Kraftfahrt-
Bundesamt

Technical catalogue of requirements for the fully automated driving function

“Automated Valet Parking (AVP)”

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Preamble

0 Section 1h of the Road Traffic Act (StVG) allows for the subsequent activation of 'silent' functions such as Automated Valet Parking (AVP) for already registered motor vehicles which have a whole vehicle type approval (WVTA) for manual operation by a driver.
Under section 1h of the StVG, therefore a special AVP operating approval is required by the Federal Motor Transport Authority. In accordance with the third sentence of Section 1h(2) StVG, the Federal Motor Transport Authority publishes the technical requirements to be complied with, the fulfilment of which must be demonstrated to the Federal Motor Transport Authority. Approvals for the subsequent activation of fully automated driving functions are issued in accordance with section 2(3) of the regulation on the approval and operation of motor vehicles with a fully automated driving function in defined operating areas under the conditions laid down therein in section 4(5) and (6).
In addition to the technical requirements for the overall AVP system, the list of requirements also includes basic test cases to be met at least for safe operation of the AVP. The AVP function can be implemented through different technological approaches and practices (see point 2.3). The objective of the list of requirements is to ensure that it is applied independently of the technical solution. Future market penetration of AVP will be accompanied by further development progress, new technical solutions and possibly new use cases and AVP application areas. The list of requirements in its current form should therefore not be regarded as exhaustive.

Justification/Note: 'Silent' function, cf. explanatory memorandum to section 1h StVG: Automated or fully automated function/component already installed by the manufacturer, but not initially active.

List of amendments

Version/Date	Variation
1.0/11.10.2022	Initial version

Chapter I: Scope of application

1.1 This set of requirements applies to motor vehicles which are capable of performing the driving task within the meaning of section 1h(2) StVG without driver in relation to parking and manoeuvring systems for use in publicly accessible parking areas defined by the manufacturer, which are separated by construction or other facilities from the rest of the public road area of running traffic and which can only be accessed and exited by vehicles by separate entrances and departures.

1.2 This set of requirements does not apply to driverless parking and manoeuvring cases in parking areas along roads (e.g. parking strips, parking bays or similar) or at the roadside.

Chapter 2: Definitions

2.1 AVP vehicle

A motor vehicle capable of performing an AVP trip. The AVP vehicle may be an overall AVP system or AVP sub-system.

2.2 AVP, AVP function

Automated Valet Parking describes a function for driverless driving and parking of an AVP vehicle within the scope of the AVP. This allows the AVP vehicle to move without driver from a defined safe handover location to a parking area specified by the system. Different functions can be assigned to the secure handover site: There are, for example, sites where:

- the AVP user is able to hand over the AVP vehicle (drop-off zone);
- the AVP user can collect the AVP vehicle (Pick-Up Zone).

The defined secure handover sites shall be located within the scope of the AVP.

2.3 AVP type

The overall AVP system may consist of several AVP subsystems, e.g. distributed over AVP vehicles, AVP infrastructure in the AVP scope and backend computers. The functional components of the overall AVP system may be distributed differently among the AVP subsystems.

Examples:

- Localisation may be done by the AVP sub-systems AVP vehicle or AVP infrastructure.
- The 'trajectory planning' function (identifying the path to be driven by the AVP vehicle) may be performed by the AVP sub-systems AVP vehicle or AVP infrastructure.

Depending on the location of defined functions, the overall AVP system can be divided into different types (not exhaustive):

Function	Type 1	Type 2	Type 3	Type 4
Target allocation	V & I	I	I	V
Route planning	V	I	I	V
Object detection	V & I	I	V & I	V
Localisation	V	I	V	V
Trajectory planning	V	I	V	V
Vehicle control	V	V	V	V

Abbreviations: I – AVP infrastructure; V – AVP vehicle

2.4 Overall AVP system

Means the totality of all AVP subsystems required to implement an AVP trip and shall include at least the AVP vehicle and the AVP infrastructure necessary to operate the AVP function, with the exception of type 4 AVP.

The overall AVP system may be subdivided into several AVP subsystems (see point 3.6).

2.5 AVP sub-system

Means the assembly of all the components which together form a reasonably delineable unit for the implementation of AVP. The AVP subsystems AVP vehicle and AVP infrastructure may be subdivided into other sub-systems of AVP. The relevant AVP subsystems include, in particular, the environment detection sensors, the actuators in the AVP vehicle, the communication links, the power supply and the systems (control units) for route planning and driving decisions.

The sum of all AVP subsystems is the total AVP system.

2.6 AVP operating approval

The AVP operating approval shall approve the overall AVP system consisting of the AVP vehicle, AVP infrastructure (if necessary) and AVP scope. The AVP operating approval shall be granted to the manufacturer upon application. The manufacturer shall be solely responsible to the approval authority for the overall AVP system.

2.7	Minimum object	Means the smallest object to be protected and is derived from a vulnerable road user that the overall AVP system must react as part of the dynamic driving task. For evidence of the test objects used, see section 7.3.3.
2.8	Actuator	A component designed to convert an electrical or mechanical input into a mechanical movement or change of a physical quantity. Actuators execute regulatory or control processes.
2.9	AVP relevant actuator	An actuator required to carry out an AVP trip, e.g. powertrain, brake and steering.
2.10	AVP scope, Operational Design Domain (ODD)	The AVP scope is the area where an AVP vehicle can perform the dynamic driving task without driver. In addition to the geographical area (hereinafter referred to as 'geographical AVP scope'), the scope of the AVP also includes, for example, the environmental and weather conditions relevant to AVP operations, such as visual and light conditions, operating times (time, day/night), road characteristics, maximum running speed, road infrastructure requirements (e.g. road markings, guard rails) and other boundary conditions that must be met for AVP activation.
2.11	Dynamic Driving Task (DDT)	The design and execution of all dynamic longitudinal and transverse activities of the AVP vehicle in the AVP scope.
2.12	Activation of AVP, AVP activation	Describes the process to achieve the activated AVP.
2.13	activated AVP	Describes the state in which it is possible to control AVP-relevant actuators by the AVP function and thus also to transmit or receive necessary instructions (e.g. driving, braking or steering commands).
2.14	Deactivation of AVP, AVP deactivation	Describes the process for reaching the deactivated AVP.
2.15	deactivated AVP	Describes the condition in which AVP-relevant actuators cannot be controlled by the AVP function and therefore no transmission or reception of necessary instructions (e.g. driving, braking or steering commands) is possible.
2.16	AVP infrastructure	Safety-related hardware and software outside the AVP vehicle for the implementation of the dynamic driving task, including secure activation and automatic deactivation. Examples: Localisation markers, environmental sensors, computers, backends, communication links, maps, etc. The components do not need to be located locally in the AVP scope. For example, data generated by the AVP infrastructure can be transferred to the AVP vehicle via a WAN connection (Wide Area Network) and used for the implementation of the dynamic driving task, e.g. to address specific actuators.
2.17	Car park infrastructure, parking area infrastructure	Installations necessary for the operation of the car park or parking area not related to AVP (e.g. payment systems, barriers, etc.). Note: If an installation is involved in carrying out an AVP trip, it is part of the AVP infrastructure (e.g. traffic light systems, etc.).
2.18	Mixed traffic	The geographical scope of the AVP is also available to other traffic participants (park area users of e.g. manually controlled vehicles or VRUs).

2.19	Permanent object	An object permanently included in the geographical scope of the AVP. Examples: Structural installations of the car park, e.g. walls, pillars, limiting stones, guard rails, traffic light masts, extended parking bollards, closed barriers and rolling gates.
2.20	Static object	An object that can move but does not move in the relevant period. This may include, in particular, a vehicle braked or parked at standstill, a VRU, a suitcase or an object hanging into the driving hose (e.g. open luggage space).
2.21	Dynamic object	An object that moves within the geographical area of application of the AVP in longitudinal and transverse traffic (e.g. leading, accommodating, even suddenly appearing). This may in particular be a VRU or another manually or AVP-controlled vehicle, etc.
2.22	AVP trip	The AVP trip includes checking all safety-related conditions in the overall AVP system for an AVP activation, the subsequent driverless execution of the dynamic driving task and the AVP deactivation.
2.23	Driving hose	Corresponds to the surface area to be crossed by the AVP vehicle when the trajectory is traveled and the space to be crossed.
2.24	Road	Corresponds to the areas suitable for driving, parking and manoeuvring in the geographical area of application of the AVP.
2.25	Trajectory, driving path	Space-time progression of a movement, defines the path (track) and speed.
2.26	Time to Collision (TTC)	A fictitious time to a fictitious collision (section of the trajectories) resulting from the current intrinsic velocity as well as the distance to another object and its current intrinsic velocity.
2.27	Minimum risk condition	As defined in section 1d(4) StVG.
2.28	Vulnerable Road User (VRU)	Vulnerable, weaker or non-motorised road users. These may include in particular children, pedestrians, cyclists, etc.
2.29	Safety-related	All aspects of the overall AVP system for which a systematic assessment in accordance with Chapter 7 has identified an impact on: - AVP activation and deactivation; or - collision avoidance; or - the prevention of hazards and damage; or - leaving the AVP field of application by the AVP vehicle.
2.30	Lateral distance	The shortest distance (measured in direct straight connection) between the respective longitudinal side of the AVP vehicle and the relevant object. In order to determine the shortest distance, the contours of the AVP vehicle and the relevant object may be projected onto the road.
2.31	Distance in direction of travel (longitudinal direction)	The shortest distance (measured in direct straight connection) between the front or rear of the AVP vehicle and the relevant object. In order to determine the shortest distance, the contours of the AVP vehicle and the relevant object may be projected onto the road.
2.32	Environmental perception	The recognition of all relevant objects necessary for the safe execution of the dynamic driving task.

