

Australian/New Zealand Standard™

**Plastic monobloc chairs—Determination
of strength and durability, stability, UV
and weathering, and ignitability**



AS/NZS 3813:2016

This Joint Australian/New Zealand Standard was prepared by Joint Technical Committee CS-088, Furniture—Domestic and Commercial. It was approved on behalf of the Council of Standards Australia on 12 October 2016 and by the New Zealand Standards Approval Board on 5 October 2016. This Standard was published on 31 October 2016.

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Australian/New Zealand Standard™

Plastic monobloc chairs—Determination of strength and durability, stability, UV and weathering, and ignitability

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PREFACE

This Standard was prepared by the Joint Standards Australia/Standards New Zealand Committee CS-088, Furniture—Domestic and Commercial to supersede AS/NZS 3813:1998.

The objective of this Standard is to provide manufacturers of plastic monobloc chairs with test methods to ensure that such chairs are safe, reliable and suitable for adult persons up to 135 kg in mass.

This revision adds what are considered to be important features missing from the previous edition of the Standard (AS/NZS 3813:1998), that is, sections on weathering and ignitability.

Further, from a strength and durability perspective the ‘domestic’ and ‘commercial’ test levels used in the previous edition of AS/NZS 3813 have been replaced with ‘normal duty’ and ‘heavy duty’. The magnitude of the applied loads is the same for both levels; the difference is in the number of times the loads are applied, that is, ‘heavy duty’ indicates a higher proven level of durability, not a higher proven level of strength.

Reference was made to the following documents in the preparation of this Standard:

- (a) ISO 7173 *Furniture—Chairs and stools—Determination of strength and durability.*
- (b) ISO 7174 *Furniture—Chairs—Determination of stability, Part 1: Upright chairs and stools.*
- (c) BS 5852 *Methods of test for assessment of ignitability of upholstered seating by smouldering and flaming ignition sources.*
- (d) ISO 4892-2 *Plastics—Methods of exposure to laboratory light sources—Part 2: Xenon-arc lamps.*
- (e) SAE J2527 (formerly SAE J1960) *Performance based standard for accelerated exposure of automotive exterior materials using a controlled irradiance xenon-arc apparatus.*
- (f) ASTM G155-13 *Standard Practice for Operating Xenon Arc Light Apparatus for Exposure of Non-Metallic Materials.*
- (g) AS 2001.4.A02 *Methods of test for textiles, Method 4.A02: Colourfastness tests—Grey scale for assessing change in colour.*
- (h) ISO 105-A02 *Textiles—Tests for colour fastness, Part A02: Grey scale for assessing change in colour.*

The term ‘normative’ has been used in this Standard to define the application of the appendices to which it applies. A ‘normative’ appendix is an integral part of a Standard.

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FOREWORD

The strength, durability (mechanical) and stability tests specified are sufficient for chairs intended for use by adults up to 135 kg, but do not ensure that failure will not eventually occur either as a result of habitual misuse or after some years of service. The forces used are sufficient to allow for normal use and reasonable misuse but not extreme or habitual misuse.

The weathering tests specified indicate polymer formulations with resistance to the effects of UV radiation and other elements of outdoor exposure but do not ensure that failure will not occur beyond the stated thresholds.

The ignitability test specified indicates a chair design and polymer formulation with the ability to resist the ignition sources used but does not ensure that ignition will not occur when a chair is subject to more aggressive ignition sources or when subject to arson.

The strength, durability and stability test results are dependent on the loads being correctly applied, that is, they need to be of the specified magnitude, direction, sense, duration and distribution. They should also be able to follow any deformation they have induced in the chair. It is important that any loading device used does not act to also inadvertently support the chair, for example, loads applied using a hydraulic or pneumatic cylinder fixed in a single line of action allow deformation along that line of action only, and are therefore inappropriate.

In the case of chair designs not catered for in the test procedures, tests should be carried out as closely as possible to those described and deviations from the test procedure noted on the test report.

