

PAS 2012-1:2019



BSI Standards Publication

M1 vehicles for the carriage of one or more passengers seated in wheelchairs

Part 1: Manufacturing requirements – Specification



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Foreword

Publishing information

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 30 November 2019.

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- Vehicle Certification Agency – Department for Transport (VCA)
- Wheelchair Accessible Vehicle Converters' Association (WAVCA)

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The PAS process enables a specification to be rapidly developed in order to fulfil an immediate need in industry. A PAS may be considered for further development as a British Standard, or constitute part of the UK input into the development of a European or International Standard.

Relationship with other publications

PAS 2012 is published in two parts, as follows:

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

Supersession

This PAS supersedes PAS 2012-1:2015, which is withdrawn.

¹ www.wavca.co.uk

Use of this document

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.

Product certification/inspection/testing. Users of this PAS are advised to consider the desirability of third-party certification/inspection/testing of product conformity with 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.

Assessed capability. Users of this PAS are advised to consider the desirability of quality system assessment and registration against the appropriate standard in the BS EN ISO 9000 series by an accredited third-party certification body.

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 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”).

Contractual and legal considerations

This publication does not purport to include all the necessary provisions of a contract. Users are responsible for its correct application.

Compliance with a PAS cannot confer immunity from legal obligations.

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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 wheelchair in a motor vehicle.

In the beginning most conversions were rudimentary, 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 access to transport in both wheelchair accessible taxis and personal private vehicles is set to rise higher in the future.

In recent years, as a result of campaigning by UK industry, the European Commission has included WAVs as a new category of “special purpose vehicle” within the amendments of Directive 2007/46/EC [1]. However, compliance with Directive 2007/46/EC is not mandatory for all WAVs produced in the UK, as there are alternative approval routes open to manufacturers. In addition, the requirements of the Directive are, in the main, limited to the securing of the wheelchair and occupant within the WAV. They do not address accessibility issues. Furthermore, the Directive 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 Directive, 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 have 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 PAS introduces a new 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 PAS was developed using data from the Department for Transport study, *A survey of occupied wheelchairs and scooters* (2006), conducted by CEDS. The survey took and catalogued various measurements of over 1 300 wheelchair users and their wheelchairs. The accessibility gauge used in this PAS 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 PAS aims to encompass the vast majority of wheelchair users in the UK.

0.3 Wheelchair mass

This PAS specifies performance and test requirements for securing wheelchairs of an unoccupied mass of ≤ 200 kg.

Whilst no requirement contained in this PAS 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 PAS 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 PAS specifies alternative test methods to demonstrate compliance with its requirements.

As an example, Annex C (a dynamic test) or Annex E (a static test), are both intended to determine the strength of wheelchair tie-down and occupant restraint anchorages for wheelchairs weighing ≤ 85 kg. Either method is acceptable as a means of satisfying the requirements of this PAS and WAV manufacturers may 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, the PAS 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 PAS 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 PAS 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. Wheelchair tie-down arrangements and driving controls for these WAVs would be difficult to standardize, however, some of the requirements of this PAS can be usefully applied to drive-from-wheelchair WAVs insofar as their basic level of accessibility is concerned. Two definitions are used in this PAS – "AWAV" (assisted entry wheelchair accessible vehicle), (see 3.1.3) and "UWAV" (unassisted entry wheelchair accessible vehicle) (see 3.1.21) to cover the two basic types of WAV. In some parts of the PAS, separate requirements apply to each.

0.6 Tie-downs

This PAS 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 the drafting of 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 PAS may also be applied to other types of WTORS and WTORS anchorages, subject to it being possible to make suitable modifications to the SWC used for testing.

1 Scope

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

NOTE 1 Some four-point strap-type tie-downs are wheelchair-specific, and are designed to be used with only one particular model of wheelchair. Care should be taken when selecting appropriate tie-downs, as not all four-point strap-type tie-downs might be suitable for test in accordance with the requirements of this PAS. For example, it might not be possible to attach some wheelchair-specific tie-downs to a SWC and some wheelchair-specific WTORSs include wheelchair occupant restraint anchorages that attach to the wheelchair itself rather than the WAV structure.

