



**Home Office**  
Scientific  
Development Branch

# High Conspicuity Livery for Police Motorcycles

Publication No. 47/06



Dr Paul Harrison

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### COVER PHOTOGRAPHS

Front and rear oblique view of Honda ST1300 Pan European marked in police motorcycle livery, with rider



## Foreword

Policing the roads of this country is a hazardous enterprise and, through working together, the Association of Chief Police Officers (ACPO) and the Home Office Scientific Development Branch (HOSDB) are determined to improve the safety of police officers and police staff.

Two phases of work have been completed as a result of which we have developed a high-conspicuity, corporate marking scheme for police vehicles that has resulted in the widespread adoption of the so-called “battenburg” and “half battenburg” livery by police forces. This has been very successful in enhancing safety, in building an image that is reassuring to the public and has a deterrent effect on those who seek to break the law on our roads.

This publication represents a product of the second phase of work – to develop a high-conspicuity motorcycle livery scheme to improve officer safety and the visibility of the police presence on our roads.

In response to an operational requirement for a motorcycle livery scheme, research has been carried out into how best to make motorcycles conspicuous and recognisable, building on previous HOSDB work and using acknowledged ergonomic principles. The resulting livery scheme is presented in this document.

We hope that the motorcycle livery will be adopted by every police force within the United Kingdom, enhancing the corporate image of the police service and promoting greater safety on our roads.

A handwritten signature in blue ink, appearing to read "S. M. Green".

S. M. Green, Q.P.M., M.A.  
Chief Constable  
Nottinghamshire Police  
Chairman ACPO RPOF

A handwritten signature in blue ink, appearing to read "Alan Pratt".

A. Pratt, CSci CPhys FInstP  
Director  
Home Office  
Scientific Development Branch

# Acknowledgements

The author wishes to extend his gratitude to the police service for its interest in developing the motorcycle livery and for its involvement in early trials of the proposed marking scheme. The feedback received, particularly concerning the possible adoption of the fluorescent yellow windscreen, an idea that was dismissed for safety reasons, has been very professional and constructive.

HOSDB would like to thank the members of the original working party that developed the operational requirement for the motorcycle livery.

HOSDB gratefully acknowledges the contribution of the police service in providing motorcycles, photographs and time for trials on marking schemes.

The professional and informative assistance of the vehicle converter companies is also gratefully acknowledged.

I also wish to thank my colleagues here at HOSDB for their support and often their personal assistance with various stages of the development work.

# Disclaimer

The photographs of motorcycle livery portrayed in this guide are intended to be typical of the type under discussion in this publication. It is beyond the remit of HOSDB or the ACPO Livery Working Group to stipulate that the livery described must be used. However, it forms a recommendation for police motorcycle livery to provide maximum safety while retaining a corporate appearance.

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# 1 Management Summary

This document provides a specification for a high-conspicuity livery scheme for police motorcycles. The scheme described is for application to police motorcycles used for duty in any location. The following are provided:

- A summary of the research and development work that has been undertaken on police motorcycle/motorcyclist conspicuity;
- Information enabling the application of the livery scheme to police motorcycles of any design;
- Detailed technical specifications for the minimum performance of materials used for marking motorcycles in order to gain the full safety benefits of the livery;
- Information concerning the correct application of the materials for marking motorcycles;
- Recommendations for the proper routine maintenance procedure for the high-conspicuity materials used for the marking scheme; and
- Recommended procedures for the removal of high-conspicuity marking materials to permit either the replacement of damaged or degraded panels or the decommissioning of motorcycles, for example prior to resale.

Sufficient information is given in this document to enable police fleet managers to commission the application of livery to police motorcycles. Companies that specialise in the marking of emergency vehicle livery should also be aware of the requirements of the livery scheme and are able to offer professional services. Contact details for some of these companies are listed in this document, together with details of some of the manufacturers of the retro reflective and fluorescent vinyl films whose products were available at the time of writing. These contact details are provided for assistance only and do not constitute a recommendation of any kind.



## 2 Operational Requirement and Background

### 2.1 Operational Requirement

The Operational Requirement for police motorcycle livery was established under the auspices of the then ACPO Traffic committee and the ACPO National Motorway Policing sub-committee (Reference [1]). This stated the Aim and Objectives of the proposed motorcycle livery research, which are set out below for information.

#### 2.1.1 Aim

‘To determine for police traffic patrol motorcycles and riders a suitable common standard of markings which enhances at a distance conspicuity and recognition as a police vehicle.’

#### 2.1.2 Objectives

‘To design a common standard livery which:

- (1) is recognisable as a police vehicle/rider at distances in excess of 200 metres in normal daylight
- (2) assists high visibility policing so as to reassure the public and enhance the potential deterrent benefits of traffic patrol activity
- (3) is readily identifiable nationally as a police vehicle, but retains the ability to associate with it Force corporate image and logos
- (4) is acceptable to at least 75% of the staff using it.’

### 2.2 Basic Principles of Recommended Livery

Although the recommended motorcycle livery scheme is very different in appearance from the ‘Battenberg’ scheme applied to cars, vans and so on, the same overall principles apply.

‘Conspicuity,’ or ‘conspicuousness,’ may be defined as ‘that quality that renders things obvious to the eye or attracting attention’ (Reference [2]). The conspicuity of an object may be enhanced in various ways (Reference [3]), including:

- Increasing its colour contrast and luminance contrast
- Maximising its size or its apparent size
- Strengthening the shape or pattern recognition potential by emphasising visual cues, e.g. outlining in reflective materials
- Employing changes of state, e.g. human eyes are particularly effective at detecting flashing lights in the periphery of their field of vision

Considering the colours found in the typical road environment, fluorescent yellow-green is the colour that provides the best contrast (Reference [3]). Therefore it makes sense to use it to increase conspicuity, especially since fluorescent colours tend to have a particularly strong impact. This is especially true in daylight. Retro reflective blue is used in relatively small quantities for the purpose of identification as a police vehicle only. Night-time conspicuity is addressed by specifying that dual-performance fluorescent and retro reflective yellow-green livery film, which is a much more efficient retro reflector than blue, should be used over as much of the surface of motorcycles as possible. This enhances conspicuity using retro reflection from headlights.

In addition, covering the bodywork in fluorescent yellow-green increases the apparent size of the motorcycle by rendering the motorcycle a single solid block of vivid colour (Reference [3]). The daylight-adjusted ('photopic') human eye shows greatest sensitivity to yellow-green hues. The opposite colour to fluorescent yellow-green on the 'colour wheel' is blue, which therefore provides the best possible contrast with the fluorescent yellow-green. Since blue has long been associated with the police, the choice was made to use fluorescent yellow-green to provide the best conspicuity, with a limited quantity of blue retro reflective livery film to provide an image associated with the police by members of the public.

A very important part of maximising the coverage of the motorcycle in fluorescent yellow-green is the rider (Reference [3]). In order to get the maximum benefit from the motorcycle livery, the rider must wear high-visibility garments comprising fluorescent yellow-green jacket and trousers to the best available quality. These must comply with the police force health and safety policy, safe system of working and any other applicable local directives. They must also bear a 'CE' mark, demonstrating that they have been tested and are compliant with relevant standards.

To the rear of the motorcycle, a single 100 mm chevron formed from red retro reflective livery film is to be used. Chevrons on larger vehicles are constructed from fluorescent orange material of a greater width – 150 mm is recommended – ensuring maximum brightness but retaining sufficient contrast to enable motorists to resolve the chevrons from some distance away. On a motorcycle, which has a much smaller surface area to the rear, a chevron 150 mm wide would be too large to be effective because it would cover too much of the background dual-performance fluorescent and retro reflective yellow-green livery film. Chevrons much smaller than 100 mm in width tend to merge into a single block of colour when viewed from a significant distance, losing their effect.

