DURABILITY AND GRADING

DURABILITY

Durability is best described as the ability of a species to resist decay and insect attack. The Division of Forest Products, Melbourne has listed Australian timbers into four classes of durability based on the durability of the truewood. The sapwood is much less durable than the truewood and in fact may be classified as "non-durable" for all timbers. Listed below are the Australian timbers described in this section.

CLASS 1 - VERY DURABLE
Species with a life of about 25 to 50 years in the ground and over 50 years in structures exposed to the weather but with no ground contact.

Grey box, Grey gum, Grey ironbark, Red ironbark, Tallowwood, Turpentine, White cypress pine, White Mahogany.

CLASS 2 - DURABLE
Species 15 to 20 years in the ground and 30 to 50 years of exposure.

Blackbutt, Spotted gum, Jarrah, White and Yellow Stringybarks, Forest Reds, Eucalyptus ashes, Red Mahogany.

CLASS 3 - MODERATELY DURABLE
Species 8 to 15 years in the ground and 10 to 30 years of exposure.

New England, Blackbutt, Brush box, Karri, Eucalyptus ashes, Queensland maple, Sydney Blue Gum, Rose gum, Siver Top Stringybark .

CLASS 4 - NON DURABLE
Species 1 to 8 years in the ground and 5 to 10 years exposure.

Coachwood, Yellow carabeen, Brush mahogany, Brown alder, White birch, Sassafras, Radiata pine, Tasmanian oak, Meranti.

In classifying durability, the intention is to indicate the expected service life relative to that of other timber species when used outdoors and in contact with soil and therefore, takes into account both resistance to decay and attack from insects such as termites. Some timbers are listed in more than one class, owing to the wide variation often found within the one timber species.

GRADING

Grading involves the determination of common standards for the sorting of timber into various quality groups suitable for particular end uses, having regard to the natural imperfections in all or any particular species. As timber is a natural product, it is subject to many factors which produce defects, or imperfections sufficient to have some effect on the usefulness of the pieces in which they occur. The grading rules operate to provide limitations to the size and occurrence of these defects which can result from growth processes (ie sloping grain, knots, gum pockets, tension wood) or from the conversion process (eg felling shakes, seasoning splits or checks, wane and want, etc.).

Grading rules have over a number of years been established by the Standards Association of Australia, and have been applied by lending authorities and incorporated in building codes.

There are two types of grades which concern us - structural grades and appearance grades.

1. Appearance grades are established principally on the look of the physical characteristics of the timber, giving due regard to the use to which the timber is to be put.

Strength is not a factor and hence certain imperfections which may not be allowed. Appearance grading is carried out on the better face and applies to timber intended for use as flooring, shelving, panelling, joinery and dressed boards. In such products seasoning is also an important factor and this is covered elsewhere.

2. Structural timbers can be either visually or mechanically (ie machine) stress graded.

Visual grading classifies pieces according to the extent of their strength reducing imperfections (knots, sloping, grain, density, etc.) and the effects of the worst permissible defects on the four faces are taken into account. Because visual grading relies somewhat on human judgement, a variation in grade of up to 5% between grading of a parcel between individual inspectors is accepted. This variation can obviously occur on a fast moving production line where it is impossible for graders to measure every knot and grain slope and it is for this reason that there is an inbuilt safety factor in visual grading.

A serious strength-reducer is sloping grain which can arise from sawing a misshapen log or from failure to saw parallel with the sapwood. As timber may be 20 times stronger parallel to the grain compared with perpendicular to the grain, any slope of grain away from the axis will have some effect on strength.
It can be difficult to detect visually and to measure. A beam with slope of grain of 1 in 8 loses 50% of its

strength compared with a beam with slope of no more than 1 in 20.
Knots, which occur mainly in softwoods, also weaken timber by causing a deviation of grain. There are a number of other imperfections which affect structural grades but these are less serious than the above.Machine stress grading has been developed on the basis of much laboratory testing which has shown that for each species, there is a correlation between bending stiffness (i.e. modulus of elasticity) and strength (basic bending stress or modulus of rapture) and that for each increase of 15% there is a 25% increase in strength. These machines apply a non-destructive bending load to each piece of timber, as it passed through 2 rollers some 0.9m apart. The deflection is measured at short intervals and is converted by a calculator to a stress grade, and a spray system applies an appropriate grade - indicated by an indelible colour strip to the timber.

A single piece of timber can have several different colour strips on it and a full length visual examination is also required to ensure that certain imperfections not measured by the machine (such as warp) are within grade limits. The piece is then graded according to the lowest stress grade shown.

TIMBER, FLAME AND FIRE HAZARD

EARLY FIRE HAZARD PROPERTIES TO AS1530:3

The Building Code of Australia (BCA), progressively introduced into formal building regulations throughout the Australian States since 1991, provides a uniform set of technical requirements and standards for the design and construction of buildings in Australia.

In summary, the basic objective of the BCA is to ensure that acceptable standards of structural sufficiency, fire safety, health and amenity are maintained for the benefit of the occupants and the community in general.

