

PAS 2012-1:2025

M1 vehicles for the carriage of one or more passengers seated in wheelchairs – Part 1: Manufacturing requirements – Specification



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Foreword

This PAS was sponsored by the Wheelchair Accessible Vehicle Converters' Association (WAVCA).¹⁾ Its development was facilitated by BSI Standards Limited and it was published under licence from The British Standards Institution. It came into effect on 31 August 2025.

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- Research Institute for Disabled Consumers (RiDC)
- Society of Motor Manufacturers and Traders (SMMT)
- Wheelchair Accessible Vehicle Converters' Association (WAVCA)

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Supersession

This part of PAS 2012 supersedes PAS 2012-1:2019, which will be withdrawn on 31 August 2027.

¹⁾ <https://wavca.co.uk/>.

Relationship with other publications

PAS 2012 is published in the following parts:

- Part 1: *M1 vehicles for the carriage of one or more passengers seated in wheelchairs – Part 1: Manufacturing requirements – Specification*; and
- Part 2: *M1 vehicles for the carriage of one or more passengers seated in wheelchairs – Part 2: Retail requirements – Specification*.

Information about this document

This is a full revision of the document, and introduces the following principal changes:

- Clause 0: Introduction updated to provide a description of the regulatory framework for motor vehicles taking into account the UK's exit from the European Union, and general update of narrative around the development of PAS 2012.
- Clause 1: Minor changes to the scope to clarify the treatment of "heavy" wheelchairs (i.e. those weighing more than 85 kg unoccupied). Addition of requirements not previously listed in the scope that are covered in the body of PAS 2012-1, such as: requirements for ISOFIX (and i-Size) child seat anchorages on WAV seats; requirements for retention of certain heavy components located within the passenger compartment (e.g. ramps and spare wheels); requirements for new or relocated fuel tanks.
- Clause 2: Normative references extended to include UN ECE Regulations on seat belt and ISOFIX anchorages, fuel tanks and interior fittings of motor vehicles.
- Clause 3: New definitions provided for "four-point strap-type effective anchorages"; "wheelchair occupant restraint effective anchorages", and "WTORS actual anchorages", "specialist seating", "internal floor slope" and "technically permissible maximum laden mass". Definitions of "mass in running order"; "internal floor slope"; "lift"; "lowering suspension system"; "M1"; "rated capacity" (formerly "safe working load"); and "ramp" revised.
- 4.5.2: The requirement for seat belt anchorages has been revised to call up specific sections of UN ECE Regulation 14 [N1].
- 4.5.3 to 4.5.7: The ISOFIX requirements have been revised to improve clarity and to include i-Size anchorages.
- 4.5.9 to 4.5.11: The requirements relating to fuel tanks have been revised to include references to specific sections of UN ECE Regulation 34 [N2]. The requirements relating to wheelchair access and WAV dimensions now include a template for a minimum size of emergency access to the wheelchair space via the secondary entrance.
- 5.2.7: A new requirement has been included regarding the WAV manufacturer providing information on the maximum mass of wheelchair that may be carried in the WAV.
- 5.3.1.4: Clarification of marking requirements that exempt ramps in multiple parts, where the addition of extra parts does not change the angle.
- 5.3.5: Ramp safe working load is now termed "ramp rated capacity", and a new normative Annex I has been added that provides a test procedure to verify ramp rated capacity.
- 5.5.4: "Lift safe working load" is now termed "lift rated capacity".
- Clause 6: Clarification of terminology around wheelchair tie-downs and occupant restraint systems (WTORS) to align with new definitions. Requirements for "actual" anchorage strength and "effective" anchorage positions for wheelchair tie-downs have also been clarified (test loads and procedures remain essentially the same, however).

- **8.1:** The information provided for the WAV technical specification in Table 1 has been clarified, with cross references to relevant clauses of this part of PAS 2012 provided next to each item of data, and "N/A" where there is no specific clause setting out how that data is to be determined.
- **8.7.2:** The requirement to provide a warranty is now a requirement to provide information about the warranty.
- **B.3.6:** The procedure for measuring internal floor slope has been amended to clarify the convention on whether a slope is positive or negative.
- **B.3.9:** The procedure for measuring ramp width has been amended to take into account features that restrict the width of the ramp, but which are not side guards.
- **Annex C:** The units of acceleration have been changed to SI units, while deceleration values are unchanged.
- **Annex I:** A new normative annex has been added to provide a test procedure for determining the rated capacity of a ramp, following the withdrawal of BS 6109.
- **Bibliography:** Amended to reflect new and updated references throughout.
- **Informative text:** Almost all Notes throughout this PAS have been reviewed and amended to clarify their purpose as recommendations, commentary, illustrations of current good practice or as further explanation.

Product certification/inspection/testing. Users of this PAS are advised to consider the desirability of third-party certification/inspection/testing of product conformity to this PAS. Appropriate conformity attestation arrangements are described in BS EN ISO/IEC 17050. Users seeking assistance in identifying appropriate conformity assessment bodies or schemes may ask BSI to forward their enquiries to the relevant association.

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It has been assumed in the preparation of this PAS that the execution of its provisions will be entrusted to appropriately qualified and experienced people, for whose use it has been produced.

Presentational conventions

The provisions of this standard are presented in roman (i.e. upright) type. Its requirements are expressed in sentences in which the principal auxiliary verb is "shall".

Commentary, explanation and general informative material is presented in smaller italic type, and does not constitute a normative element.

Where words have alternative spellings, the preferred spelling of the *Shorter Oxford English Dictionary* is used (e.g. "organization" rather than "organisation").

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0 Introduction

0.1 General

The UK wheelchair accessible vehicle (WAV) industry started in the early 1960s to assist people with a mobility impairment to travel in their wheelchairs in a motor vehicle.

Most conversions were rudimentary at first, addressing only access and basic securing of the wheelchair. Since then, the WAV industry has grown enormously and the range of WAVs offered has also grown in response to customer demand. With an ageing population, the number of wheelchair users who require transport in personal private vehicles, in WAVs provided by a range of accessible transport providers and in wheelchair accessible taxis, is set to rise higher in the future.

As a result of campaigning by UK industry, the European Commission included WAVs as a category of “special purpose vehicle” within the requirements of EC Directive 2007/46 [1] (“the EC Framework Directive”). These were retained when EC Directive 2007/46 [1] was replaced by EU Regulation 2018/858 [2] (“the EU Framework Regulation”).

Following the departure of the UK from the European Union, the approval of new road vehicle registrations in the UK has been covered by a mixture of the old EC Framework Directive [1], the current EU Framework Regulation [2], and the Road Vehicles and Non-Road Mobile Machinery (Type-approval) (Amendment and Transitional Provisions) (EU Exit) Regulations 2022 [3], setting out the approval requirements for vehicle registered in Great Britain.

However, compliance with the EC Framework Directive [1] or the EU Framework Regulation [2] is not mandatory for all WAVs produced in the UK, as there are alternative approval routes open to WAV manufacturers, set out in the Road Vehicles and Non-Road Mobile Machinery (Type-approval) (Amendment and Transitional Provisions) (EU Exit) Regulations 2022 [3]. In addition, the requirements of all this legislation are, in the main, limited to the securing of the wheelchair and occupant within the WAV. This legislation does not address accessibility issues. Furthermore, this legislation specifies certain tests based on a wheelchair mass of 85 kg, whereas electric wheelchairs substantially in excess of this mass are already routinely being carried in WAVs.

Although certain basic requirements for rearward-facing wheelchair installations (such as in many UK taxis) are now included in the above legislation, there is still no requirement for a head and back support. This has therefore been included in this PAS.

0.2 Accessibility

Minimum generic accessibility dimensions for WAVs do not take account of the varying sizes of wheelchair users and their wheelchairs, resulting in some larger wheelchair users being denied the use of a WAV and some users of smaller wheelchairs having to use WAVs which are far larger than needed, with the associated increased cost and environmental impact of running a larger WAV. Each individual wheelchair user or each particular specifier of WAVs has their own particular requirements and capabilities, so a WAV suitable for one wheelchair user might not be suitable for another.

In an attempt to address these issues, this part of PAS 2012 introduces a gauge for measuring the accessibility of WAVs so that a set of key accessibility dimensions can be provided to the end user, enabling them to make an informed decision when selecting a WAV. Previous systems of providing measurements, based on simple linear dimensions taken with a tape measure, have not been able to take into account the space that might be required to manoeuvre a wheelchair from the WAV entrance to the travelling position. Potential purchasers of a WAV are usually aware of their principal dimensions when seated in their wheelchair and can compare these with a variety of potential WAVs prior to making a choice. Similarly, specifiers of WAVs for commercial duties (e.g. care homes or taxi licensing authorities) can select a particular set of minimum dimensions that satisfies their needs for any particular application.

The accessibility gauge used in this part of PAS 2012 is designed to be adjustable to represent the length, width and height of all sizes of occupied wheelchair, ranging from the 5th percentile child at the smallest end of the scale, to a size in excess of the 95th percentile adult at the largest. In this way, this part of PAS 2012 aims to encompass the majority of wheelchair users in the UK.