It 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;
 - 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;
 - 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;
 - 2) static test method for wheelchair occupant head and back support;
- f) structural integrity; and
- g) requirements for service elements, for example, a user manual (including WAV technical specification to facilitate direct comparisons between WAVs) and re-call procedures.

It does not specify requirements for securing an occupied wheelchair in the driving position of a WAV.

NOTE 2 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.

It does not specify requirements for securing the wheelchair other than with four-point strap-type tie-downs.

NOTE 3 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.

This part of PAS 2012 does not specify requirements for the retail of WAVs.

NOTE 4 PAS 2012-2 specifies requirements for the retail of WAVs conforming to PAS 2012-1.

NOTE 5 In cases where items or features fitted to a WAV are optional, the requirements applicable to them only apply where fitted.

2 Normative references

The following referenced documents are indispensable for the application of this document. 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, *Technical systems and aids for disabled or handicapped persons – Wheelchair tie-down and occupant-restraint systems – Part 1: Requirements and test methods for all systems*

Other publications

[NR1] DRIVER & VEHICLE STANDARDS AGENCY. *Code of Practice on Vehicle Safety Defects and Recalls*. Bristol. DVSA, 2014. (<https://www.gov.uk/government/publications/code-of-practice-on-safety-defects-and-recalls-vehicle-aftermarket/code-of-practice-on-safety-defects-and-recalls-vehicle-aftermarket>)

3 Terms, definitions and abbreviations

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 was approved for use on a public road

NOTE 1 Such routes may include schemes such as EC Whole Vehicle Type Approval, EC Small Series Type Approval, National Small Series Type Approval, EC Whole Vehicle Type Approval as a Special Purpose Vehicle and 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 (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 peculiar to the converted WAV are covered by the conversion warranty.

3.1.6 designated travelling position

position of the occupied wheelchair in the WAV whilst 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 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 3° 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, 3.17, modified]

3.1.9 kerb weight

weight of the WAV with no occupants and a full supply of fuel in its tank, an adequate supply of other liquids incidental to its propulsion and no load other than the loose tools and equipment with which it is normally equipped

3.1.10 lift

device or system with a platform that can be raised or lowered to provide access for occupied wheelchairs between the floor of a passenger compartment and the ground or kerb

[SOURCE: Directive 2001/85/EC [2], modified]

3.1.11 line pull

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

3.1.12 lowering suspension system

system which lowers and lifts totally or partially the body of a vehicle relative to the normal running position

[SOURCE: Directive 2001/85/EC [2], modified]

3.1.13 M1

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

[SOURCE: Directive 2007/46/EC [1]]

3.1.14 mass in running order

mass of an unladen vehicle, carrying all liquids needed for operation, tools, spare wheel, if fitted, a mass of 75 kg in the driving seat and its fuel tank filled to at least 90% of rated capacity

[SOURCE: Directive 2007/46/EC [1], modified]

3.1.15 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

3.1.16 point P

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

3.1.17 point W

location of point P relative to a WAV datum when the accessibility gauge or SWC is in its designated travelling position

3.1.18 ramp

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

3.1.19 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

3.1.20 tie-down

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

3.1.21 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

3.1.22 WAV manufacturer

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

3.1.23 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]

3.1.24 wheelchair accessible vehicle (WAV)

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

3.1.25 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

3.1.26 wheelchair occupant restraint effective anchorage

point used to determine the angle or position of each part of the wheelchair occupant restraint belt in relation to the wheelchair occupant, and taken as the centre of the webbing strap as it passes over the last hard surface of the anchorage that alters its lie, prior to reaching the wheelchair occupant

3.1.27 wheelchair tie-down and occupant-restraint system (WTORS) anchorage

part of the WAV to which a wheelchair occupant restraint and/or tie-down can be secured

3.1.28 wheelchair tie-down effective anchorage

point used to determine the angle or position of each part of a strap-type wheelchair tie-down in relation to the wheelchair, and taken as the centre of the webbing strap as it passes over the last hard surface of the anchorage that alters its lie, prior to reaching the wheelchair

3.2 Abbreviations

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

ATD	anthropomorphic test device
AWAV	assisted entry wheelchair accessible vehicle
GVW	gross vehicle weight
PTV	pendulum test value
SWC	surrogate wheelchair
SWL	safe working load
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

4.1 Structural integrity and modifications

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.