It is recommended that 'POLICE' legends are fitted to the lower windscreen and to the panniers or the sides of the bodywork towards the rear of the motorcycle. Focus group studies conducted at HOSDB have shown that members of the public tend to recognise police vehicles very much more easily when they can see the 'POLICE' legend on the vehicle in a visually cluttered, urban environment, even when it is partly obscured. Application of the legend ought to ensure recognition of police motorcycles as police, as opposed to paramedic or other yellow-liveried motorcycles.

It is recommended that the legend should be composed of dual-performance retro reflective and fluorescent yellow-green livery film either on a background of black livery material or on a clear vinyl film placed over a

portion of the motorcycle bodywork that is dark in colour. Legends composed of retro reflective blue livery film against a yellow-green background tend to be more difficult to resolve, especially under retro reflection, because the background colour tends to dominate.

## 3 Livery Specification

### 3.1 Principles

Research (see chapter 2) suggests that maximising the coverage of the motorcycle and rider in fluorescent yellow-green provides significant benefits in terms of conspicuity. Wherever possible, fluorescent yellow-green vinyl vehicle film wrapping material should be applied to the motorcycle. Dual-performance retro reflective and fluorescent yellow-green material in the highest-performing grade available should then be applied over as much of the bodywork and fairing of the motorcycle as possible. This provides the maximum benefit during daylight hours, as stated in the Operational Requirement, but also provides for good performance at night-time because yellow-green is one of the brightest retro reflective materials.

Cut-outs, the shape of the fairing and the contours of the bodywork obviously limit what can be done with retro reflective films, whose flexibility is limited. A police-like appearance was deemed to be of secondary importance, with safety paramount. Nevertheless, a measure of corporate police identification is achieved by using a twin chequer band in retro reflective blue film and the POLICE legend applied to the motorcycle.

Maximising the yellow-green appearance of the motorcycle requires the rider to wear a high-visibility jacket and trousers and a white or brightly-coloured crash helmet whilst mounted and on duty.

Police forces have tended to want to make recognition as a police motorcycle easier by incorporating their crests on the tank. This chapter shows how crests or logos can be accommodated.

### 3.2 Base Colour of Motorcycle

Ideally, a fluorescent yellow-green motorcycle would be used. However, fluorescent paint finishes are not likely to be available direct from the motorcycle manufacturer. They could seriously affect residual values of motorcycles and might not prove economical. Modern film-wrapping techniques mean that motorcycles of any colour can be re-coloured to fluorescent yellow-green easily, cheaply and quickly. Above all, it is relatively easy to remove the film without damaging the paintwork on the motorcycle. As such, the base colour of the motorcycle is not critical, although white is recommended.

### 3.3 Front of Motorcycle

A base layer of self-adhesive fluorescent yellow-green backing film should be applied to as large a proportion of the frontal area of the motorcycle as possible. Experience usually comes into play in knowing how well the material adheres to bodywork, especially when it has complex curvature. Many of the vehicle converter companies can provide livery kits for specific, popular applications, pre-cut to suit the motorcycle. They can also arrange fitting or application of livery to alternative makes and models of motorcycle.

Wherever possible, dual-performance fluorescent and retro reflective yellow-green livery film in the highest grade available should be applied over the base layer of fluorescent yellow-green film. As much of the frontal area as possible should be covered, ensuring that the livery film adheres and conforms as well as possible to areas with complex curvature.

The 'POLICE' legend should appear above the force crest or logo. The letters should be mounted low down on the windscreen on a rectangular strip of black livery film. The letters must not be large enough to obscure the rider's forward vision. They may be either the right way around or laterally inverted (mirror image). Clear, bold block capitals in a typeface similar to that applied to British road signs as specified in The Traffic Signs Regulations and General Directions, 2002 should be used (refer specifically to Schedule 13, Parts I and II). The letters should be in dual-performance fluorescent and retro reflective yellow-green livery film against a dark background to provide the best effect, as illustrated in Figure 1 below. In order to provide better adhesion of the letters on the crinkle-finish plastics used on some motorcycles, a rectangular panel of clear or black non-retro reflective self-adhesive film may be used as a backing.

The police force crest or logo may be applied to the front of the bodywork below the 'POLICE' legend, above the headlamp (see Photograph 9 on p. 14). It must not be allowed to detract from the rider's forward vision because safety will be compromised if it does.

Photograph 1 on p. 9 provides an example, albeit without a police force crest or logo.



**Not recommended.**  
Background brightness  
outstrips lettering



**Recommended.**  
Background allows  
lettering to stand out

Figure 1. 'POLICE' legend colour for maximum effectiveness

### 3.4 Rear of Motorcycle

Once again, the same overall principle applies – maximise coverage of dual-performance fluorescent and retro reflective yellow-green livery film.

First, as much of the surface area of the rear of the motorcycle as possible should be covered with self-adhesive fluorescent yellow-green vehicle wrapping film. This is used as a base layer. Dual-performance fluorescent and retro reflective yellow-green livery film should then be applied as widely as possible, given the shape and curvature of the bodywork, as illustrated in Photograph 2 on p. 9.

A chevron 100 mm in width, formed from strips of red retro reflective livery film, should be applied. The chevron must point upward, as per HOSDB livery recommendations for other police vehicles. It must be located so that it runs centrally through the area of dual-performance fluorescent and retro

reflective yellow-green livery film, similarly to the motorcycle pictured in Photograph 2, so that it is clear that there is a chevron on the rear of the motorcycle. If it were mounted any higher, it would not be bounded by yellow-green film and it would not stand out against its background. Figure 2 illustrates this.

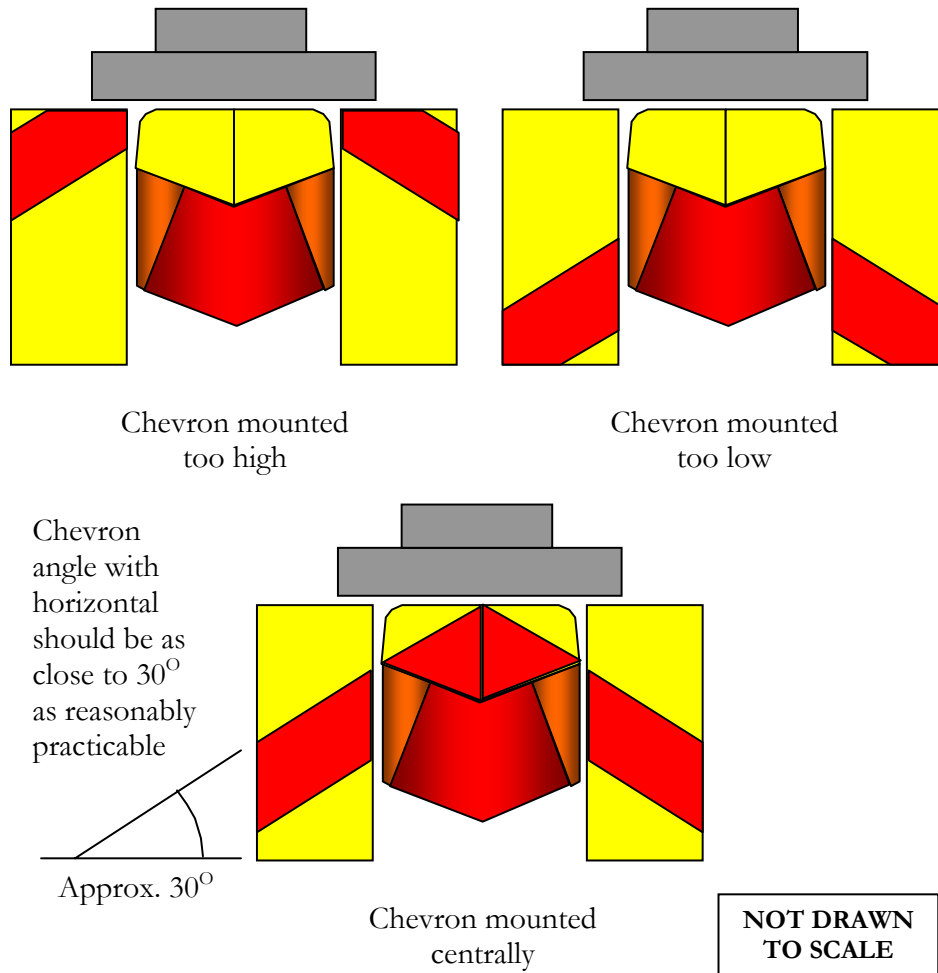


Figure 2. Correct placement of chevron to rear of motorcycle for maximum effect

### 3.5 Side of Motorcycle

The same overall principle applies as to the front of the motorcycle.

