HYUNDAI MOBIS

June 8, 2022

Steven Cliff, Administrator
National Highway Traffic Safety Administration
US Department of Transportation
1200 New Jersey Avenue, S.E., West Building
Washington, DC 20590-0001

Subject: New Car Assessment Program Request for Comments, Docket No. NHTSA-2021-0002, March 9, 2022, 87 FR 13452

Dear Administrator Cliff,

Hyundai MOBIS, a Tier 1 automotive supplier, affiliated with Hyundai Motor Group, appreciates the opportunity to provide input on the National Highway Traffic Safety Administration's (NHTSA's) Request for Comment (RFC) concerning proposed enhancements to the New Car Assessment Program (NCAP). In North America, Hyundai MOBIS Technical Center develops autonomous and advanced driver assistance systems technology. Hyundai MOBIS is currently developing pedestrian automatic emergency braking (PAEB), forward collision prevention technologies, lane keeping technologies, blind spot detection technologies, driver state monitoring technologies and other ADAS technologies for improving safety.

Our attached comments, which were developed in an effort to provide NHTSA with technical information and data pertinent to this RFC, were prepared with the support of our ADAS engineering team members who have extensive experience and knowledge of current research and best practices for ADAS.

Hyundai MOBIS appreciates NHTSA's consideration of our comments. For related questions, please contact Claire Marquardt, via email CMarquardt@mobis-usa.com, or phone 248-861-7635.

Respectfully submitted,

Inuk Park

President
Hyundai MOBIS Technical Center of North America
46501 Commerce Center Dr.
Plymouth, MI 48170

HYUNDAI MOBIS

Hyundai MOBIS Comments on
NHTSA's Mar. 9, 2022 Request for Comment Regarding NHTSA's New Car Assessment Program Docket No. NHTSA-2021-0002

Hyundai MOBIS' comments address the following sections and technologies within the proposal:

- ADAS Performance Testing Program
  - Lane Keeping Technologies
  - Blind Spot Detection Technologies
  - Pedestrian Automatic Emergency Braking (PAEB)
  - Forward Collision Prevention Technologies

- Adding Emerging Vehicle Technologies for Safe Driving Choices
  - Driver Monitoring Systems
  - Driver Distraction
  - Alcohol Detection
  - Rear Seat Child Reminder Assist

Lane Keeping Technologies

Question 1: *Should the Agency award credit to vehicles equipped with LDW systems that provide a passing alert, regardless of the alert type? Why or why not? Are there any LDW alert modalities, such as visual-only warnings, that the Agency should not consider acceptable when determining whether a vehicle meets NCAP's performance test criteria? If so, why? Should the Agency consider only certain alert modalities (such as haptic warnings) because they are more effective at re-engaging the driver and/or have higher consumer acceptance? If so, which one(s) and why?*

Hyundai MOBIS RESPONSE:

It is necessary to consider various warning methods. Haptic warnings are a good recommendation because they can reduce consumer complaints compared to existing auditory warnings.

Question 3: *LKS system designs provide steering and/or braking to address lane departures (e.g., when a driver is distracted). To help re-engage a driver, should the Agency specify that an LDW alert must be provided when the LKS is activated? Why or why not?*

Hyundai MOBIS RESPONSE:

Yes, the system should provide an alert to ensure the user understands when the system had to correct their driving due to lane crossover. By default, the alert should be on in whatever capacity the vehicle company has determined. However, like all LKS and LDW systems, the end user should be able to change settings to determine if they want alerts (audible, haptic, visual, etc.).

Question 4: *Do commenters agree that the Agency should remove the Botts' Dots test scenario from the current LDW test procedure since this lane marking type is being removed from use in California? If not, why?*

Hyundai MOBIS RESPONSE:

We agree with the proposal to remove the Bott's Dots test scenario from the current LDW test procedure.

