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***REVIEW OF TRION TENSID PRODUCTS FOR
USE BY METRONET RAIL***

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1.0 INTRODUCTION

On behalf of Thorbjorn Bengtsson, Managing Director, Trion Tensid AB, the Building Engineering Team has carried out a technical review of Trion Tensid products for possible use by Metronet Rail. This review covers a technical assessment of anti-graffiti products, the fire performance of coatings and assessments for health and safety and the environment.

2.0 PRODUCT DESCRIPTIONS

The products are divided into two groups, anti-graffiti products covering both graffiti removers and coatings and general purpose products, as described below:

2.1 ANTI-GRAFFITI PRODUCTS

AKS 3500, AKS 3502 and AKS 3503

AKS 3500, AKS 3502 and AKS 3503 are a range of sacrificial anti-graffiti coatings to protect masonry, brick, concrete and other porous surfaces against all types of graffiti. AKS 3503 is a particularly thickened version to deal with highly absorbent and porous surfaces.

Health and Safety Classification – *'Not classified as hazardous'*

AKS 3510

AKS 3510 is also a sacrificial anti-graffiti coating but it is specific for non-porous surfaces, to protect against spray paints and felt tip pen inks.

Health and Safety Classification – *'Not classified as hazardous'*

AKS 221 Liquid

AKS 221 Liquid is a graffiti and paint remover for use on sensitive surfaces e.g. on signage, either in exterior or interior locations. It can also be used on porous surfaces.

Health and Safety Classification – *'Not classified as hazardous'*

AKS 221 Thixo

This product is a gelled form of AKS 221 Liquid and can be used on similar surfaces. However, it can be applied as a thicker layer and allowed to react with the graffiti before removal. After removal, surfaces are washed with clean water.

Health and Safety Classification – *'Not classified as hazardous'*

AKS 27

AKS 27 is used to remove graffiti made from petroleum based rust protective sealers from both smooth and porous surfaces. It is brush applied and, depending upon the thickness of graffiti, a dwell time of 10-30 minutes will be

required. Following removal, surfaces are washed with medium pressure hot water.

Health and Safety Classification – *'Not classified as hazardous'*

AKS 33+

AKS 33+ is a general purpose graffiti remover, for all types of graffiti that is applicable for both masonry and metallic type surfaces and for use in interior and exterior locations.

Health and Safety Classification – *'Not classified as hazardous'*

AKS 560

AKS 560 is a graffiti removal product specifically developed for use on 'Plexiglass', plastic and other delicate surfaces. It is applied by using a clean cloth or with highly absorbent paper. When clean, surfaces should be rinsed with water and dried with a clean cloth. It can be used in both exterior and interior locations but it is not designed for porous surfaces.

Health and Safety Classification – *'Irritant'*

AKS 3+

AKS 3+ is a thickened graffiti and paint removal product for application to exterior, porous, masonry and building substrates and also to metal and timber substrates. It can be effective for spray paints, permanent markers and with some petroleum based, rust protective sealers.

Health and Safety Classification – *'Irritant'*

AKS 5 SR

AKS 5 SR is a graffiti removal product specially developed for the removal of 'graffiti shadows' that remain on surfaces, in particular shadows left from permanent markers, felt tip pen inks and other difficult to remove pigments.

Health and Safety Classification – *'Harmful'*.

AKS 5 SR TIXO

This is a thickened form of AKS 5 SR.

Health and Safety Classification – *'Harmful'*.

2.2 GENERAL PURPOSE PRODUCTS

Window Cleaner

A general purpose product for use on windshields and windows. It may be applied using a low pressure sprayer. The window is then wiped with a clean cloth.

Health and Safety Classification – *'Not classified as hazardous'*

BPS 7320 Aluminium Cleaner

An acidic cleaning agent for the removal of traffic dirt and soot from aluminium surfaces. The aluminium is wetted before treatment. The product is then applied using a low pressure spray and left on the surface for 5 -15 minutes. The cleaner is worked into the surface, agitating with a brush.

