



THINK POSITIVE

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With the publication and adoption of the 1997 Uniform Building Code (UBC) and the UBC Standard 7-2-1997 (Fire Tests of Door Assemblies), the United States is moving closer to the positive pressure code standards used in Europe, Japan and other industrialized nations. This conversion to positive pressure testing around the country promises to directly impact everyone involved with the manufacturing, testing, specifying, installing and inspecting of wood fire-door assemblies. This special report from architectural wood door manufacturer VT Industries, Inc. examines what the new codes mean to the commercial construction marketplace and its regulatory community.

Introduction

The devil is in the detail when it comes to understanding what effect the change from negative pressure to positive pressure fire door testing standards is having within the fire door industry and construction community.

During this changeover, everyone in the fire door manufacturing, distribution and inspection network is affected, says Rick Curkeet, P.E., chief engineer with Intertek Testing Services (Warnock Hersey). "For code officials, it means learning a new set of rules for determining that an opening protection system is code compliant," he explains.

"For the fire door and window manufacturer, it may require redesigning and retesting of products to obtain the required certifications. Architects and specifiers must determine the applicable requirements for each project and specify accordingly. Distributors and machiners



will have to have a dual system to be able to provide correctly identified and labeled components to the jobsite.

"And for testing and certification agencies, it will mean creating an efficient and reliable system for testing, certification and labeling of these assemblies."¹

Under positive pressure standards, the fire-door manufacturer is challenged to meet "the strictest criteria worldwide, exceeding standards in Europe and Japan," according to Rick Liddell, vice president, Architectural Door Division, VT Industries.

"To meet these new requirements, new construction techniques have been developed by the manufacturers and new installation procedures have been created for the installer."²

"The key change to fire ratings," Liddell emphasizes, "is that unlike current codes which rate each part of the total opening (i.e., door, frame, hardware, etc.), the new test procedure will require that all components be qualified together as a single assembly to meet the positive pressure fire ratings. This puts more responsibility on the architect, general contractor and building owner to assure compliance of the total opening assembly in all wood fire doors, 20-minute through 90-minute."³

The 'huge code puzzle'

Complicating the situation is the myriad of regional, state and local enforcement codes which still call for the older negative pressure testing standards.

The code-related activities of various states and large U.S. cities represent a "huge code puzzle," according to Julie Ruth, P.E., vice president of Codes & Regulatory Compliance with the Window and Door Manufacturers Association (WDMA). "And there are so many pieces, it is difficult to know where to start," she adds.⁴

In her monthly column, Greetings From The Code Arena, Ruth reports on changes taking place around the country. Her column appears in the WDMA newsletter, which is available on the association's web site at www.wdma.com.

Currently, most western and midwestern states and some local state jurisdictions have adopted positive pressure fire door rating test procedures under UBC 7-2-1997. Eventually, it is expected that the International Building Code (IBC), which also contains positive pressure and smoke-leakage test requirements, will replace the UBC and other model codes now in effect across the country.

Those model codes include the International Conference of Building Officials (ICBO) Uniform Building Code, the Southern Building Code Congress International (SBCCI) Standard Building code, and the Building Officials Code Administrators (BOCA) National Building Code. The National Fire Protection Association (NFPA) Life Safety Code 101 also provides minimum requirements for the design, operation, and maintenance of buildings and other structures for life safety from fire and similar emergencies.

Nearly 90 percent of the estimated 1,400 code jurisdictions in the U.S. use one of these codes, reports Ruth. In many jurisdictions, the NFPA 101 is used in conjunction with one of the other three model codes.

"Although many of these jurisdictions use the most recent edition of the code(s) they have adopted, others still use earlier editions," says Ruth. "The amount of time that is allowed to pass before updating to the most recent code can vary from every three years to five years or ten years. Some jurisdictions are still using codes that were written when Jimmy Carter was in office."

When adopting codes, it's not unusual for a jurisdiction to make "drastic" amendments to the original code, adds Ruth. "The number of items that can vary from code to code is limitless."⁴

Given the complexity of this code puzzle, it is the responsibility of the project coordinator, distributor, specifier or whoever is ordering the opening assemblies to know whether positive pressure compliance is being enforced in a particular jurisdiction. This information must then be communicated to the door manufacturer so the proper construction and fire label can be provided.^{2, 5}

