SUBMITTED ELECTRONICALLY VIA REGULATIONS.GOV

Mr. James Owens
Acting Administrator
National Highway Traffic Safety Administration
1200 New Jersey Avenue S.E., West Building Washington D.C. 20590-0001

March 6, 2020

Re: Request for Comment (RFC)*: Advanced Driver Assistance Systems Draft Research Test Procedures*, NHTSA Docket No. 2019-0102, 84 Fed. Reg. 64405 (November 21, 2019)

Dear Mr. Owens:

The Alliance for Automotive Innovation (Auto Innovators)[1] appreciates this opportunity to provide input to the National Highway Traffic Safety Administration (NHTSA) regarding the Advanced Driver Assistance Systems (ADAS) Draft Research Test Procedures Request for Comment (RFC).

Auto Innovators is the leading advocacy group for the auto industry, representing 36 innovative manufacturers and value chain partners who together produce nearly 99 percent of all light-duty vehicles sold in the United States.[1] The newly established organization, a combination of the Association of Global Automakers and the Alliance of Automobile Manufacturers, is directly involved in regulatory and policy matters impacting the light-duty vehicle market across the country. Members include motor vehicle manufacturers, original equipment suppliers, technology and other automotive-related companies and trade associations.

Auto Innovators members emphasize that regardless of ADAS test procedure, there are important differences in how a test procedure is designed for research versus for the New Car Assessment Program (NCAP). Auto Innovators comments herein pertain to research, per the request in the RFC. If NHTSA would like to consider any of the test procedures for inclusion in NCAP, an additional request for comment should be issued.

Overall, we recommend that NHTSA harmonize to the extent possible with international standards and Euro NCAP. We have noted specific instances of where the research test procedure protocols should be harmonized in our comments below.

---

[1] The members of Auto Innovators include (alphabetically) Aptiv PLC, Aston Martin, Robert Bosch LLC, BMW Group, Byton, Cruise LLC, DENSO, Fiat Chrysler Automobiles, Ferrari S.p.A., Ford Motor Company, General Motors Company, Honda Motor Company, Hyundai Motor America, Isuzu Motors Ltd., Jaguar Land Rover, Karma Automotive, Kia Motors, Local Motors, Maserati, Mazda Motor Corporation, McLaren Automotive, Mercedes-Benz USA, Mitsubishi Motors, Nissan Motor Company, NXP Semiconductors, Panasonic Corporation, Porsche, PSA North America, Recreation Vehicle Industry Association (RVIA), SiriusXM, Subaru, Suzuki, Texas Instruments, Toyota Motor Company, Volkswagen Group of America, and Volvo Car USA.

ALLIANCE FOR AUTOMOTIVE INNOVATION

For each ADAS research test procedure, the number of repeated trials per test condition should be determined based on a data-driven process. It is important to have a high enough sample size for test repeatability. NHTSA should assess each test procedure to determine the appropriate number.

We recommend eliminating false positive tests for all ADAS test procedures discussed herein. In general, false positive test requirements would likely result in manufacturers designing their systems to the test rather than incentivizing real world false positive countermeasures. In other words, false positive test requirements would be counterproductive.

Specific recommendations for ADAS test procedures are addressed below.

****

Attached, please find our responses below to the RFC questions for Active Parking Assist (APA), Blind Spot Detection (BSD), Blind Spot Intervention (BSI), Intersection Safety Assist (ISA), Opposing Traffic Safety Assist (OTSA), Pedestrian Automatic Emergency Braking (PAEB), Rear Automatic Braking (RAB), and Traffic Jam Assist (TJA).

Auto Innovators appreciates the opportunity to provide input to NHTSA on this important topic. We look forward to any follow up with the Agency to expand on these comments further.

Sincerely,

Senior Director, Safety

Alliance for Automotive Innovation

Active Parking Assist

Overall Comments:
NHTSA has indicated these test procedures were developed for research purposes to assess ADAS features. In conducting this research, NHTSA should survey the systems which might be categorized as Active Parking Assist (APA). Based on these systems, NHTSA can identify elements to measure which might impact the safe execution of the system feature. Once these elements have been measured for all of the systems, criteria can be established using this data along with other research and real-world data. It is not clear where the criteria in this test procedure is derived from or why the particular scenarios were chosen, which creates some challenges in providing feedback. If possible, it would be helpful if NHTSA could publish data on how the test procedure was derived.

The scope of the test procedures should clearly specify what criteria systems should meet to be within the scope for evaluation by this test procedure (TP). For example, this TP does not seem to account for systems that would drive forward into the parking spot. Does that mean this system is not within scope of the TPs?

We recommend that NHTSA focus the TPs on the safe execution of the maneuver only, rather than the HMI and operation prior to the APA activation and following the completion of the maneuver. APA is a convenience feature more than it is a safety feature so NHTSA should not establish such stringent requirements that do not relate to the safe execution of the system maneuvers.

Lastly, we recommend that NHTSA consider ISO 20900 with respect to the performance requirements of partially automated parking systems.

1. Can the test procedures be expected to assess adequately for the purposes of research, within practical limitations, the performance of the underlying ADAS technologies? If not, please provide specific reasons why, and suggestions for how they may be improved.

The APA test procedures make a number of assumptions about how the APA is expected to function and operate. For example, in Section 5.4.1, the procedure is checking for the system to select the parking spot. Systems may require the driver to select the parking spot before the APA can begin its operation or maneuvering. We suggest starting the procedure from Stage 3 and focus the procedures on the safe completion of the maneuver. The requirements also assume that the APA maneuver will begin in reverse, which will not always be the case. NHTSA should consider APAs which will begin in a forward maneuver.

In Section 5.4.4, NHTSA has established performance criteria for the final position of the vehicle within the parking spot when the parking maneuver is completed. NHTSA provides no data to explain how these criteria were derived. Specifically, we do not think the criteria for which the rear-most part of the Subject Vehicle (SV) should be ≤12 inches from the inboard perpendicular edge accounts for varying sized vehicles, as well as types of vehicles (e.g. hatchbacks). The rear distance criteria should be defined based on the vehicle size and type, and the conditions around these variables for driver/user access and comfort.

We would recommend that the parking spaces should not be fixed dimensions, but rather proportional to the size of the vehicle being tested. This would be aligned with the current industry standard, ISO 20900. Accordingly, parallel parking should be defined as follows:

(a) For vehicle length (VL) < 4 meters: VL + 1 meter

(b) For 4 meters < VL < 6 meters: VL x 1.25 meters

(c) For VL > 6 meters: VL + 1.5 meters

Likewise, perpendicular parking should be defined as follows: width of standard space = width of ego-vehicle + 1.2 meters

2. Do any of the draft research test procedures contain elements that may potentially confound the system operation and/or test results (*e.g.,* regarding test conduct)? If so, please indicate what those elements are and how they might be addressed and/or mitigated?

Within these test procedures, NHTSA has established a number of criteria regarding HMI and notifications. NHTSA should not dictate the HMI at this stage because system designs will vary and will require different levels of driver engagement based on each system. Therefore, each system should have appropriate HMI for the appropriate type of driver engagement desired.

In Section 5.3.3, there is no apparent need to restrict the SV lateral position to be within 1 ft of the center of the approach lane. As an alternative, NHTSA should reconsider prescribing a minimum distance from parked vehicles.

In Section 5.6, NHTSA has set criteria on how the APA system should be overridden. NHTSA should not require override evaluations for each control or that the depression of the brakes cancel the APA system completely. The APA cancellation maneuver should be up to the developer. Manual depression of the brakes may override the system temporarily but not cancel the system operation altogether.

Additionally, during the front encroaching pedestrian test while parallel parking, the rationale for the specification of 8' from the rear end of next car is unclear. This procedure would dominate the system and its location, which may limit the real-world safety benefit.

3. Are the draft research test procedures clearly written, understandable, and executable? If not, please provide specific areas for which clarification is necessary, and suggestions for how they may be improved.

There are several areas within the test procedures where clarification is needed:

1. Section 5.4.4 of the procedure uses the left and right-most parts of the vehicle but does not define these clearly (using mirrors as farthest points, tires, etc.).

2. Section 5.4.4 of the procedure states that at no point in the parking maneuver shall the SV cross the inboard perpendicular edge of the parking space. If the vehicle can determine that there are no obstructions, the path of the vehicle should not be limited.
3. Section 5.5.2. assumes that the system starts in Reverse. The system should be allowed to start in Drive with a forward maneuver.

Also, there are a few missing criteria within the APA draft test procedure that need to be addressed. In Section 4.3, the use of curbs is left unspecified, where specification of curb use will make the test more repeatable. Exclusion of curbs is also not a technology neutral approach as some systems may use different sensors for edge detection, like ultrasonic sensors. This example underscores that it would be helpful if NHTSA could publish data on how the test procedure was derived.

4. Are the ranges of test speeds, speed combinations, and/or speed increments specified within each draft research test procedure reasonable? If not, please provide any data or evidence to support any claim of unreasonableness from a research perspective.

The test speed of 6 mph for the detection stage is reasonable. However, it would be helpful to know how this value was derived to provide a more definitive response. NHTSA should also add a tolerance around the target velocity: Auto Innovators recommends +/- 1 mph.

The impact location of the encroaching pedestrian can vary based on the speed of the vehicle during the execution stage. A subject vehicle traveling at a faster speed may impact the dummy while it's still moving. A slower moving subject vehicle may have a bigger advantage because the dummy would have already been stopped and the relative velocity would be less. As proposed, this significantly limits the reproducibility and fair evaluation of APA through this procedure.