The accessibility gauge used in this part of PAS 2012 was developed using data from the Department for Transport study, *A survey of occupied wheelchairs and scooters* (2006) [4], conducted by the Centre for Employment and Disadvantage Studies (CEDs). The survey took and catalogued various measurements of over 1 300 wheelchair users and their wheelchairs.

0.3 Wheelchair mass

This part of PAS 2012 specifies performance and test requirements for securing wheelchairs of an unoccupied mass of ≤ 200 kg. Whilst no requirement contained in this part of PAS 2012 can be regarded as a substitute for any type of approval requirement, it is recognized that in many cases, test work to satisfy the requirements of this part of PAS 2012 might be undertaken in parallel with test work undertaken as part of a type-approval programme. It is therefore desirable to combine tests wherever possible. In some areas, this part of PAS 2012 specifies alternative test methods to demonstrate compliance with its requirements.

As an example, the separate annexes for dynamic testing and static testing are both intended to determine the strength of wheelchair tie-down and occupant-restraint anchorages for wheelchairs weighing ≤ 85 kg (see 0.7 for a full list of Annexes in this part of PAS 2012). Either method is acceptable as a means of satisfying the requirements of this part of PAS 2012, and WAV manufacturers can choose whichever test method provides the most convenient and cost-effective method of demonstrating compliance, when combined with their chosen type-approval route.

However, none of the currently available type-approval routes cater for wheelchairs weighing > 85 kg, and when testing the strength of wheelchair tie-down and occupant-restraint anchorages for such wheelchairs, this part of PAS 2012 specifies only a dynamic test method.

0.4 Forward- and rearward-facing installations

Most privately-owned WAVs provide a forward-facing designated travelling position. However, some WAVs, such as accessible UK taxis, might have a rearward-facing designated travelling position. This part of PAS 2012 differentiates between the testing requirements for forward and rearward testing by providing separate test methods for each case. The strength requirements for the back and head support for a rearward-facing wheelchair occupant closely mirror those currently applicable to accessible buses and are primarily intended to provide comfort and stability for a rearward-facing wheelchair occupant rather than crash protection.

0.5 Assisted and unassisted entry WAVs

This part of PAS 2012 is not applicable to completed drive-from-wheelchair WAVs, because such WAVs are always bespoke, taking into account an individual's ability to access and drive the WAV. While wheelchair tie-down arrangements and driving controls for these WAVs are difficult to standardize, some of the requirements of this part of PAS 2012 can be usefully applied to drive-from-wheelchair WAVs insofar as their basic level of accessibility is concerned.

Two definitions are used in this part of PAS 2012 – “assisted entry wheelchair accessible vehicle” (see 3.1.3) and “unassisted entry wheelchair accessible vehicle” (see 3.1.23) – to cover the two basic types of WAV. In some parts of this part of PAS 2012, separate requirements apply to each.

0.6 Tie-downs

This part of PAS 2012 is limited to WAVs in which the wheelchair is restrained using four-point strap-type tie-downs, due to the lack of technical data to support requirements for other types of wheelchair tie-down equipment.

In particular, when securing the wheelchair with a docking station, there are difficulties in standardizing the attachment method of the docking station interface pin to the surrogate wheelchair (SWC), especially when ballasted to masses well in excess of 85 kg. In addition, the bespoke nature of installations involving docking stations makes each WAV fitted with a docking station different, and therefore impractical to test destructively.

However, the general principles of the test methods in this part of PAS 2012 may also be applied to other types of wheelchair tie-down and occupant-restraint system (WTORS) and WTORS anchorages, subject to it being possible to make suitable modifications to the SWC used for testing.

0.7 Annexes

This part of PAS 2012 contains several Annexes to aid the user.

- Annex A (normative) – Torsion test for a structurally modified WAV.
- Annex B (normative) – Method of measurement for WAV dimensions.
- Annex C (normative) – Dynamic strength test for ramp, lift and spare wheel mountings and WTORS anchorages for forward-facing wheelchairs ≤ 200 kg.
- Annex D (normative) – Static strength test for ramp, lift and spare wheel mountings.
- Annex E (normative) – Static strength test for WTORS anchorages for forward-facing wheelchairs ≤ 85 kg.
- Annex F (normative) – Static strength test for WTORS anchorages and back and head support for rearward-facing wheelchairs.
- Annex G (normative) – Surrogate wheelchair (SWC).
- Annex H (informative) – Dimensional parameters of the back and head support.
- Annex I (normative) – Rated capacity test for a ramp.

1 Scope

This part of PAS 2012 specifies design and manufacturing requirements for a wheelchair accessible vehicle (WAV) of Category M1, in which one or more passengers travel, each seated in a wheelchair weighing ≤ 200 kg that is secured in the WAV using four-point strap-type tie-downs.

NOTE 1 *In order to develop procedures and equipment with which to test both the wheelchair tie-down systems and their anchorages in the WAV, it is necessary to decide upon a maximum weight of wheelchair that can reasonably be transported. BS ISO 10542-1:2012+A1:2021, the standard for wheelchair tie-downs and occupant restraints, initially used an 85 kg surrogate wheelchair (SWC) to represent a powered wheelchair. Since its publication, powered wheelchairs have become heavier; when PAS 2012 was first published in 2012, some of the heaviest wheelchairs on the market were around 200 kg.*

Although theoretically there is no restriction on the weight of a wheelchair that might be carried in a WAV, considerations such as the likelihood of overloading the vehicle or the carrying capacity of the ramps or lifts, as well as the technology limits of commercially available tie-down equipment, necessitate the imposition of a practicable maximum. As the Rail Vehicle Accessibility (Non-Interoperable Rail System) Regulations 2010 [5] and the European Commission Regulation 1300/2014 [6] both specify ramps with a minimum capacity of 300 kg for rail travel and these ramps need to carry the occupied wheelchair and, in most cases, an assistant, PAS 2012 uses 200 kg to represent a practicable maximum weight for an unoccupied powered wheelchair, particularly with the advent of electric base vehicles with lower payloads. This limit relates only to the weight of the wheelchair itself, and not the combined weight of the wheelchair and its occupant. Throughout this part of PAS 2012, the weight of the wheelchair and its occupant are treated separately, as they are restrained separately; the occupant weight in a crash being managed by the occupant restraint, and the weight of the wheelchair being managed by the wheelchair tie-downs.

NOTE 2 *Some four-point strap-type tie-downs are wheelchair-specific and are designed to be used with only one particular model of wheelchair. It might not be possible to attach some wheelchair-specific tie-downs to an SWC and some wheelchair-specific wheelchair tie-down and occupant-restraint systems (WTORSs) include wheelchair occupant-restraint anchorages that attach to the wheelchair itself rather than the WAV structure.*

This part of PAS 2012 specifies:

- a) a gauge-based method for measuring the key accessibility dimensions of WAVs capable of transporting occupied wheelchairs ranging from 775 mm to 1 350 mm long, 500 mm to 830 mm wide and 975 mm to 1 550 mm high;
- b) a separate method for measuring the key accessibility dimensions of WAVs capable of transporting occupied wheelchairs in excess of 1 350 mm long, 830 mm wide or 1 550 mm high;
- c) requirements for wheelchair access devices (where fitted), including:
 - 1) ramps;
 - 2) lifts; and
 - 3) winches;
- d) requirements for wheelchair tie-down and occupant-restraint system (WTORS) anchorages for securing wheelchairs ≤ 200 kg in mass, and wheelchair users, within the WAV, including:
 - 1) static and dynamic test methods (either of which can be used), for determining the strength of WTORS anchorages for forward-facing wheelchairs ≤ 85 kg; and
 - 2) a dynamic test method for determining the strength of WTORS anchorages for forward-facing wheelchairs > 85 kg to ≤ 200 kg;

- e) requirements for rearward-facing wheelchair installations including:
 - 1) static test method for WTORS anchorages; and
 - 2) static test method for wheelchair occupant head and back support;
- f) structural integrity;
- g) requirements for the mountings of heavy items within the WAV passenger compartment, such as ramps, spare wheels and lifts;
- h) requirements for additional or modified seats (including ISOFIX and i-Size anchorages) and for seatbelts;
- i) requirements for modified, relocated or new fuel tanks; and
- j) requirements for service elements (for example, a user manual including a WAV technical specification to facilitate direct comparisons between WAVs) and requirements for re-call procedures.

This part of PAS 2012 does not cover:

- 1) securing an occupied wheelchair in the driving position of a WAV;

***NOTE 3** The securing of an occupied wheelchair in the driving position of a WAV tends to be a bespoke solution for which appropriate design and test requirements have not yet been fully developed.*

- 2) securing the wheelchair other than with four-point strap-type tie-downs; and

***NOTE 4** PAS 2012-1 is limited to four-point strap-type tie-downs due to the lack of technical data to support the drafting of requirements for other, more bespoke, types of wheelchair tie-down equipment. However, the general principles of the test annexes may be applied to other types of wheelchair tie-down equipment subject to it being possible to make appropriate modifications to the SWC.*

- 3) the retail of WAVs.

***NOTE 5** PAS 2012-2 specifies requirements for the retail of WAVs conforming to PAS 2012-1.*

***NOTE 6** In cases where items or features fitted to a WAV are optional, the requirements applicable to them only apply where fitted.*

This part of PAS 2012 is of use to WAV manufacturers and designers.

