NFPA 80A

Recommended Practice for Protection of Buildings from Exterior Fire Exposures

2007 Edition

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This edition of NFPA 80A, *Recommended Practice for Protection of Buildings from Exterior Fire Exposures,* was prepared by the Technical Committee on Exposure Fire Protection. It was issued by the Standards Council on July 28, 2006, with an effective date of August 17, 2006, and supersedes all previous editions.

This edition of NFPA 80A was approved as an American National Standard on August 17, 2006.

Origin and Development of NFPA 80A

In 1924, the NFPA Committee on Protection of Openings in Walls and Partitions developed a *Suggested Practice for Protection Against Exposure of Openings in Fire-Resistive Walls* to meet the demand for a method of evaluating the severity of exposure and a uniform practice for specifying protection. This pamphlet was submitted as a tentative recommended practice and was adopted by NFPA in 1925.

In 1930, this pamphlet was added to the *Standard for the Protection of Openings in Walls and Partitions Against Fire* as an appendix, but it was not published until the 1944 edition of the *National Fire Codes*®, Vol. III, except as part of the "NFPA Proceedings." It also was summarized in the 9th edition (1941) of the *Handbook of Fire Protection.*

In 1963, a new NFPA Committee on Exposure Fire Protection was formed and was charged with the task of updating the 1925 edition of NFPA 80A. The committee submitted a complete revision of the 1925 text to the Association for tentative adoption in 1967 and a revision of the tentative text for official adoption in 1970.

In the 1987 edition, there were substantive and editorial changes. In 1993, revisions continued to examine the effect of fire on an exposed structure and calculative methods to help ensure a reduction in fire impact due to exposure fires.

In the 1996 edition, some editorial changes were made in addition to changes in the example in Appendix B.

Revisions for the 2001 edition were mainly editorial to comply with the 2000 edition of the *Manual of Style for NFPA Technical Committee Documents.* Language was added to recognize new technology such as *listed window sprinklers.*

Revisions in the 2007 edition include a change to the definition for *noncombustible material,* which accomplishes two objectives. First, it removes technical requirements from the definition in accordance with the *Manual of Style for NFPA Technical Committee Documents,* and second, it allows the technical committee responsible for NFPA 220, *Standard on Types of Building Construction,* which owns the definition, to make changes to the technical criteria, if and when they deem appropriate, without having to "cascade" changes across other documents.

Other changes were made to clarify the committee's intent in a number of sections.

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This list represents the membership at the time the Committee was balloted on the final text of this edition. Since that time, changes in the membership may have occurred. A key to classifications is found at the back of the document.

NOTE: Membership on a committee shall not in and of itself constitute an endorsement of the Association or any document developed by the committee on which the member serves.

Committee Scope: This Committee shall have primary responsibility for documents on protection of buildings from fire exposure, excluding installation details for outside sprinklers, which are handled by the Technical Committee on Automatic Sprinklers.

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NOTICE: An asterisk (*) following the number or letter designating a paragraph indicates that explanatory material on the paragraph can be found in Annex A.

A reference in brackets [ ] following a section or paragraph indicates material that has been extracted from another NFPA document. As an aid to the user, the complete title and edition of the source documents for extracts in the recommendations sections of this document are given in Chapter 2 and those for extracts in the informational sections are given in Annex C. Editorial changes to extracted material consist of revising references to an appropriate division in this document or the inclusion of the document number with the division number when the reference is to the original document. Requests for interpretations or revisions of extracted text should be sent to the technical committee responsible for the source document.

Changes other than editorial are indicated by a vertical rule beside the paragraph, table, or figure in which the change occurred. These rules are included as an aid to the user in identifying changes from the previous edition. Where one or more complete paragraphs have been deleted, the deletion is indicated by a bullet (•) between the paragraphs that remain.

Information on referenced publications can be found in Chapter 2 and Annex C.

Chapter 1 Administration

1.1 Scope. This recommended practice addresses separation distances between buildings to limit exterior fire spread based on exterior openings and other construction features.

1.2 Purpose. These recommendations are intended to provide a reasonable level of protection for combustibles within and on the exterior of a building exposed to an external building fire while effective fire-fighting activity is being contemplated.

1.3 Application. The hazards of exposure to a structure from adjacent exposing fires and the multiple conditions under which such exposure can occur make it impossible to develop a table, formula, or set of rules that adequately covers all conditions. The user of this recommended practice should become familiar with the general theory of radiation exposure hazard as outlined in A.3.3.2, Exposure Severity.

1.4 Units and Formulas. Metric units of measurement in this recommended practice are in accordance with the modernized metric system known as the International System of Units (SI). The liter unit, which is outside of but recognized by SI, is commonly used in fire protection and is therefore used in this recommended practice. In this document, values for measurements are expressed in SI units followed by an equivalent English unit. The first stated value should be regarded as the recommendation because the given equivalent value might be approximate.

Chapter 2 Referenced Publications

2.1 General. The documents or portions thereof listed in this chapter are referenced within this recommended practice and should be considered part of the recommendations of this document.

2.2 NFPA Publications. National Fire Protection Association, 1 Batterymarch Park, Quincy, MA 02169-7471.

NFPA 13, *Standard for the Installation of Sprinkler Systems,* 2007 edition.

NFPA 80, *Standard for Fire Doors and Other Opening Protectives,* 2007 edition.

NFPA 255, *Standard Method of Test of Surface Burning Characteristics of Building Materials,* 2006 edition.

2.3 Other Publications. *Merriam-Webster's Collegiate Dictionary,* 11th edition, Merriam-Webster, Inc., Springfield, MA, 2003.

2.4 References for Extracts in Recommendations Sections.

NFPA 220, *Standard on Types of Building Construction,* 2006 edition.

