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Swimming pools — Premoulded fibre-reinforced plastics — Design and fabrication



AS 1838:2021

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- Australian Institute of Building Surveyors
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- Engineers Australia
- Swimming Pool and Spa Association of Australia
- University of Southern Queensland

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Swimming pools — Premoulded fibre-reinforced plastics — Design and fabrication

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Preface

This Standard was prepared by the Standards Australia Committee PL-041, Glass Reinforced Swimming Pools, to supersede AS/NZS 1838:1994.

After consultation with stakeholders in both countries, Standards Australia and Standards New Zealand decided to develop this document as an Australian Standard rather than an Australian/New Zealand Standard.

The objective of this document is to set out procedures for the design and fabrication of premoulded fibre-reinforced plastics (FRP) swimming pools.

The major changes in this edition are as follows:

- (a) Additions and amendments to scope (see [Clause 1.1](#)), normative references (see [Clause 1.2](#)) and to terms and definitions, see [Clause 1.3](#).
- (b) Additions and amendments to materials, see [Clause 2](#).
- (c) Additions and amendments to design (see [Clause 3](#)), including the addition of hydrodynamic loads.
- (d) Additions and amendments to construction requirements (see [Clause 4](#)), including the addition of clear and textured gelcoats.
- (e) Significant changes to performance requirements (see [Clause 5](#)) in conjunction with [Appendices E and F](#).
- (f) Addition of a new appendix providing external factors that affect in-service performance, see [Appendix G](#).

The terms “normative” and “informative” are used in Standards 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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Australian Standard®

Swimming pools — Premoulded fibre-reinforced plastics — Design and fabrication

Section 1 Scope and general

1.1 Scope

This document specifies requirements for premoulded plastic swimming pools exceeding 300 mm in depth and constructed from fibre-reinforced plastics (FRP) based on thermosetting resin systems. It covers materials, design and performance requirements.

NOTE For installation of fibre-reinforced plastic pools and swimming pools conforming to this document, refer to AS 1839.

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 in this document.

AS 1170.4, *Structural design actions, Part 4: Earthquake actions in Australia*

AS 1839, *Swimming pools — Premoulded fibre-reinforced plastics — Installation*

AS 1926.3, *Swimming pool safety, Part 3: Water recirculation systems*

AS 3600, *Concrete structures*

ISO 178, *Plastics — Determination of flexural properties*

ASTM D 2583, *Test method for indentation hardness of rigid plastics by means of a Barcol impressor*

1.3 Terms and definitions

For the purposes of this document, the following terms and definitions apply.

1.3.1 at rest

state of soil condition prior to disturbance

1.3.2 bond beam

structural member that supports the coping

Note 1 to entry: See [Clause 3.5](#).

1.3.3 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

Note 1 to entry: An example would be a professional engineer who is —

- (i) a corporate member of the Institution of Engineers, Australia; or
- (ii) eligible to become a corporate member of the Institution of Engineers, Australia, and has appropriate experience and competence in the relevant field.

**1.3.4
composite**

combination of the cosmetic layer(s), corrosion barrier(s), structural layer(s) and outer surface layer

Note 1 to entry: See [Figure 4.6](#).

**1.3.5
coping**

horizontal rim or pool edge which is moulded integrally with the pool shell

Note 1 to entry: See [Clause 3.6](#).

**1.3.6
corrosion barrier/layer(s)**

one or more resin-rich layers immediately beneath the cosmetic layer(s) which provide a high level of corrosion resistance

Note 1 to entry: See [Figure 4.6](#).

**1.3.7
cosmetic layer(s)**

one or more layers, such as gelcoat, that integrally form the surface finish layer in contact with the water

Note 1 to entry: See [Figure 4.6](#).

**1.3.8
fibre prominence**

appearance of fibre pattern on the surface of the gelcoat

**1.3.9
hydrodynamic pressure**

pressure caused by moving ground water leading to impact on a pool installation

Note 1 to entry: May be caused by storms, burst pipes or any circumstances of differential water pressure.

**1.3.10
hydrostatic pressure**

pressure created by a change in the level of the water table

**1.3.11
interlaminar blisters**

osmotic blisters that develop in the composite laminate or at the interface between the gelcoat and the laminate

**1.3.12
may**

indicates the existence of an option

**1.3.13
orange peel**

gelcoat surface texture resembling the surface of an orange

**1.3.14
outer surface layer**

layer which seals the back of the structural layer

Note 1 to entry: See [Figure 4.6](#).

**1.3.15
particulate deformation**

deformation around a suspended particle in the layer of pool gelcoat that is in contact with the pool water

1.3.16**particulate dissolution**

either partial or complete dissolving of a suspended particle in the pool gelcoat that is in contact with the pool water

1.3.17**pin head blisters**

osmotic blisters, that develop up to 3 mm in diameter, that form in the gelcoat surface finish layer(s)

1.3.18**relevant authority**

agency authorized by legislation or regulation to issue determinations, orders, or other instructions in respect of any subject covered by this document

1.3.19**shall**

indicates that a statement is mandatory

1.3.20**should**

indicates a recommendation

1.3.21**skimmer box**

separate surface skimming aperture that allows debris to be removed from the water as the water is pumped or circulated back to the pool

1.3.22**structural layer(s)**

one or more layers, including the option of a syntactic core, that form the main body of the composite supplying the major part of the total structural stiffness and strength

Note 1 to entry: See [Figure 4.6](#).

1.4 New design and innovation

This document does not prevent the use of materials, methods of design, construction and procedures that do not conform to the specific requirements of this document, or are not mentioned in it, provided the minimum dimensional and performance requirements specified are met.

Section 2 Materials

2.1 Resin

The resin component of the composite shall be an appropriate thermoset resin, such as unsaturated polyester, epoxide or Bisphenol A vinyl ester resin.

2.2 Gelcoat

The gelcoat layer(s) shall comprise of one or more compatible layers specifically designed to produce the aesthetic internal surface of the swimming pool and to form the first water and chemical resistant layers.

If an alternative surface finish is applied, such as tiles and thermoplastic coatings, it shall conform to the design criteria and in-service performance requirements of this document, see [Clause 5.7](#) and [Appendix G](#). The composite structure shall also be in accordance with the testing requirements of this document.

