

2012 EDITION

FLAMMABLE FINISHES

BASED ON THE 2012 INTERNATIONAL FIRE CODE[®],
2012 INTERNATIONAL MECHANICAL CODE[®] and
2012 INTERNATIONAL BUILDING CODE[®]



APPLICATION GUIDE



Flammable Finishes Application Guide: 2012Edition

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Preface

A variety of processes and materials are available for the application of flammable finishes. Liquids can be atomized into aerosol and sprayed on objects. Goods can be immersed into open dip tanks. In a process known as powder coating, ionized solids are suspended in air and attached to metal objects after being electrically charged. Rigid thermoplastics are manufactured using glass fibers that are applied with a resin and a chemical catalyst.

Chapter 24 of the 2012 *International Fire Codes*[®] (IFC[®]) contains the minimum requirements for flammable finishes. This application guide was developed to assist code officials, design professionals and the regulated community in understanding the IFC, *International Mechanical Code*[®] (IMC[®]) and *International Building Code*[®] (IBC[®]) requirements and intent for these hazardous activities.

This application guide is divided into six modules. Module 1 addresses the general provisions of IFC Chapter 24 and includes an analysis of the hazards associated with flammable spray finishing, finishing using dip tanks, powder coating and the manufacturing of rigid thermoplastics. Module 2 addresses the IFC requirements for the protection of operations. The remaining modules address the IFC requirements for spray finishing, dipping activities, powder coating and the manufacturing of reinforced plastics. In addition, the application guide addresses the National Fire Protection Association (NFPA) 33 requirements for spray finishing and the NFPA 34 requirements for dip tanks. This application guide is designed to assist users of the IFC in its proper application and use for flammable finishes.

This application guide includes an extensive and detailed analysis of the IMC requirements for hazardous exhaust ventilation systems and NFPA Standard 70, *National Electrical Code*[®] requirements for hazardous (classified) location electrical equipment. Properly designed mechanical ventilation systems and properly specified and installed electrical equipment that is designed to be resistant to the ignition of flammable liquid vapors or combustible dusts are essential for the safe operation of equipment or areas where flammable finishing occurs. These engineered systems provide effective and economical control of ignition sources in flammable finish applications.

The information and opinions expressed in this application guide are those of the author and do not necessarily represent the official position of the International Code Council. Additionally, the opinions may not represent the viewpoint of any enforcing agency. Opinions expressed in this publication are only intended to be a resource in the application of the IFC, and the code official is not obligated to accept such opinions. The code official is the final authority in rendering interpretations of the code and its adopted standards.

Questions or comments concerning this application guide are encouraged. Please direct any correspondence to applicationguide@iccsafe.org.

About the International Code Council®

The International Code Council (ICC), a membership association dedicated to building safety, fire prevention and energy efficiency, develops the codes and standards used to construct residential and commercial buildings, including homes and schools. The mission of ICC is to provide the highest quality codes, standards, products and services for all concerned with the safety and performance of the built environment. Most United States cities, counties and states choose the *International Codes*, building safety codes developed by the International Code Council.

The *International Codes* also serve as the basis for construction of federal properties around the world, and as a reference for many nations outside the United States. The International Code Council is also dedicated to innovation and sustainability. ICC Evaluation Service, a subsidiary of ICC, issues Evaluation Reports and Listings for innovative building products as well as environmental documents such as ICC-ES VAR Environmental Reports and ICC-ES Environmental Product Declarations (EPDs).

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Module 3

Spray Finishing

Introduction

IFC Section 2404 addresses the construction of spraying spaces, spray booths and spray rooms; the application of flammable spray finishes; the location of spray finishing operations; the design and construction of spray rooms, spraying spaces and spray booths; fire protection of spray rooms and booths; control of ignition sources; spray room and spray booth mechanical ventilation systems; interlocks required for spray-finishing activities and limited spray spaces. IFC Section 2404.1 requires that spray-finishing activities also comply with the requirements in IFC Section 2403 for the protection of operations.

