Synthesis title:

Driving Lorries

Category: Vehicles

Other Relevant Topics:

- Buses, Minibuses and Coaches (Drivers)
- Driving for Work (Drivers)
- Fatigue (Drivers)
- Training (Drivers)
- Telematics (Vehicles)
- Environment (Vehicles)
- Air Quality (Vehicles)

Keywords:

Lorries, Truck, HGV, C category, N_2 and N_3 category

About the Road Safety Observatory

The Road Safety Observatory aims to provide free and easy access to independent road safety research and information for anyone working in road safety and for members of the public. It provides summaries and reviews of research on a wide range of road safety issues, along with links to original road safety research reports.

The Road Safety Observatory was created as consultations with relevant parties uncovered a strong demand for easier access to road safety research and information in a format that can be understood by both the public and professionals. This is important for identifying the casualty reduction benefits of different interventions, covering engineering programmes on infrastructure and vehicles, educational material, enforcement and the development of new policy measures.

The Road Safety Observatory was designed and developed by an Independent Programme Board consisting of key road safety organisations, including:

- Department for Transport
- The Royal Society for the Prevention of Accidents (RoSPA)
- Road Safety GB
- Parliamentary Advisory Council for Transport Safety (PACTS)
- RoadSafe
- RAC Foundation

By bringing together many of the key road safety governmental and non-governmental organisations, the Observatory hopes to provide one coherent view of key road safety evidence.

The Observatory originally existed as a standalone website, but is now an information hub on the RoSPA website which we hope makes it easy for anyone to access comprehensive reviews of road safety topics.

All of the research reviews produced for the original Road Safety Observatory were submitted to an Evidence Review Panel (which was independent of the programme Board), which reviewed and approved all the research material before it was published to ensure that the Key Facts, Summaries and Research Findings truly reflected the messages in underlying research, including where there may have been contradictions. The Panel also ensured that the papers were free from bias and independent of Government policies or the policies of the individual organisations on the Programme Board.

The Programme Board is not liable for the content of these reviews. The reviews are intended to be free from bias and independent of Government policies and the policies of the individual organisations on the Programme Board. Therefore, they may not always represent the views of all the individual organisations that comprise the Programme Board.

Please be aware that the Road Safety Observatory is not currently being updated; the research and information you will read throughout this paper has not been updated since 2017. If you have any enquiries about the Road Safety Observatory or road safety in general, please contact **help@rospa.com** or call **0121 248 2000**.

How do I use this paper?

This paper consists of an extensive evidence review of key research and information around a key road safety topic. The paper is split into sections to make it easy to find the level of detail you require. The sections are as follows:

Key Facts	A small number of bullet points providing the key facts about the topic, extracted from the findings of the full research review.
Summary	A short discussion of the key aspects of the topic to be aware of, research findings from the review, and how any pertinent issues can be tackled.
Methodology	A description of how the review was put together, including the dates during which the research was compiled, the search terms used to find relevant research papers, and the selection criteria used.
Key Statistics	A range of the most important figures surrounding the topic.
Research Findings	A large number of summaries of key research findings, split into relevant subtopics.
References	A list of all the research reports on which the review has been based. It includes the title, author(s), date, methodology, objectives and key findings of each report, plus a hyperlink to the report itself on its external website.

The programme board would like to extend its warm thanks and appreciation to the many people who contributed to the development of the project, including the individuals and organisations who participated in the initial consultations in 2010.

Key facts

- When cars collide with goods vehicles in excess of 3.5 tonnes maximum permissible gross weight (HGVs) there is a fundamental incompatibility between their structures. In addition, due to HGV's height vulnerable road users (VRUs) are able to fall or be knocked under the vehicle.
- 84% of rear impact cases between a car/HGV still underran vehicles where rear underrun protection (RUP) was fitted. This suggests that the current designs are not suitable for preventing underrun in all current accident circumstances.
- Females are typically involved in fewer collisions when pedal cycling than males. However, female cyclists appear to be overrepresented in the number of fatal collisions involving heavy goods vehicles (HGVs). (Frings et al., 2012).
- A goods vehicle operator's licence (or O licence) is required when goods are transported for hire or reward in an HGV.
- All existing and potential workplace transport operators to be screened for fitness before employment and at five-yearly intervals from age 45.
- HGV drivers are subject to more stringent eye sight tests than car drivers as they are required to have acceptable vision in both eyes.
- Drivers are legally required to accurately record their activities (using a tachograph), retain the records and produce them on demand to transport authorities who are charged with enforcing regulations governing drivers' working hours.
- Vehicles operators and drivers have a duty to ensure they comply with Regulation (EC) 561/2006 relating to Drivers' Hours restrictions which have better road safety as the main intended outcome. Certain operations are exempt from these but are still subject to GB Domestic Driver's Hours rules which again address the need for rest and overnight breaks.
- HGVs account for 25% of road traffic emissions in the EU.
- HGVs had a final MOT fail rate of 10.3%, which is generally less than that of passenger vehicles.

Note
This review includes statistics from Reported Road Casualties Great Britain: 2015, which were the latest available data when the review was written. .

Summary

Visibility

A lot of work has been done on improving the field of view of heavy goods vehicles (HGV) drivers using mirrors and direct line of sight. In addition a range of other technologies are available or under development to assist with providing pertinent information on their surroundings to drivers. These include:

- Blind spot mirrors allow the driver to see all around and in front of their vehicle, and Reversing Safety Systems allow them to see behind the vehicle. Situations on the road change quickly however, and drivers cannot look everywhere at once.
- Technologies such as Enhanced Daytime Vision Systems and blind spot warnings can direct the driver to look at the appropriate mirror.
- Autonomous Emergency Braking (AEB) systems could in the future become advanced enough to stop the vehicle when turning if a vulnerable road user is detected in the path of the vehicle.
- In addition changes to the articulation method, and multiple wheel steering could reduce lorries encroaching on paths (this is especially useful for lorries primarily used in urban areas). Multiple wheel steering including rear axle steering allows the rear of the vehicle to more closely follow the swept path of the front of the lorry. These systems have been available for more than ten years (Cebon, 2014) and can be applied to both rigid and articulated vehicles.
- Direct Vision Standards defined and implemented in London to have a minimum field of view for HGVs. This includes a star rating system with 0 star rated HGVs being banned from 2020 and 3 star minimum from 2024.

Noise

Exposure to loud noise can cause tinnitus (ringing or buzzing in the ear), hearing loss and can lead to permanent damage as well as the more standard sleep disruption. Due to the negative effects of noise, HGV movements in urban areas are often constrained during night-time and/or weekend. If such night-time delivery restrictions could either be relaxed or removed, where appropriate, there are significant potential benefits, primarily associated with reduced day-time congestion. This has been demonstrated in some trials undertaken by TfL. Alongside this, current trials undertaken by TRL on behalf of TfL are investigating the noise impacts of borough-wide retiming of deliveries in London.

Vibrations and noise from the following ancillary technologies can be reduced, Some of the key areas of noise are:

- Trailers/truck bodies (including walls, floors and stowage)
- Tail-lifts
- Refrigeration units
- Rollcages and containers (assessing both rolling noise and collision noise)
- Doors - Quiet-closing doors
- Auto-turn-off radios
- Fork lifts and pallet trucks

Technology is readily available and can be implemented at fairly low cost, which would reduce the effects of the equipment mentioned above (FORS, 2017).

Additionally for the reduction of noise it is important that: Vehicles should have a current service history in order to ensure that the vehicles are operating at their optimum, and the driver has been trained regarding the consequences of certain actions.

Underrun

Rear and front underrun guards are required on HGVs. However some types where it would be impractical to fit are exempt. In addition side guards are required, however these are currently only designed to prevent pedestrians and cyclists from directly falling under the wheels.

84% of rear impact cases between a car/HGV still resulted in underrun even where Rear Underrun Protection (RUP) was fitted, suggesting that the current designs are not suitable for preventing underrun in all current accident circumstances.

An improvement to the required designs seems prudent. However some benefit analyses of individual components changes and benefits do not support this.

An integrated approach to the improvement to the design of the RUP, side underrun protection (SUP), and Spray suppression systems of HGVs may yield much greater combined benefits at lower cost than considering the elements individually. Smooth sided guards on HGVs also have the added benefit of increasing fuel efficiency due to the improved aerodynamics.

Platooning

Platooning or Road trains have the potential benefits of greater fuel economy for all vehicles participating in the train. Network capacity benefits may accrue as a greater number of vehicles will be able to fit on the road network. Following vehicles may experience a more comfortable drive and the opportunity for human error to cause collisions may be reduced.

A number of trials undertaken have demonstrated these benefits with the SARTRE Project showing an 8% fuel saving for the lead truck and 14% for the following trucks. Apart from this, it was also found that traffic flow increases when road trains are present.

Methodology

A detailed description of the methodology used to produce this review is provided in the Methodology section of the Observatory website at http://www.roadsafetyobservatory.com/Introduction/Methods.

This synthesis was compiled during December 2013 - February 2014 and updated in May 2017.

Note
This review includes statistics from Reported Road Casualties Great Britain: 2015, which were the latest available data when the review was written.

Searches were carried out on the pre-defined sources identified in this link. Search terms used to identify relevant papers included: Behaviour, Attitudes, Interaction, Technology, Vision, Legislation, Policy, Periodic technical inspection, MOT, Annual test, Crash, Accident, collisions, Height, Length, Weight, Speed, Lorry, HGV, Heavy goods, Bus, Truck, Articulated, Car, Motorcycle, Motorbike, Pedestrian, Bicycle, emissions, platooning, autonomous lorries, direct vision standard and noise abatement.

Research articles were scored on their relevance and quality. A rating of 'high', 'medium' and 'low' was given to each article under the following criteria.

For relevance

- 'High' refers to data on a metric clearly relevant to the topic under investigation
- 'Medium' refers to data on a metric that is probably relevant to the UK
- 'Low' does not refer to data relevant to the topic under investigation

For quality

- 'High'= from a high-quality peer-reviewed publication, with clear and appropriate methods
- 'Medium'= from an academic source (e.g. book chapter, conference) but without peer-review, and/or possessing some methodological weakness (e.g. some possible confounding factors)
- 'Low'= from a more 'general' source (e.g. conference, trade paper) and/or clearly being methodologically weak or inappropriate (e.g. failing to address random variability by use of appropriate statistical techniques)

57 pieces of research, statistical reports or policy documents have been included in this review.

The scope of the topic area on lorries includes Licence category C vehicles or Type Approval category N2/N3 vehicles (vehicles for the carriage of goods over 3,500 kg).

Key statistics

Number of vehicles and distance travelled

- In 2015 there were 483,400 HGV's on British roads

(DfT, Aug 2016)

- HGVs travelled 18.4 billion vehicle km
- All motor vehicles travelled 316.7 billion vehicle km

(DfT, May 2016)

Accidents

- In 2015 there were 1,291 KSI involving HGVs per billion vehicle kilometres
- In 2015 there were 6,470 HGVs involved in an accident (right hand drive), and 473 left hand drive HGSs

(RRCGB, 2016)

- In 2015, HGVs were involved in 20% of pedestrian fatalities and 78% of cyclist fatalities in London, despite only making up 4% of road miles.
- 42% of all reported HGV accidents in 2015 had no contributory factor
- In 2015, 45% of all reported HGV accidents were due to driver impairment or distraction.
    - 64% of these were due to the driver failing to look properly

Note
This review includes statistics from Reported Road Casualties Great Britain 2015, which were the latest available data when the review was written.

- TRL estimates that the presence of safety equipment on all exempted HGVs would mean that between 3.20 and 6.85 fatalities and between 1.24 and 4.75 serious casualties could have been prevented in the five year study period. This is based on a historical analysis of KSI data in London over five years (2008 to 2012).

(TRL for TfL, 2014)

- In the freight industry there are around 2,000 serious or fatal injuries a year caused by falling from height. Over two thirds of these falls were from trailers, tail lifts and cabs.

(HSE, 2014c)

HGV/car impacts

- In 2011 rear impacts to the HGV constitute 14.3% of all car/HGV impacts and 18.3% of fatal car/HGV impacts.
- In 2011 84% of rear impact cases between a car/HGV still underran vehicles where RUP was fitted.

(Minton & Robinson, 2010)

HGV/cyclist impacts

- In the period of 2007 – 2011, it was estimated that 52% of all fatal accidents involving an HGV and pedal cyclist fatality involve an HGV making a left turn across the path of an HGV.

(Talbot, R. et al., 2014))

Unsafe loads

- In the UK every year there are 4,500 successful prosecutions against drivers and operators for unsafe loads.

(HSEQ Bulletin, 2013)

Research findings

Summaries of key findings are given below. Further details of the studies reviewed, including methodology and findings, and links to the reports are given in the References section.

Operational/Legal Requirements

Operator Licensing

The DVSA Goods Vehicle Operator Licensing states that a goods vehicle operator's licence (or O licence) is required when goods are transported for hire or reward in an HGV (≥3.5t gross plated weight) or (where there is no plated weight) an unladen weight of more than 1,525 kg. It goes on to state that the main purpose of goods vehicle operator licensing is to ensure the safe and proper use of goods vehicles and to protect the environment around operating centres.

The legislation covering operator licences can be found in the Goods Vehicles (Licensing of Operators) Act 1995 (the Act), the Goods Vehicles (Licensing of Operators) Regulations 1995, the Road Transport Operator Regulations 2011, and the Goods Vehicles (Licensing of Operators) (Fees) Regulations (VOSA, 2011a).

There are three types of operator licences; for national transport, international transport or a restricted licence for carrying a business's own goods. With the licence the operator is permitted to perform the actions covered by the licence so long as they have adequate systems in place to make sure they and their staff are able to obey all the rules, particularly covering:

- Speed limits
- Driver obligations
- Driver licensing/driver CPC
- Drivers' hours rules and the Working Time Directive
- Taxation and insurance.

Medical state

There are specific medical requirements for Group 2 (vocational – lorries, buses) licence holders. DVSA (Driver and Vehicle Standards Agency) requires all existing and potential workplace transport operators to be screened for fitness before employment and at five-yearly intervals from age 45. Group 2 licences are renewable five-yearly from age 45 and, where an individual is both a workplace transport operator and holds a Group 2 licence these assessments can be made at the same examination. A workplace transport operator who continues after age 65 should have annual assessments for fitness.

