

Technical Guideline (TR)

Mobile Vehicle Security Barriers

effective: 26/06/2019, version 0.8



Police forces of the Federation and the German *Länder*

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Change History

Version	Date	Reason for change
0.7	12/07/2018	Document created
0.8	26/06/2019	Correction of an inconsistency – Specification of test parameter "clear passage width; measuring height 0.6m" cancelled

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I General Part

I.1 Introduction

In general, the basis for procurements are engineering specifications for delivery or service specifications that are drawn up by the respective principal and made an integral part of the supply contract. In addition to the technical requirements contained in the Technical Guideline, these specifications may include further requirements, e.g. for quality assurance and final inspection.

This Technical Guideline (TR) describes the requirements for mobile vehicle security barriers. The system aims to prevent unauthorised driving of vehicles - depending on the separately shown energetic limits - in areas behind the barriers.

In order to meet the demand for technical systems to secure venues, objects or operational areas against penetrating vehicles, the UA FEK (Subcommittee Leadership, Commitment and Fight against Crime) deemed it necessary to draw up a technical guideline as a basis for procurements (Minutes of the resolutions by the 68th meeting of the UA FEK on 06th & 07th/09/2017 in Würzburg). In addition, an examination of the minimum requirements and further characteristic performance parameters for such systems is needed, the results of which are shown in the form of a test certificate and a test report.

I.2 Fundamentals

The system must be state of the art and/or meet the safety-related requirements of the generally accepted codes of practice. Efforts should be made to improve the safety standard in the course of design or technical development.

Risks of injury when working with the system should be minimised by an appropriate design of the modules and the system.

The individual assemblies must be coordinated in such a way that no assembly impairs the function of another. Checks for minimum requirements in terms of suitability and functionality must include not just the individual components but also the entire system.

The functionality and safety must be ensured irrespective of external conditions. Environmental influences (such as corrosive substances, natural UV radiation, environmental pollution) must not significantly impair the function. As a matter of principle, functionality and material resistance must be guaranteed in the temperature range -20°C to $+70^{\circ}\text{C}$. All materials used must be fire resistant according to DIN4102-1 fire behaviour class B.

The use of the system and its restoration to working order while in use should preferably be possible without special tools or specialized personnel. For repairs and servicing, components of the assemblies must be deliverable individually and detailed servicing documents be provided. For this purpose, a list of the individual parts should be handed over to the procuring office. Design changes and the resulting operating instructions or recommended procedures must be declared by the manufacturer and require a subsequent certification.

1.3 Labelling

To allow for individual labelling, the system must be impervious to the usual adhesive constituents.

For the purpose of stocktaking, permanent, unique labelling must be possible. Upon request, a suitable method should be chosen, e.g. by impressing an identification number, printing a barcode, attaching an inscribed label or an electronic mark by means of a microchip, on which specific dates – also for maintenance – can be saved. The labelling must be clearly legible and secured permanently when the system is used as intended. The label must contain the following information:

- serial number,
- manufacturer,
- model name,
- date of manufacture, stating at least month and year.

Other potentially required details:

- certification marks (e.g. seal of certification, proof of maintenance, date of expiry),
- if necessary, additional equipment details such as size or level of protection.

1.4 Scope of Technical Guideline

To participate in tenders of German federal authorities and Länder (state) authorities, a certificate is required to prove that the requirements of this technical guideline are met.

1.5 Quality Assurance

A tenderer wishing to manufacture an operating resource or an operational system (or manufacturing only individual assemblies of the system) for the German police must employ a quality assurance system in accordance with the latest EN ISO 9001 for his production and assembly (or another comparable quality assurance system).

1.6 Certification

The tenderer (manufacturer or distributor) of a system or an assembly must provide evidence by means of the relevant test certificates that the requirements of this guideline are met. The tenderer must arrange for the performance of the tests and for the issuance of the certificates after successful completion of the test at a test centre approved by the Technical Institute of the Police (PTI) (→ Appendix A1); the costs shall be borne by the tenderer.

The tenderer must supply a sufficient quantity of the material as well as spare parts, operating supplies and consumables required for testing. A description of the entire system or the assembly (material, installation and dimensions) and any other documents required must also be supplied. Samples must be presented for the test (→ chapter 2.4).

For a change in the design version of the entire system or assemblies, the tenderer – in consultation with the PTI - must apply to a PTI approved test centre for an assessment of the continued validity of the test certificate. The extent of potentially required re-examinations must be agreed and specified between the tenderer and the test centre. The costs of this recertification shall be borne by the tenderer.

Instead of the test centres listed in Appendix 1, another facility may be officially approved after prior

agreement with the PTI, provided such facility has the necessary expertise required for performing the tests (→ chapter 2.4 and Appendix A3), neutrality and is accredited pursuant to the latest version of EN ISO/IEC 17025 or has a comparable accreditation. The tenderer must provide evidence of the expertise of this facility and its accreditation vis-à-vis the PTI.

The PTI reserves the right to verify the expertise of the facility commissioned to perform the test. The PTI may revoke approval as a test centre within the meaning of this guideline at any time.

1.7 Documentary Evidence

If the requirements of this technical guideline for the entire system or the assembly are met, the respective test centre will issue relevant proof consisting of a test certificate and a test report. After certification, the complete electronic documentation (test certificate and test report) must be submitted to the PTI in German.

The **test certificate** contains not just the test report, but also at least the following details:

- Name and address of the test centre,
- Name and address of the customer who commissioned the certification or of the tenderer,
- Manufacturer and place of manufacture of the test sample,
- Brand name and type designation of the test sample to which this certificate relates (the test certificate must show clearly that it applies to the tested model only),
- Details of the test requirements (name of the technical guideline including version and date of issue),
- classification (protection class),
- Number and date of issue of the test certificate,
- Number and date of the test report,
- Date and location of the test,
- If applicable, period of validity and scheduled test interval.

The **test report** must provide insight into the entire test procedure, specify the technical documentation presented for the test and contain at least the following general information:

- Name and address of the test centre,
- Name and signature of the examiner,
- Details of the test relevant accreditations of the test centre,
- Name and address of the client commissioning the certification or of the tenderer,
- Manufacturer and place of manufacture of the test sample,
- Brand name and type designation of the test sample,
- Details of the test requirements and test specifications (name of the technical guideline including version and date of issue),
- Type of test performed,
- Identification number and date of test,
- Number and date of test report,
- Date of receiving test sample,
- Location and date of test,
- Construction/assembly, size, weight and number of test sample and other relevant details.

The test certificate and the test report shall only include subsequently manufactured products if these match the tested design version.

Changes in the design, the manufacturing process or the material must be notified to the PTI and change certifications or re-certifications obtained if necessary.

The **validity** of the test certificate and the test report expires if changes might affect the product conformity or if a subsequent test reveals a negative result.

1.8 Technical Documentation

For testing systems or assemblies, the tenderer must provide the test centres with the relevant technical documentation, i.e. a description of the construction/assembly and the materials as well as operating instructions.

