INTEGRATED SAFETY GUARDS AND SPRAY SUPPRESSION:
PARTIAL REGULATORY IMPACT ASSESSMENT

Version: Final

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Prepared for: Project Record: S0131/VE Integrated Safety Guards and Spray Suppression

Client: TTS7, Department for Transport (Alan Mendelson)

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1 Title of proposal
Possible changes in the Regulations which relate to the provision of heavy goods vehicle (HGV) safety guards and the control of spray including the impact of integrated guards, the removal of exemptions on certain vehicles and the consequences for accident reductions.

2 Purpose and intended effect

2.1 Objectives
To improve the safety record of HGVs in relation to particular classes of road traffic accident (RTA) and to improve their environmental performance in terms of fuel economy by the adoption of an integrated approach to the provision of safety guards and spray suppression equipment, including:

1. Reducing the number of HGVs that are exempt from fitting safety guards.
2. Encouraging the harmonisation and integration of the safety guard and spray suppression Regulations to promote holistic solutions that are capable of:
   a. Improving the protection for other road users in collision with an HGV, particularly pedal cyclists and pedestrians,
   b. Reducing the quantity of spray generated by HGVs by permitting the use of aerodynamic spray suppression systems in order to minimise the amount emitted and directing what is emitted into areas which have a minimal effect on the vision of other road users,
   c. Improving the fuel economy of the vehicle as a result of improved aerodynamics.

Measure 1 is intended to reduce the number of fatal and seriously injured car occupants caused by collision with the front and the rear of HGVs that are currently exempt from safety guard Regulations. It is also intended to reduce the number of fatally injured vulnerable road users caused by collision with the side of a passing HGV that is exempt from safety guard Regulations.

Measure 2(a) is designed specifically to reduce the number of fatal and seriously injured pedal cyclists and pedestrians caused by collision with the side of HGVs with the possibility of the additional benefit of preventing or mitigating car occupant casualties in accidents where they collide with the side of an HGV.

Measure 2(b) is aimed at reducing the detrimental effect that HGV spray has on the vision of other road users thereby reducing the occurrence of accidents in which HGV spray is a contributory factor. In addition, the spray suppression performance of HGVs might be improved by modifying the current Regulations to permit new and innovative methods of spray suppression.

Measure 2(c) is an expected consequence of the improvements in aerodynamics necessary to improve spray control.

It must be noted that the improvements to spray suppression, and hence the options for introducing integrated designs, is entirely dependant on developing a suitable test method to quantify spray from a vehicle. At the present time, methods for measuring spray require more development before they are suitable for routine type approval testing. This document, therefore, discusses the likely impact of the measures if a suitable test is developed.

2.2 Background
Before this project began, the provision of front, rear and side safety guards and spray suppression equipment had been considered separately, with separate UK and EC Directives separately covering each aspect. The main premise behind this work was that, if these four issues were considered as a
whole, it would be possible to make simple structural changes to an HGV that would benefit all four safety issues currently addressed by the Regulations as well as offering the potential to improve fuel economy. In addition to this, it was considered that there may be individual changes that could be made to the Regulations that would benefit safety, such as reviewing the justification for current exemptions to the Regulations and identifying any inconsistencies or weaknesses within the Regulations.

Spray is generated when the splash water thrown up by vehicle tyres is shattered into small droplets through interaction with the turbulent airflow or by impacts with following tyres or other parts of the vehicle structure. Water remaining on the tyre surface in a capillary film creates additional spray as it is stripped off near the top of the tyre by the incoming airflow. In the absence of control devices, spray builds up in the regions surrounding the wheels prior to being ejected outwards and forms a billowing plume alongside and behind the vehicle in the turbulent wake. It remains airborne as an opaque cloud for a considerable period of time after the vehicle has passed. This cloud is continuously replenished by the passage of other vehicles for as long as the same wet conditions remain.

Spray from HGVs is of particular concern because of the increased number of wheels throwing up water. With these vehicles, the under body structure promotes turbulent airflow patterns and spray is ejected outwards from the side of the vehicle at a height similar to that of the windscreens of other vehicles. The densest regions of spray are found alongside and immediately behind the vehicle, where visibility is severely reduced by the spray cloud itself and by droplets hitting the windshield of following or overtaking vehicles. Increasing the separation between vehicles reduces the degradation in visibility caused by droplets hitting the windshield. However, drivers still experience difficulty in seeing past the vehicle due to the general fog or opaqueness of airborne spray. This reduction in visibility makes the driving environment more hazardous and increases the likelihood of an accident occurring.

Both the UK and EC Directives requiring the provision of spray suppression equipment are entirely design prescriptive, specifying that mudguards, equipped with one of two types of material, are placed around each wheel within certain dimensions. This restricts innovation and prevents other spray suppression solutions, such as the use of aerodynamics, from being approved as a spray suppression system. The main reason for this approach is that spray has always been very difficult to measure, meaning that it is very difficult to reliably and fairly demonstrate whether a system meets the required performance standard. The creation of a reliable and repeatable method of measuring spray from a whole vehicle is, therefore, an essential pre-requisite for the modification of the spray Regulations to allow the use of aerodynamic spray suppression equipment.

Safety guards fitted to the front and rear of HGVs are intended to improve crash compatibility between cars and trucks. Although the intention of the two Regulations is the same, their requirements are quite different. The fact that the rear underrun Regulation was introduced in the UK in 1983 and the front Regulation was introduced in 2003 goes some way to explaining the differences, though some are a function of structural differences between the front and rear of trucks. Improvements to both Regulations are possible but no proposals have been made here because such improvements are being considered in detail by an EC research project, entitled VC-COMPAT, which has yet to reach its conclusions.

Safety guards at the side of HGVs are principally designed to protect pedal cyclists and pedestrians that fall against the side of a passing HGV, by preventing them from being run over by the rear wheels. The current minimum requirement for sideguards consists of a rail design that leaves substantial gaps in the structure at the side of an HGV. Although these are generally effective at preventing vulnerable road users from being run over, they can still cause severe or fatal injuries when struck on corners or if the vulnerable road user becomes entangled with the leading edge of the guard. Also, there are still gaps in the protection of sufficient size that the vulnerable road user could potentially still fall and be run over. There is currently no requirement for fitting side protection to the tractor units of articulated vehicles, behind the rear wheels of any vehicle, or ahead of the leading axle.
of a drawbar trailer where the axles are positioned at the centre of the vehicle. This leaves potential danger areas for vulnerable road users.

Trailer and vehicle designs have been patented that integrate the sidguards with the front and rear guards to provide a flat, smooth, continuous surface with which the vulnerable road user can interact. Some of these integrated designs have also shown that car occupants can be protected when colliding with the side of an HGV because the structure is stiff enough to prevent underrun, unlike the current rail designs.

Each of the four current Regulations considered permits a range of vehicles to be exempt from the requirements of the Regulation. The specific details of the exemptions differ for each specific regulation and there is a fundamental difference in the approach taken in UK (exemption by vehicle body type e.g. tipping body) and EC Directive (exemption based on a small number of generic use requirements such as “any vehicle where fitment is incompatible with use”). However structured, it is generally perceived that the exemptions are based mainly on a requirement to travel “off-road” or on the fact that the vehicle is fitted with equipment central to the vehicle purpose that would be obstructed by safety guards. There is, therefore, little reason for the differences in permitted exemptions between different Regulations.

It is shown later in this report that as many as 19.3% to 20.7% of the UK HGV fleet may be exempt from safety guards Regulations and that reducing the number of vehicles that are exempt from fitting safety guards can produce casualty savings. There is also evidence to suggest that many exemptions currently in place may not be justified. However, research suggests that there would be little benefit to ending exemptions from spray suppression Regulations while only current spray suppression products are available.

2.3 Rationale for government intervention

When the casualty reduction targets for 2010 were set, there was no specific target for fatalities because there were no clear differences in trends for fatal and serious injuries. The number of deaths changed in the mid 1990s and started to decline at a slower rate and increased in 2001 and 2003. If this trend in deaths was to continue, without intervention, by 2010, the reduction would only be 11% below the 2000 baseline. To achieve a 40% reduction in fatalities (which was the target for KSI), the new measures, focused on car occupants and motorcyclists, would need to reduce the overall number of deaths by one third (Broughton and Buckle, 2005).
3 Consultation

3.1 Firms consulted
Informal consultation has been carried out with:

- Vehicle manufacturers
- Haulage companies
- Manufacturers and suppliers of spray suppression equipment
- Independent designers/inventors
- Vehicle regulation enforcement agencies

3.2 Replies received
Four replies have been received; Appendix A contains copies of them. All four are from designers or manufacturers of spray suppression equipment.

3.3 Comment on the responses
Response 1 describes the design concept behind a particular product. The description indicates that, if the current Regulations were modified to allow new and innovative methods of spray suppression, the spray problem from HGVs might be reduced.

Response 2 provides a comment on the spray suppression industry in an international context.

Response 4 gives figures for the likely additional cost and weight if the regulation to fit a rail-type safety guard were replaced by a regulation to fit smooth panelling all way round the lower part of a vehicle. This respondent doubts whether the fuel savings achieved from the use of smooth panelled guards would outweigh the additional repair and damage costs.

In summary, it should be borne in mind, as noted in subsection 3.2, that these comments all come from a single sector of the industry which would be affected by any changes to the Regulations.
4 Options

The options that have been assessed in this report have been, with one exception, taken from two related RIA reports.

Appendix C consists of two Tables containing these options. Table C.1 consists of 11 options relating to Integrated Safety Guards (ISGs) while Table C.2 lists 6 Spray Suppression (SS) options. Six options (A to F) have been derived from these Tables; these are listed below.

**Option A** – Do nothing. This is ISG option 1 in Table C.1. The impending introduction of whole vehicle type approval for HGVs will mean that the EC Directives will form the basis of UK construction and use Regulations and, therefore, the only applicable requirements and exemptions will be those that are part of the relevant EC Directives.

