CK FIRE & SAFETY
Fire Safety Engineering

Fire Resistance, Combustibility and Fire Hazard Properties

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Agenda

1. Fire hazard properties
2. Fire Resistance Level
3. Combustibility

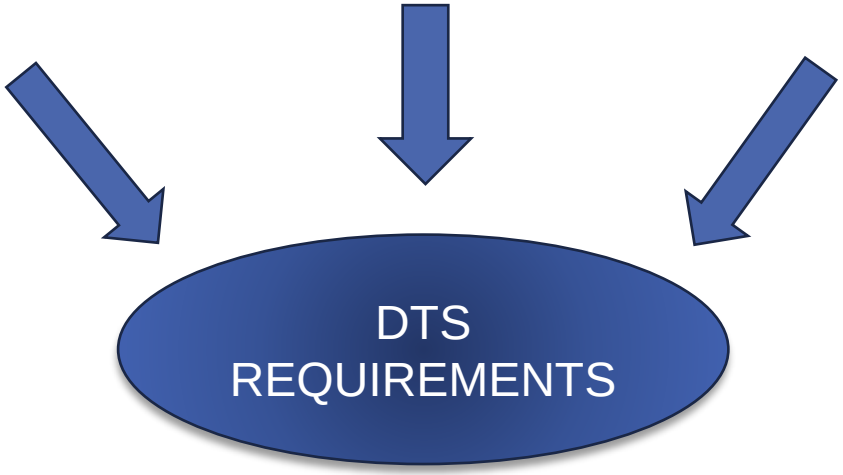
BCA Fire-related Terminology - DTS Terminology

Fire Hazard Properties

All materials in a building, except as stated otherwise within the BCA, must meet various Fire Hazard Properties requirements.

Combustibility

In addition, certain components of a buildings are required to be non-combustible.



Fire-resistance Level

In addition, certain building elements in buildings are required to have a defined Fire-resistance Level (FRL)

Fire Hazard Properties

Fire hazard properties are “Properties of a material or assembly that indicate how they behave under specific fire test conditions.”

Fire Hazard Properties – BCA Specification 7

Formally Specification C1.10

Table S7C2 Fire hazard property requirements

Lining, material or assembly	Requirement
Floor linings and floor coverings	S7C3
Wall linings and ceiling linings	S7C4
Air-handling ductwork	S7C5
Lift cars	S7C6
In fire control rooms subject to Specification 6 and fire isolated exits	S7C7
In Class 9b buildings used as a theatre, public hall or the like — fixed seating in the audience area or auditorium; and a proscenium curtain required by Specification 32	S7C7
Escalators, moving walkways and non-required non-fire-isolated stairways or pedestrian ramps subject to Specification 14	S7C7
Sarking-type material	S7C7
Attachments to internal floors, walls and ceilings	S7C7
Other materials including insulation	S7C7

A product not suitable for installation at one location may be suitable for installation at another location

Floor Coverings – Fire Hazard Properties (Example)

Table S7C3 Critical radiant flux (CHF in kW/m^2) of floor linings and floor coverings

Class of building	Building not fitted with a sprinkler system (other than a FPAA101D or FPAA101H system) complying with Specification 17	Building fitted with a sprinkler system (other than a FPAA101D or FPAA101H system) complying with Specification 17	Fire-isolated exits and fire control rooms
Class 2, 3, 5, 6, 7, 8 or 9b, excluding Class 3 accommodation for the aged and Class 9b as specified below	2.2 kW/m^2	1.2 kW/m^2	2.2 kW/m^2
Class 3 accommodation for the aged	4.5 kW/m^2	2.2 kW/m^2	4.5 kW/m^2
Class 9a patient care areas	4.5 kW/m^2	2.2 kW/m^2	4.5 kW/m^2
Class 9a areas other than patient care areas	2.2 kW/m^2	1.2 kW/m^2	4.5 kW/m^2
Class 9b auditorium or audience seating area used mainly for indoor swimming or ice skating	1.2 kW/m^2	1.2 kW/m^2	2.2 kW/m^2