2.3 Reinforcement

The reinforcement material shall be fibrous in nature, and readily wet through by the chosen resin system. The glass fibre reinforcement shall be drawn from "E" glass or E-CR glass fibre with an alkali content less than 1 % and which has been chemically sized and treated so as to be compatible with the resin system. The glass fibre reinforcement shall not have a moisture content greater than 0.15 %.

NOTE Where the glass fibre content for a swimming pool forms part of the design considerations, [Appendix A](#) may be used to determine the glass fibre content and the resin to glass ratio of all fibrous/ resin layers.

2.4 Additives

The gelcoat surface layers and resin layers may contain —

- (a) ultraviolet stabilizers;
- (b) inhibitors;
- (c) pigments;
- (d) dyes;
- (e) fillers;
- (f) synthetic particles;
- (g) glitter; and
- (h) other agents and particles,

that are compatible with the resin system to produce the required physical properties and aesthetic appearance.

Additional additives may be used in the gelcoat surface layers and resin layers, such as —

- (i) wetting agents;
- (ii) defoamers;
- (iii) dispersing agents;
- (iv) rheology agents;
- (v) particles; and

(vi) extenders.

Section 3 Design

3.1 General

The design specification for use shall be made available with each pool shell.

3.1.1 Shape

Swimming pool shapes shall be accurately defined by means of dimensioned drawings.

3.1.2 Deflection and variations

The design of the pool shall take into account the limits to the variations in shape and deflections specified in AS 1839. The design details (see [Clause 4.9](#)) shall clearly specify what deflections may be expected under the design loads.

3.1.3 Entry and exit from pool

Swimming pools shall provide a means of entry and exit for pool users. Swimming pools shall consist of one, or a combination, of the following:

- (a) Steps.
- (b) Stairs.
- (c) Ladders.
- (d) Treads.
- (e) Ramps.
- (f) Beach entries.
- (g) Underwater seats.
- (h) Benches.
- (i) Swimouts.
- (j) Other approved designs.

NOTE: Consideration should be given to the safe movement of entry into and exit from the pool.

3.1.4 Textured surfaces

Where the pool floor is less than 1.5 m deep and where horizontal surfaces including —

- (a) coping;
- (b) steps;
- (c) ledges;
- (d) beach areas;
- (e) benches;
- (f) swim-outs;
- (g) spas; and
- (h) wading pools,

are wider than 100 mm, then those sections of the pool floor and horizontal surfaces shall have a textured surface to reduce the slip potential.

NOTE The slip potential of pool surfaces is affected by contaminated water (chemicals), contamination by body fats, contaminated feet (contaminated water and body fats) and the gradient.

3.1.5 Lifting points

Lifting points shall be provided to enable the pool to be lifted and manoeuvred as required. The lifting points on any one side shall have a combined capacity of at a minimum 1.5 times the weight of the pool shell.

3.1.6 Ties

Where a bond beam is a structural element of the pool, provision shall be made for structurally connecting the bond beam to the pool shell.

3.1.7 Water recirculation

Skimmer boxes and other outlet types shall conform to AS 1926.3.

3.1.8 Emptying the pool

Specific details relating to emptying the pool shall be provided in the operating and maintenance instructions (refer to AS 1839), for use in situations where it may become necessary to drain the water.

NOTE Pre-moulded fibre-reinforced (FRP) swimming pools, that are designed for in-ground installation, are not designed to be left empty for extended periods of time. Failure to abide by the manufacturer's instructions and guidelines when draining a pool may result in deflection and damage to the pool shell and the installation.

3.2 Pools for installation in the ground

3.2.1 Soil loadings

The pool shall be designed so that it withstands at a minimum the following external loadings that may be applied by the soil profile and backfill encountered at a typical location in which the pool shell is to be installed.

The design soil types shall be clearly stated on the design drawings.

The design horizontal pressure shall be not less than —

- (a) 4.8 kPa/m depth for sand only; and
- (b) 6.6 kPa/m depth for clay and soil.

The pool, when full of water, shall be designed to resist the additional pressure from a surcharge of 2 kPa on the ground surrounding the pool.

NOTE 1 For guidance on pool design see [Appendix B](#).

NOTE 2 The design values do not take account of loads due to hydrostatic, hydrodynamic and reactive clay pressures. For guidance on such loadings, see [Appendix B](#). Refer to AS 1839 for additional requirements for the installation of the pool in these conditions.

NOTE 3 The design values do not take into account loads due to heavy machinery and equipment. Where such loading may occur, it may be necessary to brace the walls.

3.2.2 Other loadings

The design of the pool shall take into account the following:

- (a) Temporary loads during transportation.
- (b) Lifting point loads.
- (c) Loads due to earthquake, conforming to AS 1170.4, where applicable.

The design of the pool and the installation methods used shall take into account special loadings peculiar to the specific locality of the installation, including loads from —

- (i) hydrostatic pressure;
- (ii) hydrodynamic pressure; and
- (iii) reactive clay pressure.

NOTE 1 For guidance on such loadings, see [Appendix B](#). Refer to AS 1839 for additional requirements for the installation of the pool in these conditions.

NOTE 2 Hydrodynamic pressure may occur where a hard strata such as rock or shale is present near the pool. The most typical effect is disturbance of backfill or pool bedding.

3.3 Pools for installation above ground and partially exposed above ground

3.3.1 Water loading

The pool, when full of water, shall be capable of withstanding the internal loading due to static and dynamic water pressure in accordance with the requirements of this document, without the use of temporary external bracing. The minimum pressure shall be calculated from the hydrostatic head due to water of density 1 000 kg/m³.

The design of the pool shall also take into account the effects of dynamic and unsymmetrical loading.

3.3.2 Other loadings

The design of the pool shall take account of the following:

- (a) Temporary loads during transportation.
- (b) Lifting point loads.
- (c) Loads due to earthquake, conforming to AS 1170.4, where applicable.
- (d) Dynamic loading test, see [Appendix C](#).

The design of the pool and the installation methods used shall take into account special loadings peculiar to the specific locality of the installation, including loads from —

- (i) hydrostatic pressure;
- (ii) hydrodynamic pressure;
- (iii) reactive clay pressure.

