

Australian Standard™

**Timber—Methods of test for mechanical
fasteners and connectors—Basic
working loads and characteristic
strengths**

This Australian Standard was prepared by Committee TM-001, Timber Structures. It was approved on behalf of the Council of Standards Australia on 27 April 2001 and published on 19 June 2001.

The following interests are represented on Committee TM-001:

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Australian Timber Importers Federation
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This Standard was issued in draft form for comment as DR 99322.

Australian Standard™

Timber—Methods of test for mechanical fasteners and connectors—Basic working loads and characteristic strengths

Originated as AS A188—1972.
Previous edition AS 1649—1998.
Third edition 2001.

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Published by Standards Australia International Ltd
GPO Box 5420, Sydney, NSW 2001, Australia

ISBN 0 7337 3905 9

PREFACE

This Standard was prepared by the Joint Standards Australia/Standards New Zealand Committee TM-001, Timber Structures, to supersede AS 1649—1998.

This Standard is the result of a consensus among Australian and New Zealand representatives on the Joint Committee to produce it as an Australian Standard.

The objective of this Standard is to provide methods for the determination of basic design information for use in the application of particular mechanical fasteners in timber construction. The Standard also provides procedures for testing jointing systems incorporating mechanical fasteners.

A comprehensive editorial and technical revision of the previous edition has been carried out. In particular, Clauses 2.2.6 and 3.2.5 have been divided into subclauses, to differentiate the methods between timber failure and metal failure. A clause on determination of the characteristic load capacity for fastener that failed in metal under lateral load has been added.

The Standard presumes that before any of the described tests for determining characteristic strengths for a particular fastener are commenced some exploratory testing would be expected, to indicate the likely performance of the fastener and the requirements of the fastener regarding the limiting timber size, edge distance and end distance. The information from the exploratory testing will seldom be precise; therefore, further investigation may be required for the purpose of improving joint efficiency and design information.

Statements expressed in mandatory terms in notes to tables are deemed to be requirement of this Standard.

The terms ‘normative’ and ‘informative’ have been used in this Standard to define the application of the appendix 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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STANDARDS AUSTRALIA

Australian Standard

**Timber—Methods of test for mechanical fasteners and connectors—
Basic working loads and characteristic strengths**

SECTION 1 SCOPE AND GENERAL

1.1 SCOPE

This Standard defines categories of mechanical fasteners for timber, specifies methods of testing joints incorporating mechanical fasteners and sets out procedures for the determination of basic design information applicable to timber joints in which the fasteners are incorporated.

NOTE: Recommended species for establishing values for joint groups are given in Appendix A.

1.2 REFERENCED DOCUMENTS

The following documents are referred to in this Standard:

AS

1391	Methods for tensile testing of metals
1720	Timber structures
1720.1	Part 1: Design methods
2193	Methods for calibration and grading of force-measuring systems of testing machines
1148	Timber—Nomenclature—Australian, New Zealand and imported species

AS/NZS

1080	Timber—Methods of test
1080.1	Part 1: Moisture content
1080.3	Part 3: Density
1148	Timber —Nomenclature — Australian, New Zealand and imported species

1.3 DEFINITIONS

For the purpose of this Standard, the definitions below apply.

1.3.1 Fastener

A unit fastening device, together with other components that may be required, that enables a sound structural joint to be made between two or more timber members, or between timber and members of other structural materials.

1.3.2 Category A fasteners

Fasteners such as nails, staples and screws, which are used to construct a joint in which the fasteners may be subjected to either lateral or axial loading, or both (see Figure 1.1).

