FIRE RESISTANCE

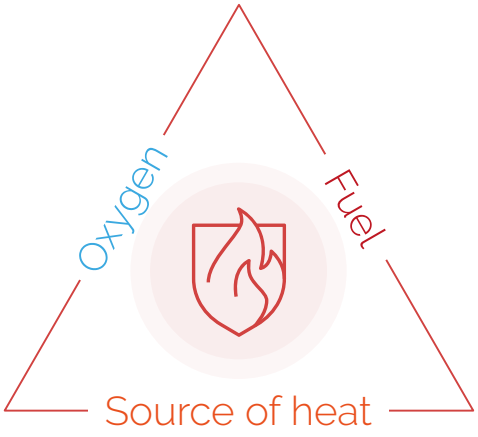
EN 1634-1

A brief explanation

European fire resistance standards have gradually taken over from the national standards and are now the reference for fire resistance tests and classification.

However, each country retains its own disparities by imposing different, specific conditions of application.

The reference for fire resistance tests on doors, shutter assemblies and windows is European standard **EN 1634-1**. Details of this reference will be given in this section, starting with the general characteristics of a fire.



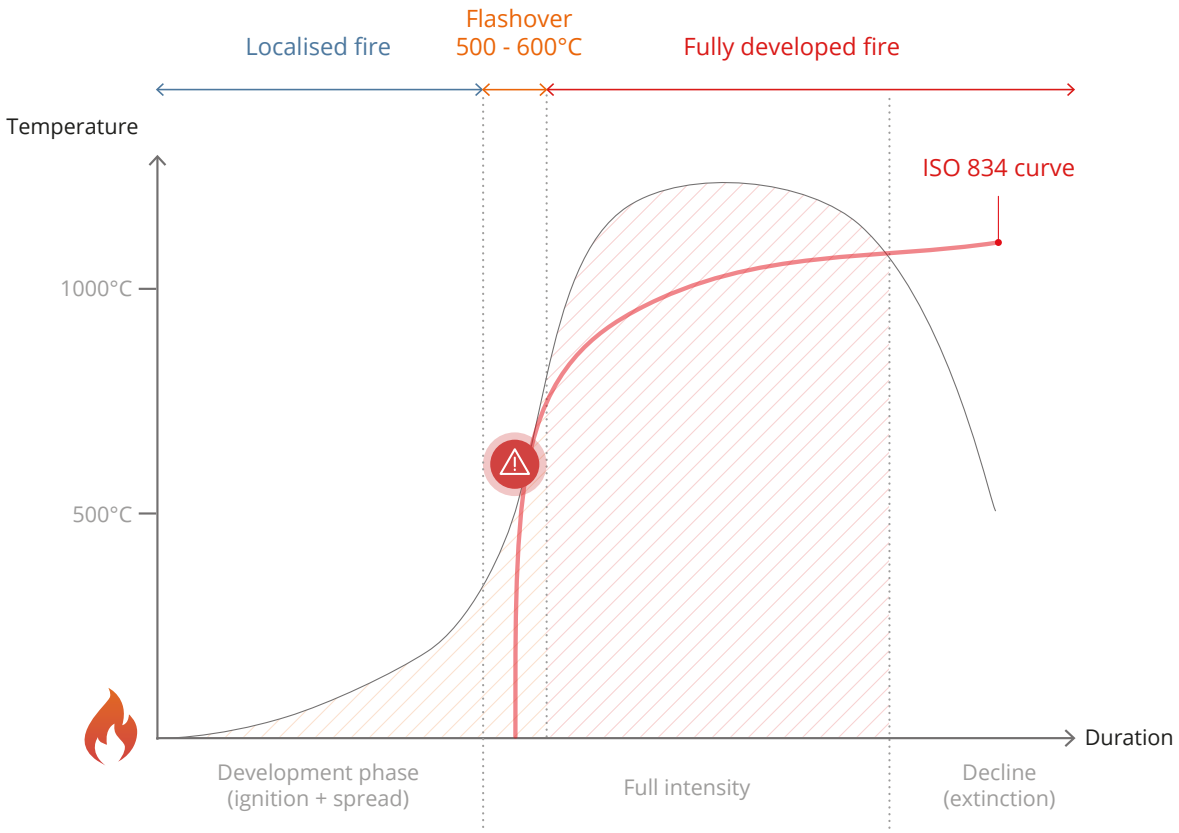
CIRCUMSTANCES OF A FIRE

A fire is a large uncontrolled flame that spreads more or less quickly and usually causes substantial damage. Its scenario is made up of unexpected elements and events and its characteristics vary according to the location, atmospheric conditions, combustible equipment elements, the means implemented to slow down its propagation, and a heap of other parameters.