NOTE 1 For guidance on such loadings, see [Appendix B](#). Refer to AS 1839 for additional requirements for the installation of the pool in these conditions.

NOTE 2 Hydrodynamic pressure may occur where a hard strata such as rock or shale is present near the pool. The most typical effect is disturbance of backfill or pool bedding.

3.3.3 Deflection under dynamic loading

When a pool above the ground is subject to dynamic loading, the design shall ensure that the movement of any pool member (e.g. wall and coping) does not exceed $l/300$, where l is the overall height or length of the pool member, in millimetres. A method for testing the effect of a dynamic load is given in [Appendix C](#).

3.4 Subpool drainage

The design of the pool shall take into account the need for subpool drainage. The design of the pool shell shall allow for the installation of a hydrostatic relief valve, if required.

3.5 Design of bond beam

3.5.1 Concrete

A concrete bond beam shall be designed in accordance with AS 3600. It shall achieve the tolerances specified in AS 1839.

3.5.2 Other materials

A bond beam to support a standard fibreglass coping may be constructed in materials other than concrete or fibreglass and shall be designed to achieve the tolerances specified in AS 1839.

3.6 Fibreglass coping

A fibreglass coping shall be designed to achieve tolerances specified in AS 1839 when a bond beam is not used.

Section 4 Construction requirements

4.1 General composite

The composite structure of the pool shall consist of the following layers:

- (a) One or more cosmetic layers designed to form the internal surface finish of the pool. It may contain particles and additives that are included to provide the aesthetic effect.
- (b) One or more corrosion barrier layers suitably matched to provide the necessary water and chemical resistance to the structure.
- (c) One or more structural layers, which may include a syntactic core, to provide structural stiffness and strength to the pool to enable the pool to meet the installation requirements of AS 1839.
- (d) A surface layer designed to seal off the structural layers from the outside.

4.2 Cosmetic layers

The internal finish of the swimming pool may comprise one or more layers in accordance with the design specification.

All layers shall be in accordance with the material specification. The layer in contact with the water shall be made from UV-light stabilized materials. All cosmetic layers shall meet the performance requirements in [Clauses 5.2, 5.3](#) and [Appendices E and F](#), and the in-service requirements in [Clause 5.7](#). Ultraviolet light stabilizers, absorbers, inhibitors and additional additives and particles may be used in accordance with the material specifications.

For clear and solid coloured gelcoats, the cured film thickness of the cosmetic layer in contact with the pool water shall not be less than 0.35 mm at any one point. The cured film thickness shall be at a minimum 0.5 mm for over 90 % of the internal surface of the pool.

For cosmetic gelcoats containing particulate materials or other special effects, the cured film thickness of the cosmetic layer in contact with the pool water shall not be less than 0.4 mm at any one point.

The thickness of each of the subsequent cosmetic layers, if applicable, shall not be less than 0.4 mm cured film thickness at any one point.

4.3 Corrosion barrier layer(s)

One or more corrosion barrier layers may be utilized in the design specification.

The corrosion barrier layer(s) shall be constructed from a water and chemical resistant resin, or a resistant fibre/resins reinforcement composite in accordance with the respective material specifications and manufacturer's instructions. The corrosion barrier layer(s) shall be free from —

- (a) dry fibres;
- (b) delamination from the cosmetic barrier(s) layer; and
- (c) under cure, visible air bubbles,

and cover the entire surface of the pool in contact with the water.

The total thickness of the corrosion barrier layer(s) shall not be less than 1.5 mm. The thickness and materials used in the corrosion barrier layer(s) shall be listed in the design specifications.

Interlaminar adhesion shall be achieved between the syntactic core (if applicable) and the adjacent layers.

4.4 Syntactic core

An optional layer that may be provided between the corrosion barrier and the first structural layer, or within the structural layers, to add stiffness and strength to the composite.

4.5 Structural laminate

The structural laminate shall be constructed from a resin/fibrous reinforcement composite manufactured in accordance with the respective materials specifications and manufacturer's instructions. The minimum thickness, which may include the corrosion barrier, shall be in accordance with the design specification. The structural layer shall be free from dry fibres, voids and delamination from the corrosion barrier or syntactic core if applicable.

4.6 Outer surface layer

The outer surface layer shall consist of a polymeric coating. Where a flowcoat is used, its thickness shall be not less than 0.35 mm. The surface shall be dry and free of protruding fibres or particles.

NOTE For an example of the components of composite, including outer surface layer, see [Figure 4.6](#).

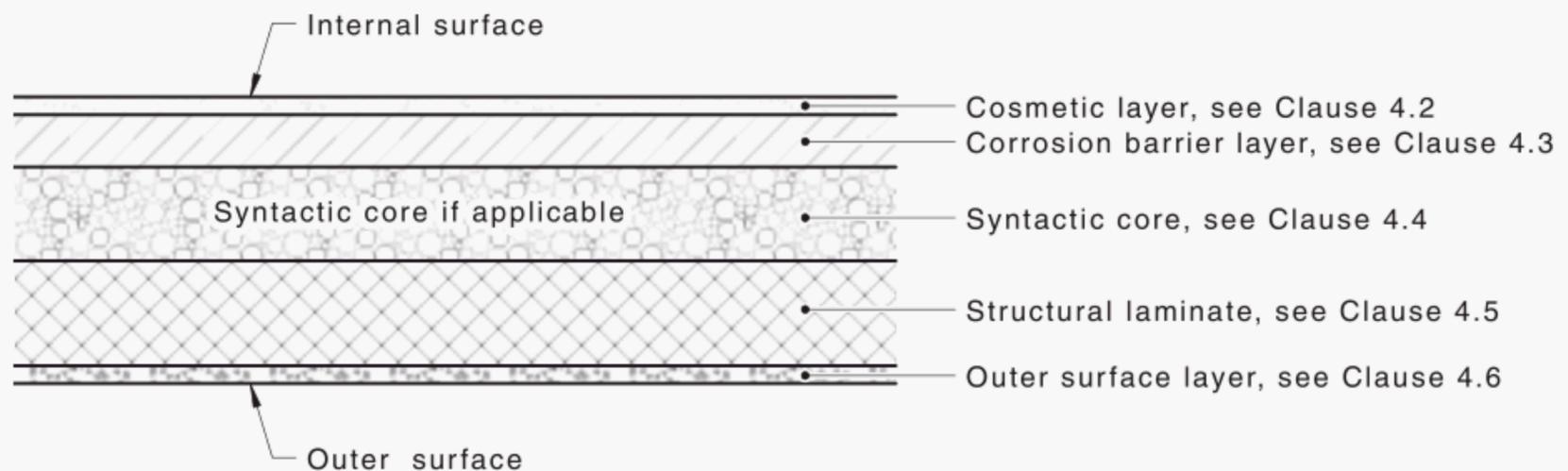


Figure 4.6 — Example of components of the composite

4.7 Cure

The hardness of the cosmetic layer of the finished pool, prior to despatch, shall not be less than 80 % of the fully cured hardness as specified in the material specification.

