UNIVERSITY of PATRAS
CIVIL ENGINEERING DEPARTMENT
Structural Materials Lab
Fire Testing Facility – Patras 26504

Fire resistance test for a door assembly (door-set) - Test report

Responsible for testing / data processing:

- **Thanasis Triantafillou**, Professor, Structural Materials Lab, Director
  (tel. 2610 996516, fax. 2610 996155, email: ttriant@upatras.gr)
- **Catherine (Corina) Papanicolaou**, Assist. Prof.
  (tel. 2610 996561, fax. 2610 996155, email: kpapanic@upatras.gr)
- **Kyriakos Karlos**, Mech. Engineer, M.Sc., Lab Associate
  (tel. 2610 996587, fax. 2610 996155, email: karloskyriakos@gmail.com)

Fire resistance test for a door assembly (door-set)
Test report

Name and address of the testing laboratory:

Fire Testing Facility of the Civil Engineering Department,
University of Patras. University of Patras, Rion Campus, Patras 26504, Greece.

Name and address of the assignor (sponsor):

"ΑΦΟΙ ΑΛΕΞΙΟΥ ΟΕ – PORTE ARMEE"
ΑΝΑΠΑΥΣΕΩΣ 3, ΧΟΛΑΡΓΟΣ, ΑΘΗΝΑ 15561

Date of the test:

06/07/2018

Unique reference nomenclature of the test:

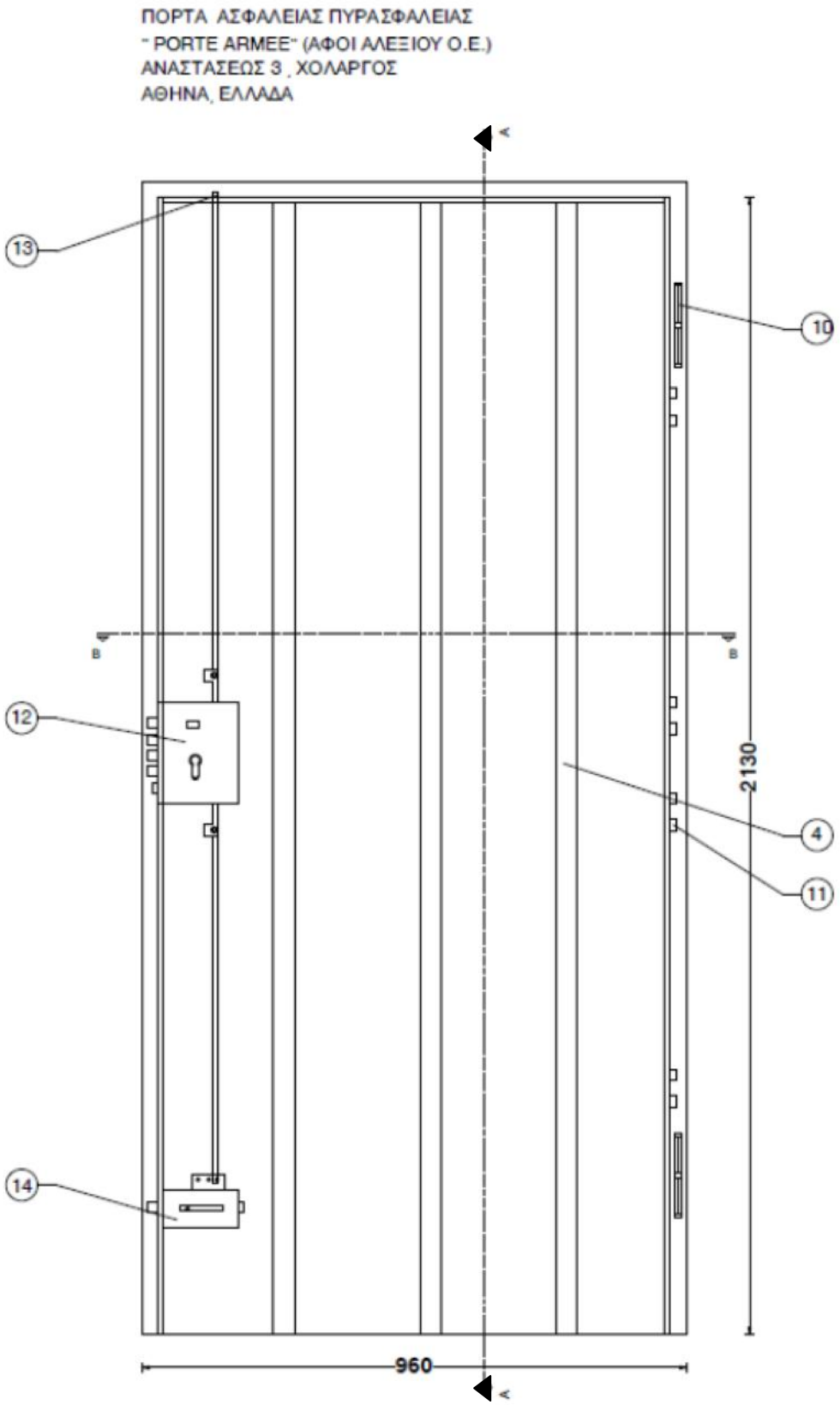
PORTE_ARMEE_#1

Name of the manufacturer of the test specimen:

"ΑΦΟΙ ΑΛΕΞΙΟΥ ΟΕ – PORTE ARMEE"

