



Plywood—Formwork



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 - Australian Forest Products Association
 - Australian Timber Importers Federation
 - Australian Wood Panels Association
 - Engineered Wood Products Association of Australasia
 - Forest and Wood Products Australia
 - Furntech-AFRDI
 - Glued Laminated Timber Association of Australia
 - Master Builders Australia
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-

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Australian Standard[®]

Plywood—Formwork

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PREFACE

This Standard was prepared by the Australian members of the Joint Standards Australia/Standards New Zealand Committee TM-011, Engineered Timber Products, to supersede AS 6669—2007. After consultation with stakeholders in both countries, Standards Australia and Standards New Zealand decided to develop this Standard as an Australian Standard rather than an Australian/New Zealand Standard.

The objective of this Standard is to provide minimum performance requirements and specifications for the manufacture and application of plywood for use in the specific application of concrete formwork in Australia.

This Standard describes formwork plywood products, either overlaid or non-overlaid, that are suitable, subject to correct installation and design of the formwork, for providing a concrete surface finish meeting Classes 2, 3, 4 and 5 off-form finishes as specified in AS 3610.1, *Formwork for concrete*. Attention is drawn to the mandatory requirements of AS 3610.1 for the need to undertake test pours where colour control or surface finishes of Class 2 or better are specified.

Significant changes in this 2016 edition include:

- (a) The alignment of characteristic structural properties for stress-grades with AS/NZS 2269.0:2012, *Plywood—Structural*, Part 0: *Specifications*.
- (b) The alignment of the specified methods for the determination of stress-grades with AS/NZS 2269.0:2012, *Plywood—Structural*, Part 0: *Specifications*.
- (c) Inclusion of new standard constructions to reflect latest product development and manufacturing practices.
- (d) The inclusion of formaldehyde emission classes for formwork plywood.

Notes used in this Standard are of an advisory nature only and are used to give explanation or guidance to the user on recommended considerations or technical procedures, or to provide an informative cross-reference to other documents or publications. Notes to clauses in this Standard do not form a mandatory part for compliance with this Standard.

The terms ‘normative’ and ‘informative’ have been used in this Standard 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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FOREWORD

This Standard is for formwork plywood at the point of manufacture, intended to deliver concrete surface classes in accordance with AS 3610.1. In addition to this Standard, subsequent factors after the point of manufacture, such as on-site handling and use, environmental exposure, storage, design and number of reuses, etc. will influence the resultant class of surface finish.

Guidance can be sought from industry bodies on the correct use, application and design of formwork plywood.

The plywood may be of either hardwood or softwood veneers, or a combination of both. The quality of veneers and surface quality is judged in the finished panel.

The quality of impregnated overlay papers is described using the paper/total weight ratio method.

Three veneer qualities, F, C, D are prescribed as follows:

- (a) F—a non-appearance grade, which is a suitable substrate for the bonding of overlay papers.
- (b) C—a non-appearance grade with a solid surface.
- (c) D—a non-appearance grade with permitted open imperfections.

Additionally, two veneer qualities U2 and U3 are recommended for use as underlay veneer, as follows:

- (i) U2—a non-appearance grade, suitable for use as an underlay veneer immediately beneath the face veneer in formwork plywood intended for a Class 2 surface finish. This grade permits solid defects but restricts the size of open imperfections, which may impair the surface quality meeting Class 2 surface requirements.
- (ii) U3—a non-appearance grade, suitable for use as an underlay veneer immediately beneath the face veneer in formwork plywood intended for a Class 3 surface finish. This grade permits solid defects but restricts the size of open imperfections, which may impair the surface quality meeting Class 3 surface requirements.

Two methods for determining the stress grade for the formwork plywood are described using the following bases:

- (A) Mechanical F-grading of formwork plywood panels.
- (B) In-grade testing of formwork plywood panels.

Two bond types, A and B, are incorporated in the Standard to cover a range of bond durability requirements for formwork plywood across a range of applications and re-use conditions.

