Cone Calorimeter

Predicting fire and smoke behaviour accurately and cost-effectively

THE CONE CALORIMETER

The Cone Calorimeter test is currently the most advanced method for quantifying a material's reaction to fire. It determines the fire and smoke behaviour of your construction material in a laboratory setting in accordance with EN 5660-1. Furthermore, with additional software, it will be possible to predict the outcome of a Single Burning Item (SBI) test (EN 13823) without the need for an excessive amount of materials required for a SBI test. This makes the Cone Calorimeter an ideal and financially attractive testing device during early product development stages. A Cone Calorimeter test makes it possible to evaluate your material:

- Ignitability
- Combustibility
- Smoke production
- Toxic gas production

HOW DOES IT WORK?

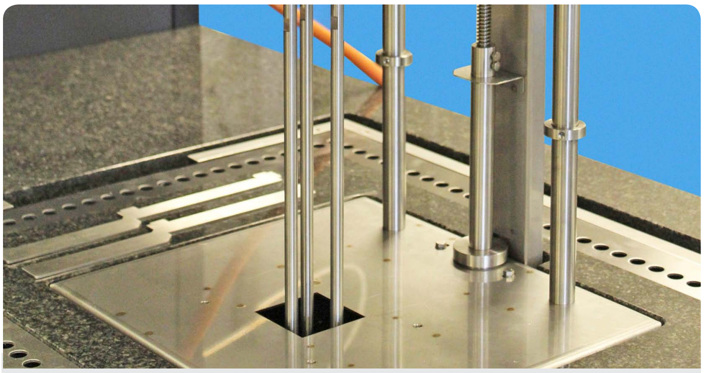
A specimen is mounted on a load cell which records the mass loss rate of the specimen during combustion. An electrical spark ignites the volatile gases emitting from the heated specimen. Combustion gases are then collected in an exhaust hood and accompanying duct. Here smoke, temperature and pressure measurements are taken. These measurements make it possible to calculate the heat release rate.

HEAT RELEASE RATE

The cone calorimeter gets its name from a conical shaped heat source, which provides a constant heat flux within a range of 0 to 100 kW/m². A thorough analysis requires testing at several irradiance levels. According to ISO/DIS 5660-1:2013, three specimens can be tested at each of the following levels: 25, 35, 50 and 75 kW/m².

SMOKE EXTINCTION AREA

Smoke production is analysed by measuring how the smoke attenuates a laser beam in the exhaust duct. The attenuation is related to volume flow, resulting in a measure of smoke density called smoke extinction area in m2/s.



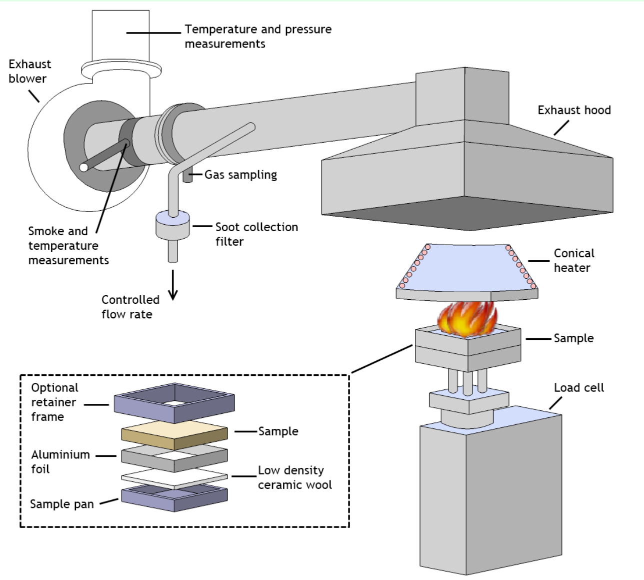
END USE SIMULATION

The specimens that need to be tested have to be similar to the final product as much as possible. The Cone Calorimeter also does its part in simulating the end use of the tested material. For instance, the material can be installed with a substrate directly behind it or with an air gap, which can significantly alter the product's behaviour. Also, depending on the end use of the product, the specimen can be tested in a horizontal orientation.

SPECIMEN REQUIREMENTS

A Cone Calorimeter can test almost all materials, including soils and liquids. Restraining equipment can be used for materials that transform while heated. A complete test involving exposure to 4 irradiance levels requires at least 12 specimens with preferably an essentially flat surface, although irregular surfaces can be tested as well (standard 3 tests with one irradiance level will be performed).