In the area of fire safety, the BCA assesses both materials and design in terms of potential hazard to occupants in the event of fire. It is accepted that such hazards may be reduced to an acceptable level through choice of material of construction, decoration or fittings, by provision of escape routes, by inclusion of fire resistive walls, floors and ceilings, by the installation of sprinkler systems and the fitting of smoke or thermal detectors.

EARLY HAZARD IN FIRE

It has been recognised that a fire within a building usually involves the ignition of contents within a space (bedroom, kitchen, office, corridor, workshop, etc) and one focus of fire control has been to inhibit the spread of the fire hazard by confining the fire to that space. Hence the requirements of fire rated walls, fire doors, sprinklers etc and the broad principle of "compartmentation".

However, the initiating fire may spread not only by ignition of adjacent introduced items but also by ignition of the materials used on floors, walls or ceilings which could be part of the building (or compartment) itself.

The comparative hazard posed by many such materials in the early stages of a fire has been assessed in terms of

ease of ignition and capacity to propagate flame, and
the amount of heat and smoke generated when burning.

The relevant data in the form of indices is derived by testing the material by a method complying with Australian Standard AS1530: Part 3(1989): Simultaneous Determination of ignitability, flame propagation, heat release and smoke release.
In some types (class) of buildings, and in some areas of those buildings, BCA Specification C.1.10 requires that materials used exhibit a certain level of performance described in terms of maximum permissible indices obtained from the above mentioned test.

In relation to the use of timber related products BCA applies the results of these tests to the various "classes" of buildings as defined in BCA Part 3.2 as follows:

(i) Class 1 and 10 Buildings
Generally, use of timber related materials internally within these Classes of buildings, is **not** restricted by those regulations which refer to properties assessed by AS1530, Part 3.

(ii) Class 2, 3, 4, 5, 6, 7, 8, 9a, 9b, Buildings.
Visible Timber based materials or components such as decorative wall or ceiling panelling and flooring which are accepted for use in these Classes 2 - 9 buildings, are specified in BCA Specification C1.10.2 and should have a:

a) Spread of Flame Index not more than 9.
OR
b) Smoke Developed Index not more than 8 where the Spread of Flame Index is more than 5.

However, the exceptions to these **general** clauses are as follows (see BCA Specification C 1.10.4)

a) Materials or components in areas forming part of the safe escape route (e.g. to fire isolated stairways or passageways or the like) should have a Spread of Flame Index of 0 and Smoke Developed Index of not more than 5.
b) Materials or components in a fire isolated stairway, fire isolated passageway or fire isolated ramp should have a Spread of Flame Index of 0 and a Smoke Developed Index of not more than 2
c) Materials or components, finishes, surface linings or attachments to the undernoted features should have the indicated indices.

(iii) Health Care Facilities
In Class 9a building in the patient–care area

	Spread of Flame Index		**Smoke Developed Index**
Ceiling	= 0		≤ 3
Wall	≤ 2		≤ 5
Floor and skirtings to 150 mm high	≤ 3 0	OR	≤ 5 ≤ 6

Continued pg 4

TABLE A – EARLY FIRE HAZARD PROPERTIES OF SELECTED TIMBERS

Note 1 These data on solid timber samples were obtained from published documents or from originals of the Certificates-of-Test held by the Timber Development Association (NSW) Ltd (TDA) which were issued by the then Commonwealth Experimental Building Station (EBS). The relevant tests were carried out in 1978–1979 according to AS1530.3 (1976).

Common Name	Botanical Name	II‡	SOF‡	HE‡	SD‡	Report Reference
Alpine Ash (Vic Ash)	Eucalyptus delegatensis	14	8	7	3	E.4161*
Australian Red Cedar	Toona australis	14	9	8	3	E.4230*
Blackbean	Castanosper–mum australe	13	8	7	3	E.4232*
Blackbutt	Eucalyptus pilularis	13	6	5	3	E.4233*
Blackwood	Acacia melanoxylon	13	9	8	3	E.4226*
Brush Box	Tristania conferta	14	3	4	2	**
California Redwood	Sequoia sempervirens	14	9	9	4	E.4253*
Canada Pine	Tsuga heterophylia	14	9	9	3	E.4223*
Cypress Pine	Callitris columellaris	13	8	7	3	E.4228*
Douglas Fir	Pseudotsuga menziesii	14	9	9	3	E.4221*
Hemlock (Western)	Tsuga heterophylia	14	9	9	3	E.4223*
Hoop Pine	Araucaria cunninghamii	14	7	6	2	**
Jarrah	Eucalyptus marginata	13	3	4	2	**
Kapur	Dryobalanops Spp.	13	7	6	3	E.4255*
Klinki Pine	Araucaria hunsteinii	15	9	8	3	E.4231*
Lauan	Shorea Spp. parashorea Spp.	14	9	10	4	E.4227*
Meranti	Shorea Spp.	14	9	10	4	E.4227*
Messmate	Eucalyptus obliqua	13	5	5	3	**
Mountain Ash (Vic. Ash)	Eucalyptus regnans	14	8	7	3	E.4161*
Oregon	Pseudotsuga menziesii	14	9	9	3	E.4221*
Pacific Maple	Shorea Spp.	14	9	10	4	E.4227*
Philippine Mahogany	Shorea Spp. parashorea	14	9	10	4	E.4227*
Queensland Walnut	Endiandra palmerstonii	13	7	7	3	E.4224*
Radiata Pine	Pinus radiata	15	7	6	3	E.4220*
Ramin	Gonystylus Spp.	14	7	7	3	E.4256*
Red Cedar (Western)	Thuja plicata	14	10	9	4	E.4219*
Redwood	Sequoia sempervirens	14	9	9	4	E.4253*
Seraya	Shorea Spp.	14	9	10	4	E.4227*
Spotted Gum	Eucalyptus maculata	13	3	4	3	E.4254*
Tallowwood	Eucalyptus microcorys	12	5	5	4	E.4229*
Tasmanian Oak	E. regnans E. obliqua E. delegatensis	14	8	7	3	E.4161*
Teak	Tectona grandis	13	9	10	5	E.4225*
Tulip Oak	Argyrodendron trifoliolatum	13	6	5	2	E.4234*
Victorian Ash	See Mountain Ash or Alpine Ash					
Western Red Cedar	Thuja plicata	14	10	9	4	E.4219*
Yellow Walnut	Beilschmledia bancroftii	14	7	6	1	(a)

