

Australian Standard[®]

**Wheelchair occupant restraint
assemblies for motor vehicles**

This Australian Standard was prepared by Committee ME/48, Restraint Systems in Vehicles. It was approved on behalf of the Council of Standards Australia on 4 February 1994 and published on 16 May 1994.

The following interests are represented on Committee ME/48:

ACROD

Australian Automobile Association

Federal Chamber of Commerce and Industries

Australian College of Rehabilitation Medicine

Commercial Vehicle Industry Association of Australia

Department of Transport and Communication

Department of Veterans Affairs

Federal Chamber of Automotive Industries

Federation of Automotive Products Manufacturers

Roads and Traffic Authority of N.S.W.

University of N.S.W.

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Additional interests participating in preparation of Standard:

Motor vehicle and restraint manufacturers

Regency Park Centre for Young Disabled (Adelaide)

Royal North Shore Hospital (Sydney)

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**Wheelchair occupant restraint
assemblies for motor vehicles**

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PREFACE

This Standard was prepared by the Standards Australia Committee on Restraint Systems in Vehicles, to supersede AS 2942—1987.

Because the first edition of this Standard was rapidly accepted and adopted into legislation in most Australian States, more information is required to verify the acceptability of given wheelchair occupant restraint assembly 'kits' available for purchase, and the removal of some previously specified installation requirements that are now subject to vehicle registration authorities' specification and approval.

This edition differs from AS 2942—1987 in the following ways:

- (a) The marking requirements now include part numbers on each readily separable component or subassembly and, where alternative or additional components may be available, an indication of compatibility between components.
- (b) The packaging requirements now separately specify the information to be displayed externally to assist with selection of an appropriate assembly, and information to be contained within the packaging.
- (c) The intent of the instructions for use and for installation has been modified so that it is now required that this information be supplied as guidelines by the restraint manufacturer. However, it is not mandatory for the restraint manufacturer to ensure that these guidelines are adopted. Manufacturers of restraint assemblies are required, where practical, to design components so that incorrect use, orientation and restraint geometry is not possible.
- (d) The range of sizes and types of wheelchairs compatible with a restraint assembly is now fully specified within the Standard or, where a restriction to this range applies, by the restraint manufacturer. References to occupant garment sizes and thickness of cushions have been deleted.
- (e) The method of test for dynamic performance of restraints has been amended to improve clarity, and remove interpretations previously required. The positioning of restraint assembly mounting points on the test trolley has been more precisely specified.
- (f) 'Guidelines for vehicle reinforcement', previously Appendix C, has been deleted as more specific requirements are now necessary to suit some vehicle registration authority specifications.
- (g) 'Guidelines for vehicles used for transport of occupants in wheelchairs', previously Appendix D, has now been deleted as unnecessary. Advice on vehicles is obtainable from vehicle registration authorities.
- (h) 'Guidelines for wheelchairs used in vehicles', now Appendix A, has been amended as its recommendations were subject to misinterpretation, resulting in refusal to permit a wheelchair occupant to travel in a vehicle in their usual wheelchair.

It recognizes that a wheelchair that best serves the overall needs of its owner may not be ideal for restraint in motor vehicles, and that prohibiting the use of such wheelchairs in a vehicle is not practical despite some additional risks of injury.

The terms 'normative' and 'informative' have been used in this Standard to define the application of the appendix to which they apply. A 'normative' appendix is an integral part of a Standard, whereas an 'informative' appendix is only for information and guidance.

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FOREWORD

Wheelchair occupant restraint assemblies complying with this Standard will give protection in most accidents if they are properly installed and attached, and worn correctly. In general, wheelchairs are not well suited to the requirements of vehicular seating, and the safety of passengers is best assured by the use of normal passenger seats and seat belts. Wheelchair occupants should transfer to passenger seats in vehicles and use the seat belt provided whenever that is practicable, and unoccupied wheelchairs should be restrained.

Effective restraint for people occupying wheelchairs requires the wheelchair to be secured in the transporting vehicle, with the occupant restrained by a seat belt which itself is secured directly to the vehicle or to parts which are themselves secured to the vehicle. The wheelchair contributes to restraint of the occupant by virtue of the support provided by the wheelchair seat, backrest, and armrests. The complete restraint for the occupant includes the wheelchair itself, i.e. includes restraints for the occupant and the wheelchair.

