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The Honorable James Clayton Owens
Acting Administrator
National Highway Traffic Safety Administration (NHTSA)
1200 New Jersey Avenue SE, West Building
Washington, D.C. 20590-0001

26-Nov-2019

Subject: reply to NHTSA's ANPRM on rear seat belt warning systems (NHTSA-2019-0093)

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Dear Mr. Owens,

IEE welcomes the opportunity to provide commentary related to the questions put forward by NHTSA in the Advance Notice of Proposed Rulemaking (ANPRM) on rear seat belt warning systems.

IEE is a global supplier of automotive sensing systems covering a large range of application areas such as occupant presence detection for seat belt reminder systems, occupant classification for advanced airbag systems, child presence detection sensors to help prevent in-vehicle heat stroke, and hands on/off detection sensors supporting assisted and automated driving.

On September 27, 2019, NHTSA published an ANPRM on rear seat belt warning systems in Docket No. NHTSA-2019-0093. This ANPRM included a variety of questions asking for feedback related to specific points.

Please find below IEE's response to those topics and questions where we feel we are in a position to comment.

1. Should the warning be visual-only, audible-only, or audio-visual? and
2. Triggering conditions

The warning should be audio-visual to maximise effectiveness for seat belt reminder (SBR) system configurations that have information about actual occupant presence. If only the buckle status is known for the rear seat occupants, the warning at the start of

the journey has to be limited to “visual only”. For change of status however, also those simpler systems should trigger an audio-visual warning, to provide a clear information to the driver as well as to the rear occupant that has unbuckled. By adding occupant detection information, audio-visual warnings can be triggered in any situation, also at the start of the journey.

“Visual only” SBR warnings can and will be easily ignored. A multitude of studies have proven that synchronized audio-visual warnings have the best effectiveness and that’s why UNECE Regulation 16 and the Euro NCAP SBR protocol require such a type of warning, for SBR configurations and situations where appropriate. Almost all other NCAP’s that have SBR incentives apply the applicable sections of the Euro NCAP SBR protocol[1]. For the sake of international harmonization, NHTSA should therefore implement the same warning principles, they are well established among the global automotive industry.

An “audible only” warning is not recommended, as only the additional synchronised visual information allows the vehicle occupant to clearly identify what the audible warning is related to.

4. Occupant detection technology & 7. Seat occupancy criteria

Rear seat SBR systems with occupant detection allow to trigger audio-visual warnings to unbelted occupants at the start of the journey. A couple of NCAP programs already incentivize such systems, respectively will do so in the near future: Japan NCAP (2011), Euro NCAP (2018), Australasia NCAP (2018), ASEAN NCAP (2021). Further NCAP’s are expected to follow.

NHTSA is correct by stating that UNECE R16 does not require occupant detection on the rear seats. NHTSA also correctly states that “*Euro NCAP does not specify that occupant detection for rear seats is needed in order to obtain bonus points*”. While this is still true today, this will change in 2022, and rear seat SBR points will ONLY be available for systems with rear seat occupant detection (same for Australasia NCAP, aligned protocols). Following this example, an update of US NCAP would be the most appropriate way to incentivize such systems, and to familiarize industry with their implementation.

To address concerns about false positives that might be triggered by cargo at the start of the journey, Euro NCAP allows the deactivation of the warning by a simple push of a dedicated button by the driver. It should however also be mentioned that rear seat occupant detection systems are available that can take into consideration the specific challenges of the rear seat compared to a front seat (cargo, CRS, foldable backrest, etc.). Sensors design allows to provide additional robustness for those situations to help avoid false positive warnings. The same applies to NHTSA’s example of a “large occupant spanning multiple seating positions”; sensor designs exist that can ignore a

[1] Euro NCAP Assessment protocol – Safety Assist v8.0.2

significant occupant overlap onto neighbouring seats preventing that a large occupant is detected as two individuals.

