SWOV Fact sheet

Measures for speed management

Summary
Measures for speed management are essential for limiting the negative effects of driving too fast and at inappropriate speeds. To begin with, safe and credible speed limits need to be determined. Dynamic and variable speed limits that take into account the current circumstances, such as weather conditions and traffic situation, can be of use here. In addition, it is important that road users always know the local speed limit. Increasingly, this can be achieved by in-vehicle information. Where necessary, local infrastructural measures such as speed humps must be used to enforce a safe speed. These infrastructural measures require a logical location and good implementation. This approach will put a stop to most speeding offences. Enforcement remains essential for the group of drivers that continues to speed. Public information campaigns and education should accompany all these measures and, in a more general sense, inform road users about the importance of speed management. Furthermore, a large effect on safety is expected of Intelligent Speed Assistance (ISA).

Background and content
Driving speed is an important road safety factor. There is a strong relation between speed on the one hand and crash rate and injury severity on the other (see SWOV Fact sheet *The relation between speed and crashes*). Furthermore, driving speed also influences accessibility, the environment, and quality of life (for more information, see OECD/ECMT, 2006). Thus, speed management is important for a variety of reasons, and we shall continuously need to find a good balance between interests that are not always harmonious. This fact sheet discusses the general concept of speed management of motorized vehicles, with the emphasis on road safety. Specific groups, such as motorcycles, delivery vans, coaches, lorries, or cars with trailers, will not be discussed. The following instruments for speed management and the relations between them will be discussed in this fact sheet (see also Van Schagen & Feypell, 2011):
- (safe and credible) speed limits;
- good information about the local speed limit;
- infrastructural measures;
- police surveillance and enforcement;
- education and information;
- Intelligent Speed Assistance (ISA).

How do we determine the correct speed limit?
Speed limits are the foundation of all speed policy; they indicate the maximum speeds which are allowed on certain roads. If all cars and delivery traffic were to keep to the limit, there would be 30% less fatalities in crashes involving one or more of these vehicles (Aarts et al., 2008).

Speed limits in the Netherlands
Speed limits were first introduced in the Netherlands in 1957. From then on there was an urban speed limit of 50 km/h. Not until more than fifteen years later, in 1974, speed limits were also set for roads outside urban areas.

The Dutch general speed limits are laid down in the Road Traffic Act. These limits are:
- 130 km/h on motorways (since 1 September 2012);
- 100 km/h on trunk roads;
- 80 km/h on other rural roads; and
- 50 km/h on urban roads.

According to the Administrative Provisions Decree, specific exceptions are possible. Possible exceptions are, for example, 30 or 70 km/h on urban roads, 60 km/h on rural roads, and120, 100 or 80 km/h on motorways. The road authority then determines which limit applies where through a traffic

order. The Administrative Provisions Decree further states that "the speed limits should be appropriate for the local road conditions. This means that, where necessary, the road environment is adapted in such a way that the intended speed is indicated by the nature and design of the road concerned and its surroundings".

Towards safe and credible speed limits
Speed limits should primarily indicate a safe speed. Which speed can be considered safe depends on the function of the road and thus on the traffic composition. Where motorized traffic mixes with pedestrians, cyclists, and moped riders, the speed limit must be low. In principle, the same applies for roads with a relatively large volume of heavy vehicles. The possibility or impossibility of certain conflicts, such as lateral or frontal conflicts, also is an indicator for determining a safe speed. *Table 1* shows the safe speeds for a number of road types and potential conflicts. Safe here means that at that speed, 90% of the crashes that take place will cause no serious injuries. Safe speeds are defined in Advancing Sustainable Safety (Wegman & Aarts, 2006) based on knowledge of the vulnerability of the human body (biomechanical tolerance) and on the Swedish Vision Zero approach. Further specifications of this can be found in, among others, Aarts & Van Nes (2007).