The HSE (Health and Safety Executive) recommend additional assessment after an absence of more than one month or after a shorter absence if it is likely that the illness has affected a driver's fitness to operate workplace transport. This provides positive confirmation of fitness to operate workplace transport in these circumstances. It must also be noted that if a GP deems the worker to be fit to return to work, this may not be the same as fitness to operate workplace transport. (HSE, 2017b)Medication – whether prescribed or bought over-the-counter – may temporarily affect a worker's fitness to operate workplace transport. The HSE recommends that drivers ask their general practitioner or pharmacist about the effects any medication may have on their ability to drive safely, and that they tell their employer if there is a risk of adverse effects which may compromise safety. They may need to stop operating workplace transport until the nature and extent of any side effects have been established. (HSE, 2017b)

No worker should drive or operate vehicles or machinery at work if they have taken alcohol or illicit drugs. (HSE, 2017b)

Driver Licence Acquisition and Training

Training to become a lorry driver requires the trainee to be aged over 18 years (although further age restrictions apply to some categories of vehicle) and hold a full car licence (category B entitlement). First, the driver must take a medical and there are more exacting requirements for drivers of lorries and buses, for example there are minimum standards for eyesight in both eyes. The drivers should obtain the correct provisional entitlement and then pass relevant theory, hazard perception and practical driving tests. Directive 2003/59/EC also requires that drivers of large goods vehicles must take CPC (Certificate of Professional Competence) training. Drivers must complete 35 hours of training every five years. The training covers continual improvement in relation to driving skill, reducing fuel consumption and therefore emissions, the management of drivers' hours, knowledge of operator licensing rules and customer care.

Endorsements that lead to licence revocation apply to all categories of vehicle (i.e. loss of driving entitlement due to car driving offences also applies to any HGV licence categories).

Tachograph

A tachograph is a device fitted to a vehicle that automatically records its speed and distance, together with the driver's activity selected from a choice of modes (Driver and Vehicle Standards Agency, 2017). They are used to make sure drivers and employers follow the rules on drivers' hours. This is done not only by recording the data, but by providing the drivers with real time information on their current drive and rest times. These devices can provide warnings when nearing regulated driving time limits, including daily, weekly and bi-weekly drive times. Doing so reduces the risk of exceeding limits, which are in place to increase road safety, while allowing organisations to maximise the usage of their vehicles.

Drivers are legally required to accurately record their activities, retain the records and produce them on demand to transport authorities who are charged with enforcing regulations governing drivers' working hours.

A tachograph must be used if the vehicle comes under EU or AETR rules (European Agreement Concerning the Work of Crews of Vehicles Engaged in International Road Transport) (passenger carrying vehicle or goods vehicle) unless exempt. The regulations concerning this are EU 165/201 and EC 561/2006.

The devices assign time to specific modes. There are usually two, one for driving and the second for resting, however for certain industries it is useful to have others (deliveries or loading for instance). The drive mode is activated automatically when the vehicle is in motion, and modern tachograph heads usually default to the "other work" mode upon coming to rest, wear by automatically assigning the time to specific tasks. The rest and availability modes can be manually selected by the driver whilst stationary.

A tachograph system comprises a sender unit mounted to the vehicle gearbox, the tachograph head and a recording medium. Tachograph heads are of either analogue or digital types. All relevant vehicles manufactured since 1 May 2006 must be fitted with digital tachograph heads. The recording medium for analogue heads are wax coated paper discs, and for digital heads are digital driver cards containing a microchip with flash memory. Digital driver cards store data as a .ddd file that can be imported into tachograph analysis software. Information from digital tachographs is saved on smart cards so it can be checked later. Data must be downloaded from the Vehicle Unit every 90 days and from driver cards every 28 days. This data must be analysed to ensure the rules have been complied with. There are different types of card for drivers and haulage companies. It is a requirement of operators to check a proportion of tachographs and this can either be done in-house or by an outside contractor.

Limits

Across Europe there are a variety of limits on speed, mass and dimension for different categories of vehicle. From these it is possible to generate a maximum that would allow a vehicle to be used all over Europe. The limits listed below are taken from (Her Majesty's Revenue and Customs, 2016)

Height

- There is no height limit within the UK, however the government suggest a maximum of 4.95m in order to make maximum use of the motorway and trunk road network. Note that bridges over ~5m are usually not marked with warnings.
- A European Directive limits the height of all vehicles and trailers to 4m, however the UK has a derogation to permit higher vehicles. Double deck trailers have found a niche in the market for trunking movements.
- If a vehicle has an overall height which is 3 metres or above, a notice must be displayed in the cab showing its full height.

Length

- 12m for a rigid vehicle.
- 16.5m for an articulated vehicle if the articulated combination can turn within concentric radii of 12.5m and 5.3m; otherwise 15.5m.
- 18.75m for a road train (this is a reference to a combination of a lorry and a trailer, not platooning).
- The DfT is conducting a ten year trial involving longer semi-trailers of 14.6 metres and 15.65 metres in length (17.5 metres and 18.55 metres total vehicle lengths respectively). Longer semi-trailers should provide significant economic and environmental benefits to the UK (DfT, 2013b).
- It should be noted that under the European Directive 2015/719, vehicles are allowed to exceed the maximum lengths shown in Annex I of European Directive 235/59 provided that there is no increase in the loading length of those vehicles or vehicle combinations. This is to allow for aerodynamic devices which would improve energy efficiency. Road safety and the safety of intermodal transport must also be taken into consideration.

Width

- 2.55m excluding driving mirrors. Refrigerated vehicles are permitted to be 2.6m wide to allow for the extra thickness of the insulation.

Weight

- 44 tonnes for lorries with 6 axles; drive axle(s) must not exceed 10,500kg and have road friendly suspension OR have a maximum axle weight not exceeding 8,500kg.
- Each part of the combination must have 3 axles and the trailer must have road friendly suspension.
- Additionally, an engine complying with at least Euro 2 specification (or gas) is needed for operation over 41,000kg.
- 40 tonnes for lorries with 5 axles with maximum axle weight limit of 11.5 tonnes.

Speed

The national speed limits for HGVs are lower for a given road type than for other lighter vehicles. Vehicles ≤ 7.5t must travel under 50 mph on single carriageways, 60 mph on dual carriageways and 70 mph on motorways unless articulated, or towing a trailer, in which case the limit is 60.

For lorries over 7.5t the limits are another 10mph lower at 40, 50 and 60 mph respectively

Most lorries are limited electronically to 56 mph (or 90 km/h) both to keep below the 60 mph limits mentioned above, as well as limits within Europe, to reduce fuel consumption and due to safety concerns. Some companies choose to set the speed limiters lower than the legal limit for fuel economy reasons.

On certain, mainly single carriageway roads especially where there is a heavy flow of HGVs, there can be a significant build-up of traffic forming a convoy behind a lorry which according to the law should only be travelling at 40 mph. It can be seen that the delay caused to car drivers having to sit behind slower moving traffic could lead some individuals to frustration and rash overtaking manoeuvres.

Goods being hauled

Dangerous goods

Lorries carrying goods considered to be dangerous present an additional risk of an incident, such as spillage of the goods, leading to hazards such as fire, explosion, chemical burn or environmental damage.

Most goods are not considered sufficiently dangerous to require special precautions during carriage. Some goods, however, have properties which mean they are potentially dangerous if carried.

Dangerous goods are liquid or solid substances and articles containing them, that have been tested and assessed against internationally-agreed criteria – a process called classification – and found to be potentially dangerous (hazardous) when carried. Dangerous goods are assigned to different Classes depending on their predominant hazard.

Regulations to deal with the carriage of dangerous goods, the purpose of which is to protect everyone either directly involved (such as consignors or carriers), or who might become involved (such as members of the emergency services and public). Regulations place duties upon everyone involved in the carriage of dangerous goods, to ensure that they know what they have to do to minimise the risk of incidents and guarantee an effective response.

Carriage of dangerous goods by road or rail is regulated internationally by agreements and European Directives, with biennial updates of the Directives take account of technological advances. New safety requirements are implemented by Member States via domestic regulations which – for GB – directly reference the technical agreements (HSE, 2014a).

Temperature controlled vehicles are another aspect which is controlled via legislation. In general, raw materials, ingredients, intermediate products and finished products likely to support pathogenic micro-organisms, or the formation of toxins, must not be kept at temperatures that might results in a health risk. The cold chain must not be interrupted. However, it is allowed to keep these goods outside temperature controlled environments for limited amounts of time provided they do not pose a risk to health, for practicality purposes. This ruling applies to both hot and cold foods. (Food Standards Agency, 2016).

Abnormal loads

Legislation requires that vehicles and load movements that exceed standard limits need to be pre-notified to police, highway and road and bridge authorities (Highways Agency, 2013; FTA 2014). An abnormal load is defined as a vehicle which has any of the following:

- A weight of more than 44,000 kg
- An axle load of more than 10,000 kg for a single non-driving axle and 11,500 kg for a single driving axle
- A width of more than 2.9 metres
- A rigid length of more than 18.65 metres

Abnormal loads may travel more slowly than standard HGVs and require escort vehicles. Risks arise from the lack of general visibility (especially for very slow loads) and the lack of visible information to convey clearly the size, speed and shape of the load and to instruct other drivers as to how to respond. Consequently, the Highways Agency provide a code of practice for the markings, lighting and signing of abnormal loads and escort vehicles. The Highways Agency system for notification of the transport of abnormal loads is called ESDAL (Electronic Service Delivery for Abnormal Loads).

Environmental

Noise

Due to the negative effects of noise, heavy goods vehicles (HGV) movements in urban areas are often constrained during night-time and/or weekend periods by local regulations which have been put in place to minimise noise impacts associated with both the transport of goods between the point of origin and final destination, and the actual collections/deliveries themselves.

If the noise generated could be reduced, then night-time delivery restrictions could either be relaxed or removed where appropriate, with significant potential benefits, primarily from reduced congestion.

There are several trials which were conducted on “out of hours” deliveries. One trial, conducted with the Noise Abatement Society and Wandsworth Borough Council, showed cost savings of £16,000 per year along with no complaints received from local residents during the trial with regards to noise (FTA, 2013). TRL are currently undertaking further analysis on retimed deliveries in the Wembley area on behalf of TfL. This analysis includes measuring the sound from deliveries at different sites in the area.

In addition, there are a number of practical equipment additions/alterations which reduce the amount of noise made by lorries. Firstly, the vehicles themselves can be purchased which were created with quietness in mind. An example of this is the Mercedes Urban e-Truck and Volvo FE CNG. Apart from this other pieces of equipment can be used such as quieter trailers, engine encapsulation, quieter reversing alarms, quieter tyres, quieter roll shutters, etc. It must be noted that these pieces of technology are alterations/redesign of the original technology to reduce the noise associated with the original piece. For example, soft closing mechanisms can reduce the noise associated with opening and closing doors and shutters on lorries (FORS, 2017). These can assist in taking advantage of out of hours deliveries.

Emissions

Engines introduced from 1 October 2005 or new vehicles first registered from 1 October 2006 must meet the Euro 4 emission standard. New engines introduced from 1 October 2008 or new vehicles first registered from 1 October 2009 must meet the Euro 5 standard.

The introduction of Euro 6 emission standards is effective for new vehicles from January 2014. Compared with the Euro 5 standard, Euro 6 vehicles must reduce nitrogen oxide emissions by 77% and soot particulates by 66%.

HGVs over 41,000kg must have an engine complying with at least Euro 2 (or be fuels with gas).

CO_2 Emissions

HGVs have improved on fuel efficiency but due mainly to increasing road freight traffic, total CO_2 emissions from them rose 36% from 1990 to 2010 (EC, 2016).

The European Commission is considering further legislation to curb CO2 emissions, such as enforcing mandatory limits on average CO2 emissions, developing modern infrastructure to support alternative fuels and effective vehicle taxation by Member States. Studies carried out showed that state-of-the-art technologies can achieve cost-effective reductions of at least 30% in CO2 emissions from new HDVs.

As HGVs account for 25% of road traffic CO_2 emissions in the EU, with emissions increasing by 36% from 1990 to 2010, it was noted by ECR that more work needs to be done. As such, another proposal is to reduce the number of miles driven by lorries. This is noted as the “five to drive” scheme which was proposed by the Efficient Consumer Response. These are aspects which will enable lorries to have fewer wasted miles, fewer total miles, intelligent routes, targeted vehicle design and efficient product form. This can be achieved by sharing services, having flexible flows of journeys, using data to drive decisions, tailoring transport usage and streamlining the stock shapes or sizes (ECR, 2015).

Air Quality

Old diesel lorries can be retrofitted with aftermarket Diesel Particulate Filters, with new ones being required by law in the EU to be factory fitted with them (Client Earth, 2013). This reduces the particulate matter emissions. There are three main technologies used to reduce particulate matter emissions: Wall-Flow Filter, Partial Flow Filter and Diesel Oxidation Catalyst. All of them involve passing the gas through a form of filter which reduces the particulate matter coming out of the vehicle. This can help lorries achieve the required standard to pass through various Low Emission Zones (LEZ) throughout Europe.

There are various Low Emission Zones across Europe which apply to lorries. These include countries such as Belgium, Germany, Sweden, Netherlands, Denmark and Italy.

The Low Emission Zone in London requires that larger vans, minibuses and other specialist diesel vehicles must meet certain standards. This includes Euro 3 standard for particulate matter emissions. For lorries, buses, coaches and other specialist heavy vehicles, these must meet the Euro IV standard for particulate matter emissions standards (TfL, 2012).

Other proposals aiming to come into effect are the ULEZ proposals by the Mayor of London. This proposal will cover the existing congestion charge zone and will affect lorries which do not meet the Euro 6 standards. It is currently due to come into effect by September 2020 but the proposal aims to bring this earlier to April 2019. Other proposals include expanding the ULEZ to cover most of Greater London by 2020 for diesel HGVs and 2021 for cars (Mayor of London, 2017).

In addition to this, another emissions related charge called the T-charge will be coming into effect in the congestion charge zone in London. This will operate during the congestion charge hours and HGVs which travel within this area at this time will be liable for the charge if the engines do not meet the Euro 4 standard (TfL, 2017).

