kennisplatform CROW

Guidance for road authorities on Intelligent Speed Assistance (ISA)

About CROW

CROW develops smart and practical solutions for issues about infrastructure, public space, traffic and transport in the Netherlands. We do that in close co-operation with external professionals to commonly develop knowledge for everyday use.
CROW is an independent, not-for-profit knowledge organization that invests in knowledge for now and in the future. We strive for the best solutions for issues from policy to management in infrastructure, public space, traffic and transport and work and safety. Moreover, we are experts in the field of tendering and contracting.

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Content

1 What is ISA?

Within European regulations, the definition of ISA is described as follows:

> Intelligent Speed Adaptation (ISA):
> 'intelligent speed assistance' means a system to support the driver in maintaining the appropriate speed for the road environment by providing dedicated and appropriate feedback.
> Source: EU 2019/2144, art 3, section 3

ISA is a system with 4 different possible feedback systems:

- Haptic* feedback, where the accelerator pedal creates resistance for the driver's foot or even pushes the foot slightly back.
- Speed Control Function, where the vehicle reduces the engine power and torque when passing a sign with a lower speed limit.
- Cascading optical** and haptic warning, where the driver first receives an optical warning and then, after a short interruption, a haptic warning by a vibrating accelerator pedal.
- Cascading optical and acoustic warning, whereby the driver is first given a visual warning and then after a short interruption an acoustic warning.

* with movement
** visible a visible signal (light, icon on dashboard or projected on the windscreen)

2 Regulations

The EU makes ISA mandatory for new vehicle models entering the market on or after July 6, 2022 and from July 7, 2024 for all new vehicles, including parts. This only concerns the open and semi-open forms of ISA. The scheme applies to motor vehicles with four or more wheels (categories: M, N, S, T, U).
Category S, T and U may be deleted later in the process of revision.

Vehicle type	Category	Description
Passenger cars en buses	M	Passenger cars and buses M Motor vehicles with four or more wheels designed and constructed for the transport of persons
Commercial Vehicles	N	Motor vehicles with four or more wheels designed and constructed for the carriage of goods
Interchangeable Trailed	S	Interchangeable Trailed
Machines Wheeled Tractors	T	Machines Wheeled Tractors
Mobile machines	U	Motor vehicles specially designed and constructed for the performance of work and not intended for the carriage of persons or goods by road

Source: RDW, Rl. 2007/46/EC of Vo. (EU) 2018/858, Rl. 2003/37/EC ofVo. (EU) Nr. 167/2013 en de Regeling Voertuigen.

In summary, the following has been determined:

Intelligent speed support meets the following minimum requirements:

a The driver can be alerted, through the gearshift control, or through specific, appropriate and effective feedback, that the applicable speed limit has been exceeded;
b The system can be switched off; speed limit information can still be provided, and the intelligent speed assistance must be in the normal operating state each time the vehicle master control switch is turned on;
c This specific and appropriate feedback must be based on speed limit information obtained by observing road signs and signals, either from infrastructure signals or from electronic map data, or both; this information must be available in the vehicle;
d The system shall not deprive the driver from exceeding the vehicle speed indicated by the system;
e The system performance targets are defined in such a way that the probability of error in real driving conditions is reduced to zero or to a minimum.

Source: EU 2019/2144, art 6, section 2.

Additional regulations are in preparation:
Vehicle safety – technical regulations and test procedures for intelligent speed support.

3 What does this mean for the road manager?

The EU makes ISA mandatory for new vehicle models
In that light, it is good to use the time until mid-2022 to properly prepare the assets (the road and road furniture) and data (sources) for this. Since ISA is switched on by default when starting the vehicle, but can be switched off by the driver if he considers this desirable or necessary, it is desirable, for the sake of road safety, to achieve maximal user acceptance. The desired behavior is that the users leave the system switched on and use it actively as much as possible.

This is important for the following reasons:
- ISA is a tool to ensure that a driver will not unknowingly exceed the applicable speed limit;
- With a sufficiently high user acceptance, the number of speed violations will decrease. This will have a positive effect on road safety and thus reduce the risk of accidents and nuisance. (see SWOV – relationship speed – road safety).