* Identifying number for tests done by CEBS in 1978–1979. Copies of certificates are available from TDA on request.

** Results reported in CSIRO Division of Building Research Technical Paper No. 6 (1974) by Beesley J., Keogh J. J., Moulen A.W.

‡**II** = Ignitability Index (0-20)
‡**SOF** = Spread of Flame Index (0–10)
‡**HE** = Heat Evolved Index (0–10)
‡**SD** = Smoke Developed Index (0–10)

TABLE B – EARLY FIRE HAZARD PROPERTIES OF PLYWOOD WITH SELECTED FACE VENEERS

Note 1 These data on plywood were obtained from originals of the Certificate-of-Test held by the Timber Development Association (NSW) Ltd (TDA) which were issued by the then Commonwealth Experimental Building Station (EBS). The relevant tests were carried out in 1978–1979 according to AS1530.3 (1976).

Common Name of Face Veneer	Botanical Name	II**	SOF**	HE**	SD**	Report Reference
Australian Cedar	Toona australis	13	8	8	3	E.4248*
Australian Cedar (grooved)	Toona australis	13	8	7	2	E.4250*
Blackbean	Castanosper–mum australe	13	9	10	3	E.4238*
Coachwood	Ceratopetalum apetalum	15	8	8	2	E.4235*
Hickory Ash	Flindersia ifflaiana	13	8	8	3	E.4249*
Hickory Ash (grooved)	Flindersia ifflaiana	14	8	9	3	E.4251*
Klinki Pine	Araucaria hunsteinii	15	8	10	4	E.4245*
Lauan	Parashorea Shorea Spp.	14	8	10	3	E.4244*
Meranti	Shorea Spp.	14	8	10	2	E.4240*
Pacific Maple	Shorea Spp.	14	8	10	2	E.4240*
Queensland Maple	Flindersia brayleyana	13	8	8	2	E.4239*
Queensland Walnut	Endiandra palmerstonii	14	8	10	3	E.4241*
Radiata Pine	Pinus radiata	14	8	9	2	E.4237*
Sapele	Entandro–phragma cylindricum	13	8	8	2	E.4243*
Silver Ash	Flindersia bourjotiana	13	8	9	3	E.4242*
Tasmanian Oak	E. obliqua E. delegatensis E. regnans	14	8	8	2	E.4236*
Teak	Tectona grandis	14	8	10	3	E.4247*
Victorian Ash	E. regnans E. delegatensis	14	8	8	2	E.4236*

Identifying number for tests done by CEBS in 1978–79.
Copies of certificates are available from TDA on request.

** **II** = Ignitability Index (0–20)
** **SOF** = Spread of Flame Index (0–10)
** **HE** = Heat Evolved Index (0–10)
** **SD** = Smoke Developed Index (0–10)

TABLE C – Indicative Early Fire Hazard Indices : Manufactured Products

Indices for some manufactured sheet materials are given below. Note that for specific branded products, verifiable data must be obtained from the particular manufacturer and/or a Registered Testing Authority.

	II*	SOF*	HE*	SD*
a hardboard (standard)	14	7	7	3
a medium density fibreboard	14	8	7	3
a particleboard (standard)	14	7	6	3
a flooring grade particleboard	14–15	7	6	2–3

Note : Such products may be available as special branded and accredited flame-retardant treated products which have been impregnated in pressure vessels with special chemicals which inhibit the spread of flame, often reducing the spread of flame index to zero (0).

