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Fire door experimental testing to study the influence of door gaps around swinging fire doors

Background: Fire development, smoke movement and ability of fire door to meet the test standards are affected by the gap sizes around the perimeter of the door, within the frame and between the bottom of the door and floor. Hence these gap sizes are regulated, and the current regulations in NFPA 80, *Standard for Fire Doors and Other Opening Protectives*, for the door clearances are from information and data gathered several years ago. Door clearances are one of the most frequently cited deficiencies on swinging doors with builders hardware. NFPA 80 currently allows a maximum bottom gap of 3/4-inch and a maximum of 1/8-inch for the perimeter (along vertical and top edges) of the swinging fire doors (with an additional 1/16-inch over-tolerance for steel doors). The clearance under swinging fire doors is frequently found to be greater than the maximum allowable gap size currently allowed by NFPA 80, due to irregularities in flatness and levelness of concrete slab floors at and around door openings. Hence it is important to have a deeper understanding of the impact of gap sizes on fire development and smoke movement.

Project Goal: The goal of the project was to determine through experimental testing the effect that door clearances might have on the performance of a fire door assembly. Single swing and double egress pair doors were evaluated, for steel and composite doors with fire protection rating up to 90 mins and wood doors rated for 20 mins. Generic full-scale fire door testing were conducted with door assemblies having sill clearance requirements set at 3/4" (19 mm) (the current maximum allowable gap in NFPA 80) and at an increased gap of 1" (25 mm) so that the effects of increased sill gaps could be evaluated. Additionally, one test was conducted with sill clearance dimensions 3/4" (6 mm) as per NFPA 252.

Summary Observations: Total of 17 fire door assemblies were tested in this project. It is important to know that the experimental fire door testing conducted in this project represents only a very small sampling of swinging fire door assemblies. The door assembly components used in tests were of known quality and had successfully passed fire door testing for the ratings (when intumescent materials were used for wood and composite doors tested under positive pressure). Experimental testing introduced non-standard conditions — door gap dimensions larger than those allowed in the fire door test standards (NFPA 252, *Standard Methods of Fire Tests of Door Assemblies*). The tests were representative of how older existing swinging fire door assemblies—those fire door assemblies tested under neutral pressure conditions—might perform when door gap clearances exceeded NFPA 80's specifications. One reason for this testing method is that many older existing swinging fire doors have excessive door gap clearance dimensions because of poor installation and maintenance practices. The majority of these older existing swinging fire doors do not have built-in intumescent materials like their modern-day counterparts tested under positive pressure fire conditions. It is generally accepted that intumescent gasketing materials mitigate large door gap clearance dimensions by sealing the spaces between door leaves and door frames when exposed to elevated temperatures. However, since older existing swinging fire doors were not required to have intumescent gasketing materials, it is uncertain whether excessive door gap dimensions might impact their ability to perform as designed.

The acceptance criteria as specified in NFPA 252 were used to evaluate the experimental tests in this project. It was noted that only the double egress pair of steel doors tested with 3/4" (19 mm) bottom gap dimensions met the acceptance criteria. The tests generally showed that larger gaps increase airflow rate and may make it more challenging to meet the acceptance criteria. Significant increase in air flow rate was observed when the sill clearance was increased from 3/4" (19 mm) to 1" (25 mm). Wood and composite doors seem to be more impacted with flaming and burn through of doors observed sooner for doors with 1" (25 mm) sill clearance than for 3/4" (19 mm).

Current fire door testing standards and protocols do not measure the volume of smoke passing around and under the doors. Thus, further research on the efficacy of swinging fire doors and its gap sizes, and their ability to contain fire, smoke, and gases is needed.

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