Group Number Examples

Table S7C4 Wall and ceiling lining materials (material groups permitted)

Class of building	Fire-isolated exits and fire control rooms	Public corridors	Specific areas	Other areas
Class 2 or 3, unsprinklered, excluding accommodation for the aged, people with disabilities and children	Walls: 1	Walls: 1, 2	Walls: 1, 2, 3	Walls: 1, 2, 3
	Ceilings: 1	Ceilings: 1, 2	Ceilings: 1, 2, 3	Ceilings: 1, 2, 3
Class 2 or 3, sprinklered, excluding accommodation for the aged, people with disabilities and children	Walls: 1	Walls: 1, 2, 3	Walls: 1, 2, 3	Walls: 1, 2, 3
	Ceilings: 1	Ceilings: 1, 2, 3	Ceilings: 1, 2, 3	Ceilings: 1, 2, 3
Class 3 or 9a, unsprinklered, accommodation for the aged, people with a disability, children and health-care buildings	Walls: 1	Walls: 1	Walls: 1, 2	Walls: 1, 2, 3
	Ceilings: 1	Ceilings: 1	Ceilings: 1, 2	Ceilings: 1, 2, 3
Class 3 or 9a, sprinklered, accommodation for the aged, people with a disability, children and health-care buildings	Walls: 1	Walls: 1, 2	Walls: 1, 2, 3	Walls: 1, 2, 3

Minimum Fire Hazard Properties Requirements

Other Materials

Clause S7C7

S7C7 Other materials

[2019: Spec C1.10: 7]

Materials and assemblies not included in S7C3, S7C4, S7C5 or S7C6 must not exceed the indices set out in Table S7C7.

NSW Table S7C7

Table S7C7: Other materials

Material or assembly location	*Flammability Index*	*Spread-of-Flame Index*	*Smoke-Developed Index*
Fire control rooms subject to Specification 19 and fire-isolated *exits*, other than a *sarking-type material* used in a ceiling or used as an attachment or part of an attachment to a building element. Note 1	N/A	0	2
Class 9b buildings used as a theatre, public hall or the like: Any part of fixed seating in the audience area or auditorium.	N/A	0	5
Class 9b buildings used as a theatre, public hall or the like: A proscenium curtain *required* by Specification 32.	N/A	0	3

Minimum Fire Hazard Properties Requirements

Other Materials

Clause S7C7

Table Notes

(1) In a fire control room or *fire-isolated stairway*, a material used as an attachment or part of an attachment to a building element must, if *combustible*, be attached directly to a *non-combustible* substrate and not exceed 1 mm finished thickness.

(2) A material, other than one located within a fire-isolated *exit* or fire control room, may be covered on all faces by concrete or masonry not less than 50 mm thick, as an alternative to meeting the specified indices.

(3) In the case of a composite member or assembly, the member or assembly must be constructed so that when assembled as proposed in a building—

(a) any material which does not comply with this Table is protected on all sides and edges from exposure to the air; and

(b) the member or assembly, when tested in accordance with Specification 3, has *Spread-of-Flame Index* and *Smoke-Developed Index* not exceeding those prescribed in this Table; and

(c) the member or assembly retains the protection in position so that it prevents ignition of the material and continues to screen it from access to free air for a period of not less than 10 minutes.

Specification 3 Fire hazard properties

S3C1 Scope

[2019: Sch. 6: 1]

This Specification sets out the procedures for determining the *fire hazard properties* of assemblies tested to AS/NZS 1530.3.

Assemblies

S3C2 General requirement

[2019: Sch. 6: 2.1]

The *fire hazard properties* of assemblies and their ability to screen their core materials as *required* under Specification 7 must be determined by testing in accordance with S3C3 to S3C6.

