Wall and ceiling linings reaction to fire

New methods for testing wall and ceiling linings reaction to fire could provide a good alternative to current techniques.

By Peter Collier, BRANZ Senior Fire Engineer

To regulate the fire properties of wall and ceiling linings, New Zealand uses a long-established fire test method, AS/NZS 1530 Part 3. We are now the only country in the world to use this test, which could be a barrier to trade and goes against the desire to use international standards wherever possible.

International research into the reaction-to-fire behaviour of wall and ceiling linings has identified new fire test methods that more accurately represent the early fire growth hazards associated with ignition and flame spread over room linings. Two of these methods are the ISO 9705 room, and the cone calorimeter.

A recently completed project at BRANZ involved the fire testing of eight examples of lining materials (see Table 1), using the ISO 9705 room and cone calorimeter, to classify the materials according to the Building Code of Australia (BCA) groups, which are as follows:

- Group 1: no flashover within 20 minutes
- Group 2: flashover between 10 and 20 minutes
- Group 3: flashover between 2 and 10 minutes
- Group 4: flashover within 2 minutes.

The materials tested were distributed over the four groups, giving a spread of results to enable an evaluation of the new test methods.

Flashover at the end of ISO 9705 test.

ISO 9705 room

An ISO 9705 test consists of a room measuring 3.6 x 2.4 x 2.4 m high, where three walls and the ceiling are lined with the material being investigated. A gas burner in one rear corner exposes the test specimen to 100 kW for 10 minutes, followed by 300 kW for 10 minutes. The exhaust gases exit from a 2 m high x 0.8 m wide doorway and are removed by an extraction hood and analysed to determine oxygen, carbon dioxide (CO_2), carbon monoxide (CO) and smoke density. The heat release rate is calculated by oxygen consumption calorimetry and the smoke production rate is determined from the smoke density and flow rate in the duct.

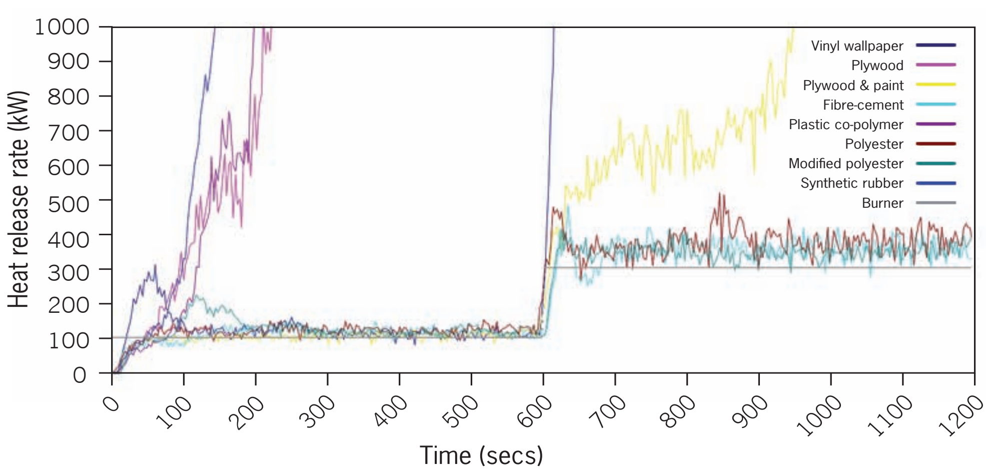

Figure 1: Heat release rates for the eight lining materials. Flashover occurs at 1,000 kW.

Figure 1 shows the heat release rate for each of the eight linings tested. When the heat release rate exceeds 1,000 kW, flashover is considered to have occurred (see photo) and the group number is assigned according to the time that it took to happen.

Cone calorimeter

The lining materials were also exposed to 50 kW/m^2 radiation using a cone calorimeter (see Figure 2). The data recorded was similar to the ISO 9705 room, including oxygen, optical density for smoke, and mass loss. Again, the results were assessed and a group number was assigned for each material.

Cone calorimeter a low cost option

The results (see Table 1) indicate that the cone calorimeter test provided the same or more conservative classifications as the room test. Since the room test costs about 10 times that of a set of cone calorimeter tests, the cone calorimeter provides a low cost option for getting a group number for a material, with the small risk of a conservative (higher group number) result.

The cone calorimeter option may not be suitable for non-homogenous materials such as metal skin panel assemblies with combustible core materials and foil faced combustible materials. In these cases, the full-scale room test should be carried out.