***II** = Ignitability Index (0-20)
SOF = Spread of Flame Index (0–10)
HE = Heat Evolved Index (0–10)
SD = Smoke Developed Index (0–10)

(iv) Theatres, Public Halls

In a Class 9b building used as a theatre, public hall or the like, specifically in those auditorium or audience seating areas and associated assembly areas which are NOT protected by sprinklers

	Spread of Flame Index	Smoke Developed Index
Ceiling	≤6	≤3
Wall	≤6	≤5
Floor, generally	≤7	≤5
Floor, indoor swimming or skating	≤9	≤8
Floor, other indoor sports or multi–purpose functions	≤8	≤7
Theatre Seating, fixed	0	≤5

Where sprinklers are used adopt the minimum Early Hazard Indicies required

FIRE RETARDANTS

The BCA states that fire retardant coatings must not be used in order to make a substrate comply with the aforenoted requirements. However, timber based products which have been pressure impregnated with approved fire–retardant chemicals may be acceptable provided the manufacturer can demonstrate that the fire retardant and the treated products satisfy the relevant BCA Specification for Spread of Flame Index and Smoke Developed Index (refer AS1530:3).

EXEMPT COMPONENTS

These requirements are not applied to:

- timber framed windows
- solid timber skirtings, handrails
- timber faced solid–core or fire doors
- any other timber component which does not significantly increase the hazards of fire.

INDICES FOR EARLY FIRE HAZARD

a. Data on Natural (Solid) Timber
   Data obtained from two sources about test results on samples of a number of natural timber species according to AS1530 Part 3 are given on Table A.

b. Data on Manufactured Products
   Factory produced wood based products such as hardboard, medium density fibreboard (MDF) waferboard, particleboard and plywood can also be assessed by AS1530.3. However, since such products may vary widely in formulation from time to time and between manufacturers (raw materials plus additives) the confirmation of specific indices, should be authenticated by the manufacturer of the particular named or branded products and a registered testing authority and/or a Certificate of Accreditation.

However, in the particular case of plywood some data is available as a result of tests carried out in the same 1978–1979 TDA program mentioned in a. above. These data are given in Table B.

For other factory made sheet materials indicative data is provided in Table C. Note, however, that this information is but a guide and verifiable data when required should be obtained by appropriate certification on the particular product by an authoritative source.

FURTHER READING

- Wood in Australia
  by K. R. Bootle, published by McGraw–Hill (1983)
  pp 188–190

- Early Burning Properties of Australian Building Timbers: CSIRO Division of Building Research Technical Paper (Second Series) No. 6 (1974)
  J. Beesley, J. J. Keogh, A. W. Moulen

- Notes on the Science of Building
  (Publisher now National Building Technology Centre)

NSB 38 Fire in Buildings
NSB 66 Combustible Wall boards and Finishes
NSB 137 Fire Hazard of Furniture and Furnishings
NSB 142 Fire hazards in the home

- Building Code of Australia (BCA), and N.S.W. Amendments
  Base document is BCA Amendment No. 5 but continuing amendments to that version, and continuing State amendments, particularly about fire safety, will require readers to ensure that the latest ...

Information reproduced from Timber Development Associaton (NSW) Ltd.
Timber Information Leaflet No.13

The Building Code of Australia (BCA) which sets down basic guidelines for the design and construction of buildings throughout Australia, has as the primary objective the maintenance of acceptable standards of structural sufficiency, fire safety, health and amenity for the benefit of occupants and the community in general.

The Building Code of Australia (BCA), the sole technical regulatory document for building in New South Wales since 1st January, 1993 has several important objectives:

(i) to impose standards related to the erection of buildings for the protection of life and other buildings from fire and structural collapse,

(ii) to prevent creation of conditions likely to adversely affect the health of building occupants,

(iii) to maintain adequate standards of amenity within and resulting from the erection of a building.

However, it is recognised that it is impractical to achieve absolute safety to life, although the requirement is for a high degree of protection.

Two broad sources of danger receive considerable attention in BCA, namely structural collapse and fire.

Avoiding structural collapse requires that buildings be designed for structural sufficiency and designers would generally refer to several "Codes" published by Standards Australia, namely the Concrete Structures Code, the Masonry Code, the Timber Structures Code and the Timber Framing Code. Broadly, BCA concedes that Structures built to these Codes would be 'deemed to comply' with the requirement for structural sufficiency.

In the area of fire safety, BCA assesses design in terms of potential hazards to occupants (and fire-fighters) in the event of fire but it is accepted that buildings should also provide for escape in the event of fire.

It is also inherent in the BCA requirements that materials and design are assessed in terms of eliminating such hazards, or reducing them to an acceptable level, by both passive and active methods. Passive methods would include choice of materials of construction, or decoration, and fittings; by design, location and control of escape routes; by isolation or compartmentation and by limitations on the floor area of each "compartment". Active methods could include installation of smoke and thermal detectors and by sprinkler systems.

Broadly, with the objective of inhibiting the spread of fire and controlling the performance of structural components, BCA requires that certain components or elements of the building(s) be assessed in terms of several Australian Standards namely:

i) AS1530: Part 1 – Combustibility test for materials.

ii) AS1530: Part 2 – Test for flammability of materials (for thin sheet or woven materials of pliable nature).

iii) AS1530: Part 3 – Simultaneous determination of ignitability, flame propagation, heat release and smoke release: (See TDA Timber Information Leaflet No. 13).

iv) AS1530: Part 4 – Fire resistance of elements of building construction.

