NEW NCAP TEST AND ASSESSMENT PROTOCOLS FOR SPEED ASSISTANCE SYSTEMS, A FIRST IN MANY WAYS

Richard Schram
Aled Williams
Michiel van Ratingen
European New Car Assessment Programme, Belgium

Johan Strandroth
Anders Lie
Swedish Transport Administration, Sweden
Michael Paine
Australian New Car Assessment Programme, Australia

on behalf of the Euro NCAP ISA Working Group

Paper Number: 13-0277

ABSTRACT

Exceeding the speed limit is a factor in the causation and severity of many road accidents. Speed limits are intended to assure safe operation of the road network by keeping traffic speeds to no more than the maximum that is appropriate for a given traffic environment. The speed of traffic also influences the flow of densely trafficked roads.

Voluntary speed assistance systems (SAS) are a means to support adherence to speed limits, by warning and/or effectively limiting the speed of the vehicle. The only technical requirements giving guidance for elements of such devices are laid down in UN/ECE Regulation 89, which is not mandatory in Europe. Those specifications are rather outdated and do not specifically apply to passenger cars.

Since 2009, Euro NCAP has rewarded manually set speed limitation devices (SLD) which meet the basic requirements of UN/ECE R89 but have additional functionality with regards to warning and set-at-speed.

In the meantime more advanced speed assistance systems have been introduced onto the market which are able to inform the driver of the current speed limit based on digital maps and/or camera based traffic sign recognition. Intelligent speed assistance (ISA) systems are expected to improve and will be more readily acceptable to the public. Hence, Euro NCAP has extended the SLD protocol to include the evaluation of the latest generation of intelligent speed assistance systems.

The work of Euro NCAP is soundly based on a synthesis of previous research findings regarding speed assistance systems, including Carsten et al., Oei and Polak, Biding and Lind and others. Functional requirements for the Speed Limit Information Function (SLIF), Manual Speed and Intelligent Speed Assistance systems (MSA and ISA) have been derived using input from various stakeholders. Recent experiences with Euro NCAP's SLD assessment have been included. Besides functional requirements, a set of agreed driving manoeuvres has been defined, in particular to verify the driver-set limitation function. The draft procedures have been evaluated in a workshop with several commercially available and prototype systems.

Test and assessment protocols have been developed that contain specifications for different types of Speed Assistance Systems (SAS), SLIF up to full ISA systems where the SLIF is coupled with the warning and speed limitation function.

Points are available for all elements of SAS with additional points awarded to systems where the speed information is directly linked to the warning and speed limitation function.

The requirements specified in the developed protocols are not design restrictive, to allow the vehicle manufacturer to develop the systems to their best knowledge and experience. It is foreseen that, after a couple of years, Euro NCAP will tighten the requirements based on best practice. As more and more countries are introducing more strict speed managements systems the consumer demand for reliable and efficient SAS is expected to increase.

BACKGROUND

With the introduction of the new rating scheme in 2009, Euro NCAP opened a whole new area of assessment; Safety Assist systems. At the start of the new rating scheme, this "Box" consisted of Seatbelt Reminder systems (SBR), Electronic Stability Control (ESC) and Speed Limitation Device (SLD).

To take into account the fast introduction of forward looking cameras with traffic sign-recognition in new vehicles, Euro NCAP already included an extension of their SLD protocol in their roadmap in 2009.

For the development of the ISA protocols, a separate Working Group was founded under the chairmanship of the Swedish Transport Administration.

The initiative was taken as a response to the introduction of cars with the ability to present speed limit information to the driver. As this information is no longer displayed by aftermarket products only, but also by the car itself, it is of interest to assess. Additionally, the initiative was motivated by the possible benefits of health loss reduction due to speed adaptation shown by earlier studies and discussed below.

The members of this WG consisted of Euro NCAP members and laboratories, vehicle manufacturers representing ACEA, JAMA and KAMA, and the two main digital map suppliers.
New to any Euro NCAP WG was the participation of Australasian NCAP (ANCAP), which supported the meetings based on Australian experience with a variety of ISA systems. The ANCAP Road Map promotes the uptake of promising safety assist technologies, including ISA. Furthermore several ANCAP stakeholders are participants in the Australasian Intelligent Speed Assist Initiative (AISAI) which stimulates the development and implementation of ISA technology in Australia and New Zealand [3].