STANDARDS AUSTRALIA/STANDARDS NEW ZEALAND

Australian/New Zealand Standard**Plastic monobloc chairs—Determination of strength and durability, stability, UV and weathering, and ignitability**

SECTION 1 SCOPE AND GENERAL

1.1 SCOPE

This Standard sets out test methods for determining the strength and durability, stability, resistance to UV radiation and weathering, and ignitability of upright plastic monobloc chairs. The types of monobloc chair covered by this Standard are those designed primarily for single occupant use, for an adult population of users, and configured with four legs, a seat and a backrest.

This Standard is appropriate for chairs with seat heights between 400 mm and 600 mm (as measured at the seat loading point) and for chairs with upright backs [30 degrees or less off vertical as determined using the chair loading position template (see Figure A1)].

Stools, or chairs with pedestal, sled, cantilever, panel or similar base configurations, are not covered by this Standard.

NOTE: ISO 17025 requirements for reporting uncertainty do not apply when determining conformance to this Standard.

1.2 REFERENCED DOCUMENTS

The following documents are referred to in this Standard:

AS

2001 Methods of test for textiles

2001.4.A02 Method 4.A02: Colourfastness tests—Grey scale for assessing change in colour

ISO

48 Rubber, vulcanized or thermoplastic—Determination of hardness (hardness between 10 IRHD and 100 IRHD)

105 Textiles—Tests for colour fastness

105-A02 Part A02: Grey scale for assessing change in colour

4892 Plastics—Methods of exposure to laboratory light sources

4892-2 Part 2: Xenon-arc lamps

BS

5852 Methods of test for assessment of the ignitability of upholstered seating by smouldering and flaming ignition sources

BS EN

1021 Furniture. Assessment of the ignitability of upholstered furniture

1021-1 Part 1: Ignition source smouldering cigarette

SAE J

1960 Accelerated exposure of automotive exterior materials using a controlled irradiance water-cooled xenon-arc apparatus

2527 Performance based standard for accelerated exposure of automotive exterior materials using a controlled irradiance xenon-arc apparatus

ASTM
G155-13 Standard Practice for Operating Xenon Arc Light Apparatus for Exposure of
Non-Metallic Materials

1.3 DEFINITIONS

For the purposes of this Standard, the following definitions apply.

1.3.1 Accuracy

The degree of closeness to the true value or the specified value of whatever dimension is being measured, or force applied.

1.3.2 Article

Chair.

1.3.3 Base formulation

The base polymer, e.g. polypropylene, polyamide (nylon), etc.

1.3.4 Chair design

This concept incorporates all the relevant features and variables that determine the final attributes of the article, that is, the mould, the base formulation, the percentage of recycled (regrind) polymer used, any colouring or other additives, and relevant process control variables.

1.3.5 Chair ingredients

All the ingredients of the moulding, that is, the base formulation, the percentage of recycled (regrind) polymer used, and any colouring or other additives such as UV stabilizers or flame retardants.

1.3.6 Durability tests

Tests simulating repeated loading occurring over long-term use. (See Clauses 2.4.6 to 2.4.8.)

1.3.7 Impact tests

Tests to assess the strength and toughness of the article under the rapid rates of loading that occasionally occur (see Clauses 2.4.11 to 2.4.14).

1.3.8 Plastic monobloc chair

A one piece moulded synthetic polymer chair.

1.3.9 Precision

The degree to which repeated measurements show the same results. It is usually expressed as a $\pm\%$ about the true value or the specified value of whatever dimension is being measured, or force applied.

1.3.10 Stability tests

Tests to assess the stability of the chair when subject to forces that tend to cause it to overturn (see Clauses 3.4.1 to 3.4.3).

1.3.11 Stool

A seat without a backrest, or a seat with a backrest where the top edge of the backrest, measured in the median plane of the chair, is less than 200 mm above the seat loading position.

1.3.12 Strength tests

Tests consisting of heavy loads being applied a few times to ensure that the chair has sufficient strength to perform its function under the highest levels of loading that might reasonably be expected to occur. (See Clauses 2.4.1 to 2.4.5, 2.4.9 and 2.4.10.)

