

6.1 DDT Performance section

6.1.2. 6.1.2 ADS Performance of the DDT in Nominal Situations

6.1.3. 6.1.3 ADS Performance of the DDT in Critical Situations

6.1.3.1. The requirements for DDT performance under nominal situations shall continue to apply during critical situations as far as is reasonably practicable under the specific circumstances with the aim of minimising overall safety risks.

6.1.4. 6.1.4 ADS Performance of the DDT in Failure Situations

6.1.4.1 The requirements for DDT performance in nominal situations shall continue to apply during failure situations as far as is reasonably practicable under the specific circumstances with the aim of minimising overall safety risks.

See also items 2.34 and 2.35

The distinction between the nominal critical and failure is important as different DDT requirements apply across the different categories of situation. Nominal situation requirements only continue to apply “as far as reasonably practicable with the aim of minimising overall risk” in critical and failure situations. In all situations the ultimate goal is to minimise the risk of harm.

Both scenarios and situations can be categorised as nominal, critical or failure depending on the conditions within them. This classification between nominal and critical is not based on the capabilities of the ADS but rather on the characteristics of the situation itself.

If the ADS causes a collision in an otherwise nominal situation the intention was that this does not make the situation critical, instead it is intended to be a noncompliance with the nominal situation requirements. (i.e. it is not reclassified as a critical situation due to an error by the ADS).

In addition, complexity alone does not make a situation critical. A nominal scenario can be complex with many road users interacting with each other but no prompt action required by the ADS in order to avoid a collision.

Examples (optional)

Nominal

- A queue of cars stopped at a traffic light
- A roundabout
- Urban street with pedestrians crossing ahead

Critical

- A pedestrian runs out in front of the ADS vehicle
- Harsh cut in on the highway
- ORU reversing into the ADS vehicle
- Extreme weather event creates a hazard on the road

Failure

- DDT-related sensor failure
- Tyre puncture
- Power loss to ADS
- ADS related actuator failure
- On-board ADS related communication failure

6.1.2.1 The driving behaviour of the ADS shall not cause a collision.¹³

13 It is acknowledged that establishing causation can be complex, and not always possible. However, where it is established that the behaviour of an ADS caused a collision, this is a non-compliance with this requirement.

Explanation of the requirement

Collision here is intended to match recognised international use i.e. not include minor incidents such as colliding with non safety-relevant objects.

This requirement is also intended to capture situations where the ADS causes a collision that does not involve the ADS vehicle.

This requirement has pre and post deployment implications. Where there are collisions in which the ADS is involved during the approval process (e.g. during confirmatory testing) there is expectation that a root cause analysis is done to assess the causes of such collision and an explanation provided. Where a collision happens post deployment it is covered by the ISMR process.

Causation can be determined by:

- The manufacturer's ISMR investigation,
- Authority investigation or,
- A court of law.

6.1.2.2 The ADS shall adapt its driving behaviour in line with safety risks: this shall at least include:

- (a) Anticipating the risks in the driving environment to reduce the likelihood of encountering a critical situation,
- (b) Adapting its speed in line with safety risks, and
- (c) Maintaining appropriate distances from other road users by controlling the longitudinal and lateral motion of the vehicle.

Explanation of the requirement

This requirement and the three sub requirements all refer to the adapting the behaviour of the ADS in line with safety risks. These separate requirements were all grouped together to cover ADS behaviour; it is intended that the manufacturer explains how the ADS demonstrates behaviours that cover these safety goals

a) *Example behaviours demonstrating the anticipation of risks in the driving environment:*

- Predicting possible hazards based on the surrounding conditions in order to avoid a situation where prompt action would be needed to avoid a collision
- Assessing the significance of possible hazards and prioritising responses recognising that other road users may sometimes not comply with traffic rules.
- Anticipating road and traffic conditions, and acting in good time
- Avoiding reactive stopping as much as possible by planning an approach to hazards which enables the vehicle to keep moving.

b) *Example behaviours demonstrating the adaption of speed in line with safety risks:*