Vehicle Safety

Underrun guards

When cars collide with goods vehicles in excess of 3.5 tonnes maximum permissible gross weight (HGVs) there is a fundamental incompatibility between their structures. In addition, due to HGV's height vulnerable road users (VRUs) are able to fall or be knocked under the vehicle.

This has been recognised as a safety concern for a long time and currently Regulation (EC) No 661/2009 requires that front, side and rear-guards are fitted to lorries, except where it is impractical to fit underrun protection (Minton & Robinson, 2010). It should be noted that there are different types and designs of underrun guards.

- **Rear underrun protection**

  Rear underrun protection (RUP) systems have to comply with Directive 70/221/EEC (as amended) in regards to fitment and strength. It is also regulated under Regulation No. 58.

  Rear impacts to the HGV constitute 14.3% of all car/HGV impacts and 18.3% of fatal car/HGV impacts. The vast majority of these are likely to be frontal impacts for the cars involved, although some could involve cars sliding sideways or even rear-end-on into the HGV (Minton & Robinson, 2010).

  Minton and Robinson (2010) found through an analysis of accident statistics, that 84% of cases still underran vehicles where RUP was fitted, suggesting that the current designs are not suitable for preventing underrun in all current accident circumstances. This could be due to low vehicles going below the minimum RUP height, the impact force exceeded the design, or where a vehicle coming in from an angle rather than straight on would overload the guard and it would break away.

  Recent submissions aimed to amend the law to significantly improve the situation when rear underrun accidents occur by introducing more demanding force and dimensional requirements for rear underrun protection devices on HGVs (Gogte & Vijendran, 2014).

- **Front underrun protection**
  EC Directive 2000/40/EC, effective since August 2003, introduced a requirement for all HGVs registered after this date to be fitted with rigid front underrun protection (FUP). Chislett and Robinson (2010) state that evidence available suggests this has not resulted in a reduction in the severity of car occupant casualties in collision with the front of HGVs, though it is not known whether this is because of inadequate data or a genuine lack of effect.

- **Side underrun protection**
  From October 2012 goods vehicles over 3.5t built in one stage are required to meet EC whole vehicle type approval (ECWVTA, implemented by Directive 2007/46/EC). There has been no regulation to retrospectively bring older vehicles up to a modern standard. Although it cannot be quantified, it is considered that most vehicles first registered before 2012 in the UK would have aimed to comply with the Road Vehicles (Construction and Use) Regulations 1986, Regulation Number 51 for sideguards. The main difference between the regulations is that the newer one replaces specific exemptions for body types with a general one for special purpose vehicles where it is impractical to fit underrun protection.

  Under the current directive, sideguards must withstand 1 kN without deforming a given amount. This force is equivalent to a mass of 100 kg accelerated by gravity, therefore will not prevent a car's ingress.

  Cookson and Knight (2010) cited literature showing that sideguards were intended to influence accidents where vulnerable road users (cyclists and pedestrians) fell towards the side of a passing HGV.

  Without sideguards, this type of accident results in the person falling in the gap between axles and subsequently being run over by the rear wheels. With sideguards, tests showed that the vulnerable road user would be deflected out of the path of the rear wheel 6 times out of 10.

  The most common type of accident where this occurred was when trucks were overtaking cyclists in an approximately straight line. Collisions where a truck turning left collided with a cyclist or pedestrian were not considered to be in scope, because the VRU would be knocked to the ground and as the lorry "cut-in" to the corner, the sideguard could pass over the top and the rear wheels could still run them over.

  A review of commercial vehicle safety priorities (Robinson & Chislett, 2010) suggested that the most cost effective sideguard improvements were still relatively low priority compared with other commercial vehicle safety measures (Cookson & Knight, 2010). However, Knight et al. (2005) showed that when all underrun protection systems were considered as one, and with the added benefit of spray suppression and the potential for improved fuel economy, smooth flat panelled sideguards would save up to 5.6m GBP from safety guard improvements, up to 338m GBP from elimination of spray accidents and approximately 77m GBP from reduced fuel consumption (420m GBP).

There is conflicting evidence of the effects of sideguards on accidents where pedal cyclists collide with an HGV which is turning left. Most evidence suggests that there will be little, if any, effect. However the analysis of exempt vehicles suggests that sideguards have a significant effect both on reducing the frequency of such collisions and on reducing the severity of injuries sustained when these collisions do occur. Which analysis is correct cannot be proven with the data available to this study (Cookson and Knight, 2010).

TRL estimates that smoother side guards can reduce total fatal collisions just in London by as much as 4.7 fatalities per year and serious collisions by as much as 4.3 per year. (TRL for TfL, 2014; Streeter, 2014)

Maintenance

- **PTI (Periodic technical inspection)**
  Vehicles over 3,500 kilograms and trailers with an unladen weight of more than 1,020 kg are required to have the Annual Test performed (Annual test, 2017). The test is similar to an MOT however, however it must be performed every year right from the vehicle being registered for use on the road.

  The full details of the requirements in the test are available for the vehicle operator from the gov.uk website. (VOSA, 2013a). There is a significant difference in the level of passes at the MOT. From 2015 to 2016, of all the MOT tests recorded, HGVs had a final MOT fail rate of 10.3%, with a retest fail rate of 5.2%. In comparison, cars, vans and passenger vehicles with up to 12 seats had a final fail rate of 27.9% and Light Goods Vehicles between 3,000kg and 3,500kg gross weight had a final fail rate of 37.3% (DVSA, 2017). This demonstrates that the safety inspections on six-week intervals are a positive safety factor.

- **Tyre: Depth**
  The Highway Code stipulates that tyres must be correctly inflated to the vehicle manufacturer's specification for the load being carried, which should be provided in the vehicle's handbook, data or labels on the vehicle.

  Tyres should also be free from certain cuts and other defects. Cars, light vans and light trailers MUST have a tread depth of at least 1.6 mm across the central three-quarters of the breadth of the tread and around the entire circumference. However motorcycles, large vehicles and passenger-carrying vehicles must have a tread depth of at least 1 mm across the whole tyre width and circumference (DfT, 2017).

- **Tyre: Recut and retread**

  It is permissible for re-cut tyres to be fitted to:

  - Motor vehicles of unladen weight exceeding 3050kg, or between 2540kg and 3050kg if fitted to wheel rims exceeding 405mm diameter, and
  - Trailers of unladen weight exceeding 1020kg (2290kg total weight for fixed plant carriers).

  If marked as permissible a tyre can be recut, up to three times (depending on the specific model), then when worn it can be retread with a new ring of rubber added. This can be done as many times as required so long as the carcass is undamaged. Sometimes operators allow the tyre to be worn down too much so that either a chunk of rubber is missing or a structural steel wire protrudes and then the carcass cannot be remoulded and has to be scrapped. It is important to consider the merits of using remoulds and there is manufacturer guidance on which position on a vehicle it is safe to use them.

Operator Safety

Driver safety

Cabin Strength Standards are important for the safety of the driver. As well as preventing ingress, the cabin needs to absorb impact, this is more difficult due to the flat fronted design of most European lorry cabs (a consequence of length limitations to allow better turning). In addition the internal layout of the cab plays an important part to mitigate injuries, Supplementary Restraint Systems (SRS) or Airbag Systems in combination with seatbelts significantly reduce the severity of injuries. This is obviously diminished if they are not worn. Seat Belt Wearing Monitors and Reminders provide an audible warning to drivers if the belt is not being used, which gets more persistent and intruding as speed increases and time passes. One excuse why belts aren't worn is comfort. Suspension Seats with Integral Seat Belts move the belts with the seat preventing the belts retraction and locking when the vehicle shakes.

Working at height and access onto vehicles

Getting on and off a vehicle to carry out loading/ unloading operations and working at height on the vehicle are often viewed as incidental to the main job. Because of this, the risks involved may not be properly considered. In fact, most of the injuries reported to HSE resulting from falls from vehicles are from a fall from below head height. The most common area of the vehicle for people to fall from is the load area, followed by the cab access steps and tractor catwalk – you don’t have to fall far to land hard. (HSE, 2014c)

Things to consider include vehicle features that are sometimes lacking:

- The provision of steps and ladders with handholds
- Ground level equipment controls
- Automatic sheeting devices

Safe loading of vehicles

The law is very specific about the safety of loads transported by vehicles and it is essential that the vehicle is suitable for the type of load being carried. It requires all loads carried on vehicles to be safe and secure and a suitable vehicle is used for the task. (DVSA, 2017b)

DVSA (2017b) states that during 2013 there were 22,000 road impact incidents caused by objects falling from vehicles which resulted in the closure of a single lane or full carriageway. This took an average of 20 minutes to deal with the incidents.

Drivers and operators are legally responsible for making sure the load is secure, so loading and unloading should only be carried out by competent personnel.

Even if they do not load the vehicle themselves, the driver is held responsible for their load once they are on their journey and so they must check the load before leaving the depot.

The load should be evenly distributed, secured and covered to prevent load movement, spillage or damage on route. The load should be positioned such that the vehicle is not overweight, either by gross weight or in terms of individual axle loads. The following factors need to be taken into account:

- The nature of the load
- The suitability of the vehicle
- The stability of the load
- The type of restraint, e.g. straps, nets, ropes
- The condition of the restraint
- Protection from the weather e.g. sheets, curtains
- Prevention of theft
- Ease of delivery

The selection of the best means of securing a load to a vehicle will depend on the type and composition of the load to be carried. Operators should equip themselves with the correct securing equipment for the types of load carried.

Safe delivery/collection non depot site

Loading and unloading can be dangerous (Freight Best Practice, 2011). It is important to consider:

- The working conditions, for example passing pedestrians
- The type of equipment being used, such as tail lifts
- The height from the ground
- How flat the surface is
- Whether fall protection is needed
- If unloading is being done at the roadside make sure there is sufficient room to offload and wheel pallets and cages
- Taking care that pedestrians are not hit by ‘barn door’ style doors opening
- Avoiding straddling of the kerb with a tail lift – it needs to rest on even ground

Mechanical handling equipment and safety

Mechanical handling devices provide the means to load or unload a vehicle. Devices in common use include lorry mounted cranes, forklift trucks and tail-lifts. All of these items can be an integral part of the vehicle and as such training of drivers is important as is proper maintenance of the equipment.

Safety whilst driving

Driving is the most dangerous work activity that most people do. 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. (RoSPA, 2014)

Loose objects

It is common to see objects such as kit bags, flasks, lunch boxes, portable devices, and other items loose in a vehicle cab. Drivers should keep objects within the cab in storage areas to stop them increasing injury during accidents. In the event of an accident or roll over loose objects inside the cab can be thrown violently causing the driver serious injury (Freight Best Practice, 2011)

Fire extinguishers should be mounted securely to a bulkhead using an appropriate bracket. Drivers should know how to operate them and on what type of fire they can be used.

Distractions

There are many sources of distraction for a driver (Freight Best Practice, 2011). Examples include:

- Hands-free devices
- Eating and drinking
- Reading (maps etc.)
- Music/Radio controls
- Distraction from passengers
- Conversing

Mobile phones are a significant distraction for the professional driver who may be under pressure to provide information on, for example, arrival times or receive information on, for example, routing changes. It is illegal in the UK to use a handheld mobile phone whilst driving. Smoking is also not allowed in work vehicles, such as HGVs, used by more than one person (driver).

Overnight Parking

When parking up overnight, drivers should make sure that they have minimised as many risks to themselves and their vehicle as possible (Freight Best Practice, 2011):

- Seek out fit for purpose lay-bys
- Park safely off the carriageway
- Park with other trucks
- Stop where you can get a good mobile phone signal
- Tell your traffic controller where the vehicle is parked
- Park under any available lighting

- Lock diesel tanks
- Lock cab doors
- Park facing up or down the slope, never sideways on
- Have brakes applied and leave in gear (when it is safe to do so)

Visibility

Blind spot mirrors

In order to reduce the risk of accidents involving blind spots, the European Union (EU) implemented Directive 2003/97/EC. As well as containing the requirement for the main exterior rear-view mirror it also implemented rules on the compulsory fitment of additional near-view, wide angle and front mirrors. Directive 2007/38/EC extended these rules to also retro-fitment onto vehicles registered after 2000. In addition to mirrors VOSA and the HA have worked together to produce a Fresnel lens to increase visibility for HGV drivers. These are placed on the passenger side window giving the driver a view of overtaking vehicles which are in a driver's blind spot (VOSA, 2007). Of those involved in the study the incidents of side-swiping decreased by 59%.

The classes of mirrors are listed below, with the applicability according to Directive 2003/97/EC in brackets:

- Class I – Interior rear-view mirror (Optional)
- Class II – Main exterior rear-view mirror (Compulsory)
- Class III –Main exterior rear-view mirror (Not permitted)
- Class IV – Wide-angle exterior rear-view mirror (Compulsory ≥ 7.5 t)
- Class V – Close proximity exterior rear-view mirror (Compulsory ≥ 7.5 t on nearside)
- Class VI – Front mounted wide View Mirror (Compulsory ≥ 7.5 t)

For class IV and V mirrors the "critical manoeuvre" was identified (O'Brien 2004) as accidents where an HGV, LCV or bus/coach was turning right (left in the UK) and a pedal cyclist or motorcyclist was involved. (O'Brien 2004) estimated that 56% of all fatal accidents involving an HGV and pedal cyclist or motorcyclist fatality did involve an HGV making a right turn (left in UK). This was based on information from the Netherlands (Knight, 2011). Other statistics demonstrate that the most common reason behind from the driver or cyclist regarding a vehicle and cyclist collision was not looking properly. This contributed to 109 fatalities in 2013 alone (Cute Injury, 2017).

Due to this information, the Mayor of London has proposed a ban on the most unsafe HGVs from London's streets by 2020. This will be done by using TfL's Direct Vision Standard – a proposal aimed to understand, assess and rate the amount a HGV driver can see directly from their cabin in relation to other road users. (Mayor of London, 2016).

It is also important for these mirrors to be clear. Rain, frost, mist, dust and dirt can severely reduce the visibility in mirrors. The highway code stipulates that they must be cleared prior to journeys, however it is difficult to clear them mid journey.