2.33	Brake transmission	Means the entirety of the components located between the actuating device and the brake and connecting them in a functional manner. The transmission may be mechanical, hydraulic, pneumatic, electric or mixed. If the braking force is generated or supported by an energy source that is independent of a vehicle driver, the energy storage device of the system shall also be part of the transmission. The transmission is divided into two independent functions: the control transmission and the energy transmission. Whenever the term “transmission” is used alone in this regulation, it means both the “control transmission” and the “energy transmission”:
2.34	E/E error	Failures in the electrical/electronic systems. For example, non-E/E errors are: Faults in mechanical systems.
2.35	Identification	An AVP activation measure that establishes the identity of the AVP vehicle before the AVP activation is completed.
2.36	Identity	The AVP vehicle intended for an AVP driving order and the vehicle at the expected location in the AVP scope are confirmed as compliant by the AVP overall system.
2.37	Localisation	A measure establishing the position and orientation of the AVP vehicle (e.g. necessary to determine where the AVP vehicle is within the scope of the AVP during an AVP trip; e.g. necessary to determine whether the AVP vehicle is within/outside an AVP scope).
2.38	Manufacturer	A natural or legal person who is responsible for all aspects of the type-approval of a vehicle, system, component or separate technical unit or for the individual vehicle approval or the authorisation procedure for parts and equipment, for ensuring conformity of production and for market surveillance matters regarding that vehicle, component, separate technical unit, part and equipment produced, irrespective of whether or not that person is directly involved in all stages of the design and construction of that vehicle, system, component or separate technical unit concerned. The manufacturer shall be solely responsible to the approval authority for the overall AVP system.
2.39	AVP Users	A natural person who uses the AVP function and triggers the AVP trip (e.g. by means of a mobile phone and AVP application software).
2.40	Cyber Security Management System (CSMS)	Includes the continuous processes and tasks to systematically identify, evaluate and mitigate IT security risks along the product life cycle (development, production and operation of the AVP system as a whole) so that, in particular, any risks of IT security do not affect the safety of transport participants and lives of persons.
2.41	AVP vehicle/AVP infrastructure type	For an IT security assessment in accordance with Chapter 12, the AVP vehicle type or AVP infrastructure type shall be types which do not differ in at least the following basic characteristics: - The designation of the relevant AVP vehicle or infrastructure type as defined for the AVP vehicle/infrastructure. - Fundamental aspects of the E/E architecture and external interfaces in relation to IT security.
2.42	ISO	International Organization for Standardization

2.43	IT security, information technology security, cyber security	Describes the condition in which an AVP vehicle, as well as an AVP infrastructure and its functions, are continuously protected against cyber-attacks and cyber hazards with respect to their electrical/electronic components.
2.44	Radio Interface	In the context of Chapter 12, means a wireless connection between components of a data processing system or data transmission system where data or control signals are exchanged. The radio interface includes all components involved in data transmission, in particular antennas, microprocessors, operating system components to control them (driver) and the transmission medium (e.g. air or cable).
2.45	Interface	In the context of Chapter 12, means a connection between components of a data processing or transmission system where data or control signals are exchanged. The interface includes all parts related to data transmission that lie between the communication partners' components and all the parts of the affected components directly involved in the communication.
2.46	Turn-in and crossings	In the AVP context, in addition to classical crossing situations, it also refers to the entry into the parking lot, exit from the parking lot and filter in operations (e.g. at the end of ramps).
2.47	Collision	Refers to the collision between the AVP vehicle and other objects (e.g. walls, objects or other traffic participants, including persons). A person walking or running into a stationary AVP vehicle also constitutes a collision.
2.48	Collision-free	The absence of a collision between the AVP vehicle and other objects.
2.49	Collision avoidance	Describes one or more measures that reduce the risk of a collision.
2.50	Handover location	A defined, secure location within the scope of the AVP where the AVP vehicle can be handed over by the AVP user to the overall AVP system (drop-off zone). The handover site may differ from the takeover site.
2.51	Takeover location	A defined, safe location within the AVP scope where the AVP vehicle can be taken over by the AVP user (see pick-up zone). The takeover site may differ from the handover site.
2.52	Camouflage object	An object which has properties (e.g. shape, size, reflectivity, colour(s), contrast with the background, velocity and direction of motion, etc.), particularly in connection with the environment, which are capable of addressing, in particular, the disadvantages and weaknesses of the sensors used to capture the environment. A camouflage object may be a static or dynamic object.

Chapter 3: General requirements

3.1 An AVP vehicle is an already registered motor vehicle which has a whole vehicle type approval (WVTA) in accordance with the relevant approval requirements for manual operation by a driver.

Justification/Note: See section 1h(1) StVG

3.2 In manual driving mode, a driver performs the dynamic driving task. The AVP vehicle shall be equipped with a driver's seat and devices to enable a driver to perform the dynamic driving task.

3.3 The AVP vehicle shall not exceed a maximum speed of 10 km/h (+ 2 km/h tolerance) during an AVP trip.

Justification/Note: See §2.3.4.1.1 UN-R79 (ACSF Category A)

3.4 In the geographical AVP scope, there shall be a sufficient number of clearly visible and accessible points to enable all AVP vehicles in the geographical AVP scope and forming part of the overall AVP system to be immediately brought to the minimum risk condition by means of AVP deactivation. This possibility must be clearly identified and protected against abuse and inadvertent operation.

Justification/Note: It must be possible, for example, for emergency workers to deactivate the overall AVP system and to put the AVP vehicles in the AVP scope directly into the minimum risk condition.
According to the BMVI's explanatory note No 180 in Transport Gazette 24/2018 promoting UN Resolution of the United Nations Economic Commission for Europe (UNECE) on Road Safety (WP.1) of 20 September 2018 (on the Vienna Convention on Road Traffic, 1968), there must be an override – at least in the form of deactivation – by a person inside or exclusively outside the vehicle which has the effect of immediately stopping driverless operation.

3.5 The effectiveness of the overall AVP system shall not be impaired by magnetic or electric fields. This shall be demonstrated for the AVP vehicle using the requirements of UN Regulation No 10, 05 series of amendments or later. This shall be demonstrated for the AVP infrastructure in accordance with Directive 2014/30/EU.

3.6 When the overall AVP system is divided into different AVP subsystems for the implementation of the dynamic driving task, the manufacturer shall ensure and demonstrate that:
- Interfaces between these subsystems are defined; and
- requirements (both functional and organisational) for the AVP subsystems are defined; and
- the sum of the AVP subsystems fulfill the requirements for the overall AVP system; and
- requirements for AVP subsystems have been implemented; and
- persons involved in the handling of the AVP subsystems are adequately trained (see point 13.5.3). A corresponding training concept must be submitted when the application is submitted.

Justification/Note:
Example 1. Requirements for the AVP infrastructure shall be laid down by the AVP vehicle (e.g. appropriate driving commands shall be sent securely to the AVP vehicle) and, conversely, requirements on the AVP vehicle for the safe implementation of the issued driving commands shall be set by the AVP infrastructure (control of actuators e.g. for driving, braking, steering). This concerns both safety and IT security (see Chapter 12).

Example 2: The environment perception sensors necessary to carry out an AVP trip may be installed exclusively in the AVP vehicle (e.g. type 1 AVP), exclusively in the geographical AVP *scope (e.g. type 2 AVP) or split between the AVP vehicle and the* geographical AVP *scope (e.g. AVP type 3). In case of splitting between different AVP subsystems, interfaces and responsibilities shall be defined accordingly. This concerns both safety and IT security (see Chapter 12).*

3.7 The operation of AVP vehicles and compliance with the StVO must be clearly and easily identified at all relevant entrances to the AVP scope.

Justification/Note: The resulting tasks are assigned and documented in the Operations Manual to the responsible roles (see point 13.5.1).

3.8 The assessments in accordance with this catalogue of requirements may be carried out by the Technical Service only by assessors/experts with the requisite technical knowledge. The Assessors/Experts of the Technical Service need in particular knowledge of ISO 26262, IEC 61508 and ISO/PAS 21448 and shall be able to identify and assess the relevant links taking into account IT security aspects e.g. in accordance with UN Regulation No 155, ISO/SAE 21434, ISO 27000. This knowledge must be demonstrated, for example, by appropriate professional qualifications or evidence of training provided to the Federal Motor Transport Authority.

3.9 If the requirements laid down in this catalogue of requirements are deviated from, this must be duly justified to the Federal Motor Transport Authority and the Technical Service (e.g. requirements not relevant for the specific application or met by equivalent measure) and documented. These deviations must be approved by the Federal Motor Transport Authority.

3.10 The manufacturer shall be the applicant and holder of the AVP operating approval.

3.11 The manufacturer is responsible for the continuous fulfilment of all the contents of the AVP requirements catalogue and the AVP operating approval and is the sole interface with the Federal Motor Transport Authority.

3.12 The scope of the AVP must be defined. In particular, the conditions and characteristics of the AVP scope necessary for the AVP vehicle to travel must be described and defined for approval (see point 11.1.2).

3.13 Changes to the overall AVP system (including AVP subsystems) after approval shall be assessed. The relevant provisions are set out in point 11.1.2.

Chapter 4: AVP activation and deactivation

4.1 Generally

4.1.1 For a deactivated AVP, there shall be no retroactivity to all systems and components relevant to manual driving.

4.2 AVP activation

4.2.1 The overall AVP system shall be designed to ensure that an activated AVP can only operate within the approved and released AVP scope.

Justification/Note: In road transport outside the geographical scope of the AVP, this ensures that the AVP vehicle is operated without retroactive effect.

4.2.2 The overall AVP system shall be designed to ensure, at least in the form of confirmation by the AVP user prior to AVP activation, that during normal operation AVP activation can only take place when no person is present in the vehicle.

Justification/Note: *For demonstration purposes, the manufacturer may derogate from this requirement in selected AVP vehicles. The manufacturer shall explain to the Federal Motor Transport Authority how it is ensured that the AVP function for demonstration purposes cannot be activated in normal operation.*

4.2.3 The AVP vehicle shall monitor independently and continuously the presence of the necessary vehicle conditions for the purpose of AVP activation (at least the standstill secured against roll away) during activation until the AVP is activated.

4.2.4 Before an AVP activation, the relevant AVP vehicle shall be clearly identified within the AVP scope.

4.3 AVP deactivation

4.3.1 When the AVP function has been activated in an AVP vehicle, the overall AVP system shall be designed to ensure that an AVP deactivation takes place as soon as the AVP vehicle leaves the AVP scope.
An apparent exit from the AVP scope (e.g. because of a temporary inaccuracy in the localization of the vehicle) with the immediate subsequent continuation of the AVP trip results in an automatic braking of the AVP vehicle in the standstill secured against roll away, but in the light of the definition of section 1d(4) of the StVG is not to be assessed as a minimum risk condition. The relevant system design shall be demonstrated by the manufacturer to the Federal Motor Transport Authority and to the Technical Service.

Justification/Note: In road transport and outside the geographical AVP *scope, this ensures that the AVP vehicle is operated without retroactive effect.*

4.3.2 The AVP vehicle shall independently establish the vehicle conditions necessary for the purpose of AVP deactivation (at least the standstill secured against a roll away) and shall continuously monitor these until the AVP is deactivated.