However, there are 3 vital elements for a fire to break out that together form **the "fire triangle":**

- fuel;
- a source of flames or heat;
- oxygen.

Stages of a fire



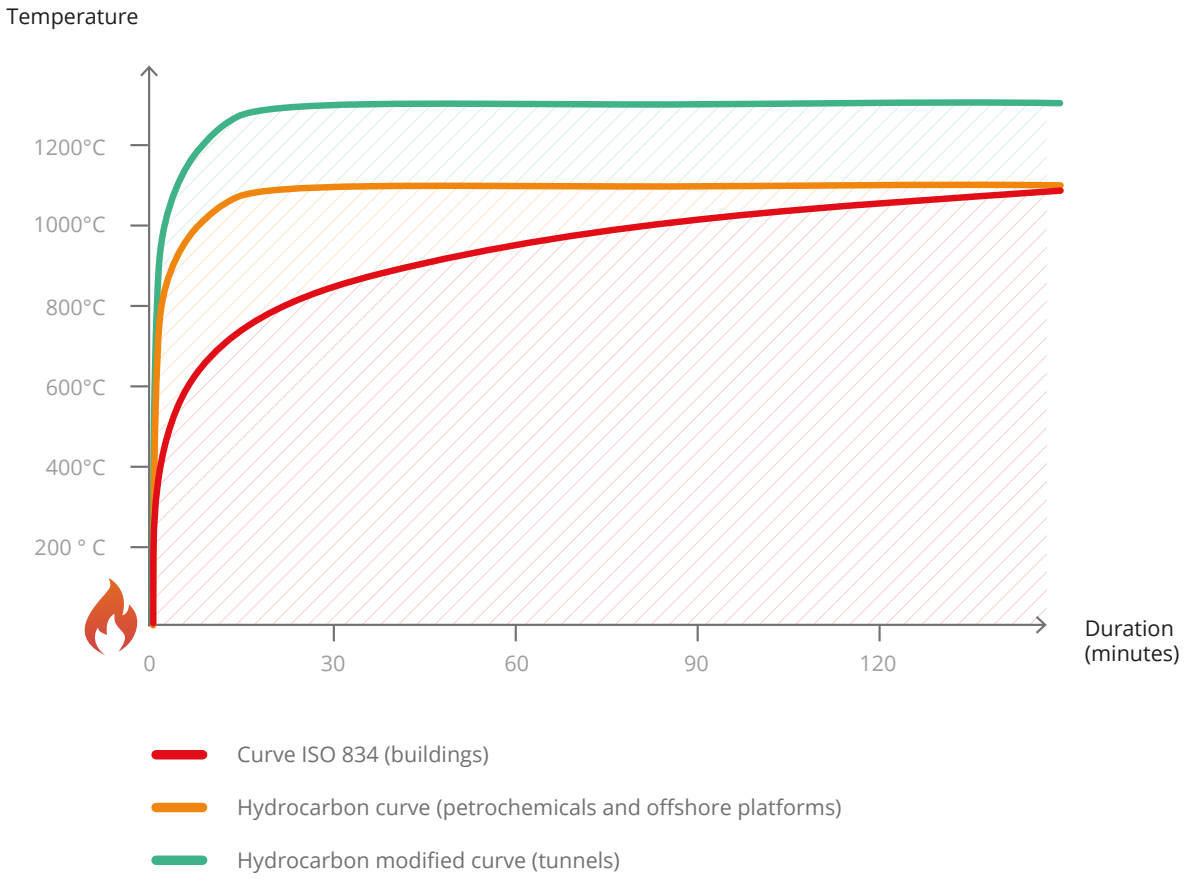
Generally speaking, the curve above is commonly considered to represent the development of a fire.