However, if measures are reduced, it must be taken into account that the road design is congruent to the speed limit that is dictated by the road regime (as is already the case now).

One of the aspects for a sufficiently high user acceptance is to have the basics of road management in order. With regard to ISA, this is possible in particular through correct signage, placed correctly and so that observability for the driver and sensors is optimal. Consideration should also be given to dynamic or variable speed regimes (which usually are only found on the main road network of motorways). Also, co-operation between market parties is necessary to keep data and roadside consistent. Roadwork activities and other temporary situations must be given sufficient attention regarding the accuracy and topicality of the available data.

4 What can the road authority do?

EU 2019/2144, art 6, paragraph 2, point c determines that:

> *Specific and appropriate feedback should be based on speed limit information obtained from sensing road signs and signals, from infrastructure signals or from electronic map data, or both; this information must be available in the vehicle.*

To optimally benefit from ISA as road authorities, one can consider the following actions:

4.1 Source data for ISA

In accordance with EU regulations, ISA is based on:

- Own observation of road signs by a camera;
- Infrastructure signals (e.g., at dynamic speed limits);
- Map data (topology files).

or a mix thereof.

4.1.1 Speeding Sign Observation

For vehicle-based observations, it is good to check whether signs can be easily detected by sensors. A twofold distinction can be made here:

- Physical perception
  This concerns the factual and correct perception of a sign by a sensor. This includes avoiding the covering of signs by vegetation, other assets such as masts, the quality of the sign and whether the sign has the correct legal status (see Appendix 1 of RVV- the Dutch traffic code). The latter may sound special, but older signs from the previous version of the code still occur sporadically along the road, just like self-made designs.

Image 1: Old sign at the end of a built-up area, and own manufactured signs.

- The interpretation of the traffic code(RVV). Think about:
  - regime-based (implicit) speed limits due to zonal signs;
  - a speed limit that is valid in accordance with the Dutch traffic code until the next intersection or fork, unless this sign is repeated after that intersection;
  - A transition between built-up area and non built-up area (implicit speed limit) halfway through a road section.

The solution for this lies in particular in the digitization of speed information (see 4.2.2).

- Position and location of traffic signs
  The location of signs also needs to be viewed from a different, machine-driven perspective. An example of this could be a speed restriction on a curve. A driver will deal with this differently than a system such as ISA. In accordance with the handling analysis (Driving Procedure B), used by the Dutch Driver's License Agency, a driver should adjust vehicle speed just before the curve and continue the curve with a slightly pulling engine. A speed limit transition, implied by a traffic sign, should therefore not be positioned in a curve, but just before or after it, so that the vehicle does not react differently in the curve than intended.

  There is an additional problem with signs on either parallel roads or the main carriageway. Sensors can read signs that actually relate to the parallel road, while the vehicle is in the main carriageway or vice versa. The basic principle here is that it must always be clear to which sign a driver should aim. If this still causes problems for sensors, the use of additional aides that contribute to a better position determination of the vehicle can be considered. Further experimentation to examine which applications can help with this is recommended.

Action 1:
Have an ISA look at your installed base of traffic signs:

- visibility/readability
- logical (location and the purpose of the sign itself)
- legally correct (Dutch Traffic Code)

Much of this knowledge is included in CROW publication 345 CROW Qualitative management of traffic signs (only available in Dutch), which says, under step 7: 'Assess whether the sign is visible, legible, understandable, executable and credible'. In addition to these criteria, it is also necessary to pay attention to whether the sign is ADAS-proof. In fact, the same criteria can be used for this, as mentioned:

- visibility;
- readability;
- comprehensibility;
- feasibility;
- credibility.

In any case, it is good to understand that sensors place even higher demands on these points than drivers.

In general, it can be said that:
If rules and signs become clearer for smart vehicles, these rules and signs will automatically become clearer for human drivers of vehicles with little or no support on board. This makes clarification and simplification wherever possible quickly a no-regret measure.