The current detection requirement defined by the above mentioned NCAP programs for the rear seat occupant detection is the 5% female (same as for the front seat in UNECE R16 and NCAP SBR protocols). There is no requirement to detect Child Restraint Systems, for occupant detection systems linked to SBR, the CRS are currently considered as “non detection” objects. This is even preferable, as some CRS have to be belted while some are attached to the vehicle via LATCH/ISOFIX. If CRS would be included in the detection requirement, one would have to be able to distinguish the different types of CRS, to avoid triggering a warning for the LATCH/ISOFIX types. So, including CRS to the detection criteria would lead to technical challenges that do not exist for the current protocol specifications. Belt usage is typically rather high for children as long as they are in a CRS, and the belt usage rates tend to drop when CRS are no more used/needed. The detection criteria for the 5% female includes a large share of this teenage population no more required to use a CRS. Defining the 5% female as detection criteria also would have the advantage to harmonize with the detection requirements existing e.g. for the front seats in FMVSS 208, and in SBR regulation or NCAP incentives in other parts of the world, making implementation easier for industry. In addition, it helps to have more robustness with regards to the risk of false positives triggered by objects. The 5% female as detection criteria strikes the right balance between including a large share of the target population, while allowing for robust non-detection for objects.

For passenger cars already equipped with rear seat buckle monitoring (13% in US for MY 2019 according to ANPRM; almost 100% of new vehicle models the EU market, legally required in EU for new types from September 2019 onwards) the additional costs for the occupant detection technology to cover the second row seating positions are in the low two-digit range. Among the vehicles that are already available on the EU market with advanced rear seat SBR systems, a couple are vehicle models that belong to the high volume, cost sensitive vehicle segments (small/compact cars). Hence one can conclude that the additional costs for the rear seat occupant detection are not prohibitive and should not be considered as a limiting factor for widespread implementation over all vehicle segments. In fact, seat belt wearing in cost sensitive vehicles is of even higher importance, as those vehicles are less frequently equipped with driver assistance systems or crash avoidance technology.

In the context of occupancy sensing, it is also worth to mention a significant difference between a seat belt reminder system and the current FMVSS 208 low-risk deployment and suppression airbag systems. The SBR system is a warning and reminding system, it does not influence the airbag deployment strategy. FMVSS 208 aims at preventing death and injury risks from deploying airbags to children. This difference in system requirements leads to a difference in the occupant sensing needs. For SBR, industry typically refers to “occupant detection”, while for FMVSS 208 compliance “occupant classification” systems are used. Occupant detection sensors are available at lower costs than occupant classification sensors. By defining the presence of a 5% female

as an SBR occupancy criterion, without any further requirements related to children and child restraint systems, one can ensure that available occupant detection technology can enable advanced rear seat SBR systems.

8. Making the system resistant to intentional and inadvertent defeat

Most of the topics described by NHTSA under *"a number of ways in which a rear seat belt warning system might be intentionally defeated"* also apply to the driver seat (and the front passenger seat). Driver SBR is already mandated today. Should NHTSA really see the necessity to upgrade the requirements for the driver SBR, in order to prevent defeating actions, then the same countermeasures are likely to be applicable to the SBR systems on other seating positions. Concerns of a possible defeat by the so-called "hard-core non-users" should not be used to question the introduction of a life-saving system like SBR, that would positively influence the overall belt usage behaviour.

The example described by NHTSA with the "remote engine starter", where people might enter the vehicle only after the potential initial warning cycle might have ended, can easily be avoided with occupant detection. The SBR warning cycle would only be triggered based on the actual presence of occupants. So, this is another example showing the advantage of knowing about actual occupant presence.

UNECE R16 as well as Euro NCAP allow the driver to acknowledge the rear seat SBR warning, and this action deactivates the visual and/or audio-visual warning. This option is however only available for the start of the journey and not for audio-visual "change of status" warnings (triggered by an unbuckling human). While any deactivation possibility can obviously have some influence on the effectiveness, it allows on the other side to balance the potential needs for deactivation (e.g. deactivate possible false positive alerts).

12. Harmonization with regulatory requirements or new car assessment programs in other markets & 25. Non-Regulatory Alternatives

The Seat Belt Reminder function would be a perfect topic to promote international harmonization of the requirements.

