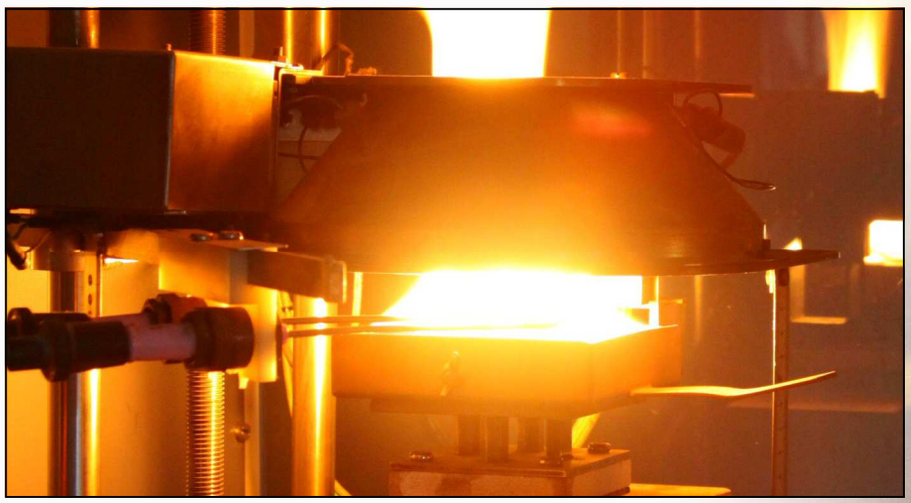
TI-1013

REACTION TO FIRE
Cone Calorimetry Testing

1 What is cone calorimetry testing?

Cone calorimetry testing 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, low cost, way to conduct research into the fire performance of experimental products whilst still in the development stage.

Test 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 performance which can then be verified by the single burning item test, EN 13823.



2 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 oxygen and temperature measurements are used to calculate the energy that is produced.

3 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.

4 The advantages of testing using a cone calorimeter

One of the main advantages of conducting cone calorimetry testing is that smaller sample sizes are required, resulting in the following benefits:

- Lower test cost in comparison to full scale investigative European testing
- Cheaper than testing larger samples, particularly when the material is expensive
- Easier transportation and lower shipping costs
- Multiple samples can be tested and used for material comparison
- Allowing testing where an investigation is being carried out and larger samples are not
  available, such as when historical treatments are already in situ
- Assisting with before and after testing comparison (for investigations into fire performance after exposure to weathering, UV light or frost etc.).

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The resulting data from a cone calorimetry test can be analysed using specialised software, in order to predict the product's performance in EN 13823 (Reaction to fire tests for building products – Building products excluding floors exposed to thermal attack by a single burning item). This prediction can be helpful during investigative work and in choosing the optimal product formulation or specification. A full European test program involving testing to EN 13823 may then be undertaken for the selected product.

5 What can testing tell you?

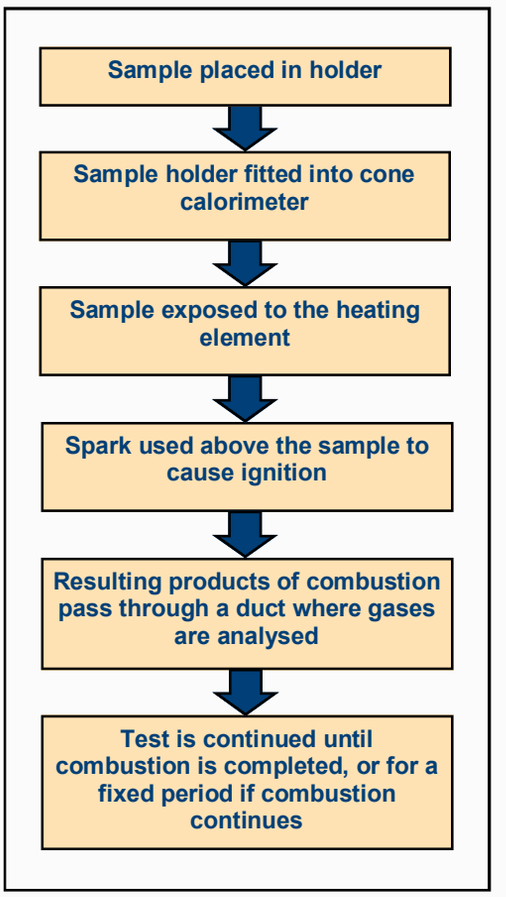
The measurements from the cone calorimetry test are used to calculate the heat release rate of the sample throughout the duration of the test. Both the amount of energy released and how quickly that energy is released can be ascertained.