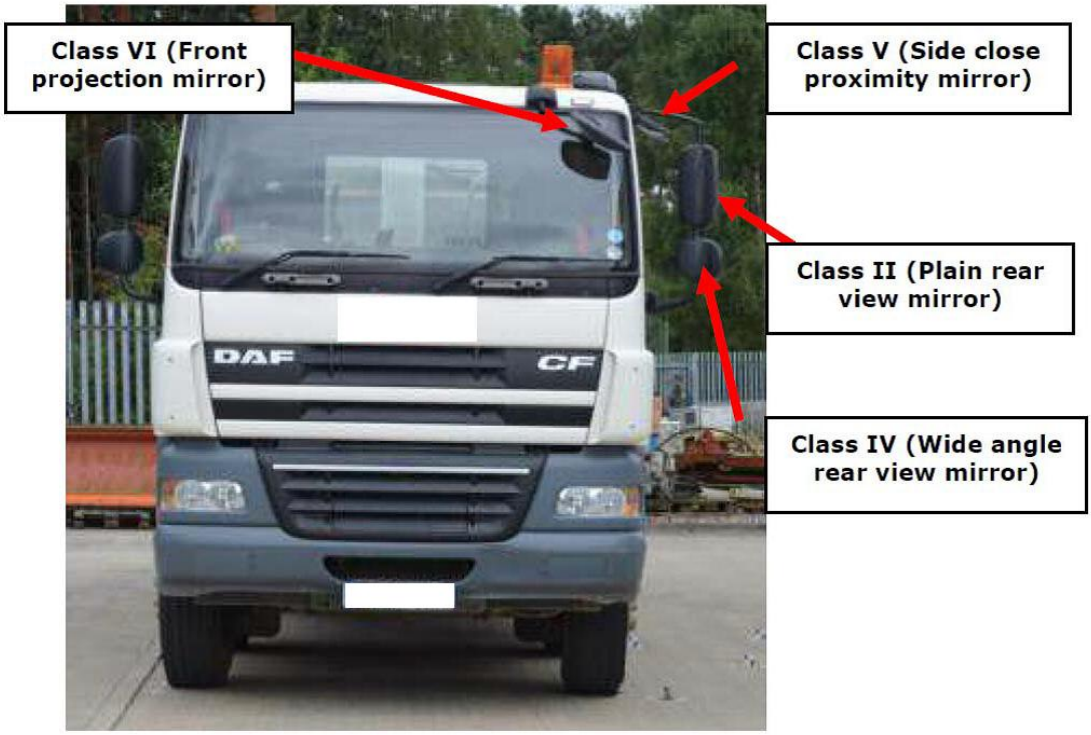

Figure: Position of Mirrors (TRL for TfL, 2014)

Direct Vision Standards

A number of collisions have occurred due to restrictions in an HGV drivers' field of direct vision. The current regulatory requirements are that HGV blindspots are to be minimised by using mirrors to improve the drivers' indirect vision. However, TRL mention, in their research, that using these aids requires the driver to be looking at the correct mirror or aid at the right time to be successful. Furthermore, there are concerns that increasing the number of devices could overload the driver during critical manoeuvres (Robinson et al., 2016).

TRL suggests that drivers react more quickly when cyclists and pedestrians are seen directly rather than by the use of mirrors or other equipment. Although regulatory standards exist for indirect vision, there are no minimum standards for how much a driver can see directly from their cab (Robinson et al., 2016). As such, TfL has commissioned the development of the first Direct Vision Standards for HGVs.

The system used a simple star rating system, similar to the NCAP rating, to objectively measure how much an HGV drive can see directly through the windows – particularly with regards to the greatest risk to vulnerable road users. Each HGV is awarded a star rating and the higher the rating, the more the driver can see directly the area of greatest risk.

Higher rated HGVs would presumably improve direct vision for a HGV driver and subsequently reduce the impact of blind spots on collisions. From 2020, 0 star vehicles would be banned from London, with this minimum requirement being 3 stars from 2024.

Additional technologies

In addition to mirrors, a range of other technologies are available, or under development, to assist with providing pertinent information on their surroundings to drivers. These include blind spot elimination cameras, reversing safety systems, autonomous emergency braking and enhanced night vision systems.

The situation on a road changes very quickly, especially in urban areas, so even with a wide range of mirrors it is possible for a driver to not see a VRU in time. Blind Spot Elimination / Enhanced Daytime Vision Systems use cameras and/or sensors to identify when VRUs enter blind spots and provide an audible or visual warning to direct the attention of the driver to a particular mirror for them to assess the situation.

Similarly, Reversing Safety Systems can audibly warn VRUs that a vehicle is reversing, warn the driver if a VRU or object is detected, and/or provide a camera view to the driver.

It may be possible in the future for these systems to stop the vehicle if it predicts a collision as AEB systems already do for frontal impacts, although for this to be feasible the driver’s and VRU's future intentions would need to be accurately predicted.

Enhanced Night Vision (ENV) Systems use light amplification or infrared cameras to see objects beyond the headlight range or in greater contrast, and display these to the driver on a screen or head-up-display. Whilst offering great potential in avoiding crashes, by providing the driver with much more time to react, care must be taken when installing the display screen in the cabin in such a way as to provide the driver with information when desired, without posing as a potential distraction.

Technologies

There are many technologies that are available to be fitted to lorries to improve their safety. These can be grouped as such: required by legislation, currently available and beneficial, currently available and the benefit is not yet proven, or under development. Key technologies identified will be discussed below.

Braking

Lorries can benefit from having Disc Brakes fitted (available and beneficial). However if used in combination with drum brakes they can wear out quickly, taking a larger proportion of the braking work. Parts are more complex and so have a higher cost, however they are easier to maintain, are lighter, and most importantly their performance does not reduce as quickly from the heat generated with use. Disk brakes have Automatic Brake Adjustment (ABA) Devices as standard, and they can be fitted to drum brakes (available and beneficial). They keep the braking force consistent as the pads wear, reducing the downtime for manual adjustment, which is required to keep the vehicles braking performance optimal.

Antilock brakes systems (required by legislation) allow brakes to work at their maximum brake force without locking-up. As stated in the Framework directive 2007/46/EC, it is a requirement for all new M (passenger) and N (freight) category vehicles and their trailers to be fitted with ABS.

In addition Regulation (EU) No 661/2009 states that, between July 2011 and 2014 depending on the category and braking type, all new types of vehicle will require Electronic Stability Control (ESC) (also called ESP) (required by legislation), and between November 2014 and July 2016 for new vehicles. ESC, together with a yaw sensor, predicts the drivers intended movement with the vehicles actual reaction and detects when the vehicle is skidding. The system then applies the appropriate level of braking to individual wheels (or groups of wheels) to allow the vehicle to recover from, or prevent, a skid. It will also become required for category O_3 and O_4 trailers (those exceeding 3.5 tonnes).

With the additional control to the individual braking modules, ABS and ESC affords the possibility of a range of other safety systems. Trailer Roll Stability (TRS) Systems (available) predict the roll-over threshold and slows the vehicle when cornering. Electronic Brake Distribution (EBD) systems (available) monitors the load on the wheels and balances the braking as appropriate, this is particularly useful for unladen trailers which are prone to lock-up. Load-Proportioning Brake Valve (LPBV) system (available) is similar to EBD but is not electronic, it monitors the pressure in the air suspension (although it can be retrofitted to mechanical suspension) and adjusts the air pressure for each specific axle.

Automatic Traction Control (ATC) systems (available) are used on lorries that regularly encounter poor road conditions. These systems perform a more simplified set of tasks than ESC systems, and only function at low speeds. When the situation is detected, the drive torque is reduced, the differential locked and the brakes are applied to the appropriate side. This prevents the vehicle from causing itself to spin.

Roll Away Emergency Parking Brake (available) system is a type of system which prevents the vehicle from rolling away if the driver leaves the vehicle without applying the parking brake. If the ignition is off, door open or driver seat left, the parking brake will automatically apply.

Safety equipment

Wheel Nut Indicators and Locks are an important consideration for lorries. The vibration, heavy loads, and significant sideways forces on turning can loosen wheel nuts which can result on the loss of a wheel. Wheel nut indicators allow a quick method of assessing whether the nuts have moved however they do not prevent the nuts from undoing. Once a nut has become loose it is very easy for it to continue to loosen, and due to the isolation in the cab the driver may be unaware until it is too late. Therefore, Wheel Nut Locks are a solution; these bind together two nuts with a sprung clip.

Tyre Pressure Management Devices monitor the tyre pressures and inform the driver if there is an issue.

There are two types of hazard that lorry drivers face associated with the railway network. These are level crossings and bridge strikes.

Rail Crossing and Road Hazards Radio and GPS Warning Systems are systems which can be used in areas with uncontrolled open level-crossings. The train communicates via radio or the mobile phone network with vehicles in the area to warn them of their approach to a crossing, allowing the vehicle to stop. In addition hazards such as a broken vehicle on the track or damage to the line can be communicated back to the train driver.

There were 1742 underline and overline bridge strikes during the 2015/2016 period where commercial vehicles hit bridges. (Network Rail, 2017. In-cab bridge strike avoidance systems are available in the market to support driver awareness by providing reliable bridge information, and may be useful (especially when a non-routine journey is being undertaken).

Coupling and parking procedure

Accidents and dangerous situations occur all too often when drivers of HGVs fail to follow safe coupling and parking procedures. Coupling is when a trailer is attached to a vehicle cab. Unsafe practices often lead to vehicle runaway or trailer rollaway situations. Before parking, hauliers, site operators and drivers should ensure that the area is level and firm enough to support both the trailer landing legs. Additional lighting may be necessary if operations are being carried out during hours of darkness to make sure the procedure is carried out safely and to reduce other risks such as falling from the vehicle.

Though not required by law, some safety features added to HGVs to prevent rollaway/runaway are advisable to prevent these accidents. There are many devices available on the market to help prevent runaway/rollaway accidents such as handbrake/park brake alarms and trailer safety park valves.

Road Train (Convoying/Platooning)

A potential technological development in lorry driving is the use of driver assistance systems to allow the formation of sequences of HGVs or electronically coupled road trains. Convoying uses systems such as lane keeping assistance and adaptive cruise control so that the driver of a vehicle following another just needs to steer the vehicle to maintain safe control. Platooning is a more advanced system whereby automatic systems are used to allow a train of vehicles to follow a manually driven lead vehicle without the need for input from the drivers of the following vehicles. The lead vehicle can communicate with the others to influence the steering, braking and acceleration to maintain safe positions of the following vehicles.

The SARTRE Project (Safe Road Trains for the Environment) (SARTE, 2014), funded by the European Commission under the Framework 7 programme successfully demonstrated platooned road trains on real roads.

In their concept a professional driver (such as a lorry or bus driver) would be the lead driver. In addition to some reduction in fuel consumption, there is a possibility that it would be connected to a payment system, with the lead driver's organisation receiving a monetary benefit.

Potential benefits are greater fuel economy as the systems may permit smaller following distances resulting in aerodynamic efficiencies that reduce fuel consumption for all vehicles participating in the train. Network capacity benefits may accrue as a greater number of vehicles will be able to fit on the road network. Drivers of the automatically controlled vehicles may experience a more comfortable drive and the opportunity for human error to cause collisions may be reduced. A number of challenges (e.g. legal, human factors, training, insurance) remain before such systems can be rolled out.

The SARTRE Project also demonstrated measured benefits of platooning. In its findings, it showed that the leader truck had a fuel saving of 8% with the following trucks having an average fuel saving of 14%. Aside from this, it was found that traffic flow increases when there are road trains present (20%) in a study done which used an HGV with 5 cars platooning as a reference (Stevens, 2015).

Alongside this project, a number of manufacturers have undertaken trials to demonstrate its capabilities. Most notable of these was the European Truck Platooning Challenge by The Netherlands in which major truck manufacturers deployed a dozen trucks to complete a week of mostly autonomous driving across Europe. Multiple countries provided their respective permits to allow the lorries to undertake these trials. The trial was deemed successfully completed and lessons were learnt in terms of driver experiences, safety, general observations and stakeholders' views. However, there are still significant issues to be worked on in terms of mitigating risks such as road wear and tear, handling complex traffic situations and handling certain infrastructural situations. Lastly, harmonisation needs to occur based on the driver's needs, the vehicle characteristics, loading and system settings. (European Truck Platooning, 2016).

Automation

Adaptive Cruise Control (ACC) systems (available) are useful for convoys and queuing traffic. As well as keeping the vehicle at a specified speed for long journeys, it detects vehicles in front and by applying the throttle and brake, keeps a present distance from the vehicle in front. However there is a danger that the driver will rely on the system, become less attentive of their surroundings and not react in time when an emergency occurs.

Lane Departure Warning System (LDWS) (available) use a camera(s) to watch for road lane markings, warning the driver through audible, visual and/or tactile signals, if the vehicle is straying towards and over the lines. Some systems go so far as correcting the steering by pushing back, and so reducing the rate of leaving a lane, unless the driver overrides the steering action with enough force. The first production lane departure warning system in Europe was developed for the Mercedes Actros lorry in 2000 and is now available from most manufacturers.

With the electronic control of brakes afforded by ESC, the sensing of vehicles in front by ACC, and the forward looking cameras of LDWS and ENV a further automation can be added. Autonomous Emergency Braking (AEB) systems (available) can bring the vehicle to a complete stop upon the detection of a frontal collision with another vehicle (TRL for the EC,2008). Further advances to AEB (which are under development) are being made to stop in the case of a pedestrian or cyclist crossing the path of the vehicle. The ability for vehicles to stop is already available as an option and implemented in modern lorries, however pedestrian AEB is currently available in a few high end passenger cars. The General Safety Regulation requires the fitting of Advanced Emergency Braking Systems to new vehicles of categories M_2, M_3, N_2 and N_3, with EU Regulation No. 347/2012 specifying technical requirements and test procedures for the systems (European Commission, 2016).