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 1 Where a base vehicle structure has been modified, consideration should be given to the design, validation and execution of the modifications, with regard to the demands likely to be placed on the completed WAV structure in use. There are no type approval requirements relating to the durability of the completed WAV, and consideration should be given to the effects of fatigue loadings on the structure and the effects 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, a suitable quality inspection procedure of the completed joints should be implemented.

NOTE 2 Where welding operations are carried out, particularly to structural areas of the WAV and to suspension components and their attachment brackets, consideration should be given to the selection of materials and welding consumables, so as to maximize compatibility with the parent metal on the base vehicle. Consideration should also be given to the metallurgical compatibility and gauges of the materials being joined. BS EN ISO 3834, combined with the product specification, gives guidance on selection of appropriate levels of weld quality for each weld. Those welds requiring welder certification can then be identified and consideration should be given to ensuring that appropriately coded welders are available to carry out these 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.

NOTE 3 Mechanical fastening techniques commonly used in WAVs include screwing, bolting and riveting (including clinched threaded fasteners). Consideration should be given to the specification of all fasteners with regard to loading, corrosion resistance (including galvanic compatibility of the materials to be joined), and the environment in which the fasteners might be expected to operate. In the case of threaded fasteners, appropriate selection of tightening torques and the correct specification of anti-vibration locking features and mating fasteners should be considered. Fasteners subject to replacement or inspection at specified intervals in service should be listed in the user manual, along with the specified replacement interval and tightening torque. Where automated or

semi-automated assembly techniques are used (e.g. rivets or other types of clinched fastener), consideration should be given to the correct selection of the consumables, as well as the maintenance and regular inspection of the tools used, to ensure the correct grip range is maintained.

NOTE 4 Adhesives are increasingly being used in the conversion of base vehicles to WAVs, often in conjunction with mechanical fasteners. Consideration should be given to the specification of any structural adhesives used in the WAV, and their compatibility with the material(s) to be joined. The design of any joints should be considered with regard to the properties of the particular adhesive being used. Appropriate protection from heat sources and complimentary traditional joining techniques for joints subject to tensile or peeling loads should be considered. Consideration should also be given to the application of the adhesives, and, in particular, the cleaning and surface preparation of the substrates and the control of temperature and humidity during the curing process.

4.2 Wheel alignment

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

NOTE Such modifications may 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; or*
- 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) for an AWAV, be located at the entrance used for wheelchair access;
- b) for a UWAV, be operable remotely from outside the 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 may 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;*
- d) *the driver's seat 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

NOTE All conversions should be carried out with due regard to the function of the finished WAV. Fittings and trim used in the section of the WAV in which the wheelchair occupant travels should be of the same or similar quality to those used throughout the rest of the base vehicle. Upholstery and floor coverings should 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.

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 either UN/ECE Regulation 14.05, 14.06 or 14.07 [3], Sections 5, 6 and 7 or Directive 76/115/EC [4] (as amended).

NOTE 1 UN/ECE Regulation 14 [3] and Directive 76/115/EC [4] 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 (the "General Safety Regulation") [5] repeals Directive 76/115/EC [4] 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 have not been removed in this review.

4.5.3 Where base vehicle seating positions or their anchorages are modified and those seats were originally equipped with one or more ISOFIX child seat anchorages, or new ISOFIX anchorages are added to the WAV, the new ISOFIX anchorages or the ISOFIX anchorages on the modified seat shall either:

- a) conform to the requirements of either UN/ECE Regulation 14.06 [3] or any subsequent amendment UN/ECE Regulation 14, Sections 5, 6 and 7; or
- b) be rendered unusable; any label or other marking denoting their presence on the seat be removed or defaced and a note fixed in the base vehicle handbook amending any pages relating to the ISOFIX fittings.

4.5.4 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 may include a mechanical lock, prop or strap to secure the seat in its tilted or folded position.