**Option B** – Close regulation ‘loopholes’ (ISG option 1A in Table C.1). Its purpose is to ensure all vehicles within the scope of the Regulations are fitted with safety guards conforming to the original spirit of the requirements. One example of where this is not currently the case relates to centre-axle drawbar trailers where there is no sideguard ahead of the axles because the wording of the Regulation requires sideguards between the axles of a vehicle or between the rear axles and the king pin in the case of a semi-trailer. Option B is the ‘exception’ mentioned above; it has not been taken from either of the initial RIA reports which are the sources for the other options.

**Option C** – This combines ISG Options 2 and 9 from Table C.1. It is likely to be the most effective option in terms of benefits. It should be noted that option 2, by itself, has not been taken forward for detailed consideration as it is thought likely to cause too many practical problems and opposition within the industry.

**Option D** – This combines ISG Options 3, 7 and 9 from Table C.1. It is thought likely to provide the most practical solution.

**Option E** – An option for allowing aerodynamic spray suppression as a stand alone change with a minimum performance standard equivalent to the current requirement (this is SS Option 2 from Table C.2).

**Option F** – An option for allowing aerodynamic spray suppression as a stand alone change with a minimum performance standard that is more demanding than the current standard (this is SS Option 3 from Table C.2).

These options are assessed in turn in sections 6 to 11.
5 Costs and benefits

5.1 Items to be valued

For each option listed in section 4, the costs and benefits are set out in the subsequent sections of this report (sections 6 to 11). In the remainder of this section, the nature of these impacts is discussed together with a description of the methods used for estimating their values.

The changes resulting from the adoption of any of the options, or a combination of options, will be a mixture of additional costs and benefits. These will include the following:

1. Increased costs to HGV manufacturers in providing the safety guards as part of revised standard vehicle specifications.

2. Increased costs to HGV operators and their clients who find that they are no longer able to carry out the planned task with their vehicle (because the safety guards make the operation impossible).

3. Increased costs to HGV operators from the increased vehicle weights and, in some cases, reduced payloads.

4. Casualty cost savings from reductions in the severity of some accidents between HGVs and other vehicles, especially pedal cycles and cars.

5. Casualty cost savings from reductions in the severity of some accidents between HGVs and pedestrians.

6. Casualty cost savings from reductions in the number of accidents in which spray was a causal or contributory factor.

7. Fuel cost savings due to improvements in aerodynamic efficiency.

Increased costs to HGV manufacturers and operators

The additional costs experienced by manufacturers and operators are reasonably straightforward to describe. It is considerably more difficult to put numerical values on them.

The DfT financial values for the prevention of road accidents include the following elements of cost:

- Loss of output due to injury - this is calculated as the present value of the expected loss of earnings plus any non-wage payments (national insurance contributions, etc.) paid by the employer.

- Ambulance costs and the costs of hospital treatment.

- Human costs - based on the ‘willingness to pay’ values, which represent pain, grief, and suffering to the casualty, relatives and friends, and, for fatal casualties, the intrinsic loss of enjoyment of life over and above the consumption of goods and services.

- Costs of damage to vehicles and property.

- Costs of police response and the administrative costs of accident insurance.
5.2 Valuations

The valuations of casualty injuries used in this report, which are listed in Table 1, are taken from Department for Transport (2004a).

<table>
<thead>
<tr>
<th>Casualty Severity</th>
<th>Valuation (million GBP)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fatal</td>
<td>1.312260</td>
</tr>
<tr>
<td>Serious</td>
<td>0.147460</td>
</tr>
<tr>
<td>Slight</td>
<td>0.011370</td>
</tr>
</tbody>
</table>

Table 1. Casualty valuations
6 Option A – do nothing

As the relevant EC Directives for whole vehicle type approval for HGV safety guards have not yet been introduced, there would be no immediate changes in costs or benefits with this option.

When they are introduced, it should be borne in mind that the exemptions granted by them are open to interpretation. The specific wording varies with each Regulation but the intention is, generally, to give exemption if the business of an operator would be hindered by the Regulations. For example, the actual phrasing used in clause 1.1 of the sideguard Regulations (Council Directive 89/297/EEC) is:

“Every vehicle of categories N2, N3, O3 and O4 shall be so constructed and/or equipped as to offer, when a complete entity, effective protection to unprotected road users (pedestrians, cyclists, motorcyclists) against the risk of falling under the sides of the vehicle and being caught under the wheels."

The Directive does not apply to:
- tractors for semi-trailers,
- trailers specially designed and constructed for the carriage of very long loads of indivisible length, such as timber, steel bars, etc.,
- vehicles designed and constructed for special purposes where it is not possible, for practical reasons, to fit such lateral protection."

The final exclusion is the key one in the present context.

As the date for the introduction of whole vehicle type approval approaches, there may be much discussion about their precise interpretation, particularly if a manufacturer has previously been approving vehicles to the UK Regulations and gaining an exemption under specific construction based criteria (e.g. tipping vehicles). One possibility is that lobbying of the DfT by industry would take place, with the objective of obtaining an understanding/interpretation which is reasonably favourable to UK industry. A particular concern would be that the UK interpretation matches that of other EC countries so that UK manufacturers, hauliers and other operators are not put in a disadvantaged position in relation to their European counterparts (see, for example, the anecdotal evidence reported in Section 3 about the need for ‘foreign’ vehicles visiting and/or operating in the UK to be subject to EC Directives).

It could be that the eventual outcome would be similar to that provided by Option 3 in Table C.1 (i.e. a Code of Practice). In the event, a COP might be introduced to help decide cases in which exemption from the fitting of safety guards is justified (and not simply expedient purely for business advantage).

There would be at least one definite change, however, arising from the reduced strength requirements for EC sideguards (1kN instead of 2kN). Previous research has suggested that this is unlikely to have much effect in practice because sideguards were typically constructed to substantially exceed these requirements regardless of which regulation they were approved under. The reason for this was considered likely to be the avoidance of frequent minor damage when using fork lift trucks to load and unload the vehicle.

Previous research has also noted that the interpretation of the EC Directives “may lead to many vehicles obtaining exemptions when they may not necessarily be required, potentially increasing the risk to vulnerable road users”.

The specific requirements of the UK regulation and the EC Directive on spray suppression are slightly different with the EC specifying a slightly more demanding performance and allowing an additional air/water separator device to be approved. However, these differences are not expected to have any significant effects on industry when whole vehicle type approval is introduced.

The net effect of all these issues is uncertain at present but it is considered unlikely to have a large effect in terms of costs or benefits because the changes are relatively small and many vehicles in use in the UK will already be approved to EC Directives rather than UK Regulations.
7 Option B – close Regulation loopholes

The following regulation loopholes have been identified:

1. Combinations consisting of a rigid HGV towing a centre-axle drawbar trailer.
2. Incompatibility between tractor units and semi-trailers on articulated vehicles

These loopholes and the consequences of their removal are discussed in the remainder of this section.

7.1 Drawbar trailer combinations

A potential weakness in the current sideguard Regulations has been identified with respect to rigid vehicles towing drawbar trailers where all the trailer axles are positioned at the centre of the trailer. The wording of the Regulations allows a large gap to be present without sideguards between the rear axle of the tow vehicle and the first axle of the trailer. This gap, which is illustrated in figure 1 below, is easily wide enough for a cyclist to fall into it.

![Figure 1: Centre axle trailer illustrating wide gap](image)

The intention of the sideguard Regulations has always been to provide a structure that prevented vulnerable road users falling against the side of an HGV and being run over by the rear wheels. The vehicle shown in figure 1 appears to correctly comply with all the requirements of the sideguard Regulations and it is evident that it should not be exempt from them because the tow vehicle is equipped with them. However, it is also evident that the sideguards have only eliminated part of the risk in this case.

At the time that the Regulation was introduced (1983), centre axle trailers towed by rigid vehicles were very rare in the UK so it is perhaps not surprising that the wording of the Regulation did not consider such a situation. However, now that they have become slightly more common (particularly in continental Europe), it would be logical to amend the Regulation to require a sideguard ahead of the first trailer axle on such centre axle trailers in order that these vehicles meet the original spirit of the regulation. Furthermore, where a rigid vehicle is designed and constructed to be capable of towing a centre axle trailer, a sideguard should be required behind its rear wheels.

The STATS19 database has been searched for the number of injury accidents which involved a collision on the side (nearside or offside) between another vehicle or pedestrian and an HGV towing a drawbar trailer (defined by field 2.6 = 4) during 1993 and 2003. Table 2 shows the results:
Table 2. Numbers of injury accidents split by year and accident severity

<table>
<thead>
<tr>
<th>Vehicle type(1)</th>
<th>Numbers of injury accidents</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>1993</td>
</tr>
<tr>
<td></td>
<td>Fatal</td>
</tr>
<tr>
<td>Pedestrians</td>
<td>1</td>
</tr>
<tr>
<td>Pedal cycles</td>
<td>0</td>
</tr>
<tr>
<td>All other vehicles</td>
<td>4</td>
</tr>
<tr>
<td>Totals</td>
<td>5</td>
</tr>
</tbody>
</table>

Note: Vehicle type includes pedestrians

This Table indicates that the numbers of accidents of this type has more doubled in the 10 year period 1993 to 2003 confirming the impression that drawbar trailers have become either more common or more likely to be involved in injury accidents. Since it does not seem likely that the accident rate (numbers of accidents per vehicle-km travelled) would have increased significantly over this 10 year period, it is concluded that a significantly greater number of these types of vehicle are being used on UK roads.

By contrast, the subset of these accidents which involve pedestrians or pedal cycles has not increased over the same period but there were more fatal accidents.

If we assume that the fatal and serious injury accidents involving pedestrians and pedal cyclists were mitigated to slight injury accidents by the fitting of sideguards between the rear axle of the tow vehicle and the first axle of the trailer, the savings in accident costs, at 2003 prices, would amount to about £1.4m in 1993 and about £3.9m in 2003.

