any other element of fire protection; and (d) remember that the different elements of fire protection support and reinforce one another and so must always be designed and considered as a system.

Because sprinkler systems are sophisticated enough to require competent fire protection engineering and function best in buildings where there is a complete integrated system of

fire protection, it is especially important that proper procedures be used in the installation and maintenance of sprinkler systems. This means careful adherence to the relevant standards: NFPA 13, *Standard for the Installation of Sprinkler Systems*; NFPA 13D, *Standard for the Installation of Sprinkler Systems in One- and Two-Family Dwellings and Manufactured Homes*; NFPA 13R, *Standard for the Installation of Sprinkler Systems in Residential Occupancies Up to and Including Four Stories in Height*; and NFPA 25, *Standard for the Inspection, Testing and Maintenance of Water-Based Fire Protection Systems*.

Because sprinkler systems are so demonstrably effective, they can make a major contribution to fire protection in any property. NFPA 101®, *Life Safety Code*; NFPA 1, *Fire Code*; and NFPA 5000®, *Building Construction and Safety Code*, have required sprinklers in all new one- and two-family dwellings, all nursing homes, and many nightclubs since the 2006 editions. The 2009 edition of the *International Residential Code* also added requirements for sprinklers in one- or two-family dwellings, effective January 2011. This protection can be expected to increase in areas that adopt and follow these revised codes.

Appendix A.
How National Estimates Statistics Are Calculated

The statistics in this analysis are estimates derived from the U.S. Fire Administration's (USFA's) National Fire Incident Reporting System (NFIRS) and the National Fire Protection Association's (NFPA's) annual survey of U.S. fire departments. NFIRS is a voluntary system by which participating fire departments report detailed factors about the fires to which they respond. Roughly two-thirds of U.S. fire departments participate, although not all of these departments provide data every year. Fires reported to federal or state fire departments or industrial fire brigades are not included in these estimates.

NFIRS provides the most detailed incident information of any national database not limited to large fires. NFIRS is the only database capable of addressing national patterns for fires of all sizes by specific property use and specific fire cause. NFIRS also captures information on the extent of flame spread, and automatic detection and suppression equipment. For more information about NFIRS visit http://www.nfirs.fema.gov/. Copies of the paper forms may be downloaded from http://www.nfirs.fema.gov/documentation/design/NFIRS_Paper_Forms_2008.pdf.

NFIRS has a wide variety of data elements and code choices. The NFIRS database contains coded information. Many code choices describe several conditions. These cannot be broken down further. For example, area of origin code 83 captures fires starting in vehicle engine areas, running gear areas or wheel areas. It is impossible to tell the portion of each from the coded data.

Methodology may change slightly from year to year.
NFPA is continually examining its methodology to provide the best possible answers to specific questions, methodological and definitional changes can occur. *Earlier editions of the same report may have used different methodologies to produce the same analysis, meaning that the estimates are not directly comparable from year to year.*

NFPA's fire department experience survey provides estimates of the big picture.
Each year, NFPA conducts an annual survey of fire departments which enables us to capture a summary of fire department experience on a larger scale. Surveys are sent to all municipal departments protecting populations of 50,000 or more and a random sample, stratified by community size, of the smaller departments. Typically, a total of roughly 3,000 surveys are returned, representing about one of every ten U.S. municipal fire departments and about one third of the U.S. population.

The survey is stratified by size of population protected to reduce the uncertainty of the final estimate. Small rural communities have fewer people protected per

department and are less likely to respond to the survey. A larger number must be surveyed to obtain an adequate sample of those departments. (NFPA also makes follow-up calls to a sample of the smaller fire departments that do not respond, to confirm that those that did respond are truly representative of fire departments their size.) On the other hand, large city departments are so few in number and protect such a large proportion of the total U.S. population that it makes sense to survey all of them. Most respond, resulting in excellent precision for their part of the final estimate.

The survey includes the following information: (1) the total number of fire incidents, civilian deaths, and civilian injuries, and the total estimated property damage (in dollars), for each of the major property use classes defined in NFIRS; (2) the number of on-duty firefighter injuries, by type of duty and nature of illness; 3) the number and nature of non-fire incidents; and (4) information on the type of community protected (e.g., county versus township versus city) and the size of the population protected, which is used in the statistical formula for projecting national totals from sample results. The results of the survey are published in the annual report *Fire Loss in the United States*. To download a free copy of the report, visit http://www.nfpa.org/assets/files/PDF/OS.fireloss.pdf.

Projecting NFIRS to National Estimates

As noted, NFIRS is a voluntary system. Different states and jurisdictions have different reporting requirements and practices. Participation rates in NFIRS are not necessarily uniform across regions and community sizes, both factors correlated with frequency and severity of fires. This means NFIRS may be susceptible to systematic biases. No one at present can quantify the size of these deviations from the ideal, representative sample, so no one can say with confidence that they are or are not serious problems. But there is enough reason for concern so that a second database -- the NFPA survey -- is needed to project NFIRS to national estimates and to project different parts of NFIRS separately. This multiple calibration approach makes use of the annual NFPA survey where its statistical design advantages are strongest.

Scaling ratios are obtained by comparing NFPA's projected totals of residential structure fires, non-residential structure fires, vehicle fires, and outside and other fires, and associated civilian deaths, civilian injuries, and direct property damage with comparable totals in NFIRS. Estimates of specific fire problems and circumstances are obtained by multiplying the NFIRS data by the scaling ratios. Reports for incidents in which mutual aid was given are excluded NFPA's analyses.

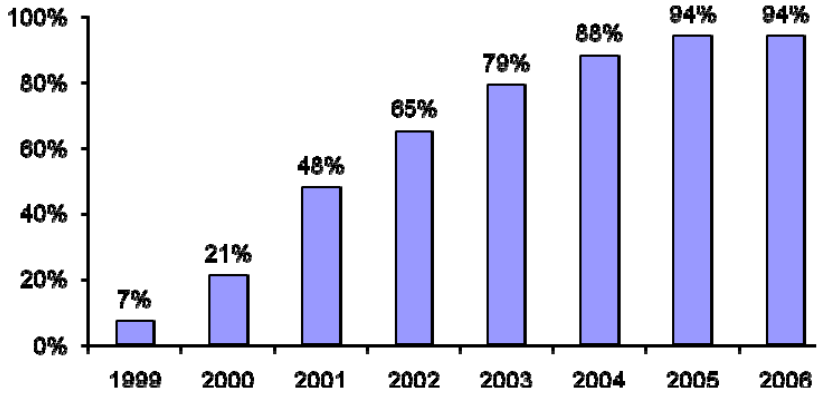
Analysts at the NFPA, the USFA and the Consumer Product Safety Commission developed the specific basic analytical rules used for this procedure. "The National Estimates Approach to U.S. Fire Statistics," by John R. Hall, Jr. and Beatrice Harwood, provides a more detailed explanation of national estimates. A

copy of the article is available online at http://www.nfpa.org/osds or through NFPA's One-Stop Data Shop.

Version 5.0 of NFIRS, first introduced in 1999, used a different coding structure for many data elements, added some property use codes, and dropped others. The essentials of the approach described by Hall and Harwood are still used, but some modifications have been necessary to accommodate the changes in NFIRS 5.0.

Figure 1 shows the percentage of fires originally collected in the NFIRS 5.0 system. Each year's release version of NFIRS data also includes data collected in older versions of NFIRS that were converted to NFIRS 5.0 codes.

Figure 1. Fires Originally Collected in NFIRS 5.0 by Year



For 2002 data on, analyses are based on scaling ratios using only data originally collected in NFIRS 5.0:

NFPA survey projections
NFIRS totals (Version 5.0)

For 1999 to 2001, the same rules may be applied, but estimates for these years in this form will be less reliable due to the smaller amount of data originally collected in NFIRS 5.0; they should be viewed with extreme caution.

NFIRS 5.0 introduced six categories of confined structure fires, including:

- cooking fires confined to the cooking vessel,
- confined chimney or flue fires,
- confined incinerator fire,
- confined fuel burner or boiler fire or delayed ignition,
- confined commercial compactor fire, and
- trash or rubbish fires in a structure with no flame damage to the structure or its contents.

Although causal and other detailed information is typically not required for these incidents, it is provided in some cases (typically 10-20%). Some analyses, particularly those that examine cooking equipment, heating equipment, fires caused by smoking materials, and fires started by playing with fire, may examine the confined fires in greater detail. Because the confined fire incident types describe certain scenarios, the distribution of unknown data differs from that of all fires. Consequently, allocation of unknowns must be done separately.

Some analyses of structure fires show only non-confined fires. In these tables, percentages shown are of non-confined structure fires rather than alls structure fires. This approach has the advantage of showing the frequency of specific factors in fire causes, but the disadvantage of possibly overstating the percentage of factors that are seldom seen in the confined fire incident types.

Other analyses include entries for confined fire incident types in the causal tables and show percentages based on total structure fires. In these cases, the confined fire incident type is treated as a general causal factor.

For most fields other than Property Use, NFPA allocates unknown data proportionally among known data. This approach assumes that if the missing data were known, it would be distributed in the same manner as the known data. NFPA makes additional adjustments to several fields. *Casualty and loss projections can be heavily influenced by the inclusion or exclusion of unusually serious fire.*

> *In the formulas that follow, the term "all fires" refers to all fires in NFIRS on the dimension studied.*
>
> **Factor Contributing to Ignition:** In this field, the code "none" is treated as an unknown and allocated proportionally. For Human Factor Contributing to Ignition, NFPA enters a code for "not reported" when no factors are recorded. "Not reported" is treated as an unknown, but the code "none" is treated as a known code and not allocated. Multiple entries are allowed in both of these fields. Percentages are calculated on the total number of fires, not entries, resulting in sums greater than 100%. Although Factor Contributing to Ignition is only required when the cause of ignition was coded as: 2) unintentional, 3) failure of equipment or heat source; or 4) act of nature, data is often present when not required. Consequently, any fire in which no factor contributing to ignition was entered was treated as unknown.
>
> In some analyses, all entries in the category of electrical failure or malfunction (factor contributing to ignition 30-39) are combined and shown as "electrical failure or malfunction." This category includes:

31. Water-caused short circuit arc;
32. Short-circuit arc from mechanical damage;
33. Short-circuit arc from defective or worn insulation;

34. Unspecified short circuit arc;
35. Arc from faulty contact or broken connector, including broken power lines and loose connections;
36. Arc or spark from operating equipment, switch, or electric fence;
37. Fluorescent light ballast; and
30. Electrical failure or malfunction, other.

Type of Material First Ignited (TMI). This field is required only if the Item First Ignited falls within the code range of 00-69. NFPA has created a new code "not required" for this field that is applied when Item First Ignited is in code 70-99 (organic materials, including cooking materials and vegetation, and general materials, such as electrical wire, cable insulation, transformers, tires, books, newspaper, dust, rubbish, etc..) and TMI is blank. The ratio for allocation of unknown data is:

$$\frac{\text{(All fires – TMI Not required)}}{\text{(All fires – TMI Not Required – Undetermined – Blank)}}$$

Heat Source. In NFIRS 5.0, one grouping of codes encompasses various types of open flames and smoking materials. In the past, these had been two separate groupings. A new code was added to NFIRS 5.0, which is code 60: "Heat from open flame or smoking material, other." NFPA treats this code as a partial unknown and allocates it proportionally across the codes in the 61-69 range, shown below.

61. Cigarette;
62. Pipe or cigar;
63. Heat from undetermined smoking material;
64. Match;
65. Lighter: cigarette lighter, cigar lighter;
66. Candle;
67 Warning or road flare, fuse;
68. Backfire from internal combustion engine. Excludes flames and sparks from an exhaust system, (11); and
69. Flame/torch used for lighting. Includes gas light and gas-/liquid-fueled lantern.

In addition to the conventional allocation of missing and undetermined fires, NFPA multiplies fires with codes in the 61-69 range by

$$\frac{\text{All fires in range 60-69}}{\text{All fires in range 61-69}}$$

The downside of this approach is that heat sources that are truly a different type of open flame or smoking material are erroneously assigned to other categories. The grouping "smoking materials" includes codes 61-63

(cigarettes, pipes or cigars, and heat from undetermined smoking material, with a proportional share of the code 60s and true unknown data.

Equipment Involved in Ignition (EII). NFIRS 5.0 originally defined EII as the piece of equipment that provided the principal heat source to cause ignition if the equipment malfunctioned or was used improperly. In 2006, the definition was modified to "the piece of equipment that provided the principal heat source to cause ignition." However, much of the data predates the change. Individuals who have already been trained with the older definition may not change their practices. To compensate, NFPA treats fires in which EII = NNN and heat source is not in the range of 40-99 as an additional unknown.

To allocate unknown data for EII, the known data is multiplied by

$$\frac{\text{All fires}}{\text{(All fires – blank – undetermined – [fires in which EII =NNN and heat source <>40-99])}}$$

In addition, the partially unclassified codes for broad equipment groupings (i.e., code 100, - heating, ventilation, and air conditioning, other; code 200- electrical distribution, lighting and power transfer, other; etc.) were allocated proportionally across the individual code choices in their respective broad groupings (heating, ventilation, and air conditioning; electrical distribution, lighting and power transfer, other; etc.). Equipment that is totally unclassified is not allocated further. This approach as the same downside as the allocation of heat source 60 described above. Equipment that is truly different is erroneously assigned to other categories.

In some analyses, various types of equipment are grouped together. (Confined fire incident types are not discussed here)

Code Grouping	EII Code	NFIRS definitions
Central heat	132	Furnace or central heating unit
	133	Boiler (power, process or heating)
Fixed or portable space heater	131	Furnace, local heating unit, built-in
	123	Fireplace with insert or stove
	124	Heating stove
	141	Heater, excluding catalytic and oil-filled
	142	Catalytic heater

	143	Oil-filled heater
Fireplace or chimney	121	Fireplace, masonry
	122	Fireplace, factory-built
	125	Chimney connector or vent connector
	126	Chimney – brick, stone or masonry
	127	Chimney-metal, including stovepipe or flue
Wiring, switch or outlet	210	Unclassified electrical wiring
	211	Electrical power or utility line
	212	Electrical service supply wires from utility
	214	Wiring from meter box to circuit breaker
	216	Electrical branch circuit
	217	Outlet, receptacle
	218	Wall switch
Power switch gear or overcurrent protection device	215	Panel board, switch board, circuit breaker board
	219	Ground fault interrupter
	222	Overcurrent, disconnect equipment
	227	Surge protector
Lamp, bulb or lighting	230	Unclassified lamp or lighting
	231	Lamp-tabletop, floor or desk
	232	Lantern or flashlight
	233	Incandescent lighting fixture
	234	Fluorescent light fixture or ballast
	235	Halogen light fixture or lamp
	236	Sodium or mercury vapor light fixture or lamp
	237	Work or trouble light
	238	Light bulb
	241	Nightlight
	242	Decorative lights – line voltage
	243	Decorative or landscape lighting – low voltage
	244	Sign
Cord or plug	260	Unclassified cord or plug

U.S. Experience With Sprinklers, 2/10 61 NFPA Fire Analysis and Research, Quincy, MA

	261	Power cord or plug, detachable from appliance
	262	Power cord or plug- permanently attached
	263	Extension cord
Torch, burner or soldering iron	331	Welding torch
	332	Cutting torch
	333	Burner, including Bunsen burners
	334	Soldering equipment
Portable cooking or warming equipment	631	Coffee maker or teapot
	632	Food warmer or hot plate
	633	Kettle
	634	Popcorn popper
	635	Pressure cooker or canner
	636	Slow cooker
	637	Toaster, toaster oven, counter-top broiler
	638	Waffle iron, griddle
	639	Wok, frying pan, skillet
	641	Breadmaking machine

Item First Ignited. In most analyses, mattress and pillows (item first ignited 31) and bedding, blankets, sheets, and comforters (item first ignited 32) are combined and shown as "mattresses and bedding." In many analyses, wearing apparel not on a person (code 34) and wearing apparel on a person (code 35) are combined and shown as "clothing." In some analyses, flammable and combustible liquids and gases, piping and filters (item first ignited 60-69) are combined and shown together

Area of Origin. Two areas of origin: bedroom for more than five people (code 21) and bedroom for less than five people (code 22) are combined and shown as simply "bedroom."

Rounding and percentages. The data shown are estimates and generally rounded. An entry of zero may be a true zero or it may mean that the value rounds to zero. Percentages are calculated from unrounded values. It is quite possible to have a percentage entry of up to 100%, even if the rounded number entry is zero. The same rounded value may account for a slightly different percentage share. Because percentages are expressed in integers and not carried out to several decimal places, percentages that appear identical may be associated with slightly different values.

Inflation. Property damage estimates are not adjusted for inflation unless so indicated.

Appendix B
Data Elements in NFIRS 5.0 Related to Automatic Extinguishing Systems

M1. Presence of Automatic Extinguishment System
This is to be coded based on whether a system was or was not present in the area of fire and is designed to extinguish the fire that developed. (The latter condition might exclude, for example, a range hood dry chemical extinguishing system from being considered if the fire began in a toaster.)

Codes:

N	None Present
1	Present
U	Undetermined (restored to coding in 2004)

M2. Type of Automatic Extinguishment System
If multiple systems are present, this is to be coded in terms of the (presumably) one system designed to protect the hazard where the fire started. This is a required field if the fire began within the designed range of the system. It is not clear whether questions might arise over a system that is not located in the area of fire origin but has the area of fire origin within its designed range; this has to do with the interpretation of the "area" of fire origin.

Codes:

1	Wet pipe sprinkler
2	Dry pipe sprinkler
3	Other sprinkler system
4	Dry chemical system
5	Foam system
6	Halogen type system
7	Carbon dioxide system
0	Other special hazard system
U	Undetermined

M3. Automatic Extinguishment System Operation
This is designed to capture the "operation and effectiveness" of the system relative to area of fire origin. It is also said to provide information on the "reliability" of the system. The instructions say that "effective" does not necessarily mean complete extinguishment but does mean containment and control until the fire department can complete extinguishment.

Codes:

1 System operated and was effective
2 System operated and was not effective
3 Fire too small to activate the system
4 System did not operate
0 Other
U Undetermined

M4. Number of Sprinklers Operating

The instructions say this is not an indication of the effectiveness of the sprinkler system. The instructions do not explicitly indicate whether this data element is relevant if the automatic extinguishment system is not a sprinkler system (as indicated in M2). The actual number is recorded in the blank provided; there are no codes.

M5. Automatic Extinguishment System Failure Reason

This is designed to capture the (one) reason why the system "failed to operate or did not operate properly." The instructions also say that this data element provides information on the "effectiveness" of the equipment. It is not clear whether this is to be completed if the system operated properly but was not effective.

Text shown in brackets is text shown in the instructions but not on the form. Note that for code 4, the phrase "wrong" is replaced by "inappropriate" in the instructions; the latter term is more precise and appropriate, although it is possible for the type of fire to be unexpected in a given occupancy.

Codes:

1 System shut off
2 Not enough agent discharged [to control the fire]
3 Agent discharged but did not reach [the] fire
4 Wrong type of system [Inappropriate system for the type of fire]
5 Fire not in area protected [by the system]
6 System components damaged
7 Lack of maintenance [including corrosion or heads painted]
8 Manual intervention [defeated the system]
0 Other _____ [Other reason system not effective]
U Undetermined

Appendix C
Multiple-Death Fires in Fully Sprinklered Properties
(Excluding Incidents Where Sprinklers Were Not Operational at Time of Fire)
1971-Present

Month and Year	Property Use	State	Deaths*	Explosion or flash fire	Firefighting
December 1971	Chemical manufacturer	New York	3	X	
April 1975	Metal recycling plant	Oregon	3 (1)	X	X
January 1976	Aerosol packaging plant	Indiana	5	X	
November 1976	Gum factory	New York	6	X	
June 1979	Ink manufacturer	California	3	X	
March 1980	Paper products warehouse	Idaho	5 (3)		X
July 1980	Metal products manufacturer	New York	11	X	
October 1981	Aerosol packaging plant	Massachusetts	5	X	
September 1982	Textile mill	North Carolina	4 (4)		X
July 1983	Supermarket	Florida	5	X	
December 1983	Vehicle parts repair	New York	7 (5)	X	
December 1984	Recycle steam plant	Ohio	3	X	
February 1985	Furniture manufacturer	Virginia	4	X	
December 1985	Shopping mall	California	4	X	
April 1986	Industrial park	California	9	X	
February 1993	Office complex	New York	6	X	
April 1995	Office building	Oklahoma	168	X	
November 1997	Toy manufacturer	California	4	X	
February 1999	Chemical manufacturer	Pennsylvania	5	X	
February 1999	Iron foundry	Massachusetts	3	X	
February 2001	Particleboard manufacturer	Pennsylvania	3	X	
May 2002	Rubber reclamation manufacturer	Mississippi	5	X	
February 2003	Insulation products manufacturer	Kentucky	7	X	
July 2003	Fireworks warehouse	Texas	3	X	
April 2004	Plastic products manufacturer	Illinois	5	X	

X – Indicates whether explosion or flash fire and/or firefighting was the factor that allowed multiple deaths in spite of the presence of operational sprinklers with complete coverage.

* "Multiple-death fires are here defined as fires with 3 or more civilian or firefighter deaths. Numbers in parentheses indicate the number of firefighter deaths in the total. The 9/11 attack on the World Trade Center involved an initial flash fire from the ignited jet fuel, but it is excluded here because the impact of the airplanes rendered the sprinklers non-operational before fire began.

Appendix D
Selected Incidents

The following published incidents are detailed examples reinforcing the need for proper inspection and testing maintenance programs and reflect the analysis discussed in the reliability and effectiveness section of the report. The collection may not be representative of all fires in terms of relative frequency or specific circumstances.

Included are short articles from the "Firewatch" column in *NFPA Journal* and incidents from the large-loss and catastrophic fires report. It is important to remember that this is anecdotal information. Anecdotes show what can happen; they are not a source to learn about what typically occurs.

NFPA's Fire Incident Data Organization (FIDO) identifies significant fires through a clipping service, the Internet and other sources. Additional information is obtained from the fire service and federal and state agencies. FIDO is the source for articles published in the "Firewatch" column of the *NFPA Journal*.

NOT IN AREA PROTECTED

Location, Dollar Loss, Date, Time	Property Characteristics and Operating Status	Fire Protection Systems	Fire Development	Contributing Factors and Other Details
New Jersey $7,100,000 September, 2005 1:41 p.m.	This four-story eight-unit condominium was of unprotected wood-frame construction and covered 4,225 square feet (392 square meters). The building was occupied.	There was completed coverage smoke detection equipment. The alarms sounded, but with a delay due to the fire's area of origin. There was a complete coverage wet-pipe sprinkler system present. There was no coverage in the area of ignition (outside). Upon arrival, the fire department pumped into the sprinkler system, but there was no effect on the fire spread.	This exposure fire began in the engine compartment of a car parked in a garage under the condominium structure. The garages were separated by wood latticework that allowed the fire to spread through the eight garages that contained vehicles, boats, and propane grills. The fire spread up cedar siding and through the truss floor assembly of the condominium units above. The fire spread to several other buildings in the condominium complex. At least 35 fire departments responded to fight the fire.	The day of the fire was very hot and humid, with a wind of 15 to 20 miles per hour (24 to 32 kilometers per mile). There had been no rain for three weeks, causing the siding to be very dry. One side of the structure was on a bay, forcing firefighters to hand lay fire hoses. The open-web truss construction of floors and roof allowed for rapid spread. Twenty-four firefighters and three civilians were treated for heat exhaustion and other injuries. The loss was $6,000,000 to structures and $1,100,000 to contents.

Stephen G. Badger, 2006, "2005 Large-Loss Fires and Explosions in the United States", *NFPA Journal,* November/December, 72.

Location, Dollar Loss, Date, Time	Property Characteristics and Operating Status	Fire Protection Systems	Fire Development	Contributing Factors and Other Details
Georgia $6,000,000 July, 2003 5:50 p.m.	This 7-story university library of protected noncombustible construction covered 200,000 square feet (18,580 square meters). There was an older (the original) building attached and the building was open and operating at the time of the fire.	A partial coverage smoke detection system was present and it activated, notifying the fire department. There was partial coverage wet-pipe system, but not in the area of origin.	This incendiary fire was set in a second-story storage area. The fire was contained to the floor of origin. An arson arrest has been made in the case.	Loss to the building was $1,000,000 and loss to the contents was $5,000,000.

Stephen G. Badger, November, 2004, *Large-Loss Fires in the United States 2003*, 29.

Location, Dollar Loss, Date, Time	Property Characteristics and Operating Status	Fire Protection Systems	Fire Development	Contributing Factors and Other Details
Texas $5,220,000 March, 2003 12:05 a.m.	This three-story, single-family dwelling of protected wood-frame construction covered 14,585 square feet (1,354 square meters) and was occupied when the fire broke out.	A partial coverage smoke detection system present operated and a partial coverage sprinkler system was present. The type and operation weren't reported, but the system wasn't in the area of origin.	The cause is undetermined. Arriving firefighters found a fire in the ceiling between the first and second story, which spread rapidly in voids throughout the house. Firefighters were forced to a defensive attack.	Loss to the house was $3,250,000 and loss to contents was $1,970,000.

Stephen G. Badger November, 2004, *Large-Loss Fires in the United States 2003*, 25.

Location, Dollar Loss, Date, Time	Property Characteristics and Operating Status	Fire Protection Systems	Fire Development	Contributing Factors and Other Details
Virginia $12,823,900 February, 2003 4:45 a.m.	This 4-story senior citizen apartment house of protected wood-frame construction contained 100 units and covered 23,536 square feet (2,186 square meters). Of the 100 units, 81 were occupied.	There was a complete coverage combination heat and smoke detection equipment. The system operated but it wasn't in the area of origin. An arriving police officer activated a manual pull station to sound the alarm. There was a complete coverage wet-pipe sprinkler system but one head operated. This system also was not in the area of origin (outside balcony).	The cause of this fire is undetermined and it originated on a third-story balcony. The fire spread up the exterior and entered the attic through roof soffits. The fire spread horizontally then down to the apartments on the fourth and third floors.	The balconies were of combustible materials, allowing for ignition. Two firefighters were injured. Loss to the building was $9,823,900 and loss to contents was $3,000,000.

Stephen G. Badger, 2004, "Large-Loss Fires for 2003", *NFPA Journal*, November/December, 56.

Location, Dollar Loss, Date, Time	Property Characteristics and Operating Status	Fire Protection Systems	Fire Development	Contributing Factors and Other Details
Colorado $28,000,000 November, 2000 8:47 p.m.	Seven-story hotel of protected noncombustible construction that covered 96,000 square feet (8,918.7 square meters). The hotel was operating at the time of the fire.	Although the hotel's complete-coverage smoke and heat detection system wasn't in the area of ignition, it operated. The hotel also had a complete-coverage wet-pipe sprinkler system. The fire began in a void and burned through the unprotected area. When the system activated, 31 sprinklers opened, causing a drop in pressure and overwhelming the system. Firefighters pumped water into the standpipes that fed both the sprinkler system and the standpipe hose connections, but pressure was inadequate.	The fire began in a second-floor fireplace and ignited a build-up of creosote, causing the vent pipe in the soffit near the fifth floor to separate. The unsupported chimney fell into the chase, allowing fire to spread throughout the void. Firefighters, who were already at the hotel on a medical call, heard the smoke alarms and discovered fire in the chase. Upon investigation, they found flames spreading rapidly through the concealed space above the top floor.	The concealed space above the top-floor ceiling was undivided, allowing the fire to burn the length of the building. Combustible exterior siding contributed to the fire's spread outside the building. It's believed that the fire burned undetected for up to three hours. Two firefighters were injured. Structural loss came to $19 million, and contents loss is estimated at $9 million.

Stephen G. Badger, 2001, "Large-Loss Fires of 2000", *NFPA Journal*, November/December, 64.

Location, Dollar Loss, Date, Time	Property Characteristics and Operating Status	Fire Protection Systems	Fire Development	Contributing Factors and Other Details
Ohio $60,000,000 August, 2000 4:05 p.m.	Three-story steel manufacturing plant was of unprotected ordinary construction covering 355,320 square feet (33,010 square meters) and was in full operation at the time of the fire.	There was no automatic detection equipment present. A wet-pipe sprinkler system was present; the extent of the coverage was not reported. The system was not a factor as the fire was in the attic and roof area, above the system. An early collapse of the roof did damage the branch and trunk lines.	No information reported on the cause. Firefighters made an initial interior attack but were forced to withdraw due to roof and ceiling collapse. Operations were switched to a defensive attack.	Three firefighters were injured. Losses totaled $40,000,000 to the structure and $20,000,000 to the contents.

Stephen G. Badger, November, 2002, *Large-Loss Fires in the United States 2001*, 11.

Location, Dollar Loss, Date, Time	Property Characteristics and Operating Status	Fire Protection Systems	Fire Development	Contributing Factors and Other Details
Hawaii $10,000,000 April, 2000 8:13 a.m.	A 16-story office building of fire-resistive construction that covered 58,564 square feet (5,440 square meters). Although the building was closed for the weekend a few occupants were in the building.	Smoke detectors and manual pull stations of unknown type activated and alerted the occupants. The extent of the system's coverage wasn't reported. A partial-coverage wet-pipe sprinkler system wasn't in the area of the fire and didn't operate.	Undetermined.	Twelve firefighters were injured. Fire loss was listed as $8 million to the structure and $2 million to the contents.

Stephen G. Badger, 2001, "Large-Loss Fires of 2000", *NFPA Journal*, November/December, 63.

Location, Dollar Loss, Date, Time	Property Characteristics and Operating Status	Fire Protection Systems	Fire Development	Contributing Factors and Other Details
Pennsylvania $25,000,000 May, 2000 8:00 a.m.	General product warehouse of unprotected noncombustible construction. The building was 40 feet (12 meters) high and covered 400,000 square feet (37,161 square meters). Its operating status wasn't reported.	The warehouse had no automatic detection system. Automatic suppression equipment had been installed, but only in two sections of the warehouse, and the fire originated elsewhere. By the time the system activated, the fire was too large for it to handle.	The fire's cause is still under investigation. No other details were reported.	One firefighter was injured. Fire loss was listed as $15 million to the structure and $10 million to the contents.

Stephen G. Badger, 2001, "Large-Loss Fires of 2000", *NFPA Journal*, November/December, 62.

Propane Gas Grill Fire Spreads from Apartment Balcony, Wisconsin
A propane gas grill on a fourth-floor balcony leaked fuel, which ignited, and the resulting fire spread to the apartment building roof.

The four-story building, constructed of wood framing with a brick veneer, housed several apartments on the second, third, and fourth floors. Retail businesses were located on the first floor, and there was a parking garage in the basement. Smoke alarms were installed throughout, and there were heat detectors in the attic and mechanical rooms. Manual pull stations were located on every floor. A residential wet-pipe sprinkler system installed in compliance with NFPA 13R, *Installation of Sprinkler Systems in Residential Occupancies Up To and Including Four Stories in Height,* was operational at the time of the fire.

The fire began when the occupant of the fourth-floor unit started a propane grill on her balcony in preparation for cooking. She had only had the grill for about a month and had difficulty lighting the grill due to a faulty igniter switch. To start the grill, she resorted to either matches or lighted pieces of paper.

As she waited for the grill to warm up, the woman got a phone call and after five minutes shut off the grill. When she returned 45 minutes later, she restarted the grill again using a match when the igniter didn't work. Once the fire was going, however, she noticed flames near the neck of the propane cylinder. Although she immediately turned the burners off, the fire still burned at the cylinder. The woman called 911 to report the fire, then returned to the balcony to find that the fire had spread to the floor.

The woman tried to control the fire, but the flames continued to spread, so she left the apartment with her 4-year-old son. On the way out, she told occupants of the building she met in the stairwell about the fire but failed to activate a pull station that would have alerted the entire building.

Attempts by two occupants to control the fire with a portable extinguisher knocked down about 70 percent of the blaze, but failed to extinguish the flames that soon reached the ceiling of the balcony.

Responding to the 7:13 p.m. call, firefighters found fire on the top floor. Shortly after their arrival, they saw fire rolling across the fourth-floor ceiling. They later discovered fire in the eaves, but didn't realize fire was in the attic above them. Then firefighters discovered there was no standpipe connection available, they lowered ropes from a fourth-floor window and pulled a hose line up.

A second alarm was sounded as firefighters fought for more than two hours to control the fire.

Investigators determined that the fire began when a propane gas leak was ignited by the grill's burners. The fire then spread to combustible wood framing and roof supports, through the vinyl and aluminum covered soffits.

The residential sprinkler system in the apartment operated, but the fire spread in the attic. Eventually, the ceiling collapsed. Fire spread from the deck into the fourth floor was reduced by the sprinkler system, which didn't extend to the attic and roof.

The building suffered a $2 million loss. There were no injuries during the fire.

Kenneth J. Tremblay, 2000, "Firewatch," *NFPA Journal*, July/August, 18.

Neon Signs Ignite Wood Siding in Strip Mall, Arkansas

Flames traveled along a strip mall's open exterior façade before firefighters extinguished it. Although sprinklers and a fire wall kept the flames from entering the main building, damage was estimated at nearly $1 million.

The 15 retail stores in a single-story shopping center were of wood-frame construction. Each store had an individual fire detection system, and a wet-pipe sprinkler system had been installed throughout the building. The stores were closed for the night when the fire broke out.

A passerby discovered the blaze and called 911 on his mobile phone at 1:50 a.m. When firefighters arrived, they found the façade engulfed in flames and used a deck gun to extinguish the blaze. The wood-frame façade was sheathed in wood siding and affixed with a neon sign for each occupancy. Unfortunately, it was open from one end to the other with no separation.

The fire heavily damaged the facade, although three sprinklers and a fire wall kept flames from entering the stores. Investigators determined that one of the neon signs, which had recently been replaced, short circuited and ignited the siding.

The building, which had an estimated value of $750,000, suffered $650,000 in damage. Damage to the contents, valued at $300,000, came to $250,000.

Kenneth J. Tremblay, 2000, "Firewatch," *NFPA Journal*, September/October, 23.

Location, Dollar Loss, Date, Time	Property Characteristics and Operating Status	Fire Protection Systems	Fire Development	Contributing Factors and Other Details
Illinois $15,000,000 August, 1999 5:47 a.m.	This one-story warehouse for palletized cardboard cartons was of unprotected ordinary construction with a ground floor area of 140,000 square feet (13,006 square meters). When the fire broke out, the plant was closed.	The plant didn't have any automatic detection equipment. It did have a complete coverage wet-pipe sprinkler system, which activated and sounded an alarm. The sprinklers were ineffective, however, because the fire spread above the sprinkler heads.	The fire originated at ceiling level above the sprinklers system and spread through the wood truss roof. The cause was undetermined. Firefighters initiated an offensive attack. While venting the roof, firefighters found it to be spongy and evacuated the entire building. Soon after the roof collapsed. No injuries were reported.	The collapsing roof broke cross feeds to the sprinkler system. The open truss area contributed to the fire spread.

Stephen G. Badger and Thomas Johnson, 2000, "1999 Large-Loss Fires and Explosions", *NFPA Journal*, November/December, 88.

Location, Dollar Loss, Date, Time	Property Characteristics and Operating Status	Fire Protection Systems	Fire Development	Contributing Factors and Other Details
Wisconsin $5,000,000 September, 1999 6:11 p.m.	This one-story wood product manufacturing plant was of protected, ordinary construction and covered a ground-floor area of 100,000 square feet (9,290 square meters). The plant was in operation at the time of the fire.	The plant had no automatic detection equipment but did have a complete coverage wet-pipe sprinkler system. Although the sprinklers operated and sounded an alarm, they were ineffective because the fire started above them.	Workers performing roofing operations ignited a small fire in the roofing materials. The workers thought they completely extinguished the fire and left the area two hours later. A fire broke out approximately one hour later in the Styrofoam insulation between the upper and lower plywood roof decks. Firefighters initiated an interior attack on the fire until conditions deteriorated and they withdrew to a defensive attack. One firefighter was injured.	Fire department notification of the initial fire was delayed almost three hours. The water supply in the area was limited. Firefighters had trouble getting to the fire building. Railroad tracks on one side of the building and a lake on two other sides limited firefighters accessibility to only one side.

Stephen G. Badger and Thomas Johnson, 2000, "1999 Large-Loss Fires and Explosions", *NFPA Journal*, November/December, 88.

SHUT OFF

Two Intentional Fires in Foreclosed Home, Arizona
An intentionally set fire substantially damaged the second floor of a large, single-family house. Although the house, which was under foreclosure, had a fire sprinkler system, it failed to operated because the water had been shut off due to nonpayment.

The two-story wood-frame home, which covered approximately 5,900 square feet (548 square meters), was vacant at the time of the fire. All it contained was some trash and an upholstered couch. Hardwired smoke detectors were located in the common areas and bedrooms, but they had been disabled by lack of electricity.

A neighbor noticed the fire and called 911 at 11:58 p.m. Firefighters arrived minutes later to find heavy smoke and flames coming from the second floor, and extinguished the blaze using a tower ladder and several monitor nozzles.

Investigators found evidence that a door had been forced open before the firefighters arrived. They also determined that an accelerant poured on the second floor and in the first floor hallway had been ignited by an unknown ignition source. The fire consumed some of the remaining contents before it spread through structural floor and ceiling voids to the attic.

The home, valued at $1 million, incurred $200,000 in damage.

Two nights later, the house was destroyed by a second fire. By the time firefighters were summoned to the property at 8:05 p.m., flames were visible on both floors of the structure, and they had to use more than 160,000 gallons (606,000 liters) of water to extinguish the blaze.

Investigators found that the lock on the natural gas supply valve had been broken and that valves on the gas line in the laundry room had been opened before an accelerant poured in a first-floor hallway was ignited. The fire spread up the open stairs and vented through the roof, which had been opened during the previous fire.

Ken Tremblay, 2009, "Firewatch", *NFPA Journal*, September/October, 24.

Large-Loss Fire Involving Former Mill Building, Massachusetts
Dollar Loss: $26,000,000
Month: July 2007
Time: 4:14 am

Property Characteristics and Operating Status:
This three-story, irregularly-shaped former mill building was used by 56 mercantile businesses and covered 350,000 square feet (32,500 square meters). It was of unprotected ordinary construction. The building was closed at the time of the fire.

Fire Protection Systems:
There was no smoke detection equipment present. There was a full-coverage combination wet- and dry-pipe sprinkler system. A sprinkler valve in the area of ignition was padlocked shut, allowing the fire to quickly overwhelm the rest of the system. The fire department was not notified that the system was shut down.

Fire Development:
Investigators believe the fire started after welding was done in the basement the day before, without a permit from the fire department.

Contributing Factors and Other Details:
Several code noncompliance issues, such as the welding and shutting down the sprinkler system, contributed to the fire. Four hundred firefighters from 78 fire departments in two states responded to this fire. Nine firefighters were injured. The loss was estimated at $16,000,000 to the structure and $10,000,000 to the contents.

Stephen G. Badger, 2008, *" Large-Loss Fires in the United States in 2007", NFPA* Fire Analysis and Research, Quincy, MA

Location, Dollar Loss, Date, Time	**Property Characteristics and Operating Status**	**Fire Protection Systems**	**Fire Development**	**Contributing Factors and Other Details**
Maryland $11,000,000 May, 2005 7:00 p.m.	This storage complex consisted of a one-story vacant warehouse of unprotected ordinary construction and a second warehouse of unprotected noncombustible construction and covered 100,000 square feet (9,290 square meters). The site was closed.	There was no detection equipment present. There was a complete coverage dry-pipe sprinkler system present. The system was not operational, as it had been shut down when building became vacant.	This was an incendiary fire. The fire caused a complete collapse of the older brick building and fire damage to the steel storage building.	Four firefighters were injured. The loss was $10,000,000 to the structure and $1,000,000 to the contents.

Stephen G. Badger, 2006, "Large-Loss Fires for 2005", *NFPA Journal*, November/December, 68.

Location, Dollar Loss, Date, Time	Property Characteristics and Operating Status	Fire Protection Systems	Fire Development	Contributing Factors and Other Details
Illinois $20,000,000 April, 2005 6:00 p.m.	This one-story paper products manufacturing plant was of protected noncombustible construction and covered 243,000 square feet. The plant was at full operation when the fire broke out.	There was a partial coverage combination smoke and heat detection system present. The system was not located in the area of origin and it was not reported if the system activated. There was a complete coverage wet-pipe sprinkler system present. The flow from this system was not sufficient. The main switch to the fire pump was found shut off. How or when it was shut off was not reported.	An incendiary fire was set in the rolled paper storage area. This fire is still under investigation.	None Reported.

Stephen G. Badger, 2003, "Large-Loss Fires for 2002", *NFPA Journal*, November/December, 77.

Location, Dollar Loss, Date, Time	Property Characteristics and Operating Status	Fire Protection Systems	Fire Development	Contributing Factors and Other Details
Texas $11,000,000 August, 2004 5:56 p.m.	This four-story 100-unit apartment building was of unprotected wood-frame construction covering 32,000 square feet. The building was under construction at the time. Some workers were at the site when the fire broke out.	There was no detection equipment yet installed. There was a complete coverage wet-pipe sprinkler present but it was shut down before the fire due to a leak in the system.	A fire of unknown cause broke out on the second level of the building. Wind helped spread the fire throughout the units I the section of the building that was still in the framing phase. The fire spread to a parking garage then ignited a structure on the opposite side of the street.	Despite openings not yet protected by fire-rated doors, fire walls were effective in limiting the spread of fire. Two firefighters were injured.

Stephen G. Badger, 2005, "Large-Loss Fires for 2004", *NFPA Journal*, November/December, 44.

School Fire Spreads Due to Sprinkler Shut-Off, California

Fire heavily damaged an unoccupied school, because the water supply to the sprinkler system was shut off, allowing the fire to spread to the attic.

The single-story, wood-framed elementary school, which was 60 feet (18 meters) by 60 feet (18 meters), contained five classrooms, two work rooms, two bathrooms, and two mechanical rooms. The building had a peaked roof with a skylight in the middle. Although the property had sprinklers, the building's well, which supplied its water, was shut-down due to dirt in the system. There was also no fire detection system.

When neighbors saw smoke from the school at 7:07 p.m., they called 911 and activated the fire alarm on the building. Nine minutes later, arriving firefighters found smoke and flames coming from the roof and fire at one end of the interior hallway. They stretched hoselines to the building, entered, and began extinguishment.

Several fire companies coordinated a fire attack and ventilation strategy to extinguish the blaze, which had spread to the attic and roof before it even damaged the classrooms below.
One of the building's heating units was found within inches of the wall of origin. No other potential heat sources were found in the area.

Because there was no detection system or operating sprinkler system, the fire burned undetected into concealed spaces.

The structure, valued at $1 million, sustained an estimated $400,000 in direct property damage. Contents were valued at $150,000 and sustained $60,000 in damage.

Kenneth J. Tremblay, 2000, "Firewatch," *NFPA Journal*, July/August, 20.

Location, Dollar Loss, Date, Time	Property Characteristics and Operating Status	Fire Protection Systems	Fire Development	Contributing Factors and Other Details
Colorado $15,000,000 April, 1999 2:58 p.m.	This two-story single-family home had a ground-floor area of more than 5,000 square feet (464 square meters). The type of construction wasn't reported. No one was home when the fire broke out.	The house had an automatic detection system of unknown type and coverage, which operated. It also had a residential set-pipe sprinkler system, but it had been shut down during remodeling.	A light fixture in a closet ignited structural members. No details on the fire's subsequent growth and spread were reported. No injuries were reported.	None reported.

Stephen G. Badger and Thomas Johnson, 2000, "1999 Large-Loss Fires and Explosions", *NFPA Journal*, November/December, 93.

Location, Dollar Loss, Date, Time	Property Characteristics and Operating Status	Fire Protection Systems	Fire Development	Contributing Factors and Other Details
Massachusetts $10,000,000 June, 1999 3:37 p.m.	The warehouse in which the main losses occurred was in an old mill complex and stored new commercial dryers. The ground-floor area wasn't reported. The building in which the fire originated was a vacant one-story structure of unprotected, wood-frame construction.	No information was reported on automatic detection equipment. The warehouse's sprinkler system had been shut down before the fire.	Investigators believe that smoking materials caused the fire, which started in grass outside. The fire spread to a wood-frame dye house then to the warehouse. More than 250 firefighters responded from 24 cities and towns. Crews managed to contain the fire to approximately half the complex.	If the sprinkler system hadn't been shut down, it could have extinguished the fire in its incipient stage.

Stephen G. Badger and Thomas Johnson, 2000, "1999 Large-Loss Fires and Explosions", *NFPA Journal*, November/December, 88, 90.

Location, Dollar Loss, Date, Time	Property Characteristics and Operating Status	Fire Protection Systems	Fire Development	Contributing Factors and Other Details
Oregon $13,522,500 August, 1999 4:13 a.m.	This five-story apartment building with businesses on the lower level was under construction at the time of the fire. It was of protected, wood-frame construction and covered a ground-floor area of more than 50,000 square feet 4,645.0 square meters). There was no one at the site when the fire broke out.	No information was reported on automatic detection equipment. The building had a wet-pipe sprinkler that had been shut down during construction.	The only information reported was that this was an incendiary fire. No injuries were reported.	None reported.

Stephen G. Badger and Thomas Johnson, 2000, "1999 Large-Loss Fires and Explosions", *NFPA Journal*, November/December, 95.

Location, Dollar Loss, Date, Time	Property Characteristics and Operating Status	Fire Protection Systems	Fire Development	Contributing Factors and Other Details
Washington $7,000,000 December, 1999 3:23 a.m.	This 12-foot (3.7 meter) retail tool store was of unprotected, ordinary construction with a ground-floor area of 102,000 square feet (9,475.8 square meters). The store of origin, which was one of six businesses in the strip mall, covered a ground-floor area of 32,400 square feet (3,010 square meters). The store was closed.	No information was reported on automatic detection equipment. The entire strip mall had a shared wet-pipe sprinkler system, which had been disabled in the store of origin by a prior forklift incident. The sprinkler in the adjoining business helped control fire spread. There was also a dry-pipe system in a dry storage area.	Cardboard boxes containing plastic tarps failed and fell from rack storage, landing within a foot (.03 meters) of a heater. The propane heater was set up to help dry out the stock made wet by the sprinkler incident earlier in the day. The heater ignited the boxes and the blower pushed the burning embers into other storage. No injuries were reported.	With the sprinkler system disabled, there was no water flow alarm to notify the fire department, allowing the fire to burn a long time before the neighboring business' sprinkler activated.

Stephen G. Badger and Thomas Johnson, 2000, "1999 Large-Loss Fires and Explosions", *NFPA Journal*, November/December, 91.

Large-Loss Fire Warehouse Fire, Alabama
Dollar Loss: $5,000,000
Date: October 1997
Time: Not reported.

Property Characteristics and Operating Status:
This one-story general item warehouse was of unprotected, wood-frame construction with a ground-floor area of 297,000 square feet (28,000 square meters). It was in operation when the fire broke out.

Fire Protection Systems:
The building had no automatic detection system. It did have a complete-coverage dry-pipe sprinkler system, but the system didn't operated because it was out of service undergoing repair.

Fire Development:
The crew members of a passing fire department EMS transport unit discovered the fire when they noticed a large smoke plume in the air. The fire, which spread rapidly through

paper and wood and involved some pesticides, was allowed to burn to reduce the toxicity of involved areas. Its cause and origin are undetermined.

Contributing Factors:
None were reported.

Stephen G. Badger and Thomas Johnson, 1998, 1997 Large-Loss Fires and Explosions, *NFPA Journal,* November/December, 88.

Large-Loss Warehouse Fire, Texas
Dollar Loss: $45,000,000
Time: 10:31 a.m.
Month: November 1993

The Building:
The warehouse was used to store baled and rolled paper, and plastics. The single-story structure was of unprotected noncombustible construction with a ground-floor area of 500,000 square feet. It was operating at the time.

Detection and Suppression Systems:
The warehouse was not equipped with automatic detectors, but it did contain a complete wet-pipe sprinkler system.

The Fire:
Fire investigators believe that loose scrap paper became lodged in a forklift that was being used to move bales of paper. The paper caused the forklift to overheat and ignite the baled paper. Workers discovered the fire and notified the fire department using 911. Fire fighters attempted an interior fire attack, but they were forced out of the warehouse after the roof started to show signs of collapse. The entire warehouse and its contents were destroyed.

Contributing Factors and Other Details:
The water supply to the sprinkler system had been turned off due to a leak in the supply pipe for the system.

Large undivided areas, tons of combustible paper storage, and open overhead doors contributed to the rapid spread of fire throughout the warehouse.

Michael J. Sullivan, 1994, "Property Loss Rises in Large-Loss Fires" *NFPA Journal*, November/December, 95.

INOPERATIVE

Delayed Alarm Leads to $2 Million Loss, Texas

A plastic manufacturing plant was completely destroyed when a cutting torch ignited cardboard, plastics, and other trash, and the fire spread rapidly to storage. A delay in fire department notification and a disabled sprinkler contributed to the huge loss.

The two-story plant had a steel frame, with a metal deck roof and masonry walls. It was 200 feet (61 meters) long and 400 feet (122 meters) wide. A wet-pipe system was inoperable, and its owners had been issued a notice to repair by fire officials. There were no smoke alarms, and the building was operating at the time of the fire.

Employees were using a cutting torch to remove a metal gate and overhead door assembly on a loading dock when the torch came into contact with the combustible trash. The resulting fire spread quickly while the employees tried to control it with hand-held extinguishers before calling the fire department.

The department received a 911 call from the plant manager at 10:35 A.M. Arriving 2 ½ - minutes later, the first company saw "a wall of fire" at one corner of the building.

Two firefighters and two civilians were injured during the incident. The structure, valued at $1 million, and contents, valued at $1 million, were a total loss.

Kenneth J. Tremblay, 2000, "Firewatch," *NFPA Journal*, May/June, 38.

WRONG TYPE OF SYSTEM

Location, Dollar Loss, Date, Time	Property Characteristics and Operating Status	Fire Protection Systems	Fire Development:	Contributing Factors and Other Details
Arizona $100,000,000 August, 2000 4:58 p.m.	The fire broke out in a warehouse containing a home and garden supply company and a pharmaceuticals distribution company. The construction and height of the structure weren't reported. Employees were working in one of the companies when the fire broke out.	No information was available on automatic detection equipment. A sprinkler system, whose type and extent of coverage weren't known, wasn't adequate for the stored merchandise.	Due to litigation, officials are releasing no information on the fire's development.	None reported.

Stephen G. Badger, 2001, "Large-Loss Fires of 2000", *NFPA Journal*, November/December, 61.

Location, Dollar Loss, Date, Time	Property Characteristics and Operating Status	Fire Protection Systems	Fire Development:	Contributing Factors and Other Details
Georgia $7,300,000 March, 1999 1:23 p.m.	This two-story general storage warehouse of protected noncombustible construction covered a ground-floor area of 75,000 square feet (6,967.5 square meters). The warehouse was operating at the time of the fire.	The warehouse didn't have an automatic detection system. It did have a wet-pipe sprinkler system, but its coverage wasn't known. The system operated but wasn't effective because it hadn't been maintained well and because it wasn't designed for the commodities stored.	Because investigators believe that toxic materials were present, they suspended investigation of this fire before determining a cause. The fire broke out in an unoccupied area. With a rapid fire spread due to 700 to 1,000 tons (635 to 907.2 metric tons) of group A plastics and a delay in notifying the fire department, an interior fire attack wasn't possible. By the time the fire department arrived, flames had consumed 100 feet (30.5 meters) of the building. No injuries were reported.	The sprinkler system was poorly maintained and not appropriate for the commodities stored. It took awhile for someone to discover the fire because it stared in a remote, unoccupied area. The person who discovered the fire called others in the building before notifying the fire department.

Stephen G. Badger and Thomas Johnson, 2000, "1999 Large-Loss Fires and Explosions", *NFPA Journal*, November/December, 88.

Location, Dollar Loss, Date, Time	Property Characteristics and Operating Status	Fire Protection Systems	Fire Development:	Contributing Factors and Other Details
Pennsylvania $6,000,000 August, 1999 5:57 p.m.	This approximately 50-foot (15.2 meters) steel manufacturing building was of unprotected, noncombustible construction with a ground-floor area of 20,000 square feet (1,858 square meters). Although the plant was closed for the night, maintenance workers were inside.	The plant didn't have any automatic detection equipment, but it did have a partial coverage wet-pipe sprinkler system. The sprinklers were ineffective because of missing heads and the fact that the system wasn't designed for this hazard. The system outside the area did help stop the fire spread.	Investigators haven't determined the cause of this fire, but they believe it started in a dip-tank area. Six firefighters were injured fighting the blaze.	The poorly maintained sprinkler system wasn't designed for the hazard involved, and heads were missing.

Stephen G. Badger and Thomas Johnson., 2000, "1999 Large-Loss Fires and Explosions", *NFPA Journal*, November/December, 85-86.

SYSTEM COMPONENT DAMAGE

Location, Dollar Loss, Date, Time	Property Characteristics and Operating Status	Fire Protection Systems	Fire Development	Contributing Factors and Other Details
Indiana $10,000,000 September, 2005 11:59 p.m.	This outdoor furniture and cushion manufacturing plant was of unprotected ordinary construction and had a ground floor area of 279,000 square feet (25,919 square meters). The height was not reported. The plant was in full operation.	There was no detection equipment present. There was a complete coverage combination wet- and dry-pipe sprinkler system. The system operated but risers were heavily damaged by a roof collapse.	The fire broke out in a woodworking area. The ignition sequence is still under investigation.	Over the years, the building had many add-ons and multiple roofs that firefighters had to work through to reach to the fire.

Stephen G. Badger, 2006, "Large-Loss Fires for 2005", *NFPA Journal*, November/December, 70.

Location, Dollar Loss, Date, Time	Property Characteristics and Operating Status	Fire Protection Systems	Fire Development	Contributing Factors and Other Details
Missouri $5,000,000 October, 2005 2:42 p.m.	This two-story food preparation plant was under construction. It was of protected noncombustible construction. The ground floor area was not reported. Workmen were on location with ongoing construction.	There was unreported coverage smoke detection equipment present. The system had been shut off due to construction work. There was an unreported coverage wet-pipe sprinkler system present. The system was damaged during the explosion and it did not operate.	An explosion and fire occurred when a natural gas valve was installed in the kitchen area and left in the open position and uncapped. The source of ignition is still under investigation.	One person died and 15 were injured in the explosion.

Stephen G. Badger, 2006, "Large-Loss Fires for 2005", *NFPA Journal*, November/December, 69-70.

Location, Dollar Loss, Date, Time	Property Characteristics and Operating Status	Fire Protection Systems	Fire Development	Contributing Factors and Other Details
Indiana $5,000,000 Apri, 2004 7:45 a.m.	This two-story foam products vinyl coating plant was of protected non-combustible construction and covered 20,000 square feet. The plant was in full operation at the time of the fire.	There was no automatic detection equipment present. There was a complete coverage wet-pipe sprinkler system. The system did not operate due to damage to its supply line during an explosion.	A small explosion occurred in or around an automatic spray booth where vinyl was sprayed onto foam. The cause is still under investigation. A second and larger explosion occurred, blowing out walls and collapsing the roof. A fire broke out in two of the paint booths. The fire was contained to this area by the fire department.	Five civilians suffered various injuries related to the explosion and fire. Damage to the structure was estimated at $1,500,000 and $3,500,000 to the contents.

Stephen G. Badger, November, 2005, "Large-Loss Fires in the United States 2004", 22.

Location, Dollar Loss, Date, Time	Property Characteristics and Operating Status	Fire Protection Systems	Fire Development	Contributing Factors and Other Details
North Carolina $9,000,000 December, 2003 12:24 p.m.	This one-story plastics item manufacturing plant of heavy timber construction covered 18,000 square feet (1,672 square meters) and was in full operation at the time of the fire.	No automatic detection equipment was present. A complete coverage wet-pipe sprinkler system was present and operated but it was ineffective due to damage from a collapse that caused a large loss of water to other sections of the system.	Welding on a piece of machinery ignited a pile of polyester waste on the floor. Employees attempted to extinguish the blaze with hand-held extinguishers but were unsuccessful against a large spreading fire.	Three firefighters were injured and loss to building was $5,000,000 and loss to contents was $4,000,000.

Stephen G. Badger, 2004, "Large-Loss Fires for 2003", *NFPA Journal*, November/December, 52.

Location, Dollar Loss, Date, Time	Property Characteristics and Operating Status	Fire Protection Systems	Fire Development	Contributing Factors and Other Details
Wisconsin $17,000,000 July, 2002 9:23 p.m.	This 110-foot-high magazine printing plant with automated rack storage retrieval was of unprotected noncombustible construction and covered 61,600 square feet. The plant was in full operation when the fire broke out.	There was a complete coverage smoke detection system present but its installation was not yet complete. There was a complete coverage wet-pipe sprinkler system present. A building collapse prior to the fire damaged and rendered useless the sprinkler system and risers.	A building collapse caused stored magazine paper to come in contact with a broken 400-watt metal halide light bulb. Fire then spread rapidly throughout the collapsed structure. The reason for the collapse was not reported.	The paper contents and windy conditions contributed to rapid fire spread. The suppression system was damaged in the collapse and did not operate. The collapse also blocked alleyways, hampering firefighting operations.

Stephen G. Badger, 2003, "2002 Large-Loss Fires", *NFPA Journal*, November/December, 77.

Location, Dollar Loss, Date, Time	Property Characteristics and Operating Status	Fire Protection Systems	Fire Development	Contributing Factors and Other Details
Mississippi $16,070,001 May, 2002 6:00 p.m.	This one-story rubber reclaiming plant was of unprotected noncombustible construction and covered 60,000 square feet. The plant was in full operation at the time of the fire and explosion.	There was a complete coverage heat detection system present. This system did not operate because an explosion destroyed a large portion of it. There was a local suppression system in the drying system, which operated but was not effective. There was a complete coverage wet-pipe sprinkler system present. The system was damaged by the explosion and was not effective in the area of origin but did control the fire in the area unaffected by the blast.	A fire in a rubber dust particle drying system was not fully extinguished by the dryer's suppression system, allowing the fire to extend through a vent pipe located above the roof. Embers ignited accumulated rubber dust on the roof. The fire then spread to the bagging station where a rubber dust explosion occurred throughout the plant, igniting more rubber dust and combustibles.	Five civilians were killed and seven injured in this fire.

Stephen G. Badger, 2003, "2002 Large-Loss Fires", *NFPA Journal*, November/December, 77.

Location, Dollar Loss, Date, Time	Property Characteristics and Operating Status	Fire Protection Systems	Fire Development	Contributing Factors and Other Details
Kansas $15,000,000 September, 2002 2:26 p.m.	This 70-foot-high alcohol distillery was of unprotected noncombustible construction. The area covered was not reported. The plant was in full operation at the time of the explosion and fire.	There was no automatic detection system present. There was a partial coverage wet sprinkler system present. It was not effective due to damage caused by the explosion.	A manhole cover door left open in a lower vapor chamber of a still allowed vapors to escape into the still house. An unknown ignition source caused an explosion that ruptured additional pipes, allowing a large amount of grain alcohol to flow and continue to burn.	Four civilians were injured in this fire.

Stephen G. Badger, 2003, "2002 Large-Loss Fires ", *NFPA Journal*, November/December, 78.

Location, Dollar Loss, Date, Time	Property Characteristics and Operating Status	Fire Protection Systems	Fire Development	Contributing Factors and Other Details
Virginia $40,000,000 September, 2001 9:40 a.m.	Five-story office building of protected noncombustible construction was in full operation at the time. The building covered a ground floor area of approximately 1.3 million square feet (approximately 123,500 square meters).	There was a complete coverage smoke detection system present. There was a partial coverage wet-pipe sprinkler system. These systems were overwhelmed by the massive explosion, fire and structural collapse.	A hijacked commercial airliner crashed into the side of the office building and exploded on impact. Burning jet fuel ignited standard office furniture and materials.	One hundred and eighty-nine civilians were killed and 99 building occupants and 12 firefighters were injured.

Stephen G. Badger, November, 2002, "Large-Loss Fires in the United States 2001", 29.

Location, Dollar Loss, Date, Time	Property Characteristics and Operating Status	Fire Protection Systems	Fire Development	Contributing Factors and Other Details
Minnesota $10,000,000 March, 2001 5:08 a.m.	Two-story wood products manufacturing plant of unprotected wood frame construction was in full operation at the time the fire broke out. The ground floor area was not reported.	There was no automatic detection equipment present. A dry-pipe sprinkler system was present. The extent of coverage was not reported. A ceiling collapse preceding the fire damaged the system, rendering it ineffective.	A roof collapse caused by a heavy snow load is believed to have caused wires to spark and ignite dust that had accumulated above the ceiling. The fire then spread to pallets of wood product.	None reported.

Stephen G. Badger, November, 2002, "Large-Loss Fires in the United States 2001", 13-14.

State, Date, Time of Alarm, Dollar Loss	Property Characteristics and Operating Status	Fire Protection Systems	Fire Development	Contributing Factors and Other Details
Michigan. March, 2001 8:11 a.m. $5,500,000	One-story plastic products manufacturing plant of protected ordinary construction covering 44,160 square feet (4,103 square meters) was in full operation at the time of the explosion and fire.	There was a partial coverage smoke detector system that was not in the area of the explosion and it did not activate. There was a complete coverage wet-pipe sprinkler system present. This system was damaged by the explosion and roof collapse. Water flowing from the severed branch main did extinguish the fire.	A fire on a forklift vehicle in this plant impinged on the propane cylinder on the vehicle. The cylinder exploded. The explosion collapsed the wall and roof of the plant and caused a small fire.	Losses totaled $4,000,000 to the structure and $1,500,000 to the contents.

Stephen G. Badger, November, 2002, "Large-Loss Fires in the United States 2001", 16.

Location, Dollar Loss, Date, Time	Property Characteristics and Operating Status	Fire Protection Systems	Fire Development	Contributing Factors and Other Details
Michigan $650,000,000 February, 1999 1:00 p.m.	This six-story power plant at an automobile manufacturing complex was of protected, noncombustible construction and covered a ground-floor area of 80,874 square feet (7,513.2 square meters). The plant was in full operation at the time of the explosion and ensuing fire.	The power plant didn't have automatic detection equipment. There was a partial area coverage wet-pipe sprinkler system. The areas covered weren't reported. This system did activate but wasn't able to contain or extinguish the fire due to the extreme circumstances and damage to the system by the explosion and fire.	A build-up of natural gas in a boiler was ignited by an undetermined source. The explosion heavily damaged the building. Six civilians died in the blast and another 38 were injured.	According to investigators, several safety devices were removed or inoperative.

Stephen G. Badger and Thomas Johnson, 2000, "1999 Large-Loss Fires and Explosions", *NFPA Journal*, November/December, 95-96.

Location, Date, Time of Alarm, Number of Deaths	Occupancy Type and Use, Construction Type, Number of Stories, and Operating Status	Detection Systems	Suppression Systems	Fire Origin and Path	Contributing Factors and Other Details
Michigan November, 1999 9:00 p.m. Five	Convalescent home; protected ordinary construction; one story; full operation.	The building had smoke alarms and heat detectors throughout.	The wet-pipe sprinkler system in the basement was destroyed in the explosion.	The fire started in the boiler room. A small initial explosion was followed by another. Other details of the ignition remain undetermined.	The occupants had no time to react to the explosion.

Robert S. McCarthy, 2000, "1999 Catastrophic Multiple-Death Fires", *NFPA Journal*, September/October, 59.

LACK OF MAINTENANCE

Location, Dollar Loss, Date, Time	Property Characteristics and Operating Status	Fire Protection Systems	Fire Development	Contributing Factors and Other Details
South Carolina $8,000,000 March, 2005 6:53 a.m.	Four-story textile manufacturing plant of heavy timber construction covering 67,500 square feet (6,271 square meters) was in full operation at the time this fire broke out.	There was a complete coverage detection system of an unreported type. This system was out of service for an unreported reason at the time of the fire. A complete coverage wet-pipe sprinkler system was present. The system operated but was ineffective due to lack of maintenance. The sprinkler heads were coated with cotton dust. There were pressurized water and ABC extinguishers present, which the employees used to extinguish the fire in a baler.	A fire originating in a baler was believed extinguished by the employees. The cause was not reported. When firefighters arrived and investigated they found the fire had extended to the second floor. Firefighters attempted an interior attack, but conditions deteriorated rapidly and walls started to collapse, so all firefighters were withdrawn to a defensive attack.	Three firefighters were injured. Holes in the floor on the second story allowed the fire to extend to the second story. Losses totaled $5,000,000 to the structure and $3,000,000 to the contents.

Stephen G. Badger, November, 2002, "Large-Loss Fires in the United States 2001", 14.

Location, Dollar Loss, Date, Time	Property Characteristics and Operating Status	Fire Protection Systems	Fire Development	Contributing Factors and Other Details
California $6,000,000 July, 1999 7:25 p.m.	This four-story furniture showroom of protected, non-combustible construction covered a ground-floor area of approximately 44,000 square feet (4,087.5 square meters). The showroom was closed but construction workers were in the building.	The building had no automatic detection system but did have a partial-coverage sprinkler system. Sprinklers helped control fire spread on the second and third floors but weren't effective on the fourth floor because of sediment in the system. Firefighters found sediment blocking several heads. The building also had portable extinguishers and a stand pipe system. Investigators believe that workers used the extinguishers.	Molten slag came in contact with furniture during welding operations and ignited a fire. The fire spread out the second-floor windows and into the third floor. Flames then breached a ceiling and entered the fourth floor where there was a flashover. No injuries were reported.	Sediment blocked sprinklers on the fourth floor.

Stephen G. Badger and Thomas Johnson, 2000, "1999 Large-Loss Fires and Explosions", *NFPA Journal*, November/December, 92.

OBSTRUCTED WATER FLOW

Location, Dollar Loss, Date, Time	Property Characteristics and Operating Status	Fire Protection Systems	Fire Development	Contributing Factors and Other Details
Arizona $8,000,000 December, 2004 7:33 p.m.	This two-story convention center was of protected non-combustible construction. The ground floor area was not reported. The center was fully operating at the time of the fire.	There was a smoke detection system present that operated and alerted the occupants. The coverage was not reported. There was a wet-pipe sprinkler system present. The system did activate with over 30 heads flowing water.	Heat from a halogen light ignited walnut dust used in filming a collapse scene in a mine for a movie. The fire ignited polyurethane beams and walls of a cave and extended to the cave roof. A covering over the movie set prevented water from the sprinkler from reaching the seat of the fire but the sprinkler flow did prevent the fire's spread beyond the set.	Original reports were that one worker was missing. A primary search was initiated but the worker was located unharmed. Visibility was zero as firefighters attempted an initial fire attack. Firefighters were warned initially of loose rattlesnakes at the movie set. The snakes were corralled by an animal handler and posed no threat to the firefighters and harmed no one.

Stephen G. Badger, 2005, "Large-Loss Fires for 2004", *NFPA Journal*, November/December, 49.

WATER FLOW ISSUES

Location, Dollar Loss, Date, Time	Property Characteristics and Operating Status	Fire Protection Systems	Fire Development	Contributing Factors and Other Details
Iowa $250,000,000 February, 2000 7:02 a.m.	One-story machinery storage warehouse of unprotected non-combustible construction covering 990,000 square feet (91,974 square meters) was in full operation at the time the fire broke out.	There was no automatic detection equipment. A system was in the process of being installed. A wet-pipe sprinkler system was present. The extent of the coverage was not reported. This system activated but was not effective because of a water flow problem. The cause of the problem is still being investigated.	A fire of unknown cause broke out in the shipping/receiving area of this warehouse. Responding firefighters reported a large column of smoke from a distance away. With the sprinkler system activated, firefighters made an interior attack. Walls without openings within the warehouse hindered firefighters in reaching the fire. When large areas of the roof began to collapse and high rack storage failed, firefighters withdrew to a defensive attack.	Five firefighters were injured. The water supply was far below the fire flow requirements. A tanker shuttle was set up to assist until late in the day when the water problems were corrected.

Stephen G. Badger, November, 2002, "Large-Loss Fires in the United States 2001", 17.

OTHER

Location, Dollar Loss, Date, Time	Property Characteristics and Operating Status	Fire Protection Systems	Fire Development	Contributing Factors and Other Details
Texas $18,000,000 December, 2005 2:06 p.m.	This was a cotton storage facility of unprotected noncombustible construction was operating. The height and area were not reported.	No information on detection equipment was reported. There was a sprinkler system in the building. The coverage and type was not reported. The system operated but was overwhelmed by the spreading fire.	This was an exposure fire. A welder working in a livestock auction facility unintentionally ignited hay in a pen. The fire spread to grass and then across a road to cotton bales, and into the storage building.	High winds spread the fire very rapidly. Embers blowing from the fire ignited several smaller fires in town. Ten fire departments were called to assist.

Stephen G. Badger, 2006, "Large-Loss Fires for 2005", *NFPA Journal*, November/December, 72.

Location, Dollar Loss, Date, Time	Property Characteristics and Operating Status	Fire Protection Systems	Fire Development	Contributing Factors and Other Details
Louisiana $11,000,000 September, 2005 12:57 p.m.	This L-shaped, one-story mall of unprotected ordinary construction had a floor area of 100,000 square feet (929 square meters) and contained 110 stores and eateries. The operating status was not reported.	There was smoke detection equipment present. The coverage and operation was not report. There was a wet-pipe sprinkler system of unreported coverage. The system did operate as designed until pressure was lost to the system. By the time the fire department re-established water flow and pressure to the systems the fire had overwhelmed the system and 100 sprinklers operated.	This incendiary fire was set in a show room of a mall store in wearing apparel. The fire spread to and destroyed 15 stores in one wing of the building, and caused smoke and water damage to the rest of the mall.	The loss was $8,000,000 to the structure and $3,000,000 to the contents.

Stephen G. Badger, November, 2006, "Large-Loss Fires In The United States 2005," 25.

Location, Dollar Loss, Date, Time	Property Characteristics and Operating Status	Fire Protection Systems	Fire Development	Contributing Factors and Other Details
Oregon $23,013,625 July, 2005 12:42 p.m.	This one-story sawmill was of heavy-timber construction and covered a ground floor area of more than 100,000 square feet (9,290 square meters). The mill was at full operation at the time of the fire.	There was no detection equipment present. There was an unreported coverage wet-pipe sprinkler system present. The system operated but was overpowered by the spreading fire.	The fire originated in the area of an electric motor above a dryer. The exact heat source and first materials ignited were still under investigation. The fire burned in hidden areas until it spread to the heavy timber bowstring truss roof construction. Several interior attacks were attempted but the fire was very deep-seated and firefighters were withdrawn for an exterior attack. Shortly after this, there was a structural collapse.	There was a long delay in notifying the fire department while workers attempted to extinguish the fire. Firefighters were told upon arrival the fire was out, but on investigation, firefighters found a deep-seated fire. Three firefighters were injured. The loss was $5,013,000 to the structure and $18,000,625 to contents.

Stephen G. Badger, 2006, "Large-Loss Fires for 2005", *NFPA Journal*, November/December, 70.

Location, Dollar Loss, Date, Time	Property Characteristics and Operating Status	Fire Protection Systems	Fire Development	Contributing Factors and Other Details
Georgia $50,000,000 May, 2004 4:25 a.m.	This one-story chemical manufacturing plant was of protected ordinary construction and covered 400,000 square feet. The plant was in operation at the time.	There was no automatic detection equipment present. There was a complete coverage wet-pipe sprinkler system present. The system activated but was overpowered by the spreading fire. The reason for this was not reported.	A fire broke out when a chemical reaction occurred in the warehouse area of the plant. The chemicals involved were not identified.	Very heavy smoke covered the area, causing local officials to evacuate many downwind of the fire. Damage to the structure was estimated at $20,000,000 and $30,000,000 to the contents.

Stephen G. Badger, 2005, "Large-Loss Fires for 2004", *NFPA Journal*, November/December, 46.

Location, Dollar Loss, Date, Time	Property Characteristics and Operating Status	Fire Protection Systems	Fire Development	Contributing Factors and Other Details
Illinois $6,800,000 October, 2003 4:03 a.m.	This three-story warehouse containing tires was of heavy timber construction and covered 150,000 square feet (13,935 square meters). The warehouse was closed for the weekend.	No automatic detection equipment was present. A complete coverage wet-pipe sprinkler system was present and operated, but was ineffective due to the large fire load.	The cause is undetermined.	Fire growth was extremely fast due to the fire load. Firefighters were forced to withdraw to a defensive attack. Two firefighters were injured. Loss to the building was $800,000 and loss to contents was $6,000,000.

Stephen G. Badger, 2004, "Large-Loss Fires for 2003", *NFPA Journal*, November/December, 57.

Location, Dollar Loss, Date, Time	Property Characteristics and Operating Status	Fire Protection Systems	Fire Development	Contributing Factors and Other Details
Oregon $8,501,000 March, 2004 8:21 a.m.	This one-story petroleum recycling plant was of heavy-timber, construction and covered 186,900 square feet. The plant was in full operation at the time.	No information was reported on any detection equipment. There was a complete coverage dry-pipe sprinkler system present. The system operated, but its rate of application was insufficient to control the fire.	A spark from an oxy/acetylene cutting torch fell into an open sludge-oil pit and ignited the contents instantaneously. The fire grew out of control quickly despite the activation of the sprinkler system. The fire spread through several businesses inside the building.	Firefighters reported insufficient water pressure in hydrants originally. Two firefighters were injured. Damage to the structure was estimated at $3,000,000 and $5,501,000 to the contents.

Stephen G. Badger, 2005, "Large-Loss Fires for 2004", *NFPA Journal*, November/December, 47.

Location, Dollar Loss, Date, Time	Property Characteristics and Operating Status	Fire Protection Systems	Fire Development	Contributing Factors and Other Details
Colorado $30,000,000 December, 2002 8:47a.m.	This 24-foot-high, one-story general products warehouse was of protected ordinary construction and covered a ground floor area of 120,415 square feet. The warehouse was closed at the time of the fire.	There was no automatic detection system present. There was a complete coverage wet-pipe system present. The system did activate but was ineffective when it was overwhelmed by the fire's growth.	Several incendiary fires were set in this warehouse to cover up a burglary.	One firefighter and four civilians were injured.

Stephen G. Badger, 2003, "2002 Large-Loss Fires", *NFPA Journal*, November/December, 78.

Location, Dollar Loss, Date, Time	Property Characteristics and Operating Status	Fire Protection Systems	Fire Development	Contributing Factors and Other Details
Indiana $27,000,000 October, 2002 3:00 a.m.	This one-story steel manufacturing plant was of unprotected ordinary construction. The ground floor area was not reported. The plant was in full operation at the time of the fire.	There was no automatic detection system present. There was a complete coverage sprinkler system of unreported type present. The system operated but was overwhelmed by the spreading fire.	The fire originated in a hanging natural gas furnace and swept through the plant.	None Reported.

Stephen G. Badger, 2003, "2002 Large-Loss Fires", *NFPA Journal*, November/December, 77.

Location, Dollar Loss, Date, Time	Property Characteristics and Operating Status	Fire Protection Systems	Fire Development	Contributing Factors and Other Details
Montana $7,000,000 January, 2002 9:40 p.m.	This two-story lumber warehouse was of unprotected noncombustible construction and covered a ground floor area of 9,000 square feet. The warehouse was closed for the night.	There were no automatic detection or suppression systems present. An exposure building did have a dry-pipe sprinkler system, but this was overcome and ineffective when the fire attacked that structure from the exterior.	This incendiary fire was set in available combustible materials. The building was fully engulfed in fire when the fire department arrived, forcing them to go to an exterior attack. The fire spread to several warehouses in the area.	Because of the remote location, the fire burned undetected for some time. Faulty hydrants and dead-end mains impeded water supply. Three firefighters were injured.

Stephen G. Badger, November, 2003, "Large-Loss Fires in the United States 2002", 17.

Location, Date, Time of Alarm, Number of Deaths	Occupancy Type and Use, Construction Type, Number of Stories, and Operating Status	Detection Systems	Suppression Systems	Fire Origin and Path	Contributing Factors and Other Details
Michigan February, 1999 1:00 p.m. Six	Industrial power plant; unprotected non-combustible construction; six stories; full operation.	None.	The power plant had a partial wet-pipe sprinkler system.	An undetermined source ignited an accumulation of natural gas in a boiler.	According to the state OSHA report, several safety devices at the plant had been defeated or removed, and there were no written procedures posted for shutting down the boiler. Sprinklers were unable to control the fire caused by the explosion. Thirty-eight workers were injured in the blast.

Robert S. McCarthy, 2000, "1999 Catastrophic Multiple-Death Fires", *NFPA Journal*, September/October, 59.

Home Fire Sprinkler®
COALITION
Protect What You Value Most®

Home Fire Sprinkler Systems:
Separating Fact from Fiction

This fact sheet was prepared by the nonprofit Home Fire Sprinkler Coalition (HFSC). HFSC is the only national, non-commercial organization working exclusively to educate the public about the life-saving value of installed residential fire sprinkler systems. HFSC develops a wide range of fire safety educational materials for consumers, members of the homebuilding industry, insurance and real estate professionals, and for the fire service to use in local educational outreach. All materials are provided at no charge and are available via HFSC's Web site: www.homefiresprinkler.org.

Home Fires: More than 3,000 Lives Lost Every Year
The fire problem in the U.S. is overwhelmingly a home fire problem. According to the nonprofit National Fire Protection Association (NFPA), homes account for about 80% of all fire deaths in a typical year and more than 95% of all deaths in structure fires in a typical year. Quite clearly, any improvements in overall fire safety must be improvements in home fire safety, and no strategy has as much documented life safety effectiveness as fire sprinklers.

Homes Burn, Whether New or Old
Few fatal home fires involve installed features of homes. Instead, they usually involve the actions and errors of the occupants in combination with the flaws and vulnerabilities of products brought into the home.

Modern Home Fires Burn Faster
New homes benefit from fire sprinkler protection as much as older homes. Research conducted by the National Institute of Standards and Technology (NIST) has shown that home fires become deadly in as few as three minutes. "Fires today seem to burn faster and kill quicker, because the contents of modern homes (such as furnishings) can burn faster and more intensely," says NIST Research Richard Bukowski. New and old homes alike are filled with these newer contents and furnishings, which provide less margin for success for smoke alarms and add to the need for fire sprinklers.

Most Fires Occur in Properties without Fire Sprinklers
NFPA data show that while sprinkler usage is growing in most properties, most fires occur in structures without fire sprinklers. The percentage of reported fires in sprinklered properties continues to fall in the range of 1-2% for one- and two-family dwellings.

Smoke Alarms Are Essential, But Only Part of the Solution

Every home needs working smoke alarms on each level, and each household should hold regular fire drills to practice how to properly respond to a fire alarm. Smoke alarms cut the risk of dying if a home fire occurs by one-half. However, many high-risk populations – infants, children, people with disabilities, older adults – can have difficulty hearing smoke alarms, difficulty being wakened by smoke alarms, or difficulty reacting quickly and effectively enough for safe escape. Some of these limitations can be removed with changes in smoke alarm design and requirements and with education. But there will always be people who need more time to escape than any detection/alarm system can provide. Their lives depend on stopping the fire early in its development. Their lives depend on fire sprinklers.

Fire Sprinklers Do What No Other Technology Can

Fire sprinklers provide a level of protection that no other fire protection technology can offer. Smoke alarms are essential: they provide valuable early warning. Fire sprinklers immediately respond to a fire while it is still small, controlling the spread of deadly heat, flames and toxic smoke – whether or not the occupants have appropriately responded to the signaling smoke alarm. Fire sprinklers make up for human error, and they provide a life-saving cushion for a time-consuming escape.

How Fire Sprinklers Work

In most settings where there is a municipal water supply, sprinklers operate off the household water main. When the water supply is a well, or there is not enough water pressure, a holding tank is used. Sprinklers are linked by a network of piping, typically hidden behind walls and ceilings. The high temperature of an early-stage fire (135˚-165˚F) will cause the sprinkler to activate. Only the sprinkler closest to the fire will operate, spraying water directly on the flames. This quick action immediately controls (often extinguishes) the flames, slowing the spread of deadly heat and toxic smoke and providing occupants with more time to safely escape.

Smoke Cannot and Will Not Cause a Fire Sprinkler to Operate

Fire sprinklers respond only to the high temperature of flames. Unlike interconnected smoke alarms (if one signals, they all signal), fire sprinklers activate independently. Despite the fictional special effects commonly seen in action movies, fire sprinklers do not spray water all at once. They do not operate in response to smoke, burned toast, cooking vapors, steam, or an activating smoke alarm.

Home Fire Sprinklers Are Simple to Maintain

Home fire sprinkler systems require very little maintenance. In fact, the sprinklers themselves require nothing more than an occasional look to ensure that nothing is hanging from them, or blocking them. Valves should be similarly checked to ensure they are turned on. The sprinkler system flow switch and water flow alarms should be tested about once a year – a simple test that can be done by the homeowner.

Fire Sprinklers Are a Smart Investment for Homeowners

Installing fire sprinklers in a new home – at an average cost of $1.50 - $2.50 per square foot nationally – is equivalent to installing solid-surface counter tops or other similar

upgrades. The sprinkler system is paid for over the life of a mortgage, just as is the electrical or plumbing system. A national poll conducted in Dec. 2005 by Harris Interactive® showed that two-thirds (69%) of U.S. homeowners say having a fire sprinkler system increases a home's value.

Fire Sprinklers Are a Smart Investment for Developers

Reduced labor costs and trade-up incentives have made fire sprinklers a valuable way for homebuilders to protect their bottom line. Options vary, but typical trade ups for a sprinklered residential development or sub-division include street width reduction, additional units, and increased hydrant spacing.

The Home Insurance Industry Encourages Sprinkler Installations

The insurance industry banks on the fact that having installed fire sprinklers not only protects against fire injuries and deaths; they also protect against fire damage. As an incentive for customers, insurance companies offer discounts ranging from 5% to 30% off the fire portion of homeowner premiums. HFSC urges consumers to shop around for the best insurance discount.

The Fire Service Supports Home Sprinkler Installations

No one knows better than first responders how quickly a home fire grows and spreads, becoming lethal to occupants as well as to firefighters. Since publication of the 1973 watershed national report *America Burning*, the fire safety field generally and the fire service in particular have been vocal advocates for increasing home fire sprinkler installations as a means to reduce residential fire injuries and deaths.

Home Builders Rely on HFSC for the Facts

Since 2003, the Home Fire Sprinkler Coalition (HFSC) has actively reached out to the homebuilding industry in an effort to educate builders, developers and architects about the value of offering sprinklers as an option to new home buyers. By bringing factual and simplified sprinkler information directly to builders – primarily through the National Association of Home Builders International Builders Show and its 50+ Housing Council, we have made great strides in our builder education campaign. In fact, more than 3,500 members of the home building community have personally requested HFSC's "Built for Life" educational kit.

Home Fire Safety Resources

Home Fire Sprinkler Coalition: www.homefiresprinkler.org
Home Safety Council: www.homesafetycouncil.org
National Fire Protection Association: www.nfpa.org
Residential Fire Safety Institute: www.firesafehome.org
Underwriters Laboratories Inc.: www.ul.com/consumers/
U.S. Fire Administration: www.usfa.dhs.gov

Date Submitted	3/2/2010	**Section**	102.1	**Proponent**	Heinz Rosen
Chapter	1	**Affects HVHZ**	No	**Attachments**	No

TAC Recommendation No Affirmative Recommendation with a Second

Commission Action Pending Review

Related Modifications

Summary of Modification

add the following to the end of the first sentence of 102.1: "... provided it is at least as restrictive as the general requirement."

Rationale

DCA-DEC-351 is based on the FBCB 102.1 requirement that if general and specific requirements exist the specific requirement shall be applicable. However, 102.1 also requires that "… the most restrictive shall govern." The FBC has adopted the NEC (more restrictive) and AAMA 2100 (more specific.) The proposed amendment is intended to close the loophole through which any requirement in the FBC can be weakened by developing a more specific but less restrictive requirement.

Fiscal Impact Statement

Impact to local entity relative to enforcement of code

None

Impact to building and property owners relative to cost of compliance with code

Unknown

Impact to industry relative to the cost of compliance with code

Unknown

Requirements

Has a reasonable and substantial connection with the health, safety, and welfare of the general public

The proposed modification will prevent the proliferation of extension cords and reduce unpermitted and uninspected electrical work.

Strengthens or improves the code, and provides equivalent or better products, methods, or systems of construction

Strengthens the code by closing a loophole that might weaken the FBC.

Does not discriminate against materials, products, methods, or systems of construction of demonstrated capabilities

Yes

Does not degrade the effectiveness of the code

Increses the effectiveness of the FBC

102.1 General. Where there is a conflict between a general requirement and a specific requirement, the specific requirement shall be applicable, provided it is at least as restrictive as the general requirement. Where, in any specific case, different sections of this code specify different materials, methods of construction or other requirements, the most restrictive shall govern.

CA4167

Date Submitted	3/31/2010	**Section**	102.2(h)	**Proponent**	ali hosein
Chapter	1	**Affects HVHZ**	No	**Attachments**	No

TAC Recommendation No Affirmative Recommendation with a Second
Commission Action Pending Review

Related Modifications

Summary of Modification

To clearify the usage of personal and commercial uses of Chickee/Tiki huts as per florida building codes

Rationale

To clarify the usages of commercial / personal Chickee/Tiki hut as per florida building and fire codes

Fiscal Impact Statement

Impact to local entity relative to enforcement of code

None

Impact to building and property owners relative to cost of compliance with code

None

Impact to industry relative to the cost of compliance with code

None

Requirements

Has a reasonable and substantial connection with the health, safety, and welfare of the general public

None

Strengthens or improves the code, and provides equivalent or better products, methods, or systems of construction

Iproves code compliance to save lives

Does not discriminate against materials, products, methods, or systems of construction of demonstrated capabilities

Doese not

Does not degrade the effectiveness of the code

Does not

Alternate Language

1st Comment Period History 04/15/2010 - 06/01/2010

Proponent James Battaglia **Submitted** 6/1/2010 **Attachments** Yes

CA4167-A2

Rationale

This alt language clears-up the petitioner's request as to any other structures within 50 feet.

Fiscal Impact Statement

Impact to local entity relative to enforcement of code

None.

Impact to building and property owners relative to cost of compliance with code

Benefit if a fire were to occur to neighboring structures.

Impact to industry relative to the cost of compliance with code

Cost to comply, although would increase, properties adjoining said buildings not related to the specific landowner has a lesser chance of fire damage.

Requirements

Has a reasonable and substantial connection with the health, safety, and welfare of the general public

Most definitely! Fire prevention and education does save lives.

Strengthens or improves the code, and provides equivalent or better products, methods, or systems of construction

Strengthens the FBC, so as to protect lives and property.

Does not discriminate against materials, products, methods, or systems of construction of demonstrated capabilities

Actually, no. Would require systems to meet one of many approved methods.

Does not degrade the effectiveness of the code

Nope.

102.2 Building. Change to read as shown.

(h) Chickees constructed by the Miccosukee Tribe of Indians of Florida or the Seminole Tribe of Florida. As used in this paragraph, the term "chickee" means an open-sided wooden hut that has a thatched roof of palm or palmetto or other traditional materials, and that does not incorporate any electrical, plumbing, or other nonwood features.

Chickees/Tiki constructed for commercial purposes (Bars, Restaurants etc) within 50 feet of a commercial structure incorporating any electrical plumbing, shall comply with the Florida Fire Prevention Code.

Chickee/Tiki thatched roofing material (palmetto, palm or traditional materials)must have Fire-resistant protection for type of construction maintained annually and applied with a tested and rated material whether or not it has a fire protection system(Sprinklers, Halon)

Chickees/Tiki constructed for commercial purposes (Bars, Restaurants etc), within 50 feet of any other structures, sheds, or storage areas that incorporate electrical, plumbing, shall comply with the *Florida Fire Prevention Code.*

Chickee/Tiki thatched roofing material (palmetto, palm or traditional materials) without a certified fire-rating must have fire-resistant protection for type of construction maintained annually and applied with a tested and rated material, regardless if it has a fire protection system(Sprinklers, Halon)

Date Submitted	3/12/2010	**Section**	104.10	**Proponent**	Anthony Apfelbeck
Chapter	1	**Affects HVHZ**	No	**Attachments**	No

TAC Recommendation No Affirmative Recommendation with a Second

Commission Action Pending Review

Related Modifications

None.

Summary of Modification

Reinsert section 104.10 from the 2009 IBC into the FBC.

Rationale

The change restores section 104.10 to be consistent with the 2009 IBC. Since section 104.10 is currently reserved, section 104.11 is now being utilized to satisfy the void create by the lack of section 104.10. This is not really the intent and a misapplication of section 104.11 which is directed at materials, designs and methods. This is different from "Modifications."

Fiscal Impact Statement

Impact to local entity relative to enforcement of code

Provides flexibility for local building officials to meet the spirit and intent of the code with modifications that do not lessen the requirements. This is currently occuring under section 104.11 but the IBC has separated the 104.10 and 104.11 concepts out into two issues.

Impact to building and property owners relative to cost of compliance with code

This change provides added flexibilty when it is needed to meet the spirit and intent of the code. This may reduce costs and/or add flexibility in design and reuse.

Impact to industry relative to the cost of compliance with code

This change provides added flexibilty when it is needed to meet the spirit and intent of the code. This may reduce costs and/or add flexibility in design and reuse.

Requirements

Has a reasonable and substantial connection with the health, safety, and welfare of the general public

Section 110.4 provides language that specifically ensures that code modifications maintain compliance with the spirit and intent of the code. This ensures the protection of the health, safety and welfare of the public.

Strengthens or improves the code, and provides equivalent or better products, methods, or systems of construction

This proposal provides added guidance to an action that building officials are already taking. The language in 104.10 provides specific guidance as to how this action should be applied in accepting modifications. This guidance strengthens the code and its application.

Does not discriminate against materials, products, methods, or systems of construction of demonstrated capabilities

This proposal does not discriminate in any manner. It provides greater flexibility.

Does not degrade the effectiveness of the code

The language of section 104.10 ensures that the effectiveness of the code is maintained with respect to the spirit and intent.

104.10 Modifications. ~~**Reserved.**~~Whereever there are practical difficulties involved in carrying out the provisions of this code, the building official shall have the authority to grant modifications for individual cases, upon the application of the owner or owner's representative, provided the builidng official shall first find that special individual reason makes the strict letter of this code impractical and the modification is in compliance with the intent and purpose of this code and that such modification does not lessen health, accessibility, life and fire safety, or structural requirements. The details of action granting modifications shall be recorded and entered in the files of the department of building safety.

Date Submitted	4/2/2010	**Section**	105.1	**Proponent**	James Battaglia
Chapter	1	**Affects HVHZ**	No	**Attachments**	No

TAC Recommendation No Affirmative Recommendation with a Second

Commission Action Pending Review

Related Modifications

None

Summary of Modification

Add storage systems to the list of required permit activity.

Rationale

To be sure no electric, plumbing, gas, or HVAC work is either modified, added, or deleted.

Fiscal Impact Statement

Impact to local entity relative to enforcement of code

Increased enforcement of possible regulated work.

Impact to building and property owners relative to cost of compliance with code

Cost of building permit itself.

Impact to industry relative to the cost of compliance with code

Would cause most all cabinetry companies to secure specialty license.

Requirements

Has a reasonable and substantial connection with the health, safety, and welfare of the general public

Most definitely. Would increase safety of this type of work.

Strengthens or improves the code, and provides equivalent or better products, methods, or systems of construction

Assures compliance of the Codes.

Does not discriminate against materials, products, methods, or systems of construction of demonstrated capabilities

Correct.

Does not degrade the effectiveness of the code

Not all all.

105.1 Required. Any owner or authorized agent who intends to construct, enlarge, alter, repair, move, demolish, or change the occupancy of a building or structure, or to erect, install, enlarge, alter, repair, remove, convert or replace any required impact-resistant coverings, electrical, gas, mechanical or plumbing system, or cabinet or storage systems which may effect the same, the installation of which is regulated by this code, or to cause any such work to be done, shall first make application to the building official and obtain the required permit.

CA3611

Date Submitted	3/22/2010	**Section**	105.1	**Proponent**	Michael Hemmer
Chapter	1	**Affects HVHZ**	No	**Attachments**	No

TAC Recommendation No Affirmative Recommendation with a Second

Commission Action Pending Review

Related Modifications

Summary of Modification

This modification is meant to add language to encompass all Product Approved Opening Protection be incorporated in the permitting process to insure conformity.

Rationale

This modification is to ensure that the opening protection utilized by the owner/ builder be consistant to the standards set forth by the code.

Fiscal Impact Statement

Impact to local entity relative to enforcement of code

This modification will assist in the enforcement of the code pretaining to the proper documentation and installation criteria for the opening protection being obtained prior to issuance of a permit as well as upon inspection.

Impact to building and property owners relative to cost of compliance with code

Minimal impact.

Impact to industry relative to the cost of compliance with code

Minimal impact.

Requirements

Has a reasonable and substantial connection with the health, safety, and welfare of the general public

This modification will insure the building owner has the proper documentation along with installation instructions pretaining to the opening protection utilized.

Strengthens or improves the code, and provides equivalent or better products, methods, or systems of construction

This modification will strengthen the code with product approved products being utilized.

Does not discriminate against materials, products, methods, or systems of construction of demonstrated capabilities

Does not discriminate.

Does not degrade the effectiveness of the code

Does not degrade the effectiveness of the code.

Section 105 Permits

Section 105.1 Required. Change to read as shown.

105.1 Required. Any owner or authorized agent who intends to construct, enlarge, alter, repair, move, demolish, or change the occupancy of a building or structure, or to erect, install, enlarge, alter, repair, remove, convert or replace any required impact resistant coverings and/or product approved opening protection, electrical, gas, mechanical or plumbing system, the installation of which is regulated by this code, or to cause any such work to be done, shall first make application to the building official and obtain the required permit.

Date Submitted	3/1/2010	**Section**	105.3.1.2	**Proponent**	Albert Jenks
Chapter	1	**Affects HVHZ**	No	**Attachments**	No

TAC Recommendation No Affirmative Recommendation with a Second

Commission Action Pending Review

Related Modifications

Summary of Modification

Provide a note to clarify what components are to be included when defining when an engineer is required based on system cost.

Rationale

With the raising of S.S. 471.003(2)(h) 1 to $125,000 from $50,000 further clarification is required of what system cost consist of.

Fiscal Impact Statement

Impact to local entity relative to enforcement of code

It will take extra time for the AHJ to understand exacly what is actually being installed and the value of that system.

Impact to building and property owners relative to cost of compliance with code

In the past a path was created to get around hiring an engineer. Now they will have to hire an engineer to properly make sure the system is safely designed. This could add 3-10 percent to the cost of the job.

Impact to industry relative to the cost of compliance with code

Contractors won't have as much control on the design and thus might have to put a more sophisticated system in and thus lower their profit margin.

Requirements

Has a reasonable and substantial connection with the health, safety, and welfare of the general public

When a contractor installs a system without an engineer, typically the total system is not considered. A contractor is paid to supply and install equipment to minimum code. By using an engineer on larger systems of $125,000 will force a system design and not just minimum code for the installation.

Strengthens or improves the code, and provides equivalent or better products, methods, or systems of construction

Get rid of the inconsistency of a contractor not needing an engineer because his PO was for $50,000, but is connecting to a $150,000 system such as a generator or a 100 ton chiller. Safety is achieved by making sure the system is considered and not just the single component being installed.

Does not discriminate against materials, products, methods, or systems of construction of demonstrated capabilities

NONE

Does not degrade the effectiveness of the code

Only strengthens and gives consistancy throughout the State of Florida

NOTE: System cost consists of total material cost, labor cost, and equipment cost of the system to be installed or connected too.

Date Submitted	3/30/2010	**Section**	107.2.1	**Proponent**	Sergio Ascunce
Chapter	1	**Affects HVHZ**	No	**Attachments**	No

TAC Recommendation No Affirmative Recommendation with a Second

Commission Action Pending Review

Related Modifications

Summary of Modification

To allow the Building Official to require electronic media, in a file format specified, to be submitted when the jurisdiction is capable of processing electronically.

Rationale

Almost all design professionals produce their work electronically. Those building departments that are capable of processing permit documents digitally should be able to require that the documents be submitted electronically and in the specified file format. This will avoid capable departments from having to convert paper documents . This additional process and expense is unnecessary. This code change still gives the Building Official the flexibility of not requiring electronic media.

Fiscal Impact Statement

Impact to local entity relative to enforcement of code

None, those local entities that are not capable of processing electronic documents yet will simply not require them.

Impact to building and property owners relative to cost of compliance with code

Cost reduction, this change will actually provide a cost savings to the owners. The cost being passed on to owners for having paper documents converted to electronic media by those building department will not be necessary.

Impact to industry relative to the cost of compliance with code

Negligible. That very minute percentage of design professionals that are still producing drawings by hand can have their paper documents inexpensively converted.

Requirements

Has a reasonable and substantial connection with the health, safety, and welfare of the general public

Health, safety, and welfare of the general public is enhanced by having electronic plans available for first responders.

Strengthens or improves the code, and provides equivalent or better products, methods, or systems of construction

Electronic media provides for a more efficient and effective way of processing permits.

Does not discriminate against materials, products, methods, or systems of construction of demonstrated capabilities

Electronic drawing is currently deployed throughout the United States by most design professionals. These offices are required to revert back to paper based submittals when applying for building permits.

Does not degrade the effectiveness of the code

This code modification does not degrade the effectiveness of the code, it may actually enhance code compliance if automated checklists were implemented.

107.2.1 Information on construction documents. Construction documents shall be dimensioned and drawn upon suitable material. Electronic media documents are permitted to be submitted when approved by the building official. When capable, the Building Official may require electronic media, in the file format specified, to be submitted. Construction documents shall be of sufficient clarity to indicate the location, nature and extent of the work proposed and show in detail that it will conform to the provisions of this code and relevant laws, ordinances, rules and regulations, as determined by the building official.

Date Submitted	3/12/2010	**Section**	201.3 and 201.4	**Proponent**	Anthony Apfelbeck
Chapter	2	**Affects HVHZ**	No	**Attachments**	No

TAC Recommendation No Affirmative Recommendation with a Second

Commission Action Pending Review

Related Modifications

None.

Summary of Modification

Revises section 201.3 and 201.4 to eliminate the unnecessary Florida specific changes and restore a majority of the text to the core text in the 2009 IBC.

Rationale

This change restores the language in 201.3 and 201.4 to be consistent with the 2009 IBC with the exception of the specific references to the "Florida" versions of the codes. This separates out the two different items in section 201.3 by restoring the text to 201.4

Fiscal Impact Statement

Impact to local entity relative to enforcement of code

Eliminates unnecessary Florida specific changes and restores the orginal IBC format and elminates a "reserved" section. Improves readability.

Impact to building and property owners relative to cost of compliance with code

None. Improves readability.

Impact to industry relative to the cost of compliance with code

None. Improves readability.

Requirements

Has a reasonable and substantial connection with the health, safety, and welfare of the general public

This change restores the code text to the original IBC text and improves readability. There is no technical changes. Mainly and editorial change.

Strengthens or improves the code, and provides equivalent or better products, methods, or systems of construction

This change restores the code text to the original IBC text and improves readability. There is no technical changes. Mainly an editorial change.

Does not discriminate against materials, products, methods, or systems of construction of demonstrated capabilities

This change restores the code text to the original IBC text and improves readability. There is no technical changes. Mainly an editorial change. This change does not discriminate in anyway.

Does not degrade the effectiveness of the code

This change restores the code text to the original IBC text and improves readability. There is no technical changes. Mainly an editorial change. This change does not degrade the effectiveness of the code.

201.3 ~~Words not defined.~~ ~~Words not defined herein shall have the meanings stated in the Florida Building Code, Plumbing, Mechanical and Fuel Gas, or the Florida Fire Prevention Code. Words not defined in the Florida Building Codes, shall have the meanings in Webster's Third New International Dictionary of the English Language, Unabridged.~~ **Terms defined in other codes.** Where terms are not defined in this code and are defined in the Florida Existing Building Code, Florida Mechanical Code, Florida Plumbing Code, Florida Fuel Gas Code or the Florida Fire Prevention Code, such terms shall have the meanings ascribed to them as in those codes.

201.4 Terms not defined. **~~Reserved.~~** When terms are not defined through the methods authorized by this section, such terms shall have ordinarily acccepted meanings such as the context implies.

Date Submitted	3/12/2010	**Section**	202	**Proponent**	Anthony Apfelbeck
Chapter	2	**Affects HVHZ**	No	**Attachments**	No

TAC Recommendation No Affirmative Recommendation with a Second

Commission Action Pending Review

Related Modifications

None.

Summary of Modification

Provides a definition for "Nonresidential Farm Buildings" as the term is utilized in section 102. Provides a definition for "Farm" as utilized in the the definition of "Nonresidential Farm Buildings."

Rationale

The term "nonresidential farm building" is utilized in section 102.2 but the term is undefined. This definition melds the language in the staturory provisions of 604.5 and 823.14 with the restrictions of section 312.1 which covers Agricultural, Barns, Silos, Greenhouses, Livestock Shelters, Stables, Tanks and Towers to provide specific direction as the what is covered via the exemption in 102.2.

Fiscal Impact Statement

Impact to local entity relative to enforcement of code

This code change provides clarity as to what specific buildings and structures meet the exemption under section 102.2. Building Code agricultural exemptions cause frequent debate at the local level. Regardless of the definition, this issue needs clarification by the Commission in the code.

Impact to building and property owners relative to cost of compliance with code

Providing greater clarity will eliminate the uncertainty as to the proper application or exemption from the code. Some buildings previously determined to be exempt might be subject to the definitions. Others might now be exempt. Cost impact is project specific.

Impact to industry relative to the cost of compliance with code

Providing greater clarity will eliminate the uncertainty as to the proper application or exemption from the code. Some buildings previously determined to be exempt might be subject to the definitions. Others might now be exempt. Cost impact is project specific.

Requirements

Has a reasonable and substantial connection with the health, safety, and welfare of the general public

This proposal provides greater clarity to the proper application of the code. Proper application is directly related to the health, safey and welfare of the general public.

Strengthens or improves the code, and provides equivalent or better products, methods, or systems of construction

This proposal strengths the code by specifically calling out when exception (c) to 102.2 should be applied.

Does not discriminate against materials, products, methods, or systems of construction of demonstrated capabilities

This proposal does not discriminate against any product, methos, or systems of construction.

Does not degrade the effectiveness of the code

This proposal does not degrade the effectiveness. To the contrary, it improves the effectiveness by clarifying the appropriate application of the code and statutory exemption.

1st Comment Period History 04/15/2010 - 06/01/2010

Proponent Victor Chodora **Submitted** 5/14/2010 **Attachments** No

CA3587-G1

Comment:

While it is great to have a definition for nonresidential farm building, is it necessary? Are we now modifying the ICC code for a Florida specific change, when so many other proposed changes in this cycle are targeting the removal of Florida specific changes? Such as the proposed changes in Mods 3588 & 3585.

Nonresidential farm building. Any building or support structure that is used for agricultural purposes, is located on a farm that is not used as a residential dwelling, and is located on land that is an integral part of a farm operation or is classified as agricultural land under s. 193.461. Buildings not meeting the definintion of Group U in Section 312.1 are not nonresidential farm buildings and are regulated by the Florida Building Code.

Farm. Any land, buildings, support facilities, machinery, and other appurtenances used in the production of farm or aquaculture products.

Date Submitted	3/25/2010	**Section**	401.2.1	**Proponent**	J Glenn-BASF
Chapter	4	**Affects HVHZ**	No	**Attachments**	No

TAC Recommendation No Affirmative Recommendation with a Second

Commission Action Pending Review

Related Modifications

Summary of Modification

Retain language from the base code and renumber “Florida Specific” language starting at Section 430 and reserve section 424 – 429 for future code expansion.

Rationale

The base code language provides equal or better protection. Future code devlopment will be enhanced by not having to renumber base code sections and adding the reserved sections provides for future development of special classifications as needed in Florida.

Fiscal Impact Statement

Impact to local entity relative to enforcement of code

Enforcement personnel will have to learn the new Florida section numbers.

Impact to building and property owners relative to cost of compliance with code

None

Impact to industry relative to the cost of compliance with code

None

Requirements

Has a reasonable and substantial connection with the health, safety, and welfare of the general public

None

Strengthens or improves the code, and provides equivalent or better products, methods, or systems of construction

Provides consistency with the base code.

Does not discriminate against materials, products, methods, or systems of construction of demonstrated capabilities

Change does not discriminate

Does not degrade the effectiveness of the code

Change does not degrade effectiveness of code

401.2.1 Scope. In addition to the provisions of this chapter, the following special occupancies, standards, requirements and codes shall conform to the following sections:

Section ~~419~~ 430: Hospitals

Section ~~420~~ 431: Nursing homes

Section ~~421~~ 432: Ambulatory surgical centers

Section ~~422~~ 433: Birthing centers

Section ~~423~~ 434: State requirements for educational facilities

Section ~~424~~ 435: Swimming pools and bathing places

Section ~~425~~ 436: Public lodging establishments

Section ~~426~~ 437: Public food service establishments

Section ~~427~~ 438: Mental health programs

Section ~~428~~ 439: Manufactured buildings

Section ~~429~~ 440: Boot camps for children

Section ~~430~~ 441: Mausoleums and columbariums

Section ~~431~~ 442: Transient public lodging establishments

Section ~~432~~ 443: Use of asbestos in new public buildings or buildings newly constructed for lease to government entities–prohibition

Section ~~433~~ 444: Adult day care

Section ~~434~~ 445: Assisted living facilities

Section ~~435~~ 446: Control of radiation hazards

Section ~~436~~ 447: Day care occupancies

Section ~~437~~ 448: Hospice Inpatient Facilities and Units and Hospice Residences.

Chapter 30: Elevators and conveying systems

Section 3109: Structures seaward of a coastal construction control line

Do not renumber existing code sections 419 – 423

Insert new section as follows:

Section 224: Reserved for future use.

Section 225: Reserved for future use.

Section 226: Reserved for future use.

Section 227: Reserved for future use.

Section 228: Reserved for future use.

Section 229: Reserved for future use.

CA3691

Date Submitted	3/23/2010	**Section**	1512.4, 1512.4.1, 1512.4.2, 1512.4	**Proponent**	chris schulte
Chapter	15	**Affects HVHZ**	Yes	**Attachments**	No

TAC Recommendation No Affirmative Recommendation with a Second

Commission Action Pending Review

Related Modifications

Summary of Modification

Clarification

Rationale

This language should be found in Chapter 1, Section 109 "Inspections".

Fiscal Impact Statement

Impact to local entity relative to enforcement of code

$0

Impact to building and property owners relative to cost of compliance with code

$0

Impact to industry relative to the cost of compliance with code

$0

Requirements

Has a reasonable and substantial connection with the health, safety, and welfare of the general public

Clarification

Strengthens or improves the code, and provides equivalent or better products, methods, or systems of construction

Clarification

Does not discriminate against materials, products, methods, or systems of construction of demonstrated capabilities

Does not discriminate

Does not degrade the effectiveness of the code

Does not degrade

Chapter 15 - Roof Assemblies and Rooftop Structures

1512.4 ~~Inspections performed outside these high-velocity hurricane zone requirements shall comply with Section 109.~~

1512.4.1 ~~All roofing work for which a permit is required shall be inspected by the building official. One or more inspections may be performed at the same time at the request of the roofing contractor or when feasible. Lack of roofing contractor's personnel at the job site, in and of itself, shall not be cause to fail the inspection. Certain roofing inspections shall be performed during specific phases of the applications as noted below:~~

1512.4.2 ~~For discontinuous roofing systems (as defined herein or Chapter 2):~~

1512.4.2.1 ~~During or after application of the base sheet, anchor sheet or underlayment of any roofing system.~~

1512.4.2.2 ~~During the installation of the cap sheet.~~

CA3692

Date Submitted	3/23/2010	**Section**	1512.4.2.3, 1512.4.2.4, 1512.4.3,	**Proponent**	chris schulte
Chapter	15	**Affects HVHZ**	Yes	**Attachments**	No

TAC Recommendation No Affirmative Recommendation with a Second

Commission Action Pending Review

Related Modifications

MOD 3691

Summary of Modification

Clarification

Rationale

This language should be found in Chapter 1, Section 109 "Inspections".

Fiscal Impact Statement

Impact to local entity relative to enforcement of code

$0

Impact to building and property owners relative to cost of compliance with code

$0

Impact to industry relative to the cost of compliance with code

$0

Requirements

Has a reasonable and substantial connection with the health, safety, and welfare of the general public

Clarification

Strengthens or improves the code, and provides equivalent or better products, methods, or systems of construction

Clarification

Does not discriminate against materials, products, methods, or systems of construction of demonstrated capabilities

Does not discriminate

Does not degrade the effectiveness of the code

Does not degrade

Chapter 15 - Roof Assemblies and Rooftop Structures

1512.4.2.3 ~~During the installation of any prepared roof covering, such as shingles, tiles, slates, shakes and similar.~~

1512.4.2.4 ~~Upon completion of all adhesive set and mortar set tile systems, and prior to the final inspection, a field verification and static uplift test, in compliance with TAS 106 shall be required to confirm tile adhesion to the underlayment. This test may be required by the building official for mechanically attached tile systems. All results of this test shall be submitted to the building official.~~

1512.4.3 ~~For continuous roofing systems (as defined in herein or Chapter 2):~~

1512.4.3.1 ~~During application of any roofing system prior to the full concealment of the adhesion/attachment process to the roof deck or to the existing roofing assembly.~~

Date Submitted	3/23/2010	**Section**	1512.4.3.2, 1512.4.3.3	**Proponent**	chris schulte
Chapter	15	**Affects HVHZ**	Yes	**Attachments**	No

TAC Recommendation No Affirmative Recommendation with a Second

Commission Action Pending Review

Related Modifications

MOD 3691
MOD 3692

Summary of Modification

Clarification

Rationale

This language should be found in Chapter 1, Section 109 "Inspections".

Fiscal Impact Statement

Impact to local entity relative to enforcement of code

$0

Impact to building and property owners relative to cost of compliance with code

$0

Impact to industry relative to the cost of compliance with code

$0

Requirements

Has a reasonable and substantial connection with the health, safety, and welfare of the general public

Clarification

Strengthens or improves the code, and provides equivalent or better products, methods, or systems of construction

Clarification

Does not discriminate against materials, products, methods, or systems of construction of demonstrated capabilities

Does not discriminate

Does not degrade the effectiveness of the code

Does not degrade

1512.4.3.2 ~~In cases where a roof area is less than 1,500 square feet (139 m^2), and when the building official is not able to perform any of the above requested inspection in a timely manner, the building official may authorize to continue with the work and may require that satisfactory evidence be provided to show that the covered work was performed in compliance with this code.~~

1512.4.3.3 ~~After all roofing work has been completed; a final inspection shall be performed by the building official.~~

Date Submitted	3/27/2010	**Section**	3202.5	**Proponent**	J Glenn-BASF
Chapter	32	**Affects HVHZ**	No	**Attachments**	No

TAC Recommendation No Affirmative Recommendation with a Second

Commission Action Pending Review

Related Modifications

Summary of Modification

Remove unnecessary requirements are covered in the existing base code.