4.3.3 After completed parking procedure, an AVP deactivation shall be carried out.

Chapter 5: Dynamic Driving Task

5.1 Generally

5.1.1 The overall AVP system shall be designed to ensure that the AVP vehicle meets the requirements for the dynamic driving task.

5.1.2 The requirements for the dynamic driving task apply to all relevant environmental and weather conditions in the AVP scope, such as visual and light conditions (e.g. lighting, sun, smoke, etc.) and the structural characteristics of the roadways (e.g. slopes such as ramps, friction/change of friction, etc.) and structural facilities that change their condition (e.g. movable parking bollards (retracted/extended), barriers and rolling gates (open/closed). If, for example, the performance of sensors to comprehend the environment thereby is affected, the AVP system as a whole must respond appropriately.

5.1.3 The identity of the AVP vehicle, confirmed in accordance with point 4.2.4, shall be continuously determined throughout the AVP trip.

Justification/Note: See points 2.35, 2.36 and 5.6.1 as a consequence of an unconfirmed identity of the AVP vehicle.

5.1.4 The AVP vehicle shall autonomously activate the standstill secured against roll away when standing during an AVP trip (e.g. as a result of an identified static object in the driving hose) or during the planned termination of an AVP trip (e.g. after reaching the reserved parking area or the pick-up zone).

5.2 Trajectory planning, speeds

5.2.1 The dynamic driving task is safely implemented in all driving situations within the AVP scope (including narrow curve radii, ramps, narrow points) by suitable selection of the trajectory (driving path).

5.2.2 The localization of the AVP vehicle shall be carried out continuously during the AVP trip.

5.3 Freedom of collision and collision avoidance

5.3.1 Generally

5.3.1.1 The overall AVP system shall be designed to ensure that the AVP vehicle detects and responds safely to all objects and persons relevant to the AVP scope (permanent, static and dynamic) so as to ensure fundamental freedom of collision with those objects and persons.
In the case of unavoidable alternative harm to different legal interests, the importance of the legal interests must be taken into account, with the protection of human life being the highest priority. No further weighting based on personal characteristics shall be provided in the event of an unavoidable alternative risk to human life.

5.3.1.2 The minimum distances necessary to comply with the fundamental freedom of collision (e.g. side, direction of travel and rearward direction) to all relevant objects and persons (permanent, static and dynamic) in the AVP scope and depending on the speed of the AVP vehicle shall be derived by the manufacturer for all driving situations relevant to the AVP scope and the derivation shall be presented to the Federal Motor Transport Authority. Within the overall AVP system, the stop-specific parameters shall be taken into account. This includes, in particular, the response time from object detection to the start of braking (or steering) and the braking distance of the AVP vehicle.

5.3.1.3 In order to avoid collisions, the AVP vehicle shall initiate an appropriate manoeuvre, but at least a brake manoeuvre.

Justification/Note: Braking because of o*bjects located further away from the AVP vehicle may be performed with a lower deceleration than because of objects that appear suddenly and unexpectedly immediately in front of the AVP vehicle.*

5.3.1.4 The overall AVP system shall be designed in such a way as to ensure that the response time and deceleration is at least equal to the performance of a person in charge of the vehicle to avoid collision.

Justification/Note: As regards the performance of a driver, see Regulation on the approval and operation of motor vehicles with an autonomous driving function in defined operating areas – Annex I – Part 2 – point 10 (published on 30 June 2022 in Federal Law Gazette No 22).

5.3.1.5 The aim of braking shall be to avoid collision or at least to mitigate the consequences by reducing speed. The residual risk of non-avoidable collisions shall be demonstrated to the Federal Motor Transport Authority and to the Technical Service on the basis of specific scenarios.

5.3.2 Object properties

5.3.2.1 The relevant objects (permanent, static and dynamic), the minimum object, camouflage objects and driving situations must be systematically derived and demonstrated as part of the development process (see Chapter 7) for the AVP scope, e.g. by theoretical consideration/analysis (e.g. morphological box, hazard and risk analysis, observations of real car park operations, etc.).

5.4 Interaction with other traffic participants

5.4.1 The safety of all traffic participants is given the highest priority when performing the dynamic driving task. In the event of unexpected events, even if they occur suddenly, the AVP vehicle shall respond appropriately.

5.4.2 Static and dynamic objects in the direction of travel in the driving hose shall be detected. The minimum distance specified in 5.3.1.2 shall be observed at all times in each speed range and in every possible driving situation.

5.4.3 The AVP vehicle may be started or restarted from the standstill secured against roll away only if the distances to the objects derived in accordance with 5.3.1.2 are respected.

5.4.4 In the event that an object adjacent to the AVP vehicle approaches the longitudinal side of the vehicle and falls short of the minimum lateral distances specified in point 5.3.1.2, the collision avoidance requirements set out in point 5.3.1.3 shall apply.

Justification/Note: Side objects could converge further with an AVP vehicle in passing (lateral vehicle flank).

5.4.5 Other traffic participants shall not be obstructed or put at risk. This applies in particular to turning-in and crossing.

5.4.5.1 The AVP vehicle shall only enter an intersection if, at the time of entry, it is foreseeable that it will also be able to leave the intersection completely.

5.4.5.2 The implementation of the dynamic driving task and the manageability for other traffic participants in the respective crossing and turning situations in the geographical AVP scope shall be demonstrated to the Federal Motor Transport Authority and to the Technical Service on the basis of specific scenarios.

5.5 Compliance with traffic rules

5.5.1 All traffic requirements for driving in the geographical AVP scope must be complied with.

Justification/Note: See section 1e(2)(2) StVG.

5.6 Minimum risk condition

5.6.1 The overall AVP system shall be capable of detecting system boundaries and failures of systems or functions relevant to the dynamic driving task at any time. If the overall AVP system detects that the corresponding system boundaries have been reached or failures have occurred, there is an independent and immediate transfer to the minimum risk condition. This applies in particular to:

- on-board faults (e.g. E/E faults such as on-board power supply failure and faults in a control unit, non-E/E faults such as tyre pressure loss), or
- transmission-side faults (e.g. a for the AVP operation critical disconnection of radio links); or
- infrastructure-side failures (e.g. E/E errors such as power failures and component failures, errors in vehicle identification or localization); or
- the case that the maximum speed defined according to the system design/safety concept is exceeded during an AVP trip; or
- errors in the data storage (see Chapter 9); or
- leaving the planned trajectory.

A temporary termination of radio connections or a temporary obstruction of a sensor with the immediate subsequent continuation of the AVP trip results in the AVP vehicle being automatically braked in the standstill secured against roll away, but in the light of the definition of section 1d(4) StVG is not to be assessed as a minimum risk condition. The relevant system design shall be demonstrated by the manufacturer to the Federal Motor Transport Authority and to the Technical Service.

5.6.2 Immediate transfer to the minimum risk condition also takes place in the case of:

- a recognised operation of driving and control elements (min. opening of vehicle doors or flaps, operation of the steering wheel, throttle pedal or brake pedal); or
- actuating the option in accordance with point 3.4; or
- an AVP deactivation as a result of a fault or malfunction.

Justification/Note: It shall be possible to open the doors from the inside at any time.

5.6.3 Leaving the minimum risk condition

5.6.3.1 Exit from the minimum risk condition for the continuation of the AVP trip by the AVP system may only take place if it has been demonstrated and documented and if it is ensured that there are no faults in the systems or functions relevant for the safe execution of the dynamic driving task (see Chapter 8) and that there is no immediate risk to other traffic participants. The corresponding execution specifications shall be specified in the operations manual referred to in point 13.5.8.

5.6.3.2 The AVP vehicle may leave the minimum risk condition by being manually controlled by a person in charge of the vehicle. The AVP function shall be deactivated by actuating the manual control devices in the respective AVP vehicle.

Justification/Note: The driver shall have the possibility of manually driving an AVP vehicle braked at standstill.

5.6.3.3 Alternatively, the AVP vehicle may, at the request of the technical personnel, leave the minimum risk condition.

Justification/Note: So that it can be driven away or removed by technical staff (see Chapter 13).
An AVP vehicle immediately transferred to the minimum risk condition may also be manually driven away by the technical staff if, for example, they have access to the AVP vehicle (e.g. client keys or access to the AVP vehicle is provided by means of a digital key). This concerns in particular those (permanent) faults/disturbances where it is not possible to continue the AVP trip and the AVP vehicle must be removed.

5.6.3.4 In the event that leaving the minimum risk condition is initiated by remote control, this shall be possible only by means of a remote control located near the AVP vehicle. In this case, the maximum distance between the driver and the AVP vehicle shall not exceed 6 metres measured in a direct straight connection. The remote-controlled AVP vehicle shall only move at step speed.

Chapter 6: Environment capture sensor

The requirements of the chapter ‘sensors’, including ageing, are taken into account in the Regulation implementing the Act amending the Road Traffic Act of 1 July 2022 and can be found in Chapters 5, 7 and 8 of this catalogue of requirements.

Chapter 7: Functional and operational safety in the error free case

7.1 Generally

7.1.1 For the safety of the overall AVP system, the requirements set out in this Chapter shall be implemented by the AVP vehicle and AVP infrastructure subsystems.

7.1.2 Non-E/E errors of the overall AVP system shall be analysed and systematically secured through the relevant standards and regulations.

7.2 Functional safety

7.2.1 For the functional safety of the overall AVP system in the event of an E/E error, the following or equivalent standards shall be applied:
- AVP vehicle according to ISO 26262
- AVP infrastructure according to IEC 61508

7.2.2 In particular, the following requirements shall be implemented:

7.2.2.1 Establishment of a safety plan

7.2.2.2 Systematic deducing and assessment of potential hazards that may affect the safe conduct of the AVP trip by means of a hazard and risk analysis. For potential hazards, the analysis of incidents and faults regarding the AVP vehicle (e.g. failure in the on-board power supply), regarding the transmission-side (e.g. a for the AVP operation critical termination of radio links) and those regarding the AVP infrastructure (e.g. power failure) must be included.

7.2.2.3 Derivation of safety objectives based on the hazard and risk analysis

7.2.2.4 Definition and alignment of safety objectives between AVP system and AVP sub-systems

7.2.2.5 Establishment of a safety concept based on the previously defined and aligned safety objectives

7.2.2.5.1 The safety policy shall include at least the following information:

7.2.2.5.2 The safety concept describes how the overall AVP system reacts in the event of a fault in possible operational situations and the impact of these reactions on the safety of the AVP trip. This shall in any case include the safety of other traffic participants.