Upon delivery, the relevant technical documentation must also be provided for each assembly. In addition to the name and address of the manufacturer, and, if applicable, of his authorized representative established in the European Community, this documentation must contain all appropriate information on at least the following points:

- Proper use,
- Warnings and special notes,
- Technical data,
- Instructions for storage, transport, assembly, use, cleaning, if necessary, disinfection, technical checks, servicing, maintenance, repairs, replacement of consumables and spare parts,
- Purpose and use of accessories,
- Parts list as well as characteristics and sources of standard parts or suitable spare parts,
- The type of packaging suitable for transport of the product,
- The meaning of any markings.

The documentation must be written in German and should be clear and simple. It must also be available in electronic format in a common file format.

Furthermore, the test certificate (or, if applicable, a partial test certificate) and the test report must be contained in the product documentation and an acceptance test record be issued for future traceability if needed.

1.9 Environmental Compatibility and Disposal

A tenderer manufacturing a system or individual assemblies must provide evidence of a certified eco-management pursuant to Regulation (EC) No. 761/2001 (→ Appendix A2).

For the manufacturing process of the assemblies and the entire system, only state-of-the-art materials that can be disposed of without risk to the environment may be used, as set out in the latest version of DIN EN ISO 14001 (→ Appendix A2).

2 Special Part

2.1 General Requirements

2.1.1 Use

The intended purpose of mobile vehicle security barriers is to effectively protect both open-air (event) locations and buildings from penetrating vehicles. Mobile vehicle security barriers must be as simple as possible in technical terms, require little personnel and training, be modular and be suitable for flexible use.

2.1.2 Modularity

Mobile vehicle security barriers must offer options in a modular design:

- to flexibly block off differently dimensioned squares, roads, paths and buildings without necessarily having to resort to external peripheral developments (such as parts of building, posts, trees),
- Erection, assembly and disassembly must be quick and not require specialist technical knowledge.

2.1.3 Security against Manipulation

A manipulation with simple, commercially available means, which may lower the system's functionality, must be ruled out.

Electronic systems must be protected with appropriate access protection.

2.1.4 Measures, Weights, Functionality

The properties and condition of mobile vehicle security barriers must be such that commonly used vehicle and hoisting logistics suffice – without the aid of complex infrastructure – to safely load and transport as well as place and flexibly relocate the barriers at their place of use. In doing so, the system's functionality must be sustained even after repeated transport, erection and disassembly.

2.1.5 Weathering Resistance

The system's protective properties must be ensured irrespective of external conditions. In particular weather conditions such as rain, humidity or the ambient air temperature must not reduce the protective properties.

2.1.6 Passive Safety

Mobile vehicle security barriers must be constructed, designed and marked in such a way that:

- They do not endanger people when handled properly – in particular during storage, erection and disassembly as well as placement at the place of usage,
- Design-related injuries to people (through sharp edges, tripping hazards, slip hazards etc.) are avoided,
- They are clearly recognisable as obstacles in public places in all lighting conditions, in

particular for motorcyclists, cyclists or other people moving rapidly (such as inline skaters). Pertinent statutory regulations, in particular in respect of traffic law and accident prevention, must be complied with.

2.1.7 Structural Stability and Effectiveness

Mobile vehicle security barriers must ensure structural stability and effectiveness when used properly.

2.1.8 Access for Emergency Services and Evacuation

In case of an incident, the configuration, dimensions and weights of mobile vehicle security barriers must be suitable to quickly and as simply as technically feasible create

- Access for emergency services,
- Escape routes for people as part of a crowd management.

Special needs such as those of wheelchair users and prams must be taken into consideration.

2.1.9 Maintenance, Storage, Environmental Comptability

Mobile vehicle security barriers must be robust and low-maintenance.

To store mobile vehicle security barriers in a way that ensures their safety, retains their value and in particular retains their protective character, it must also be possible to store them outdoors all year round, with minimum space requirements - either as individual elements or as modular assemblies. Where this requires suitable containers or covers, the tenderer must ensure their manufacture and supply.

It must be ensured that no substances harmful to the environment are released when used properly.

2.2 Specific Requirements

2.2.1 Vehicle Categories

Generally, the system must stop all multi-track vehicles that might present a danger to the life or health of people when such vehicles penetrate the area to be protected. Despite offering complete protection, as far as possible, accessibility (in particular for mobility scooters, wheelchairs, prams) must be ensured.

The system must safely stop vehicles irrespective of their type of drive (front-wheel drive, rear-wheel drive or four-wheel drive).

2.2.2 Safety at Impact

In case of impact, any dislocation of the barrier or the penetration distance of the vehicle into the area to be protected must be reduced to a physically unavoidable minimum. Therefore, the system must be fixed in one place, if possible.

Upon impact, the physically unavoidable range of dispersion of vehicle components or parts of the barrier must also be restricted to a minimum.

A dislocation of the barrier, the penetration distance of the vehicle and the range of dispersion must be included in tests, as outlined more closely in section 2.4.5.

2.2.3 Protection Classes

Special protection classes are used to categorise the different technical barriers, depending on the energy absorption capacity. These levels are determined on the basis of physically calculable parameters (gross vehicle mass, impact speed, energy absorption of the vehicle, residual energy).

In addition, a distinction must be made between solid (S) and non-solid (N) foundations.

Protection class (SK)	Minimum impact energy	Rigid foundations (B)	Non-rigid
Protection class 1	800 kJ	SK1B	SK1U
Protection class 2	1950 kJ	SK2B	SK2U
Protection class 2+	2400 kJ and higher	SK2+B	SK2+U

2.2-1: Table of protection classes (SK) according to energy levels and type of foundation

Certification according to protection class 2+ indicates that the minimum impact energy established during the test is in excess of 2400 kJ. The precise level of the tested impact energy can be found in the test report.

An overview of the impact energy generated in relation to the vehicle mass and the impact speed can be found the Protection Class-Energy Value - Matrix in Appendix 4.

For mobile vehicle security barriers that are used on non-rigid foundations, anchors may be installed.

2.3 Interface Requirements

None

2.4 Certification Requirements

For the certification of a mobile vehicle security barrier by means of impact testing, only test centres approved by the PTI may be used. In addition to the requirements set out in chapter 1.5, they must provide evidence of accreditation according to DIN EN 1317 plus IWA 14-1 [4] or alternatively PAS 68 [2], ASTM F2656 [5] or ONR 2216221 [1].

For a subsequent certification of design changes or another protection class than the one demonstrated during the impact test, only test centres approved by the PTI may be used. Test centres performing additional certification must, in addition, meet the requirements set out in chapter 1.5 and the requirements of Appendix A3.

2.4.1 Scope of Testing

The test includes proof of effectiveness and a determination of the performance parameters of a mobile vehicle security barrier for a specific protection class under test conditions. The impact test consists of a simple, horizontal impact of an unmanned vehicle onto the test object, with the impact parameters and the further test conditions being clearly defined. This ensures comparability between systems of different operating principles and allows for an evaluation of the possible field of application. The actual effectiveness and the performance parameters can vary greatly when ambient conditions differ significantly.

Proof of effectiveness is furnished by meeting **all three minimum requirements**:

1. The rearmost axle of the test vehicle has not passed the horizontal datum line of the mobile vehicle security barrier, and
2. The test vehicle stops at the latest 50m after impact, and
3. The test vehicle is unfit to drive (test drive after standstill).