This part of PAS 2012 might be of interest to wheelchair manufacturers, regulators, retailers, consumer and public interest groups, health and safety experts, local authorities, fleet owners, mobility charities, accessibility charities, care providers and wheelchair users.

2 Normative references

The following documents are referred to in the text in such a way that some or all of their content constitutes provisions, or limits the scope, of this document.²⁾ For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

Standards publications

BS EN 1756-2:2004+A1:2009, *Tail lifts – Platform lifts for mounting on wheeled vehicles – Safety requirements – Part 2: Tail lifts for passengers*

BS ISO 6487, *Road vehicles – Measurement techniques in impact tests – Instrumentation*

BS ISO 10542-1:2012+A1:2021, *Technical systems and aids for disabled or handicapped persons – Wheelchair tiedown and occupant-restraint systems – Requirements and test methods for all systems*³⁾

Other publications

- [N1] UNITED NATIONS ECONOMIC COMMISSION FOR EUROPE (UNECE). Agreement concerning the adoption of uniform technical prescriptions for wheeled vehicles, equipment and parts which can be fitted and/or be used on wheeled vehicles and the conditions for reciprocal recognition of approvals granted on the basis of these prescriptions. Regulation No. 14: Uniform provisions concerning the approval of vehicles with regard to safety-belt anchorages, ISOFIX anchorages systems and ISOFIX top tether anchorages. Geneva: UNECE, 2011.
- [N2] UNITED NATIONS ECONOMIC COMMISSION FOR EUROPE. Agreement concerning the adoption of uniform technical prescriptions for wheeled vehicles, equipment and parts which can be fitted and/or be used on wheeled vehicles and the conditions for reciprocal recognition of approvals granted on the basis of these prescriptions. Regulation No. 34: Uniform provisions concerning the approval of vehicles with regard to the prevention of fire risks. Geneva: UNECE, 2016.
- [N3] UNITED NATIONS ECONOMIC COMMISSION FOR EUROPE. Agreement Concerning the Adoption of Harmonized Technical United Nations Regulations for Wheeled Vehicles, Equipment and Parts which can be Fitted and/or be Used on Wheeled Vehicles and the Conditions for Reciprocal Recognition of Approvals Granted on the Basis of these United Nations Regulations. Regulation 145: Uniform provisions concerning the approval of vehicles with regard to ISOFIX anchorage systems ISOFIX top tether anchorages and i-Size seating positions Geneva: UNECE, 2019.
- [N4] UNITED NATIONS ECONOMIC COMMISSION FOR EUROPE. Regulation No 21 of the Economic Commission for Europe of the United Nations (UN/ECE). Uniform provisions concerning the approval of vehicles with regard to their interior fittings. Geneva: UNECE, 2008.
- [N5] DRIVER AND VEHICLE STANDARDS AGENCY (DVSA). *Vehicle safety defects and recalls: Code of practice*. Bristol: DVSA, 2013.⁴⁾

²⁾ Documents that are referred to solely in an informative manner are listed in the Bibliography.

³⁾ This PAS also gives an informative reference to BS 10542-1:2012+A1:2021.

⁴⁾ Available at <https://www.gov.uk/government/publications/code-of-practice-on-vehicle-safety-defects-and-recalls/vehicle-safety-defects-and-recalls-code-of-practice>.

3 Terms, definitions and abbreviated terms

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

3.1 Terms and definitions

3.1.1 approval route

regime under which the WAV is approved for use on a public road

NOTE 1 Such routes can include schemes such as: EC Whole Vehicle Type Approval; GB Whole-Vehicle Type Approval; UK(NI) Whole-Vehicle Type Approval; GB Medium Series Type Approval; EC Small Series Type Approval; National Small Series Type Approval; GB Small Series Type Approval; UK(NI) National Small Series Type Approval; EC Whole Vehicle Type Approval as a Special Purpose Vehicle; GB Whole-Vehicle Type Approval as a Special Purpose Vehicle; UK(NI) Whole-Vehicle Type Approval as a Special Purpose Vehicle; GB Individual Vehicle Approval; UK(NI) Individual Vehicle Approval.

NOTE 2 In some cases, such as highly bespoke conversions to suit a particular user's needs, a WAV might not have been approved in its completed state but converted "post-registration". Similarly, a WAV that has been approved prior to registration might also have been subsequently subjected to further modifications.

3.1.2 assistant

person who assists a wheelchair user to board and alight the vehicle and aid the correct use of WTORS

NOTE The assistant is usually the driver.

3.1.3 assisted entry wheelchair accessible vehicle (AWAV)

WAV designed such that an assistant is required to aid the boarding and alighting of a wheelchair user

3.1.4 base vehicle

vehicle used as the foundation for a WAV conversion

3.1.5 conversion warranty

warranty provided by the WAV manufacturer on those parts of a WAV that are not covered by the base vehicle warranty

NOTE A WAV converted from a base vehicle (i.e. a multi-stage WAV, as distinct from a WAV built in a single stage) is typically covered by two warranties. Those parts and systems on the WAV that relate to the base vehicle (e.g. transmission, brakes, steering) are covered by the base vehicle manufacturer's warranty, and those that are specific to the converted WAV are covered by the conversion warranty.

3.1.6 designated travelling position

position of the occupied wheelchair in the WAV while travelling

NOTE For measuring and testing purposes, to achieve the designated travelling position, point P on the accessibility gauge or SWC is aligned with point W (the location of point P relative to a WAV datum when the accessibility gauge or SWC is in its designated travelling position as nominated by the WAV manufacturer).

3.1.7 forward-facing

orientation of the occupied wheelchair within the WAV facing towards the front of the WAV such that the longitudinal centre line of the wheelchair or seat is at an angle of 10° or less to the longitudinal centre line of the WAV

3.1.8 four-point strap-type tie-down

wheelchair tie-down system that uses four or more strap assemblies to secure the wheelchair in the vehicle, attaching to four separate securement points on the wheelchair

[SOURCE: BS ISO 10542-1:2012+A1:2021, 3.17, modified. Original version reads: “wheelchair tiedown system that uses four strap assemblies to secure the wheelchair in the vehicle, attaching to the wheelchair at four separate securement points and to the vehicle at four separate anchor points”]

3.1.9 four-point strap-type tie-down effective anchorage

geometrical point used to determine the angle of the strap of a four-point strap-type wheelchair tie-down relative to the horizontal, when attached to the surrogate wheelchair or accessibility gauge and viewed from the side

NOTE This might or might not coincide with a wheelchair four-point strap-type tie-down actual anchorage. A wheelchair four-point strap-type tie-down actual anchorage might be positioned on a part of the WAV's floor but due to the presence of other hardware, the angle that the strap makes with the horizontal, when attached to the surrogate wheelchair or accessibility gauge might not be the same as the angle it would make with the horizontal if it were attached directly to the actual anchorage. In practice, this point is usually taken as the centre of the webbing strap as it passes over the last hard surface that alters its lie, prior to reaching the wheelchair.

3.1.10 internal floor slope

angle recorded by the inclinometer on the accessibility gauge, when the accessibility gauge is placed on any part of the WAV floor over which the wheelchair passes in order to reach a designated travelling position, after its front wheel contact patches cross the point of intersection between the ramp (or lift) and the WAV floor

3.1.11 lift

platform that can be raised or lowered while carrying an occupied wheelchair, with or without an assistant, to provide access between the interior floor of the WAV and the ground or pavement

3.1.12 line pull

mass, in kg, that a winch is able to lift vertically through a height of not less than 0.5 m

3.1.13 lowering suspension system

system which lowers the height of one or more entrances to a vehicle relative to the ground, to aid access and egress, and raises it to its normal running position for use on the road

3.1.14 M1

vehicles designed and manufactured for the carriage of passengers and comprising no more than eight seats in addition to the driver's seat

[SOURCE: BS ISO 362-1:2022, 3.4.2.1, modified – “vehicles used” replaced with “vehicles designed and manufactured”]

3.1.15 mass in running order

sum of unladen vehicle mass, all liquids needed for operation, tools, spare wheel (if fitted), a fuel tank filled to at least 90% of rated capacity, (in the case of vehicles propelled by combustible fuel), plus 75 kg in the driving seat, in order to account for the driver's mass

[SOURCE: BS ISO 8709:2010, 3.4.4, modified – by merging and modifying the definitions of unladen vehicle mass and mass in running order in 3.4.5 and 3.4.4 of BS ISO 8709:2010]

3.1.16 maximum access dimensions

maximum length, width and height of the accessibility gauge that can be manoeuvred from the ground, into each designated travelling position, and back

3.1.17 point P

reference point on the accessibility gauge or SWC, taken to represent the wheelchair user's hip when seated in their wheelchair

3.1.18 ramp

series of one or more movable elements used to form an inclined surface for wheelchairs to enter the vehicle from the ground or pavement

3.1.19 rated capacity

maximum weight or force that a component fitted to a WAV is designed to withstand in typical use

NOTE Examples might include the rated capacity of items such as the wheelchair ramp, winch, lift or the wheelchair tie-downs.

