Whitepaper | September 2021

Does legislation focus on the deadliest killer?

In our recent blog post, 'What is more deadly than fire? Smoke', we looked at smoke and the fact that **50-80%** of fire-related deaths are **caused by smoke.** Smoke can be a stealthy, silent killer, literally asphyxiating victims in their sleep or causing disorientation and physical distress, making escape difficult. It also makes it much harder for fire fighters to do their job. The thick black smoke clogging the corridors of Grenfell Tower, hampered evacuation and rescue, the Grenfell Inquiry has heard.

Whilst fire safety has very much been under the microscope since Grenfell, perhaps smoke protection should also be placed under equal scrutiny.

This whitepaper will look at current regulation, the test environment, and consider what additional steps might be taken to protect life safety.

Current position

The current requirement for smoke doors is laid out in Approved Document B (2019) to the Building Regulations and in BS 9999: 2017 (section 32.1.7). Smoke tests are conducted separately from fire tests and use pressurised air rather than smoke.

The measure is that the rate of ambient temperature leakage should not exceed 3m³/h/m (head and jambs only) at a pressure of 25Pa when tested. The overall leakage rate of the door assembly, in m3/h, is divided by the length of the gap between the leaf and the door head and jambs to arrive at the final measure of m³/h/m.

The suffix 'S' is added where a doorset has met the leakage criteria as laid out in BS 476-31.1 (S_a under ambient conditions in BS EN 1634-3). For example, an FD30S is an ambient temperature smoke control door with 30 minutes fire resistance.

Test methodology

The important bit to note here is 'head and jambs'. The current UK guidance allows for the threshold to be blocked-off with adhesive tape during the test, so only the head and jambs are tested. This is because, when BS 476-31.1 came into being, there were very few commercial threshold sealing systems available. Sealing systems are now widely available of course, so one might ask if the methodology of the tests needs to be updated.

$$\text{Leakage rating } (m^3/h/m) = \frac{\text{Smoke leakage } (m^3/h)}{\text{Gap between door leaf and door head } (m)}$$

What's wrong with the 3mm gap?

The use of adhesive tape to block off doors in the test environment means that smoke control fire doors are permitted to have a 3mm gap at the threshold. What this approach overlooks is the smoke generated during the developing phase of the fire – smoke can drift through a fire door and spread before the intumescent fire seal is activated, which normally takes about 15 minutes. A fire door with the standard 3mm gap at the threshold can easily permit a leakage rate of about 10m3/m per hour. In reality, the currently approved 3mm gap is actually rarely achieved consistently because of uneven and variable floor finishes – a 5-10mm gap is far more likely, allowing even more smoke to seep through before the intumescent seals kick in.

The 3mm gap in tests

There are currently working groups and leading experts actively campaigning for additional regulation for smoke protection, such as the Smoke Control Consultation Group which is trying to coordinate parties with similar interests around enhanced smoke protection. The Intumescent Fire Seals Association (IFSA) actively questions the rationale of 'head and jambs only' testing and commissioned a series of tests to explore what happens when smoke seeps through the threshold. Using the methodology of BS EN 1634-3, the tests demonstrated smoke leakage performance on three door assemblies:

1) with the threshold taped
2) with a 3mm gap
3) with an automatic threshold seal fitted

The test was set up so that a transparent box was fitted around the doorset to represent a corridor. A smoke generator was placed inside the chamber to make the air leakage visible and a fire exit sign and other realistic features were placed on the door-leaf. The pressure was set at 25Pa as required in Approved Document B and the test was run for 2 minutes as set out in the guidance.

Images and test results courtesy of IFSA

The results

The leakage figures above speak for themselves. The door with the 3mm gap at the threshold was completely obscured by the smoke after two minutes, rendering the fire exit sign and any other distinguishing features totally invisible. Even in a test environment, this is obviously alarming. In an emergency situation where panic has set in, it is easy to imagine why it is so difficult to navigate one's way out of a smoke filled building.