	Safe speed
Roads with possible conflicts between cars and unprotected road users	30 km/h
Intersections with possible lateral conflicts between cars	50 km/h
Roads with possible frontal conflicts between cars	70 km/h
Roads on which frontal and flank conflicts with other road users are impossible	$\geq$ 100 km/h

Table 1. *Safe speeds for a number of road types and their potential conflicts (after Tingvall & Haworth, 1999).*

Not only should the speed limit be safe, it should also be credible. This means that the speed limit meets the expectations evoked by the road image which is defined by the road's features and its surroundings (Van Schagen et al., 2004, Wegman & Roszbach, 2004)). This way, drivers will be more inclined to keep to the safe limit. Research has shown that it is possible to identify specific characteristics of road and environment that influence credibility, and that on average, drivers are indeed more inclined to keep to credible limits rather than to incredible limits. If a speed limit does not match the road image, either the limit or the design should be changed. This principle is not new, but in the application of the principle there is still a lot of room for improvement. For more information on this topic and on its application, see SWOV fact sheet *Towards credible speed limits.*

Dynamic and variable speed limits
At this moment, the majority of speed limits in the Netherlands are static. They do not allow for adapting to the circumstances, while these circumstances are a main determinant of a safe speed. Dynamic and variable speed limits do take these circumstances into account. Dynamic limits take *real-time* circumstances at a specific moment into account, such as the traffic situation, while variable limits take circumstances into account in a more general sense, for example through applying a different limit at daytime than at night time, or for wet and dry road surfaces (see also OECD/ECMT, 2006) Dynamic and variable limits will usually be more credible than static limits, especially where they involve circumstances that are visible to the road user.

At the moment,the Netherlands has dynamic and variable limits only to a limited extent. Variable limits can be found at parts of motorways that have a limit of 130 km/h in the evening and at night, and a limit of 100 or 120 km/h during the day. Dynamic limits can also be found at motorways, namely when the limit is adjusted due to, for example, incidents or extreme weather conditions. In 2009, the Directorate-General for Public Works and Water Management in the Netherlands started experiments with dynamic speed limits on some motorways on the basis of traffic concentration and weather conditions to learn about the effects on safety, traffic flow and environment. This was done on the pretext of ‘faster where possible and slower where needed’. The results (Wilmink, Schreuder & Stoelhorst, 2010) show that dynamic speed limits can help to improve these and that road users appreciate the dynamic speed limits and actually adjust their behaviour. The results did not show any negative side effects.

Apart from that, in a completely dynamic speed limit system the limit at that place and at that time will probably be indicated in the vehicle. However, before this can be accomplished, not only do some necessary technical details have to be developed, but also some crucial questions need to be answered. One of the most important questions is which speed limit under which circumstances can guarantee an acceptable level of safety.

How does the driver know the speed limit?
As mentioned before, the road authority first has to determine which speed limit applies at a location. Then, it is important that the road user knows the speed limit at any location and at any time. In practice, this often turns out not to be clear (Hendriks, 2005). Information about the local limit is currently often indicated by a road sign. However, general limits are not communicated by road signs; the road user is supposed to know them. In addition, it is possible to consistently use road markings as, for example, is pleaded for in 'Essential Recognizability Features' (see also SWOV Fact sheet *Recognizable road design*). Increasingly, in-vehicle information will be used, often linked to a navigation system.

What can we achieve with infrastructural measures?
Where needed, the road design and the infrastructure must physically support the speed limit. At places where a low speed is very important, e.g. in the vicinity of schools, pedestrian crossings and cyclist crossings, but also at intersections, physical speed limiters can be used. In this manner drivers will be forced to lower their speed. At intersections on distributor roads, mainly roundabouts and sometimes raised junctions are placed in order to establish a speed reduction. At access roads, especially within the urban area, speed humps are used to physically reduce speed at intersections. In general, the speed humps are located just before the crossing area**.** On urban access roads, axis offsets and road narrowing are also used to limit speed. For all physical speed reducing measures, it is important that the location is logical and that the geometric design is consistent with the purpose and the applicable speed regime.