3.1.20 rearward-facing

orientation of the occupied wheelchair within the WAV, facing towards the rear of the WAV such that the longitudinal centre line of the wheelchair or seat is at an angle of 10° or less to the longitudinal centre line of the WAV

3.1.21 specialist seating

seats or seat fixings that have been added or modified for the purposes of the WAV conversion

3.1.22 technically permissible maximum laden mass (TPMLM)

maximum mass allocated to a WAV on the basis of its construction features and its design performances

[SOURCE: BS ISO 10896-8:2024, 3.11, modified – “laden truck (3.10) or towed vehicle (3.1)” replaced with “WAV”]

NOTE This is the maximum weight at which the WAV manufacturer authorizes the vehicle to be used.

3.1.23 unassisted entry wheelchair accessible vehicle (UWAV)

WAV designed such that an assistant is not required to aid the boarding and alighting of a wheelchair user

3.1.24 WAV manufacturer

person or company that manufactures a WAV through the conversion of a base vehicle or through building in a single stage

3.1.25 wheelchair

device to provide wheeled mobility with a seating support system for a person with impaired mobility

[SOURCE: BS ISO 7176-26:2007, 4.1.1]

3.1.26 wheelchair accessible vehicle (WAV)

vehicle designed to transport one or more passengers seated in their wheelchairs

3.1.27 wheelchair occupant restraint

system or device intended to restrain a wheelchair occupant within their wheelchair during an abrupt vehicle movement or an impact, in order to prevent ejection from the wheelchair and to prevent or minimize contact with the vehicle interior components and other passengers

3.1.28 wheelchair occupant-restraint effective anchorage

geometrical point at any end of an occupant-restraint strap which determines the lie of that strap relative to the wearer's body

NOTE This helps to get the best possible fit of the belt when worn. It might or might not coincide with a wheelchair occupant restraint actual anchorage. For example, a wheelchair occupant restraint actual anchorage might be positioned on a part of the WAV's interior roof structure, but if a height adjuster is incorporated into the occupant restraint assembly, the height the effective anchorage can vary. In practice, this point is usually taken as the centre of the webbing strap as it passes over the last hard surface that alters its lie, prior to reaching the wheelchair user.

3.1.29 wheelchair tie-down

device or system designed to secure a wheelchair in place in a WAV

3.1.30 wheelchair tie-down and occupant-restraint system (WTORS)

part of a structure to which a WTORS can be secured

NOTE In the case of a wheelchair tie-down, this is a physical part of the vehicle structure to which the wheelchair tie-down can be secured. In the case of a wheelchair occupant restraint, this is part of either the wheelchair or the vehicle, to which at least one end of the wheelchair occupant restraint (such as the top of the shoulder belt, or height adjuster, or either of the ends of the lap belt or the retractor) can be secured.

3.2 Abbreviated terms

For the purposes of this PAS, the following abbreviations apply.

ATD	anthropomorphic test device
AWAV	assisted entry wheelchair accessible vehicle
SWC	surrogate wheelchair
TPMLM	technically permissible maximum laden mass
UWAV	unassisted entry wheelchair accessible vehicle
VIN	vehicle identification number
WAV	wheelchair accessible vehicle
WTORS	wheelchair tie-down and occupant-restraint system

4 General provisions

COMMENTARY ON CLAUSE 4.

Some clauses of this part of PAS 2012 require measurements to be taken, such as weights, distances, angles, forces and accelerations. The method of measuring these quantities is left, wherever possible, to the discretion of the organization determining compliance. It is therefore not possible to prescribe calibration procedures for all the equipment used, but it is desirable to check that any measuring equipment used to determine compliance is regularly calibrated to a degree of accuracy and traceability appropriate to the measurement being taken. Where calibration is critical, tolerances on measurements have been provided throughout this part of PAS 2012.

4.1 Structural integrity and modifications

COMMENTARY ON 4.1.

There are no type-approval requirements relating to the durability of the completed WAV, so it is advisable that the design, validation and execution of any modifications made to a base vehicle structure take into account the demands likely to be placed on the completed WAV in use. Factors to take into account might include the effects of fatigue loadings on the structure and of corrosion, particularly in areas where the corrosion protection of the base vehicle has been breached during the conversion. This can be especially important where galvanically dissimilar metals are placed in electrical contact with one another. Accelerated life cycle tests (such as salt spray and pavé track work) might be useful in validating the design of the WAV structure. In all cases where a structural modification is made, it is advisable to implement a suitable quality inspection procedure of the completed area(s).

Where welding operations are carried out, particularly to structural areas of the WAV and to suspension components and their attachment brackets, it is advisable to select materials and welding consumables that maximize compatibility with the parent metal on the base vehicle, as well as the gauges of the materials being joined. When specifying welding operations, the BS EN ISO 3834 series, combined with the product specification, gives guidance on the selection of appropriate levels of weld quality for each weld. Those welds can then be identified and, if appropriate, coded welders can be used to carry out those welding operations. Commonly used standards for approval testing of coded welders include BS 4872-1, BS 4872-2, BS EN ISO 9606-1 and BS EN ISO 9606-2, depending on the material(s) being welded and the welding processes being used.

Adhesives are increasingly used in the conversion of base vehicles to WAVs, often in conjunction with mechanical fasteners. It is advisable to check that any structural adhesives used in the WAV are appropriate for use with the material(s) to be joined and that joints are designed to take into account the properties of the particular adhesive being used. Protection from heat sources and the addition of complementary traditional mechanical fasteners for joints subject to tensile or peeling loads are also advisable.

It is advisable that the adhesive manufacturer's instructions for the cleaning and surface preparation of the substrates and the control of temperature and humidity during the curing process are followed at all times, along with the adhesive manufacturer's recommended storage conditions and requirements for shelf life.

4.1.1 Torsional stiffness

4.1.1.1 Where the construction of a WAV involves modification to the structure of a base vehicle in the floor, roof, door or tailgate aperture area, the torsional stiffness of the WAV shall be tested in accordance with Annex A.

4.1.1.2 When tested in accordance with Annex A, the deflection of the completed WAV shall be between 0.5 times and 1.5 times the deflection of the base vehicle.

NOTE The torsional stiffness values specified in 4.1.1.2 represent the minimum acceptable requirements for the purposes of this PAS. WAV manufacturers are advised that individual base vehicle manufacturers might have their own requirements or recommendations for torsional stiffness, set out in their bodybuilders' manuals or other guidance to converters.

4.1.2 Fasteners subject to periodic replacement

Fasteners subject to replacement or inspection at specified intervals in service shall be listed in the user manual, along with the specified replacement interval and tightening torque [see 7.4 h)].

NOTE 1 *In the case of threaded fasteners, tightening torques appropriate for the joint under consideration should be selected.*

NOTE 2 *Mechanical fastening techniques commonly used in WAVs include screwing, bolting and riveting (including clinched threaded fasteners). When specifying such fasteners, it is advisable to take into account the loading, corrosion resistance (including galvanic compatibility of the materials to be joined) and the environment in which the fasteners are expected to operate.*

NOTE 3 *Where the joint is subject to vibration in use (e.g. suspension components), anti-vibration locking features (such as locking nuts or thread locking compound) might be specified. Where automated or semi-automated assembly techniques are used (e.g. rivets or other types of clinched fastener), it is advisable to consult the fastener manufacturer's data so that the fasteners are correctly specified for the types and thicknesses of the materials being joined. A process for the regular inspection (and, if necessary, adjustment) of the tools used to fit the fasteners is also desirable.*

4.2 Wheel alignment

Where wheel alignment is affected by the conversion process, the WAV manufacturer shall have a documented system in place for checking and re-adjusting the wheel alignment to within the WAV manufacturer's specifications.

NOTE *Such modifications include, but are not limited to:*

- a) *modification of a suspension linkage or attachment point;*
- b) *modifications to the base vehicle structure within 500 mm of a suspension attachment point; and*
- c) *the alteration of spring rates or base vehicle ride height.*

4.3 Ground clearance

When measured in accordance with Annex B (see B.3.14), the minimum ground clearance shall be 120 mm.

4.4 Lowering suspension system

4.4.1 A failure of the lowering suspension system shall not leave the WAV immobilized.

NOTE *It is acceptable for the WAV's speed to be considerably reduced by a failure of the lowering system, provided that it can be moved to a place of safety under its own power.*

4.4.2 At least one set of controls for the operation of the lowering suspension system shall:

- a) be located at the entrance used for wheelchair access for an assisted entry wheelchair accessible vehicle (AWAV); and
- b) be operated remotely from outside an unassisted entry wheelchair accessible vehicle (UWAV).

4.4.3 The design of the lowering suspension system shall be such that either:

- a) the system automatically raises itself to normal running position if the WAV is moved under its own power before the speed reaches 10 km/h; or
- b) an audible and/or visual warning device alerts the driver if the handbrake is released whilst the lowering suspension system is in its lowered state.

4.4.4 The WAV shall incorporate one or more features intended to prevent the lowering suspension system from being activated when the WAV is being driven.

NOTE Examples of such features include, but are not limited to, interlocks preventing the lowering suspension from being activated under the following conditions:

- a) the parking brake being released;
- b) all doors (including the tailgate) being closed;
- c) the road wheels turning; or
- d) the driver's seat being occupied.

4.4.5 A lowering suspension system relying on compressed air in order to function shall be equipped with a means of either preventing the formation of condensation or automatically draining condensation.

4.5 Seats, fuel tanks, fittings and trim

COMMENTARY ON 4.5.