The following **performance parameters** must be determined:

1. Kinetic energy of the test vehicle immediately prior to impact,
2. Maximum penetration distance of test vehicle, load, vehicle barrier or debris with a minimum weight of 100 kg,
3. Range of dispersion of debris with a minimum weight of 2 kg and maximum dispersion distance.

2.4.2 Information and Materials to be Supplied

For certification, the required information and documents must be supplied to the commissioned test centre in German or in English.

All product specific documents must be labelled with a unique ID and are subject to version control:

- Technical data sheet or product specification,
- Technical drawings and manufacturing drawings of the entire system, its assemblies and the individual components including dimensions, tolerances, materials and surface specifications, compliance certificates for materials used as well as full and partial assembly drawings from the manufacturing process,
- User manual including instructions for assembly, installation, placement, maintenance, inspections, repairs and a maintenance schedule and spare parts list,
- Maintenance instructions with maintenance schedule, recurring inspections and repair instructions,
- Other necessary information such as disposal notices, warning notices and safety notices.

Furthermore, the client must provide the following information:

- Contact details of client and manufacturer of test object,
- Designation of test object with model number or prototype identification number,
- Graphic representation or picture clearly showing the front of the test object the tenderer intends to use and/or the impact face,
- In case of linear, modular vehicle security barriers, information on the length for which the protection class sought is to be used,
- Information on whether this is an active or passive vehicle security barrier,
- If applicable, any certificates, test reports or similar documents already available for the test object,
- Specification of the foundation (rigid or non-rigid) and of the impact angle (45° or 90°),
- Specification of the protection class (SK1, SK 2 or SK2+ with details of impact energy) and selection of test parameters according to the tables below. The commissioned test centre can make a recommendation.

SK1B und SK1U					
Vehicle mass	Tolerance	Speed	Tolerance	Impact energy	
				Min.	Max.
7 500 kg	± 100 kg	53 km/h	+ 5 km/h	802 kJ	986 kJ
12 000 kg	± 200 kg	42 km/h	+ 5 km/h	803 kJ	1040 kJ

2.4-1: Table of test parameters for protection classes SK1B and SK1U

SK2B and SK2U					
Vehicle mass	Tolerance	Speed	Tolerance	Impact energy	
				Min.	Max.
7 500 kg	± 100 kg	83 km/h	+ 5 km/h	1967 kJ	2271 kJ
12 000 kg	± 200 kg	66 km/h	+ 5 km/h	1983 kJ	2373 kJ

2.4-2: Table of test parameters for protection classes SK2B and SK2U

The protection class 2+ (SK2+) is intended for mobile vehicle security barriers that were tested with an impact energy of at least 2400 kJ. For these tests, test vehicles with weights of 12000 kg or 30000 kg are available. The selected test speed must be at least 73 km/h or 46 km/h respectively.

SK2+B and SK2+U				
Vehicle mass	Tolerance	Speed	Tolerance	Min. impact energy
12 000 kg	± 200 kg	≥ 73 km/h	+ 5 km/h	≥ 2426 kJ
30 000 kg	± 400 kg	≥ 46 km/h	+ 5 km/h	≥ 2416 kJ

2.4-3: Table of test parameters for the protection classes SK2+B and SK2+U

At an impact angle of 90°, one test object must be provided, at an impact angle of 45° two test objects must be provided. The intended impact face must be marked on the test object. The client commissioning the certification must keep the material used in the impact test for a minimum of ten years and hand this over for re-certification/subsequent certification if necessary.

2.4.3 Test Preparations

Compliance of the test object presented with the documents supplied must be checked in terms of dimensions, materials used and other properties by means of a visual inspection. Any discrepancies must be remedied by the client commissioning certification before the test is performed. In doing so, traceability must be ensured by means of version control of the documents and/or the identification number of the test object.

Only for active vehicle security barriers: In case of malfunctions, such as a failure of the manual or electronic control mechanism, a condition shall automatically be established that maintains the protective function of the mobile vehicle security barrier (fall-back position). If the fall-back position corresponds to the closed normal state, the test shall only be performed for this configuration. If the fall-back position deviates from the closed normal condition, both configurations shall be tested separately in order to meet the requirements for the protection class sought. In case of an active vehicle security barrier, appropriate design measures shall be taken to ensure that after opening of the thoroughfare the closed normal state or the fall-back position is reliably restored. Compliance with these requirements must be checked before planning and performing the test, e.g. by demonstrating the function in connection with the implemented mechanisms for activation of the fall-back position or reference to the technical documentation.

The initial contact point and the horizontal and vertical datum line of the test object must be determined and documented in a traceable and comprehensible manner (→ Appendix B1).

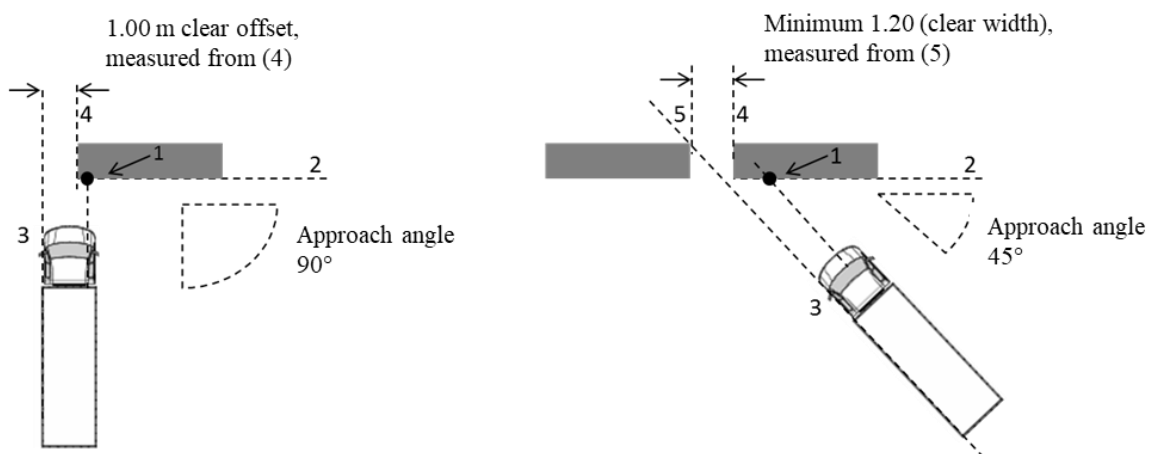
Taking into consideration the Model Ordinance Governing the Construction and Operation of Places of Assembly (MVStättVO), the assumed passage width alongside a mobile vehicle security barrier is 1.20 m. The approach direction is determined by the approach angle (90° or 45°) relative to the horizontal datum line of the test object.

At an impact angle of 90°, the approach path is determined in such a way that the extension of the left-hand side of the vehicle is 1.00 m from the left-hand side of the test object.

At an impact angle of 45°, a second test object is placed alongside the test object, with a side clearance of 1.20 m (clear opening width) in order to align the test object; the impact faces of the test objects must point in the same direction and be coplanar. The approach path is determined in such a way that the extension of the left-hand side of the vehicle is tangent to the right-hand side or the rear of the test object on the left – placed there for the purpose of alignment. The test object (left) deployed for the purpose of alignment is not required for the actual impact test.