S3C3 Form of test

[2019: Sch. 6: 2.2]

Tests must be carried out in accordance with—

(a) for the determination of the *Spread-of-Flame Index* and *Smoke-Developed Index* — AS/NZS 1530.3; and

(b) for the determination of the ability to prevent ignition and to screen its core material from free air — AS 1530.4.

S3C4 Test specimens

[2019: Sch. 6: 2.3]

Test specimens must incorporate—

(a) all types of joints; and

(b) all types of perforations, recesses or the like for pipes, light switches or other fittings, which are proposed to be used for the member or assembly of members in the building.

S3C5 Concession

[2019: Sch. 6: 2.4]

S3C4 does not apply to joints, perforations, recesses or the like that are larger than those in the proposed application and have already been tested in the particular form of construction concerned and found to comply with the conditions of the test.

Fire Hazard Properties Testing

S3C6 Smaller specimen permitted

[2019: Sch. 6: 2.5]

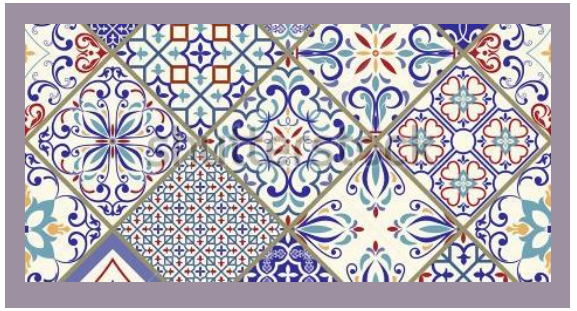
A testing laboratory may carry out the test specified in S3C3(b) at pilot scale if a specimen (which must be not less than 900 mm x 900 mm) will adequately represent the proposed construction in the building, but the results of that test do not apply to construction larger than limits defined by the laboratory conducting the pilot examination.

No assessment of fire hazard properties

Plaster

Cement render

Curtains



Ceramic

Timber-framed solid core doors & fire doors

Timber-framed windows

Adhesives

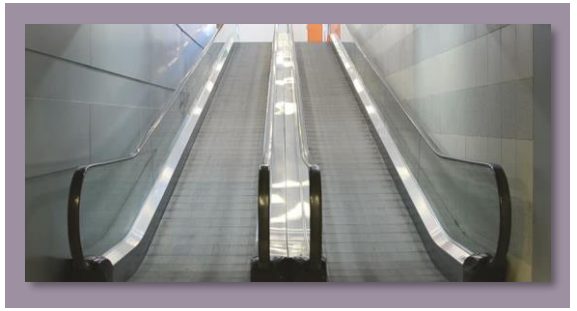
Concrete

Examples of Materials and Assemblies that Must Comply with Fire Hazard Properties

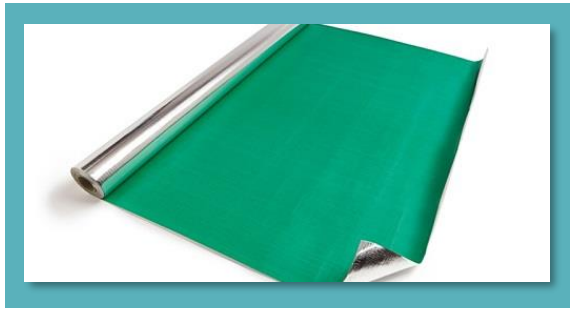
Floor, wall, ceiling linings and floor coverings

Air-handling ductwork

Lift cars



Moving walkways, ramps and non-required non-fire-isolated stairways in Cl. 5 & 6



Sarking-type materials

Materials used in theatres & public halls

Attachments to floors, ceilings, internal walls and internal linings of external walls

Other, including insulation

Refrigeration Pipe Insulation

- Does the white insulation comply with the Fire Hazard Properties?
- Does it need to comply with fire hazard properties?
- Why?