STANDARDS AUSTRALIA

Australian Standard
Plywood—Formwork

SECTION 1 SCOPE AND GENERAL

1.1 SCOPE

This Standard specifies requirements for the manufacture, grading, finishing and branding of plywood used specifically in formwork, with a maximum length of 3100 mm and width of 1500 mm, intended to meet off-form surface finish requirements of Classes 2, 3, 4 and 5 as specified in AS 3610.1.

This Standard does not include specifications for formwork plywood intended to meet off-form surface finish Class 1.

Specifications for stress and surface grades, overlays, veneer qualities, bond quality, standard lay-up construction, dimensional tolerances, joints, moisture content and characteristic strength and stiffness values for the nominated F-grades are provided.

The following alternative methods for the determination of stress grades for formwork plywood are specified:

- (a) Mechanical F-grading of the finished sheet of formwork plywood.
- (b) In-grade testing of finished formwork plywood panels.

Three outer veneer grades, based on the veneer quality of the face and back veneers; F, C and D are prescribed, and four surface quality grades Classes 2, 3, 4 and 5 are described.

Two bond types, A and B, are specified.

Formwork plywood is usually a multiple-use product subject to on-site handling and use, environmental exposure, storage, design and number of re-uses, etc. The physical and structural characteristics of formwork plywood products, as branded and specified in this Standard, are appropriate for the products as manufactured. Inspection of the product is required at all stages including but not limited to, before and after each use, to ensure ongoing required performance across all characteristics.

NOTE: Structural adjustment factors for multiple uses are specified in AS 3610.1.

1.2 APPLICATION

The specification for any grade of formwork plywood shall comply with the requirements of the following Sections:

- (a) General requirements..... Section 1.
- (b) Requirements for veneers..... Section 2.
- (c) Requirements for surface quality Section 3.
- (d) Manufacturing requirements Section 4.
- (e) Application of stress grades and mechanical properties Section 5.

Relevant requirements are also specified in the following normative Appendices:

- (i) Section properties Appendix B.
- (ii) Method for mechanically F-grading formwork plywood panels Appendix C.

(iii) Overlay test methods Appendix F.

NOTES:

- 1 Appendix A provides recommendations for correct storage and handling of formwork plywood.
- 2 Appendix D provides means for demonstrating compliance with this Standard.
- 3 Appendix E provides information that should be supplied with inquiries and orders for formwork plywood.
- 4 Appendix G provides recommendation for underlay veneer qualities U2 and U3.
- 5 Appendix H provides guidelines for surface finish class.

1.3 NORMATIVE REFERENCES

The following normative documents are referenced in this Standard:

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

AS

- 3610 Formwork for concrete
 3610.1 Part 1: Documentation and surface finish

AS/NZS

- 1604 Specification for preservative treatment
 1604.3 Part 3: Plywood
- 2098 Methods of test for veneer and plywood
 2098.1 Method 1: Moisture content of veneer and plywood
 2098.2 Method 2: Bond quality of plywood (chisel test)
 2098.3 Method 3: Bond quality and strength of scarf joints in plywood
 2098.4 Method 4: Measurement of dimensions and shape for sheets of veneer and plywood
 2098.11 Method 11: Determination of formaldehyde emissions for plywood
- 2269 Plywood—Structural
 2269.0 Part 0: Specifications
 2269.1 Part 1: Determination of structural properties—Test methods
 2269.2 Part 2: Determination of structural properties—Evaluation methods
- 2754 Adhesives for timber and timber products
 2754.1 Part 1: Adhesives for manufacture of plywood and laminated veneer lumber (LVL)
- 4063 Characterization of structural timber
 4063.2 Part 2: Determination of characteristic values
- 4491 Timber—Glossary of terms in timber-related Standards

1.4 DEFINITIONS

For the purpose of this Standard, the definitions given in AS/NZS 4491 apply.

1.5 GRADES OF FORMWORK PLYWOOD

1.5.1 General

Formwork plywood shall be graded according to surface quality (e.g. Class 2, Class 3), stress grade (e.g. F11, F14, F17), bond durability type that is Type A or Type B, and, where appropriate, surface veneer quality (e.g. CC).

1.5.2 Surface quality

The surface quality of the formwork plywood shall be capable of meeting the off-form finish Class 2 to Class 5 prescribed in AS 3610.1. The formwork plywood shall be branded to indicate the highest class of off-form finish achievable with the product (e.g. Class 2, Class 3).

NOTES:

- 1 Details on formwork plywood surface quality requirements are provided in Section 3.
- 2 For guidelines on surface finish class, see Appendix H.

1.5.3 Veneer qualities

The standard face and back veneer quality shall be Grade F, Grade C or Grade D and shall correspond to qualities F, C and D veneer in accordance with Section 2.

Where appropriate, the face and back veneer grade of the formwork plywood shall be designated by a combination of letters that denote the quality of the face veneer (first letter) and the back veneer (second letter) (see Note 1).

The quality of veneer and surface quality shall be assessed in the finished panel (see Note 2).

Core and long-band veneers shall be a minimum quality D, except where structural properties are determined via in-grade testing of product manufactured to a written manufacturing specification as specified in Clauses 5.3 and 2.5, respectively (see Note 3).

Other veneer qualities may be used, provided the quality is defined in a manufacturing specification and an equivalent quality of surface finish and structural performance is delivered.

NOTES:

- 1 For example, CC grade represents formwork plywood with a C grade face veneer and C grade back veneer.
- 2 Underlay veneers should be quality U2, U3, C or D depending on the surface finish and thickness of the face veneer as specified in Section 3.
- 3 The use of veneer of qualities specified in Section 2 is not intended to be restrictive.

1.5.4 Stress grades

F-grades for formwork plywood shall be F7, F8, F11, F14, F17, F22, F27 and F34.

NOTE: Procedures for the application of F-grades are provided in Section 5.

Other stress grades with specific characteristic strength and stiffness properties may be determined in accordance with in-grade testing procedures specified in Clause 5.3.

Other stress grades shall be defined by—

- (a) a suite of published structural properties; or
- (b) publishing of span tables based on specific structural properties.

Both of the above shall be linked to the product by a unique descriptor and/or performance rating.

1.6 DIMENSIONS AND SHAPE

1.6.1 Dimensions

When measured in accordance with AS/NZS 2098.4, the actual dimensions of formwork plywood shall not differ from the ordered dimension by more than the following tolerances:

- (a) *Thickness:*
 - (i) Sheets up to and including 7.5 mm thick..... $\pm 7\%$.

- (ii) Sheets over 7.5 mm thick up to and including 17.5 mm thick.....±4%.
- (iii) Sheets over 17.5 mm thick and up to and including 25 mm thick±3%.
- (iv) Sheets over 25 mm thick not specified.

These thickness tolerances shall apply to formwork plywood prior to the addition of overlays. For standard overlays up to 60/150 overlay-grade, an additional thickness tolerance of +0.2 mm per side is permitted. Where the overlay thickness is above 0.2 mm per side in the finished panel, thickness tolerances shall be provided.

- (b) *Length and width* ±1.5 mm.

1.6.2 Shape

When measured in accordance with AS/NZS 2098.4, the formwork plywood sheets shall comply with the following requirements:

- (a) *Squareness* The difference in length of the two diagonals of the sheet shall not exceed 3 mm.
- (b) *Straightness of edges* Any edge of a sheet shall not deviate from a straight line by more than 1 mm.
- (c) *Flatness* For an unloaded sheet, the maximum distance between the underside of the sheet and a flat horizontal surface shall not exceed the following:

- (i) For sheets not exceeding 7.5 mm thick 50 mm.
- (ii) For sheets exceeding 7.5 mm thick 30 mm.

Additionally, when the sheet is loaded as specified in the following, the sheet shall touch the flat horizontal surface vertically below the loaded area:

- (A) For sheets not exceeding 7.5 mm thick 10 kg.
- (B) For sheets exceeding 7.5 mm thick 15 kg.

When loading twisted panels in which the four corners do not touch the flat horizontal surface when the sheet is in the unloaded state, three corners shall be held in contact with the flat horizontal surface while the measurement of maximum distance is taken in the unloaded state and while the specified loads are applied to the distorted area.

The tolerances on dimensions and shape shall be determined prior to installation or use. At the time of the test, panels shall be in accordance with the moisture requirements of Clause 1.7.

NOTE: At the time of the test, the panels should have been stored as recommended in Appendix A.

1.7 MOISTURE CONTENT

At the time of the formwork plywood dispatch, the moisture content anywhere within a sheet, when determined in accordance with AS/NZS 2098.1, shall be not less than 6% nor more than 15%.

In the event of dispute, the moisture content shall be determined by the oven-drying method described in AS/NZS 2098.1.

1.8 EDGE FINISH

Edges shall be solid (no missing veneer permitted except where it is associated with permitted open defects), clean cut and square to the face. Sawing defects within 5 mm of the edge shall be permitted.

Where formwork plywood is required to provide Class 2 or Class 3 off-form finish, the panel edge shall be coated to minimize moisture uptake.

1.9 JOINTS IN SHEETS

Joints in formwork plywood sheets in accordance with Clause 4.2 may be permitted by agreement between the purchaser and the vendor.

Where structural sheets are jointed, suitable reduction factors shall be applied to characteristic structural properties. These reduction factors shall be established using the in-grade testing method detailed in Clause 5.3, ensuring the joints were tested in the worst load and/or positional combinations.

1.10 LYCTID-SUSCEPTIBLE SAPWOOD

Lyctid-susceptible sapwood shall not be permitted.

NOTES:

- 1 The method for detection of lyctid-susceptible sapwood is given in AS 1604.1.
- 2 A method of rendering sapwood non-susceptible to lyctid includes treatment to hazard class H1 of AS/NZS 1604.3.

1.11 FORMALDEHYDE EMISSION CLASSES

When measured in accordance with AS/NZS 2098.11, the formaldehyde emissions from structural plywood shall be in accordance with the limits specified in Table 1.1, for emission classes Super E_0 to E_1 .

TABLE 1.1
FORMALDEHYDE EMISSIONS
FROM STRUCTURAL PLYWOOD

Emission class	Formaldehyde emission limit mg/L
Super E_0	Average 0.3, 0.4 max.
E_0	0.5 max.
E_1	1.0 max.

1.12 BRANDING

1.12.1 Branding F-grade structural plywood

Each sheet of formwork plywood shall have the following information legibly affixed thereon at the point of manufacture, at least once:

- (a) The manufacturer's name or registered mark.
- (b) The words 'formwork plywood' or product description.
- (c) Reference to this Standard, i.e. AS 6669.
- (d) Country of origin.
- (e) The surface quality Classes 2, 3, 4 or 5. Where the surface class differs from face to back, both surface qualities shall be indicated (e.g. Class 2/5).
- (f) Where appropriate, the grade of the veneers (face first, back last), e.g. CC, CD or DD.
- (g) The bond type of the glue (e.g. A BOND or B BOND, etc.)
- (h) The stress grade of the sheet (e.g. F17). If different, the stress grades both parallel and perpendicular to the face grain, in that order (e.g. F17/F14).

- (i) The section properties, as follows:
 - (i) For listed constructions in Table B1, the panel construction code, e.g. 17-10-7.
 - (ii) For unlisted or non-standard constructions, the second moment of area (I) and the section modulus (Z) in directions parallel and perpendicular to the face grain in that order, as determined in accordance with AS/NZS 2269.1 (e.g. I-195 Z-22.0/I-33 Z-8.3).
- (j) The formaldehyde emission class, e.g. E_1 (see Table 1.1).

