**VMAD SG4 SDG - Informal Document**

*This document was prepared the members of VMAD SG4’s small drafting group (SDG). It was prepared by the SDG with a view of informing the co-chairs and members of VMAD on the current status of the subgroup’s work and on its outstanding issues, envisaged work and accompanying timelines. Perhaps more importantly in light of the expiring mandate of VMAD, this document also sets out views on the necessity to continue the work as well as thoughts on possible working methods.*

*Due to the limited time between the last meeting of the SDG and the VMAD session on 16 May 2022, this document was sent for information to both the VMAD co-chairs and SG4 members simultaneously. The first annex represents a marginally updated version of document VMAD-SG4-13-02 on the outstanding issues and work plan, which was approved of by members of SG4 during the subgroup meeting on 6 April 2022. The content of this document and its second annex were instead developed by the SDG in response to respectively the requests of VMAD co-chairs and the instructions set out in the SG4 work plan, and should therefore be regarded in that context.*

**I. Current Status**

Following the decision made by SG4 during its 13th session on 6 April 2022, as also announced during the 25th session of VMAD on 12 and 13 April 2022, a small drafting group (SDG) was established. The membership of the SDG is composed of representatives from China, the Netherlands, CIECA and ETSC. A first meeting was held on 26 April 2022, during which SG4’s outstanding issues as well as the necessity and scope of future work were reflected upon in the context of the expiring mandate of VMAD. An approach for developing the first draft general matrix for physical testing was also agreed upon. The second meeting of the SDG was held on 12 May 2022, during which the outstanding issues and required future work were discussed again, as well as an initial draft general matrix established.

The results of the discussions on the expiring mandate of VMAD, including recommendations towards the co-chairs and members of VMAD on the necessity to continue the work, can be found in the next section of this document.

An overview of SG4’s outstanding issues as well as a work plan including an indicative timeline can be found in Annex I to this document.

The current status of the draft general matrix for physical testing can be found in Annex II. It is based on an initial review of the possibility to use track testing and/or real world testing for validating compliance with FRAV’s performance requirements and their detailed provisions.

**II. Views on the Expiring Mandate of VMAD**

***In short, the SDG is in agreement that the development of VMAD’s physical testing pillars still requires significant work and should therefore should continue after June 2022. The SDG however considers that the working method under GRVA should be reviewed, with the view of ensuring closer cooperation between the different work streams and in particular between FRAV and VMAD.***

Both VMAD’s NATM Master Document and the NATM Guidelines set out the agreed approach for the development of the track and real world testing methods. The agreed approach consists of a general matrix for physical testing and separate test matrices for respectively track testing and real world testing, to be accompanied by testing protocols. As the test matrices rely on the deliverables of other groups under GRVA – in specific FRAV for the requirements and measurable criteria to be tested, and VMAD SG1’s scenarios for track testing – for their content, SG4’s work on its final deliverables cannot commence until the other work has sufficiently matured. Instead, SG4 intends to work in the short and medium term on draft test matrices and address the outstanding issues that are independent from the content of the test matrices, as reflected and described in more detail the work plan (see Annex I).

It was noted during the SDG’s preparatory work on the draft general matrix that at present, there was considerable distance between the currently established safety provisions and the required testable criteria. SG4’s preparatory work therefore confirmed that the safety requirements still require significant work in order for them to be refined into the verifiable criteria required as content for the respective test matrices.

