
Rated Fire Door Assemblies with Fusible Alignment Pins (Fire Pins)

INTRODUCTION

This bulletin addresses potential questions and concerns regarding fusible alignment pins (fire pins) installed in the meeting edge (or strike edge) of fire-rated doors. Fusible alignment pins in fire-rated doors are door hardware components essential to the critical function of fire-rated doors (reducing fire spread), do not impede occupant use of fire-rated doors, and do not interfere with fire fighting efforts.

SPECIFIC FIRE DOOR CONFIGURATION

The specific door and door hardware configuration which is the subject of this bulletin is fire-rated doors installed in a framed opening and with latches at the top of each door (often referred to as fire doors with “less bottom rod” or LBR door hardware). These doors commonly have a fusible alignment pin (fire pin) mortised into the edge of the door and aligned with a hollow receptor.

When these fire-rated doors are exposed to the untenable elevated temperatures of a fire, the fusible alignment pin fuses (because of the heat of the fire) and extends into the opposing receptor. In combination with the latch at the top of the door, the fusible alignment pin helps keep the closed fire doors aligned in the opening, enabling the fire doors to achieve their intended function – protecting life and property by controlling spread of the fire.

Fusible components are used in many other types of approved fire door hardware, and although the exact mechanisms vary by hardware design, they follow similar principles of function and safety.

DESCRIPTION OF A FUSIBLE ALIGNMENT PIN (FIRE PIN)

The fusible alignment pin (fire pin) is essentially a spring-loaded short metal rod mortised flush into the edge of a fire door approximately 12” to 15” above the floor. During a fire, and after the door is exposed to the fire’s high temperatures long enough, the fusible material restraining the spring-loaded pin softens or melts (at a door internal temperature of 350°F to 450°F) and the pin is released from its retracted position allowing the pin to extend about 1” from the edge of the door and into the mating receptor.

FIRE DOOR TESTS

Fire-rated doors, per most building codes in the United States, are required to be tested to ANSI/UL 10B “Fire Tests of Door Assemblies” or ANSI/UL 10C “Positive Pressure Fire Tests of Door Assemblies”. These tests require fire-rated doors to remain closed, and doors to remain in alignment, during and after exposure to the test “fire” and subsequent hose stream test. These fire and hose stream tests, as expected, subject the doors to a prescribed, but aggressive, fire exposure and impact force.

The fire door test (per ANSI/UL 10B and ANSI/UL 10C) is conducted on an apparatus that is essentially a tremendously oversized gas “grill” turned on its side in front of the test doors. This oversized “grill” is larger than the doors to be tested. The test doors are positioned in front of the “grill”, the burners ignited, and fuel is regulated to provide a prescribed heat exposure over a prescribed test period (time / temperature curve). The fire door test subjects the surface of the test doors to temperatures much hotter and more intense than a backyard gas grill.

The time / temperature curve requires the door to be exposed to 1,000°F heat at 5 minutes into the test, and 1,300°F heat at 10 minutes, and the temperature within the furnace is gradually increased for the remainder of the test (minutes to hours). Fusible alignment pins commonly activate 8 to 12 minutes after the start of the fire door test, when the fire test exposure temperature has been rising above 1,000°F for 3 to 7 minutes.

In addition to the fire door “burn” test of ANSI/UL 10B and 10C, fire doors are required to be subjected to the hose stream test immediately after the fire exposure test. The hose stream test requires fire doors to remain closed when impacted by a solid straight stream of water (not a fog spray) from a smooth bore nozzle applied in a grid pattern back and forth and up and down over the entire door assembly. This stream of water impacts the door with adequate force that fire exit hardware such as panic bars designed for use with fire doors – if they remained functional after the fire exposure test – could be “operated” by the hose stream, thereby releasing

the door's latching hardware. This standardized hose stream test, which represents a rough usage test, is an integral performance requirement of the ANSI/UL 10B and ANSI/UL 10C tests, and in other test standards utilized for fire-rated construction (i.e. ASTM E 119, Standard Test Methods for Fire Tests of Building Construction and Materials; ASTM E 814, Standard Test Method for Fire Tests of Penetration Firestop Systems) to demonstrate a fire-rated assembly is resistant to unintentional breaching during a fire.

