BRANZ

ISSUE 628 **BULLETIN**

SHEET FLOORING

October 2018

- Sheet flooring laid over lightweight steel or timber framing is quick and easy to install and provides improved safety on site as it creates an immediate working platform.
- This bulletin describes each sheet flooring option and its design and installation requirements.
- This bulletin updates and replaces Bulletin 371 *Particleboard flooring*.

1 INTRODUCTION

1.0.1 Sheet flooring laid over lightweight steel or timber framing is quick and easy to install and provides improved safety on site as it creates an immediate working platform.

1.0.2 This bulletin describes:
- sheet flooring options
- structural floor diaphragm design requirements for NZS 3604:2011 *Timber-framed buildings*
- recommended exposure times for sheet flooring
- general installation requirements for each flooring option
- maintenance, storage and handling.

1.0.3 Sheet flooring options for suspended floors include:
- particleboard
- strand board (treated or untreated) – also described as flakeboard, oriented strand board (OSB) or random OSB
- plywood (treated or untreated)
- cross-laminated timber (CLT) (treated or untreated)
- compressed fibre-cement sheet
- autoclaved fibre-cement sheet
- magnesium oxide boards and structural insulated panels (SIPs).

1.0.4 Wood-based sheet flooring is typically manufactured from timber shavings, flakes, strands, veneers or boards that are bonded together with adhesive and the application of heat and pressure. The resulting materials have greater strength and stability than the timber from which they are manufactured. Timber-based sheet flooring is also referred to as engineered wood products (EWPs), reconstituted wood boards (RWBs) or reconstituted wood panels (RWPs).

1.0.5 This bulletin updates and replaces Bulletin 371 *Particleboard flooring*.

2 DESIGN REQUIREMENTS

2.0.1 NZS 3604:2011 sets out the requirements for suspended timber floors including subfloor ventilation and access. It also describes the structural floor diaphragm requirements using sheet flooring materials.

2.0.2 For lightweight steel floor framing, guidance is given in NASH standards *Residential and Low-rise Steel Framing, Part 1: Design Criteria* and *Residential and Low-rise Steel Framing, Part 2: Light Steel Framed Buildings*.

2.1 SUBFLOOR VENTILATION

2.1.1 Subfloor spaces must have adequate ventilation, provided at a rate of at least 3,500 mm^2 of open vent area for every square metre of floor.

2.1.2 For continuous concrete foundation walls, ventilation openings must:
- be evenly spaced around the perimeter at 1.8 m centres maximum
- be no more than 750 mm from corners
- be located as high as possible on the foundation wall and positioned to allow a cross-flow of air
- not be obstructed in any way or by any part of the building such as a party wall or exterior vegetation
- be located no more than 7.5 m from any part of the ground under the building.

2.1.3 If any of these requirements cannot be met, an alternative is to:
- lay moisture-resistant 0.25 mm polythene sheeting over the whole of the subfloor ground area secured in place by heavy objects such as bricks, blocks or stones
- provide at least 700 mm^2 of ventilation for every square metre of floor
- ensure that the ground is graded so that water cannot pond on the DPM and will drain to the exterior.

2.1.4 For piled foundations, ventilation can be provided by:
- a continuous 20 mm wide gap between baseboards
- a 50 mm gap between the wall plate and boundary joists at the ends of cantilevered floor joists and the wall plate and joists where the bearer is cantilevered
- any other regularly spaced openings that provide the required ventilation.

2.2 SUBFLOOR CLEARANCES

2.2.1 A minimum clearance of 450 mm to the underside of the floor joists is required to provide access to the subfloor space. Specific clearance between natural ground and the underside of the flooring may also be required – 550 mm minimum for particleboard.

2.3 STRUCTURAL FLOOR DIAPHRAGMS

2.3.1 Floor diaphragms consist of sheet flooring with specific fixing patterns laid over the entire area of the diaphragm to allow a wider spacing of the bracing lines below the floor. NZS 3604:2011 sets out floor diaphragm requirements as follows:
- A maximum size of 12 m in the longest direction.
- The length and width of the diaphragm must be at right angles to one another and between brace lines.
- For a single-storey building, the diaphragm must have a maximum length of 2.5 times the width.
- For a 2-storey building, the diaphragm must have a maximum length of 2.0 times the width.
- The flooring over the entire area of the diaphragm must be a timber-based sheet material complying with AS/NZS 1860.1 *Particleboard flooring – Part 1: Specifications* or plywood complying with AS/NZS 2269 *Plywood – Structural*.

