RoSPA
The Royal Society for the Prevention of Accidents

Vehicle Technology

A Manager's Guide

THINK!
Road Safety

Produced with the support of the Department of Transport

Contents

Introduction

Roads and vehicles are an essential part of everyday life. Businesses and organisations use them for a variety of reasons, whether it is carrying goods or passengers, or simply travelling from A to B. Unfortunately, driving is the most dangerous work activity that most people do. Research indicates that about 20 people are killed and 220 seriously injured every week in crashes involving someone who was driving, riding or otherwise using the road for work.

HSE Guidelines, "Driving at Work", state that "health and safety law applies to on-the-road work activities as to all work activities and the risks should be effectively managed within a health and safety system".

Therefore, within the framework which they should already have in place for managing health and safety at work, employers must conduct suitable risk assessments and put in place all 'reasonably practicable' measures to ensure that work related journeys are safe, staff are fit and are competent to drive safely and that vehicles are fit-for-purpose and in a safe condition. Such measures will more than pay for themselves by reducing accident costs, many of which will be uninsured.

The Provision and Use of Work Equipment Regulations also require employers to ensure that work equipment (including vehicles and the equipment in them) is suitable and safe, and employees are properly trained in its use.

An increasing number of vehicles, especially fleet vehicles, are being fitted with various devices designed to help the driver drive safely, or to help the driver do other things, such as schedule deliveries and pick-ups more efficiently. While these different technologies can, if used properly, reduce the risk of drivers crashing, they can also increase the risk (e.g., by distracting the driver) if not used properly.

Different technology communicates with drivers in different ways, and it is crucial to ensure that drivers understand what the vehicle is 'telling' them.

Warnings

Vehicles have had several warning systems in place for many years. For example, the low fuel warning light on the dashboard. More recent technology provides visual, and/or audible warnings, but there are also tactile alerts, such as a vibrating pedal.

Intervention

Systems can intervene and assist a driver by augmenting their actions. For example, Electronic Stability Control (ESC) helps to prevent a skid during an emergency manoeuvre by braking individual wheels, independently of the driver.

Control

Ultimately, vehicles may take on a level of automation, taking control of various aspects of driving and preventing dangerous circumstances from occurring.

It is essential that managers and drivers understand what such technology can and cannot do, how to use it safely and the potential risks of mis-using it.

This Guide is intended to help managers to assess the likely benefits, and potential problems, of different types of technology.

Managers will also find "Driving for Work: Vehicle Technology" a useful companion to this Guide.
It can be downloaded from

www.rospa.com/roadsafety/info/vehicletech.pdf

The Role of Vehicle Technology

The effective use of technology to reduce accident risk needs to be incorporated into the organisation's driving for work policy.

Before selecting specific technology to be included in vehicles used for work, its likely effectiveness in preventing accidents or reducing injury, and the potential for mis-use, should be assessed. There is published research about the effectiveness of some technology, but for others little has yet been published.

It is important to consider the type of accidents that a particular type of technology is meant to reduce. For example, if the majority of accidents in a company are due to drivers reversing on site, then technology to assist this manoeuvre should be considered. If drivers are involved in loss of control accidents on public roads, then technology that prevents skids may be more appropriate.

It may be more difficult for small businesses with smaller fleets to identify accident trends, in which case they may need to rely on published research showing the effectiveness of different technologies.

Research that shows the potential accident reduction for a particular technology could also be used to set performance targets.

Where fitted, recent technological advances mean that many things are now possible on vehicles that were not possible just a few years ago. Sensors and other in-built technology can collect information about the environment around the vehicle, the vehicle itself, and even about what the driver is doing. Essentially, this enables the vehicle to assist the driver to avoid accidents or to reduce their severity. It can help to prevent accidents in different ways.

Planning the journey

Technology can be used to identify and plan routes, including potential resting places along the way. For example, drivers use Satellite Navigation Systems or journey planning websites to plan journeys, to obtain information about traffic conditions on their route and identify alternative routes where necessary.

Normal driving

During normal driving, many types of vehicle technology search for, and prioritise, hazards. Some monitor the condition of the vehicle; others monitor the route being used.

Warning phase

During the warning phase the vehicle has collected enough information, usually by radar, cameras or sensors that scan the area around the vehicle, to identify a serious risk. They then alert the driver, often through a visual or audible signal. For example the Blind Spot Information System warns drivers if it detects a vehicle or cyclist is in the blind spot.

Assistant phase

During the assistant phase, the vehicle has detected that an accident will occur if nothing is done. The accident is still avoidable although an evasive manoeuvre is required to prevent it. It usually requires the driver to take action and augments the actions, if necessary. For example, Brake Assist ensures that the brakes are fully operated during an emergency stop.

Pre-crash phase

In the pre crash phase, a collision has become unavoidable. However, some modern vehicles have time to work out how to best protect the occupants. For example, it may measure the likely impact speed and calculate how best to deploy the airbags.

Crash

During an accident, vehicle technology can prevent or reduce injury to the occupants. Airbags and seats belts are established examples of this type of technology.

Post-crash/rescue phase

After an accident has occurred, on board systems can be used to alert the emergency services to the exact location and severity of the accident.

Seat Belts

Seat belts are a well-established and accepted safety technology. On modern vehicles, they are designed to work as the key part of a wider safety system, that includes airbags and head restraints, all of which combine to provide maximum protection.

Type of injury Seat Belts help to prevent

Seat belts are designed to:

- prevent an occupant from being thrown about inside the car, and thrown from the vehicle
- limit the movement of an occupant so that they do not make contact with any of the vehicle's interior
- stretch sufficiently to prevent the restraining force of the seat belt causing a serious injury to the occupant.

Effectiveness

Seat belts are a highly effective way of preventing injuries to vehicle occupants.

- users of safety belts sustained approximately 35% less 'major-fatal' grade injuries than did non-users. (1)
- the simple act of buckling a safety belt can improve an occupant's chance of surviving a potentially fatal crash by 45% to 73%. (2)
- Seat belts provided much greater protection, with seat belt use reducing the risk of death by 65%. (3)

Using Seat Belts

Seat belts are only effective if they are worn, and whilst front seat belt wearing rates are over 90%, this still means that one in every ten journeys is made unbelted. It has been estimated that 300 lives every year could be saved if the wearing rate was at 100%.

Managers should check that company drivers, especially van drivers and passengers, are wearing their seat belts.

