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Timber — Softwood — Visually stress-graded for structural purposes



AS 2858:2023

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- Australian and New Zealand Timber Preservative Manufacturers Association
- Australian Forest Products Association
- Australian Pesticide and Veterinary Medicines Authority
- Australian Timber Flooring Association
- Australian Timber Importers Federation
- Building Research Association of New Zealand
- Construction Information Systems (NATSPEC)
- Engineered Wood Products Association of Australasia
- Forest and Wood Products Australia
- Forestry Corporation of NSW
- Glued Laminated Timber Association of Australia
- National Centre for Timber Durability and Design Life
- New Zealand Timber Preservation Council
- New Zealand Wood Processors Association
- NZ Ministry of Business, Innovation and Employment (MBIE)
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- Tasmanian Timber Promotion Board
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Timber — Softwood — Visually stress-graded for structural purposes

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Preface

This Standard was prepared by the Australian and New Zealand members of the Joint Standards Australia/Standards New Zealand Committee TM-012, Timber Grading, to supersede AS 2858:2008.

The objective of this document is to specify requirements for visual stress grading of sawn softwood that is intended for structural purposes.

The major changes in this edition are as follows:

- (a) Removal of outdated information.
- (b) Inclusion of initial qualification testing.
- (c) Inclusion of annual verification checks.
- (d) Removal of the heart in stud grade for seasoned pinus species.
- (e) Changes to moisture content requirements.

The terms “normative” and “informative” are used in Standards to define the application of the appendices to which they apply. A “normative” appendix is an integral part of a Standard, whereas an “informative” appendix is only for information and guidance.

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Timber — Softwood — Visually stress-graded for structural purposes

Section 1 Scope and general

1.1 Scope

This document specifies requirements for visual stress grading of sawn softwood that is intended for structural purposes at the time of grading.

This document does not apply to timber species with an average density at 12 % moisture content below 360 kg/m³.

NOTE The coverage of softwood species or species mixtures listed in this document does not imply their availability or the availability of any particular grade of any species or species mixture.

The relevant grade description given in [Sections 2, 3 or 4](#) are intended to accompany the classification of timber graded in accordance with this document.

1.2 Normative references

The following documents are referred to in the text in such a way that some or all of their content constitutes requirements of this document.

NOTE Documents referenced for informative purposes are listed in the Bibliography.

AS 1720.1, *Timber structures, Part 1: Design methods*

AS/NZS 1080.1, *Timber—Methods of test, Method 1: Moisture content*

AS/NZS 1080.2, *Timber—Methods of test, Method 2: Slope of grain*

AS/NZS 1148, *Timber—Nomenclature—Australian, New Zealand and imported species*

AS/NZS 1604.1, *Preservative-treated wood-based products, Part 1: Products and treatment*

AS/NZS 2878, *Timber—Classification into strength groups*

AS/NZS 4063 (all parts), *Characterization of structural timber*

AS/NZS 4491, *Timber—Glossary of terms in timber-related Standards*

AS ISO 17025, *General requirements for competence of testing and calibration laboratories*

1.3 Terms and definitions

For the purposes of this document, the terms and definitions given in AS/NZS 4491 and the following apply. Where the definitions in this document differ from those given in AS/NZS 4491, those below apply.

1.3.1

batch

production run of timber where the grading process does not change and for which verification is claimed

1.3.2

competent person

person who has acquired, through education, training, qualification or experience or a combination of these, the knowledge and skill enabling that person to perform the task required

1.3.3

growth rings within 50 mm of the centre of the pith

rings that grow during the first development of the shoot of the tree

Note 1 to entry: The intention of limiting these growth rings to a given size is to restrict the occurrence, in sawn timber, of the low stiffness material that occurs in the first growth rings of the log.

1.3.4

internal check

check confined to the interior of a piece

1.3.5

knot

<hoop only> section of a branch embedded anywhere in a piece of timber exposed by sawing

1.3.5.1

arris knot

<cypress only> knot appearing only on an adjoining face and edge of a piece of timber, where the pith is exposed on a surface or is outside the piece, and containing the intersection of these surfaces

1.3.5.2

knot cluster

two or more knots grouped together as a unit where the grain of the timber is deflected around the entire unit

Note 1 to entry: This term is not to be confused with a knot group.