BCA classifies buildings in terms of fire risk into three classes A, B, C and requires that their construction conform to certain guidelines.

Depending on the Class of building the guidelines may require that elements of construction be non-combustible, and/or have some prescribed ranking in terms of a "fire resistance level" or perhaps a prescribed resistance to incipient spread of fire.

For detailed requirements, specifiers must be familiar with the BCA and Amendments introduced by NSW regulatory authorities, particularly with regard to material properties (e.g. combustibility) and required performance of prototype building elements under standard fire conditions.

For timber-related products or structures, the following brief comments are relevant.

COMBUSTIBILITY

The evaluation of the combustibility of a building material by AS1530 – Part 1 will rank all timber and timber based products as combustible and thus restrict their use in some parts of some buildings of Class 2, 3, 4, 5, 6, 7, 8, 9a, 9b and 10a, being either Type A, B or C construction.

COMPARTMENTATION AND FIRE RESISTANCE LEVEL (FRL)

The description of a building component, for example a whole wall, ceiling or floor, in terms of a Fire Resistance Level is based on the results of tests set down in AS1530: Part 4 which interprets the performance of the prototype component under a controlled fire situation. The resulting report will provide a measure of that performance with regard to:

- structural adequacy (in minutes)
- integrity (in minutes)
- insulation (in minutes)

The extrapolation of that data to the actual building element or component proposed for the (new) structure should be such as to satisfy the approving authority, (usually the Local Government body for the area in which the building will be erected).

(i) Structural Adequacy
As established from the standard test procedure the component would be expected to support the fire design load for the required time – in minutes – called for in BCA.

(ii) Integrity
Particularly for walls, roofs, floors the expectation for the component is that it will continue to provide a barrier to the transmission of flame and hot gases for the time – in minutes – called for in BCA.

(iii) Insulation
Again for walls, ceilings, floors for example, the component is expected to provide insulation such that the temperature on the unexposed side will not be elevated to a hazardous level during the test within the required time.

(iv) Report on FRL
The properties of the prototype component in terms of its "fire resistance level" are quoted, for example, as 60/60/60 which means that the component is expected to maintain each of its designed load-carrying capacity, integrity, and insulating performance for 60 minutes under fire test conditions.

It is important to note that the FRL notation refers only to test performance where fire conditions are controlled, not real-life performance where such control would not be expected.

COLUMNS AND BEAMS – STRUCTURAL ADEQUACY
In the special example of timber columns or beams, AS1530.4 makes the provision for testing these as single elements under load from which the report would nominate that the element or component was structurally adequate for a measured time. Usually, as required in BCA, FRL's of 30/-/-, 60/-/-, 90/-/- or 120/-/- would be required.

The effect of fire on solid timber of large cross section is that the timber faces exposed directly to the flames will char slowly. However, the rate of charring, and hence the rate of reduction of load carrying capacity caused by the loss of effective cross section, is predictable. By substituting appropriate values in the equations below, the residual cross section can be calculated with sufficient accuracy for design of the element and consequent compliance with the requirements of BCA, as allowed for in Specification A2.3 Clause 3.

$$C = 0.4 + (280/D)^2$$

where:

C = notional charring rate, millimetres per minute (mm/min)
D = timber density at a moisture content of 12% in kilograms per cubic metre (kg/m3)

Effective Depth of Charring (in millimetres)

$$dc = C.t + 7.5$$

where:

dc = calculated effective depth of charring in millimetres (mm)
C = notional charring rate in millimetres per minute (mm/min) as calculated
t = period of time, in minutes (min)

NOTE that the net effect of charring/fire will depend on the number of faces of the member exposed to the fire – 1, 2, 3, or 4.

Broadly, the charring rate (C) is inversely proportional to the density (in kg/m^3) of the timber element but the calculation of expected performance must allow for charring and hence on 1, 2, 3, or 4 sides as appropriate. (see AS1720 Part 4 for detailed discussion and later for sample calculations).

Note : Fire rated plasterboard manufacturers can provide information about systems to protect columns if necessary. AS1720:4 Clause 2.9 provides guidance for calculation of "fire resistance period" for protected members.

STUD WALLS AND FRL
A conventional timber stud wall frame covered with special fire rated gypsum plasterboard could be built up with one or more layers of that special board to achieve some desired FRL's. At this time, verification of performance of gypsumboard covered timber stud wall system should be sought from the manufacturers of the branded plasterboard.