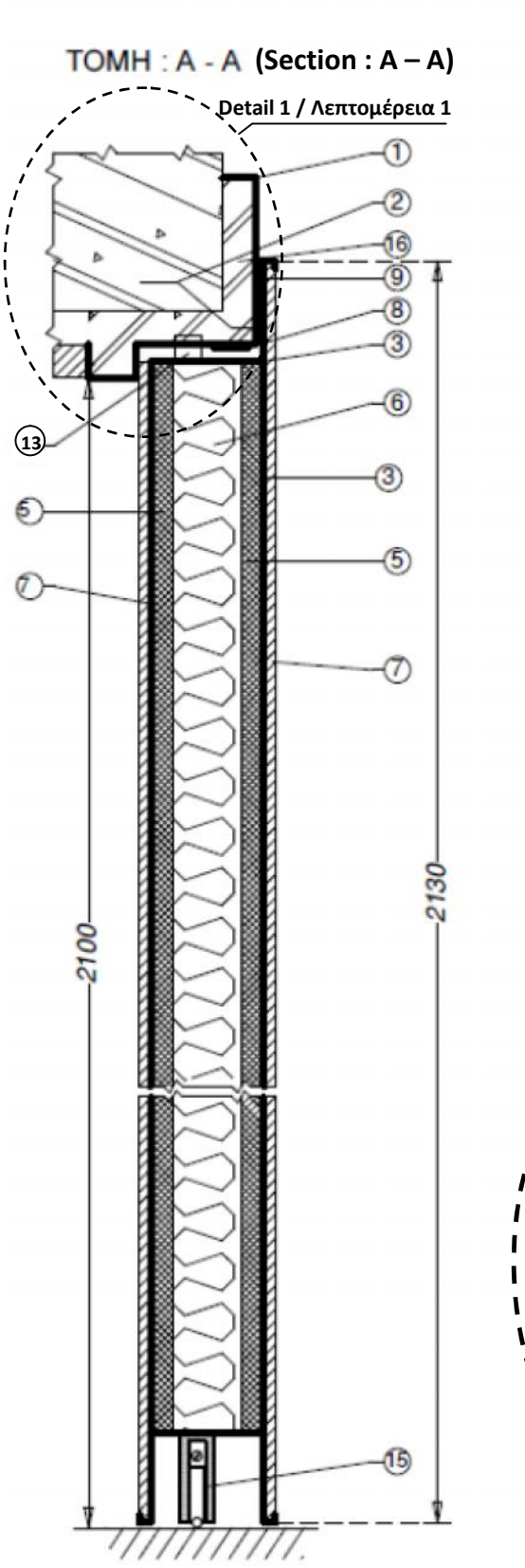
Constructional details of the test specimen:

The test specimen comprised a single-action door-set installed in a rigid standard supporting construction (as per EN 1363-1). The door-set was designated by the assignor as "Πόρτα ασφαλείας – Πυρασφαλείας" (Fire-resistant safety door-set). The test specimen and all its components were full size (as used in service). The door-set was hinged with timber leaves and a metal frame (no transom). The total thickness of the door was equal to 70 mm. Constructional details are depicted in **Fig. 1**.



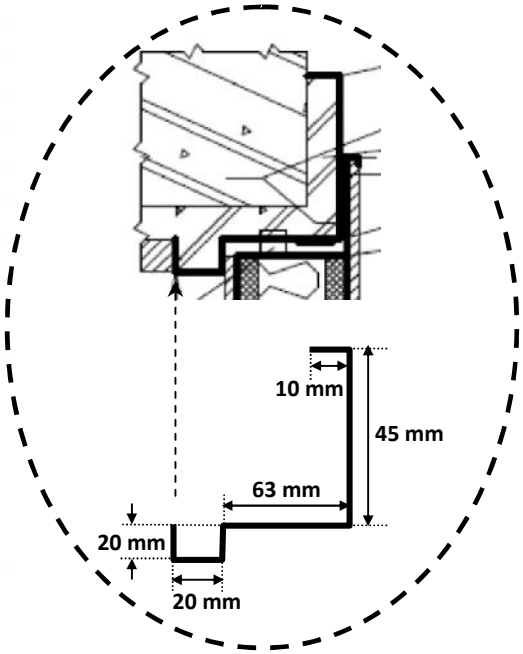
(α)

4. Π-shaped steel stiffeners 1.25 mm thick / Χαλύβδινες νευρώσεις σε σχήμα Π πάχους 1,25 mm
10. Adjustable heavy-duty hinge / Μεντεσές περιστρεφόμενος βαρέως τύπου ρυθμιζόμενος
11. Immovable pins / Σταθεροί πείροι
12. Safety cylinder lock / Κλειδαριά ασφαλείας κυλίνδρου
13. Top latch / Πάνω σύρτης
14. Bottom deflector / Κάτω εκτροπέας