There are currently no recognized Standards covering wheelchairs suitable for vehicle seating, and, even if such Standards could be rapidly implemented, the problems of vehicular transport for people occupying non-complying wheelchairs would remain for many years. However, provided that suitable restraints are fitted, tests have shown that some types of wheelchairs can survive a severe impact without fractures of the frame.

This Standard specifies restraints for wheelchairs and their occupants and does not specify strength requirements for wheelchair structures or for vehicle structures used to anchor wheelchair occupant restraint assemblies. Rather, the manufacturer of wheelchair occupant restraint assemblies is required to provide details of strength requirements at the anchorages of a restraint assembly. Vehicle regulatory authorities require approval of restraint installations, and should be consulted for advice on reinforcement of vehicle structures at anchorages.

To allow for various applications, the Standard allows for designs that do not require any wheelchair modifications, those in which parts of the restraint assembly are fitted onto the wheelchair restraint assemblies, wheelchairs that incorporate a child safety seat complying with AS 1754 *Child restraint systems for use in motor vehicles*, and wheelchair frames manufactured with integral restraint components.

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STANDARDS AUSTRALIA

Australian Standard

Wheelchair occupant restraint assemblies for motor vehicles

SECTION 1 SCOPE AND GENERAL

1.1 SCOPE This Standard specifies requirements for restraint assemblies for commonly available manual and electric wheelchairs and their occupants in motor vehicles.

This Standard does not apply to the restraint of wheelchair occupants who are driving a vehicle.

NOTES:

- 1 It is a requirement of most States and Territories that their vehicle registration authorities approve the installation of a wheelchair occupant restraint assembly.
- 2 Appendix A gives guidelines for wheelchairs for use in vehicles.

1.2 REFERENCED DOCUMENTS The following documents are referred to in this Standard:

AS

1753 Webbing for restraining devices for occupants of motor vehicles

AS/NZS

1754 Child restraint systems for use in motor vehicles

2596 Seat belt assemblies for motor vehicles

4475 Restraint systems for motor vehicles—Performance tests

4475.1 Method 1: Determination of webbing durability in adjustment duty

4475.2 Method 2: Determination of webbing durability in withdrawing and retracting duty through a sash guide

4475.3 Method 3: Determination of fatigue resistance of a flexible member

4475.4 Method 4: Determination of adjustment device forces

4475.5 Method 5: Determination of locking angle of tilt-lock adjustment device

4475.6 Method 6: Determination of free-end device strength

ADR*

4 Seat belts

11 Internal sun visors

21 Instrument panel

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

1.3.1 Anchor fitting—the terminal part of an occupant restraint strap designed to transfer forces of restraint to the vehicle, or to the structure of the wheelchair restraint assembly.

1.3.2 Anchor point—the point where the centre-line of an occupant restraint strap passes into the anchor fitting or changes direction. For anchor fittings which are designed to pivot or are secured by a single bolt, the anchor point is the intersection of the axis of rotation, or the centre-line of the bolt, with the surface of the supporting structure. (See also Clause 1.3.20.)

1.3.3 Anchorage—that part of a vehicle designed to transfer loads from a wheelchair occupant restraint assembly to vehicle structure.

* Australian Design Rules for motor vehicles and trailers. This reference refers to the latest edition of the design rule, in place at the time this Standard is used.

1.3.4 Attachment—the engagement of restraint components without the use of tools, to secure the wheelchair and its occupant as would occur when preparing for a journey.

1.3.5 Child safety seat—a restraint device for children comprising a structural shell providing lateral restraint and head restraint, a restraint harness, and which complies with AS 1754.

1.3.6 Compatible wheelchair—a wheelchair suitable for use with a given restraint assembly as specified by the restraint manufacturer. In the case of wheelchair occupant restraint assemblies of Types A and B (see Clause 1.4), the term compatible wheelchair is taken to include sizes within the range shown in Figure 2.1.

1.3.7 Detachment—the release of restraint components to remove the wheelchair, without the use of tools, and its occupant from the vehicle as would occur at the conclusion of a journey.

1.3.8 Forward-facing—facing the front of the vehicle, with the seating reference plane within 10 degrees either side of the longitudinal axis of the vehicle.

1.3.9 Frontal impact—an impact at the front of a vehicle in the direction of the longitudinal axis of the vehicle.

1.3.10 Harness (or harness belt)—a seat belt assembly consisting of at least one strap designed to provide pelvic restraint, and two or more torso straps. (See Figure 1.1.)

