
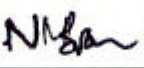




# Stewart Signs Limited Signshine™

## Assessment of Signshine™ for Exterior Livery Applications on Rail Vehicles

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## Executive Summary

Stewart Signs Limited has patented a new protective repellent coating for film-based graphics called Signshine™. It is a permanent, non-sacrificial clear coat ink that is printed onto self-adhesive vinyl film without distorting or yellowing the image underneath. It provides a high lustre finish with virtually zero surface tension, which repels most kinds of graffiti and dirt, and is resistant to a wide range of paints, chemicals and solvents. Signshine™ has the added advantage that it creates a single-layer printed vinyl film that is conformable over vehicle body contours and irregular surfaces.

Atkins Rail has been commissioned to conduct a performance assessment of Signshine™ and to assist with its promotion within the rail industry. This report is a record of the assessment process and provides a written endorsement of rail vehicle exterior applications for which Signshine™ is deemed to be suitable.

Signshine™ has demonstrated a good resistance to physical wear, with an estimated acceptable life of 5-6 years. It has also demonstrated a good resistance to chemical attack from typical cleaning agents used in railway washing plants, and to soiling from air-borne contaminants such as iron oxide (brake dust). Any soiling that does occur is easily removed with standard cleaning agents.

The repellent properties of Signshine™ make it very difficult to vandalize with typical graffiti markers used in the railway environment. The only marker that may leave residual ghosting is leather dye.

When printed on to 3M Controltac™ Series 180 graphic marking film, Signshine™ complies with the mandatory requirements of GM/RT2120 Issue 2 applied to an aluminium substrate and to an aluminium substrate coated with an ex-BR Specification 81 paint system. Compliance with GM/RT2120 Issue 2 can also be considered to apply for water-borne paint systems and for steel substrates with and without a paint system.

Signshine™ printed on to 3M Controltac™ Series 180 graphic marking film complies with all of the recommended requirements in BS 6853:1999 for an exterior vertical surface on Category Ia, Ib and II vehicles when applied to an aluminium substrate. This compliance can also be considered to apply for a steel substrate. The smoke

and toxic fume emissions recorded are so low as to have little or no effect on the overall emissions when applied to either a steel or aluminium substrate coated with a paint system. Therefore, the limiting factor will be the smoke and toxic fume emission properties of the paint system.

Although the assessment relates to Signshine™ printed on to 3M Controltac™ Series 180 graphic marking film, experience suggests that Signshine™ printed on to graphic marking films from other suppliers will have similar fire performance properties. However, before proceeding with any application tests should be conducted to confirm compliance with the requirements.

This endorsement of Signshine™ as being suitable for exterior livery applications on rail vehicles does not exempt each application from the Rail Safety and Standards Board's (RSSB) Engineering Acceptance process. However, it is considered likely that most livery applications will qualify to be certificated as Minor Modifications.

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## 1. Introduction

Rail vehicle liveries have traditionally been applied with a paint system, either by using a spray process or by brush. In more recent years self-adhesive graphic vinyl films have been used for both corporate liveries and advertising liveries to great effect. A major drawback to the use of these systems has been the dramatic increase in graffiti vandalism, which has proven difficult and costly to remove. Vinyl films can be supplied laminated with an anti-graffiti over-layer; however these have the disadvantage that they do not conform well over vehicle body contours and irregular surfaces.

Stewart Signs Limited based in Eastleigh, Hampshire has patented a new protective repellent coating for film-based graphics called Signshine™. Signshine™ is a permanent, non-sacrificial clear coat ink that is printed onto self-adhesive vinyl film without distorting or yellowing the image underneath. It provides a high lustre finish with virtually zero surface tension, which repels most kinds of graffiti and dirt, and is resistant to a wide range of paints, chemicals and solvents. Signshine™ has the added advantage that it creates a single-layer printed vinyl film that is conformable over vehicle body contours and irregular surfaces.

Stewart Signs Limited has commissioned Atkins Rail to conduct a performance assessment of Signshine™ and to assist with its promotion within the rail industry. This report is a record of the assessment process and provides a written endorsement of rail vehicle exterior applications for which Signshine™ is deemed to be suitable. It is not a substitute for the Rail Safety and Standards Board's Engineering Acceptance process, which must still be undertaken for each application of a Signshine™ livery.