1.3.5.3

edge knot

<all species except cypress and hoop> knot with its boundary lying wholly within a designated central portion of the edge or cross-sectional area of the piece

<cypress> knot, other than an arris knot, face knot or through-knot, that occurs on the edge

Note 1 to entry: There is no centrally designated portion for cypress or hoop.

1.3.5.4

face knot

<all species except cypress and hoop> knot with its boundary lying wholly within a designated central portion of the face or cross-sectional area of the piece

<cypress> knot, other than an arris knot, edge knot or through-knot, that occurs on the face

Note 1 to entry: There is no centrally designated portion for cypress or hoop.

1.3.5.5

knot group

two or more knots grouped together as a unit but the grain of the timber passes between them

Note 1 to entry: This term is not to be confused with a knot cluster.

1.3.5.6

other knot

<all species except cypress and hoop> knots and knots in clusters where any part of the knot or cluster is outside the designated central portion of the face or edge, and those knots not otherwise defined herein

1.3.5.7

through knot

<cypress only>

<1> knot appearing on both the edge and face of the piece, but which does not contain the intersection of these surfaces

<2> knot appearing on both the adjoining face and edge of a piece containing the intersection of these surfaces and on the opposite face, edge or arris or originating within the piece

Note 1 to entry: [Figures B.1.1\(j\), B.1.1\(k\) and B.1.1\(l\)](#) show knots occurring at the intersection of surfaces, while [Figure B.1.1\(m\)](#) shows one originating within the piece.

1.3.5.8

knot-area ratio

KAR

ratio of the projected cross-sectional area of one or more knots to the cross-sectional area of the piece

1.3.6

occluded branch stub

stub of a pruned branch or dead branch that has fallen off, and which has become encased by the living wood of the tree trunk

1.3.7

shake

partial or complete dislocation, breakage or longitudinal separation of wood fibres due to causes other than drying, and usually originating either in the standing tree or in the log during felling or conversion. Types include the following:

- (a) *Cross-shake, felling shake, wind shake* — a fracture not in the direction of the fibres and resembling a breakage of the fibre.
- (b) *Heart shake* — a shake extending from the pith of a tree, not to be confused with a check.
- (c) *Radial shake* — a shake originating on the circumference of a log and extending inwards along the radius, not to be confused with a check.
- (d) *Ring shake* — a shake following a growth ring, also referred to as a shell shake or cup shake, in which case the timber may be described as shelly.

1.3.8

sized

gauged

timber machined by fine sawing or dressing to a tighter tolerance than “sawn” timber

1.3.9

species mixture

parcel of timber that contains timber of one or more species from a designated group of species

Note 1 to entry: One particular parcel may consist of only one of the species in the group.

Note 2 to entry: See [Tables A.2 and A.4](#).

1.3.10

surface

outside of a piece of sawn timber but not including an end

Note 1 to entry: See [Figure 1.1](#).

1.3.11

termite gallery

irregularly shaped passage or burrow excavated by termites in the bark or wood

Note 1 to entry: An enclosed termite gallery is one that is not completely open to visual inspection throughout its entire length.

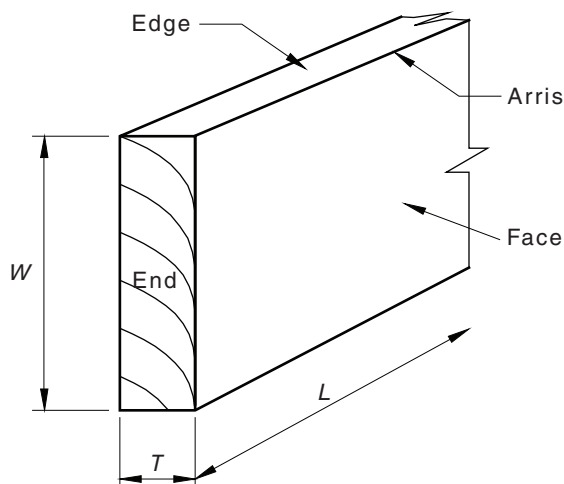
Note 2 to entry: An enclosed termite gallery may extend well beyond the visible portion of the gallery.