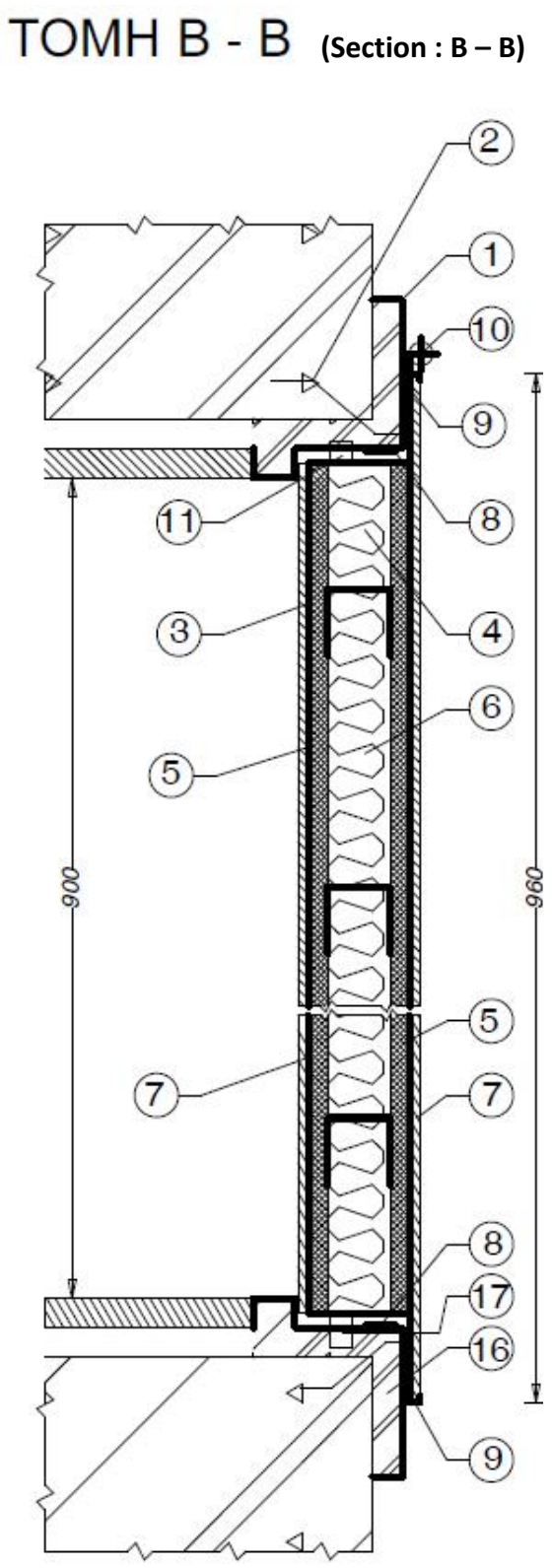


(β)

1. Steel frame 2 mm thick / Χαλύβδινο πλαίσιο (κάσα) πάχους 2 mm
2. Z-shaped steel brackets 2 mm thick / Τζινέτια σε σχήμα Z πάχους 2 mm
3. Steel door leaf 1 mm thick / Χαλύβδινο φύλλο πόρτας πάχους 1 mm
5. Fire-resistant plasterboard 12 mm thick (KNAUF) / Πυράντοχη γυψοσανίδα πάχους 12 mm (KNAUF)
6. Rockwool with a density of 80 kg/m^3, 30 mm thick (FIBRANgeo) / Πετροβάμβακας πυκνότητας 80 kg/m^3, πάχους 30 mm (FIBRANgeo)
7. Wooden paneling 7 mm thick/ Επένδυση ξύλινη πάχους 7 mm
8. Self-adhesive fire & smoke intumescent strip placed on the steel frame / Στη μεταλλική κάσα, αυτοκόλλητη θερμοδιογκούμενη ταινία – φραγμός καπνού
9. Rubber seal strip / Λάστιχο στεγανοποίησης
13. Top latch / Πάνω σύρτης
15. Adjustable windbreak / Ανεμοφράκτης ρυθμιζόμενος
16. Steel frame-to-wall connection through lime-based plaster for test purposes (through cement in practice) / Σύνδεση της κάσας με τον τοίχο με γύψο για τη δοκιμή (τσιμέντο στην πράξη)



Detail 1 / Λεπτομέρεια 1



1. Steel frame 2 mm thick / Χαλύβδινο πλαίσιο (κάσα) πάχους 2 mm
2. Z-shaped steel brackets 2 mm thick / Τζινέτια σε σχήμα Z πάχους 2 mm
3. Steel door leaf 1 mm thick / Χαλύβδινο φύλλο πόρτας πάχους 1 mm
4. Π-shaped steel stiffeners 1.25 mm thick / Χαλύβδινες νευρώσεις σε σχήμα Π πάχους 1,25 mm
5. Fire-resistant plasterboard 12 mm thick (KNAUF) / Πυράντοχη γυψοσανίδα πάχους 12 mm (KNAUF)
6. Rockwool with a density of 80 kg/m^3, 30 mm thick (FIBRANgeo) / Πετροβάμβακας πυκνότητας 80 kg/m^3, πάχους 30 mm (FIBRANgeo)
7. Wooden paneling 7 mm thick/ Επένδυση ξύλινη πάχους 7 mm
8. Self-adhesive fire & smoke intumescent strip placed on the steel frame / Στη μεταλλική κάσα, αυτοκόλλητη θερμοδιογκούμενη ταινία – φραγμός καπνού
9. Rubber seal strip / Λάστιχο στεγανοποίησης
10. Adjustable heavy-duty hinge / Μεντεσές περιστρεφόμενος βαρέως τύπου ρυθμιζόμενος
11. Immovable pins / Σταθεροί πείροι
16. Steel frame-to-wall connection through lime-based plaster for test purposes (through cement in practice) / Σύνδεση της κάσας με τον τοίχο με γύψο για τη δοκιμή (τσιμέντο στην πράξη)
17. Sliding safety lock pins / Κινητοί πείροι κλειδαριάς ασφαλείας

(γ)

Fig. 1 Constructional details of the specimen

Method of assembly and installation of the test specimen:

The specimen was delivered ready for testing and was fitted in a standard rigid supporting construction (a masonry wall comprising cellular – i.e. lightweight – concrete blocks, as described in EN 1363-1). Cellular –concrete blocks measured 600 mm × 200 mm × 250 mm (as in length × width × height). The installation method was representative of the use of the door-set in practice. The test was performed with the leaf opening towards the fire. The test specimen was mounted within the supporting construction flush with the exposed face of the supporting construction.