Further information and advice about seat belts and child car restraints is available on the THINK! Road Safety website,

www.thinkroadsafety.gov.uk/campaigns/seatbelts/seatbelts.htm and on **www.childcarseats.org.uk.**

(1) Safety belt effectiveness in rural California automobile accidents. Tourin, B. and J.W. Garrett. Automotive Crash Injury Research of Cornell University. 1960
(2) The Economic Impact of Motor Vehicle Crashes 2000. Blinco, L., A Seay, E. Zaloshnja, T. Miller, E. Romano, S. Lutcher, and R. Spicer. NHTSA. 2000
(3) Association of driver air bags with driver fatality: a matched cohort study. Cummings, P. McKnight, B. Rivara, F. Grossman, D. BMJ 2002;324:1119-1122

Seat Belt Reminder System

Many vehicles are now fitted with Seat Belt Reminder systems (SBR). They sense whether the seat belt is fastened in an occupied seat, and if not, alert the occupant that the seatbelt should be worn. They are most common for the driver's seat, but many now also cover the passenger seats.

They alert occupants in a variety of ways, sometimes with a simple warning light on the dashboard, although many also have an audible alarm, which is activated when the vehicle has gone over a certain speed or has travelled a certain distance.

There are no current legal standards for seat belt reminder systems. However, EuroNCAP have set performance standards for systems and vehicles are awarded points if they are fitted with an SBR that meets these standards.

It is expected that in future, all new vehicles will be fitted with Seat Belt Reminder Systems.

Effectiveness

- For all observations the total seat belt wearing rate was 97.5% in cars with SBR, while it was 85.8% in cars without. (4)
- The wearing rate in cars with mild reminders [cars with SBR which do not conform to the EuroNCAP standards] was 93.2%, indicating that the levels of the audio and visual reminder signals are of importance. (5)
- Overall use rates were estimated at 71% for drivers in vehicles without the reminder system and 76% for drivers in vehicles with belt reminders. (6)
- Occupants were unrestrained during any part of a trip on 32 percent of trips they undertook...when the SBR system was activated, this percentage reduced to 17 percent. (6)

Using Seat Belt Reminder Systems

Well-designed systems make it obvious to vehicle occupants what the warning means but managers should ensure that their staff know what type of alert the system will give.

(4) Intelligent Seat Belt Reminders: Do they Change Driver Seat Belt use in Europe? Lie, A. Kullgren, A. Krafft, M. Tingvall, C. The 20th International Technical Conference on the Enhanced Safety of Vehicles (ESV), 2007, Paper number: 07-0388

(5) Effectiveness of Ford's belt reminder system in increasing seat belt use. Williams AF, Wells JK, Farmer CM. Inj Prev. 2002 Dec;8(4):293-6.

(6) Effects on Driving Performance of Long-term Exposure to a Seat Belt Reminder System: Findings from the Australian TAC Safecar Project.Regan, M. Young, K. Triggs, T. Tomasevic, N. Mitsopoulos, E. Stephan, K. The 20th International Technical Conference on the Enhanced Safety of Vehicles (ESV), 2007, Paper Number 07-0149

Airbags

Airbags are a type of vehicle technology designed to prevent injury to vehicle occupants. They are designed to work with seat belts and are not a substitute for them. They will not provide adequate protection if the occupant is not also using a seat belt – for this reason they are also known as a Secondary Restraint System.

An airbag deploys rapidly and forcefully in a crash so that it is fully inflated by the time an occupant contacts it. This then cushions the occupant, helping to prevent them hitting hard parts of the vehicle's interior.

It is not compulsory to fit an airbag in new vehicles. However, all manufacturers now fit them as they are an effective way of helping them meet the required occupant protection standards. They also help improve scores in 'consumer' tests such as EuroNCAP.

The EuroNCAP scores give an overall indication of how well the vehicle helps to protect occupants should there be a crash. That protection can only work if all the safety systems are used properly.

Airbag locations

Airbags can be found in many different positions in a car and increasingly in vans. The most common airbags are found in the middle of the steering wheel and in the passenger dashboard. They are designed to provide additional protection for the front occupants in collisions.

Airbags are also located in the side of some vehicles to protect front and sometimes rear occupants if a vehicle suffers a side impact. There are several different types of side airbags; some are designed to protect the head, and others deploy lower from within the door or seat to offer protection for the hip or lower body.

Other airbags are becoming available on more expensive vehicles, for example, a knee airbag underneath the steering wheel can help to limit occupant movement and reduce the chances of leg injuries.

Effectiveness

- Frontal airbags offer extra protection to vehicle occupants, with significant overall benefits for head injuries [7].
- Air bags reduce the overall fatality risk of car drivers by a statistically significant 11 percent (confidence bounds: 7 to 15 percent). In other words, a fleet of cars equipped with air bags will have 11 percent fewer driver fatalities, total, than the same cars would have had if they did not have air bags[8].

Using airbags

You should always wear your seat belt, as an airbag is not a substitute for its protection.

Airbags deploy very quickly in order to be inflated by the time an occupant reaches them, and it can be dangerous if the airbag hits anything that might obstruct deployment. It is important therefore to make sure that nothing is close to, or obstructing, the airbag.

Advice for drivers in the US and Canada, and more recently supported by research in the UK [9] is to make sure that there is at least 25cm (10 inches) between the steering wheel airbag and the driver's breast-bone – but as front airbags can differ between vehicles you should always check and follow any specific advice that the car manufacturer gives.

If a driver is sat closer than this distance to the steering wheel, contact the vehicle manufacturer or a local garage authorised by the manufacturer. They may be able to offer further practical advice or assistance.

There is also a risk of injury if occupants are out of position and resting against an airbag – for example if the front passenger puts their feet on the dashboard.

It is illegal to use a rearward facing baby seat where there is an active frontal airbag, check the vehicle hand book for safety advice about older children and airbags.

It is dangerous to obstruct airbags with objects such as seat covers. And do not mount something on the cover of an air-bag compartment – such as a SatNav – because that could injure a occupant if the air-bag deploys.

When replacing airbags, never fit second hand air bags, as they may not work in the same way as the originals. Always use parts approved by the vehicle's manufacturer, fitted to the manufacturer's specifications.

Adaptive restraints

Sensors are allowing the development of 'Smart' airbag and seat belt technology, which can adapt to circumstances of individual crashes to protect occupants better. External airbags to help reduce injuries to pedestrians or two-wheelers are also being developed.

[7] Assessment of Airbag Effectiveness; Vehicle Safety Research Centre S0011/VF

[8] Fatality reduction by air bags: analysis of accident data through early 1996; Kahane CJ. DOT Report Number HS 808 470. Washington, DC:National Highway Traffic Safety Administration, 1996.

[9] An Assessment of Airbag Deployments for Small Drivers; Welsh, R and Watson, J. IMechE Vehicle Safety Conference Proceedings 2004.

EuroNCAP

The protection for occupants and other road users varies widely between cars, with newer designed vehicles (generally) providing better safety performance than older ones. The European New Car Assessment Program (EuroNCAP) conducts crash tests on vehicles to assess the level of safety that they provide.

All vehicles sold in Europe must meet minimum legal requirements, However, EuroNCAP conducts its tests at higher speeds to identify the relative levels of protection that vehicles offer over and above the minimum legal standards.