First, as much of the surface area of the motorcycle as possible should be covered with self-adhesive fluorescent yellow-green vehicle wrapping film as a base layer. Dual-performance fluorescent and retro reflective yellow-green livery film should then be applied as widely as possible whilst allowing adhesion, given the shape and curvature of the fairing, as illustrated in the example above.

A twin chequer band of retro reflective blue livery film should be applied to the sides of the fairing and to the rear of the bodywork or pannier, depending upon the model of motorcycle. The blue panels should measure 50 mm by 50 mm. It is also acceptable to use panels that measure 100 mm long by 50 mm high. This serves two purposes: (1) to provide a contrast against the

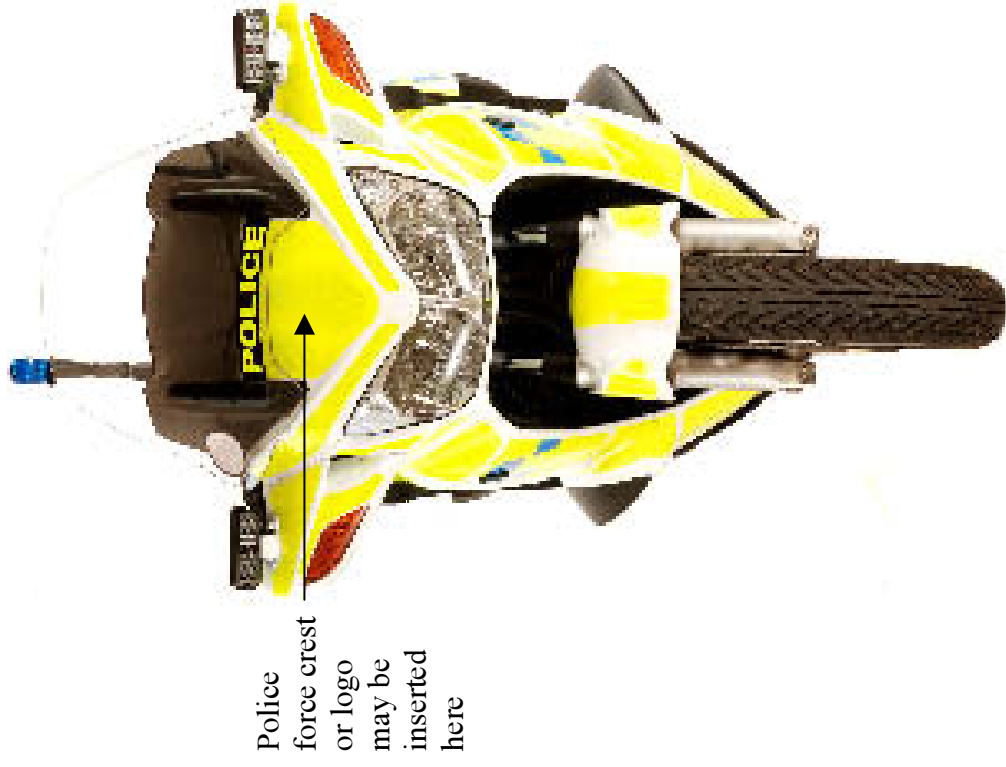
fluorescent yellow-green colour, enhancing conspicuity and (2) to convey an appearance associated by members of the public with the police.

The word 'POLICE' should appear in the lower portion of the rear bodywork or pannier, as illustrated in the example shown in Photograph 3 on p. 10. Clear, bold block capitals in a typeface similar to that applied to British road signs as specified in The Traffic Signs Regulations and General Directions, 2002 should be used (refer specifically to Schedule 13, Parts I and II). The letters should be formed from dual-performance fluorescent and retro reflective livery film against a black or dark background to provide the best effect, as illustrated in Figure 1 above. In order to help with the adhesion of the letters on the crinkle-finish plastics used on some motorcycles, a rectangular panel of clear or black non-retro reflective self-adhesive film may be used as a backing.

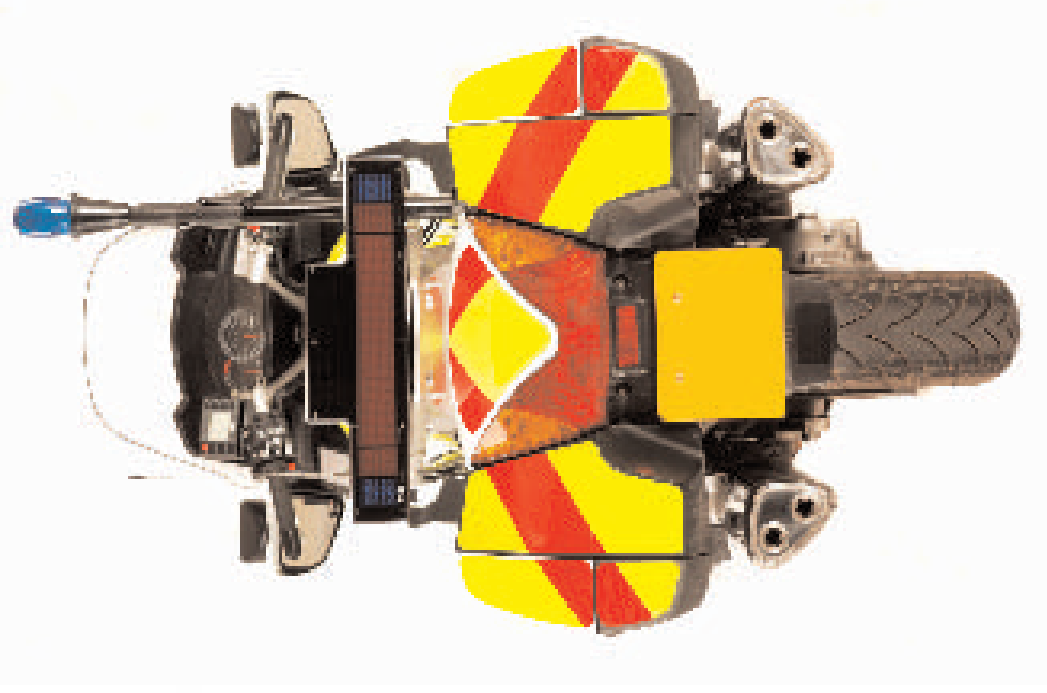
The police force crest or logo should be applied in place of the motorcycle manufacturer's logo on the petrol tank (see Photograph 10 on p. 14). The manufacturer's logo may be removed or covered over with vehicle wrapping film of a suitable colour to blend in with the motorcycle's paintwork.

### **3.6 Motorcyclist**

In order to preserve and enhance the yellow-green appearance of the motorcycle as much as possible when viewed with a rider mounted, the motorcycle-mounted police officer must wear high-visibility fluorescent yellow-green jacket and trousers at all times whilst on duty. These garments must be CE marked, ensuring that they are compliant with relevant standards and should be to the specification stipulated by police force health and safety policy, safe systems of working and any other applicable local directives. Typical examples are shown in Photograph 15 on p. 16.