- Making safe, reasonable progress appropriate for the road, traffic and weather conditions and the road signs and speed limits
- Not exceeding the speed limit.
- Approach hazards at a safe, controlled speed, without being over cautious or interfering with the progress of other traffic.
- Adopting a safe, realistic speed for the road and traffic conditions

c) *Example behaviours demonstrating the maintaining of appropriate distances:*

- Maintain a safe following distance, adjusting for speed, road gradients, surface conditions and weather.
- Allowing for longer stopping distances on wet or slippery roads

- Leaving enough space in traffic queues to manoeuvre safely if the vehicle in front becomes obstructed
- Leaving enough space when overtaking other road users taking into account approaching road users if necessary.

6.1.2.3 The ADS shall avoid unreasonable disruption to the flow of traffic in line with safety risks.

Explanation of the requirement

The intention of this requirement is to avoid the ADS stopping or driving slowly in a way that is unreasonably disruptive to other road users. The addition of ‘unreasonable’ was included to prevent normal interaction with traffic (e.g. using an on ramp to a highway, slowing for traffic lights, waiting at unprotected turns), which technically require other road users to adapt their speed, from being a violation of this requirement. Compliance with traffic rules is not intended to be considered as causing an unreasonable disruption (See also 6.1.2.6).

6.1.2.4 The ADS shall detect and respond to objects and events relevant to its performance of the DDT

Examples of objects that are relevant to the DDT

- ORU
- Infrastructure
- Street furniture

Examples of Objects that are not relevant to the DDT

- Planes in the sky,
- People inside buildings,
- Vehicles driving on an adjacent (but completely segregated) road
- Leaves blowing in the wind.

6.1.2.5 The ADS shall detect and respond to priority vehicles in accordance with the applicable traffic law(s)

Explanation of the requirement

This requirement allows for an ADSF-1 to transfer control to the fallback user (fallback response) in the case of a priority vehicle interaction. For both ADSF-1 or ADSF-2, the manufacturer may also use non-ADS strategies to ensure that the priority vehicles are responded to correctly (however the ADS is always responsible for detecting them). The manufacturer is encouraged to follow any available guidance and best practice engaging with emergency services prior to deployment.

Example Non-ADS Strategies (non-exhaustive list)

- Remote intervention directly in the operation of the ADS Vehicle in order to respond to priority vehicles (if permitted under applicable law)
- Remote intervention indirectly in the operation of the ADS Vehicle by giving additional information to ADS in order to respond to priority vehicles

6.1.2.6 The ADS shall comply with traffic rules in accordance with application of relevant law within the area of operation

Explanation of the requirement

This requirement uses the terms “application of relevant law” to refer to how the law is applied in practice, consistent with case law.

The intention is to allow flexibility for the ADS to deal with complex real world situations but is not intended for the manufacturer to ignore traffic rules if other humans are (e.g. speeding on the motorway); in these situations case law would show humans in similar situations were still held liable. This provision is also intended to cover cases where traffic rules conflict with one another to still allow the ADS to take appropriate action. The term “area of operation”

refers to the specific jurisdiction the ADS is operating in and the applicable traffic rules that apply in that jurisdiction.

6.1.2.8 The ADS shall avoid collisions with safety-relevant objects

Explanation of the requirement

Safety-relevant objects are defined as an object that, if collided with, is likely to cause non-trivial damage to the vehicle or that is likely to pose a safety risk to other road users, vehicle occupants, or infrastructure.

Nontrivial damage is a threshold defined by the manufacturer in 7.3.2.3. This is intended to allow for cases where hitting some objects (e.g. a plastic bag, road debris) may be safer than the ADS taking evasive action or stopping to avoid it. Collisions with other road users would be likely to pose a safety risk to them.

Examples (illustrative and non-exhaustive)
safety-relevant objects

- Any ORU (pedestrian, cyclist, other vehicle)
- Street furniture (bollards, signage etc)
- Parked vehicle

Non-safety-relevant objects

- Plastic bag
- Road debris
- Litter

6.1.2.9 The ADS shall signal its operational status if required by applicable laws.

Explanation of the requirement

This requirement refers to external signalling of the ADS status, this regulation does not mandate the use of an ADS status signal unless the applicable laws in the area of operation require one.