Pre-test conditioning of the test specimen:

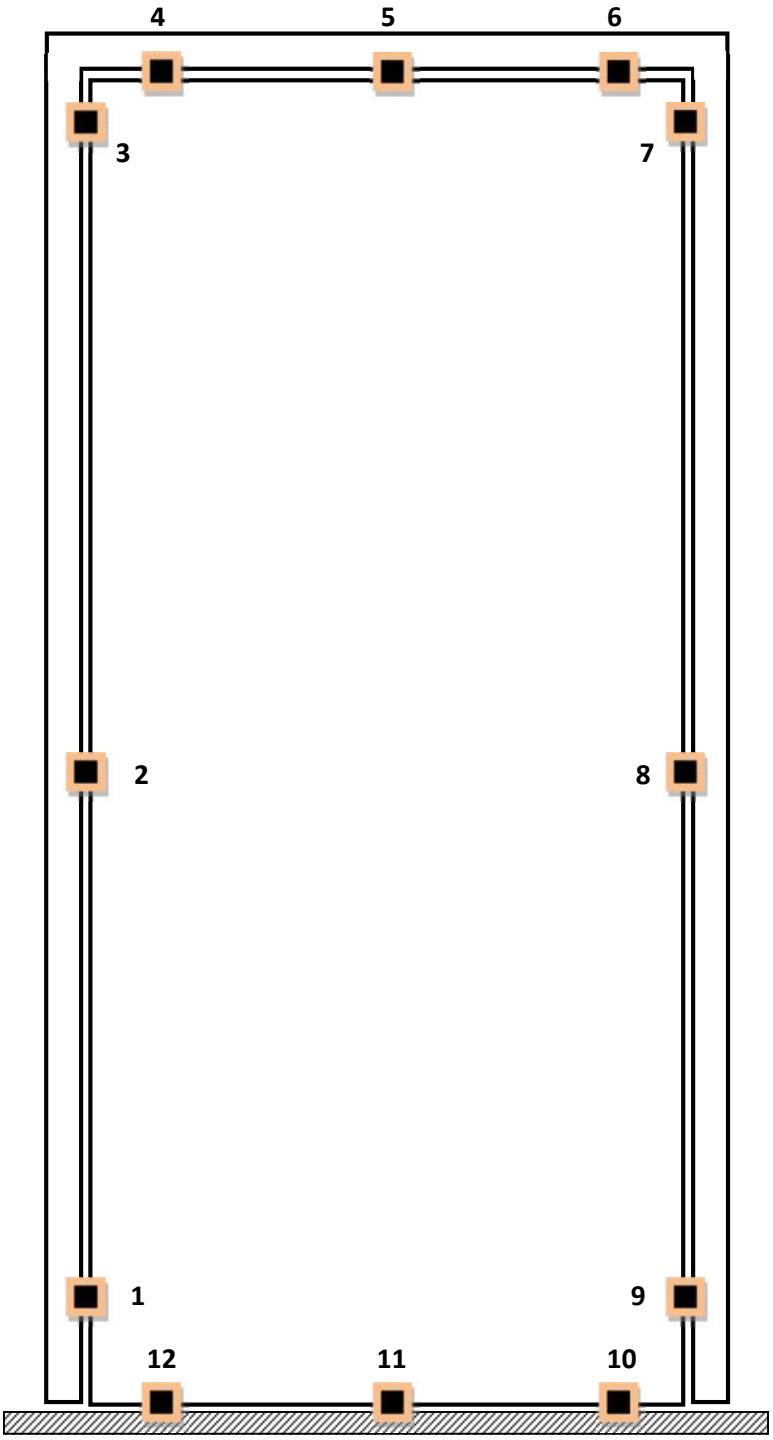
At the time of the test the moisture content of the test specimen approximated to that expected in normal service. Prior to testing the test specimen was stored in an ambient atmosphere of 50% relative humidity at 23°C. The supporting construction (lightweight concrete masonry wall) was conditioned in accordance with EN 1363-1 and born no influences on the behaviour of the specimen.

Pre-test examination and preparation:

Before the fire test an examination and preparation was carried out in the following sequence:

a) Mechanical pre-test conditioning in accordance with the requirements in EN 14600: The specimen was checked for operability in the fire test frame by operating from fully closed to fully open to the maximum possible, for 25 cycles. The opening and closing operation was manual and was witnessed by representatives of the assignor.

b) Gap measurements: Gaps were either calculated or measured prior to the fire resistance test in accordance with the sequence given in EN 1634-1:2014. It is noted that gaps account for clearance between two nominally adjacent surfaces and/or edges. Primary gaps in particular are between the edge of the leaf and the reveal of the frame and between the face of the leaf and the frame stop. **Fig. 2** illustrates the positions at which gap measurements were taken. All gaps but those of positions 10-12 were internal; thus, they were calculated. Gaps at positions 10-12 were visible and were measured. All gap measurements are given in Table 1.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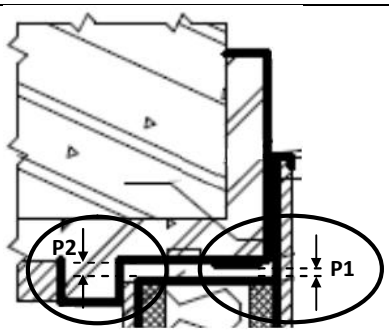
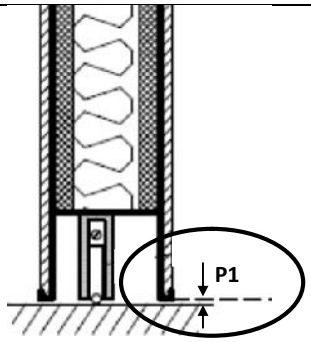
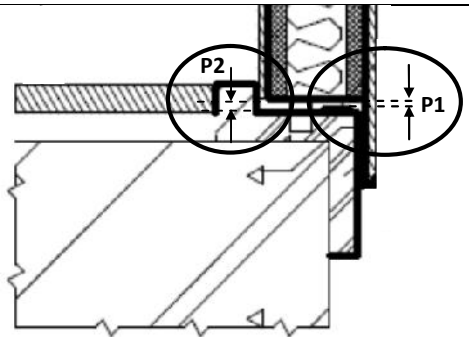


(Section A-A, top: positions 4-6)



(Section A-A, bottom: positions 10-12)



(Section B-B, same for either side of the leaf: positions 1-3 & 7-9)

Fig. 2. Positions at which gap measurements (Pi) were taken.