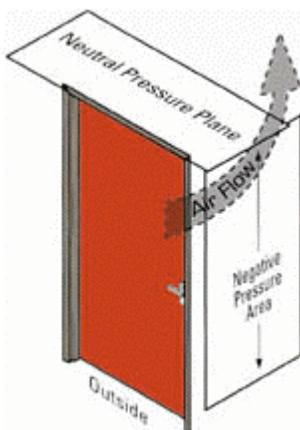
Intertek's Curkeet adds that the traditional "neutral pressure" rating system will continue to be used for the foreseeable future, along with the new positive pressure test standards. "Since positive pressure and existing neutral pressure assemblies share many components," he explains, "the authorities having jurisdiction (AHJs) will require a labeling system to determine that a finished assembly complies with the applicable requirements."⁶

Third-party certification

In order to achieve fire-resistance labeling, fire door assemblies must be tested by an independent, third-party testing and certification agency.⁷ The major U.S. testing organizations are Intertek Testing Services (Warnock Hersey), Factory Mutual Research and Underwriters Laboratories.

In an account of a typical certification process, Intertek general manager Howard Stacy offers the following scenario: "After the manufacturer has completed the design phase, working within guidelines for the product's application, it contacts a third-party certification agency, who then visits the manufacturer's plant to witness and document the door's components and fabrication.

"The sample door is then taken back to the agency's lab and mounted in an appropriately labeled fire door frame using fire-rated hardware. Detailed installation measurements are then recorded for the sake of the test report, results verification and the product listing. This entire assembly is then installed in the fire-test furnace (to stimulate an actual site installation), complete with wall construction above and to either side of the door's frame.

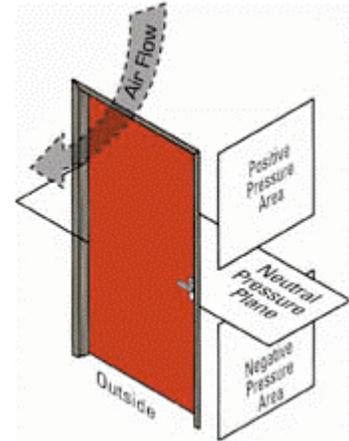


"Once in place, the testing engineer lights the burners of the gas-fired test furnace, typically a large box with the test assembly forming one face, with various and discrete temperature measuring devices surrounding it. Then the temperature is increased at the specified rate (via the temperature-time curve specified in the test standard, e.g., UBC 7-2, NFPA 252, ASTM E152)."⁸

In negative pressure tests, the fire-test furnace is regulated to maintain a neutral pressure plane at the top of the door assembly (see illustration at left).

Everything below the top of the door is under negative pressure, causing ambient air to be drawn into the furnace at any point where the assembly being tested might leak.^{1, 2} The flow of air into and around the test assembly actually assisted certain assemblies to pass tests.⁹

In positive pressure testing, the fire-test furnace is pressure controlled so that the neutral pressure plane is held at 40 inches above the floor, regardless of the door height. This increases positive pressure in the upper portion of the wood door assembly, simulating real fire conditions in an enclosed area (see illustration at right).^{6, 10}



In both positive and negative pressure testing, the burn cycle is continued for the time period for which the door is to be rated with the temperature in the furnace typically reaching 1,000°F at five minutes, and continuing up to 1,925°F at three hours depending on the length of the test, according to Intertek's Stacy. "During this portion of the test," Stacy explains, "the door must remain latched and in position, with no through openings developing or flame penetrating to the unexposed outside face."

Following the burn cycle, the entire assembly, still in the furnace frame, is positioned for a hose-stream test using a high-pressure water cannon. "More severe than the fire testing," adds Stacy, "this is actually where most doors fail, as through openings and/or the door no longer remains latched in the door frame." In the U.S., fire door assemblies rated for 20-minute are exempt from hose-stream testing requirements.⁸

Intertek's Curkeet adds that the positive pressure test is considered more severe than the traditional negative pressure test. "It will be assumed," he states, "that any system eligible for a positive pressure rating can be used in openings requiring compliance with the existing neutral-pressure standards."⁶

Technically speaking

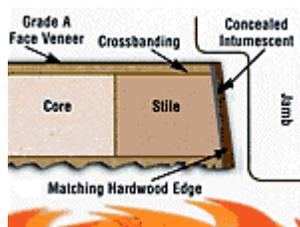
Most interior wood fire doors used for schools, hospitals, hospitality and commercial buildings are designed to meet a fire-resistance rating of at least 20-minute. Hallway and stairwell wood fire doors may require a fire-resistance rating that's anywhere from 45-to 90-minute, depending on their location and construction.⁵

Although some 20-minute wood fire-door assemblies meet positive-pressure fire requirements without modification, many designs must incorporate an intumescent sealant (IS) as part of the installation. When heated to approximately 300°F (149°C), the IS forms a flame-resistant barrier against the outflow of hot gasses and other combustibles from around the door. IS materials have been used in fire doors for decades in Great Britain, Germany and Japan.¹¹