Several of such examples can be found in the comments column of Annex II on the draft general matrix or physical testing. One such example is the detailed provision that the ADS should be able, as part of the DDT, to operate at safe speeds. Refining this detailed provision into a measurable criteria would require significant work, including further scientific research, as the measurable criteria would have to answer what safe speeds are under various different variables. The SDG noted that this would require gathering collections of existing examples and best practices on what constitutes safe speed under particular variables, with the examples to be gathered from both national sources as well as academic literature. While it was further noted that some collections are already available, it was underlined that gathering these collections and identifying gaps in them, requires significant efforts. And while this would be relatively easier for safe infrastructure related speeds (e.g. safe speeds at intersections, in curves, etc) as formulae are more readily available, it would be harder to gather examples/formulae for, for example, environmental conditions (e.g. on wet roads), for the interaction with other road users, and notably for combinations of different variables. Work on this is currently ongoing in FRAV. The SDG however considered that some instances (notably when different variables play a role) might require subjective assessments in order for the compliance of the vehicle with the safety provision to be fully assessed. This in turn would require the development of training methods for assessors/examiners specifically geared towards the assessment of automated vehicles, in order to reduce the subjectivity of the assessment as much as possible. Research on human drivers’ examination have already shown that it is possible, as have experiences with the use of the Wiener Fahrprobe, which involves observations of human drivers and ADAS systems. This in turn also underlines the necessity for any developed assessment method to be validated prior to being regulated.

The example above highlights not only that significant work is still required and that a mandate to work on (at least) the physical testing methods should be requested, it also highlights the close relationships between the development of the measureable criteria, the scenarios and the testing methods. In this regard, the SDG considers that the working methods of FRAV and VMAD should be reviewed, and perhaps restructured, with a view of closer cooperation between the different work streams. It was noted that the work is currently being conducted ‘in silos’, which risks overlaps as well as gaps. The SDG suggests in-depth discussions on this topic between co-chairs as well as subgroup/work stream leaders of VMAD and FRAV, where the SDG underlines that it should not be assumed that the existing methods and structures are best suited to finalise the work of both FRAV and VMAD effectively and efficiently.

**Annex I**

**SG4 Outstanding Issues & Draft Work Plan**

*Status: May 2022*

This annex sets out SG4’s outstanding issues as well as a work plan to address them. The work plan is divided into short term, medium term and medium-long term sections.

1. **Main outstanding issues**
* Develop the general matrix for physical testing;
	+ Decision on the level of detail to be provided in the general matrix;
	+ Decision on how to handle ‘if encountered’ occurrences in the approach;
* Develop the test matrix and test protocols for track testing;
* Develop the test matrix and test protocols for real world testing;
* Validation of the testing approach (see GRVA-12-12 for specific considerations);
* Discussions, and developing guidance where appropriate, on:
	+ Necessity of remote support functions;
	+ Ensuring safety during real world testing;
	+ Auditing of test equipment used for track testing;
	+ How to test on test tracks, if the test track is not part of the ODD;
	+ The work and experiences with ALKS.
1. **Work Plan**

Short term:

*The items below would be addressed at the upcoming VMAD SG4 meetings, in the upcoming months. A selection of the items below would be listed on the agenda for each meeting to spread and balance the work load for the meetings.*

*A small drafting group was established in April 2022 and started work on the development of a draft general matrix for physical testing. The current status of the draft general matrix can be found in Annex II.*

* Further development of a draft general matrix for physical testing, including:
	+ Decision on level of detail to be provided in the general matrix;
	+ Decision on how to handle ‘if encountered’ occurrences during real world testing;
	+ Discussion on how to test on a test track if the test track is not part of the ODD, and development of guidance, if deemed appropriate.
* Discussion on the necessity for remote support functions, and developing guidance, if deemed appropriate.
* Discussion on ensuring safety during real world testing, and developing guidance, if deemed appropriate.
* Continuation of the discussion on auditing of test equipment used for track testing.
* Discussion on the work and experiences with ALKS, and exploring the possibilities of incorporating suitable parts in the guidelines.

Medium term:

*The items below are dependent on the work by other entities, notably FRAV and VMAD SG1. While it is anticipated that work on the items below may start in the near future, the timing would depend on when the prerequisites are made available. The main purpose of the work below is to gain experience with developing the test matrices, with a view of facilitating a (more) swift development of the eventual complete matrices once the required input becomes available (see long term work plan). This work would also allow SG4 to already to draft guidance on those missing elements (e.g. test protocols) and other issues that arise during the development of the draft matrices, which are not (entirely) dependent on the eventual measureable criteria or scenarios.*

* Development of a draft test matrix for track testing based on the results of the currently on-going collaboration between VMAD SG1 and FRAV on the lane keeping scenario.
* Development of a draft test matrix for real world testing based on the detailed provisions developed by FRAV and limited to the highway use case. This work could potentially start once the draft general matrix for physical testing is completed, as it should demonstrate whether the provisions are sufficiently detailed to allow for this exercise. Alternatively, should measurable criteria for one or more of the safety requirements be developed by FRAV, these would be used instead.