Chapter 3 Definitions

3.1 General. The definitions contained in this chapter apply to the terms used in this recommended practice. Where terms are not defined in this chapter or within another chapter, they should be defined using their ordinarily accepted meanings within the context in which they are used. *Merriam-Webster's Collegiate Dictionary,* 11th edition, is the source for the ordinarily accepted meaning.

3.2 NFPA Official Definitions.

3.2.1* Approved. Acceptable to the authority having jurisdiction.

3.2.2* Authority Having Jurisdiction (AHJ). An organization, office, or individual responsible for enforcing the requirements of a code or standard, or for approving equipment, materials, an installation, or a procedure.

3.2.3 Should. Indicates a recommendation or that which is advised but not required.

3.3 General Definitions.

3.3.1 Exposure. The heat effect from an external fire that might cause ignition of, or damage to, an exposed building or its contents.

3.3.2* Exposure Severity. The intensity of an exposing fire.

3.3.3 Noncombustible Material. A substance that will not ignite and burn when subjected to fire. [**220,** 2006]

3.3.4* Pilot Ignition. The ignition of a material by radiation where a local high-temperature igniting source is located in the stream of gases and volatiles issuing from the exposed material.

Chapter 4 Classification of Exposures and Recommended Separation Distances

4.1 Exposures. Two types of exposure should be considered, as described in 4.1.1 and 4.1.2.

4.1.1 Exposure to Radiation. Exposure to radiation results from any of the following:

(1) Radiant energy passing through windows or other openings in the façade of a burning building
(2) Flames issuing from the windows of a burning building
(3) Flames issuing from the burning façade of a building

4.1.2 Exposure to Flames. Exposure to flames results from flames issuing from the roof or top of a burning building in cases where the exposed building is higher than the burning building.

4.2 Exposure from Buildings of Greater or Equal Height.

4.2.1 Where a building is exposed by a building of greater or equal height, only the thermal radiation from the walls or wall openings of the exposing building should be considered.

4.2.2 Separation distances should be determined so that pilot ignition of the exposed building or its contents is unlikely, assuming no means of protection are installed in connection with either building.

4.3 Minimum Separation Distance.

4.3.1 General. The minimum separation distances between buildings should be determined using 4.3.2 through 4.3.8 and Table 4.3.7.3 and Table 4.3.8.2.

4.3.2 Width of Exposing Fire.

4.3.2.1 The width of the exposing fire should be considered to be the length in meters (feet) of the exposing wall between interior fire separations (such as partition walls or fire walls) or between exterior end walls where no fire separations exist.

4.3.2.2 Fire separations should have sufficient fire resistance to contain the expected fire.

4.3.3 Height of Exposing Fire.

4.3.3.1 The height of the exposing fire should be regarded as the height in meters (feet) of the number of stories involved in the exposing fire, considering such factors as the building construction, closure of vertical openings, and fire resistance of floors.

4.3.3.2 The relevant fire separations should have a fire resistance sufficient to contain the expected fire.

4.3.4 Percentage of Opening in Exposing Wall Area. The percentage of opening in the exposing wall area should be regarded as the percentage of the exposing wall made up of doors, windows, or other openings within the assumed height and width of the exposing fire.

4.3.4.1 Walls without the ability to withstand fire penetration in excess of 20 minutes should be treated as having 100 percent openings.

4.3.4.2 Walls having the ability to withstand fire penetration for not less than 20 minutes but not exceeding the expected duration of the fire should be treated as having 75 percent openings or the actual percentage of openings, whichever is greater.

4.3.5 Severity.

4.3.5.1 Three levels of exposure severity should be assumed: light, moderate, and severe. Two of the important properties influencing fire severity are as follows:

(1) The average combustible load per unit of floor area
(2) The characteristics and average flame spread ratings of the interior wall and ceiling finishes

4.3.5.2 Table 4.3.5.2(a) and Table 4.3.5.2(b) should be used to assess severity based on the properties described in 4.3.5.1, and the more severe of the two classifications should govern.

Table 4.3.5.2(a) Severity of Fire Load

Fire Loading of Floor Area		Classification of Severity
kg/m²	lb/ft²	
0–34	0–7*	Light
35–73	8–15	Moderate
≥74	≥16	Severe

*Excluding any appreciable quantities of rapidly burning materials such as certain foamed plastics, excelsior, or flammable liquids. Where these materials are found in substantial quantities, the severity should be classified as moderate or severe.

Table 4.3.5.2(b) Severity of Interior Wall and Ceiling Finish

Average Flame Spread Rating of Interior Wall and Ceiling Finish*	Classification of Severity†
0–25	Light
26–75	Moderate
≥76	Severe

*See NFPA 255, *Standard Method of Test of Surface Burning Characteristics of Building Materials*.
†Where only a portion of the exposing building has combustible interior finish (e.g., some rooms only, ceiling only, some walls only), this factor is considered when judging severity classification.

4.3.5.3 Where all openings in the façade of the exposing building are equipped with opening protectives having a fire protection rating equal to or greater than the expected duration of the fire, the following adjustments may be applied. Moderate and severe severity classifications determined in accordance with 4.3.5.2 may be reduced to light and moderate, respectively, for use in Table 4.3.7.3. Where the severity classification determined in accordance with 4.3.5.2 is light, the percentage of openings for use to Table 4.3.7.3 may be 50 percent of the actual value.

4.3.6 Width/Height or Height/Width.

4.3.6.1 Width versus height, *w/h*, or height versus width, *h/w*, should be determined as a measure of the configuration of the exposing face and should be expressed as a ratio.

