

## Technical information

### Reaction to fire

#### Cone calorimetry testing

#### 01 What is cone calorimetry testing?

Cone calorimetry testing in accordance with ISO 5660-1 analyses the behaviour of products and materials when exposed to heat and a source of ignition. Due to the small sample sizes used for the test, cone calorimetry testing is a quick, cost effective, way to conduct research into the fire performance of products whilst still in the development stage.

Results gained from a cone calorimeter test provide a valuable contribution to many fire behaviour research applications and by using specialised software, can help to predict probable performance which can then be verified by the single burning item test, EN 13823.

#### 02 The cone calorimeter

The cone calorimeter gets its name from the conical shaped heating element that the samples are exposed to. When exposed to the heat source, a spark ignites the

sample leading to combustion. The cone calorimeter then gathers all the products of combustion in a duct and measurements are used, in conjunction with a load cell for mass loss data, to calculate many useful parameters.

#### 03 What can be tested?

The majority of materials and products, including solids and liquids, can be tested in the cone calorimeter. Products that undergo physical changes when heated, such as intumescence or warping, can be tested with the use of restraining equipment.

Tests are normally conducted with the product in a horizontal position, however, should a product be destined for vertical installation, it is possible to test in a vertical orientation.

The heat flux that the specimen is exposed to can be changed, typically  $25\text{kWm}^{-2}$ ,  $35\text{kWm}^{-2}$  or  $50\text{kWm}^{-2}$  is used. This allows for testing of a range of products, from very combustible products to those that do not easily ignite.

Parameter	Description
<b>Ignition time (s)</b>	Time taken for the specimen to ignite at given heat flux
<b>Total heat release (MJ/m<sup>2</sup>)</b>	Total heat released per unit area during the entire test for the tested thickness of product.
<b>Effective heat of combustion (MJ/kg)</b>	The energy produced per kg of the product. It is averaged over the length of the test.
<b>MAHRE (kW/m<sup>2</sup>)</b>	The maximum average rate of heat emission. Where the average rate of heat emission is calculated for each logging interval recorded. This figure is used extensively in railway rolling stock standards.
<b>Heat release rate (kW/m<sup>2</sup>)</b>	Mean – The mean rate of energy release at any one time per m <sup>2</sup> of burning material during the test.  Peak - The maximum energy release per m <sup>2</sup> measured in the test and the time this occurred.
<b>Mass loss rate (g/s)</b>	The mass lost per second, at a moment in time.
<b>Total smoke (m<sup>2</sup>/m<sup>2</sup>)</b>	The total smoke parameter during the test. It is normalised for the surface area of the specimen.
<b>Rate of smoke production (m<sup>2</sup>/s/m<sup>2</sup>)</b>	The rate of smoke production at a moment in time.
<b>Specific extinction area (m<sup>2</sup>/kg)</b>	A measurement of smoke produced, and is related to the mass of product combusted.
<b>Carbon dioxide yield (kg/kg)</b>	The mass of carbon dioxide produced per mass of product combusted.
<b>Predicted Euroclass *</b>	An indication of how the product may perform in an indicative EN 13823 Single Burning Item test.
<b>THR (RCT) *</b>	An indication of how the product may perform in the ISO room corner test. THR is Total Heat Release.
<b>Time to Flashover (RCT) *</b>	An indication of how the product may perform in the ISO room corner test. This result indicates the time in which the standard room could reach flashover if it were lined with the material tested.
<b>Indicative char rate (mm/min)</b>	This is an additional service offered which indicates char rates in timber products; it is based on the time taken for the rear surface of the specimen to reach 300°C.

## 04 Advantages of cone calorimetry testing

- Lower test cost in comparison to full scale investigative European or ISO testing
- More cost effective than testing larger samples, particularly when the material is expensive
- Easier transportation and lower shipping costs
- Fast turn around time for indicative R&D and investigative work
- Multiple samples can be tested quickly and used for material comparison.

## 05 Applications for cone calorimetry testing

- **R&D** – Testing of a range of samples to ascertain the most desirable performance to put forward for other larger full scale testing methods.
- **Investigative testing** - Allowing testing where an investigation is being carried out and larger samples are not available, such as when historical treatments are already in situ but their performance is unknown.
- **Durability of fire retardants** – Assisting with before and after testing comparison (for investigations into fire performance after exposure to weathering, UV light or frost etc.).
- **Compliance** – Some standards and building regulations call upon the ISO 5660-1 test
- **Fire engineering** – Many of the results obtained can be readily used by fire engineers in their calculations and simulations.

## 06 What can testing tell you?

Measurements from the cone calorimetry test are taken throughout the duration of the test which is typically 32 minutes + the time taken for the specimen to ignite. The following table details some of these parameters:

*\* This evidence is for the clients' internal use only and is determined using software developed by SP (Sweden). The results must not be used for claiming compliance with the European or ISO reaction to fire suites of testing.*

## 07 The test samples

Test samples are 100mm x 100mm (+0mm and -2mm) and must be no thicker than 50mm.

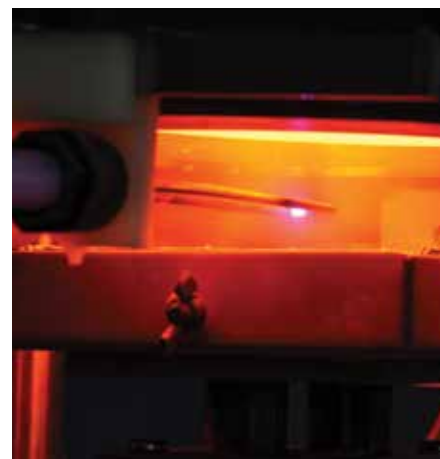
Substrates and air gaps can be included in the specimen construction when required, multi-layered composite products can also be tested.

## 08 Number of tests required

It is possible to do indicative testing on single samples when sample material is limited but it is often preferential to undertake full testing in accordance with the standard and conduct three tests, using the averaged results. Full testing includes conditioning of samples prior to testing in accordance with ISO 554 and the provision of a full test report.

## 09 Further Information

For further information on the single burning item test refer to T1-03: Reaction to fire - testing and certification. A free copy of this is available to download from our website [www.bmtrada.com](http://www.bmtrada.com).



Sample with spark above it, before ignition.



The cone calorimeter.



The new cone calorimetry test apparatus at BM TRADA.

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