Question 10: *As discussed above, the Agency is concerned about LKS performance on roads that are curved. As such, can the Agency correlate better LKS system performance at higher lateral velocities on straight roads with better curved road performance? Why or why not? Furthermore, can the Agency assume that a vehicle that does not exceed the maximum excursion limits at higher lateral velocities on straight roads will have superior curved road performance compared to a vehicle that only meets the excursion limits at lower lateral velocities on straight roads? Why or why not? And lastly, can the Agency assume the steering intervention while the vehicle is negotiating a curve is sustained long enough for a driver to re-engage? If not, why?*

Hyundai MOBIS RESPONSE:

While LKS system performance at higher lateral velocities on straight roads may correlate to some extent with better curved road performance, it is difficult to confirm this correlation given curved road performance requires the use of additional data and more complex algorithms. More research would be needed to determine the extent to which LKS system performance at higher lateral velocities on straight roads correlates with better curved road performance.

Question 12: *Since most fatal road departure and opposite direction crashes occur at higher posted and known travel speeds, should the LKS test speed be increased, or does the current test speed adequately indicate performance at higher speeds, especially on straight roads? Why or why not?*

Hyundai MOBIS RESPONSE:

Most fatal road departures and opposite direction crashes are more likely to result from conditions beyond the control of the LKS, regardless of speed (e.g., accidents that occur under conditions in which LKS control cannot be activated, such as completely crossing a lane). Therefore, Hyundai MOBIS believes it is not necessary to increase the test speed for this purpose.

Blind Spot Detection Technologies

Question 16: *Should all BSW testing be conducted without the turn signal indicator activated? Why or why not? If the Agency was to modify the BSW test procedure to stipulate activation of the turn signal indicator, should the test vehicle be required to provide an audible or haptic warning that another vehicle is in its blind zone, or is a visual warning sufficient? If a visual warning is sufficient, should it continually flash, at a minimum, to provide a distinction from the blind spot status when the turn signal is not in use? Why or why not?*

Hyundai MOBIS RESPONSE:

Blind Spot Warning (BSW) testing should be conducted with and without the turn signal. Without the turn signal on, BSW is simply informational. When the turn signal is active, indicating the intent of a lane change, the alert is necessary to prevent a crash. This should be placed in conjunction with lane keep assist as many users often do not utilize turn signals when making a lane change. If the vehicle senses a principal other vehicle (POV) in the blind spot area and also detects the subject vehicle (SV) heading out of its lane, an alert should be issued.

Audible or haptic warnings should not be a requirement because they may influence users to turn the system off. A visual warning is used to indicate an urgency in the alert when a turn signal is turned on. Some automakers also use flashing signals when an approaching vehicle is going faster than the current speed of the SV.

Question 22: *Is it reasonable to perform only BSI tests in conjunction with activation of the turn signal? Why or why not? If the turn signal is not used, how can the operation of BSI be differentiated from the heading adjustments resulting from an LKS intervention? Should the SV's LKS system be switched off during conduct of the Agency's BSI evaluations? Why or why not?*

BSI should be tested both with and without turn signal activation as many users do not consistently utilize their turn signal when making lane changes.

The LKS system should be turned off during BSI and BSW testing. This will help to ensure that only the BSI and BSW systems are being evaluated and tested. Results may be different if the LKS system is active and BSI may not fully engage.

Pedestrian Automatic Emergency Braking (PAEB)

Question 34: *Are there other safety areas that NHTSA should consider as part of this or a future upgrade for pedestrian protection?*

Hyundai MOBIS RESPONSE:

An additional AEB assessment for cyclists is another safety area NHTSA should consider.