4.3.6.2 The larger of *w/h* or *h/w* values should be used.

Table 4.3.7.3 Guide Numbers for Minimum Separation Distances

Severity			Width/Height or Height/Width																
Percentage of Openings*			Guide Number [multiply by lesser dimension, add 1.52 m (5 ft)† to obtain building-to-building separation]																
Light	**Moderate**	**Severe**	**1.0**	**1.3**	**1.6**	**2.0**	**2.5**	**3.2**	**4**	**5**	**6**	**8**	**10**	**13**	**16**	**20**	**25**	**32**	**40**
20	10	5	0.36	0.40	0.44	0.46	0.48	0.49	0.50	0.51	0.51	0.51	0.51	0.51	0.51	0.51	0.51	0.51	0.51
30	15	7.5	0.60	0.66	0.73	0.79	0.84	0.88	0.90	0.92	0.93	0.94	0.94	0.95	0.95	0.95	0.95	0.95	0.95
40	20	10	0.76	0.85	0.94	1.02	1.10	1.17	1.23	1.27	1.30	1.32	1.33	1.33	1.34	1.34	1.34	1.34	1.34
50	25	12.5	0.90	1.00	1.11	1.22	1.33	1.42	1.51	1.58	1.63	1.66	1.69	1.70	1.71	1.71	1.71	1.71	1.71
60	30	15	1.02	1.14	1.26	1.39	1.52	1.64	1.76	1.85	1.93	1.99	2.03	2.05	2.07	2.08	2.08	2.08	2.08
80	40	20	1.22	1.37	1.52	1.68	1.85	2.02	2.18	2.34	2.48	2.59	2.67	2.73	2.77	2.79	2.80	2.81	2.81
100	50	25	1.39	1.56	1.74	1.93	2.13	2.34	2.55	2.76	2.95	3.12	3.26	3.36	3.43	3.48	3.51	3.52	3.53
—	60	30	1.55	1.73	1.94	2.15	2.38	2.63	2.88	3.13	3.37	3.60	3.79	3.95	4.07	4.15	4.20	4.22	4.24
—	80	40	1.82	2.04	2.28	2.54	2.82	3.12	3.44	3.77	4.11	4.43	4.74	5.01	5.24	5.41	5.52	5.60	5.64
—	100	50	2.05	2.30	2.57	2.87	3.20	3.55	3.93	4.33	4.74	5.16	5.56	5.95	6.29	6.56	6.77	6.92	7.01
—	—	60	2.26	2.54	2.84	3.17	3.54	3.93	4.36	4.82	5.30	5.80	6.30	6.78	7.23	7.63	7.94	8.18	8.34
—	—	80	2.63	2.95	3.31	3.70	4.13	4.61	5.12	5.68	6.28	6.91	7.57	8.24	8.89	9.51	10.05	10.50	10.84
—	—	100	2.96	3.32	3.72	4.16	4.65	5.19	5.78	6.43	7.13	7.88	8.67	9.50	10.33	11.15	11.91	12.59	13.15

* Where the percentage of openings or width/height or height/width ratio is between table values provided, interpolation between respective guide numbers should be made. See A.4.3.7 for treatment of unequally distributed windows.

†Where openings in exterior walls are equipped with opening protectives, see 4.3.7.1.

4.3.7* Determination of Separation Distances.

4.3.7.1 To determine distances, the lesser dimension of either width, *w*, or height, *h*, should be multiplied by the guide number. Where all openings are not equipped with opening protectives having a fire protection rating equal to or greater than the expected duration of the fire, 1.5 m (5 ft) is added to the result.

4.3.7.2 Where non-cellulosic combustible materials are installed on the façade of the exposed building, the material should be subjected to appropriate tests to determine the minimum value of *I* at which it will ignite in the presence of a pilot flame. Where the *I* value for the non-cellulosic combustible materials used is indicated by appropriate tests to be less than 12.5 kW/m^2 (1.10 $Btu/ft^2 \cdot sec$), the percentage of openings should be decreased by multiplying by the ratio I/12.5 kW/m^2 (1.10 $Btu/ft^2 \cdot sec$). Where *I* is indicated by appropriate tests to be greater than 12.5 kW/m^2 (1.10 $Btu/ft^2 \cdot sec$) and there are no openings in the façade of the exposed building, the percentage of openings may be increased by multiplying by the ratio I/12.5 kW/m^2 (1.10 $Btu/ft^2 \cdot sec$).

4.3.7.3 Recommended separation distances assume fire department response. Where no organized fire-fighting facilities are available, the distances derived from the guide numbers in Table 4.3.7.3 should be increased by a factor of 3 or less.

4.3.8* Exposure from Buildings of Lesser Height.

4.3.8.1 Where the exposing building is of lesser height than the exposed building, the separation distance should first be determined from Table 4.3.7.3.

4.3.8.2 Where the roof assembly of the exposing building is combustible and has no fire resistance rating, means of protection should be provided above the roof level of the exposing building in accordance with Table 4.3.8.2.

4.3.8.3 Where separation distances derived from Table 4.3.7.3 do not exceed the distances indicated in Table 4.3.8.2, means of protection should be applied on the exposed building wall to a height equal to the separation distance, commencing at the height of the roof of the exposing building.

4.3.8.4 Where the roof of the exposing building has a fire resistance rating sufficient to contain the expected fire (based on the fire loading within the area), no exposure hazard is considered to exist throughout the roof.

4.3.8.5 Where the roof has a fire resistance rating less than necessary to contain an expected fire, means of protection should be provided in accordance with Table 4.3.8.2, taking into consideration the fire stability of the roof assembly involved, the fuel it could contribute, including roof insulation and covering, and its tendency to inhibit flaming through the roof.