In addition to signage, there are also traffic regulations that are difficult to interpret by a system such as ISA. As said before, a speed limit is only valid until after the next intersection (see Image 2). This is the case unless the sign is repeated after the next intersection. This does not apply to zonal applications (e.g. zone 30/60) or area-oriented applications (built-up areas, motorways, highways and 'woonerf' regimes). Sensors and vehicle intelligence cannot (properly) interpret rules at the moment. It is therefore important to avoid applying speed limits over shorter stretches within road sections (such as 70 or 60 in front of an intersection). If the speed limit that has been observed is not lifted by ISA after the intersection, it will have a negative impact on user acceptance.

4.1.2 Speed limit data

Traffic signs are still the only legal signals to indicate a speed limit. In addition to sensor observations from these signs, speed data is very important for a system like ISA. This data is currently roughly collected in 2 ways:

- road section information at the NWB
  Road sections in the National Roads File (NWB) are arranged according to the European standard for road information (Geographic Data Files, see ISO standard 30763), based on the concept of 'Road element'. This concept means that a road section is a line element between two intersections. There is only one valid speed limit that can be set for an entire road section, making it difficult to assign a speed limit change within this road section.

  For each road section (road section ID), the speed information can be entered in the nationalewegenbestand.nl (NWB). It is important to report officially government-appointed traffic rulings as soon as possible.

  see also: https://docs.ndw.nu/api/

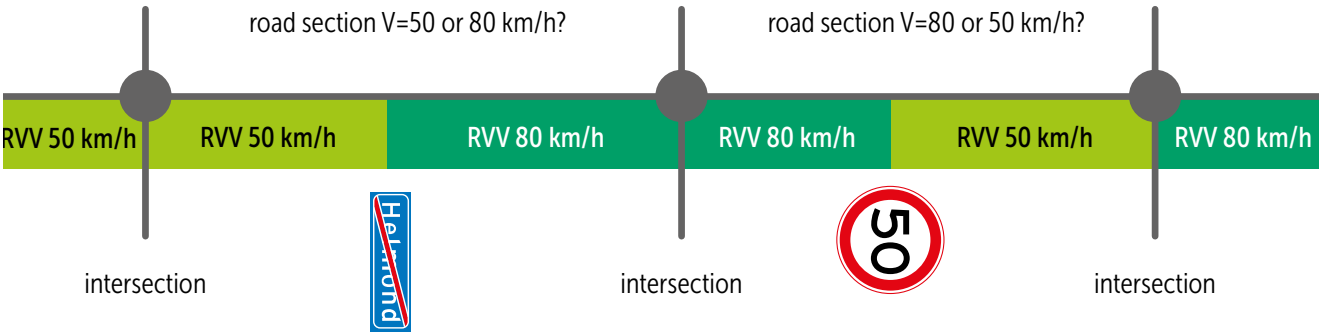

Image 2: Point of attention when specifying speed limits per road section. (RVV = Dutch road code, in this case the maximum speed (speedlimit).

Image 3: 60 and end 60 within a road section and over a very short distance.

- Road Sign Files
  In addition to road section information, information about traffic signs is centrally collected nationally. The Ministry of Infrastructure and Water Management has taken the initiative for this. The Dutch traffic code numbers end up in a central national database via IPSm. There, the exact location and position (in coordinates, the wind direction (N, S, E, W), location (at the roadside or above the road), link with road section, road number, municipality name and image) is made available as data. The so-called 'red code' A1 indicates the category of speed signs. The more detailed 'black code' (for example A01-30) is available in IPSm and will be made available through the Ultimate Signing Foundation.

  Newly placed signs must be digitally recorded immediately (in accordance with NEN3381: 2020 Annex E). New signs have a QR code on the back or at the side and can be registered via the IPSm app*. Removing, moving or switching an interpreter on and off is done by means of the same App, which is made available by the Ministry in basic order. The digital recording of traffic decisions has been mandatory since 2013 and is part of the IPSm data environment.