SWEDISH STUDY

The relationship between driving speed and crash/injury risk has been extensively studied. While the causal role of speed in road injury crashes can be difficult to quantify, exceeding the speed limit is a frequently cited traffic offence and is responsible for many severe road accidents [4]. Speeding has also been recognized as a major public health issue. The Organization for Economic Co-operation and Development (OECD) and the European Conference for Ministers for Transport (ECMT) has reported it to be the number one road safety problem around the world.

Earlier research on ISA is based primarily on field operational tests in Sweden, UK and the Netherlands. The largest field experiment until now was in Sweden 1999-2002 where approximately 5.000 cars and 10.000 drivers participated. Interviews were used to investigate the driver acceptance of ISA and 700 of the vehicles had data logging. In the Netherlands 20 cars were equipped with forcing ISA and driven by 120 drivers during eight weeks in 1999-2000. The field test in UK consisted of one fleet of 20 vehicles driven for two years with a total of eighty participants [5]. Simulations and modeling has also been made in the Netherlands and smaller projects have been made in Denmark, Finland, France, Spain, Australia and China [6].

Effects on speed adaptation

Results from field trials show a reduction on average travel speed and a smaller speed distribution with ISA. The test in Sweden showed an average speed reduction of 3-4 km/h and generally smoother driving with less variation in speed. However, travel times were unchanged, probably due to fewer stops. In addition ISA showed a calming effect on other road users [7]. In a review made by SWOV it was concluded that ISA contributed to an average speed reduction of 2-7 km/h depending on type of ISA. ISAs with forced feedback were more effective than advisory systems. ISA also reduced the number of speed violations and reduced the speed variation [8]. In the UK trial, ISA diminished excessive speeding, but reduced also the speed variation [5]

Effects on injuries

The most cited study was made in England were 100 percent implementation and no behavioral adaptations were the basic assumptions [9]. Results show that an advisory ISA with fixed speed limits is estimated to have an effect of 14 percent reduction in fatal and serious accidents. The argest effect was estimated with a dynamic mandatory ISA, 59 percent reduction in fatal accidents.

Similar studies in the Netherlands, which has made the assumption of 100 percent coverage with mandatory ISA and fixed speed limits, shows similar results; a reduction of severe accidents of 25-30 percent. This study however shows some indications of a more risky behavior with shorter distance to the vehicle in front [10].

AUSTRALIAN STUDIES

Australia has been conducting research on ISA and speed limiting of vehicles since the 1990s. A summary of research and trials is presented by Paine [11]. In 2010 the New South Wales Centre for Road Safety conducted a comprehensive ISA trial in the Illawarra region of East Australia. Doecke and others [12] analysed the results of the trial and applied the findings to predict the savings that advisory ISA could be expected to produce for state government car fleets. It was estimated that casualty crashes could be reduced by 20%.

Using in-depth crash study data for Australia, Doecke and others [13] estimated the reductions in casulty crashes by eliminating various levels of speeding. They concluded that the greatest benefits arise from targeting low-level speeding. That is, speeds of 1km/h to 5km/h over the speed limit. This is range where conventional speed enforcement is not effective. Voluntary speed compliance, supported by ISA, would be effective for low-level as well as high level speeding. The study built on earlier research which showed that reducing collision speeds by just a few km/h can markedly reduce the risk of serious injury. In Australia many motorists tend to travel slightly over the speed limit and this is reflected in the collision speeds determined from in-depth crash studies. It was shown that encouraging this group to not exceed the speed limit would have reduced the collision speeds sufficiently to change a fatal or serious crash into a less serious one.

ASSESSMENT PROTOCOL

As a starting point to achieve the above, the requirements within the assessment protocol are not design restrictive to allow the vehicle manufacturers to develop the systems to their best knowledge and experience.

The Speed Assist Systems assessment protocol is developed in such a way that it allows different types of Speed Assist Systems to be assessed. It foresees four different elements of systems:

- Speed Limit Information Function (SLIF)
- Manual Speed Assistance systems (MSA)
- Systems consisting of both SLIF and MSA but not coupled
- Intelligent Speed Assistance (ISA), where SLIF and MSA are coupled

Car manufacturers may develop systems delivering all or some of the elements listed above.