4.8 Freedom from defects

Prior to despatch, the interior surface of the swimming pool shall be visibly free from —

- (a) soft and tacky spots;
- (b) cracks;
- (c) crazing blisters;
- (d) fibre prominence;
- (e) lack of adhesion;
- (f) delamination;
- (g) pinholes; or
- (h) foreign inclusions.

Moulding and blow-off marks shall not be determined as defects.

4.9 Design details

Details of the pool design shall be in accordance with good engineering practice. The pool design shall specify, at a minimum, the following details on the pool drawings and/or pool computations:

- (a) Pool dimensions.
- (b) Design thicknesses of the composites and their respective tolerances.
- (c) Structural detail of the pool shell.
- (d) Deflections which apply to the design.
- (e) Laminate properties used in the design specifications.
- (f) Design soil type and soil reactivity.
- (g) Design backfill type.
- (h) Details of fibreglass pool coping.
- (i) Details of the bond beam, where the bond beam forms part of the design considerations of the pool.

Section 5 Performance requirements

5.1 Material properties

The material properties shall be clearly nominated in the specification and/or design details.

The flexural strength and apparent elastic modulus of the laminate, using test specimens prepared in accordance with [Appendix D](#), shall be determined in accordance with ISO 178.

5.2 Chemical-resistance rating

When tested in accordance with [Appendix E](#), the average chemical resistance rating for the two test specimens shall not exceed a rating of 3.

5.3 Water-resistance rating

When tested in accordance with [Appendix F](#), the average water-resistance rating for the two test specimens shall not exceed a rating of 3.

The samples of the proposed swimming pool shall be tested for the chemical resistance rating (see [Clause 5.2](#)) and the water-resistance rating and pass both of these test procedures. Where both resistance rating test procedures are not passed, the overall testing shall be determined as not meeting the requirements of this document.

5.4 Dynamic load test for pools installed above the ground

When tested in accordance with [Appendix C](#), the maximum deflection of any pool member (e.g. wall and coping) shall not exceed $l/300$, where l is the overall height or length of the pool member, in millimetres.

5.5 Acetone test

Select three non-adjacent representative areas of the pool surface, each consisting of a minimum area of 200 mm × 200 mm and rub the surface for a minimum of 15 s with a clean, white, lint-free cloth dampened with acetone.

After evaporation of the acetone, the treated area shall be non-tacky. The cloth shall not show any colour from the pool.

5.6 Barcol hardness

When determined in accordance with ASTM D 2583, the hardness of the cosmetic layer shall be not less than 80 % of the fully cured hardness after a 24-h period.

NOTE The fully cured hardness is that specified by the resin manufacturer.

5.7 In-service performance

5.7.1 Chemical-fade resistance

When rated in accordance with [Table E.7](#), the cosmetic layer below the normal operating water level of the pool, shall be determined as meeting the requirements of this document, if there is —

- (a) no colour change greater than a rating of 3; and
- (b) no loss of visible gloss greater than a rating of 3,

for a period of not less than 12 months from the date of installation.

5.7.2 Water-resistance

When rated in accordance with [Table F.6](#), the composite structure below the normal operating level of the pool shall be determined as meeting the requirements of this document provided the average degradation rating on an area of 4 500 mm² is not greater than 3 for a period of not less than 3 years from the date of installation.

5.7.3 External factors

For external factors affecting in-service performance, see [Appendix G](#).

NOTE Such factors, if not controlled, may result in damage to the pool surface and structure.

Section 6 Records and markings

6.1 Records

Accurate manufacturing data records shall be kept and maintained for a period of 10 years.

6.2 Markings

All pools shall be legibly and indelibly marked or electronically tagged with the following information in a position that will be readily visible or scannable after pool installation:

- (a) Manufacturer's name or registered trademark, or both.
- (b) Serial number.

NOTE Manufacturers making a statement of conformance to this document on a product, packaging, or promotional material related to that product are advised to ensure that such conformance is capable of being verified.

Appendix A (informative)

Determination of resin and glass content of corrosion barrier and structural layers

A.1 Scope

This appendix provides a method that may be used to determine percentage by mass of resin in glass fibre-reinforced plastics.

NOTE 1 Where reinforced plastics contain organic fillers, or if the resin is incompletely combustible, the percentage by mass resin content cannot be determined directly by this method.

NOTE 2 Glass content may be calculated directly provided no inorganic fillers are present.

A.2 Apparatus

The following apparatus is required:

- (a) *Crucibles* — Three, of platinum or porcelain, each of 30 mL approximate capacity.
- (b) *Muffle furnace* — Capable of maintaining temperature in the range 540 °C to 590 °C.
- (c) *Desiccator*.
- (d) *Balance* — Capable of weighing to an accuracy of ± 0.01 g.
- (e) *Fume cupboard*.

A.3 Preparation

A.3.1 Test specimens

Cut three specimens of minimum mass 10 g each from a test panel and the cosmetic layer removed by machining. Edges of test specimens should be machined back to a hard, clean surface.

A.3.2 Conditioning

Test specimens need to be conditioned at ambient conditions for a period of not less than 12 h prior to commencement of the procedure.

A.4 Procedure

The procedure is as follows:

- (a) Determine and record the constant mass of each crucible to the nearest 0.01 g.
All three crucibles should be heated to 500 °C and cooled in the desiccator to remove moisture, combustible residue or other material, prior to weighing.
- (b) Place a test specimen in each crucible and determine the mass.