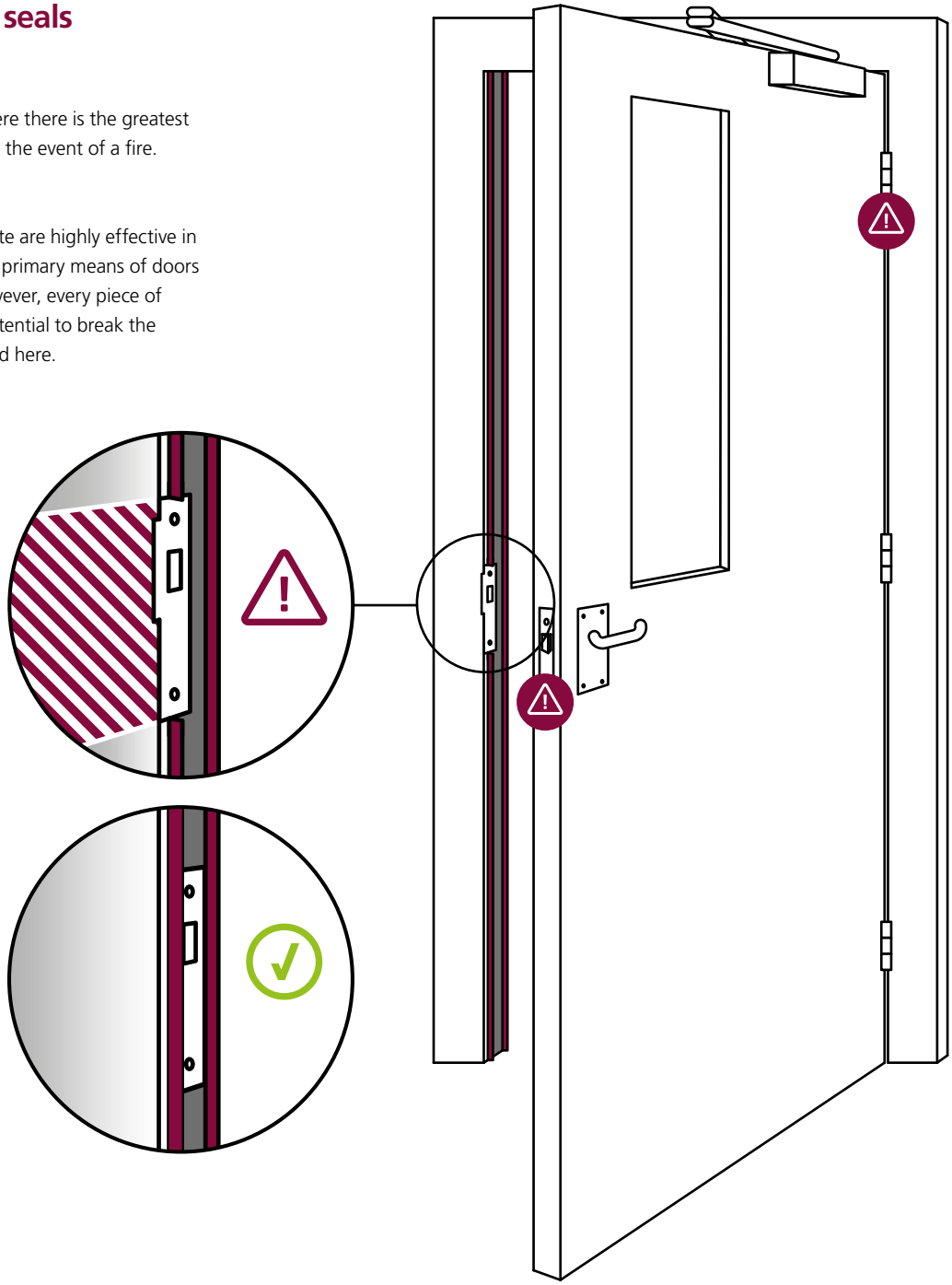
In comparison, the door with the automatic threshold seal kept the smoke at bay to the extent that the fire exit sign and other features were easily visible after two minutes. The door that was taped off gave the same results but as we have already discussed, this scenario is not true to life.

So, in conclusion, the smoke leakage rate is reduced by a factor of more than ten when an automatic threshold seal is fitted, compared with the currently approved 3mm threshold gap (which often ends up being more in the region of 5-10mm).So, in conclusion, the smoke leakage rate is reduced by a factor of more than ten when an automatic threshold seal is fitted, compared with the currently approved 3mm threshold gap (which often ends up being more in the region of 5-10mm).

Where else may smoke seals be jeopardised?

The threshold gap is clearly the area where there is the greatest potential for rapid migration of smoke in the event of a fire. But it isn't the only problem area.

Smoke seal fins applied to the door rebate are highly effective in preventing smoke migration and are the primary means of doors successfully passing the smoke test. However, every piece of hardware fitted to the rebate has the potential to break the run of those smoke seal fins, as illustrated here.



The Rutland Technical Team has had questions from customers about how to achieve the required smoke containment in conjunction with our door closers. Having explored and tested the options, we recommend running one of the fins to the side of all hardware in order to maintain the unbroken seal right round the rebate. Generally, there is space for this, and it ensures the integrity of the seal.

Recommendations

As part of our continuous effort to enhance life safety within buildings, the technical team here at Rutland has been monitoring and engaging with the industry discussion on smoke seals. It seems clear that, in time, legislation is likely to stipulate more comprehensive smoke sealing around doorsets, wherever restriction of smoke leakage is mandated.

That requirement is likely to be that the entire doorset should be fitted with a continuous smoke seal within the rebate of the door, uninterrupted by any hardware, and that the threshold has a seal too. Forward-thinking door manufacturers would be well advised to start factoring this likely requirement into their plans.

Conclusions

The annual number of deaths due to fire has fallen gradually since the early 2000s, when the annual number of fire fatalities was consistently over 500. Obviously, 2017 was a tragic exception to this downward trajectory. This overall drop in fatalities is largely attributed to increased regulatory activities on fire safety – for example legislation around combustible furniture and furnishings and also smoke detection in new properties.

It could be argued that to bring down this number further, we should look more closely at smoke protection on doors. The reality is that threshold smoke seals are not an overly onerous or expensive component to fit where smoke restriction is required on a doorset. The increase in life protection that it affords is well worth the effort. Pressure is growing for more stringent requirements and the industry is moving towards greater protection from smoke leakage. With further legislation potentially looming on the horizon, it is doubly good sense to start building smoke safety into fire doors as standard.

Discuss your specific requirements with Rutland

Rutland provides specialist support with preparation for smoke, fire and security testing of doorsets and door assemblies. Please make contact if you would like to hear more about our support.

Call 01246 261491 or email sales@rutland.co.uk to start a conversation.