2.3.2 Diaphragms must be:
- full sheets of at least 2.4 x 1.2 m except where the building dimensions prevent the use of a complete sheet
- on floor joists that are laterally supported around the entire perimeter of the diaphragm
- fixed with either power-driven or hand-driven corrosion-resistant 60 x 2.8 mm ring-shanked hot-dip galvanised or stainless steel annular-grooved nails
- fixed at 150 mm centres around the perimeter, 300 mm centres at intermediate supports and no closer than 10 mm to the edges of the sheets
- on subfloor framing timber, fixed in accordance with NZS 3604:2011 Table 7.5.

3 COMMON REQUIREMENTS

3.0.1 A number of design and installation requirements are common across most of the sheet flooring options.

3.0.2 New Zealand Building Code clause E3 *Internal moisture* requires the floor surface in any space that contains a sanitary fixture or laundering facilities to have an impervious and easily cleaned surface. In areas exposed to watersplash that have a particleboard floor, this requirement can be met (E3/AS1) by having:

- polyvinylchloride (PVC) sheet flooring with sealed joints and coving for at least 75 mm
- ceramic or stone tiles with no more than 6% water absorption, waterproof grouted joints and an adhesive specified by the tile manufacturer
- an applied waterproof coating such as three coats of polyurethane.

3.0.3 Shower enclosures and the area within a 1,500 mm horizontal radius from the shower rose if there is no shower enclosure must have an impervious floor surface. If tiled, the tiles must be laid on a continuous impervious membrane.

3.0.4 Install flooring in accordance with the specific manufacturer's instructions.

4 PARTICLEBOARD

4.1 SHEET SIZES

4.1.1 Particleboard flooring is available in sheet sizes of 2.4 or 3.6 m long x 1.2 m wide. Sheets are 20 mm thick and typically have an average density of 740 kg/m^3.

4.2 TREATMENT AND USE

4.2.1 Particleboard is only available untreated with melamine urea formaldehyde resin added to increase weather exposure and provide increased moisture resistance when used in wet areas. Extended exposure to weather or water can result in particleboard swelling and losing strength. If used in wet areas such as bathrooms, laundries and kitchens, it must be sealed with n impervious coating.

4.2.2 Particleboard is not suitable for use:

- in any exterior situations such as open verandas
- as a decking substrate
- in any situation that will allow an ongoing moisture content of 16% or more, such as rooms with spa pools.

4.2.3 Although polyurethane is an acceptable coating under Acceptable Solution E3/AS1, some particleboard manufacturers do not believe it provides sufficient medium and long-term protection to meet all the requirements of the Building Code. They recommend that a specialist wet area waterproofing system is used.

4.3 EXPOSURE TO WEATHER

4.3.1 Particleboard may be left exposed to weather for up to 12 weeks (check with the supplier). Until the building is enclosed, the flooring should not be covered or have a liquid sealer applied.

4.3.2 If the flooring does become wet:

- do not let water remain ponded on the surface
- remove water as soon as possible by sweeping
- allow the flooring to dry naturally.

4.4 INSTALLATION

4.4.1 General installation requirements:

- Sheets should be continuous over three joists except at floor edges where infill sheets may be required.
- Square-edge sheets must be supported at all edges and may therefore require additional blocking.
- Blocking is not required under tongue and groove joints.
- Allow 8 mm minimum expansion gaps between sheet edges and fixed elements such as bottom plates, and allow 2 mm per metre for 10 m maximum spacings on larger floor areas.
- Fix sheets with hot-dip galvanised or stainless steel annular-grooved nails or screws (for non-floor diaphragm situations only) at sizes and spacings recommended by the manufacturer. When installing flooring as a diaphragm, fixings must be in accordance with NZS 3604:2011.
- In addition to mechanical fixing, adhesive may be applied with:
  - a continuous 5 mm bead of adhesive to the top of the joists
  - a 5 mm bead of adhesive at sheet edges as installation proceeds for square-edge sheets
  - a thin bead of adhesive along the top of each tongue before inserting into the groove for tongue and groove sheets.
- Do not use power-driven staples to fix particleboard flooring.

5 STRAND BOARDS

5.1 SHEET SIZES

5.1.1 Sheets are available in sizes up to 3.6 m long and up to 1.2 m wide. Sheets are generally 20 mm thick and have a density of approximately 680 kg/m^3.