Table 1. Gap measurements

	Positions											
Gap measurements [mm, accuracy not exceeding 0.5 mm]	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**
P1	2.5	2.5	2.5	3	3	3	2.5	2.5	2.5	5	5	5
P2	6.0	6.0	6.0	6.5	6.5	6.5	6.0	6.0	6.0	-	-	-

d) Final setting: Prior to the fire resistance test, the test specimen was subjected to a final closing involving opening the leaf to a distance of approximately 300 mm and returning it to the closed position. The leaf was latched prior to the fire resistance test but not locked. All final setting procedures were carried out with the test specimen in position on the furnace. The latter was in an ambient pressure condition (i.e. with no air input or extraction).

Fig. 3 illustrates the layout of thermocouples on the unexposed surface of the test specimen. Thermocouples 1-5 were fixed on the steel frame of the door-set whereas thermocouples 6-15 were fixed on the door leaf. During the test the door leaf movement (deflection) relative to the frame was recorded at 1 min intervals. Both door leaf and frame deflections were measured by laser distance meters (range: 0.05 m to 100 m; measurement accuracy: 1.5 mm) placed on a fixed platform positioned 5 m away from the unexposed side of the specimen. Measurement points (laser targets) are shown in **Fig. 3** ("L" and "F" for leaf and frame measurement points, respectively). Zero leaf relative to door frame displacement was recorded.

The general layout of the specimen just prior to testing is given in **Fig. 4**.

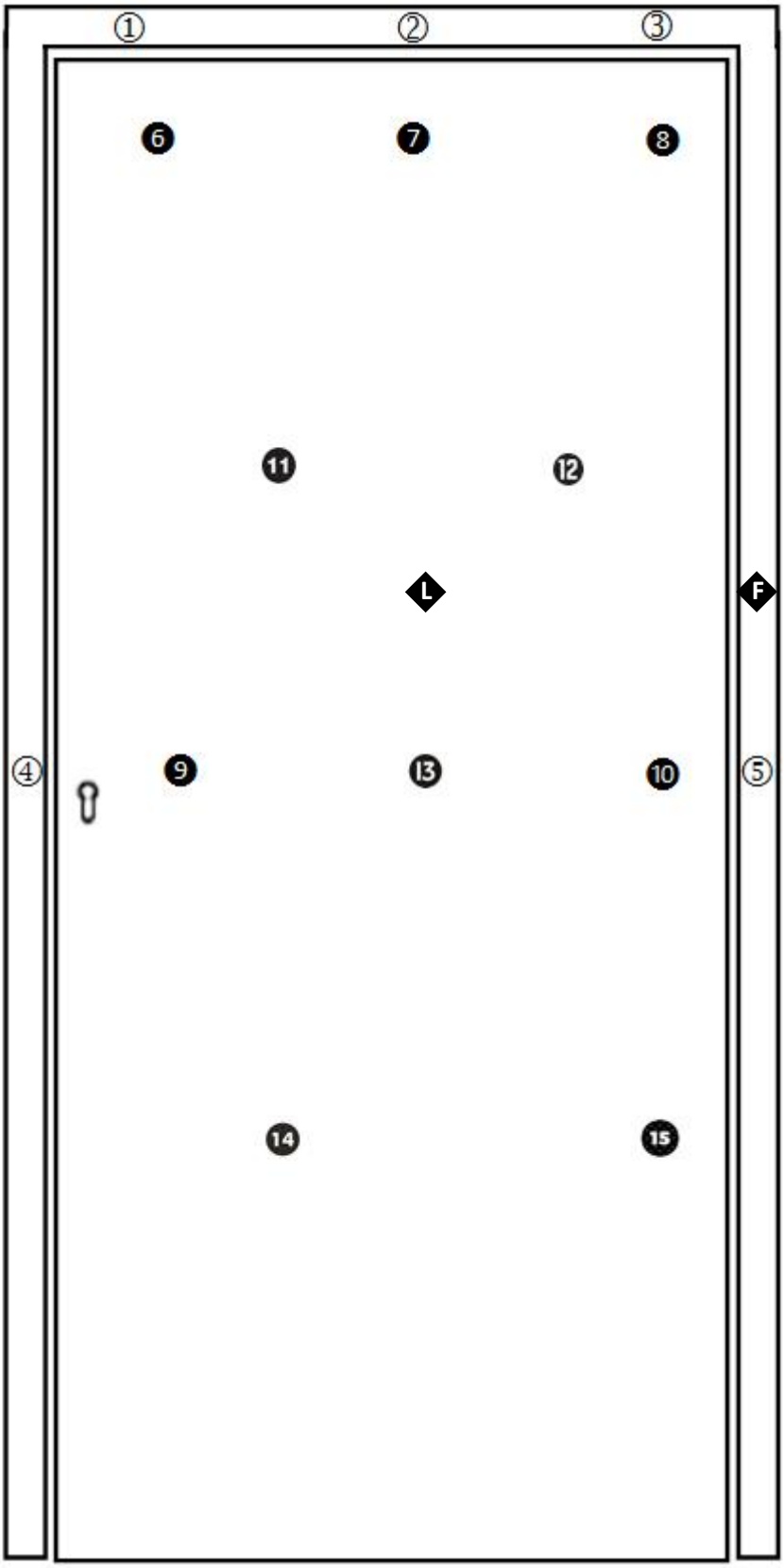


Fig. 3. Layout of thermocouples on the unexposed surface of the test specimen

Fig. 4. General layout of the specimen just prior to testing

Test procedure:

The test was carried out in accordance with EN 1634-1:2014 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.

The average temperature of the furnace was monitored and controlled such that it followed **Eq. (1)**.

$$T = 345 \log_{10}(8t+1)+20 \qquad \textbf{Eq. (1)}$$

where,

T is the average furnace temperature, in °C;
t is the time, in min.

Ambient temperature was continuously recorded during testing and ranged between 30°C and 32°C. A time-lapse video was recorded during testing (shooting interval: 5 s, clip length: 41s, frames per second: 25).

