

Evaluating new trends in emergency vehicle markings

Advertising agency visibility, Battenburg markings and the Chevron debate

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This is the second article in a series looking at emergency vehicle markings and warning lights. An extended version of the first article can be downloaded from the Ambulance Visibility website [CLICK HERE](#). These articles are provided to ensure all members of the Colorado EMSAC community have access to the up-to-date information presented at the 3rd Annual EMS Safety Summit held in October 2010.

Example 1 - The competitive markings of Law and Order

Each year the publishers of Law and Order magazine run a [Police Vehicle Design Contest](#) which is a great idea and possibly one that should be mirrored by EMS. The judging across fifteen different categories includes a People's Choice award as well as the tongue-in-cheek "ugly-vehicle" prize. In 2011 the competition attracted 215 entries from police agencies across the United States. In the publishers favour they include a short list of recommendations for marking-up police vehicles. Looking through the contest images it quickly becomes apparent that there is an almost total absence of fluorescent safety colours or contour markings on the competition vehicles. There are no high-conspicuity formats to be seen as most of the vehicles are painted either jet black, polar white or a combination of the two colors. The remaining vehicles are painted in palettes of the standard dealer colors. While I have no difficulty with police agencies choosing a color that maximises return at the end-of-lease sale further thought should always be extended to the important issue of visual safety for their personnel working under operational conditions. In most cases these less-than-effective police vehicle markings are ill-conceived after having been applied to the fleet after consulting with a sign-writing firm or an advertising agency.

Example 2 - Airborne camouflage finds its way onto ground ambulances

The Vanderbilt University Medical Center in Tennessee recently announced that the marking scheme on [VUMC ambulances](#) has changed. The old white and Omaha orange format has been superseded by a new (and noticeably less safe) black and white color scheme with a gold ribbon. Incredibly, the ground ambulance now displays a highly disruptive black stripe along the waistline, just below a set of oversize pilot's wings affixed to the patient care module. The layout was intentionally designed to match the graphics on the EMS helicopters operated by the VUMC. This new marking design clearly subjugates vehicle safety down to the level of a roadside billboard. The changes at VUMC followed the relaxation of a Tennessee state ruling which had earlier rigidly controlled ambulance marking schemes throughout the state. As a consequence of the legislative amendment, the VUMC ambulance scheme was redesigned by the University's marketing department in conjunction with a vehicle-wrap supplier with very little expert input on the new design.

The panorama of advertising agency camouflage displayed on EMS vehicles

I have explained many times during presentations how the so-called "pool of knowledge" for emergency vehicle conspicuity resides within the four walls of sign-writing firms and the advertising agencies around the world. Nothing could be further from the truth when it comes down to reality regarding the safety aspects of emergency vehicle markings. Even more worrying is the large number of emergency agencies that seek expert assistance from design firms, only to receive flawed

advice in return. Faulty advice often ignores valid conspicuity research in favor of popular graphic styles that ebb and flow in tune with changing fashion. In addition, there appears to be an informal competition between the design teams of America. This rivalry sees each firm attempting to outdo the others by displaying sensationally creative or eye-catching graphics on their particular portfolio of emergency vehicles. This competitive rivalry occasionally extends to the management teams of Police, Fire and EMS as well.

Cherry-picking conspicuity features from the world's emergency vehicle fleets

It is entirely natural for people and organizations to look around and compare the marking layouts displayed on different vehicles from their own country or overseas. Problems start to arise when individual conspicuity features or exclusive elements are lifted and separated from one or more different vehicles to be later merged into a new hybridized (or fusion) design. Hybrid layouts that encompass a novel patchwork of different design elements usually end up being totally dysfunctional. For this reason alone every new or recently created hybrid layout should be specifically trialed and tested to ensure it is visually suitable for use on-road.