SLIF

Only basic requirements have been set for the Speed Limit Information Function. For this function, camera or map based systems are considered as well as the combination of both, which is potentially more accurate. It is should be noted that, for map based systems, the speed limit information could either be provided by vehicle-integrated devices or by mobile devices connected to the vehicle network. To be eligible for points in the scoring for the latter, a list of compatible devices needs to be mentioned in the vehicle handbook.

Most important for SLIFs is to show the maximum allowed legal speed at the location and in the circumstance the car is driving. The system needs to display this within direct field of view of the driver and as long as the speed limit is assumed to be valid.

For map-based systems, a short report is required where the OEM details the accuracy of the maps used, the coverage and reliability of these maps and the ready-to-assist rate. With this information, Euro NCAP will in future protocols set more stringent requirements on the maps used to ensure the best possible information to the consumers.

Manual Speed Assist

The manual speed assist is a function that the user activates to limit the speed of the car to a specified value. This part of the protocol is mainly derived from the previous SLD protocol. The SLD protocol covered passive SLD, which are now called the MSA warning function, and the active SLD, which is now called the MSA speed limitation function. The old protocol also allowed additional points to be scored for good warnings and set-at-speed. These items are now incorporated in the MSA requirements.

The warning function needs ~~a~~ to consist of a visual warning combed with a supplementary warning, e.g. audible, haptic or head-up display. The visual warning needs to be shown for the duration of the time that the vehicle speed indicated by the speedometer exceeds the speed the driver has set (Vadj), for more than 3 km/h.

The supplementary warning may have a shorter duration, not to annoy the driver when he intentionally increased the speed without applying a positive action. The total duration of the additional warning is at least 10 seconds that can consist of a positive signal of 2 seconds every 30 seconds.

The speed limitation function will prevent the driver from exceeding the set speed by reducing the throttle input to the engine. However, in some situations the engine brake is not sufficient and either a warning or actively applying the brakes is required to avoid the vehicle going over the speed set. From the old SLD protocol, only two requirements remain. Within stable speed, this stable speed may not vary more than 3km/h and the stable speed shall not exceed the speed set, to which the driver wants to be limited, by more than 3km/h.

Intelligent Speed Assist

New to the protocol are the requirements regarding ISA. An intelligent system, where SLIF and MSA are combined, is the best system to help the driver to adhere to the speed limit. Any change in speed limit will be indicated to the driver by the SLIF and is adopted by the ISA system. It is acknowledged that the performance of the ISA systems primarily depends on the accuracy of the SLIF. That is why for the moment, a driver confirmation to adjust to the newly proposed speed limit is allowed. In future, when the quality of SLIFs improve, an automatic ISA may be required. The warning and speed limitation function have the ~~exact~~ same requirements as for the MSA system described earlier.

TESTING SPEED ASSIST SYSTEMS

At present it is not feasible to verify the complete coverage of the SLIF as Euro NCAP requires the system to be available in all EU-27 countries as an option. A rudimentary check is performed by the laboratories to verify the functionality of the SLIF rather than to verify its accuracy. To do so, the laboratories will drive at least 100km on different types of roads and will determine whether there are any inconsistencies between the speed limit indicated by the SLIF and the actual speed limit as indicated by traffic signs. This information is also

gathered to be able to derive more stringent requirements for future protocols.
The MSA is tested at three different speeds: 50, 80 an 120 km/h. These are representative of the different road types within Europe. The warning is simply assessed by setting the speed and exceeding them. The speed limitation function is verified by setting the speed and accelerating the vehicle without applying a positive action. When the speed limitation function is engaged, the speed is maintained for at least 30 seconds to be able to determine the stabilized speed.
When fitted to the vehicle, the ISA system is simply verified to ensure that the speed limits from the SLIF can be taken over by the MSA.
One difficulty is finding closed roads where the operation of the speed limiting system can be verified without exceeding the posted speed limit on a public road.

SCORING

Points can be scored for the SLIF, the Warning function and the Speed Limitation function separately as shown in Table 1.
A digital map based system is awarded half of the available points, while a camera based system scores only 0.25 out of 1 as it is thought that the digital map based system is able to provide more reliable speed limit information. Only the combination of both can score the full point as this is seen as the optimal system that is able to cover both permanent and temporary speed limits.
When the SLIF and MSA are linked to have ISA functionality, the Warning function score doubles.

