# USE OF TIMBER UNDER NZ BUILDING CODE FIRE REGULATIONS

**A. Buchanan[1] & J. Parker[2]**

[1]Prestressed Timber Ltd, Christchurch.

[2]NZ Wood Producers and Manufacturers Association (WPMZ), Wellington.

In April 2012 the NZ Building Code Regulations for Reaction-to-Fire were changed. These changes to Section C3 of the Building Code became mandatory in April 2013.

**Background**

These new regulations have changed the ways in which the fire properties of timber are assessed when wood is used as linings in most types of buildings in New Zealand. The effect of the changes has been to reduce the number of locations where exposed wood surfaces can be used in new buildings, largely because the new regulations make it less easy for a fire engineer to offer an alternative solution to relax the code requirements.

There are several contributing factors creating difficulty for designers and manufacturers:

1. The changes are in the Building Code itself, not in the Acceptable Solution or the Verification Method, which makes it far more difficult for a fire engineer to offer an alternative solution to achieve the same performance.
2. New test methods are prescribed for surface coatings, and very few manufacturers of coatings have done sufficient tests to provide appropriate coatings in the market place.
3. The new tests are not specified in the same way anywhere else in the world, so NZ manufacturers cannot easily rely on overseas test results.
4. Of the two prescribed test methods, the best test method requires an expensive full-room fire test, which manufacturers are reluctant to use. Unfortunately this is the only test which may give satisfactory results for some coatings on wood.

Recognition of these changes has come late to the NZ timber industry, and some provocative statements have been made. Many architects have said that these changes actively discourage the use of any exposed wood surfaces.

The changes were based on a large amount of work done at BRANZ on reaction-to-fire of internal linings of buildings and followed similar, but different, changes adopted in Australia in 2006. See BRANZ Study Reports 160, 301, 302 and 314.

These Reaction-to-Fire regulations are intended to increase life safety by preventing rapid fire growth in the early stages of a fire. They are entirely separate from the requirements for fire resistance (based on charring rates) which are needed for containment and prevention of structural collapse in a fully developed fire.

**Group Numbers:**

Restrictions on linings depend on the Group Number of the surface exposed to a possible fire. The New Zealand Building Code specifies different Group Numbers for different types of building use and locations in the building, depending on whether the building is protected with an automatic sprinkler system.

The main Group Numbers are

Group 3 – moderate contribution to fire growth rate

Group 2 – low contribution to fire growth rate

Group 1 – extremely low contribution to fire growth rate

Slightly more restrictive Group numbers, Group 1-S and Group 2-S, are required when Group 1 and Group 2 products are used in unsprinklered buildings, with an additional requirement limiting the amount of smoke produced during the test.

For most materials the Group Number can be lowered with application of applied surface finishes, but testing is required for each specific coating, and very few coatings are available.

**Some uses of wood without restrictions**

There are some places where wood and wood products are allowed to be used without restriction, such as:

1. There is no limitation on the use of timber as wall or ceiling linings in detached homes or within

individual apartment units (i.e. no proof of Group Number is required).

2. There are no limitations on timber joinery, or general decorative trim.
3. Small non-conforming areas of up to 5.0 m2 are permitted (i.e. where the material is not of the specified Group Number).
4. There are no limitations on structural timber elements (beams, columns or walls) except that individual structural shear walls may not be more than 3.0 m long.

Note that structural timber is normally made from solid timber, glulam, plywood, laminated veneer lumber (LVL), or cross-laminated timber (CLT), all of which should have similar performance.

**Summary of requirements**

A summary of the Group Numbers required for different types of building is given in Table 1. This list does not include detached homes or individual apartment units as listed above.

**Table 1: Typical allowed uses for different Group Numbers, depending on sprinklers**

| Group | Unsprinklered Buildings | Sprinklered Buildings |
|---|---|---|
| 1 | Walls and ceilings in exitways.<br>Walls and ceilings in emergency services buildings.<br>Walls and ceilings in sleeping areas of care/detention buildings.<br>Internal surfaces of HVAC ducts. | |
| 2 | Walls and ceilings in crowd spaces (shops, schools, restaurants).<br>Walls and ceilings in other sleeping spaces | Walls and ceilings in exitways.<br>Walls and ceilings in emergency services buildings.<br>Walls and ceilings in sleeping areas of care/ detention buildings.<br>Internal surfaces of HVAC ducts.<br>Ceilings in crowd spaces (shops, schools, restaurants), and in other sleeping spaces. |
| 3 | Walls and ceilings in buildings other than crowd or sleeping occupancies (eg offices, small factories). | Walls and ceilings in buildings other than crowd or sleeping occupancies (eg offices, small factories).<br>Walls in crowd or assembly spaces (shops, schools, restaurants), and in other sleeping spaces. |