- (c) Heat the crucibles in a Bunsen flame until the contents ignite.
Maintain a temperature at which the material burns at a uniform and moderate rate until only glass, ash and carbon remain when the burning has ceased.
- WARNING — COMBUSTION OF PLASTIC MATERIALS MAY PRODUCE TOXIC GASES. COMBUSTION SHOULD BE CARRIED OUT IN A FUME CUPBOARD.**
- (d) Heat the crucible and contents to constant mass at a temperature in the range of 540 °C to 590 °C in the muffle furnace.
- (e) Allow the crucible and contents to cool to ambient temperature in a desiccator and then determine the mass to the nearest 0.01 g.

A.5 Calculations

The percentage by mass of resin in each test specimen is calculated using the following [Equation A.5\(1\)](#):

$$\text{percent res} = \frac{(m_1 - m_2)}{(m_1 - m_c)} \times 100 \quad \text{A.5(1)}$$

where

- m_1 = mass of crucible and test specimen before ignition, in grams
 m_2 = mass of crucible and contents after ignition, in grams
 m_c = constant mass of crucible, in grams

When no inorganic fillers are present, the percentage by mass of glass in each test specimen may be calculated using the following [Equation A.5\(2\)](#):

$$\text{percent glass} = \frac{(m_2 - m_c)}{(m_1 - m_c)} \times 100 \quad \text{A.5(2)}$$

NOTE Where inorganic fillers are present, an estimate of the glass content may be obtained by sieving the crucible contents to remove the filler and weighing the glass remaining. Reference should be made to details of the method employed as required in the report.

A.6 Test report

The test report will contain the following:

- (a) Full identification of the specimen under test.
 (b) Percentage of resin in each test specimen.
 (c) Mean percentage of resin in the glass fibre-reinforced sample.
 (d) Presence or otherwise of fillers (and method of removal if appropriate).
 (e) Where applicable, the percentage of glass in each test specimen.
 (f) Where applicable, the mean percentage of glass in the glass fibre-reinforced plastic.
 (g) Reference to this test method, i.e. AS 1838:2021 [Appendix A](#).

Appendix B **(informative)**

Design guidance

B.1 Scope

This appendix provides additional design factors to be taken into account when determining the design details for an installed pool.

B.2 General

Engineered design calculations should be supplied to the relevant authority. The pool design details should cover general applications. The relevant authority may require special considerations relevant to a particular area. These special considerations should be resolved by a competent person during the initial general approval. Sites with particular complications should be examined on an individual basis.

B.3 New technology

The type and percentage of reinforcement and the type of resin used will influence the strength of a given thickness of laminate. Fibre-reinforced plastic (FRP) technology is evolving and, in the event of new technology being introduced into the market, theoretical analysis should be supported by prototype testing.

B.4 Design pressures

The soil pressure generated against the pool wall relates to —

- (a) type of soil;
- (b) topography of the surrounding areas; and
- (c) landscaping around the pool.

General building practice, which involves the cutting of a hole into which the pool is placed with backfill around, results in a release of at rest pressures. Special requirements may be required for certain clays, particularly if the penetration of the pool into the clay varies around its perimeter.

NOTE For further information regarding the different levels of reactive clay to be found in Australia, refer to AS 2780.

For design guidance regarding installation and the likely movements which can occur in relation to those different levels of soil reactivity, refer to AS 1839. The impact of the pressure of the reactive clay against the pool walls and pool floor may create additional deflection in the walls, floor and also the pool bond beam. Consideration of the soil reactivity for any particular clay site is important during the installation of the pool.

Pools may be subject to external hydrostatic or hydrodynamic pressures, even though a hydrostatic valve is incorporated in the pool floor. Build-up of this pressure may be avoided by the incorporation of sub-surface drainage, refer to AS 1839.

Where the pool is founded on varying ground strata, or where even bearing may not be relied upon, or where ground heave may occur, the pool design should be specifically determined and modified as

necessary. In a location where long-term differential settlement may occur, suitable measures should be taken during the installation of the pool to ensure that no damage is caused to the pool structure.

Appendix C (normative)

Dynamic load test

C.1 Scope

This appendix sets out a method for testing the effect of a dynamic load on a pool above the ground.

C.2 Principle

A 200 L drum filled with water is dropped into the water-filled pool and any resulting wall deflections are measured.

C.3 Apparatus

The following apparatus is required:

- (a) *Drum* — A standard 200 L drum filled with water.
- (b) *Release device* — Means of holding the drum at the specified height above the pool and capable of releasing the drum cleanly.
- (c) *Measuring equipment* — Suitable gauges affixed to independent frames.

C.4 Procedure

The procedure shall be as follows:

- (a) Position the cylindrical drum above the pool with its longitudinal axis horizontal, 2 000 mm \pm 100 mm above the normal pool water level, see [Figure C.4](#).
- (b) Release the drum so that it impacts the water surface at the pool centre with its long side.
- (c) Determine the extent of any deflections in pool members.
- (d) Inspect pool for any sign of leakage or cracking.