Photograph 1. Layout of markings to front of motorcycle

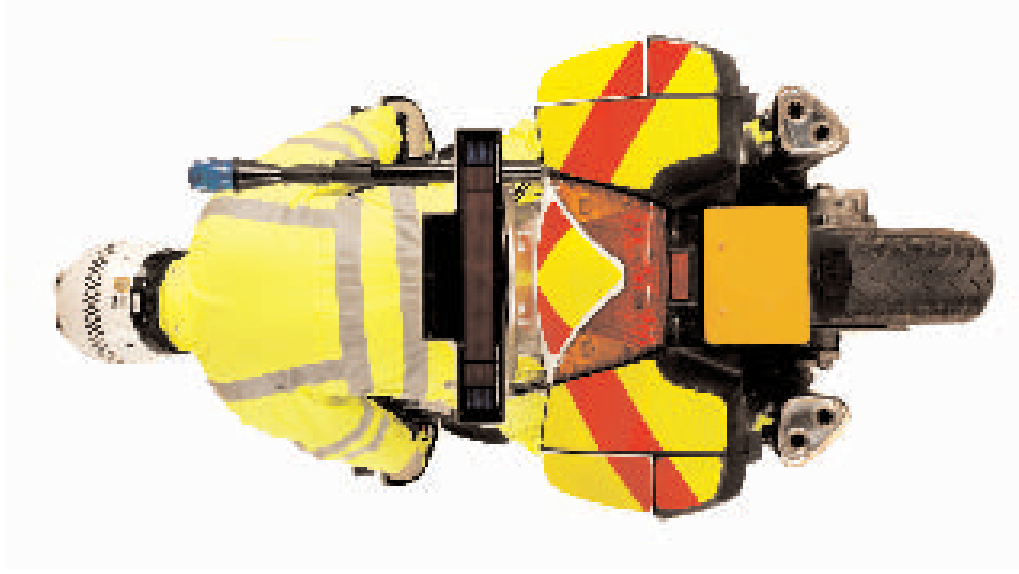


Photograph 2. Layout of markings to rear of motorcycle





Photograph 3. Layout of markings to side of motorcycle



Photograph 4. Rear view of motorcycle and rider



Photograph 5. Front view of motorcycle and rider



Photograph 6. Side view of motorcycle and rider



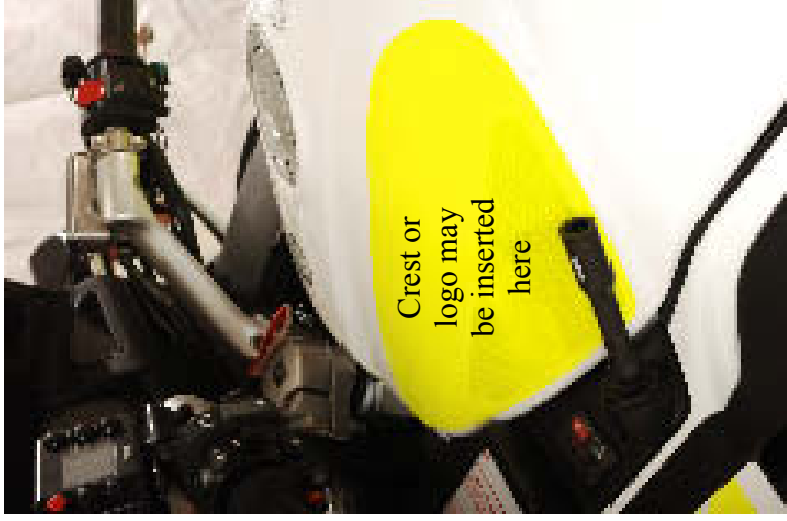
Photograph 7. Front side view of motorcycle and rider



Photograph 8. Rear side view of motorcycle and rider



Photograph 9. Detail of layout of livery material on front of motorcycle, showing where police force crest or logo may be sited



Photograph 10. Detail of petrol tank area of motorcycle, showing where police force crest or logo may be sited



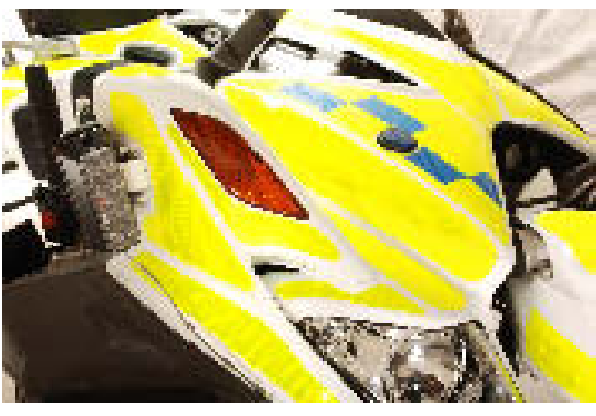
Photograph 11. Detail of pannier area, showing recommended arrangement of POLICE legend



Photograph 12. Detail of rear of pannier, showing layout of livery material



Photograph 13. Detail of side of bodywork



Photograph 14. Detail of front portion of side of motorcycle, showing layout of livery material



Photograph 15 (a, b and c). Typical high-visibility garments to BS EN 471 Class 3 standard

## 4 Application and Maintenance

The following guidance is broadly in line with the recommendations issued by the manufacturers of livery film materials and is provided for convenience only. Definitive instructions should be sought directly from manufacturers.

### 4.1 Introduction

Whilst many police fleet personnel do not fit entire livery schemes to vehicles often, if at all, it is likely that panels of livery film will need to be replaced from time to time due to accident repairs or film deterioration. For this reason, a brief series of notes has been included to provide guidance as to the use of livery film materials.

### 4.2 Cleaning of surfaces

Livery film should be applied only to surfaces that have been thoroughly cleaned and degreased to remove any road film and other contaminants. This will ensure maximum adhesion of livery film materials.

### 4.3 Air temperature

The range of air temperatures and surface temperatures at which livery film application should be undertaken is stated in the manufacturer's instructions. Application of self-adhesive materials within the stated temperature range will ensure that adhesion is optimised.

### 4.4 Application

IMPORTANT NOTES:

Do not touch the adhesive side of the film during application. This will remove part of the adhesive backing, reducing the adhesion performance of the product, increasing the likelihood of curling at the edges.

It is important that excessive force is not used when pressing and smoothing livery film into place, since this will tend to stretch the film. This tends to cause shrinkage of livery film panels after a period of time.

The recommended approach is to peel back a small section of the release liner along one edge of the film, enabling alignment of the livery film panel onto the target surface of the vehicle. Application involves aligning the livery film panel onto the vehicle, removing the remainder of the release liner and applying the film. Any air bubbles should then be removed by use of a spatula covered with a soft cloth, or other suitable applicator, working from the centre of the livery film panel towards the edges. If air bubbles cannot be removed in this way, they can be pierced with a pin and then flattened out.

Manufacturers' instructions should be followed. In general, the recommended application technique involves aligning the panels and pressing them into



place using a spatula covered with a soft cloth, or other suitable applicator, to prevent scratching of the reflective surface of the film.

Application is usually carried out with the target surface dry, but some manufacturers' instructions give advice that the application of their products can be eased by spraying the target surface with a mixture of 98-99 parts water and 1-2 parts liquid soap. This helps with aligning the livery film panels onto the target surface by allowing some repositioning of the film if necessary.

#### **4.5 Curved surfaces**

Retro reflective livery films generally conform to flat or simple shallow curved surfaces with a single radius. Most are not suitable for use on surfaces with curvature in more than one direction (compound curves). Judgement and experience will guide the application of livery material to motorcycle bodywork.

#### **4.6 Panel cutting**

Livery film materials can be cut easily using a sharp knife or scissors. Note that some livery film materials require edge sealing when they are cut; the manufacturer's instructions should be followed. Some companies offer livery film panels pre-cut to the correct size and shape for application to specific vehicles. A list of some of these companies can be found in the Appendices.

#### **4.7 Material storage**

When not in use, livery film materials should be stored in the packaging in which they are supplied. It is also advisable to place wax paper at either end of rolls of adhesive film to prevent dirt and dust from sticking to the edges.

