

## **Fire resistance of timber doors – Part II: Technical solutions and test results**

DANIEL IZYDORCZYK, BARTŁOMIEJ SĘDŁAK, PAWEŁ SULIK

Fire Research Department of Building Research Institute

**Abstract:** This paper discusses the main issues related to the fire resistance of timber doors. Technical solutions which help to achieve the expected fire resistance class have been described. Moreover, an example of temperature rise results for unexposed surface of the tested specimen have been presented.

*Keywords: timber glazed door, fire resistance, integrity, thermal insulation, radiation*

### TECHNICAL SOLUTIONS

The structure of the fully panelled fire resistant timber door leaf consists usually of the following:

- door leaf frame of the specific cross-section depending on the expected fire resistance class (two horizontal members: head and sill, and two vertical members: handle and hinge), made of hardwood or softwood; the frame members are bonded together or jointed using e.g. steel staples,
- panel filling consisting of special, high density chipboards in sandwich structure: individual layers of the sandwich structure have different densities and thicknesses, according to the expected fire resistance,
- both sides of the leaf are lined with MDF or HDF panels.

All components of the door leaf filling are jointed to the frame and lining using a special adhesive.

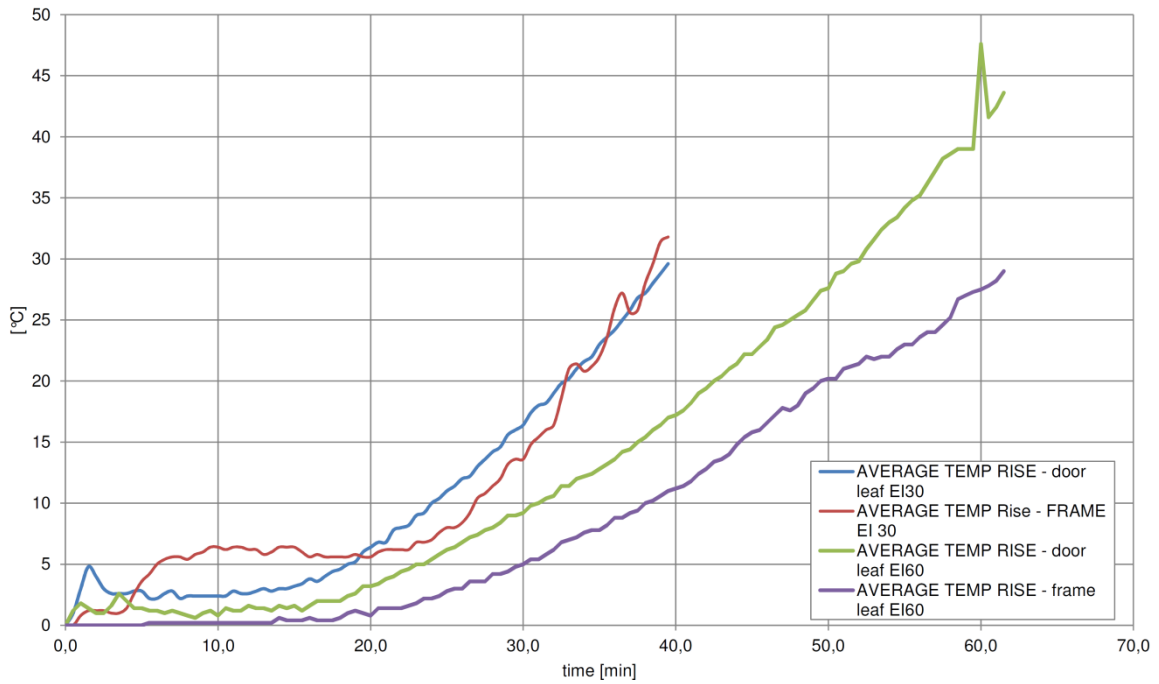
An important component of the entire door assembly is the door frame, consisting of vertical members and the head, usually jointed together using steel screws. The door frame is made of timber or MDF. The door frame cross section and density of its material depend on the expected fire resistance class.

Fire resistant timber door assemblies should also be equipped with intumescent (temperature expandable seals). They are mounted in specially milled grooves or directly bonded along all edges of the door leaves and frame.