There are three star ratings currently awarded by EuroNCAP

- **Occupant protection**

The occupant protection star rating is the one most frequently quoted in advertising. The star rating is a combination of how well a vehicle performs in three different crash tests – frontal impact, side impact and a side impact against a pole. Vehicles are given points for each of these tests which are added up to make the final star rating. Vehicles are also given points if they have a seat belt reminder system.

- **Child protection**

The child protection rating gives an indication of how well the vehicle is designed to protect child occupants in the rear and how well the vehicle performs in a crash with the child restraint used in the test.

- **Pedestrian protection**

Vehicles can be designed to reduce the severity of injuries should they hit a pedestrian or cyclist, and EuroNCAP tests how well they achieve this.

The results of the tests, and a star rating, for a wide range of cars can be viewed on the EuroNCAP website, **www.euroncap.com.**

Type of accident/injury assessed by EuroNCAP

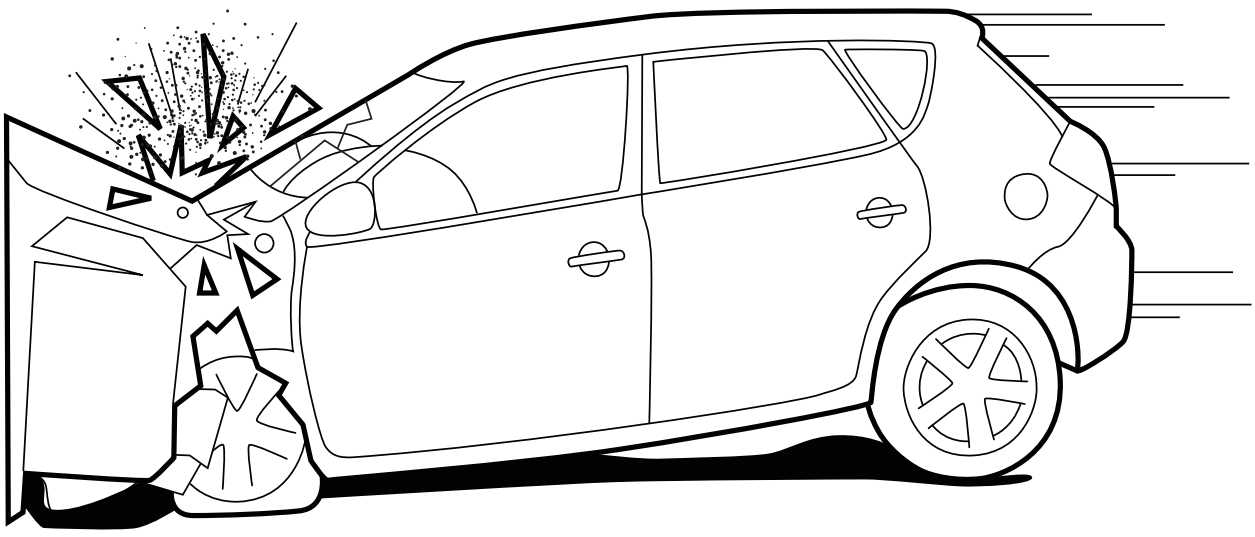
The tests assess the protection provided for an adult driver and adult passenger in the front seats, and child passengers in the rear seats. Vehicles are tested against a crash barrier in a frontal (head on) impact and side impact. The vehicle's bonnet is also tested to measure the level of injury a pedestrian would suffer if the vehicle were to hit them.

Effectiveness

- In car to car collisions, cars with three or four stars are approximately 30% safer, compared to two star cars or cars without an EuroNCAP score. [10]

Using EuroNCAP

Managers can use the results of the tests and the other details provided by EuroNCAP to inform their choice of fleet vehicles.



[10] How Does EuroNCAP Results Correlate to Real Life Injury Risks – A Paired Comparison Study of Car-to-Car Crashes. Lie, A. et Tingvall, C. Paper presented at the IRCOBI conference. Montpellier 20 September 2000.

Head Restraints

Head restraints protect the neck from whiplash injuries, which are caused by rapid movement of the head. A properly adjusted head restraint reduces the distance between the back of the head and head restraint, stopping the neck from bending back. It also reduces the amount of time it takes the head to contact the head restraint, and increases the amount of time that it is supported during an accident.

Thatcham, the Motor Insurance Repair Research Centre, conducts tests to assess and rate head restraints from 'good' to 'poor'. Seats are tested separately for both good geometry and their performance in a rear impact test. The results of the dynamic and static tests are combined to create an overall rating for the seat, which can then be compared against other vehicles.

Details of these tests, and the best performing seats, can be viewed on the Thatcham website at **www.thatcham.org/ncwr/**

It can also be useful to discuss technologies that help to prevent whiplash with the vehicle manufacturer.

Type of injury head restraints help to prevent

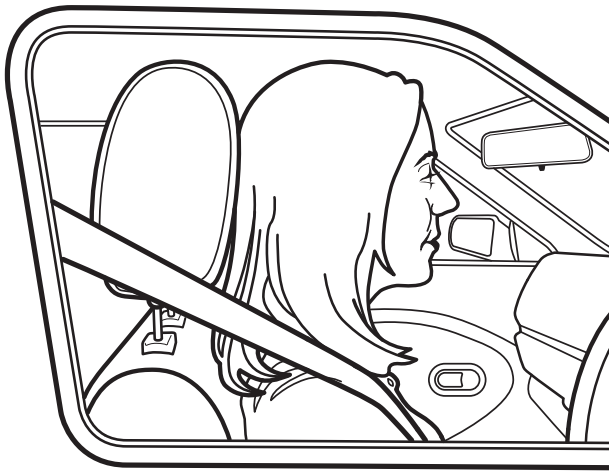
There are 250,000 cases of whiplash in the UK each year. It is the most common injury resulting from car accidents, and can often be long term and debilitating.

Effectiveness

- Individuals at risk of neck pain [...] reduced their risk by more than 40% with adequately positioned head restraints. (11)
- Cars fitted with advanced whiplash protection systems had 50% lower risk of whiplash injuries leading to long-term symptoms compared with standard seats launched after 1997. (12)
- new seat designs such as active head restraints [...] give added benefit, producing about a 43% reduction in whiplash injury claims (55% reduction in female drivers). (13)
- Drivers of cars with good rated head restraints are 24% less likely than drivers with poor-rated head restraints to suffer neck injuries in rear end crashes. (14)

Using Head Restraints

It is important that vehicle occupants know how to position their head restraints properly.



- Position the top of the head restraint as high as the top of the head
- Move the head restraint as close to the rear of the head as possible.