Several years ago in Australia an example of indiscriminate hybridization occurred when a major metropolitan hospital marked-up a new patient transport ambulance. The hospital's marketing firm began sourcing ideas from both local and interstate ambulance fleets. The designers also cherry-picked certain elements of the UK Battenburg scheme along with other features from different high-conspicuity layouts. Despite expert advice from the sign writers to



the contrary, the promoters continued to push ahead with the new hybrid design, insisting that the marketing dynamic was a key visual feature. The end result was an exceptionally complex marking scheme containing a mix of colors, checks, stripes and circles with a giant Maltese cross overlaid onto the design. The overlapping patterns in this complex layout produced confusion amongst other drivers on the road, leaving them to speculate about the identity and purpose of the vehicle, especially at night when it reflected confusing patterns. During an emergent role any confusion factor dramatically extends the time taken by other drivers to recognise, react and respond, thus hindering the progress of the emergency vehicle.

The hazards of adopting uncoordinated hybrid designs

What happened next with this ambulance clearly demonstrates the dangers of borrowing and assimilating an unproven design; a design that went on to become popularised through media exposure and come very close to migrating onto mainstream emergency vehicles. The ambulance was soon featured in an Australian television series, operating in the story role of a high-profile response vehicle. After the series went to air requests started coming in from emergency providers seeking permission to duplicate the markings onto their own emergency vehicles. Fortunately, the marking scheme never found its way onto any of the national fleets. In a similar scenario, newly hybridized markings created for the promotional launch of a concept police car at a conference were marketed as "high visibility markings". This time the design transitioned into operational service on [highway patrol vehicles](#) in the Australian state of Tasmania.

Now you may think that “pattern creep” does not happen very often but a similar situation has already developed in the United States. The red and yellow chevron ‘safety’ pattern is starting to appear on the rear of fire trucks and ambulances built under the revised NFPA standards. Chevron patterns still remain visually untested but despite this are being directly copied from emergency vehicles in the United Kingdom. In addition, hybridized Sillitoe checkered layouts (the small to medium size checks or squares layered in multiple lines) have become common on ambulances across the United States. More and more American agencies are mistakenly adopting the very same Sillitoe check layout that is being removed from emergency vehicles operating in other countries and being replaced with single-color fluorescent markings that have been proven in [research trials](#) to be more conspicuous than the multicoloured or block patterns.

Hybrid check patterns promoted as Battenburg are never safer!

The original UK Full Battenburg design is composed of large and carefully proportioned rectangles which are stacked and offset in two parallel rows. The size, position and color of the rectangular pattern is carefully detailed in the [Specification for the livery on Police patrol cars](#)¹. Contrary to some viewpoints, Battenburg was never designed to completely cover the entire vehicle in “high-conspicuity blocks” as seen on and actively promoted by some North American ambulance manufacturers and design teams. Battenburg was originally designed only for sedan vehicles.

Over the last few years an increasing number of EMS agencies have begun to use unconventional designs or new color schemes that incorporate the much smaller Sillitoe check pattern. The Sillitoe has been used in different colours by countries around the world to identify police, fire and ambulance vehicles for decades. Sillitoe markings are definitely not a high-visibility pattern nor have the smaller squares ever originated or been sourced from the more recent Battenburg pattern. In a reversal of the current US trend to adopt checkered Sillitoe markings for emergency vehicles, the confusing square patterns are being removed from emergency vehicles in many overseas countries. The Sillitoe markings are being vigorously replaced with a single continuous fluorescent color that has been proven by [research](#) to actually *increase* vehicle conspicuity.



Checked designs should never be used on the rear of vehicles; the pattern of squares readily disrupts the visual profile of the vehicle. It has also been suggested that the check pattern (along with the chevron pattern) interferes with the capacity of following drivers to accurately determine closing speed and distance, thus affecting their braking distances. In addition, hybridized patterns derived from the Sillitoe check should never be promoted as a safer variation of the original police Battenburg design, which was only ever tested by the UK Home Office in the initial fluorescent yellow-green and blue paired color format.