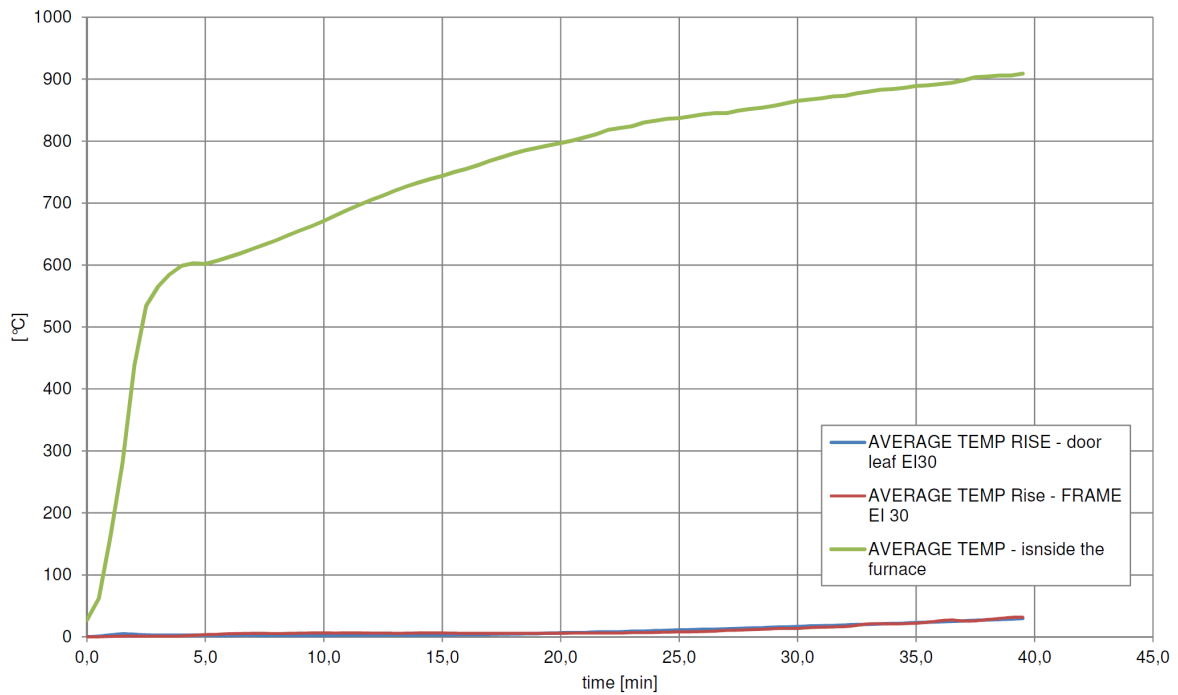
Timber doors may be equipped with a wooden sill, and in such case the sill edge of the door leaf is equipped with a special falling seal.

### **Temperature rise during the testing of fire resistance of fully panelled timber door assemblies**

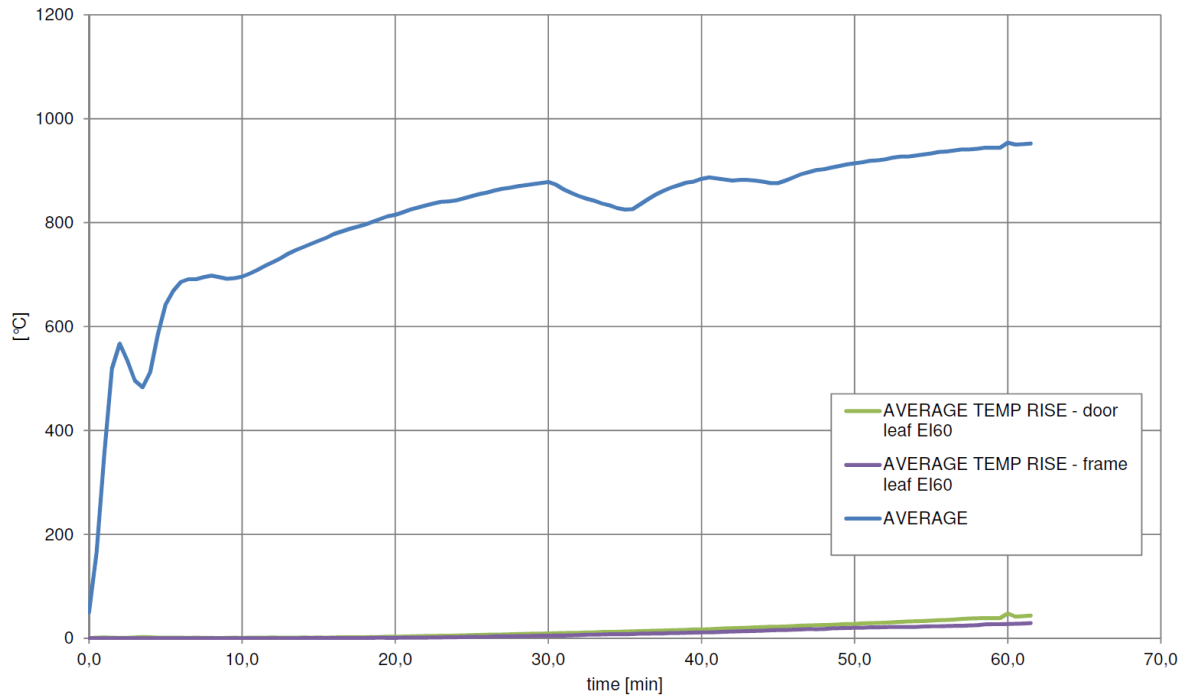
Fig. 2 shows diagrams of mean rise of the maximum temperature measured on the unexposed surface of the timber door frame, and the mean rise of the mean and maximum temperatures measured on the unexposed surface of the timber door leaf of fire resistance class EI<sub>2</sub> 30, compared with similar diagrams of temperature rise for the timber door assembly of fire resistance class EI<sub>2</sub> 60. And for comparison, Figures 3 and 4 show the above diagrams with the mean furnace temperature during the test.