Test results:

The time versus (actual) furnace temperature curve (in comparison to the standard – i.e. target – time versus temperature one) is given in **Fig. 5a**. The time versus furnace pressure is given in **Fig. 5b**. The percentage deviation (d_c) in the area of the time versus actual furnace temperature curve from the area of the standard time/temperature curve is shown in **Fig. 6**; this deviation is compared in **Fig. 6** to the maximum permissible one referenced in EN 1363-1 (tolerance; red line in **Fig. 6**). For the total duration of the test (excluding the first 5 min) d_c was lower than the tolerance. The rapid temperature increase in the first 5 min of the test was responsible for the exceedance of the tolerance (common to fire resistance tests – see EN 1363-1).

The temperature recorded by the furnace thermoplates (10 in number) versus time is shown in **Fig. 7**. At any time after the first 10 min of test, the temperature recorded by any thermoplate in the furnace

did not differ from the corresponding temperature of the standard temperature/time curve by more than 100°C (as required by EN 1363-1).

Fire integrity assessment: Fire integrity is the ability of the door that acts as a partition to withstand fire applied at one side only, without transferring fire to the unexposed side as a result of flame or hot gas penetration to the other side. The specimen continued to maintain its separating function **for more than 60 min** without either:

(a) causing the ignition of a cotton pad applied in accordance to clause 10.4.5.2 of EN 1363-1 (**Fig. 8**);
(b) permitting the penetration of a gap gauge as specified in clause 10.4.5.3 of EN 1363-1 (**Fig. 9**);
(c) resulting in sustained flaming **Fig. 10**).

Fire insulation assessment: Fire insulation is the ability of the door to withstand fire applied at only one side, without transferring the fire to the unexposed side as a result of significant heat transfer from the heated side to the unheated side. Fire insulation assessment is carried out according to the following:

In the case of fire insulation class I1:

i. measurement of the mean temperature rise of the unexposed surface of the door leaf, which should be limited to 140°C above the initial mean temperature,
ii. measurement at the maximum temperature rise, limited to 180°C at any point of the unexposed door leaf surface, without consideration of the measurement of temperature on the door leaf within the area located at a distance of less than 25 mm from the border line of the visible door leaf edge,
iii. measurement of the temperature rise at any point of the door frame, measured at the distance of 100 mm from the visible edge of the unexposed door leaf surface, provided the door frame is wider than 100 mm, or otherwise, at the door frame/supporting structure border, which should be limited to 180°C.

In the case of fire insulation class I2:

i. measurement of the mean temperature rise of the unexposed surface of the door leaf, which should be limited to 140°C above the initial mean temperature,
ii. measurement at the maximum temperature rise, limited to 180°C at any point of the unexposed door leaf surface, without consideration of the measurement of temperature on the door leaf within the area located at a distance of less than 100 mm from the border line of the visible door leaf edge,
iii. measurement of the temperature rise at any point of the door frame, measured at the distance of 100 mm from the visible edge of the unexposed door leaf surface, provided the door frame is wider than 100 mm, or otherwise, at the door frame/supporting structure border, which should be limited to 360°C.

The assessment of point (i) is shown in **Fig, 11**. The assessment of point (ii) – considering all door leaf thermocouples – is shown in **Fig. 12**. The assessment of point (iii) is shown in **Fig. 13** (all door frame thermocouples were placed mid-width). Based on **Figs. 11-13**, the fire insulation class of the fire door is that of I2.

The test was terminated at 1 h 22 min at the request of the assignor.

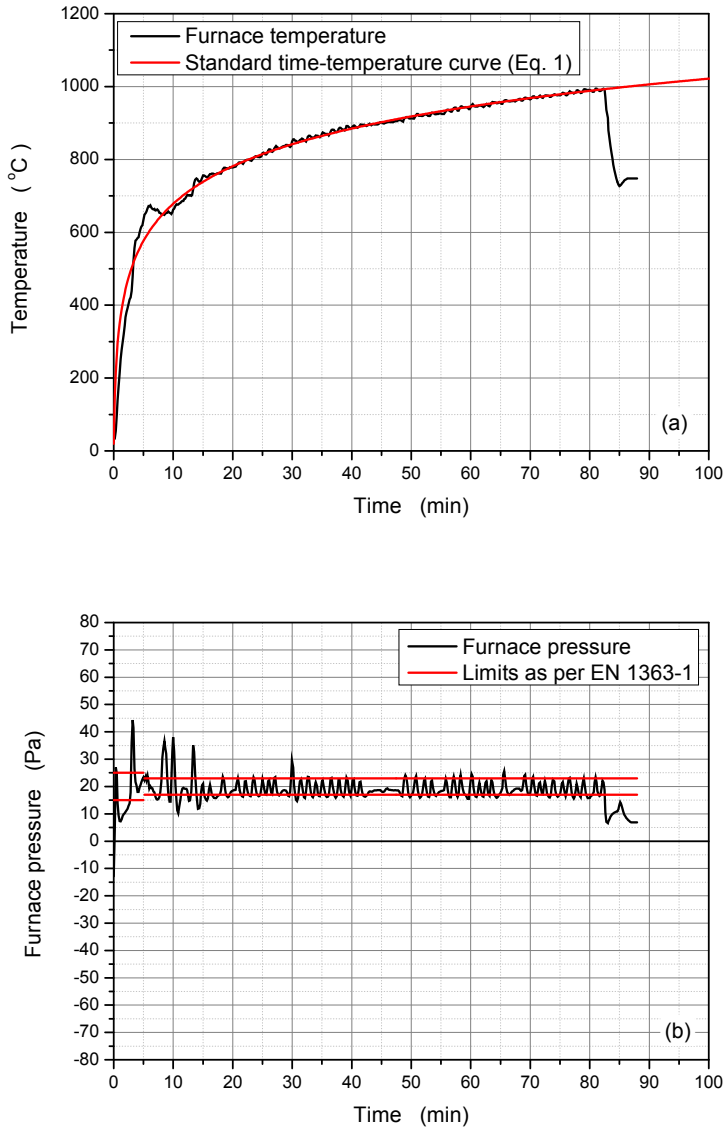


Fig. 5. (a) Time versus (actual) furnace temperature curve (in comparison to the standard – i.e. target – time versus temperature curve); (b) Time versus furnace pressure