4.3.8.6 Subject to 4.3.8.4 and 4.3.8.5, the number of stories expected to contribute to flaming through the roof should be considered to be the top story together with those stories that are successively located beneath the top story and are not separated from it, as indicated in 4.3.3.

Table 4.3.8.2 Minimum Separation Distance for Exposing Buildings with Combustible/Nonrated Roof Assemblies

Number of Stories Likely to Contribute to Flaming Through the Roof	Horizontal Separation Distance or Height of Protection Above Exposing Fire	
	m	**ft**
1	7.5	25
2	10	33
3	12.5	41
4	15	49

4.3.8.7 High attic spaces should be counted as a story and be subject to 4.3.8.4 and 4.3.8.5. Where the height of the attic is low, interpolation between the values provided in Table 4.3.8.2 should be made.

Chapter 5 Means of Protection

5.1 Types. Various means of protecting buildings from fire damage resulting from exterior exposure, listed as follows in no specific order with regard to adequacy, should be considered:

(1) Buildings
  (a) Clear space between buildings
  (b) Total automatic sprinkler protection
(2) Walls
  (a) Blank walls of noncombustible materials
  (b) Barrier walls (self-supporting) between the building and exposure
  (c) Extension of exterior masonry walls to form parapets or wings
  (d) Automatic exposure protection sprinkler systems for combustible walls
(3) Wall openings
  (a) Elimination of openings by filling with equivalent construction
  (b) Glass block panels in openings
  (c) Wired glass in steel sash (fixed or automatic closing) in openings
  (d) Automatic exposure protection sprinklers systems
  (e) Listed automatic window sprinklers
  (f) Automatic (rolling steel) fire shutters on openings
  (g) Automatic fire doors on door openings
  (h) Automatic fire dampers on wall openings

5.2 Additional Protection.

5.2.1 Additional means of protection that can be developed, such as double-glazed glass in metal sash, flame-retardant coatings, and other arrangements, also should be considered.

5.2.2 Any additional means of protection should be approved before being implemented.

5.3 Evaluation of Protection. In evaluating the suitability of any of the types of protection specified in Section 5.1, the adverse effects of convected heat, flame impingement, and small flying brands associated with winds, as well as the beneficial effects of fire department operations, have been considered. Large flying brands have not been considered.

5.4 Selecting the Means of Protection. The means of protection selected should be approved for the individual application and should be installed in accordance with appropriate standards (e.g., fire doors installed in accordance with NFPA 80, *Standard for Fire Doors and Fire Windows*; automatic sprinklers installed in accordance with NFPA 13, *Standard for the Installation of Sprinkler Systems*).

5.5 Manual Operation. Manually operated window shutters or sprinklers should not be used. The excessive time needed to close or activate them at the time of a fire incident and the fact that the property exposed could be vacant or uninhabited at the time of the fire incident make their value questionable.

5.6 Application of Means of Protection. The various means of protection to reduce the separation distances indicated in Table 4.3.7.3 and Table 4.3.8.2 should be applied in accordance with the guidelines provided in 5.6.1.

5.6.1 Separation Adjustments. Table 5.6.1(a) through Table 5.6.1(e) should be used for adjusting the separation distances derived from Table 4.3.7.3 and Table 4.3.8.2.

Table 5.6.1(a) Frame or Combustible Exposed Exterior Walls

Means of Protection	Separation Distance Adjustment
Replace with blank fire-resistive wall (3-hour minimum)	Reduce to 0 m (0 ft)
Install automatic exposure protection sprinkler systems over entire wall with no windows, with wired glass windows, or with windows closed by ¾-hour protection	Reduce to 1.5 m (5 ft)
Install automatic exposure protection sprinkler systems over entire wall with ordinary glass windows	Reduce by 50 percent

Table 5.6.1(b) Frame or Combustible Exposed Exterior Wall [*I* Greater Than 12.5 kW/m² (0.3 cal/cm²·sec or 66 Btu/ft²·min)] with Openings

Means of Protection	Separation Distance Adjustment
Replace with blank fire-resistive wall (3-hour minimum)	Reduce to 0 m (0 ft)
Install automatic exposure protection sprinkler systems over entire wall with no windows, with wired glass windows, or with windows closed by ¾-hour protection	Reduce to 1.5 m (5 ft)
Install automatic exposure protection sprinkler systems over entire wall with ordinary glass windows	Reduce by 50 percent
Close all wall openings with material equivalent to wall, or close with ¾-hour protection and eliminate combustible projections that have *I* less than wall	Reduce in accordance with 4.3.7.2

5.6.2 Combustible Eaves. Combustible eaves, cornices, and other exterior ornamentation on exposed buildings should be treated as unprotected openings, in accordance with 5.6.1.

5.6.3* Exposing Building. Where the exposing building or structure is protected throughout by an approved, properly maintained automatic sprinkler system or other approved automatic fire suppression system of adequate design for the hazard involved, no exposure hazard should be considered to exist.