Table 1
SAS Scoring overview

	SLIF	MSA	ISA
Communicating speed limit	**1.00**		**1.00**
Camera based	0.25		0.25
Digital Map based	0.50		0.50
Camera and Digital Map combined	1.00		1.00
Warning Function		**1.00**	**2.00**
Speed Limitation		**1.00**	**1.00**

PROTOCOL LIMITATION

The requirements specified in the developed protocols are deliberately not design restrictive, to allow the vehicle manufacturer to develop systems to their best knowledge and experience, especially in the area of HMI.
With regards to the SLIF requirements, Euro NCAP acknowledges that the geographical coverage and map quality varies significantly within the EU-27 countries. It is expected that, due to initiatives like EuroRAP [14] and FP7-ROSATTE [15], the quality of roads and map data will increase rapidly.
Euro NCAP also acknowledges differences in strategy and variability of speed signs around Europe.
For the moment, it is neither feasible nor affordable for an organization like Euro NCAP to perform extensive testing of SLIFs. Possibilities like vehicle in the loop tests are considered and may be an affordable option in the future to perform more extensive tests.
The current speed-alert margin ("more than 3km/h") is taken from the UN-ECE regulation that relies on mechanical speedometers. For future revisions to the protocol the speeding margins may be reviewed for a better efficiency of SAS systems.

Euro NCAP is aware that consumer acceptance of ISA systems depends on the quality of the systems. Without user acceptance the benefits are small. A close collaboration with industry is foreseen as ISA products and Euro NCAP protocols develop in the future.

CONCLUSIONS

In a limited time, the ISA WG has developed a first set of test and assessment protocols for assessing Speed Assist Systems for implementation in 2013.
As a first in the world, two NCAPs worked together to develop a protocol. It is hoped that this successful co-operation will lead to a more global harmonisation of protocols.
Since the enforcement of the protocol an increased percentage of the vehicles assessed in 2013 have a SAS implemented, when compared to vehicles equipped with a SLD in 2012. The implementation rate is expected to further increase over the years to come.
When a large number of systems have been assessed, Euro NCAP will reinitiate the WG to further develop these protocols to ensure the implementation of the best possible system that support the driver to adhere to the speed limits and safe driving.

ACKNOWLEDGEMENT

Euro NCAP and the Chairman of the ISA WG would like to thank the members of the working group for their participation and constructive contribution to finalize the ISA Test- and Assessment Protocols:

Euro NCAP representatives
Anders Lie, STA, Chairman
Richard Schram, Euro NCAP, Secretary
Oliver Bartels, BASt
Sandro Bolthauser, IDIADA
Aurelien Garcia, UTAC
C Gauss, ADAC
J König, DEKRA
Michael Paine, ANCAP
Michiel van Ratingen, Euro NCAP
Derwin Rovers, RDW
Johan Strandroth, STA
Aled Williams, Euro NCAP

Industry representatives
Jean-Francois Boissou, PSA
Markus Fach, Daimler
Jurgen Hilgenstock, VW
Ahmed Nasr, Nokia
Maminirina Ranovona, TME
Raimondo Sferco, Ford
Steven T'Siobbel, TomTom
Rainer Walz, BMW

REFERENCES

[1] Euro NCAP 2010-2015 Strategic Roadmap, 2009. http://www.euroncap.com/Content-Web-Page/c6f9d381-1889-4c66-bfcd-c5c0a69a364d/technical-papers.aspx

[2] Euro NCAP Assessment Protocol – SA. http://www.euroncap.com/Content-Web-Page/fb5e236e-b11b-4598-8e20-3eced15ce74e/protocols.aspx

[3] David Paine, Michael Paine, John Wall & Ian Faulks (2013) Development of an assessment protocol for after-market speed limit advisory devices, Proceedings of the 23rd International Technical Conference on the Enhanced Safety of Vehicles (Paper 393), Seoul, May 2013.

[4] Julie A. Lahausse, Nicole van Nes, Brian N. Fildes, Michael D. Keall. (2010) Attitudes towards current and lowered speed limits in Australia, Accident Analysis and Prevention 2010 Nov; 42(6):2108-16.

[5] Lai F and Carsten O. (2010) What benefit does Intelligent Speed Adaptation deliver? - A close examination of its effect on vehicle speeds, Accident Analysis and Prevention 48 (2012) 4– 9.