Fire-Resistance Level

Fire-resistance level (FRL)

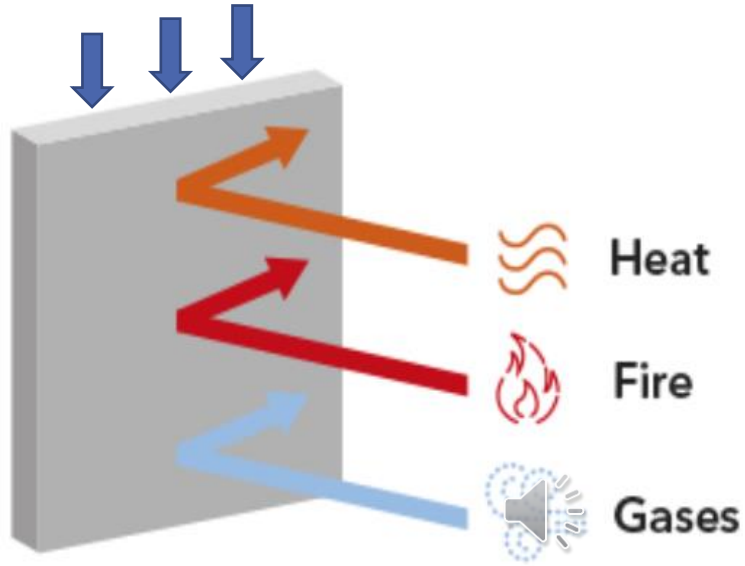
- The grading periods in minutes determined in accordance with Specifications 1 and 2, for the following criteria—
- Structural adequacy- the ability to maintain stability and adequate loadbearing capacity; and
- Integrity - the ability to resist the passage of flames and hot gases; and
- Insulation - the ability to maintain a temperature on the surface not exposed to the furnace below the limits specified in the test standard.

Fire-resisting

- For the purposes of—
- Volume One, applied to a building element, having an FRL appropriate for that element; or
- Volume Two, applied to a structural member or other part of a building, having the FRL required for that structural member or other part.

Notes

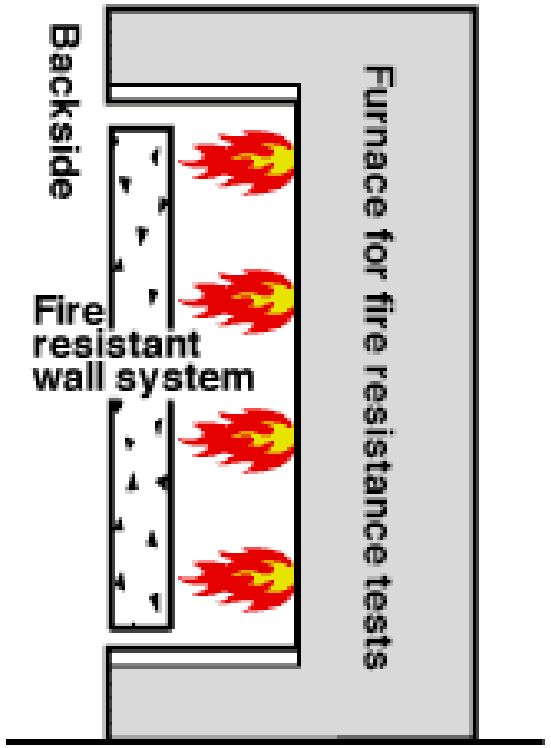
A dash means there is no requirement for that criterion. For example, 90/–/– means there is no requirement for an FRL for integrity and insulation, and –/–/– means there is no requirement for an FRL.