7.2.2.5.3 The safety concept shall demonstrate at system level the detection and minimisation or circumvention of the potential hazards identified in the hazard analysis in accordance with the state of the art by appropriate measures. Possible security measures include in particular:
- Technical measures, e.g.:
  - Functional degradation
  - Activation of fallback levels
  - Direct transfer to the minimum risk condition
  - AVP deactivation
- Organisational measures, e.g.:
  - Narrowing of the geographical AVP scope
  - Adaptation of the road or signage

7.2.2.6 Carrying out error analyses, including determination of probabilities, error severity and error detection. Appropriate analytical methods shall be used (e.g. Failure Mode and Effect Analysis (FMEA) or Fault Tree Analysis (FTA)).

7.2.2.7 Validation and verification: Full implementation of security measures and testing as well as documentation by means of appropriate implementation/integration tests.

7.2.2.8 Preparation and completion of the documented safety case

7.2.2.9 In the event of a failure or an incident, the overall AVP system shall be capable of achieving the minimum risk condition independently (see point 5.6.1).

7.2.2.10 With reference to point 7.2.2.9, at least the following boundary conditions shall be taken into account:

7.2.2.10.1 The failure rate of the overall AVP system shall be systematically derived using the methodology described in IEC 61508 and allocated to the AVP subsystems concerned.

7.2.2.10.2 In the event of a failure of any part of the braking transmission of the AVP vehicle, under consideration of the failure rate determined in point 7.2.2.10.1 it shall be ensured that the minimum risk condition is achieved directly by the AVP vehicle at any point in the geographical AVP scope (including ramps).

7.3 Operational safety in the error free case

7.3.1 Permanent or case-by-case system boundaries in the error free case shall be systematically derived and assessed.
This includes, in particular, external disturbances such as weather and environmental conditions, as well as the characteristics of the roadways, which may lead to safety-related restrictions on the overall AVP system (e.g. impairment of the performance of sensors for the environmental perception).
Appropriate analytical methods shall be used (e.g. ISO/PAS 21448).

7.3.2 On the basis of identified risks, system behaviour or system improvements must be defined and implemented for the relevant scenarios and events referred to in point 7.3.1, which make it possible to avoid hazards or minimise their risk.

7.3.3 The test objects used to verify section 7.3.2 (e.g. their surface characteristics such as reflectiveness, colours, etc.) are suitable for capturing and checking, in particular, the disadvantages and weaknesses of the sensors used for the environmental perception.

Chapter 8: Permanent system monitoring including ageing/degradation

8.1 All AVP subsystems relevant for the safe execution of an AVP trip shall be continuously monitored for their functionality before leaving the secured standstill and during an AVP trip. It does not include the topics that are otherwise addressed in the operations manual (see e.g. point 13.5.5).

Justification/Note: The system monitoring described in Chapter 8, including ageing/degradation, relates to active components (control units/sensors and actuators).

8.2 This includes, in particular, a hardware functional test of the braking system (e.g. brake pressure set-up test) necessary to achieve the minimum risk condition.

8.3 System monitoring shall be carried out in such a way that relevant impairments are detected in a timely manner to ensure the safe execution of the dynamic driving task in the AVP scope at all times (e.g. by degrading the AVP function or by immediately transferring the AVP vehicle to the minimum risk condition, cf. point 7.2.2.5.3).

8.4 The overall AVP system shall meet the functional requirements also taking into account the ageing and wear of the relevant components of the system.

Justification/Note: The demonstration of general wear components (e.g. tyres, brake linings) may be implemented with reference to the responsibility of the vehicle owner or holder for the safe condition of the AVP vehicle and to periodic roadworthiness tests (HU).

8.5 If ageing phenomena affect the performance of sensors for the environmental perception, measures are implemented by the overall AVP system to compensate for the risks arising from the reduced performance of sensors.

Chapter 9: Data storage

9.1 For the operation of the AVP function, a data storage shall be operational that stores the occurrence of defined events (see point 9.2) and the related information during an AVP trip.

Justification/Note: AVP operations are permitted only with operational data storage (see point 5.6.1).

9.2 The events and the related information can be found in Chapter 15 of this catalogue of requirements.

Chapter 10: Testing and validation

10.1 Verification of compliance with the technical requirements associated with this set of requirements may be carried out on the basis of simulations, driving manoeuvres on the test site and driving tests in the real AVP scope. However, it must not be based solely on computer simulations.

10.2 The test cases relevant to the verification shall be systematically derived by the manufacturer during the development process and placed in a test catalogue. The test catalogue shall provide sufficient test coverage for all scenarios, test parameters and environmental influences and shall be capable of demonstrating sufficient robustness of the environmental perception technical equipment against interference with input/sensor data and adverse environmental conditions.

In addition, the basic test cases contained in Annex 1 to this list of requirements must be taken into account in all cases.

Justification/Note: Established methods for test case derivation can be found, for example, in ISO 26262-4:2018 chapters 7.4 and 8.4.

10.3 The manufacturer's derivation of the passing criteria must be systematically derived from combinations of parameters relevant to the AVP scope, at least in the form of a worst-case assessment (examples: Environmental and weather conditions in the geographical AVP scope, such as visual and light conditions (e.g. brightness, lighting, sun, smoke, etc.) and characteristics of the road (e.g. slopes such as ramps, friction values, curvature radii, speed range, etc.).

10.4 For example, environmental conditions that may occur in the AVP scope of the overall AVP system but which are not representable in physical tests, it shall be demonstrated by other means (e.g. simulations) that the overall AVP system masters them safely.

Justification/Note: For test cases which can in principle be represented in physical tests but are planned by the manufacturer as simulation, the Federal Motor Transport Authority may insist on carrying out physical tests.

10.5 The Federal Motor Transport Authority selects test cases from the test catalogue that will be used to verify compliance with the technical requirements associated with this catalogue of requirements.

The Federal Motor Transport Authority may at any time extend the test cases selected from the manufacturer's test catalogue to include further test cases.

10.6 Compliance with the passing criteria of the selected test cases shall be demonstrated by the manufacturer to the Technical Service. The Federal Motor Transport Authority may at any time accompany and assess the tests.

10.7 For testing the requirements for failure of AVP functions, self-testing of the overall AVP system and initiation and implementation of a manoeuvre to achieve a minimum risk condition, errors may be artificially induced or the overall AVP system or AVP sub-system in AVP operation be artificially placed in situations and exposed to environmental conditions reaching the system boundaries of the AVP function.

10.8 Physical tests

10.8.1 The tests must be carried out in such a way as not to endanger the personnel involved.

10.8.2 The selected test site shall have characteristics (example: Friction value) corresponding to the AVP scope of the overall AVP system intended for approval.

10.8.3 The AVP scope applied for can be used as a test site itself, provided that the necessary tests can be carried out safely for other traffic participants.

10.8.4 In addition to real vehicles, state-of-the-art test tools may be used to carry out the tests to replace real-world vehicles and other road users (examples: Soft targets, pedestrian dummies, mobile platforms). The test tools used shall correspond to the characteristics relevant for sensory performance assessment, real vehicles and other traffic participants.

10.9 Simulations

10.9.1 Compliance with technical requirements may also be verified by appropriate simulations. If simulations or simulation tools are used as part of the verification, the following requirements shall apply.

10.9.2 The simulation tools shall be validated. The validation of simulation tools shall be carried out by comparison with a representative sample of real-world tests. There shall be no significant difference between the parameters from a simulation and a driving test.

10.9.3 The performance of sensors in terms of detection and classification of objects depending on different distances and environmental conditions, as well as object movement conditions, shall be determined for simulation in real-life tests.

10.9.4 Each series of simulations shall, if deemed necessary by the Federal Motor Transport Authority or Technical Service, be supplemented by real-world tests for validation purposes.

10.9.5 In the simulation, the overall AVP system can also be broken down into meaningful AVP sub-systems in order to reduce complexity and target testing (e.g. perception and trajectorial planning could be tested separately).

Chapter 11: (Development) processes

11.1 Generally

11.1.1 With regard to both the software and hardware used in the overall AVP system, effective processes, methods and tools must be in place and applied to meet product safety concerns and regulatory compliance throughout the product life cycle (development and operational phases, including compliance with traffic rules and decommissioning).

11.1.2 In principle, amendments to the overall AVP system and extensions to additional AVP scopes require approval by the Federal Motor Transport Authority. Therefore, the manufacturer must submit to the Federal Motor Transport Authority a process to define the scopes of amendments that are relevant to the approval, including assessment, with the involvement of the Technical Service.

Justification/Note: Any change in the form of software updates shall be assessed on the basis of the manufacturer's process and in line with UN R156.

11.2 AVP subsystems

11.2.1 The development processes including safety management system, requirements management, implementation, testing, error tracking and correction and clearance are defined and applied.

Justification/Note: With regard to AVP vehicle: e.g. development and release of the AVP vehicle, AVP application software and backend. With regard to AVP infrastructure: Development and release of the AVP infrastructure.

11.2.2 Effective communication channels between the bodies responsible for functional and operational security, IT security and, where appropriate, other safety-related disciplines are in place and implemented.

11.2.3 Regular and independent process audits shall be carried out to ensure that the processes established in accordance with points 11.2.1 to 11.2.2 inclusive are in place and applied. The process audits may be carried out by independent internal or external auditors.

11.3 Overall AVP system

11.3.1 A release process is defined that takes into account all AVP subsystems relevant to an AVP operation and is to be continuously applied during the development and operation phases.

11.3.2 Effective processes are established to detect and resolve safety-related incidents (e.g. collisions with other traffic participants) during the operational phase.
This includes a process to address safety-related gaps in the overall AVP system identified after the granting of the operating approval.

Justification/Note: With regard to AVP infrastructure: e.g. further development and provision of necessary updates of AVP infrastructure in the operational phase. Addressing security vulnerabilities: With regard to AVP vehicle: e.g. further development and provision of necessary updates for vehicle sizes in the operational phase. Similarly, for IT security, Chapter 12 (points 12.2.1.5 to 12.2.1.7) requires such processes (e.g. incident and response management).

11.3.3 For changes to the overall AVP system or to an AVP sub-system requiring approval determined in accordance with point 11.1.2, all necessary documentation for assessment shall be submitted to the Federal Motor Transport Authority and to the Technical Service prior to introduction.