(11) Neck Pain and Head Restraint Position Relative to the Drivers Head in Rear End Collisions. Chapline, J. Ferguson, S. Lillis, R. Lund, A. Williams, A. Accident Analysis and Prevention 32 (2000) 287-297

(12) The Effect of Whiplash Protection Systems in Real-life Crashes and their Correlation to Consumer Crash Test Programmes. Kullgren, A. Krafft, M. Lie, A. Tingvall, C. The 20th International Technical Conference on the Enhanced Safety of Vehicles (ESV), 2007, Paper number: 07-0468

(13) Effects of Head Restraint and Seat Redesign on Neck Injury Risk in Rear-End Crashes. Farmer, C., Wells, J., Lund, A. Report of Insurance Institute for Highway Safety, November 2002.

(14) Relationship of Head Restraint Positioning to Driver Neck Injury in Rear End Crashes. Farmer, C. Wells, J. Werner, J. Accident Analysis and Prevention 31 (1999) 719-728.

Anti-lock Braking Systems

Anti-lock Braking Systems (ABS) are designed to prevent a vehicle from skidding under heavy braking. During braking there is a chance that the wheels stop rotating, and 'lock up', which can increase a vehicle's stopping distance, increase the chances of the vehicle skidding, and prevent a driver from steering to avoid an obstacle.

Anti-lock Braking Systems use sensors that monitor the rotation of the wheels to detect when they are going to lock up, and if so, the system rapidly releases and reapplies the brakes. This helps to prevent the vehicle from skidding, and allows the driver to have some control over the steering of the vehicle.

Type of accident ABS helps to prevent

ABS will help to prevent accidents which are a result of the loss of steering control under braking. It can reduce the severity of an accident or the chances of being involved in a collision following heavy braking, by maintaining steering control.

Anti-lock Braking Systems are now standard on the majority of new cars that are approved for sale in the UK, although older vehicles may not have them.

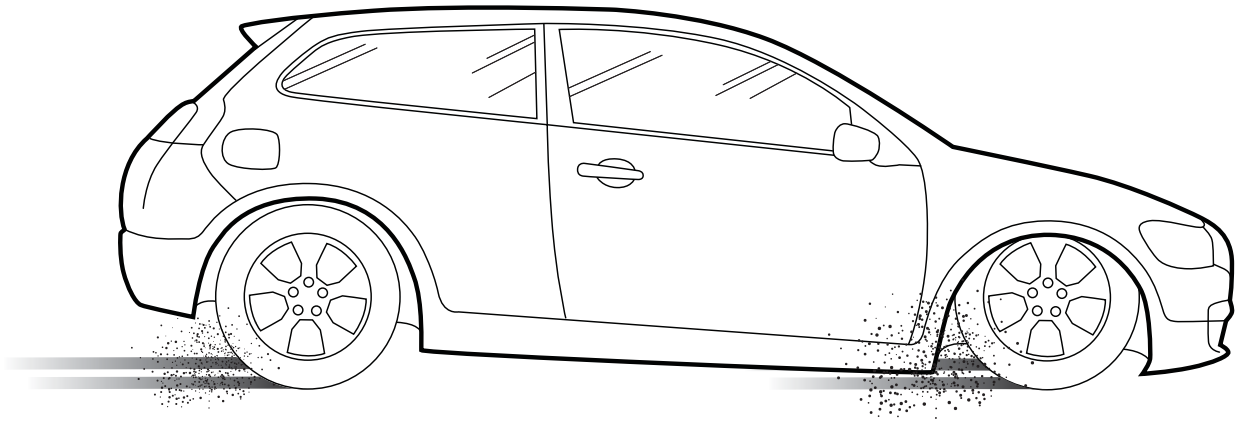
Effectiveness

Much research has been published about the effectiveness of ABS, with some studies indicating it reduces crash risk, but other research suggesting it does not, potentially due to misuse. Some studies even found that ABS increased certain types of accident.

How To Use Anti-lock Braking Systems

It is crucial that drivers know whether their vehicle has ABS, and if so, that they understand how to use it. Most drivers have probably driven a vehicle with antilock braking systems at some point, although many may not have performed an emergency stop with it. In cars without ABS a driver may have learnt to 'pump' the brakes. On a vehicle with ABS, the driver should keep their foot hard on the brake without pumping the pedal. Pumping will prevent the ABS working properly.

Drivers may also not know how to react if they feel the brake pedal vibrating or pulsing when the ABS is activated, and may even take their foot off the brake – which is the wrong thing to do.



Electronic Stability Control

Electronic Stability Control (ESC) uses sensors to monitor the vehicle's direction and the speed of each individual wheel. If it detects that a wheel is losing grip and the vehicle's direction is changing relative to that intended by the driver, it may reduce the vehicle's engine power and brake individual wheels to prevent loss of control and keep the vehicle heading in the intended direction.

There is a wide range of options for ESC (manufacturers have several different names for this system). Some vehicles come fitted with ESC as standard, some have it as an optional extra, and on other vehicles, it is not possible to have if fitted.

The Thatcham website (www.thatcham.org/esc) gives an overview of which manufacturers and models offer ESC as standard, as an optional extra, and which ones do not include ESC at all.

Advice is also available from individual vehicle manufacturers.

Type of accident ESC helps to prevent

ESC will help to prevent accidents involving loss of control. It is most effective in preventing vehicle crashes where drivers have taken a bend too fast, have to suddenly avoid an obstacle or have not fully appreciated the effects of wet weather or icy road surfaces. Drivers who are making an emergency manoeuvre will also benefit from ESC.

Effectiveness

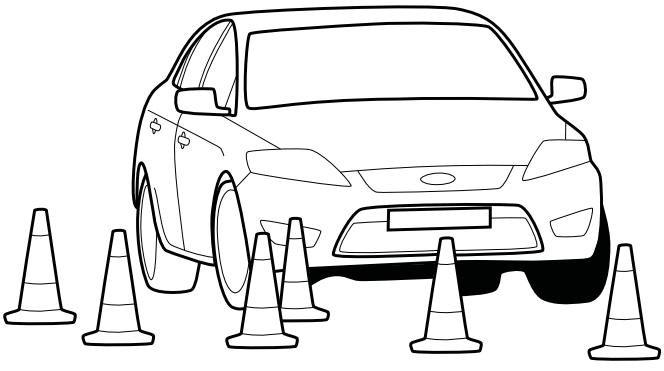
- The results show that ESC effectiveness is 7% in crashes of all severity. Serious crashes are 11% lower compared to non ESC cars and fatalities 25% lower. [15]
- Compared to non-ESC cars, 27% fewer ESC vehicles were involved in all single vehicle crashes compared to 7% for multi and single vehicle crashes taken together. [15]
- ESC was found to reduce crashes with personal injuries, especially serious and fatal injuries. The effectiveness ranged from at least 13% for car occupants in all types of crashes with serious or fatal outcome to a minimum of 35% effectiveness for single/oncoming/overtaking serious and fatal crashes on wet or icy road surface. [16]
- VSC showed approximately a 35% reduction for single car accidents, a 30% reduction for head-on collisions with other automobiles, and approximately 50% and 40% reductions for accidents where severe or moderate damage occurred, compared to that of the vehicles without VSC. [17]
- A benefit of electronic stability programs, in particular in conjunction with rollover protection, can be expected for commercial vehicles...a reduction of up to 9% in the number of serious accidents involving trucks is possible. [18]
- ESP was found to reduce accidents with personal injuries. The best estimate for the effectiveness of all accidents was 22.1%. [19]

Using ESC

Research shows significant benefits for ESC. It improves the stability of a vehicle to give a larger margin for safety, but managers need to ensure that their drivers understand how it works, what it does and how to use it.