AEB could be used with Blind Spot Elimination / Enhanced Daytime Vision Systems. Research by Professor David Cebon at the University of Cambridge (2014) has been looking at possible systems to mitigate side impacts with VRUs and particularly with cyclists. This includes braking when the trailer ingresses over a path or other lane, and devices such as all wheel steering, which not only improves turning, reducing the chance of the vehicle going over paths, but also reduces wear on tyres, increasing their life. Autonomous capable trucks is another area which is currently being investigated for future use. An array of equipment such as video cameras, radar and accelerometers can be used to enable a truck to drive autonomously. A key component to this system is known as Lidar – a device which uses a pulsed laser to obtain detailed data about the truck's surroundings. This technology could reduce the need for driver input, improve safety from man-made errors and reduce labour costs for the operator. However, there are challenges in terms of legislation in this field and technical issues such as sensor inaccuracies (Freedman, 2017).

How effective?

Rear underrun

Rear impacts to the HGV constitute 14.3% of all car/HGV impacts and 18.3% of fatal car/HGV impacts. The vast majority of these are likely to be frontal impacts for the cars involved, although some could involve cars sliding sideways or even rear-end-on into the HGV (Minton & Robinson. 2010).

Minton and Robinson (2010) found through an analysis of accident statistics, that 84% of cases still underran vehicles where RUP was fitted, suggesting that the current designs are not suitable for preventing underrun in all current accident circumstances.

(Minton & Robinson, 2010)

Front underrun

EC Directive 2000/40/EC, effective since August 2003, introduced a requirement for all HGVs registered after this date to be fitted with rigid front underrun protection (FUP). Chislett, and Robinson (2010) state that evidence available suggests this has not resulted in a reduction in the severity of car occupant casualties in collision with the front of HGVs, though it is not known whether this is because of inadequate data or a genuine lack of effect.

(Chislett and Robinson, 2010)

Side underrun

There is conflicting evidence of the effects of sideguards on accidents where pedal cyclists collide with an HGV which is turning left. Most evidence suggests that there will be little, if any, effect. However an analysis of exempt vehicles suggests that sideguards have a significant effect both on reducing the frequency of such collisions and on reducing the severity of injuries sustained when these collisions do occur. Which analysis is correct cannot be proven with the data available to this study.

(Cookson and Knight, 2010)

Subsequent analysis by TRL has shown that sideguards are a positive safety feature and are being mandated.

(TRL 2014)

References

Title:	**Noise abatement and night deliveries**
Published:	Finlay, Hugh. (2008) Masters. Paper 31. Dublin Institute of Technology
Link: **Free/priced:**	http://arrow.dit.ie/cgi/viewcontent.cgi?article=1032&context=engmas Free
Objectives:	A review of international best practice for urban traffic noise abatement for developing low noise products and procedures.
Methodology:	By identifying the "peak" noise events and an identification of the HGV components and ancillaries to which noise attenuation solutions might best be applied
Key Findings:	• The hypothesis has been established that Acoustic materials are available or can be developed and applied to Heavy Goods Vehicles and ancillaries, which effectively and economically abate the noise caused by night deliveries. • Further research is desirable to further improve the availability of commercially viable and acoustically effective solutions acceptable to all the parties concerned.
Keywords:	
Comments:	A master's thesis

Title:	**Safer Lorry Scheme – The Way Forward**
Published:	TRL for TfL January 2014
Link: **Free/priced:**	http://tfl.gov.uk/cdn/static/cms/documents/safer-lorry-scheme-the-way-forward-report.pdf Free
Objectives:	This guide has been produced to give an overview of accidents relating to heavy goods vehicles (HGVs) in London especially concerning cyclists.
Methodology:	Written by Transport Research Laboratory (TRL) with the support of the Mayor of London and industry associations, the guide is intended to help both new and existing operators understand the core requirements of safety features on HGVs.
Key Findings:	• Between 2008 and 2012, 53 per cent of cyclist fatalities in London involved lorries, though they make up only around 4 per cent of the traffic.
Keywords:	HGV, DSA
Comments:	Some of the mirror types (recommended under directive 71/127/EC) for HGVs registered before 2005/6 are optional thereby making it difficult to identify HGVs not meeting the required standards

Title:	**LHD Vehicles Blind Spot: Fresnel Lens Report**
Published:	VOSA (8/11/2007) Hugh Edwards, Mark Warden, John Fitch, Martyn Pegg
Link: **Free/priced:**	http://02a9828.netsolhost.com/VOSAsFresnelReport.pdf Free
Objectives:	The objective of the project was to evaluate whether or not: • Fresnel lenses could make a contribution to improving left-hand drive (LHD) HGV driver vision to the nearside (offside in the UK); and, • Fresnel lenses could make a contribution to reducing the number of 'sideswiping' incidents.
Methodology:	The first phase was to collect data before the issue of the lenses - so as to enable the project to determine of the scale of the sideswiping problem generally. The second phase was to enable the project to determine whether or not there had been any reduction in incidents after the issue of the lenses.
Key Findings:	• LHD side-swiping incidents decreased by 59% - from 26 per week before the lenses were distributed to an average of 11 subsequently. • In 91% of LHD side-swiping incidents the HGVs did not have a lens fitted.
Keywords:	
Comments:	

Title:	**Boris bans trucks without sideguards and cyclist safety equipment in London**
Published:	A.K. Streeter, (February 4, 2014) Treehugger
Link: **Free/priced:**	http://www.treehugger.com/cars/bike-friendlier-big-trucks-are-drawing-board.html Free
Objectives:	Discuss the problems of vehicle design and cyclist accidents
Methodology:	Feature article
Key Findings:	• Rounded cab design could prevent hundreds of deaths
Keywords:	Eco-profile, vehicle design
Comments:	In Sweden, truck manufacturers Volvo and Scania are already said to be working on safer cab designs

Title:	**Safety in Freight Transport Operations**
Published:	Freight Best Practice, DfT, March 2011
Link: **Free/priced:**	http://www.freightbestpractice.org.uk/categories/3589_210_datblygu-sgiliau--developing-skills-.aspx Free
Objectives:	This Guide was written to give a definitive document covering safety in planning, in loading and whilst in transit.
Methodology:	This was a well-researched document that had significant input from HSE and other safety organisations.
Key Findings:	• Brings together a lot of safety related items in easy language for drivers. Still being used by driver trainers. Safe Loading of Vehicles.
Keywords:	Driver, vehicle safety features, loading area, reversing, Loading,
Comments:	Although 3 years old, it still it up to date and covers most of the main issues from an operator's point of view

Title:	**Autonomous Emergency Braking (AEB)**
Published:	TRL for the European Commission (2008)
Link: **Free/priced:**	http://ec.europa.eu/enterprise/sectors/automotive/files/projects/report_aebs_en.pdf Free
Objectives:	The research considered the various developments on braking systems, and the ability of the technology in the vehicle to control braking.
Methodology:	The team of researchers considered many systems and reviewed accident data and modelled the impacts of reduced congestion and injury/fatality costs by accident reduction. A cost benefit analysis was conducted.
Key Findings:	• At the time of publishing three lorry manufacturers were offering AEB systems and the study found there was a better cost benefit ratio for the use of this type of system on HGVs than cars due to greater impacts should an accident occur.
Keywords:	Autonomous Emergency Braking AEB, Adaptive Cruise Control ACC, Traction Control TC, Brake Assist BA.
Comments:	This document found that Autonomous Emergency Braking systems do have a positive effect and should be further developed and implemented.

Title:	**Driving for work: Drink and Drugs**
Published:	RoSPA (Accessed 7/3/2014)
Link: **Free/priced:**	http://www.rospa.com/rospaweb/docs/advice-services/road-safety/employers/work-drink-drugs.pdf Free
Objectives:	Guidance for people and organisations regarding driving for work.
Methodology:	
Key Findings:	
Keywords:	
Comments:	

Title:	**Goods Vehicle Operator Licensing: Guide for Operators**
Published:	VOSA, DfT (November 2011a) Document number: VOSA/2224/S&C/NOV 11.
Link: **Free/priced:**	https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/193518/Goods_Vehicle_Operator_Licensing_Guide.pdf Free
Objectives:	This guide has been produced to give an overview of how the licensing system works for operators of heavy goods vehicles (HGVs).
Methodology:	Written with the support of the traffic commissioners and industry associations, the guide is intended to help both new and existing operators understand the core requirements of the operator licensing system.
Key Findings:	n/a
Keywords:	Goods Vehicle Operator Licensing, HGV, VOSA
Comments:	

Title:	**Bicyclist Fatalities Involving Heavy Goods Vehicles: Gender Differences in Risk Perception, Behavioral Choices, and Training**
Published:	Frings, D., A. Rose, et al. (2012). Department of Psychology, London South Bank University, London, UK. (Traffic Inj Prev. 2012 Sep;13(5):493-8. doi: 10.1080/15389588.2012.664796.)
Link: **Free/priced:**	http://www.ncbi.nlm.nih.gov/pubmed/22931179 € 28
Objectives:	Females are typically involved in fewer collisions when pedal cycling than males. However, female cyclists appear to be overrepresented in the number of fatal collisions involving heavy goods vehicles (HGVs). These collisions often involve cyclists passing HGVs on the side furthest from the HGV driver (nearside). It is hypothesized that this pattern of fatalities may be partly due to differences in how males and females perceive the risk associated with various cycling manoeuvres. It is also hypothesized that this difference may be overcome with advanced training.
Methodology:	4,596 UK cyclists completed an online questionnaire in which they reported their level of cycle training and rated the risk they perceived to be associated with various cycling manoeuvres, the likelihood that they would engage in them, and history of collision involvement.
Key Findings:	• Females perceived a slightly greater level of risk to be associated with cycling. • However, males differentiated between the risks involved in nearside and offside overtaking to a greater extent than females. • Risk perception was significantly correlated with the reported likelihood that participants would engage in risky manoeuvres such as overtaking on the nearside and also with past collision prevalence. • Advanced cycling training was correlated with higher levels of perceived risk associated with overtaking on the nearside; however, basic cycle training was not. • Cyclists who do not correctly differentiate between the risks associated with nearside and offside overtaking may be more at risk of being involved in HGV-related collisions. • Advanced cycling training is linked to more accurate risk perception. • To reduce fatalities, public awareness campaigns should focus on the increased risk of nearside overtaking and encourage cyclists to take advanced training.
Keywords:	Cyclist, HGV, risk perception,
Comments:	

Title:	**Rules on Drivers' Hours and Tachographs: Goods vehicles in GB and Europe**
Published:	VOSA (2011b) (Revised 2011 GV262 - 03)
Link: **Free/priced:**	https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/208091/rules-on-drivers-hours-and-tachographs-goods-vehicles-in-gb-and-europe.pdf Free
Objectives:	This guide provides advice to drivers and operators of goods vehicles, whether used privately or commercially. It explains the rules for drivers' hours and the keeping of records, and updates previous guidance from 2009. The EU regulations also place a responsibility on others in the supply chain such as consignors, freight forwarders, contractors, sub-contractors and driver agencies. People working in these sectors of the road haulage industry may benefit from an understanding of the guidance offered here.
Methodology:	
Key Findings:	
Keywords:	Driver Hours, Tachograph, HGV
Comments:	

Title:	**The SARTRE Project**
Published:	SARTRE (2012) European Commission
Link: **Free/priced:**	http://www.sartre-project.eu/ Free
Objectives:	Safe Road Trains for the Environment, funded by the European Commission under the Framework 7 programme, aims to develop strategies and technologies to allow vehicle platoons to operate on normal public highways with significant environmental, safety and comfort benefits. The project aims to encourage a step change in personal transport usage by developing of environmental road-trains called platoons. Systems will be developed facilitating the safe adoption of road trains on un-modified public highways with interaction with other traffic. A scheme will be developed whereby a lead vehicle with a professional driver will take responsibility for a platoon. Following vehicles will enter a semi-autonomous control mode that allows the driver of the following vehicle to do other things that would normally be prohibited for reasons of safety; for example, operate a phone, reading a book or watching a movie.
Methodology:	
Key Findings:	
Keywords:	Road-train, platooning, convoying, HGV, mass-transit, motorway

Title:	**A future 'quiet HGV' permissive certification scheme: phase 1 report**
Published:	Morgan, P. A., M. Muirhead, et al. (2009). A future 'quiet HGV' permissive certification scheme: phase 1 report. TRL published project report (PPR432). Crowthorne: Trasnport Research Laboratory. (ISBN: 978-1-84608-930-5) (ISSN: 0968-4093)
Link: **Free/priced:**	https://trl.co.uk/reports/PPR432 Free
Objectives:	HGV movements in urban areas are often constrained during night-time and/or weekend periods by local regulations which have been put in place to minimise noise impacts. If such night-time delivery restrictions could either be relaxed or removed where appropriate, there are significant potential benefits, primarily from reduced congestion. TRL has been commissioned by the Department for Transport (DfT) to consider the need for and the feasibility of a permissive low-noise certification scheme for HGVs and their operation, with options for scheme operation. It is envisaged that a relaxation of delivery restrictions could be granted by a local authority for a certain operator using 'quiet HGVs' that met the requirements of such a scheme.
Methodology:	This report reviews existing restrictions on night-time goods deliveries, implemented schemes or research projects addressing the issue, the needs (if any) for a permissive certification scheme based upon consultations with relevant stakeholders, barriers to the future introduction of such a scheme as well as the likely benefits and likelihood of successes. The roles of stakeholders and scheme managers and the issues related to the enforcement of such a scheme are also discussed.
Key Findings:	• Provisional recommendations are set out for a scheme addressing vehicle, body and ancillary noise associated with both the transport of goods between the point of origin and final destination, and the actual collections/deliveries themselves.
Keywords:	HGV, noise, quiet HGV, deliveries

Title:	**Introduction to the carriage of dangerous goods**
Published:	HSE (Accessed 9/1/2014a)
Link: **Free/priced:**	http://www.hse.gov.uk/cdg/introduction.htm Free
Objectives:	Carrying goods by road or rail involves the risk of traffic accidents. If the goods carried are dangerous, there is also the risk of an incident, such as spillage of the goods, leading to hazards such as fire, explosion, chemical burn or environmental damage. Most goods are not considered sufficiently dangerous to require special precautions during carriage. Some goods, however, have properties which mean they are potentially dangerous if carried.
Methodology:	
Key findings:	
Keywords:	