Chapter 12: Information technology security, including data transmission and radio communication

12.1 Generally

12.1.1 The IT security requirements set out in this chapter are fully coordinated and continuously ensured, considering the interfaces between the AVP subsystems AVP vehicle and the AVP infrastructure.

12.1.2 Throughout the development and operation period of the AVP vehicle and AVP infrastructure, it shall be ensured that the threat scenarios (e.g. simulation of an AVP infrastructure, manipulation of communication links between AVP vehicle and AVP infrastructure, manipulation of control units in the AVP vehicle) of the components and radio interfaces between AVP vehicle and AVP infrastructure relevant for carrying out an AVP trip are systematically derived and addressed with effective measures.
This also implies protection against attacks linked to software updates.

The following protection objectives in terms of their relevance within the overall AVP system shall be systematically assessed and addressed by appropriate measures:
- Confidentiality
- Integrity
- Authenticity
- Availability
- Accountability
- Detectability

Justification/Note: An appropriate assessment is carried out for the protection objectives, which makes it possible to identify the relevance in the context of AVP and thus also to derive the necessary measures in a targeted manner.

12.1.3 The overall AVP system shall be subject to the technical and organisational requirements for the manufacturer set out in this Chapter 12 and set out in UN-R 155 'UN Regulation on uniform provisions concerning the approval of vehicles with regard to cyber security and cybersecurity management systems'. The requirements of UN-R 155 in points 1, 3, 4, 5.3.1 to 5.3.7 do not apply to the AVP infrastructure. The other requirements, including those which include the vehicle type or vehicles in the language of UN-R 155, shall be applied to the AVP infrastructure. Existing UN-R 155 approvals may be used as evidence for the AVP vehicle.

Justification/Note: If necessary, the applicability of these requirements to AVP infrastructure shall be checked in consultation with the Federal Motor Transport Authority and the Technical Service and, if necessary, any adaptations or equivalent alternatives shall be derived.

12.2 Assessment of the Cyber Security Management System

12.2.1 In order to meet the information technology security requirements, for the AVP overall system and the AVP sub-systems AVP vehicle and AVP infrastructure, it shall be ensured that the procedures applied under the CSMS are adequate. The CSMS shall include at least the following processes and procedures used to

12.2.1.1 ensure security in information technology;

12.2.1.2 continuously identify threats to vehicle and infrastructure types during the development phase;

12.2.1.3 adequately address identified threats in terms of time and content (including their assessment and categorisation);

12.2.1.4 validate and verify the IT security of an AVP vehicle or AVP infrastructure type;

12.2.1.5 continuously assess and identify threats and vulnerabilities during the operational phase;

Justification/Note: Incident and Response Management during the operational phase

12.2.1.6 be able to respond to identified cyber-attacks and cyber threats during the operational phase by implementing measures;

Justification/Note: Incident and Response Management during the operational phase

12.2.1.7 assess the effectiveness of the implemented cyber-attacks and cyber-hazard response measures during the operational phase.

Justification/Note: Incident and Response Management during the operational phase

12.3 Assessment of IT security of AVP vehicle and AVP infrastructure types

12.3.1 In order to protect the AVP vehicle type or the AVP infrastructure type, the following requirements shall be implemented in particular:

12.3.1.1 Collect and verify the information required for assessment from relevant supply chain levels.

12.3.1.2 Carry out risk assessments for the AVP vehicle or AVP infrastructure type and its interfaces and systems, in particular for:
- AVP infrastructure components (including e.g. servers, sensors, wiring) and backends
- Components of the AVP vehicle (including, for example, the control units involved) and, where applicable, Backends
- Control units such as the mobile phone, its operating system software and the AVP application software
- Interfaces: Between all components involved, in particular safety critical radio interface(s) between control unit, AVP vehicle and AVP infrastructure

12.3.1.3 Identify and address potential risks as well as those identified in the threat analysis according to the state of the art by appropriate measures. Possible measures to protect the AVP vehicle and the AVP infrastructure and its interfaces and systems are:
Technical measures, e.g.:
- Signed software
- Safe booting
- Use of hardware security modules (HSM)
- End-to-end encryption
- Mutual authentication
- Signed communication
- Functional degradation/deactivation
- Direct transfer to the minimum risk condition

Organisational measures in accordance with CSMS, e.g.
- Incident and Response Management
- Limitation of the basic availability of the AVP function to the customer

12.3.1.4 Radio interfaces shall be designed in such a way as to minimise the risk of unauthorized access to the connections in accordance with the state of the art. The establishment of the connection and the transmission of data shall be protected with the use of open and established standards, at least with regard to the protection objectives of integrity and authenticity. If, following the threat analysis and risk assessment referred to in points 12.3.2.2 and 12.3.2.3, the confidentiality objective is relevant (e.g. due to data protection requirements), the data transfer shall be encrypted in addition. At least the RFC 8446 Standard (TLS 1.3) as published by the IETF in August 2018, an evolution of the same or a standard providing equivalent safety shall be used.

Justification/Note: For the selection of cryptographic procedures, Technical Guidelines TR-02102-1 of the Federal Office for Information Security and, for the use of TLS, the Technical Guidelines of the Federal Office for Security in Information Technology, to be obtained via the Federal Office for Information Security, PO Box 200363, 53133 Bonn; they are stored there and are also available from subsequent internet sources at the time of publication of this catalogue of requirements. The use of different procedures shall be justified to the Federal Motor Transport Authority and to the Technical Service.

TR-02102-1:
https://www.bsi.bund.de/SharedDocs/Downloads/DE/BSI/Publikationen/TechnischeRichtlinien/TR02102/BSI-TR-02102.pdf

TR-02102-2:
https://www.bsi.bund.de/SharedDocs/Downloads/DE/BSI/Publikationen/TechnischeRichtlinien/TR02102/BSI-TR-02102-2.pdf

12.3.1.5 Where a mobile phone or AVP application software installed on the mobile phone is allocated safety-critical scopes of the AVP function, appropriate measures shall be implemented in accordance with the state of the art, e.g.:

- Provision of the AVP application software exclusively via the operating system provider's official sources (app stores)
- Testing and updating of the operating system software installed on the mobile phone and the AVP application software before AVP activation
- Testing and restriction of the screen overlay function of AVP application software and other application software on the mobile phone before AVP activation

The dynamic driving task shall not be performed via the AVP application software.

12.3.1.6 A system-recognised unauthorised access to components and radio interfaces relevant to the conduct of an AVP trip between the AVP vehicle and the AVP infrastructure triggers the immediate transfer of the AVP vehicle to the minimum risk condition.

12.3.1.7 The AVP infrastructure and the AVP vehicle shall provide the technical possibility to implement appropriate safety measures during the operational phase, such as uploading software updates.

12.3.1.8 Validation and verification: The full implementation of security measures and testing (including by means of simulated attacks by independent or external service providers) and documentation through appropriate implementation/integration tests.

Chapter 13: Operations manual

13.1 An operational concept according to IEC 61508 or comparable standards is available for the operation of the overall AVP system.

13.2 An operating manual derived from the concept of operations is available. Requirements for an AVP operation going beyond the system-side performance of the dynamic driving task shall be systematically derived and documented in the operations manual.

Justification/Note: The operations manual shall document the tasks systematically derived and assigned to the stakeholders for the safe AVP operation.

13.3 The complete operations manual shall be submitted to and checked by the Federal Motor Transport Authority and the Technical Service at the time of application.

13.4 The full operations manual shall be made available to those involved in the implementation and organisation of safe AVP operations.

Justification/Note: This explicitly does not refer to the AVP user referred to in point 2.39, which is addressed in the instructions referred to in point 13.5.13.

13.5 In particular, the following aspects shall be addressed and implemented in the operations manual:

13.5.1 All roles necessary for the safe AVP operation must be defined, including the designation of the relevant persons responsible and the allocation of organisational and technical tasks.

13.5.2 The necessary qualifications of the persons involved in the AVP operation (e.g. technical personnel) shall be defined.

13.5.3 The persons involved must be given initial and continuous briefing for their tasks and duties (e.g. through training). This initial and continuous briefing shall be documented.

Justification/Note: e.g. maintenance and troubleshooting of AVP vehicle scopes, carrying out software updates, carrying out system analyses, authorising the continuation or resumption of the AVP trip to end the minimum risk condition, etc.

13.5.4 The inspection and maintenance work on the AVP infrastructure should be defined.

Justification/Note: e.g. visual inspection of glass panes at stationary vehicle stop switches (see point 3.4), implementation of software updates.

13.5.5 The inspection and maintenance work of the AVP vehicle shall be defined.

Justification/Note: Separate evidence is required in so far as AVP-specific maintenance work on the AVP vehicle becomes necessary. Otherwise, the established vehicle instructions apply from the manufacturer to the keeper or user as regards their responsibilities, e.g.:
- *to comply with after-sales service intervals;*
- *to perform maintenance measures (e.g. replacement of tyres in the event of a worn-out profile, replacement of defective lighting)*

Measures to ensure general road safety (e.g. change of summer/winter tyres, compliance with the correct vehicle loading condition, legible plates)

13.5.6 The inspection and maintenance tasks of the parking area shall take account of AVP operation.

Justification/Note: Refers to the parking area or the car park in general: e.g. emergency exits, lighting, heating system, fire-fighting system, lifts, cleaning, bird protection, etc.

13.5.7 The conditions for the basic availability of the AVP function for the respective AVP scope shall be defined.

Justification/Note: This does not refer to AVP activation/deactivation in accordance with Chapter 4. Switching on and off the AVP functionality means whether or not the AVP function is commercially available to the customer (e.g. whether a reservation of an AVP parking space can be made and the AVP trip can be initiated by the customer in the car park). Example: In the case of construction works in the geographical AVP scope, the availability of the AVP function in the backend would be temporarily restricted so that customers cannot use the AVP function during this period.

13.5.8 Measures to eliminate disturbances during AVP operations (e.g. release to continue or resume the AVP trip to end the minimum risk condition, clear broken down AVP vehicles in the geographical AVP scope) shall be defined.

Justification/Note: The requirement regulates how to deal with incidents during AVP operations. Such failures may be caused by system failures or external boundary conditions (e.g. power failure in the car park).
One possible measure to remedy an incident is to allow the continuation of the AVP trip. Other measures are also conceivable or may become necessary if, for example, the AVP vehicle is defective and could no longer restart.

13.5.9 A process should be defined for the release to continue or resume AVP trips after clarification of the causes (system analyses) of system related terminations of AVP trips.