5.2 TREATMENT AND USE

5.2.1 Sheets are available untreated or with a variety of

treatments. Check with the manufacturer to ensure the correct product is specified for the intended use.

5.2.2 Strand boards are not suitable for use:
- in any exterior situations such as open verandas
- as a decking substrate
- in any situation that will allow an ongoing moisture content of 16% or more, such as rooms with spa pools.

5.2.3 Although polyurethane is an acceptable coating under Acceptable Solution E3/AS1, some board manufacturers do not believe it provides sufficient medium and long-term protection to meet all the requirements of the Building Code. They recommend that a specialist wet area waterproofing system is used.

5.3 EXPOSURE TO WEATHER

5.3.1 Exposure times for boards vary depending on treatment type but up to 12 weeks is an option depending on the specific product and treatment. Check relevant times with the manufacturer. Until the building is enclosed, the flooring should not be covered or have a liquid sealer applied.

5.3.2 If the flooring does become wet:
- do not let water remain ponded on the surface
- remove water as soon as possible by sweeping
- allow the flooring to dry naturally.

5.4 INSTALLATION

5.4.1 General installation requirements:
- Sheets should be continuous over three joists except at floor edges where infill sheets may be required.
- Square-edge sheets must be supported at all edges and may therefore require additional blocking.
- Blocking is not required under tongue and groove joints.
- Allow 8 mm minimum expansion gaps between sheet edges and fixed elements such as bottom plates, and allow 2 mm per metre for 10 m maximum spacings on larger floor areas.
- Fix sheets with hot-dip galvanised or stainless steel annular-grooved nails or screws (for non-floor diaphragm situations only) at sizes and spacings recommended by the manufacturer. When installing flooring as a diaphragm, fixings must be in accordance with NZS 3604:2011.
- In addition to mechanical fixing, adhesive may be applied with:
  - a continuous 5 mm bead of adhesive to the top of the joists
  - a 5 mm bead of adhesive at sheet edges as installation proceeds for square-edge sheets
  - a thin bead of adhesive along the top of each tongue before inserting into the groove for tongue and groove sheets.
- Do not use power-driven staples to fix strand board flooring.

6 PLYWOOD

6.0.1 Plywood is manufactured from thin layers or plies of wood veneer that are bonded together with the wood grain in adjacent plies laid at right angles to one another to provide increased strength and stability.

6.0.2 Plywood sheets are typically 2.7 or 2.4 m long x 1.2 m wide and are available in flooring thicknesses ranging between 15 and 32 mm depending on the supplier.

6.0.3 Plywood is available untreated or treated to H3.1 (LOSP) and H3.2 (CCA or ammoniacal copper quaternary). Treated plywood may be used for wet area flooring in areas such as bathrooms, laundries and kitchens. Untreated plywood is recommended for internal situations where permitted according to NZS 3602:2003 *Timber and wood-based products for use in building*.

6.0.4 Sheets can be supplied with a square edge or tongue and groove edge.

6.1 PLYWOOD GRADING

6.1.1 The two grading categories for plywood specification are:
- surface or visual grading
- stress grading.

6.1.2 Surface or visual grading of the veneer faces is relevant for finishes and coverings, while stress grading is for structural design.

6.2 SURFACE GRADING

6.2.1 Surface grading is based on appearance. Grading classification, defined in AS/NZS 2269.0:2012 *Plywood – Structural – Part 0: Specifications*, is given by two letters denoting the appearance of each face of the plywood. The first letter describes the front face and the second letter the rear face. For CD plywood:
- C is the front face and has filled knots and defects
- D is the rear face and has unfilled knots and defects.

6.2.2 Most plywood grades are supplied with a sanded front surface.

6.3 STRESS GRADING

6.3.1 Plywood sheets are labelled with the letter F and a number according to characteristics that describe the strength and stiffness properties of plywood. Stress grading is determined in accordance with AS/NZS 2269.0:2012 for stresses such as bending, tension, compression and shear and for modulus of elasticity and rigidity.

6.3.2 F8 is the most commonly available stress grade for plywood in New Zealand, while F11 and other stress grades are less readily available.

6.3.3 Structural plywood flooring must be:
- at least CD grade
- at least 15 mm thick (F8 grade) for maximum spans of 400 mm or 19 mm thick (F11 grade) for maximum spans of 600 mm and floor loads of 2 kPa.