[6] Effects of trip computers med fuel consumption follow up and Intelligent Speed Assist. Koucky & Partners AB 2010.

[7] Biding, T., Lind, G., Intelligent stöd för anpassning av hastighet (ISA): resultat av storskalig försöksverksamhet i Borlänge, Lidköping, Lund och Umeå under perioden 1999-2001, Publikation 2002:89, Vägverket, Borlänge 2002.

[8] Intelligent Speed Assistance, SWOV fact sheet. Institute for road safety research, Leidschendam, The Netherlands, 2010

[9] Carsten, O., Tate, F. N. (2005) Intelligent Speed Adaptation: Accident savings and cost-benefit analysis, Institute for Transport Studies, University of Leeds, 2005

[10] Oei, H. L., Polak, P. H. (2002) INTELLIGENT SPEED ADAPTATION (ISA) AND ROAD SAFETY, International Association of Traffic and Safety Sciences, VOL 26, NO. 2, sid 45-51, Japan, 2002.

[11] Michael Paine, David Paine, & Ian Faulks (2009). Speed limiting trials in Australia. Proceedings of the 21st International Technical Conference on the Enhanced Safety of Vehicles (Paper 378), Stuttgart, Germany, 15-18 June 2009.

[12] Sam D Doecke, Robert WG Anderson, Jonathon E Woolley (2010) Advisory Intelligent Speed Adaptation for government fleets, Centre for Automotive Safety Research The University of Adelaide, CASR Report 099, July 2011.

[13] Sam Doecke, Claus Kloeden & Jack McLean (2011) Casualty crash reductions from reducing various levels of speeding, Centre for Automotive Safety Research The University of Adelaide, CASR Report 076, February 2011.

[14] EuroRAP, http://www.eurorap.org/

[15] FP7 Project ROSATTE, www.rosatte.eu

APPENDIX: SPEED ASSIST ASSESSMENT PROTOCOL

Speed assist assessment protocol extract from the Safety Assist Assessment protocol "Euro NCAP Assessment Protocol – SA".

4 ASSESSMENT OF SPEED ASSIST SYSTEMS

4.1 Introduction

Excessive speed is a factor in the causation and severity of many road accidents. Speed restrictions are intended to promote safe operation of the road network by keeping traffic speeds below the maximum that is appropriate for a given traffic environment, thereby protecting vehicle occupants and other road users, both motorised and non-motorised. These maximum speeds are intended to control energy levels in typical crashes and to allow sufficient time for drivers to react to traffic situations. Properly selected speed limits should facilitate efficient traffic flow, reduce violations and promote safe driving conditions. Greater adherence to speed limits would avert many accidents and mitigate the effects of those that occur.

Voluntary speed limitation devices are a means to assist drivers to adhere to speed limits. Euro NCAP hopes to encourage manufacturers to promote such speed-limitation devices, to fit them as standard equipment. This, it is hoped, will lead to greater demand by consumers and an increased introduction of speed limitation systems.

The margins for alarm activation set out in this document are based on prevailing speedometer accuracy, which is specified by regulation and typically overstates the vehicle speed by several km/h.

This version of the protocol contains technical requirements for both Manual Speed Assist (MSA) systems where the driver needs to set the limited speed and Intelligent Speed Assist (ISA) systems where the car 'knows' the current legal speed limit to be used in the warning or speed limitation function. To be able to score full points for the speed limitation function the system (both MSA and ISA) need to fulfil the warning function and speed setting requirements.

4.2 Definitions

Throughout this protocol the following terms are used:

- Vindicated – The velocity the car travels as displayed to the driver by the speedometer as in ECE R39.
- Speed Limit – Maximum allowed legal speed for the vehicle at the location and in the circumstance the vehicle is driving.
- Vadj – Adjustable speed Vadj means the voluntarily set speed for the MSA/ISA, which is based on Vindicated and includes the offset set by the driver.
- MSA – Manual Speed Assistance. MSA means a system which allows the driver to set a vehicle speed Vadj, to which he wishes the speed of his car to be limited and/or above which he wishes to be warned.
- SLIF - Speed Limit Information Function. SLIF means a function with which the vehicle knows and communicates the speed limit.
- ISA – Intelligent Speed Assistance. ISA is a MSA combined with SLIF, where the Vadj is set by the SLIF with or without driver confirmation.