1.3.12

visual stress grading

act of inspecting each piece of timber or wood product in its final size and assigning a structural grade according to a set of limits on visual characteristics

Note 1 to entry: The type and extent of visual characteristics are used as indicators of material properties and the limits are based on their effect on strength, appearance or utility.



Key

L = length
 T = thickness
 W = width

Figure 1.1 — Illustration of terms — Surfaces and arris

1.4 Initial evaluation of structural properties

An initial evaluation process shall be undertaken before any timber of that grade or size combination is commercially visually stress graded. Details of the resource and characterization of structural properties shall be documented in a report.

The evaluation shall be undertaken in accordance with AS/NZS 4063.1 and AS/NZS 4063.2. A competent person shall conduct the initial evaluation, to ensure the representiveness of the resource sampling and the accuracy of the visual stress grading process.

Where multiple sizes and grades are involved, it is permissible to evaluate the highest and lowest grades, as well as a small (less than 150 mm) and a large size (not less than 190 mm) in each of those grades. It is permissible to interpolate for intermediate grade/sizes. It is also permissible to pool data from the various grade/sizes to improve the statistical reliability. Extrapolation of evaluations is not permitted except where it is possible to demonstrate that extrapolation is made in such a way that the results are conservative.

Initial evaluation of structural properties shall be conducted on timber after all manufacturing processes are completed. For example, preservative treated timber shall be evaluated after treatment at the moisture content that the product will be sold at.

Characterization of all structural properties listed in AS 1720.1 shall be undertaken.

Laboratories that perform the testing for initial evaluation shall meet the requirements of AS ISO/IEC 17025 and have experience in timber testing.

NOTE Initial evaluation of structural properties should be undertaken after all stages of manufacture. For example, if graded timber is preservative treated, the initial evaluation of structural properties would be undertaken after treatment and redrying if applicable.

1.5 Timber species and stress grades

The standard trade names of species covered by this document shall be those defined in AS/NZS 1148.

NOTE 1 A list of species and species mixtures is given by standard trade name in [Appendix A](#).

NOTE 2 The stress grades applicable to the structural grades, for a range of seasoned and unseasoned softwood species and species mixtures, are listed in [Appendix A](#).

NOTE 3 The stress grades applicable to the structural grades for mixed species, where the mixture is not specifically listed in [Tables A.3](#), should be based on the species in the mix which has the lowest stress grades when assessed in accordance with [Table A.1](#), [Table A.2](#), [Table A.4](#) and [Table A.5](#).

NOTE 4 The stress grades applicable to unidentified softwoods should be as given for unidentified species in [Appendix A](#).

Timber with exceptionally low density shall not be accepted in accordance with AS/NZS 4491.

NOTE 5 The lower density species need extra care in regard to assessing nail and connector holding capacity.

NOTE 6 The stress grade values in [Tables A.1](#) to [A.4](#) should take precedence over the stress grade values determined through the application of [Tables B.1](#) and [B.2](#).

NOTE 7 This document may be used for the grading of species other than those listed in [Appendix A](#), provided the appropriate strength group for the species has been determined in accordance with AS/NZS 2878 or the appropriate stress grade has been determined by in-grade testing and analysis in accordance with AS/NZS 4063.

NOTE 8 The stress grades given in this document do not preclude the specific mechanical properties of a species being used for design purposes, refer to AS 1720.1 for further information.

NOTE 9 Information on the relationship between strength groups, structural grades and stress grades is given in [Appendix B](#).

1.6 Grades

1.6.1 Structural grades of softwood

The grades of structural softwood (excluding cypress and hoop) shall be as follows:

- (a) Structural grade no. 1.
- (b) Structural grade no. 2.
- (c) Structural grade no. 3.
- (d) Structural grade no. 4.
- (e) Structural grade no. 5.
- (f) Structural appearance grades.