4.5.5 Where an existing fuel tank for liquid fuel or its filler neck and associated pipework is modified, or an alternative tank is fitted, the fuel tank, the filler neck and associated pipework used shall conform to either the requirements of UN/ECE Regulation 34.02 [6], Part I, or EC Directive 70/221 (as amended) [7], Annex I, Sections 5 and 6.

NOTE 1 UN/ECE Regulation 34 [6] and Directive 70/221/EC [7] 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 (the "General Safety Regulation") [5] repeals Directive 70/221/EC [7] 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 have not been removed in the revision of this PAS.

NOTE 3 Attention is drawn to Regulation 39 of the UK Road Vehicles (Construction and Use) Regulations 1986 [8] containing legal requirements for fuel tanks made from a plastic material.

4.6 Spare wheel and associated equipment

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

- a) a wheelbrace 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 wheelbrace to be used with the locking wheel nuts;
- c) a jack with a Safe Working Load rating of at least half the greatest maximum permitted axle weight specified by the WAV manufacturer; and
- d) sufficient stroke to raise any one wheel of the WAV clear of the ground when the WAV is parked on level ground.

NOTE 1 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 obviously necessary to also supply the means to change it.

NOTE 2 In most cases, the jack supplied with the base vehicle is likely to be retained. In the absence of any safe working load markings and if the WAV manufacturer has not increased the maximum permitted axle weights, it may reasonably be assumed that the jack is capable of meeting this requirement.

NOTE 3 Consideration should also be given to the stability of the jack provided and the compatibility of the lifting head of the jack with the WAV's jacking points.

5 Wheelchair access and WAV dimensions

5.1 Entrance

5.1.1 At least two entrances on the WAV shall provide access to the wheelchair space.

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

NOTE This is to ensure that an assistant can reach the wheelchair user once he or she is inside the vehicle (in most WAVs, the wheelchair itself blocks the wheelchair entrance). It is not intended to be a second means of access for an occupied wheelchair.

5.2 Wheelchair space

5.2.1 The maximum length, width and height of an occupied wheelchair that can 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 (as defined in **3.1.15**) 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 The floor in the wheelchair area should be slip resistant. Materials that are likely to achieve slip resistance include coatings with granular aggregate. As there is considerable variation in the materials that may be used to form the floors of WAV wheelchair areas, it is impossible to specify a level of slip resistance that will guarantee stability in all cases. However, a "dry grip value" (or "PTV") of 36 or more, when measured in accordance with the test method specified in BS 7976-2:2002+A1:2013 (or a similar standard relating to a specific flooring material), on all floors inclined at >5° to the horizontal, is likely to prove adequate in most cases.

5.2.7 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.

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

NOTE However, any control may be used to stop an operation.

5.3 Ramps

5.3.1 Surface

NOTE 1 The ramp surface should be slip resistant. The slip resistance needed depends on the ramp angle in use and on whether the ramp could become wet. Materials that are likely to achieve slip resistance include coatings with granular aggregate. As there is considerable variation in the materials that may be used to form the surfaces of ramps, it is impossible to specify a level of slip resistance that will guarantee stability in all cases. However, a “wet grip value” (or “PTV”) of 36 or more, when measured in accordance with the test method specified in BS 7976-2:2002+A1:2013 (or a similar standard relating to a specific flooring material), is likely to prove adequate in most cases.

NOTE 2 Attention is drawn to the UK Road Vehicle Lighting Regulations 1989 [9] 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 surface with no gaps, holes or recesses within the working surface capable of allowing the complete insertion of a spherical probe greater than 15 mm in diameter.

5.3.1.2 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) 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 may be required to provide satisfactory gradient”.

5.3.1.3 The ramp surface shall contain no obstructions greater than 7 mm in height or depth, except at the point where the ramp meets the surface on to 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 1.

5.3.1.4 Any gap between the ramp and the WAV floor shall not be capable of allowing the complete insertion of a spherical probe greater than 15 mm in diameter.

5.3.2 Side guards

NOTE Side guards on ramps are also known as upstands.