6.4 EXPOSURE TO WEATHER

6.4.1 Untreated plywood can be exposed to the weather for up to 3 months but the colour and appearance may be affected. If appearance is important, the plywood should be protected during construction. H3 treated plywood may

be left exposed but the appearance is likely to be affected with prolonged exposure if it is not protected.

6.5 INSTALLATION

6.5.1 General installation requirements:

- Install sheets with face grain at right angles to joist direction.
- Lay sheets in a staggered pattern.
- Sheets should be continuous over three joists (two spans) except at floor edges where infill sheets may be required.
- Square-edge sheets must be supported at all edges and therefore may require additional blocking.
- Blocking is not required under tongue and groove joints.
- Allow 2–3 mm expansion gaps between sheets and 5 mm expansion gaps at the perimeter of the floor.
- Fix sheets with hot-dip galvanised or stainless steel annular-grooved nails or screws (for non-floor diaphragm situations only) at sizes and spacings recommended by the manufacturer. When installing flooring as a diaphragm, fixings must be in accordance with NZS 3604:2011.
- Do not use jolt or bullet head nails.
- In addition to mechanical fixing, adhesive may be applied with:
  - a continuous 5 mm bead of adhesive to the top of the joists
  - a 5 mm bead of adhesive at sheet edges as installation proceeds for square-edge sheets
  - a thin bead of adhesive along the top of each tongue before inserting into the groove for tongue and groove sheets.
- Ensure that the selected adhesive is compatible with the plywood treatment.

7 CROSS-LAMINATED TIMBER (CLT)

7.0.1 Cross-laminated timber (CLT) is made up of a number of layers (typically 3, 5 or 7) of timber boards. They are arranged with the grain in each alternate layer at right angles to the previous layer. The alternating grain direction provides strength and rigidity to the panels in both directions.

7.0.2 Panels are custom-made to sizes as required by the design specifications. Thicknesses range between 60 and 250 mm. The layers can be of different thicknesses although they must be symmetrical about the centre layer – for example, 35/20/35 mm.

7.1 TREATMENT AND USE

7.1.1 CLT may be untreated or treated to hazard classes H1.2 or H3.2.

7.1.2 CLT has a high strength-to-weight ratio, which means long floor spans up to 7 m are achievable without the need for intermediate supports for commercial flooring situations. For residential loadings, recommended spans are 3.4 m maximum for 105 mm thick panels and 5.1 m maximum for 175 mm thick panels. The spanning capacities mean there can be a reduction in the number of foundation supports, but this will require specific design.

7.1.3 The design of CLT flooring is outside the scope of NZS 3604:2011. A consent application must demonstrate compliance with the performance requirements of the Building Code and be proposed as an alternative method. There are currently no New Zealand standards that are specific to the manufacture and use of CLT.

7.2 EXPOSURE TO WEATHER

7.2.1 CLT panels should be protected from rain and groundwater during construction if visual appearance is important. Treated panels are not affected structurally by weather exposure.

7.2.2 If panels become wet before installation, they should be left to dry naturally to the appropriate moisture content level before being installed. The level of protection for panel surfaces depends on whether they are to be left exposed or covered.