NOTE 1 The assumed relationships between the visual structural grade classifications, the stress grades (F ratings) and the strength groups are given in [Appendix A](#).

NOTE 2 Structural appearance grades are derived from the visual structural grades by tightening the allowances for factors affecting appearance (see [Clause 2.6](#)).

NOTE 3 A summary of the grade descriptions (excluding cypress and hoop) is given in [Appendix C](#).

NOTE 4 A summary of the grade descriptions for cypress is given in [Appendix D](#).

NOTE 5 A summary of the grade descriptions for hoop is given in [Appendix E](#).

NOTE 6 The summaries of the grade descriptions given in [Appendices C, D](#) and [E](#) are not exhaustive and do not take the place of the requirements given in this document. Reference should be made to the appropriate sections of this document for a complete description of the grades.

1.6.2 Grades of structural cypress

The grades of structural cypress shall be as follows:

- (a) Stress grade F7.
- (b) Stress grade F5.
- (c) Stress grade F4.
- (d) Structural appearance grades.

NOTE 1 The assignment of F grades for cypress is based on the Forestry Commission of NSW unpublished report No. 871.

NOTE 2 The summaries of the grade descriptions for cypress given in [Appendix D](#) are not exhaustive and do not take the place of the requirements given in this document. Reference should be made to the appropriate sections of this document for a complete description of the grades.

1.6.3 Grades of structural hoop

The grades of structural hoop shall be as follows:

- (a) Stress grade F8.
- (b) Stress grade F7.
- (c) Stress grade F5.
- (d) Structural appearance grades.

NOTE 1 The assignment of F grades for hoop is based on knowledge gained from testing carried out in accordance with AS/NZS 4063.

NOTE 2 The summaries of the grade descriptions for hoop given in [Appendix E](#) are not exhaustive and do not take the place of the requirements given in this document. Reference should be made to the appropriate sections of this document for a complete description of the grades.

1.7 Sizes and tolerances

1.7.1 Dimensions

The dimensions of the timber shall adhere to the following requirements:

- (a) The ends shall be trimmed so that the length is not less than the specified length (see [Sections 2, 3](#) and [4](#)).
- (b) The width and thickness, except where permitted want and wane occurs, shall be —
 - (i) of 2 mm maximum difference within any piece, except for cypress, which shall be 3 mm maximum difference within any piece; and

- (ii) measured at any point on its length —
 - (A) *for unseasoned timber* —
 - (1) up to and including F7 — +2, -4 mm; and
 - (2) stress grade F8 and above — ± 3 mm;
 - (B) *for seasoned or MC specified timber* — +5, -0 mm;
 - (C) *for sized timber* — as for Items (A) or (B) with an additional requirement of a maximum 2 mm difference between all pieces within a parcel for the sized dimension of the timber; and
 - (D) *for dressed timber* — +2, -0 mm of the specified finished size.

NOTE 1 When timber is supplied as dressed, the nominal size may be reduced due to the process of dressing to a “finished dimension” or “finished size”. Design calculations should be based on the “finished dimension”.

NOTE 2 For the effect of shrinkage on tolerances when carrying out a grading check, see [Clause 1.10.5](#).

1.7.2 Squareness

The tolerance on squareness shall be ± 2 degrees. That is, the angle at the arrises shall be 90 ± 2 degrees.

1.8 Moisture content

1.8.1 Testing

In the event of a dispute, the moisture content of the timber shall be determined in accordance with AS/NZS 1080.1.

NOTE Moisture content is typically measured by electronic means for production purposes.

1.8.2 Seasoned timber

Where timber is claimed to be seasoned, the moisture content, at the time of manufacture, shall conform to the following requirements:

- (a) The average moisture content of a batch shall not be greater than 15 %.
- (b) No piece shall exceed 21 % moisture content.

NOTE 1 Where this moisture content is unsuitable for a particular location or purpose, the purchaser may specify a suitable moisture content. If this is done, the purchaser should consider the implications to creep deflection using the design process in AS 1720.1.