Title:	**Providing effective regulation of freight transport, Trialling longer HGV semi-trailers**
Published:	DfT, DSA (9/12/2013b) (Accessed 6/3/2014)
Link: **Free/priced:**	https://www.gov.uk/government/policies/providing-effective-regulation-of-freight-transport/supporting-pages/trialling-longer-hgv-semi-trailers Free
Objectives:	Carrying goods by road or rail involves the risk of traffic accidents. If the goods carried are dangerous, there is also the risk of an incident, such as spillage of the goods, leading to hazards such as fire, explosion, chemical burn or environmental damage. Most goods are not considered sufficiently dangerous to require special precautions during carriage. Some goods, however, have properties which mean they are potentially dangerous if carried.
Methodology:	
Key Findings:	
Keywords:	
Comments:	

Title:	**Medical standards for drivers**
Published:	HSE (Accessed 24/02/2017b)
Link: **Free/priced:**	http://www.hse.gov.uk/workplacetransport/personnel/medicalfitness.htm Free
Objectives:	This guidance is for occupational health professionals who are consulted about the medical fitness of workplace transport drivers.
Methodology:	
Key findings:	
Keywords:	
Comments:	

Title:	**Haulage & distribution**
Published:	HSE (Accessed 9/1/2014c)
Link: **Free/priced:**	http://www.hse.gov.uk/logistics/haulage-distribution.htm Free
Objectives:	Guidance and measures for preventing accidents and raising awareness of the dangers from: Fails from vehicles, Manual handling, Load security, etc.
Methodology:	
Key Findings:	Falls from vehicles • Accidents caused by moving lorries at the workplace caused 2 deaths, 79 major injuries and 249 over-3-day injuries to employees in the 'freight by road' industry, in the 2009/10 work year. Manual handling • Lifting and moving by hand is the main cause of reportable accidents in the 'freight by road' industry. There were 278 major and 3639 over-3-day injuries reported in 2006/07 work year. Bad backs were the most common injury. Load security • 3 deaths and 160 major injuries in the 'freight by road' industry were caused by objects falling onto people in the 2009/10 work year. 740 more people received injuries severe enough to keep them off work for over three days.
Keywords:	HSE, accidents, falls, Load security
Comments:	

Title:	**Highways Agency. Abnormal loads**
Published:	Highways Agency (Accessed 17/12/2013)
Link: **Free/priced:**	http://www.highways.gov.uk/specialist-information/abnormal-loads/ Free
Objectives:	Legislation requires that vehicles and load movements that exceed standard dimensions need to be pre-notified to police, highway and bridge authorities, a process that currently involves millions of faxes being sent every year. Using ESDAL's innovative mapping system, Hauliers can plot the route they need to take, get full details of all the organisations they will need to notify before making the movement and also deliver fully compliant notifications. Hauliers can also perform an appraisal of the route for an indication of the suitability of their vehicle.
Methodology:	
Key findings:	
Keywords:	
Comments:	

Title:	**Freight Transport Association. Abnormal loads**
Published:	FTA (Accessed 09/01/2014) Freight Transport Association
Link: **Free/priced:**	http://www.fta.co.uk/policy_and_compliance/road/vehicles/abnormal_loads.html Free
Objectives:	FTA information regarding abnormal loads
Methodology:	
Key Findings:	
Keywords:	
Comments:	

Title:	**The annual test for lorries, buses and trailers**
Published:	Annual test (8 March 2017)
Link: **Free/priced:**	https://www.gov.uk/annual-test-for-lorries-buses-and-trailers
Objectives:	The annual test for lorries, trailers and buses is similar to the MOT test that cars take each year. The annual test is for: • motor vehicles with a gross weight of more than 3,500 kilograms (kg) • vehicles that are built or have been adapted to form part of an articulated vehicle • semi-trailers • horseboxes with a gross weight of more than 3,500 kg • 'A' frame trailers and converter dollies manufactured on or after 1 January 1979 • trailers with an unladen weight of more than 1,020 kg with powered braking systems (instead of standard overrun brakes and as well as the required parking brake) • all public service vehicles with more than 8 passenger seats - not including the driver's seat
Methodology:	
Key Findings:	
Keywords:	MOT, PTI, Annual test, HGV
Comments:	

Title:	**Categorisation of Defects**
Published:	VOSA (10/07/2013a) VOSA
Link: **Free/priced:**	https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/265114/categorisation-of-defects.pdf Free
Objectives:	This Guide is intended primarily for the use of Examiners within VOSA and Authorised Constables. However, it is made available more widely so that vehicle owners, operators and drivers can become more aware of VOSA's standards. Its purpose is: • to provide guidance on the action to take when roadworthiness defects are found during vehicle inspections; • to promote consistency among Examiners
Methodology:	
Key Findings:	
Keywords:	MOT, PTI, Annual test, HGV
Comments:	

Title:	**VOSA effectiveness report 2012 to 2013**
Published:	VOSA (3/10/2013b) VOSA
Link: **Free/priced:**	https://www.gov.uk/government/publications/vosa-effectiveness-report-2012-to-2013 Free
Objectives:	VOSA's effectiveness report contains data on vehicle testing and enforcement activity - including details on volumes and outcomes for both. The data covers heavy goods vehicles (HGVs), public service vehicles (PSVs) and light goods vehicles as well as the MOT scheme and other small and specialist schemes.
Methodology:	
Key Findings:	
Keywords:	MOT, PTI, Annual test, HGV
Comments:	

Title:	**Rear underrun protection for heavy goods vehicles: the potential effects of changes to the minimum technical requirements**
Published:	Minton, R. and Robinson, T. (2010). Rear underrun protection for heavy goods vehicles: the potential effects of changes to the minimum technical requirements. TRL published project report (PPR517). Crowthorne: Transport Research Laboratory. (ISBN: 978-1-84608-895-7) (ISSN: 0968-4093)
Link: **Free/priced:**	https://trl.co.uk/reports/PPR517 Free
Objectives:	A study to assess the effectiveness of rear underrun protection on HGVS and its interaction with cars.
Methodology:	This study undertook a review of the UK evidence relating to the effectiveness of existing RUP.
Key Findings:	• When cars collide with goods vehicles in excess of 3.5 tonnes maximum permissible gross weight (HGVs) there is a fundamental incompatibility between their structures. • This has been recognised as a safety concern for a long time as the energy-absorbing structural parts of the car (at about bumper level) are unlikely to interact with any structural parts of the HGV until they meet the rear suspension or wheels. • By this time the load deck of the HGV, which is higher than the car front bumper and typically substantially overhangs the rear axle of the HGV, may well have intruded into the car's passenger compartment, which has little structural strength, with resulting potential for serious and fatal occupant injury. • The fitment of rear underrun protection (RUP) to most HGVs was intended to solve this problem and has been a requirement in the UK (and most of the rest of the EU) for a considerable time. • The study concluded that the technical requirements for RUP are not adequate to fully engage the crash structures of current passenger cars and to fully utilise their safety performance. A number of policy options were proposed for consideration.
Keywords:	HGV, RUP, compatibility, bumper
Comments:	

Title:	**Investigating the real-world effectiveness of introducing mandatory fitment of front underrun protection to heavy goods vehicles**
Published:	Chislett, W. and Robinson, T. L. (2010). Investigating the real-world effectiveness of introducing mandatory fitment of front underrun protection to heavy goods vehicles. TRL published project report (PPR515). Crowthorne: Transport Research Laboratory. (ISBN: 978-1-84608-893-3) (ISSN: 0968-4093)
Link: **Free/priced:**	https://trl.co.uk/reports/PPR515 Free
Objectives:	A study to assess the effectiveness of front underrun protection on HGVS and its interaction with cars.
Methodology:	This study has undertaken an analysis of STATS19, the national accident dataset, and the Heavy Vehicle Crash Injury Study (HVCIS) fatal accident database to investigate the actual real-world effect of fitment of FUP on accident outcome.
Key Findings:	• Passenger car occupants that are involved in a head-on collision with a heavy goods vehicle (HGV) remain the largest casualty group for accidents involving HGVs, and research into the mitigation of injury to this group is, therefore, a priority. • EC Directive 2000/40/EC, effective since August 2003, introduced a requirement for all HGVs registered after this date to be fitted with rigid front underrun protection (FUP). This requirement was expected to reduce the number of fatal and serious casualties resulting from car to HGV head-on collisions. • The evidence available suggests that the mandatory fitment of FUP has not resulted in a reduction in the severity of car occupant casualties in collision with the front of HGVs, though it is not known whether this is because of inadequate data or a genuine lack of effect. • Suggestions have been put forward for potential future work to better understand the reasons why FUP does not appear to be as effective as had been expected.
Keywords:	HGV, FUP, compatibility, bumper

Title:	**Sideguards on heavy goods vehicles: assessing the effects on pedal cyclists injured by trucks overtaking or turning left**
Published:	Cookson, R. and Knight, I. (2010). Sideguards on heavy goods vehicles: assessing the effects on pedal cyclists injured by trucks overtaking or turning left. TRL published project report (PPR514). Crowthorne: Crowthorne: Transport Research Laboratory. (ISBN: 978-1-84608-892-6) (ISSN: 0968-4093) p8
Link: **Free/priced:**	https://trl.co.uk/reports/PPR514 Free
Objectives:	In recent years there has been a substantial increase in pedal cycle traffic but at the same time the number of pedal cyclists killed and seriously injured in road accidents has reduced, implying a very substantial reduction in the casualty risk per km ridden. Transport for London (TfL) developed and published a “Cycle Safety Action Plan” (TfL, 2010) that proposed a wide range of actions to improve cycle safety. The actions include, under the heading “technology”, working with the freight industry to identify the most cost-effective commercial vehicle safety measures that could be fitted either to new vehicles or to the existing fleet. The action specifically states that sideguards and motion sensors will be considered.
Methodology:	This study has drawn together the findings of research literature, in particular three recent studies that consider heavy vehicle safety generally and/or sideguards specifically, and undertaken analysis of relevant accident data in order to inform consideration of the likely effectiveness of sideguards in terms of mitigating pedal cycle casualties in London and in GB as a whole.
Key Findings:	• Accidents between HGVs and pedal cyclists have higher relative priority in London compared with the rest of GB. In London, left turn accidents are a higher relative priority than other HGV/Pedal cycle collisions but in the rest of GB this is not the case. It is, therefore, likely that the most cost effective safety measures may be different if implemented only in London compared to if they were implemented across GB. • All of the evidence suggests that existing sideguard designs have been very effective at reducing the severity of injury sustained by cyclists in collision with an HGV passing in an approximately straight line.

	• There is conflicting evidence of the effects of sideguards on accidents where pedal cyclists collide with an HGV which is turning left. Most evidence suggests that there will be little, if any, effect. However an analysis of exempt vehicles suggests that sideguards have a significant effect both on reducing the frequency of such collisions and on reducing the severity of injuries sustained when these collisions do occur. Which analysis is correct cannot be proven with the data available to this study. • All of the evidence suggests that if the exemptions to the fitment of current sideguards were ended and/or the design of existing sideguards was improved it would produce additional casualty savings in accidents. However, these savings are likely to be relatively modest and were not ranked highly in the Robinson and Chislett (2010) study of commercial vehicle safety priorities. • There is some evidence to suggest that improved sideguards with a lower ground clearance could have some effect on left turn accidents but there is also considerable technical uncertainty regarding the likely effectiveness of such a measure. The HVCIS database and the Robinson and Chislett (2010) review of commercial vehicle safety priorities both suggested that countermeasures that improved the field of view would be more effective. In this context, improved field of view could mean any system that improved the ability of the HGV driver to recognise the presence of a cyclist in a dangerous area. It could potentially be implemented either through changes to direct or indirect vision, or by the introduction of emerging technologies such as vulnerable road user warning systems, which was ranked by Robinson and Chislett (2010) as one of the top five commercial vehicle safety priorities.
Keywords:	HGV, SUP, VRU, pedal cycle
Comments:	

Title:	**Commercial vehicle safety priorities - Ranking of future priorities in the UK based on detailed data from 2006-2008**
Published:	Robinson T. and Chislett, W. (2010). Commercial vehicle safety priorities - Ranking of future priorities in the UK based on detailed data from 2006-2008.TRL published project report (PPR486). Crowthorne: Transport Research Laboratory. (ISBN: 978-1-84608-868-1) (ISSN: 0968-4093)
Link: **Free/priced:**	https://trl.co.uk/reports/PPR486 Free
Objectives:	An assessment of potential safety measures has been undertaken and five measures that could be implemented through vehicle design and construction standards were selected for more detailed cost-benefit analysis. This is the second review of this kind, the first having taken place in 2006.
Methodology:	This study has defined, quantified and prioritised a list of casualty groups that can be used to inform the relative priorities for future developments in vehicle safety.
Key Findings:	• Goods vehicles, large passenger vehicles and other large vehicles such as agricultural vehicles and mobile machinery make up a relatively small proportion of the vehicles on the roads in Great Britain (GB). However, the frequency and/or severity of their involvement in accidents can be disproportionate to the distances they travel. • In 2008 they were involved in accidents that resulted in approximately 29% of all GB road fatalities and so these vehicles can have a significant influence on the UK's road safety performance.
Keywords:	HGV, accident, collision
Comments:	

Title:	**Integrated safety guards and spray suppression – final summary report**
Published:	Knight, I., Dodd, M., Bowes, D., Donaldson W. et al (2005). Integrated safety guards and spray suppression – final summary report. TRL published project report (PPR075). Crowthorne: Transport Research Laboratory. (ISBN: 1-84608-924-7) (ISSN: 0968-4093) p82
Link: **Free/priced:**	https://trl.co.uk/reports/PPR071 Free
Objectives:	Current regulations require the fitment of sideguards, and front and rear underrun protection to new goods vehicles and trailers over certain weights. The front and rear underrun protection is to prevent cars that collide with the goods vehicle running under the structure of the larger vehicle. The sideguards are designed to protect pedestrians and cyclists from falling under the vehicle wheels, rather than prevent underrun from other vehicles, although they do provide some protection against this. Regulations also require the fitment of spray suppression equipment to goods vehicles. These devices consist of wheel guards, mud flaps and matting. The main objectives for this study were to assess the benefits of integrating front, side and rear underrun protection in terms of: Improved protection for other road users in collision with an HGV. Allowing the use of improved aerodynamics to control spray emission in wet conditions, including the development of a regulatory test procedure. Improved fuel efficiency as a result of improved aerodynamics.
Methodology:	The work on safety guards in this study has focused more on side protection than front or rear because improvements to these features were being considered in a parallel study commissioned by the European Commission (EC): Vehicle Crash Compatibility (VC_COMPAT). The project was structured in two elements. The safety guards element included a review of current regulations and vehicle exemptions, computer simulation and assessment of the potential benefits of improved sideguards, and investigation of the issue of tractor/ trailer height compatibility and the potential benefits from the use of alternative materials. The spray suppression element in addition included a windtunnel assessment of different spray suppression methods, development of a test method which could be used as a regulatory test procedure, and comparative spray testing of standard and aerodynamically enhanced HGVs followed by fuel economy testing of the same. This report contains detailed results from each element of the project. A cost benefit analysis was completed which is reported separately in TRL report PPR071.