#### **4.8 Removal**

If it becomes necessary to remove livery film panels for damage repair or decommissioning of vehicles, the panel should be heated gently with a hot air gun to help to soften the adhesive. One side of the livery film panel should then be lifted and slowly pulled back, folding it back flat against the surface.

Should any adhesive remain on the vehicle, it can be removed by dabbing a fresh piece of livery film material onto the relevant areas, adhesive side down. Alternatively, it may be possible that isopropanol or paint thinners can be used, wiped over the surface to be cleaned using a soft, clean cloth.

**Please note:** Reference should always be made to the manufacturers of both the livery film products being removed and the vehicle from which they are being removed to ensure that the solvent being used will remove any adhesive residue without causing damage to the paint finish on the vehicle.

## 5 Livery Film Specification

The following is the recommended specification for the minimum level of performance of livery films that would be acceptable if the conspicuity benefits of conspicuous livery schemes are to be realised.

Material thickness	Preferably less than 1.7 mm
Orientation requirements	As per manufacturer's instructions
Applicable automatic cutting methods	Die, plotter or manually cuttable using laser or knife
Life expectancy	As per manufacturer's advice
Warranty period	As per manufacturer's advice
Temperature range	-25°C to 50°C

Table 1. General livery film material information

Observation Angle	Entrance Angle	$R_A$				
		Fl. Yellow-Green	Fl. Orange	Blue	White	Red
0.20°	5°	300	160	25	350	60
	30°	150	80	12	150	25
	45°	33	18	3	40	7
0.33°	5°	80	80	10	150	25
	30°	60	50	4	60	10
	45°	16	20	2	30	5
0.50°	5°	50	45	7	110	20
	30°	20	20	3	60	10
	45°	9	8	1.3	20	3.6
1.00°	5°	8	8	1	9	2.5
	30°	6	4	0.75	6	1
	45°	2	2	-	3	-
Coefficient of retro reflection, $R_A$ , is a measure of the amount of light radiation retro reflected from a surface relative to the amount of light radiation incident upon the surface, per unit area. Units are candelas per lux per square metre, $\text{cd.lx}^{-1}.\text{m}^{-2}$ . Further details are available from CIE publication 54.2 – 2001.						
<b>Note:</b> These values are similar to those quoted in BS 873: 1983 and ASTM D 4956 – 01a.						

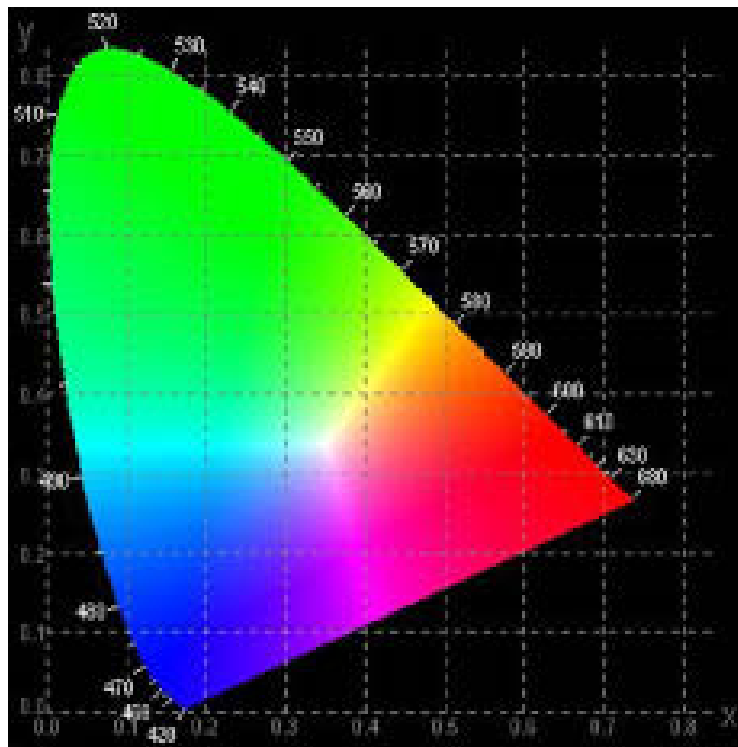
Table 2. Coefficient of Retro reflection ( $R_A$ ) Minimum Values

Performance Degradation	Fl. Yellow-Green	Fl. Orange	Blue	White	Red
Acceptable maximum degradation	50%	20%	20%	20%	20%
Degradation period	3 years	3 years	3 years	3 years	3 years
<b>Note:</b> These values are per ISO 4892-1: 1994 and ISO 4892-2: 1994.					

Table 3. Maximum Permissible Retro reflectivity Degradation

Daytime Chromaticity	CIE D65 Illuminant							
	1		2		3		4	
	x	y	x	y	x	y	x	y
Fl. Yellow-Green	0.375	0.620	0.460	0.532	0.398	0.450	0.350	0.508
Fl. Orange	0.506	0.404	0.570	0.429	0.655	0.345	0.560	0.340
Blue	0.065	0.216	0.190	0.255	0.245	0.210	0.144	0.030
White	0.285	0.325	0.335	0.375	0.355	0.355	0.305	0.305
Red	0.550	0.358	0.640	0.365	0.735	0.265	0.660	0.233

**Note:** These values are similar to those quoted in BS 873: 1983 and ASTM D 4956 – 01a.



For each colour, plot x- and y-values on the respective x- and y-axis on the plot shown. Four pairs of coordinates generate a four-sided polygon on the plot. The colour of the livery film, as determined in accordance with CIE publication 54.2 – 2001, section 8, must fall within that polygon.

**Footnote:** Night-time chromaticity data are not yet available. HOSDB will publish a revised livery film specification when necessary.

Table 4. Daytime and Night-Time Chromaticity

Fluorescent materials	Luminance factor $\beta$ , min		
	CIE D65		CIE D150
	$\beta_{Total}$	$\beta_{Fluorescent}$	$\beta_{Total}$
Fl. Yellow-Green	30	15	40
Fl. Orange	15	7	15
Blue	0.7	NA	NA
White	17	NA	NA
Red	0.5	NA	NA

(NA – Not Applicable)

Table 5. Fluorescent and Non-Fluorescent Luminance Factor

Impact Resistance	ASTM D4956 – 01a: 6.10 or ASTM D2794 – 93
Shrinkage	ASTM D4956 – 01a: 6.6
Flexibility	ASTM D4956 – 01a: 6.7
Chemical/solvent resistance	BS 873: Part 1: 1983 section 12 (solvent wipe test) Chemicals – at minimum, should be resistant to splashing with diesel, petrol and LPG that can occur during refuelling Solvents – at minimum, should be resistant to white spirit, turpentine, kerosene and cleaning solutions likely to be used

Table 6. Standards compliance

Livery film, as applied to the vehicle and conditioned as necessary, should withstand washing during routine maintenance under the conditions specified below.	
Maximum fluid temperature	38°C or higher
Spray fan pattern required	As per manufacturer's instructions
Minimum incident angle of spray axis	15° or less to perpendicular of surface
Nozzle distance from surface	1.2 metres or further
Nozzle pressure	75 bar or less

Table 7. Power washing guidelines

NOTE: These values should be considered to be minimum performance guidelines for livery film materials. If specific films are resistant to cleaning at a higher temperature, incident angle or pressure or at a shorter distance between the nozzle and the film surface, this may be considered to be superior performance.

## 6 Legislation

Legislation that applies to vehicle livery schemes includes the Road Vehicle Lighting Regulations, 1989 ('the RVLRL'), which restricts the colour, size and positioning of reflective materials to the rear and sides of vehicles. Regulations relating to the rear of vehicles are clear, whilst those relating to the sides are somewhat more vague. Advice from the Department for Transport (Working Group Report for ACPO Traffic, 1997) indicated that amendments to the RVLRL would be possible, but only with Ministerial support. Basically, the RVLRL prohibits the fitment of any colour other than red retro-reflectors to the rear of vehicles, except in a few very specific instances.