Testing can tell you:

- **Time to ignition of the specimen**
- **The calorific value of the product (MJ/kg)** – the energy stored within the product
- **Total heat release (MJ/m^2)** – the total energy given off per unit area of the sample
- **Total heat release plotted against time** – useful when comparing a range of samples
- **Heat release rate (kW/m^2)** – the amount of energy given off by the specimen at any one time, for each metre squared area.
- **Smoke production (m^2)**
- **The physical behaviour of the product** – e.g. swelling or shrinking
- **A prediction of product performance in the single burning item test** - when specialised software is used to analyse the test data

Results are available immediately after testing, allowing research to proceed quickly. Results include a large number of possible parameters, all of which are included in the test report.

6 The Testing Process



The test is conducted to the following principles:

- BS 476-15: 1993
- ISO 5660-1: 2002

6.1 The test samples

It is recommended to test three samples to check for any deviation in the results, but any number of samples can be tested. The test samples must be of certain dimensions in order to fit within the test equipment and to provide useful and comparable results. Samples should be 100mm x 100mm with a tolerance of +0mm and –2mm.

Limits are placed on the thickness of the sample as a product that is too thick would not fit into the cone calorimeter equipment, and a product that is too thin would not have sufficient material to produce useful results. The specified thickness should be a maximum of 50mm.

Products greater than 50mm thick will be cut down prior to testing. Products that are less than 6mm thick can be tested, but will require either a substrate or an air gap.

Products with irregular surfaces may also be tested in the cone calorimeter.

The sample holder.

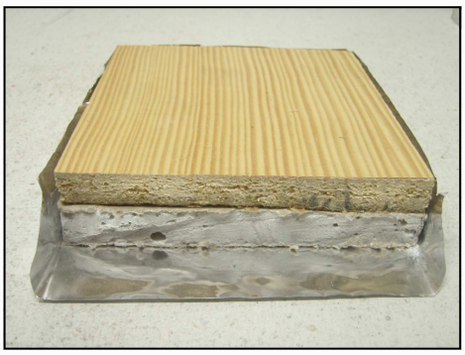
6.2 Testing variables

In their final use, products are often installed with another material, called a substrate, directly behind them. The presence of a substrate can affect the performance of the product in its end use application, and substrates can be included in the cone calorimeter test to assess the difference in performance.

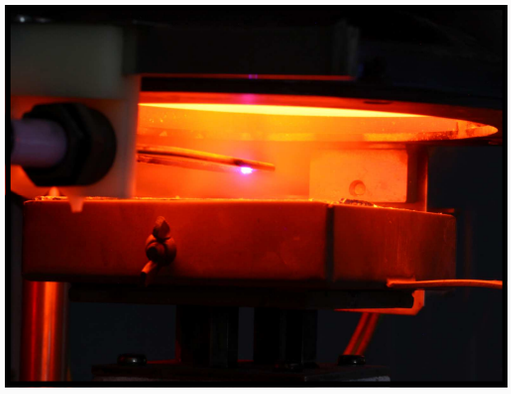
Products can also be installed in their final use with an air gap behind the product and this can significantly affect the product's fire performance. The cone calorimetry tests can incorporate an air gap if this is required.

The cone calorimeter can be set to different heat flux levels of exposure. This allows for testing of a range of products, from very combustible products to those that do not easily ignite. A different heat flux setting can also be used to represent different fire scenarios in research work, e.g. flashover conditions can be created.

Before and after. Each sample is wrapped in foil to ensure it stays within its original boundaries as it breaks down / melts.



Products can perform differently with a substrate or air gap.



Sample with spark above it, before ignition.

Sample immediately after ignition.

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7 Further Information

For further information on the single burning item test refer to *TI-0803: Reaction to Fire - Testing and Certification*. A free copy of this is available to download from our website www.chilternfire.co.uk.

8 How Chiltern International Fire can help

Chiltern International Fire has more than 30 years' experience in fire testing, product consultancy (development and assessments), and fire research which it uses to assist clients in making good testing decisions.

Chiltern International Fire is a UKAS accredited test laboratory offering reaction to fire testing to EU standards as well as ad-hoc testing to meet project specific requirements or as part of research and development. In addition, we offer fire resistance testing to BS EN standards.

We support our clients at every stage of the testing process and offer a level of service we believe is unmatched within the industry.

Chiltern International Fire is a Notified Body under the Construction Products Directive.

The new cone calorimetry test apparatus at Chiltern International Fire.

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