Table 5.6.1(c) Noncombustible Exposed Exterior Wall (Fire Resistance Less Than 3 Hours)

Means of Protection	Separation Distance Adjustment
Replace wall with blank fire-resistive wall (3-hour minimum)	Reduce to 0 m (0 ft)
Close all wall openings with material equivalent to wall, or close with ¾-hour protection and eliminate combustible projections	Reduce by 50 percent
Install automatic exposure protection sprinkler systems over entire wall with no windows, with wired glass windows, or with windows closed by ¾-hour protection	Reduce to 1.5 m (5 ft)
Install automatic exposure protection sprinkler systems on all wall openings equipped with ordinary glass and on combustible projections	Reduce by 50 percent
Install listed automatic window sprinklers in accordance with their listings	Reduce by 50 percent

Table 5.6.1(d) Veneered Exposed Exterior Wall [Combustible Construction Covered by a Minimum of 100 mm (4 in.) of Masonry]

Means of Protection	Separation Distance Adjustment
Replace wall with blank fire-resistive wall (3-hour minimum)	Reduce to 0 m (0 ft)
Close all wall openings with ¾-hour protection and eliminate combustible projections	Reduce by 50 percent
Close all wall openings with material equivalent to wall construction and eliminate combustible projections	Reduce to 1.5 m (5 ft)
Install automatic exposure protection sprinkler systems over windows equipped with wired glass or over ¾-hour closed openings and on combustible projections	Reduce to 1.5 m (5 ft)
Install automatic exposure protection sprinkler systems over windows equipped with ordinary glass and on combustible projections	Reduce by 50 percent
Install listed automatic window sprinklers in accordance with their listings	Reduce to 1.5 m (5 ft)

Table 5.6.1(e) Fire-Resistive Exposed Exterior Wall (Minimum 3-Hour Rating)

Means of Protection	Separation Distance Adjustment
Close all openings with material equivalent to wall or protect all wall openings with 3-hour protection	Reduce to 0 m (0 ft)
Protect all openings with ¾-hour protection	Reduce by 75 percent [max. recommended = 3 m (10 ft)]
Protect all wall openings with ¾-hour protection	Reduce by 50 percent [max. recommended = 6 m (20 ft)]
Install automatic exposure protection sprinkler systems on all wall openings with wired glass or with ¾-hour or 1½-hour protection	Reduce to 1.5 m (5 ft)
Install automatic exposure protection sprinkler systems on all wall openings equipped with ordinary glass	Reduce by 50 percent
Install listed automatic window sprinklers in accordance with their listings	Reduce by 75 percent

5.6.4* Exposed Building. Where the exposed building or structure is protected throughout by an approved, properly maintained automatic sprinkler system or other approved automatic fire suppression system of adequate design for the hazard involved, the exposure hazard to the total exposed building and its contents should be considered to be substantially reduced depending upon the construction of the exterior wall.

Annex A Explanatory Material

Annex A is not a part of the recommendations of this NFPA document but is included for informational purposes only. This annex contains explanatory material, numbered to correspond with the applicable text paragraphs.

A.3.2.1 Approved. The National Fire Protection Association does not approve, inspect, or certify any installations, procedures, equipment, or materials; nor does it approve or evaluate testing laboratories. In determining the acceptability of installations, procedures, equipment, or materials, the authority having jurisdiction may base acceptance on compliance with NFPA or other appropriate standards. In the absence of such standards, said authority may require evidence of proper installation, procedure, or use. The authority having jurisdiction may also refer to the listings or labeling practices of an organization that is concerned with product evaluations and is thus in a position to determine compliance with appropriate standards for the current production of listed items.

A.3.2.2 Authority Having Jurisdiction (AHJ). The phrase "authority having jurisdiction," or its acronym AHJ, is used in NFPA documents in a broad manner, since jurisdictions and approval agencies vary, as do their responsibilities. Where public safety is primary, the authority having jurisdiction may be a federal, state, local, or other regional department or individual such as a fire chief; fire marshal; chief of a fire prevention bureau, labor department, or health department; building official; electrical inspector; or others having statutory authority. For insurance purposes, an insurance inspection department, rating bureau, or other insurance company representative may be the authority having jurisdiction. In many circumstances, the property owner or his or her designated agent assumes the role of the authority having jurisdiction; at government installations, the commanding officer or departmental official may be the authority having jurisdiction.

A.3.3.2 Exposure Severity. For the purposes of this document, *exposure severity* has been defined as "the intensity of an exposing fire." Exposure severity is intended to be a measure of the radiation level developed per unit window area by the exposing fire. It represents a combination of radiation emitted through the window itself as well as that produced from the flames that project out the window and up the front of the building. Thus, because radiant transfer from the flames as well as from the interior room walls is involved, the flame emissivity, dependent on fuel character as well as flame dimensions, could be of great importance. It is generally assumed for radiation calculation purposes that emissivity, ε, is 1.0.

The emission of flames and hot gases from the window of a room or building compartment during a fire could result from the establishment of a thermal pump. The pump is created by buoyancy differences between the hot combustion products and the surrounding outside ambient air, and it provides a positive means for furnishing fresh air to the fire and discharging flames and combustion products through the window. If the room involved is provided with only a single window and no internal source of air, the window serves the dual purpose as a passage for the entry of fresh air and for the discharge of flames and other hot combustion products. If, however, an internal duct or passage is available for the supply of fresh air to the fire room, a much larger fraction of the window can be used effectively for the discharge of flaming gases. Winds also could significantly influence the ventilation behavior of a building fire and thus the exposure severity.

In addition to ventilation, a number of other system variables influence exposure severity. The most important of these are as follows:

(1) The combustible load, including both the occupancy and building construction combustibles
(2) The fuel dispersion or surface-to-volume ratio of the fuel
(3) The size, geometry, and surface-to-volume ratio of the room involved
(4) The thermal properties, conductivity, specific heat, and density of the interior finish

The current state of the art of fire protection engineering is such that it is not possible to define clearly how all or even a few of these variables interact to influence exposure severity. However, this general discussion provides a guide to trends.

A.3.3.4 Pilot Ignition. In practice, a glowing ember or a flash of flame could constitute a high-temperature ignition source, which often serves to ignite the flammable gases and volatiles. This mechanism differs from spontaneous ignition by radiation in which there is no local high-temperature igniting source and for which higher intensities of radiation are necessary.