The driver often insufficiently adapts his/her speed, especially in the transitions from a high speed limit to a lower speed limit. One of the reasons lies in the fact that after driving at a high speed for a long time, the driver, at a given moment, underestimates the speed and does not adjust it sufficiently (see also SWOV Fact sheet *Speed choice: the influence of human, vehicle, and road*).

At these locations, physical, infrastructural measures can be useful. The transition between a rural and an urban area presents a specific problem especially on main roads that pass through villages. Here, too, one has often been driving at a higher speed for some time. What is more, the required reduction in speed that usually accompanies an urban-rural transition is often insufficiently 'visible' or 'noticeable' to the driver. Specific measures to clearly mark this transition can result in substantial safety improvements. These measures should be supplemented with physical and visual speed limiters, for instance a gate construction, and preferably urban measures should also be applied (see CROW, 1999).

Continued police surveillance on top of it all?
When all the above measures have been carried out adequately, we may assume that a large part of all speed offences are prevented.. But for as long as drivers can ultimately determine their speed themselves, there will always be violations, and for that reason police surveillance remains necessary. As long as the previously mentioned measures have not been carried out sufficiently, more police surveillance based on general deterrence and prevention will be needed. SWOV Fact sheet *Police surveillance and driving speed* discusses the how and why of police surveillance and the various methods and their effects.

What is the role of education and public information?
Education and public information are a support and a prerequisite for each of the measures discussed aboveThe possibilities for education and information at primary and secondary schools are limited. With primary school pupils, it is practically impossible to influence the driving speed behaviour that they will display at a later age. However, it may be possible to introduce the subject of speed to the children with the idea that they will address their parents about it. For pupils of secondary schools, the moped training is a good moment for paying attention to the consequences of driving (too) fast.

In the driver training the future drivers have to learn all about safe speeds. This includes the limits themselves, why speed limits are necessary, adjusting speeds to the circumstances, et cetera. They must also learn to anticipate and to adjust speed in time. After the driving test has been passed, there are still some possibilities for education, among other things through the Educational Measure Behaviour. This measure is intended for road users who deliberately engage in risky behaviour and as a result create danger for themselves and for others. This measure also considers serious speeding dangerous behaviour (see SWOV Fact sheet *Rehabilitation courses for road users*).

Finally, public information can be used to explain speed measures such as police surveillance and speed humps. In addition, information helps to increase awareness of the effects of driving (too) fast. This was also the purpose of the Dutch national campaign 'Keep to the speed limit' that has been held regularly since 2010. The discrepancy between individual advantages (fun in driving and – assumed – shorter driving periods) and social disadvantages (road safety, the environment) is a recurrent problem in information about speed. Information is effective mainly in combination with other measures, particularly in combination with police surveillance (see SWOV Fact sheet *Public information about road safety*).

What is the position of Intelligent Speed Assistance (ISA)?

Intelligent Speed Assistance (ISA) is a system that uses information exchange between surroundings and vehicle. The vehicle receives information from the surroundings about the desirable or mandatory speed limit and reacts to it. The term ISA is often immediately associated with a completely intervening system. However, ISA is in fact a collective term for various in-vehicle systems that inform, warn, register and/or intervene. An ISA system can work with static speed limits, with or without the location-dependent (advised) speed limits. It will also be increasingly possible to work with dynamic speed limits. Large safety benefits are expected from ISA, especially from the more intervening systems.

A recent test with ISA in the Netherlands for notorious speed offenders by the Directorate-General for Public Works and Water Management showed that a speed lock (impedes exceeding the speed limit) as well as a speed monitor (gives feedback when the speed limit is exceeded, and becomes a speed lock at a certain level of exceeding the speed limit) decreased the number of speeding offences considerably (Van der Pas, Van Ingen & De Wildt, 2012). At the same time it was shown that the systems used in the test were not yet developed sufficiently for implementation as speed locks for notorious speed offenders. For more information on ISA see the SWOV Fact sheet *Intelligent Speed Assistance (ISA)*.