1.4 MARKING

1.4.1 General

All chairs shall be adequately and clearly marked when supplied. The information provided shall include the items in Clause 1.4.2.

1.4.2 Marking

All chairs shall be clearly and durably marked with the following:

- (a) The manufacturer's or importer's name and address.
- (b) Date of manufacture.
- (c) That the chair is not suitable for shower or bathroom use.
- (d) An industry-accepted recyclability and materials identification code.
- (e) The Sections of this Standard (AS/NZS 3813) to which it is claimed to be compliant and, if appropriate, at what level.
- (f) Whether the chair is stackable or non-stackable.

1.5 PRODUCT CONFORMITY

This Standard includes two levels of compliance for strength and durability, one level for stability, two levels for UV and weathering (and an additional 'non-compliant' one for indoor use only), and one level for ignitability. An item may be tested to any section of the Standard but compliance to the strength, durability and stability sections are intended to be core requirements, with UV and weathering, and the ignitability sections intended as adjuncts to be specified where appropriate.

The two levels of strength and durability compliance, normal and heavy duty, are distinguished by the number of load application cycles, not the magnitude of the loads applied. The heavy duty level is subject to twice the number of load application cycles in both the strength and durability tests.

Meeting the requirements of either of the UV and weathering section's levels of compliance indicates the chair is suitable for outdoor use and that the chair's polymer did not show any significant change in appearance such as blistering, chalking, cracking, crazing or major colour change until after the specified exposure period. These changes in appearance are indicative of declining mechanical properties, that is, a reduction in the polymer's tensile strength and toughness or an aesthetic change which the consumer may consider unacceptable.

For the lower level of UV and weathering compliance, intended for intermittent outdoor use, the exposure period is 1000 light-hours (41.7 days) in a Xenon weatherometer (in accordance with SAE J2527, SAE J1960, ASTM G155-13 Cycle 1 or 2 or ISO 4892-2 Cycle 1 or 2) and includes being subjected to a water spray to simulate the effect of rain.

For the higher level of compliance, where more frequent or continuous outdoor exposure is anticipated, the exposure period is 2000 light-hours (83.3 days).

For either level, if a dark cycle is included in the program, the overall test time shall increase accordingly to compensate.

Chairs that exhibit the indicators of declining mechanical properties or major colour changes prior to the minimum exposure hours required at the lower level of compliance, or those which were not subjected to the UV and weathering section of the standard, should be considered appropriate for indoor use only.

It should be noted that a chair that has achieved either of the UV and weathering compliance levels will still have a longer useful life if stored inside and used as much as possible out of the line of direct sunlight. It should also be noted that UV and weathering embraces many separate and highly variable effects and testing it is an imprecise science. Accelerated UV and weather testing procedures correlate imperfectly with long term exposure tests. For example, a chair that is judged suitable for intermittent outdoor use in Townsville (where the average global radiation is 180 kLy/year would most likely be suitable for continuous outdoor use in Hobart (where the average global radiation is 100 kLy/year). The UV and weathering tests in this Standard don't 'map' directly to the exposure levels expected in any particular Australian town or location. They are, however, more closely aligned with higher exposure areas (such as Townsville) than with lower exposure areas (such as Hobart).

The ignitability section includes two ignition sources; the smouldering cigarette and match flame equivalent.

The mechanical properties of polymers vary with temperature and the Standard has been designed to indicate appropriate performance at ambient temperatures between 5°C and 35°C.

Not every product will be tested to all sections of the Standard but all products shall be appropriately marked/labelled to indicate which sections they are compliant with (and, if applicable, at what level).