In order to fit in the testing equipment, the specimen have to be 100 x 100mm, with a tolerance between -2mm and +0mm. The specified thickness is limited to a maximum of 50mm. Specimens less than 6mm thick can be tested with the use of an air gap or substrate, but when a specimen is too thin, it risks having an insufficient amount of material to produce meaningful test results.



START A SBI TEST WITH FULL CONFIDENCE

Efectis combines the Cone Calorimeter with a sophisticated software model. This model predicts the likely fire and smoke class in accordance with the SBI test (EN 13823). And while a Single Burning Item test needs three specimens with an area of 2.25 m^2 each, the Cone Calorimeter only uses a maximum of twelve specimens of 0.01 m^2.

This might prove valuable in the early development stages of a new product. For instance, the Cone Calorimeter test makes it easier to quickly test several versions of one material and see which one performs best before moving on to a SBI test. In some cases it is even allowed to compare and validate the current status of a material using earlier Cone Calorimeter test results.

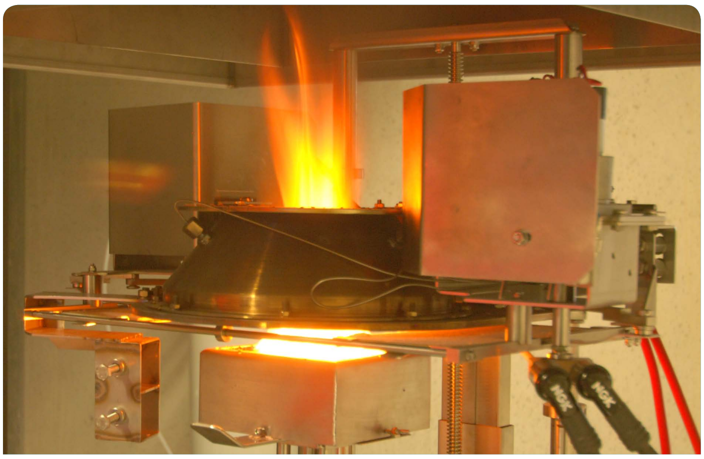
PUTTING OUR EXPERTISE TO YOUR ADVANTAGE

Your time and money are valuable and Efectis therefore strives to present the most accurate test results. With our knowledge and working philosophy we:

- Use all tests to further improve the prediction model, to make it more accurate still
- Combine the prediction model with our other fire safety tests, to check for correlations

CONE CALORIMETER VS. SBI

- SBI test: 3 x 1.5m x 1.5m x 0.2m = 1.35m^3 Cone
- Calorimeter test: 12 x 0.1m x 0.1m x 0.05m = 0.006m^3
- A factor of (maximum) 225 in volume difference



ADVANTAGES

One of the main advantages of a Cone Calorimeter test is that only very small sample sizes are required, which makes it very cost-effective in terms of e.g. material costs and transportation costs. Furthermore, a Cone Calorimeter test:

- Give an indication how to improve your tested product
- Is in accordance with EN 5660-1
- Can reasonably predict the outcome of a Single Burning Item test (EN 13823)
- Can be used for flooring products that are tested with the Flooring Radiant Panel tester (EN ISO 9239)
- Is fast, safe and accurate, with immediate results
- Can test multiple samples and inform about the differences between them
- Allows testing where larger samples are not available, such as monumental buildings
- Can compare before and after use, e.g. with exposure to weathering or frost

Beside for product development the Cone Calorimeter test can also be used as a quality control tool and as a means of a quick assessment during building inspections.

TEST REPORT

The test report contains information about dimensions, pre-treatment and conditioning of the specimen, as well as information on the test conditions. The following parameters are determined (the unit m^2 is related to specimen area):

- Time to ignition [s]
- Total heat released [MJ/m^2]
- Maximum heat release rate [kW/m^2]
- Average heat release rate after 180s and after 300s [kW/m^2]
- Effective combustion heat [MJ/kg]
- Average smoke production [m^2/s]
- Production of CO (carbon monoxide) [g]
- Optional measurements of production of other gas components, like HCN (cyanic acid).

The following results are given graphically for the four applied irradiation levels:

- Heat release rate [kW/m^2]
- Smoke production rate [m^2/s]
- Production rate of CO and HCN [g/s]
- Specimen mass as function of time [g/s]

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Efectis is the expert in fire science, engineering, design and modeling, risk analysis, testing, inspection and certification. Efectis covers all fire safety capabilities and know-how in testing and modeling around the world with offices and laboratories located in France, the Netherlands, Spain, Turkey, the USA, the Middle-East area and China.