With regards to the overall warning requirements and the introduction of a buckle monitoring function to the rear seats, NHTSA could easily use the recently adopted UNECE Regulation 16 as a reference to update FMVSS 208 and to mandate the same SBR functionalities.

The Euro NCAP SBR protocol is well established and many other NCAPs refer to it, either to the current version or earlier versions. Also, on NCAP level, NHTSA could contribute to harmonization by creating short-term incentives in US NCAP that would be aligned to the Euro NCAP SBR protocol. Two goals could be achieved: a) promote more advanced warnings and rear seat buckle monitoring SBR functions before a possible FMVSS 208 update might enter into force; b) follow Euro NCAP and other NCAPs by incentivizing advanced rear seat SBR functions with occupant detection.

SBR incentives have been key elements in many NCAP ratings in the past and continue to be so today. The main motivation for the NCAPs to promote SBRs is that the vehicle safety rating is only applicable for belted occupants. When unbelted, one can easily die in a low speed crash, even if riding in a five-star car. And unrestrained rear seat occupants can endanger the life of front row occupants. Drivers are about twice as likely to be fatally injured in crashes in which the left rear passenger was unbelted[2]. This is a frequently ignored risk linked to unbelted rear seat occupants.

The overview in table 1 shows that, except for US NCAP, all other NCAPs have implemented SBR incentives on the front and rear seats. US NCAP can easily follow the other NCAPs by implementing SBR incentives. The SBR technology is widely available, easy to install, cost-effective and has a proven effect on increasing seat belt wearing rates. Having just celebrated its 40th anniversary, US NCAP could send a strong message by aligning with the rest of the NCAP family.

NCAP	Front seats	Rear seats
Japan	Advanced SBR	Buckle monitoring & Advanced SBR
Europe	Advanced SBR	Buckle monitoring & Advanced SBR
Australia	Advanced SBR	Buckle monitoring & Advanced SBR
Korea	Advanced SBR	Buckle monitoring
Latin	Advanced SBR	Buckle monitoring
ASEAN	Advanced SBR	Buckle monitoring
China	Visual warning SBR & Advanced SBR	Buckle monitoring

Table 1: NCAP incentives worldwide

The SBR incentives lead in general to increasing fitment rates of the systems into new vehicles. Since 2011 almost 100% of the Euro NCAP tested vehicles were equipped with advanced SBR on the front seats, and since 2015 on average about 96% of the tested vehicles have a rear seat buckle monitoring SBR function. This success in market penetration of such SBR systems though NCAP incentives paved the way for a regulatory requirement in Europe, effective September 2019 for new type approvals. Euro NCAP will therefore focus on incentivizing advanced rear seat SBR systems. A score for such systems was introduced in 2018, and it will even be increased in 2020. Figure 1 shows the evolution of the SBR fitment to Euro NCAP tested vehicles for the various seating positions since the creation of the SBR incentives. Worth to notice is the rise of advanced rear seat SBR systems with occupant detection, already reaching 42% in 2019 (status November).