1.6 GENERAL PROVISIONS

The strength and durability tests in this Standard shall be performed at any ambient temperature between 18°C and 25°C. A polymer product proven to have satisfactory performance within this temperature range is not necessarily going to perform the same way outside this range. At lower temperatures, it is likely to be stiffer, but more brittle. At higher temperatures, it is likely to be more flexible, but tougher. Chairs that are expected to be used predominantly in environments at either extreme of the normal outdoor temperature range ($5^{\circ}\text{C} \geq t \geq 35^{\circ}\text{C}$, i.e. 5°C and below or 35°C and above), or which are made using polymers known to have mechanical properties that significantly degrade close to the ambient test temperature range (18°C–25°C), are outside the scope of this Standard and should be subject to separate and appropriate specialist evaluation.

The forces used in the tests are appropriate to chairs intended for adult persons up to 135 kg.

The tests consist of the application, to various parts of the item, of loads or forces simulating normal functional use, as well as misuse that might reasonably be expected to occur.

The test results are only valid for the articles tested. When the test results are intended to be applied to other similar articles, the test specimen should be representative of the production model.

In the case of designs not catered for in the test procedures, the test should be carried out as far as possible as described, and deviations from the test procedure recorded in the test report.

Tests carried out according to this Standard are intended to demonstrate the ability of the item to give satisfactory service in its intended environment. It should be understood that such tests do not ensure that structural failure will not eventually occur as a result of habitual misuse or after a long period of service, or more than occasional use by persons weighing more than 135 kg.

1.7 FAILURE CRITERIA

1.7.1 Strength and durability

The item is deemed to have failed if either of the following occurs:

- (a) The prescribed loads cannot be achieved and held for the durations and cycles specified.
- (b) Permanent deformation that leads to the item failing any of the stability tests.

NOTE: The presence of either cracks, discolouration or permanent deformation that does not lead to the item failing any of the stability tests, does not indicate failure.

1.7.2 Stability

The item is deemed to have failed if it begins to overturn.

1.7.3 UV and weathering

This Section involves classification into categories of resistance to UV and weathering. Failure criteria are not applicable. The relevant classification criteria are specified in Clause 4.4.

1.7.4 Ignitability

The item is deemed to have failed in accordance with the methods and requirements specified in the relevant section of BS 5852:2006 (see Clause 5.4).

SECTION 2 DETERMINATION OF STRENGTH AND DURABILITY

2.1 GENERAL TEST REQUIREMENTS

2.1.1 Preliminary preparation

Before any of the tests are commenced, the item shall be old enough to ensure that it has developed its full strength. At least four weeks in normal indoor conditions shall have elapsed between manufacture and testing. See also Clause 2.3 for preliminary noting of existing defects.

A standardized atmosphere is to be used for pre-conditioning. It shall have a temperature of $23 \pm 2^\circ\text{C}$ and a relative humidity of $(50 \pm 5)\%$. The chair shall be conditioned for at least 48 h in this atmosphere prior to testing. Testing shall be carried out in indoor ambient conditions at temperatures between 18°C and 25°C .

The chair shall be tested as delivered.

2.1.2 Sample selection

The full testing schedule specified in this Section should be applied to representative samples of chair designs in any of the following categories:

- (a) Previously untested designs.
- (b) Previously tested designs subject to design modification [see the definition of chair design in Clause 1.3.4 and also the discussion on colouring additives in this Clause (2.1.2)].
- (c) Previously tested designs where full testing was last conducted more than three years ago.
- (d) Previously tested designs at any time considered appropriate to check or confirm full compliance to this Section of the Standard.

In situations other than those outlined above it may be appropriate to perform partial validation testing only. A suggested testing schedule is specified below. This schedule is recommended as sufficient for chair designs based on new additives, for example, colouring, FR or UV additives(s), where the design (in another colour, for example) has proven conformance to a level of this Standard and where that new additive is known to have negligible effect on the mechanical performance of the chair design.

NOTE: 'Mechanical performance' principally means the chair's strength, stiffness and load cycle durability.

2.1.3 Partial validation testing schedule

Chair designs other than those listed in Clause 2.1.2(a) to (d) shall at least comply with the following Clauses of the Standard—Clauses 2.4.1 to 2.4.5 and 2.4.9 to 2.4.14.