If the minimum passage width of 1.20 m (clear opening width) is given within **one** continuous test object, the test may be performed with just one test object, analogous to the previous explanations on determining the approach path.

The initial contact point is determined by adjusting the constellation of test vehicle and test object immediately before impact.



- 1 Initial contact point determined
- 2 Horizontal datum line of the test object
- 3 Left-hand side of vehicle
- 4 Left-hand side of the test object
- 5 Right-hand side of the test object

2.4-4: Determination of the approach path and the initial contact point at an approach angle of 45° or 90°

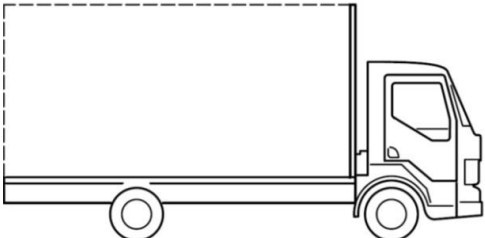
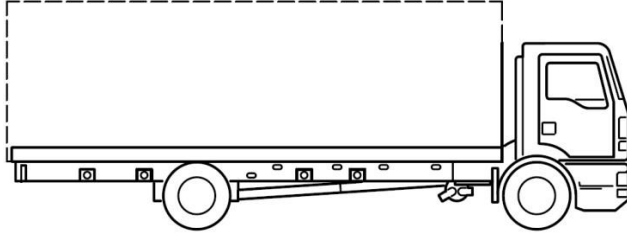
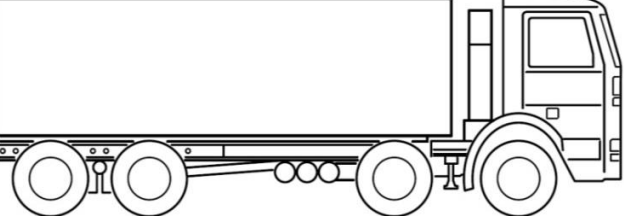
A test vehicle must not be used multiple times for certification. A commercially available vehicle must be chosen which meets the usual standards and represents a type of vehicle typically used on the roads. The test vehicle must not be older than 15 years.

The test vehicle must be in a roadworthy condition and fit to drive. This applies in particular to an intact drive system, tyres, shock absorbers, tracking (directional stability), bodywork, brakes and chassis.

The test vehicle is selected and procured by the commissioned test centre. The vehicle data must be

documented according to the template in Appendix A5 and attached to the test report.

Vehicle assistance systems may impair the actual test and falsify the test results. Such systems require modifications to the test vehicle. This applies in particular to automatic (electronic) emergency braking, lane departure warning systems with optical sensors, and automatic distance control.

<p>7 500 kg: two-axle HGV with rear-wheel drive, unladen mass at least 3575 kg, payload 3925 kg, vehicle length 7610 ±1520 mm, axle distance 4210 ±830 mm, min. distance lower edge longitudinal chassis beam to floor 515 ±175 mm.</p>	 <p style="text-align: right;">N2A</p>
<p>12 000 kg: two-axle HGV with rear-wheel drive, unladen mass at least 6100 kg, payload 5900 kg, vehicle length 9560 ± 1910 mm, axle distance 5910 ±1250 mm, min. distance lower edge longitudinal chassis beam to floor 750 ±200 mm.</p>	 <p style="text-align: right;">N3</p>
<p>30 000 kg: four-axle HGV with rear-wheel drive 8x4 or 8x6, unladen mass at least 10500 kg, payload 19500 kg, vehicle length 9600 ±1000 mm, outer axle distance 6800 ±500 mm, min. distance lower edge longitudinal chassis beam to floor 810 ± 200 mm.</p>	 <p style="text-align: right;">N3F</p>

2.4-5: Table of permissible test vehicle specifications based on IWA 14-1 [4]

To document the test vehicle's dimensions, the form in Appendix A5 must be used.

The test vehicle's tyres must be inflated to the tyre pressure stipulated by the manufacturer. Summer tyres with at least the statutory tread depth must be used. Contaminations of the test vehicle, which may impair the test results or complicate the test documentation, must be removed. The test vehicle must be loaded in accordance with the usual requirements for loading.

The test vehicle must carry a load in order to record the behaviour of the load after impact. The load must be secured on the test vehicle as a part load in the form of concrete slabs in accordance with the guideline VDI 2700 "Securing of loads on road vehicles"; its weight must be stated in kg. The load should create a form-lock with the front loading compartment wall, if possible be distributed across the entire width of the loading compartment and fixed with the usual aids for securing loads. The maximum axle load must not be exceeded.

The basic colour of the test vehicle, test object, test equipment and foundations must be clearly distinguishable. In particular the test equipment and its assembling devices should be marked conspicuously, as they are not to be assigned to the debris (→ chapter 2.4.5).

The markings on the test foundations, test object and test vehicle, which are required for the performance and analysis of the test, should be clearly visible, not least of all with a view to a later analysis of the pictures and videos.

The position of the test object while stationary, the horizontal datum line and the – projected - initial contact point, which may not be accessible until the test has been performed, must be marked and indicated on the test foundations.

The test foundations must be plane and smooth, must not have an incline of more than 2.5 % at any point or have obstacles and must provide sufficient space for the respective test [4]. The requirements for the condition of the test foundations, rigid or non-rigid, must be met in the area extending from the installation site of the barrier in a sector up to the anticipated stop position.

For certification of a mobile vehicle security barrier to be used on rigid foundations (SK1B, SK2B and SK2+B), the test must be performed on wet and damp asphalt without ponding.

For certification of a mobile vehicle security barrier to be used on non-rigid foundations (SK1U, SK2U and SK2+U), the test must be performed on non-rigid foundations which must meet the following specifications based on F2656/F2656M-18 "Standard Test Method for Crash Testing of Vehicle Security Barriers" [5]:

- A ballast bed with a depth of at least 0.6 m in an area of at least 10 m behind the initial contact point. The test foundations must be in a similar condition up to 30 m behind the initial contact point and non-rigid up to 50 m behind the initial contact point.
- Degree of consolidation of at least 90 %. Based on a screen analysis, the ballast bed must be shown to contain the following particle sizes:

Screen size [mm]	Screenings [%]
50.0	100
25.0	75-95
9.5	40-75
4.75	30-60
2.00	20-45
0.425	15-30
0.0075	5-20

2.4-6: Table of distribution of particle sizes for screen analysis according to F2656/F2656M-18 [5]

At the time of the test, there must be no water accumulation, snow, ice, de-icing agents or contaminations. In particular collections of dust must be prevented by suitable measures as they may impair the quality of pictures and videos.

The approach path must be such that a stable approach for a distance of at least 8 m before the initial contact point is made and as little vehicle inclination or vibrations as possible occur. In case the unmanned test vehicle careers out of control, security measures must be provided for. Technical safety precautions for manual or automatic control over the test vehicle after impact, e.g. for the steering mechanism, drive system or brakes, are permissible. However, if such control over the test vehicle becomes necessary after impact, the test will be deemed to have been failed.