7.2 Incompatibility of articulated vehicles

Research supporting the original sideguard regulation (Riley et al, 1985) showed that the ground clearance of a sideguard was an important factor influencing its effectiveness. It showed that in general lower ground clearances improved performance with cyclists being run-over in tests six out of ten times when the ground clearance was 550mm reducing to none as the ground clearance was lowered to 300mm. Both the UK and EC sideguard Regulations are intended to ensure that the ground clearance is never more than 550mm. However, the Regulations are worded such that when a semi-trailer is approved the ground clearance is measured when the vehicle is positioned on flat level ground and the load bed of the trailer is also flat and level.

The heights of the fifth wheel/king pin coupling of articulated vehicles are standardised in an ISO standard but the standard permits a significant tolerance that can mean that when some vehicles and trailers are coupled together, the load bed of the trailer slopes significantly downward toward the rear of the vehicle. This can mean that if the ground clearance of the sideguard is 550mm when the load bed is level that it is significantly higher in service. This is perceived to be more likely to be a problem in the UK where tractor unit 5th wheels are perceived to be positioned at the higher end of the scale to allow more room for the spray suppression equipment. Previous research indicated that 15% of articulated vehicles were found in-service to have sideguards exceeding the maximum 550mm permitted by regulation, although it was not known whether this was as a result of compatibility problems with the coupling height or simple non-compliance in the design.

The existence of vehicle combinations with sideguard ground clearances in excess of 550mm does present an increased risk to vulnerable road users. In addition to this it also creates problems for periodic inspection and roadside enforcement agencies. The enforcement authorities have found
incidences where a vehicle has failed its annual inspection because of non-conformance with the sideguard Regulations but the vehicles are only one year old and have not been modified by the owner who purchased the vehicle in good faith from a reputable manufacturer.

Consultation with industry during this project suggested that several manufacturers did not recognise this as a significant problem but that most would not object to re-wording the regulation such that the ground clearance must be no more than 550mm when the king-pin was at the upper height permitted by the ISO standard for the 5th wheel or even to be no more than 550mm in all legal travelling conditions. The front underrun Directive is already worded in a similar way such that in practice most guards are substantially lower than the maximum in order to ensure that they always meet the requirements on all vehicle variants and in all conditions.

Both the costs and benefits of this change are likely to be low because only a relatively small number of vehicles would be affected and the technical change is also relatively small. However, it has not been possible to quantify this further.
8 Option C – end all exemptions and combine/update EC Directives

Option C combines the following two options:

- **Option 2**: End all exemptions.
- **Option 9**: Combine and update Regulations 2000/40/EC, 89/297/EC and 70/221/EC to require integrated designs that offer improved protection all around the vehicle.

8.1 Option 2 (end all safety guard exemptions)

Ending all safety guards exemptions would mean that all vehicles would have to be fitted with underrun protection on the front, rear and sides.

The sideguards are designed to protect pedestrians and cyclists from falling under the trailer wheels, rather than prevent underrun of other vehicles, although they do provide some protection against this particularly when the angle of impact is acute.

For those vehicles not currently equipped, there would be an increase in the cost of constructing a new vehicle. Assuming the same limits on maximum permitted weight are maintained there would be a reduction in the usable payload and, therefore, the productivity of the vehicle would be reduced, increasing costs to the haulage industry. For some specialist operations, it may no longer be possible to carry out the work with a road going vehicle. Some operations may have to cease and others may require purchase of specialist plant equipment that is not subject to the underrun Regulations. An additional phase of the operation to transfer load from plant to goods vehicle for the road transport may be required in some cases.

8.1.1 Pedal cyclists and pedestrians

Previous research provides a range of estimates of changes in accident costs for pedal cyclists and pedestrians. The range of values has resulted from different estimates of the proportion of exempt vehicles (lower, mid and upper, as defined in the report) which would be affected by the removal of the exemptions. These savings, which relate to the year 2000, are presented in Table 3.

<table>
<thead>
<tr>
<th>Affected group</th>
<th>Cost Change (million GBP)</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Pedal cyclists</td>
<td>-2.1 to -2.5</td>
<td></td>
</tr>
<tr>
<td>Pedestrians</td>
<td>-0.4 to -1.1</td>
<td></td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>-2.5 to -3.6</strong></td>
<td></td>
</tr>
</tbody>
</table>

*Note 1: Negative signs indicate cost savings*

8.1.2 Cars

Two methods of estimating the changes in accident costs have been used. These are described in turn.

**Method 1**

Department for Transport (2004b) (Table 23) provides numbers of RTAs and casualties for all RTAs between HGVs and cars. The totals are 6048 RTAs involving 7098 casualties (161 fatal, 639 serious, 6298 slight).
In order to estimate the likely effect of the ending of exemptions on HGV/car impacts, this accident data needs to be split by the following two factors:

1. the percentages of exempt vehicles in each casualty severity class,
2. the level of mitigation that would result if the exempt vehicles were provided with safety guards.

The values of these factors are not known at present but provisional values have been derived, as described in Appendix D, and used in the calculation of cost changes. Table 4 contains a range of accident cost changes derived from this analysis.

Table 4. Changes in accident costs - car drivers

<table>
<thead>
<tr>
<th>Affected group</th>
<th>Cost Change (million GBP)(^1)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Car Drivers</td>
<td>-11.9 to -14.6</td>
</tr>
</tbody>
</table>

Note 1: Negative signs indicate cost savings

Possible savings arising from the mitigation of slight injury accidents to damage only accidents has not been included in Table 4. However, if a 10% mitigation did result from the implementation of Option 2, a further £1.0m to £1.2m would be saved (on the assumption that the cost of a damage-only accident is 10% of a slight injury accident).

**Method 2**

Knight (2000) analysed a large sample of fatal accidents involving trucks and showed that 7% of all car occupants killed in a collision with an HGV collided with the rear of the HGV. It was also estimated that 8% of all the car occupant fatalities arising from such accidents could be prevented by ending all exemptions to rear underrun Regulations. In 2001, 180 car occupants were killed in two-vehicle collisions with an HGV. Applying the estimates to the 2001 figures suggests that approximately one fatality per year could be prevented by ending exemptions to the rear underrun Regulations with an associated prevention value of approximately £1.365 million.

Front underrun Regulations were only introduced in 2003 and, as yet, there is insufficient accident data involving vehicles equipped with the protection to make reliable evaluations of their effectiveness or predictions of the benefits if no exemptions existed. However, as a tentative initial estimate it can be assumed that the relative benefit of ending exemptions is the same as that for the rear (8%). Knight (2000) showed that in the UK approximately 50% of all car occupants killed in collision with an HGV are involved in a head on collision. Using the assumption of an 8% improvement combined with the 2001 data suggests that approximately 7 fatalities per year could be prevented by ending exemptions to front underrun protection, translating to a financial value of prevention of approximately £9.557 million per year.

In total, the work has suggested that ending all exemptions to all safety guard regulation could potentially prevent up to a likely maximum of 11 fatalities per year with a prevention value of up to approximately £14.4 million.

The upper estimates obtained by using these different methods are very close.

**8.1.3 Other road users**

It is likely that ending exemptions to safety guards Regulations could also have positive benefits for other road users. For example, additional protection could potentially be offered to the occupants of light vans that collide with the front or rear of an HGV. In addition to this, it is known that some motorcyclists are killed when they collide with the side of an HGV and get run over by the rear
wheels, usually after losing control on left hand bends. It is possible that the provision of sideguards could help to prevent run over by the rear wheels and thus offer benefits. However, for both of these cases there has been little or no research to demonstrate the physical characteristics and effectiveness of safety guards in these crash configurations. For this reason, it has not been possible to quantify these potential benefits.

8.1.4 Spray and fuel consumption effects

The provision of the safety guards on exempt vehicles is likely to have no impact upon spray generation and fuel consumption.

8.1.5 Additional costs for HGV manufacturers and operators

Construction costs of vehicles not normally equipped with safety guards (i.e. tippers, refuse disposal vehicles and skip loaders) would increase under Option 2. It has been estimated from 2003 data (see Appendix D) that about 73,000 HGVs out of the total population of 433,500 are currently exempt from the need to fit safety guards. If the average additional cost of safety guards lies in the range £500 to £1,000 per vehicle, the total additional capital cost would lie between £36.5m and £73.0m. If, in addition, we assume that these vehicles last 10 years on average, then the additional annual cost for new vehicles can be simply estimated to lie in the range £3.6m to £7.3m.

For some specialist operations, it may no longer be possible to carry out the work with a road-going vehicle. In fact, some operations may have to cease altogether and others may require purchase of specialist plant equipment that is not subject to the underrun Regulations. An additional phase of the operation to transfer load from plant to goods vehicle for the road transport may be added. This situation would be strongly opposed by industry.

It is not currently possible to estimate the costs of these operational changes with any accuracy. However, for illustrative purposes, let us assume that between 2% and 4% of the operations of the exempt vehicles could no longer be carried out because of the addition of safety guards. Special equipment would need to be purchased to carry out the operations of these 1,460 to 2,920 vehicles. If the investment in this equipment represented an annual additional cost of £1,000 to £2,000 per vehicle, the total additional costs would lie in the range £1.5m to £5.8m. These figures are very speculative and may underestimate the real additional costs considerably especially as they ignore any other additional costs associated with the new operations, including wages.

Assuming the same limits on maximum permitted weight are maintained, there would be a reduction in the usable payload and, therefore, the productivity of the vehicle would be reduced, increasing costs to the haulage industry. This effect has not been valued here.

8.1.6 Summary

The total estimated cost changes for Option 2 are given below in Table 5.
Table 5. Option 2 - valuation and cost changes

<table>
<thead>
<tr>
<th>Subsection</th>
<th>Item</th>
<th>Valuation of change (million GBP)</th>
</tr>
</thead>
<tbody>
<tr>
<td>8.1.1</td>
<td>Cyclists and pedestrians</td>
<td>-2.5 to -3.6</td>
</tr>
<tr>
<td>8.1.2</td>
<td>Cars</td>
<td>-11.9 to -14.6</td>
</tr>
<tr>
<td>8.1.3</td>
<td>Other road users</td>
<td>Unknown (small –ve?)</td>
</tr>
<tr>
<td>8.1.4</td>
<td>Spray</td>
<td>Nil</td>
</tr>
<tr>
<td>8.1.4</td>
<td>Fuel savings</td>
<td>Nil</td>
</tr>
<tr>
<td></td>
<td>Total savings(1)</td>
<td>-14.4 to -18.2</td>
</tr>
<tr>
<td>8.1.5</td>
<td>Manufacturers and operators</td>
<td>+5.1 to +13.1</td>
</tr>
<tr>
<td></td>
<td>Net change(1)</td>
<td>-1.3 to -13.1</td>
</tr>
</tbody>
</table>

Note1: Excluding change for ‘Other Road Users’

These figures can only be indicative of the final outcome but imply that ISG Option 2, by itself, is likely to lead to net cost savings.