Clearly this has an impact on the police (and other Emergency Services) in that the liveries they employ for Health and Safety reasons and to promote public awareness demand fluorescent yellow-green and red retro-reflectors to the rear. Temporary exemptions to the RVLRL are in place that permit the use of these markings.

Lettering used for the word 'POLICE' to the sides and to the rear of police motorcycles should be in block capitals and in a typeface similar to that applied to British road signs as specified in The Traffic Signs Regulations and General Directions, 2002 (refer specifically to Schedule 13, Parts I and II).

Legislation, including the Health and Safety at Work Act and the Personal Protective Equipment Directive, applies to the high-visibility garments that should be worn by police motorcyclists.

## 7 Summary of Key Recommendations

### 7.1 Recommendations for Police Motorcycle Livery

- A. Maximum coverage of the vehicle firstly in fluorescent yellow-green vehicle wrapping vinyl film and then wherever the curvature of the bodywork permits in dual-performance fluorescent and retro reflective yellow-green livery film will ensure maximum conspicuity of police motorcycles.
- B. A corporate police appearance is conveyed by using a twin chequer band of retro reflective blue livery film panels measuring either 50 mm square or rectangular 50 mm high by 100 mm long to the sides of the bodywork. Corporate appearance was deemed from the outset to be of lesser importance than conspicuity.
- C. 'POLICE' legends applied to the front and sides of the motorcycle convey a corporate police image. This should assist with recognition of motorcycles as police vehicles by members of the public and should help to avoid confusion with other yellow motorcycles, such as paramedic or AA motorcycles.
- D. A single 100 mm wide chevron formed from red retro reflective vehicle livery film is more effective than multiple narrow fluorescent orange and yellow chevrons, given the small rearward-facing surface area to the rear of motorcycles.

### 7.2 Recommendations for Police Motorcyclist

- E. In order to preserve the single solid block of fluorescent yellow-green applied to police motorcycles, their riders should wear high-visibility jackets and trousers in fluorescent yellow-green at all times whilst on duty. These garments must be CE marked, indicating compliance with relevant standards, must be in accordance with police force health and safety policy or guidelines (safe systems of working and other applicable local directives) and must be in good condition.
- F. A white or other brightly-coloured crash helmet would be advised. Studies have shown that they can reduce the probability of a collision significantly.

## 8 References

- [1] Letter dated 30<sup>th</sup> January 1997 from the Traffic Committee of the National Motorway Conference of the Association of Chief Police Officers, re 'Common Standards of Markings for Patrol Vehicles,' setting out the Operational Requirement for the planned motorcycle livery scheme.
- [2] Web page at <http://www.merriam-webster.com/dictionary/conspicuousness>, accessed in January 2006.
- [3] Various Ice Ergonomics and Ergonomics and Safety Research Institute (ESRI) reports, 1992-2003.





## Appendix A: Vehicle Marking Companies and Film Manufacturers

### A.1 Vehicle Marking Companies (Converter Companies)

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**Please note: This list must not be considered to be a recommendation. It is not exhaustive. Other companies that are not listed may be able to offer professional livery application services and it is the responsibility of individuals procuring such goods or services to determine their suitability.**

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#### **A & R Signs & Display Ltd.**

Unit 12B, Acton Place Industrial Estate, Long Melford Road, Acton, Sudbury, Suffolk, CO10 0BB

Tel: +44 (0) 1787 373001

Fax: +44 (0) 1787 373332

Email: bcolin855@aol.com

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#### **Bluelite Graphics Ltd.**

Unit 2, 64 Victoria Road, Burgess Hill, West Sussex, RH15 9LH

Tel: +44 (0) 1444 232366

Fax: +44 (0) 1444 232376

Email: info@bluelightgraphics.com

Website: www.bluelightgraphics.com

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#### **Brisco Signs & Graphics Ltd.**

Unit 25, Cater Road, Bishopsworth, Bristol, BS13 7TX

Tel: +44 (0) 117 311 3777

Fax: +44 (0) 117 311 6777

Email: sales@brisco.co.uk

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#### **Design Works UK Ltd.**

18 High Street, Old Town, Swindon, Wiltshire, SN1 3EP

Tel: +44 (0) 1793 421900

Fax: +44 (0) 1793 421901

Email: enquiries@designswindon.com

Website: www.designswindon.com

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#### **DeSigns Signage Solutions Ltd.**

Saxon House, Unit 6, Burma Drive, Marfleet, Kingston upon Hull, HU9 5SD

Tel: +44 (0) 1482 787713

Fax: +44 (0) 1482 787714

Email: sales@signage-solutions.co.uk

Website: www.signage-solutions.co.uk

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**Please note: This list must not be considered to be a recommendation. It is not exhaustive. Other companies that are not listed may be able to offer professional livery application services and it is the responsibility of individuals procuring such goods or services to determine their suitability.**

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**Fenn Graphics Ltd.**

Fenn House, 1 Old Tramway, Fenton, Stoke on Trent, Staffordshire, ST4 3PX

Tel: +44 (0) 1782 344100

Fax: +44 (0) 1782 344155

Email: sales@fenngraphics.co.uk

Website: www.fenngraphics.co.uk

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**KPMF Direct Ltd. (Note – raw material supply only)**

13 Prospect Drive, Lichfield, Staffordshire, WS14 9UX

Tel: +44 (0) 870 121 1285

Fax: +44 (0) 870 121 1286

Email: sales@kpmfdirect.co.uk

Website: www.kpmfdirect.co.uk

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**Marking Service Signs (2006) Ltd.**

King Street Works, King Street, Drighlington, Bradford, West Yorkshire, BD10 1EJ

Tel: +44 (0) 113 285 2745

Fax: +44 (0) 113 285 4748

Email: marserve@btconnect.com

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**Nav-Comm (Newport Specialist Vehicles Ltd.)**

Portland Hall, 41 Portland Street, Southport, PR8 1HU

Tel: +44 (0) 1704 530391

Fax: +44 (0) 1704 540692

Email: sales@nav-comm.net

Website: www.nav-comm.net

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**Pearlan Decals Ltd.**

Unit 18, Hereward Rise, Halesowen Industrial Park, Halesowen, West Midlands, B62 8AW

Tel: +44 (0) 121 550 8116

Fax: +44 (0) 121 550 8264

Email: sales@pearlandecals.co.uk

Website: www.pearlandecals.co.uk

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**PVL UK Ltd.**

Unit 1, Avocet Trading Estate, Victoria Gardens, Burgess Hill, West Sussex, RH15 9NH

Tel: +44 (0) 1444 258980

Fax: +44 (0) 1444 258981

Email: info@preview.co.uk

Website: www.preview.co.uk

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**Please note: This list must not be considered to be a recommendation. It is not exhaustive. Other companies that are not listed may be able to offer professional livery application services and it is the responsibility of individuals procuring such goods or services to determine their suitability.**

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**Reflex Design International Ltd.**

The Old Mill, 10 Pelham Street, Oadby, Leicestershire, LE2 4DJ

Tel: +44 (0) 8700 111511

Fax: +44 (0) 8700 111611

Email: sales@reflexdesign.uk.com

Website: www.reflexdesign.uk.com

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**Ringway Vehicle Graphics**

Winterstoke Road, Weston-Super-Mare, Somerset, BS24 9BQ

Tel: +44 (0) 1934 421400

Fax: +44 (0) 1934 421401

Email: signs@ringway.co.uk

Website: www.rvgonline.co.uk

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**Supersine Duramark Ltd.**

Freemantle Road, Lowestoft, Suffolk, NR33 0EA

Tel: +44 (0) 1502 501234

Fax: +44 (0) 1502 583544

Email: sales@ssdm.co.uk

Website: www.ssdm.co.uk

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**William Smith Ltd.**

Grove Works, 5 Queen Street, Barnard Castle, County Durham, DL12 8JG

Tel: +44 (0) 1833 690305

Fax: +44 (0) 1833 637268

Email: info@williamsmith.co.uk

Website: www.williamsmith.co.uk

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## A.2 Film Manufacturers and Suppliers