The test equipment must meet the requirements of DIN EN 1317 and be traceable according to EN ISO/IEC 17025. If test equipment was installed in the vehicle, this must be added to the load. This must not result in the payload being exceeded Photographs:

Photographs:

- A. Panoramic view (0° - 360°) of test vehicle and test object in 45° increments. Supplementary, detailed pictures should be taken – where necessary – to account for the relevant details for the test analysis
- B. In case of an active mobile vehicle security barrier the different positions (open, closed, fall-back position), and
- C. At the tenderer's discretion meaningful pictures of the loading compartment, the inside of the driver's cab and the anticipated initial contact point, if possible by reconstructing the impact configuration.

Compliance with the test specifications must be checked by suitable methods and documented accordingly. Camera images must document the behaviour of the test object and test vehicle upon and after impact until it has come to a complete standstill: from an aerial view, perpendicular to the vehicle's front, and lateral views of both sides of the test object at a right angle to the direct of approach. The complete test performance shall be recorded by a camera. The impact itself and the 8 m after impact must be documented by at least one high-speed camera. Further cameras may be used at the test centre's discretion.

2.4.4 Test Performance

The test object must be set up and positioned in accordance with the assembly and installation instructions supplied.

In case of active mobile vehicle security barriers, one operating cycle must be filmed, as well as an example of the fall-back position being activated from a fully-open condition and the return to the normal, closed condition.

The approach to the initial contact point must be made in compliance with the tolerance range of $\pm 0,3$ m and a maximum deviation of $\pm 2^{\circ}$ from the intended approach angle at a constant speed. The acceleration should be stable and straight to avoid unwanted vibration and an inclination of the test vehicle. [4]

The test vehicle must come to a standstill no later than 50 m after impact. It must not exceed the distance of 50 m to the initial contact point with any section of the largest connected part.

Immediately after the test vehicle comes to a standstill, the vehicle's unfitness to drive is checked by means of a test drive. During that test drive, the vehicle must not move more than 3 m (forwards or backwards). If the engine cannot be started, the usual measures for jump starting the vehicle must be taken.

2.4.5 Test Analysis

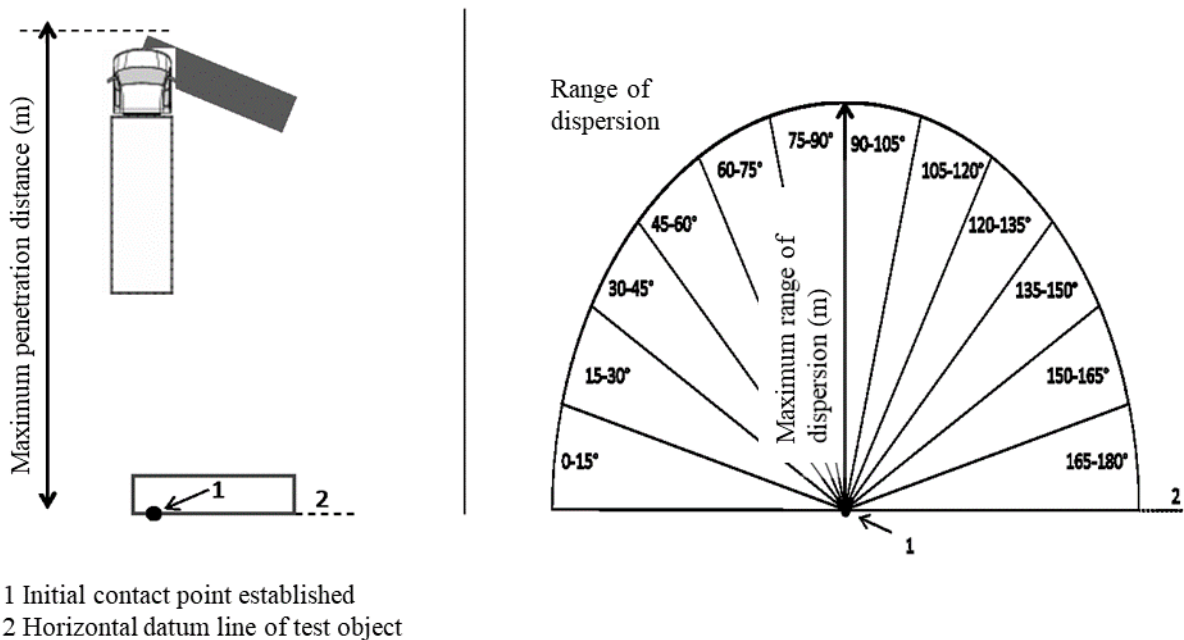
Compliance with the test parameters before impact – taking into account the permissible tolerances – must be documented clearly and comprehensibly.

The **impact energy** [kJ] is calculated on the basis of the speed measured immediately before impact [km/h] and the vehicle mass [kg].

The **maximum penetration distance** [m] with one decimal place is determined on the basis of the greatest distance between the initial contact point and the part being furthest away, with a minimum weight of 100 kg (vehicle, load, test object or debris).

The **range of dispersion** documents the distribution of the debris (vehicle, test object, load) behind the initial point of contact. In each 15° sector of 0 - 180°, the debris furthest away from the initial point of contact, weighing at least 2 kg, is documented. The weight [kg] and the position (distance [m], angle [°]) of the test vehicle, the test object and the debris must be document in a table. A photographic overview and a graphic representation of the tabular values (size of position marker reflects weight of debris), which also depicts the penetration distance and the range of dispersion with details of the distance, must be drawn up. The original position of the test object and the positions of the test vehicle and test object must be marked.

Based on photographs and measurements, the damage to the test vehicle, test object and test foundations must be documented. Debris with a weight of more than 2 kg must be photographed vertically from above. If needed, further meaningful photographs shall be taken.



2.4-7: Analysis to determine maximum penetration distance, range of dispersion and maximum dispersion distance

2.4.6 Test Report and Test Certificate

A test report must be drawn up for each impact test performed.

A **partial report** is issued for the tested approach angle (either 90° or 45°), if the minimum requirements according to 2.4.1 were met.

A **test certificate** (= overall certificate) for a protection class may only be issued if the minimum requirements for this protection class were met for both approach angles, 45° and 90°. The test certificate is only valid in conjunction with the partial reports required to obtain the overall certificates.

The partial report or test certificate must contain the following table in addition to the details outlined in chapter 1.6:

Test guideline used with title, version and date	
Product name and model number	
Certificates already existing, with details of protection class and impact angle:	
Protection class certified with this test	<input type="checkbox"/> SK1B <input type="checkbox"/> SK1U <input type="checkbox"/> SK2B <input type="checkbox"/> SK2U <input type="checkbox"/> SK2+B <input type="checkbox"/> SK2+U
Impact angle	<input type="checkbox"/> 45° <input type="checkbox"/> 90°
Test performed	<input type="checkbox"/> Certification with impact test or <input type="checkbox"/> Change certification with theoretical verification for the purpose of (check): <input type="checkbox"/> Serial production <input type="checkbox"/> Change of design version <input type="checkbox"/> Additional certification
Category	<input type="checkbox"/> Active <input type="checkbox"/> Passive
Weight of test vehicle	<input type="checkbox"/> 7 500 kg <input type="checkbox"/> 12 000 kg <input type="checkbox"/> 30 000 kg
Impact speed [km/h]	
Impact energy [kJ]	
Maximum penetration distance [m]	
Maximum dispersion distance [m]	

2.4-8: Mandatory content for the test parameters and test results to be included in the test certificate

2.4.7 Certification without Impact Test

Every change in the design of a mobile vehicle security barrier requires a **Change Certification** or – depending on the extent of the changes –new certification with renewed performance of an impact test. Under certain condition, and only upon approval by the PTI, alternative test methods can be used for **change certification without impact test**, employing purely theoretical procedures for furnishing proof after design changes. The effects of the design change compared to the test configuration must be documented, analysed, evaluated and their impact on the effectiveness and the performance parameters of the mobile vehicle security barriers determined. Change certification for serial construction is required as a matter of principle after certification of a prototype, if the mass product's design differs from the prototype.