8.1.7 Comment
The review of the vehicles that were exempt suggested that there was potentially significant scope for reducing the number of vehicles that gained exemptions but that some were essential to the operation of the vehicle and would be required for the foreseeable future. It is therefore unlikely that this option could be implemented in its entirety so, in practice, any action taken on exemptions would, therefore, only achieve a proportion of the benefits predicted above, depending on the number and use of the vehicles for which exemptions were ended.

8.2 Option 9 (integrated designs that offer improved protection)
This option would require all vehicles subject to underrun protection Regulations to fit more comprehensive protection all around the vehicle.
This would improve the protection offered to other road users in collision with an HGV. It may also improve safety through allowing improved spray suppression and may also improve fuel economy through better aerodynamics.
The benefits from the reduced impact in frontal collisions cannot be quantified at this time because the number of vehicles equipped with current front underrun devices is still low. However, this measure could prevent the deaths of up to 5% of pedal cyclists and 3% of pedestrians in collision with the side of an HGV.
This option could also be expected to increase the cost of constructing the vehicle, increase the unladen weight, decrease the payload and decrease productivity. The costs associated with the loss of productivity could be minimised by the use of modern alternative materials such as Carbon Fibre Reinforced Plastics (CFRP). However, this would further increase the construction cost. In addition, some operations could benefit from improved fuel economy because of improved aerodynamics such that the money saved on fuel might outweigh the additional purchase cost and the loss of payload.

8.2.1 Pedal cyclists and pedestrians
Previous unpublished research provides a range of estimates of changes in accident costs for pedal cyclists and pedestrians as a result of fitting smooth sideguards which have been generated by
different estimating methods, as described in the report. These savings, which relate to the year 2000, are presented in the following table (Table 6).

Table 6. Option 9 - changes in accident costs - pedal cyclists and pedestrians

<table>
<thead>
<tr>
<th>Affected group</th>
<th>Cost Change (£m)$1</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pedal cyclists</td>
<td>-0.6 to -2.1</td>
</tr>
<tr>
<td>Pedestrians</td>
<td>0 to -3.5</td>
</tr>
<tr>
<td>Total</td>
<td>-0.6 to -5.6</td>
</tr>
</tbody>
</table>

Note 1: Negative signs indicate cost savings

8.2.2 Cars

It has been assumed in this proposal that the standard of front and rear protection would remain the same, at least until the conclusions of the VC-COMPAT project are known, so no change is expected in the severity of injuries sustained by car occupants that collide with the front or rear of an HGV. It is possible that some designs of integrated safety guard may prove sufficiently stiff to prevent underrun when a car collides with the side of an HGV. Although a relatively infrequent accident type, this would result in some casualty reduction benefits. However, there has been little research to evaluate this possibility objectively and the proposals do not recommend a minimum standard of performance that would be sufficient to guarantee these benefits so they cannot be quantified further at this stage.

8.2.3 Other road users

It is possible that introducing integrated safety guards could also have positive benefits for other road users. It has been assumed in this proposal that the standard of front and rear protection would remain the same, at least until the conclusions of the VC-COMPAT project are known, so it is unlikely that any other vehicle occupants would be protected in crashes with the front or rear. However, the provision of flat smooth sideguards as part of the package may bring additional benefits to motorcyclists that collide with the side. However, again there has been little or no research to demonstrate the physical characteristics and effectiveness of safety guards in these crash configurations. For this reason, it has not been possible to quantify these potential benefits at this time.

8.2.4 Spray effects and their mitigation

The generation of spray and its impacts on vehicles and traffic has been described in Section 2.2. Spray from HGVs travelling at high speeds on wet roads has been shown to be a serious problem for other motorists (see, for example, Baughan et al, 1982). Other research has shown that cars travelling on motorways are subjected to dense spray from HGVs for less than one percent of their motorway driving time. The equivalent time spent in the less dense HGV spray plumes was less than two percent. The author hypothesised that the contrast between the low proportions of driving time and the widespread reporting of HGV spray as a problem to car drivers might indicate that the nuisance, when it does occur, is very severe.

Past research into spray was reviewed in 1990. This work, which relates mainly to studies carried out in the late 1960s and early 1970s, indicates that accidents due to splash/spray were, at that time, rare or at least rarely identified. The review indicated that the percentage of accidents with a “splash or spray contribution” was between 0.4% and 2.7% on UK roads but lower (0.012% to 0.36%) in the US.
For the analysis in this report, the US results have been omitted since the definition of “splash or spray contribution” in the USA may be different. In addition, the frequency of occurrence of rainfall and/or water on the road may be significantly different in the USA or, at least, in the states (Michigan and Connecticut) to which the US results quoted above refer.

The provision of integrated protection all round the vehicle would have a significant impact upon spray generation.

It may be shown, using data from Department for Transport (2001), that the total number of recorded UK accidents in 2001 was 229,014 and that the average value of prevention of accidents was 54,710 GBP. This suggests that if ALL accidents where spray was a contributory factor could be prevented there would be a total financial benefit of between approximately 50.117 million GBP and 338.293 million GBP.

However, it is proposed that this option would only be required for vehicles that are not exempt from current safety guard requirements. It has already been shown that between 19.3% and 20.7% of all UK vehicles are currently exempt, so it can be reasonably assumed that the predictions for spray benefits can be factored by the number of vehicles to which it would be applied (79.3% to 80.7%). The range of potential benefits from improved spray suppression is, therefore, reduced to between 39.7 million GBP and 273.0 million GBP. These predictions assume that the changes completely eliminate spray accidents 100%.

A further factor needs to be taken into account: some spray is generated by passenger cars and by other vehicles that would not be included in the scope of the improvements. It is, therefore, likely that the introduction of such spray suppression systems as standard would prevent only a proportion of those accidents influenced by spray. Table 7 shows the range of benefits for different assumptions of effectiveness of the spray control measures.

<table>
<thead>
<tr>
<th>Spray suppression effectiveness</th>
<th>Minimum saving (million GBP)</th>
<th>Maximum saving (million GBP)</th>
</tr>
</thead>
<tbody>
<tr>
<td>100%</td>
<td>39.7</td>
<td>273.0</td>
</tr>
<tr>
<td>75%</td>
<td>29.8</td>
<td>204.8</td>
</tr>
<tr>
<td>50%</td>
<td>19.9</td>
<td>136.5</td>
</tr>
<tr>
<td>25%</td>
<td>9.9</td>
<td>68.3</td>
</tr>
</tbody>
</table>

8.2.5 Effects on fuel consumption

The provision of integrated protection all round the vehicle would have a significant impact upon fuel consumption.

Comparative trials were carried out using a Krone SafeLiner trailer that had adopted the integrated approach of flat panels all around the sides of the vehicle and on the underside. These trials showed that there were significant benefits for both spray and fuel economy. Based on the results of these trials, and on the knowledge that only vehicles travelling long distances at high speeds would achieve the predicted benefits, it is estimated that, if all high speed articulated vehicle travel was completed in vehicles adopting a similar integrated design as the Krone SafeLiner, 19 million gallons (87 million litres) of fuel could be saved, reducing the fuel bills of the haulage industry by approximately £77 million. Associated societal benefits would also be accrued from reduced noxious emissions.

An additional factor which needs to be taken into account is that the SafeLiner semi-trailer was 910kg heavier than the tested standard York semi-trailer. Therefore, the payload the SafeLiner semi-trailer is able to transport will be less than the York semi-trailer is able to transport in circumstances where the payload is restricted by the maximum gross vehicle weight. Such operations would require...
additional journeys to transport the same load, consuming additional fuel should the SafeLiner semi-trailer be used. However, there is extra storage space within the chassis structure of the SafeLiner semi-trailer, potentially offering increased capacity in cases where the load transported is limited by volume. However, it should be noted that the Krone SafeLiner is just one example of how integrated safety guards and spray suppression systems may be implemented. The review of alternative materials also showed that it may well be possible to mitigate the increases in weight associated with an integrated guard design such that the cost impact of the reduced payload is minimised or even eliminated.

8.2.6 Additional costs for HGV manufacturers and operators

This option can be expected to increase the cost of constructing the vehicle, increase the unladen weight, decrease the payload and decrease productivity. The cost associated with the loss of productivity could be minimised by the use of modern alternative materials such as Carbon Fibre Reinforced Plastics (CFRP) however, this would further increase the construction cost. However, some operations could benefit from improved fuel economy because of improved aerodynamics such that the money saved on fuel might outweigh the additional purchase cost and the loss of payload.

Krone has estimated that the SafeLiner trailer design costs between 1,500 to 2,500 euros (1,000 to 1,700 GBP) more to produce than a traditional trailer design. This is considered to be an upper limit on costs because this particular trailer is the result of a completely different design and manufacture concept, rather than a modification to an existing design, which might be considerably cheaper. The number of registered articulated tractor units in 2003 was 116,700 (Department for Transport, 2004c). If it is assumed that each trailer has a usable life of 30 years and that there are between 1.3 and 1.5 trailers for each registered tractor unit, the trailer stock numbers in 2003 was in the range 151,710 to 175,050 units. It follows that the additional cost of between 5,057 and 5,835 new trailers each year would be approximately £5.1m to £9.9m. The productivity of the trailers would be affected by these design changes but this factor has not been costed.

8.2.7 Summary

Table 8 shows that the itemised changes resulting from implementing an integrated safety guard and spray suppression regulation for all vehicles currently subject to the individual Regulations. Benefits in the range 116 million GBP to 360 million GBP per year could result made up of societal benefits through reduced accidents and direct financial savings for the haulage industry through reduced fuel costs.