During the development phase, the curve shows a relatively slow rise in temperature up to the major event that is known as **the flashover.**

This phenomenon generally occurs when the temperature reaches 500 to 600°C, i.e. when the gaseous layers caused by the fire ignite themselves, triggering the ignition of all combustibles present in the fire.

The fire then enters its most intense phase and is fully developed.

Temperature curves



TEST CIRCUMSTANCES

The test circumstances attempt to reproduce real-life circumstances but without the development phase, so that the elements being tested can be exposed directly when **the fire is at full intensity.**

In order to frame and define the test circumstances, nominal curves showing a rise in temperature have been determined, following a curve similar to that of the flashover. During “classic” fire tests, the temperatures are determined by the **ISO 834 curve.**

This curve with a very rapid rise in temperature makes it possible to reach 550°C after just five minutes of testing.

In order to undergo the tests, Heinen doors are built into a wall which is one of the sides of a test furnace. This furnace is calibrated to reach the temperatures defined by the ISO 834 curve, as well as a set pressure and a precise oxygen level.

The doors are tested on both sides, i.e. with the fire located on the side of closure and opening. In other words, the test is carried out with the hinges IN the fire during a first test and OUTSIDE of the fire during the second test. The duration of the test is determined by the resistance class and ranges from 15 to 240 minutes.

The success of fire resistance tests involves different categories of criteria: integrity **(E)**, radiation **(W)** and insulation **(I)**.

INTEGRITY

Integrity (E), formerly known as 'pare-flammes' (flame resistance) in French standards, is the first condition in order to obtain a fire classification.
It is determined by three measurement criteria:

- a piece of **cotton wool** should not catch fire when held very close to the door;
- a **flame** cannot take shape in a continuous manner for more than 10 seconds on the protected side of the door;
- no opening can be formed through the door that measures over 25 mm in diameter nor any slit that measures more than 150 mm by 6 mm.

If one of these three criteria is not met, the door automatically loses its integrity (E).

THERMAL INSULATION

Thermal insulation (I) is a criterion that measures the rise in temperature of the door on the protected side.

To measure this rise in temperature, **thermocouples** are placed at different standardised points of the door. In addition to the fixed thermocouples, a mobile thermocouple is used to take measurements at points that are likely to exceed the authorised temperatures.

Insulation is subdivided into two categories which apply in different countries: **I1 and I2.**

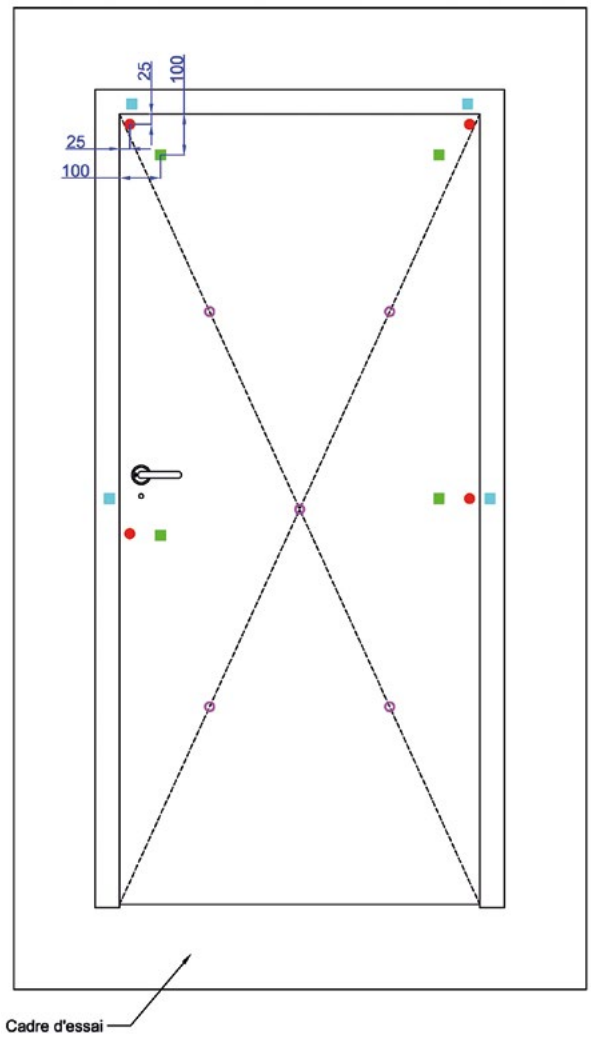
The I1 fire resistance tests are more stringent than the I2 tests (see data in the table on the next page).