Key Findings:	• The UK Department for Transport (DfT) has commissioned TRL Limited (TRL) to investigate the benefits of taking an integrated approach to these topics. • If further improvements to these systems are considered individually the improvements in each area may appear small. • However, an integrated approach to the design of the front, rear and side of HGVs may yield much greater combined benefits at less cost than considering the elements individually.
Keywords:	SUP, spray suppression, HGV,

Title:	**Cost benefit analysis on blind spot mirrors - final report**
Published:	O'Brien (2004). Cost benefit analysis on blind spot mirrors - final report. Jacobs consultancy, Issue No. 2
Link: **Free/priced:**	http://ec.europa.eu/transport/roadsafety_library/publications/mirrors_final_report.pdf Free
Objectives:	The Commission has implemented a directive to make the fitting of mirrors and supplementary systems for indirect vision compulsory for specified vehicle types. The principal objective is to reduce the number of “blind spot” accidents. This directive will only apply to new vehicles. The objective of the study is to assess, by means of cost-benefit analysis, the probable consequences of extending this legislation to cover existing vehicles.
Methodology:	The main tasks were: • a literature review; • interviews with stakeholders; • analysis by spreadsheet.
Key Findings:	• The latest directive, Directive 97/2003/EC, came into force on 29 January 2004. The objective is to harmonise rules relating to type-approval of devices for indirect vision and vehicles equipped with these devices. • For the purposes of this study, it is assumed to mean that by the end of 2006, all new vehicles being entered into service will be fitted with the new systems. Preliminary responses from manufacturers suggest that the systems will only be fitted when it is compulsory (and therefore that few will be fitted before 2006). • The most significant findings from the literature review were: • UK Driver’s Field of View from Large Vehicle (ICE Ergonomics, 1999): The project concluded that the most cost-effective means for improvement to the driver’s field of vision entailed a combination of additional, modified and repositioned mirrors. Their approach was to estimate how many lives would need to be saved to justify the measure and this came to around 13.

	• UK TRL (ongoing): This research is currently underway and its objective is to consider the impact of prospective legislation on fitting rear view devices to goods vehicle over 7.5 tonnes. • Netherlands Improvement of the Vision of Drivers of Trucks and Vans (TNO, 1998): Potential accident savings were calculated resulting in a 43% decrease of "blind spot" fatalities (15 fatalities per year). • Netherlands Systems for Improving Fields of Vision for Trucks (TNO, 1999): Field test were undertaken to compare "blind spot" devices in terms of the percentage of objects in the "blind spot" detected by the different systems. • Netherlands Analysis of Police Reports relating to Field of Vision and Location of Victims (TNO, January 2001): Police records were used to show the final resting locations of victims. The results showed that most of the victims are to the rear of the driver's position, up to 2.5 metres out from the cab. • Netherlands Fields of Vision related Victims among Small Two-wheeled Vehicles: a European Perspective (TNO, November 2001): The analysis of the incidence of heavy vehicles in collisions with cycles and mopeds was extended to other countries in Europe. The most useful data was obtained for Belgium, Germany and the UK. • Netherlands Cost Benefit Analysis of Measures to Improve Goods Vehicle Safety Draft Report (SWOV, January 2004): SWOV are undertaking a comparative review of the costs and benefits of various measure to improve goods vehicle safety, including retrofitting of blind spot mirrors and cameras. • Germany Right Turning Vehicle Accidents in Berlin: The analysis predicted that annually there are approximately 200 fatal accidents in Germany between right turning trucks and cyclists. • United States (several sources): Much of the US literature review reveals topics on the periphery of interest to the current study. The discussions tend to be of technical rather than economic issues. • Japan National Police Agency: Japan has introduced the installation of Class IV mirrors to all new trucks to improve driver spatial awareness. Statistics collated by the National Police Agency show that from 1976 the number of fatal accidents caused by left-turning vehicles dropped dramatically over a period of 8 years as the new regulations were implemented.
Keywords:	blind spot mirrors, HGV, Class IV mirrors

Title:	**The risk of bridge strikes: Bridge strikes continue to be a significant risk to railway safety**
Published:	Network Rail (accessed 05/05/2017)
Link: **Free/priced:**	https://www.networkrail.co.uk/running-the-railway/looking-after-the-railway/bridges-tunnels-viaducts/risk-bridge-strikes/ Free
Objectives:	Each bridge strike, whether the railway passes over a road or the road crosses the railway, is a risk to the safety of train passengers and railway workers, may damage the bridge, and may cause significant delays to train services. Bridge strikes can result in the death or serious injury of the driver or passengers of the vehicle involved, as well as other innocent road users. Bridge strikes are financially costly to the vehicle owner as well as the railway.
Methodology:	
Key Findings:	The number of bridge strikes reported at our bridges carrying the railway over roads (underline) in the 2015/2016 period was 1606. This is a slight increase (4%) compared to the previous year.
Keywords:	Rail, bridge strike, safety
Comments:	

Title:	**The Highway code: Annex 6. Vehicle Maintenance, safety and security**
Published:	DfT(2017)
Link: **Free/priced:**	https://www.gov.uk/guidance/the-highway-code/annex-6-vehicle-maintenance-safety-and-security Free online
Objectives:	
Methodology:	
Key Findings:	
Keywords:	Highway code, maintenance, safety, security
Comments:	This Highway Code applies to England, Scotland and Wales, and is essential reading for who uses the roads.

Title:	**A study of the implementation of Directive 2007/38/EC on the retrofitting of blind spot mirrors to HGVs. Published project report**
Published:	Knight, I. (2011). A study of the implementation of Directive 2007/38/EC on the retrofitting of blind spot mirrors to HGVs. Published project report. TRL (PPR588). Crowthorne: Transport Research Laboratory. (ISBN: 978-1-908855-22-0) (ISSN: 0968-4093)
Link: **Free/priced:**	https://trl.co.uk/reports/PPR588 Free
Objectives:	It has long been acknowledged that large vehicles have blind spots around them which the driver is unable to see into and that this has the potential to contribute to the cause of accidents. In order to reduce the risk of accidents involving blind spots, the European Union (EU) implemented Directive 2003/97/EC, which substantially increased the field of view available from the mirrors of new trucks and buses sold in the EU from January 2007. These included requirements that certain vehicles be fitted with mirrors to cover the blind spot at the front of the vehicle and on the passenger side of the vehicle. It was also considered to be cost-effective to require existing heavy goods vehicles (HGVs) already in-service to be retro-fitted with the side view blind spot mirrors, and this was implemented by Directive 2007/38/EC.
Methodology:	This report describes in full a review of the implementation of Directive 2007/38/EC, which involved: A brief review of recent literature regarding the effectiveness of mirrors and other technologies at preventing blind spot accidents; Analysis of the results of a questionnaire sent by the Commission to each of the Member States, and Analysis of accident and casualty data supplied by the Commission
Key Findings:	
Keywords:	Blind spot, mirrors, VRU, HGV
Comments:	

Title:	**Cambridge Vehicle Dynamics Consortium: Professor David Cebon**
Published:	University of Cambridge (Accessed 09/01/2014)
Link: **Free/priced:**	http://www-cvdc.eng.cam.ac.uk/directory/dc@eng.cam.ac.uk Free
Objectives:	The 'Cambridge Vehicle Dynamics Consortium' is a collaboration between a group of companies from the heavy truck industry and engineers from Cambridge University who have joined forces to develop better heavy goods vehicles.
Methodology:	The research concentrates on optimising existing suspension components and investigating advanced concept suspensions with computer-controlled 'active' and 'semi-active' elements. The work involves computer modelling, laboratory testing of prototype hardware and field trials of instrumented vehicles.
Key Findings:	
Keywords:	HGV, VRU, technology, all-wheel steering, AEB
Comments:	

Title:	**Road Traffic Estimates: Great Britain 2015**
Published:	Department for Transport (2016) (PDF)
Link: **Free/priced:**	https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/524261/annual-road-traffic-estimates-2015.pdf Free
Objectives:	The statistical release provides annual estimates of traffic on Great Britain's roads. It looks at recent and long term trends in traffic, in the context of related statistics.
Methodology:	The report uses annual traffic statistics compiled from 8,000 roadside 12-hour manual counts, continuous data from around 300 automatic traffic counters, and data on road lengths.
Key Findings:	• Lorry traffic grew 3.7% from 2014 values • HGVs travelled 16.7 billion miles
Keywords:	Road traffic statistics 2015, road traffic estimates, road traffic
Comments:	

Title:	**Domestic Road Freight Statistics, United Kingdom 2015**
Published:	Department for Transport (2016) (PDF)
Link: **Free/priced:**	https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/546346/domestic-road-freight-statistics-2015.pdf Free
Objectives:	The statistical release summarises the latest road freight statistics from the Continuing Survey of Road Goods Transport Great Britain (CSRGT GB).
Methodology:	The survey measures the activity of GB-registered HGVs operating across the UK. It also summarises a number of economic, environmental and safety statistics about HGVs and the road freight industry.
Key Findings:	
Keywords:	Road freight, road freight statistics

Title:	**Drivers' hours and tachographs rules: goods vehicles (GV262)**
Published:	Driver and Vehicle Standards Agency (2016)
Link: **Free/priced:**	https://www.gov.uk/guidance/drivers-hours-goods-vehicles (Accessed: 27/03/2017) Free
Objectives:	Provides general guidance about drivers' and tachograph rules for goods vehicles. It reflects the DVSA's current enforcement policy.
Methodology:	
Key Findings:	Tachographs must record duration of drive, breaks and rest periods, vehicle's speed, and distance vehicle has travelled. Driver must take a break of 45 minutes and drive a maximum of 4.5 hours continuously, unless they take a rest period. Daily and weekly driving limits apply. Penalties apply if rules not adhered to.
Keywords:	Tachograph, tachograph rules, drivers' hours rules, GV262
Comments:	General guide for drivers' and tachographs. Can be updated at any time.

Title:	**Reported Road Casualties Great Britain (RRCGB) 2015**
Published:	Department for Transport (2016).
Link: **Free/priced:**	https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/568484/rrcgb-2015.pdf Free, PDF and data tables (CSV format)
Objectives:	Summary of vehicles involved in reported RTIs by severity and vehicle type and summary of contributory factors for RTIs in 2015.
Methodology:	Reports from RTIs reported to the police. It is accepted that there is likely to be a level of under-reporting, however this remains the biggest single source of road casualty data in the UK. Not all RTIs are attended by police, and even when an accident is attended, it is not always possible to record a suitable contributory factor. However, this data remains one of the best sources of RTI contributory factors in GB.
Key Findings:	In 2015, • 31 HGV occupants were killed and 1162 seriously injured on Britain's roads. • 50 pedestrians were killed and 113 seriously injured in collisions involving HGVs. • 6,470 HGVs were involved in an accident.
Keywords:	Accident numbers, Accident severity, Contributory factors.
Comments:	The largest single source of GB data. Results are designated National Statistics.

Title:	**Night-time Deliveries – Wandsworth trial**
Published:	Freight Transport Association (2013) (PDF)
Link: **Free/priced:**	http://content.tfl.gov.uk/wandsworth-retiming-case-study.pdf Free
Objectives:	The Wandsworth Borough Council lifted the restrictions on night-time deliveries for a Sainsbury supermarket in Wandsworth with the aim of demonstrating that night-time deliveries do not have a detrimental impact on local residents and the community.
Methodology:	An FTA toolkit was provided for retailers and logistics providers who aim to undertake night-time deliveries. This should be applied when negotiating to relax driver curfews. A number of measures were taken such as doors not being slammed, enhanced communication and adequate complaint procedures for members of public.
Key Findings:	• Journey time reduced by 60 minutes in total. • Savings of over £16,000 per year (for this route) • 68 tonnes of CO_2 saved per year • No complaints received • Improved customer feedback for the store
Keywords:	Wandsworth retimed deliveries, TfL retiming deliveries
Comments:	

Title:	**Reducing CO_2 emissions from Heavy-Duty Vehicles**
Published:	European Commission (2016)
Link: **Free/priced:**	https://ec.europa.eu/clima/policies/transport/vehicles/heavy_en (Accessed: 13/03/2017) Free
Objectives:	Illustrating the impact of HGV emissions.
Methodology:	
Key Findings:	HGV emissions rose by 36% from 1990 to 2010. Goal of reducing GHG emissions from transport by 60% by 2050 from 1990 levels.
Keywords:	Emissions reduction, European Commission climate action
Comments:	

Title:	**Mayor sets out measures to rid London of dangerous lorries**
Published:	Mayor of London (2016)
Link: **Free/priced:**	https://www.london.gov.uk/press-releases/mayoral/new-measures-to-rid-london-of-dangerous-lorries (Accessed: 08/03/2017) Free
Objectives:	Mayor's plans to reduce dangerous lorries in London. Includes a Direct Vision Standard being introduced.
Methodology:	
Key Findings:	• Direct Vision Standard to be introduced • Star rating to be implemented, with 0 star rated being banned from 2020 and 3 star minimum from 2024 onwards.
Keywords:	Direct Vision Standard
Comments:	