Forward Collision Prevention Technologies

Question 38: *For the Agency's FCW tests:*

- *If the Agency retains one or more separate tests for FCW, should it award credit solely to vehicles equipped with FCW systems that provide a passing audible alert? Or, should it also consider awarding credit to vehicles equipped with FCW systems that provide passing haptic alerts? Are there certain haptic alert types that should be excluded from consideration (if the Agency was to award credit to vehicles with haptic alerts that pass NCAP tests) because they may be a nuisance to drivers such that they are more likely to disable the system? Do commenters believe that haptic alerts can be accurately and objectively assessed? Why or why not? Is it appropriate for the Agency to refrain from awarding credit to FCW systems that provide only a passing visual alert? Why or why not? If the Agency assesses the sufficiency of the FCW alert in the context of CIB (and PAEB) tests, what type of FCW alert(s) would be acceptable for use in defining the timing of the release of the SV accelerator pedal, and why?*

- *Is it most appropriate to test the middle (or next latest) FVW system setting in lieu of the default setting when performing FCW and AEB NCAP tests on vehicles that offer multiple FCW timing adjustment settings?*

Hyundai MOBIS RESPONSE:

All alert types should be tested for FCW (audible, visual, haptic). Hyundai Mobis suggests testing using the default settings in the vehicle, as this will be the initial experience of the user who also may not know how to change it.

The nuisance factor of the haptic/audible alerts will ultimately depend on the number of false positives the system produces. But this should not determine what is considered acceptable for FCW alert types.

Clothing and size of the user is one consideration that should be made for the haptic alert's detectability. During winter, the user may have more layers on and may not easily feel the haptic alert if the haptics are contained within the driver's seat.

Testing should be done using the shortest timing. If the system cannot pass, then then it should be reassessed for the options that are provided.

Question 40: *Should the Agency remove the DBS test scenarios from NCAP? Why or why not? Alternatively, should the Agency conduct the DBS LVS and LVM tests at only the highest test speeds proposed for CIB – 70 and 80 kph (43.5 and 49.7 mph)? Why or why not? If the Agency also adopted these higher tests speeds (70 and 80 kph (43.5 and 49.7 mph)) for the LVD CIB test, should it also conduct the LVD DBS test at these same speeds? Why or why not?*

If the Agency continues to perform DBS testing in NCAP, is it appropriate to revise when the manual (robotic) brake application is initiated to a time that corresponds to 1.0 second after the FCW alert is issued (regardless of whether a CIB activation occurs after the FCW alert but before initiation of the manual brake application)? If not, why, and what prescribed TTC values would be appropriate for the modified DBS test conditions?

Hyundai MOBIS RESPONSE:

As with EuroNCAP, it is suggested to apply the manual (robot) brake 1.2 seconds after the FCW warning occurs. Braking later than 1.0 seconds simulates a worst-case scenario and provides the best evaluation opportunity.

Question 41: *Is the assessment method NHTSA has proposed for the CIB and DBS tests (i.e., one trial per test speed with speed increments of 10 kph (6.2 mph) for each test condition and repeat trials only in the event of POV contact) appropriate? Why or why not? Should an alternative assessment method such as multiple trials be required instead? If yes, why? If multiple trials should be required, how many would be appropriate, and why? Also, what would be an acceptable pass rate, and why? If the proposed assessment method is appropriate, it is acceptable even for the LVD test scenario if only one or two test speeds are selected for inclusion? Or, is it more appropriate to alternatively require 7 trials for each test speed, and require that 5 out of the 7 trials conducted pass the "no contact" performance criterion?*

Hyundai MOBIS RESPONSE:

An appropriate assessment would be to conduct 3 trials for each test rate and require 2 out of 3 trials performed to pass the "no contact" performance criterion to confirm consistent performance of the AEB function.

It is best to proceed in a consistent way whether it is 5 out of 7 trials, 2 out of 3 trials, 3 out of 4 trials, etc.

Driver Monitoring Systems

Question 62: *What are the capabilities of the various available approaches to driver monitoring systems (*e.g., *steering wheel sensors, eye tracking cameras, etc.) to detect or infer different driver state measurement or estimations (*e.g., *visual attention, drowsiness, medical incapacity, etc.)? What is the associated confidence or reliability in detecting or inferring such driver states and what supporting data exist?*

Hyundai MOBIS RESPONSE:

Several metrics can be used to infer driver state. Some of these include:

- Steering wheel sensor
- Gaze orientation / eyes off road
- Blink rate and blink duration
- Head pose
- Mouth activity
- Head nod activity

- Eye closure
- Body posture

There is enough available data to correlate driver status with one or more measurement, but not enough to be confident or reliable.