By default, if specifications indicate a fire performance without specifying I1 or I2, for example: EI-30, they refer to I2, or in this case EI2-30, which is used in most EU countries. Belgian legislation requires EI1 (replacing the national Benor-ATG standard).

RADIATION

Radiation (W) is a measurement of the **radiation flow** on the protected side, 1 m from the element tested, and may not exceed 15 kW/m2. This criterion (W) is never noted alone, but always together with the integrity criterion (E). In the Netherlands, for example, so-called EW doors are required, such as EW30, EW60, EW120 etc.

EN 1634-1 (door sets)



I1	I2	○ Average temperature rise: max. 140°C
		■ Maximum temperature: max. 180°C
		■ Maximum temperature frame: max. 180°C I1, max. 360°C I2
		● Maximum temperature (additional operating mode): max. 180°C

I1

The average of the five fixed thermocouples positioned in a cross in the centre of the leaf may not exceed a temperature rise of 140°C. None of these points may exceed a temperature rise of 180°C.

All the fixed thermocouples (positioned at least **25 mm** from the visible edges of the leaf), as well as the mobile thermocouple, may not exceed a temperature rise of 180°C.

The fixed thermocouples placed on the frame may not exceed a temperature rise of **180°C.**

I2

All the fixed thermocouples (positioned at least **100 mm** from the visible edges of the leaf), as well as the mobile thermocouple, may not exceed a temperature rise of 180°C.

The fixed thermocouples placed on the frame may not exceed a temperature rise of **360°C.**

Test results

DIRECT APPLICATIONS

The “direct applications” are given at the end of each test report. Among other things, they describe the maximum authorised dimensions for the doors that have been tested. Those dimensions are defined as follows. When measuring the test time, the door usually exceeds the classification time. The length of this additional period is commonly known as **the overrun**.

Example: a door classified as EI1-60 which actually meets the E and I1 criteria for 65 minutes will have an overrun of 5 minutes.

In addition to the “minimum” classification value (60 minutes in our example), a second period is defined in the standard: the classification duration plus a certain overrun period (for our example, EI1-60, overrun of 8 minutes), see table in the following section.

Doors having passed the test for a period just above the desired classification period are therefore category A; those having exceeded the classification period by the additional duration required (overrun) are category B.

Example: door EI1-60 which has withstood the E and I1 criteria for 65 minutes will be classed in category A; if it withstands for 72 minutes, it will be classified in category B.

In **category A**, the doors may be made in **dimensions reduced** by up to 50% in width and 75% in height.

In **category B**, the doors may be reduced under the same conditions but also **enlarged**:

- by 15, 20 to 25 % in width and height;
- by 20, 25 to 30% in surface area.

These different values applying to the increase in size will depend directly on the mechanical distortions of the door measured during the tests, depending on whether they are classified as poor, average or high.

EXTENDED APPLICATIONS

The “extended applications” are set out in additional reports and are not obligatory. They describe all the **variations** that a tested door may undergo when being configured.

Heinen invests a great deal in these extended applications, as they make it possible to offer a wide range of different configurations: hardware, attachments, frame, accessories and combination of performance features.