Note that FRL-rated stud wall systems are only part of the structure(s) and in practice much complementary work would link those walls to external walls, ceilings, roof, etc. Some detail of such complementary construction is given in a publication by N.A.F.I – "Timber Framed Multi-Residential Construction: Construction Details for Separating Walls Class 1 Buildings" (February 1993).
Sample Calculations

(i) Notional Charring Rates

a) Species: Radiata Pine
Density @ 12% M.C. = 550 kg/m^3

$$C = 0.4 + \left[\frac{280}{550}\right]^2$$
$$= 0.66 \text{ mm/min}$$

b) Species: Brush Box
Density @ 12% M.C. = 900 kg/m^3

$$C = 0.4 + \left[\frac{280}{900}\right]^2$$
$$= 0.5 \text{ mm/min}$$

(ii) Sample Calculation to achieve 60/-/- FRL (for columns of material in a) and b) above)

GENERAL CONDITIONS

- Support post to sustain load for 60 mins under fire conditions.
- Size of post needed after 60 mins to support design load is 50 x 50 mm (Note for calculation of working stress design loads under fire conditions refer to AS1720 Part 4 Clause 2.8).
- Calculation needed to give post dimensions before being subjected to fire.
- Assume the fire will affect all four sides of the post.

a) Radiata pine post
Depth of charring = C.t + 7.5
= (0.66 x 60) + 7.5
= 39.6 + 7.5
= 47.1 mm each side

Thus for an FRL: 60/-/- post or column in seasoned radiata pine, average density 550kg/m^3 the specifier would seek a glue laminated product built up to say 150 mm square as a minimum. (Note: Glue laminated products are considered as solid timber sections).

b) Brush box post
Depth of charring = C.t + 7.5
= (0.5 x 60) + 7.5
= 30 + 7.5
= 37.5 mm each side
Size of column required:
50+37.5+37.5 = 125 mm square

Thus for an FRL: 60/-/- post or column in seasoned brush box, average density 900 kg/m^3 the specifier would seek unseasoned brush box posts of 150 x 150 mm nominal size, or a glue-laminated post built up to at least 125 x 125, or more pragmatically, allowing for typical dressed, seasoned laminate sizes, the designer could order posts of glue laminated brush box 140 x 133 (7 plies/laminates each 140 x 19 mm)

FURTHER READING
Standards Australia Publications

AS1530 Methods for fire tests on building materials, components and structures.

Part 1: Combustibility test for materials
Part 2: Test for flammability of materials (thin sheet or woven materials of pliable nature)
Part 3: Simultaneous determination of ignitability, flame propagation, heat release and smoke release.
Part 4: Fire resistance of elements of building construction.

AS1684 1992: The National Timber Framing Code.
AS1720 Timber Structures
Part 1: Design Methods
Part 2: Timber Properties
Part 4: Fire-resistance of structural timber members.
AS3959 Construction of Buildings in Bushfire-prone areas.

Building Code of Australia (and N.S.W. Amendments)

Part A1.1 Definitions
Part A2.1 Suitability of Materials
Part A2.2 Evidence of suitability
Part A2.3 Fire resistance of building elements
Part A2.4 Early Fire Hazard Indices
Part A3 Classification of Buildings and Structures
Part A4 United Buildings

SPECIFICATIONS
Part A2.3 Fire resistance of building elements
Part A2.4 Early Fire Hazard Test for Assemblies

FURTHER READING CONT.
National Building Technology Centre for Publications

Notes on the Science of Building series (NSB)
NSB 38 Fire in Buildings
NSB 66 Combustible Wallboards and Finishes
NSB 87 Fire resisting Construction
NSB 90 Materials for Fire resisting Construction
NSB 107 Fire in Multistorey Buildings
NSB 118 Fire Safety in Apartment Buildings
NSB 136 Fire doors, fire shutters and fire windows
NSB 142 Fire hazards in the home
NSB 154 Houses exposed to bushfires

National Association of Forest Industries Publicat(

Timber Framed Multi Residential Construction: Construction details for Separating Walls Class 1 Buildings (Feb 1993)

Information reproduced from Timber Development Association (NSW) Ltd Timber Information leaflet No12

SUMMARIES OF THE VARIOUS PARTS OF THE AS1530.

FULL TEXT AVAILABLE FROM STANDARDS AUSTRALIA)

AS 1530 –
METHODS FOR FIRE TESTS ON BUILDING MATERIALS, COMPONENTS AND STRUCTURES

AS 1530.1 – 1984
COMBUSTIBILITY TEST FOR MATERIALS
Describes a combustibility test for classifying building material. Apparatus, test procedures and classification criteria are given.
(ISBN 0 7262 3517 1)

AS 1530.2 – 1973
TEST FOR FLAMMABILITY OF MATERIALS
Describes procedure for preparing and determining flammability index of thin sheet or woven materials of pliable nature which are combustible and do not melt readily or shrink away from an igniting flame. The index is determined according to a speed factor, heat factor and spread factor.
(ISBN 0 7262 0039 5)

AS 1530.3 – 1989
SIMULTANEOUS DETERMINATION OF IGNITABILITY, FLAME PROPAGATION, HEAT RELEASE AND SMOKE RELEASE
Amdt 1 April 1992 (ISBN 0 7262 7399 6) X Describes a single test for grading building materials on the basis of ignition tendency, flame spread, heat development and tendency to produce smoke. Apparatus, test procedure and indices for grading are provided.
(ISBN 0 7262 5867 9)

AS 1530.4 – 1990
FIRE-RESISTANCE TEST OF ELEMENTS OF BUILDING CONSTRUCTION
Sets out test procedures and criteria for the determination of fire-resistance of elements of building construction. Follows the basic principles and provisions contained in ISO 834 – Fire-resistance tests – Elements of Building Construction.
(ISBN 0 7262 5963 2)
AS1530.5 – 1989
TEST FOR PILOTED IGNITABILITY
Specifies a test for examining the ignition characteristics of the exposed surfaces of specimens, composites or assemblies of building products, not exceeding 70mm in thickness, when placed horizontally and subjected to specified levels of thermal irradiance.
(ISBN 0 7262 5787 7)

Summaries of the various parts of the AS1530. (Full text available from Standards Australia).