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**Please note: This list must not be considered to be a recommendation. It is not exhaustive. Other companies that are not listed may be able to offer professional livery application services and it is the responsibility of individuals procuring such goods or services to determine their suitability.**

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### **3M United Kingdom Plc.**

Customer Service Centre, 3M House, 28 Great Jackson Street, Manchester, M15 4PA

Tel: +44 (0) 161 237 6394

Fax: 0800 378127

Website: [www.3m.co.uk](http://www.3m.co.uk)

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### **Kay Premium Marking Films Ltd.**

Oakwood Close, Penyfan Industrial Estate, Crumlin, Newport, NP11 3HY

Telephone: +44(0) 1495 242300

Fax: +44(0) 1495 249446

Email: [sales@kpmf.com](mailto:sales@kpmf.com)

Website: <http://www.kpmf.com>

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### **Reflexite U.K. Ltd.**

4420 Nash Court, John Smith Drive, Oxford Business Park South, Oxford, OX4 2RU

Tel: +44 (0) 1865 396959

Fax: +44 (0) 1865 396960

Email: [sales@reflexite.co.uk](mailto:sales@reflexite.co.uk)

Website: [www.reflexite-europe.com](http://www.reflexite-europe.com)

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### **Rennicks U.K. Limited.**

Stuart Road, Manor Park, Runcorn, Cheshire, WA7 1TS

Tel: +44 (0) 1928 579966

Fax: +44 (0) 1928 579965

Email: [uksales@rennicks.com](mailto:uksales@rennicks.com)

Website: [www.rennicksuk.com](http://www.rennicksuk.com)

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## Appendix B: Scientific Basis for the High-Conspicuity Motorcycle Livery

The following summarises the research and development that has been done in designing the recommended motorcycle livery scheme.

### **B.1 March 1995 – ICE Ergonomics Report “A Review of Conspicuity Devices for Police Motorcycles”**

Description: A review of police motorcyclist activities, relevant scientific literature, the opinions of specialist motorcycle organisations and the manufacturers of conspicuity devices, followed by a discussion of the main conspicuity issues and how ergonomic principles might be applied to solving them.

Main findings:

- Maximise surface area of motorcycle/rider unit covered with conspicuity treatments. Use of a single colour increases perceived size of motorcycle/rider unit, improving its visibility;
- Use fluorescent yellow to increase conspicuity of motorcycle/rider unit. Red also offers good colour contrast but is neither as bright, nor as effective at night;
- Exploit ‘concept of unity’ whereby coverage of fluorescent yellow is not interrupted by application of further markings, such as police force insignias, badges, etc., since they will reduce conspicuity and introduce camouflage effects by breaking up the shape;
- Fluorescent materials improve daytime conspicuity, whereas retro reflective materials improve night-time conspicuity. Combined fluorescent and retro reflective material is recommended wherever possible. If this is not available:
  - Cover whole surface in fluorescent material. Otherwise maximise cover as much as possible using blocks of film rather than strips;
  - Use retro reflective material to outline shape of motorcycle. Maximum effect will be gained by outlining on the sides and rear;
- Fluorescent colour should be used high up on the motorcycle/rider unit. This enables greater conspicuity of the motorcyclist in traffic, i.e. over tops of cars and through windows. Viewed in conjunction with the first point above, this suggests that it would be advantageous for the rider to wear fluorescent yellow clothing and helmet;
- Retro reflective materials should be positioned where they are most likely to be picked up in other vehicles’ headlamps;

- Movement or changes in state, such as a flashing light (which may be used in conjunction with a steady light), are good for attracting attention in the visual periphery and so can improve conspicuity;
- Use a dipped headlamp in preference to a single daytime running lamp, since the latter is less bright and so less conspicuous and gives the rider a false sense of security.

## **B.2 November 1996 – ICE Ergonomics Report “Conspicuity Schemes for Police Motorcycles and Their Riders”**

Description: An appraisal of three different conspicuity schemes, each incorporating different rider clothing and motorcycle marking and lighting treatments. The schemes were devised according to criteria established in the previous report described above.

Main findings:

- No single scheme was found to be the most conspicuous in all aspects of rider clothing and motorcycle markings and lighting when assessed under all viewing conditions;
- No particular scheme emerged as the best overall, although two livery schemes emerged as the joint best performers;
- It was deemed that one of these livery schemes should perform better for ergonomic reasons;
- Further trials were advocated to investigate various synergies and possible combinations of livery elements for best performance;
- Ergonomic principle of covering as much of the motorcycle as possible in fluorescent yellow-green was cited as the reason why the theoretical best livery scheme should perform best.

## **B.3 May 1998 – ICE Ergonomics Report “Factors Affecting Drivers’ Vision”**

Description: A literature review on the state of the art in respect on human vision, prepared with a view to identifying whether any facets of the subject could be exploited to maximise the visibility of vehicles or pedestrian officers.

No specific findings of significance to the research in hand were given. However, there is discussion about how conspicuity and the driving task are related.

## **B.4 November 1998 – ICE Ergonomics Report “Further Assessment of Conspicuity Schemes for Police Motorcycles and their Riders”**

Description: This report outlines work that was done to draw together concepts tried in previous studies by ICE Ergonomics into a single livery

scheme, employing the best aspects of all those tried. Several different police motorcycle livery schemes were tried against ICE Ergonomics' own design.

Main findings:

- Use daytime running lights to maximise frontal daytime conspicuity and, with reduced output, also to aid night-time conspicuity;
- Maximise the area of fluorescent yellow for daytime conspicuity;
- Use yellow retro reflective material (dual performance, if possible) to aid night-time visibility;
- Careful use of blue material will provide benefits of association [with the police by members of the public] and aid identification. Some restraint may be necessary to avoid degrading the medium to long distance conspicuity performance of the scheme;
- Judicious application of high-performance retro reflective materials may be preferable to larger areas of lower grade products (further work may be necessary to confirm this);
- Further development of clothing performance requirements should include the specification for day/night and conspicuity/identification to allow informed creation of designs.

## **B.5 October 1999 – ICE Ergonomics report “Police Motorcycle Conspicuity – Summary of Work to Date”**

Description: Summary of previous research and development effort and reports prior to October 1999. It lists the aims, scope and main findings of each preceding report, along with recommendations. It then suggests the way forward, listing issues that need to be resolved.

Suggested way forward:

- Issues to resolve:
  - Clothing treatments:
    - Base colour – yellow trousers as well as jackets?
    - Stickman outline, BS EN 471 or a combination?
    - Colour of retro reflective material – silver, combined performance yellow, silver with blue ‘POLICE’ legend or blue?
    - Base colour of crash helmet – white or fluorescent yellow?
    - Colour, form and location of reflective tape?
  - Motorcycle treatments:
    - Form and size of markings?

- Lighting:
  - Dipped beam headlight
  - Running lights – where, how many?
  - Other lights – steady indicators?
- How to resolve:
  - Information to identify – for clothing treatments, motorcycle treatments and lighting, specifications need to be developed to consider:
    - Distance at which officers need to be seen both on and off the motorcycle;
    - Day/night performance – relative importance;
    - Visibility/police identity/consistent image with cars – relative weights;
    - For clothing, need for compliance with BS EN 471;
  - How to identify:
    - Questionnaire to forces via ACPO. May be directed to individual responsible for traffic section, fleet manager and/or riders;
  - Development of options – the West Mercia and ICE options can be refined further in light of the specification and tested to determine which meets the safety needs of police motorcyclists best;
  - How to test – opinions of ICE and of ACPO working party sought thus far. It would be beneficial to measure what the public is actually likely to do rather than what they say they will do. The following may be useful:
    - Use of visibility meter;
    - Driver glimpse technique using road model at ICE (to model daytime testing only).

