

# **Executive Summary of the DESKTOP REVIEW OF CONSPICUITY MARKINGS FOR HEAVY VEHICLES**

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The Centre for Accident Research and Road Safety – Queensland (CARRS-Q) was commissioned by 3M to examine currently available research into the effectiveness of heavy vehicle visibility markings in reducing crash involvement and its relevance for Australia.

A desktop review of the available literature was undertaken and an attempt made to describe the potential benefits in terms of crash reductions under Australian conditions. This is a summary of that review. All references in this summary are cited in the original paper.

## **Accident Studies**

A literature search was undertaken looking at both Australian and international studies. A wide range of sources were used but it was difficult to draw comparisons due to differences in definitions of heavy vehicles and the scope of accidents.

Looking solely at the Australian data, heavy vehicle fatalities have remained stable at approximately 18% over the last few decades.

Data for injuries is harder to obtain but when compared with fatalities, heavy vehicles contribute a larger proportion of fatalities than injuries (18% versus 3%). A truck with more mass is more likely to cause a fatality than a car.

There has been a marked increase in heavy vehicle usage in recent years, coupled with the stability of fatalities, this can be considered a positive outcome.

When considering the role of conspicuity markings in heavy vehicle crashes, the data for dark, dusk, dawn and low light was examined.

It was found that most fatalities involved the occupant of the other vehicle (58%) and 30% of the accidents occur between 6pm and 6am.

Articulated trucks with proportionally more accidents occurring at night, dusk and dawn are arguably the most amenable to conspicuity treatments.

While there has been a decline in night-time accidents in the last decade, this has been attributed to reforms around driving hours. Conspicuity was not considered as a contributing factor.

## **Conspicuity Markings**

International research concludes that heavy vehicle conspicuity is an issue that can be addressed through the application of contour markings.

Both Europe and the US have mandated regulations for the use of reflective heavy vehicle markings. The US introduced their regulations in 1993 and since 2009 all heavy vehicles on the road must be marked. In Europe the ECE 104 regulation defines both line marking for defining the length/width of the vehicle and contour marking defining the height as well.

Currently in Australia both Class 1 and Class 2 reflective rear marker plates are permitted, as per AS4001.1 and AS4001.3. There appears to be a dichotomy between the two standards which needs to be addressed. Class 1 is widely acknowledged to be superior and brighter but because of the conflicting advice in the two standards its exclusive use is not mandated. Reflective side markings are not legally required but voluntary adoption of the European regulations by the Australian Trucking Association in 2003 has proved beneficial. Also there is no requirement for fluorescence but the benefits of fluorescent markings was noted in Europe.

## Conspicuity Studies Relating to Heavy Vehicles

It has been noted that in poor lighting conditions drivers often misjudge the relative speed between them and other vehicles. Use of reflective markings will increase the distance a vehicle can be identified with the outcome being fewer crashes. Conspicuity markings should not only alert drivers to the presence of an obstacle but that obstacle should also be recognisable.

Literature estimates of effectiveness vary widely but all literature concludes that reaction times are improved, viewing distance is increased and significant crash reductions were likely when compared with signal lamps or single reflectors.

Studies of effectiveness of markings on actual heavy vehicle crashes are limited. From those analysed a US NHTSA study conducted before introducing mandatory marking in 1993 estimated a crash reduction of 15-25%

Another US study reported a reduction in side and rear impacts of 29% in dark conditions when reflective markings were used. It was also noted that a 55% reduction was found with flat bed trailers. The thinking is that the flat bed trailers, having a particularly low profile, were especially difficult to see prior to marking with reflective tape.

A European report gives a reduction in fatalities of 8.9% but this is considered to be conservative as detailed marking specifications were not cited and technology has improved markedly since the study was conducted (1995-2001).

Four studies giving cost benefit analyses were examined. These gave a cost-benefit ratio of between 1 and 4. There are wide variations in the basis of these studies and it is difficult to draw conclusions from them. Some saw the benefit as too low to be profitable while others saw the benefits to be good. TUV Rhineland Group, 2004, commented "there is no sufficiently precise cost-benefit analysis available for Europe". Despite the seemingly low ratios, Europe and the US have adopted mandatory contour marking regulations.

## Relevance for Australia

There are numerous environmental and regulatory differences between Australia and the other countries where data was sourced. The following factors may increase or limit the transferability of the findings.

- Most data is from the US or Europe where there are longer hours of darkness. Also there are significant differences in the hours of daylight between Northern Queensland/ Northern Territory and Tasmania.
- Australia has less snow and fog than the US and Europe.

- Australia has no mandatory regulations on rear and side under-run protection. This would make it more important to improve conspicuity to prevent the impact of under-run accidents.
- There are variations in crash statistics between Australia and other countries. Some factors will increase benefits while others will decrease benefits.  
It is noted that Australia has more heavy vehicle accidents in high speed zones and more fatalities with articulated trucks which will increase benefits. Australia also has more single vehicle accidents and accidents in urban areas which may decrease benefits.

## Assessing Potential Benefits under Australian Conditions

It is not possible to assess the benefits without answers to a number of questions. These include the probability of accidents, costs of fitting markings, mix of new and existing vehicles in relation to variation in fitting costs, fluorescence and its daytime benefits and the number of vehicles currently using reflective markings.

Answers to these questions will lead to other factors affecting the costs and benefits. These factors do not have answers either:

- whether the requirement is for line markings, full contour markings, or some variation of these
- the vehicle specifications (mass, length etc) to which the requirement/s would apply
- whether the requirement would apply to all vehicles of certain specification, or only new vehicles
- the timeframe for implementation
- the cost, grade and lifespan of materials
- opportunity costs for operators
- the value of each crash and equivalent crash cost avoided

## Conclusions

Crashes involving heavy vehicles and other road users are still a significant issue in Australia. The fatal crash rate for articulated trucks is about double that for rigid trucks. Approximately 31% of fatal heavy vehicle crashes in Australia occur at night, with articulated trucks more likely to be involved in fatal night crashes than rigid trucks (38% vs. 21%). Research from other countries shows potential crash reductions of relevant crash types of approximately 2% to 45% from the use of conspicuity markings, and estimated cost-benefit ratios have been generally positive.

The relatively high percentage of fatal articulated truck crashes occurring at night in Australia suggests that improved conspicuity markings may have a significant effect in reducing crashes. Higher grade (Class 1) retroreflective materials which combine fluorescence with reflective properties in conspicuity markings may also help to reduce daytime heavy vehicle crashes. There is a need for more research on the potential effectiveness of improved conspicuity markings for heavy vehicles in Australia, particularly with regard to cost-benefit ratios and the many variables to consider in such calculations. However, the available evidence suggests that a significant reduction in conspicuity-related crashes is possible with appropriate application of high quality conspicuity markings.