Justification/Note: In comparison with point 13.5.8, point 13.5.9 sets out the boundary conditions for the specific release for the continuation of the AVP trip after system related terminations. This is necessary because such clearance should only take place under limited boundary conditions, in so far as safe operation continues to be ensured. Examples of clearing broken down AVP vehicles:
(a) Towing, e.g. salvage caterpillar
(b) access of technical staff to the AVP vehicle and driving away of the vehicle
(C) remote control in the nearby area of the AVP vehicle

13.5.10 In the event of failures in the overall AVP system that pose a risk to the safety of the driverless operation of the AVP vehicle in the AVP scope, the AVP function shall no longer be available to the holders and AVP users in all AVP vehicles concerned until the origin of the failure is clarified and corrected.

13.5.11 The influence of AVP operations on parking operations must be identified, assessed and, where appropriate, supported by appropriate measures.

Justification/Note: The organisation of the parking area shall consider the AVP operation. These include, for example, roads/road markings, road signs/signatures, the influence, if any, of structural facilities that may change their condition (e.g. movable parking bollards (retracted/extended), barriers and rolling gates (open/closed). Their impact on AVP operations shall be assessed. The resulting tasks are documented in the operations manual (see point 13.5.1).

13.5.12 Changes to the parking area (e.g. planned structural measures) must take account of AVP operation. A process should be defined to ensure an assessment of the planned changes. This is without prejudice to the obligations set out in point 11.1.2.

Justification/Note: e.g. construction sites/structural alterations, (temporary) changes to traffic flows, (temporary) changes to signage, (temporary) changes to road markings.

13.5.13 The holder and the AVP user of the AVP vehicle shall be informed of the functionality of the overall AVP system (e.g. by means of operating instructions) and the conditions of use of the AVP operation. In particular, it shall include instructions for the AVP user on the intended use of AVP (e.g. that no persons or animals are to be present on the AVP vehicle during an AVP journey).

Justification/Note: e.g. also
— Activation of AVP trip via AVP application software
— Vehicle maintenance

The instructions need not necessarily be a printed document, but may also be available online, e.g. in the AVP vehicle or in an AVP application software.

13.5.13.1 The holder and the AVP user of the AVP vehicle shall be informed of possible risks of the overall AVP system.

13.5.13.2 The owner of the AVP vehicle shall be informed, where necessary, of any change or adjustment of the compulsory insurance as a result of the operation of the AVP.

13.5.14 An emergency plan must be implemented and a summary emergency map must be drawn up to deal with emergencies.

Justification/Note: Instructions/guidelines on behaviour in emergencies such as accidents involving the AVP vehicle/personal/property damage.

13.5.15 All role assignments derived from the Operations Manual shall be documented in writing. The associated document management must be in line with the state of the art.

Justification/Note: The requirement shall be deemed to be met if the requirements of ISO 9001 are met.

13.5.16 The reports/checklists to be drawn up during inspection, testing and maintenance work should be defined.

13.5.16.1 These reports/checklists must be drawn up in writing or electronically.

13.5.16.2 The reports shall be signed in writing or electronically as soon as the tasks have been carried out.

Chapter 14: Data protection

14.1 Data processing within the overall AVP system for conducting an AVP trip shall primarily be based on the requirements of Chapter 9 (Data storage) of this catalogue of requirements. In doing so, it is necessary to comply with the applicable data protection laws, in particular Regulation (EU) 2016/679 of the European Parliament and of the Council of 27 April 2016 on the protection of natural persons with regard to the processing of personal data and on the free movement of such data, and repealing Directive 95/46/EC (General Data Protection Regulation).

14.2 The overall approach must comply with the requirements of Articles 24, 25 and 32 of the General Data Protection Regulation.

14.3 The purpose of data processing is, inter alia, to ensure this catalogue of requirements, in particular the data storage requirements set out in Chapter 9. The person in charge shall independently assess whether a data protection impact assessment needs to be carried out in accordance with Article 35 of the General Data Protection Regulation.

Chapter 15: Reporting

15.1 General requirements

15.1.1 The manufacturer shall submit the reports and ad hoc reports referred to in points 15.2 and 15.3 in electronic form to the Federal Motor Transport Authority from the date of issue of the operation approval for the overall AVP system.

15.1.2 The overall AVP system shall be designed in such a way that AVP vehicles listed in the reports and ad hoc messages referred to in points 15.2 and 15.3 can be physically identified by the manufacturer.

15.1.3 The Federal Motor Transport Authority may at any time require the manufacturer to provide further information in addition to that required under points 15.2 and 15.3.

15.1.4 The format and presentation of the reports and ad hoc reports referred to in points 15.2 and 15.3 shall be agreed with the Federal Motor Transport Authority prior to the first reporting.

15.1.5 The content of reports which are also part of manufacturer's reports which already exist elsewhere may, after approval by the Federal Motor Transport Authority, be excluded from the reporting arrangements described in Chapter 15, provided that the time limits for the content of the reports concerned are not longer than those laid down in points 15.2.1 and 15.3.1.

15.1.6 As part of the reporting, the manufacturer does not transmit any personalized or personable data to the Federal Motor Transport Authority. This is without prejudice to the ability of the manufacturer to identify an AVP vehicle in accordance with point 15.1.2.

15.2 Regular reporting

15.2.1 The manufacturer must report regularly to the Federal Motor Transport Authority every week. The frequency can be adjusted by the Federal Motor Transport Authority with increasing operational experience.

15.2.2 Regular reporting shall include at least the following information:

15.2.2.1 A cumulative overview of:
- the number of AVP trips carried out and
- the number of successful AVP trips and
- the number of AVP trips interrupted but successfully carried out
- the ratio of the number of successful AVP trips to the number of AVP trips carried out and
- the driverless distance travelled in kilometres (including two decimal places) and
- the number of minimum risk conditions and
- the number of detected manipulations and manipulation attempts of the overall AVP system of

all AVP vehicles of the manufacturer since issue of the operation approval and on its basis.

Justification/Note: In addition to manipulations and manipulation attempts regarding IT security in accordance with point 12.2.1.5, this also includes manipulations and manipulation attempts to components of the AVP vehicle and the AVP infrastructure.

15.2.2.2 The following information up to and including point 15.2.2.2.6 shall be provided for the reporting period defined in accordance with point 15.2.1 per AVP vehicle and per AVP scope and per intervening technical staff:

15.2.2.2.1 Number of overall AVP system activations

15.2.2.2.2 Driverless distance travelled in kilometres (including two decimal places)

15.2.2.2.3 Detected error messages and error descriptions from the AVP relevant control units in the AVP vehicle and the AVP infrastructure.

15.2.2.2.4 Number of interrupted (e.g. short-term loss of radio connection) and cancelled AVP trips.

15.2.2.2.5 Number of detected manipulations and manipulation attempts of the overall AVP system.

15.2.2.2.6 Number of critical traffic situations (see point 11.3.2).

15.3 Ad hoc notifications

15.3.1 The manufacturer shall immediately inform the Federal Motor Transport Authority if:

15.3.1.1 Safety-related incidents are detected in accordance with point 11.3.2; or

15.3.1.2 Manipulations or manipulation attempts of the overall AVP system are detected; or

15.3.1.3 Failures in the overall AVP system that pose a risk to the safety of the driverless operation of the AVP vehicle in the AVP scope; or

15.3.1.4 other events affecting the safety of the driverless operation of the AVP vehicle in AVP scope occur.

15.3.2 The ad hoc notification shall include at least the following information:

15.3.2.1 Operation approval number

15.3.2.2 Description (including AVP scope and date/time) of the event that occurred

15.3.2.3 Vehicle types and number of AVP vehicles and AVP infrastructures concerned

15.3.2.4 Corrective measures already implemented and planned

15.3.2.5 A unique reference for physical identification per AVP vehicle concerned

References

IEC 61508	ISO 61508 – Functional safety of safety-related electrical/electronic/programmable electronic systems
ISO/SAE 21434	ISO/SAE 21434 – Road vehicles – Cybersecurity engineering
ISO 23374	ISO 23374 – Automated valet parking systems (AVPS) – System framework, requirements for automated driving, and communication interface
ISO 26262	ISO 26262 – Road vehicles – Functional safety
ISO 27000	DIN EN ISO/IEC 27000 – Information technology – Security procedures – Information security management systems
ISO/PAS 21448	ISO/PAS 21448 – Road vehicles – Safety of the intended functionality
ISO 19206-2	ISO 19206-2 – Road vehicles – Test devices for target vehicles, vulnerable road users and other objects, for assessment of active safety functions – Part 2: Requirements for Pedestrian targets
ISO 9001	ISO 9001 – Quality management systems – Basics and terms
StVG	Road Traffic Law

Annex I – Test catalogue

1 Preamble

This Annex defines basic test cases that can be used to test an overall AVP system (see point 2.4) with regard to compliance with the requirements and thus complements Chapter 10 of the Technical Catalogue of Requirements for Automated Valet Parking (AVP).

Test objectives are the demonstration of:

- Target function
- Possibilities for AVP deactivation or immediate transfer to the minimum risk condition inside and outside the AVP vehicle
- Collision avoidance with appropriate sensory environmental perception
- Safe behaviour in the relevant traffic situations/error free cases
- Activation/automatic deactivation
- Safe driving behaviour in case of errors

Depending on the overall AVP system and the (geographical) AVP scope, the basic test cases defined in this Annex I shall be adapted if necessary or test cases going beyond those in this Annex I are to be defined (see point 10.5 of the AVP requirements).

This test catalogue is formatted in such a way that it can be printed and used to log a tests series.

Some of the following basic test cases include several consecutive individual tests. Such basic test cases are accompanied by an appropriate indication that individual test steps can be carried out in succession without the AVP trip having to be cancelled or a new AVP driving order issued for each of these test stages.

The test personnel can only be used as a test person or object if safety at work is ensured and a risk is ruled out (cf. point 10.8.1 of the AVP requirements).

When the test description refers to *object*, this refers to the minimum object (cf. point 2.7 of the AVP Requirements Catalogue) or a larger object. In basic test cases where a deviation from the minimum object is necessary, the object to be used shall be described to the Federal Motor Transport Authority.

The procedural processes (e.g. notification to technical staff) following the transfer of the AVP vehicle to the minimum risk condition depend on the operational concept in question and are not further specified in the relevant test cases, but must be described and tested as part of the test.