NOTE 2 AS 1720.1 and the AS 1684 series specify specific moisture content for timber to be used as seasoned timber.

NOTE 3 Attention is drawn to the need to consider any circumstances that may require seasoning to a particular moisture content outside the range specified above (e.g. in areas of high or low equilibrium moisture content). Information on the equilibrium moisture content applicable to species under particular use conditions may be available from timber research organisations.

NOTE 4 Conformance limits for the verification of moisture content are specified in Table G.1 AS/NZS 4490:2011.

1.9 Characteristics

1.9.1 Measurement of characteristics

The measurement of characteristics shall be as given in [Appendix C](#).

1.9.2 Combination of characteristics

A combination of characteristics shall be permitted if the aggregate size of the combination is less than that of one characteristic of the maximum permissible size.

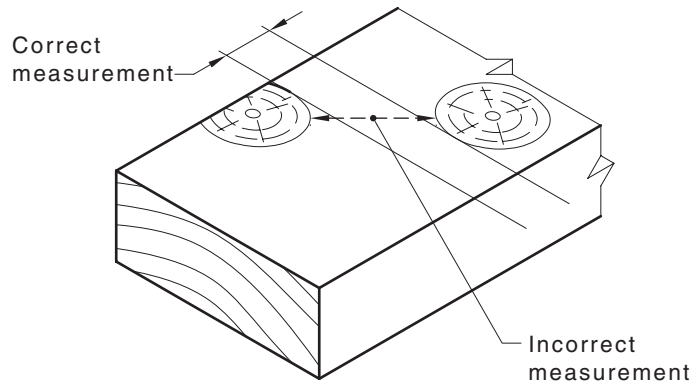
A combination exists when two or more characteristics occur in a length of the piece such that there is less than the lesser of 150 mm and twice the width of the piece between them. Characteristics in combination may not necessarily appear on the same surface (see [Figure 1.2](#)).

The distance between characteristics shall be measured parallel to the length of the piece between lines drawn at 90 degrees to the arrises (see [Figure 1.2](#)).

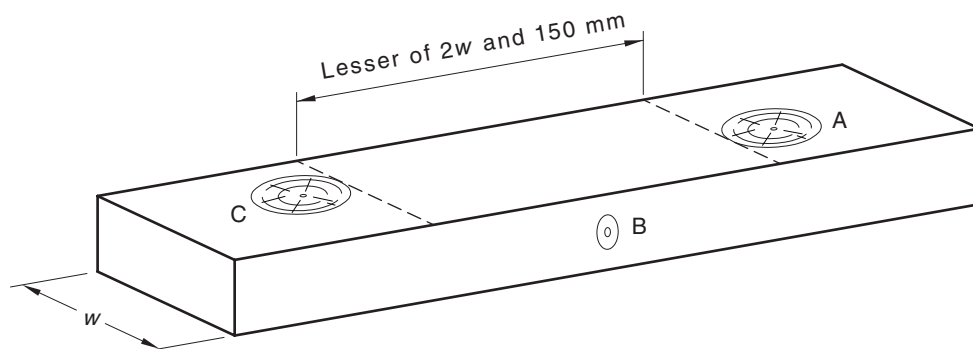
If bow, spring, twist or cup is present in the piece, each shall be measured separately. These shall be deemed not to be in combination with each other or with any other characteristic.

Example 1 Considering the case of a “face” knot and an “other” knot in combination, if the “face” knot is only 30 % of the maximum permitted size for a “face” knot, then the “other” knot may be up to 70 % of the maximum permitted size for an “other” knot.

Example 2 Considering the case of a face knot and an overgrowth of injury in combination, if the face knot is only 40 % of the maximum permitted size for a face knot, then the overgrowth of injury may be up to 60 % of the maximum permitted size for an overgrowth of injury.



(a) Method of measurement of distance between characteristics



(b) Examples of combinations

NOTE 1 Given that A is 90 % of its allowance, B is 15 % of its allowance, and C is 85 % of its allowance, the combination of B and C conforms to the rules for combinations, but the combination of A and B does not conform to the rules for combinations.