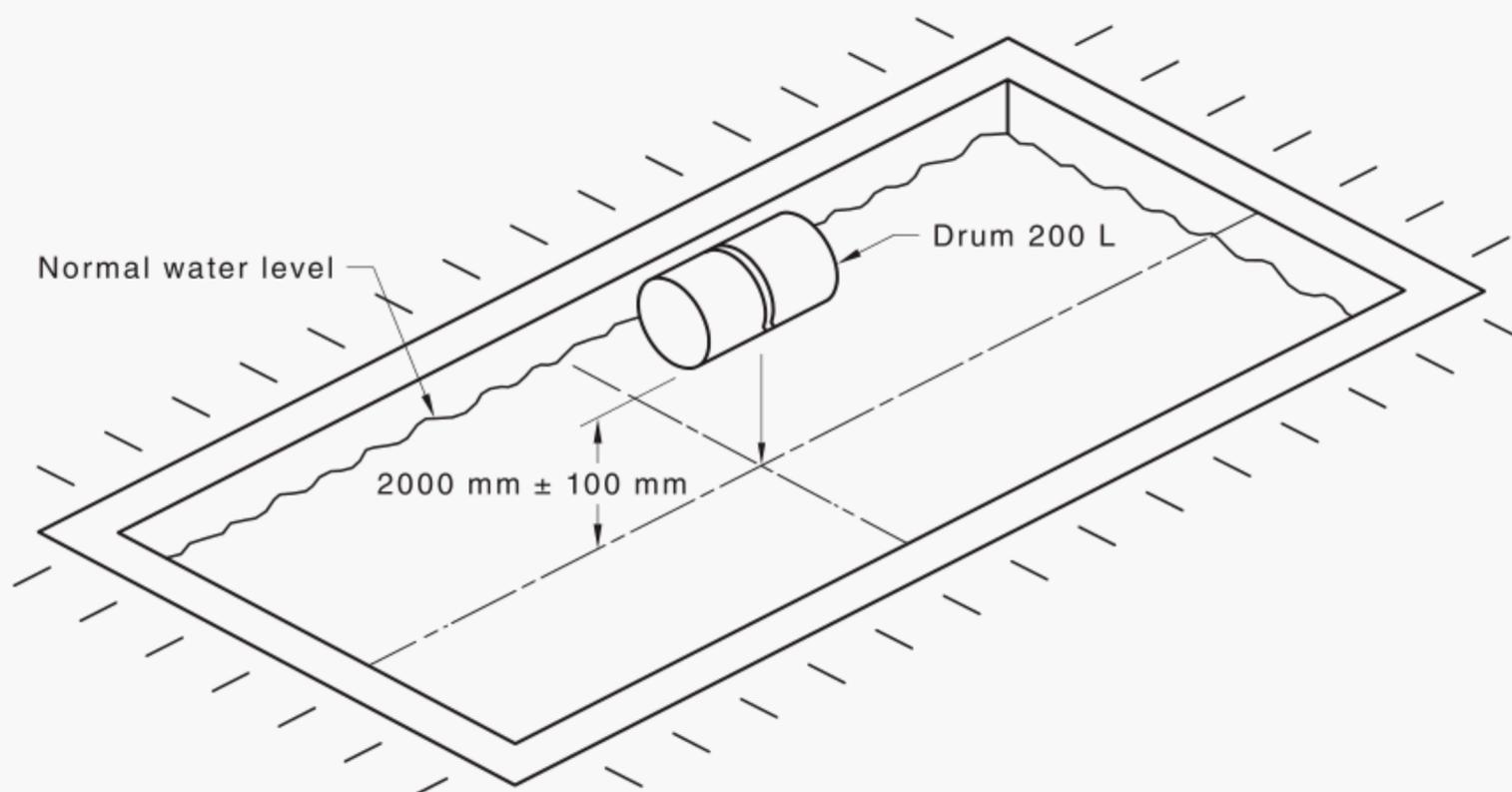


Figure C.4 — Positioning for dynamic load test

C.5 Test report

The test report shall contain the following:

- (a) Full description of the pool tested.
- (b) Maximum deflection of each pool member.
- (c) Any evidence of failure.
- (d) Reference to this test method, i.e. AS 1838:2021 [Appendix C](#).

Appendix D (normative)

Preparation and conditioning of test panels

D.1 Scope

This appendix sets out the preparation and conditioning requirements for test panels.

D.2 Preparation of test panels

Test panels of sufficient dimension to conform to the panel sizes identified in [Appendices E](#) and [F](#) shall be obtained from waste areas cut from the pool moulding. Alternatively, test panels shall be prepared using the same materials and construction techniques utilized in fabricating the pool shell.

D.3 Conditioning

The test specimens prepared using the same materials and construction techniques utilized in fabricating the pool shell shall be post cured at 40 °C for 16 h. Any particulate deformation or changes to the specimens from the control specimen shall be recorded and rated against the test results of [Appendices E](#) and [F](#).

Test specimens shall be tested within 670 h of manufacture.

Appendix E (normative)

Chemical-resistance test

E.1 Scope

This appendix sets out a method for determining the resistance to colour fading of the cosmetic layer used in swimming pool manufacture.

E.2 Principle

Test specimens shall be exposed to a hypochlorite solution containing acid at a temperature of 60 °C for 24 h, then visually inspected for colour fading.

E.3 Apparatus

The following apparatus is required:

- (a) *Heating system* — Air circulating oven or other means of maintaining a glass beaker of solution at 60 °C ± 2 °C for 24 h, e.g. water bath with circulator/heater.
- (b) *Beakers* — 2 × 1 L (tallform) glass graduated beakers.
- (c) *Glass stirring rod*.
- (d) *Beaker cover* — Polyethylene film and rubber band for sealing 1 L (tallform) beaker.
- (e) *pH meter* — pH meter which can be calibrated and can measure at different temperatures, including 60 °C.
- (f) *Water bath*.

E.4 Reagents

The following reagents are required:

- (a) *Calcium hypochlorite* — 65 % active chlorine or equivalent quantity of available chlorine.
- (b) *Concentrated hydrochloric acid* — Metering device such as pipette with rubber teat, or eye dropper.

E.5 Preparation of test specimens

Three test specimens (60 mm × 150 mm) shall be cut from a test panel obtained and prepared by the method described in [Appendix D](#).

One specimen shall be marked and retained as the control specimen.

The remaining two test specimens shall be tested in accordance with the procedure specified in [Clause E.6](#).

E.6 Procedure

The procedure shall be as follows:

- (a) Add 1 L of water at approximately 70 °C to the 1 L glass graduated beaker.
- (b) Add 0.75 g of calcium hypochlorite and stir until dissolved. The temperature of the solution shall be approximately 60 °C after stirring.
- (c) Adjust the water temperature to 60 °C and carefully add (i.e. drop by drop) hydrochloric acid until the pH meter reads 6.5 ± 0.2 .
- (d) Stand test specimens upright in the second 1 L beaker and carefully decant a sufficient amount of the solution to cover approximately half the panel.

NOTE 1 Avoid splashing the solution.

- (e) Secure polythene cover on the 1 L beaker then place beaker in suitable oven or suspend in a water bath and maintain at $60 \text{ °C} \pm 2 \text{ °C}$ for 24 h.
- (f) After 24 h remove, rinse and dry the test specimens.