6.1.2.11 The ADS shall have strategies in place to appropriately detect and respond to instructions from road safety agents

Explanation of the requirement

This requirement allows for the response for an ADSF-1 to transfer control to the fallback user (fallback response) in the case of a road safety agent interaction. For either feature type the manufacturer may also use non-ADS strategies to ensure that the road safety agents are responded to correctly (however the ADS is always responsible for detecting them).

Example Non-ADS Strategies (non-exhaustive list)

- Remote intervention directly in the operation of the ADS Vehicle in order to fulfil the instruction (if permitted under applicable law)
- Remote intervention indirectly in the operation of the ADS Vehicle in order to fulfil the instruction, by converting the road safety agent's instructions into a form that the ADS can follow
- The road safety agent may be permitted to drive the vehicle themselves

6.1.3.3.1 "The ADS shall not resume travel unless:

- (a) The safe operational state of the ADS vehicle has been verified, and

(b) It is permissible under the applicable laws.”

Explanation of the requirement

This requirement does not allow the ADS to move off following a collision until both points are fulfilled; it is permissible under applicable law and the operational state has been verified. This might be accomplished in a variety of ways; the ADS checking itself, the fallback user checking the operational state or a third-party confirming safety in some way.

Where applicable laws require that a vehicle not be moved off after an collision occurs, the completion of the necessary procedures regarding vehicle movement under the applicable laws may be interpreted as “permissible”.

6.1.3.3.2 Notwithstanding para. 6.1.3.3.1.(a), if the collision occurred while an ADSF-2 was active, when directed by a road safety agent, the ADS shall move the vehicle unless the ADS determines that the manoeuvre poses an unreasonable safety risk or is not technically possible due to damage. Alternatively, the safety case shall describe how the road safety agent's instructions will be complied with in such circumstances

Explanation of the requirement

This requirement provides an exception to the previous requirement, specifically when the operational state has not yet been verified but there is still a need to move the vehicle in an emergency. E.g. moving the vehicle off the road to allow emergency services access or to move to a safer location away from a burning vehicle. This may be accomplished by the ADS or non-ADS strategy. It is limited to ADSF-2 as with an ADSF-1 the fallback user would move the vehicle.

Example Non-ADS Strategies (non-exhaustive list)

- Remote intervention directly in the operation of the ADS Vehicle in order to fulfil the direction by a road safety agent (if permitted under applicable law)
- Remote intervention indirectly in the operation of the ADS Vehicle by giving additional information to ADS in order to fulfil the direction, by converting the road safety agent's directions into a form that the ADS can follow
- The road safety agent may be permitted to drive the vehicle themselves

6.1.3.3 In the event of a collision involving the ADS vehicle, if required to stop by applicable law, the ADS shall fall back to an MRC or bring the vehicle to standstill as appropriate. During this process the user may initiate deactivation of the ADS if the design of the ADS allows.

Explanation of the requirement

In this requirement the obligation to stop is determined by whether the applicable law in the area of operation would require a vehicle to stop following that collision. In some cases it would be more appropriate to bring the vehicle to an immediate standstill rather than find an appropriate MRC.

6.1.4.2 The ADS shall detect faults, malfunctions, and abnormalities that compromise its capability to perform the DDT within the ODD.

Explanation of the requirement

This requirement encompasses three kinds of issues:

1. Warning signals sent by other systems (note this is covered more directly by paragraph 6.3.6)
2. Faults, malfunctions and abnormalities without warning signals that a driver would be expected to perceive (e.g., sideways drift when braking)

3. Faults, malfunctions and abnormalities within the ADS itself (e.g. sensors/perception, actuators...)

Receiving a warning does not necessarily mean an immediate impact on the DDT and the obligation is to detect and respond to faults that do compromise the capability to perform the DDT.