5. To reduce test burden for the assessment of some technologies for research purposes, the number of repeated trials per test condition is proposed to be less than or equal to seven based on our experience from past test procedure design work. Is this adequate, or should another number of repeated trials be performed for all technology/condition combinations to support an assessment of whether differences in the test results, for a given condition, are statistically significant?

The number of repeated trials per test condition should be determined based on a data-driven process and result in valid assessments.

6. Are there additional ADAS technologies NHTSA should be evaluating for research purposes? If so, please indicate what they are.

No additional ADAS technologies need to be evaluated at this time.

7. Are there existing, alternative test procedures for the ADAS technologies identified in this notice that NHTSA should consider? If so, please identify them and provide any comparisons/contrasts that might be useful to the agency.

As previously mentioned, NHTSA should align with ISO 20900 where possible.

Blind Spot Detection

Overview
In general, we support the proposed test procedure for Blind Spot Detection (BSD) and Blind Spot Intervention (BSI). We believe the proposed test parameters will allow NHTSA to quantify the benefits of BSD and BSI. In response to the various questions, we offer a number of suggestions (see response to Q3 & Q4) that we believe will improve the test procedure. We also noted several test parameters (See response to Q1, Q2, and Q3) that we believe need to be clarified to allow consistent, accurate and successful testing. Finally, we suggest NHTSA consider adopting similar parameters as those used by ISO 17387:2008 and Euro NCAP. This will allow consistent data to be collected world-wide. Responses to BSD and BSI questions follow:

1. Can the test procedures be expected to assess adequately for the purposes of research, within practical limitations, the performance of the underlying ADAS technologies? If not, please provide specific reasons why, and suggestions for how they may be improved.

The title of this specification is "Blind Spot Detection Confirmation Test," yet the test procedures apply to a zone extending well behind the actual vehicle blind zone. Other test protocol names tend to be more generic yet inclusive of blind spot detection such as Euro NCAP's Lane Support System protocol. Auto Innovators recommends updating the protocol name to better reflect the feature set under evaluation as well as improve feature naming consistency.

2. Do any of the draft research test procedures contain elements that may potentially confound the system operation and/or test results (*e.g.,* regarding test conduct)? If so, please indicate what those elements are and how they might be addressed and/or mitigated?

In Section 3.2, the distance between lines A and C depends on the differential speed (Δv) between the SV and the POV. Line B, which is used to calculate the position of line C using a curve fit of ISO Standard 17387-2008 performance specifications, is perpendicular to the SV's longitudinal centerline and located at the rearmost (trailing) edge of the SV. However, the distance between line B to line C is too short. As a result, this draft test procedure does not allow a proper evaluation of lane pass by performance of Type III Lane Change Decision Aid Systems (LCDAS), which activates an alert earlier. We recommend eliminating false positive tests for all ADAS test requirements because they would likely result in manufacturers designing their systems to the test rather than incentivizing real world false positive countermeasures. However, if NHTSA chooses to conduct this test, we suggest that NHTSA describe BSD onset headway in Table 4 as the distance BSD must start the alert and describe the distance (or TTC) which BSD must not start to alert.

In Section 5.3.1.1, the lateral distance between SV and POV after the POV completes the diverge lane change is >4m (13.1 ft). However, the minimum lateral distance after the POV completes the diverge lane change should be greater than 6m to align with the current industry standard, ISO 17387. The evaluation criteria should be this same distance (6m).

The Section 5.3.1.4 Evaluation Criteria says: "During the diverge lane changes, the BSD alert may remain active when the lateral distance between the SV and POV is >3 m (9.8 ft), but ≤5 m (16.4 ft). The BSD shall not be active once the lateral distance between the SV and POV >5 m (16.4 ft)." In order to confirm it, the lateral distance after the diverge lane change ends must be 6m, in accordance with ISO 17387.

In Section 5.3.2.1, the Starting Longitudinal Distance between SV and POV is too short - nominally a 5 second gap. We recommend that NHTSA assign with ISO 17387:2008 and adopt a 150m distance. Additionally, in this section two numbers are listed as lateral distance between SV and POV. There is no explanation for those two numbers. We suggest that NHTSA provide additional clarification regarding these numbers.

In Section 5.3.2.4, BSD Onset Headway is too short for evaluating TYPE III LCDAS performance. We recommend that to evaluate TYPE III LCDAS, the maximum "BSD Onset Headway" should be determined by the distance between the SV and POV for which the BSD alert must NOT activate. In addition, BSD Termination Headway specifies that the warning should be extinguished when the rear most part of the POV passes the front-most part of the SV by certain longitudinal distances. Requiring the warning to be displayed when the POV is not in the blind spot may confound consumers regarding the performance of the system.

3. Are the draft research test procedures clearly written, understandable, and executable? If not, please provide specific areas for which clarification is necessary, and suggestions for how they may be improved.

We identified the following suggestions for improving the clarity of this test procedure:

- In Table 3, the lateral distance specification between POV and SV is not clear. One entry states 4.9 +/- 1.6 ft and other is 5 +/- 1 ft. This specification needs to be clarified.
- Section 4.4.1 of this procedure specifies an ambient temperature of 45° F – 104° F. However, ambient temperature has little impact on performance of this feature especially since performance is not based on a dynamic change in the vehicle path.
- If considered for NCAP:
    - In general, the lane widths of 3.7 to 4.3 m (12 to 14 ft) proposed by NHTSA appear wider than and subsequently do not align with U.S. lane width standards. AASHTO standards specify a lane width of 2.7 to 3.6 m (9 to 12 ft) depending on the type of road.[2] Auto Innovators believes that the test procedures should align with U.S. lane width standards and specify a 12 ft maximum lane width. We recommend that this can be achieved by harmonizing with Euro NCAP standards which specify 3.5 to 3.7 m (11.5 to 12 ft).
    - If this test procedure is extended to regulatory and/or NCAP applications in the future, adjustments are recommended to the Instrumentation Dynamic Initialization instructions described in Section 5.1.1. This procedure does not reflect the initialization procedures applicable to all GPS-based instrumentation options that may be used for this testing including the latest releases for OxTS RT equipment commonly used

[2] https://safety.fhwa.dot.gov/geometric/pubs/mitigationstrategies/chapter3/3_lanewidth.cfm

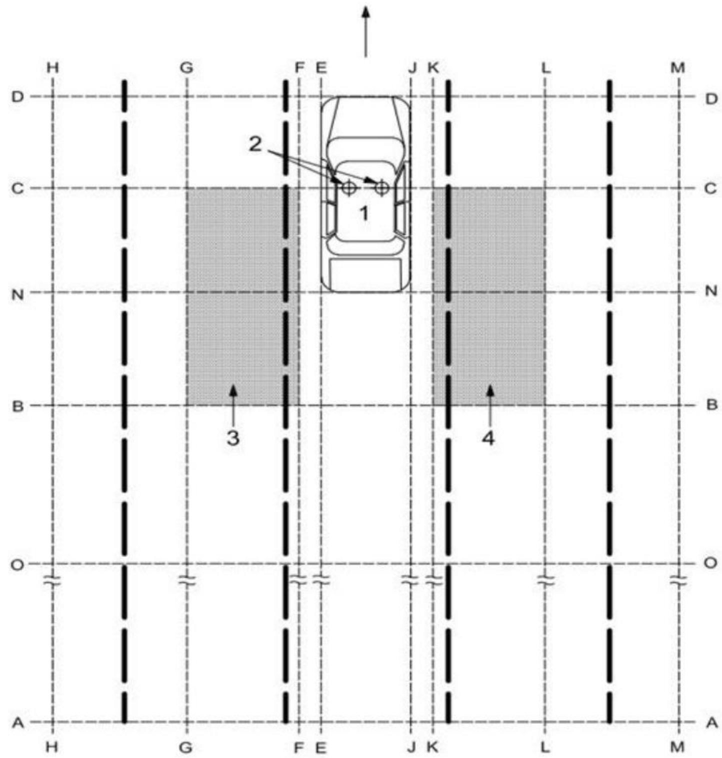
throughout the industry. Auto Innovators recommends simplifying this section to instruct testers to follow the equipment manufacturer initialization guidelines.

- In Section 5.3.1, “Straight Line Converge & Diverge Test”, the text refers to a lane change with lateral velocity of 3 ft/s. Figure 2, however, includes a value range of 0.8 – 4.9 ft/s that is not described in the text. This value range either needs to be explained or corrected to align with the lane change parameters described in the text.
- Section 5.3.2, “Straight Line Pass-by Test”, states the SV & POV are to remain 1.5m apart throughout duration of test. Yet, Table 3 includes two tolerances: 1.5±0.5m & 1.5±0.3m. This tolerance needs to be clarified.
- Section 4.5 POV Specifications – Although we expect BSD performance to be substantially the same amongst high production mid-sized passenger cars, greater consistency in research can be achieved by specifying a specific mid-sized passenger car.
- Section 4.6.1.1 SV & POV position (BSD flag) – Photocells may exhibit differences in sensitivity or latency. For the sake of consistency in research, the photocell should be specified.
- Section 5.3.2.1 Test Validity Criteria (Table 3) – Lateral distance between SV and POV is specified as both “4.9 +/- 1.6 ft; 5 +/- 1ft”. This is duplicative and conflicting.
- Subchapter 4.1 of Blind Spot Detection should be the same as in the Blind Spot Intervention Tests.

4. Are the ranges of test speeds, speed combinations, and/or speed increments specified within each draft research test procedure reasonable? If not, please provide any data or evidence to support any claim of unreasonableness from a research perspective.

