



Heavy vehicle visibility

Technical Advisory Procedure



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About this Technical Advisory Procedure (TAP):

This Technical Advisory Procedure is published by the Australian Trucking Association Ltd (ATA) to assist the road transport industry to improve the visibility of heavy commercial trucks and trailers.

This TAP is not, nor is it intended to be, complete or without exceptions.

The Technical Advisory Procedure is a guide only and its use is entirely voluntary. Recommendations or procedures may not be suitable for or applicable to all operators. Operators should consider their own circumstances, practices and procedures when using this Technical Advisory Procedure.

Operators must comply with the Australian Design Rules (ADRs), the Australian Vehicle Standards Regulations, the Roadworthiness Guidelines and any specific information and instructions provided by manufacturers in relation to vehicle's systems and components.

No endorsement of products or services is made or intended. Brand names, where used in this Technical Advisory Procedure, are for illustrative purposes only.

Suggestions or comments about this Technical Advisory Procedure are welcome. Please write to the Industry Technical Council, Australian Trucking Association, Minter Ellison Building, 25 National Circuit, Forrest ACT 2603.

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Acknowledgement

The ATA wishes to acknowledge the Freight Transport Association of the UK for allowing the images, as noted, to be reproduced. www.fta.co.uk



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1) Vehicle visibility and safety

Collisions between heavy trucks and trailers with smaller, lighter vehicles can often result in severe injuries or even death to the occupants of the smaller vehicle. In many cases, these accidents may be the result of the heavy vehicle not being seen by the approaching motorist in time for the accident to be avoided, particularly in poor weather conditions or at night.

Extensive research in both the United States and Europe has shown a dramatic reduction in the frequency and intensity of such vehicle accidents with the use of retroreflective stripes and other markings that outline the contour of the vehicle.

A 2001 report by the US National Highway Traffic Safety Administration¹, reported a reduction in a range of lighting conditions by 29 to 41 percent for side and rear impacts into trailers when retroreflective tape is fitted, while in dark conditions the tape reduced side and rear impacts that resulted in fatalities or injuries to drivers of any vehicle by 44 percent. However, the Australian Design Rules mandate a higher level of lighting and reflector requirements and as a result these benefits are illustrative only and may not be fully replicated in the Australian market.

A European report detailed 1984 Bavarian accident statistics, which highlighted the potential for contour markings to improve the visibility of the combination on road.²

Potential for improved truck visibility

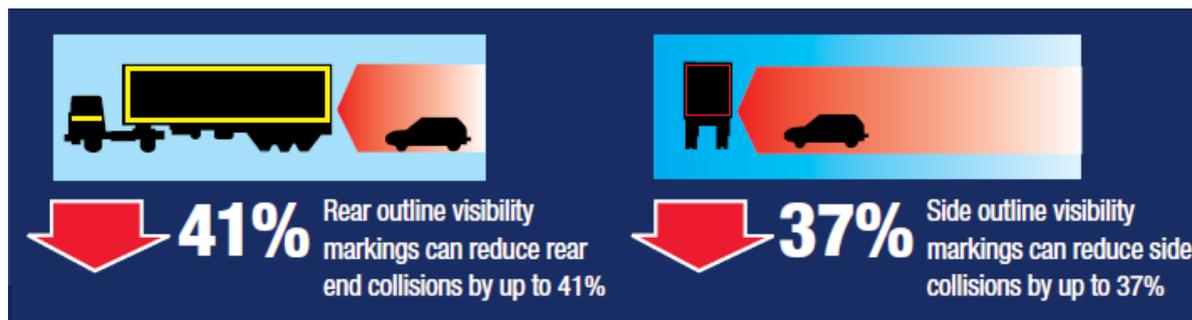


Figure 1: European report (1984 Bavarian accident statistics) for truck/passenger car accidents with injured persons for “night time/twilight” where “recognition too late” or “no recognition at all”³

The Australian 2015 NTI Major Accident Investigation Report⁴ found that “single vehicle accidents attributed to 71.8% of losses with the balance of 28.2% involving collisions with third party vehicles. In losses with third parties, not involving fatal injury, the NTI insured heavy vehicle was liable in 59.4% of cases. In collisions involving fatalities however, the truck was not at fault on 84% of occasions”. Further NTI Australian data highlights about 30% of multi vehicle crashes occur between 6 pm and 6 am overnight when traffic is at lightest and visibility is most critical. Data indicates that the vast majority of fatal accidents involving trucks and light vehicles are caused by the light vehicle. Where these accidents had resulted from a lack of truck visibility, it would be expected that there be a reduction in collisions for vehicles fitted with retro-reflective markings as experienced in the US and Europe.

In an effort to reduce accidents due to poor visibility, the ATA together with industry representatives, have developed this heavy vehicle visibility TAP, describing the methods by which increased vehicle visibility can be achieved. These requirements are based on European

¹ US study - the effectiveness of retroreflective tape on heavy trailers - www.nhtsa.gov/cars/rules/regrev/evaluate/809222.html

² Contour Markings of Vehicles Final Report FO76/00. Schmidt-Clausen, 2000 Darmstadt University of Technology

³ Contour Markings of Vehicles Final Report FO76/00. Schmidt-Clausen, 2000 Darmstadt University of Technology

⁴ NTI reports can be found at www.nti.com.au. NTI is a significant insurer of heavy vehicles in Australia.

Regulation UN ECE R104 – “Uniform Provisions Concerning the Approval of Retro-Reflective Markings for Heavy and Long Vehicles and their Trailers”, which define the performance, placement and material specification of the markings.

Overall, the goods transportation sector has seen an improvement in the fatal crash rates for articulated vehicles. Chart 1 illustrates that over time there has been a decline in crashes (orange line), but an almost double of the total articulated combinations in service (yellow line), which has produced a huge reduction in the fatal crash rate (green line).

Fatal crash rate per articulated vehicle, 1982 - 2015

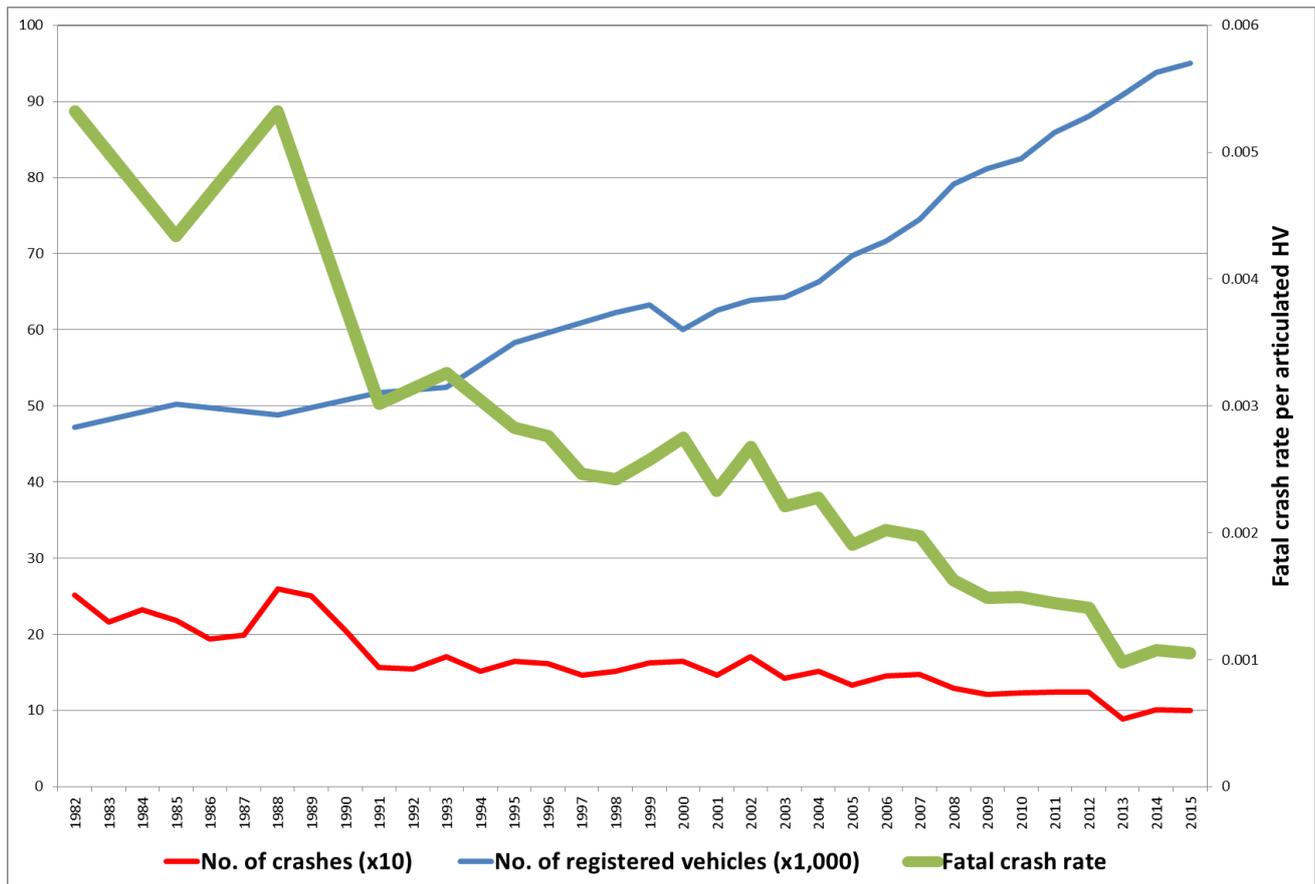


Chart 1: Fatal crash rates⁵

The risk of an accident between a truck and a car is 30 times greater when a truck does not have high visibility markings⁶. A truck with outline reflective markings is recognised much earlier than an unmarked truck because they help to define the total size of the truck to other road users. This gives drivers more time to manoeuvre safely in traffic.

Note:

This Technical Advisory Procedure is to be used in addition to and is not intended to replace existing regulations and ADR lighting or marking requirements.

⁵ Adelaide University Centre for Automotive Safety Research (CASR)

⁶ Prof.Dr-Ing. H.-J. Schmidt-Clausen, Laboratory Of Lighting Technology, Darmstadt University and LBI Unfallforschung Austria: Viewing Behaviour Survey/2001.

2) Contour markings

Contour markings on a heavy vehicle outlines the shape of the vehicle with retroreflective tape to give other road users visibility of the vehicle ahead and the ability to perceive their distance and closing rate. A full contour of the vehicle makes this visual perception easiest. Three levels of contour markings are acceptable:

a) Full contour – the preferred layout.

Reflective tape is applied as close as possible to the edge of the vehicle to form a continuous line depicting the outline of the vehicle. This provides maximum visibility to other road users and is best practice. This method must also be chosen if there are retro-reflective graphics on the side of the vehicle.

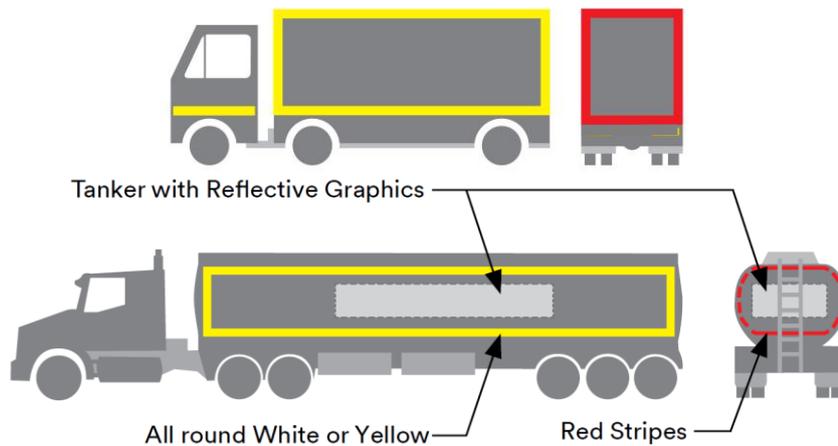


Figure 4: Full contour marking for a tanker

b) Partial contour

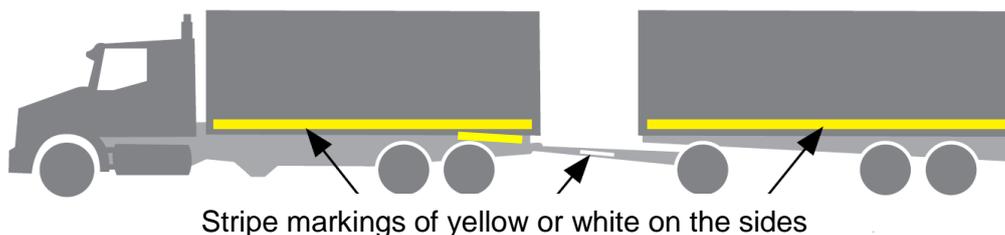
A single stripe of retro-reflective tape is applied along each side and rear of the body or trailer, with 'L' shape sections 0.5 m long in each corner.



Figure 5: partial contour marking

c) Stripe marking

A single stripe of retro-reflective tape is applied along each side of the vehicle and body or trailer side, and a strip across the rear. This basic layout shall only apply to those vehicles that do not utilise retro-reflective graphics or logos or have limited structure onto which tape can be applied on the upper sections of the trailer.



Stripe markings of yellow or white on the sides

Figure 6: Stripe contour marking for truck and dog

d) Front of trailers

The UN ECE R104 does not require the forward face of the trailer to be marked, however, it is highly recommended if the trailer is regularly parked outside a secured depot, retroreflective tape should also be applied to the trailer's forward face.



Figure 7: Stripe contour marking for the front of trailers is optional

e) Options for curtain sided vehicles

As a result of the material used for curtain sided trailers, specific retroreflective tapes must be selected. These tapes are either flexible or segmented so that they can flex as the curtain is retracted. These markings should as a minimum be applied to the lower section of the curtain, underneath the line of the straps. The placement of stripe should follow one of the three options detailed previously.

The continuous flexible tape can be applied in the same format as detailed previously, the segmented tape must be placed so that each segment is not spaced more than 50 per cent of the width of the segment apart, and covers at least 80 per cent of the vehicle length.



Figure 8: Example of segmented tape options for curtain sided trailers

3) Key material requirements

It is recommended that the retro-reflective material used for contour markings and its colour be appropriate to the location, complying with the requirements of class 1A material as specified in the UN ECE R104 regulation. Additionally, tape incorporating the European E marking (see figure 9), in accordance with Clause 5 of UN ECE R104, easily identifies that it is suitability for this application.

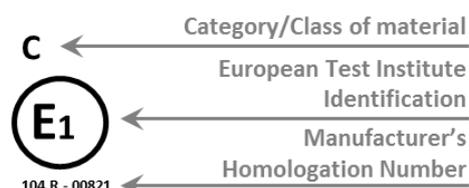


Figure 9: Example of UN ECE R104 compliant E-mark displayed on tapes

4) Key dimensional requirements

The total minimum length of the retro-reflective markings shall be at least 80 per cent of the combined length bumper to bumper (including the prime mover), and 80 percent of the width of the vehicle.

Where non-continuous stripes are used, the distance between single elements shall be as small as possible and should not exceed 50 per cent of the length of the shortest element. Such segments shall be evenly distributed.

The stripes shall be installed as close to parallel to the ground as possible, at a minimum height of 250 mm and a maximum height of 1.5 m from the ground. Where vehicle designs do not allow compliance with the 1.5 m maximum height, a 2.1 m maximum height is acceptable.

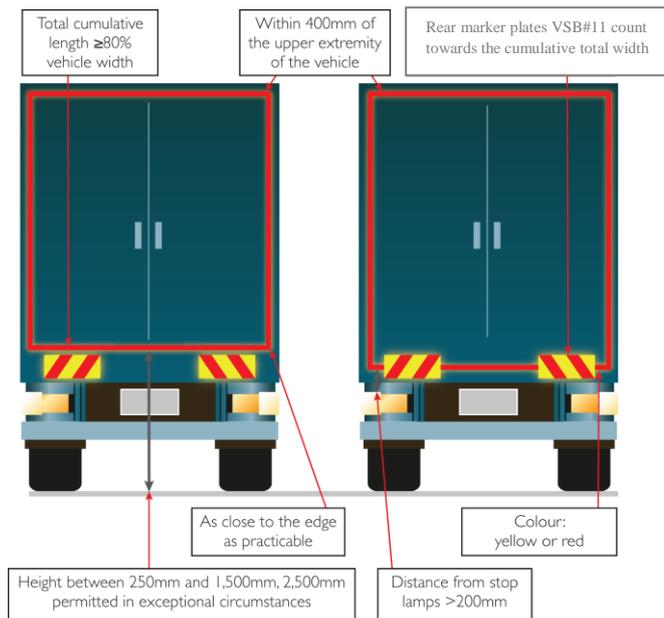
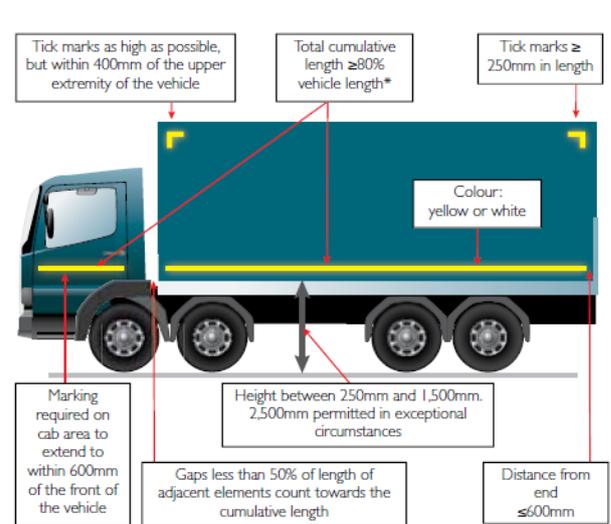


Figure 10: rear positional requirements⁷



*Vehicle length excludes the cab, however the cab area must be marked to comply with the requirement to extend to within 600mm of the front of the vehicle

Figure 11: side positional requirements⁵

There are a range of suppliers and importers offering a wide range of options.

It is recommended to use tape compliant to UN ECE R104 with dimension of $50 \begin{smallmatrix} +10 \\ -0 \end{smallmatrix}$ mm.

- Select the colour of the tape appropriate to the location and surface type.
- Select class 1A material, which has typically been E Marked for quality purposes.

⁷ The ATA wishes to acknowledge the Freight Transport Association of the UK for allowing the images to be used.

5) Best practice / recommended colours

Location on vehicle	Recommended colour	Allowable optional colours, but not recommended
Front	White	None
Side	Yellow	White
Rear	Red	Yellow

Table 1: Permissible colours on vehicle sides



Figure 12: Sample colour swatch

The recommended colours, listed in table 1 above, have been selected to align with the typical lights used in the equivalent directions:-

- White (head lights) to the front
- Yellow (side marker lights) lights to the side
- Red (brake and stop lights) to the rear

Notes:-

- Refer to ADR 13/00 Installation of Lighting and Light Signalling Devices, ADR 47/00 Retroreflectors and Heavy Vehicle (Vehicle Standards) National Regulation for additional guidance. Noting that the National Heavy Vehicle Law (NHVL) for vehicle standards defers to the second or third edition ADR, if the HVNL is inconsistent with the ADR, regardless of whether or not the vehicle is required to comply with the requirement.
- Exempt vehicles, such as emergency and police vehicles, are not required to comply with this standard.

6) Applicability to vehicle types

It is recommend that high visibility markings, as detailed in this TAP, be fitted to all heavy goods vehicles with a Gross Vehicle Mass (GVM) or Gross Trailer Mass (GTM) greater than 4.5 tonne. This is in line with the UN ECE R104 requirements.

7) Issues with the use of US style red/white block stripe markings

The FMVSS 108 marking requirements have been in force in the US since December 1993. It applies to trailers over a GTM of 10,000 lbs (4,535 kilograms) and rear of prime movers. It is most visibly illustrated as the red/white block stripe pattern down the side and across the back of US trucks and trailers.

An updated version of ADR 13/00, registered 10 May 2013, is believed to be the first occasion that the optional conspicuity marking requirements were limited and that they needed to comply with the UN ECE R104 regulation. This change was not widely known within the industry and combined with an incorrect listing of the acceptable colour for side retroreflective tape detailed within ADR13/00, produced a conflict with the first edition of this TAP.

As at the date of issue of this TAP, ADR13/00 is still waiting to be updated, but it is recognised by the authorities that the colours detailed in section 4 of this TAP are approved.

This has resulted in the US style red/white block stripe conflicting with the ADR and as a result, it can no longer be used on road. The National Heavy Vehicle Inspection Manual (NHVIM) will be updated in time to clarify how these conspicuity markings will be handled for in-service vehicles.



Figure 13: US approved installation, which is NOT approved in Australia

8) Costing estimate for a full contour marking

Based on a prime mover and a single trailer combination with an overall length of 19 metre.



Figure 14: Full contour marking

Material Cost

Front (white) 11 m @ \$95 per 15 m roll

Side (yellow) 68 m for the trailer and 6 m for the truck @ \$95 per 15 m roll

Rear (red) 11 m @ \$95 per 15 m roll

Total estimate for material cost \$608 per semi-trailer combination.

Notes

- Pricing is indicative only and applicable as of July 2016.
- Retroreflective tape to suit either curved or flexible surfaces will cost about 50 per cent more than standard tape applicable to hard flat surfaces.

Labour hours for marking a prime mover and semi-trailer.

Front (trailer only) 15 minutes for a stripe marking

Side 75 minutes per side,

Rear 45 minutes

Estimated total 2 hours and 15 minutes

Notes

- Applications is dependent on access to the top of the trailer
- Skill level and the availability of suitable equipment for working at heights to apply the material will have a significant impact on the tapes fitment time.

9) Applying the tape

Instructions and application requirements can typically be found on the tape suppliers' website.

Notes

- The key is surface preparation it must be rust and dirt free.
- Clean with isopropyl alcohol (IPA) surface solution.
- Ensure air and surface temperatures are between 18 and 30 degC.

10) Application examples



Figure 15: Tanker with partial contour markings⁸



Figure 16: Skip loader with line markings⁶

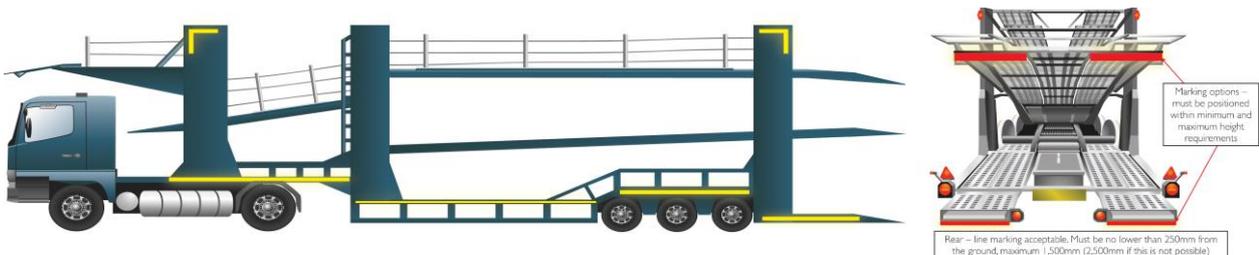


Figure 17: Car carrier with partial contour markings⁶



Figure 18: Semi-trailer with tray and line markings⁶

⁸ The ATA wishes to acknowledge the Freight Transport Association of the UK for allowing the images to be used.
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Application examples – continued

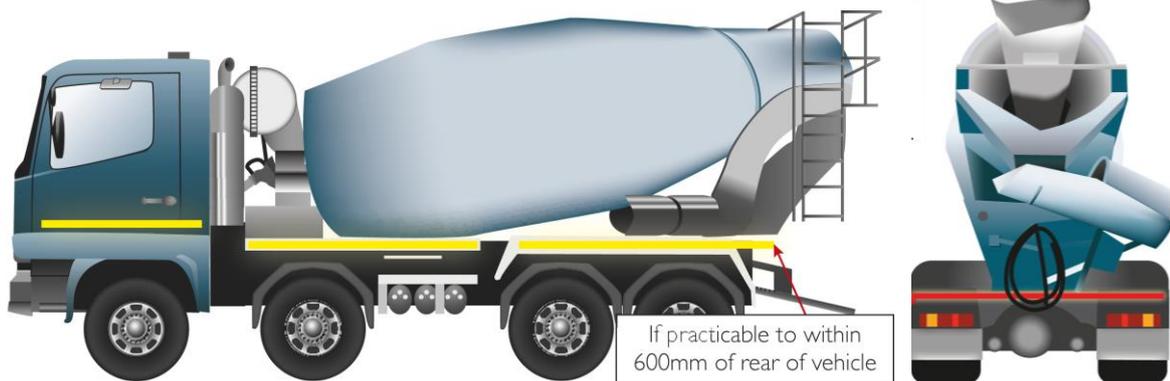


Figure 19: Concrete mixer/agitator with line markings⁷



Figure 20: Rubbish truck with partial contour markings⁷

Many rubbish trucks will not be able to take a full line or contour marking due to the equipment being fitted. In these cases, it is acceptable to retain rear marker plates with conspicuity markings fitted to the fullest extent practicable.



Figure 21: Rigid with tray and line markings⁹

⁹ The ATA wishes to acknowledge the Freight Transport Association of the UK for allowing the images to be used.

Application examples – continued.

Semi-trailer combination with full contour marking



B-double tanker combination with stripe marking

The retroreflective tape should be applied along widest segment of the tanker to have maximum visibility effect for other road users, which is usually the vertical surface. This may place the tape more than 1.5 m above the road surface as required by UN ECE R104, but the enhanced visibility of the tape is preferred.



Application examples – continued

Rubbish truck full contour marking



Tray and flatbed truck: (mark the best profile you can for the vehicle).



B-double tanker trailers



TAP development process, history and validation

The process

The ITC will approve the need for the creation of a new TAP or the triennial routine review of an existing TAP. The nominated editor(s), who are listed below, with support of the ITC and specialist industry technical members as required, will agree on the TAP content with approval by an ITC member majority vote. A suitably qualified and experienced ATA appointed peer reviewer will further review the publication and if necessary, recommended changes. These changes will then be reviewed and approved again by an ITC member majority vote before the document is released.

Document version control

Edition	Date	Nature of change / comment	Editor(s)
First	July 2003	Initial issue	David Coonan, ATA National Manager - Policy
Second	July 2016	General update and rewrite to bring the document in line with current practices with additional illustrative pictures.	Chris Loose, ATA, Senior Adviser Engineering

The next review is expected on or before August 2020.

Drafting committee, first edition

Member	Organisation	Title / Qualification
Pippa Batchelor	3M Australia	Technical and Regulatory BDM, 3M ANZ. Engineering
Mark Gorman	3M Australia	ANZ Business Development Manager - Markings

Peer review, second edition

Edition	Date	Peer Reviewer	Organisation / Qualifications
Second	July 2016	Ivan Babic	Manager Signs and Delineation Assets - RMS NSW, Bachelor of Engineering and Chair of Standards Australia working group ME-053 Motor Vehicles - Rear Marker Plates



About the ATA Industry Technical Council:

The Industry Technical Council (ITC) is a standing committee of the Australian Trucking Association (ATA). The ITC's mission is to improve trucking equipment, its maintenance and maintenance management. The ITC was established in 1995.

As a group, the ITC provides the ATA with robust professional advice on technical matters to help underpin ATA policymaking. It is concerned with raising technical and maintenance standards, improving the operational safety of the heavy vehicle sector, and the development of guidelines and standards for technical matters.

ITC performs a unique service in the Australian trucking industry by bringing operators, suppliers, engineers and other specialists together in a long-term discussion forum. Its members provide expert and independent advice in the field to inform the work of the ITC. The outcomes from ITC benefit all ITC stakeholders and the industry at large.

The ITC operates under the Australian Trucking Association's Council, which formulates industry policy for the implement by the organisation.

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