2 Test scenarios

2.1 Target functions

2.1.1 Parking procedure

Description	AVP trip from the handover location to the intended parking space.		**Test protocol**		
Test objective	Show the target function 'parking procedure'.				
Reference	Points 3.3, 4.2.2, 4.2.3, 4.3.2, 4.3.3, 5.1.4, 5.4.3 and 5.5.1 of the AVP requirements catalogue.				
Preconditions	AVP vehicle parked at the handover site.				
Test step	**Description**	**Expected results**	**OK**	**nOK**	**Comment**
1	Set up an AVP driving order (e.g. via AVP application software on a mobile phone).	The AVP user will be notified of the successful handover of the AVP vehicle to the overall AVP system (e.g. via an AVP application software on a mobile phone).	☐	☐	
		The measures to ensure that no person is on the AVP vehicle have been implemented.	☐	☐	
		During AVP activation, the AVP vehicle is in a standstill secured against roll away.	☐	☐	
		AVP vehicle starts moving autonomously.	☐	☐	
2	Observe AVP trip.	The AVP vehicle runs uniformly throughout the AVP trip.	☐	☐	
		The maximum speed allowed in the AVP scope is continuously respected.	☐	☐	
		The minimum distances to objects required in the AVP scope are respected.	☐	☐	
		The AVP vehicle shall comply with the prescribed traffic direction (e.g. permitted direction of travel, stop-plates).	☐	☐	
		The direction of the vehicle shall be correctly indicated by means of direction indicator lamps of the AVP vehicle.	☐	☐	

3	Wait until AVP trip ends.	The AVP vehicle parks in the intended parking space.	☐	☐	
		The vehicle autonomously establishes the standstill secured against roll away.	☐	☐	
		The AVP function is disabled.	☐	☐	
		The AVP user is informed by the overall AVP system of the successful completion of the AVP trip (e.g. via an AVP application software on a mobile phone).	☐	☐	

2.1.2 Retrieval procedure

Description	AVP trip from parking space to take-over site.		**Test protocol**		
Test objective	Show the “retrieval procedure” function.				
Reference	Points 3.3, 4.3.3, 5.1.4, 5.4.3 and 5.5.1 of the AVP requirements catalogue.				
Preconditions	AVP vehicle standing on AVP parking space.				
Test step	**Description**	**Expected results**	**OK**	**nOK**	**Comment**
1	Set up an AVP driving order (e.g. via AVP application software on a mobile phone).	The AVP user will be notified of the successful take-over of the AVP system (e.g. via an AVP application software on a mobile phone).	☐	☐	
		AVP vehicle starts moving autonomously.	☐	☐	
2	Observe AVP trip.	The AVP vehicle runs uniformly throughout the AVP trip.	☐	☐	
		The maximum speed allowed in the AVP scope is continuously respected.	☐	☐	
		The minimum distances to objects required in the AVP scope are respected.	☐	☐	
		The AVP vehicle shall comply with the prescribed traffic direction (e.g. permitted direction of travel, stop-plates).	☐	☐	
		The direction of the vehicle shall be correctly indicated by means of direction indicator lamps of the AVP vehicle.	☐	☐	
3	Wait until AVP trip ends.	The AVP vehicle comes to a stop at the takeover site.	☐	☐	
		The vehicle autonomously establishes the standstill secured against roll away.	☐	☐	
		The AVP function is disabled.	☐	☐	
		The AVP user is informed by the overall AVP system of the successful completion of the journey (e.g. via an AVP application software on a mobile phone).	☐	☐	

2.2 Functions for deactivation of AVP or immediate transfer to the minimum risk condition

2.2.1 Actuating device in the car park

Description	Deactivation of all AVP vehicles in the AVP scope.		**Test protocol**		
Test objective	Demonstrate the possibility of overriding or deactivation by third parties in special situations (e.g. by passers-by in emergency situations or by emergency services / task forces).				
Reference	Points 3.4, 3.3.4, 5.6.2 and 5.6.3.3 and Chapter 13 of the AVP requirements catalogue.				
Preconditions	AVP successfully activated and AVP vehicle driving autonomously.				
Test step	**Description**	**Expected results**	**OK**	**nOK**	**Comment**
1	Actuate any stationary AVP vehicle stop switch.	AVP deactivation takes place.	☐	☐	
		AVP vehicle stops immediately and is transferred to the minimum risk condition.	☐	☐	
		The AVP function is deactivated.	☐	☐	
		Conduct in accordance with the operational concept (see Chapter 13 of the AVP Requirements Catalogue – e.g. notification to technical staff).	☐	☐	
2	Leaving the minimum risk condition initiated by the technical staff.	The AVP vehicle leaves the minimum risk condition at the request of the technical staff.	☐	☐	

2.2.2 Within the AVP vehicle

Description	Immediate transfer of the AVP vehicle to the minimum risk condition in case of intervention in driving or control elements (e.g. by opening a vehicle door from the inside) by a person remaining in the interior of the vehicle.		**Test protocol**		
Test objective	Show the possibility of overriding by a person remaining in the AVP vehicle.				
Reference	Points 5.6.2 and 5.6.3.2 and Chapter 13 of the AVP requirements catalogue.				
Conditional	AVP successfully activated and AVP vehicle driving autonomously.				
Test step	**Description**	**Expected results**	**OK**	**nOK**	**Comment**
1	Test personnel actuates the appropriate driving or control element.	AVP vehicle stops immediately and is transferred to the minimum risk conditions, when a) the steering wheel, b) the accelerator pedal, c) brake pedal, d) any vehicle door from the inside is actuated.	☐	☐	
		Vehicle doors can be opened from the inside.	☐	☐	
		Conduct in accordance with the operational concept (see Chapter 13 – e.g. notification to technical staff).	☐	☐	
2	Taking over the manual driving task by a driver.	AVP vehicle leaves the minimum risk condition due to manual control by a driver.	☐	☐	

2.3 Collision avoidance

2.3.1 Starting

Description	Minimum object close to the AVP vehicle before the start of the trip, at several locations around the AVP vehicle.		**Test protocol**		
Test objective	Detection of the minimum object close the AVP vehicle to prevent starting.				
Reference	Points 5.3.1.2 and 5.4.3 of the AVP requirements catalogue.				
Conditional	AVP vehicle is at the handover site or the AVP parking space and the AVP function has been successfully activated.				
Test step	**Description**	**Expected results**	**OK**	**nOK**	**Comment**
1.1	Place minimum object in front of AVP vehicle.	AVP vehicle does not start.	☐	☐	
1.2	Place minimum object behind AVP vehicle.	AVP vehicle does not start.	☐	☐	
1.3	Place the minimum object on the left side of the AVP vehicle.	AVP vehicle does not start.	☐	☐	
1.4	Place the minimum object to the right side of the AVP vehicle.	AVP vehicle does not start.	☐	☐	
2	Remove minimum object.	AVP vehicle starts and continues the AVP trip autonomously.	☐	☐	

Note: Test steps 1.1 to 1.4 may be carried out consecutively without the AVP trip having to be cancelled or a new AVP driving order issued for each of these test stages.

2.3.2 Minimum object central to the driving hose

Description	Minimum object at various locations centrally in the driving hose.		**Test protocol**		
Test objective	Detection of minimum objects and timely stopping, restart in the case of free driving hose.				
Reference	Points 5.3.1.2, 5.3.1.3 and 5.4.2 of the AVP requirements catalogue.				
Conditional	AVP successfully activated and AVP vehicle driving autonomously.				
Test step	**Description**	**Expected results**	**OK**	**nOK**	**Comment**
1.1	Place the minimum object centrally in the driving hose, at least one length of the vehicle from the parking space.	AVP vehicle stops with a minimum permitted distance from the minimum object.	☐	☐	
1.2	The minimum object shall be placed centrally in the driving hose, behind a curve.	AVP vehicle stops with a minimum permitted distance from the minimum object.	☐	☐	
1.3	Place a minimum object in the upper part (between 0 metres and ≤ 1.0 metres after the start of the constant gradient) of a downward ramp.	AVP vehicle stops with a minimum permitted distance from the minimum object.	☐	☐	
1.4	Place a minimum object at the level behind a downward ramp (between 0 metres and ≤ 1.0 metres after the beginning of the plane).	AVP vehicle stops with a minimum permitted distance from the minimum object.	☐	☐	
1.5	Place the minimum object centrally in the parking space.	AVP vehicle stops with a minimum permitted distance from the minimum object.	☐	☐	
1.6	Place minimum objects at the bottom (between 0 metres and ≤ 1.0 metres after the start of the constant gradient) of an upward ramp.	AVP vehicle stops with a minimum permitted distance from the minimum object.	☐	☐	
1.7	Place minimum object behind an upward ramp (between 0 and ≤ 1.0 metres after the beginning of the plane).	AVP vehicle stops with a minimum permitted distance from the minimum object.	☐	☐	
2	Remove minimum object.	AVP vehicle restarts and continues the AVP trip autonomously.	☐	☐	

Note: Test steps 1.1 to 1.7 may be carried out consecutively without the AVP trip having to be cancelled or a new AVP driving order issued for each of these test stages.

2.3.3 Object at the side of the driving hose

Description	Static or dynamic object at the side of the driving hose, at several locations.		**Test protocol**		
Test objective	Predictive detection of static or dynamic objects at the side of the driving hose and adjustment of speed.				
Reference	Points 5.3.1.2 and 5.3.1.3 of the AVP requirements catalogue.				
Conditional	AVP successfully activated and AVP vehicle driving autonomously.				
Test step	**Description**	**Expected results**	**OK**	**nOK**	**Comment**
1.1	A static object shall be placed at a distance lower than the permitted minimum distance to the side of the driving hose before the AVP vehicle approaches.	AVP vehicle stops at a minimum permitted distance in front of the static object. Or An AVP vehicle shall initiate an appropriate evasive manoeuvre to maintain the minimum distance.	☐	☐	
1.2	In case of stop of the AVP vehicle: The static object is removed.	AVP vehicle restarts and continues the AVP trip autonomously.	☐	☐	
2.1	A dynamic object shall be moved parallel to the AVP vehicle at a lateral distance lower than the permitted minimum distance while the AVP vehicle is approaching.	AVP vehicle stops at a minimum permitted distance in front of the dynamic object. Or An AVP vehicle shall initiate an appropriate evasive manoeuvre to maintain the minimum distance.	☐	☐	
2.2	In case of stop of the AVP vehicle: The dynamic object is removed.	AVP vehicle restarts and continues the AVP trip autonomously.	☐	☐	

Note: Test steps 1.1 to 2.2 may be carried out consecutively without the AVP trip having to be cancelled or a new AVP driving order issued for each of these test stages.