Long term:

*The items below depend on the work by other entities, notably FRAV and VMAD SG1. Work on these items is not expected to commence in the near future.*

* Development of the complete test matrix for track testing as well as accompanying test protocols. Requires finalised measurable safety criteria as well as scenarios.
* Development of the complete test matrix for real world testing as well as accompanying test protocols. Requires finalised measurable safety criteria.
* Developing and conducting the validation process of the testing approach. (An initial discussion on the development of the validation process may perhaps also start once the draft test matrices (see medium term items) are developed, if deemed appropriate.)

**Annex II**

**Draft General Matrix for Physical Testing**

*Status: May 2022*

This annex sets out a first draft of the general matrix for physical testing.

As described in the NATM Master Document (GRVA-12-12), the purpose of the general matrix for physical testing would be to provide a clear overview of how the respective safety performance requirements set by FRAV would/could be assessed using track testing, real world testing, or both.

Although it is envisaged that the general matrix for physical testing will contain the upcoming measurable criteria to be set by FRAV, this document is based on the already available provisional safety requirements and detailed provisions developed by FRAV.

The exercise of preparing a draft general matrix based on FRAV’s provisional requirements and provisions serves the following purposes:

* To reach a general understanding of which safety requirements could be validated by track testing and real world testing. (Please note that the current activity aims to identify which requirements *could* be validated (in terms of technical feasibility), and does not seek to identify which requirements *should* be validated by which methods).
* To hold exploratory discussions on how the identified relevant requirements could be assessed using respectively track or real world testing, or both. This would furthermore allow SG4 to discuss the outstanding issue of what level of detail the general matrix should contain. (See the steps below for more details).
* To address/discuss the outstanding issue of how “if encountered” occurrences during real world testing should integrated in the approach.
* To address/discuss the outstanding issue of "how can you test on the test track, if the test track is not part of the ODD?".
* Once finalised, to facilitate the start of the development of the test matrices for respectively track testing and real world testing. (For track testing this could perhaps be done based on the work currently done by SG1 in cooperation with FRAV).
* Once finalised, to facilitate a more rapid development of the eventual general matrix for physical testing once the measurable criteria become available, by providing a more advanced starting point for the discussions as well as the experiences with filling in the matrix.

As a first step, the draft matrix was filled in with respectively "Yes", "No", and "If encountered". As a starting point for the discussions, the matrix had been pre-filled based on document VMAD-SG4-07-07-Rev.1. It was subsequently reviewed during the SG4 SDG meeting on 12 April 2022. In addition to filling the matrix with “Yes”, “No” and “If encountered”, several comments were made during the meeting regarding the (work necessary to derive) measurable criteria as well as testing methods.

In a possible future second step, an exploratory discussion would be held on how the identified relevant requirements could be assessed using the applicable physical testing methods. Based on these discussions, a decision should be made by SG4 on whether the general matrix should include more detail, in line with the option presented in the NATM Master Document.

In the context of coordination with FRAV, the discussions may also lead to providing feedback on what SG4 would require from the measurable criteria in order to facilitate their use in the VMAD's physical testing pillars.

In a possible future third step, and based on the outcomes of the second step's discussions, an exploratory discussion could be held on the outstanding issue of how to incorporate 'if encountered' occurrences during real world testing in the approach. In particularly, the discussion could focus on the desirability to include the 'if encountered' occurrences in the general matrix for physical testing, their inclusion in the test matrix for real world testing, and their inclusion in the test protocols for real world testing. (A discussion should also be held on whether 'if encountered' should be replaced by more appropriate terminology.)

In a possible future fourth step, the draft general matrix could be further developed and elaborated in line with the decisions of Step 2 and Step 3.