[2] IIHS Status Report, Vol 52, No. 5, August 3, 2017

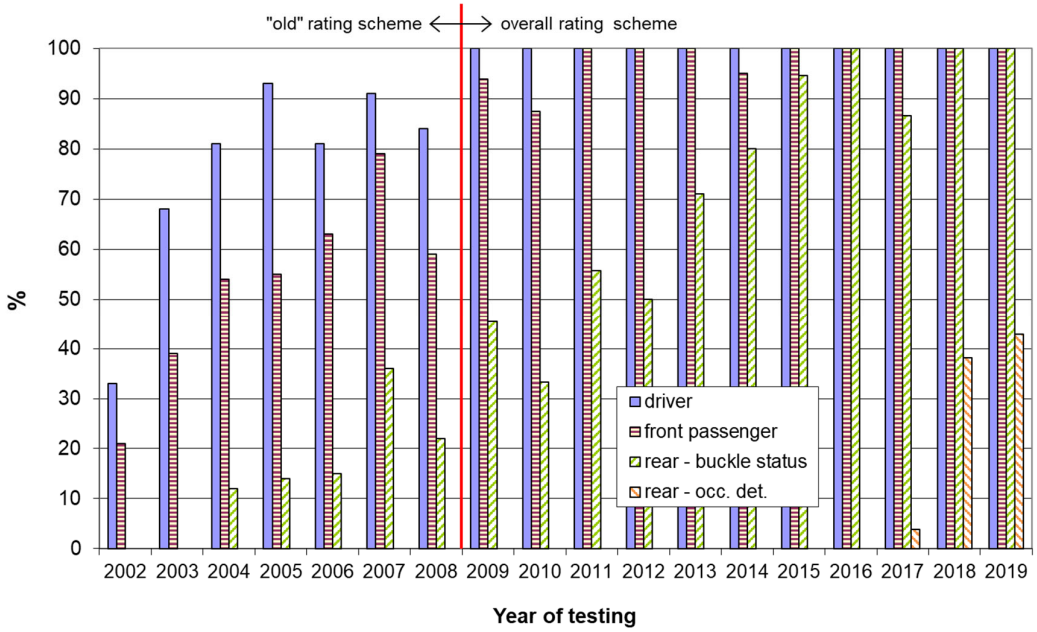


Figure 1: SBR installation rates for Euro NCAP tested vehicles

Harmonization addresses one of the key concerns of industry: if different countries apply different requirements, this leads to engineering and implementation challenges, resulting in additional costs. Internationally harmonized requirements make it easier for the global automotive industry to adapt to the regulatory or NCAP needs.

The NCAP approach is a proven and very effective way in promoting new vehicle safety technologies. However, in order to be an effective market influencer, the incentives for the new technology have to be relevant. The example mentioned under H. 25. on the US NCAP evaluating automatic emergency braking systems is therefore not a very suitable reference. This AEB evaluation has no influence whatsoever on the vehicle's star rating and is only add-on information. The various NCAP's of the world assessing SBR systems have made SBR a rating relevant item. The points contribute to the vehicle safety score and potentially influence the star rating for the good or the bad. So, if US NCAP is going to evaluate SBR systems, this evaluation shall be rating relevant and not just "for information only".

The ANPRM mentions to possibly issue "voluntary guidelines" that could identify best practices. Considering all the existing regulatory and NCAP activities on rear seat SBR, one can confidently state that best practices are already well established and known to the industry. Voluntary guidelines have a significant weakness: they are only voluntary. In a situation where worldwide SBR regulations and NCAP incentives are implemented to tackle low seat belt usage on the rear seats, the "voluntary guidelines" approach sounds like stagnation rather than making a step forward.

20. Effectiveness of rear seat belt warning systems & 21. Potential consumer acceptance concerns

NHTSA's own research found that a majority of people recognized the safety benefit of wearing a seat belt also on the rear seats, and that drivers familiar with rear SBR systems say that they help them to encourage rear seat occupants to buckle up. Based on market availability one can conclude that the interviewees have experience only with the buckle status information systems.

The simple monitoring of the rear seat belt buckle status only allows for visual information to the driver and optionally the rear seat passengers at vehicle start. An audible warning can only be triggered if there is a "change of status", i.e. if a belted rear seat occupant unbuckles during the trip. The lack of a continuous audible alert limits the effectiveness of those simple systems. Their effectiveness highly depends on whether the driver intervenes or not.

Very little data is available on the effectiveness of such SBR systems. In a comment to NHTSA in 2010[3], Volvo stated: *"…Volvo surveyed Volvo owners in Sweden and Italy in 2005. The survey clearly demonstrated that the belt usage rate in the rear seat, with the monitoring system as compared to without belt reminders, had increased from around 60% to around 82%"*. This would correspond to a reminder effectiveness of approximately 50%.

An advanced SBR function on the front seats, as specified by the Euro NCAP protocol, triggers an audio-visual warning at the start of the journey, which has to last at least 90 seconds (or until the occupant buckles up). Such advanced SBR systems have proven to reduce the number of unbelted front seat passengers by 90%[4].