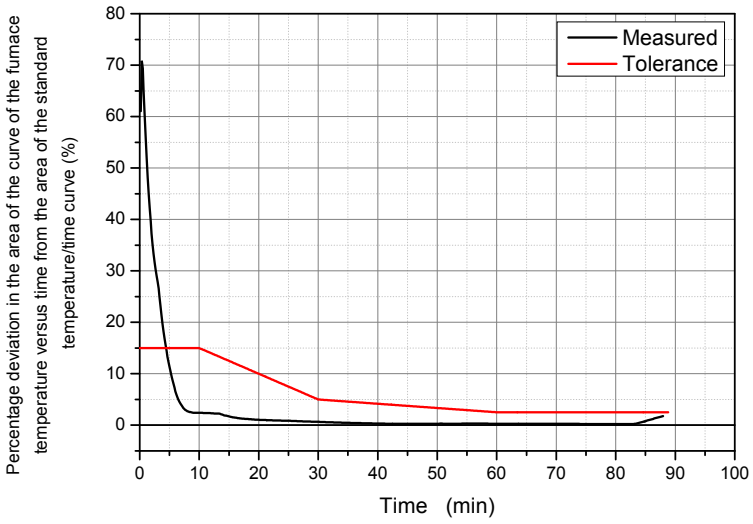


Fig. 6 Percentage deviation in the area of the time versus actual furnace temperature curve from the area of the standard time/temperature curve and maximum permissible one as per EN 1363-1

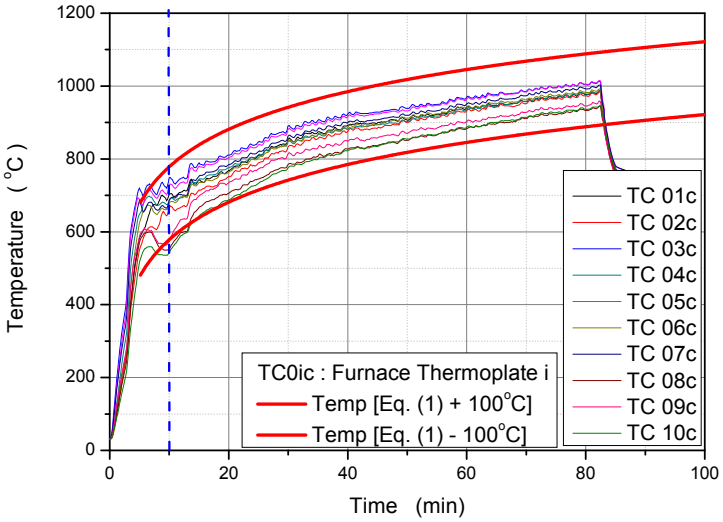


Fig. 7 Time records of temperature recorded by each thermoplate in the furnace in comparison to limit temperatures (standard temperature ±100°C)