Source: Promat.com

Fire-Resistance Test

- Standard fire test:
  AS 1530.4 Methods for fire tests on building materials, components and structures
  Part 4: Fire-resistance tests for elements of construction



Vertical cross-sectional view of furnace for fire resistance tests

After heating a test specimen for a given period of time

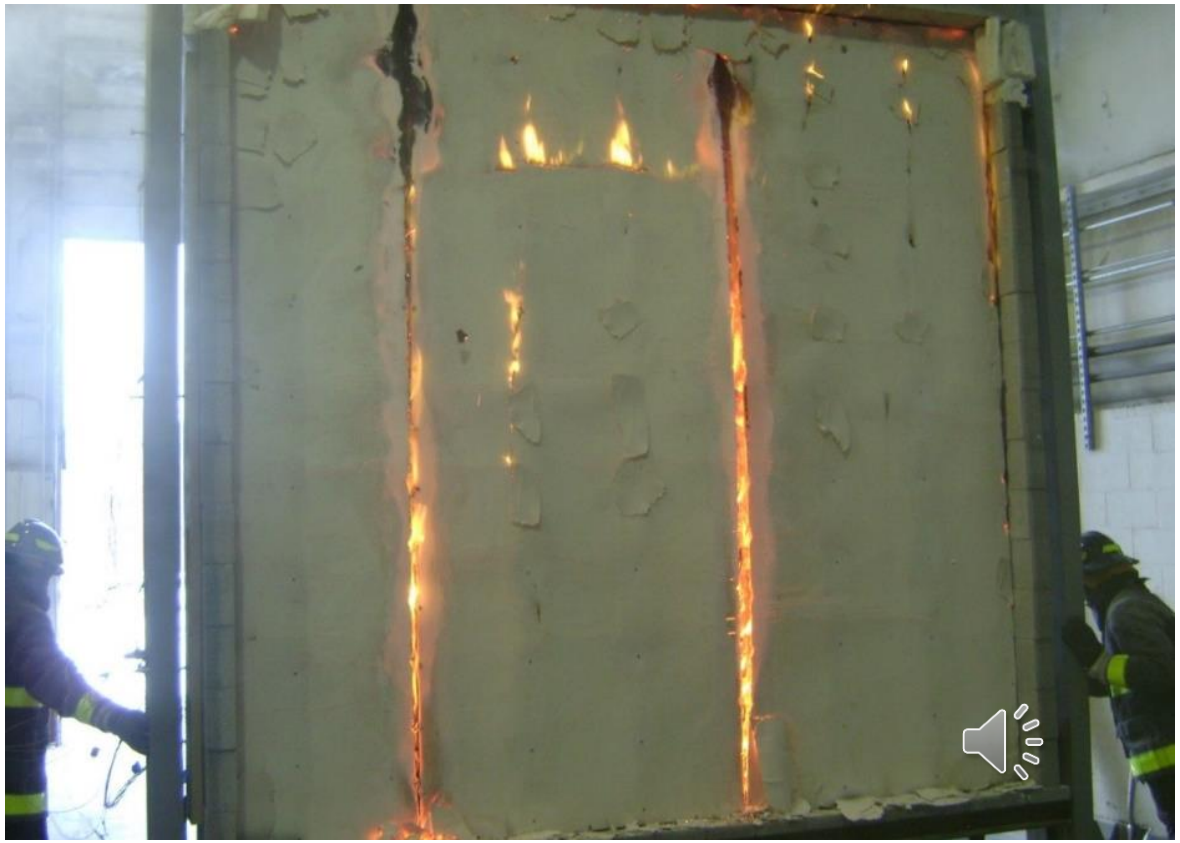
- Temperature of the backside of wall surface
- Any cracks or damages on the wall?

Pass!