## 2. Company Profile

Stewart Signs has been producing high-quality liveries, signs and displays for some of the most image-conscious organisations in Britain for over 40 years. Together with its sister installation company, TFM Ltd., Stewart Signs offers complete livery, sign and display solutions.

Stewart Signs is an independent, highly experienced and knowledgeable resource with the capability to produce, project manage, install and maintain the most complex sign schemes.

Stewart Signs operates a Quality Management System that complies with the requirements of BE EN ISO 9001: 2000 and an Environmental Management System that complies with BS EN ISO 14001: 1996. It also has a Health and Safety Policy that is fully compliant with current legislation. Copies of the Certificates of Registration and Health and Safety Policy are available on the Company website ([www.stewartsigns.co.uk](http://www.stewartsigns.co.uk))

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## 3. Signshine™ Assessment

The assessment relates solely to the use of the Signshine™ system for exterior liveries, although future developments may mean that it or a similar system can be considered for interior applications.

The basic requirements of a rail vehicle livery system are durability, resistance to chemical attack, resistance to soiling from airborne particles such as iron oxide (brake dust) and resistance to graffiti. There are also mandatory requirements for control of reaction to fire, which are dependant on the category of rail vehicle that the livery is to be applied. The Signshine™ system has been independently tested for all of the above requirements with a great deal of success.

### 3.1 Physical Properties

#### 3.1.1 Physical Wear Test

The durability of the Signshine™ system has been assessed by a simulated carriage washing machine test conducted by Scientifics Limited at its Doncaster laboratory. The test was conducted in accordance with Adtranz Specification “Simulated Carriage Washing Machine: Paint Wear Test”, but with a slightly modified method, as no cleaning product or abrasive sand was used. A comparison was made with a multi-pack clear over base paint system, the wear rate of each being graded by gloss retention. This enabled the likely life to be established that the Signshine™ system could reasonably expect to be maintained to an acceptable level.

The results were very favourable to the Signshine™ system, having a greater gloss retention compared with the paint system. A life span of 5-6 years has been estimated for Signshine™.

(Scientifics Report Reference SS/JH/DOC03049/LR DON 997/C0093).

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## 3.2 Chemical Resistance

### 3.2.1 Chemical Resistance Test

The likely effect of exposure of Signshine™ to a range of chemicals currently used within railway washing plants has been assessed by Scientifics Limited. The test method used was based on BS 3900: Part G5 Method 2 (now BS EN ISO 2812-1: 1995 Method 3). Products used in the test were Exmover, Oxiwash, DP17 and Mainline, used at recommended working strengths.

No visible defects occurred after 1 hour exposure and 24 hours exposure to any of the chemical cleaning agents used in the test.

(Scientifics Report Reference SS/JH/DOC03049/LR DON 997/C0093).

### 3.2.2 Resistance to Iron Oxide Staining

A series of laboratory tests have been conducted on Signshine™ by Scientifics Limited to assess the resistance to soiling, in particular iron oxide staining, and its ease of cleaning.

It was noted that the surface provided poor adhesion for iron oxide solution and other contaminants, with any soiling that did occur being easily removed with standard cleaning agents.

(Scientifics Report Reference SS/JH/DOC03049/LR DON 997/C0093).

### 3.2.3 Resistance to Graffiti

Signshine™ samples have been subjected to various types of graffiti markers encountered in the railway environment and assessed for ease of removal and residual markings following cleaning. Types of graffiti tested were leather dye, aerosol paint and permanent marker pen.

It was noted that the good repellent properties of Signshine™ made the surface difficult to vandalize and that the graffiti was readily removed with the exception of leather dye, which did leave some residual ghosting.

(Scientifics Report Reference SS/JH/DOC03049/LR DON 997/C0093).

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### 3.3 Reaction to Fire

#### 3.3.1 Requirements for Fire Performance

Requirements for fire performance are contained within two documents. Mandatory requirements are in Railway Group Standard GM/RT2120 Issue 2; “Requirement for the Control of Risks Arising from Fires on Railway Vehicles” and recommended best practice requirements are in BS 6853: 1999; “Code of Practice for Fire Precautions in the Design and Construction of Passenger Carrying Trains”. Both documents specify requirements according to the location and orientation of a surface or a material, whereas BS 6853: 1999 also specifies requirements dependant on the operating environment of the rail vehicle under consideration.