IFC Section 2404.2 regulates the location of spray-finishing operations:

2404.2 Location of spray-finishing operations. Spray finishing operations conducted in buildings used for Group A, E, I or R occupancies shall be located in a spray room protected with an *approved automatic sprinkler system* installed in accordance with Section 903.3.1.1 and separated vertically and horizontally from other areas in accordance with the *International Building Code*. In other occupancies, spray-finishing operations shall be conducted in a spray room, spray booth or spraying space *approved* for such use.

Exceptions:

1. Automobile undercoating spray operations and spray-on automotive lining operations conducted in areas with *approved* natural or mechanical ventilation shall be exempt from the provisions of Section 2404 when *approved* and where utilizing Class IIIA or IIIB *combustible liquids*.
2. In buildings other than Group A, E, I or R occupancies, *approved* limited spraying space in accordance with Section 2404.9.
3. Resin application areas used for manufacturing of reinforced plastics complying with Section 2409 shall not be required to be located in a spray room, spray booth or spraying space.

In Group A, E, I and R occupancies, spraying operations must be conducted in a spray room. IFC Section 202 defines a “Spray room” as follows:

A room designed to accommodate spraying operations constructed in accordance with the *International Building Code* and separated from the remainder of the building by a minimum 1-hour fire barrier.

In the indicated occupancies, the spray room must be vertically and horizontally separated from the other portions of the building in accordance with the requirements of IBC Table 509, Incidental Uses. For spray rooms, IBC Table 509 (under the provisions for paint shops) permits two separation options: a minimum 2-hour fire-resistance-rated fire barrier isolating the spray room



Definitions

LIMITED SPRAYING SPACE.

An area in which operations for touch-up or spot painting of a surface area of 9 square feet (0.84 m²) or less are conducted.

SPRAY BOOTH. A mechanically ventilated appliance of varying dimensions and construction provided to enclose or accommodate a spraying operation and to confine and limit the escape of spray vapor and residue and to exhaust it safely.

SPRAY ROOM. A room designed to accommodate spraying operations constructed in accordance with the *International Building Code* and separated from the remainder of the building by a minimum 1-hour fire barrier.

from the remainder of the building or a combination of a minimum 1-hour fire-resistance-rated fire barrier enclosing the spray room and an approved automatic fire-extinguishing system within the spray room. Given the requirement in IFC Section 2404.3 for the installation of an IFC Section 903.3.1.1 (NFPA 13)-compliant automatic sprinkler system throughout Group A, E, I or R occupancies housing a spray room, the 1-hour fire-resistance-rated separation option will be the most commonly used method to obtain compliance.

**TABLE 509
INCIDENTAL USES**

ROOM OR AREA	SEPARATION AND/OR PROTECTION
Furnace room where any piece of equipment is over 400,000 Btu per hour input	1 hour or provide automatic sprinkler system
Rooms with boilers where the largest piece of equipment is over 15 psi and 10 horsepower	1 hour or provide automatic sprinkler system
Refrigerant machinery room	1 hour or provide automatic sprinkler system
Hydrogen cutoff rooms, not classified as Group H	1 hour in Group B, F, M, S and U occupancies; 2 hours in Group A, E, I and R occupancies.
Incinerator rooms	2 hours and automatic sprinkler system
Paint shops, not classified as Group H, located in occupancies other than Group F	2 hours; or 1 hour and provide automatic sprinkler system
Laboratories and vocational shops, not classified as Group H, located in a Group E or I-2 occupancy	1 hour or provide automatic sprinkler system
Laundry rooms over 100 square feet	1 hour or provide automatic sprinkler system
Group I-3 cells equipped with padded surfaces	1 hour
Waste and linen collection rooms located in either Group I-2 occupancies or ambulatory care facilities	1 hour
Waste and linen collection rooms over 100 square feet	1 hour or provide automatic sprinkler system
Stationary storage battery systems having a liquid electrolyte capacity of more than 50 gallons for flooded lead-acid, nickel cadmium or VRLA, or more than 1,000 pounds for lithium-ion and lithium metal polymer used for facility standby power, emergency power or uninterruptable power supplies	1 hour in Group B, F, M, S and U occupancies; 2 hours in Group A, E, I and R occupancies.

For SI: 1 square foot = 0.0929 m², 1 pound per square inch (psi) = 6.9 kPa, 1 British thermal unit (Btu) per hour = 0.293 watts, 1 horsepower = 746 watts, 1 gallon = 3.785 L.