**The ADS should drive safely.**

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|  |  |  |  |  | Track Testing | Real World Testing | *Comment* |
| **1** | **The ADS shall be capable of performing the entire Dynamic Driving Task (DDT) within the ODD of its feature(s).** |  | **Yes** | **Yes** | *Track and real world testing alone not deemed sufficient to assess compliance with performance requirement.* |
|  | a | The capability of the ADS to perform the entire DDT should be determined in the context of the ODD of the ADS. |   | Yes | Yes | *Track and real world testing alone not deemed sufficient to assess compliance with performance requirement.* |
|  | b | As part of the DDT, the ADS should be able to: |   | - | - |  |
|  |  | i | Operate at safe speeds. |   | Yes | Yes | *Requires collection of existing examples on what constitutes safe speeds under particular variables, with the examples gathered from both national and academic literature. (This will be easier to gather for infrastructure related safe speeds, e.g. safe speeds at intersections, in curves, etc, as formulas are more readily available to serve as starting points for further development. It will be harder to gather existing examples/formulas for environmental conditions (e.g. wet roads) and for the interaction with other road users for example, and for combinations of different variables as well.) Work is currently ongoing in FRAV. Some instances might require subjective assessments in order to be able to fully judge the vehicle in a real world test.* |
|  |  | ii | Maintain appropriate distances from [other road users] by controlling the longitudinal and lateral motion of the vehicle. |   | Yes | Yes |  |
|  |  | iii | Adapt its behaviour to the surrounding traffic conditions (e.g., by avoiding disruption to the flow of traffic). |   | Yes | Yes |  |
|  |   | iv | Adapt its behaviour in line with safety risks (e.g., by giving all road users and passengers the highest priority). |   | Yes | If encountered |  |
|  |  |  |  |  | Track Testing | Real World Testing | *Comment* |
| **2** | **The ADS shall recognize the conditions and boundaries of the ODD of its feature(s) pursuant to the manufacturer’s declaration under paragraph 3.3** |  | **Yes** | **Yes** |  |
|  | a | The ADS should be able to determine when the conditions are met for activation. |   | Yes | Yes |  |
|  | b | The ADS should detect and respond when one or more ODD conditions are not or no longer fulfilled. |   | Yes | Yes | *We would expect real world testing to include sections that are not part of the ODD, in order to verify compliance with this requirement as well as related requirements (e.g. relevant HMI requirements for such situations).* |
|  | c | The ADS should be able to anticipate planned exits of the ODD. |   | Yes | Yes |  |
|  | d | The ODD conditions and boundaries (measurable limits) should be established by the manufacturer. |   | - | - |  |
|  | e | The ODD conditions to be recognized by the ADS should include: |   | - | - |  |
|  |  | i | Precipitation (rain, snow) |   | Yes | If encountered |  |
|  |  | ii | Time of day (light intensity, including the case of the use of lighting devices) |   | Yes | Yes |  |
|  |  | iii | Visibility |   | Yes | If encountered |  |
|  |   | iv | Road and lane markings |   | Yes | Yes |  |

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|  |  |  |  |  | Track Testing | Real World Testing | *Comment* |
| **3** | **The ADS shall detect and respond to objects and events relevant to its performance of the DDT.** |  | **Yes** | **Yes** |  |
|  | a | Objects and events might include, but are not limited, to: |   | - | - |  |
|  |  | i | Vehicles, motorcycles, bicycles, pedestrians, obstacles |   | Yes | Yes |  |
|  |  | ii | Road accidents |   | Yes | If encountered |  |
|  |  | iii | Road safety agents / enforcement agents |   | Yes | If encountered |  |
|  |   | iv | Emergency vehicles |   | Yes | If encountered | *One possible measurable criteria that should be considered is the assessment of whether the ADS acts in accordance with national or regional expected behaviour (e.g. creation of an emergency corridor or anticipation that the emergency vehicle might travel on the hard shoulder).* |
|  | b | The ADS shall detect objects in and around its path of travel that exceed a minimum size. |   | Yes | Yes |  |
|  | c | The ADS shall recognize objects as static or mobile. |   | Yes | Yes |  |
|  | d | The ADS shall recognize markings and signals used to indicate priority vehicles within the ODD of its feature(s). |   | Yes | Yes |  |
|  | e | The ADS shall classify priority vehicles within the ODD of its feature(s) in accordance with the relevant traffic law(s). |   | Yes | Yes |  |
|  | f | The ADS shall yield the right of way to priority vehicles in service in accordance with the relevant traffic law(s). |   | Yes | Yes |  |