2.1.4 Application of forces

The forces in the static strength tests and durability tests shall be applied sufficiently slowly to ensure that negligible dynamic load is applied. Unless otherwise stated, static forces shall be maintained for 5 s to 8 s and durability forces for 0.5 s to 1.5 s.

2.1.5 Accuracy and precision

Unless otherwise stated, all forces shall have an accuracy of $\pm 2\%$, and a precision of $\pm 5\%$, that is, all force application devices shall be initially set to $\pm 2\%$ of the specified value and all subsequent applications of force shall fall within $\pm 5\%$ of the specified value. All mass

measuring instruments shall have an accuracy of $\pm 2.0\%$. All dimensional measuring instruments shall have an accuracy of ± 0.5 mm. Dimensional measurements shall have a precision of ± 2 mm.

Polymer chairs often exhibit significant creep under load, that is, time, temperature and load dependent deformation. For some tests it may be difficult to maintain the specified force for the time required due to creep. For these tests a lower than normal requirement for precision has been specified.

2.1.6 Sequence of testing

All applicable tests shall be carried out on the same chair in the order listed.

2.2 TEST ENVIRONMENT AND APPARATUS

2.2.1 General

The tests may be applied by any suitable device because results are dependent only upon correctly applied loads and not upon the apparatus, except in the case of impact tests where the apparatus described in Clauses 2.2.5 and 2.2.6 shall be used.

2.2.2 Floor surface

Horizontal, flat smooth stainless steel (2B mill finish^{*}) on a hard substrate. This surface shall be used where specified. In all other instances the floor surface shall be horizontal, flat and smooth, made of any suitable material. For the drop test (Clause 2.4.14) a rubber mat 2 mm thick, with hardness 85 IRHD ± 10 according to ISO 48, on a horizontal, flat, concrete floor shall be used.

2.2.3 Stops

To prevent the article from sliding but not tilting, no higher than 12 mm, except in cases where the design of the item necessitates the use of higher stops, in which case the lowest that will prevent the item from sliding shall be used.

2.2.4 Loading pads

2.2.4.1 General

All loading pads shall be capable of pivoting in relation to the direction of the applied force.

2.2.4.2 Seat loading pad

Naturalistically shaped rigid indent (see Figure 2.1) with a hard, smooth surface.

2.2.4.3 Smaller seat loading pad

Rigid circular object 200 mm in diameter the face of which has a convex spherical curvature of 300 mm radius with a 12 mm front edge radius (see Figure 2.2).

2.2.4.4 Back loading pad

Rigid rectangular object 200 mm high and 250 mm wide the face of which is curved across the width of the pad with a convex cylindrical curvature of 450 mm radius and with a 12 mm radius on all front edges (see Figure 2.3).

2.2.4.5 Local loading pad

Rigid cylindrical object 100 mm in diameter, with a flat face and a 12 mm radius on the front edge which is used for the arm loading test.

* Defined as 'Cold rolled, softened, descaled with a final light pinch pass through polished rollers'.

2.2.4.6 *Foam for facing loading pads*

25 mm thick layer of polyether, polyurethane or similar foam with a density of 27 kg/m³ to 30 kg/m³. Alternatively, a layer of this foam may be loosely positioned between the loading pad and the test structure.

2.2.5 **Seat impacter**

NOTE: See Figure 2.4.

2.2.5.1 *Circular body*

Approximately 200 mm in diameter separated from the striking surface by helical compression springs and free to move relative to it on a line perpendicular to the plane of the central area of the striking surface.

The body and associated parts minus the springs shall have a mass of 17 ± 0.1 kg and the whole apparatus, including mass, springs and striking surface, shall have a mass of 25 ± 0.1 kg.

2.2.5.2 *Springs*

Which shall be such that the combined spring system has a spring rate of 0.69 ± 0.1 kg/mm and the total friction resistance of the moving parts is between 0.025 kg and 0.045 kg.

The spring system shall be compressed to an initial load of 104 ± 0.5 kg (measured statically) and the amount of spring compression movement available from the initial compression point to the point where the springs become fully closed shall be not less than 60 mm.