As this assessment of Signshine™ is for its application as an exterior livery on rail vehicles, only the requirements of the above documents for an exterior vertical surface and for an exterior vertical limited extent surface are applicable and, therefore, only these shall be considered.

The definition of a vertical surface is:

*A continuous surface within 45° of the vertical with an area greater than 0.2m<sup>2</sup>. In assessing whether 0.2m<sup>2</sup> is exceeded, the maximum linear dimension considered shall be 1 metre.*

The definition of a vertical limited extent surface is:

*A vertical surface whose maximum vertical extent is less than 1 metre and which has no point on its surface that is closer to any other limited extent surface than a distance measured vertically upwards, equal to its maximum vertical extent.*

Bodyside and vehicle end liveries qualify as vertical surfaces; however, the application of some smaller vinyl decals may qualify as vertical limited extent surfaces.

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### 3.3.2 Mandatory Requirements

GM/RT2120 Issue 2 considers only the flammability of a surface or a material and does not differentiate between whether it is interior or exterior to the vehicle; nor does it differentiate for the operating environment of the vehicle. Therefore, the mandatory requirements for a vertical surface (interior or exterior) are:

- Surface spread of flame in accordance with BS 476 Part 7, Class 1;
- Surface spread of flame in accordance with BS 476 Part 7, Class 2 (limited extent).

Signshine™ printed on to 3M Controltac™ Series 180 graphic marking film has been tested in accordance with BS 476 Part 7 adhered to an aluminium substrate and to an aluminium substrate coated with a typical ex-BR Specification 81 paint system. The above combination achieved a Class 1 rating for both surfaces and, therefore, is suitable for all exterior livery applications that are required to be certificated by the Rail Safety and Standards Board's Engineering Acceptance process.

(BRE Test Report No. 219612 - Signshine™ on aluminium).

(Warrington Fire Report No. 145826 - Signshine™ on aluminium/BR 81 paint system).

### 3.3.3 Recommended Requirements

BS 6853: 1999 specifies requirements for flammability, smoke generation and toxic fume emission. The requirements vary depending on the operating environment of the vehicle being considered and on whether the surface or material is internal or external to the vehicle. There are two main operating environments; Category I for underground vehicles and Category II for surface vehicles. Category I is sub-divided into Category Ia and Category Ib, creating three categories defined as follows:

*Category Ia: Rail vehicles that operate for substantial periods in a single track tunnel with no side exits to a walkway and escape shafts, or sleeper vehicles*

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*that operate underground for significant periods, or trains that operate without staff.*

*Category Ib: Rail vehicles that operate for substantial periods in a multi-track tunnel, or a tunnel with side exits to a walkway and escape shafts, or sleeper vehicles that do not operate underground for significant periods.*

*Category II: Surface vehicles with no substantial operating periods in tunnels.*

The requirements for an exterior vertical surface are:

For a Category Ia vehicle

- Surface spread of flame in accordance with BS 476 Part 7, Class 1;
- Surface spread of flame in accordance with BS 476 Part 7, Class 2 (limited extent);
- Smoke density per unit of material measured in accordance with BS 6853: 1999 Annex D Panel Test,  $A_0$  (ON) max 4.4 and  $A_0$  (OFF) max 6.6;
- Weighted summation of toxic fume emission in accordance with BS 6853: 1999 Annex B,  $R$  (max) 1.7.

For a Category Ib vehicle

- Surface spread of flame in accordance with BS 476 Part 7, Class 1;
- Surface spread of flame in accordance with BS 476 Part 7, Class 2 (limited extent);
- Smoke density per unit of material measured in accordance with BS 6853: 1999 Annex D Panel Test,  $A_0$  (ON) max 7.0 and  $A_0$  (OFF) max 10.5;

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- Weighted summation of toxic fume emission in accordance with BS 6853: 1999 Annex B,  $R$  (max) 2.7.

For a Category II vehicle

- Surface spread of flame in accordance with BS 476 Part 7, Class 2;
- No criterion for smoke emission;
- No criterion for toxic fume emission.

As stated in clause 3.3.2 above, Signshine™ printed on to 3M Controltac™ Series 180 graphic marking film has been tested in accordance with BS 476 Part 7 adhered to an aluminium substrate and to an aluminium substrate coated with a typical ex-BR Specification 81 paint system, and achieved a Class 1 rating for both surfaces.