Paint shops (IBC terminology) that occur in other occupancy groups, except for Groups F and H, must also be separated under the requirements of IBC Section 509.4 and Table 509. Where a paint shop is located within a Group F occupancy, the provisions of IBC Table 509 do not apply; however, compliance with IBC Section 416.2 is still required. This results in a minimum 1-hour fire barrier separation between the spray room and the remainder of the building housing the Group F occupancy. Where the paint shop is classified as a Group H occupancy, the required level of separation is mandated by IBC Section 508.4.4, and the hourly rating of the required fire barrier separation is found in IBC Table 508.4.

The designation of a specific area as an “incidental use” does not change the overall occupancy classification of the use or area of the building or occupancy under the requirements of the IBC. For example, a Group A occupancy with a compliant, incidental-use

spray room remains a Group A occupancy and does not become a Group H occupancy because of the spraying activity.

IBC Section 509.4.1 specifies the requirements of the fire-resistance-rated construction. For a spray room that is protected by an approved automatic sprinkler system and constructed inside of an occupancy other than Group F or H, the IBC mandates:

- The construction of fire barriers in accordance with IBC Section 707 and horizontal assemblies, where applicable, in accordance with IBC Section 711,
- Self-closing fire door assemblies with a minimum fire protection rating as specified in IBC Table 716.5.

Figure 3-1 shows a Group H-2 occupancy used as a spraying room.

In Group A, E, I and R occupancies, the IFC requires that limited spraying areas be separated from other portions of the building using the same methods as prescribed by the IBC for incidental uses. The IFC also requires the installation of an automatic sprinkler system that complies with the requirements of IFC Section 903.3.1.1 and NFPA 13.

Exception 1 in Section 2404.2 exempts automobile undercoating spraying activities and the application of spray-on bed liners from the requirements of Section 2404 when the spraying area is equipped with adequate natural or mechanical ventilation and the sprayed liquid has a closed-cup flash-point temperature of 140°F (60°C) or greater (a Class IIIA or IIIB combustible liquid, for example). Fire code officials should recognize that NFPA 33 Chapter 14 has specific requirements concerning spray-on bed liners or spray undercoating activities. The requirements include:

- A minimum 20-foot (6096 mm) separation between the spraying operation and open flames, spark-producing equipment and drying or curing apparatus.
- The selected coating must not contain any constituents with a closed-cup flash-point temperature less than 100°F (38°C) or be a Class IIIB combustible liquid without any organic peroxides or evaluated and classified in accordance with UL Standard 340, *Test for Comparative Flammability of Liquids*. NFPA 33 is less restrictive than the requirements in the IFC, which requires the liquid to have a minimum closed-cup flash-point temperature of 140°F (60°C) or greater.
- Solvents used for cleaning must be Class II, IIIA or IIIB combustible liquids (see Figure 3-2).

If the installation does not comply with all of the requirements in its Chapter 14, NFPA 33 requires that these activities be performed in a spray space or booth that complies with all of its applicable requirements.

Exception 2 to IFC 2404.2 allows “limited spraying spaces” in other than Group A, E, I or R occupancies, without sprinkler protection or fire barrier separation when the space meets the requirements of IFC 2404.9.



Figure 3-1:
Group H-2 Spraying Room



Figure 3-2:
Spray Application of a Bed Liner

Key Concept

A spray booth is a mechanical appliance, while a spray room is separated from the remainder of the building by a minimum 1-hour fire barrier that complies with the IBC.

Exception 3 exempts indoor areas used for the application of resins used in the manufacturing of reinforced plastics, provided the area complies with IFC Section 2409, which requires these manufacturing areas to be provided with mechanical ventilation and an approved automatic sprinkler system that complies with IFC Section 903.3.1.1 and NFPA 13.

Design and Construction of Spray Rooms, Spray Booths and Spray Spaces

IFC Section 2404 sets forth the requirements for the design and construction of spray rooms, spray booths and spray spaces. Regardless of the occupancy classification of the area where spraying is occurring, the IFC requires all spraying rooms, booths and areas to be:

- Constructed of approved materials,
- Equipped with an automatic fire-extinguishing system,
- Maintained to the requirements for housekeeping and storage of hazardous materials,
- Designed to control sources of ignition,
- Properly illuminated using approved luminaires,
- Equipped with an approved mechanical ventilation system and
- Equipped with required interlocks.