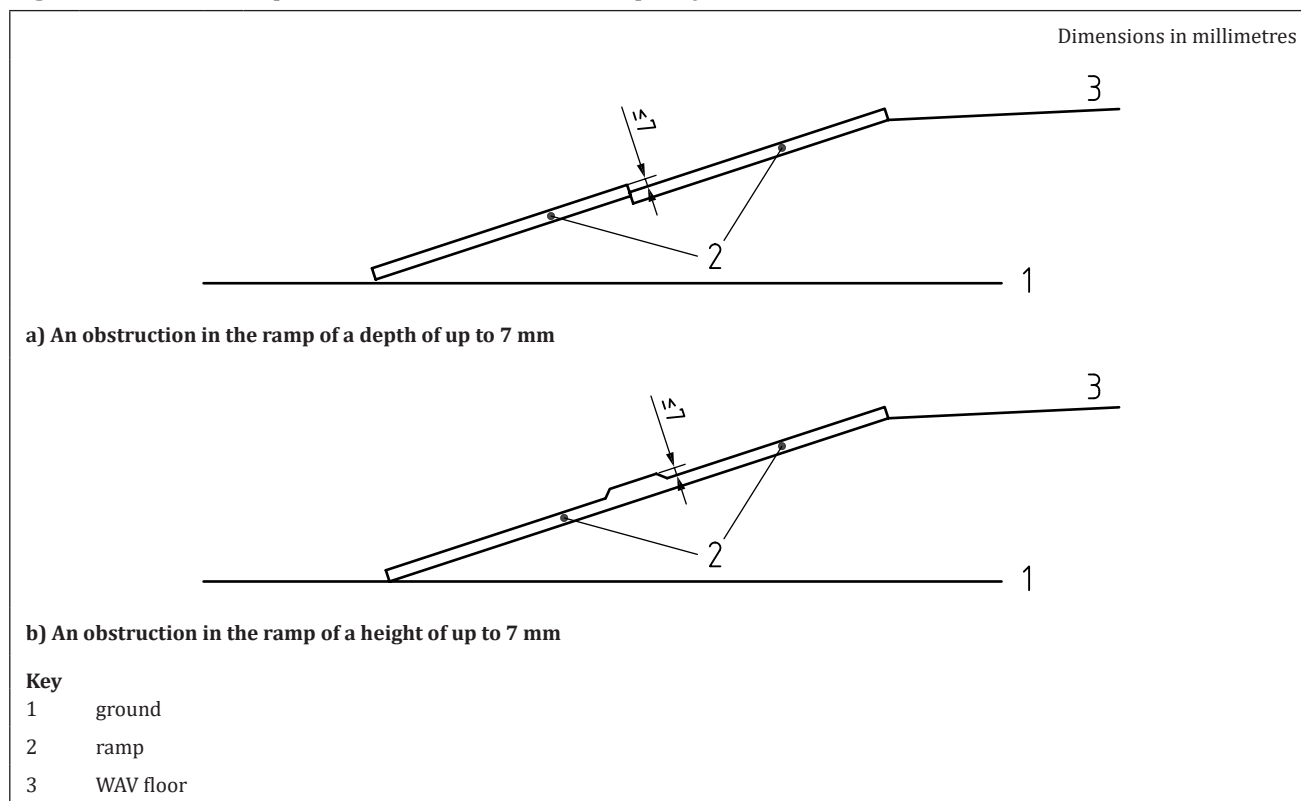
5.3.2.1 When deployed, the ramp shall be provided with side guards along either side of its surface.

NOTE Side guards are necessary to reduce the risk of the wheelchair falling off the side of the platform. Side guards may 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 could 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 surface, measured in the plane of the ramp surface;
- b) extend from the point where the ramp 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 surface;

NOTE Whilst the minimum side guard height specified in this PAS is 25 mm to align with existing standards, a minimum height of 40 mm is recommended. 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

Figure 1 — Maximum permitted obstructions in ramp surfaces

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 surface, measured perpendicular to the ramp surface;

NOTE 1 Figure 2 shows an example of a ramp with gap (G) in the side guard.