Example of Testing for Fire Resistance

Standard fire test – AS1530.4

After the test - Example

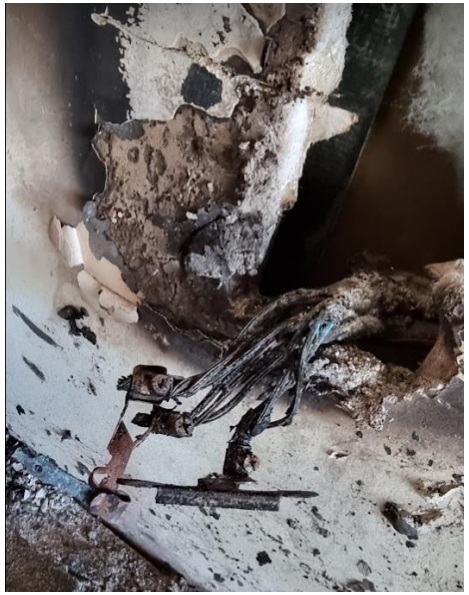


Source: https://technokontrol.com/

FRL Requirements for Building Elements

Building element	Class of building — FRL: (in minutes) *Structural adequacy*/*Integrity*/*Insulation*			
	2, 3 or 4 part	5, 7a or 9	6	7b or 8
EXTERNAL WALL (including any column and other building element incorporated within it) or other external building element, where the distance from any *fire-source feature* to which it is exposed is—				
For *loadbearing* parts—				
less than 1.5 m	90/ 90/ 90	120/120/120	180/180/180	240/240/240
1.5 to less than 3 m	90/ 60/ 60	120/ 90/ 90	180/180/120	240/240/180
3 m or more	90/ 60/ 30	120/ 60/ 30	180/120/ 90	240/180/ 90
For non-*loadbearing* parts—				
less than 1.5 m	–/ 90/ 90	–/120/120	–/180/180	–/240/240
1.5 to less than 3 m	–/ 60/ 60	–/ 90/ 90	–/180/120	–/240/180
3 m or more	–/–/–	–/–/–	–/–/–	–/–/–
EXTERNAL COLUMN not incorporated in an *external wall*—				
For *loadbearing* columns—	90/–/–	120/–/–	180/–/–	240/–/–
For non-*loadbearing* columns—	–/–/–	–/–/–	–/–/–	–/–/–
COMMON WALLS and FIRE WALLS—	90/ 90/ 90	120/120/120	180/180/180	240/240/240
INTERNAL WALLS—				
Fire-resisting lift and stair *shafts*—				
Loadbearing	90/ 90/ 90	120/120/120	180/120/120	240/120/120
Non-*loadbearing*	–/ 90/ 90	–/120/120	–/120/120	–/120/120
Bounding *public corridors*, public lobbies and the like—				
Loadbearing	90/ 90/ 90	120/–/–	180/–/–	240/–/–
Non-*loadbearing*	–/ 60/ 60	–/–/–	–/–/–	–/–/–

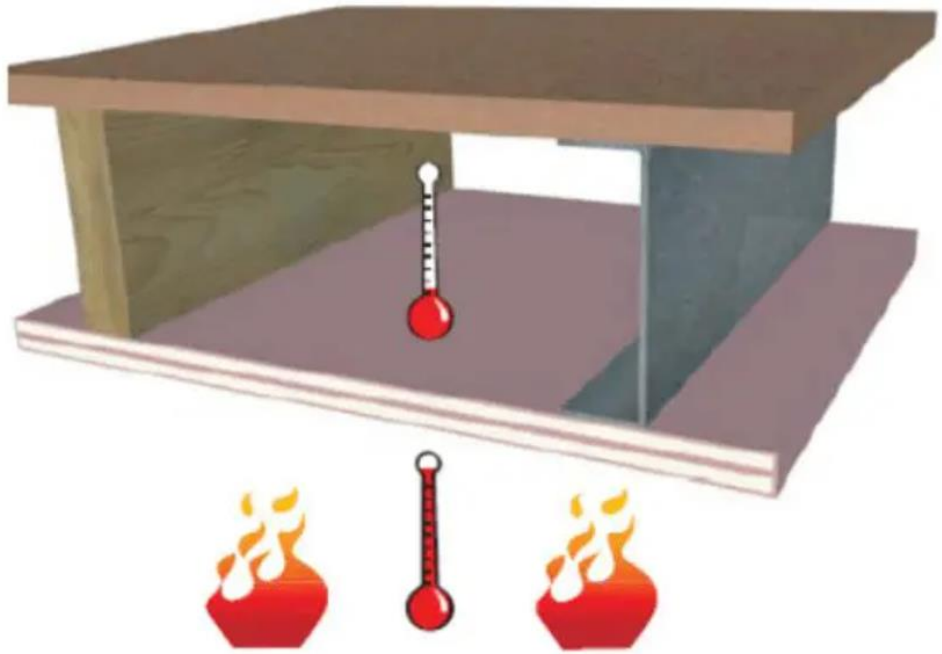
Protection of Openings - Challenges



Protection of Openings - Challenges

Resistance to Incipient Spread of Fire

Resistance to Incipient Spread of Fire (RISF)