Battenburg markings – recognising the true picture

Research leading to the development of the Full Battenburg marking scheme was initially directed toward increasing the conspicuity and recognition of police vehicles

patrolling the network of high-speed motorways around Great Britain. It is not well understood that an off-shoot of this research was the evolution of the alternative and less expensive half-Battenburg design which was found during trials to be superior to the full-sized scheme when vehicles were viewed against complex city and urban landscapes. The project objectives of the Police and Home Office for the Battenburg project were primarily directed towards promoting public recognition of police vehicles as well as increasing vehicle conspicuity – the objectives are summarised in the list below:

1. Enhance officer /vehicle conspicuity and safety
2. Recognisable as a police vehicle to a distance of 550 yards (500 meters) in daylight.
3. Assist in high-visibility policing (ie highly visible police presence).
4. Identifiable nationally as a police vehicle.
5. A cost-neutral option compared with the average cost of the current markings
6. Acceptable to at least 75% of the staff

Note that four of the six objectives deal with public recognition of the police vehicle and the necessity of acceptance of the new design by the police personnel themselves. Only one objective emphasises vehicle conspicuity. The cost-neutral objective for markings was a failure due to the high price charged by signwriting firms to fit the labour intensive Full Battenburg design which is considerably more expensive than any of the previous marking schemes. The higher cost associated with changing to Battenburg has led some UK police forces to reject the new design so that funding can be reallocated towards other projects. The emphasis on police recognition and officer satisfaction with Battenburg shows the researchers probably never considered the possibility of the pattern “creeping” onto other emergency service vehicles in later life. It does however confirm that continuing recognition of the previous police blue check Sillitoe branding after replacement by the new format was of paramount importance to police management. This recognition factor was considered even more important than the other primary element of conspicuity; especially if police forces across Britain were to accept the new Battenburg scheme and progressively take up the distinctive new identification pattern into the future.

Battenburg has excellent recognition qualities, but only in Great Britain

There is no doubt the full and half Battenburg designs possess exceptionally high levels of community recognition for police vehicles in the UK, more so than any of the earlier police marking schemes. However, exporting a successful British design like Battenburg to another countries leaves the viewing public of the other countries



easily confused by an unfamiliar pattern with colors that have no historical background or significance. In the United States police vehicles have been returning to the traditional but familiar black and white schemes. By comparison, the

occupation-specific UK Police Battenburg colors of yellow and blue (Police) are now being displayed on American ambulances (EMS) which were previously marked in Omaha orange formats. Meanwhile back in the United Kingdom, NHS ambulances are marked differently in yellow and green and so it all tends to become very confusing when Battenburg criss-crosses international borders! By comparison, the rear chevron design recommended by the NFPA suffers slightly less role confusion as the chevron is a somewhat familiar pattern to most drivers around the world. Here is a list of the inconsistencies that arise when Battenburg is adopted by other countries beyond the United Kingdom:

1. Battenburg recognition by the public may be either reduced or non-existent.
2. Cross-cultural variations and subsequent misinterpretation are likely.
3. Non-standard or low-visibility color combinations tend to become common.
4. No international standard currently exists that designates the particular color combinations for Police, Fire or EMS.
5. Use by the public is not regulated; patterns find their way onto private vehicles
6. Local or state legislation in other countries may prohibit certain Battenburg colours or patterns from being displayed on emergency vehicles.

The green and yellow National Health Battenburg scheme is a re-colored conspicuity pattern taken from UK police sedans and modified to help identify British ambulances. The reality is however that visual conspicuity on NHS ambulances is actually achieved by the bright yellow RAL1016 paint covering the whole body, not the Battenburg markings.



The only purpose of the Battenburg waistline band is to identify the ambulance as an official government medical vehicle. The European Union (EU) as a whole has already agreed that the body color of all ambulances operating within member countries will be painted high-visibility RAL1016 yellow. There is no EU requirement to fit Battenburg markings as a multi-national ambulance ID marking although several nations have started using hybridized variations of the Battenburg scheme. Your agency should seriously consider the preferred option of changing to a high-visibility body color for your new ambulances before simply adopting a checked marking pattern sourced from overseas; an imported pattern that may just confuse the public without necessarily enhancing your safety or visibility.

The Pros & Cons of Battenburg

The Full Battenburg scheme was designed to provide a maximum viewing distance of about 600 yards across the open landscapes of British motorways. The simpler and less expensive Half Battenburg scheme is considered to be more effective on vehicles operating within urban areas or cityscapes where the maximum recognition distance of half-Battenburg is around 220 yards or only



one third the distance of its full-sized parent scheme. This leaves a substantial visibility gap of about 400 yards between the two different patterns. Therefore this deficit value has significant ramifications for an agency using either of the Battenburg vehicle schemes within a mix of city, urban and highway operations. Below is a list of Battenburg Pros and Cons to help you make the correct decision about whether to fit Battenburg onto your vehicles.