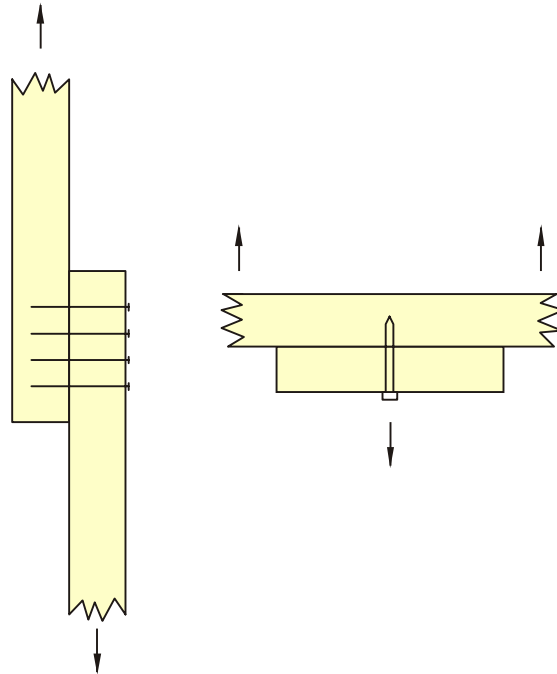


FIGURE 1.1 CATEGORY A FASTENER

1.3.3 Category B fasteners

Fasteners other than nails, staples or screws, acting as dowels, or the like, capable of transferring load from the face of one joint member to the face of another, the two faces involved lying in planes parallel to one another (see Figure 1.2).

NOTE: These fasteners are required to be set in pre-drilled holes or in pre-cut grooves or, if toothed, to be placed between the members, which are subsequently pressed together to effect the joint. Connectors made with special types of fasteners of this category almost invariably require a bolt to keep the members from moving apart from one another and thereby reducing the effectiveness of the fastener.

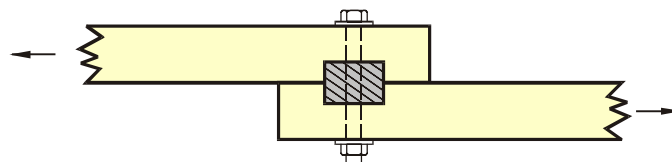


FIGURE 1.2 CATEGORY B FASTENER

1.3.4 Category C fasteners

Fasteners acting as gussets or splice plates capable of transferring load from the face of one member to the face of another, the two faces involved lying in the same plane (see Figure 1.3).

NOTE: Such fasteners are usually of flat steel plate either pre-drilled to allow nails to be driven through them into the timber members, or with attached teeth formed from the parent metal, the toothed plates being pressed into the timber members to form the required joint.

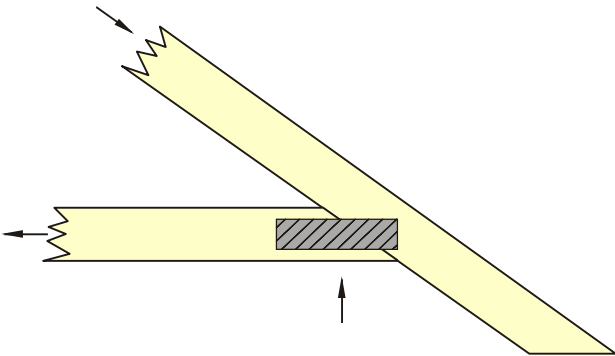


FIGURE 1.3 CATEGORY C FASTENER

1.3.5 Category D fasteners

Fasteners acting as brackets capable of transferring load from the face of one joint member to the face of another, the two faces involved usually lying in planes at right angles to each other (see Figure 1.4).

NOTE: Such fasteners are usually of steel plate, preformed to shape and pre-drilled to allow nails to be driven through them into the timber members.

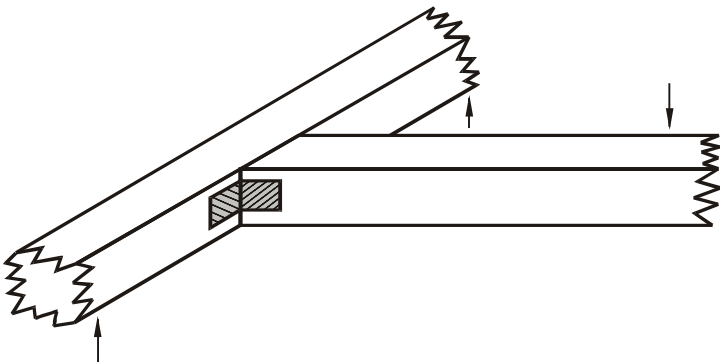


FIGURE 1.4 CATEGORY D FASTENER

1.4 NOTATION

The following symbols are used in this Standard:

- a, a_1, a_2 = specimen dimensions shown in Figures 2.2, 2.3, 2.4 and 2.8
- b = specimen dimensions shown in Figures 2.4 and 2.8
- D = diameter of nail or screw, in millimetres
- d_1, d_2 = fastener dimensions shown in Figure 2.3
- f_c = bearing strength parallel to the grain for joint groups (Table 3)

H_1, H_2	=	factor for timber condition
i	=	individual test value number, 1 to n (used in Appendix B)
k	=	constant used to calculate 5th percentile of logarithm of test values
K_{sec}	=	secant modulus (used in Clause 3.4)
LPL	=	lower probability limit (usually the 5th percentile)
l, l_1, l_2, l_3	=	specimen dimensions shown in Figures 2.2, 2.3, 2.4, 2.8 and 2.9
m	=	sample mean
n	=	number of test values (used in Appendix B)
N	=	the total number of fasteners or of single shear units (nails or teeth) acting in one member of the joint
$P_{\text{max.}}$	=	maximum load resisted before failure
P_1	=	5th percentile LPL of the maximum loads, $P_{\text{max.}}$
P	=	load applied to specimen
P_2	=	average of the maximum loads, $P_{\text{max.}}$
P_3	=	5th percentile LPL of the loads at 2.5 mm displacement
p	=	fastener penetration, in millimetres; or coefficient adjusting the basic working load (used in Clause 3.2.2)
R_{bwl}	=	basic working load (used in Clause 3.2)
R_k	=	characteristic load capacity (used in Clause 3.5)
S	=	expected maximum load (used in Clause 2.2.6.2(b))
s	=	standard deviation (used in Appendix B)
t, t_1, t_2	=	specimen dimensions shown in Figures 2.2, 2.3, 2.4, 2.8 and 2.9
$t_{0.1}$	=	factor relating to statistical analysis
ULL_1, ULL_2, ULL_3	=	unilateral load per fastener (used in Clause 3.2)
w, w_1, w_2, w_3	=	specimen dimensions shown in Figures 2.2, 2.3, 2.4, 2.8 and 2.9
x_i	=	individual test value (used in Appendix B)
$\bar{y}$	=	mean logarithm of n test values (used in Appendix B)
$y_{5 \text{ percent}}$	=	5th percentile lower probability limit of the logarithm of test values (used in Appendix A)
y_i	=	logarithm of test value (used in Appendix B)
δ_0	=	displacement of joint at basic working load (used in Clause 3.4)

1.5 SAMPLING OF FASTENERS AND TIMBER

1.5.1 Fasteners

The fasteners selected for test purposes shall be representative of commercial production.

1.5.2 Timber

The timber selected for test purposes shall comply with the following requirements:

- (a) **Quality** No significant strength reducing characteristics shall be present except small pin knots, and the like, if typical of the species.

- (b) *Species* When general design data are required, the species shall be chosen from those in common use as structural timbers.

When establishing the properties of a fastener in a particular joint group, a relatively obscure species shall not be selected.

The species chosen shall be positively identified.

NOTE: For example, the selection of a timber broadly classified as Victorian hardwood, which could be either a single species or a mixture of several species representing a fairly wide range of strength properties, would not be appropriate for establishing design values for a specific joint group.

Clause 1.8 specifies requirements for species suitable for tests for the determination of design properties for the joint strength groups provided for in AS 1720.1.

- (c) *Representation* Sampling shall be such that the specimens are representative of the material sampled.

NOTE: A random selection of the test material from a sufficiently large parcel, or preferably from several parcels of sawn timber of the required species, is usually regarded as representative.

- (d) *Moisture content* For timber intended for use in the green condition, the moisture content at the time of selection shall be more than 30%, and the timber shall be stored so that its moisture content does not fall below that level.

Moisture content for selection purposes shall be determined in accordance with AS/NZS 1080.1.

1.6 TEST CONDITIONS FOR TIMBER

1.6.1 Dry timber

Timber specimens that are to be tested in the dry condition shall be stored so as to ensure uniformity of moisture content within the range of 10% to 15%.