Resistance to the incipient spread of fire, in relation to a ceiling membrane, means the ability of the membrane to insulate the space between the ceiling and roof, or ceiling and floor above, so as to limit the temperature rise of materials in this space to a level which will not permit the rapid and general spread of fire throughout the space.

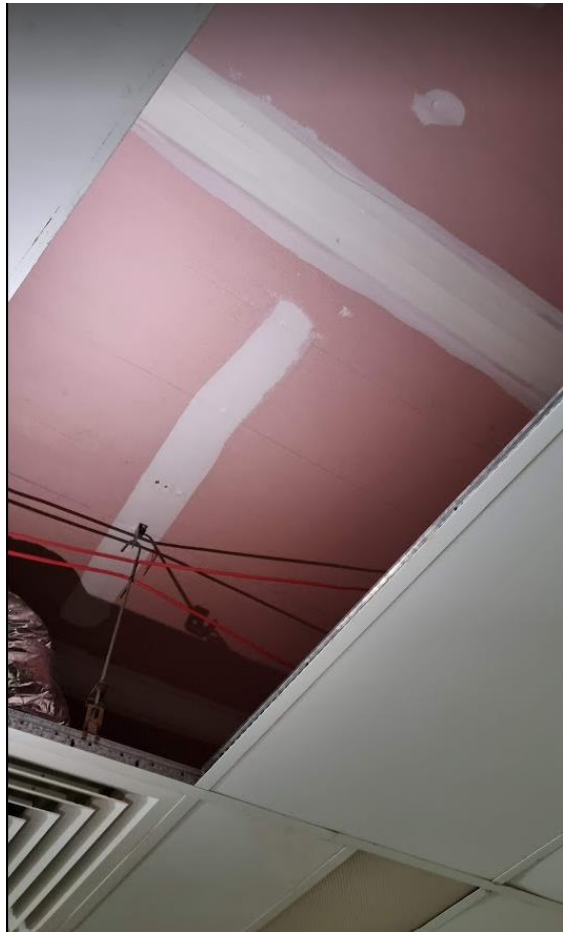
Explanatory information:

Resistance to the incipient spread of fire refers to the ability of a ceiling to prevent the spread of fire and thermally insulate the space between the ceiling and the roof or floor above. "*Resistance to the incipient spread of fire*" is superior to "fire-resistance" because it requires a higher standard of heat insulation.

Resistance to Incipient Spread of Fire

Renovations

Resistance to Incipient Spread of Fire – Water Damage



Combustibility

What is combustibility?