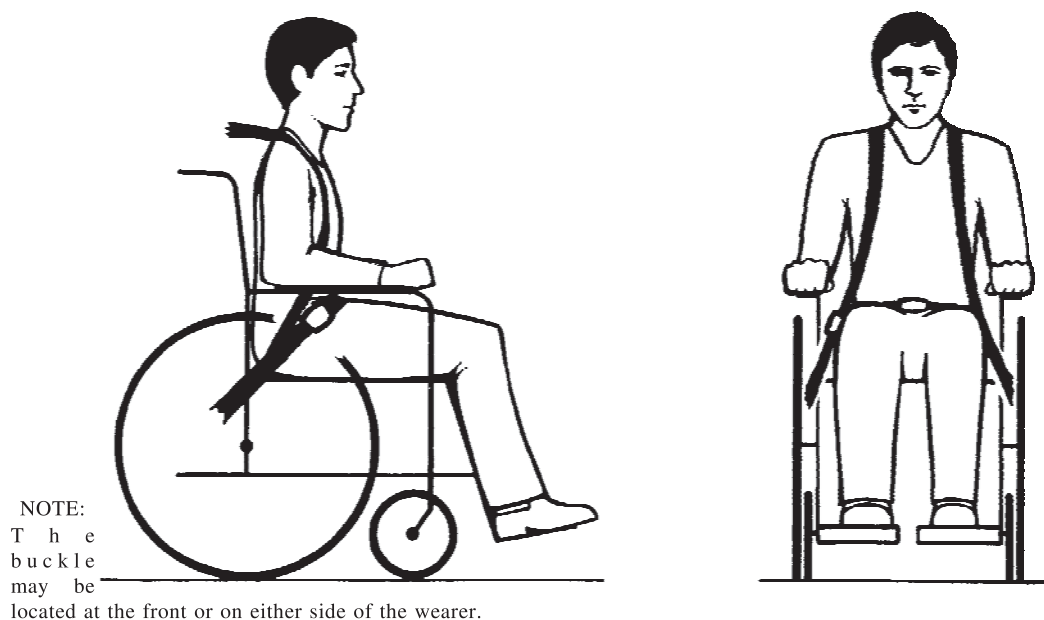


FIGURE 1.1 HARNESS BELT

1.3.11 Harness straps—the shoulder straps only of a harness belt.

1.3.12 Head and back restraint—a device which transmits restraint forces to the back of the head and to the back of the torso so as to limit rearward movement of the head or torso.

1.3.13 Informative—an Appendix giving additional information, recommendations, guidelines or other non-mandatory statement.

1.3.14 Installation—the process of permanently fastening structural components of the restraint assembly to the vehicle or another structural component of the restraint assembly.

NOTE: Installation is intended to be performed only by authorized installation personnel or as part of the manufacturing process (see Clause 3.1.1(c)).