We have identified the following suggestions for improving the definitions of the test speed combinations for this test procedure:

- We recommend the following ISO Standard 17387-2008 for defining the blind zone for section 3.2. For example, Line B from ISO 17387-2008 should be used instead of the line C definition shown in this procedure. This would reduce confusion since other NCAPS globally reference & use the ISO verbiage.



- Using defined values for line C may improve clarity and reduce the likelihood of errors. Line B in ISO 17387-2008 is 3m, for example. The included formula for longitudinal distance (BC) works out to TTCs of 2.5, 3.0 and 3.5 at the various relative speeds (10, 15, 20 m/s). The formula may be shown as reference to indicate how the specific TTC's were developed but Auto Innovators recommends utilizing defined values for the test specifications.
- In the RFC document under "Supplementary Information", NHTSA states, in part, "This RFC includes test procedures that have been developed for research purposes only. Additionally, NHTSA notes within the same section that "While the procedures include draft evaluation criteria, there are no pass/fail assessments provided because they have been assembled for research purposes only." However, the "Evaluation Criteria" section of this test procedure appears to be written as a performance requirement and not merely and assessment criteria for research. As such, Auto Innovators will hold comments on this section until any comment periods related to potential future regulatory or NCAP activities.
- Auto Innovators recommends eliminating the high relative test velocities (45/60 and 45/65 mph) due to the difficulty in maintaining the prescribed validity criteria. Factoring in distance to get to these speeds and hold them for the needed time, a straightway of longer than 2km would be needed. We suggest reducing the SV test speed to 35 mph and opening the validity criteria to get more valid tests with human drivers.

5. To reduce test burden for the assessment of some technologies for research purposes, the number of repeated trials per test condition is proposed to be less than or equal to seven based on our experience from past test procedure design work. Is this adequate, or should another number of

repeated trials be performed for all technology/condition combinations to support an assessment of whether differences in the test results, for a given condition, are statistically significant?

The number of repeated trials per test condition should be determined based on a data-driven process and result in valid assessments.

6. Are there additional ADAS technologies NHTSA should be evaluating for research purposes? If so, please indicate what they are.

No additional ADAS technologies need to be evaluated at this time.

7. Are there existing, alternative test procedures for the ADAS technologies identified in this notice that NHTSA should consider? If so, please identify them and provide any comparisons/contrasts that might be useful to the agency.

This document references ISO17387 but then does not follow the ISO definitions of the lines and pictograms. Auto Innovators recommend following the ISO17387 performance criteria and naming conventions, as this is also now used by China, Korea, Latin and ASEAN NCAPs.

Blind Spot Intervention

1. Can the test procedures be expected to assess adequately for the purposes of research, within practical limitations, the performance of the underlying ADAS technologies? If not, please provide specific reasons why, and suggestions for how they may be improved.

The test scenarios and much of the procedure are appropriate to assess the performance of Blind Spot Intervention. However, we have provided comments below to identify several issues in the test procedure and facility requirements. Comments are also provided to help address future changes such as inclusion in US NCAP or use of the procedure to assess vehicles with various levels of automation.

Please refer to the following comments in detail.

2. Do any of the draft research test procedures contain elements that may potentially confound the system operation and/or test results (*e.g.,* regarding test conduct)? If so, please indicate what those elements are and how they might be addressed and/or mitigated?

4.5.1 Surrogate Vehicle.
The version of the Global Vehicle Target (GVT), also known commercially as the "Soft Car 360" by one manufacturer, should be specified for test repeatability purposes. The latest version is recommended for use. In the case of the "Soft Car 360," it is Version G. We recommend that NHTSA establish a public record of the version specified to ensure that both NHTSA and the industry have the same versions available.

5.3.7.3 SV Lane Changes During Automated Vehicle Level 0 or 1 Operation
(c) Comparison of Baseline and Evaluation Trials (automation level 0 or 1)
1. Synchronization of the evaluation trial with the baseline composite so that the onsets of the respective lane changes occur within 20ms of each other.
2. Comparison of the SV yaw rate data collected during the evaluation trial with that defined by acceptability corridor. The SV yaw rate data collected during the evaluation trial shall not exceed the boundaries of the baseline acceptability corridor within the applicable validity period defined in S5.3.7.5.

Issue:
It is hard to keep synchronization of onsets baseline lane change and evaluation lane change within 20ms. Also comparing yaw rate between baseline and evaluation trials for detection of False Positive activation may cause errors.

Suggestion:
False positive test requirements would likely result in manufacturers designing their systems to the test rather than incentivizing real world false positive countermeasures. We recommend eliminating false positive tests from the requirements.

3. Are the draft research test procedures clearly written, understandable, and executable? If not, please provide specific areas for which clarification is necessary, and suggestions for how they may be improved.

If this test procedure is extended to regulatory and/or NCAP applications in the future, adjustments are recommended to the Instrumentation Dynamic Initialization instructions described in Section 5.1.1. This procedure does not reflect the initialization procedures applicable to all GPS-based instrumentation options that may be used for this testing including the latest releases for OxTS RT equipment commonly used throughout the industry. Auto Innovators recommends simplifying this section to instruct testers to follow the equipment manufacturer initialization guidelines.

Additional recommendations are as follows:

5.3.5.4 SV Lane Changes During Automated Vehicle Level 2 or 3 Operation
In automation level 2 or 3, the longitudinal and lateral position of the vehicle is automatically controlled by the SV, not by the driver. Therefore, evaluation of the SV's BSI system while the vehicle is operating in automation level 2 or 3 requires that the SV be equipped with an automatic lane change system. For vehicle's so-equipped, the SV driver shall operate the vehicle in automation level 2 or 3 for the duration of the validity period defined in S5.3.5.5. Without touching the steering wheel, the SV driver activates the left turn signal indicator at least 3 seconds after the onset of this validity period.

Issue:
In the market there is SAE automation level 2 or 3 in which automatic lane change is not activated without touching the steering wheel after the SV driver activates a left turn signal indicator. Therefore, to define "Without touching the steering wheel" cannot properly evaluate BSI system performance of those SVs.

Suggestion:
As for vehicles of SAE automation Level 2 or 3 in which automatic lane change is not activate unless the SV driver touches a steering, add definition of "touch the steering enough to activate automatic lane change". Auto Innovators recommends that NHTSA refer to the owner's manual on how to activate automatic lane change as this technology is still maturing and not all Level 2 or 3 systems will require a "touch" on the steering wheel to activate the lane change. This comment also applies to S5.3.6.3, 5.3.7.4(a), (b).

5.3.6.2 SV Lane Changes During Automated Vehicle Level 0 or 1 Operation
The SV driver shall activate the left SV turn signal indicator when the POV is 4.9 ± 0.5 seconds from a vertical plane defined by the rear of the SV and perpendicular to the SV travel lane. Within 1 ± 0.5 seconds after the turn signal has been activated, the SV driver shall begin the lane change shown in Figure 4 using the SV lane change path definition previously described Figure 2.

Issue:
Considering the allowable time tolerances, turn signal indicator timing is specified first (TTC=4.9±0.5s), then lane change timing is specified next (1±0.5s after signal). This causes a potential "stack-up," considering ±0.5s tolerance for each, potentially resulting in a total of 2s difference in lane change timing (e.g., TTCmin = 4.9-0.5-1.5 = 2.9s, TTCmax = 4.9+0.5-0.5 = 4.9s.)

Suggestion:
It is recommended for test repeatability purposes that lane change timing in addition to signal indicator timing be both specified in TTC (i.e. TTC of indicator being 4.9±0.5s, TTC of lane change being 3.9±0.5s).

4.3 Lane Width
Each lane required by this test procedure shall be delineated with two lane lines. Measured from inside edge to inside edge, these lines shall be spaced 12 to 14 ft (3.7 to 4.3 m) apart.

Issues:
In general, the lane widths of 3.7 to 4.3 m (12 to 14 ft) proposed by NHTSA appear wider than and subsequently do not align with U.S. lane width standards.

Suggestion:
AASHTO standards specify a lane width of 2.7 to 3.6 m (9 to 12 ft) depending on the type of road.[3] Auto Innovators believes that the test procedures should align with U.S. lane width standards and specify a 12 ft maximum lane width. We recommend that this can be achieved by harmonizing with Euro NCAP standards which specify 3.5 to 3.7 m (11.5 to 12 ft).

4. Are the ranges of test speeds, speed combinations, and/or speed increments specified within each draft research test procedure reasonable? If not, please provide any data or evidence to support any claim of unreasonableness from a research perspective.

The speeds reflect a real potential customer usage condition and are aligned with additional NHTSA and European NCAP test conditions. The procedure appears to be appropriate for assessing and demonstrating capability for a blind spot intervention system.

However, in case of the higher levels of automation (Level 2-5), flexibility would be recommended depending on automated systems, for example, 56mph/90kph for a highway system.

5. To reduce test burden for the assessment of some technologies for research purposes, the number of repeated trials per test condition is proposed to be less than or equal to seven based on our experience from past test procedure design work. Is this adequate, or should another number of repeated trials be performed for all technology/condition combinations to support an assessment of

[3] https://safety.fhwa.dot.gov/geometric/pubs/mitigationstrategies/chapter3/3_lanewidth.cfm

whether differences in the test results, for a given condition, are statistically significant?

The number of repeated trials per test condition should be determined based on a data-driven process and result in valid assessments.

6. Are there additional ADAS technologies NHTSA should be evaluating for research purposes? If so, please indicate what they are.