NOTE: For most species, an average uniform moisture content of approximately 12% can be achieved by exposure for a sufficient period to conditions approximating 65% relative humidity at 20°C.

1.6.2 Green timber tested green

Timber specimens that are to be tested in the green condition shall be maintained by suitable means at a moisture content in excess of 30%, before and after joint assembly, until they are tested.

1.6.3 Green timber tested dry

Many types of fasteners, under certain conditions of loading, undergo significant changes in the strength properties of a joint after assembly, particularly if the joint is assembled with green timber and the timber then dries before loading.

Joints fabricated with green timber intended to be tested in the dry condition shall, immediately after preparation, be open-stacked under conditions similar to those specified for dry timber in Clause 1.6.1. The stacking shall be such as to allow a free flow of air over all faces and ends of all specimens. The specimens shall remain in this condition until a uniform moisture content within the range 10 to 15% is achieved.

NOTES:

- 1 End-grain surfaces of specimens being dried from the green condition should be coated with emulsified wax or similar sealing compound, to reduce the rate of end-drying and the incidence of end checking.
- 2 To comply with the requirements for green timber tested in the dry condition, it may be necessary to kiln-dry specimens using mild conditions to minimize surface and internal checking. Suitable kiln-drying schedules for refractory species are available from CSIRO.

1.7 CONDUCT OF TESTS

1.7.1 Apparatus

The tests shall be carried out in a testing machine of B Class or better (see AS 2193) and of suitable capacity.

NOTE: It is desirable that joints to be tested in tension should have the opportunity for self-alignment, and apparatus used for holding or supporting the specimens should, if practicable, be designed with this in view. Similarly, the use of a self-aligning head in the conduct of compression tests is preferred to one that is fixed.

1.7.2 Temperature

Testing shall be carried out at a temperature of not less than 20°C.

NOTE: Where the effect of temperature on joint strength is being specifically investigated lower temperatures may be appropriate.

1.7.3 Moisture content and density

The moisture content and density of each specimen prepared shall be determined immediately after testing by the methods specified in AS/NZS 1080.1, using the oven dry method, and AS/NZS 1080.3, respectively.

1.7.4 Numbers of specimens for establishing design properties

Where design properties of fasteners in seasoned timber are required, at least 10 joints for each test series shall be fabricated and tested using seasoned timber.

Where design properties of fasteners in unseasoned timber are required, two sets each of at least 10 joints shall be fabricated for each test series using green timber, one for testing in the green condition (see Clause 1.6.2) and one for testing after conditioning (see Clause 1.6.3).

1.7.5 Time of testing

Specimens shall be kept for at least 14 days after assembly and driving of any fasteners to allow for relaxation of joint materials.

Specimens shall be appropriately stored in accordance with Clause 1.6 until testing.

1.8 TEST SPECIES FOR JOINT STRENGTH GROUPS

For the purposes of establishing appropriate design loads for a fastener for a joint strength group provided for in AS 1720.1, the mean air-dry density of the timber selected to represent the joint group shall be at the bottom end of the range of density given in Table 1.

NOTES:

- 1 More information on timber density is given in Paragraph C8, Appendix C.
- 2 Suitable species complying with this requirement are listed in Appendix A.
- 3 Species mean densities of most Australian and some imported species may be obtained from CSIRO, Division of Forest Products, Technological Paper No. 13 (1961), Shrinkage and Density of Australian and Other Woods, by R.S.T. Kingston and C. June E. Risdon.
- 4 For Category C fasteners that are characterized as having very short teeth, care should be taken when selecting species suitable for use in generating joint group design loads. Where these fasteners are used in species that exhibit defined earlywood/latewood bands, tests on these species should be included within the testing program.

TABLE 1
MEAN DENSITY RANGE FOR JOINT GROUPS

Joint group	Group mean basic density range, kg/m ³
UNSEASONED TIMBER (group mean basic density)	
J1	> 750
J2	600 to 745
J3	480 to 595
J4	380 to 475
J5	300 to 375
J6	240 to 295
SEASONED TIMBER (group mean air-dry density at 12% moisture content)	
JD1	> 940
JD2	750 to 935
JD3	600 to 745
JD4	480 to 595
JD5	380 to 475
JD6	300 to 375