It's essential for drivers to avoid relying on ESC too much, and for example, thinking they can drive faster on bends because it would get them out of trouble.

Some vehicles have an option to switch the ESC off, therefore, managers should ensure that drivers know how to check that it is left on during normal driving.



[15] Effectiveness of Electronic Stability Control Systems in Great Britain. Frampton, R. Thomas, P. Vehicle Safety Research Centre Loughborough University On behalf of The Department for Transport 2007

[16] The Effectiveness of ESC in Reducing Real Life Crashes and Injuries. Lie, A. Tingvall, C. Krafft, M. Kullgren, A. The 19th International Technical Conference on the Enhanced Safety of Vehicles (ESV), 2005. Paper number 05-0135

[17] Analysis of Vehicle Stability Control's Effectiveness from Accident Data. Aga, M. Okada, A. The 18th International Technical Conference on the Enhanced Safety of Vehicles (ESV), 2003, Paper No. 541

[18] Benefit Potential of ESP in Real Accident Situations Involving Cars and Trucks. Langwieder, K. Gwehenberger, J. Hummel, T. Bende, J. The 18th International Technical Conference on the Enhanced Safety of Vehicles (ESV), 2003, Paper Number 150.

[19] The Effectiveness of ESP in Reducing Real Life Accidents. Tingvall, C. Krafft, M. Kullgren, A. Lie, A. The 18th International Technical Conference on the Enhanced Safety of Vehicles (ESV), 2003, Paper Number 261

Brake Assist

Brake Assist is designed to enhance a vehicle's braking performance in emergency situations. When responding to an emergency, many drivers do not fully depress the brake pedal and so do not get the full potential out of the vehicle's braking system. On detecting that a driver is making an emergency stop, Brake Assist applies full pressure to the brakes, bringing the vehicle to a halt more quickly.

Brake Assist does not activate when the driver is braking normally and vehicles with and without Brake Assist behave similarly in most other circumstances.

Type of accident Brake Assist helps to prevent

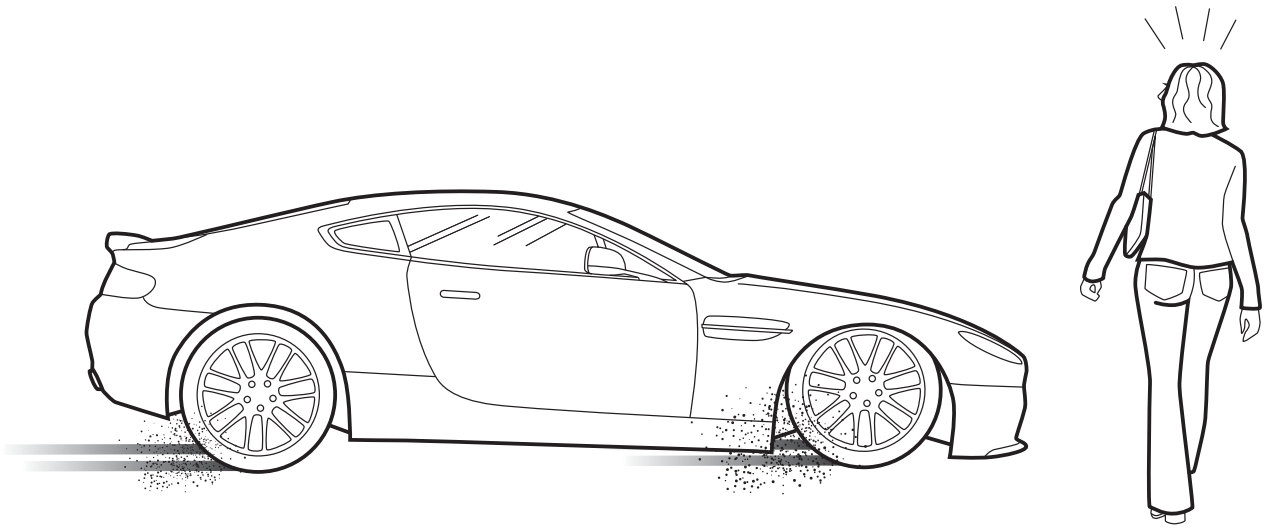
Brake Assist helps to prevent accidents where a driver has to perform an emergency stop.

Effectiveness

- It is reasonable to assume that BAS will result in a reduction of pedestrian fatalities of greater than zero and less than twelve percent. Within this estimate, it is likely that the true answer will lie somewhere in the mid-range of values. [20]
- EBA with maintained maximum braking force during the emergency phase would reduce the number of car occupant fatalities by between 6.5% and 9% and pedestrian fatalities by about 10% to 12%. [21]
- 50% of drivers did not activate the ABS, which shows that drivers do not step strongly enough on the brake pedal. [22]
- an emergency brake assist could have avoided up to 30% of crashes. [22]

Using Brake Assist

Even when fitted, drivers will not normally use Brake Assist because it only functions in emergency stops when the pedal is pressed hard. However, it is important than drivers are aware that it's fitted and how it works, but do not think it means they can driver faster because the technology will get them out of trouble.



[20] A Study on the Feasibility of Measures Relating to the Protection of Pedestrians and Other Vulnerable Road Users. Hardy, B. Lawrence, G. Knight, I. Carroll, J. TRL Ltd, 2006

[21] Are Expected and Observed Effectiveness of Emergency Brake Assist in Preventing Road Injury Accidents Consistent? Page, Y. Foret-Bruno, J-Y. Cuny, S. The 19th International Technical Conference on the Enhanced Safety of Vehicles (ESV), 2005, Paper Number 05-0268

[22] Active Safety Experiments with Common Drivers for the Specification of Active Safety Systems. Perron, T. Kassaagi, M. Brissart, G. The 17th International Technical Conference on the Enhanced Safety of Vehicles (ESV), 2001, Paper Number 427

Tyre Pressure Monitoring Systems

Tyres are a vital part of a vehicle's safety system. Tyres in poor condition impair the vehicle's performance, increase its stopping distance and the chances of a 'blow out'.

Tyres should be frequently checked for damage and to ensure there is sufficient tread depth. RoSPA recommends that tyres are replaced well before the legal minimum tread limit of 1.6mm is reached – ideally as soon as they reach 3mm.