Nowadays, NCAPs in Japan, Europe and Australia also award advanced SBR functions on the rear seats. Their rear seat SBR protocols require the audio-visual warning to last at least 30 seconds. A number of vehicle models with such advanced rear seat SBR function have already been introduced into the Japanese and European market.

A laboratory study was conducted in Japan in 2012[5], comparing the effect of various optical and audible SBR warnings on the belt use of rear seat passengers. The table below summarises the most important study results. The initial belt wearing rate without SBR warning was 38%. Where an optical warning was only presented to the driver, who then reminded the rear seat passengers, the belt use increased to 56%. When both, driver and rear seat passengers were presented with an optical warning, the usage rose to 72%. And when an audio-visual warning was used, 97% of the rear seat passengers buckled-up. So audio-visual SBR warnings motivated up to 95% of the

[3] A. Kopstein, "Docket reference: NHTSA-2010-0061-0018", www.regulations.gov, 2010
[4] A. Lie, A. Kullgren, M. Krafft and C. Tingvall, "Intelligent Seatbelt Reminders: Do they change driver seat belt use in Europe," in Paper 07-0388, ESV 2007
[5] M. Akamatsu, H. Hashimoto and S. Shimaoka, "Assessment Method of Effectiveness of Passenger Seat Belt Reminder," in SAE International 2012-01-0050, 2012

initially non-belted rear seat occupants to buckle up. For visual-only warnings the effectiveness was limited to 50% (in line with the Volvo data above).

		Rear seat passenger information		
		No SBR information	Ceiling icon, blinking with frequency change, no audible signal	Ceiling icon, blinking with frequency change, audible signal with frequency change
Driver information	No SBR information	38 %	-	-
	Meter cluster icon, blinking with frequency change, no audible signal	56 %	72 %	-
	Meter cluster icon, blinking with frequency change, audible signal with frequency change	-	-	97 %

Table 2: Belt wearing rates for various rear seat SBR warning systems

The first vehicles with an advanced rear seat SBR systems only entered the Japanese and EU markets in recent years, and significant vehicle volumes only build-up in the EU market since 2018. Hence, to our knowledge, there is not yet any field-data available with regards to the effectiveness of those advanced systems in increasing the belt wearing rates. But the laboratory study indicates a clear trend with regards to the effectiveness of the various warning strategies.

Summary

Wearing the seat belt is one of the most effective ways to prevent injury or death in a vehicle crash. However, a lot of people still don't buckle up, for various reasons. For those who just forget about it, seat belt reminders have proven to be highly effective, especially when the warning signal is audio-visual.

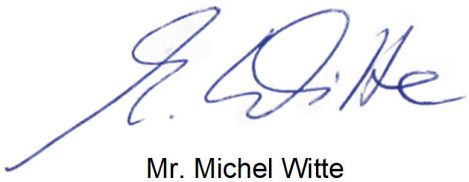
Already widely established on the front seats, SBR systems are nowadays also increasingly available on the rear seats. The various NCAP incentives have significantly helped to increase SBR availability in various worldwide markets. They also paved the way for UNECE regulation 16, making SBR systems mandatory, even on the rear seats (buckle monitoring). Some NCAPs have started to incentivize more advanced rear seat SBR systems, enabled by occupant detection sensors to trigger audio-visual warnings at the start of the journey.

Increasing the seat belt wearing rate on the rear seats is important for two reasons: a) the belt wearing rates on the rear seats are lower than those on the front seats, and b) unbelted rear seat occupants are significantly increasing the injury and fatality risk for front seat passengers.

NHTSA has plenty of established best practices available to increase the market penetration of SBR systems in US vehicles. UNECE R16 could be the basis for an upgrade of FMVSS 208, and the Euro NCAP SBR protocol would be a suitable basis to create incentives in US NCAP in a relatively short timeframe.

Should you have any further questions regarding this document, please feel free to contact Mr. Thierry Mousel, Global Regulatory Strategist, by phone at +352 2454 2446.

Sincerely,



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