NOTE 2 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, it is necessary to ensure that any gaps in the side guards (or between the side guards and the bodywork at the point the wheelchair enters the vehicle interior), are 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 longer 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 of ≥ 0.5 mm on all edges contactable with a sphere of diameter (100 ± 5) mm;
- f) where the thickness of the side guard $t < 20$ mm, have corner radii $R \geq 5$ mm; and

NOTE Figure 2 shows a side view and sectional view of a typical WAV ramp.

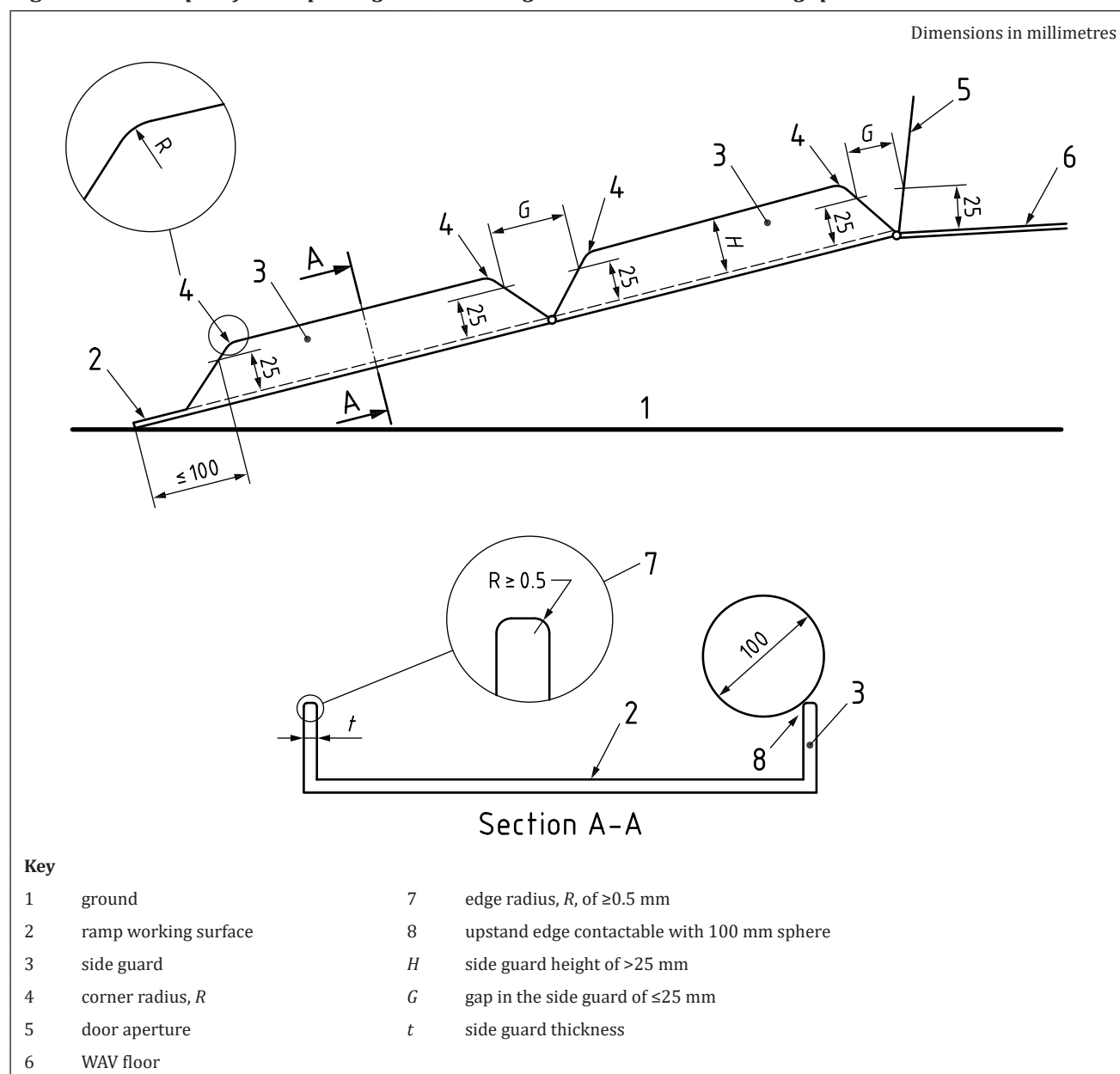
- g) where the thickness of the side guard $t \geq 20$ mm, have corner radii $R \geq 0.5$ mm.