The classes and values

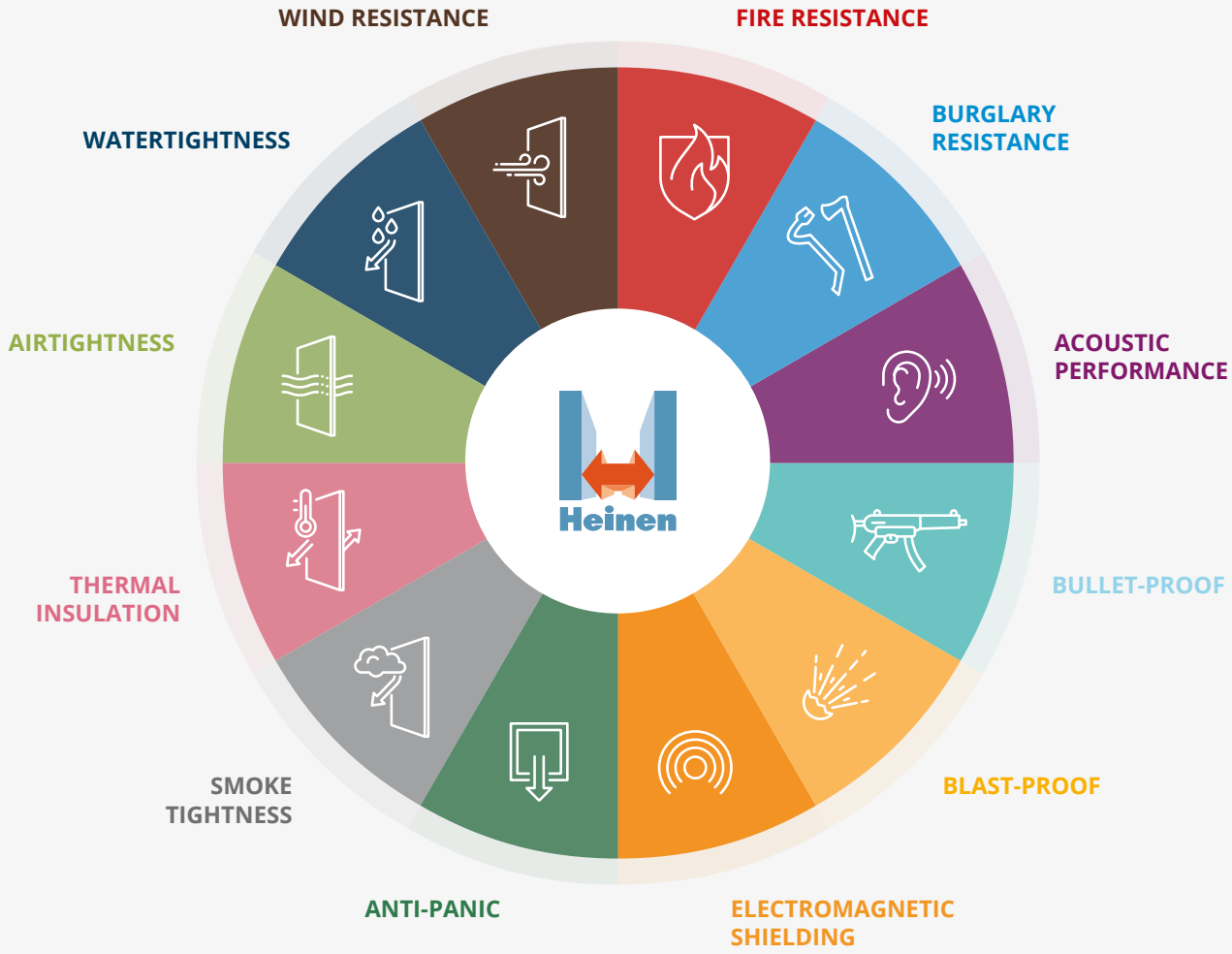
EN 1634-1

Fire resistance			
Class	Duration of fire resistance	Duration with overrun	Oven maximum temperature
30	30 min	36 min	822°C
60	60 min	68 min	925°C
90	90 min	100 min	986°C
120	120 min	132 min	1029°C
180	180 min	196 min	1090°C

EN 1191

Durability of the automatic closure C	
Class	Duration of fire resistance
C5	200 000
C4	100 000
C3	50 000
C2	10 000
C1	500
C0	0

Combining bespoke performance features



Heinen doors can combine performance features on a bespoke basis. Depending on your needs, one or more performance features are added to the basic, robust METAL+ door.