<table>
<thead>
<tr>
<th>Subsection</th>
<th>Item</th>
<th>Valuation of change (million GBP)</th>
</tr>
</thead>
<tbody>
<tr>
<td>8.2.1</td>
<td>Cyclists and pedestrians</td>
<td>-0.6 to -5.6</td>
</tr>
<tr>
<td>8.2.2</td>
<td>Cars</td>
<td>Nil (or small –ve)</td>
</tr>
<tr>
<td>8.2.3</td>
<td>Other road users</td>
<td>Nil (or small –ve)</td>
</tr>
<tr>
<td>8.2.4</td>
<td>Spray</td>
<td>-39.7 to -273.0$^{(1)}$</td>
</tr>
<tr>
<td>8.2.5</td>
<td>Fuel savings</td>
<td>-77</td>
</tr>
<tr>
<td>-</td>
<td>Total savings</td>
<td>-117.3 to -355.6$^{(2)}$</td>
</tr>
<tr>
<td>8.2.6</td>
<td>Manufacturers and operators</td>
<td>+5.1 to +9.9$^{(3)}$</td>
</tr>
<tr>
<td>-</td>
<td>Net change</td>
<td>-107.4 to -350.5$^{(2)}$</td>
</tr>
</tbody>
</table>

Notes: (1) Maximum changes  
(2) Omitting Cars and Other Road Users  
(3) Excluding productivity changes

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8.2.8 Comment

Unlike Option 2, Option 9 is likely to result in very substantial benefits to the community which would outweigh any additional costs.

8.3 Options 2 and 9 in combination

The costs and benefits of a combination of the two options would not be simply additive since the effects of the two separate options overlap one another to a certain extent.

Benefits estimated for pedestrians and pedal cyclists (see subsections 8.1.1 and 8.2.1) are not mutually exclusive. However, both these savings, though significant, are small compared with the benefits to be obtained from reduced spray and fuel savings. Furthermore, the additional costs to manufacturers and operators, described in subsections 8.1.5 and 8.2.6, may not always be mutually exclusive.

It is concluded that Option C would result in substantial savings which are likely to amount to over 100 million GBP per annum (and possibly as high as 200 million GBP per annum or more).
9  **Option D – provide Code of Practice, redefine off-road vehicle and combine/update EC Directives**

Option D combines the following options

- **Option 3**: Provide a Code of Practice (COP) for certification agencies to help determine vehicles where it is not practical to fit sideguards and an exemption is justified.
- **Option 7**: Amend the framework directive 70/156/EC to have a more discriminatory definition of an off road vehicle and exempt vehicles that meet this definition.
- **Option 9**: Combine and update Regulations 2000/40/EC, 89/297/EC and 70/221/EC to require integrated designs that offer improved protection all around the vehicle.

It should be noted that a COP (Option 3) is not compulsory and may not necessarily be followed by all agencies involved in the type approval process.

9.1  **Comment**

Option D would remove the exemptions of fewer vehicles than Option C with the result that benefits would be reduced but, in addition, costs would be lower.

It is thought to be the most practical option considered in this report and, in addition, would probably attract less criticism and opposition than Option C.
10 Option E – spray suppression whole vehicle option (with performance limit set at current level)

10.1 Reducing spray and its impact

A description of spray generation and its impact on traffic is given in subsection 2.2.

In order to reduce the detrimental affect that HGV spray has on the vision of road users and thereby reduce the number of accidents occurring in which HGV spray is a contributory factor, it is necessary to devise methods to minimise the amount of spray that is emitted and to direct what is emitted into areas which have a minimal affect on the vision of other road users.

At present, these objectives are achieved by the application of the current spray suppression Regulations. These Regulations are briefly described in section 10.2. and can be seen to be extremely design prescriptive. This option considers changing the Regulation to remove the design prescriptive nature and permit more innovative solutions and to encourage competition, in line with the Government’s “better Regulations” initiative.

10.2 Current Regulations

In Europe, there are currently three standards which relate to spray suppression; they are described in Appendix E.

These Regulations and standards all provide requirements for spray suppression devices at the component level. This focus on the performance of individual components may limit the requirement placed on vehicle designers and manufacturers to improve the spray suppression capability of the whole vehicle. It should be noted that improving the spray suppression capability of an HGV through an integrated approach would, almost certainly, have a positive effect on vehicle aerodynamics, resulting in improved fuel efficiency and reduced vehicle running costs.

10.3 The likely impact of Option E

This option would introduce a whole vehicle assessment for new vehicles to facilitate the testing of any form of spray suppression device, including those using aerodynamic techniques. In this case, the spray emission limit would be set at the same level as that achieved with current grass matting spray suppression equipment. In this way, the change can permit the improvements promoted by the “better regulation” initiative without imposing any additional mandatory burden on industry. However, unless there is a financial incentive for operators, it is possible that they would choose not to take advantage of the new solutions offered and, therefore, the performance of spray suppression devices might not voluntarily improve above the set limit. Therefore, the numbers of fatalities and injuries in road accidents directly attributable to spray might remain at their present level.

However, the aerodynamic spray suppression devices already marketed might become cheaper to produce because they may not need to have traditional grass matting style suppression fitted as well, simply to conform to current Regulations. It is possible that their performance might voluntarily exceed the minimum standard resulting in some casualty reduction and fuel economy benefits. This would be dependent not only on performance but also on their market acceptance within the industry. However, the fact that several companies already market products with some sales despite the difficulties caused by the Regulation suggests that there would be at least some voluntary take up of the improvements offered. Estimated accident reduction benefits range up to 338 million GBP per annum though the expectation for Option E would be much lower than this maximum figure.
Direct Costs

It is possible that the new aerodynamic spray suppression devices would be more expensive than the current grass matting. Vehicle manufacturers would need to test their vehicles according to the new whole vehicle requirement including the labour cost for test technicians and test driver, transportation of vehicle including fuel, administration and reporting, and other overheads.

The retail cost for testing one new vehicle has been estimated at 1,000 GBP (based on three man-days per test). It is estimated that the number of new vehicle types introduced each year would be relatively low, perhaps ten or twenty.

Other costs

There would also be administrative costs associated with the change to the regulation and ongoing test costs for new vehicle introduction. In addition, investment in test equipment would be required including cameras, target boards and track mountings, water depth meter, water spray bars, computer hardware and software, and weather station. Based on the use of an existing test track, the test equipment cost and set-up has been estimated at 10k to 20k GBP.

Monitoring, enforcement and compliance costs would depend on the level of monitoring chosen as appropriate and on the frequency and form of the measures adopted.

In summary, the costs and benefits of this option are difficult to estimate in advance. However, it is important to note that any additional cost imposed on industry would be accepted voluntarily, presumably for some other commercial gain. The response of industry (manufacturers and operators) will, therefore, determine the overall impact of this option.
11 Option F – spray suppression whole vehicle option (with performance limit set at a lower level)

11.1 Background

One reason for changing the current spray suppression Regulation is to change it to be non-prescriptive in terms of design. The main reason to change the current spray suppression equipment Regulations is to reduce the hazard that spray poses to road users, and the frequency and severity of accidents and associated casualties and injuries. Any reductions would result in societal benefits and reduce the societal costs associated with accidents and injuries.

This change in regulation would probably require re-investment and change for the current equipment suppliers, particularly if their current products were not able to meet the performance requirements.

11.2 The likely impact of Option F

This change in the “performance level” would result in a reduction in the amount of spray emitted which, in turn, would lead to a saving in spray-related accident costs.

The accident cost changes would be the same as those presented in subsection 8.2.5 for Option C (i.e. a maximum saving of 338 million GBP per annum). This level of saving assumes that the “lower level” set for the performance of the devices was sufficiently low to gain all the spray benefits possible from integrated safety guards.

Direct Costs

The costs identified in Option E apply. In addition, there would be the cost of equipment fitted as part of the OEM build. This would include design and testing, increased materials cost and investment in production facilities.

For the vehicle operators, there may be increased operating costs due to increased vehicle weight, offset by fuel economy savings if the aerodynamic efficiency of the vehicle is improved.

It should be noted that wheel and tyre changing and safety checks could be hindered by some designs.

As noted in subsection 8.2.6, the additional construction cost of SafeLiner-type trailers has been estimated to amount between approximately 5.1 million GBP and £9.9 million GBP.

11.3 Summary

Option F would provide a greater benefit than Option E and is likely to be, of the two, the preferred option.
12 Summary of costs and benefits

It is not possible, at present, to put numerical values on all the costs and benefits.

Indications (with numerical values where known or estimated) are given in Appendix F. Table F.1 provides a numerical and/or descriptive summary for all 6 options (A to F) while Table F.2 presents the same information in more detail for the two options (ISG Options 2 and 9) which make up option C.

The aim of Table G.1 (within Appendix G) is to present a summary of the responses from industry and the public to the proposed Options. The entries are based upon the questionnaire responses (Appendix A) and earlier discussions with manufacturers and operators.

To date, a few questionnaire responses have been received from component designers and manufacturers but none from vehicle manufacturers or fleet operators. As a result, Table G.1 cannot be completed.

13 Small firms impact

A number of firms will be affected by these options particularly those listed, by type, in subsection 3.1.

14 Competition assessment

Manufacturers of safety guards and spray suppression equipment could be affected considerably (either beneficially or adversely, depending upon the option chosen).

Operators of tippers would be affected especially by Options C and D. Some of these affected firms would be small.

15 Enforcement, sanctions and monitoring

The ISG related Options A to C would be enforced in one of two ways, either:

(1) by repealing the current regulatory directives and replacing them with a single integrated regulation, or

(2) by modifying each individual regulation.

ISG Option D contains a Code of Practice element (ISG option 3) – this part is non-regulatory and non-enforceable. The other parts of Option D (ISG options 7 and 9) would be enforced as described above for the new Options A to C.

