

RETRO-REFLECTIVE MATERIAL AT THE REAR OF HEAVY VEHICLES: DETERMINING WHETHER USAGE IS IN LINE WITH THE UPDATED TRAFFIC REGULATIONS

M. L. Haarhoff

University of Natal Interdisciplinary Accident Research Centre (UNIARC)

Centenary Building, University of Natal, Durban 4001. Tel 031 260 3136/7. Fax: 031 260 1411.

ABSTRACT

A survey conducted at three of the country's toll plazas and one heavy vehicle checkpoint next to a fourth toll plaza, in August 2002, aimed to establish how many of the heavy vehicles using South African roads carry the regulatory yellow retro-reflective tape correctly, at the back. The tape is expected to alert drivers coming up behind heavy vehicles in the dark, at high speed, to their presence and size.

The data recorded for 1 000 heavy vehicles offered the following information:

- The retro-reflective tape on 42.1% of the vehicles was applied correctly.
- 57.9% of the vehicles had tape that did not follow the regulations.
- Heavy vehicles are required to carry a horizontal strip of the tape across the full width of the body of the vehicle. 36.7% of the vehicles had no tape at all on their body.
- Where heavy vehicles have under-run bars, a further, extra strip of the tape should be carried across the full width. 15.8% had no tape on their under-run bars.
- 2.7% of the vehicles had no under-run bars. Under-run bars are fitted to prevent smaller vehicles sliding under heavy vehicles from the rear (and thus decapitating the occupants) during crashes.
- 6% of the vehicles had no tape at all across their rear sides.
- The retro-reflective tape on 12.9% of the vehicles was in such bad condition that its retro-reflective qualities were ineffective.
- The retro-reflective quality of the tape on 8.1% of the vehicles was ineffective due to the mud and dirt adhering to the tape.

Unexpected findings included:

- During the fieldwork, 22 heavy vehicles without any registration plates were spotted.
- The available statistics on head/rear collisions offer little conclusive information.
- Various levels of non-compliance are apparent and may need to be enforced according to a graded system.

Recommendations involved a combined process of internal communication and education within the traffic fraternity, external communication with stakeholders and communication via the media. Thereafter, a programme to increase enforcement in order to improve compliance was suggested.

INTRODUCTION

Head/rear collisions cause severe damage to the rear vehicle and its occupants, and can involve multiple fatalities. More collisions occur during the night than during the day. The Department of Transport's May 2002 statistics found that most crashes occur between 18:00 and 23:00. 56% of the crashes involved trucks, though how many of these were sedan head/rear collisions with the truck ahead, was not defined. Psychometric testing has proved that the comfort zone into which night drivers often retreat, due to boredom and fatigue, is an ever-present threat. In the absence of several other cars, they can see nothing beyond the range of their vehicle lights, on which to focus. The field of vision narrows considerably and they fail to notice lights well within their peripheral vision or line of sight.

Table 1. Head/rear collisions, 1998.

Year	Casualties	Deaths	Serious injuries	Slight injuries
1998	17 011	644	3 504	12 863

Source: Road Traffic Collisions Report, 1998

BACKGROUND TO THE STUDY

The National Road Traffic Act was amended in 1996 to require all heavy vehicles to carry standardised retro-reflective strips across the back of the vehicle. This project aimed to measure compliance rates. Regulation 192A of the National Road Traffic Act 93/1996 should be considered in conjunction with Regulation 104: 2.2.1, 2.2 and 2.3, as indicated below (in laymen's terms).

- A heavy vehicle (10 000kg and upwards) must display a continuous strip of retro-reflective tape horizontally from side to side, to its full width, or as wide as is possible.
- When under-run bars are fitted to the vehicle, they must also carry a strip of retro-reflective material, to the full width of the vehicle. Therefore, two strips must be seen.
- Rear contour markings must show, as nearly as possible, the vehicle size and shape.
- When strips cannot be in one continuous line (due to the presence of objects such as lights or retro-reflector lights), the distance between each piece of strip must be as small as possible and the spaces between pieces must be no more than half the length of the shortest piece of retro-reflective strip that forms part of the full horizontal strip.
- The retro-reflective marking materials must be between 250mm and a 1,500mm from the ground.

MOTIVATION FOR THE STUDY

The amendments to the regulations were made due to the number of accidents involving cars rear-ending heavy vehicles on freeways at night. Heavily loaded vehicles reduce their speed when travelling uphill and sedan drivers were failing to react to reduce their own speed in time to avoid colliding with them. Drivers also need to be aware that the vehicle they are about to overtake is longer than normal, so that they have sufficient space to complete the manoeuvre safely. In this context, the survey was proposed.

A high percentage of heavy vehicles overtake each other during the hours of darkness, making greater use of the 'fast' lanes. Lecturers at a traffic training colleges reported that some heavy vehicles use yellow packaging tape instead of the regulation retro-reflective tape. Only in the dark can the distinction be easily discerned. When interviewed in the course of the project, these traffic-training gurus argued that packaging tape offers a cheap alternative, but does not fulfil the requirements: it shines in the sun but does not reflect in the dark.

The applicable regulations are difficult to enforce except at truck-check stations, but these are sometimes hopelessly understaffed. Head/rear collisions between sedans and 'heavies' invariably receive heavy media coverage due to the shocking injuries caused to the occupants of the second vehicle and the difficulty in cutting the injured from the wreckage. Small hope exists of getting them to trauma centres within the first 'golden' hour and the cost of incident management is extremely high.

None of the approved statistics record the number of smaller vehicles that drive into/under heavy vehicles at high speed, at night. Even the most recent sets of statistics available from the Department of Transport quote separate figures for sedan vehicles involved in crashes, for trucks involved in crashes and a third figure for head/rear crashes, but no information to relate the three figures to each other. Table 1 gives an indication of the sort of numbers involved.

Head/rear collisions decreased by 17.65% for May 2002 against May 2001 and 56% of May, 2002's crashes, involved trucks. The number of fatalities during May, for both years, in the head/rear crash category stayed the same, although there were three more head/rear crashes recorded in 2002. Accident costs for all

categories rose from R76.57m to R83.86m (up R7.29m) for 2002 (National Department of Transport) but this increase could be as the result of annual inflation.

Still with May 2002: head/rear collisions comprised 8.21% of the total crashes and 8.33% of the fatalities. Table 2 gives a comparative analysis. These figures appear to be low considering the rise in the 'live truck population' on NaTIS (National Traffic Information System) which shows an increase from 22 6174 to 46 2052, in one year.

Table 2. Comparative national statistics for June 2001/2 for head/rear collisions.

Categories	June 2001	June 2002	Difference	% increase
Total head/rear collisions	7	22	+ 15	+ 314
Total head/rear fatalities	8	29	+ 21	+ 362.5
Urban head/rear collisions	3	7	+ 4	+ 233.3
Urban head/rear fatalities	3	13	+ 10	+ 433.3
Rural head/rear collisions	4	15	+ 11	+ 375
Rural head/rear fatalities	5	16	+ 11	+ 320

Source: Arrive Alive Monitoring and Reporting, 2001/2002

All crashes rose by well over 250% for June 2002 against June 2001. Reading any month in isolation can give a false impression of the state of road safety for a longer period. Weather factors, such as rain, mist and fog, vary from year to year. Alcohol consumption, fatigue and human driver error are some of the human factors involved. In June, large numbers of holiday makers drive long distances. The averages of May and June 2001 together, compared to those of 2002, would probably offer a more realistic scenario.

AIMS AND OBJECTIVES

This survey aimed to answer three simple questions:

- How many heavy vehicles travelled past particular points on certain of our main highways on two chosen days of a single week during two predetermined four-hour 'windows'?
- What percentage of them did display the obligatory retro-reflective material correctly?
- What percentage did not, or displayed material that had been badly damaged?

METHODOLOGY

Sampling and sites chosen

A sample of 1 000 heavy vehicles was used. Weekly vehicle counts from various toll plazas were collected and calculations, according to time of day and day of week, were made. Four sites were used countrywide, so that the sample represented the national picture. The final choice included four that were some distance apart and covered traffic flow on different highways. Vehicle counts obtained from the NRA/plaza management at Kranskop Plaza, Middleburg Plaza and the Huguenot Tunnel showed that about 140 vehicles might use the toll plazas during each four-hour stretch identified. This was an estimate and could not be guaranteed. Marianhill became the last of the four (see Table 4).

Table 3. Sampling framework per site.

Plaza/checkpoint	Geographical Position	Sample size
Huguenot Tunnel	+/- 50 km north of Cape Town on the N1	250
Kranskop Plaza	+/- 150 km north of Pretoria on the N1	250
Middleburg Plaza	+/- 100 km east of Pretoria on the N4	250
Mariannhill Plaza	+/- 20 km west of Durban on the N3	250
Total sample size	Countrywide	1 000

Table 4. NRA data for head/rear collision statistics on the N1 (north) and N4 (east).

Route/sections	Geography	Dates	Head/rear collisions
N1/21-29	Pretoria – Zimbabwe border	1/2/01-31/1/02	8
N4/3-8	Pretoria – Mozambique border	1/7/01-1/7/02	25

Note: NRA = National Roads Agency

Kranskop, Huguenot and Middleburg Plazas all managed to fulfil their quotas and more, although in all cases, one side was busier than the other. Mariannhill Toll Plaza proved to be by far the busiest of the four sites. The heavy vehicle traffic leaving Durban (westbound) was so prolific, that all the passing vehicles could not be recorded.

Training on technical details

Each team had a leader with the technical knowledge needed to coach fieldworkers according to the instruction document and ensure that all could identify 10 000kg (and above) vehicles. Each leader augmented his team with three fieldworkers. Material from specialist technical/lecturing officials was collated with the pertinent regulations, into a written document with relevant diagrams. This was then sent to all team leaders, who briefed their teams and took them, before their shifts, to truck-hire companies/corporate fleet yards to learn to recognise 10 000kg vehicles.

Arrangements with toll concessionaires

All arrangements were made with the toll concessionaires (through the National Roads Agency) and letters of introduction were supplied to the teams, together with detailed instructions. Letters of reminder went out to team leaders, toll plaza managers and the NRA employees delegated to liaise with the researcher. Individual security measures were followed to the letter.

Positioning and action at sample sites

Fieldworkers were stationed on both sides of the four tollgates from 19:00 – 23:00 on 12/8/2002 and 16/8/2002. One of each pair read the registration numbers, checked the retro-reflective material and called to the other, who acted as scribe. Sixty-four hours were worked in total. The retro-reflective quality of the material is far more apparent in the dark. The booths/truck stops offered safety to the fieldworkers, sufficient light to read and write and, as each vehicle pulled off onto the dark freeway, retro-reflective qualities could be easily observed. At the Huguenot Tunnel, fieldworkers were asked to work at the heavy vehicle checkpoint because the toll plaza was considered unsafe for them. Due to the surge of heavy-vehicle traffic at Mariannhill, the team on the westbound side concentrated on only one lane, instead of the three used by heavy vehicles. The registration number often differs at either end of the vehicle, so all the information was noted after a vehicle had passed the fieldworkers.

DATA ANALYSIS

The study included both qualitative and quantitative factors. In some situations the figures do not add up to 100%. For example: those vehicles that had no retro-reflective material on the bodies and those that had none on the under-run bars, provided an overlap.

In some cases, material could scarcely be identified as retro-reflective from a few metres away, due to a build-up of dirt. The criteria used to grade the information are demonstrated in Table 5. Fieldworkers were generally astounded when a vehicle displaying retro-reflective tape in pristine condition passed them; since they were few and far between.

Table 5. Criteria for analysis of the retro-reflective information.

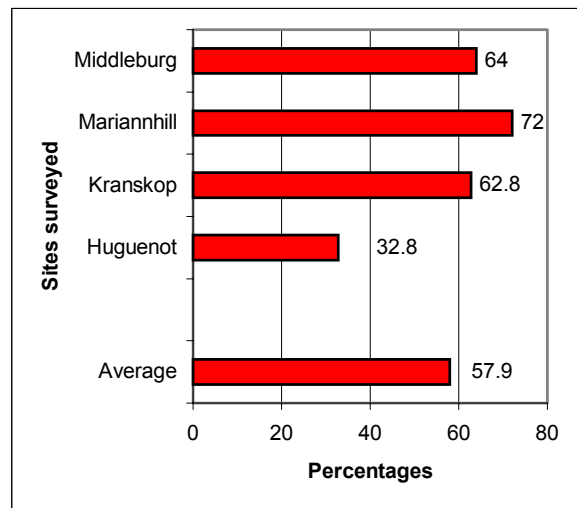
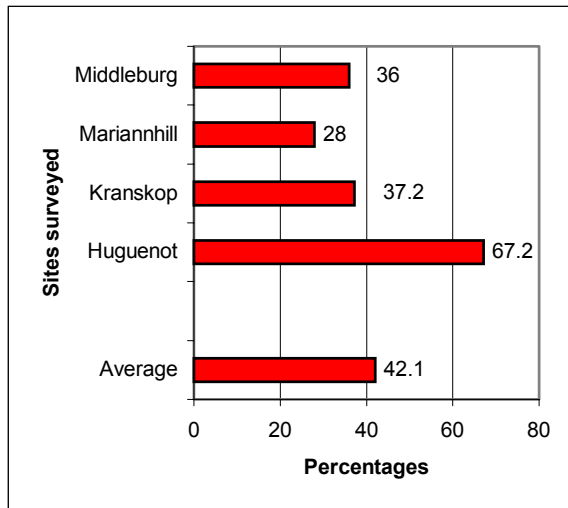
Description Criteria	Percentage Correct and Retro-Reflective Effectiveness	
	% Correct	Distance of Effectiveness
Excellent, good, fine	80-100	75+ metres
Acceptable, reasonable, fair, satisfactory, okay	50-80	50-70 metres
Poor, dirty, damaged, bad, tatty	0-50	<50 metres

MAIN FINDINGS AND DISCUSSION

Some information is absolute e.g. the trucks either displayed the tape or they did not. The quality of the material depended in part, though, on individual perception. Whether the material had been displayed according to regulations should have been an absolute, but the Huguenot Tunnel findings showed that this is also an individual perception.

Retro-reflective regulation and non-compliance

Figures 1 and 2 show that the regulations were either followed to the letter or not correctly adhered to.



Note: Total sample is 1 000 and sample size per site = 250

Figure 1. Retro-reflective material regulations followed.

Figure 2. Retro-reflective material regulations not followed.

Those vehicles using the material incorrectly (including those that had no tape at all), have either not read the regulations, have not understood what they have read, may have worked according to hearsay or simply have no intention of following the regulations. This last implies disinterest and a lack of respect for both

regulations and authority. The regulations, as written, are not easy to understand: if traffic officers are having difficulty grasping that the presence of an under-run bar demands a second strip of tape, and that each strip must be continuous, there is little reason to suppose that others, some less literate, would find them easy - traffic officers undergo training to familiarise them with the Act, the public does not.

Uneven application of the regulations

As technical documents they are necessary to road traffic management; there to ensure that all traffic, throughout the country, is managed according to the same exacting standards. Is traffic actually being managed to the same standards throughout the country? The use of retro-reflective material is a very small part of the enforcement/compliance ritual. If disparity exists between provinces on this one matter, it is sure to exist on others. What is acceptable to officials in one province is difficult to enforce in another. Successful fine collection or prosecution in, for example, KwaZulu-Natal, for an offence committed there, by a vehicle licensed in Gauteng, but never ticketed in its home province, is jeopardised, making enforcement a farcical exercise.

The Huguenot Tunnel numbers differed noticeably from those of the other three sites surveyed and was the only site where fieldworkers worked in conjunction with traffic officials. The Huguenot Tunnel heavy vehicle check-point was manned throughout the hours that the fieldworkers were on site, thus another possibility exists: could fleet managers from all over the country send only their best-marked vehicles to Cape Town because they are aware that the enforcement there is better than elsewhere? This is a doubtful possibility.

It appears that the Huguenot heavy vehicle checkpoint is manned twenty-four hours a day, which precludes the need for heavy vehicles to time their trips to avoid contact with authority. Whether the officials who man it were more stringent than those elsewhere, would only be cause for debate if the figures retrieved from this site showed less compliance than the other sites. Instead the figures show far more compliance. It follows that traffic officials need more detailed instruction.

The regulations were written to serve a particular purpose. Results of the study show that strict compliance with the letter of the regulations does not appear to be a priority. If the issue is important enough to have specifications attached, surely it is important enough to warrant correct enforcement? A senior traffic official of the Durban Metro Police agreed wholeheartedly that rear retro-reflective material is of vast importance. He is, however, concerned about the low number of convictions obtained for other important offences, e.g. overloading. The Bayhead Weighbridge Management and Operation Report for May 2002 high lights the serious lack of traffic officials to perform the checks.

Challenges to traffic officials

The obvious lack of respect for the regulations suggests a far deeper issue: enforcement needs to be as consistent and exacting as the law itself to inculcate a sense of respect for authority. The lack of incentive to follow regulations, needs to be rectified from within the ranks of the fraternity. Administration, management and training of the officials who are Traffic Management's direct link to the public, need to be far more exacting to allow individual officials to perform adequately. The more officials are seen to be exacting severe consequences for vehicles non-compliant with the letter of the law, the more respect the regulations will obtain.

Where cases are thrown out of court, officers should receive coaching and support. Traffic crime is far more able to earn income to sustain competent policing than other forms of crime. Incarcerating criminals costs the state/taxpayer money. Traffic crime, to a far greater degree, could ensure that the money needed for adequate policing is available. Obvious and long-standing difficulties exist between the Departments of Justice and Transport. The 'penalty system' will develop solutions, if managed correctly. Until then, improvement of the status quo should be a priority.

Breaches of the retro-reflective regulations

The main breaches of the regulations concerning retro-reflective tape can clearly be seen in Table 6, where they have been dealt with per site surveyed. The high compliance rate for the Huguenot Tunnel is immediately apparent. While the numbers for the other sites do not follow an exact pattern, they generally show similar trends.

Table 6. Main findings tabulated per provincial survey site.

Information Surveyed	Findings per provincial survey site (%)				Average (%)
	Huguenot	Kranskop	Mariannhill	Middleburg	
Regulations followed	67.2	37.2	28	36	42.1
Regulations not followed	32.8	62.8	72	64	57.9
No tape on body of vehicles	1.6	36.4	61.6	47.2	36.7
No tape on u/r** bar	4	30.8	6	22.4	15.8
No tape at all on back	1.6	10	4.4	8	6
No u/r** bar on vehicles	0	7.2	0.8	2.8	2.7
Condition of r/r* tape bad	22.4	13.2	7.2	8.8	12.9
R/r* tape dirty and ineffective	8.4	10.8	10.8	2.4	8.1

* r/r = retro-reflective. ** u/r = under-run.

Vehicles at each site are a mix of registration numbers from all over the country and beyond its borders. The Huguenot Tunnel was the only one of the four sites where more vehicles were recorded without tape on the under-run bars. The figures in breach of regulation were so slight here, that it raised the question: are the traffic officials who man the heavy vehicle checkpoint au fait with the regulations?

The Kranskop, Mariannhill and Middleburg numbers all showed similar, but varied patterns. Kranskop and Middleburg both reported substantial percentages of vehicles without retro-reflective tape on the under-run bars, Mariannhill reflected very few. Instead, the vehicles carrying no tape on the body of the vehicles were higher at Mariannhill than for any of the other sites. If the percentages for displaying only one strip of tape are added together, more similarity between the three sites immediately becomes apparent: Kranskop - 67.2%, Mariannhill - 67.6% and Middleburg - 69.6%. The Huguenot Tunnel remains the only anomaly, with a total of 5.6%. Most offenders, then, used the retro-reflective tape correctly on either the under-run bar or the body of the vehicle, but generally chose not to fit both with tape.

Vehicles carrying no retro-reflective tape at all are clearly the least compliant. That these vehicles are left to function on our roads at night does not inspire confidence: car carriers, brand new vehicles for delivery and old and badly kept vehicles appeared to be the main 'offenders'.

Data collection per site and national averages

Semi-observance of the regulations is far more apparent and should, perhaps, be blamed on obvious factors: misunderstanding of the exact regulations, the relative expense of the retro-reflective tape and lack of enforcement. If an owner has fitted tape in one area, it follows that the regulations concerning the tape are at least partly understood. The retro-reflective tape is a consumable item, thereby requiring repeated outlay. Wear and tear is ongoing, especially when loading and off-loading. Much of the tape on under-run bars was also damaged. Replacement is a continual expense. It may be for this reason that so many vehicles are 'short-taped'. The difference between contour markings that effectively delineate the outer edges of the vehicle and strategic placement of a few small pieces of tape, may well 'cash in' on the confusion.

Retro-reflective replacement needed

A number of vehicles clearly needed to replace the tape on the back of their vehicles with new. While the retro-reflective quality of the tape dissipates over time, and may be due to several reasons, a measurement is clearly needed to define the point at which it is no longer effective and can be judged a 'finable' offence. As long as the tape presently in use remains a consumable item, no supplier will wish to manufacture a more durable product – replacement guarantees turnover.

If preference is to remain with the tape presently in use, would it be worth designing and manufacturing a strong, metal 'carrier' strip (flat, but with curves top and bottom; to be cut to vehicle widths) which could be pop-riveted to body and under-run bar? While this would protect the tape from a certain amount of rough treatment, preventing tearing and chipping, it would not reduce weathering. It would also increase fitting costs, but would vastly reduce replacement costs. Companies/professionals dedicated to the invention, production and manufacture of marketable products in this field, could be approached for comment and/or intensive research into a practical solution. At present, the retro-reflective tape conforms to SABS standards as laid down in the regulations. Would it be sensible to change the relevant specifications?

Some vehicles carried tape that was too dirty to attract sufficient attention from motorists in the dark. It would be impossible to maintain the tape in a state of pristine cleanliness in muddy weather and fining in this situation is not up for suggestion.

STRATEGIC EXPOSURE AND TACTICS ON RETRO-REFLECTORS

Comment on the build-up of heavy vehicle traffic at Mariannahill Toll Plaza in the early evenings is essential. The Bayhead Weighbridge has been operating at most until 17:00 on a daily basis. For this reason, many heavy vehicles have been waiting until after 17:00 to leave the harbour. It can be assumed that most are overloaded and well aware of it. Metro Police insist that the weighbridge will soon be operating twenty-four hours a day. The traffic officers manning the weighbridge could bring in considerable revenue to augment Metro Police operational expenses.

Where weighbridges and heavy vehicle checkpoints only pull out some passing vehicles for thorough checks, officials should be required to pull out all vehicles where retro-reflective material does not conform to the minimum standard. A drum of water, detergent, scrubbing brushes and squeegees could be provided for drivers to clean their tape prior to continuing their journey. Personal driver inconvenience may prove a far greater deterrent than fining – the driver becoming a direct link to the company. This tactic also underlines the responsibility of drivers for their vehicles.

UNEXPECTED FINDINGS AND OTHER ISSUES NOTICED

Statistics would be more helpful if demarcated more fully by vehicle type and linked to more tightly descriptive categories of collisions/accidents. While this may not be necessary for all situations or research, in the case of this project, the information was certainly not sufficient to make absolute deductions.

In order to link this project to a specific type of collision, the regulations for retro-reflective tape on the side of vehicles were not included. In many cases, though, where teams could see the tape on the near-side of the vehicle, this was also reported to be faulty.

CONCLUSIONS

The following conclusions can be drawn from the survey:

- An average of 42.1% of the vehicles that had retro-reflective tape fitted according to regulations, included some with tape in imperfect condition or dirty.
- A small proportion of owners clearly flout the regulations. The number was not high and may depend on product cost or incomplete understanding of the regulations.
- It seems that insufficient attention is given to enforcement of the retro-reflective material regulations.

RECOMMENDATIONS AND GENERAL COMMENT

Recommendations involve a combination of communication within the traffic fraternity, communication with stakeholders and the media:

- MINCOM should agree on minimum requirements, whether a graduated fining system should be used for lesser/greater offenders and the press release provided.
- Each province to ensure that directions are given to all traffic officials. Alternatively, short workshops could be held. Learning material should be issued to each officer.

- Press release the media, especially magazines with special interests in the trucking sector, to convey the project findings. Companies should be warned that their vehicles will not only be fined, but will also not be allowed to continue overnight trips.
- Send a letter to the oil companies, suggesting that forecourt staff, while refuelling heavy vehicles, offer to wash the retro-reflective material on trucks.
- Thereafter, blitz/fine any vehicle not displaying the retro-reflective material to the minimum standard and refuse to allow it to continue a night journey. This will only be practical, where there is adjacent parking. Plan road-blocks accordingly.
- Check dockets issued for traffic infringements, to ensure convictions. Exact fine collection to the best of each local team's ability. If enough fines are issued to particular companies, compliance becomes the line of least resistance. If loads are delayed – companies will pay.
- A personal appointment with the managers of large fleets, may be sufficient for advisement by, and agreement with, the Traffic Department for action to be taken.
- Alternatively, invite fleet managers to forums – these to include some background and a clear explanation of the requirements for complete compliance. 'Hard copy' instructions could be issued. Events of this nature would take about two hours and would need guest lists, invitations, RSVPs and refreshments, but might greatly improve relationships and perceptions. An element of distrust surely presently exists, where bribe money is often part of a budgeted and quoted price. Forums could provide a basis for sound future relationships, giving fleet managers a platform may reduce the need for underhand dealings. Once traffic management is privatised, it will need to communicate on a far more personal basis. Forums of this nature are common in the business world, where Financial Managers gather to exchange, for example, information on companies that are bad credit risks.
- An official at the National Department of Transport should contact one of the major retro-reflective tape suppliers and discuss the practicality of producing and marketing more substantial, longer-lasting material.

REFERENCES

1. Road Traffic Collisions Report, 1998. National Department of Transport, RSA.
2. South African National Road Traffic Act 93/1996.
3. Dickson, L., 2000. Exploring the phenomena surrounding road traffic collisions and loss reduction strategies along a stretch of the N3 freeway in KwaZulu-Natal. UNIARC, 2000/3.
4. The AA Annual Traffic Safety Audit, 1998. The Automobile Association.
5. Highway News, December 2001. The newsletter of the National Roads Agency. National Roads Agency, RSA.
6. National Road Report, 1998. National Department of Transport, RSA.
7. Weeklong traffic counts – Huguenot Tunnel and Middleburg Plaza. June 2002. National Roads Agency, RSA.
8. Accident Report N1/21 – N1/29. 1/2/01 – 31/1/02. National Roads Agency, RSA.
9. Accident Report N4/3 – N4 /8. 1/7/01 – 1/7/02. National Roads Agency, RSA.
10. Fatal Road Crash Reports and Statistics. May and June 2002. Division Road Traffic Management, National Department of Transport.
11. Bayhead Weighbridge Management and Operation Report. May 2002. Durban Metro Traffic Police.