NOTE Figure 2 shows a side view and sectional view of a typical WAV ramp.

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.

Figure 2 — Example of a ramp side guard with height >25 mm – Permissible gaps and radii



NOTE All ramps should be able to accommodate a variety of ground and kerb surface conditions. In particular, consideration should be given to 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 Safe working load (SWL)

5.3.5.1 For an AWAV designed for a wheelchair mass of ≤ 150 kg, the ramp SWL 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 an AWAV designed for a wheelchair weighing > 150 kg, the ramp SWL shall be at least equivalent to the maximum mass of the wheelchair that can be carried plus 150 kg.

5.3.5.3 For a UWAV, the ramp SWL shall be at least equivalent to the maximum combined mass of the wheelchair and occupant for which the UWAV has been designed.

5.3.5.4 The ramp SWL shall be tested as follows, placing the ramp so that it is fully extended and supported only by its intended support points during the following tests:

- a) Move a wheeled load of not less than 110% of the rated safe working load along the ramp. Check that no defect has developed.
- b) Place a load of 125% of the rated safe working load at position of maximum stress, along the length of the ramp. Check that there is no excessive deflection and that no defects have developed.
- c) Remove the load and check the ramp, its mountings to the vehicle and the vehicle itself to check that there is no permanent deflection.
- d) Check all ramp equipment for satisfactory installation and operation.

NOTE 1 This is based on a test taken from BS 6109-2:1989, which is now withdrawn.

NOTE 2 When selecting a wheeled load, the nature of a typical wheelchair should be used as guidance. In particular, it is recommended that the wheeled load comprises 4 wheels with rubber tyres (pneumatic or solid); and that the spacing of those wheels does not exceed that specified for the Accessibility Gauge in Figure B.1.

5.3.5.5 The ramp SWL in kg shall be marked on all ramps in characters ≥ 15 mm in height.

5.3.6 Angle

NOTE 1 If a lowering suspension system is fitted, it may be in the lowered position when measuring the ramp angle.

NOTE 2 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 and size 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 possible to produce AWAVs with ramps of a sufficiently shallow angle to guarantee stability for all wheelchair and occupant combinations. The presence of an assistant at all times when the wheelchair user is boarding or alighting and the provision of adequate warnings and guidance by both wheelchair manufacturers and WAV manufacturers should therefore be regarded as current best practice.

NOTE 3 Although there is a requirement (see **5.3.6.2**) to fit a winch, or other assistive device, to an AWAV whose ramp angle $> 13^\circ$, winches may be fitted to AWAVs whose ramp angle $\leq 13^\circ$ and to UWAVs. However, the maximum ramp angle for a UWAV is not permitted to be $> 11^\circ$ even if a winch is fitted (see **5.3.6.4**).

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 on to level ground; and
- b) for a side-entry AWAV, with the ramp deployed on to 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) ensure that the wheelchair is prevented 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 on to 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 on to the ground.

5.3.6.5 For a side-entry WAV, with a ramp intended to be deployed on to 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 be marked as such and if permanently fixed to the WAV, shall be located at the point of entry served by the ramp.

NOTE If controlled remotely (e.g. by a key fob) the control need not be located at the point of entry.

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

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

NOTE 2 For a UWAV, it should be possible for the wheelchair user to operate the power ramp controls whilst seated in the wheelchair, from both inside and outside the UWAV. Whilst it is impossible to prescribe precise requirements to enable unassisted use of a ramp to a UWAV in all cases, consideration should be given to the siting of the remote control unit, provision for its stowage when not in use, the length of the connecting lead, or, if a cordless remote control is used, the ease of replacement of batteries and provision for backup in the event of failure. Consideration should also be given to the provision of a master switch to avoid inadvertent use, and an indicator to denote that the powered ramp is operational.