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| **4** | **The ADS shall comply with safety-relevant traffic laws according to the ODD of the feature in use.** |  | **Yes** | **Yes** |  |
|  | a | ADS should comply with the traffic laws in nominal conditions, except when in specific circumstances or when necessary to enhance the safety of the vehicle’s occupants and/or other road users. |   | Yes | Yes, and if encountered | *Real world testing: If encountered for those specific circumstances, as they cannot be guaranteed to occur during a real world assessment.* |

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|  |  |  |  |  | Track Testing | Real World Testing | *Comment* |
| **5** | **The ADS shall interact safely with other road users.** |  | **Yes** | **Yes** |  |
|  | a | The ADS shall avoid collisions with safety-relevant objects where possible. |   | Yes | If encountered |  |
|  | b | The ADS shall signal intended changes of direction. |   | Yes | Yes | *Question to be addressed: How to verify that the external signal (e.g. indicator lights, brake lights) have been activated appropriately during real world conditions? Including the emergency stop signal lights, if applicable.* |
|  | c | The ADS shall signal its operational status (active/inactive) as needed. |   | Yes | Yes |  |

**The ADS should interact safely with the ADS vehicle user(s).**

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|  |  |  |  |  | Track Testing | Real World Testing | *Comment* |
| **6** | **User interaction with and the interface of ADS (features) shall have a high-level commonality of design.** |  | **-** | **-** | *The FRAV Users Group set out in FRAV-27-09 that they envisage this to be assessed as part of the audit.* |
|  | a | The ADS should be designed to foster a level of trust that is aligned with its capabilities and limitations to ensure proper use of the system. |   | - | - |  |
|  | b | The operation of the interaction shall have in common: |   | - | - |  |
|  |  | i | Use of common sequence of states in the transition/activation/overriding/… |  | - | - |  |
|  | c | The interaction should be simplified: |   | - | - |  |
|  |  | i | Limit the number of roles |   | - | - |  |
|  |  | ii | Limit the number of potential transitions |   | - | - |  |
|  |  | iii | Limit the number of settings |   | - | - |  |
|  |   | iv | Limit the number of different interaction modes |   | - | - |  |
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|  |  |  |  |  | Track Testing | Real World Testing | *Comment* |
| **7** | **The ADS HMI shall provide clear and unambiguous information to the user.** |  | **Yes** | **Yes** | *This could be assessed during both track and real world tests. However, as the FRAV User Group points out in FRAV-27-09, this would (also) require a different type of track and real world testing than has up to now been discussed in SG4, namely the use of naïve drivers. (The assessment would have to demonstrate that naive participants can understand it. The necessity of such assessment would however depend on whether HMI commonality requirements are established).* |
|  | a | The vehicle shall indicate its ADS capabilities in terms of their automated features and their ODD. |   | Yes | Yes |  |
|  | b | The ADS shall inform the user on the current conditions: |   | - | - |  |
|  |  | i | ADS status information |   | Yes | Yes |  |
|  |  | ii | The availability of ADS features |   | Yes | Yes |  |
|  |  | iii | User Role  |   | Yes | Yes |  |
|  |  | iv | Responsibility |   | Yes | Yes |  |
|  |  | v | Permitted NDRA |   | Yes | Yes |  |
|  |  | vi | Potential roles to activate |   | Yes | Yes |  |
|  |  | vii | "Standard” information: |   | - | - |  |
|  |  |   | Vehicle speed, range and Time to Fuel |   | Yes | Yes |  |
|  |  | viii | ADS failure information |   | Yes | If encountered |  |
|  | c | The ADS shall inform the user on the upcoming conditions: |   | - | - |  |
|  |  | i | ODD boundaries |   | Yes | Yes |  |
|  |  | ii | Upcoming actions or change in roles |   | Yes | Yes |  |
|  |  | iii | Oncoming decisions/manoeuvers |   | Yes | Yes |  |
|  |  | iv | Estimated time until take over in normal conditions |   | Yes | Yes |  |
|  |   | v | Transition related communication |   | Yes | Yes |  |
|  | d | The ADS shall ensure that safety related information is prioritized and presented in a clear and unambiguous manner. |   | Yes | If encountered |  |
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|  |  |  |  |  | Track Testing | Real World Testing | *Comment* |
| **8** | **The ADS shall be designed to prevent misuse and errors in operation.** |  | **Yes** | **If encountered** | *Note that the FRAV User Group suggests that audits could be sufficient. Nevertheless included here given that all these points could theoretically be assessed during track and real world tests.* |
|  | a | The ADS shall be designed to prevent inadvertent activation or deactivation. |   | Yes | If encountered |  |
|  | b | The controls dedicated to the ADS shall be clearly distinguishable from other controls. |   | Yes | Yes |  |
|  | c | The ADS shall provide feedback when the user attempts to enable unavailable functions. |   | Yes | If encountered |  |