**Test methods**

Two test methods for assigning Group Numbers are given in Appendix A to section C/VM2 of the Approved Documents to the New Zealand Building Code. The two test methods measure either the time to flashover in a room fire test (ISO 9705), or the rate of heat release in a cone calorimeter test (ISO 5660). The room fire test is the reference test, requiring construction of a room 2.4m by 3.6m in plan and 2.4m high, with a door opening in one of the smaller end walls, as shown in Figure 1. The tested surface material must be on the ceiling and the three walls not including the door. The area of test material is hence 2.4m x 3.6m x 3 + 2.4m x 2.4m = 32m2. The cone calorimeter test is much less expensive than a room fire test, with a test specimen 100mm square (0.01m2), so the material for one room fire test could provide specimens for 3000 cone calorimeter tests. The fire in the room is provided by a standard gas burner in a back corner, and the test result is the time to flashover (time to full-room

involvement). Only one surface finish material can be tested in one test.

Because the room fire test is expensive (over $10,000 per test), there is great interest in using the much

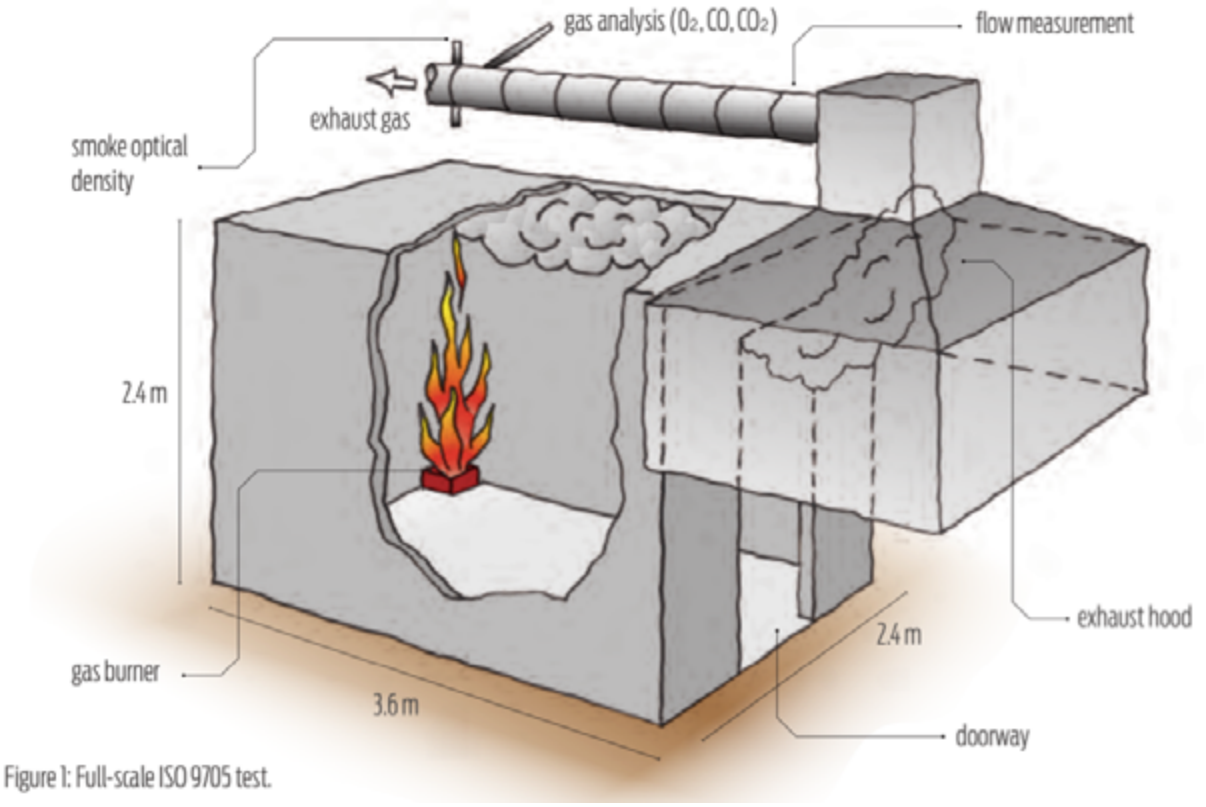


**Figure 1:** *Full-scale ISO 9705 test (Whiting 2012).*

smaller and less expensive cone calorimeter test. An extensive research programme at BRANZ has shown that there is a reasonable correlation between cone test results and the room fire test, but the correlation is not perfect. The cone test often gives a higher Group Number than the room fire test for the same material, so some room fire tests are essential.

Another complication is that the cone calorimeter test procedure is different in Australia where the less conservative AS/NZS 3837 test is permitted, rather than the ISO 5660 test required in New Zealand. The ISO test avoids a loophole in the AS/NZS test which can be used to get erroneous results, soon to be corrected.

### Testing required

Very few room fire tests have been carried out in New Zealand or Australia with exposed wood and applied surface finishes. There is clearly a need for the timber industry to get together with a number of coating manufacturers to initiate a series of full-scale experiments, in order to develop several Group1 and Group 2 products for the New Zealand market, with the help of qualified researchers.