The same combination of Signshine™ printed on to 3M Controltac™ Series 180 graphic marking film has also been tested for smoke and toxic fume emissions, in accordance with the above tests, adhered to an aluminium substrate. The following results were recorded:

- Smoke density,  $A_0$  (ON) 3.94 and  $A_0$  (OFF) 4.77;  
(BRE Test Report No. 219776).
- Weighted summation of toxic fume emission,  $R = 0.758$ .  
(BRE Test Report No. 219777).

Therefore, Signshine™ printed on to 3M Controltac™ Series 180 graphic marking film can be recommended for exterior livery applications on all Categories of rail vehicles where applied directly to an aluminium bodyshell.

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## 4. Discussion

The reaction to fire tests for Signshine™ printed on to 3M Controltac™ Series 180 graphic marking film have been conducted on aluminium substrates with the surface spread of flame test also having been conducted on aluminium coated with an ex-BR Specification 81 paint system. These test results can also be considered to apply to steel substrates, as both materials are classified as non-combustible and, therefore, only the combustible materials will have made a significant contribution to the end results. Similarly, the surface spread of flame test on the coated aluminium can also be considered to apply to new water-borne paint systems, as these systems are known to have better fire performing properties than the ex-BR 81 solvent-based paints.

Tests for smoke and toxic fume emissions have only been performed on an aluminium substrate and not on a substrate coated with a paint system. However, the results achieved were so low that it can be confidently predicted that Signshine™ printed on to 3M Controltac™ Series 180 graphic marking film will have little or no overall effect on the smoke and toxic fume emissions of the coating. Therefore, the limiting factor will be the smoke and toxic fume emission properties of the paint system.

Although, as yet, the fire performance properties of Signshine™ have only been tested when printed on to 3M Controltac™ Series 180 graphic marking film, experience suggests that it will perform in a similar manner when printed on to vinyl graphic marking films from other suppliers. However, before any other vinyl film is used, verification of compliance by testing would be advisable.

This endorsement of Signshine™ as being suitable for exterior livery applications on rail vehicles does not exempt each application from the Rail Safety and Standards Board's (RSSB) Engineering Acceptance process. However, it is considered likely that most livery applications will qualify to be certificated as Minor Modifications in accordance with RSSB's Non-Compliance 04/079/NC and Technical Notes TN-029 and TN-030d.

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## 5. Conclusions

- 5.1 Signshine™ has a good resistance to physical wear with an estimated acceptable life of 5-6 years when tested in accordance with the “Simulated Carriage Washing Machine: Paint Wear Test”.
- 5.2 Signshine™ has a good resistance to the range of chemical agents currently used in railway washing plants.
- 5.3 Signshine™ has a good resistance to soiling from airborne contaminants, in particular iron oxide staining, with any residues being easily cleaned with standard cleaning agents.
- 5.4 The good repellent properties of Signshine™ make it difficult to vandalize the surface with the typical graffiti markers encountered in the railway environment.
- 5.5 Graffiti is readily removed with the exception of leather dye, which may leave residual ghosting.
- 5.6 Signshine™ printed on to 3M Controltac™ Series 180 graphic marking film complies with the mandatory requirements of GM/RT2120 Issue 2 when applied on to an aluminium substrate and on to an aluminium substrate coated with an ex-BR Specification 81 paint system.
- 5.7 GM/RT 2120 Issue 2 compliance can be considered to apply to a steel substrate and to a steel substrate coated with an ex-BR Specification 81 paint system.
- 5.8 GM/RT 2120 Issue 2 compliance can also be considered to apply to steel and aluminium substrates coated with water-borne paint systems.
- 5.9 Signshine™ printed on to 3M Controltac™ Series 180 graphic marking film complies with all of the recommended requirements in BS 6853:1999 for an exterior vertical surface on Category Ia, Ib and II vehicles when applied directly to an aluminium substrate.

- 5.10 Smoke and toxic fume emissions of Signshine™ printed on to 3M Controltac™ Series 180 graphic marking film are so low as to have little or no effect on the overall emissions when applied to a steel or aluminium substrate coated with a paint system.
- 5.11 Experience suggests that Signshine™ printed on to graphic marking films from other suppliers will have similar fire performance properties, although tests should be conducted prior to considering their application.
- 5.12 Applications of Signshine™ will be subject to the RSSB Engineering Acceptance process.