1.3.15 Lap belt—a seat belt assembly designed to provide pelvic restraint only. (See Figure 1.2.)

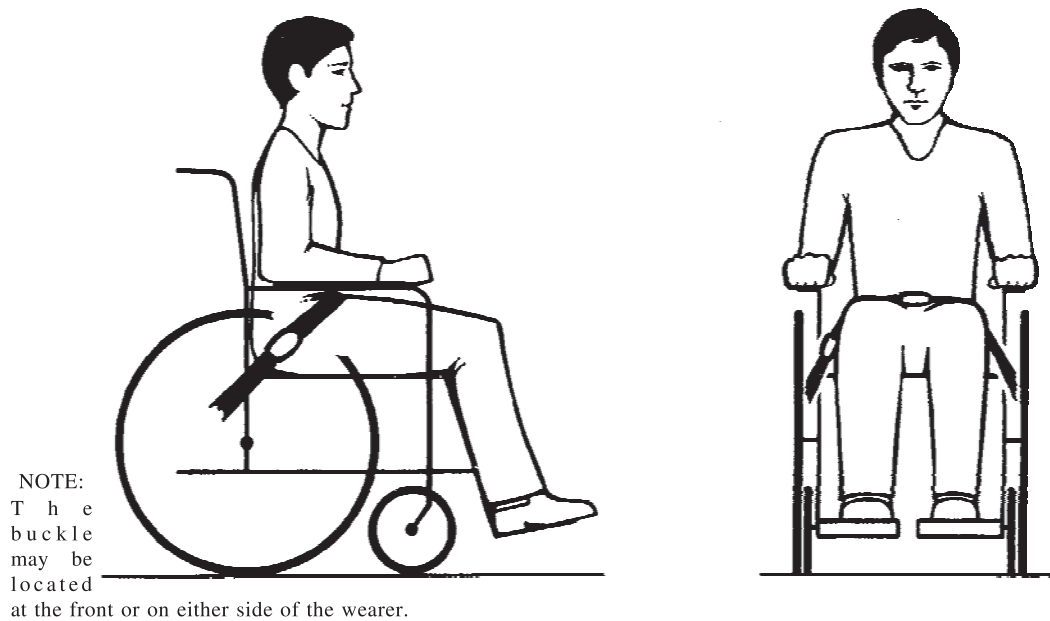


FIGURE 1.2 LAP BELT

1.3.16 Lap-sash belt—a seat belt assembly combining a lap strap and torso strap. (See Figure 1.3.)

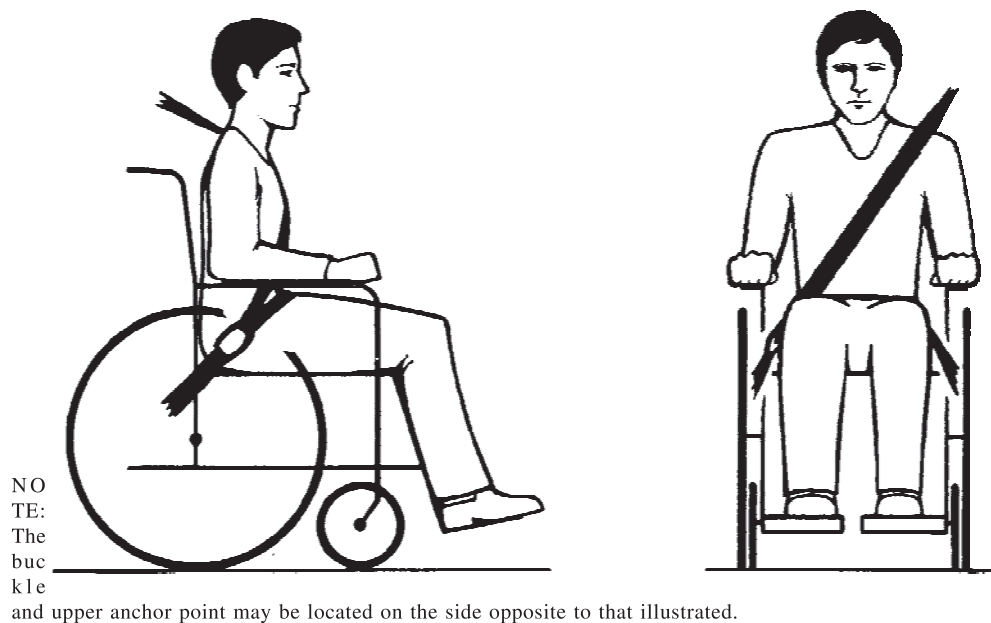


FIGURE 1.3 LAP-SASH BELT

1.3.17 Lap-sash point—the point representing the intersection of the lap and torso strap of a lap-sash belt.

- 1.3.18 Lap strap**—a strap which provides pelvic restraint.
- 1.3.19 Manual adjustment**—the adjustment procedure that can be conveniently performed, without the use of tools.
- 1.3.20 Mounting point**—a point at the intersection of the centre-line of a mounting bolt and the surface of the vehicle structure.
- 1.3.21 Normative**—an Appendix which is essential to the understanding or implementation of the Standard.
- 1.3.22 Occupant restraint**—a device for securing a wheelchair occupant within a motor vehicle.
- 1.3.23 Partial engagement**—a partial engagement of a release device is an engagement which requires a force of more than 5 N to disengage, but which does not constitute a complete engagement.
- 1.3.24 Pelvic restraint**—a device which transmits restraint forces to the body through the bones of the front of the pelvis to prevent compression of the abdominal contents between the restraint and the lumbar spine.
- 1.3.25 Rear impact**—an impact at the rear of a vehicle in the direction of the longitudinal axis of the vehicle.
- 1.3.26 Rearward-facing**—facing the rear of the vehicle, with the seating reference plane within 10 degrees either side of the longitudinal axis of the vehicle.
- 1.3.27 Reference point P**—with a wheelchair viewed in side view, point P is the centre of a disc of 100 mm diameter lying in the seating reference plane and touching the backrest and the upper surface of the seat, assuming the sling seat and backrest to be taut. (See Figure 1.4.)
- 1.3.28 Sash guide**—any device that alters the direction of a sash strap between the anchor point and the point where the strap leaves the shoulder of the wearer.
- 1.3.29 Sash location point**—the point where the centre-line of a sash strap first changes direction after leaving the shoulder of the wearer.
- 1.3.30 Sash strap**—the torso strap of a lap-sash belt.
- 1.3.31 Seating reference plane**—a vertical plane in a vehicle, being the plane of symmetry of the seat of a wheelchair correctly positioned in a wheelchair occupant restraint assembly. (See Figure 1.4.)
- 1.3.32 Shall**—indicates that a statement is mandatory.
- 1.3.33 Should**—indicates a recommendation.
- 1.3.34 Side impact**—an impact at the side of a vehicle in a horizontal direction perpendicular to the longitudinal axis of the vehicle.
- 1.3.35 Strap**—a length of webbing material.
- 1.3.36 Upper torso restraint**—a device which transmits restraint forces to the front of the ribcage and shoulders so that crash forces are applied to these structures symmetrically about the midline or are applied across the midline to the ribcage and one shoulder.
- 1.3.37 Wheelchair occupant restraint assembly**—a complete system comprising occupant restraints, wheelchair restraints and fittings for installing the assembly, suitable for restraining a person occupying a wheelchair within a motor vehicle.
- 1.3.38 Wheelchair restraint**—a device for securing an occupied wheelchair within a motor vehicle, including parts fitted onto a wheelchair for the purpose of restraint, but not including parts of the wheelchair frame.

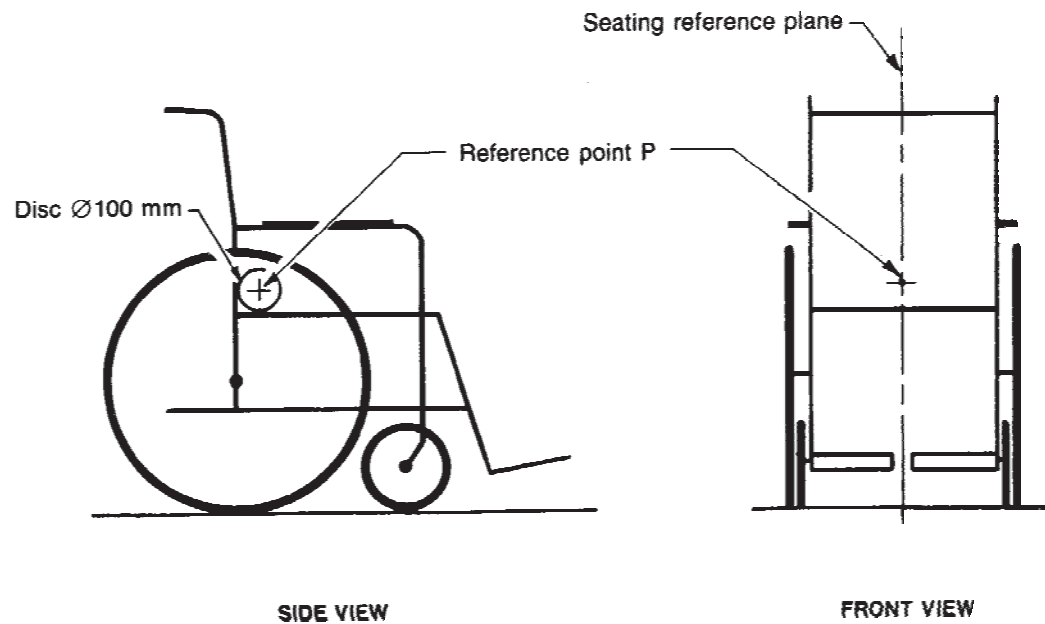


FIGURE 1.4 POSITION OF REFERENCE POINT P AND SEATING REFERENCE PLANE

1.4 RESTRAINT TYPES Wheelchair occupant restraint assemblies shall be classified according to their design principles as follows:

- (a) *Type A*—a wheelchair occupant restraint assembly designed for use with wheelchairs which have not been modified by the addition of parts for the purpose of restraint.
- (b) *Type B*—a wheelchair occupant restraint assembly designed with parts for installation onto a wheelchair for the purpose of restraint, these parts being added to the wheelchair subsequent to its manufacture.
- (c) *Type C*—a wheelchair occupant restraint assembly designed with parts permanently incorporated into the frame of a wheelchair during manufacture of the frame.

SECTION 2 DESIGN, CONSTRUCTION, AND TESTING

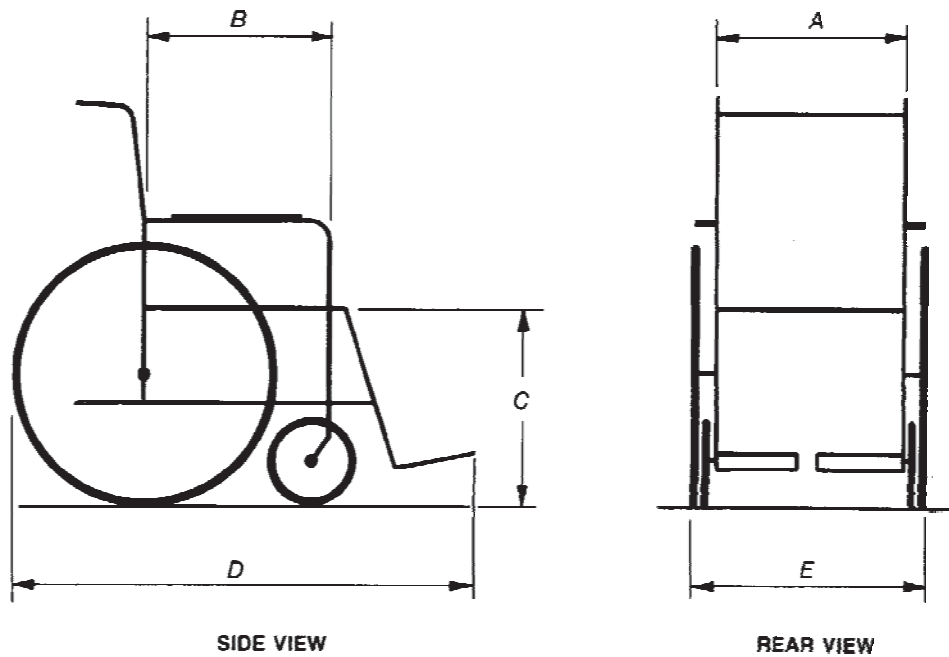
2.1 GENERAL Wheelchair occupant restraint assemblies shall include provisions for restraining both wheelchairs and their occupants to vehicle structure and shall comply with the following:

- (a) A wheelchair occupant restraint assembly shall be designed so that the occupant is—
 - (i) forward-facing; or
 - (ii) rearward-facing.
- (b) A wheelchair occupant restraint assembly shall be designed so that the wheelchair occupant can remain in the wheelchair while an assistant is attaching, detaching, or manually adjusting the assembly.
- (c) A wheelchair occupant restraint assembly shall be designed and constructed to prevent injury to the occupant, and to an assistant who may be required to attach and detach the wheelchair or manually adjust the restraints.
- (d) A wheelchair shall not be restrained by forces transmitted through the body of an occupant and which are likely to increase the risk of injury.
- (e) Wheelchair occupant restraint assemblies shall be designed so that restraint components are not required to pass through the wheels of a wheelchair.
- (f) Wheelchair occupant restraint assemblies of types A and B shall accommodate wheelchairs having dimensional parameters within the range shown in Figure 2.1.

2.2 WHEELCHAIR RESTRAINTS Wheelchair restraints shall comply with the following:

- (a) Wheelchair restraints shall either—
 - (i) incorporate means of manual adjustment to remove slack; or
 - (ii) limit movement of the reference point P (see Figure 1.4) of a compatible wheelchair to not more than 25 mm in any horizontal direction due to the application of a horizontal force equal to the weight of the wheelchair and acting through the reference point P.
- (b) Wheelchair restraints shall be designed so that a compatible wheelchair can be attached to or detached from a vehicle without the use of tools.
- (c) The means of attaching and detaching a wheelchair—
 - (i) shall be designed to prevent inadvertent release and shall not be capable of partial engagement; a potential for inadvertent release or partial engagement shall be demonstrated by methods specified in Appendices B and C;
 - (ii) shall include a positive method of restraining the restraint attachment, e.g. captive hooks; and
 - (iii) where a wheelchair release mechanism can be engaged in more than one way, shall comply with Clause 2.9 for each way in which the mechanism can be engaged.
- (d) The wheelchair shall be restrained regardless of deformation of wheelchair components as a result of a crash, therefore positive methods of restraint attachment are required, e.g. captive hooks.

NOTE: The dynamic performance test method specified in this Standard for types A and B restraints utilizes a rigid test seat to simulate a wheelchair, hence this test does not indicate the suitability of a restraint to remain attached to a wheelchair that may deform during a crash.



Wheelchair parameter	Minimum-sized wheelchair	Maximum-sized wheelchair
A (frame width)	350	500
B (seat depth)	330	530
C (seat height)	350	530
D (length overall)	800	1 200
E (width overall)	450	700
Wheel diameters	100 to 660	

DIMENSIONS IN MILLIMETRES

FIGURE 2.1 SIZE RANGE OF WHEELCHAIRS TO BE ACCOMMODATED BY RESTRAINT ASSEMBLIES (i.e. COMPATIBLE WHEELCHAIRS)

- (e) Wheelchair restraints shall be attached to, or installed onto, the frame of the wheelchair and not to the wheels, axles, backrest, armrests, footrests or upholstery.
- (f) Restraint fittings that are to be installed onto a wheelchair frame after manufacturing shall be designed so that installation of the fittings does not require—
 - (i) removal of frame material;
 - (ii) heating of the frame;
 - (iii) permanent deformation of the frame; or
 - (iv) use of adhesive processes.

NOTE: This requirement does not apply to operations carried out during manufacture of a wheelchair frame.

- (g) Threaded fasteners used in wheelchair restraints shall incorporate a design feature to ensure locking of the fastener.
- (h) For release device mechanisms incorporating springs, the load required to operate the mechanism shall not be reduced by more than 20% after the mechanism has been subjected to 50 000 operations at a frequency of 0.5 ± 0.25 Hz, each involving a movement of not less than 95% of the design movement for mechanism release.

NOTE: Securing buckles from seat belt assemblies complying with AS 2596 need not be subjected to this test.

- (i) Wheelchair restraints which incorporate webbing shall comply with the requirements specified in Clauses 2.3.2(b), 2.3.2(c), 2.3.3(b), 2.3.3(e), 2.3.4(a), 2.3.4(b), 2.3.4(c) and 2.3.4 (d).

2.3 OCCUPANT RESTRAINTS

2.3.1 General configuration Occupant restraints shall—

- (a) include a lap belt or other form of pelvic restraint meeting all the requirements for lap belts, should desirably include a lap-sash belt or harness to provide upper torso restraint and may include a child restraint complying with AS 1754 as an integral part of the assembly;
- (b) be designed so that their anchor fittings may be properly attached to anchorages with anchor points located anywhere within the zones—
 - (i) for lap belt anchorages; shown in Figure 2.2;
 - (ii) for upper anchorages for harnesses, shown in Figure 2.3; and
 - (iii) for upper torso anchorages for lap-sash belts, shown in Figure 2.4;

for any compatible wheelchair correctly secured on the vehicle by the wheelchair restraint.

2.3.2 Webbing All webbing shall comply with AS 1753 and the following:

- (a) Harness straps shall be Class C13, Class D16 or Class D22 as specified in AS 1753; all other body restraining straps shall be Class D16 or Class D22.
- (b) Webbing ends shall not unravel.
- (c) Where a strap passes through another component, other than a sash guide used in conjunction with an emergency locking retractor and there is relative movement between the strap and the component as a result of adjusting operations, the webbing when tested with the component shall comply with AS/NZS 4475.1.
- (d) Where a lap-sash belt incorporates an emergency locking retractor and there is relative movement between the retracting strap and the sash guide system (other than the retractor itself) during the wearing and retracting operations, the webbing when tested with the sash guide shall comply with AS/NZS 4475.2.

2.3.3 Webbing components Webbing connections and associated components shall comply with the following:

- (a) Flexible components or flexible load-bearing members designed to bend and flex, other than webbing complying with AS 1753, shall be capable of sustaining a tensile force of 15 kN when tested, with the subassembly which contains them, in accordance with AS/NZS 4475.3.
- (b) All rigid components, including attachment and installed devices, buckles, adjusters, anchor fittings, bolts, screws, and rivets shall be designed or located to minimize harm to the wearer or damage to the wearer's clothing during use.
- (c) The securing buckle shall comply with AS 2596.