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|  |  |  |  |  | Track Testing | Real World Testing | *Comment* |
| **9** | **The ADS shall be designed to ensure safe ADS feature activation.** |  | **Yes** | **Yes** | *From the FRAV User Group: track and real world testing: test that the ADS cannot be activeated outside ODD; The correct functioning of the HMI can be tested through human out of the loop simulation.* |
|  | a | The ADS shall inform the user that preconditions for activation are met. |   | Yes | Yes |  |
|  | b | The activation should follow a common sequence of actions and states: |   | - | - |  |
|  |  | i | Common sequence to be a pass/fail criterion. |  | Yes | Yes | *Common sequence would need to be developed.* |
|  | c | The ADS shall provide confirmation that the system is activated. |   | Yes | Yes |  |

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|  |  |  |  |  | Track Testing | Real World Testing | *Comment* |
| **10** | **An ADS which permits a transition of control shall be designed to ensure safe transitions of control.** |  | **Yes** | **Yes** | *Note from the FRAV User Group: Real world/test track: needs to be tested with a wide diversity of typical drivers.*  |
|  | a | The interaction shall follow a common sequence of actions and states in the Transition of control (change of user roles): |   | - | - |  |
|  |  | i | Common sequence to be a pass/fail criterion. |   | Yes | Yes |  |
|  |  |  | cid:image001.jpg@01D773FA.2A967280 |  | - | - |  |
|  | b | Transition of control shall return to a common default user role (to prevent mode confusion and other risks): |   | - | - |  |
|  |  | i | This shall normally be fully engaged driving (conventional driver). |   | Yes | Yes |  |
|  |  | ii | Common default user to be a pass/fail criterion. |   | Yes | Yes |  |
|  | c | The ADS shall continuously verify whether the user is available for the transition of control and warn the user if not available when required. |   | Yes | Yes |  |
|  | d | The ADS shall verify that the driver is in stable control of the vehicle to complete the transfer of control to the user. |   | Yes | Yes |  |
|  | e | During transition, the ADS shall remain active until the transition of control has been completed or the ADS reaches a minimal risk condition. |   | Yes | Yes, and if encountered | *Depending on the minimal risk condition, it may not be desirable to require an assessment of this in real world testing (e.g. stopping in lane on a motorway) hence why "if encountered" is added for real world testing.* |