## **B.6 January 2001 – ICE Ergonomics report “Police motorcycle/motorcyclist conspicuity – a Consensus Scheme,” Phase 1: Analysis of questionnaire responses and accident data**

Description: This document aims to produce a performance specification for the design of markings for police motorcycles and police motorcyclist clothing, generated from the responses to a questionnaire given by 374 police motorcyclists from 48 forces and 41 accident records from 11 forces.



Main findings:

- Most frequent survey response concerning the aims of markings for motorcycles was for motorcycles and their riders to assist in being seen;
- Having an image associated with the police and an image which differentiates the police from civilian motorcycles were respectively rated as the second and third aims of the marking scheme;
- When asked the distance at which motorcycle and rider clothing markings need to be seen, 100 m was the most frequently stated distance;
- 40-50 respondents stated that the markings should be visible from ‘as far as possible,’ citing distances of up to ½ mile for rider clothing markings and 1 mile for motorcycle markings;
- The mean response was 275 m for motorcycle markings and 229 m for motorcyclist clothing markings;
- Resulting suggestions for future marking schemes include that they must be conspicuous:
  - When riding on single carriageway roads, residential and non-residential and on rural roads;
  - Also on dual carriageways;
  - Especially during the daytime and also at dusk;
  - Night-time under street lighting is also important for motorcycle markings only;
  - Primarily when undertaking patrol duties and also when attending road traffic accidents, undertaking traffic control duties and escorting abnormal loads, motorcycle markings are important;
  - From all angles of view but especially from the front and rear.

## **B.7 January 2002 – ICE Ergonomics report “Police motorcycle/motorcyclist conspicuity – a Consensus Scheme,” Phase 2: Identification of conspicuity treatments**

Description: Aims to develop a performance specification for motorcycle/motorcyclist markings derived from objectives identified in phase one and from the ergonomic principles of conspicuity. Proposed schemes were evaluated and a review of conspicuity treatments was undertaken against the performance specification derived.

Main findings and recommendations:

- Lighting – use steady headlamp, flanked by running lamps in mirrors and rear lighting that emphasises width;

- Markings – use fluorescent yellow paint, fluorescent yellow retro reflective material wherever possible, retro reflective blue markings to provide contrast and improve recognition as a police vehicle;
- Helmet – use fluorescent yellow helmet, with retro reflective material where possible;
- Clothing – fluorescent yellow clothing with retro reflective blue markings where possible should be used;
- Other items were proposed for discussion, such as:
  - Use of modulating headlamp or auxiliary lamps;
  - Use of light dressing (e.g. neon, LED, electroluminescent wire);
  - Use of fluorescent yellow windscreen;
  - Use of photoluminescent materials on motorcycle, rider clothing and helmet;
  - Helmet lighting.

## **B.8 May 2002 – ICE Ergonomics report “Police motorcycle/motorcyclist conspicuity – a Consensus Scheme,” Phase 3: Scheme refinement**

Description: Aims to develop a conspicuity scheme for police motorcycles and motorcyclists based on an assessment of the risks undertaken on duty and on the ergonomic principles relating to conspicuity.

Main recommendations:

- Lighting as follows:
  - Steady headlamp;
  - Running lamps in mirrors – static or modulating;
  - LED light clusters (suitability to be determined);
  - LED linear scanning array to front (suitability to be determined);
  - LED linear scanning array to rear (suitability to be determined);
  - Neon lighting (suitability to be determined);
  - Electroluminescent lighting (under assessment);
  - Permanently on (when not in use) indicators;

- Motorcycle marking applications:
  - Fluorescent yellow vehicle paint for base colour;
  - Fluorescent yellow retro reflective vinyl for outlining;
  - Blue retro reflective vinyl for identification;
  - Fluorescent yellow windscreen;
- Clothing applications:
  - Fluorescent yellow jacket and trousers;
  - Fluorescent yellow retro reflective tape to BS EN 471 arm and leg hoop formats;
  - Fluorescent yellow retro reflective tape defining body shape – ‘Stickman;’
  - Retro reflective silver/blue tape stamped with ‘POLICE’ along edge of arms and legs;
  - Photoluminescent-reflective clothing tape (suitability to be determined);
  - Electroluminescent clothing (under assessment);
  - Fluorescent yellow crash helmet with retro reflective markings (format to be confirmed);
  - ‘Halo’ – elasticised retro reflective band to base of crash helmet providing 360<sup>0</sup> visibility (suitability to be determined).

## **B.9 March 2003 – ICE Ergonomics report “Police motorcycle/motorcyclist conspicuity – a Consensus Scheme,” Phase 4: Scheme assessment**


Description: Aims to assess conspicuity of scheme developed in phase three against West Mercia scheme using performance specification and ergonomics aspects of conspicuity as a means of benchmarking the designs.

Main findings:

- Photometric measures to assess marking schemes:
  - Luminance, contrast and visibility of both schemes assessed using a photometric camera;
  - In general, ESRI scheme achieved better performance on all measures (mean luminance, contrast and visibility);
  - ESRI scheme was outperformed at night from front and rear, although standard-fit lighting to West Mercia vehicle was considered to be a major contributory factor;

- Expert appraisal of both marking schemes was undertaken in order to provide an informed and objective evaluation. It was anticipated that:
  - By day – the ESRI scheme is likely to outperform the West Mercia scheme due to its greater use of fluorescent yellow on both motorcycle and rider, creating a solid form that is not broken up by use of other materials;
  - By night – the ESRI scheme is likely to perform better due to the greater coverage by retro reflective materials and the use of higher luminance materials. In terms of the rider, both schemes offer benefits and it is difficult to determine which scheme will perform best overall;
- Participant trials:
  - When participants were required to make a forced choice between schemes after a limited exposure of 2 seconds, the ESRI scheme was favoured. It was also favoured by them for adoption by the police;
  - ESRI scheme found to be more distinctive than West Mercia, apart from rear (100 m and 200 m) and side (night at 100 m), where no significant difference was found. No preference was found for clothing, except that the ESRI rider scheme was favoured at night;
  - All lighting concepts were found not to be visible under bright daytime conditions and so data was obtained for dusk and night-time only. Addition of front and rear lighting concepts to ESRI scheme improved its performance over West Mercia scheme;
- Lighting review – advantages were found with specific dynamic sequences of flashing LED clusters, intended for use as running lamps. However, these have not been pursued for use in the final scheme due to the visual dominance of the headlamp and due to participants' views that they would erroneously understand these running lamp sequences to mean that the motorcycle was engaged in an emergency;
- Conclusions:
  - Both schemes went some way to meeting the performance specification, although the ESRI scheme achieved a better match with the requirements;
  - ESRI scheme has superior performance due to its use of:
    - Fluorescent yellow on both motorcycle and rider;
    - Single, large blocks of colour, equating to size of motorcycle and rider, with minimal interruption from other colours;
    - Larger areas of retro reflective material at night on the motorcycle, which is of higher luminous performance than those employed by West Mercia;
    - Additional lighting;
    - A yellow windscreen;

- Recommendations:
  - Livery:
    - Maximise area covered by fluorescent and retro reflective yellow material;
    - Where dual performance material cannot be applied due to its relative inflexibility, fluorescent yellow should be used instead;
    - Use of blue (or other colour) identifiers should be minimised;
    - Use a fluorescent yellow windscreen, subject to confirmation that it does not impede the rider's control and safety in riding the motorcycle;
  - Lighting:
    - Additional lighting improves the attention-getting qualities of the scheme;
    - Trade-offs with discomfort glare, disability glare and conveyance of inappropriate meaning to other road users need further attention;
    - Dual-intensity lighting to achieve luminance appropriate for daytime and night-time use is needed;
  - Clothing:
    - Maximise area covered by fluorescent yellow retro reflective materials;
    - Investigate further the feasibility of using fluorescent and retro reflective yellow tape upon clothing as opposed to the silver retro reflective tape conventional to BS EN 471 formats.



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