The SS related options (E and F) rely on the existence of a suitable test method to quantify spray from a vehicle, as already noted in subsection 2.1. Such a method is not yet available so these options are not realistic at present. Even if a new spray test method were available that was suitable for use with new vehicles at type approval, it would be unrealistic to try to enforce the requirements of any spray suppression regulation in service, i.e. in the course of the vehicle’s annual roadworthiness checks.
References


Department for Transport (2004a) 2003 valuation of the benefits of prevention of road accidents. Highways Economic Note No. 1


Appendix A. Questionnaire responses
Response 1

Integrated Safety Guards and Spray Suppression Equipment: Industry Questionnaire

TRL is currently engaged in a project for the UK Department for Transport investigating the costs and benefits of an integrated approach to the fitting of front and rear underrun protective guards, sideguards and spray suppression equipment on Heavy Goods Vehicles (HGVs).

The main objectives of such equipment would be to:

- Improve the protection afforded to other road users involved in a collision with an HGV.
- Improve the HGV's aerodynamics to assist in the control of spray emissions in wet conditions.
- Improve fuel efficiency as a result of improved aerodynamics.

A significant proportion of HGVs are exempt from having to fit safety guards on the basis of their use in locations where the guards would interfere with operations, especially off-road or in rough road conditions. The project is looking at possible changes to the exemption Regulations; one of the project sponsor’s concerns is the possible impact of any regulatory changes on UK businesses and on other firms which operate HGVs or manufacture and supply HGVs for use in the UK.

This questionnaire is designed to give you the opportunity to let us know the ways in which any changes in Regulations would affect you and your operations.

It should be emphasised that none of the changes that we mention are on the statute book for implementation – we are simply wanting to understand how you would be affected if any of the changes discussed were implemented in the future.

We would appreciate your help in assisting us with this project. Any information that you provide will be treated as strictly confidential and solely in the furtherance of this project.

It would be helpful if you were able to reply by Wednesday 12th October, if possible. If this isn’t practical for any reason, please still let us know your views; we will try to take account of them in our report.

If you have any queries about the project, or this questionnaire, please contact the TRL Project Manager (Mr David Bowes, tel. no. 01344 – 770627) or the TRL Project Technical Director (Mr Iain Knight, tel. no. 01344 – 770079).

Thank you for your cooperation.

Ron Bartlett
Integrated Safety Guards and Spray Suppression Equipment: Industry Questionnaire

Q1. Name and address of business …Spraydown, 28 Mere Avenue, Raby Mere, Wirral CH630NE.

Q2. Respondent's name, position and telephone number
………J. Downes Director 01928 511 476


Q4. Does this business include the use of HGVs, including use off-road or on rough roads? Please tick all that apply.

No, off-road use………………………………………….
No, use on rough roads ...........................................
Yes, use on normal roads …Component supply for these vehicles………………………………
No  ........................................................................

Q5. Would you be affected if the exemptions to the requirement to fit safety guards to HGVs were removed?

No ............... 

Q6. If yes, in what ways would your business be affected? Please tick all that apply.

Additional manufacturing costs .................................
Restrictions on vehicle usage .................................
Effects of increased vehicle net weight......................
Reduced load carrying ........................................
Additional fuel costs ..........................................
Q7. Would you be affected if the Regulations which currently require the fitting of rail-type safety guards were replaced by a regulation to fit smooth flat panelling all the way around the lower part of a vehicle (in order to provide improved protection, spray suppression, and fuel economy)?

Yes .................

Q8. If yes, how would you be affected?

The Spraydown Flap operates dynamically and requires a flow of air through it. Panelling all around the truck and over the wheels would enhance the Spraydown flap performance because this would then ensure that the only path for the air, water and mist would be via the Spraydown flap, where separation of the water occurs. This would prevent the side emission hazardous spray seen with conventional (Monsanto type) devices, even where wheel side panels are used.

Q9. Any other comments?

I would welcome the opportunity to provide Spraydown flaps for use in any trials that TRL may propose.

Thank you for your time in completing this questionnaire
Response 2

Dear Mr Bartlett,

Thank you for sending a questionnaire to us for completion.

Jonesco only runs 4 commercial vehicles but as these spend their entire lives delivering spray suppression to the UK market, we would like to make a few points that we hope are useful to the project.

1. Increasingly vehicles operating on UK roads are foreign (over 50%) and often registered where no spray suppression law is applied despite 91/226 EEC.
2. The effectiveness of the safety law on British roads is diminished by this increasing trend and the law should be extended to cover either transiting vehicle or represented to Brussels for automatic adoption by EEC countries.
3. The costs of manufacture/maintenance of vehicles fitted exceeds those that do not comply giving their builders and operators an advantage when avoiding safety.
4. Increasingly a trend of minimizing the fitment on the trailer is happening where a single valance is fitted with a front and rear spat. This solution is not covered well in the 1992 and 1986 legislation. We feel it provides poorer safety than the mudguard and flap solution.
5. For difficult vehicles the law should ask for a best effort attempt at spray suppression – ie rear steered axles on milk tankers.
6. When considering another system we should be aware that the world is adopting the existing standard (India, Israel, Sweden, Italy etc) at the moment and we will make another variant and complexity within the marketplace.
7. For side guard enclosures to work an adequate test for homologation is needed and I hear on the grapevine that this has been a very difficult obstacle to overcome. Has the data been released yet concerning the measurability of spray reduction on moving vehicles?
8. Side guard enclosures also rely on the trailer unit and tractor unit aerodynamics complementing each other when in reality the tractor unit will possibly be swapped on a very regular basis.
9. Trailer builders are currently in a poor shape in Europe due to the Steel price increases over last year and large overcapacity. Fruehauf closed its doors in the UK this year leaving only a couple of significant UK producers. It is believed that only a few builders will survive the next 5 years and mainly German ones will dominate the market. It will be necessary to bring these builders to accept any new legislation for trailer units.
10. Jonesco is in favour of improved road safety and should this new proposal prove to hold significant benefit over the existing method in safety, cost of fitment, fuel saving, maintenance, brake life etc we will applaud the British leading the way again on vehicle design.

Jonesco (Preston) Ltd employs 130 staff in the UK dedicated to the supply of Mudguards, toolboxes, Antispray flaps and fire cabinets. 50% of our goods are exported to 42 countries worldwide.

I hope these few spontaneous observations from the market help and look forward to any feedback that is given.

Yours sincerely
Peter M Williams
Sales Director
Jonesco (Preston) Ltd
Pittman Way
Fulwood
Preston
Lancashire
PR2 9ZD
01772 704488
www.jonesco-plastics.com
Response 3

Integrated Safety Guards & Spray Suppression Equipment: Industry Questionnaire

Q1. Name & address of business

Q2. Respondent's name, position and telephone number

Q3. Nature of business

Q4. Does this business include the use of HGVs, including use off-road or on rough roads? Please tick all that apply.
- Yes, off-road use
- Yes, use on rough roads
- Yes, use on normal roads
- No

Q5. Would you be affected if the exemptions to the requirement to fit safety guards to HGVs were removed?

- Yes
- No

Q6. If yes, in what ways would your business be affected? Please tick all that apply.
- Additional manufacturing costs
- Restrictions on vehicle usage
- Effects of increased vehicle net weight
- Reduced load carrying
- Additional fuel costs
- Other ways (please specify)

2
Q7. Would you be affected if the regulations which currently require the fitting of rail-type safety guards were replaced by a regulation to fit smooth flat panels all the way around the lower part of a vehicle (in order to provide improved protection, spray suppression, and fuel economy)?

Yes [ ]  No [ ]

Q8. If yes, how would you be affected?

________________________________________________________________________
________________________________________________________________________
________________________________________________________________________
________________________________________________________________________
________________________________________________________________________
________________________________________________________________________

Q9. Any other comments?

[Handwritten note]

Our approach is the only
fine management solution to
got in with release air from
the regulator is set to

Thank you for your time in completing this questionnaire

[Signatures]
Response 4

Integrated Safety Guards & Spray Suppression Equipment: Industry Questionnaire

Q1. Name & address of business: [Handwritten text]

Q2. Respondent’s name, position and telephone number: [Handwritten text]

Q3. Nature of business: [Handwritten text]

Q4. Does this business include the use of HGVs, including use off-road or on rough roads? Please tick all that apply.
   - Yes, off-road use: [X]
   - Yes, use on rough roads: [X]
   - Yes, use on normal roads: [ ]
   - No: [X]

Q5. Would you be affected if the exemptions to the requirement to fit safety guards to HGVs were removed?
   - Yes: [ ]
   - No: [X]

Q6. If yes, in what ways would your business be affected? Please tick all that apply.
   - Additional manufacturing costs: [ ]
   - Restrictions on vehicle usage: [ ]
   - Effects of increased vehicle net weight: [ ]
   - Reduced load carrying: [ ]
   - Additional fuel costs: [ ]
   - Other ways (please specify): [ ]
Q7. Would you be affected if the regulations which currently require the fitting of dual type safety guard were replaced by a regulation to require all panels at the rear of the lower part of a vehicle in order to provide improved protection to spray suppression, and fuel economy?

Yes: ........ Y

No: ........ 

Q8. If yes, how would you be affected?

Additional Costs

Amount: £554 per trailer

Extra Weight: 554 kg per trailer

Q9. Any other comments?

1 - In my experience [25% yes, the]

Extra repair and maintenance costs

Associated with [25% yes, the]

Government £554 per trailer

Amount of fuel saved: £258 per trailer

2 - The trade unions are not to go back to the rail fare

3 - I am unable to comment as to

The safety effects of equipping

of the smooth panelled panels.

Thank you for your time in completing this questionnaire

4 - Overall I think it is a bad move
to introduce such a regulation. It could damage the railway industry with extra costs. I make the suggestion to complete with foreign vehicles with more difficult.
Appendix B. Background to this survey

Safety guards have been in use on goods vehicles and trailers in the UK for about 20 years. The first designs were side guards designed to protect pedestrians and cyclists from falling under a trailer’s wheels if hit by the vehicle. They are not designed primarily to prevent underrun by other vehicles.

Related legislation also covers rear underrun protection and, much more recently, front underrun protection. Other Regulations cover the provision of spray suppression equipment – wheel guards, mud flaps and matting.