Pros

1. The large Battenburg block pattern is visually effective & conspicuous.
2. It continues to be a recognizable pattern under most light conditions.
3. The Police blue & fluoro-yellow are the only true high-conspicuity colors.
4. The full scheme overlays & covers both sides of a sedan in any base color.
5. The block of blue is the last colour to be visualised under low light conditions.
6. Both Full and Half Battenburg schemes include a roofline contour stripe.
7. Some similarities to the traditional police Sillitoe pattern are retained.
8. Remains effective under different types and lamp colors of street lighting.

Cons

1. Battenburg does not specify any fluorescent colour on the front hood area.
2. Battenburg can be difficult to apply onto small, curved or odd shaped surfaces
3. The pattern must be accurately die-cut to fit most vehicle shapes.
4. Battenburg incurs high costs for the die-cut materials and fitting labour.
5. It is impossible to add sign-writing or text over the block scheme or chevrons.
6. Becomes a confusing pattern when several parked vehicles visually overlap.
7. Breaks up the vehicle shape when viewed against complex landscapes.
8. The rear chevron pattern has never been tested or shown to increase safety.
9. Colour combinations (other than police yellow/blue) are not as effective and certain colours can progress to camouflage when used on certain body colors.
10. The block pattern is easily disrupted by open doors and hatches.

It should now be apparent that there can be major problems transferring the original police Battenburg scheme onto ambulances operating in the United States or elsewhere. Altering the pattern or changing the colors may actually reduce the level of conspicuity and increase confusion even more as members of the public struggle to decipher unfamiliar markings. Research has shown that solid fluorescent colors are more effective, especially on vehicles operating in city and urban landscapes.

Chevrons on the back of Fire and EMS vehicles always provoke controversy

The inverted-V chevron designs in many colors have already started to migrate onto the rear-facing surfaces of fire vehicles and ambulances operating across the United States. Chevron patterns have been lifted directly from emergency vehicles in the UK and progressively they have become the default rear safety marking for the United States; especially under the umbrella of the recently confirmed NFPA 1901 and the proposed NFPA 1917 specification for ambulances. Chevron patterns have been adopted over the last few years (more through popular opinion rather than



by a scientific process of testing and research) into a set of nationally sanctioned emergency vehicle visibility specifications.

The earliest chevron pattern was introduced after several red V-stripes were installed on the rear trunk of police sedan vehicles in the United Kingdom during a pilot study. This was done in an attempt to reduce the incidence of rear-end collisions involving police cars stopped on motorways. Up to this point other emergency agencies around the world had been using either a narrow striped band or small panels of diagonals on the rear bumper of their vehicles. British Police borrowed the chevron pattern from the roadside signs found around Britain and this probably accounts for the inverted-V orientation. The only definitive document I have found with any meaningful explanation about the orientation of chevrons is the [Guide to Hazard Markers](#) published by Queensland Main Roads (Australia). This document does outline the rationale for particular chevron directions but it does not include any type of upright chevron pattern within the definitions.

The effectiveness of chevrons & rear-end collisions involving police vehicles

There is almost no research that proves the efficacy of chevrons in reducing the likelihood of rear end collisions when they are displayed on the rear of emergency vehicles. The operational testing of the Battenburg scheme two decades ago concentrated on increasing community awareness of the checkered blue and yellow side markings rather than evaluating the anti-collision qualities of the red/orange stripes affixed on the rear of the vehicle. There was never any individual testing undertaken with the colored chevron elements on the rear separated away from the block markings covering the vehicle sides. The original development team simply borrowed the red/white chevron pattern from the earlier police vehicles and converted the chevron stripes to the latest fluorescent colours before amalgamating them back into the Battenburg block design. At the time, the researchers obviously took it for granted that the novel red and yellow fluorescent striped chevrons would reduce the incidence of rear-end collisions with parked police cars; collisions that had in fact been increasing during the years before Battenburg and continued to increase even after the Battenburg scheme was released into service on Britain's motorways.