It is currently industry good practice that fittings and trim used in the section of the WAV in which the wheelchair occupant travels are of the same or similar quality to those used throughout the rest of the base vehicle. It is advisable that upholstery and floor coverings match, as closely as possible, those in the parts of the WAV in which other passengers travel.

4.5.1 For every seating position in the WAV, including any wheelchair space(s), a minimum of a three-point occupant restraint shall be provided.

NOTE Attention is drawn to the Road Vehicles (Construction and Use) Regulations 1986 [7] (as amended), reg. 47 (seat belts) and reg. 48 (maintenance of seat belts), and in particular, those sections relating to disabled persons' belts.

4.5.2 Where any new seat belt anchorage is provided, or modifications to the base vehicle or seat structure are carried out within 300 mm of any existing seat belt anchorage, the seat belt anchorages of the affected seating position(s) shall conform to the strength, positional and testing requirements for three-point belt anchorages fitted to vehicles of category M1, set out in UN/ECE Regulation 14 [N1], 05 (or any subsequent amendment), Sections 5, 6 and 7.

NOTE 1 UN/ECE Regulation 14 [N1] and EC Directive 76/115 [8] (as amended) are considered equivalent and interchangeable. Depending on the approval route used by the WAV manufacturer, they are not always mandatory. In order for a WAV to conform to this PAS, this requirement is always applicable regardless of the approval route.

NOTE 2 EC Regulation 661/2009 [9] (the "General Safety Regulation") repeals EC Directive 76/115 [8] and all its amending Directives. However, some approval regimes in the UK still accept compliance with the Directive. For this reason, references to the Directive are retained in this part of PAS 2012.

4.5.3 Where ISOFIX or i-Size-equipped base vehicle seats (or their anchorages) are modified, the ISOFIX or i-Size anchorages shall either:

- a) conform to the requirements of either UN/ECE Regulation 145 [N3], 00 (or any subsequent amendment), or to those parts of UN/ECE Regulation 14 [N1], 06 (or any subsequent amendment), sections 5, 6 and 7 relating to ISOFIX or i-Size anchorages, or
- b) the ISOFIX or i-Size anchorages of that seat shall be rendered unusable and any label or other marking denoting their presence shall be removed or defaced.

NOTE Many WAV users do not need to transport children in ISOFIX or i-Size seats. For such vehicles, re-testing of the ISOFIX or i-Size anchorages after modifications to the vehicle seats or seat mountings serves no useful purpose, so rendering the ISOFIX and i-Size anchorages unusable and removing or defacing the labels is a permitted alternative in this standard.

4.5.4 Text drawing the user's attention to the new arrangements and containing any different instructions for their use shall be included in the WAV User Manual (see Clause 7).

4.5.5 Where new seats with ISOFIX or i-Size anchorages are added to the WAV, the ISOFIX or i-Size anchorages shall conform to the requirements of either UN/ECE Regulation 145 [N3], 00 (or any subsequent amendment), or to those parts of UN/ECE Regulation 14 [N1], 06 (or any subsequent amendment), sections 5, 6 and 7 relating to ISOFIX or i-Size anchorages.

4.5.6 Text drawing the user's attention to the new arrangements and containing any different instructions for their use, shall be included in the WAV User Manual (see Clause 7).

4.5.7 Where an ISOFIX or i-Size-equipped base vehicle seat is replaced by one or more different seats without ISOFIX or i-Size anchorages as part of the conversion, the details of any removed ISOFIX or i-Size child seat anchorages and any different instructions for their use, shall be included in the WAV user manual (see Clause 7).

***NOTE** This is to remove any confusion that might arise if the WAV user refers to the base vehicle User Manual, which might describe seating arrangements and instructions for use for seats that are no longer fitted to the vehicle.*

4.5.8 Where one or more seats within the WAV need to be tilted or folded to allow a wheelchair user to be carried, a means of preventing the seats from falling back down shall be provided.

***NOTE** Such means include a mechanical lock, prop or strap to secure the seat in its tilted or folded position.*

4.5.9 Where an existing fuel tank for liquid fuel or its filler neck and associated pipework is modified in any respect other than the routing or length of the refuelling duct, fuel hoses and fuel vapour pipes, and re-positioning of either the original tank or the evaporative control devices provided by the manufacturer of the base vehicle, the modified installation shall comply with the requirements of UN/ECE Regulation 34 [N2], 02 (or any subsequent amendment), paragraphs 5.4, 5.5, 5.6, 5.7, 5.8 and 5.11.

4.5.10 Where an alternative tank is fitted, the fuel tank, the filler neck and associated pipework used shall conform to the requirements of UN/ECE Regulation 34 [N2], 02, Part I.

***NOTE 1** UN/ECE Regulation 34 [N2], 02, Part I and EC Directive 70/221 [10] (as amended), Annex I, Sections 5 and 6 are considered equivalent and interchangeable. Depending on the approval route used by the WAV manufacturer, they are not always mandatory. In order for a WAV to conform to this PAS, this requirement is always applicable regardless of the approval route.*

***NOTE 2** EC Regulation 661/2009 [9] (the "General Safety Regulation") repeals EC Directive 70/221 [10] and all its amending Directives. However, some levels of approval in the UK still accept compliance with the Directive. For this reason, references to the Directive are retained in this part of PAS 2012.*

***NOTE 3** Attention is drawn to the Road Vehicles (Construction and Use) Regulations 1986 [7], regulation 39, in relation to legal requirements for fuel tanks made from a plastic material.*

4.5.11 Where an alternative fuel tank is fitted, the WAV manufacturer shall declare the capacity of the new tank, in litres.

4.6 Spare wheel and associated equipment

Where a spare wheel is provided with the WAV, the WAV manufacturer shall also supply:

- a) a wheel brace of the correct size for the wheel nuts on the vehicle;
- b) in the case of locking wheel nuts, any necessary adaptor or key to allow the wheel brace to be used with the locking wheel nuts;

- c) a jack with a rated capacity of at least half the greatest maximum permitted axle weight specified by the WAV manufacturer; and

***NOTE 1** In most cases, the jack supplied with the base vehicle is likely to be retained. In the absence of any rated capacity markings and if the WAV manufacturer has not increased the maximum permitted axle weights, it can reasonably be assumed that the jack is capable of meeting this requirement.*

***NOTE 2** When selecting a jack for the WAV, it is advisable to check the compatibility of the lifting head of the jack with the WAV's jacking points in order to maximize the stability of the WAV on the jack provided.*

- d) sufficient stroke to raise any one wheel of the WAV clear of the ground when the WAV is parked on level ground.

***NOTE 3** It is not necessary to supply a spare wheel with a WAV, as many users prefer to call a breakdown service for assistance in the case of a puncture. However, where a spare wheel is supplied, it is necessary to also supply the means to change it.*

5 Wheelchair access and WAV dimensions

5.1 Entrance

5.1.1 A minimum of two entrances on the WAV (the wheelchair access entrance and the secondary entrance) shall provide access to the wheelchair space.

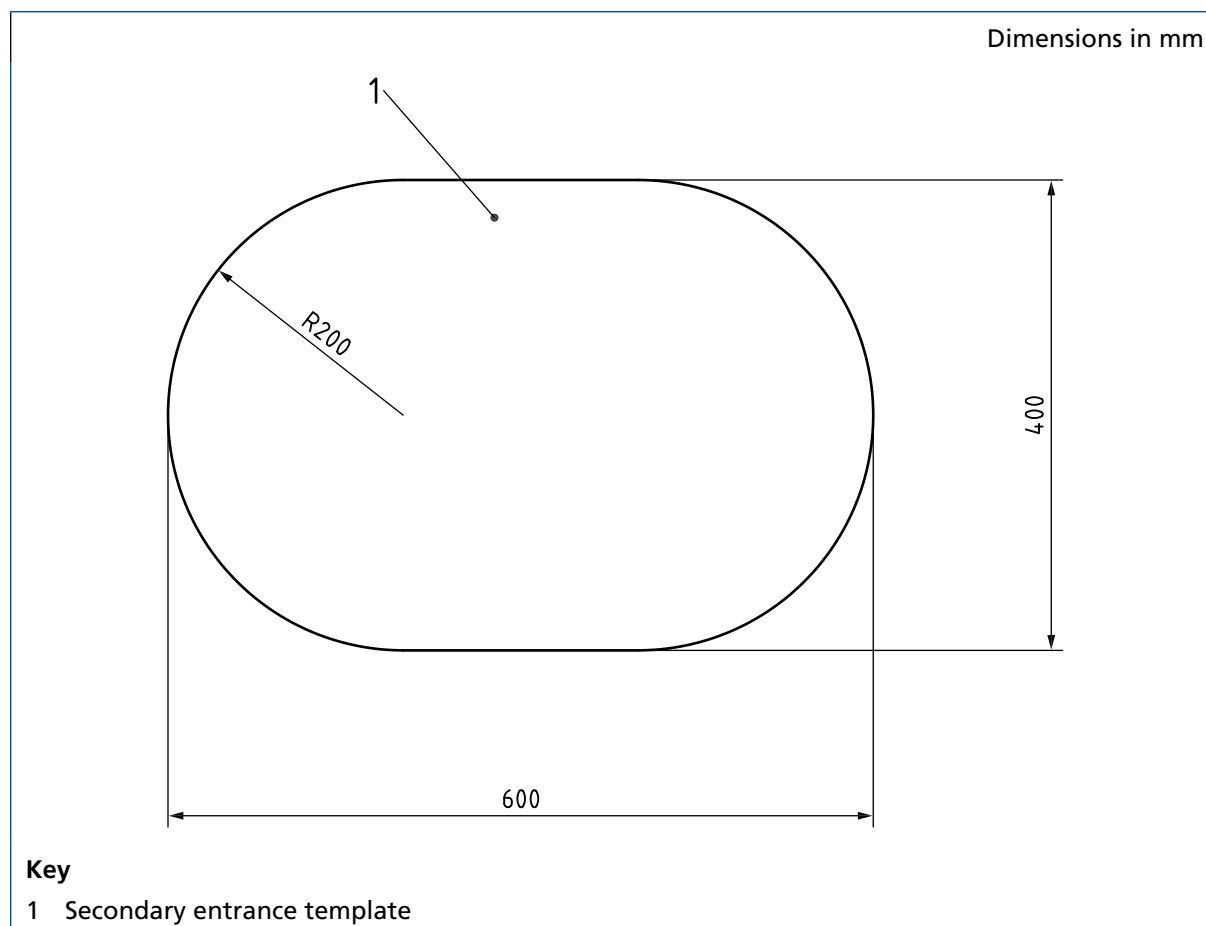
5.1.2 The wheelchair access entrance shall allow access and egress for an occupied wheelchair of the dimensions determined in **B.3.15**.