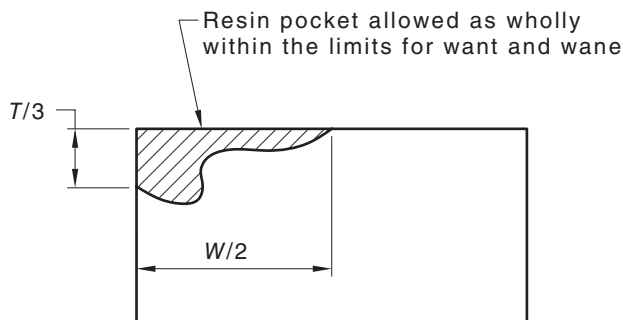
NOTE 2 C and B are in combination and A and B are in combination, while A and C are not in combination.

Figure 1.2 — Combinations of characteristics

1.9.3 Want and wane

Irrespective of the limits imposed by the grade descriptions, any characteristic or combination of characteristics occurring wholly within the limits prescribed for want and wane shall be permitted (see [Figure 1.3](#)).

NOTE This does not apply to enclosed termite galleries as they may extend well beyond the visible portion of the gallery.



NOTE This figure shows a 90 mm × 45 mm piece within structural grade no. 2.

Figure 1.3 — Characteristics occurring within the limits for want and wane

1.9.4 Mechanical damage

Damage caused by hooks, ropes, forklifts and the like shall be permitted provided that the effect of the damage is not more than that of a permissible characteristic.

1.10 Grade limitation and grading

1.10.1 Basis

Grading to the structural grades in this document is based on assessing the characteristic or group of characteristics within a piece to determine which has the greatest limiting effect on the grade of that piece when assessed in accordance with the grading rules. Each piece shall be inspected on all surfaces and ends.

NOTE In some instances, the grade limits are expressed in terms of fractions in order to simplify the process of visual grading.

1.10.2 Limitations

The grade descriptions in [Sections 2, 3 and 4](#) take into account all characteristics known to have an effect on strength and describe material on the lower limit of that grade. Each parcel shall contain a range of material so that not all of the material is near the lower limits of the grade.

1.10.3 Variations in assessment

Within any parcel, a maximum variation of 5 % between the gradings of pieces by individual inspectors or graders shall be acceptable for use provided none of the pieces in the disputed 5 % falls more than one grade below the designated grade. If grading to the lowest grade, no piece in the disputed 5 % shall have characteristics that exceed the maximum allowed in the grade by more than 10 %.

1.10.4 Resawing

If the cross-section of the piece of timber is reduced by longitudinal sawing or dressing, the original grading shall be invalid.

1.10.5 Moisture content of preservative-treated timber

Where timber is seasoned and subsequently preservative treated, the preservative treatment process may increase the moisture content of timber considerably and, therefore, affect the structural properties. Unless such timber is redried to the moisture content range for seasoned timber, it does not conform to the requirements of this document for seasoned timber.

1.10.6 Docking of multiple lengths

When grading a piece of timber that is to be supplied as a multiple of a shorter ordered length, it may be graded as if it was in the shorter lengths.

1.11 Preservative treatment

When timber graded in accordance with this document is preservative treated, the treatment shall confer adequate durability for the end use.

1.12 Identification of grade

If the timber is branded, labelled, stamped or marked to indicate that it conforms to this document, the information shall be legible and include the following:

- (a) The designation of this Australian Standard, i.e. AS 2858.
- (b) Identification of the source of grading.
- (c) Identification of the species, species group or species mixture.
- (d) If graded as seasoned, the word “SEASONED” or the abbreviation “S” (see [Clause 1.7](#)).

NOTE 1 Timber marked with a species mixture name given in [Tables A.2](#) or [A.5](#) should not include species other than those listed in the appropriate groups in [Tables A.2](#) and [A.5](#).

NOTE 2 The marking of a stress grade on visually graded timber, as provided for in this document, gives a link to the stress grade structural properties specified in AS 1720.1.