In case of minor changes that do not affect mechanical parts of a mobile vehicle security barrier, a purely theoretical procedure for furnishing proof is permissible, proving that no change in the effectiveness or performance parameters is to be expected. In case of changes to individual, major components of the mobile vehicle security barrier, numerical methods of analysis such as a finite element method must be used. If proof cannot be furnished, new certification is required. In case of major changes that may cause a change in the effectiveness or performance parameters, new certification is required, if proof cannot be furnished that the design change would not have major effects on the test results of a renewed impact test under the same conditions.

To furnish proof for an additional protection class, **additional certification** without an impact test can be performed. This may be done, for example, by means of interpolation as mathematical verification, finite element methods (FEM) or computer simulation.

For **additional certification**, the theoretical test parameters must be selected in accordance with the requirements for an impact test. As a matter of principle, the requirements of DIN CEN/TR 16303-1 must be complied with.

The following documents must be supplied to the commissioned test centre, in German or English, for change certification or additional certification:

- Complete documentation of certification already performed,
- Description of the changes compared to the version already certified and list of changed documents,
- Complete documentation of the product in the new version to be certified,
- Report of tenderer's calculations,
- Simulation models, if applicable.

The calculations and simulations performed and the respective results must be documented comprehensibly and traceably in the test report.

Certification without impact test requires that the test object or an earlier version of the same was certified at least once with an impact test as set out in this Technical Guideline.

If the test performed as part of change certification or additional certification shows that

- The mass product matches the configuration of the certified prototype,
- The change of design version does not impair the effectiveness and performance parameters established during the impact test with a test vehicle,
- The required effectiveness and performance parameters were proven by means of theoretical reference methods,

a certificate shall be issued (→ chapter 2.4.6).

Appendix A – Technical Appendices

A1 Addresses of Test Centres in Alphabetical Order

- 1) *Crashtest-service.com GmbH, Amelunxenstraße 30, 48167 Münster
E-mail: info@crashtest-service.com
Tel.: +49 (0)2506 / 7099070
Homepage: www.crashtest-service.com
- 2) *DEKRA Automobil GmbH, Crash Test Center, Rungestr. 9, 24537 Neumünster
E-mail: crashtestcenter@dekra.com
Tel.: +49 (0)4321 / 39056-0
Homepage: www.crashtestcenter.de
- 3) **TÜV Nord EnSys GmbH & Co. KG, Große Bahnstraße 31, 22525 Hamburg
E-Mail: tnensys@tuev-nord.de
Tel.: +49 (0)511 / 998-61990
Homepage: www.tuev-nord.de
- 4) **TÜV Süd Industrie Service GmbH, Westendstraße 199, 80686 München
E-mail: crashsimulation@tuev-sued.de
Tel.: +49 (0)89 / 5791-3277
Homepage: www.tuev-sued.de

*Test centre approved by the PTI for certification of mobile vehicle security barriers

**Test centre approved by the PTI for change certification and additional certification of mobile vehicle security barriers

A2 Further Applicable Documents

DIN 4102-1	Fire behaviour of building materials and elements – Part 1: Classification of building materials; Requirements and testing; as amended from time to time
DIN EN ISO 9000	Quality management systems – Fundamentals and vocabulary; as amended from time to time
DIN EN ISO 9001	Quality management systems – Requirements; as amended from time to time
DIN EN DIN EN 1317	Road restraint systems
DIN EN 1317-1	Part 1: Terminology and general criteria for test methods
DIN EN 1317-2	Part 2: Performance classes, impact test acceptance criteria and test methods for safety barriers including vehicle parapets
DIN EN 1317-3	Part 3: Performance classes, impact test acceptance criteria and test methods for crash cushions
DIN EN 1317-4	Part 4: Performance classes, impact test acceptance criteria and test methods for terminals and transitions of safety barriers
DIN EN 1317-5	Part 5: Product requirements and evaluation of conformity for vehicle restraint systems (German only) Teil 5 Anhang I: Anforderungen an die Organisation (Person/Gruppe), die die Tätigkeiten zur virtuellen Prüfung ausführt; as amended from time to time
ISO 10392	Road vehicles – Determination of centre of gravity; as amended from time to time
DIN CEN/TR 16303-1	DIN SPEC 91103-1- Road restraint systems –Guidelines for computational mechanics of crash testing against vehicle restraint system – Part 1: Common reference information and reporting; as amended from time to time
DIN EN ISO 14001	Environmental management systems; as amended from time to time
EN ISO/IEC 17025	General requirements for the competence of testing and calibration laboratories; as amended from time to time
MVStättV: 2014-07	Model Ordinance Governing the Construction and Operation of Places of Assembly (MVStättVO), issued July 2014
Guideline VDI 2700	Securing loads on road vehicles
Directive 2007/46/EC of the European Parliament and of the Council of 05 September 2007 establishing a framework for the approval of motor vehicles and their trailers, and of systems, components and separate technical units intended for such vehicles	
Regulation (EC) No. 761/2001 of the European Parliament and of the Council of 19 March 2001 allowing voluntary participation by organisations in a Community eco-management and audit scheme (EMAS)	

A3 Requirements for Test Centres Performing Certifications without Impact Test

According to E DIN EN 1317-5:2014-02 – Draft – Appendix I (informative) there are separate requirements for test centres proving the effectiveness of a mobile vehicle security barrier by means of a virtual test and determining the further performance parameters by computational methods.

They must have access to licensed software that allows for a proper description of the impact phenomena. This software must meet at least the following requirements:

- Contact, including friction (vehicle, test object, road surface and test site ground),
- Strong displacement, rotation, elongation,
- Non-linear material laws,
- Energy absorption in the vehicle, test object and foundations,
- Ability to handle buckling of the vehicle and the test object,
- Definition of the accelerometer,
- Representation of the vehicle's movements.

They must have the necessary knowledge and experience in the fields of physics and engineering to understand and recognise which physical phenomena dominate the physical incident of interest. Some relevant areas might be: mechanics, elasticity, material strength, ruptures, non-linear geometric influences, dynamics, vibrations, optimisation, mouldability and breaking load, buckling and instability, limit states, multi-physical analyses, stochastics, and non-deterministic procedures to evaluate uncertainty.

They must have knowledge of measuring principles/devices/techniques suitable for validation of the model for a virtual test.

