

Enhancing the Value of Reflective & Conspicuous Markings on Emergency Vehicles

By John Killen

Emergency vehicles should satisfy five important awareness criteria to safely guide a timely, appropriate and safe response from other road users. The use of the word “guide” in the preceding sentence is by no means accidental. Five factors assist road users in avoiding an emergency vehicle after being alerted to its presence and recognizing an emergency response. These factors are:

- Location:** approaching, passing, crossing laterally, departing or stationary;
- Size:** indicates distance and the changing rate of closure;
- Shape:** outlines vehicle type and orientation;
- Speed:** equals time available for decision-making and avoidance;
- Intended path:** determined by the projection of information providing visual clues and predictability.

The livery (identifying design) on an emergency vehicle is the passive one-third of a total warning package that includes warning lights and sirens. Few of today’s emergency vehicles display a livery or marking scheme that effectively generates important visual clues for other drivers. These vital clues speed up the decision-making process, making the decisions safer and helping prevent collisions. How many times have you seen an organization’s name emblazoned across a vehicle in large reflective lettering with little space left for anything else? Most drivers are not interested in reading text while they are trying to avoid a collision.

Emergency vehicle markings must be visible during daylight, twilight and under artificial lighting at night. Visual feedback from the livery to other drivers is important and even more so at night. Livery should provide the discrete tools other road users need to improve the quality and safety of their decision-making when an emergency vehicle is nearby.

A major influence on modern livery design is the natural process of deterioration in human vision as individuals’ age beyond 40 years old. The ability of the human pupil to adjust and allow additional light into the eye is greatly reduced by

age 70. Growing older means we cannot see detail in low-light situations and require up to 32 times more contrast at 80 years than needed at 20 to see with the same clarity. Our night vision adaptation is reduced and we may experience image blurring, halos around light sources and increasing disability from glare. Age-related vision deterioration and eye disease affects around 40% of the population with up to 10% of the entire population experiencing red or green color-blindness.



Major Features of an Effective Emergency Vehicle Livery

The starting point is the base color of your vehicles. If your vehicle fleet is already painted white, that is an appropriate base color. You need not immediately repaint your vehicles in chrome yellow or yellow-green visibility colors to achieve a high-scoring visibility result. If the fleet is painted in the darker traditional colors such as red, blue or black, you can still add improvements, although you may need to be more innovative.

For example, a circuit of stripes may be added to black and white police vehicles to outline the black sections. Some reflective products appear black in daylight but will shine as white under headlight illumination. Overall visibility increases at night without disrupting the

black-painted panels. This improvement in safety comes at minimal extra cost.

Queensland Ambulance in Australia redesigned the livery and warning lights on its next-generation fleet. The new vehicles now feature fluorescent/retro-reflective livery, improved warning lights and a contemporary corporate image. The subsequent increase in safety was achieved with a 30% saving in costs over the earlier vehicle designs. Fleet managers may only need to add one or two of the following solutions to dramatically improve the performance of their organization’s vehicle livery. The following discussion reviews four simple methods to increase 24-hour vehicle conspicuity across a wide range of different weather conditions.

Apply Fluorescent/Retroreflective Colors to Increase Vehicle Conspicuity

High-visibility colors can be applied to vehicles in yellow, yellow/green or orange/red. Stripes and panels of color increase viewer awareness of an emergency vehicle both day and night. The bright color attracts viewer attention in the central and peripheral fields of vision over much greater distances than conventional markings. Fluorescent colors are not commonly seen in the natural countryside or in urban road environments. The yellow/green color is formulated to match the point of peak sensitivity in human vision and can elicit a response even if first seen at the edges of the peripheral visual fields.

To be effective, the chosen color must cover at least 10% of the total surface area of the vehicle. Take care in sizing and positioning the colored stripes or panels so the vehicle’s profile remains proportionally intact and the fluorescent/reflective color is not visually overwhelming in either daylight or darkness.

Colored stripes or panels affixed to the sides of the vehicle should extend downwards so they are lower than the top of the wheel arches. This leaves two semi-

continued on page 8

Enhancing the Value of Reflective & Conspicuous Markings on Emergency Vehicles

continued from page 7

circular cutouts over the wheels, which communicate strong visual information to the viewer about the size, length and orientation of the vehicle. These informative gaps in the reflective livery are vital at night.

Key benefits of these materials are:

- 1) the visual brightness of the fluorescent color during daylight;
- 2) the vivid luminosity generated in the semidarkness around dawn and dusk and with increasing atmospheric haze;
- 3) the narrow angle, high-efficiency reflective brightness of the colors at night.