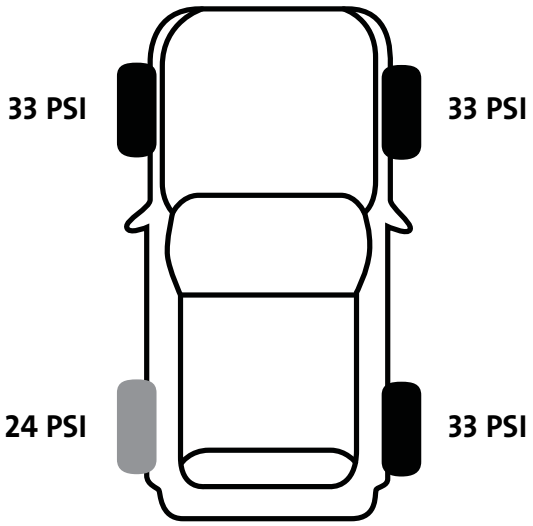
It is vital that tyre pressures are maintained at the levels recommended by the manufacturer to ensure maximum tyre life, the best ride and handling characteristics. Over-inflated or under-inflated tyres can have serious consequences, such as:

- Increased wear of the tyre's treads
- Reduced handling characteristics and less control of the vehicle
- Longer stopping distances
- Shorter lifespan of the tyre
- Increased fuel costs
- Higher chance of sudden tyre failure.

Tyre Pressure Monitoring Systems (TPMS) monitor the pressure of each tyre and warn the driver if one or more is incorrectly inflated.

Further advice on tyre safety is available at

www.rospa.com/roadsafety/advice/motorvehicles



Type of accident TPMS help to prevent

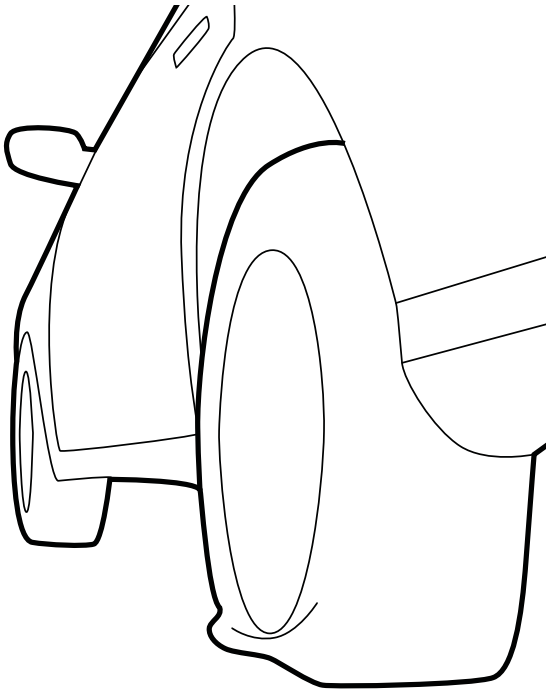
Although tyre failure is a relatively uncommon cause of an accident, poorly inflated tyres can contribute to some types of accident, by increasing stopping distances and impairing the vehicle's handling. Under inflated tyres can also cause parts of the tread to wear quicker.

Effectiveness

- Surveys of vehicles without TPMs found that just under 56% of passenger cars had at least one tyre which was under inflated. [23]
- Stopping distances in the wet start to increase dramatically at tread depths of below 3mm. [24]
- Compared to tyres with full thread, the legal minimum tread depth of 1.6mm, stopping distance is increased by 36.8% on the hot rolled asphalt and 44.6% on smooth concrete. [24]

Using Tyre Pressure Monitoring Systems

Tyre Pressure Monitoring Systems are not a substitute for regularly checking tyre pressures. Different makes vary in their accuracy, and how they alert the driver. Therefore, it is important to make sure that drivers know what levels of deflation the TPMS will warn them about, how it will warn them, and what they should do. Drivers should understand that they still need to manually check tyre pressures, tread depths and tyre condition regularly.



[23] The National Highway Traffic Safety Administration, 2006
[24] An investigation into the Effects of Tyre Tread Depth on Wet Road Breaking and Cornering Performance, MIRA/BRMA, 2003

The purpose of all these systems is to provide better information to the driver about the road and traffic environment and to provide early warning of hazards. They can reduce the risk of accidents. However, it's essential that managers and drivers know how to use them safely and do not regard them as a substitute for essential elements of safe driving such as alertness, good observation and anticipation, and freedom from sleepiness and fatigue.

There are several different types of systems that are intended to make driving easier, more comfortable and safer. For most of these systems, there is not a large body of research giving an indication of their effectiveness, although there is some evidence that drivers may change their behaviour when using them.

Adaptive Cruise Control

Many manufacturers sell Adaptive Cruise Control as a comfort device to help drivers keep their distance from the vehicle ahead. It uses a radar or laser to monitor the space between the two vehicles and the speed of the vehicle ahead. When necessary, it reduces the vehicle's speed by controlling the throttle or applying mild braking to slow down, and 'back off', from the vehicle in front.

As well as helping drivers to maintain a safe distance, Adaptive Cruise Control has other potential advantages; for example, it may reduce instances of heavy braking in what should be free flowing traffic – which will prevent congestion.

Lane Departure Warning Systems

Lane Departure Warning Systems help to prevent a vehicle from drifting out of its lane. If it detects that the vehicle is changing lane without the driver using the indicator, it alerts the driver of an unintentional lane change. It helps to prevent unintended lane changes due to, for example, inattention or distraction.

It should not be mistaken as a driver sleepiness warning system. If a driver is wandering out of lane because he is falling asleep, a warning is too late because he will have been making errors before reaching that point [25]

Blind Spot Information Systems

Some vehicles have systems that monitor its blind spots. When a sensor detects a vehicle in the blind spot, the system alerts the driver, generally by a warning light or an icon displayed close to the mirror. By giving the driver additional information about the road environment around the car, it can alert the driver to vehicles or riders that they may have missed.

Driver Fatigue Monitoring

There are a variety of methods to monitor a drivers physical signs – such as cameras to monitor a drivers eye movement. If they detect signs of fatigue then they will alert the driver.

These need to be used as part of a system that includes driver training on spotting the signs of sleepiness and in sleep hygiene generally. They cannot be regarded as reliable warnings of detecting sleepiness because individuals differ and it may be that they warn too late - for the reason mentioned in "Lane Departure Warning Systems" above.

Reversing and Parking Aids

Sensors or cameras alert the driver to the proximity of objects or people behind the vehicle.

[25] DfT Road Safety Research Reports - Driver sleepiness (No.21)
http://www.dft.gov.uk/pgr/roadsafety/research/rsrr/theme3/driversleepinessno21

Driver Comfort, Assistance, and Safety Systems

Adaptive Front Lighting Systems

This new technology directs the headlight beams to the direction of travel e.g. partially round a corner as determined by the angle of the steering wheel angle.