Question 63: *Of further interest are the types of system actions taken based on a driver monitoring system's estimate of a driver's state. What are the types and modes of associated warnings, interventions, and other mitigation strategies that are most effective for different driver states or impairments (e.g., drowsy, medical, distraction)? What research data exist that substantiate effectiveness of these interventions?*

Hyundai MOBIS RESPONSE:

There are several modes of warning and intervention techniques that can be employed. These include:

- Audio (chime or speech)
- Visual (cluster, center stack or HUD)
- Steering wheel vibration
- Seat or seat belt vibration
- Interior lighting

One or a combination of the above warning modes can be used depending upon the driver's state of impairment and its severity. The necessary alert depends on the situation. If the driver needs medical attention, issuing alerts to the driver will not be effective. Options for in-cabin monitoring alerts include driver alerts, passenger alerts and, if possible, emergency responders (via telephone/radio). [(1)]

There is enough empirical data to show the effectiveness of the different modes of alerts on the driver.

Question 64: *Are there relevant thresholds and strategies for performance (e.g., alert versus some degree of intervention) that would warrant some type of NCAP credit?*

Hyundai MOBIS RESPONSE:

Some strategies and Key Performance Indicators (KPI's) that can be used to determine NCAP

credit include:

- A time-based threshold dependent upon the driver's impairment state.
- The adaptability of the alert system based upon the driver's current state.
- The percentage of the drive that the system is enabled and working.
- The effectiveness of the alerts.
- The accuracy of the alerts.
- The number of scenarios the system addresses.

Question 65: *Since different driver states (e.g., visual distraction and intoxication) can result in similar driving behaviors (e.g., wide within-lane position variability), comments regarding opportunities and tradeoffs in mitigation strategies when the originating cause is not conclusive are of specific interest.*

Hyundai MOBIS RESPONSE:

In situations where the driver state cannot be explicitly detected or categorized, an adaptive driver warning, engagement and an externally developed automated vehicle system must be employed to take over the vehicle.

Question 66: *What types of consumer acceptance information (e.g., consumer interest or feedback data) are available or are foreseen for implementation of different types of driver monitoring systems and associated mitigation strategies for driver impairment, drowsiness, or visual inattention? Are there privacy concerns? What are the related privacy protection strategies? Are there use or preference data on a selectable feature that could be optionally enabled by consumers (e.g., for teen drivers by their parents)?*

Hyundai MOBIS RESPONSE:

Consumer interest can be divided based on comfort/convenience and safety. A basic in-cabin system can issue a warning. A more advanced system coupled with ADAS will ensure safe hand-over/take-over control.

Driver Distraction

Question 67: *What in-vehicle and HMI design characteristics would be most helpful to include in an NCAP rating that focuses on ease of use? What research data exist to support objectively characterizing ease of use for vehicle controls and displays?*

HYUNDAI MOBIS

Hyundai MOBIS RESPONSE:

Hyundai MOBIS suggests that NCAP use the following HMI design characteristics:

- Touch screens and buttons
- Swipe and gestures
- Speech recognition technology
- Rotary push controllers

Question 68: *What are specific countermeasures or approaches to mitigate driver distraction, and what are the associated effectiveness metrics that may be feasible and appropriate for inclusion in the NCAP program? Methods may include driver monitoring and action strategies, HMI design considerations, expanded in motion secondary task lockouts, phone application / notification limitations while paired with the vehicle, etc.*

Hyundai MOBIS RESPONSE:

The following warning strategies and HMI design characteristics can be used in conjunction with functional limitations (e.g., typing in a destination address, limiting access to certain touch screen menu features, texting when a cell phone is connected to the vehicle infotainment system) during vehicle motion.

Warning strategies:

- Audio (chime or speech)
- Visual (cluster, center stack or HUD)
- Steering wheel vibration
- Seat or seat belt vibration
- Interior lighting

HMI Design Characteristics:

- Touch screens and buttons
- Swipe and gestures
- Speech recognition technology
- Rotary push controllers

Adaptive alerts can also be used to mitigate driver distraction. An example of this is when the external/internal noise is high, audio can be replaced with visual alerts based on the location of the driver's gaze.