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|  |  |  |  |  | Track Testing | Real World Testing | *Comment* |
| **11** | **An ADS which permits user takeovers of control shall be designed to ensure safe user-initiated takeovers.** |  | **Yes** | **Yes** | *From the FRAV User Group: real world/test track: needs to be tested with a wide diversity of naive drivers;*  |
|  | a | Under safe conditions the user is allowed to initiate a takeover of the ADS. |   | Yes | Yes |  |
|  | b | The deactivation should follow a common sequence. |   | - | - |  |
|  |  | i | Common sequence to be a pass/fail criterion. |  | Yes | Yes |  |
|  | c | The ADS should prevent and warn a user for a user-initiated takeover that would likely lead to an unsafe situation. |   | Yes | If encountered |  |
|  | d | The ADS should provide a clear feedback of the successful user initiated takeover. |   | - | - |  |
|  |  | i | The clear feedback should be a pass/fail criterion. |  | Yes | Yes |  |
|  | e | The user-initiated takeover should return to a common default user role (to prevent mode confusion and other risks) |   | - | - |  |
|  |  | i | This should normally be fully engaged driving (conventional driver). |   | Yes | Yes |  |
|  |   | ii | Common default user role to be a pass/fail criterion. |   | Yes | Yes |  |
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|  |  |  |  |  | Track Testing | Real World Testing | *Comment* |
| **12** | **The use of the ADS shall be supported by documentation and tools to facilitate the user in understanding the functionality and operation of the system.** |  | **Partially** | **Partially** |  |
|  | a | Documentation: *The following information should be documented:* |   | - | - | *Assessment via the audit pillar would likely be more appropriate.* |
|  |  | i | Theoretical and practical training |   | No | No |  |
|  |  | ii | How it aligns with common HMI and interaction |   | No | No |  |
|  |  | iii | Operational Description of ADS (features) capabilities and limitations (the information should also refer to specific scenarios) |   | No | No |  |
|  |  | iv | Description on roles and responsibility of driver/user and ADS when ADS (feature) is on/off  |   | No | No |  |
|  |  | v | Description of allowed transition of roles and procedure for the transition (activation/deactivation, ToC, Override) |   | No | No |  |
|  |  | vi | General overview list of NDRA allowed when an ADS feature is active |   | No | No |  |
|  | b | Tools: |   | - | - | *The FRAV User Group indicated track and real world testing could be used.* |
|  |  | i | The ADS supports the user in correct operation (coaching). |  | Yes | Yes |  |
|  |   | ii | The ADS gives prompt feedback on erroneous operation. |   | Yes | If encountered |  |
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|  |  |  |  |  | Track Testing | Real World Testing | *Comment* |
| **New** | **The integration of an ADS with the entire vehicle HMI shall be assured** |  | **Partially/Yes** | **Partially/Yes** | *Could potentially be partially covered by audit, if commonality requirements are set. The FRAV User Group also indicated track and real world testing could be used. RWT could for example be used to double check compliance demonstrated in the audit.* |
|  | a | The entire HMI design should be defined and the integration with ADS HMI assured by analysis and/or test |   | Yes | Yes |  |
|  | b | Potential of the user being confused by physical controls that have different meanings in different states should be avoided.  |   | Yes | Yes |  |
|  | c | The vehicle and ADS HMI needs to take into account potential impairments of authorised users (such as colour blindness, impaired hearing) which do not require specific hardware adaptations of the vehicle.  |   | Yes | Yes |  |

**The ADS should manage safety-critical situations.**

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|  |  |  |  |  | Track Testing | Real World Testing | *Comment* |
| **13** | **The ADS shall execute a fallback response in the event of a failure in the ADS and/or other vehicle system that prevents the ADS from performing the DDT.** |  | **Yes** | **If encountered** |  |
|  | a | In the absence of a fallback-ready user, the ADS should fall back directly to a Minimal Risk Condition (MRC) |   | Yes | If encountered |  |
|  | b | If the ADS is designed to request and enable intervention by a human driver, the ADS should execute an MRM in the event of a failure in the transition of control to the user |   | Yes | If encountered |  |
|  |  | i | Upon completion of an MRM, a user may be permitted to assume control of the vehicle |  | Yes | If encountered |  |
|  |   | ii | The user should be permitted to override the ADS to assume full control over the vehicle |   | Yes | If encountered |  |