The response of the ADS to these faults is handled in other requirements (e.g. 6.1.4.3.)

6.1.4.3

In response to a fault, the ADS shall either:

- (a) Execute a fallback response and prohibit activation of the impacted feature(s) if the fault prevents the ADS from performing the DDT in accordance with the requirements under paragraph 6.1., or
- (b) Adapt its performance of the DDT in accordance with the severity of the fault provided the resulting performance complies with the requirements under paragraph 6.1.

Explanation of the requirement

Part b of this requirement covers the case where there is a fault that has led to a failure which has impaired the ability of the ADS to perform the DDT but it is still capable of doing so with reduced performance. If the ADS continues to perform the DDT in this failure situation with reduced performance then as far as reasonably practicable continue to meet the nominal situation requirements with the aim on minimising overall risk in accordance with 6.1.4.1 (e.g.. it could increase risk , on a highway to fall back to a MRC immediately rather than continuing to a better point.)

Examples

- A single camera is suffering a fault, so the ADS slows down and maintains extra buffer while continuing along the highway.
- Braking performance is reduced by a fault but still safe, so the ADS lowers speed and increases following distance while continuing
- A sensor for driving in heavy rain is damaged, it minimises risk for the ADS to continue driving during clear conditions rather than stopping immediately

6.1.4.4

6.1.4.4. The ADS shall be capable of remote termination.

6.1.4.4.1. The procedure for remote termination of an ADS performing the DDT shall include the capability to perform an ADS fallback response.

6.1.4.4.2. The remote termination of an ADS or ADS feature(s) shall render it unable to be activated until such time as the remote termination is rescinded.

Explanation of the requirement

This requirement refers to the capability to prevent an ADS Feature being used. This could apply to an ADS feature across many vehicles (e.g. a problem has been identified with a feature and it is dangerous to use) or a single vehicle that needs to be stopped in an emergency (e.g. an ADS vehicle is operating out of ODD in a dangerous manner). This covers both the cases where the ADS needs to immediately fallback to a MRC and where it is preferable to complete its journey and then subsequently no longer allow activation of the feature, which option is appropriate would be dependent on the specific situation. In the case where the remote termination is triggering a fallback to a MRC the ADS still performs the DDT and chooses an appropriate stopping position. This regulation only covers the mechanism for remote termination being possible, the ADS still operates in accordance with applicable laws regarding if and when it could be used.

6.1.5.4.1

In response to an ODD exit, ADSF-2 shall aim to bring the ADS vehicle to a stop in a safe location that complies with traffic rules (e.g., a parking space)

Explanation of the requirement

As ADSF-2 features by definition do not have a fallback user so there is no guarantee any human driver will be able to take over the performance of the DDT following a MRC. As such a higher standard is expected for an acceptable stopping point following an ODD exit, in order to prevent the MRC resulting in the vehicle blocking the road or being parked illegally. The use of “aim to” acknowledges that some conditions may prevent a legal parking space being achieved in some specific circumstances but that the ADS is still “aiming” to park legally. The fallback to MRC in both an ADSF-1 or ADSF-2 may be interrupted by the user taking over if the design of the ADS allows. For both feature types the ADS feature is required to be designed to be free from unreasonable risk (see 5.2) and the MRC would reflect that.

- 6.1.6.2 For ADSF-1, if it has not been possible to complete a system-initiated deactivation procedure, the ADS shall execute a fallback to an MRC. During the fallback to MRC the user may initiate deactivation of the ADS.

Explanation of the requirement

The text “not been possible to complete a system-initiated deactivation procedure” means the case where the normal system-initiated deactivation process (i.e. transition demand) has not resulted in the fallback user taking the role of the driver. This could be due to fallback user not responding in the transition period determined by the manufacturer, or some external event preventing that full transition period being possible (e.g. a sudden unexpected ODD exit where it is not safe for the ADS to wait for the entire transition period before beginning the fallback to MRC). In this latter case the fallback user may still want to take over performance of the DDT during this fallback to an MRC, rather than wait for the vehicle to come to a stop.