Rationale

Covered by existing language in the base code. Encroachment on sidewalks covered by other section of 3202.

Fiscal Impact Statement

Impact to local entity relative to enforcement of code

No impact to local enforcement is created by this change

Impact to building and property owners relative to cost of compliance with code

None

Impact to industry relative to the cost of compliance with code

None

Requirements

Has a reasonable and substantial connection with the health, safety, and welfare of the general public

No change

Strengthens or improves the code, and provides equivalent or better products, methods, or systems of construction

Brings Florida in-line with nationally accepted practice

Does not discriminate against materials, products, methods, or systems of construction of demonstrated capabilities

Does not discriminate against anything

Does not degrade the effectiveness of the code

Does not degrade the code

~~**3202.5 Sidewalk or street obstructions.** Unless allowed by the applicable governing authority having jurisdiction of the right-of-way or public property, public property shall be maintained clear of any and all obstructions, including among others, posts, columns, display of wares or merchandise and sidewalk signs.~~

Date Submitted	4/2/2010	**Section**	New Appendix	**Proponent**	steve ferguson
Chapter	2706	**Affects HVHZ**	No	**Attachments**	Yes

TAC Recommendation No Affirmative Recommendation with a Second

Commission Action Pending Review

Related Modifications

none

Summary of Modification

The purpose of this proposed change is to add a new optional appendix to the FBC for green and high-performance buildings.

Rationale

See rationale in the attached file.

The purpose of this proposed change is to add a new optional appendix to the FBC. The proposed appendix will reference the International Green Construction Code including the ANSI/ASHRAE/USGBC/IES 189.1 jurisdictional compliance option. Both documents are newly-developed, consensus-based codes and standards that can be used to develop local code requirements specific to green buildings or that could be applied to all buildings covered in the scope.

Fiscal Impact Statement

Impact to local entity relative to enforcement of code

There will need to be additional education to a local jurisdiction when a code is adopted for green and high performing buildings to train code officials on how to enforce the new proposed requirements. The adoption of a single code will bring consistency to the enforcement of green construction.

Impact to building and property owners relative to cost of compliance with code

The construction of green and high performance green buildings will increase the cost of construction and operation over current minimum requirements. However, it is an additional cost that the owner will choose to make when they decide they want to build a green and high performing building.

Impact to industry relative to the cost of compliance with code

The reference to the International Green Construction Code including the ANSI/ASHRAE/USGBC/IES 189.1 jurisdictional compliance option will provide consistent guidance to the green construction industry.

Requirements

Has a reasonable and substantial connection with the health, safety, and welfare of the general public

The emergence of green building codes and standards is an important next step for the green building movement, establishing a much-needed set of baseline regulations for green buildings that is adoptable, usable and enforceable by jurisdictions.

Strengthens or improves the code, and provides equivalent or better products, methods, or systems of construction

Bringing together the code expertise of ICC with technical expertise of ASHRAE to create a comprehensive green building code will accelerate our transformation to more sustainable building practices.

Does not discriminate against materials, products, methods, or systems of construction of demonstrated capabilities

This proposal does not discriminate against materials, products, methods or systems of construction of demonstrated capabilities that are consistent with green and high performing buildings.

Does not degrade the effectiveness of the code

This makes the code more robust by providing effective minimum high performing green building requirements in addition to the current minimum criteria.

1st Comment Period History 04/15/2010 - 06/01/2010

CA4384-G1

Proponent Ann Stanton **Submitted** 4/21/2010 **Attachments** No

Comment:

Proponent requested that the following link be provided to the proposed standard:
http://www.iccsafe.org/CS/IGCC/Pages/default.aspx

1st Comment Period History 04/15/2010 - 06/01/2010

CA4384-G2

Proponent Jack Glenn **Submitted** 6/1/2010 **Attachments** No

Comment:

The new appendix is based on a proposed standard that is not yet approved.

Add a new Appendix "F" as follows:

APPENDIX 'F'

Green and High-Performance Buildings

The provisions in this appendix are not mandatory unless specifically referenced in the adopting ordinance.

SECTION F101

GENERAL

F101.1 Scope. The provisions of this appendix are applicable to all occupancies covered by the International Green Construction Code (IGCC).

F101.2 Intent. The intent of this appendix is to provide mandatory requirements for the construction, alteration and renovation of and addition to buildings within its scope. Such requirements are intended to conserve energy and natural resources and lessen, overall, the negative impact on the environment from buildings and the occupation and use of buildings.

F101.3 Requirements. The construction, alteration, and renovation of and addition to buildings shall comply with the International Green Construction Code including ANSI/ASHRAE/USGBC/IES 189.1 if selected as a jurisdictional compliance option.

Add the Following to Chapter 35 – references:

ASHRAE

American Society of Heating, Refrigerating and Air-Conditioning Engineers, Inc.

1791 Tullie Circle, NE

Atlanta, GA, 30329-2305

Standard Referenced

ANSI/ASHRAE/USGBC/IES Standard 189.1—2009

Title

Standard for the Design of High-Performance, Green Buildings Except Low-Rise Residential Buildings

Reference in code section number

Appendix F

ICC

International Code Council, Inc.

500 New Jersey Avenue, NW

6th Floor

Washington, DC 20001

Standard Referenced

IGCC-10

Title

International Green Construction Code®

Reference in code section number

Appendix F

New Appendix XX to the FBC

Proponent: ***Name/Company/Representing (3.3.1):*** *(NOTE: DO NOT USE ACRONYMS FOR YOUR COMPANY OR ORGANIZATIONAL NAME)*

Steve Ferguson/ American Society of Heating, Refrigerating, and Air-Conditioning Engineers

Add a new Appendix "L" as follows:

APPENDIX 'L'

Green and High-Performance Buildings
The provisions in this appendix are not mandatory unless specifically referenced in the adopting ordinance.

SECTION L101
GENERAL

L101.1 Scope. The provisions of this appendix are applicable to all occupancies covered by the International Green Construction Code (IGCC).

L101.2 Intent. The intent of this appendix is to provide mandatory requirements for the construction, alteration and renovation of and addition to buildings within its scope. Such requirements are intended to conserve energy and natural resources and lessen, overall, the negative impact on the environment from buildings and the occupation and use of buildings.

L101.3 Requirements. The construction, alteration, and renovation of and addition to buildings shall comply with the International Green Construction Code including ANSI/ASHRAE/USGBC/IES 189.1 if selected as a jurisdictional compliance option.

Add the Following to Chapter 35 – references:

ASHRAE

American Society of Heating, Refrigerating and Air-Conditioning Engineers, Inc.
1791 Tullie Circle, NE
Atlanta, GA, 30329-2305

Standard Referenced
ANSI/ASHRAE/USGBC/IES Standard 189.1—2009

Title
Standard for the Design of High-Performance, Green Buildings Except Low-Rise Residential Buildings

Reference in code section number
Appendix L

ICC

International Code Council, Inc.
500 New Jersey Avenue, NW
6th Floor
Washington, DC 20001

Standard Referenced
IGCC-10

Title
International Green Construction Code®

Reference in code section number
Appendix L

Reason:

1. **The purpose of this proposed change is to add a new optional appendix to the FBC.**
2. **The proposed appendix will reference the International Green Construction Code including the ANSI/ASHRAE/USGBC/IES 189.1 jurisdictional compliance option. Both documents are newly-developed, consensus-based codes and standards that can be used to develop local code requirements specific to green buildings or that could be applied to all buildings covered in the scope.**
3. **Green buildings are currently being designed and constructed nationwide using different programs guidelines, rating systems, and standards that are not developed using consensus-based methods. The IGCC which includes ASHRAE's standard 189.1, was developed under the direction of ICC in conjunction with representatives from other nationally-recognized organizations with experience and expertise in this field, including ASHRAE members. Several state and local jurisdictions already require, or are considering a requirement, that building projects within their jurisdiction be designed and constructed according to "green building" principles. In many cases, limited guidance is given as to the criteria to be used to determine if the building project meets the expectations. The IGCC and Standard 189.1 jurisdictional compliance path of the IGCC provides a publicly-reviewed resource for local jurisdictions to adopt and use in the administration of green building construction.**

Sub Code: Existing Building

Date Submitted	4/1/2010	**Section**	405.1	**Proponent**	Anthony Apfelbeck
Chapter	4	**Affects HVHZ**	No	**Attachments**	No

TAC Recommendation No Affirmative Recommendation with a Second

Commission Action Pending Review

Related Modifications

None.

Summary of Modification

This proposal clarifies the application of a Level 3 Alterations as it applies to portions of buildings.

Rationale

There is currently significant question as to the application of a level 3 alteration when a tenant space is entirely gutted but the tenant space does not exceed 50% of the entire building. In some cases, this may be an entire floor but not exceed 50% of the building. Most code officials believe it is the intent of 405.1 to apply the 50% rule on a tenant space basis. This appears to be consistent with the intent of the code.

Fiscal Impact Statement

Impact to local entity relative to enforcement of code

It appears that most building deparments are already enforcing 405.1 on a tenant basis. This code change will provide clarity to code officials, contractors and designers as to the intent of the application of this section.

Impact to building and property owners relative to cost of compliance with code

Since this code change proposal is already being enforced in this manner and it appears to be the intent of the code, cost impact appears to be minimal. In many cases, the added clarity wil reduce confusion and lost time.

Impact to industry relative to the cost of compliance with code

Since this code change proposal is already being enforced in this manner and it appears to be the intent of the code, cost impact appears to be minimal. In many cases, the added clarity will reduce confusion and lost time.

Requirements

Has a reasonable and substantial connection with the health, safety, and welfare of the general public

This code change clarifies the application of level 3 alterations and ensures that proper classification occurs when greater than 50% of a tenant space has work. This is directly related to proper code enforcement which is a safety concern.

Strengthens or improves the code, and provides equivalent or better products, methods, or systems of construction

This code change strengthens the code by clarifying the application of a level 3 alteration to a tenant space when the work area exceeds 50%.

Does not discriminate against materials, products, methods, or systems of construction of demonstrated capabilities

This code change does not discriminate against products, methods or systems.

Does not degrade the effectiveness of the code

This code change does not degrade the effectiveness of the code in any many. It strengthens the code by improving the clarity of the application.

405.1 Scope. Level 3 alterations apply where the work area exceeds 50 percent of the aggregate area of the building, tenant space or dwelling unit and made within any 12-month period.

Exception: Work areas in which the alteration work is exclusively plumbing, mechanical or electrical shall not be included in the computation of total area of all work areas.

Sub Code: Mechanical

Date Submitted	4/2/2010	**Section**	All	**Proponent**	Doug Harvey
Chapter	1	**Affects HVHZ**	No	**Attachments**	Yes

TAC Recommendation No Affirmative Recommendation with a Second

Commission Action Pending Review

Related Modifications

Summary of Modification

Replace the Florida Building Code-Mechanical with the 2009 International Mechanical Code in its entirety.

Rationale

There are no Florida specific problems that are not covered by the regulations contained within the 2009 International Mechanical Code.

Fiscal Impact Statement

Impact to local entity relative to enforcement of code

There is no impact to local enforcement other than gaining consistency and putting inspection and review personnel in line with the Code that certification is attained under and used throughout the nation

Impact to building and property owners relative to cost of compliance with code

None

Impact to industry relative to the cost of compliance with code

Allows for a code that is more up to date with the new standards, practices and materials. Improves consistency and compliance in design, construction and enforcement. Saves money and time by allowing for a single place to request code modifications.

Requirements

Has a reasonable and substantial connection with the health, safety, and welfare of the general public

No change

Strengthens or improves the code, and provides equivalent or better products, methods, or systems of construction

Improves

Does not discriminate against materials, products, methods, or systems of construction of demonstrated capabilities

This change does not discriminate

Does not degrade the effectiveness of the code

This change does not degrade the effectiveness of the code and should improve effectiveness as consistency will be increased

1st Comment Period History 04/15/2010 - 06/01/2010

CA4383-G1

Proponent Doug Harvey **Submitted** 6/1/2010 **Attachments** No

Comment:

We, the Building Officials Association of Florida (BOAF), believe this modification may require some additional explanation. The BOAF executive board has been consulted regarding this code proposal and they are in agreement that the proposal appears to go along the line of the vote taken by the Commission last fall to remove non-Florida specific items, return to the base documents and have a separate Florida supplement, if needed. The International Code is the base code for the Florida Codes. As such, a strike-through/underline version of the document has not been attached to this modification. Due to the length and file sizes needed, as well as the proposed document being familiar as the base code, this did not seem necessary. Since the base document is the root document for the Florida code, and the Commission voted to return to the base documents over the next two (2) code cycles, we ask the Commission to accept the proposal and allow it to move forward. This is based on the vote taken by the Commission during a public meeting in the Fall of 2009. BOAF supports taking the very specific items modifying the base code to meet Florida Statutes or rules into a smaller and easier to manage stand alone Florida supplement.

Replace the ~~Florida Building Code Mechanical~~ with the 2009 International Mechanical Code in its entirety.

Date Submitted	
Mod Number	
Code Version	2010
Code Change Cycle	2010 Triennial Original Modifications 03/01/2010/-/04/02/2010
Sub-code	Mechanical
Chapter Topic	Publication
Section	All
Related Modification	
Affects HVHZ	No
Summary of modification	Replace the Florida Building Code-Mechanical with the 2009 International Mechanical Code in its entirety.
Text of Modification	The 2009 International Mechanical Code text in its entirety.
Rational	There are no Florida specific problems that are not covered by the regulations contained within the 2009 International Mechanical Code.
Fiscal Impact statement	There is no fiscal impact by this change
Impact to Local Enforcement	There is no impact to local enforcement other than gaining consistency and putting inspection and review personnel in line with the Code that certification is attained under and used throughout the nation
Impact to Building owner	None
Impact to Industry	Allows for a code that is more up to date with the new standards, practices and materials. Improves consistency and compliance in design, construction and enforcement. Saves money and time by allowing for a single place to request code modifications.
Requirements	None
Has connection to health safety and Welfare	No change
Strengths or improves Code	Improves
Does not discriminate	This change does not discriminate
Does not degrade effectiveness of code	This change does not degrade the effectiveness of the code and should improve effectiveness as consistency will be increased

Sub Code: Plumbing

Date Submitted	4/2/2010	**Section**	All	**Proponent**	Doug Harvey
Chapter	1	**Affects HVHZ**	No	**Attachments**	Yes

TAC Recommendation No Affirmative Recommendation with a Second

Commission Action Pending Review

Related Modifications

Summary of Modification

Replace the Florida Building Code-Plumbing with the 2009 International Plumbing Code in its entirety.

Rationale

There are no Florida specific problems that are not covered by the regulations contained within the 2009 International Plumbing Code.

Fiscal Impact Statement

Impact to local entity relative to enforcement of code

There is no impact to local enforcement other than gaining consistency and putting inspection and review personnel in line with the Code that certification is attained under and used throughout the nation

Impact to building and property owners relative to cost of compliance with code

None

Impact to industry relative to the cost of compliance with code

Allows for a code that is more up to date with the new standards, practices and materials. Improves consistency and compliance in design, construction and enforcement. Saves money and time by allowing for a single place to request and present code modifications.

Requirements

Has a reasonable and substantial connection with the health, safety, and welfare of the general public

No change

Strengthens or improves the code, and provides equivalent or better products, methods, or systems of construction

Improves

Does not discriminate against materials, products, methods, or systems of construction of demonstrated capabilities

This change does not discriminate

Does not degrade the effectiveness of the code

This change does not degrade the effectiveness of the code and should improve effectiveness as consistency will be increased

Alternate Language

1st Comment Period History 04/15/2010 - 06/01/2010

Proponent Eberhard Roeder **Submitted** 6/1/2010 **Attachments** Yes

CA4380-A1

Rationale

Oppose proposal P4380. Florida statutes provide statutory delineations and authorizations that are different from those in the International Plumbing Code. Changing these delineations by administrative procedures appears to be lacking legislative authority. As an example, the currently proposed Florida specific language already recognizes the regulation of what the IPC terms “private” sewage disposal systems by health authorities in Florida. As an alternative proposal, the proposed alt

Fiscal Impact Statement

Impact to local entity relative to enforcement of code

should make enforcement easier by referring to Florida-specific authority

Impact to building and property owners relative to cost of compliance with code

no change to current rules

Impact to industry relative to the cost of compliance with code

no change to current rules

Requirements

Has a reasonable and substantial connection with the health, safety, and welfare of the general public

Clarifies coordination between plumbing, health and environmental authorities

Strengthens or improves the code, and provides equivalent or better products, methods, or systems of construction

clarifies terms in the code

Does not discriminate against materials, products, methods, or systems of construction of demonstrated capabilities

yes

Does not degrade the effectiveness of the code

yes

1st Comment Period History 04/15/2010 - 06/01/2010

CA4380-G1

Proponent	Doug Harvey	Submitted	6/1/2010	Attachments	No

Comment:

We, the Building Officials Association of Florida (BOAF), believe this modification may require some additional explanation. The BOAF executive board has been consulted regarding this code proposal and they are in agreement that the proposal appears to go along the line of the vote taken by the Commission last fall to remove non-Florida specific items, return to the base documents and have a separate Florida supplement, if needed. The International Code is the base code for the Florida Codes. As such, a strike-through/underline version of the document has not been attached to this modification. Due to the length and file sizes needed, as well as the proposed document being familiar as the base code, this did not seem necessary. Since the base document is the root document for the Florida code, and the Commission voted to return to the base documents over the next two (2) code cycles, we ask the Commission to accept the proposal and allow it to move forward. This is based on the vote taken by the Commission during a public meeting in the Fall of 2009. BOAF supports taking the very specific items modifying the base code to meet Florida Statutes or rules into a smaller and easier to manage stand alone Florida supplement.

Replace the ~~Florida Building Code Plumbing~~ with the 2009 International Plumbing Code in its entirety.

701.2 Sewer required.

Every building in which plumbing fixtures are installed and all premises having sanitary drainage piping shall be connected to a ~~public sewer, where available,~~ collection/transmission system and/or a treatment plant regulated by environmental authorities under Chapter 403, Florida Statutes, and Chapters 62-620 (Wastewater Facility Permitting) and 62-604 (Collection Systems and Transmission Facilities), Florida Administrative Code, or to an approved ~~private~~ onsite sewage treatment and disposal system regulated by health authorities under Chapter 381.0065, Florida Statutes, and ~~in accordance with~~ Chapter 64E-6, Florida Administrative Code, Standards for Onsite Sewage Treatment and Disposal Systems ~~the International Private Sewage Disposal Code~~.