NOTE 3 Additional branding may be required, for example, when a product is preservative treated.

1.13 Check on accuracy of the grading method

1.13.1 General

The accuracy of the grading method shall be checked by sampling and testing graded timber at least once per year.

Where species mix and production methods are very similar for a number of producers, products may be pooled, but the result from the check (pass or fail test) shall apply to all mills contributing to the sample.

NOTE 1 It is advisable that all structural properties be checked against [Clause 1.4](#) if resource or production methods have changed.

NOTE 2 Guidance on verification of production is contained within AS/NZS 4490.

Where pooling of data from multiple mills occurs, the individual sample number contributed from each mill may be less than that required in [Clause 1.13.2](#). However, the total sample number from all mills in the pooling group shall meet the requirements of [Clause 1.13.2](#).

1.13.2 Sampling

A sample consisting of at least 100 specimens of the the most common grade and size combination shall be obtained. The specimens shall be cumulatively drawn from production throughout the year. The specimens shall be drawn at random, so that each sample is free of bias and represents the production.

Where a product contains a mix of species, the proportion of species in the sample shall be similar to that in typical production.

Where the sample has been stored, the moisture content shall conform to the moisture content requirements of this document at the time of testing if seasoned, or the moisture content as defined for unseasoned timber in AS 1720.1.

NOTE Mills producing unseasoned timber may need to store accumulated samples under plastic wrap and dispatch samples for testing more frequently, in order to mitigate any potential change in structural properties due to moisture content change.

1.13.3 Testing

Timber shall be tested for modulus of elasticity (MOE) and either bending or tension strength. The location of the test within the length of the sample shall be random. Test equipment shall be maintained by trained staff using calibrated equipment. Calibration of the test rig shall be conducted at least annually. Testing shall be in accordance with AS/NZS 4063.1 with the following exceptions:

- (a) If the testing is performed soon after production, ambient conditions are acceptable.
- (b) Where sampled timber is stored under cover for some time, the moisture content at the time of testing shall be within the bounds defined in this document for the moisture condition of the product.

The two test stages are as follows:

- (i) At the first stage, a minimum of 50 specimens shall be selected at random from the accumulated sample and tested. Test results shall be evaluated as described in [Clause 1.13.4](#). Where both the evaluated properties exceed the characteristic values for design, there is no need to progress to the second stage.
- (ii) At the second stage, if the first stage testing gave a characteristic value for MOE or a characteristic value for strength that did not exceed the characteristic values for design for the properties, the remaining specimens in the sample shall then be tested. The results of the first and second stage test results shall be pooled to give a single data set.

Moisture content and density shall be recorded for all specimens.

1.13.4 Evaluation

1.13.4.1 Modulus of elasticity (MOE)

The MOE shall be evaluated from all test specimens from either the first stage or the pooled data from the first and second stage testing, as applicable.

The mean MOE of the tested specimens shall be determined as the arithmetic average of the MOE values.

The MOE shall be evaluated as follows:

- (a) Where the mean MOE is greater than or equal to the characteristic value for design for the nominates stress grade, the MOE shall “pass”.
- (b) Where the mean MOE is less than the characteristic value for design for the nominates stress grade, the MOE shall “fail”.

1.13.4.2 Strength property

One strength property, from either the bending strength or the tension strength, shall be evaluated on all test specimens from either the first stage of testing or the pooled data from the first and second stage of testing, as applicable.

The fifth percentile strength of the test specimens shall be evaluated using a log-normal fit through all of the test data.

The strength property shall be evaluated as follows:

- (a) Where the fifth percentile strength ($R_{0.05}$) is greater than or equal to the characteristic value for design for the nominates stress grade, the strength shall “pass”.
- (b) Where the fifth percentile strength ($R_{0.05}$) is less than the characteristic value for design for the nominates stress grade, the strength shall “fail”.

1.13.5 Results

The check on grading accuracy shall “pass” only if both MOE and strength give “pass” results. Otherwise, the check shall “fail”.

A “pass” result shall mean that the permissible characteristics in the grade descriptions in [Sections 2, 3](#) or [4](#), as applicable, do not need to be altered.