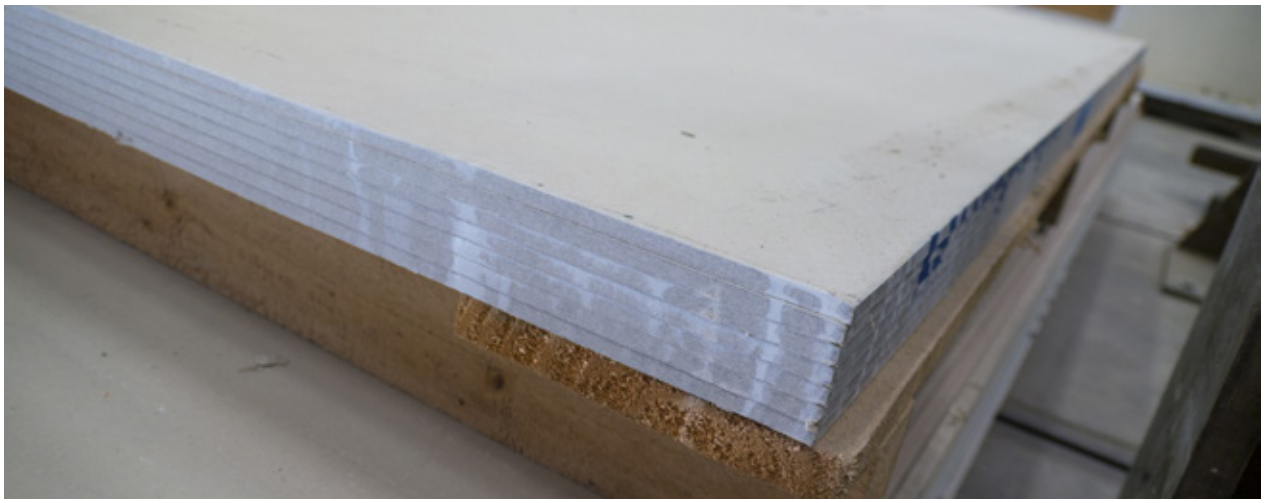
7.3 INSTALLATION

7.3.1 The panels are generally large so often need to be craned into position.

7.3.2 After fixing into position, panel joints should be taped and flashing tape applied to exposed edges of openings to cover and protect end grain. Do not let water pond or penetrate the panel edges.

8 FIBRE-CEMENT

8.0.1 A range of fibre-cement sheet flooring options are available. Compressed fibre-cement sheet is a dense, hardwearing, impact-resistant, non-combustible sheet material that is resistant to water damage and fungal and insect attack. It is dimensionally stable, making it suitable as a structural flooring under finishes such as tiles, carpet, vinyl, marble and slate in both wet and dry areas.



8.1 MANUFACTURE

8.1.1 It is manufactured from a mixture of cellulose fibre, Portland cement, sand and water, which is formed and then cured in an autoclave.

8.2 SHEET SIZES

8.2.1 Compressed fibre-cement sheet is formed and then compressed and cured in a high-pressure autoclave and is available as 1.8 or 2.4 m long x 1.2 m wide x 18 mm thick flooring material.

8.2.2 Also available are sheets that are formed and cured in a high-pressure autoclave. Sheets are typically 2.7 m long x 600 mm wide x 19 mm thick but other sizes may be available depending on the supplier.

8.2.3 Sheets are suitable for use in internal and external wet or dry areas. Typical uses include for laundries, bathrooms, kitchens, decking, verandas, balconies, pool surrounds and commercial flooring situations.

8.3 INSTALLATION

8.3.1 Compressed sheet fixing is typically using 50 mm long minimum type 304 stainless steel, compressed sheet, countersunk screws. Screws may be driven 2–3 mm below the sheet surface, but when tiling is laid directly over the fibre-cement sheet, screw fixings should be flush finished. For high-pressure autoclaved sheets, fixings are typically 50 mm ring shank nail or 50 mm long type 304 stainless steel, countersunk screws. Nails and screw fixings should be flush finished.

8.3.2 In wet areas to be tiled, the flooring must be finished with a waterproof membrane that meets the performance requirements of clause E3.

8.4 SAFETY PRECAUTIONS

8.4.1 Dust generated from working with fibre-cement sheets contains crystalline silica, which may be a cause of cancer or lung disease called silicosis.

8.4.2 When cutting sheets, wear a correctly fitted, approved dust mask or respirator (such as P1 or P2).

8.4.3 Minimise dust by using a dust-reducing saw blade (recommended by the manufacturer) attached to an M-class extractor unit.

8.4.4 During clean-up, use a HEPA vacuum or wet clean-up. Avoid dry sweeping fibre-cement off-cuts or dust.

9 OTHER SHEET FLOORING OPTIONS

9.0.1 As with many building products, new options are coming to the market. With any new products, the onus ultimately is on the specifier to ensure that the product will be durable and fit for purpose. Recent additions that have become available in the New Zealand market:

- Oriented strand board that has been designed to span 450 mm centres with a premarked nailing grid for easy installation. Available sheet sizes are 2.7 m x 905 mm x 18 mm and 2.4 m x 905 mm x 21 mm.
- Magnesium oxide board consisting of glass fibre-reinforced magnesium oxide board with shiplap joints in sizes of 1.8 m x 1. 2 m x 20 mm and 2.0 m x 1.2 m x 20 mm.
- Magnesium oxide-faced structural insulated panels for floors.
- 75 mm thick reinforced autoclaved aerated concrete panels with a tongue and groove edge joint. Typical dimensions are 2.2 m long x 600 mm wide x 75 mm thick, and density is typically 520 kg/m^3.