This discussion previously explained and reviewed the IFC definition and IBC requirements for a spray room. Section 2404.3.1 contains the IFC requirements for the construction of spray rooms:



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Section 2404.3.1,
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2404.3.1 Spray rooms. Spray rooms shall be constructed and designed in accordance with this section and the *International Building Code*, and shall comply with Sections 2404.4 through 2404.8.

2404.3.1.1 Floor. Combustible floor construction in spray rooms shall be covered by *approved*, noncombustible, nonsparking material, except where combustible coverings, including but not limited to thin paper or plastic and strippable coatings, are utilized over noncombustible materials to facilitate cleaning operations in spray rooms.

IFC Section 2404.3.1 references requirements found in IBC Sections 416 and 508.2 and the requirements in Sections 2404.4 through 2404.8 of the IFC. IBC Section 416.2 requires that spray rooms be separated from other uses by fire barriers having a minimum 1-hour fire-resistance rating, separated by horizontal barriers complying with IBC Section 711, or a combination of both. However, in other than Group F and Group H occupancies, the separation requirements of IBC Section 509 are also applicable. The more restrictive requirement of these two IBC sections must be applied. IBC Sections 416.2.1 and 416.3.1 require the interior wall surfaces and any surfaces where accumulations can be deposited to be smooth in order to allow free air movement and to facilitate cleaning. The IBC requirements match those in IFC Section 2404.3.2.2:



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Section 2404.3.2.2,
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2404.3.2.2 Surfaces. The interior surfaces of spray booths shall be smooth; shall be constructed so as to permit the free passage of exhaust air from all parts of the interior, and to facilitate washing and cleaning; and shall be designed to confine residues within the booth. Aluminum shall not be used.

The IFC and IBC prohibit the use of aluminum in the construction of spray rooms, booths or areas. Aluminum exhibits a much lower melting point when compared to carbon steel, limiting an aluminum booth's ability to confine a fire.

IFC Section 2404.3.2 contains the requirements for the design and construction of spray booths. Unlike a spray room, which is a room that is enclosed and separated in accordance with the IBC, a spray booth is an appliance that can be open on one or more sides to facilitate material handling or the movement of large parts. A spray booth is an appliance, not an occupancy. The occupancy requirements of the IBC, including those for Group H occupancies, do not apply to a properly designed and constructed spray booth.

IFC Section 202 defines a "Spray booth" as:

A mechanically ventilated appliance of varying dimensions and construction provided to enclose or accommodate a spraying operation and to confine and limit the escape of spray vapor and residue and to exhaust it safely.

To comply with the definition, a spray booth requires mechanical ventilation. A properly designed and maintained mechanical ventilation system provides sufficient supply and exhaust air to maintain the atmosphere inside of a spray booth or area below 25 percent of the LFL of the most volatile flammable liquids sprayed. The mechanical ventilation system dilutes the flammable vapor with air by mixing it inside a plenum and safely discharging the vapor/air mixture outside a building or into a pollution-control device. Dry or wet filters are provided to capture pigments and film formers and prevent them from being discharged through the mechanical ventilation system.

Spray booths generally are manufactured in one of three styles: open face, cross draft, or down draft. Open-face spray booths are open at the front and may also have openings on each side of the booth. These booths are generally used where parts are moved by industrial conveyors into the spraying space for the application of flammable finishes. Once the part is coated, the conveyor carries the finished part or material to a dryer or a drying room, or it is air dried. Airflow originates through the front or side openings from separate fans that provide a volume of supply air equal to the exhaust flow rate for the spray booth (see Figure 3-3).

Cross-draft spray booths are similar to open-face spray booths in that the supply air is exhausted through the cross-sectional area of the spray space. The major difference is that supply air enters either through the top or through specific openings in the spray booth. The air is drawn in by the suction (negative pressure) created when the exhaust fan is operating (see Figure 3-4).

Down-draft spray booths or rooms take advantage of gravity by introducing the supply air through the top of the spray booth or spray space. As the air flows



Figure 3-3:
Open-Face Spray Booth