No additional ADAS technologies need to be evaluated at this time.

7. Are there existing, alternative test procedures for the ADAS technologies identified in this notice that NHTSA should consider? If so, please identify them and provide any comparisons/contrasts that might be useful to the agency.

ISO 19638:2018 should be referenced with respect to the performance requirements of a blind spot intervention system when applicable as an alternative test procedure.

We recommend alighting with Euro NCAP when applicable. Further we recommend that SV path distance tolerance be tightened from ±0.25 or ±0.5m in the procedure to ±0.05m to ensure stable performance and repeatability. This is the tolerance set in Euro NCAP procedures.

Intersection Safety Assist

Overview

We appreciate NHTSA's thoughtful consideration in developing research test procedures to assess adequately the limitations and performance of intersection safety assist technologies. We recommend that the agency evaluate and consider aligning with the proposals developed by the EVADE 2022 working group. These procedures will likely support the development of other similar NCAP procedures, for example, the Euro NCAP 2022 automatic emergency braking junction assist procedure. Also, the distance of intersection identified in the near miss scenario may require additional review.

1. Can the test procedures be expected to assess adequately for the purposes of research, within practical limitations, the performance of the underlying ADAS technologies? If not, please provide specific reasons why, and suggestions for how they may be improved.

While we understand that GVT revision G is the latest version which accommodates the 2020 Euro NCAP left turn scenario, it does not accurately replicate a vehicle in the crossing scenario and S2 near-miss scenario. NHTSA should consider the fidelity of the GVT in the various scenarios they consider as it could yield inaccurate results.

Additionally, NHTSA should assess the yaw tolerance for this procedure, as it may not be large enough for test execution.

2. Do any of the draft research test procedures contain elements that may potentially confound the system operation and/or test results (*e.g.,* regarding test conduct)? If so, please indicate what those elements are and how they might be addressed and/or mitigated?

ISA Scenario 1 has two types of POV approaches: crash-imminent and near-miss. The near-miss defines the SV first breaching the vertical plane on the approach side 6.6ft (2m) behind the POV. This can result in a high rate of false positives, and can be mitigated by increasing the distance of intersection behind the vehicle to 5m. (Note: False positive test requirements would likely result in manufacturers designing their systems to the test rather than incentivizing real world false positive countermeasures. We recommend eliminating false positive tests from the requirements.)

NHTSA is using a single radius to define their left turn paths for the POV and the SV as a single radius (page 83 and 86 of the TJA procedures, left image). The justification for this is to simplify the programming of the driving robot. Euro NCAP (right image) uses a modified left turn that is a combination of clothoids and a radius. We understand that this would increase programming complexity, but the goal is to simulate/test real-world driving scenarios and a single radius does not justify that.

Additionally, for L0 and L1 system testing, NHTSA should harmonize with EuroNCAP and define car-to-car lateral distance as well as minimize tolerance in order to minimize variability in testing and results.

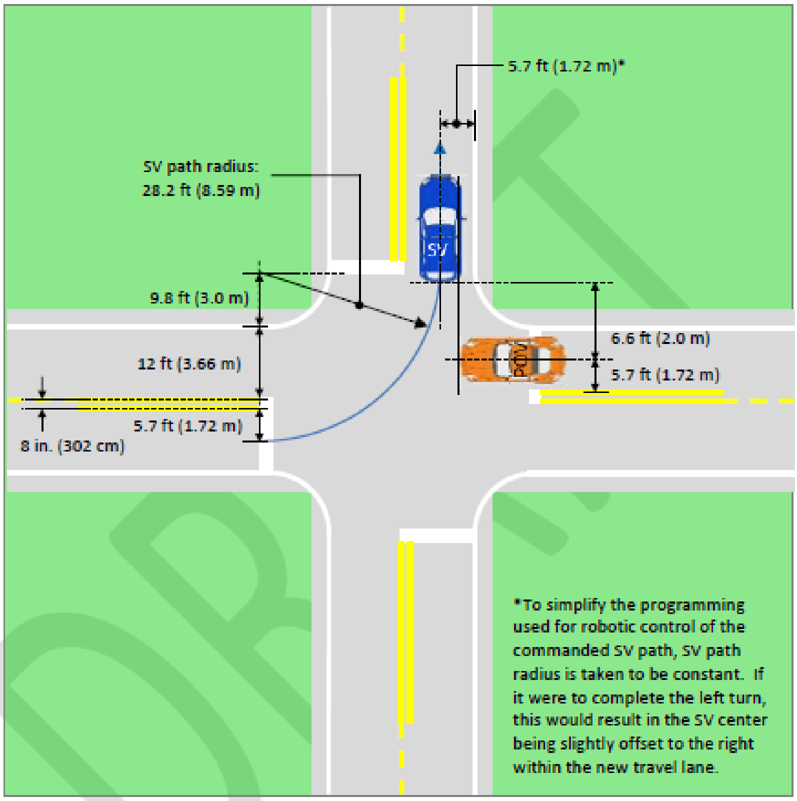
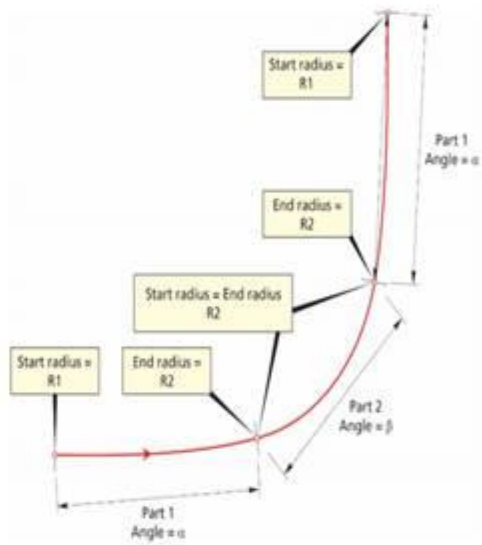


Figure A8. S3 path details, near-miss timing.



Test speed	Part 1 (clothoid)			Part 2 (constant radius)			Part 3 (clothoid)		
	Start Radius R1 [m]	End Radius R2 [m]	Angle α [deg]	Start Radius R2 [m]	End Radius R2 [m]	Angle β [deg]	Start Radius R2 [m]	End Radius R1 [m]	Angle α [deg]
10 km/h	1500	9.00	20.62	9.00	9.00	48.76	9.00	1500	20.62
15 km/h	1500	11.75	20.93	11.75	11.75	48.14	11.75	1500	20.93
20 km/h	1500	14.75	21.79	14.75	14.75	46.42	14.75	1500	21.79

Figure 8-6: CCFtap scenario paths definition

3. Are the draft research test procedures clearly written, understandable, and executable? If not, please provide specific areas for which clarification is necessary, and suggestions for how they may be improved.

For real world purposes, and potential crash-reducing behavior, the L2/L3 ADS may want to bias on one side of the lane versus staying in the middle of the lane at all times. Prescribing how much “center” the vehicle is could raise barriers to innovation. If in L2/3, then the vehicle should determine where in the lane it wants to be. NHTSA should not determine where the vehicle should be in the lane.

It would be helpful for NHTSA to clarify when defining contact with the POV in scenario 3, does a "virtual box" define the POV outline as in Euro NCAP pedestrian testing? Or is it actual SV front-center to POV left-corner contact?

4. Are the ranges of test speeds, speed combinations, and/or speed increments specified within each draft research test procedure reasonable? If not, please provide any data or evidence to support any claim of unreasonableness from a research perspective.

When the left turning radius of the POV is 8.58m and the evaluation speed is 24km/h, the lateral acceleration is 5.5m/s^2, which is considered to be too high from the design of the intersection. In the normal intersection geometry design, the lateral acceleration is designed to be 2-3m/s^2 or less for safety in rainy weather etc.

For this test procedure, NHTSA should consider the intersection geometry in Euro NCAP, wherein the left turning radius is 15m when evaluating at 20km/h. In addition, GVT (3D vehicle dummy) slips in the lateral direction at 5.5m/s^2 of lateral acceleration creating issues with unstable vehicle behavior in the S2 scenario.

However, this example may not apply if the four-way intersection used for ISA evaluations is considered the typical layout for U.S. intersections with many accidents. https://cdn.Euro NCAP.com/media/56143/euro-ncap-aeb-c2c-test-protocol-v302.pdf (see 7.1.4). Also, it is possible that the calculations used in S2-A, S2-B, S3-A0, S3-A1, S3-B0, S3-B1 do not align with the scenarios appropriately. NHTSA should consider the limitations of the sensors used to assess the scenario and the time required to take action. The system will need time to recognize objects/obstacles, judge the situation, and then time to brake if the system detects an imminent crash. We have concerns that some of the scenarios don't allow enough time for the system to adequately and accurately assess the scenario with time to take mitigation action.

We propose that the SV driver activate the left turn signal indicator before starting turning for 5.3.8 Scenario 3: SV Left Turn Across POV Path. This will more accurately represent real world driving conditions.

Additionally, within Scenario S3-A0, -A1, -C0 (near-miss, with constant speed POV), it is desired that the POV decelerate, similar to Pedestrian behavior in the PAEB near-miss test.

5. To reduce test burden for the assessment of some technologies for research purposes, the number of repeated trials per test condition is proposed to be less than or equal to seven based on our experience from past test procedure design work. Is this adequate, or should another number of repeated trials be performed for all technology/condition combinations to support an assessment of whether differences in the test results, for a given condition, are statistically significant?