A.4.3.7 *Separation Distances.* Table 4.3.7.3 determines the separation distance necessary between two buildings so that pilot ignition of combustibles on the façade of the exposed building or its contents is unlikely, assuming no means of protection are installed in connection with either building. Guide numbers are obtained from this table.

Table 4.3.7.3 is based on a maximum tolerable level of incident radiation (I) at the façade of an exposed building of 12.5 kW/m^2 (0.3 cal/cm^2·sec or 66 Btu/ft^2·min), assuming the façade is constructed of typical cellulosic materials.

Derivation of Table 4.3.7.3. The principles underlying the derivation of the separations specified in Table 4.3.7.3 are discussed in detail in "Fire and the Spatial Separation of Buildings" (McGuire, 1966).

The spread of fire from one building to another across a vacant space can be caused by convective or radiative heat transfer or flying brands. The hazard created by large flying brands was not a consideration in these recommendations. Convective heat transfer is also disregarded where the source of hazard is associated with openings in the façade of the exposing building, because ignition by radiation can occur at distances substantially greater than those at which flame impingement and convective heat transfer usually constitute a hazard. Therefore, ignition as a result of radiative heat transfer is the event that these recommendations are intended to combat.

The applicable equation that expresses the relationship for radiant heat transfer is $I = I_o\Phi$, or the unit intensity at an exposed building (I) is equal to the unit intensity at the exposing building (I_o) multiplied by the configuration factor (Φ), which is based on radiator size, geometry, and spatial distance. The radiation intensity per unit area at the exposure building (I_o) is calculated as follows:

$$I_o = \varepsilon\sigma T^4$$

Where ε is emissivity of the flames, which, as indicated previously, is generally assumed to be 1.0, σ is the Stefan-Boltzmann constant (5.67×10^{-11} kW/m^2·K^4), and T is the absolute temperature of the flames in degrees K (degrees K = degrees C + 273).

The maximum tolerable level of radiation at the façade of an exposed building (I) has been established as 12.5 kW/m^2 (0.3 cal/cm^2·sec or 66 Btu/ft^2·min). This value, originally derived from work of the Joint Fire Research Organization in the United Kingdom, is now generally accepted as that below which the pilot ignition of most cellulosic materials is unlikely to occur. Substantially higher levels of radiation are necessary to cause spontaneous ignition. It is believed that a local high-temperature ignition source usually is present; thus the selection of pilot ignition is indicated. Where materials are located in an enclosure irradiated through a small opening, appreciably lower levels can cause ignition. This factor has been ignored because irradiation times of more than 30 minutes usually are involved.

Since Table 4.3.7.3 was created, new building materials, other than cellulosic products (wood), having greater or lesser ability to resist ignition have been developed. Greater separation distances or fewer openings are needed for materials with greater propensity to ignite. Those offering greater resistance to ignition can be separated at lesser distances or more openings can be permitted.

Information on the radiation levels near burning buildings (I_o) was established by a number of case histories and by a series of experimental burns known as the "St. Lawrence Burns." The most important findings of the latter experiments were that radiation levels were related to the percentage of openings in building walls and that combustible interior walls or ceiling linings give rise to particularly high levels of radiation outside the building.

Another notable conclusion of the St. Lawrence Burns was that maximum radiation levels were not greatly affected by the type of exterior covering. In all the experiments, the exterior walls were not close to penetration by the fire during times of maximum radiation.

The St. Lawrence Burns produced maximum levels of radiation so high that protection against them would involve unduly large distances of separation. However, much lower levels prevailed for at least the first 20 minutes. It was decided to base separation distance recommendations on these lower values. It was believed that the likelihood of fire department attendance at an early stage of a fire justified this approach. Subsequently, a field incident has confirmed that the recommended separations cannot be considered universally adequate and that an unusual combination of adverse conditions could allow fire spread even where the recommended separation distances are used.

In calculating the recommended separations, a rectangular radiator has been assumed, with a uniform emissive power being taken as proportional to the percentage of window openings. The expression for the configuration factor (Φ) of a rectangular radiator at an elemental receiving surface (i.e., the ratio of the radiant intensity at the receiver to that at the radiator) is as follows:

$$\Phi = \frac{2}{\pi}\left[\frac{x}{\sqrt{x^2+y^2}}\arctan\left(\frac{z}{\sqrt{x^2+y^2}}\right)+\frac{z}{\sqrt{y^2+z^2}}\arctan\left(\frac{x}{\sqrt{y^2+z^2}}\right)\right]$$

where:
x = half-length of rectangular radiating surface
z = half-height of rectangular radiating surface
y = separation distance between radiator and receiving surface

Three levels of radiation hazard from a burning building were considered: light, moderate, and severe. For light, moderate, and severe hazard levels, configuration factors (Φ) of 0.14, 0.07, and 0.035, respectively, were adopted.

Using the relationship $I = I_o\Phi$ and setting $I = 12.5$, the radiation intensities at the exposing building (I_o) assumed in developing the guide numbers are 89.3, 178.6, and 357.1 kW/m^2, respectively. The temperatures required to produce these radiation intensities, assuming the flames have an emissivity of 1.0, are 847°C (1557°F), 1059°C (1938°F), and 1311°C (2392°F), respectively.

An additional value of 1.5 m (5 ft) was added to the computed values of separation distance to account for the horizontal projection of flames from unprotected windows and doors, and to guard against the risk of ignition by direct flame impingement where small separations are involved.

Uniformity of Openings. The derivation of Table 4.3.7.3 assumes that openings are uniformly distributed on the façade and that the separation distance (blank wall) between openings is small (i.e., no more than one-third of the separation distance between the buildings). Where this is not the case, insufficient spatial separations can be predicted. The following measures remedy this deficiency substantially:

(1) Where the openings in the façade are not uniformly distributed and a small portion of the façade includes a large number of windows, a separate calculation should be made with respect to the smallest rectangle conveniently including all the windows in this area. In many cases, a single window constitutes this rectangle. The spatial separation chosen for this area should be the largest value determined by any of the calculations involving the windows for the area.