Health and Safety Classification – *'Irritant'*

TCS 25

A strongly alkaline cleaner, mostly to be used for heavy duty, heavily soiled applications. A typical concentration is 1 part to 20 parts of water for medium soiling and 1 part to 50 parts of water for light soiling.

Health and Safety Classification – *'Irritant'*

3.0 TECHNICAL EVALUATION

Trion Tensid has submitted various anti-graffiti products to be assessed by independent test consultants. The results of these assessments are described in Sections 3.1 and 3.2 below.

The methodology employed was originally developed by the Scientific Services of London Underground Ltd and has subsequently been adopted by the Anti-Graffiti Association. Spray paints and felt tip pen inks were applied to various substrates. The test method then evaluates the ease of removal together with an evaluation of surface damage according to a scoring system. Both coating and removal products are then classified from 'excellent' to 'very poor' according to their performance.

3.1 GRAFFITI RESISTANCE OF COATINGS

Certificate of Tests No. 4801 and No. 4858, issued by Taylor Woodrow Technology (formerly) Taywood Engineering), for the graffiti resistance of AKS 3503 and AKS 3510 have been reviewed. The ease of removal of four felt tip pen inks and two aerosol spray paints was evaluated for both products.

AKS 3503 was applied to three masonry substrates, LBC sand-faced Fletton facing bricks, pre-cast concrete paving slabs and terrazzo floor tiles and compared with a sacrificial anti-graffiti coating that had previously gained acceptance for use within London Underground. The results showed that AKS 3503 performed as well as the accepted standard system and that for all substrates, the coloured markers, both paint and felt tip, were completely removed without any significant residual 'ghosting'.

AKS 3510 was applied to an aluminium panel finished with a white powder coating (ref. trade name Bonalux AG, formerly manufactured by Ferro Drynamels). This type of coating is typically found in the interior of train rolling stock. All colours, both paint and felt tip, were again completely removed

without residual 'ghosting' and without damage to the substrate. The overall performance was classified as 'excellent'.

AKS 3503, along with products of a similar formulation, AKS 3500 and AKS 3502, are considered acceptable for use for application to premises within London Underground. In addition, AKS 3510 is considered acceptable for application to rolling stock and painted surfaces.

The graffiti resistance of AKS 3502, a sacrificial coating, was carried out by 4-Rail Services Ltd (report ref. R18236, dated 10.08.2000.) in liaison with Robert McAlpine Construction. The coating was applied to a reinforced concrete slab (reference Dacomo Belgian) with an acid etched finish. The removal of four marker pen inks, two spray paints and two leather dyes was evaluated, comparing coated and uncoated surfaces. The test showed that all coloured marks could be completely removed using a hot water pressure washer. The felt tip pen marks and paints could be removed within about 10 seconds of pressure washing while brown and purple leather dyes took longer, in the region of 20-30 seconds for complete removal. By comparison, similar marks on untreated areas were clearly visible after the same pressure wash treatment.

3.2 EFFICACY OF REMOVAL PRODUCTS

Various graffiti removal products were submitted to 4-Rail Services Ltd for independent assessment. The test work produced by this consultant is described in the following reports and summarised below:

Product type: AKS 221: Report ref. R17414, dated 29.03.1999.
Product type: AKS 5: Report ref. R20250, dated 12.11.2002.
Product types: AKS 27: Report ref. R20448, dated 06.01.2003.

AKS 221

AKS 221 was used to remove graffiti marks consisting of spray paint, felt tip pen inks and leather dye from a number of substrates which included polyurethane paint, polysiloxane paint, and a powder coated system (Bonlux AG and Bonlux 2000). The product completely removed spray paint from all substrates although it was less good for felt tip pen ink and leather dye. For the powder coating removal was classified as either 'excellent' or 'very good'. Removal from the polysiloxane paint system was 'very good' while removal from the polyurethane was classified as 'good'. No surface damage occurred to any substrate.

