# SWOV Fact sheet

## Daytime running lights (DRL)

**Summary**
Europe has decided that as from 2011, new types of passenger cars and delivery vans must be fitted with lights that automatically switch on when the car is started. Daytime running lights (DRL) increase the visibility of road users and thus reduce the risk of a crash. Research has shown that road users who do not carry lights during the daytime, pedestrians and cyclists, can also benefit from DRL. If almost every driver had their headlights on during the daytime, more than 30 road deaths and 500 serious road injuries per year could be saved in the Netherlands.
DRL's negative consequences, such as a higher fuel consumption and thus larger emissions of harmful materials, are limited considerably by using energy-saving lamps.

**Background and content**
DRL involve motor vehicles having their headlights on during hours of daylight. These can be their dipped headlights or a special DRL device (lamps using switches). Having motor vehicle headlights on during daytime makes motor vehicles more noticeable and saves road crash casualties.
DRL are already compulsory in a number of European countries. As yet, this has not been the case in the Netherlands. However, it can be seen that many motorists voluntarily switch their headlights on during daylight hours, especially on rural roads and when the visibility is poor. The last time that the use of DRL was measured in the Netherlands was in 1993; 30% of the drivers then used DRL (Lindeijer & Bijleveld, 1994).
The European Commission (EC) aims at harmonization of the DRL regulations and setting the corresponding necessary vehicle requirements. In doing so it is important to emphasize the positive effects (saving road crash casualties) and to limit the negative effects (greater fuel consumption) as much as possible. Another point of interest for the EC is whether the road users who do not carry lights (cyclists and pedestrians) will still be noticed, and whether motorcyclists (who already use DRL) are still sufficiently conspicuous. The EC has decided that as from 2011, new types of passenger cars and delivery vans must be equipped with energy saving lights which automatically switch on when the car is started during daytime. In 2003, the EC commissioned a study of the effects of DRL and the implementation strategies, in preparation for this European legislation. Research institutes in the Netherlands (Netherlands Organization for Applied Scientific Research TNO and SWOV) and in Norway (Institute of Transport Economics TØI) carried out this study. This fact sheet not only presents the results of this study, but also those of studies carried out in the 1990s. The safety effects of DRL, the visibility of other road users, the expected decrease in road crash casualties in the Netherlands, possible disadvantages of DRL, and the current state of affairs in Europe will be discussed in this order.

**What is the effect of DRL?**
In-depth crash studies have shown that not having seen the other road user plays a role in 50% of the daytime crashes, and for intersection crashes this is even 80%. Theoretical insight and observations mainly attribute the DRL effect to the greater contrast between vehicles and their surroundings; DRL increase the visibility of vehicles and makes them better identifiable. An additional effect is that vehicles with DRL are estimated to be closer than they really are. This reduces taking risks while overtaking and when entering intersections.
DRL are a tool to assist road users in their visual observation task. DRL studies in the 1990s indicated reductions of 10-15% (Elvik, 1996) and 8-22% (Koornstra, 1993) in the numbers of daytime crashes in which two or more road users were involved.
The 2003 study commissioned by the EC involved a meta-analysis of 41 studies of the effect for cars and 16 studies of the effect for motorcycles (Elvik et al., 2003). This showed that for cars DRL reduce the number of daytime injury crashes by 3-12%. The effect on fatal crashes can be estimated as somewhat greater (-15%). For motorcycles DRL reduce the number of injury crashes by 5-10%. For these categories we should mention that the results found per individual study (may) differ greatly. The reduction refers to daytime crashes in which more than one road user was involved. A greater effect may be estimated for fatal crashes. Some of the studies found that the effect of DRL decreased after

some time, but others found that it did not decline. No proof was found that the effect of DRL depends on the season. In agreement with the previous study of Koornstra et al. (1997), it was found that the effect depends on latitude, but the relation is now shown to be less strong.
The fact that rear lights that are on in the daytime can obscure the brake lights, is no longer a problem since the introduction of the third brake light which has been compulsory in the Netherlands since 1994.

**How visible are the other road users?**
It is sometimes suggested that vehicles who do not have their lights on in daytime are visually 'pushed aside' by DRL vehicles due to the obscuring effect. The EC has also had this investigated. TNO carried out a laboratory experiment (Brouwer et al., 2004) in which subjects were shown slides with pictures of traffic situations in daylight circumstances. The slides contained a car with or without DRL and another road user: a pedestrian, a cyclist, or a motorcyclist with or without lights. The subjects were instructed to determine as quickly as possible whether there was another road user present. The results showed that subjects were able to identify the traffic situation of cars with DRL more accurately and faster than that of cars without DRL. No indications were found of a lesser conspicuousness of vulnerable road users when near a car with DRL. On the contrary, results pointed in the opposite direction: road users without lighting in fact profited from DRL. It is also an advantage that vulnerable road users can see cars with DRL sooner than cars without DRL.
The meta-analysis of Elvik et al. (2003) concludes - be it with some reservation - that DRL probably reduce the number of car crashes involving cyclists and pedestrians. A study carried out by the Austrian Epigus Institut (Pfleger, 2007) concludes that, based on a study of road users' looking behaviour, DRL have no benefits in good weather, but is an advantage in bad weather. In rare cases DRL could be responsible for obscuring persons and vehicles, according to this study.
Motorcyclists in the Netherlands, who nearly all have their headlight on during daytime, sometimes express the fear that their conspicuousness will lessen if cars also have their lights on during daytime. The TNO laboratory experiment (Brouwer et al., 2004) showed that the subjects saw both motorcycles with their lights off and motorcycles with their lights on earlier if cars also used DRL. However, motorcycles with DRL were spotted faster. Wildervanck (1994) had already explained this phenomenon earlier. By having his headlight on a motorcyclist separates himself from the static surroundings and is therefore noticeable as a moving vehicle. And that situation does not change, even if the surrounding vehicles also have their lights on.