Changes to the Building Code possible

The ISO 9705 test method has been adopted by the Building Code of Australia as the primary means of demonstrating acceptable fire properties for walls and ceilings. Similarly, the correlation method, based on the cone calorimeter, has also been adopted for prediction of the group number, providing a more convenient and less expensive alternative. The Department of Building and Housing will consider these findings in a future review of the New Zealand Building Code compliance document for fire safety.

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For more information see BRANZ Study Report SR160, downloadable from the BRANZ website at www.branz.co.nz.

Table 1: Physical properties and test results of products tested.

Product	Weight kg/m^2	Density kg/m^3	Thickness mm	BCA Group No.	Cone calorimeter prediction of BCA Group No.
Vinyl wallpaper	0.21	452	0.46	2	2
Plywood	4.67	513	9.1	3	3
Plywood with one coat of undercoat and two coats of intumescent paint	4.79	510	9.4	2	3
Fibre-cement board with a glazed finish on fire exposed side	6.47	1378	4.7	1	1
Plastic co-polymer wall lining	4.37	929	4.8	3	4
100% polyester wall covering	0.38	127	3	1	2
100% modified polyester wall covering	1.8	150	12	1	3
Synthetic rubber mass loaded noise barrier with polypropylene scrim backing	5.04	1938	2.6	3	3

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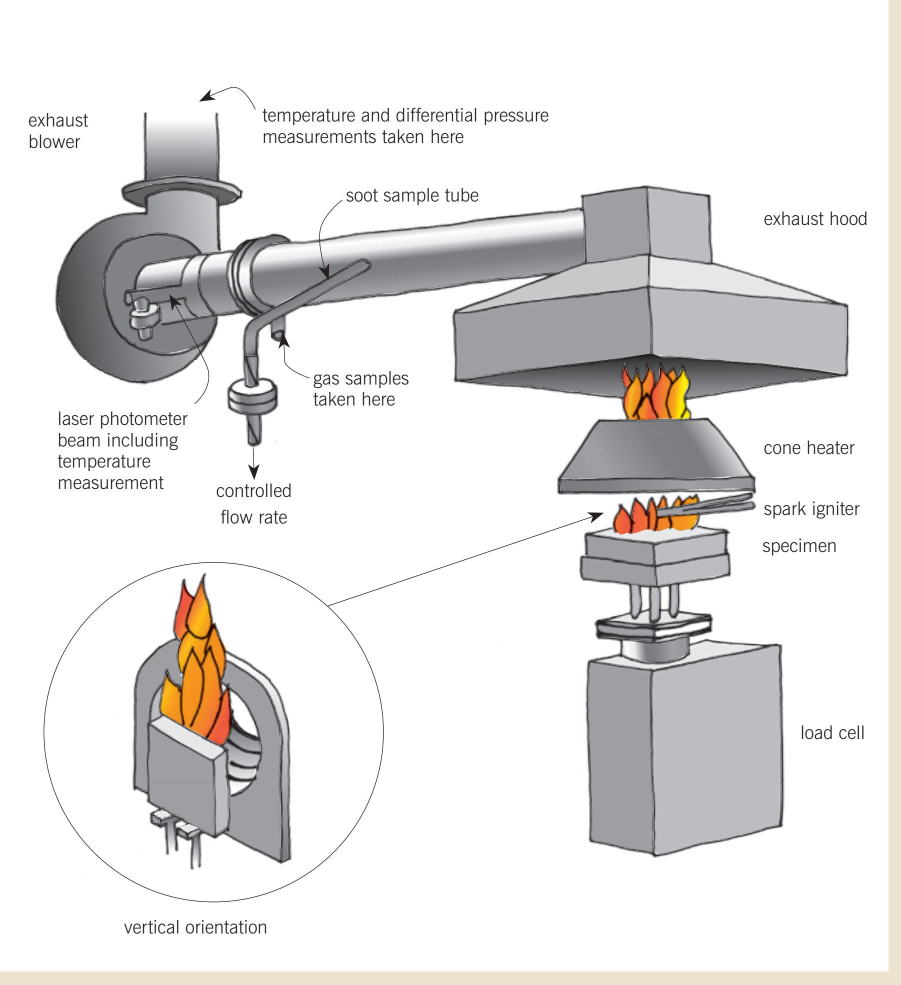

Figure 2: Cone calorimeter (adapted from www.doctorfire.com/cone.html).