Other systems, such as pedestrian detection and collision warning technology, are rapidly beginning to be introduced.

Effectiveness

As these types of technology are relatively new, there is little published research about their effectiveness.

Adaptive Cruise Control

- its use caused drivers to have more collisions when approaching a stationary traffic queue, potentially due to too large expectations of the system, which lead to drivers making too late and abrupt interventions. (26)
- a significant difference with regard to the frequency and potential risk clearly show the difference in the distance behaviour of driver and ACC. (27)

Using this type of technology

These types of devices are designed to make driving easier by providing additional information to the driver, and in some cases (e.g. Adaptive Cruise Control) by intervening in how the vehicle is being driven. While this has many potential advantages, there is also a risk that drivers may mis-use the technology and/or rely on it to such an extent that they concentrate less or assume the vehicle will keep them safe on its own. For example, a driver may rely on the braking function of the adaptive cruise control rather than using their own judgement about when to brake.

Many of these devices only work above specific speeds and so may not always work when a driver is expecting one to.

Fleet managers need to assess whether drivers are using such devices correctly and provide any necessary education or training.

(26) Safety Effects of Adaptive Cruise Controls in Critical Traffic Situations. Nilsson, L. Reprint from proceedings of Steps Forward, Volume III, the Second World Congress on Intelligent Transport Systems. Yokohama, Japan, November 9-11, 1995, pp 1254-1259

(27) Distance Behaviour on Motorways with Regard to Active Safety – A Comparison Between Adaptive-Cruise-Control (ACC) and Driver. Filzek, B. Breuer, B. The 17th International Technical Conference on the Enhanced Safety of Vehicles (ESV), 2001, Paper Number 20

Satellite Navigation Systems

Satellite Navigation Systems (Sat Navs) are designed to help drivers plan and drive on the most suitable routes for their journey. They are not an accident prevention technology, although they can improve safety by providing drivers with directions while they are driving so that they are less likely to hesitate or make late manouevres. They provide information to the driver either through spoken instructions, and/or by showing the directions on a map.

Sat Navs can be bought as standard equipment in the vehicle, or they can be bought separately and then fixed to the inside of the vehicle.

Type of accident Sat Navs help to prevent

Sat Navs may help to prevent crashes due to drivers hesitating or making last minute manoeuvres.

Effectiveness

As yet, there is no published research assessing their effectiveness.

Using a Sat Nav

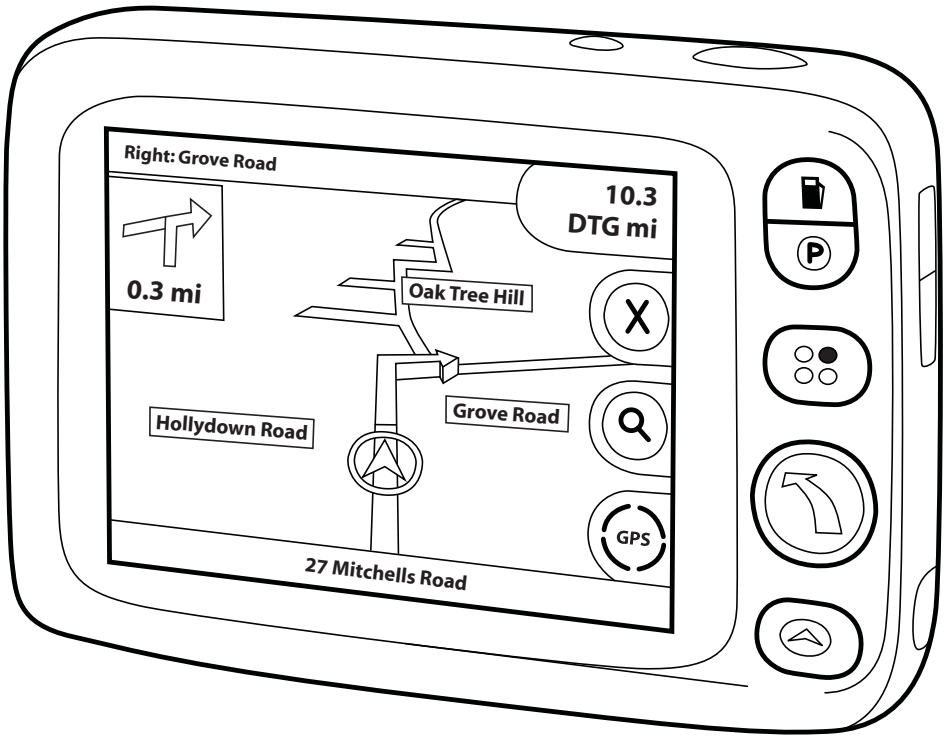
It is important to ensure that the Sat Nav is not fitted where it might reduce a driver's view of the road, be hit by airbag if one went off or be likely to cause injury in a collision. It should also be easy for the driver to see.

It is important that drivers understand how best to use their Sat Nav. They should understand the need to input destinations and routes only when the vehicle is safely parked. Managers should ensure that their drivers appreciate the potential for driver distraction when using a Sat Nav and that they are helped to develop ways of using it in a manner they find least distracting.

Drivers should know not to automatically follow the Sat Nav directions as it may sometimes send them on an inappropriate route. Drivers must obey road signs, markings and signals, no matter what the Sat Nav says, and, of course, be aware of what's happening on the road around them.

Sat Nav systems are generally designed for use in cars. They do not currently include restrictions/hazards/information (such as lane widths) relevant to heavy commercial vehicles or buses/coaches. Such systems will be available in due course. In the meantime, drivers of large vehicles need to be cautious and not to rely on Sat Nav instructions in all circumstances.

Further advice on planning journeys is available in 'Driving for Work: Safer Journey Planner' which can be found at **www.rospa.com/roadsafety/info/worksafejourney.pdf**



Speed Warning Devices

There are several different types of Speed Warning Devices, which are designed to help drivers keep to speed limits. They usually give a visual and/or audible warning if the vehicle exceeds a pre-set speed. Some also warn drivers if they are entering a road where there are safety cameras.

They are often, but not always, incorporated into a Sat Nav. Some vehicles have a built-in device, with which an upper speed can be set so that the vehicle delivers a warning when it is exceeded. Speed Warning Devices can be fitted to a vehicle when it is purchased (for example as part of an inbuilt Sat Nav, or separate speed alert device) or as an after-purchase device, which is retro-fitted inside the vehicle.

It is expected that these systems will be developed to keep the driver continuously informed about their speed, and help them to stay within speed limits.

Type of accident Speed Warning Devices help to prevent

They can help drivers stay within speed limits, and so contribute to avoiding speed-related crashes.