**Reduction of casualties through DRL in the Netherlands**
If almost every driver had their headlights on during the daytime, more than 30 road deaths and 500 serious road injuries could be saved in the Netherlands on a yearly basis.
This calculation is based on the casualty numbers of 2009 and a DRL use of 20% in urban areas and 50% in rural areas. The decrease in the number of casualties is based on the meta analysis of DRL studies by Elvik et al. (2003):
- fatal crashes: reduction of 15%;
- serious injury crashes: reduction of 10%.

In Europe, as from 2011 all new passenger car models must be equipped with automatic energy saving DRL lights. This means that the full benefits of DRL will be not be visible until 2025, when all cars will be equipped with it. In order to benefit from DRL before this time, drivers without this equipment have to switch on the dipped headlights manually during daytime.

**Does DRL have any disadvantages?**
The use of DRL increases fuel consumption. Obviously, when the lights are switched on, a bigger load is placed on the dynamo. However, there is a large difference between using the customary dipped headlights and using low-energy LED lights. We will first take a look at the customary dipped headlights. Although the extra consumption due to switching on the dipped headlights is the same per car (2x55W), the relative differences are large. A fuel efficient car using 6.7 litres per 100 km (1:15) with DRL by using dipped headlights has an extra consumption of 3%. A 10 litres per 100 km (1:10) car, for example, uses 2% more, and a lorry using 33 litres per 100 km uses 1% more (ETSC, 2003). At the same time, increased fuel consumption causes an increased emission of harmful materials which is bad for the environment. The $CO_2$ emissions of car traffic would increase by 0.6-1.4% (Elvik et al., 2003). Saving fuel and reducing $CO_2$ emissions can be achieved for more than 50% by using special DRL lamps (21W per lamp) and for 90% by using LED (about 5W per lamp).
Another disadvantage of using conventional dipped headlights for DRL is that headlamps burn out faster, because they are switched on longer. This problem is only small if LED lamps are used.

There is also the matter of to what extent blinding occurs when DRL is used. Blinding has been researched extensively (Koornstra et al., 1997; Hagenzieker, 1990). There are different degrees of blinding, varying from a nuisance to complete blinding. It has been established that DRL can cause blinding (mainly nuisance) when the light intensity of the dipped light is too high and the surrounding lighting is at a relatively low level (for example at sunset). The too high intensity of dipped lights is due to incorrect adjustment. In fact this is not a DRL problem; the blinding is more serious at night time. Nowadays, dipped lights are quite well adjusted because of the MOT (Ministry of Transport test: an annual test of automobile safety, roadworthiness aspects and exhaust emissions required for most vehicles over three years old) and built-in systems that take care of automatic adjustment of headlights. Blinding does not occur with lamps that have been specially developed for DRL purposes, like the low-energy DRL lighting that can be used from 2011.

**What is the current state of affairs in Europe?**
At present, 16 EU countries have some form of compulsory DRL for cars. Denmark, Estonia, Finland, Latvia, Lithuania, Norway, Poland, Slovenia, Slovakia, the Czech Republic and Sweden have compulsory DRL throughout the year for all roads. Bulgaria has compulsory DRL for all roads during the winter months. In Hungary, Italy and Romania DRL is compulsory on rural roads throughout the year. In Portugal, switching on the lights is compulsory throughout the year on roads for which this is indicated. A number of other countries, among which Germany, France and Spain, recommend the use of DRL in certain road and weather circumstances. In Austria compulsory DRL has been abolished as of 1 January 2008 (see also SWOV position *Daytime running lights is safer)*. However, Austria is in favour of the future compulsory low-energy DRL lighting. In Belgium and Spain dipped lights are compulsory for motorcycles during daytime hours.

In countries that have the compulsory DRL, the driver must switch on the dipped headlights manually, so this is a behavioural measure. Then there is the vehicle measure, which is an automatic DRL device in cars. Swedish car producers have begun to equip their cars with this device. This means that in Scandinavian countries where DRL is always compulsory, there are many cars with automatic DRL devices. Volvos and Saabs imported into the Netherlands are also equipped with this device

The incentive for the European implementation of DRL was a study done by the Netherlands (TNO and SWOV) and Norway (research institute TØI), commissioned by the European Commission (EC); (Commandeur et al., 2003). This research led to quite some discussion between the member states, after which the EC eventually decided to implement DRL. This decision entails that as from 2011, new types of passenger and delivery vehicles must be equipped with low-energy lights that switch on automatically when the car is started (EC, 2008). For other vehicles the measure will be introduced one year later. This decision in fact comes down to a gradual introduction of DRL. Considering the differences of opinion within Europe it has been decided not to introduce the compulsory behavioural measure to switch on DRL manually.

**Conclusion**
DRL make a contribution to further road safety improvement. There is no scientific support for the often assumed negative effects for pedestrians, cyclists or motorcyclists. As from 2011, in Europe all new models of passenger cars must be equipped with low-energy DRL lighting. This means that all passenger cars will be equipped with DRL around 2025. If we would wish to benefit from the road safety effects of DRL before that time, all drivers that do not have this device should manually switch on dipped lights during daytime. In 2009, this would have saved more than 30 road deaths and 500 serious road injuries.

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

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