The following terms are used for the assessment of the Speed Limitation function:

- Vstab – Stabilised speed Vstab means the mean actual vehicle speed when operating. Vstab is calculated as the average speed over a minimum time interval of 20 seconds beginning 10 seconds after first reaching Vadj – 3km/h.
- Vmax – Maximum speed Vmax is the maximum speed reached by the vehicle in the first half

period of the response curve.

4.3 Requirements for SLIF, MSA and ISA

4.3.1 The Speed Assist Systems is developed in such a way that it allows different types of Speed Assist Systems to be assessed. Four types of possible Speed Assist Systems are foreseen:

- SLIF Speed Limit Information Function
- MSA Manual Speed Assistance
- SLIF + MSA Both SLIF and MSA but not coupled
- ISA Intelligent Speed Assistance, SLIF and MSA coupled

4.3.2 The table below details which sections are applicable for the different types of SA systems:

Type	Sections
SLIF	4.4
MSA	4.5.1, 4.6, 4.7
ISA	4.4, 4.5.1, 4.5.2, 4.6, 4.7

4.4 Speed Limit information Function

The Speed Limit Information Function can be a standalone function or an integrated part of ISA. Any SLIF, camera or map based or a combination of both, need to fulfil the requirements of this section. Additionally, manufacturers need supply Euro NCAP with additional background information of the SLIF as identified in the table in Appendix III.

4.4.1 General requirements

4.4.1.1 Visual and standard requirements

4.4.1.1.1 When the SLIF is active, the latest known speed limit information (can be absent when last known speed is not reliable) must be shown or accessible at any time with a simple operation and needs to be shown at the start of the next journey (excluding the initialization period).

4.4.1.1.2 The speed limit must be in the direct field of view of the driver, without the need for the head to be moved from the normal driving position, i.e. instrument cluster, rear view mirror and centre console.

4.4.1.1.3 The speed limit indication shall preferably use a traffic sign in line with the Vienna Convention.

4.4.1.1.4 When Vindicated is exceeding the speed limit, the speed limit information shall be indicated to the driver when the SLIF is active.

4.4.1.1.5 (Temporary) absence of reliable speed limit information shall be clearly indicated to the driver

4.4.2 Camera based systems

4.4.2.1 The speed limit display needs to be indicated for at least 20s after the system has identified speed limit information unless there is a change in speed limit.

4.4.3 Digital Map based systems

4.4.3.1 The speed limit display needs to be indicated while the system has valid speed limit information.

4.4.3.2 The speed limit information could either be provided by vehicle-integrated devices or by mobile devices connected to the vehicle network. A list of compatible devices needs to be mentioned in the vehicle handbook.

4.4.4 Combined Camera and Map based systems

4.4.4.1 The speed limit display needs to be indicated while the system has valid speed limit information.

4.5 Setting the Speed

Both MSA and ISA systems must comply with section 4.5.1. ISA systems meeting the requirements of section 4.4 are eligible for a higher score when also meeting the requirements in section 4.5.2.

4.5.1 Manually setting the speed (MSA and MSA function of ISA)

4.5.1.1 Activation / de-activation of the system

- The system must be capable of being activated/de-activated at any time.
- At the start of a new journey, the vehicle should not limit the speed without confirmation from the driver

4.5.1.2 Setting of Vadj

- It shall be possible to set Vadj, by a control device operated directly by the driver, by steps not greater than 10km/h between 30km/h and 130km/h or by steps not greater than 5mph between 20mph and 80mph when imperial units are used.
- It shall be possible to set Vadj independently of the vehicle speed.
- If Vadj is set to a speed lower than the current vehicle speed, the system shall limit the vehicle speed to the new Vadj within 30s and/or shall initiate the supplementary warning (section 4.6.2) no later than 30s after Vadj has been set.

4.5.1.3 The Vadj value shall be permanently indicated to the driver and visible from the driver's seat. This does not preclude temporary interruption of the indication for safety reasons or driver's demand.