The number of repeated trials per test condition should be determined based on a data-driven process and result in valid assessments. A sample size of three tests may be low when there are SV criteria that have a high variance, as stated in question three. Increasing the sample size or reducing vehicle path variation are solutions to this.

6. Are there additional ADAS technologies NHTSA should be evaluating for research purposes? If so, please indicate what they are.

No additional ADAS technologies need to be evaluated at this time.

7. Are there existing, alternative test procedures for the ADAS technologies identified in this notice that NHTSA should consider? If so, please identify them and provide any comparisons/contrasts that might be useful to the agency.

The EVADE 2022 proposal will serve as a basis for the Euro NCAP 2022 intersection procedures, and we would recommend aligning with this where applicable for the benefit of harmonization. Specifically, we recommend NHTSA use the tolerances from Euro NCAP for section 5.3.1, number 9 and 10.

Opposing Traffic Safety Assist

Overview

The draft test procedure for opposing traffic safety assist is clearly written and understandable. In order to execute this procedure more effectively, we suggest that a robotic control be used for the tolerances specified by the agency. This will help to ensure that the test procedure is conducted in a repeatable and reliable manner.

1. Can the test procedures be expected to assess adequately for the purposes of research, within practical limitations, the performance of the underlying ADAS technologies? If not, please provide specific reasons why, and suggestions for how they may be improved.

- In section 5.3.7 OTSA Scenario 2, it is not appropriate nor necessary to test the scenario where the SV departs from the lane with the turn signal ON, which essentially indicates driver's intentional turn signal operation and intentional lane departure for overtaking. Studies have shown that drowsiness and distraction accounted for about 75% lane departure accidents which are likely unintentional lane departures.
- In Section 5.3.6.5 Evaluation Criteria, it is not appropriate to specify a minimum lateral position of the SV relative to the POV to evaluate OTSA intervention. We recommend that the evaluation criteria should ultimately be whether the OTSA system avoids the collision, which is consistent with Euro NCAP's Lane Support Systems test protocol for Emergency Lane Keeping Oncoming test in Section 7.4.6.[4]

2. Do any of the draft research test procedures contain elements that may potentially confound the system operation and/or test results (*e.g.,* regarding test conduct)? If so, please indicate what those elements are and how they might be addressed and/or mitigated?

- Use of robotic control to execute subject vehicle trajectory may interact with the lateral control aspects of the underlying OTSA function for automation level 2 or 3 as described in the draft procedure. For example, many ADAS lateral control functions have driver torque override capability that allows the driver ability to override the automated lateral control function. Therefore, the robotic system executing trajectory control will need to interact with the OTSA lateral control function in a manner that does not override the vehicle path correcting actions of the OTSA system.
- Based on the tolerances recommended, we do not believe a human driver can perform the tasks repeatedly and reliably. Therefore, a robotic system is likely required. However, we anticipate that extensive tuning of the robotic system would be required to not interfere with lateral control aspects of the system during operation in level 2 and 3 automation.
- Specified lane width of 12 ~ 14 ft (3.7 to 4.3m) is too wide. AASHTO specifies lane widths to be 2.7 to 3.6m (9 to 12 ft) for US roadways. However, 3.6m is most appropriate for this case. We suggest that the lane width be reduced to 3.6m to align with US roadways.

---

[4] https://cdn.euroncap.com/media/53143/euro-ncap-lss-test-protocol-v302.pdf

- Passing criteria should be "no contact" between vehicles.
- NHTSA should consider LKS as optional to be activated during testing.

3. Are the draft research test procedures clearly written, understandable, and executable? If not, please provide specific areas for which clarification is necessary, and suggestions for how they may be improved.

The draft test procedure is clearly written and understandable but poses challenges regarding execution. For example, executing trajectory within the tolerance described will most likely require a robotic driver, which may interfere with lateral control as described in Question 2.

4. Are the ranges of test speeds, speed combinations, and/or speed increments specified within each draft research test procedure reasonable? If not, please provide any data or evidence to support any claim of unreasonableness from a research perspective.

While many of the speed ranges described in the research test procedure appear to be reasonable and consistent with previous NCAP procedures, they may not cover all speed and road combinations. Specifically, a test speed of 25mph (40km/h) appears to be too low. Lane departure fatal accidents have occurred at about 90km/h as a median, and over 98% of them have occurred at over about 50km/h, which was analyzed using NASS/GES2009. If considered for NCAP, it is recommended that the test speed be at least 50km/h.

5. To reduce test burden for the assessment of some technologies for research purposes, the number of repeated trials per test condition is proposed to be less than or equal to seven based on our experience from past test procedure design work. Is this adequate, or should another number of repeated trials be performed for all technology/condition combinations to support an assessment of whether differences in the test results, for a given condition, are statistically significant?

The number of repeated trials per test condition should be determined based on a data-driven process and result in valid assessments.

6. Are there additional ADAS technologies NHTSA should be evaluating for research purposes? If so, please indicate what they are.

No additional ADAS technologies need to be evaluated at this time.

7. Are there existing, alternative test procedures for the ADAS technologies identified in this notice that NHTSA should consider? If so, please identify them and provide any comparisons/contrasts that might be useful to the agency.

Additional considerations:

- Euro NCAP Test protocol for Lane Support Systems (July 2019)
- NHTSA Lane Departure Warning System Confirming test
- NHTSA Lane Keeping Support Performance Documentation

- EVADE 2022 – While still in draft form, we recommend that NHTSA discuss the EVADE 2022 procedures, if possible.
- Euro NCAP safety margin to limit damage to vehicle (0.3m)

Pedestrian Automatic Emergency Braking (PAEB)

Overview

We encourage the agency's continued efforts to evaluate PAEB systems. As noted by the agency, pedestrian traffic fatalities continue to rise despite an overall reduction in traffic fatalities. Today's PAEB systems are already demonstrating substantial improvements for pedestrian safety. NHTSA's draft test procedures generally provide a sound and comprehensive method to evaluate PAEB performance. The additional comments provided below seek to make meaningful improvements to facilitate more effective and efficient evaluation of PAEB systems. Of specific importance, we strongly urge the agency to consider the allowance of the Articulated Leg Pedestrian Test Mannequin (PTM)

1. Can the test procedures be expected to assess adequately for the purposes of research, within practical limitations, the performance of the underlying ADAS technologies? If not, please provide specific reasons why, and suggestions for how they may be improved.

9.1.5.5 Speed Reduction (Evaluation Criteria)

NHTSA's latest test procedure implements a method to calculate the magnitude of the SV speed reduction attributable to PAEB intervention. This calculation improves upon the prior version that implemented a simple "pass-fail" criteria based upon whether the CV contacts the PTM. We agree with NHTSA's latest evaluation criteria that appears to consider both full crash avoidance and crash mitigation (i.e. SV speed reduction). Such criteria allow for a significantly more meaningful evaluation of pedestrian injury risk reduction in the real world. We further suggest that NHTSA adopt a linear evaluation scale which awards points with respect to the magnitude of SV speed reduction.

9.1.1 S1a-b-c-d-f-g Test Course Setup (S1f and S1g scenario)

With current PAEB sensing technology and braking performance, the AEB will need to activate at a time that substantially overlaps with the dummy deceleration timing (see Figure 1). In other words, when the system determines that the pedestrian has completely stopped, the AEB system has already activated the brakes to avoid the collision. If the test procedure intends to evaluate a false-positive scenario (i.e. the SV is expected to not come to a stop) – which we do not recommend including – it is expected that the performance of PAEB would need to be reduced in true positive conditions. Auto Innovators members design PAEB systems by balancing the performance of true positive/false positive scenarios both in the real world and on the test course.

Overall, Auto Innovators recommend eliminating false positive tests for all ADAS test requirements because they would likely result in manufacturers designing their systems to the test rather than incentivizing real world false positive countermeasures. However, if NHTSA chooses to conduct this test, we suggest the following: In real world situations where a pedestrian walks this close to a vehicle, a human driver should (and would likely) stop to avoid a seemingly imminent collision. For the reasons above, we propose that the S1f and S1g scenario should be modified to reflect more realistic situations. We recommend modifying S1f such that the pedestrian stops at a more realistic distance, such as that proposed in the prior PAEB test procedure draft. For S1g, the PTM should "clear the vehicle's path" with greater margin (distance) to represent a more realistic case of a walking pedestrian with the SV not expected to stop.