  Built-up area signs are not (well) detected by sensors. Because ISA does not only act on observations of assets, but can also do so on the basis of area data, it is good to map out the data of speed areas and make it publicly available. This data must always be kept up to date. Parallel to this, Europe is looking at 1 uniform built-up area sign with a recognizable symbol.

* See next page for further explanation.

Another argument for digitization is that unintended observations by cameras with regard to weight restriction signs at (e.g.) bridges can be prevented. A sign with a restriction for vehicles with a total mass of, for example, '30 t', can be read by a sensor as 30 km/h. If ISA can then fall back on the data from the speed regimes, this provides more certainty about the actual regime speed.

That is why EU regulations also state that speed data can be obtained by sensor observations, the use of speed data and a combination of the two. This combination is the most promising, but it can also contain conflicts. Traffic sign data therefore usually prevails over road section information and these combined data sources should in turn prevail over sensor observations, in order to shift unintended numbers on the aforementioned weight limit signs or even stickers. put on wheelie bins by individual citizens, to the background.

A possible aid in keeping the traffic sign database up to date is the Intelligent Public Space Management App (IPSm app). With this free App, road authorities can adjust changes in the sign file in real time in both the NDW Open Data file and in the IPSm platform with the detailed and complete traffic sign database.

Image 4: The Public Space Management app (HR Groep Streetcare)

- Temporary signage.
  With the IPSm App, RVV signage can also be temporarily switched on and off. The data is pushed directly through the IPSm platform to the NDW, where the information can be retrieved by providers via an API.

Road authorities must check their speed regimes and sign stock for ISA suitability. Does the signage still meet the set standards and is the dataset complete? In many cases it will be necessary to adapt or complete speed signs.

The corresponding traffic decisions must be made, and the signs must be placed along the road. Work is also currently underway on a link between the traffic decision and the data in the IPSm platform.
See also:

- traffic decisions (legally required for road authorities)
- handbook data-top 15
- From Traffic Sign Database to ITS application (Flanders)

Action 2:
Continue to contribute to the introduction and updating of the applicable (static) speed regimes based on topological data profiles.

4.1.3 Infrastructure signals

If dynamic speeds are used, this current information must be made available so that ISA can also use the correct and current speed as a starting point. After all, if a driver assumes through habituation that 'the system does monitor that the speed is not exceeded', dynamic speed limits can unintentionally still lead to the speed being exceeded.

Image 5: Dynamic speeds.

Action 3:
Provide up-to-date and correct central data access to dynamic speeds.

Image 6: Dynamic speeds (foto: Gerard van Dijck)

Image 7: Dynamic speed limit per lane, and static speed limit per time period: 50, 70, 100, 120 or 130 km/h.

4.2 A logical, safe speed limit

A speed regime will not always match the road design and may be perceived as too slow by road users. There can be good arguments for this, but it can be a source of irritation from the driver's point of view. Examples include:

- Overstretched city limits (built-up areas), where there are no more contiguous buildings (not in accordance with BABW).
- Speed limits on roads with segregated carriageways, separate cycle paths and few points of conflict.

Image 8: Built-up area boundary not in accordance with BABW.

Image 9: Zone 60 on a road with separate lanes and separate bicycle paths does not conform to CROW. (See CROW publication Basisinformatie\Basiskenmerken wegontwerp - Categorisering en inrichting van wegen, paragraaf 1.1.6 Veilige snelheden en geloofwaardige snelheidslimieten).

Action 4:
Ensure correct and logical limits for built-up areas in accordance with regulations and, where possible, have the road design match the regime speed

See also SWOV publicatie de bijdrage van geloofwaardige limieten en isa aan snelheidsbeheersing

5 Information

In view of the advantages of ISA for the road authority (traffic safety and possible austerity of additional measures (such as speed bumps) in the future), it is very important that drivers switch off ISA as little as possible during the journey. For the user, however, there are also some adverse effects to be expected that may receive the right attention with education:

- ISA can have the side effect that the regime speed will be interpreted even more by the driver as 'the speed to be driven'. This is of course not a regime speed, but it is the maximum permitted (upper limit). A driver must always adjust her speed in such a way that she can stop the vehicle within the required safe distance
- If there is an error somewhere in the ISA information chain, then it is no excuse for speeding into a built-up area at 80 km/h. It is up to the driver to maintain a sensible and responsible driving style.
- ISA users (certainly in the introductory phase where most vehicles are not yet equipped) may be hounded by non-ISA users. Perhaps something can be done with this in a publicity campaign.