Two forms of IS are used in wood fire-door assemblies. Soft-puff intumescent, which foam and gently expand, are often used on 20-, 45- and 60- and even some 90-minute positive-pressure wood fire door installations. Hard-puff intumescent, which expand with enough force to lodge a door in an opening, can be found on 60-minute pair and 90-minute single and pair positive-pressure door installations.^{1, 2, 5}

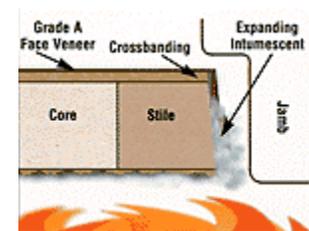
Depending on the door manufacturer and assembly design, IS may be incorporated into the positive-pressure wood door opening assembly as part of the fire-door construction, or surface applied as a self-adhesive gasket to the frame.^{1, 3, 11, 12}

When IS is surface-applied, its installation onto the assembly frame becomes the responsibility of the general contractor or door installer. Intertek requires that installation instructions for the total assembly, including all components, be attached to the door for review and approval by the AHJ.¹³ These instructions must be kept on file at the jobsite by the distributor, general contractor or owner, and the installer should offer a copy of the instructions to the AHJ to verify that the installation was done correctly.^{2, 12}



When the IS is concealed within the wood fire door structure (see illustration), details in the instructions are greatly simplified and installation is easier to complete. Concealing IS inside the edge of the door eliminates the possibility of damage that can occur with surface-applied IS due to vandalism or improper installation, while preserving the aesthetics of the door assembly.^{2, 11}

Positive pressure testing has demonstrated the effectiveness of IS edge-sealing as an integral part of the wood fire-door structure. As the temperature in the furnace rises, the face veneer and wood edge burns away, enabling the IS to activate until it fully expands to seal the opening (see illustration).²



Concealed IS edge-sealing is available in positive pressure fire rated wood doors with 20-, 45-, 60- and 90-minute assembly ratings in both 5-ply wood veneer and 3-ply and 5-ply .050 high pressure decorative laminate. Other UB 7-2-1997 approved wood fire-door facings include 3-ply and 5-ply medium density overlay (MDO) and hardboard facings (with IS surface-applied to the frame).^{2, 12}

Determining compliance

When ordering positive pressure wood fire door assemblies, specifications must state that all products are in compliance with UBC 7-2-1997 and UL 10C. The type of preferred edge-sealing system also should be called out in the specification.²

In order to determine whether a specific door assembly and IS system meets positive pressure standards compliance, architects, specifiers and code officials may need to consult with the fire-door manufacturer or its third-party testing and certification agency.¹²

Using Intertek Testing Services (Warnock Hersey) guidelines as an example, opening assemblies that pass the UBC 7-2-1997 test with no additional edge-sealing system are specified as a "Category A" positive pressure fire door construction. This category applies to fire doors that feature an intumescent seal concealed inside the door's construction by its manufacturer. Fire door constructions that require the application of an additional IS or elastomeric edge-sealing system to meet positive pressure fire requirements are specified as "Category B".²

When specifying the ITS (Warnock Hersey) Category A positive-pressure fire door construction, the specification should read:

"Where UBC 7-2-1997 requirements for positive pressure must be met, doors shall include all requirements as part of the door construction per 'Category A' guidelines as published by ITS/Warnock-Hersey. No intumescent is allowed on the frame. Only smoke gasketing applied around the perimeter of the frame to meet the 'S' smoke rating is permissible in instances where smoke control is required."²



For Category B positive pressure fire door applications, the specification should read:

"All door openings must incorporate field-applied intumescent materials, applied by a licensed installer according to the manufacturers' instructions, which must be kept on file. Additional gasketing may be necessary to meet 'S' smoke rating if required." ²

Due to the significant amount of positive pressure fire door testing expected over the next few years, Intertek Testing Services (Warnock Hersey) now publishes a semiannual Directory of Listed Positive-Pressure Rated Door Assemblies and Components. In addition to a comprehensive listing of fire doors, frames and hardware that have been tested to positive pressure standards, the directory provides labeling options available to manufacturers or machining-distributors.¹⁴

When determining whether a specific door assembly and IS system meets positive-pressure standards compliance, architects and specifiers should consider the following steps:¹

1. Verify the door to be used is of the required minimum duration and meets any applicable temperature rise requirement. If not, a different door must be specified.
2. Determine if the doors qualify with the standard frame. If neither the frame nor the door is rated, perhaps a gasket system has been specified that will qualify the door/frame combination. If not, the assembly cannot be labeled for positive pressure.
3. If the door, frame and gasket system provide a qualified combination, next determine if the door preparations specified are allowed for the assembly. A lite kit certified and labeled for positive-pressure applications may be needed to meet the appropriate fire rating. Always follow the lite kit manufacturer's instructions. Failure to use a listed and labeled lite kit could disqualify the assembly.
4. If no other components are to be installed in the field beyond ordinary attachments of hinges and hardware, the door can be labeled for compliance.