NOTE 2 This further testing serves to monitor any improvement or degradation in quality. This procedure should be carried out 3 to 4 times a year.

E.7 Chemical-resistance rating

The test specimens shall be visually compared to the control specimen for both colour fading and loss of visible gloss in accordance with [Table E.7](#). The section of panel to be rated in each case shall be the worse of either the fully immersed half or the half exposed to the vapour only.

The chemical resistance rating shall be determined by totalling the ratings of colour change and loss of visible gloss and dividing by two.

Table E.7 — Chemical resistance ratings

Rating	Colour change grey scale	Loss of visible gloss
0	5	Nil
1	4 to 5	5 units
2	4	10 units
3	3	15 units
4	3	20 units
5	2 to 3	40 units

E.8 Test report

The test report shall contain the following:

- (a) Full description of the test specimen.
- (b) Chemical resistance rating.
- (c) A failure remark if the rating is greater than 3.
- (d) Reference to this test method, i.e. AS 1838:2021 [Appendix E](#).

Appendix F (normative)

Water-resistance test

F.1 Scope

This appendix sets out a method for determining the resistance to water of the composite structure used in swimming pool manufacture.

F.2 Principle

Test specimens are exposed to water at 80 °C for a period of 720 h total. The specimens are visually rated for various types of degradation at 240 h and 720 h.

F.3 Apparatus

The following apparatus is required:

- (a) *Test tank* — A stainless steel test tank or alternative material of suitable size, equipped with portholes each of a minimum area of 6 400 mm², and means of maintaining the tank contents at 80 °C ± 2 °C, is required.

NOTE A porthole diameter of 90 mm min. to 110 mm max. should be used, i.e. approximately 6 400 mm² to 9 500 mm².

- (b) *Gaskets* — Suitable gaskets, e.g. made of silicone or other non-reactive rubber, shall be used to prevent leakage.
- (c) *Thickness measuring instrument* — Means of measuring cosmetic layer thickness, e.g. small portable-type microscope with calibrated eyepiece graticule or similar.
- (d) *Barcol hardness impressor model No. 934-1.*

F.4 Preparation of test specimens

Three test specimens of a size suitable for the test tank shall be obtained and prepared in accordance with the method in [Appendix D](#). Test specimens shall conform to the construction requirements of [Section 4](#).

The thickness of the cosmetic layer on each specimen shall be measured along all edges and the average thickness for the cosmetic layer for each specimen be recorded. Any defects in the cosmetic layer, e.g. fibre pattern, shall be recorded.

The Barcol hardness of each specimen shall be measured on an area that will be exposed to the water and be recorded. One specimen shall be marked and retained as the control specimen. If the Barcol hardness does not meet the requirements of [Clause 5.6](#) the specimens shall be discarded and replaced with specimens that meet the requirements of [Clause 5.6](#).

The remaining two specimens shall be secured, cosmetic layer inwards, each to one porthole, by stainless steel fittings or alternative material using a suitable sealing gasket on each port. Any unused portholes shall be covered with a non-reactive material.

F.5 Procedure

The procedure shall be as follows:

- (a) Fill the test tank with distilled water so that the portholes are covered.
- (b) Raise the temperature of the water to $80\text{ °C} \pm 2\text{ °C}$ and maintain.
NOTE 1 Good circulation of the water is essential for consistent results.
- (c) Maintain the water level and the temperature until the first inspection period is due, i.e. 240 h.
- (d) Drain the test tank after 240 h.
- (e) Remove the specimens and inspect for —
 - (i) fibre prominence;
 - (ii) particulate dissolution;
 - (iii) cracks;
 - (iv) pinhead blisters;
 - (v) interlaminar blisters;
 - (vi) loss of visible gloss; and
 - (vii) particulate deformation (not rated).
- (f) Rate specimens for increase in fibre prominence, particulate dissolution, cracks, pinhead blisters, interlaminar blisters and loss of visible gloss according to [Table F.6](#).
- (g) Continue with the test if the average rating is not greater than 2.
- (h) Complete Steps (a) and (b) and maintain water level and temperature for a further 480 h continuous.
- (i) Drain test tank at 720 h.
- (j) Remove and dry specimens, and inspect for fibre prominence, cracks, pin head blisters, interlaminar blisters and loss of visible gloss (if applicable) in accordance with [Table F.6](#).
- (k) Determine loss of visible gloss in accordance with [Table F.6](#).

NOTE 2 After the final inspections have been completed at 720 h, testing may continue until blistering or cracking occurs.

NOTE 3 Further testing serves to monitor any improvement or degradation in quality. This procedure should be carried out 3 to 4 times a year.

F.6 Water-resistance rating

The test specimens shall be visually compared with the control specimen and rated in accordance with [Table F.6](#) at —

- (a) *240 h* — For increase in fibre prominence, particulate dissolution, cracks, pin head blistering, interlaminar blisters; and loss of visible gloss.
- (b) *720 h* — For increase in fibre prominence, particulate dissolution, cracks, pin head blistering, interlaminar blistering, and loss of visible gloss.

NOTE 1 Particulate deformation around a suspended particle is not considered pin head blistering and is not rated in this test.

The tested specimens shall be rated against the control panel for the following, in accordance with [Table F.6](#) and [Clause 5.3](#):

- (i) Failed if the average rating at 240 h for fibre prominence, particulate dissolution, cracks, pin head blisters, interlaminar blisters and loss of visible gloss (if applicable) is greater than 2; and
- (ii) Failed if the average rating at 720 h for fibre prominence, particulate dissolution, cracks, pin head blisters, interlaminar blisters and loss of visible gloss (if applicable) of the test specimens is greater than 3.

Particulate deformation around any particle in the surface finish caused by heat distortion or heat shrinkage shall not be determined as a failure. Such particulate deformation shall not be included in the report.

NOTE 2 See [Clause 5.3](#) for water-resistance ratings.