Action 5:
Think about education about ISA with the aim of maximizing user acceptance and also using ISA in the right way.

6 Feedbackloop road authorities/market parties

There are good arguments for the road authority as well as the automotive industry and service providers to make ISA work optimally within the total system of cars, roads and data. However, it turns out that working together constructively in this regard can be difficult. If speed limit signs are digitally available at all, the true challenge is to get and keep this data accurate and correct with a low latency. If on the basis of data, a vehicle expects a sign, but data from vehicles shows that quite a number of vehicles have not detected it, a feedback loop can be set up so that a message is returned to the road authority. The road authority can then take action and make the sign visible again or place it again. It is advisable to organize this in a regional context.. Provinces can play a leading role here as regional director.

Action 6:
Consider win-win situations in regional partnerships to strengthen and better maintain systems such as ISA by linking public and private interests to each other and thereby strengthening them.

7 The own (management) organizations

Both the arrival of ISA and other smart applications (Smart Mobility) require a different working method and commitment from management organizations and policymakers. Systems may have to be set up differently, other competences or additional knowledge are probably required within the own organization in order to set up asset management that is more in line with the arrival of smart vehicles. Cyber security will increasingly play a role in this development.

Action 7:
Consider whether your own organization is still sufficiently capable of using knowledge and systems to follow and operate current trends in such a way that policy objectives can be better achieved.

For further matters in the field of implementation of services on both Human factors and your own organization, see CROW's assessment framework for smart mobility services.

CROW Smart Mobility Services Weighing Framework

8 Roadwork activities and temporary restrictions

It will still be a challenge to consistently enrich the traffic data systems with the current state of affairs when it comes to speed limits, especially during roadwork activities.
How can a contractor install or remove a speed limit in the future and what must be arranged in the specifications?
How do we organize the verification of this in, for example, functionally oriented contract forms such as UAV-gc?
In that sense, the arrival of smart vehicles will eventually also have consequences for contracts and agreements, both in construction and maintenance contracts.
Temporary restrictions that a road authority sets itself must also be reported for a properly functioning ISA (see also section 4.1.2: Speed limit data).

Image 10: Informing ISA in head-up display.

Other references

- Driving Assistance Systems (ADAS) and road layout
- CROW webinar 6 April 2020 ISA
- Smart-infra

Appendix 1: Table of possible direction of solutions

The table below provides an overview of a possible mindset for an ISA-related problem. Perhaps this can help you find a solution. The table should be seen as an aid and contains as scope the purport and content of this document.