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|  |  |  |  |  | Track Testing | Real World Testing | *Comment* |
| **14** | **The ADS shall signal its intention to place the vehicle in an MRC.** |  | **Yes** | **If encountered** |  |
|  | a | The ADS should signal its intention to place the vehicle in an MRC to:  |   | - | - |  |
|  |  | i | ADS user or vehicle occupants |   | Yes | If encountered |  |
|  |   | ii | Other road users (e.g., by hazard lights) |   | Yes | If encountered |  |

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|  |  |  |  |  | Track Testing | Real World Testing | *Comment* |
| **15** | **Pursuant to a traffic accident, the ADS shall stop the vehicle.** |  | **Yes** | **If encountered** | *What is the definition of an accident? E.g. striking a kerb with the tyres, would that count as a collision? Would nevertheless be desirable to verify the state of the tyre prior to continuing the trip).* |
|  | a | ADS reactivation should not be possible until the safe operational state of the ADS has been verified. |   | Yes | If encountered |  |

**The ADS should safely manage failure modes.**

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|  |  |  |  |  | Track Testing | Real World Testing | *Comment* |
| **16** | **The ADS shall detect and respond to system malfunctions and abnormalities relevant to its performance of the DDT.** |  | **Yes** | **If encountered** |  |
|  | a | The ADS should perform self-diagnosis of faults in accordance with the OEMs prescribed list |   | Yes | If encountered |  |
|  | b | The ADS should detect system malfunctions/abnormalities and evaluate system’s ability to fulfill the entire DDT |   | Yes | If encountered |  |

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|  |  |  |  |  | Track Testing | Real World Testing | *Comment* |
| **17** | **The ADS shall be designed to protect against unauthorized access.** |  | **Yes** | **If encountered** |  |
|  | a | The measures ensuring protection from unauthorized access should be provided in alignment with engineering best practices. |   | - | - | *The assessment of whether it is in alignment with best practices is likely more suitable for audits.* |

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|  |  |  |  |  | Track Testing | Real World Testing | *Comment* |
| **18** | **The ADS shall signal [faults/failures] compromising its capability to perform the entire DDT relevant to the ODD of its feature(s).** |  | **Yes** | **If encountered** |  |

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|  |  |  |  |  | Track Testing | Real World Testing | *Comment* |
| **19** | **The ADS shall be designed to protect against unauthorized modifications to safety-critical hardware and software.** |  | **Yes** | **n/a** | *Please note: this list only sets out technical possibilities to conduct such testing. Whether relevant to conduct such test on a test track, in the context of all NATM methods is a topic for future discussions.* |

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|  |  |  |  |  | Track Testing | Real World Testing | *Comment* |
| **20** | **The ADS may continue to operate in the presence of [faults/failures] that do not prevent that ADS from fulfilling the safety recommendations applicable to the ADS.** |  | **Yes** | **If encountered** |  |
|  | a | The limited operation of the ADS should comply to the normally applicable safety requirements. |   | Yes | If encountered |  |
|  | b | For situations where the ADS is not able to perform the DDT safely, the ADS should have the function to prevent activation. If the ADS has OTA functionality, this function may be activated remotely if the authorities or the vehicle manufacturer determine that the ADS is unsafe. |   | Yes | If encountered |  |

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|  |  |  |  |  | Track Testing | Real World Testing | *Comment* |
| **21** | **The ADS shall signal [faults/failures] compromising its ability to execute the DDT.** |  | **Yes** | **If encountered** |  |
|  | a | The ADS should signal [faults/failures] affecting the ability to execute the DDT. |   | Yes | If encountered | *We suspect the FRAV User Group might desire to complement this requirement with provisions on clear HMI.* |

**The ADS should maintain a safe operational state.**

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| **22** | **The ADS should signal required system maintenance to the user.** |  | **Yes** | **If encountered** |  |

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|  |  |  |  |  | Track Testing | Real World Testing | *Comment* |
| **23** | **The ADS should be accessible for the purposes of maintenance and repair to authorized persons.** |  | **Yes** | **n/a** |  |

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|  |  |  |  |  | Track Testing | Real World Testing | *Comment* |
| **24** | **ADS safety should be ensured in the event of discontinued production/support/maintenance.** |  | **n/a** | **n/a** |  |