5.1.3 The secondary entrance shall also provide access to the wheelchair space. It shall be possible to pass the secondary entrance template shown in Figure 1, from point P of each wheelchair space in turn, through the vehicle, to the secondary entrance, in the direction in which a passenger evacuating the vehicle is expected to move if the wheelchair access entrance is unavailable. The template shall be kept perpendicular to that direction of motion and not meet any obstacle.

NOTE 1 *This is to enable an assistant to reach the wheelchair user once the wheelchair user is inside the vehicle, because in most WAVs, the wheelchair itself blocks the wheelchair access entrance. It is not intended to be a second means of access for an occupied wheelchair. In effect, the requirement is to be able to describe the path of a "tube" whose cross section is the same as that of the secondary entrance template, from point P of each travelling position, to the outside of the vehicle.*

NOTE 2 *For WAVs capable of carrying more than one wheelchair, it is not necessary to position a wheelchair in each travelling position simultaneously whilst this exercise is being carried out.*

NOTE 3 *Seats that are capable of being adjusted, displaced or removed without the use of tools may be adjusted, displaced or removed to permit this to happen and the gauge may be rotated during the process.*

Figure 1 – Secondary entrance template

5.2 Wheelchair space

5.2.1 The maximum length, width and height of an occupied wheelchair that is intended to be accommodated in each designated travelling position shall be determined in accordance with Annex B.

5.2.2 The maximum dimensions of the wheelchair access entrance shall be determined in accordance with Annex B.

5.2.3 The maximum access dimensions shall be determined in accordance with Annex B.

5.2.4 The internal floor slope shall be determined in accordance with Annex B.

5.2.5 The slope of the wheelchair in each designated travelling position shall be determined in accordance with Annex B.

5.2.6 The seated eye height of each designated travelling position shall be determined in accordance with Annex B.

NOTE It is advisable that the floor in the wheelchair area is slip resistant. Materials that are likely to achieve slip resistance include coatings with granular aggregate. As there is considerable variation in the materials that can be used to form the floors of WAV wheelchair areas, it is impossible to specify a level of slip resistance that guarantees stability in all cases. However, a "dry grip value" (or "pendulum test value") of 36 or more, when measured in accordance with the test method specified in BS EN 16165 (or a similar standard relating to a specific flooring material), on all floors inclined at $>5^\circ$ to the horizontal, is likely to prove adequate in most cases.

5.2.7 The WAV manufacturer shall state the maximum mass of wheelchair that can be carried in the WAV.

5.2.8 For a UWAV, any door through which the wheelchair user can enter the WAV shall be operable with remote controls, from both inside and outside the UWAV.

5.2.9 The use of any one set of controls shall inhibit all other controls from initiating an operation, such that only the control being used is capable of operating the door or any powered part of the access equipment.

NOTE Any control can be used to stop an operation.

5.3 Ramps

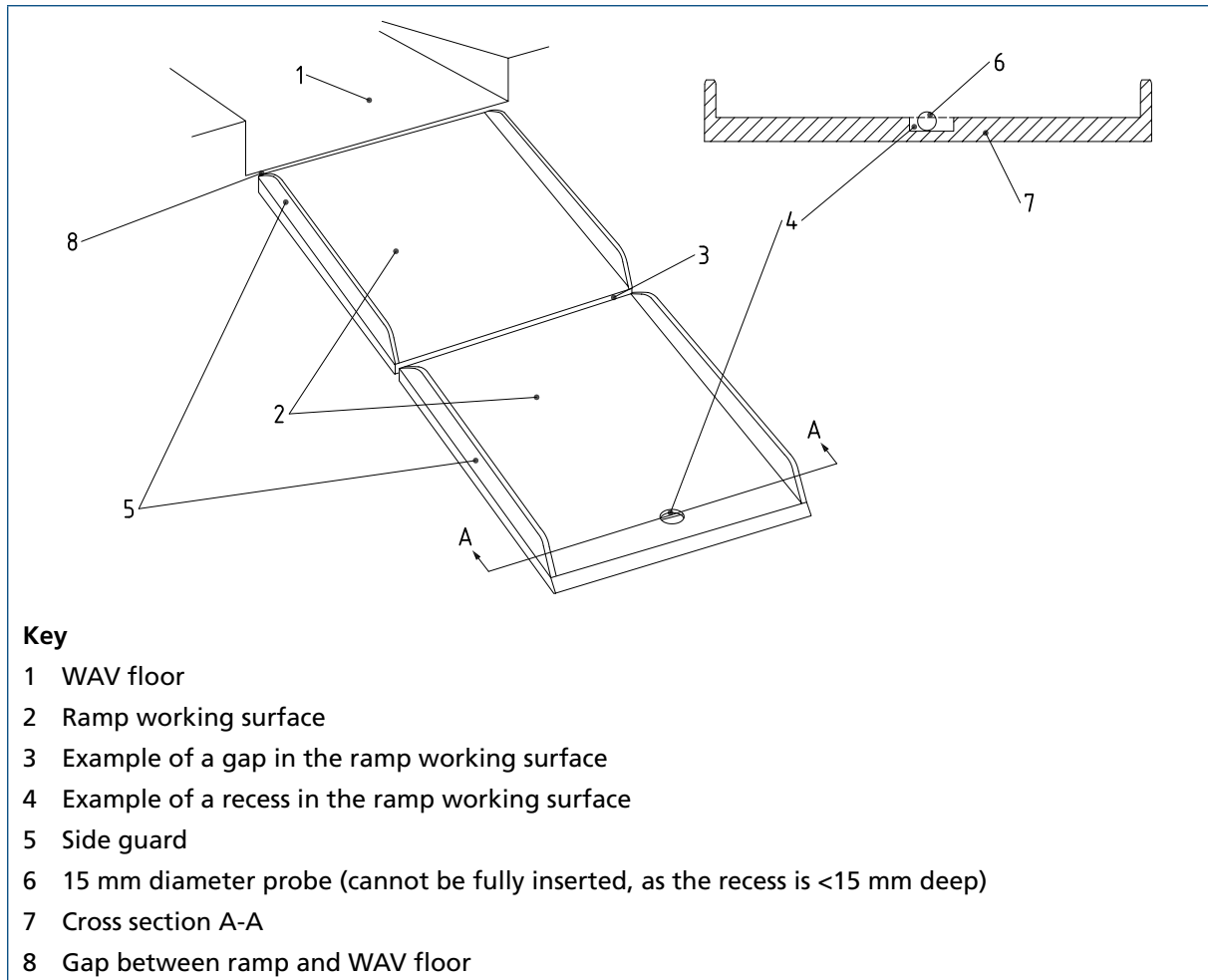
5.3.1 Working surface

COMMENTARY ON 5.3.1.