Subject	Problem	Direction of solution	No-regret measure	Dutch Data top 15 nr
Traffic sign	Signs with texts such as '30t' (sign C17 – C21) may indicate incorrect speed limit indication with sensor detection. 	Digitization of speed limit data.	Yes, it is part of the data top 15.	05 speed limits 06 signs
	Signs on parallel lanes	Where possible, avoid these speed limit differences as much as possible. Where that is not possible, try to place signs in such a way that the chance of 'reading' from the wrong lane is minimized. If the problem persists, support measures for better positioning can be considered.	Yes, what is clear for sensors is also clear for vehicle drivers.	05 speed limits 06 signs
	Speed limit within a road section (sign A1) is , unless repeated automatically canceled after the next intersection by Dutch regulations. Sensors cannot establish the link that the speed limit does not expires after an intersection, and topology is based on road sections (from intersection to intersection). 	Overcome with data traffic signs? Try to avoid such short restrictions as much as possible. Weigh utility-necessity carefully. If necessary (e.g., plateau at intersection outside the bowl, then clear signage.	Situation dependent.	05 speed limits 06 signs
	Visibility of signs leaves something to be desired.	Place signs so that they are clearly visible. Combine as many signs as possible on other assets such as VRI, signage or public lighting masts.	Yes, what is clear for sensors is also clear for vehicle drivers.	-
	Speed limit (sign A1) placed in a curve, as a result of which the vehicle cannot maintain speed well in the bend. 	Place this restriction in a different location than in the curve. Reducing speed in the curve is not in accordance with the Driving procedure B CBR (general comments vehicle operation, P. 18).	Yes, because in principle this is an undesirable situation.	-
	Legibility of signs leaves something to be desired (reflection class, aging)	Sign to be replaced by new sign, place signs in accordance with BABW and implementation regulations BABW and CROW Pub. 345	Yes, what is clear for sensors is also clear for vehicle drivers.	-
	Stickers '30' on private objects	Digitization of speed data.	Yes, prevents pollution of legal status and traffic decisions.	05 speed limits
	Temporary speed limit (sign A1, A2 or F8) due to roadworks does not match data of speed limits 	Placing extra clear signage, or: Short term: inform road user 'ISA off' Long term: digitizing and including requirements in contracts in case of road works.	Situation dependent.	02 current road works

Subject	Problem	Direction of solution	No-regret measure	Dutch Data top 15 nr
Areas	start/end built-up area (sign H1/H2) cannot (properly) be detected by sensors 	Digitization of speed data.	Yes, it is part of the data top 15.	05 speed limits 06 signs
	Location start/end built-up area (sign H1/H2) 	In accordance with BABW and implementation regulations BABW (see also ASVV: Built-up area boundaries – recommendations for location and layout).	Yes, it complies with the regulations!	-
	Are speedzones 30/60 km/h always clear in relation to ISA? (sign A1 zone and A2 zone)	Digitization of speed data.		05 speed limits
	Sensors themselves do not link the regulation-speed to the motorway- and highwaysigns (sign G1 to G4) and residential area (sign G5/6) 	Digitization of speed data.	Yes, it is part of the data top 15.	05 speed limits
	border signs at national borders	Digitization of speed data.	Yes, it is part of the data top 15.	05 speed limits
Variable speed limits	Dynamic speedlimits are not well sensed by camera's (board A3, F9) 	Digitization of speed data.		05 speed limits
	Time-based variable speed limits are not recog-nized by sensors (board A1 with bottom board)	Digitization of speed data.		05 speed limits
Credibility	Does the speed limit match the local environment and road layout?	Application according to CROW p.315 See, among others, 1.1.6 Safe speed limits and credible speed limits of the CROW publication Basisinformatie/Basis-kenmerken wegontwerp - Categorisering en inrichting van wegen.	Yes, to comply with CROW guideline.	-
Support and acceptance	How can a road authority contribute to the proper use of ISA?	Employer's approach: stimulating the installation of ISA in existing vehicle fleet. Education and information to ISA users (campaigns).	Situation dependent.	-
Critical Mass	How can we increse the number of vehicles equipped with ISA?	Employer's approach: stimulating the installation of ISA in existing vehicle fleet. Education and information to ISA users (campaigns).	Situation dependent.	-
Dates	How can I best unlock my data and what is needed for this?	Regional cooperation/joining forces with a leading role for provinces (regional role).	Yes, cooperation is basically good.	-
	What does this mean for my organization?	Provide the right competencies or attract services to get and keep the datasets up to date. A regional cooperation is strongly recommended.	Situation dependent.	-
Automotive collaboration	How can I organize a feedback loop?	Convert sensor observations of road signs into actionable feedback information. Where a sensor expects a sign based on data, but an x number of vehicles do not find the expected sign, this can be a starting point.	Yes, it is a win – win in public-private partnership.	
	Difficult points for speed determinations	The aforementioned points, such as parallel roads and changes in speed within a road section, may be temporarily helped by auxiliary signs especially for smart vehicles or a better position determination (pilot).	?(Pilot)	
			See also Handbook data top 15	

Colofon

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