Until recently, all these devices were provided and assessed as separate items. TRL is currently engaged in a project for the UK Department for Transport (DfT) to look at the benefits and costs of an integrated approach.

This survey forms part of an assessment of possible impacts upon businesses located and/or operating in the UK.
Appendix C. Integrated safety guards and spray suppression

C.1 Options, risks, benefits and costs

The six options (A to F) chosen for detailed cost benefit analysis within this Partial RIA have been colour coded in the tables in this appendix as indicated in the following table.

### Definitions and colour coding of options

<table>
<thead>
<tr>
<th>RIA Option A</th>
<th>RIA Option B</th>
<th>RIA Option C</th>
<th>RIA Option D</th>
<th>RIA Option E</th>
<th>RIA Option F</th>
</tr>
</thead>
<tbody>
<tr>
<td>ISG Option 1</td>
<td>ISG Option 1A</td>
<td>ISG Option 2</td>
<td>ISG Option 9</td>
<td>ISG Option 3</td>
<td>SS Option 2</td>
</tr>
<tr>
<td></td>
<td></td>
<td>ISG Option 9</td>
<td>ISG Option 7</td>
<td>ISG Option 9</td>
<td>SS Option 3</td>
</tr>
<tr>
<td>Option No.</td>
<td>Description</td>
<td>Risks</td>
<td>Benefits</td>
<td>Costs (£)</td>
<td>Comments</td>
</tr>
<tr>
<td>-----------</td>
<td>-------------</td>
<td>-------</td>
<td>----------</td>
<td>-----------</td>
<td>----------</td>
</tr>
<tr>
<td>1</td>
<td>Do nothing&lt;sup&gt;(1)&lt;/sup&gt;</td>
<td>Exemptions are open to interpretation. Side guards may be more prone to failure</td>
<td>None</td>
<td>None</td>
<td>EC exemptions will apply in the UK.</td>
</tr>
<tr>
<td>1A</td>
<td>Close regulation ‘loopholes’</td>
<td>Risks to ORUs&lt;sup&gt;(3)&lt;/sup&gt; in particular situations reduced</td>
<td>Increased protection to ORUs</td>
<td>Some increased construction costs</td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>End all exemptions (i.e. fit SGs&lt;sup&gt;(2)&lt;/sup&gt; on all vehicles)</td>
<td>Risks to ORUs reduced</td>
<td>Increased protection to ORUs (not fully quantifiable)</td>
<td>Increased construction costs; reduced payload and productivity for affected vehicles</td>
<td>-2.51m to -3.55m (cyclists and pedestrians only)</td>
</tr>
<tr>
<td>3</td>
<td>Amend EC Directives&lt;sup&gt;(5)&lt;/sup&gt; to exempt specific vehicle types only.</td>
<td>Some vehicles will still operate without SGs (in some cases, unnecessarily).</td>
<td>Fewer exemptions and so greater benefits than for option 3. Benefits not as large as for option 2.</td>
<td>Likely to be similar to option 2.</td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>Amend Directive 70/156/EC definition of an off-road vehicle; exempt vehicles accordingly</td>
<td>All vehicles will need SGs; some of them will have ground clearances greater than 550mm (so less effective).</td>
<td>Unlikely to be as great as for option 2.</td>
<td>Similar to option 2. Effect on specialist vehicles should be reduced or eliminated.</td>
<td></td>
</tr>
<tr>
<td>5</td>
<td>End all exemptions and amend EC Directives to specify ground clearance requirements</td>
<td>Some vehicles, not used or intended for use off-road, would be inhibited</td>
<td>Will reduce the number of exempt vehicles but not necessarily all the right ones.</td>
<td>Will still allow a large number of exemptions. Benefits less than for option 2.</td>
<td>Similar to, but lower than for option 3.</td>
</tr>
<tr>
<td>6</td>
<td>Amend Directive 70/156/EC definition of an off-road vehicle; exempt vehicles accordingly</td>
<td>Some vehicles, not used or intended for use off-road, would be inhibited</td>
<td>Most vehicles would require SGs; benefits would be greater than for option 2.</td>
<td>Costs comparable but somewhat higher than for option 2.</td>
<td></td>
</tr>
<tr>
<td>7</td>
<td>Do nothing</td>
<td>No change to requirements.</td>
<td>No additional benefits compared with keeping same Regulations.</td>
<td>None relating to harmonising and updating the Regulations.</td>
<td></td>
</tr>
<tr>
<td>8</td>
<td>Combine and update EC Directives to require integrated and innovative designs</td>
<td>May impose additional burdens on industry in terms of weight and operational capabilities of SGs.</td>
<td>Possible improvements are not as great as for option 6 (but not as great as for option 2).</td>
<td>Would involve reduced construction and operational costs.</td>
<td>If $15m to $5.61m (cyclists and pedestrians only)</td>
</tr>
<tr>
<td>9</td>
<td>Amend EC Directives individually such that integrated and innovative designs are encouraged.</td>
<td>Vehicle designers and operators may not appreciate benefits of integrated designs and may choose to fit separate SGs.</td>
<td>Less than for option 9 as some manufacturers will continue to fit separate SGs.</td>
<td>Same as for option 9 for those vehicles fitted with integrated SGs.</td>
<td></td>
</tr>
</tbody>
</table>

Notes:
(1) Strictly, this option is ‘Do minimum’;
(2) SG = Safety Guard;
(3) ORU = Other Road User;
(4) COP = Code of Practice;
(5) EC Directives (relevant to the project) are 2000/40/EC, 89/297/EC, 70/221/EC, 79/490/EC and 70/156/EC;
(6) Type ‘G’ is defined in EU framework 70/156/EC.
### Table C.2. Spray suppression options

<table>
<thead>
<tr>
<th>Option Number</th>
<th>Description</th>
<th>Risks</th>
<th>Benefits</th>
<th>Costs (£)</th>
<th>Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Do nothing. Maintain current spray suppression equipment Regulations.</td>
<td>Problem maintained at current level. Opportunity to improve missed.</td>
<td>No change</td>
<td>No change</td>
<td>Current casualty rate is maintained.</td>
</tr>
<tr>
<td>2</td>
<td>Introduce a whole vehicle assessment for new vehicles to facilitate the testing of devices whose limit is the same as for the current grass matting equipment.</td>
<td>As for option 1.</td>
<td>Some casualty reductions and fuel economy benefits may occur.</td>
<td>Additional costs to manufacturers.</td>
<td>?</td>
</tr>
<tr>
<td>3</td>
<td>Same as option 2 but with a lower limit than current grass matting equipment.</td>
<td>Change in regulation may require re-investment.</td>
<td>Less spray leading to fewer accidents.</td>
<td>As for option 2 plus the cost of equipment. Operating costs may increase (due to increased vehicle weight) offset by possible fuel savings.</td>
<td>?</td>
</tr>
<tr>
<td>4</td>
<td>Introduce a whole vehicle assessment for existing vehicles as part of the annual road worthiness test.</td>
<td>As in option 3 plus investment needed by operators.</td>
<td>-</td>
<td>-</td>
<td>Not considered further here.</td>
</tr>
<tr>
<td>5</td>
<td>Maintain current Regulations but introduce variable speed limits (VSLs) for HGVs travelling on wetted road surfaces.</td>
<td>VSL signing would be required; also driver education, and enforcement of the speed limits.</td>
<td>-</td>
<td>-</td>
<td>Not considered further here.</td>
</tr>
<tr>
<td>6</td>
<td>Permeable road surfaces.</td>
<td>Effectiveness of these surfaces deteriorates over time.</td>
<td>-</td>
<td>-</td>
<td>Not considered further here.</td>
</tr>
</tbody>
</table>
Appendix D. ISG option 2, part of RIA option C

D.1 Estimation of exemption and mitigation percentages (Method 1)

D.1.1 Percentages of exempt vehicles

Previous unpublished research contains an estimate of the proportions of HGVs which are exempted from fitting sideguards, based on an analysis of a subset of HGVs in the STATS 19 database which were involved, in the period 1990 to 1992, in an RTA while engaged in a movement coded as “going ahead other” impacting a pedal cyclist on the vehicle’s nearside. The exemptions are based on an analysis of body type and are different for different accident severities, as follows: fatal (54%), serious (35%) and slight (18%) – 24.5% overall.

The report found that for this category of accident involving pedal cyclists that the apparent over-involvement of exempt vehicles was statistically significant. The report found that there were suggestions of over-involvement of exempt vehicles in other categories of collisions with cyclists but that these were not statistically significant. There was also a suggestion that exempt vehicles might be over involved in fatal and serious accidents where pedestrians collided with the nearside of an HGV that was ‘going ahead other’ but this was not statistically significant.

A second estimate of the overall percentage of exempt HGVs has been obtained using the 2003 registration statistics (Transport Statistics GB, 2004). This data (from Table 9.6) includes more body type categories than in the 1993 analysis. The range of exemption percentages is 19.3% to 26.0%. The mid value, 20.7%, is lower than the 1993 figure quoted above. This second estimate, 20.7%, would imply that there were, in 2003, about 89,500 exempt HGVs.

In view of this, it has been assumed, in order to provide a second estimate of exemption percentages, that exempt vehicles are also over represented in fatal and serious accidents with cars (as well as in accidents involving pedestrians) since the lack of safety guards on the exempt vehicles is likely to increase the severity of these accidents as well. On this basis, a second set of exemption percentages has been derived using the overall mid exemption figure above (20.7%) but retaining the proportionate differences between fatal, severe and slight as above, i.e. 54%: 35%: 18%. These assumptions give the following values for vehicle exemptions for the different severity categories: fatal (46%), severe (30%) and slight (15%).

D.1.2 Mitigation levels

Previous TRL research provides an analysis of fatal RTAs between cars and HGVs. Estimates are provided of the proportions on fatalities likely to be saved by the provision of rigid safety guards (11% of all car fatalities) or energy absorbing safety guards (16%). These estimates have been used here though the accident data predates the introduction of front underrun safety guards. It is assumed that all the mitigated fatal accidents become serious injury accidents.