NOTE 3 Where any remote control unit relies on radio waves to operate, attention is drawn to the Radio Equipment Directive, 2014/53/EU [10] and in the UK, the legal requirements contained in Statutory Instrument 2000 No. 730 – The Radio Equipment and Telecommunications Terminal Equipment Regulations 2000 [11].

5.3.7.4 A device to inhibit the operation of a powered ramp when the WAV is in motion shall be fitted.

NOTE Examples of suitable devices might include, but are not limited to:

- a) an interlock requiring the handbrake to be engaged before power can be drawn by the ramp;*
- b) a device to interrupt the supply of power to the ramp on detection of wheel rotation; or*
- c) a device to interrupt the supply of power to the ramp if it detects all the vehicle doors being shut and the engine running.*

5.3.7.5 Powered ramps shall be capable of manual operation.

NOTE Powered ramps need to be capable of manual operation so that in the event of power failure the wheelchair user can alight from the WAV whilst remaining seated in their wheelchair.

5.3.7.6 A WAV fitted with a powered ramp shall also be fitted with a means of providing the wheelchair user with information on the position of the ramp.

NOTE 1 Such means may include audible tones to signal complete deployment, a mirror or CCTV camera and display screen positioned so as to provide a wheelchair user facing away from the ramp with information as to whether the ramp is fully deployed, partially deployed or stowed.

NOTE 2 Attention is drawn to the UK Supply of Machinery (Safety) Regulations 2008 [12]. These regulations require compliance with the EC Machinery Directive (2006/42/EC) (as amended) [13]. Powered ramps generally fall within the scope of these regulations and the EC Machinery Directive (2006/42/EC).

5.4 Internal floor slope

5.4.1 The internal floor slope of the WAV shall be determined according to **B.3.6**.

5.4.2 For an AWAV used without any other assistive device for aiding access (e.g. a winch), the internal floor slope shall be $\leq 13^\circ$ above the horizontal.

NOTE 1 In some WAVs, it is possible that internal floor slope will be a "negative angle", i.e. the wheelchair travels down a slope, running at an angle below the horizontal within the WAV, in order to reach the designated travelling position. Only slopes requiring the wheelchair to negotiate "positive angles" need be considered.

NOTE 2 For a UWAV, it is recommended that wherever possible, the internal floor slope should not exceed 11° .

5.5 Lifts

NOTE 1 BS 6109-2 gives details of design and safety recommendations, operating procedures, installation and inspection recommendations for lifts for assisting entry or exit of passengers with or without wheelchairs into and out of WAVs through a height of ≤ 1.7 m.

NOTE 2 BS EN 1756-2 provides information on the design, fitting and operation of tail lifts for WAVs.

NOTE 3 Lifts should be able to accommodate a variety of ground surface conditions. In particular, consideration should be given to all reasonably foreseeable conditions of WAV use (e.g. accessing the WAV on slopes or uneven surfaces).

5.5.1 Lift platform dimensions

The maximum dimensions of an occupied wheelchair that can be loaded using the lift shall be determined in accordance with **B.3.12**.

5.5.2 Edges

NOTE Any edges of the lift that, when the lift is deployed, are contactable by a sphere of 100 ± 5 mm diameter, should have an edge radius of ≥ 0.5 mm and a corner radius of ≥ 5 mm.

5.5.3 Side guards

5.5.3.1 When deployed, the lift platform shall have side guards extending along the full length of either side of its surface.

5.5.3.2 The side guards shall be ≥ 25 mm high perpendicular to the lift platform surface.

5.5.4 Guards

5.5.4.1 A guard, ≥ 70 mm high when deployed, shall be fitted to the end of the lift platform furthest from the WAV.

NOTE Large powered wheelchairs suitable for outdoor use could be capable of overcoming a 70 mm high guard. On WAVs intended to transport such wheelchairs, the guard height of 100 mm is preferred. Consideration should also be given to the strength of the guard for such applications.

5.5.4.2 The guard shall operate automatically as the lift platform leaves the ground. Full deployment of the guard shall be achieved before the closest distance between any moving part of the platform and the ground reaches 50 mm.

5.5.5 SWL

5.5.5.1 For an AWAV designed for a wheelchair mass of ≤ 150 kg, the lift SWL shall be ≥ 225 kg.