The advantage of fluorescence is how the colored pigments reach their peak when most needed during the twilight hours and under certain weather conditions. The increased levels of ultraviolet light present in the atmosphere activate and excite the pigments within the layers. Under high UV levels, the fluorescent films take on an almost ethereal glow.

In darkness, the efficient prismatic construction of the film takes over, reflecting a higher percentage of artificial light within a narrow observation angle so the livery appears much brighter than conventional reflective products. Under headlights, the reflective light output from yellow/green prismatic materials can often equal the brightness of reflected white, previously the most efficient reflective color.

Fluorescent/reflective materials impart very high levels of contrast, not just during daytime and nighttime, but also in fog, rain and smoke conditions. Another benefit of fluorescence is how effectively it compensates for the vision degeneration and impairment found in older members of the population. More importantly, when people with a color vision deficiency view the yellow color, the yellow remains unchanged and does not appear to be a shade of grey.

Resist the temptation to position fluorescent orange/red films in close proximity to the rear brake lights. The intensity of the color can dominate in daylight, masking an illuminated brake lamp. This proximity causes confusion and the activated brake lamp may remain unseen by the drivers following behind.

Avoid Complex Reflective Patterns

The inclusion of murals, candy stripes, diagonal lines, zigzags, chequers and patterns should be avoided. These reflective patterns may be visually spectacular at night, but they present as camouflage, especially in daylight. Irregular patterns break the vehicle's silhouette into small unrelated segments. Patterns can slow recognition of the emergency vehicle and may also increase reaction times. Keep the livery uncomplicated by using simple stripes or panels of color.

A hierarchy of brightness exists for the different reflective colors and the value may vary according to the individual observation angles. The light reflectivity (%) of each nonprismatic color in order are white (84%), yellow (57%), red (13%) and blue (8%). There is a dramatic difference in the reflected light values between white, yellow and the other colors. The darker colors are not as efficient and should they be used, a larger area of coverage will be needed to compensate. Blue text is easy to read in daylight but very difficult to read by reflected light at night. The human eye is forced to adjust rapidly to accommodate the different wavelength of each individual color. Positioning colors like red and blue alongside each other makes them more difficult to interpret or to read clearly.

Vehicle Shape Should be Reflective & Outlined at Night

The distinct shape and outline of the vehicle must be highlighted with a closed circuit of reflective tape. Headlight illumination at night will clearly emphasize the size, shape, orientation and even the type of emergency vehicle. The importance of this particular feature cannot be overemphasized. The reflective outline reduces the risk of collision when road users may not clearly see the vehicle's extremities beneath the glare of bright warning lights.

If several emergency vehicles are parked together, each individual reflective circuit will visually overlap and the chance of an approaching vehicle attempting to drive between the parked vehicles is diminished. When horizontal bands of fluorescent color are installed at the waistline and roofline, the remaining vertical segments around the vehicle should be in-filled with outline tape. As a general rule, this tape should be of a simi-

lar color to the bodywork so it remains unseen and will not corrupt the vehicle's silhouette in daylight.

Minimize Badges, Text & Signage

The size, shape and color of the vehicle are the most important gross details. The transmitted visual clues must be interpreted quickly by other drivers following a fast glance to locate and identify the emergency vehicle.

Emergency service agencies will always be needed to affix markings of corporate text, badging, vehicle ID numbers, advisory messages and sponsorship signs to a response vehicle. The surface area consumed by reflective sign writing and badgework should be carefully assessed in proportion to the total surface area of the vehicle. Any unnecessary duplication of text should be removed.

If possible, multilingual localities should try replacing the two lines of language text with a commonly recognizable graphic symbol. A new specialized signage film has been developed in the U.K. that highlights roof markings showing identification numbers and symbols. The markings are easily seen in total darkness using an airborne thermal-imaging camera.

Research has proven that bold upper- and lower-case text (title case) is more easily seen, can be read faster and is legible at greater distances than block capitals. Depending on the background color, the most easily read colors for text are dark blue, dark green and black. A decision to affix nonreflective or reflective colored lettering must be considered in the context of readability.

It may take several years and a few generations of vehicle development to reach the final solution that is right for your organization. Carefully plan and watch over your livery development process. ■

John Killen is an intensive care paramedic working in Canberra, Australia. His research into livery, markings and warning light design over the last 10 years has brought substantial change to visibility practice throughout Australia and more recently to international organizations. For more information, visit www.ambulancevisibility.com or contact Killen at john@ambulancevisibility.com.