Estimates of mitigation percentages of serious injury accidents to slight injury have been obtained in discussion with Iain Knight.

Estimates of mitigation percentages of slight injury accidents to damage only are arbitrary: they were added for the purpose of a sensitivity analysis.

The mitigation percentages used in the analysis are summarised within Table D.1.
### Table D.1. Exemption and mitigation percentages

<table>
<thead>
<tr>
<th>Topic</th>
<th>Accident Severity</th>
<th>Fatal</th>
<th>Serious</th>
<th>Slight</th>
</tr>
</thead>
<tbody>
<tr>
<td>Vehicle exemptions (%)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Table 12 values</td>
<td></td>
<td>54</td>
<td>35</td>
<td>18</td>
</tr>
<tr>
<td>Values based on the ‘lower’ overall estimate</td>
<td></td>
<td>46</td>
<td>30</td>
<td>15</td>
</tr>
<tr>
<td>Mitigation of accident severity</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Rigid safety guards</td>
<td></td>
<td>11&lt;sup&gt;(1)&lt;/sup&gt;</td>
<td>10 to 20&lt;sup&gt;(2)&lt;/sup&gt;</td>
<td>0 to 10&lt;sup&gt;(3)&lt;/sup&gt;</td>
</tr>
<tr>
<td>Energy absorbing safety guards</td>
<td></td>
<td>16&lt;sup&gt;(1)&lt;/sup&gt;</td>
<td>15 to 25&lt;sup&gt;(2)&lt;/sup&gt;</td>
<td>0 to 10&lt;sup&gt;(3)&lt;/sup&gt;</td>
</tr>
</tbody>
</table>

**Notes:**
2. Estimates of mitigation of serious accidents are thought to cover the likely ranges
3. Estimates of mitigation of slight accidents: range added for sensitivity analysis
Appendix E. Current spray suppression standards

In Europe, the following three standards relating to spray suppression apply:

1. EEC Directive (91/226/EEC) specifies the types of spray suppression equipment that must be fitted to vehicles above 7.5t and trailers above 3.5t. Unbodied vehicles, off road vehicles and vehicles on which the presence of spray suppression devices is incompatible are exempt from fitting such devices. The test procedures for obtaining type approval for the two main types of spray suppression material; the energy absorber type and the air/water separator type, are described. Both tests consist of pumping water at a vertically suspended sample of the spray suppression material and then measuring the amount of water collected in a tray beneath the sample at the end of the test. The directive also gives specific requirements for the different spray suppression systems with regard to the dimensions and area of coverage of the mudguards, outer valences and rain flaps for different axle types.

2. British Standard BS AU 200 comprises two parts. Part 1a specifies the physical requirements for containment and suppression devices such as wheel guards, valences and wheel flaps. It is applicable to motor vehicles having a maximum gross weight exceeding 7.5t, articulated tractor units having a train mass exceeding 7.5t and trailers having a maximum gross mass exceeding 3.5t. It also specifies the requirements for spray suppression devices when conventional wheel guards are not used but instead the floor of the vehicle body always covers the vehicle’s wheels. These are only applicable to non-steerable rear wheels on single and multiple axles of motor vehicles whose maximum gross mass exceeds 7.5t and to trailers whose gross mass exceeds 3.5t. Part 2a specifies performance requirements of suppression materials and devices and air/water separating material and devices. It details the two test methods used to determine the level of performance of the suppression material or device used for the valences and/or wheel flaps. The test procedure is the same as that used in EEC Directive 91/226/EEC for testing the energy absorbing spray suppression material. To test the durability of the air/water separating device or material the device is mounted in relation to the design specification of Part 1a. The wheels are then rotated and caused to pass laterally through the device in a simulated steering motion. The device is then examined to check that any gaps in the device, caused by the wheel turning, automatically close when the wheel is returned to the straight ahead position. The tyre is also examined to check that no visible damage has occurred.

3. Road Vehicles (Construction and Use) Regulation 64 specifies that the types of spray suppression equipment detailed in BS AU 200 must be fitted to certain classes of vehicles. It applies to all wheeled goods vehicles which are motor vehicles first used on or after 1st April 1986 having a maximum gross weight exceeding 12,000kg, trailers manufactured on or after 1st May 1985 having a maximum weight exceeding 3,500kg or trailers, whenever manufactured, having a maximum gross weight exceeding 16,000kg and two or more axles. The Regulation also lists vehicles that are exempt from these requirements due to their construction or usage. The 1992 amendment to Regulation 64 exempts a vehicle from the existing requirements relating to the fitting of spray suppression devices if it is fitted with a spray suppression system in accordance with Council Directive 91/226/EEC and the devices fitted are marked in accordance with the Directive.
## Appendix F. Summary of costs and benefits

### Table F.1. Summary of options

<table>
<thead>
<tr>
<th>Impact</th>
<th>Option A (ISG Option 1)</th>
<th>Option B (ISG Option 1A)</th>
<th>Option C (ISG Options 2 and 9)</th>
<th>Option D (ISG Options 3, 7 and 9)</th>
<th>Option E (SS Option 2)</th>
<th>Option F (SS Option 3)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Changes in Accident Costs&lt;sup&gt;(1)&lt;/sup&gt;</td>
<td>Pedestrians v. small -ve</td>
<td>small -ve</td>
<td>Medium -ve</td>
<td>Small changes only</td>
<td>Small changes only</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Pedal Cycles v. small -ve</td>
<td>small -ve</td>
<td>Medium -ve</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Cars v. small -ve</td>
<td>small -ve</td>
<td>Large -ve</td>
<td>Unknown at present (range is from small to v. large)</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Other Road Users v. small -ve</td>
<td>small -ve</td>
<td>Probably medium -ve</td>
<td>Unknown at present (range is from small to v. large)</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Spray related nil</td>
<td>nil</td>
<td>Large or v. large -ve</td>
<td>Similar changes to Option C but fewer exempt vehicles so reduced benefits and lower changes in costs</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Changes in fuel costs&lt;sup&gt;(1)&lt;/sup&gt;</td>
<td>nil</td>
<td>nil</td>
<td>Large -ve</td>
<td></td>
<td>Substantial</td>
<td></td>
</tr>
<tr>
<td>Changes in costs for manufacturers and operators&lt;sup&gt;(1)&lt;/sup&gt;</td>
<td>v. small +ve</td>
<td>small +ve</td>
<td>Probably medium or large +ve</td>
<td></td>
<td>Uncertain at present</td>
<td></td>
</tr>
<tr>
<td>Totals&lt;sup&gt;(1)&lt;/sup&gt;</td>
<td>v. small or small -ve</td>
<td>probably small -ve</td>
<td>Large -ve</td>
<td>Probably medium or large -ve</td>
<td>Unknown at present</td>
<td></td>
</tr>
</tbody>
</table>

**Note:** (1) Definitions of (annual) cost changes are:
- v. small or small < £1m;
- £1m < medium < £10m;
- £10m < large < £100m;
- £100m < v. large.
### Table F.2. Details of Options 2 and 9

<table>
<thead>
<tr>
<th>Impact</th>
<th>Option 2</th>
<th>Option 9</th>
<th>Totals</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Pedestrians</strong></td>
<td>-0.4 to -1.1</td>
<td>0 to -3.5</td>
<td>-0.4 to -4.6</td>
</tr>
<tr>
<td><strong>Pedal Cycles</strong></td>
<td>-2.1 to -2.5</td>
<td>-0.6 to -2.1</td>
<td>-2.7 to -4.6</td>
</tr>
<tr>
<td><strong>Cars</strong></td>
<td>-11.9 to -14.6</td>
<td>Nil (or small –ve)</td>
<td>large –ve</td>
</tr>
<tr>
<td><strong>Other Road Users(^{(1)})</strong></td>
<td>Unknown (probably small –ve)</td>
<td>Nil (or small –ve)</td>
<td>small or medium -ve</td>
</tr>
<tr>
<td><strong>Spray related</strong></td>
<td>Nil</td>
<td>-50 to -338(^{(2)})</td>
<td>-50 to -338(^{(2)})</td>
</tr>
<tr>
<td><strong>Changes in fuel costs</strong></td>
<td>Nil</td>
<td>-77</td>
<td>-77</td>
</tr>
<tr>
<td><strong>Changes in costs for manufacturers and operators(^{(1)})</strong></td>
<td>+5.1 to +13.1</td>
<td>+5.1 to +9.9</td>
<td>+10.2 to +23.0</td>
</tr>
<tr>
<td><strong>Totals(^{(3)})</strong></td>
<td>-1.3 to -18.2</td>
<td>-122.5 to -415.5</td>
<td>probably large -ve</td>
</tr>
</tbody>
</table>

**Note:**

1. Definitions of (annual) cost changes are: small < £1m; £1m < medium < £10m; £10m < large < £100m.
2. Maximum values
3. Ignoring Cars and Other Road Users
Appendix G. Summary of manufacturer and operator responses

Table G.1. Summary of responses

<table>
<thead>
<tr>
<th>Impact</th>
<th>Option A (ISG Option 1)</th>
<th>Option B (ISG Option 1A)</th>
<th>Option C (ISG Options 2 and 9)</th>
<th>Option D (ISG Options 3, 7 and 9)</th>
<th>Option E (SS Option 2)</th>
<th>Option F (SS Option 3)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Net cost changes (accident costs, fuel costs, manufacturing costs, operating costs)</td>
<td>v. small or small -ve</td>
<td>probably small -ve</td>
<td>probably large -ve</td>
<td>probably medium or large -ve</td>
<td>Unknown at present (range is from small to v. large)</td>
<td>Unknown at present (range is from small to v. large) but likely to be greater than for Option E.</td>
</tr>
<tr>
<td>Responses from industry</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Vehicle manufacturers</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Vehicle operators</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Other (selected) responses</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>General population</td>
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<td>Environmental lobby</td>
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</table>

**Note:** (1) Definitions of (annual) cost changes are:
- v. small and small < £1m;
- £1m < medium < £10m;
- £10m < large < £100m;
- £100m < v. large.