Effectiveness

- A speed warning system which displays the speed limit in vehicle and alerts the driver to changes in the posted limit has been predicted to prevent 10% of all injuries in accidents, 14% of serious and fatal injuries and 18% of fatal injuries. [28]
- A speed warning system which controls the speed of a vehicle to the posted limit, and slows a vehicle in dangerous conditions such as fog, rain, has been predicted to prevent 36% of all injuries in accidents, 48% of serious and fatal injuries and 59% of fatal injuries. [28]

Using speed warning systems

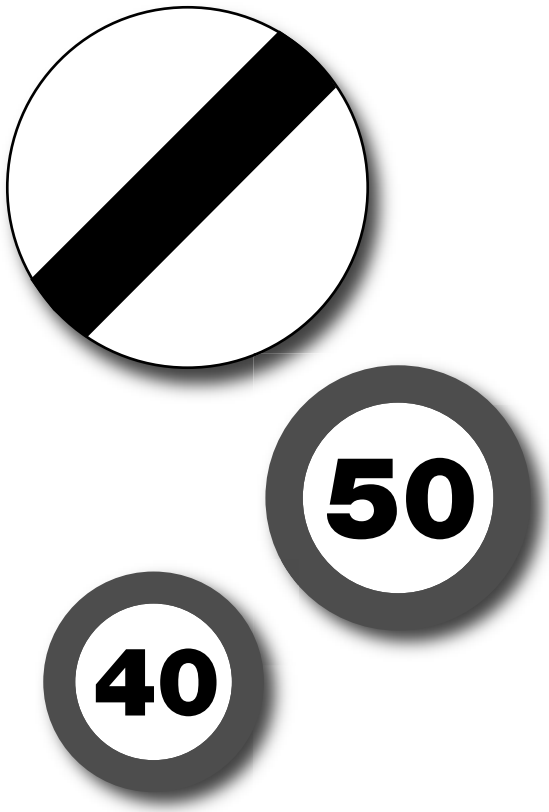
Drivers need to know how to use their speed warning devices. In particular, they should be set before the start of a journey, the driver should know how it will warn them and what to do if it does.

As part of journey planning, drivers should check that the speed they set the device is relevant to the roads on their route. For example, if they are mainly driving on 30mph roads, then the warning could be set at 30mph. If driving on motorways, then setting it to give a warning if 70mph is exceeded makes more sense.

Managers should take particular care if the device also warns of the presence of safety cameras, and ensure that their drivers do not use this to help them get away with speeding, by driving over the speed limit and relying on the device to alert them if cameras are ahead so they can slow down just for the camera.

Further advice about developing a Safer Speed Policy is available in 'Driving for Work: Safer Speeds', which can be found at

www.rospa.com/roadsafety/info/workspeed.pdf



[28] Intelligent Speed Adaptation: The Best Collision Avoidance System? Carsten, O. Tate, F.
The 17th International Technical Conference on the Enhanced Safety of Vehicles (ESV), 2001, Paper 324

Alcohol Interlocks

Drink Driving continues to be a major cause of death on the road.

Alcohol Interlocks require the driver of a vehicle to provide a breath sample before the car can be started. If the alcohol content in the driver's breath is above a set limit the car will not start. If a driver is under the limit the car will start, although it may warn the driver if he or she is close to the limit.

Alcohol interlocks are currently rare in the UK, but some vehicle manufacturers are planning to introduce alcohol interlocks as an optional extra on vehicles in the UK from 2008.

Type of accident Alcohol Interlocks help to prevent

Alcohol interlocks prevent drink driving, by removing the driver's ability to start their car if they have been drinking. Their most common use around the world is as part of part of rehabilitation programmes to reduce the chances of convicted drink drivers from repeat offending.

Effectiveness

Currently research has only assessed the effectiveness of alcohol-interlocks by convicted drink drivers as part of rehabilitation programmes.

- they lead to 40-95% reductions in the rate of repeat Driving While Impaired offences, where fitted [29]

Using Alcohol Interlocks

If considering their use, employers should consult widely with their staff to ensure that everyone understands the level of risk and harm created by drink driving and the reasons the company wishes to use alcohol-interlocks.

Some alcohol interlocks can be set at levels below the legal drink drive limit, and some also have an override function which allows the system to be bypassed a limited, or unlimited, number of times. Some systems will also allow managers to access this data to see if the system has been overridden.

Further advice for employers, 'Driving for Work: Drink and Drugs', can be found at

www.rospa.com/roadsafety/info/workdrinkdrugs.pdf

[29] Alcohol Ignition Interlock Devices I: Position Paper. ICADTS Working Group on Alcohol Ignition Interlocks. International Council on Alcohol, Drugs and Traffic Safety

Data Recorders

Event Data Recorders (EDR), also known as 'Black Boxes', record vehicle data over a period of time. They can collect information on vehicle speeds, braking (deceleration), vehicle dynamics, airbag deployment and road environment.

Some systems monitor and record this data for a few seconds only unless an 'event' (e.g., a collision or an emergency stop) occurs when they make a permanent record of what happened. This type of EDR can be used to accurately determine the causes of road accidents. Other systems, known as Journey Data Recorders, keep records of data over a longer period.

Type of accident Data Recorders help to prevent

While they do not directly prevent accidents, they do provide information for managers and drivers to identify problems with a vehicle or with the way it is being driven that can then be used to identify what action (for example, driver training) is needed to prevent problems from being repeated.

Effectiveness

- Fleet studies have shown that the preventive effect of the installation of Event Data Recorders can reduce collisions by 20-30%. [30]
- When viewing the total group of fleets involved in the study, it is possible to estimate an accident reduction of some 20%. [31]

Using Data Recorders

This type of technology is best used as part of a Managing Occupational Road Risk policy to help identify risks and the most appropriate way of reducing them. Commitments may need to be given to staff about the way data is used and the confidentiality of information relating to identifiable individuals.

[30] Event Date Recorders - Summary of Findings by the NHTSA EDR Working Group, US National Highway Transportation Safety Administration, (US) 18, 67-68. http://dmses.dot.gov/docimages/pdf70/138037_web.pdf

[31] Black Box Study Shows a Reduction in the Number of Accidents, SWOV 1997 http://www.swov.nl/uk/research/swovschrift/inhoud/08/black_box_study_shows_a_reduction_in_the_number_of_accidents.htm

The Future

Vehicle technology is progressing quickly, and new technologies are constantly being introduced.

This will bring many improvements to the safety and environmental performance of vehicles. However, it will also have significant effects on the way we drive, and in particular on the way in which the vehicle interacts with the driver.

It is also likely that many of these new technologies will be introduced in fleet vehicles first.

Therefore, employers need to be aware of the way their vehicles are changing and how this affects their drivers.

Employers should incorporate the selection and provision of vehicle technology into their Managing Occupational Road Risk policy so that risk assessment includes the benefits and risks of providing the technology, staff are educated and trained in its safe use and the effects of its introduction are monitored.

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