They must have knowledge of creating models for virtual tests in order to recognise which kinds of model hypotheses are appropriate and permissible.

They must have knowledge of mathematical procedures and numerical calculations in order to understand which numerical techniques are applied in the models for the virtual test and to evaluate whether an approach and numerical solution errors are permissible.

They must have knowledge of the finite element method or multibody modelling in order to understand how model hypotheses and simplifications are transferred.

They must have knowledge of the material laws and methods of characterisation in order to evaluate if the right material laws are applied for modelling, characterisation and choice of materials, in particular for composite constructions.

A4 Protection Classes – Energy Value – Matrix

Calculation formula:

$$E_{kin} = f(x) = \frac{1}{2}mv^2$$

Kinetic energy E_{kin} in [kJ]

Velocity v in $\left[\frac{m}{s}\right]$

Weight m in [kg]

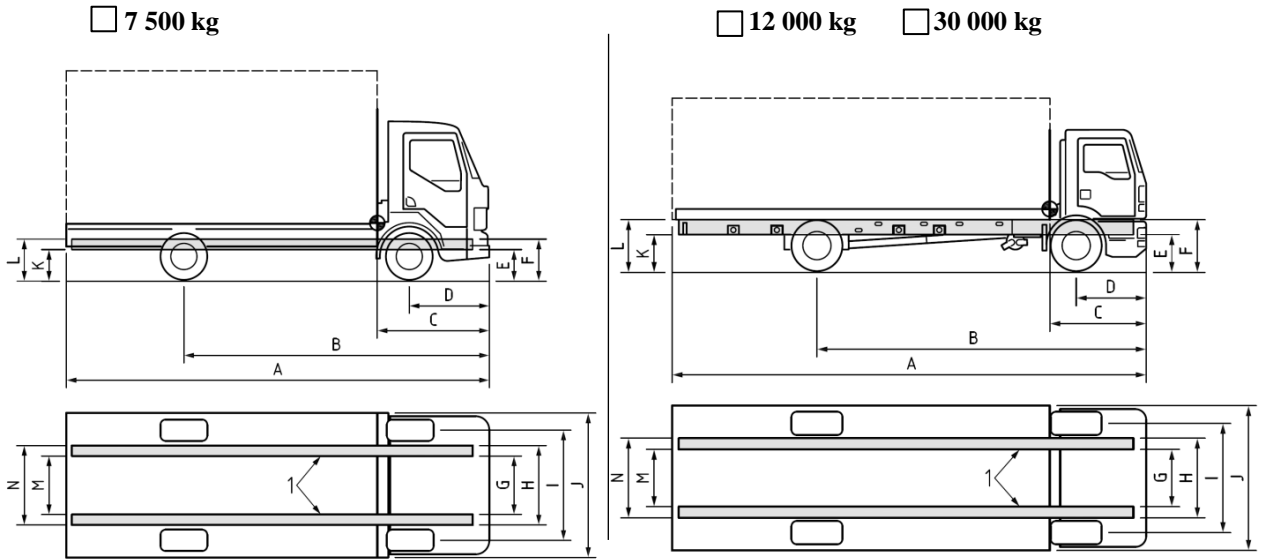
Vehicle weight up to 7500 kg																	
Wight m in [kg]																	
	500	1000	1500	2000	2500	3000	3500	4000	4500	5000	5500	6000	6500	7000	7500		
Velocity v in [km/h]	10	2	4	6	8	10	12	14	15	17	19	21	23	25	27	29	SK1
	20	8	15	23	31	39	46	54	62	69	77	85	93	100	108	116	
	30	17	35	52	69	87	104	122	139	156	174	191	208	226	243	260	
	40	31	62	93	123	154	185	216	247	278	309	340	370	401	432	463	
	50	48	96	145	193	241	289	338	386	434	482	530	579	627	675	723	SK2
	60	69	139	208	278	347	417	486	556	625	694	764	833	903	972	1.042	
	70	95	189	284	378	473	567	662	756	851	945	1.040	1.134	1.229	1.323	1.418	
	80	123	247	370	494	617	741	864	988	1.111	1.235	1.358	1.481	1.605	1.728	1.852	
	90	156	313	469	625	781	938	1.094	1.250	1.406	1.563	1.719	1.875	2.031	2.188	2.344	SK2+
	100	193	386	579	772	965	1.157	1.350	1.543	1.736	1.929	2.122	2.315	2.508	2.701	2.894	
	110	233	467	700	934	1.167	1.400	1.634	1.867	2.101	2.334	2.568	2.801	3.034	3.268	3.501	
	120	278	556	833	1.111	1.389	1.667	1.944	2.222	2.500	2.778	3.056	3.333	3.611	3.889	4.167	
	130	326	652	978	1.304	1.630	1.956	2.282	2.608	2.934	3.260	3.586	3.912	4.238	4.564	4.890	SK2+
	140	378	756	1.134	1.512	1.890	2.269	2.647	3.025	3.403	3.781	4.159	4.537	4.915	5.293	5.671	

Vehicle weight in excess of 7500 kg																	
Wight m in [kg]																	
	8000	9000	10000	11000	12000	13000	14000	15000	16000	17000	18000	20000	30000	40000	50000		
Velocity v in [km/h]	10	31	35	39	42	46	50	54	58	62	66	69	77	116	154	193	SK1
	20	123	139	154	170	185	201	216	231	247	262	278	309	463	617	772	SK2
	30	278	313	347	382	417	451	486	521	556	590	625	694	1.042	1.389	1.736	
	40	494	556	617	679	741	802	864	926	988	1.049	1.111	1.235	1.852	2.469	3.086	SK2+
	50	772	868	965	1.061	1.157	1.254	1.350	1.447	1.543	1.640	1.736	1.929	2.894	3.858	4.823	
	60	1.111	1.250	1.389	1.528	1.667	1.806	1.944	2.083	2.222	2.361	2.500	2.778	4.167	5.556	6.944	
	70	1.512	1.701	1.890	2.079	2.269	2.458	2.647	2.836	3.025	3.214	3.403	3.781	5.671	7.562	9.452	
	80	1.975	2.222	2.469	2.716	2.963	3.210	3.457	3.704	3.951	4.198	4.444	4.938	7.407	9.877	12.346	SK2+
	90	2.500	2.813	3.125	3.438	3.750	4.063	4.375	4.688	5.000	5.313	5.625	6.250	9.375	12.500	15.625	
	100	3.086	3.472	3.858	4.244	4.630	5.015	5.401	5.787	6.173	6.559	6.944	7.716	11.574	15.432	19.290	
	110	3.735	4.201	4.668	5.135	5.602	6.069	6.535	7.002	7.469	7.936	8.403	9.336	14.005	18.673	23.341	
	120	4.444	5.000	5.556	6.111	6.667	7.222	7.778	8.333	8.889	9.444	10.000	11.111	16.667	22.222	27.778	
	130	5.216	5.868	6.520	7.172	7.824	8.476	9.128	9.780	10.432	11.084	11.736	13.040	19.560	26.080	32.600	
	140	6.049	6.806	7.562	8.318	9.074	9.830	10.586	11.343	12.099	12.855	13.611	15.123	22.685	30.247	37.809	

SK1B	SK1U	Recommended field of application up to 750 kJ
SK2B	SK2U	Recommended field of application up to 1900 kJ
SK2+B	SK2+U	Recommended field of application: tested impact energy minus 100 kJ

A-1: Protection Classes – Energy Value – Matrix

A5 Form "Test Vehicle Dimensions"



Twin tyres on rear axle are permissible and must be entered accordingly.