2.2.5.3 *Striking surface*

Approximately flat leather pad containing fine dry sand.

2.2.6 **Pendulum impact hammer**

Cylindrical object having a mass of 6.5 ± 0.1 kg, supported from a pivot by a steel tube of 38 mm in diameter and with a wall thickness of 1.6 mm. The distance between the pivot and the centre of gravity of the striker is 1 m. The pendulum arm is pivoted by a low friction bearing (see Figure 2.5).

2.2.7 **Chair loading position template**

As described in Appendix A.

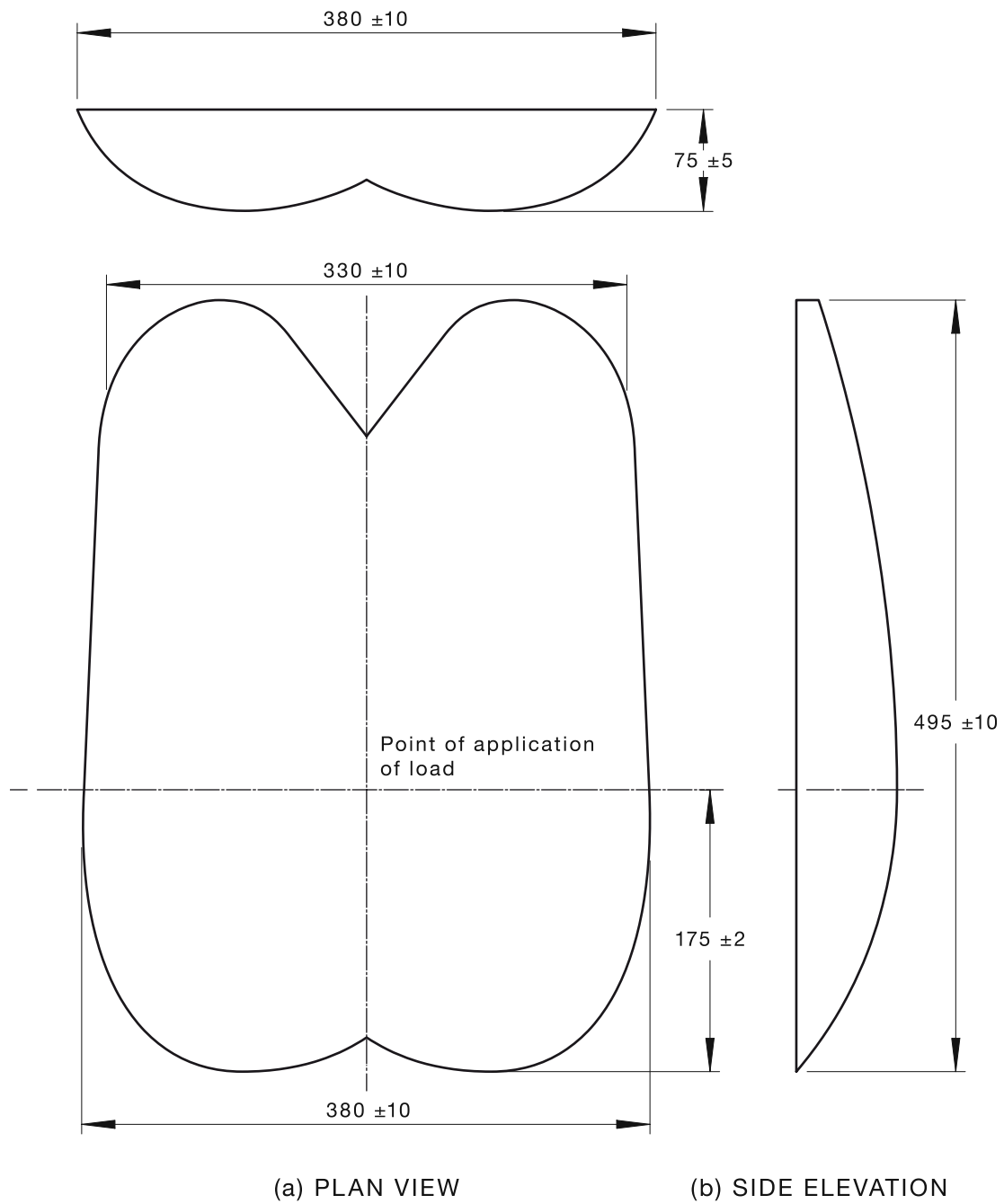


FIGURE 2.1 DETAILS OF THE NATURALISTICALLY SHAPED SEAT LOADING PAD

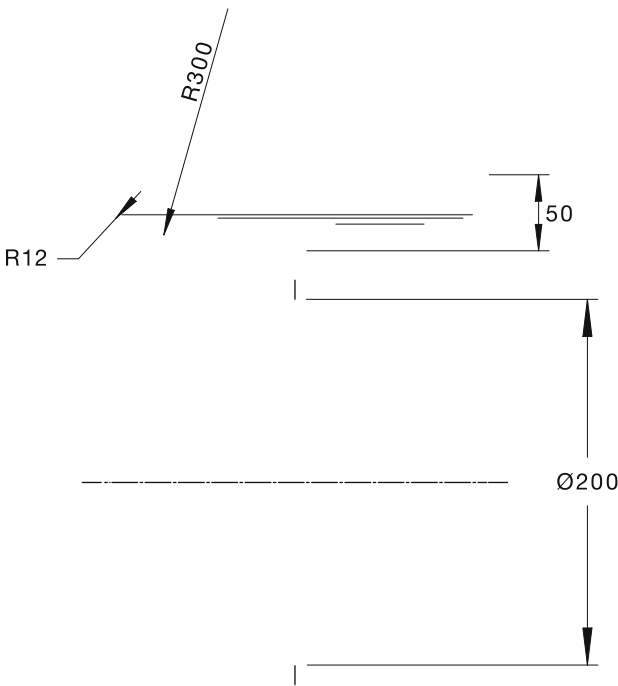


FIGURE 2.2 DETAILS OF THE SMALLER SEAT LOADING PAD

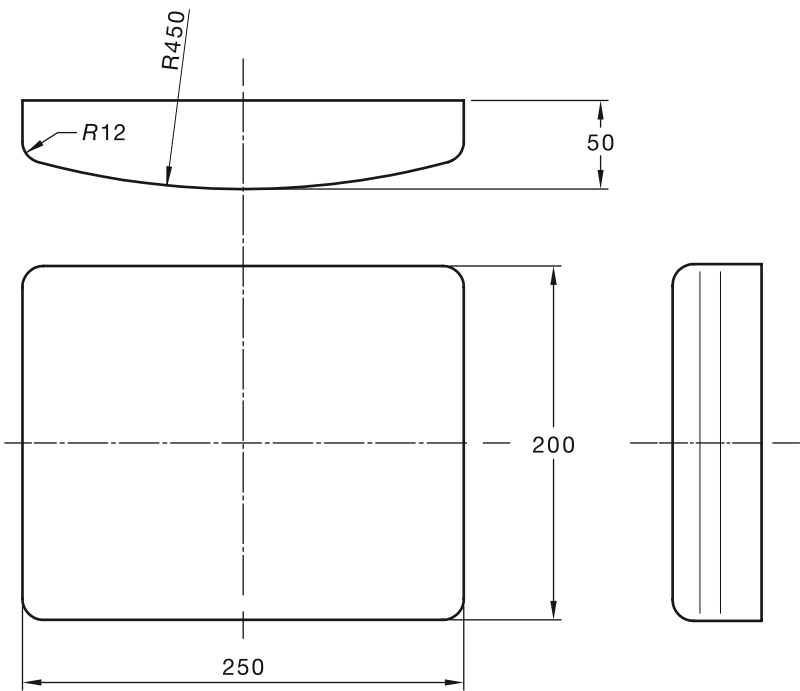


FIGURE 2.3 DETAILS OF THE BACK LOADING PAD