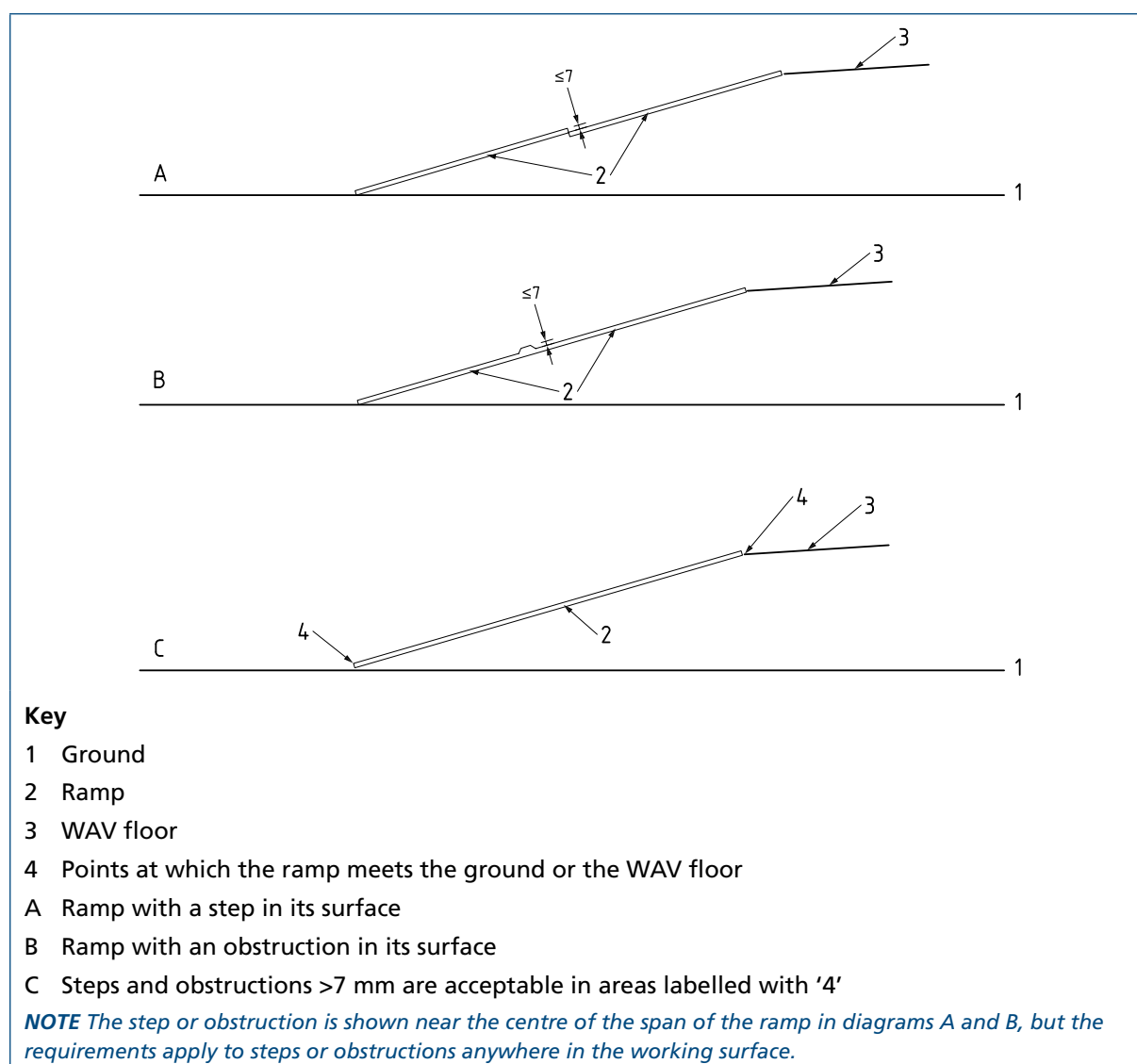
It is advisable that the ramp surface is slip resistant. The slip resistance needed depends on the ramp angle in use and on whether the ramp might become wet. Materials that are likely to achieve slip resistance include coatings with granular aggregate. As there is considerable variation in the materials that can be used to form the surfaces of ramps, it is impossible to specify a level of slip resistance that guarantees stability in all cases. However, a "wet grip value" (or "pendulum test value") of 36 or more, when measured in accordance with the test method specified in BS 7976-2 (or a similar standard relating to a specific flooring material), is likely to prove adequate in most cases.

Attention is drawn to the UK Road Vehicle Lighting Regulations 1989 [11], which require certain rear lights to be visible when all doors, tailgates, and for a WAV, ramps or lifts, are open or deployed.

5.3.1.1 When the ramp is deployed, it shall provide a continuous working surface (the surface available to support a wheelchair or assistant) containing no gaps, holes or recesses capable of allowing the complete insertion of a spherical probe greater than 15 mm in diameter, in accordance with Figure 2.

Figure 2 – Gaps and recesses in ramp working surface

5.3.1.2 The ramp working surface shall contain no steps or obstructions greater than 7 mm in height, except at the point where the ramp meets the surface onto which it is deployed and where it meets the WAV floor. The extent of any obstruction shall be measured perpendicular to the ramp surface in accordance with Figure 3.

Figure 3 – Maximum permitted steps or obstructions in ramp working surfaces

5.3.1.3 Where a ramp is composed of more than one separate part, and those parts are not permanently attached to each other:

- a) all mating parts shall be positively located together when deployed; and
- b) in cases where the addition of more separate parts changes the angle of the deployed ramp, the part closest to the wheelchair access door shall display the following text so as to be visible when the ramp is deployed: "WARNING Ramp extension piece might be required to provide satisfactory gradient".

5.3.2 Side guards

COMMENTARY ON 5.3.2.

Side guards on ramps are also known as “upstands”.

5.3.2.1 When deployed, the ramp shall be provided with a side guard along either side of its surface.

NOTE Side guards are necessary to reduce the risk of the wheelchair falling off the side of the platform. Side guards can be an integral part of the ramp structure or a part of the surrounding WAV bodywork or a combination of the two. For example, the WAV rear bumper in the area towards the top of the ramp might be used as a side guard.

5.3.2.2 Side guards shall, when deployed:

- a) lie within 50 mm of the edge of the ramp working surface, measured in the plane of the ramp working surface;
- b) extend from the point where the ramp working surface crosses the door aperture, to within at least 100 mm of the edge of the ramp in contact with the ground;
- c) be ≥ 25 mm high, measured perpendicular to the ramp working surface;

NOTE 1 While the minimum side guard height specified in this part of PAS 2012 is 25 mm to align with existing standards, a minimum height of 40 mm is advisable. Some wheelchairs, particularly those with large diameter wheels or powered wheelchairs suitable for outdoor use, are capable of overcoming a 25 mm side guard. For the more powerful outdoor wheelchairs, even a side guard 100 mm high might not guarantee that the wheelchair remains on the ramp. At the same time, tall side guards increase the trip hazard for the assistant, encroach into the wheelchair space on many WAV designs when the ramp is stowed, and increase the risk of “railroading” (where the side guard becomes trapped between the wheel and the manual propelling rings on some designs of manual wheelchair).

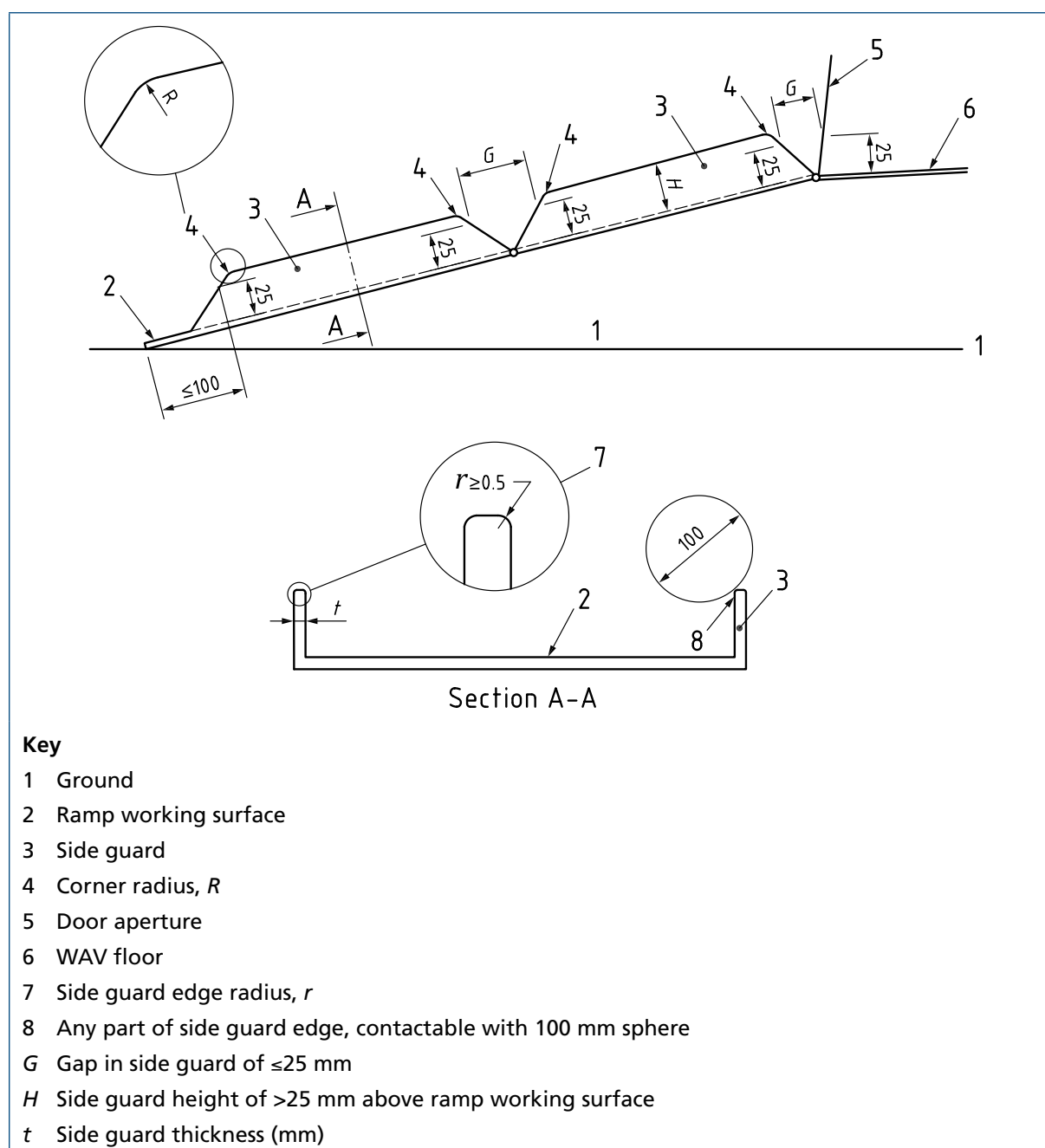
- d) contain no gaps in the side guards, or between the upper end of the side guard and the door aperture, that exceed 25 mm in length at any point to a height of 25 mm above the ramp working surface, measured perpendicular to that surface;