Title:	**Saving Lives: Boosting Car Safety in the EU**
Published:	European Commission (2016) (PDF)
Link: **Free/priced:**	http://ec.europa.eu/DocsRoom/documents/20508/attachments/2/translations/en/renditions/pdf Free
Objectives:	The European Commission Staff Working Document lists candidate measures for consideration for implementation in the General Safety and Pedestrian Regulations. It also summarises the further work required for their possible implementation in the General Safety and Pedestrian Regulations.
Methodology:	The European Commission used TRL's report on the feasibility and cost-benefit assessment of a wide range of possible measures for inclusion in the EU legislation update. It also used the updated and revised information along with insights in terms of the benefit and feasibility of specific measures, along with further work into the findings.
Key Findings:	• AEB required to be fitted to vehicle categories M_2, M_3, N_2 and N_3.
Keywords:	European Commission boosting car safety 2016
Comments:	

Title:	**Lessons Learnt – Hypothesis and recommendations for future cross border Field Operational Tests of truck platooning in Europe**
Published:	European Truck Platooning Challenge (2016) (PDF)
Link: **Free/priced:**	https://www.eutruckplatooning.com/PageByID.aspx?sectionID=131542&contentPageID=529927 Free
Objectives:	To demonstrate the analysis, conclusions and recommendations from the European Truck Platooning Challenge in 2016. It aims to provide some information for further field operational tests for truck platooning in Europe.
Methodology:	A challenge took place to platoon trucks to Rotterdam passing through Sweden, Denmark, Germany and Belgium. It was a joint operation between authorities of member states, and industry. Analysis was done in terms of the risks associated, vehicle characteristics, traffic safety and state authority regulation allowances/changes.
Key Findings:	• Harmonisation needed to occur based on drivers' needs, vehicle characteristics, loading and system settings. • Risks need to be further mitigated. • Trial was deemed successfully completed.
Keywords:	European Truck Platooning Challenge, Lessons Learnt
Comments:	

Title:	**Self-Driving Trucks**
Published:	David H. Freedman (2017)
Link: **Free/priced:**	https://www.technologyreview.com/s/603493/10-breakthrough-technologies-2017-self-driving-trucks/ (Accessed: 05/05/2017) Free
Objectives:	Article outlining the implementation of self-driving trucks. It provides brief reviews of the technology used in these trucks and potential benefits in terms of costs and human safety.
Methodology:	It reviews the technology currently being researched to implement into a self-driving truck, including the trial run of one by Otto. It includes interviews with drivers, a vehicle manufacturer, and technology providers.
Key Findings:	
Keywords:	Autonomous truck, self-driving truck, MIT technology review
Comments:	

Title:	**Emissions Standards Change (PDF)**
Published:	Transport for London (2012)
Link: **Free/priced:**	http://content.tfl.gov.uk/lez-leaflet-jan-2012.pdf Free
Objectives:	Outlines the changes to the emissions standards for the LEZ, the new requirements for each vehicle type and the repercussions for not adhering to the standards.
Methodology:	
Key Findings:	• Euro 3 standards for PM emissions • For lorries, buses, coaches and other specialist heavy vehicles, these must meet Euro IV standards for PM emissions.
Keywords:	LEZ TfL, LEZ requirements leaflet
Comments:	

Title:	**Assessing the Direct Vision Performance of Heavy goods Vehicles (HGVs)**
Published:	Robinson, T., Knight, I., Martin, P., Seidly, M., Manning, J., Eyers, V. (2016)
Link: **Free/priced:**	http://content.tfl.gov.uk/assessing-direct-vision-in-hgvs-summary.pdf Free
Objectives:	To define 3 categories of direct vision, with the lowest level producing an increased view in comparison to a standard construction sector HGV with off-road specifications.
Methodology:	• Collecting data and modelling designs to define the areas it is important to see, and how vision performance could be quantified. • Review of scientific literature and existing standards with respect to the measurement of field of view and definition of human visual characteristics. • Engaging stakeholders to ensure the protocol developed was well suited to its expected use.
Key Findings:	• Driver aids such as mirrors requires drivers to be looking at the correct aid at the right time. • There are no minimum standards for how much a driver can see directly from their cab.
Keywords:	Direct Vision Standards, TRL Direct Vision Standards consultation
Comments:	

Title:	**Summary of annual tests for lorries, buses and trailers**
Published:	Driver & Vehicle Standards Agency (DVSA) (2017)
Link: **Free/priced:**	https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/570667/dvsa-com-01-summary-of-annual-tests-for-lorries-buses-and-trailers__1_.csv/preview https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/570457/dvsa-mot-01-mot-test-results-by-class-of-vehicle__1_.csv/preview Free
Objectives:	Provides a statistical summary of the MOT pass and fail rates for lorries, buses and trailers along with those for vehicle classes 1 to 7.
Methodology:	Data obtained from annual MOT tests taken by these vehicles.
Key Findings:	• HGVs had a final MOT fail rate of 10.3% • Cars, vans and passenger vehicles had a MOT final fail rate of 27.9%.
Keywords:	HGV MOT pass rate
Comments:	This page covers the MOT pass/fail rates for 2015-2016

Title:	**T-Charge**
Published:	Transport for London (TfL) (2017)
Link: **Free/priced:**	https://tfl.gov.uk/modes/driving/emissions-surcharge (Accessed: 04/04/2017) Free
Objectives:	Outlines the proposal for a T-Charge.
Methodology:	Charge implemented in addition to the congestion charge to help increase air quality in London.
Key Findings:	• £10 T-charge to start in October 2017. • Operates during congestion charge hours. • HGVs are required to meet Euro IV engine standards.
Keywords:	T-Charge TfL
Comments:	

Title:	**Mayor plans to introduce Ultra Low Emission Zone in April 2019**
Published:	Mayor of London (2017)
Link: **Free/priced:**	https://www.london.gov.uk/press-releases/mayoral/mayor-plans-to-introduce-ulez-in-april-2019 (Accessed: 04/04/2017) Free
Objectives:	Outlines the proposal for an Ultra-Low Emission Zone to expand it across Greater London for heavy diesel vehicles in 2020 and a ULEZ zone in central London from 2019.
Methodology:	
Key Findings:	• Diesel vehicles not meeting Euro 6 standards will have to pay a daily ULEZ fee. • Consultation to increase ULEZ zone to cover all of Greater London to be applied by 2020. • Operates all year around, ever day of the week.
Keywords:	ULEZ Mayor of London
Comments:	

Title:	**Conceptual design and development of movable rear underrun protection**
Published:	Gogte, S., and Vijendran, N. (PDF) (2014)
Link: **Free/priced:**	http://publications.lib.chalmers.se/records/fulltext/202882/202882.pdf Free
Objectives:	Developing a new design for a movable Rear Underrun Protection mechanism for the shortest overhang chassis segment that addresses the design constraints.
Methodology:	Initially undertake a study on dimensional constraints and define the boundaries for the new concept. Research and conceptual analysis deliverable then determined. After this, there is the creation of a concept design and virtual testing. Furthermore, there is a refinement of the deliverable and creation of a prototype. Lastly, a comprehensive report made which contains details of the steps taken and process.
Key Findings:	Solution created which was ready for further development. The Guide concept was better in terms of probable design failures.
Keywords:	Rear underrun protection, RUP design
Comments:	

Title:	**Load securing: vehicle operator guidance**
Published:	Driver & Vehicle Standards Agency (2017b)
Link: **Free/priced:**	https://www.gov.uk/government/publications/load-securing-vehicle-operator-guidance/load-securing-vehicle-operator-guidance (Accessed: 05/05/2017) Free
Objectives:	Providing a guide for vehicles to secure their load safely in accordance to the rules and regulations regarding this. It also aims to provide the repercussions of poor load securing along with general guidance for the different types of loads.
Methodology:	
Key Findings:	• 22,000 road impacts incidents caused by objects falling from vehicles which resulted in the closure of a single or dual lane carriage way. • Average of 20 minutes taken to deal with incidents.
Keywords:	Rear underrun protection, RUP design
Comments:	Other aspects discussed in the guide.

Title:	**Cycling Accident Statistics in the UK**
Published:	Cute Injury (2017)
Link: **Free/priced:**	http://www.cuteinjury.co.uk/2015/02/cycling-accident-statistics-uk/ (Accessed: 03/05/2017) Free
Objectives:	Collates and provides statistics into the number of cyclists injured or killed during 2013.
Methodology:	• Figures include only cyclist injuries/deaths which were road related. • Statistics broken down into percentage groups. • Other interesting findings noted.
Key Findings:	• 109 people killed while cycling. • Most commonly noted reason was the diver or cyclist not looking properly. • Nearly 100% of children's cycling accidents happen during the daytime
Keywords:	Cycling accident statistics
Comments:	

Title:	**HSEQ Bulletin Safety Advice Notice: 34**
Published:	HSEQ (2013)
Link: **Free/priced:**	Free
Objectives:	Provides a reminder on the code of practice for the safe loads on vehicles. It also outlines the penalties relevant to unsafe loads.
Methodology:	
Key Findings:	• 4,500 successful prosecutions for unsafe loads against drivers. • Person regarded to be driving dangerously if load can cause danger to any person. • Do not use less than four anchorage points when securing an item of plant or machine.
Keywords:	HSEQ Bulleting December 2013
Comments:	

Title:	**Pedal cyclist fatalities in London: analysis of police collision files (2007 - 2011)**
Published:	Talbot, R., et al. (2014) (PDF)
Link: **Free/priced:**	http://content.tfl.gov.uk/pedal-cyclist-fatalities-in-london.pdf Free
Objectives:	• To extract and analyse data from police files involving fatal and seriously injured cyclists occurring in London between 2007 and 2011. • To identify the main factors that caused or contributed to these crashes. • To consider and evaluate countermeasures that could have prevented or mitigated these crashes. • To recommend action that could be taken to assist in preventing such crashes occurring in the future.
Methodology:	• Detailed information collected at the source. Protocol for doing this established. • Exercises undertaken to establish what data is relevant. • Establishment of what data was already available by visiting the police department. • Simple database created to record quantitative data. • Small scale pilot undertaken to test the data collection protocols. • Regular communication between data collections to limit variation and ensure a consensus was reached. • Supplement this with data from STATS 19. • Case review undertaken to record relevant data under streamlined headings. • Countermeasures assigned to contributory factors. • Countermeasures then grouped under different categories.
Key Findings:	• Multiple suggestions for changes in infrastructure, cyclists cycling behaviour, recommendations in preventing fatal collisions with large vehicles and recommendations regarding user behaviour. • 52% of all fatal crashes between cyclist and HGV involved the HGV making a left turn across the path of a cyclist.
Keywords:	Pedal cyclist fatalities in London by Talbot

Title:	**Reducing Particulate Matter Emissions from Diesel Vehicles and Equipment**
Published:	Client Earth (2013)
Link: **Free/priced:**	https://www.healthyair.org.uk/documents/2013/10/black-carbon-retrofit-guidance.pdf Free
Objectives:	Provides a guide for fleet operators on retrofit diesel abatement for particulate matter. It also includes information on technical options, benefits and costs. It aims to be a starting point on particulate matter abatement rather than a holistic guide.
Methodology:	It reviews the laws applicable with emission standards. Furthermore, it reviews commercially available options for retrofit exhaust abatement.
Key Findings:	• Wall flow filters reduce PM emissions potentially by more than 95% in terms of mass and more than 99% in terms of numbers. • Partial flow filters potentially reduces PM emissions by greater 30 – 60%. • Diesel oxidation catalysts reduce PM emissions in terms of mass by less than 25%.
Keywords:	Client Earth. Reducing particulate matter emissions.
Comments:	

Title:	**Reducing wasted miles**
Published:	Efficient Consumer Response (ECR) (2015) (PDF)
Link: **Free/priced:**	http://www.igd.com/Research/Supply-chain/ECR-UK/Reducing-wasted-miles-free-report/ (Accessed: 05/05/2017) Free
Objectives:	The aim is to inspire thinking in the industry to reduce wasted miles in the supply chain.
Methodology:	It presents solutions in the form of a "five to drive" scheme. It includes input from the ECR UK Reducing Wasted Miles workshop. It also draws on published industry research along with a new industry survey which draws on interviews with industry experts, academics and ECR board members.
Key Findings:	• 14% of business identify reducing miles as their biggest cost saving opportunity. • 160 billion euros estimated in annual cost of road transport inefficiency in Europe. • Increase in congestion leads to an estimated at 18 to 34 seconds lost per vehicle mile by 2040.
Keywords:	ECR reducing wasted miles
Comments:	

Title:	**Moving goods by road**
Published:	Her Majesty's Revenue and Customs (HMRC) (2016)
Link: **Free/priced:**	https://www.gov.uk/guidance/moving-goods-by-road (accessed: 08/05/2017) Free
Objectives:	A guide on how to move goods including the type of vehicles used, key documents, insurance and licensing
Methodology:	Written by HMRC for the government website, it includes their recommendations on moving goods by road based on the laws applicable at the time of writing. The web page is subject to updates when situations change.
Key Findings:	
Keywords:	Moving goods by road, vehicle size limits
Comments:	

Title:	**Connected and Automated Vehicles: Development in the UK**
Published:	Stevens, A. (2015)
Link: **Free/priced:**	http://dpti.sa.gov.au/__data/assets/pdf_file/0005/246803/Alan_Stevens_Presentation.pdf _ Free
Objectives:	Review of autonomous development in the UK over the years along with issues faced and findings.
Methodology:	
Key Findings:	
Keywords:	Autonomous vehicles, automated vehicles IDCC
Comments:	

Title:	**Quiet equipment and vehicles: making the right choice**
Published:	Fleet Operator Recognition Scheme (FORS) (2017)
Link: **Free/priced:**	https://www.fors-online.org.uk/cms/wp-content/uploads/2017/05/Matrix-Final-03.05.17-FORS-1.pdf Free
Objectives:	Review and recommendation of quieter alternatives for lorries and technology commonly used in lorries.
Methodology:	
Key Findings:	
Keywords:	Out of hours delivery, FORS quiet equipment
Comments:	

Title:	**Guidance on temperature control legislation in the United Kingdom**
Published:	Food Standards Agency (2016)
Link: **Free/priced:**	https://www.food.gov.uk/sites/default/files/multimedia/pdfs/tempcontrolguiduk.pdf (PDF) Free
Objectives:	Provides a guide for temperature control requirements found in certain hygiene legislation.
Methodology:	Uses various legislation to create a quick practice guide on how temperature controlled foodstuffs should be transported in the UK.
Key Findings:	
Keywords:	Refrigerated vehicles, food safety vehicles
Comments:	

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