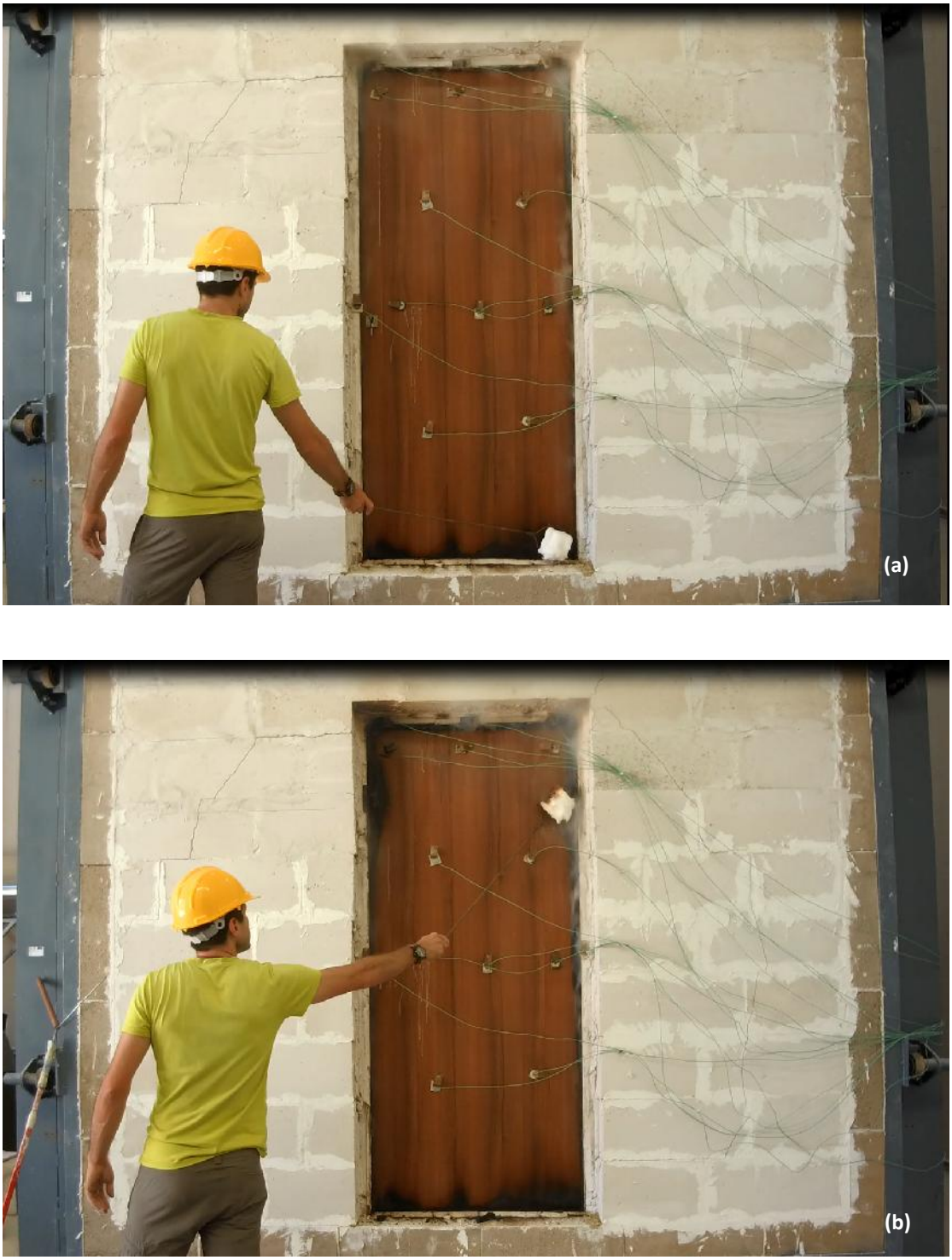


Fig. 8 Cotton pad check: (a) 1h (cotton pad remained intact) and (b) 1h 19 min post the commencement of the test (cotton pad ignition)

Fig. 9 Gap gauge check: the 6 mm gap gauge can be passed through the test specimen such that the gauge projects into furnace (but cannot be moved a distance of 150 mm along the gap) at 1h 12 min post the commencement of the test

Fig. 10 Sustained flaming (continuous flame lasting more than 10 s) at 1h 19 min post the commencement of the test

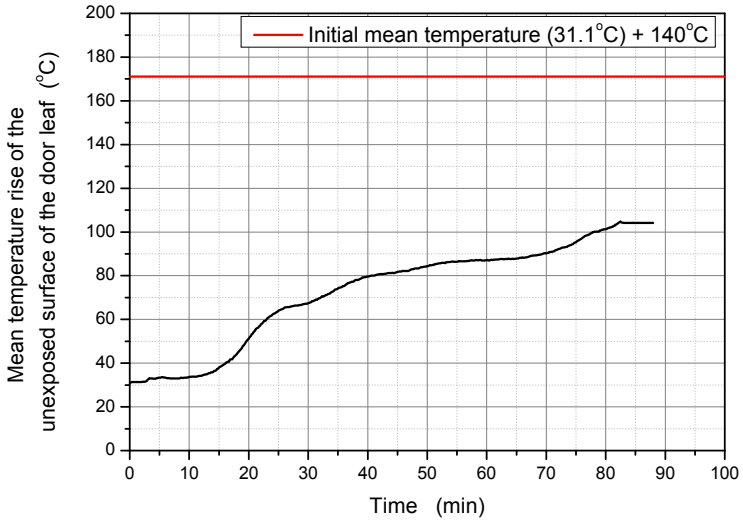


Fig. 11 Mean temperature rise of the unexposed surface of the door leaf versus time [fire insulation: assessment of point (i)]

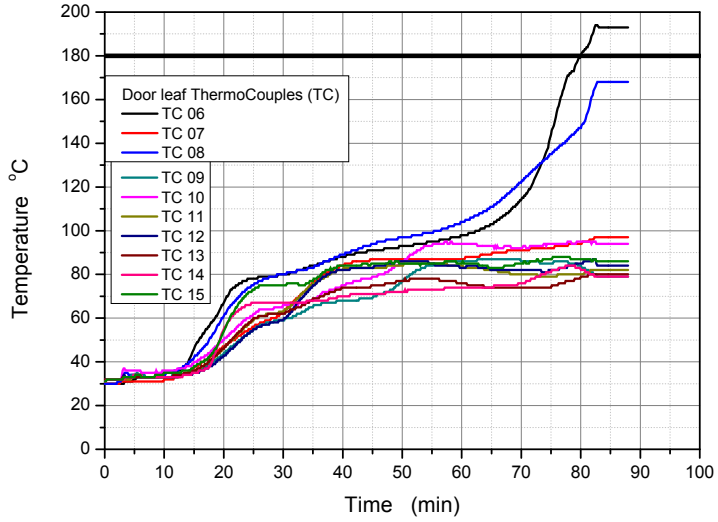


Fig. 12 Temperature rise at any point of the unexposed door leaf surface versus time (all door leaf thermocouples considered) [fire insulation: assessment of point (ii)]

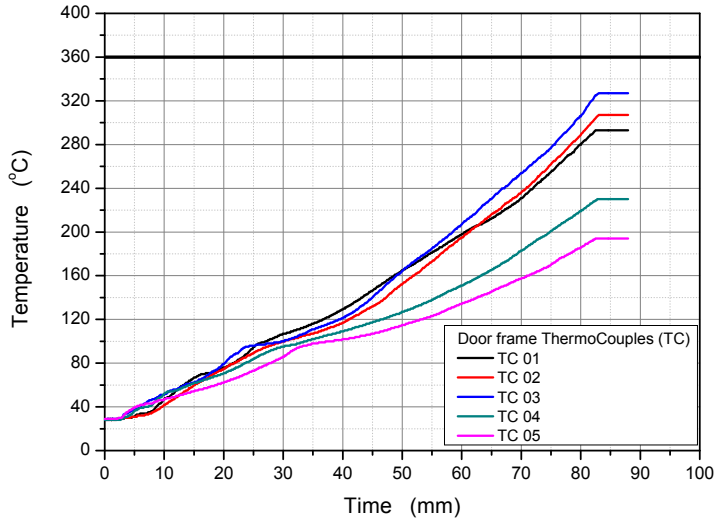


Fig. 13 Temperature rise at any point of the door frame versus time [fire insulation: assessment of point (iii)]