There are almost no statistics publicly available from the UK police that allow any reliable interpretation to indicate the level of success or failure of the chevron pattern in reducing rear-end collisions. Only one group of researchers were given access to the police statistics and they subsequently published the report [An analysis of 'Looked but failed to see accidents involving parked police vehicles'](#) This important study by Langham, Hole, Edwards & O'Neill examined police vehicles along with the "Looked But Failed To See" phenomenon which led to the following conclusions in the report:

"On a theoretical level, the accident data clearly demonstrates that high levels of conspicuity (in sensory terms) do not guarantee detection of a vehicle, a conclusion supported by the results of our two experiments. They also suggest that cognitive factors, such as drivers' expectations, may play an important role in causing this kind of 'looked but failed to see' accident. Precisely which cognitive factors are involved include fatigue, false hypotheses, inattention or a combination of all of these remains to be determined by future studies? On a practical level, the results suggest that

drivers of all vehicles that are stationary on a high-speed road should try to draw attention to the fact that their vehicle is motionless: parking at an angle is one way to achieve this.”

Chevrons cannot promise higher levels of safety for the rear of the vehicle

The research demonstrated that the use of rear chevrons does not guarantee a reduction in rear-end collisions. During the test simulations one participant actually collided with the rear of a police vehicle that was clearly marked with red/yellow chevrons. The research did demonstrate that parking in the echelon (or angled to traffic) position at an accident scene provides significant additional protection due to the unusual vehicle orientation which is highly effective in drawing the attention of approaching drivers. Unfortunately echelon parking also decreases the effectiveness of any rear-facing chevron patterns as the angled emergency vehicle no longer faces directly toward the oncoming traffic.

The National Health Service (NHS) in the UK has altered original yellow/blue Battenburg pattern and then adopted then a new custom green/yellow blocked combination for their NHS ambulances. They also expanded the chevron pattern to cover the entire rear loading ramp on their vehicles, but this rear layout had limited success. These changes marked the point in time that would eventually lead to the modified NHS ambulance chevron layout becoming popular and then migrating onto fire and EMS vehicles located overseas. These colour variations become even more fascinating when the Dublin Fire Brigade ambulances in Ireland were then dressed in a red/yellow Battenburg scheme. You should always remember this one pertinent fact; there still is no research to this day that has concluded with any certainty that chevron patterns reduce rear-end collisions! There is also some conjecture that chevron patterns may actually induce distance perception errors in the braking process of drivers following on busy city roads.



The inverted-V chevron based on the original UK Battenburg design has by default become the international orientation standard. The logic for the inverted orientation appears to relate back to the direction of the descending arms on signs in the UK indicating that the required direction of travel for traffic was to pass along both sides, well away from the sign displaying the chevrons. This format was based on the scanning pattern undertaken by most people when looking at signs. As other emergency services in the UK picked up the new Battenburg/chevron pattern they continued to alter and customise the markings, thus unintentionally creating exotic low-visibility combinations that are displayed on many types of vehicles with palettes of less safe colors; colors in combinations that have never been fully tested as fit for purpose.

The development of the chevron pattern outside the UK

After the year 2000 the UK Battenburg and chevron patterns began to enjoy increasing popularity in other countries. This led to rapid expansion in the use of chevrons on emergency vehicles and was due in part to the following:

1. Emergency personnel overseas found the pattern to be eye-catching and therefore believed it must be an attractive option. This added to the vehicle safety debate which lacked any appropriate rear-end solutions.
2. International signage firms began to acknowledge and promote the unique Battenburg scheme, going on to dramatically transform the original design (including the rear chevrons) into new hybridized layouts that exhibited significant variations from the original large block pattern with fluorescent colors.
3. There was and still is an industry and public perception that chevrons prevent rear-end collisions and therefore must increase the level of rear-end safety. This is despite no supporting evidence being available.
4. Widespread promotion by vehicle manufacturers who began marketing their own “high-visibility Battenburg and chevron” using flawed hybrid patterns on their concept safety vehicles.
5. Finally, the adoption of chevron markings into NFPA 1901, thus formally endorsing the approved rear safety chevron pattern for all US fire appliances.