**Fig. 2.** Diagrams of mean rise of the maximum temperature measured on the unexposed surface of the timber door frame, and the mean rise of the mean and maximum temperatures measured on the unexposed surface of the timber door leaf of fire resistance class EI<sub>2</sub> 30 and EI<sub>2</sub> 60.



**Fig. 3.** Mean temperature rise on the door frame and door leaf compared with the mean temperature in the furnace during the testing of the door for class EI<sub>2</sub>30



**Fig. 4.** Mean temperature rise on the door frame and door leaf compared with the mean temperature in the oven during the testing of the door for class EI<sub>2</sub>60

The timber door assemblies were tested according to standard EN 1634-1:2008 [4] (by heating from the hinge side). The EI<sub>2</sub> 30 fire resistance class doors had thickness of 51 mm, the door frame was made of pine wood, and had a cross section of 55 x 120 mm. The EI<sub>2</sub> 60 fire resistance class doors had thickness of 61 mm, the door frame was made of pine wood, and had a cross section of 54 x 120 mm.

#### SUMMARY

The presented test results indicate that the properly designed fully panelled timber door assemblies make an excellent fire barrier. Temperature rises on the unexposed door frame surfaces of the door frames and leaves are relatively low, which indicates that the timber material and the wood-based panels that together create a door assembly, create an excellent insulation as a whole. The only problem in designing the fire resistant timber structure to achieve the expected fire resistance class is to select the appropriate thicknesses, densities, cross sections and proper jointing of the door structure components.

## REFERENCES

### *Articles*

- [1] Sędlak B., 2012: Metodyka badań odporności ogniowej drzwi przeszklonych Cz.1, Świat szkła; R.17, nr 3, 56-58,60 (*in Polish*)
- [2] Sędlak B., 2012: Metodyka badań odporności ogniowej drzwi przeszklonych Cz.2, Świat szkła; R.17, nr 4, 55-58,60 (*in Polish*)

### *European Standards*

- [3] EN 13501-2+A1:2009 Fire classification of construction products and buildings elements – Part 2: Classification using data from fire resistance tests, excluding ventilation services
- [4] EN 1634-1:2008 Fire resistance and smoke control tests for door and shutter assemblies, openable windows and elements of building hardware – Part 1: Fire resistance test for door and shutter assemblies and openable windows.
- [5] EN 1363-1:2012 Fire resistance tests - Part 1: General Requirements
- [6] EN 1363-2:1999 Fire resistance tests - Part 2: Alternative and additional procedures
- [7] EN 15269-03:2012 Extended application of test results for fire resistance and/or smoke control for door, shutter and openable window assemblies, including their elements of building hardware – Part 3: Fire resistance of hinged and pivoted timber doorsets and openable timber framed windows.

**Streszczenie:** *Odporność ogniowa drzwi drewnianych – Część II. Rozwiązania techniczne oraz wyniki badań.* W niniejszym artykule omówione zostały główne problemy związane z odpornością ogniową rozwieranych drzwi drewnianych pełnych. Przedstawione zostały rozwiązania techniczne pozwalające na osiągnięcie oczekiwanej klasy odporności ogniowej takich zespołów drzwiowych. Ponadto zaprezentowano oraz porównano przykładowe wyniki przyrostów temperatury na nienagrzewanej powierzchni drewnianych zespołów drzwiowych.

Corresponding author:

Paweł Sulik, p.sulik@itb.pl