SELECTED PROPERTIES

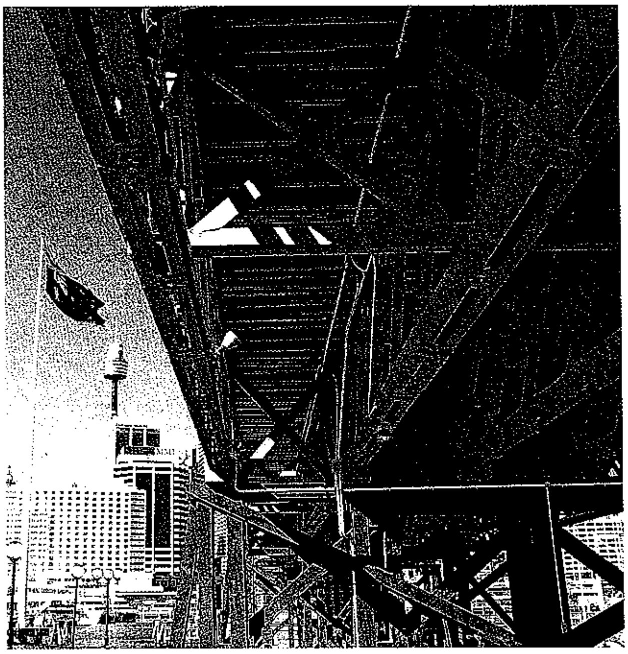
COMMON AUSTRALIAN TIMBERS

Common Name	Janka Hardness	Strength Group Hardness	Durability Class	Density Kg/m³ @ 12% MC
Ash, Killarney Eucalyptus dunnii	7.2	SD4	not known	800
Ash, Victorian Eucalyptus delegatensis/ Eucalyptus regnans	4.9	SD4	4	650
Blackbutt NSW/Qld Eucalyptus polulari	8.9-9.2	SD2	2	900
Blackbutt WA Eucalyptus patens	6.9	SD4	2	850
Brushbox Tristania conferta	9.1	SD3	3	900
Gum, Sydney Blue Eucalyptus saligna	8.1	SD3	2	850
Gum, Spotted Eucalyptus maculata	11.0	SD2	2	1000
Ironbark Red Eucalyptus sideroxylon	11.9	SD3	1	1050
Ironbark Grey Eucalyptus siderphloia	16.3	SD1	1	1100
Jarrah Eucalyptus marginata	8.5	SD4	2	1100
Oak, Tasmanian Eucalyptus regnans Eucalyptus delegatensis Eucalyptus obliqua	4.9	SD4	4	650
Pine, radiata Pinus radiata	3.3	SD6	4	550
Stringybark, Brown Eucalyptus baxteri Eucalyptus blaxandi Eucalyptus capitellata	7.5	SD3	3	850
Stringybark, Red Eucalyptus macrorhyncha	8.8	SD4	3	900
Stringybark, White Eucalyptus eugenioides Eucalyptus globoidea	9.0	SD3	2	850
Stringybark, Yellow Eucalyptus muellerana	8.6	SD3	2	900
Tallowwood Eucalyptus microcopys	8.6	SD2	1	1000
Turpentine Syncarpia glomulifera Syncarpia laurifolia	11.6	SD3	1	950

LIST OF TERMITE RESISTANT SPECIES AVAILABLE FROM BORAL TIMBER

BOTANICAL NAME	COMMON NAME
AUSTRALIAN HARDWOODS	
EUCALYPTS	
E. blakelyi	Forest Red Gum
E. bosistoana	Coast grey box
E. maculata	Spotted gum
E. marginata	Jarrah
E. microcorys	Tallowwood
E. moluccana	Grey box
E. muelleriana	Yellow Stringybark
E. paniculata	Grey ironbark
E. pilularis	Blackbutt
E. sideroxylon	Red ironbark
E. andrewsii	New England Blackbutt
E. canaliculata	Grey gum
E. eugeniodes	White bark
E. resinifera	Red Mahogany
NON-EUCALYPTUS	
Lophostemon confertus	Brushbox
Syncarpia glomulifera	Turpentine

COMMERCIAL TIMBERS



Durable Australian eucalypt timbers are outstanding for use in major commercial and civil engineering applications. Boral Timber processing and treatment plants supply a wide range of specialist products which offer minimum deflection, superior spanning capabilities and high load bearing capacity. Available in seasoned and unseasoned timber.