Chevron creep

For the United States, the five factors listed above have over time led to “chevron creep” onto new ambulances and other emergency vehicles. It has also become common for the UK police chevrons (along with the yellow and blue police block pattern) to be copied intact onto non-police Fire & EMS vehicles across the United States. The recent NFPA draft specification 1917 for ambulances has almost certainly secured and formalised the Inverted-V red & yellow chevron as the recommended rear marking for all future ambulances being built in the United States. Although the NFPA guidelines are not mandatory, they still carry substantial weight in the government, industry and public arenas. This will ensure the inverted-V chevron orientation will by default become the international standard. This has led to an official and public expectation secured by formal specifications stipulating that any chevron pattern fitted to emergency vehicles in either the US or the UK will:



1. Be an inverted-V design
2. Use only reflective red and yellow or the equivalent fluorescent colors.
3. Use a chevron stripe width at least 6” (150mm) wide.
4. Be fitted to the rear (but not the sides or front) of emergency vehicles

A set of guidelines for fitting chevrons to vehicles

There is currently no concrete evidence confirming the design rationale or the efficacy of chevrons (displayed in any orientation) on the rear of a vehicle. The knowledge base available to help you in making a decision about the pros and cons of fitting chevrons to your vehicle fleet is almost non-existent. Here are some brief guidelines that may help you decide if or how you will fit chevrons to your vehicles. Refer to the [Colorado Safety Summit PowerPoint PDF](#) (pp 31 – 36) which displays slides and images of the points listed:

1. Use the standard colors; don’t try to match chevrons to your vehicle markings.

2. Narrow chevrons widths produce visual confusion; the wider the better.
3. Always align the V onto the centerline, don't skew the pattern to one side.
4. Never attempt to write text in any color across the chevron pattern – allocate space above, below or alongside the chevron panel/s for reflective text.
5. If your vehicle has an unusual or asymmetrical rear shape then balance and reduce the area of the chevrons or just substitute a solid fluorescent color.
6. Too many lights or equipment on a complex rear end? Use a solid colour.
7. Aim for the minimum 50% coverage on the rear rather than a full 100%. This leaves room for text and reduces visual overstimulation and confusion.
8. Arched or twin pillar chevron patterns will frame the rear doors, rapidly adding to a viewer's comprehension of the situation around the rear of ambulances.
9. Place yellow or white contour stripes vertically alongside the chevron panel to clearly delineate the vehicle edges; this eliminates the visual ragged edge effect seen along the line of alternating stripes.
10. Checkerplate dot solutions should not be applied unless absolutely necessary for compliance, the pattern colours become muted in daylight & irregular at night.
11. No chevron markings should be placed on the inside surfaces of side doors or hatches where they will confuse viewers – outline the doors with white or yellow reflective tape so they are easily interpreted as an open door shape at night.

The final word....

Emergency agencies should consider carefully the options available for marking-up their vehicles. The information offered by advertising agencies and sign shops should never be considered to be expert advice with regard to visibility and conspicuity issues. It is reasonable to look around at other vehicles for effective conspicuity features but care must be exercised when those ideas are combined into a new marking scheme that needs to be tested as fit-for-purpose before being released into road operations. The superiority of the simple uninterrupted fluorescent marking should not be overlooked, especially if your vehicles have intricate bodywork or complicated fittings that will interfere with the clarity of any visually complex marking schemes.

The Battenburg schemes may be effective recognition markings overseas, but they do not always suit the American landscape, especially within crowded city environments. Some hybrid Sillitoe patterns can easily induce camouflage effects and hybrids should never be promoted as a close relative of the two original Battenburg patterns. Keep in mind that Sillitoe markings on emergency vehicles operating overseas are being removed and replaced with uninterrupted fluorescent designs. Any Battenburg and chevron designs introduced onto American roads may also end up being copied many times over for use on private vehicles, especially if protective legislation is not forthcoming within a reasonable timeframe.

Chevrons have become almost compulsory by popular demand rather than valid research. There are already many examples of bad chevron design out and about on the roads. Try to follow the suggestions listed above to avoid some of the mistakes. If you feel the chevrons on your vehicles tend to be visually overwhelming or cluttered, then reduce the coverage by using one of the pillar or arched layouts to allow extra room for organizational text. Good luck setting up your vehicles!