NOTE 2 Figure 4 shows an example of a ramp with gap (G) in the side guard. The intention behind the requirement is to reduce the possibility of one or more wheelchair wheels dropping over the edge of the ramp either on the way in or out of the WAV. For this reason, any gaps in the side guards are to be kept below 25 mm, at least up to the minimum required height of the side guard (which is 25 mm). As there is no requirement for a side guard higher than 25 mm, it follows that gaps greater than 25 mm are acceptable above this height.

NOTE 3 The term “door aperture” refers to the aperture left by the door when the door is open, usually defined by the door seal round the perimeter of the aperture or, in the absence of a door seal, the plane occupied by the ramp when in the stowed position.

- e) have an edge radius, r , of ≥ 0.5 mm on all edges contactable with a sphere of diameter (100 ± 5) mm;
- f) where the thickness of the side guard, t , is < 20 mm, have corner radii, R , ≥ 5 mm; and
- g) where the thickness of the side guard, t , is ≥ 20 mm, have corner radii, R , ≥ 0.5 mm.

Figure 4 – Side guards: dimensions, edge radii and corner radii



5.3.3 Stability

5.3.3.1 Any special instructions for ramp use or limitations when deployed under particular conditions shall be provided in the WAV user manual in accordance with Clause 7.

NOTE Good practice is to design ramps to accommodate a variety of ground and kerb surface conditions. This includes taking into account all reasonably foreseeable conditions of WAV use (e.g. accessing the WAV on slopes or uneven, unstable, wet or slippery surfaces).

5.3.3.2 For an AWAV, the ramp, when deployed, shall be positively located at the point of its attachment to the WAV.

NOTE When the ramp is deployed, the edge of the ramp attached to the WAV should be located in such a way as to minimize the risk of it becoming dislodged during boarding or alighting of the wheelchair user.

5.3.3.3 For a UWAV, the ramp shall be permanently attached to the WAV at the point of entry for the wheelchair.

5.3.3.4 It shall be possible to lock any additional ramp supports (e.g. a prop under the central hinge of a folding ramp) in position when the ramp is deployed. The locking mechanism shall prevent movement of the ramp support whilst the ramp is deployed and:

- a) in the case of an AWAV, operate either automatically or manually; or
- b) in the case of a UWAV, operate automatically.

5.3.4 Dimensions

5.3.4.1 The width of a ramp measured between the side guards at any point along its length shall be ≥ 500 mm. The width shall be determined in accordance with **B.3.9**.

5.3.4.2 For a rear-entry WAV, the ramp projection from the WAV, when deployed, shall be ≤ 2.1 m, when determined in accordance with **B.3.13**.

5.3.4.3 For a side-entry WAV, ramp projection, when deployed, shall be ≤ 1.5 m, when determined in accordance with **B.3.13**.

NOTE The widest part of the WAV when the ramp is deployed might be the edge of the open wheelchair access door or a door mirror.

5.3.5 Rated capacity

5.3.5.1 For a WAV designed for a wheelchair mass of ≤ 150 kg, the rated capacity of the ramp shall be ≥ 300 kg.

NOTE In order to carry a wheelchair of ≤ 150 kg, plus an occupant of nominal mass 75 kg and an assistant of nominal mass 75 kg, the ramp needs to be capable of carrying a load of ≥ 300 kg.

5.3.5.2 For a WAV designed for a wheelchair weighing > 150 kg, the rated capacity of the ramp shall be at least equivalent to the maximum mass of the wheelchair that can be carried plus 150 kg.

5.3.5.3 When tested in accordance with Annex I:

- a) the average of the maximum permanent deflection at each side of each span greater than 200 mm in length shall be no greater than 0.5% of the length of that span; and
- b) there shall be no breakage of any part of the ramp.

5.3.5.4 The rated capacity of the ramp, in kg, shall be marked on all ramps in characters ≥ 15 mm in height.

NOTE The marking should be visible to a standing observer when the ramp is deployed.

5.3.6 Angle

COMMENTARY ON 5.3.6.

If a lowering suspension system is fitted, it may be in the lowered position when measuring the ramp angle.

It is possible that some combinations of wheelchair and occupant might become unstable on slopes exceeding a certain angle. This varies with factors such as the design of wheelchair, the weight, size and position of the occupant, and any additional equipment or luggage being carried on the wheelchair. Depending on these factors and the position of the attachment point of any winch line to the wheelchair, it might become possible for the wheelchair and its occupant to tip backwards if the wheelchair is released by the assistant. Given the current designs of both wheelchairs and base vehicles, it is not practicable to produce AWAVs with ramps of a sufficiently shallow angle to guarantee stability for all wheelchair and occupant combinations. It is therefore advisable to provide adequate warnings on the vehicle, in the vehicle documentation, and to recommend the presence of an assistant at all times when the wheelchair user is boarding or alighting the AWAV.

Although there is a requirement to fit a winch or other assistive device to an AWAV that has a ramp angle $>13^\circ$ (see 5.3.1.1), winches may be fitted to AWAVs that have a ramp angle $\leq 13^\circ$ and to UWAVs. However, the maximum ramp angle for a UWAV is not permitted to be $>11^\circ$ (see 5.3.6.4) even if a winch is fitted.

5.3.6.1 The ramp angle of the WAV shall be determined according to B.3.11.

5.3.6.2 For a ramp fitted to an AWAV and used without any other assistive device for aiding access (e.g. a winch), the angle that it makes with the horizontal shall be $\leq 13^\circ$ when measured:

- a) for a rear-entry AWAV, with the ramp deployed onto level ground; and
- b) for a side-entry AWAV, with the ramp deployed onto a horizontal surface 125 mm above the ground on which the WAV rests.

NOTE 1 The 125 mm represents the height of a typical pavement.

NOTE 2 The maximum ramp angle is not specified for an AWAV fitted with an additional device for aiding access (e.g. a winch) that might be attached to the wheelchair in such a way so as to:

- a) reduce the level of effort required from the assistant to load the occupied wheelchair; and
- b) prevent the wheelchair from rolling back down the ramp if released by the assistant.

5.3.6.3 For a side-entry AWAV, a second measurement of the ramp angle shall be taken with the ramp deployed onto the ground on which the WAV rests.

5.3.6.4 For a ramp fitted to a UWAV, the angle that it makes with the horizontal shall be a maximum of 11° when the ramp is deployed onto the ground.

NOTE Unlike an AWAV, where, by definition there is always an assistant present when the wheelchair user is boarding or alighting and the assistant is able to provide additional stability for the wheelchair, a wheelchair user needs to be able to access a UWAV completely independently, even when the UWAV is parked on a sloping road. By design, some wheelchairs can become unstable on upward slopes, as their occupied centre of gravity is close to the rear axle. In order to mitigate against wheelchair instability to the greatest extent practicable, the ramp angle for a UWAV is therefore limited to less than that permissible for an AWAV.

5.3.6.5 For a side-entry WAV, with a ramp intended to be deployed onto a pavement, the following text shall be reproduced on the ramp so as to be visible when the ramp is deployed: "WARNING Ramp intended for use onto pavements".

5.3.7 Powered ramp

5.3.7.1 Any ramp fitted to a UWAV shall be powered.

NOTE An AWAV may be fitted with a powered ramp.

5.3.7.2 The powered ramp controls shall either:

- a) be marked as such; or
- b) have a tag with the markings provided, along with a means of securing the tag to the control.

NOTE If controlled remotely (e.g. by a key fob), the control need not be located at the point of entry. As it is not always practicable to mark a key fob due to its small size, a tag with the appropriate markings may be used instead and secured to the fob (e.g. by attaching it to the same keyring).

5.3.7.3 If permanently fixed to the WAV, at least one set of controls shall be located at the point of entry served by the ramp.

5.3.7.4 For a UWAV, the powered ramp controls shall be remotely operable.

NOTE 1 This is so that the wheelchair user can operate the powered ramp whilst seated in their wheelchair, i.e. without having to leave their wheelchair.

NOTE 2 Where any remote-control unit relies on radio waves to operate, attention is drawn to EU Directive 2014/53 [12] ("the Radio Equipment Directive") and in the UK, the legal requirements contained in the Radio Equipment and Telecommunications Terminal Equipment Regulations 2000 [13].