Component compatibility

On positive pressure door assemblies, the door carries the fire label for the complete opening. In addition to identifying the fire-door manufacturer, the issued label lists the name of the third-party testing and certification agency and the fire-door rating assigned to the door (see example).



It also includes required building code information for the intended use of the door, such as maximum temperature rating. (Note: The smoke or "S" rating is achieved only after surface applying an approved smoke gasket around the perimeter of the frame.)⁸

Even if a door has been labeled by a qualified, third-party certification agency, it can still be rejected by local code officials who have final authority, according to Intertek's Stacy. He cites the following examples:⁸

- A label may be invalidated if a door has been cut away, drilled or modified to add lites or vision panels, etc.
- Other components of the door assembly (i.e., frame or hardware) may not be listed and labeled for the minimum required rating.
- The door, frame and hardware may not have been installed in accordance with the requirements for a rated assembly even though each individual component may bear a valid rating label.



VT Industries' Liddell emphasizes, "The fundamental mandate of positive pressure codes is the requirement for labeling of the entire opening assembly. Doors, frames, hardware and accessories do not achieve the positive pressure fire-rating label until they are assembled and installed."²

To ensure that various components of the opening are installed correctly, the door manufacturer's installation instructions need to include information on the use of only approved components in the opening and, if applicable, the necessity of installing a field-applied IS to maintain the positive pressure rating. More detailed instructions are required for the use of IS on appropriate lite kits and hardware and to specify any special requirements for the door frame.¹⁵

A rule of thumb for architects and specifiers when choosing hardware and accessories for positive pressure doors is that anything below the 40-inch neutral plane to the sill of the floor most likely passes the new criteria without modification.¹²

Hardware installed above the 40-inch neutral plane needs to be evaluated per UBC 7-2-1997 Part 1, including: cylindrical locks, mortise locks, surface-mounted vertical rod exit devices, rim exit devices, concealed vertical rod exit devices, mortise vertical rod exit devices, card locks, deadbolts, surface flush bolts and standard hinges. Continuous hinges must be tested and approved for positive pressure applications.²

Approved accessories include lite kits (listed and labeled for UBC 7-2-1997), protective plates up to 48 inches, door bottoms, plant-on moldings and fusible link louvers up to 38 x 30 inches (or 1140 square inches).²

Other component-related considerations include:

- Whenever components are to be field installed, there needs to be an additional step. A temporary label calling attention to the required installation details must be applied. An instruction sheet must also be attached to the door notifying the installer of the additional components that must be installed.¹
- Steel frames certified to UL 63 can be used with virtually any fire-rated door of any fire-resistance rating.⁶ Some aluminum frames are approved for 20-minute applications.¹²
- Lite kits will require a positive-pressure evaluation. Glazing will be qualified in conjunction with the lite kits (and sealants) and be specified in the lite kit installation instructions.¹⁵
- To achieve the "S" smoke rating under UBC 7-2-1997 Part 2, additional gasketing may be required. Smoke gasketing is surface-applied to the inside of the frame and would be in addition to the surface-applied intumescent edge sealing system for Category B installations.¹²
- Buildings that exist prior to adoption of positive pressure code requirements by the local AHJ usually are exempt from compliance. In cases where re-labeling of negative pressure door assemblies is desirable, it will be necessary to check with the manufacturers of each component in the assembly to establish compliance. Certain components such as lite kits may need to be replaced and a representative of a third-party certification agency will have to make a field inspection of the openings and apply the supplemental positive pressure labels.¹⁶

Summary

The AHJ inspector will follow these standards when inspecting the wood fire-door openings for positive pressure, fire-rated assembly compliance:

- Under positive pressure requirements, the entire opening assembly is rated as an integral unit.²



- Components are not automatically interchangeable.²
- Compliance is achieved only when assembly components are properly installed.²
- Where necessary, field-applied intumescent seals for Category B installations must be applied according to manufacturer's instructions, which must be kept on file.¹⁷
- The door will carry the positive pressure fire label for the complete assembly.²
- Installation instructions must be kept on file at the jobsite for use by local inspectors.
- Without the proper certification mark and label on fire doors, local code officials can enforce removal of the doors and delay building occupancy until proper certifications are shown.⁸

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