Date Submitted	
Mod Number	
Code Version	2010
Code Change Cycle	2010 Triennial Original Modifications 03/01/2010/-/04/02/2010
Sub-code	Plumbing
Chapter Topic	Publication
Section	All
Related Modification	
Affects HVHZ	No
Summary of modification	Replace the Florida Building Code-Plumbing with the 2009 International Plumbing Code in its entirety.
Text of Modification	The 2009 International Plumbing Code text in its entirety.
Rational	There are no Florida specific problems that are not covered by the regulations contained within the 2009 International Plumbing Code.
Fiscal Impact statement	There is no fiscal impact by this change
Impact to Local Enforcement	There is no impact to local enforcement other than gaining consistency and putting inspection and review personnel in line with the Code that certification is attained under and used throughout the nation
Impact to Building owner	None
Impact to Industry	Allows for a code that is more up to date with the new standards, practices and materials. Improves consistency and compliance in design, construction and enforcement. Saves money and time by allowing for a single place to request and present code modifications.
Requirements	None
Has connection to health safety and Welfare	None
Strengths or improves Code	Improves
Does not discriminate	This change does not discriminate
Does not degrade effectiveness of code	This change does not degrade the effectiveness of the code and should improve effectiveness as consistency will be increased

Sub Code: Residential

Date Submitted	4/2/2010	**Section**	12-21	**Proponent**	Doug Harvey
Chapter	12	**Affects HVHZ**	No	**Attachments**	Yes

TAC Recommendation No Affirmative Recommendation with a Second

Commission Action Pending Review

Related Modifications

Replace the Florida Building Code, Residential Section 25-32 Mechanical with Section 25-32 Mechanical of the 2009 International Residential Code in its entirety.

Summary of Modification

Replace the Florida Building Code, Residential Section 12-21 Mechanical with Section 12-21 Mechanical of the 2009 International Residential Code in its entirety.

Rationale

There are no Florida specific problems that are not covered by the regulations contained within the International Residential Code Section 12-21 Mechanical.

Fiscal Impact Statement

Impact to local entity relative to enforcement of code

There is no impact to local enforcement other than gaining consistency and putting inspection and review personnel in line with the Code that certification is attained under and used throughout the nation

Impact to building and property owners relative to cost of compliance with code

None

Impact to industry relative to the cost of compliance with code

Allows for a code that is more up to date with the new standards, practices and materials. Improves consistency and compliance in design, construction and enforcement. Saves money and time by allowing for a single place to request code modifications.

Requirements

Has a reasonable and substantial connection with the health, safety, and welfare of the general public

No change

Strengthens or improves the code, and provides equivalent or better products, methods, or systems of construction

Improves

Does not discriminate against materials, products, methods, or systems of construction of demonstrated capabilities

This proposed code change does not discriminate

Does not degrade the effectiveness of the code

This change does not degrade the effectiveness of the code and should improve effectiveness as consistency will be increased.

1st Comment Period History 04/15/2010 - 06/01/2010

Proponent Doug Harvey **Submitted** 6/1/2010 **Attachments** No

CA4390-G1

Comment:

We, the Building Officials Association of Florida (BOAF), believe this modification may require some additional explanation. The BOAF executive board has been consulted regarding this code proposal and they are in agreement that the proposal appears to go along the line of the vote taken by the Commission last fall to remove non-Florida specific items, return to the base documents and have a separate Florida supplement, if needed. The International Code is the base code for the Florida Codes. As such, a strike-through/underline version of the document has not been attached to this modification. Due to the length and file sizes needed, as well as the proposed document being familiar as the base code, this did not seem necessary. Since the base document is the root document for the Florida code, and the Commission voted to return to the base documents over the next two (2) code cycles, we ask the Commission to accept the proposal and allow it to move forward. This is based on the vote taken by the Commission during a public meeting in the Fall of 2009. BOAF supports taking the very specific items modifying the base code to meet Florida Statutes or rules into a smaller and easier to manage stand alone Florida supplement.

Replace ~~Florida Building Code – Residential Chapter 12-21~~ with 2009 International Residential Code Chapter 12-21 Mechanical text in its entirety.

Date Submitted	
Mod Number	
Code Version	2010
Code Change Cycle	2010 Triennial Original Modifications 03/01/2010-04/02/2010
Sub-code	Florida Building Code, Residential
Chapter Topic	Publication
Section	12-21 Mechanical
Related Modification	
Affects HVHZ	No
Summary of modification	Replace the Florida Building Code, Residential Section 12-21 Mechanical with Section 12-21 Mechanical of the 2009 International Residential Code in its entirety.
Text of Modification	Replace ~~Florida Building Code – Residential Chapter 12-21~~ with 2009 International Residential Code Chapter 12-21 Mechanical text in its entirety.
Rational	There are no Florida specific problems that are not covered by the regulations contained within the International Residential Code Section 12-21 Mechanical.
Fiscal Impact statement	There is no fiscal impact by this change
Impact to Local Enforcement	There is no impact to local enforcement other than gaining consistency and putting inspection and review personnel in line with the Code that certification is attained under and used throughout the nation
Impact to Building owner	None
Impact to Industry	Allows for a code that is more up to date with the new standards, practices and materials. Improves consistency and compliance in design, construction and enforcement. Saves money and time by allowing for a single place to request code modifications.
Requirements	None
Has connection to health safety and Welfare	None
Strengths or improves Code	Improves
Does not discriminate	This change does not discriminate
Does not degrade effectiveness of code	This change does not degrade the effectiveness of the code and should improve effectiveness as consistency will be increased.

Date Submitted	4/2/2010	**Section**	14-23	**Proponent**	Doug Harvey
Chapter	14	**Affects HVHZ**	No	**Attachments**	Yes

TAC Recommendation No Affirmative Recommendation with a Second

Commission Action Pending Review

Related Modifications

Summary of Modification

Replace the Florida Building Code, Residential Section 14-23 Plumbing with Section 14-23 Plumbing of the 2009 International Residential Code in its entirety.

Rationale

There are no Florida specific problems that are not covered by the regulations contained within the 2009 International Residential Code Section 14-23 Plumbing.

Fiscal Impact Statement

Impact to local entity relative to enforcement of code

There is no impact to local enforcement other than gaining consistency and putting inspection and review personnel in line with the Code that certification is attained under and used throughout the nation

Impact to building and property owners relative to cost of compliance with code

None

Impact to industry relative to the cost of compliance with code

Allows for a code that is more up to date with the new standards, practices and materials. Improves consistency and compliance in design, construction and enforcement. Saves money and time by allowing for a single place to request code modifications.

Requirements

Has a reasonable and substantial connection with the health, safety, and welfare of the general public

No change

Strengthens or improves the code, and provides equivalent or better products, methods, or systems of construction

Improves

Does not discriminate against materials, products, methods, or systems of construction of demonstrated capabilities

Theis change does not discriminate

Does not degrade the effectiveness of the code

This change does not degrade the effectiveness of the code and should improve effectiveness as consistency will be increased.

1st Comment Period History 04/15/2010 - 06/01/2010

Proponent Doug Harvey **Submitted** 6/1/2010 **Attachments** No

CA4387-G1

Comment:

We, the Building Officials Association of Florida (BOAF), believe this modification may require some additional explanation. The BOAF executive board has been consulted regarding this code proposal and they are in agreement that the proposal appears to go along the line of the vote taken by the Commission last fall to remove non-Florida specific items, return to the base documents and have a separate Florida supplement, if needed. The International Code is the base code for the Florida Codes. As such, a strike-through/underline version of the document has not been attached to this modification. Due to the length and file sizes needed, as well as the proposed document being familiar as the base code, this did not seem necessary. Since the base document is the root document for the Florida code, and the Commission voted to return to the base documents over the next two (2) code cycles, we ask the Commission to accept the proposal and allow it to move forward. This is based on the vote taken by the Commission during a public meeting in the Fall of 2009. BOAF supports taking the very specific items modifying the base code to meet Florida Statutes or rules into a smaller and easier to manage stand alone Florida supplement.

The 2009 International Residential Code Section 14-23 Plumbing text in its entirety.

Date Submitted	4/2/2010
Mod Number	
Code Version	2010
Code Change Cycle	2010 Triennial Original Modifications 03/01/2010-04/02/2010
Sub-code	Florida Building Code, Residential
Chapter Topic	Publication
Section	14-23
Related Modification	
Affects HVHZ	No
Summary of modification	Replace the Florida Building Code, Residential Section 14-23 Plumbing with Section 14-23 Plumbing of the 2009 International Residential Code in its entirety.
Text of Modification	The 2009 International Residential Code Section 14-23 Plumbing text in its entirety.
Rational	There are no Florida specific problems that are not covered by the regulations contained within the 2009 International Residential Code Section 14-23 Plumbing.
Fiscal Impact statement	There is no fiscal impact by this change
Impact to Local Enforcement	There is no impact to local enforcement other than gaining consistency and putting inspection and review personnel in line with the Code that certification is attained under and used throughout the nation
Impact to Building owner	None
Impact to Industry	Allows for a code that is more up to date with the new standards, practices and materials. Improves consistency and compliance in design, construction and enforcement. Saves money and time by allowing for a single place to request code modifications.
Requirements	None
Has connection to health safety and Welfare	None
Strengths or improves Code	Improves
Does not discriminate	This change does not discriminate
Does not degrade effectiveness of code	This change does not degrade the effectiveness of the code and should improve effectiveness as consistency will be increased.

Date Submitted	4/2/2010	**Section**	24	**Proponent**	Doug Harvey
Chapter	24	**Affects HVHZ**	No	**Attachments**	Yes

TAC Recommendation No Affirmative Recommendation with a Second

Commission Action Pending Review

Related Modifications

Summary of Modification

Replace the Florida Building Code, Residential Section 24-Fuel Gas with Section 24 Fuel Gas of the 2009 International Residential Code in its entirety.

Rationale

There are no Florida specific problems that are not covered by the regulations contained within the 2009 International Residential Code Section 24 Fuel Gas.

Fiscal Impact Statement

Impact to local entity relative to enforcement of code

There is no impact to local enforcement other than gaining consistency and putting inspection and review personnel in line with the Code that certification is attained under and used throughout the nation

Impact to building and property owners relative to cost of compliance with code

None

Impact to industry relative to the cost of compliance with code

Allows for a code that is more up to date with the new standards, practices and materials. Improves consistency and compliance in design, construction and enforcement. Saves money and time by allowing for a single place to request code modifications.

Requirements

Has a reasonable and substantial connection with the health, safety, and welfare of the general public

No change

Strengthens or improves the code, and provides equivalent or better products, methods, or systems of construction

Improves

Does not discriminate against materials, products, methods, or systems of construction of demonstrated capabilities

This change does not discriminate

Does not degrade the effectiveness of the code

This change does not degrade the effectiveness of the code and should improve effectiveness as consistency will be increased.

1st Comment Period History 04/15/2010 - 06/01/2010

Proponent Doug Harvey **Submitted** 6/1/2010 **Attachments** No

CA4388-G1

Comment:

We, the Building Officials Association of Florida (BOAF), believe this modification may require some additional explanation. The BOAF executive board has been consulted regarding this code proposal and they are in agreement that the proposal appears to go along the line of the vote taken by the Commission last fall to remove non-Florida specific items, return to the base documents and have a separate Florida supplement, if needed. The International Code is the base code for the Florida Codes. As such, a strike-through/underline version of the document has not been attached to this modification. Due to the length and file sizes needed, as well as the proposed document being familiar as the base code, this did not seem necessary. Since the base document is the root document for the Florida code, and the Commission voted to return to the base documents over the next two (2) code cycles, we ask the Commission to accept the proposal and allow it to move forward. This is based on the vote taken by the Commission during a public meeting in the Fall of 2009. BOAF supports taking the very specific items modifying the base code to meet Florida Statutes or rules into a smaller and easier to manage stand alone Florida supplement.

The 2009 International Residential Code Section 24 Fuel Gas text in its entirety.

Date Submitted	4/2/2010
Mod Number	
Code Version	2010
Code Change Cycle	2010 Triennial Original Modifications 03/01/2010-04/02/2010
Sub-code	Florida Building Code, Residential
Chapter Topic	Publication
Section	24
Related Modification	
Affects HVHZ	No
Summary of modification	Replace the Florida Building Code, Residential Section 24-Fuel Gas with Section 24 Fuel Gas of the 2009 International Residential Code in its entirety.
Text of Modification	The 2009 International Residential Code Section 24 Fuel Gas text in its entirety.
Rational	There are no Florida specific problems that are not covered by the regulations contained within the 2009 International Residential Code Section 24 Fuel Gas.
Fiscal Impact statement	There is no fiscal impact by this change
Impact to Local Enforcement	There is no impact to local enforcement other than gaining consistency and putting inspection and review personnel in line with the Code that certification is attained under and used throughout the nation
Impact to Building owner	None
Impact to Industry	Allows for a code that is more up to date with the new standards, practices and materials. Improves consistency and compliance in design, construction and enforcement. Saves money and time by allowing for a single place to request code modifications.
Requirements	None
Has connection to health safety and Welfare	None
Strengths or improves Code	Improves
Does not discriminate	This change does not discriminate
Does not degrade effectiveness of code	This change does not degrade the effectiveness of the code and should improve effectiveness as consistency will be increased.

Date Submitted	3/23/2010	**Section**	R4402.1.4, R4402.1.4.1, R4402.1.5	**Proponent**	chris schulte
Chapter	44	**Affects HVHZ**	Yes	**Attachments**	No

TAC Recommendation No Affirmative Recommendation with a Second

Commission Action Pending Review

Related Modifications

MOD 3691
MOD 3692
MOD 3693

Summary of Modification

Clarification

Rationale

This language should be found in Chapter 1, Section R109 "Inspections".

Fiscal Impact Statement

Impact to local entity relative to enforcement of code

$0

Impact to building and property owners relative to cost of compliance with code

$0

Impact to industry relative to the cost of compliance with code

$0

Requirements

Has a reasonable and substantial connection with the health, safety, and welfare of the general public

Clarification

Strengthens or improves the code, and provides equivalent or better products, methods, or systems of construction

Clarification

Does not discriminate against materials, products, methods, or systems of construction of demonstrated capabilities

Does not discriminate

Does not degrade the effectiveness of the code

Does not degrade

-

R4402.1.4 ~~Inspections performed outside these High-Velocity Hurricane Zone requirements shall comply with Section R109.~~

-

R4402.1.4.1 ~~All roofing work for which a permit is required shall be inspected by the building official. One or more inspections may be performed at the same time at the request of the roofing contractor or when feasible. Lack of roofing contractor's personnel at the job site, in and of itself, shall not be cause to fail the inspection. Certain roofing inspections shall be performed during specific phases of the applications as noted below:~~

-

R4402.1.4.2 ~~For discontinuous roofing systems (as defined herein or Chapter 2):~~

-

R4402.1.4.2.1 ~~During or after application of the base sheet, anchor sheet or underlayment of any roofing system.~~

Date Submitted	3/23/2010	**Section**	R4402.1.4.2.2, R4402.1.4.2.3, R44	**Proponent**	chris schulte
Chapter	44	**Affects HVHZ**	Yes	**Attachments**	No

TAC Recommendation No Affirmative Recommendation with a Second

Commission Action Pending Review

Related Modifications

MOD 3691
MOD 3692
MOD 3693
MOD 3694

Summary of Modification

Clarification

Rationale

This language should be found in Chapter 1, Section R109 "Inspections".

Fiscal Impact Statement

Impact to local entity relative to enforcement of code

$0

Impact to building and property owners relative to cost of compliance with code

$0

Impact to industry relative to the cost of compliance with code

$0

Requirements

Has a reasonable and substantial connection with the health, safety, and welfare of the general public

Clarification

Strengthens or improves the code, and provides equivalent or better products, methods, or systems of construction

Clarification

Does not discriminate against materials, products, methods, or systems of construction of demonstrated capabilities

Does not discriminate

Does not degrade the effectiveness of the code

Does not degrade

R4402.1.4.2.2 ~~During the installation of the cap sheet.~~

R4402.1.4.2.3 ~~During the installation of any prepared roof covering, such as shingles, tiles, slates, shakes, and similar.~~

R4402.1.4.2.4 ~~Upon completion of all adhesive set and mortar set tile systems, and prior to the final inspection, a field verification and static uplift test, in compliance with TAS 106 shall be required to confirm tile adhesion. This test may be required by the building official for mechanically attached tile systems. All results of this test shall be submitted to the building official.~~

Date Submitted	3/23/2010	**Section**	R4402.1.4.3, R4402.1.4.3.1, R440	**Proponent**	chris schulte
Chapter	44	**Affects HVHZ**	Yes	**Attachments**	No

TAC Recommendation No Affirmative Recommendation with a Second

Commission Action Pending Review

Related Modifications

MOD 3691
MOD 3692
MOD 3693
MOD 3694
MOD 3695

Summary of Modification

Clarification

Rationale

This language should be found in Chapter 1, Section R109 "Inspections".

Fiscal Impact Statement

Impact to local entity relative to enforcement of code

$0

Impact to building and property owners relative to cost of compliance with code

$0

Impact to industry relative to the cost of compliance with code

$0

Requirements

Has a reasonable and substantial connection with the health, safety, and welfare of the general public

Clarification

Strengthens or improves the code, and provides equivalent or better products, methods, or systems of construction

Clarification

Does not discriminate against materials, products, methods, or systems of construction of demonstrated capabilities

Does not discriminate

Does not degrade the effectiveness of the code

Does not degrade

R4402.1.4.3 ~~For continuous roofing systems (as defined in herein or Chapter 2):~~

R4402.1.4.3.1 ~~During application of any roofing system prior to the full concealment of the adhesion/attachment process to the roof deck or to the existing roofing assembly.~~

R4402.1.4.3.2 ~~In cases where a roof area is less than 1,500 square feet (139 m^2), and when the building official is not able to perform any of the above requested inspection in a timely manner, the building official may authorize to continue with the work and may require that satisfactory evidence be provided to show that the covered work was performed in compliance with this code.~~

Date Submitted	3/23/2010	**Section**	R4402.1.4.3.3	**Proponent**	chris schulte
Chapter	44	**Affects HVHZ**	Yes	**Attachments**	No

TAC Recommendation No Affirmative Recommendation with a Second

Commission Action Pending Review

Related Modifications

MOD 3691
MOD 3692
MOD 3693
MOD 3694
MOD 3695
MOD 3696

Summary of Modification

Clarification

Rationale

This language should be found in Chapter 1, Section R109 "Inspections".

Fiscal Impact Statement

Impact to local entity relative to enforcement of code

$0

Impact to building and property owners relative to cost of compliance with code

$0

Impact to industry relative to the cost of compliance with code

$0

Requirements

Has a reasonable and substantial connection with the health, safety, and welfare of the general public

Clarification

Strengthens or improves the code, and provides equivalent or better products, methods, or systems of construction

Clarification

Does not discriminate against materials, products, methods, or systems of construction of demonstrated capabilities

Does not discriminate

Does not degrade the effectiveness of the code

Does not degrade

R4402.1.4.3.3 ~~After all roofing work has been completed; a final inspection shall be performed by the building official.~~