HEAT EXPOSURE, BUILDING OCCUPANTS, FIREFIGHTERS, AND FIRE DOORS

Building occupants become evacuees in a fire emergency. Disregarding the lethal effects of smoke progressing ahead of a fire, research indicates evacuees can be expected to withstand a heat flux of 4.5 kilowatts per square meter (kW/m²) for about 30 seconds or 23 kW/m² for about 3 seconds before exposed skin (i.e. face, hands) receive 2nd degree burns. This "human limit" is equivalent to approximately 70 kilojoules of heat energy exposure (for the short exposure) to 135 kilojoules of heat energy exposure (for the 30 sec. exposure) to each square meter (kJ/m²) of skin during each of these time periods.¹

Firefighter personal protective equipment (turnout gear) is designed to provide limited protection for the firefighter and is required to be tested to NFPA 1971. NFPA 1971 requires turnout gear to be tested with a radiant and convective heat flux of 84 kW/m² and achieve a Thermal Protective Performance (TPP) of 35.² The heat flux of 84 kW/m² is based on a close-to-the-floor firefighter's heat exposure during a fire flashover. A TPP of 35 is equivalent to 17.5 seconds before skin protected by the turnout gear would suffer 2nd degree burns. This means a firefighter in turnout gear, exposed to flashover, can be expected to receive 2nd degree burns in 17.5 seconds (or sooner, regrettably, if there is moisture inside the turnout gear).³ Heat flux exposure of 84 kW/m² for 17.5 seconds is equivalent to 1,470 kJ/m² of heat energy exposure to the firefighter PPE.

To achieve the temperatures required by the ANSI/UL 10B or ANSI/UL10C tests, the test doors are subject to radiant and convective heat from the apparatus' burners, which reach heat output rates of approximately 45 kW/m² at 10 minutes and 100 kW/m² at 60 minutes.⁴ The ANSI/UL 10B or ANSI/UL10C tests, at 90 seconds into the fire door test, have applied approximately 1,500 kJ/m² of heat energy. At 8 minutes into the fire door test – the earliest the fusible alignment pins are observed to release – the UL 10B and 10C tests have delivered approximately 12,000 kJ/m² of heat energy to the exposed door surfaces. These estimates indicate it takes a minimum of 8 times as much heat for a fusible alignment pin to release as a firefighter can withstand fully protected by firefighter PPE.

LIFE SAFETY AND FIRE DOORS

Environmental conditions on the fire-exposed side of a door often become untenable (not compatible with life) because of elevated temperatures and smoke. Fire-rated doors, when exposed to the ravages of a fire, commonly expand, warp, and become inoperable while performing as intended to help control the fire. Fire doors must transition from functioning as exit devices to functioning as fire barriers. The elevated temperatures of a fire, along with smoke, create untenable conditions much sooner than the elevated temperatures may cause a fire-protection rated door to become inoperable.

Firefighters, when protected by their personal protective equipment (turnout gear) and exposed to heat at levels similar to fire door tests, could be expected to withstand these temperatures for only a short period of time (less than 90 seconds). Firefighters – for personal safety – will have exited the building long before fire doors become "silent sentries" and do their job of controlling the fire's spread. Thus, occupant and fire fighter life safety is not compromised if fire-protection rated doors become inoperable from exposure to elevated temperatures of a fire.

SUMMARY

Pairs of fire-rated doors with vertical rod fire exit hardware without the bottom rod and with a fusible alignment pin (fire pin) meet fire and life safety requirements by helping to prevent the spread of fire, and do not impede emergency escape and rescue, and do not impede fire fighting activities.

The Builders Hardware Manufacturers Association (BHMA) represents commercial door hardware manufacturers in North America. Our members are responsible for the design and production of builders hardware offering safety and security along with compliance to building and fire codes throughout the United States and Canada. Questions or requests for further supporting information such as fire door test videos, may be addressed to Mike Tierney (860-533-9382), or John Woestman (515-422-6027).

¹ Stoll, M.A., Chianta, M.A., "Method and Rating System for Evaluation of Thermal Protection," Aerospace Medicine, November 1969

² NFPA 1971 Standard on Protective Ensembles for Structural Fire Fighting and Proximity Fire Fighting, 2007 Edition, National Fire Protection Association, Quincy, Mass.

³ Mell, W.E., Lawson, J.R., "A Heat Transfer Model for Fire Fighter's Protective Clothing", NISTIR 6299, National Institute of Science and Technology, 1999

⁴ Berhinig, R., Ghandi, P., "Report on Development and Application of ISO PDGUIDE 834-2, Fire resistance tests-Elements of building construction – Part 2: Guide on measuring uniformity of furnace exposure on test samples", Underwriters Laboratories, Northbrook, Illinois, April 4, 2008