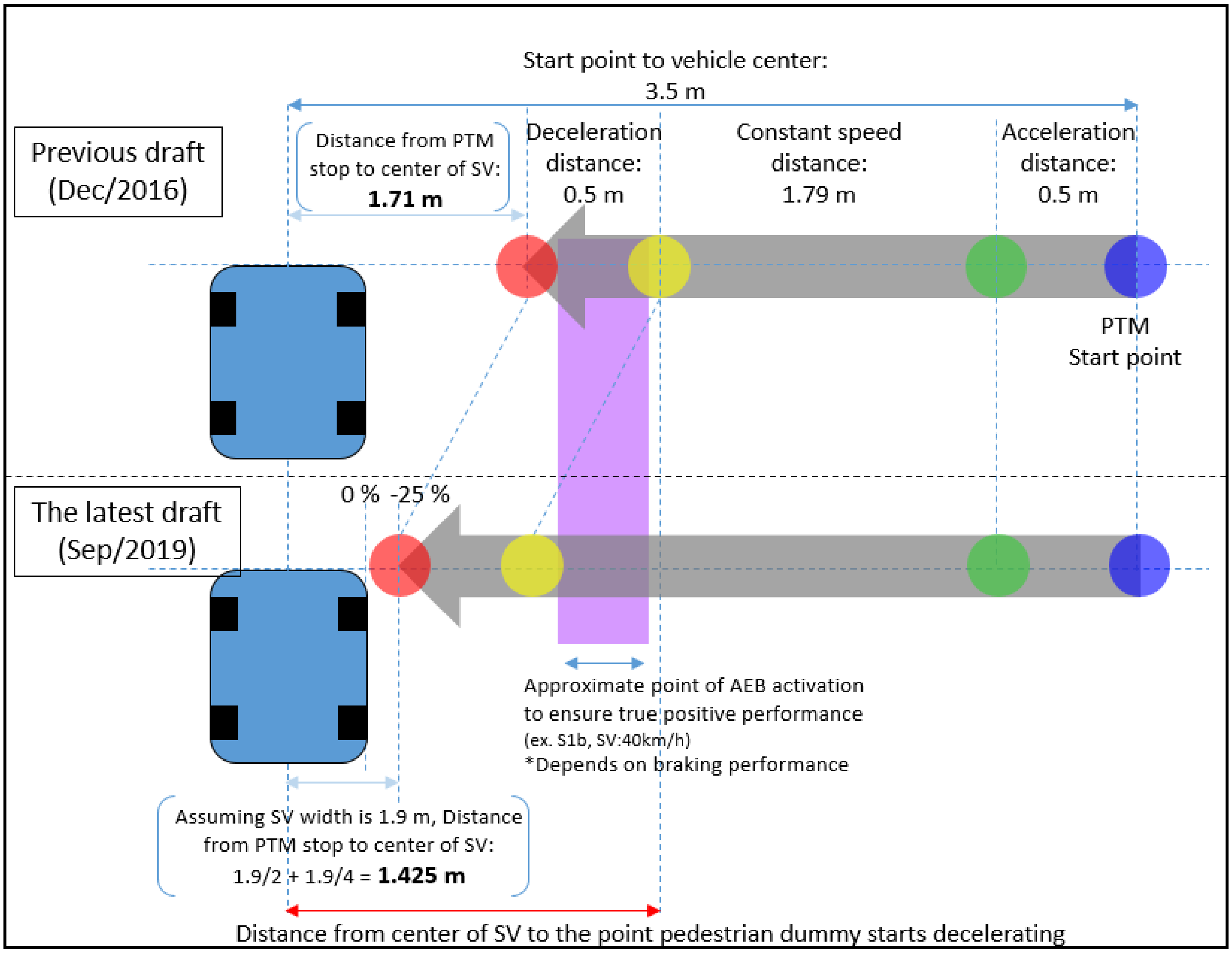


Figure 1: Diagram of PTM and SV approach in S1f scenario

9.2 (S4) Pedestrian Walking Along/Against Traffic

The procedure proposes two scenarios that represent a stationary pedestrian standing in the roadway, both facing away (S4a) and facing towards (S4b) the vehicle. While we acknowledge the real-world accident possibility of both scenarios, the test procedure could accurately represent both conditions with one test scenario. We recommend that NHTSA pick either S4a or S4b to represent both accident scenarios.

2. Do any of the draft research test procedures contain elements that may potentially confound the system operation and/or test results (*e.g.,* regarding test conduct)? If so, please indicate what those elements are and how they might be addressed and/or mitigated?

6.1.2.5 SV Throttle Pedal Position (Robot Speed Control)

The procedure specifies that the SV throttle pedal shall be measured to ensure [the human] driver has removed input from the throttle when the SV warning event is recognized. Our experience indicates that throttle control variability in this procedure with a human driver can be significantly improved with a robot. We recommend that the agency allow for the implementation of accelerator control by a robot to eliminate any potential test variation related to this.

4.3.2 Pedestrian Test Mannequin (PTM)

NHTSA's testing requires the use of a posable PTM with non-articulating legs that do not move relative to itself while testing. Today's advanced PAEB systems continue to make significant improvements in detection accuracy and recognition speed while minimizing false-positives. Non-articulating leg PTMs are more challenging for PAEB systems to detect while also encouraging systems to detect objects that are not representative of real pedestrians. Figure 1 provides an example of how Articulated leg PTMs more accurately represent a real pedestrian, when viewed by a PAEB sensor system. Such effects are also likely to occur for camera systems as well.

For these reasons, we strongly urge that the agency allow the use of the Articulated Leg PTM for evaluating PAEB systems. Pedestrian crash avoidance, both in this test procedure and in the real world, often present very challenging scenarios where the pedestrian is obstructed and/or provide very short reveal times. In order for PAEB systems to effectively address pedestrian injuries in the real world, it is critical that PAEB sensors recognize pedestrians quickly and accurately. Therefore, it is critical that PTMs used to evaluate this technology be as representative of a real pedestrian as possible. The allowance of an articulated leg PTM is absolutely necessary to ensure that PAEB performance can be maximized while also minimizing false-positive activations (e.g. with roadside objects). We also note that only the articulated leg PTM will be allowed in Euro NCAP from 2018 and in J-NCAP from 2020.

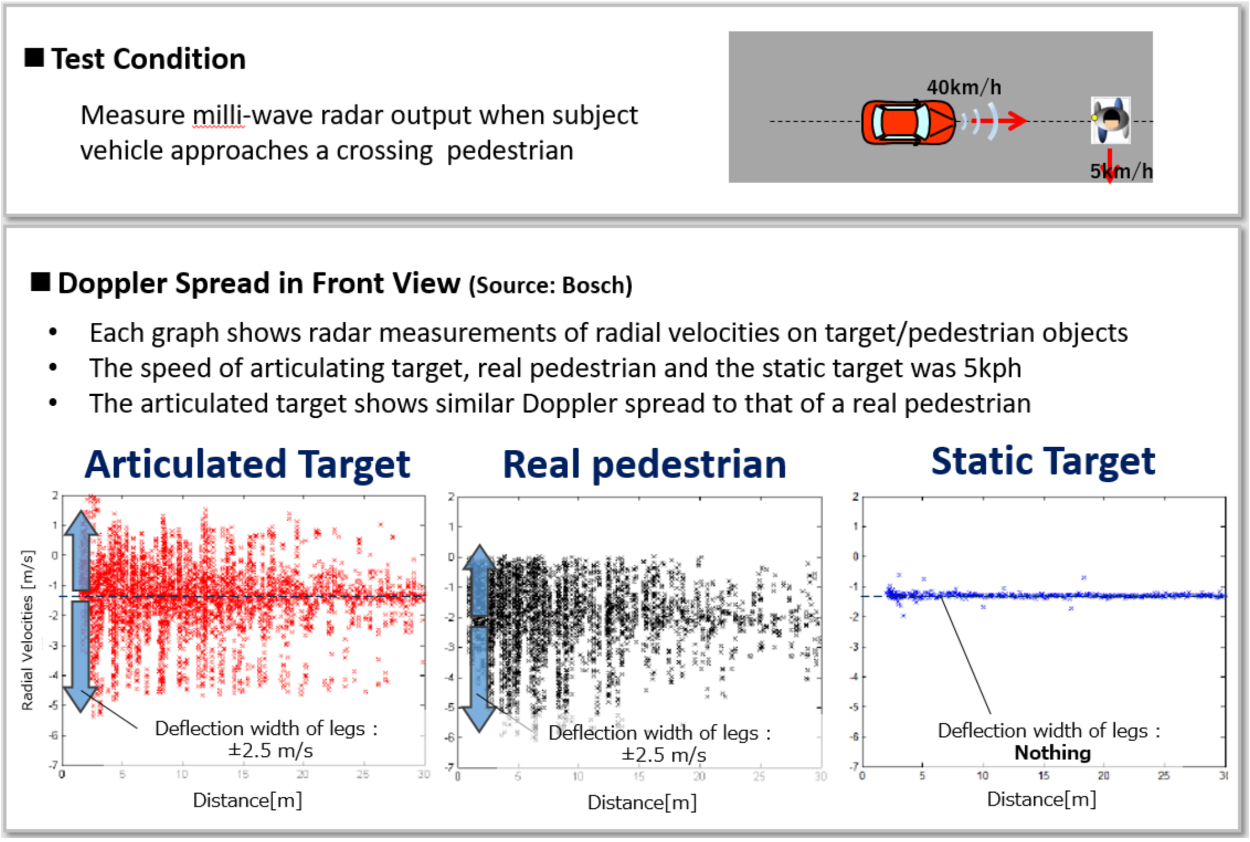


Figure 2: Pedestrian Target Mannequin Leg

These test procedures seek to evaluate “near-miss” or false-positive scenarios without an indication of what the expected performance should be. As previously mentioned, Auto Innovators do not recommend the inclusion of false positive testing. PAEB systems should focus on addressing the true-positive safety scenarios as a priority. We recommend that if NHTSA proceeds with false-positive testing, the Agency ensure that false-positive scenarios do not inappropriately incentivize a reduction in PAEB performance in true-positive scenarios.

3. Are the draft research test procedures clearly written, understandable, and executable? If not, please provide specific areas for which clarification is necessary, and suggestions for how they may be improved.

In general, the test procedures are clearly written, understandable and executable. However, there a few areas where additional clarification is needed. Specifically:

- Clarification of event onset - What would be the onset of the event; the deceleration, visual warning or first occurrence of feedback mode? Our interpretation of the proposed test procedures concludes that manufacturers can only choose between visual, haptic, **or** audible - not two or not all at once. To address this concern, Auto Innovators recommends that NHTSA change the text as “(e.g. visual, haptic, deceleration, and/or audible)” to say those are options but not prescribe exactly what warnings can be used.