Conclusion

There are many ways to bring road users to a safer speed. However, to get there, an integrated, step by step approach is required. It begins with determining a safe speed limit which matches a road's function and, often dependent on its function, the traffic composition. Furthermore, the road image must also support the limit, so that the limit is credible. Physical speed limiters mayl be necessary at locations where a low speed is crucial, for example in residential areas, near schools, at pedestrian crossings, and at intersections. Also, it must always be clear for the driver what the actual speed limit is. These measures are expected to put a stop to most speeding offences. To counteract the remaining speed offences, police surveillance remains essential. Education and public information are supplementary measures and are needed to inform the road users about the dangers of driving (too) fast and the positive effects of the various measures.

There are various technological developments that can make speed management more effective and more credible. For example, there are already systems, usually linked to a navigation system, that show the local speed limit inside the vehicle. The possibilities of using dynamic speed limits that take the local weather and traffic conditions into account are increasing rapidly available. Finally, speeding can be prevented with the help of ISA, but some developments concerning technological and legal issues are required, at least to make ISA compulsory for notorious speed offenders.

Publications and sources
(SWOV reports in Dutch have an English summary)

Aarts, L.T. & Nes, C.N. van (2007). *Assistance for speed policy aimed at safety and credibility; First initiative for a decision-support instrument*. (In Dutch) D-2007-2. Stichting Wetenschappelijk Onderzoek Verkeersveiligheid SWOV, Leidschendam.

Aarts, L.T., Weijermars, W.A.M., Schoon, C.C. & Wesemann, P. (2008). *Maximaal 500 verkeersdoden in 2020: waarom eigenlijk niet?* R-2008-5. Stichting Wetenschappelijk Onderzoek Verkeersveiligheid SWOV, Leidschendam.

CROW (1999). *Bebouwdekomgrenzen: aanbevelingen voor locatie en inrichting.* CROW kenniscentrum voor verkeer, vervoer en infrastructuur, Ede.

Hendriks, T. (2005). *De weggebruikerstoets: wat kunnen we er van leren?* In: Verkeerskundige werkdagen, Ede, 1 en 2 juni 2005.

OECD/ECMT (2006). *Speed management*. OECD/ECMT Joint Transport Research Committee, Paris.

Pas, J.-W. van der, Ingen, A. van & Wildt, L. de (2012). *Snelheidsslot en snelheidsmonitor: evaluatierapport*. In opdracht van Rijkswaterstaat, Dienst Verkeer en Scheepvaart DVS. DTV Consultants, Breda.

Schagen, I. van & Feypell, V. (2011). *Speed and speed management for road safety: an overview of the findings of the OECD Working Group on Speed Management*. In: Fit to Drive: proceedings of the 5th International Traffic Expert Congress, The Hague, April 6th-8th 2011, p. 81-86.

Schagen, I.N.L.G. van, Wegman, F.C.M. & Roszbach, R. (2004). *Safe and credible speed limits; A strategic exploration* (in Dutch). R-2004-12. Stichting Wetenschappelijk Onderzoek Verkeersveiligheid SWOV, Leidschendam.

Wegman, F.C.M. & Aarts, L.T. (red.) (2006). *Advancing Sustainable Safety; National Road Safety Outlook for 2005-2020.* SWOV Institute for Road Safety Research, Leidschendam. [In English]

Tingvall, C. & Haworth, N. (1999). *Vision Zero: an ethical approach to safety and mobility*. In: Proceedings of the 6th ITE International Conference Road Safety & Traffic Enforcement: Beyond 2000, Melbourne, 6-7 September 1999.

Wilmink, I., Schreuder, M. & Stoelhorst, H. (2010). *Effecten van de proeven met een dynamische snelheidslimiet op de Nederlandse autosnelwegen.* In: Nationaal Verkeerskundecongres 2010 3 november 2010, Rotterdam; Bijdragen en presentaties. CROW kenniscentrum voor verkeer, vervoer en infrastructuur, Ede.