4.5.2 Automatic setting the speed (ISA)

An automatic setting is using the speed limit information from the SLIF to advise (requiring driver confirmation) or directly set the Vadj. Systems fulfilling the requirements from section 4.4 and section 4.5.1 are eligible for scoring when meeting the following additional requirements:

4.5.2.1 Activation / de-activation of the system

- The system must be capable of switching between MSA and ISA mode at any time with a simple operation.
- At the start of a new journey, the vehicle shall not limit the speed without confirmation from the driver

4.5.2.2 Setting of Vadj

- The system must adopt, with or without driver confirmation, an adjusted Vadj within 5s after a change in the speed limit.
- If Vadj is set to a speed lower than the current vehicle speed, the system starts to limit the vehicle speed to the new Vadj and/or shall initiate the supplementary warning (section 4.6.2) no later than 30s after Vadj has been set.
- A negative and/or positive offset with respect to the known speed limit is allowed but may not be larger than 10 km/h (5 mph). This offset is included in Vadj.
- The Vadj in the automatic mode of an ISA system may be retained at the end of a journey.

4.5.2.3 Where Vadj is set to the speed limit advised by the SLIF, the indication Vadj may be suppressed.

4.6 Warning Function

All MSA and ISA systems need to meet the warning requirements of section 4.6.1 to indicate the driver that Vadj is exceeded. In addition a supplementary warning is required, e.g. audible, haptic and head-up display meeting the requirements in section 4.6.2.

Vehicles with Speed Limiter function activated do not need a warning function when active braking is applied to limit the vehicle speed.

It shall still be possible to exceed Vadj by applying a positive action, e.g. kickdown. After exceeding Vadj by applying a positive action, the speed limitation function shall be reactivated when Vindicated drops to a speed less than Vadj.

4.6.1 Visual warning requirements

4.6.1.1 The visual signal must be in the direct field of view of the driver, without the need for the head to be moved from the normal driving position, i.e. instrument cluster, rear view mirror and centre console.

4.6.1.2 The driver is informed when Vindicated of the vehicle is exceeding Vadj by more than 3 km/h.

4.6.1.3 The driver continues to be informed for the duration of the time that Vadj is exceeded by more than 3 km/h.

4.6.1.4 The warning signal does not preclude temporary interruption of the indication for safety reasons.

4.6.2 <u>Supplementary warning requirements</u>

4.6.2.1 The warning shall be clear to the driver.

4.6.2.2 No supplementary warning needs to be given when Vadj is exceeded as a result of a positive action.

4.6.2.3 The warning commences when the Vindicated of the vehicle is exceeding Vadj by more than 3km/h.

4.6.2.4 The total duration of the warning shall be at least 10 seconds and must start with a positive signal for at least 2 seconds. If the signal is not continuous for the first 10 seconds, it needs to be repeated every 30 seconds or less, resulting in a minimum total duration of at least 10 seconds.

4.6.2.5 The warning sequence does not need to be reinitiated for each exceedence of Vadj until Vindicated has reduced to more than 5km/h below Vadj.

4.7 Speed Limitation Function

Scoring is only eligible when the warning signal requirements from section 4.6 are met.

4.7.1 <u>Speed Limitation</u>

4.7.1.1 The vehicle speed shall be limited to Vadj, also see sections 4.5.1.2 and 4.5.2.2.

4.7.1.2 It shall still be possible to exceed Vadj by applying a positive action, e.g. kickdown.

4.7.1.2.1 After exceeding Vadj by applying a positive action, the speed limitation function shall be reactivated when the vehicle speed drops to a speed less than Vadj.

4.7.1.2.2 The speed limitation function shall permit a normal use of the accelerator control for gear selection.

4.7.1.3 The speed limitation function shall meet the following requirements (see test protocol):

When stable speed control has been achieved:

- Speed shall not vary by more than ±3 km/h of Vstab.
- Vstab shall not exceed Vadj by more than 3 km/h.

4.8 Scoring and Visualisation

The following points are awarded for systems that meet the requirements:

	SLIF	MSA	ISA
Communicating speed limit (Section 4.4)	**1.5**		**1.5**
Camera based	0.50		0.50
Digital Map based	0.50		0.50
Camera and Digital Map combined	1.50		1.50
Warning Function (Section 4.5 and 4.6)		**1**	**2**
Speed Limitation Function (Section 4.7)		**1**	**1**

The final score for the overall rating will be scaled from maximum of 4.5 points to a maximum of 3 points. These points will contribute to the Safety Assist Score.

Note: systems meeting ECE R89 will no longer be sufficient to be rewarded points under this protocol.