Unseasoned

Unseasoned commercial Timbers are available in selected species with structural stress grades between F17 and F22 and a durability of Class 1 and Class 2. They are suitable for:

- Commercial wharf decking
- Girders
- Poles
- Bridge girders, decking, sheeting and building member components
- Cross arms for power poles – available in Tallowwood and other selected high strength, high durability species.

Seasoned

Seasoned commercial Timbers are available in selected species with structural stress grades between F17 and F27 and a durability of Class 2 and higher. Minimum strength rating is SD3. They are suitable for:

- Bridge timbers – seasoned engineered products for laminated timber decks
- Commercial wharf decking

Commercial Timbers available from Boral Timber - Standard Trade Names and General Properties

Reproduced from AS1720. 2-1990

1	2	3	4	5	6		7		8	9	10		11		12		13	14	15	16	17
Index No	Standard trade name	Origin	Species brand	Classification	Strength group		Joint group		Density 12% M.C † kg/m³	Unseasoned density kg/m³	Hardness side (kN)		Tangential cleavage N/mm		Toughness (N/m)		Tangential % shrinkage	Tendency to split for unseasoned timber	% Unit tangential movement	Durability class §	Sapwood lyctus susceptible
					G	D	G	D			G	D	G	D	G	D					
293	gum, spotted	N, Q, V	SG	H	S2	SD2	J1	JD1	950	1200	8.8	11	78.8	86.1	25.3	27.5	6.1	low	0.38	2	S
322	ironbark, grey	N, Q	GI	H	S1	SD1	J1	JD1	1100	1250	10.8	16.3	87.3	78.4	30.0	33.0	7.5	medium	0.39	1	NS
325	ironbark red	N, Q, V	RI	H	S2	SD3	J1	JD1	1050	1200	10.7	11.9	93.4	74.6	26.0	23.0	6.3	low	0.37	1	S
326	ironbark, red, broad leaved	N, Q	BI	H	S1	SD1	J1	JD1	1100	1200	12.0	14.0	-	-	-	-	-	-	-	1	NS
327	ironbark, red, narrow leaved	N, Q	NI	H	S2	SD3	J1	JD1	1050	1250	12.0	14.0	-	-	-	-	-	-	-	1	NS
384	mahogany, red	N, Q	RM	H	(S2)	(SD3)	J1	JD1	950	1200	9.1	12.0	67.0	75.8	17.4	19.1	6.3	medium	0.34	2	S
22	ash, alpine	N, T, V	AA	H	S4	SD4	J3	JD3	650	1050	4.0	5.0	60.4	70.2	17.1	18.9	8.5 ‡	high	0.35	4	S (Tas) RS elsewhere
30	ash, mountain	T, V	MA	H	S4	SD3	J3	JD3	650	1050	3.4	4.9	49.9	72.6	17.0	20.0	13.3‡	high	0.36	4	NS
37	ash, silvertop	N, T, V	ST	H	S3	SD3	J2	JD2	850	1100	6.7	9.7	79.3	101.0	22.6	22.6	10.6‡	high	0.36	3	RS
84	blackbutt	N, Q	BB	H	S2	SD2	J2	JD2	900	1150	6.4	8.9	70.0	77.0	21.1	22.0	7.3‡	medium	0.37	2	NS
86	blackbutt New England	N, Q	NA	H	S3	SD3	J2	JD2	850	1150	6.6	9.2	84.5	86.4	16.9	20.7	11.4‡	high	0.36	2	S
121	box, brush	N, Q, Y	BH	H	S3	SD3	J2	JD2	900	1150	7.8	9.1	83.3	110.4	20.7	16.2	9.7‡	high	0.38	3	NS
165	brown barrel	N, V	BL	H	S4	SD4	J3	JD3	750	1100	5.0	5.5	63.3	86.1	18.9	18.1	11.8‡	high	0.34	4	S
254	gum, blue Sydney	N, Q	SY	H	S1 -S3	SD1 -SD3	J2	JD2	850 -950	1100	5.8	8.1	71.8	84.0	17.8	18.4	9.5	high	0.35	2-3	S
677	stringybark, silvertop	N, Q	SS	H	S2	(SD2)	J3	JD2	850	1050	5.5	8.8	-	-	-	-	8.0‡	-	-	3	-
680	stringybark, white	N, Q, V	WS	H	S3	SD3	J2	JD2	850	1100	6.4	9.0	74.4	96.6	19.7	21.7	10.6‡	high	0.36	2	NS
681	stringybark, yellow	N, V	YS	H	S3	SD3	J2	JD2	900	1150	6.6	8.6	70.0	73.5	19.4	18.7	7.5‡	medium	0.37	2	NS
688	tallowwood	N, Q	TW	H	S2	SD2	J1	JD2	1000	1200	7.1	8.6	73.8	67.2	19.7	19.7	6.1	low	0.37	1	S
723	turpentine	N, Q	TP	H	S3	SD3	J2	JD2	950	1050	6.6	11.6	70.3	107.8	18.5	14.7	13.0‡	high	0.35	1	NS
434	messmate	N,Q,S, T,V,	MS	H	S3	SD3	J3	JD3	750	1100	5.3	7.2	64.5	82.8	17.0	16.7	11.3‡	high	0.36	3	S