(2) Where the separation distance (blank wall) between openings is appreciably more than one-third of the separation distance between the buildings (as provisionally estimated), an additional calculation for a single window should be made. If a higher building spatial separation results, this value should be used.

It is fundamental to the derivation of Table 4.3.7.3 that a row of results relating to a percentage of window openings of less than 20 percent (severe hazard), 10 percent (moderate hazard), or 5 percent (light hazard) is not valid for inclusion in the table.

Separations less than those provided by the first row of the table can, however, often be derived by considering individual windows or groups of windows. The radiation level at the exposed building opposite a particular point on a façade of the exposing building is hardly influenced by radiation from a region of the exposing building façade further removed from the point than twice the estimated separation between buildings recommended. If windows or groups of windows are separated by more than this distance (which is likely if the percentage of openings is small), individual calculations are considered to be valid. The resulting building separations then can be used even though they need to be lower than those that would be predicted in association with a large area of façade and the smallest percentage opening area provided by the table.

A.4.3.8 *Derivation of Table 4.3.8.2.* NFPA searched its photographic records of building fires in which flames penetrated the roof. Of the thousands of photographs examined, 176 showed flames above roofs at what appeared to be maximum or near maximum heights. No significant correlation between flame height and occupancy was apparent. In fact, the principal relationship was the number of stories involved in the fire. Table A.4.3.8 provides the average of the flame heights illustrated in some of the records. This table is reproduced from the May 1968 issue of *Fire Journal*.

Table A.4.3.8 Average Heights of Flames Penetrating Roofs

Number of Stories Burning	Flame Height Above Roof (in Stories)
1	1.4
2	1.8
3	2.2
4	2.6
5	2.9
6	3.1

The relationships shown in Table A.4.3.8 do not agree with those suggested by British and Japanese work based on theory and experiments, which, in general, would produce much higher values. The NFPA study does indicate that flame heights can be great under unusual circumstances, such as the heavy involvement of liquid fuels. The recommendations provided here are not intended to provide adequate protection under such circumstances.

In the event of a moderate wind, flames can be expected to extend horizontally for as great a distance as they might otherwise extend upward. For this reason, protection is recommended where the separation between two buildings is no more than the height to which the flames could otherwise extend.

Varying reductions in separation distance for blank fire-resistive walls with less than 3-hour ratings have not been made, because current test data are insufficient to evaluate appropriate reductions properly. It is hoped that future studies and tests will produce varying reductions with varying resistance ratings. Three-hour fire-resistance-rated walls are assumed to be clad with noncombustible material.

A.5.6.3 Where the exposing building is properly protected by automatic sprinklers, a fire in that building is assumed to be controlled; exposure, therefore, is also assumed to be controlled.

A.5.6.4 Where the exposed building is properly protected by automatic sprinklers, ignition within the exposed building is possible where separation distances are less than those recommended or where means of protection are not provided on exposed openings, walls, or projections with lesser separation distances. Such an ignition, however, is assumed to be controlled by sprinklers in the exposed structures.

Where automatic exposure protection is provided for exposed openings in sprinklered buildings, as recommended in 5.6.1, such sprinklers could be located on the inside of the building, adjacent to the opening being protected and in a position where the sprinkler can sense the exposing fire. Under these conditions, such sprinklers could be of the closed type supplied by the wet pipe system within the building. Their water demand, however, should be calculated in addition to or separate from the demand of the remainder of the system.

Annex B Example

This annex is not a part of the recommendations of this NFPA document but is included for informational purposes only.

B.1 Application of NFPA 80A. Annex B provides an example of the application of NFPA 80A to a typical building exposure scenario as shown in Figure B.1.

Construction:

Walls: North — 4-hour openings as illustrated

South — 4-hour openings as illustrated

West — 4-hour openings as illustrated

East — Nonrated wall

Floors: Reinforced concrete — 3 hours

Floor openings: 2-hour enclosures

Roof: 2 hours

Interior finish: Noncombustible, except ceiling of office has a flame spread rating of 100

Occupancy:

Second floor: Office

First floor: Receiving and shipping

Manufacturing — electronic parts

Warehouse — palletized storage to 7.9 m (26 ft) in height

Analysis of Exposure:

North:

Width of exposing fire, w — 22.9 m (75 ft) (The blank wall casts no exposure, and the wall is of sufficient fire resistance to contain the expected fire.)

Height of exposing fire, h — 4.6 m (15 ft) [The floor is of sufficient fire resistance to contain the expected fire, and openings are protected. If openings in the floor are unprotected, h is 9.1 m (30 ft).]

Severity (from Table 4.3.7.3 and Table 4.3.8.2):

Office fire loading — light

Average interior finish — moderate

Shipping and receiving fire loading — moderate

Interior finish — light

Severity — moderate

w/h or h/w — 22.9 m/4.6 m (75 ft/15 ft) = 5

Percentage of openings — 30 percent

Guide number (from Table 4.3.7.3) — 1.85

Separation distance — [1.85 × 4.6 m (15 ft)] + 1.5 m (5 ft) = 8.5 m (28 ft) + 1.5 m (5 ft) = 10 m (33 ft)

South:

Exposure hazard from the two-story section of the building is the same as the north wall. The one-story section then should be calculated.