Chassis number: _____

Number of axles: _____

Unladen mass: _____ [kg]

Tyre size: _____

Tread depth of tyres: _____ [mm]

(Outer) wheel base (B-D): _____ [mm]

1	Longitudinal chassis beam	
A	Overall length of vehicle	
B	Outer wheel base	
C	- not required -	
D	Distance vehicle front to front axle	
Rear section:		
K	Height lower edge longitudinal chassis beam	
L	Height upper edge longitudinal chassis beam	
M	Inside distance of longitudinal chassis beam	
N	Outside distance of longitudinal chassis beam	
Front section:		
E	Height lower edge longitudinal chassis beam	
F	Height upper edge longitudinal chassis beam	
G	Inside distance of longitudinal chassis beam	
H	Outside distance of longitudinal chassis beam	
I	Track	
J	Vehicle width	

A-2: Form for entering test vehicle dimensions (based on IWA 14-1 [4])

Appendix B - Lists

B.1 Technical Terms

Active vehicle security barrier: vehicle security barrier that can be operated mechanically or electronically either by personnel or an automatic control to allow for access of vehicles.

Impact speed: Speed of the test vehicle immediately before impact.

Initial contact point: Initial contact of test vehicle and test object during test performance.

Impact angle: Angle in the horizontal plane between the horizontal datum line of the test object and the approach path of the test vehicle to the test object.

Rigid foundation: Rigid foundations include, inter alia, bitumen, blacktop, asphalt, concrete and paved surfaces. Usually, vehicle security barriers are not intended to be installed permanently in rigid foundations.

Horizontal datum line of test object: Horizontal datum line formed from the initial contact point and the parallel displacement of the impact face.

Kinetic energy: The energy that an object possesses due to its motion speed. It depends on the weight of the object and its speed and is stated in Joule [J] or Kilojoule [kJ]. 1000 Joule are equivalent to one Kilojoule.

Load: Weight of the load in [kg] secured on the test vehicle in compliance with Guideline VDI 2700. Ballast may be necessary to reach the required test weight.

Unladen mass of the test vehicle: Mass of the test vehicle in [kg] with the usual manufacturer's equipment, including quantities of operating fluids and fuel as required for short-term operation of the vehicle.

Clear opening width: Unobstructed opening/passage width between two test objects. This is the minimum distance between two test objects or the clear width of a passage within a test object. The smallest distance is measured at a right angle to the horizontal datum line of the test object. In terms of the requirements for a passage, the provisions pursuant to MVStättVO, section 2 – Access for Emergency Services – apply.

Linear mobile vehicle security barrier: Mobile vehicle security barrier whose effect is based on a chain of several uniform elements.

Maximum penetration distance: Performance parameter in [m] to be recorded after test performance for the maximum distance between the initial contact point and the outermost part of a piece of debris weighing more than 100 kg (test vehicle, test object, load or debris).

Maximum dispersion distance: Performance parameter in [m] to be recorded after test performance for the maximum distance between the initial point of contact and the location of the outermost piece of debris weighing more than 2 kg.

Mobile vehicle security barrier: Non-permanent or not permanently installed resource to prevent penetration of a vehicle into a protected area.

Passive vehicle security barrier: Vehicle security barrier that is static after installation and deployment, ensuring effectiveness and not providing any access for vehicles.

Test object: Mobile vehicle security barrier whose effectiveness and performance parameters are to be tested or determined in accordance with the stipulations of this Technical Guideline.

Test centre: Testing institute that has the required accreditations and is authorised to issue a certificate confirming successful test completion in accordance with this Technical Guideline.

Range of dispersion: Visual representation of the dispersion of debris in the area behind the initial contact point after test performance.

Test vehicle: A vehicle that is permissible for the performance of the test method in accordance with the stipulated criteria. This is a type of vehicle commercially available at the time of testing, with EU registration allowing its use on European roads, and complying with Directive (EU) 2007/46/EG. Vehicles with modifications of the chassis, cargo space or frontal structure are not permissible for the test.

Non-rigid foundation: Non-rigid foundations include, inter alia, earth, lawn, crushed rock and gravel. On non-rigid foundations, connections between the mobile vehicle security barrier and the foundation are generally permissible.

Vertical datum line of the test object: Vertical datum line running from the initial point of contact perpendicular to the ground.

B.2 List of Abbreviations

ASTM	American Society for Testing and Materials
CEN	Comité Européen de Normalisation
CEN ISO/TR	Technischer Bericht der CEN oder ISO
CWA	CEN working agreement
DEKRA	Deutscher Kraftfahrzeug-Überwachungs-Verein
DHPol	Deutsche Hochschule der Polizei
DIN	Deutsches Institut für Normung
DIN SPEC	DIN-Spezifikation
EC	European Commission
EG	Europäische Gemeinschaft
EN	Europäische Norm
EU	Europäische Union
FEM	Finite-Elemente-Methode
ISO	Internationale Organisation für Normung
IEC	Internationale elektrotechnische Kommission
IWA	International Workshop Agreement
MVStättVO	Muster-Versammlungsstättenverordnung
ONR	ON-Regel, Regel des österreichischen Normungsinstituts
PAS	Publicly Available Specification
PTI	Polizeitechnisches Institut an der Deutschen Hochschule der Polizei

SK	Schutzklasse
TR	Technische Richtlinie (engl. Technical Guideline)
TÜV	Technischer Überwachungsverein
UA FEK	Unterausschuss Führung, Einsatz und Kriminalitätsbekämpfung
UV-Strahlung	ultraviolette Strahlung
VDI	Verein Deutscher Ingenieure

B.3 List of Measurement Units

°C	Degree Celsius
J	Joule
kJ	Kilojoule
kg	Kilogramme
km/h	Kilometres per hour
m/s	Metres per second
mm	Millimetre
m	Metre

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B.5 List of References

- [1] ONR 2216221:2011; Vehicle security barriers – Performance requirements, test methods and guidance on application. European Committee for Standardization Workshop Agreement.
- [2] PAS 68:2013; Impact test specifications for vehicle security barrier systems. The British Standards Institution 2013
- [3] PAS 170-1:2017; Vehicle security barriers – Low speed impact testing; Part 1: Trolley impact test method for bollards. The British Standards Institution 2017
- [4] IWA 14-1:2013(E); Vehicle security barriers – Part 1: Performance requirement, vehicle impact test method and performance rating. International Workshop Agreement
- [5] F2656/F2656M-18; Standard Test Method for Crash Testing of Vehicle Security Barriers; ASTM International

Note: Only the German version of this TR is legally binding.

This translation of the Technical Guideline "Mobile Vehicle Security Barriers" was funded by the European Union's Internal Security Fund-Police within the framework of the project SafeCi, coordinated by Berlin Police.



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This project was funded by the European Union's Internal Security Fund - Police