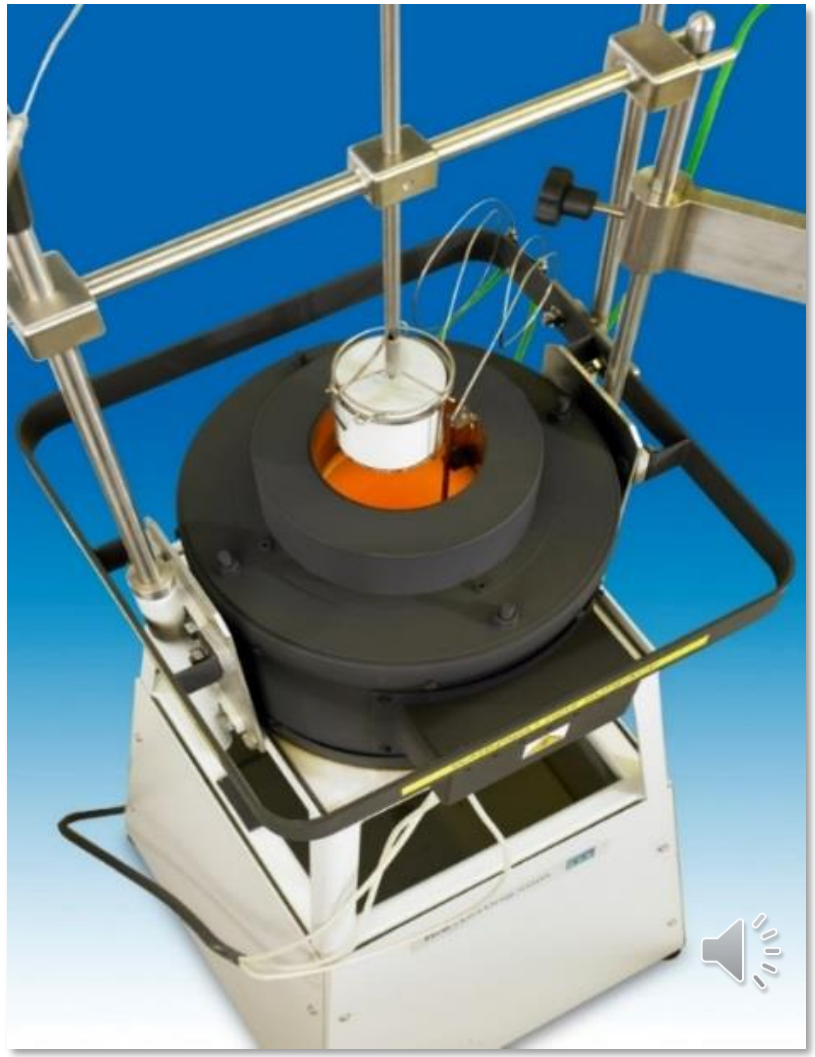
- **Combustible**
  Applied to —

a) a material — means combustible as determined by AS 1530.1; and

b) construction or part of a building — means constructed wholly or in part of combustible materials.

Example

- Expose specimen to 750ºC
- Record:
  - specimen surface & center temperature
  - temperature rises
  - total flaming time
  - mass loss
- Result: Combustible or Non-combustible



Limitations of AS1530.1

- The AS 1530.1 test method is **not applicable** to products that are coated, faced, or laminated.
- In such cases, separate tests may need to be conducted on the individual materials from which the product is formed, and this should be clearly stated in the test report.

Use of Combustible Materials where Non-combustible Material is Required

- Pre-finished metal sheeting having a *combustible* surface finish not exceeding 1 mm thickness and where the *Spread-of-Flame Index* of the product is not greater than 0.
- *Sarking-type materials* that do not exceed 1 mm in thickness and have a *Flammability Index* not greater than 5.
- Bonded laminated materials.
- Plasterboard.
- Perforated gypsum lath with a normal paper finish.
- Fibrous-plaster sheet.
- Fibre-reinforced cement sheeting.

Examples of building elements allowed to be combustible– C2D10

(a) Gaskets.

(b) Caulking.

(c) Sealants.

(d) Termite management systems.

(e) Glass, including laminated glass, and associated adhesives, including tapes.

(f) Thermal breaks associated with—

  (i) glazing systems; or

  (ii) *external wall* systems, where the thermal breaks—

    (A) are no larger than necessary to achieve thermal objectives; and

    (B) do not extend beyond one *storey*; and

    (C) do not extend beyond one *fire compartment*.

(g) *Damp-proof courses*.

(h) Compressible fillers and backing materials, including those associated with articulation joints, closing gaps not wider than 50 mm.

(i) Isolated—

  (i) construction packers and shims; or

  (ii) blocking for fixing fixtures; or

  (iii) fixings, including fixing accessories; or

  (iv) acoustic mounts.

Combustible vs Fire Hazard Properties

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