Table F.6 — Water resistance ratings

Rating	Fibre prominence	Particulate dissolution	Cracks	Pin head blisters < 2 mm	Interlaminar blisters > 2 mm	Loss of visible gloss
0	Nil	Nil	Nil	Nil	Nil	Nil
1	Very slight distortion	1 particle dissolved	1 crack < 5 mm	1 to 2 blisters	1 blister	5 units
2	1 to 2 visible fibres or very slight orange peel	2 particles dissolved	2 cracks < 5 mm or 1 crack < 10 mm	< 5 blisters	2 blisters	10 units
3	5 to 10 visible fibres or slight orange peel	3 particles dissolved	2 cracks < 5 mm and 1 crack < 10 mm	< 10 pinhead blisters	6 blisters	15 units
4	5 to 10 visible fibres and slight orange peel	5 particles dissolved	5 cracks < 10 mm	< 5 % of the surface area blistered	> 6 but < 10 blisters	20 units
5	> 10 visible fibres or heavy orange peel	> 5 particles dissolved	More than 5 cracks < 20 mm	> 5 % and < 10 % of	> 10 but < 20 blisters	40 units

NOTE 1 The rating is taken on an area of 4 500 mm² (75 mm diameter) from centre of specimen.

NOTE 2 Loss of visible gloss is not to be considered where the outer gelcoat layer in contact with the pool water contains suspended particles.

NOTE 3 Particulate deformation is not considered as pin head blistering.

F.7 Test report

The test report shall contain the following:

- (a) Full identification of the test specimen, see [Table F.6](#).
- (b) List individual ratings for fibre prominence, particulate dissolution, cracks, pin head blisters, interlaminar blisters and loss of visible gloss (if applicable) at 240 h and 720 h.
- (c) Average cosmetic layer thickness, in millimetres, for the control and each tested specimen.

- (d) Reference to this test method, i.e. AS 1838:2021 [Appendix F](#).

Appendix G (informative)

External factors affecting in-service performance

G.1 Scope

This appendix provides external factors that may affect the performance of the pool shell after installation.

G.2 External factors

G.2.1 General

The external factors provided in [Clauses G.3 to G.7](#) will, if not maintained correctly, adversely affect the in-service chemical fade resistance and in-service water-resistance performance referred to in [Clause 5.7](#) and [Appendices E and F](#). Installation and maintenance requirements will be provided with the pool.

NOTE 1 For minimum requirements and guidance on water chemistry, refer to AS 3633.

NOTE 2 For minimum requirements and guidance on pool covers, refer to AS 3634.

G.2.2 Water chemistry testing records

In order to demonstrate conformance with the in-service resistance performance requirements of [Clause 5.7](#), a record of all pool water chemistry testing should be maintained.

G.3 Measurement of pH

A pH of less than 7 is acidic and may accelerate corrosion of some metal components associated with the pool or the pool water.

A low pH increases the effectiveness of the chlorine sanitiser in the water which may damage the pool surface if the active chlorine levels are too high.

A pH of above 7 is alkaline.

The levels of pH for a fibreglass pool should be 7.2 to 7.6.

When the pH increases above 7.6, hypochlorite ion formation increases resulting in reduced hypochlorous acid levels. The chlorine in this form becomes less effective as a sanitizer, and the water becomes more corrosive to the pool surface due to increased hypochlorite concentration and alkalinity.

At a pH of 8.5 the majority of the active chlorine is present as the hypochlorite ion.

The combination of high chlorine levels and high pH may result in chemical damage to the interior pool surface which presents as a whitening of the pool surface.

Water chemistry conditions should be maintained in accordance with the manufacturer's instructions.

Where applicable, pH automatic sensing and dosing equipment should be maintained regularly to ensure pH levels are between 7.2 and 7.6.

G.4 Chlorine levels

Chlorine is an extremely reactive reagent. The level of chlorine in the pool is relevant to sanitization for safe swimming and for the longevity of the aesthetic appearance of the pool surface.

It is essential to maintain a chlorine residual in the pool at all times to protect users. However, chlorine levels should not be allowed to rise above recommended parameters as damage will occur to the pool surface rapidly, especially if the pH and the water temperatures are also allowed to rise simultaneously without restriction.

Pool sanitizers should be maintained and adjusted regularly to ensure the correct water chemistry is maintained.

G.5 Water temperature

Combinations of high pH, high chlorine and high water temperatures will be detrimental to the cosmetic layer and may cause chemical attack and premature degradation.

The use of pool covers and pool water heaters may adversely affect the cosmetic interior of the pool if not adjusted and minimised.

Pool water heaters should be regulated to maintain the appropriate water temperatures. High water temperatures will accelerate the rate of the chemical attack on the cosmetic interior when the water chemistry levels have not been maintained in accordance with the pool manufacturer's instructions.

G.6 Pool covers

With the exception of mesh covers, all pools covers designed to float on the surface of the pool water should be as follows:

- (a) Made to fit a minimum of 20 mm short of the pool edge around the perimeter of the pool.
- (b) Removed from the pool for a minimum of 48 h in any one week to remove entrapped gases and allow the ultraviolet sun's rays to dissipate the chloramines and excess free chlorine.

NOTE Where pool covers are allowed to ride up over the area between the water level and the coping of the pool, entrapped superheated water and chemicals may cause irreversible damage to the surface of the pool.

G.7 Chemical water balance

While levels of pH, chlorine and water temperature have the highest impact on swimming pool surfaces, the following factors should also be maintained within the recommended levels to ensure proper water balance, water sanitization, operation serviceability of the sanitizing equipment and protection of the pool interior surface:

- (a) Combined chlorine.
- (b) Total hardness.
- (c) Total alkalinity.
- (d) Cyanuric acid or pool stabilizer.
- (e) Total dissolved solids.
- (f) Salinity.
- (g) Calcium hardness.

Pool water that is not correctly balanced may deposit minerals on the surface of the pool. Severe mineral deposition will occur if unchecked.

An incorrect water balance may mask the ability of automatic sensing and dosing equipment to accurately calibrate the levels of pH and chlorine causing them to progress to aggressive levels that may damage the pool surface.

Maintenance of all the correct water chemistry parameters and the serviceability of the pool equipment, to accurately maintain those recommended levels, is the responsibility of the pool owner.

Bibliography

AS 2780, Refractories and refractory materials — Glossary of terms

AS 3633, Private swimming pools — Water quality

AS 3634, Solar heating systems for swimming pools

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