10 SURFACE PROTECTION

10.0.1 Sheet flooring materials provide a substrate for:

- carpet
- vinyl or linoleum sheet or tiles
- tiles (ceramic, stone, granite or marble) – incorporating a waterproofing system in wet and watersplash areas
- overlay flooring
- clear finish (polyurethane) to wood-based flooring.

10.0.2 Where the floor covering is not impervious to moisture (such as carpet) and there is a possibility of the floor being regularly wetted, particularly by urine in rest homes or care facilities, the sheet flooring should be sealed with a minimum of three coats of polyurethane before the floor finish is installed.

10.0.3 Install floor coverings in accordance with the manufacturer's instructions.

10.1 CLEAR FINISH PREPARATION AND APPLICATION

10.1.1 If a clear polyurethane finish is required, avoid staining or damaging the floor surface during construction.

10.1.2 For a good surface finish:

- punch nails
- sand the entire floor using 40–80 grit sandpaper
- thoroughly remove all dust from the floor and skirtings
- apply the first clear finish coat in accordance with the manufacturer's instructions
- fill nail holes
- apply additional coats in accordance with the manufacturer's instructions, lightly sanding between each coat
- follow the manufacturer's instructions to complete.

11 HANDLING AND STORAGE

11.0.1 Sheet flooring materials have similar handling and storage requirements:

- Handle and store sheets to minimise surface and edge damage.
- Store in dry indoor conditions. If outside, store for short periods of time only and protected from the weather.
- Store clear of ground contact.
- Store flat on a minimum of three supports (at each end and centrally) across the full width of the sheets.
- Ensure that supports are aligned above and below.
- Locate stored sheets away from construction traffic to avoid exposure to mechanical damage.
- Do not drag sheets across each other or other surfaces.
- Do not store vertically by leaning sheets against a wall.

12 MAINTENANCE

12.0.1 Maintenance tasks for sheet flooring include:

- checking subfloor spaces regularly (1–2 times per year) – any evidence of plumbing leaks, moisture migration, external source leakage or mould growth should be investigated and corrective action taken
- ensuring that foundation wall vents are kept free of vegetation and other obstructions
- ensuring that floor wastes are kept unobstructed and drain to the exterior
- maintaining coatings such as clear-finish polyurethane and recoating before the finish deteriorates.

12.0.2 If water spillage or flooding occurs that cannot easily be mopped up:

- lift carpets and remove other floor coverings such as vinyl if water has seeped between the covering and the floor surface
- for types of subfloor insulation that do not tolerate being wet, check and remove to dry or replace as required
- thoroughly dry the floor before replacing floor coverings.

13 HEALTH AND SAFETY

13.0.1 Health and safety requirements should be followed when working with and installing any sheet flooring materials:

- Wear a P1 or P2 respirator complying with AS/NZS 1715:2009 *Selection, use and maintenance of respiratory protective equipment* and AS/NZS 1716:2012 *Respiratory protective devices* when machining sheets.
- Use eye protection such as safety glasses complying with AS/NZS 1337.1:2010 *Personal eye-protection – Part 1: Eye and face protectors for occupational applications*.
- Use hearing protection such as earmuffs when machining sheets.
- Wear long-sleeved shirts, trousers and work gloves if skin irritation occurs.
- Provide ventilation when installing H3.1 LOSP-treated plywood until the preservative solvent has gassed off (evaporated).

14 CODES AND STANDARDS

New Zealand Building Code clauses:

- B1 *Structure*
- B2 *Durability*
- C *Protection from fire*
- E3 *Internal moisture*
- F2 *Hazardous building materials*

Standards

NZS 3602:2003 *Timber and wood-based products for use in building*

NZS 3604:2011 *Timber-framed buildings*

AS/NZS 1337.1:2010 *Personal eye-protection – Part 1: Eye and face protectors for occupational applications*

AS/NZS 1604.2:2012 *Specification for preservative treatment – Part 2: Reconstituted wood-based products*

AS/NZS 1604.3:2012 *Specification for preservative treatment – Part 3: Plywood*

AS/NZS 1715:2009 *Selection, use and maintenance of respiratory protective equipment*

AS/NZS 1716:2012 *Respiratory protective devices*

AS/NZS 1859.1:2017 *Reconstituted wood-based panels – Specifications – Part 1: Particleboard*

AS/NZS 1860.1 *Particleboard flooring – Part 1: Specifications*

AS/NZS 2269 *Plywood – Structural*

AS/NZS 2908.2:2000 *Cellulose-cement products – Flat sheets*

AS 3740-2010 *Waterproofing of domestic wet areas*

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