- Triggering event - Auto Innovators recommends releasing the throttle at a specific TTC with boundary conditions met (Euro NCAP uses: 4s) for consistent performance.
- Equipment Location/Weights - With respect to section 6.1, the prescribed test equipment locations may not be practicable for all types of vehicles (e.g., roadsters without a rear seat. As a result, Auto Innovators recommends that the test equipment position and nominal weight should not be defined by the protocol and only maximum load or axle load should be defined.
- Pre-test System Calibration/Readiness Procedures – Before any testing, OEM specific vehicle calibration/"readiness" procedures should be followed.

4. Are the ranges of test speeds, speed combinations, and/or speed increments specified within each draft research test procedure reasonable? If not, please provide any data or evidence to support any claim of unreasonableness from a research perspective.

9.1.5.1 SV Approach (Speed)

NHTSA proposes SV speeds of 16 km/h and 40 km/h which differs from Euro NCAP. We are interested in understanding if NHTSA views the proposed speeds as more reasonable than those used in Euro NCAP.

11.0 Data Sheets – S1 Scenario Summary (PTM Speed and Acceleration Distances)

NHTSA's procedure proposes that the PTM achieves a constant speed of 5.0 km/h +/- 0.4. Our experience indicates that PTM speed variability can cause repeatability issues when running the tests. We recommend that NHTSA reduce the speed tolerance to +/- 0.2 km/h which is consistent with the Euro NCAP protocol when using the same 4activePS dummy.

Regarding PTM acceleration distances, Euro NCAP also originally considered using 0.5m (PTM Walking) and 1.0m (PTM Running), as currently proposed in NHTSA's draft. Through our experience in Euro NCAP, we determined that these short acceleration and deceleration distances lead to unstable speed and movement of the dummy. This behavior is undesirable because it is not representative of natural human movement and confounds PAEB sensor systems which primarily rely on the pedestrian torso to determine overall pedestrian speed and movement. We recommend that NHTSA consider increasing the acceleration and deceleration distances by 0.5m (1.0m for PTM walking scenarios, and 1.5m for PTM running scenarios), which also aligns with Euro NCAP's protocol.

5. To reduce test burden for the assessment of some technologies for research purposes, the number of repeated trials per test condition is proposed to be less than or equal to seven based on our experience from past test procedure design work. Is this adequate, or should another number of repeated trials be performed for all technology/condition combinations to support an assessment of whether differences in the test results, for a given condition, are statistically significant?

9.1.5.4 Number of Test Trials

The number of repeated trials per test condition should be determined based on a data-driven process and result in valid assessments. Care should be taken to not create overly burdensome requirements that provide no additional value.

6. Are there additional ADAS technologies NHTSA should be evaluating for research purposes? If so, please indicate what they are.

No additional ADAS technologies need to be evaluated at this time.

7. **Are there existing, alternative test procedures for the ADAS technologies identified in this notice that NHTSA should consider? If so, please identify them and provide any comparisons/contrasts that might be useful to the agency.**

As the agency is aware, the Euro NCAP AEB VRU Test Protocol (Version 3.0.2, July 2019) includes similar PAEB test procedures. However, NHTSA's draft procedures contain significant deviations from the Euro NCAP protocol with unknown need/rationale. The comments provided in this PAEB section intend to provide meaningful recommendations to the agency, based upon experience gained from Euro NCAP test protocols. We recommend that the agency also evaluate the extent to which NHTSA protocols can be aligned with Euro NCAP, so that automakers can more quickly and effectively deploy advanced crash avoidance systems to address growing concerns with VRU traffic fatalities in the U.S.

Rear Automatic Braking

1. Can the test procedures be expected to assess adequately, for the purposes of research, within practical limitations, the performance of the underlying ADAS technologies? If not, please provide specific reasons why, and suggestions for how they may be improved.

The rear automatic braking draft test procedure seems to assess the performance of an ADAS system to detect a 6-year-old pedestrian mannequin at the rear of the vehicle.

2. Do any of the draft research test procedures contain elements that may potentially confound the system operation and/or test results (*e.g.,* regarding test conduct)? If so, please indicate what those elements are and how they might be addressed and/or mitigated?

Indoor testing may introduce variances not typically found in parking lots or other outdoor environments where the system is intended to operate. Auto Innovators is concerned that there may be unnecessary variables that are not typical of the outdoor environment. Auto Innovators recommends that NHTSA consider both indoor and outdoor performance variances. We would also like to note that requiring indoor testing could be prohibitive for some manufacturers/suppliers.

In addition, the grid pattern on the test surface is different than typical real-world environment. We recommend that the grid pattern on the test surface be eliminated. If it is not eliminated, the lines used should be standardized as defined in the MUTCD.

3. Are the draft research test procedures clearly written, understandable, and executable? If not, please provide specific areas for which clarification is necessary, and suggestions for how they may be improved.

"10.1 D. Visibility" states the lux shall be no less than 16.0 lux. Auto Innovators feels that is quite a low lux value. We recommend that NHTSA apply a lux specification that is representative of daytime conditions.

Auto Innovators requests the posture of the mannequin be clarified to increase the consistent performance evaluation and repeatability. We recommend that NHTSA define mannequin posture, such as in Section 2.4 of the following, for increased repeatability:
https://www.acea.be/uploads/publications/Articulated_Pedestrian_Target_Specifications_-_Version_1.0.pdf

The center of the mannequin is unclear. In Appendix A, 13.1 "Test Procedure", step 2 states "Position the test object such that it is : *Longitudinally centered* along a line perpendicular to the vehicle's centerline and 20 ft. from the rearmost point on the vehicle's rear bumper." We recommend that NHTSA use hip point of the pedestrian mannequin to be longitudinally centered line up with the vehicle's centerline.

Regarding fuel level, the requirement of "full" is unclear. During testing, the vehicle may be on, idle for hours, and drive enough to use a non-trivial amount of fuel. Auto Innovators requests a parameter to set expectations and increase repeatability from one test to another. For other fluids, there are defined "full" lines and not likely to use up all the fluids in a test day. We recommend modifying 11.1.B for fuel from "full" to "greater than 75%."

A clarification is required regarding the speed for vehicle without creep mode available in Section 5.2 "Test Procedure Comments." If the SV were a vehicle that does not "creep," or move in reverse, at idle after the driver releases the brake and the vehicle does not have a variant in the vehicle line with an automatic transmission, then there is no speed set. We recommend that the speed should be tested at 4 kph which closely aligns with NHTSA's study of the 3 production vehicles in the draft test procedure assessment in Figure 4, as shown below.

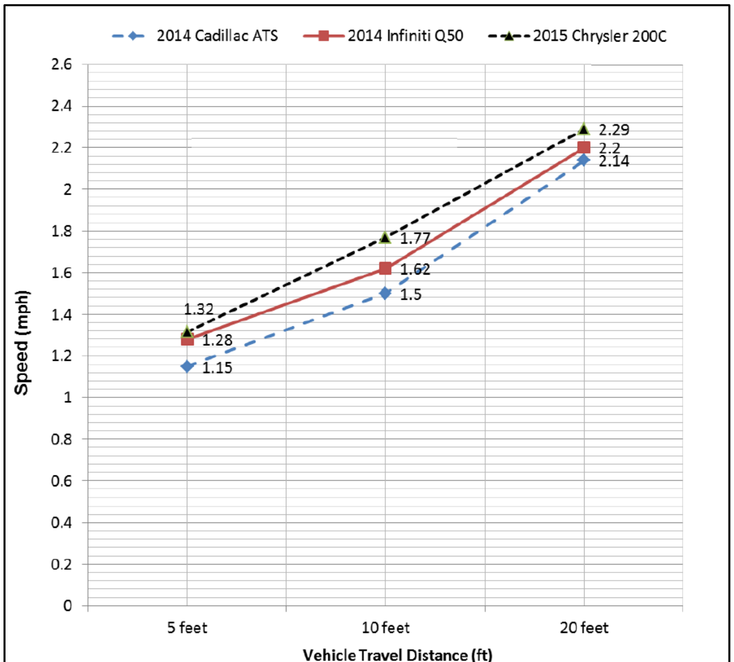


Figure 4. Average Backing Speed Over 20-Foot Distance for Vehicles Tested

4. Are the ranges of test speeds, speed combinations, and/or speed increments specified within each draft research test procedure reasonable? If not, please provide any data or evidence to support any claim of unreasonableness from a research perspective.

See response to Question 3.

5. To reduce test burden for the assessment of some technologies for research purposes, the number of repeated trials per test condition is proposed to be less than or equal to seven based on our experience from past test procedure design work. Is this adequate, or should another number of repeated trials be performed for all technology/condition combinations to support an assessment of whether differences in the test results, for a given condition, are statistically significant?

The number of repeated trials per test condition should be determined based on a data-driven process and result in valid assessments.

It is unknown what state the vehicle should be in after a RAB activation but before the next test run. Auto Innovators suggests a state or condition the vehicle should be in before executing a test run. We recommend that NHTSA specify a standby condition that prescribes that each test run start in the same condition every time (e.g. returning to the original position and set to stand-by condition). Only "shifting to P" does not prescribe enough to "ready" for next test run, because the standby condition differs depending on a RAB system. The standby condition should be prescribed to be able to start a test run in the same condition every time (e.g. returning to the original position and set to stand-by condition).

6. Are there additional ADAS technologies NHTSA should be evaluating for research purposes? If so, please indicate what they are.

No additional ADAS technologies need to be evaluated at this time.