2.3.4 Dynamic objects

Description	Dynamic objects approach the moving AVP vehicle in different directions.		**Test protocol**		
Test objective	AVP vehicle starts braking on dynamic objects in a timely manner.				
Reference	Points 5.3.1.2, 5.3.1.3 and 5.4.2 of the AVP requirements catalogue.				
Conditional	AVP successfully activated and AVP vehicle driving autonomously.				
Test step	**Description**	**Expected results**	**OK**	**nOK**	**Comment**
1.1	A dynamic object crosses the driving hose from outside the driving hose with a minimum of 5 km/h in front of the moving AVP vehicle, resulting in a high risk of collision.	AVP vehicle stops immediately and autonomously establishes the standstill secured against roll away.	☐	☐	
1.2	When passing the AVP vehicle, a dynamic object moves from outside the driving hose into the side flank of the vehicle, resulting in a high risk of collision.	AVP vehicle stops immediately and autonomously establishes the standstill secured against roll away.	☐	☐	
1.3	A dynamic object moves towards the direction of travel on the AVP vehicle with a minimum of 5 km/h.	AVP vehicle stops immediately and autonomously establishes the standstill secured against roll away.	☐	☐	
2	The dynamic object is removed.	AVP vehicle restarts and continues the AVP trip autonomously.	☐	☐	

Note: Test steps 1.1 to 1.3 may be carried out consecutively without the AVP trip having to be cancelled or a new AVP driving order issued for each of these test stages.

2.4 Compliance with traffic rules

2.4.1 Exit from AVP parking space

Description	AVP vehicle is waiting for parking out if another vehicle passes.		**Test protocol**		
Test objective	AVP Vehicle shall observe right of way when parking out.				
Reference	Point 5.5.1 of the AVP requirements catalogue.				
Conditional	AVP vehicle standing on the AVP parking space; another vehicle (e.g. manually controlled) is ready to claim right of way.				
Test step	**Description**	**Expected results**	**OK**	**nOK**	**Comment**
1	Set up the AVP driving order followed by a successful AVP activation.	AVP trip under preparation.	☐	☐	
2	The other vehicle runs in such a way that it passes the AVP parking space if the AVP vehicle would already start moving without traffic.	AVP vehicle shall maintain and give priority to the other vehicle.	☐	☐	
3	The other vehicle continues.	AVP vehicle restarts and continues the AVP trip autonomously.	☐	☐	

2.4.2 Rule of priority

Description	The AVP vehicle shall stop in junction, crossing or filter in areas or, in accordance with the rules of priority, shall take account of the fact that another vehicle is approaching these areas.		**Test protocol**		
Test objective	The AVP vehicle shall comply with the rules of priority applicable in the parking area.				
Reference	Point 5.5.1 of the AVP requirements catalogue.				
Conditional	AVP successfully activates and AVP vehicle drives autonomously approaching the junction, crossing or filter in area; another vehicle (e.g. manually controlled) is ready to claim right of way.				
Test step	**Description**	**Expected results**	**OK**	**nOK**	**Comment**
1	The other vehicle runs in such a way that it reaches the junction, crossing or filter in area approximately at the same time as the AVP vehicle.	AVP vehicle shall maintain and give priority to the other vehicle.	☐	☐	
2	The other vehicle continues.	AVP vehicle restarts and continues the AVP trip autonomously.	☐	☐	

2.5 AVP activation

2.5.1 Identical AVP vehicle at the handover site

Description	Identical AVP vehicle stands at the handover site		**Test protocol**		
Test objective	No AVP activation for the identical AVP vehicle which is not intended for the AVP driving order, and no AVP activation for the AVP vehicle actually intended for the AVP driving order which is not at the handover site.				
Reference	Points 4.2.4 and 5.1.3 of the AVP requirements catalogue.				
Conditional	AVP #1 parks at the handover site. AVP #2 parks elsewhere in the car park.				
Test step	**Description**	**Expected results**	**OK**	**nOK**	**Comment**
1	AVP driving order for AVP vehicle #2 shall be set up.	No AVP activation for AVP vehicles #1 and #2.	☐	☐	
		AVP user of AVP vehicle #2 shall be informed of the failed AVP activation trial.	☐	☐	

2.6 Environmental perception

2.6.1 Sensor coverage

Description	Environmental perception sensors are covered during the AVP trip.		**Test protocol**		
Test objective	AVP vehicle does not drive to unknown areas.				
Reference	Point 5.1.2 of the AVP requirements catalogue.				
Conditional	AVP successfully activated and AVP vehicle driving autonomously.				
Test step	**Description**	**Expected results**	**OK**	**nOK**	**Comment**
1	Sensors for environmental perception of the AVP vehicle are covered.	AVP vehicle stops immediately and autonomously establishes the standstill secured against roll away.	☐	☐	
2	Cover is removed.	AVP vehicle restarts and continues the AVP trip autonomously.	☐	☐	

2.6.2 Camouflage objects

Description	Relevant camouflage objects are detected.		**Test protocol**		
Test objective	The disadvantages and weaknesses of the sensors used for the environmental perception are considered for the safe execution of the dynamic driving task.				
Reference	Points 2.52, 5.1.2, 5.3.1.2, 5.3.1.3, 5.3.2.1, 5.4.2 and 7.3.3 of the AVP requirements catalogue.				
Conditional	AVP successfully activated and AVP vehicle driving autonomously.				
Test step	**Description**	**Expected results**	**OK**	**nOK**	**Comment**
1	Relevant camouflage objects (e.g. with a highly homogeneous surface, weak contrast to background, reflectivity) shall be placed at any point in the driving hose of the AVP vehicle.	The AVP vehicle shall stop in front of the object with a minimum permitted distance. Or The AVP vehicle shall initiate an appropriate evasive manoeuvre to maintain the minimum distance.	☐	☐	

2.7 Error cases

2.7.1 Loss of a crucial radio connection

Description	Interruption of a radio communication crucial for the AVP trip during an AVP trip.		**Test protocol**		
Test objective	Demonstrate that when the radio connection with the AVP infrastructure is lost, the AVP vehicle is transferred to the minimum risk condition.				
Reference	Point 5.6.1 of the AVP requirements catalogue.				
Conditional	AVP successfully activated and AVP vehicle driving autonomously.				
Test step	**Description**	**Expected results**	**OK**	**nOK**	**Comment**
1	Radio connection is interrupted (e.g. switch off the power of the Wi-Fi Access Point).	AVP vehicle stops immediately and autonomously establishes the standstill secured against roll away.	☐	☐	
2	If necessary, wait until the AVP system interprets the loss of the radio connection as a permanent loss of the radio link.	The AVP vehicle shall be transferred to the minimum risk condition.	☐	☐	
		Conduct in accordance with the operational concept (see Chapter 13 – e.g. notification to technical staff).	☐	☐	

Note: Depending on the design of the system, there may be a defined waiting period in accordance with test step 2, after which the AVP vehicle is transferred to the minimum risk condition. Such system design shall be described and tested as part of the test.

2.7.2 Faulty environmental perception sensor

Description	Artificially induced sensor error during the AVP trip.		**Test protocol**		
Test objective	Demonstrate that the overall AVP system detects faults in the sensors needed for the environmental perception and transfers the AVP vehicle to the minimum risk condition.				
Reference	Point 5.6.1 of the AVP requirements catalogue.				
Conditional	AVP successfully activated and AVP vehicle driving autonomously.				
Test step	**Description**	**Expected results**	**OK**	**nOK**	**Comment**
1	The data line shall be separated from a sensor relevant for the environmental perception in the current driving area of the AVP vehicle.	AVP vehicle stops immediately and is transferred the minimum risk condition.	☐	☐	
		Conduct in accordance with the operational concept (see Chapter 13 – e.g. notification to technical staff).	☐	☐	

2.7.3 Errors within the AVP infrastructure

Description	Critical error in the server of the AVP infrastructure during an AVP trip.		**Test protocol**		
Test objective	Demonstrate that the overall AVP system detects critical server errors and transfers the AVP vehicle to the minimum risk condition.				
Reference	Point 5.6.1 of the AVP requirements catalogue.				
Conditional	AVP successfully activated and AVP vehicle driving autonomously.				
Test step	**Description**	**Expected results**	**OK**	**nOK**	**Comment**
1	A critical error for the AVP trip in the server of the AVP infrastructure is artificially induced (e.g. by increasing computational load up to overload).	AVP vehicle stops immediately and is transferred to the minimum risk condition.	☐	☐	
		Conduct in accordance with the operational concept (see Chapter 13 – e.g. notification to technical staff).	☐	☐	

2.7.4 Errors inside the AVP vehicle

Description	Artificially induced error in the AVP vehicle during an AVP trip.		**Test protocol**		
Test objective	Demonstrate that the AVP vehicle is transferred to the minimum risk condition.				
Reference	Point 5.6.1 of the AVP requirements catalogue.				
Conditional	AVP successfully activated and AVP vehicle driving autonomously; Test personnel sitting in the AVP vehicle.				
Test step	**Description**	**Expected results**	**OK**	**nOK**	**Comment**
1	A critical error in the AVP vehicle for the AVP trip is artificially induced (e.g. by removing a fuse of an AVP relevant control unit).	AVP vehicle stops immediately and is transferred to the minimum risk condition.	☐	☐	
		Conduct in accordance with the operational concept (see Chapter 13 – e.g. notification to technical staff).	☐	☐	

Appendix II – Appendix ‘AVP’ to the information document for automated/fully automated driving functions that can subsequently be activated

8. AVP spezifische Angaben
AVP specific information:

8.1 Bauliche und strukturelle Anforderungen an das Parkhaus / die Parkfläche (falls zutreffend)
Architectural and structural requirements of the parking facilities (if applicable):

8.2 Liste der Fahrzeugtypen mit AVP
List of vehicle types supporting AVP:

8.3 AVP Typ gem. KBA Anforderungskatalog
AVP type according to KBA catalogue of requirements:

8.4 Hersteller AVP-Infrastruktur (falls zutreffend)
Manufacturer AVP infrastructure (if applicable):

8.5 Höchstgeschwindigkeit im fahrerlosen AVP Betrieb
Max. speed during the AVP operation:

8.6 Weitere Angaben in Bezug auf die im Anforderungskatalog gestellten Anforderungen
Further information related to the requirements of the KBA catalogue of requirements: