Should Fire Engines be Red?
Contemporary Urban Fire Fighting Vehicles – Visibility, Warning Devices and Local Area Traffic Management

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Biography
Roger Doyle joined the New South Wales Fire Brigades in September 1990 and is now Director Logistics Support. The Directorate provides much of the Brigades infrastructure including some 800 specialised heavy vehicles, 338 Fire Stations, mechanical and electrical engineering services in an integrated logistics support environment to around six thousand operational personnel.

Roger has worked in areas as diverse as specialised heavy vehicle fitout design, electro-mechanical control equipment, fire detection and suppression systems, motion picture and broadcast television.

Prior to joining the Brigades in 1990, he held positions including Group Technical Manager, Wormald International Ltd., and Technical Director, Samuelson Communications Ltd., based in London.

Abstract
This paper explores contemporary fire service vehicles, the results of recent conspicuity trials that explored base the colours of red, lime yellow and white. Also considered was the highly reflective banding (candy-striping) used around the vehicles, plus the warning beacons now widely deployed and sirens.

Difficulties in heavy vehicle operation when responding to emergency incidents in congested inner-city areas and problems presented by traffic calming devices is considered following analysis of the width, turning circles and gradients appropriate to negotiate narrow roads. Extensive field tests were carried out to verify the correctness of the assumptions.

A NSWFB Recommended Practice *Guidelines Emergency Vehicle Access* was subsequently prepared for the benefit of town planners, civil engineers and designers of road systems. A copy is included in the conference papers.

1. INTRODUCTION

While there is obviously much commonality of operation between emergency services, Fire Brigades tend to stand out – if only because of the size of our responding vehicles relative to those of most others. A *Varley* Commander is a typical example of a contemporary urban pumper and customarily carries a crew of 4 or more firefighters.

Obviously most people associate the Fire Brigades with pumper such as this along with equipment like turntable ladders and elevating platforms.

However the makeup of the fleet is actually rather more diverse, and includes amongst others, hazmat and urban search and rescue units. The design of these highly specialised vehicles requires well-developed engineering skills that today, go far beyond simply designing a box-shaped body on a commercial cab-chassis and fitting a large pump. Road

handling and safety are now key elements in this process and specifications now emphasise this requirement and pre-acceptance testing includes roll-over prediction.

While quite short wheelbased and having an overall length of under than 9 metres, Urban Pumpers are not exactly light as they carry around 2000 litres of water and when fully equipped usually weigh about 15 tonnes. Being required to negotiate suburban streets, they must be capable of withstanding the rigours of high curbs, median strips and contemporary traffic calming devices – including the dreaded chicanes and round-a-bouts. A very small turning circle is obviously an advantage in satisfying operational demands within the restricted urban environment in which they must safely operate!

Advances in urban fire service pumpers include full or part air suspension, full air brakes (rather than air-over-hydraulic), ABS, traction control and ideally, a chassis well capable of withstanding the punishment to which they are regularly subjected.

These attributes do not necessarily come easily. Over the past 10 years or so, operator safety has taken on a new meaning, with cabin seating designed to accommodate the self-contained compressed air breathing apparatus worn by firefighters. This permits firefighters to exit the vehicle in readiness to enter hazardous environments and is seen as a significant advance over the older arrangement where this equipment was stowed in side lockers. Such an arrangement can realistically only be accommodated in full crew-cab vehicles such as shown here and while clearly desirable, such a facility cannot be accommodated in smaller commercial vehicles having less commodious cabins.

These advances clearly come not only at significant cost, short wheel-based vehicles carrying a large crew-cab and air front suspension (which in itself typically adds another couple of hundred kilos) inevitably presents a significant mass over the front axle assembly. By way of example, a Scania 94D with leaf springs, has a front axle mass of some 4.2 tonnes as delivered. Add the in-cab items, fire pump and specialised equipment and this quickly rises to the 6 tonnes currently permitted by the RTA.

While compliance with the 6.0 tonne limit is possible for urban pumpers, an Aerial Pumper, which is a combination unit with a high capacity forward mounted fire pump and elevating boom mounted over the rear, presents a mass of some 6.5 tonnes over the front axle. Other specialist heavy vehicles present similar problems and while undesirable, overmass permits are inevitably required. One way around this is of course to deploy dual steer axles, however manoeuvrability becomes a significant factor as negotiating traffic calming devices is not only quite difficult, in order to meet operational demands of responding quickly, the vehicle itself suffers. The largest items in the Brigades arsenal of heavy plant are the Turntable Ladders and Aerial Platforms – the latter of course having dual steer axles. A *Bronto* being typical of contemporary platforms deployed by many Australian fire services has an overall mass of some 27 tonnes.

Not all Brigade vehicles are that big and we do have many smaller vehicles, used both in city areas, regional centres and towns.

The Brigades also analysed the width, turning circles and gradients appropriate to negotiate narrow roads and conducted extensive field tests to verify the correctness of the assumptions. NSWFB Recommended Practice *Guidelines Emergency Vehicle Access* was prepared for the benefit of town planners, civil engineers and designers of road systems and is available from the NSWFB website. A copy in PDF should be available to conference delegates along with this paper.

2. TRADITIONALLY FIRE ENGINES ARE RED – BUT IS THAT THE MOST APPROPRIATE COLOUR?

The community generally acknowledge red as the colour most readily identified with fire service vehicles, however trials conducted internationally over many years strongly indicate that red may actually be rather less than ideal. Red shows up quite clearly during the day, however at night red tends to darken visually and recedes.

International airport fire service vehicles are generally, lime yellow. This was picked up by the ACT fire service some years ago and continues today. The New South Wales Brigades undertook conspicuity trials on identical vehicles with one being white, one lime yellow and one in plain red (as against red with a white roof as is now customary). Also trialed was the combination of front and rear red and blue warning beacons and alternative reflective striping formats.

Operator reports on vehicle colours indicated that under certain conditions, white did not show up well against strong backlight, as many commercial trucks being white, tended to mask their vehicle. Yellow was reported as visually good and although certainly better than red at night, however during the day operators felt there seemed to be little advantage. Advice from academics working in this field suggest that solid colour schemes are better than multi-coloured. The notion of say, all red was challenged by the Brigades Engineers who demonstrated the advantages obtained by retaining a white roof, in that reflection of the warning beacons was advantageous in spreading the pattern. It was also significantly cooler than red and was less subject to fading. Senior Officers were of the view that there seemed relatively little advantage in changing the existing standardised vehicle colour scheme of red with white.

The results of trials on the reflective tape applied to the vehicles, was far more positive, with high reflectance banded white deemed far preferable.

The outcome of the trials resulted in the now familiar scheme of red on the lower sections (although several shades lighter than previously used) in combination with white on the upper sections, roof and super-structure. Reflective tape is white, banded against yellow or red. Red and blue warning beacons are now of course universal.

A review of the positioning of roof mounted warning beacons across all vehicle types supported comments made by operators that early warning of the presence of a responding fire appliance is increasingly problematic. With windows closed, airconditioning, mobile phones and the dreaded doof-doof door stereos, driver awareness to the environment outside their vehicle is compromised. While outside the scope of this paper due to the time available for presentation, the sounds generated by warning sirens, volume and placement of the drive unit are all significant factors in attempting to overcome the increasingly isolated state of many motorists. The laws of physics state that the angle of incidence equals the angle of reflection of light. Sound is similarly effected and the signal from a siren mounted low tends to be dispersed and not have much reach, whereas one mounted on the roof of a heavy truck may project rather better. However this may be disadvantageous when close behind other vehicles. Obviously this is a significant problem for all emergency service and public safety organisations and while we can always make sirens louder, there are obvious OH&S issues to the occupants of responding vehicles. As it is, the Brigades vehicles can only just comply with our requirement of 85dBa measured in the cabin with the siren on – and that is with the windows closed.

Forward engined passenger vehicles having a long bonnet and low rake front glass as is typical of the Falcons, Commodores and light 4x4s, with the warning beacons located over the ‘B’ pillar, result in a forward projection of over 2.5 metres. A cab-over engined truck

having a more vertical front glass and more rigid roof panel permits the warning beacons to be mounted rather more forward. However even here, a significant distance remains, although being higher, the beacons can be seen more easily at a distance. Even so, there is a downside. A tall vehicle travelling closely behind passenger cars may have its warning beacons too high to be seen in the rear view mirror. Flashing red and blue lights are therefore fitted to the front and rear of all our vehicles, along with low beam flashing headlights. All well and good for visibility at both ends, however warning persons to the side of emergency service vehicles remains. While strobes are significantly brighter and far more energy efficient than rotating beacons, there is a downside. Strobes tend to be far more directional, whereas a rotating beacon gives up to 360 degrees of dispersion – which is further assisted at night by reflections from the white roof.

Highly advantageous is the inclusion of blue *intersection* strobes mounted low and as far forward as reasonably possible - angled to the sides. These provide early warning to motorists at 90 degrees to the responding vehicle. We understand that the NSW Brigades was the first emergency service to adopt the intersection strobes in this country and these are now installed on Ambulances and Police vehicles.

To summarise: Should fire engines be red? Most probably not. However it is obvious that there is far more to the problems associated with clearly identifying the presence of a responding fire engine. Colour alone seems not the answer. Recognition of a responding fire engine is a complex blend of visual and auditory stimulation. The future might well see on-board transponders on all emergency service and public safety agency vehicles and detectors fitted to all vehicles. At least one such system is promoted commercially and was trailed with taxis, suggesting that the idea has merit. However such systems cost money and unless legislation is introduced requiring the installation of receiving detectors in all vehicles, it is unlikely to be adopted by vehicle manufacturers.