NOTE: The requirements of Items (b), (c), (d), (f), (g) and (h) should be set out as follows:

- (a) *Example 1:*

**FORMPLY—AS 6669
CLASS 2—B BOND E_1
F17/F14—17-10-7
MADE IN AUSTRALIA**

The above example indicates a formwork plywood—

- (i) capable of providing a Class 2 off-form surface finish in accordance with AS 3610;
 - (ii) with a Type B bond;
 - (iii) a formaldehyde emission Class of E_1 ; and
 - (iv) with an F-grade of F17 parallel to grain and F14 perpendicular to grain, with a construction detailed for 17-10-7.
- (b) *Example 2:*

**FORMPLY—AS 6669
CLASS 2—B BOND E_1
F17/F14—I-195 Z-22.0/
I-33 Z-8.3
MADE IN AUSTRALIA**

The above example indicates a formwork plywood—

- (i) capable of providing a Class 2 off-form surface finish in accordance with AS 3610;
- (ii) with a Type B bond;
- (iii) a formaldehyde emission Class of E_1 ; and
- (iv) with an F-grade of F17 parallel to grain and F14 perpendicular to grain, with a non-standard construction, the second moment of area (I) = 195 mm⁴/mm and the section modulus (Z) = 22.0 mm³/mm parallel to the face grain, the second moment of area (I) = 33 mm⁴/mm and the section modulus (Z) = 8.3 mm³/mm perpendicular to the face grain.

1.12.2 Branding other stress-grade formwork plywood

Each sheet of other stress-graded formwork plywood, as permitted in Clause 1.5.4, shall have the following information legibly affixed thereon at the point of manufacture, at least once:

- (a) The manufacturer's name or registered mark.
- (b) The word 'formwork plywood' or product description.
- (c) Reference to this Standard, i.e. AS 6669.
- (d) Country of origin.
- (e) The reference to a product name or unique descriptor that identifies the structural performance characteristics of the plywood.

NOTES:

- 1 For the unique descriptor, see Clause 1.5.4.
 - 2 Other stress grades may be applied to non-standard veneer grades.
- (f) The bond type of the glueline (i.e. A BOND).
- (g) The formaldehyde emission class [e.g. E_0 (see Table 1.1)].
- (h) If immunized or preservative treated, branding in accordance with AS/NZS 1604.3.

NOTES:

- 1 The requirements of Items (b), (c), (d), (e) and (f) should be set out as follows:

Example 1:

FORMWORK PLYWOOD— AS 6669 PRODUCT NAME—A BOND—E_0 MADE IN AUSTRALIA

Example 1 indicates product labelled 'Product name' with a Type A bond and a formaldehyde emission class E_0 .

- 2 If the plywood is preservative-treated, the appropriate Standard and treatment level should also be included (e.g. AS/NZS 1604.3—H3).

SECTION 2 VENEER QUALITY

2.1 GENERAL REQUIREMENTS FOR ALL VENEERS

All veneers in a finished sheet of formwork plywood shall comply with the following requirements:

- (a) Veneers shall be free from decay and active insect attack.
- (b) Limitation for aggregate defect shall be as follows:
 - (i) For standard veneer qualities F, C and D, in any 300 mm long line drawn across the grain anywhere on the formwork plywood sheet, the aggregate dimension of knots, gaps in edge joints, splits, holes, patches, bark and resin pockets, gum veins and areas of inactive decay shall not exceed 120 mm.
 - (ii) For a non-standard veneer quality, which is permitted provided structural properties are assigned through in-grade testing in accordance with Clause 5.3, limitations for aggregate defect shall be defined in the manufacturing specification.

In non-standard quality veneer, the impact of aggregate and individual imperfection on surface finish quality shall be taken into consideration.

NOTE: For measurement of aggregate defects, see Figure 2.1.

- (c) Veneers shall be smoothly and tightly cut to a uniform thickness.
- (d) Veneers may be in more than one piece.

The veneer qualities in Clauses 2.2 to 2.4 describe veneers on the lower limit of grade. Each pack of formwork plywood shall include a reasonable distribution of panels having face veneer of quality above the lower limit.

NOTE: Recommendations for underlay veneer qualities U2 and U3 are provided in Appendix G.

2.2 QUALITY F VENEER

2.2.1 General

Each sheet of quality F veneer in a finished sheet of formwork plywood shall comply with Clause 2.1.

2.2.2 Non-permitted imperfections

The following imperfections shall not be permitted:

- (a) Bark, gum and resin pockets.
- (b) Unfilled holes, open splits and open edge joints.
- (c) Knots—loose, encased and unsound.
- (d) Severe surface roughness.