Width of exposing fire, w — 38 m (125 ft)

Height of exposing fire, h — 4.6 m (15 ft)

Severity (from Table 4.3.7.3 and Table 4.3.8.2):

Fire loading — moderate

Interior finish — light

Severity — moderate

w/h or h/w — 38 m/4.6 m (125 ft/15 ft) = 8.3

Percentage of openings — 20 percent

Guide number (from Table 4.3.7.3) — 1.32

Separation distance — [1.32 × 4.6 m (15 ft)] + 1.5 m (5 ft) = 6 m (20 ft) + 1.5 m (5 ft) = 7.6 m (25 ft)

Separation distance from south wall, therefore, should be 10 m (33 ft) (the recommended separation distance from the two-story section, which is calculated as greater than that from the one-story section).

West:

Width, w — 61 m (200 ft)

Height, h — 4.6 m (15 ft)

Severity — moderate

w/h or h/w — 61 m/4.6 m (200 ft/15 ft) = 13.3

Percentage of openings — 80 percent

Guide number (from Table 4.3.7.3) — 5.04

Separation distance — [5.04 × 4.6 m (15 ft)] + 1.5 m (5 ft) = 23 m (75.6 ft) + 1.5 m (5 ft) = 24.6 m (80.6 ft)

East:

Manufacturing area:

Width, w — 30.5 m (100 ft)

Height, h — 4.6 m (15 ft)

Severity — moderate

w/h or h/w — 30.5 m/4.6 m (100 ft/15 ft) = 6.7

Percentage of openings — 100 percent (nonrated wall)

Guide number (from Table 4.3.7.3) — 4.89

Separation distance — [4.89 × 4.6 m (15 ft)] + 1.5 m (5 ft) = 22.4 m (73.4 ft) + 1.5 m (5 ft) = 23.9 m (78.4 ft)

Warehouse:

Width, w — 30.5 m (100 ft)

Height, h — 9.1 m (30 ft)

Severity (from Table 4.3.7.3 and Table 4.3.8.2):

Fire loading — severe

Interior finish — light

Severity — severe

w/h or h/w — 30.5 m/9.1 m (100 ft/30 ft) = 3.3

Percentage of openings — 100 percent

Guide number (from Table 4.3.7.3) — 5.27

Separation distance — [5.27 × 9.1 m (30 ft)] + 1.5 m (5 ft) = 48.1 m (158.1 ft) + 1.5 m (5 ft) = 49.7 m (163.1 ft)

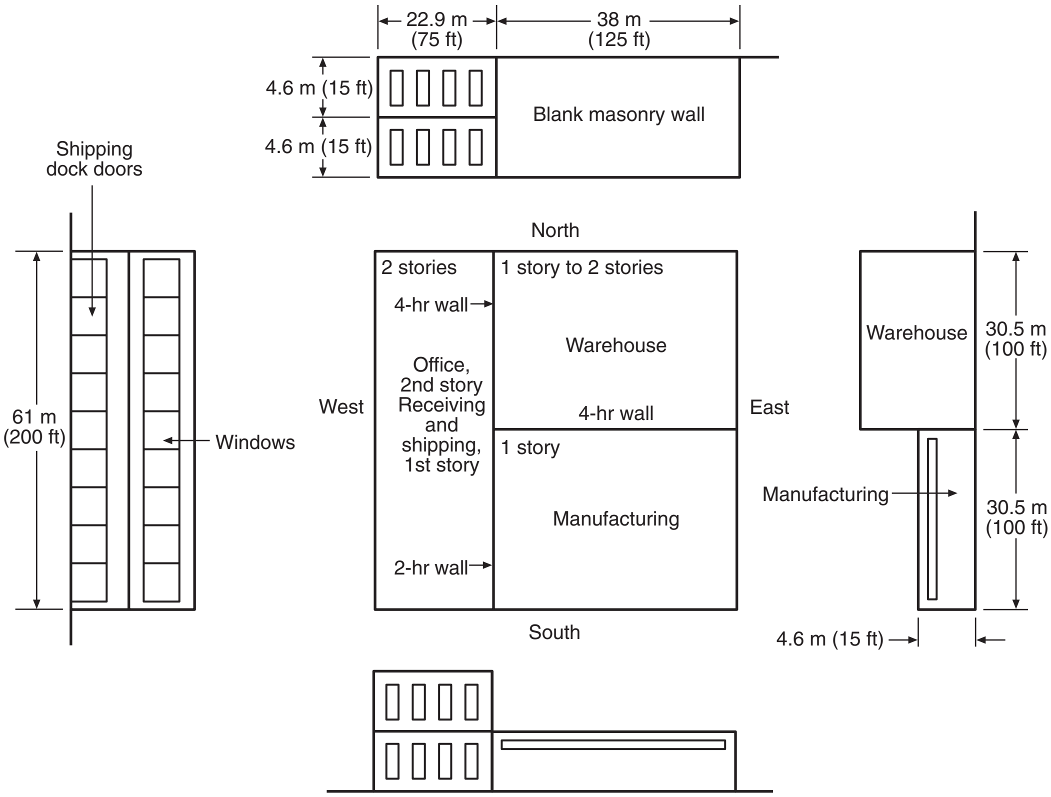

FIGURE B.1 Example of Building Exposure Scenario.

Annex C Informational References

C.1 Referenced Publications. The documents or portions thereof listed in this annex are referenced within the informational sections of this recommended practice and are not part of the recommendations of this document unless also listed in Chapter 2 for other reasons.

C.1.1 NFPA Publications. (Reserved)

C.1.2 Other Publications. McGuire, J. H. 1966. "Fire and the Spatial Separation of Buildings." Reprinted from *Fire Technology*, vol. 1, no. 4, Technical Paper No. 212, NRC 8901, National Research Council of Canada, Division of Building Research, Ottawa, 278–287.

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C.3 References for Extracts in Informational Sections. (Reserved)

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