A “fail” result shall be interpreted as meaning that the permissible characteristics in the grade descriptions in [Sections 2, 3](#) or [4](#), as applicable, need to be altered to be more conservative.

NOTE A failed annual check does not imply that production during the sampling period is non-conforming.

Section 2 Grade descriptions

A summary of the grade descriptions is provided in [Appendices C, D and E](#).

2.1 Structural grade no. 1

2.1.1 General

Each piece of timber of structural grade no. 1 shall conform to the requirements of [Section 1](#). Structural grade no. 1 timber shall be free from the following:

- (a) Compression failures and other fractures.
- (b) Occluded branch stubs.
- (c) Termite galleries.
- (d) Resin pockets.
- (e) Bark pockets.
- (f) Overgrowths of injury.
- (g) Shakes.
- (h) Splits.
- (i) End-splits.
- (j) Decay.

No piece shall be of exceptionally low density in accordance with AS/NZS 4491.

NOTE See [Tables A.1](#) and [A.3](#) for average species density.

2.1.2 Permissible characteristics

Where present in graded pieces, singly or in combinations, the following characteristics shall be within the limits prescribed in this clause (see also [Clauses 1.9.3](#) and [1.9.4](#)):

- (a) *Knots (tight or loose, sound or unsound, intergrown or not, round or oval, single or in clusters), including knot holes, cone holes and holes other than those caused by insects —*
 - (i) *face and edge, wholly within the central half of the face or edge — knot-area ratio shall not exceed 25 %; and*
 - (ii) *other — knot-area ratio shall not exceed 15 %.*
- (b) *Borer holes —*
 - (i) *diameter of up to and including 3 mm — shall not exceed 10 borer holes in any 100 mm × 100 mm or equivalent area of the surface on which they occur; and*
 - (ii) *diameter of over 3 mm and up to and including 10 mm — shall not exceed 1 borer hole in any 100mm × 100 mm or equivalent area of the surface on which they occur.*
- (c) *Slope of grain — shall not exceed 1 in 15.*
- (d) *Width of growth rings within 50 mm of the centre of the pith — shall not exceed 6 mm.*
- (e) *Pith — unlimited.*

- (f) *Checks other than internal* —
 - (i) *width* — shall not exceed 2 mm; and
 - (ii) *individual length* — shall not exceed 450 mm.
- (g) *Wane or want* —
 - (i) shall not exceed one-tenth of the cross-sectional area;
 - (ii) *in pieces that are up to and including 38 mm thick* — shall not exceed one-seventh of the width of the surface on which it occurs; and
 - (iii) *in pieces that are over 38 mm thick* — shall not exceed one-third of the edge on which it occurs and not exceed one-half of the width of the face on which it occurs.
- (h) *Stain* — unlimited.
- (i) *Sapwood* — unlimited.
- (j) *Bow, spring and twist* — shall not exceed the amount given in [Tables B.1](#) and [B.2](#).
- (k) *Cup* — shall not exceed 1 mm per 50 mm of width.

2.2 Structural grade no. 2

2.2.1 General

Each piece of timber of structural grade no. 2 shall conform to the requirements of [Section 1](#). Structural grade no. 2 timber shall be free from the following:

- (a) Compression failures and other fractures.
- (b) Occluded branch stubs.
- (c) Termite galleries.
- (d) Shakes.
- (e) Splits.
- (f) End-splits.
- (g) Decay.

No piece shall be of exceptionally low density.

NOTE See [Tables A.1](#) and [A.3](#) for average species density.

2.2.2 Permissible characteristics

Where present in graded pieces, singly or in combinations, the following characteristics shall be within the limits prescribed in this clause (see also [Clauses 1.9.3](#) and [1.9.4](#)):

- (a) *Knots (tight or loose, sound or unsound, intergrown or not, round or oval, single or in clusters), including knot holes, cone holes and holes other than those caused by insects* —
 - (i) *face and edge, wholly within the central half of the face or edge* — knot-area ratio shall not exceed 40 %; and