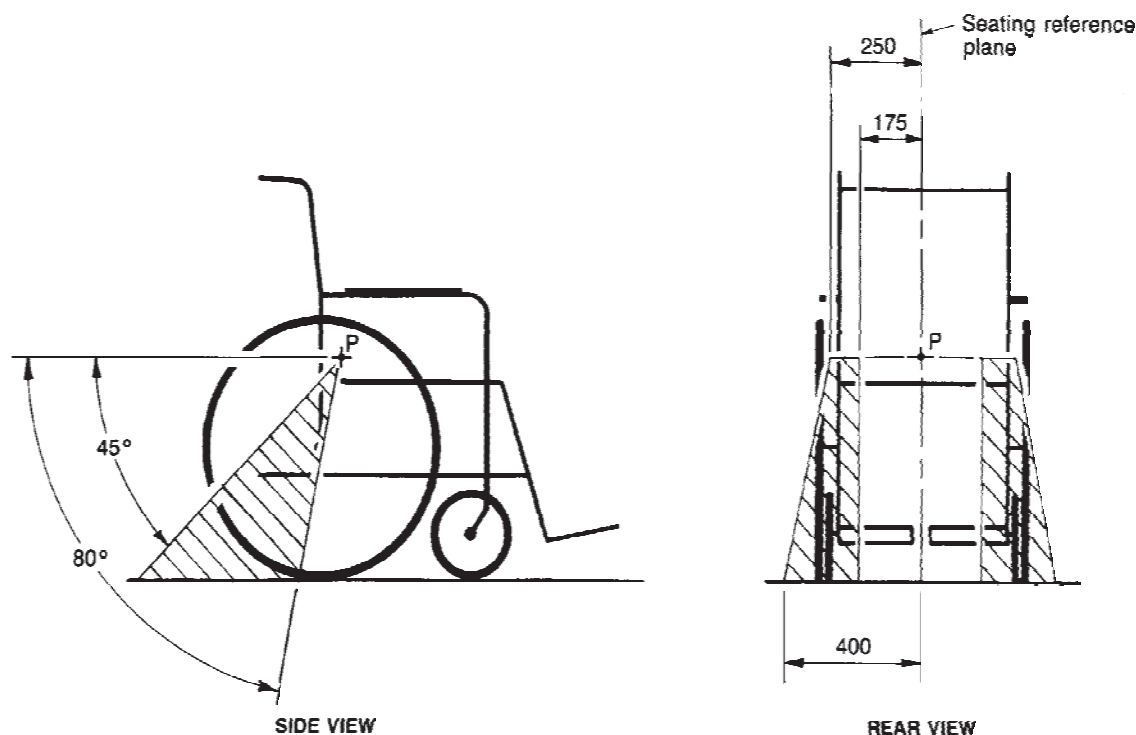
- (d) The overall width of any component used in conjunction with webbing, and likely to contact the wearer in normal use, shall not exceed the width of such webbing by more than 20 mm when measured at right angles to the length of the webbing.
- (e) Webbing connections (e.g. stitching) shall be capable of complying with the requirements for resistance to light degradation specified in AS 1753.

2.3.4 Adjustment devices Adjustment devices for straps shall comply with the following:

- (a) When tested in accordance with AS/NZS 4475.4, adjustment devices shall require an adjustment force not greater than 50 N. When tested in accordance with AS/NZS 4475.5, a tilt-lock adjustment device shall lock at angles of less than 25°.
- (b) When tested in accordance with Appendix D, webbing slippage shall not be greater than 25 mm.
- (c) Not less than 25 mm of material shall extend from the adjustment device to provide a grip for adjustment purposes.

NOTE: The material may either be connected to, or form part of, the free end of the strap.

- (d) The free end of an adjustable strap shall not pass through the adjustment device for normal adjustments when tested in accordance with AS/NZS 4475.6.
- (e) Retractors for straps shall comply with the requirements for retractors specified in AS 2596.



NOTE: Shading indicates permitted zones.

DIMENSIONS IN MILLIMETRES

FIGURE 2.2 PERMITTED ZONES FOR LOCATION OF ANCHOR POINTS FOR A LAP BELT