These tests may cost several hundred thousand dollars, because at least a dozen tests are likely to be needed with different coatings on different wood substrates of different species, density and surface finishes. If all of these room fire tests are matched with cone calorimeter tests, sufficient confidence may be built up to allow future developments to be based on cone tests rather than room fire tests.

## CURRENT GROUP NUMBER PRODUCTS

### Group 3 products

Most uncoated, paint coated or clear coated timber meets Group 3 under the regulations, with no need for testing, provided that the wood is:

- at least 9mm thick
- at least 400kg/m3 density for wood (or 600kg/m3 for particle board)

If there is a water-based or solvent-based paint coating, varnish or stain, it shall be no more than

**Figure 2:** *A 100mm x 100mm sample burning in the cone calorimeter test, ISO 5660 or AS/NZS3837 (Whiting 2012).*

0.4mm thick and no more than 100g/m2. Testing will be required if these conditions are not met.

**Group 2 products**

There are currently no clear finishing materials available in New Zealand which give Group 2 status for wood or wood products (excluding expensive Group 1 products). This is a huge impediment to the use of wood, and a huge market opportunity. Table 1 shows the huge number of situations where a Group 2 finish is required.

There are some coatings from other countries which may be available to meet the Group 2 requirements in New Zealand. See below.

**Group 1 products**

There is at least one Group 1 intumescent surface coating for wood available in New Zealand. For example the CAP508 system for pigmented surfaces, and the CAP 800-1S system for a clear finish.

http://www.zonenz.net.nz/finish-coat-systems-clear.html. The Décortech Firesafe range includes pre-finished plywood and MDF with a Group 1-S rating http://www.decortech.co.nz/. Such products can also be used in Group 2 situations, but the price often makes it uneconomic.

**Products available in other countries**

The specified test methods and finish requirements in the NZ Building Code are specific to New Zealand. However, there are some possibilities for using products tested in other countries.

Some products are available in Australia, but Group 2 status in Australia is not exactly the same as in New Zealand because a different standard for the cone calorimeter test is specified in the two countries (AS/NZS 3837 in Australia and ISO 5660 in New Zealand). Hence Australian Group 2 products may or may not meet NZ requirements. Another difference is that most Australian solutions use treated wood rather than applied coatings because on-site applied coatings are not permitted to be used in Australia to improve the

group number of a substrate.

Mr John Murlewski of Prudential Coatings http://www.prudentialcoatings.com/ advises that Qualifire QRT-100 (Clear Timber Fire Retardant) listed on their website as Group 2 is not currently available because it is being enhanced for interior and exterior use, with a new product to be launched in six months or so.

Urgent industry action is needed to re-assess all Group 2 products on the Australian market for use in New Zealand. Peter Whiting from BRANZ advises that some products may not get a Group 2 rating without a room fire test, because some timber coatings have performed worse than expected in the cone calorimeter, and there are too few room test results for comparison.

In another positive development, Colleen Wade from BRANZ advises that it may be possible to map the requirements of the Euroclass system across to meet the NZ Building Code. BRANZ is in discussion with MBIE to see what might be possible. If this is successful it could make a much larger number of fire retardant finishes available for use in New Zealand.

**Possible changes to the NZ Building Code**

Changes should be made to the NZ Building Code to allow this problem to be treated in a more logical manner, consistent with all other parts of the Building Code. Clause 3.4 of the Building Code should be replaced by performance statements of the type used everywhere else in the Building Code. The words in the current Clause 3.4 should be moved to an Acceptable Solution where they can be used to demonstrate compliance with the required performance, in the normal way.

Such a change would allow the specification of surface finishes to become part of the normal design process for fire safety, providing solutions to meet the performance statements of the Code. It would also allow the adoption of innovative alternative solutions to provide the same level of fire safety, but in a far less prescriptive environment.

Very careful wording would be needed to ensure quantifiable performance requirements which can be met with rational engineering procedures, given our limited ability to calculate surface spread of flame.

**CONCLUSIONS**

1. Timber has not been completely shut out of the interior linings of buildings in NZ.
2. The unrestricted use of wood as wall and ceiling linings is allowed in residential uses (except in shared exitways)
3. Small areas of wood are permitted as structure and finishes in most buildings.
4. Wood with a Group 3 finish (bare wood, or a clear or varnished finish) can be used in many places in buildings, but wood is excluded from many other buildings where a Group 2 finish is required, partly because there are no Group 2 coatings available on the NZ market.
5. There is an urgent need for economical treatments and coatings which can enable clear finished timber to meet the requirements of Group 2. This will require expensive testing, possibly helped by new product development in Australia and in Europe.
6. Urgent changes should be made to the New Zealand Building Code to replace Clause 3.4 with performance statements of the type used elsewhere in the Code.

REFERENCE

Whiting, P., 2012. Changes to Assessing Interior Surface Linings. Build 132 - 1 October 2012.