Question 69: *What distraction mitigation measures could be considered for NCAP credit?*

Hyundai MOBIS RESPONSE:

Some mitigation measures that we suggest NHTSA consider for NCAP credit include:

- Disabling the ability to type a destination address into navigation during vehicle motion.
- Limiting access to certain touch screen menu features during vehicle motion.
- Disabling texting while the cell phone is connected to the vehicle infotainment system.

A "predictive model" based on the driver's past behavior could also be used as a distraction mitigation measure. This system could reduce in-vehicle infotainment audio if necessary and alert the passenger in the front seat if there is not an expected response from the driver.

Alcohol Detection

Question 70: *Are there opportunities for including alcohol-impairment technology in NCAP? What types of metrics, thresholds, and tests could be considered? Could voluntary deployment or adoption be positively influenced through NCAP credit?*

Hyundai MOBIS RESPONSE:

Hyundai MOBIS believes there is an opportunity to include alcohol-impairment technology in NCAP when both invasive and non-invasive alcohol detection systems mature to a point of reasonable accuracy. Additionally, the technology must permit the seamless integration of invasive and non-invasive detection systems. The system should continue to function accurately over the expected lifespan of the vehicle with little or no maintenance after installation. Breath analyzer tests and estimated BAC levels can be used as a reference point for NCAP credit.

The accuracy and consistency of BAC detection as well as the life and maintainability of the detection system are important metrics in determining how early the system is adopted into usage. The main motivating factor for the voluntary adoption of this technology is through monetary incentives (either federal/state subsidy or discount from insurance providers).

Question 71: *How can NCAP procedures be described in objective terms that could be inclusive*

of various approaches, such as detection systems and inference systems? Are there particular challenges with any approach that may need special considerations? What supporting research data exist that document relevant performance factors such as sensing accuracy and detection algorithm efficacy?

Hyundai MOBIS RESPONSE:

The biggest challenge in implementing alcohol testing technology is making it secure, protected, disguised, and accurate. Another challenge is making the alcohol detection system recognize when someone is trying to trick it.

Question 72: *When a system detects alcohol-impairment during the course of a trip, what actions could the system take in a safe manner? What are the safety considerations related to various options that manufacturers may be considering (e.g., speed reduction, performing a safe stop, pulling over, or flasher activation)? How should various actions be considered for NCAP credit?*

The exact cause of impairment may not be determinable with a camera-based driver monitoring system. The response time and the sequence of actions a vehicle performs once it detects alcohol impairment is critical for vehicle safety and should be included in NCAP credit. Warning levels can be escalated gradually when there is no response from the driver. After a specified period of time with no driver response, a safe stop maneuver may be executed.

This could be considered similar to minimal risk maneuver (MRM) in autonomy, except a nonresponsive driver is different from impaired driver. Once the system is certain it has detected impaired driving and after all alerts are ignored by the driver, the system then can initiate MRM. Executing MRM can be challenging if/when the impaired driver tries to interfere with an MRM that is in progress.

Rear Seat Child Reminder Assist

Question 84: *If NHTSA considers this technology for inclusion in NCAP, are door logic solutions sufficient? Should NHTSA only consider systems that detect the presence of a child?*

Hyundai MOBIS RESPONSE:

Door logic solutions may be sufficient if the system remains active at all times and no provision exists for the driver to deactivate the system. In the future, we believe that NHTSA's NCAP

program should incentivize the installation of motion-detection sensors in addition to door logic solutions in order to better detect infants left in car seats as well as pets.

References

(1) National Highway Traffic Safety Administration. (2016, December). Human factors design guidance for driver-vehicle interfaces (Report No. DOT HS 812 360). <https://www.nhtsa.gov/sites/nhtsa.gov/files/documents/812360_humanfactorsdesignguidance.pdf>