7. Are there existing, alternative test procedures for the ADAS technologies identified in this notice that NHTSA should consider? If so, please identify them and provide any comparisons/contrasts that might be useful to the agency.

NHTSA should consider 2020 Euro NCAP Rear Automatic Braking, if it applies to the United States market

Other areas to increase test repeatability:

Road Friction

Research that involves braking should include friction as a data point. The difference between hitting a pedestrian mannequin or not can be heavily influenced by the coefficient of friction between the road and tires.

> **Recommendation**: Auto Innovators recommends using a coefficient of friction of 0.9 to be consistent with other brake-dependent test procedures

Sun Angle

Sun angle may also affect the sensors used in the RAB test procedure.

> **Recommendation**: Adopting the visibility provision that is used in other ADAS test procedures such as Section in 4.3.4 in Intersection Safety Assist

Speed Control

To ensure stable and repeatable speed control during testing, factors influencing engine speed should be controlled (e.g., AC operation, etc).

Brake Burnishing/Temperature Control

Braking is essential to Rear Automatic Braking in evaluating performance of the vehicle.

Recommendation:
- Auto Innovators recommends consistency with S14.1.2 & S14.1.3 of FMVSS to increase repeatability and full braking capability,
- Brake temperature specifications and warm up procedures should be specified.

Vehicle Mileage

A vehicle after a few hundred miles may be slightly different from one when it comes off the production line due to manufacturing processes. Some vehicles may have "break in" periods.

Recommendation:
- For research purposes, try to reasonably limit the number of miles on the vehicle
- If evaluating performance for programs such as NCAP, then Auto Innovators recommends testing vehicles between 200-5000 miles, or after OEM recommended vehicle brake-in period

Traffic Jam Assist

1. Can the test procedures be expected to assess adequately for the purposes of research, within practical limitations, the performance of the underlying ADAS technologies? If not, please provide specific reasons why, and suggestions for how they may be improved.

Auto Innovators recommends that vehicles, if operating in L2/L3 mode, be allowed to continue to control its lateral position in the lane. We are concerned that constraining the lateral position for a test procedure could not allow for driving behavior that could reduce crash risk (i.e. Driving farther from the double yellow lines when oncoming vehicle is approaching).

2. Do any of the draft research test procedures contain elements that may potentially confound the system operation and/or test results (*e.g.,* regarding test conduct)? If so, please indicate what those elements are and how they might be addressed and/or mitigated?

Partially. According to ISO15622 and ISO 20035:2019, the average automatic deceleration of ACC systems should not exceed $3.5m/s^2$ when traveling above ~45mph and should not exceed $5m/s^2$ when traveling below ~12mph. At NHTSA test speed of 15mph the equated deceleration level is $\sim 4.83m/s^2$ and for 25mph the decel level is $\sim 4.38m/s^2$. Due to the POV braking at a higher deceleration level of $5m/s^2$, is it allowable for the Level 2 TJA system to "hand off" to the AEB system for higher forced braking?

In Section 4.3, NHTSA specifies the lane width to be 3.7 to 4.3 m. For L2/L3 systems, lane centering control is necessary as a basis for automatic lane change system, but lane centering control might not be active because the lane width is too wide. In general, the lane widths of 3.7 to 4.3 m (12 to 14 ft) proposed by NHTSA appear wider than and subsequently do not align with U.S. lane width standards. AASHTO standards specify a lane width of 2.7 to 3.6 m (9 to 12 ft) depending on the type of road.[5] Auto Innovators believes that the test procedures should align with U.S. lane width standards and specify a 12 ft maximum lane width. We recommend that this can be achieved by harmonizing with Euro NCAP standards which specify 3.5 to 3.7 m (11.5 to 12 ft).

Some member's TJA requires specific ODD criteria (limited access highway, for example). This is confirmed through high-def mapping data. TJA would not be supported on private test track.

Evasive maneuvers are precluded in this TP. Should allow for lane changes.

3. Are the draft research test procedures clearly written, understandable, and executable? If not, please provide specific areas for which clarification is necessary, and suggestions for how they may be improved.

[5] https://safety.fhwa.dot.gov/geometric/pubs/mitigationstrategies/chapter3/3_lanewidth.cfm

In the Traffic Jam Assist Test Development Considerations (DOT HS 812 757), NHTSA refers to the Soft car 360 micro. Auto Innovators recommends that NHTSA utilize the GVT/GST hatchback variant in the test procedure, as defined in other draft procedures. The GVT/GST hatchback is the standard target defined in the Euro NCAP

In LVDAD scenario, it is described that the SV shall follow the POV that pulls away after over three-seconds stop. Some systems require driver's input for this particular scenario. Driver resuming operation should be specified in the protocol.

Additional recommendations are as follows:

3.0 Definition
"In the context of this document, TJA is a driver assistance system capable of automatically controlling the lateral position of the SV within its travel lane while simultaneously and automatically establishing and maintaining a constant longitudinal headway behind the vehicle immediately ahead of it at speeds up to 25 mph (40 km/h)".

Issue:
Some systems' speed range is over 25mph

Suggestion:
It is better to explain that "test scenario in this document covers speeds up to 25mph although some systems' speed range is over 25mph".

5.3.1 General Test Requirements
"5. The SV driver's hands shall not be touching the SV steering wheel."

Issue:
As described in a foot note most of systems cancel if the SV driver keep hands off. This may be appropriate depending on the level of automation of the system being tested. For example, a Level 2 system is intended to be "hands on" whereas a level 3 system is intended to be hands off. The procedure defined that this is intended for both a SAE automation Level 2 or 3. Regardless of the system, Auto Innovators believes that we need to be able to test the lateral performance of the system without SV driver influence.

Suggestion:
Agree that TJA should allow assessment of both "hands on" and "hands off" systems. NHTSA should take into account if it is a Level 2 or 3 system.

5.3.5.2 Test Overview
"After the SV has been stopped for ≥3 seconds, the POV shall accelerate to the desired speed with an average acceleration of 0.127g (1.25 m/s2) [6]".

Issue:
Needs to be aware that when the POV accelerates after the SV stopped, the SV may NOT resume following the POV automatically. Some systems may resume acceleration only when the stopping period is less than 3 seconds. Some systems may require the driver's positive action (e.g. depressing acceleration pedal, pressing resume button).

Suggestion:
a) Stopping period needs to be decided after investigation of existing systems' practice.
B) The timing of driver's positive action needs to be determined (e.g. 1 second after the POV starts to move.)

"After being driven at the desired speed for ≥3 seconds, the POV shall brake to a stop using an average deceleration of 0.5g (5 m/s2)."

Issue:
It is hard to determine the duration being driven at the desired speed.

Suggestion:
Explain how to determine that duration (e.g. "After being driven at desired speed until the SV speed reaches the speed of POV").

"In response to this, the SV is also expected to stop for a second time, also without impacting the POV".

Issue:
An average deceleration of 0.5g seems too high.

Suggestion:
If ACC braking does not create enough deceleration, Autonomous Emergency Brake (AEB) will brake to avoid the SV contacting the POV. Therefore, it should be explained whether or not AEB is activated.

General

Issue: There is no test scenario to evaluate lateral control performance.

Suggestion: Some of the candidates are:

a) The SV is following the POV in straight line and the distance between them is far enough so that lane lines are detected by a camera on the SV. When the POV makes lateral move, the SV remains the center of the lane.

b) The SV is following the POV in straight line and the distance between them is so close that lane lines are NOT detected by a camera on the SV. When the POV makes lateral move, the SV follows the POV's motion path.

c) The SV is following the POV in a bend in the road, The SV remains the center of the lane or follow the POV's motion path.

Issue: The criteria is not clear. If the SV contacts POV, the test fails?

Suggestion: The criteria should be described.

Issue:
Some systems may require an initialization procedure to achieve optimal TJA performance (which would otherwise be accomplished through normal driving)

Suggestion:
Add language that allows specific manufacturer initialization procedures, as needed.

Typo: In "Figure 2. POV acceleration and velocity profiles used during LVDAD scenario evaluations", the duration POV being driven after the first stop should be ≥3 seconds, not 3 seconds.

4. Are the ranges of test speeds, speed combinations, and/or speed increments specified within each draft research test procedure reasonable? If not, please provide any data or evidence to support any claim of unreasonableness from a research perspective.

Due to differences in vehicle deceleration levels between TJA and AEB (TJA – up to 0.3g and up to 0.5g), scenarios where both systems are expected to be activated are not appropriate for TJA evaluation.

5. To reduce test burden for the assessment of some technologies for research purposes, the number of repeated trials per test condition is proposed to be less than or equal to seven based on our experience from past test procedure design work. Is this adequate, or should another number of repeated trials be performed for all technology/condition combinations to support an assessment of whether differences in the test results, for a given condition, are statistically significant?

The number of repeated trials per test condition should be determined based on a data-driven process and result in valid assessments.

6. Are there additional ADAS technologies NHTSA should be evaluating for research purposes? If so, please indicate what they are.

No additional ADAS technologies need to be evaluated at this time.

7. Are there existing, alternative test procedures for the ADAS technologies identified in this notice that NHTSA should consider? If so, please identify them and provide any comparisons/contrasts that might be useful to the agency.

In Section 5.3.7, regarding LVLCB scenario, Euro NCAP AEB assessment needs similar SOV-POV control in the scenario named CCRb, in which there is a large difference compared to the procedure. Tolerance of initial clearance between SV and POV is ±0.5m on Euro NCAP tests as opposed to ±1m in the procedure. Since the initial clearance strongly affects system performance, it should be tightly controlled as Euro NCAP.