AKS 5

Using as a substrate, a polyester powder coated aluminium panel, found typically in rolling stock, AKS 5 completely removed spray paint and felt tip pen ink and was classified as 'excellent'. AKS 5 effectively removed leather dye, only leaving a faint shadow visible. For this it was classified as 'good'. In all cases there was no surface damage to the substrate.

AKS 27

AKS 27 completely removed graffiti ghosting (type undefined in report) from both a polyester powder coated aluminium panel and a polyurethane painted panel.

4.0 FIRE PERFORMANCE EVALUATION

4.1 FIRE PERFORMANCE REQUIREMENTS

Fire performance test criteria are given in London Underground Standard 2-01001-002 'Fire Safety Performance of Materials'. This Standard requires that testing should be carried out according to the following parameters:

- Combustibility/flammability to BS 476 parts 6 & 7, to attain a Class 0 rating.
- Smoke Emission to BS 6853.
- Toxic fume emission (methodology outlined in 2-01001-002).

These aspects of testing are discussed in the section below.

4.2 FIRE TEST ASSESSMENT

The coatings, AKS 3503 and AKS 3510, have been tested for fire performance by two independent test consultancies, Warrington Fire Research and Transfire Services Ltd. Report references are detailed below:

Warres. Report numbers L16964 and L16866 - product reference AKS 3503,
Warres. Report numbers L17057 and L16971 - product reference AKS 3510
and, Transfire Report number R17301 - all products referenced above.

The coating products AKS 3503 was tested on a substrate consisting of a 6mm thick Cembrit building board in order to mimic the application to a masonry substrate.

All three anti-graffiti coating systems tested, AKS 3503 and AKS 3510, met London Underground requirements in accordance with Engineering Standard 2-01001-002 when assessed for flammability, potential for emission of toxic fumes and for smoke emission. Hence, these products can be installed without restriction in below ground locations, premises and other fixed locations, and within rolling stock interiors, as appropriate.

5.0 HEALTH AND SAFETY

The health and safety precautions summarised below apply to all products:

- Suitable gloves (rubber, chemically resistant) should be worn. Avoid contact with skin, as products will cause irritation. If skin contact should occur, wash well with soap and plenty of water.
- Safety glasses or goggles must be worn if there is a danger of splashing. This particularly applies to alkaline and acidic products such as BPS 7320 Aluminium Cleaner and TCS 25 where there is a risk of serious damage to eyes. If eye contact should occur, wash well with plenty of water for up to 15 minutes and, if irritation persists, seek medical attention.
- In the unlikely event of ingestion, the mouth should be thoroughly rinsed with water. The injured person should be removed from exposure, taken to fresh air and should drink a plentiful supply of water. Seek medical attention.
- Users must avoid the inhalation of vapour or spray and, particularly, in confined spaces, respiratory protection may be required.

The main emphasis of the above directions is to avoid skin and eye contact since, with the product range, there is a low inhalation risk and, during normal use, ingestion is unlikely. The use of all products is, of course, subject to assessment according to the COSHH (Control of Substances Hazardous to Health) Regulations.

6.0 ENVIRONMENTAL

All products in this review are considered biodegradable and are not expected to bio-accumulate. Nonetheless, any spillage should be dealt with using an appropriate absorbent material e.g. a clay or sawdust based product. Waste should not be washed into drainage or into watercourses. In particular, AKS 5 SR and AKS 5 SR TIXO contain solvents which are harmful to aquatic organisms.

Due to the alkalinity of TCS 25 and the limitation on discharging alkaline effluent to sewers, it should not be used neat but should be diluted accordingly. The pH values (as a measure of alkalinity) at recommended dilutions are as follows:

Neat product	pH = 13.0
1 part to 20 parts water	pH = 11.4
1 part to 50 parts water	pH = 10.9

The maximum acceptable alkaline discharge level is pH = 11.0 and, hence, discharging at the dilution of 1 part to 50 parts water is acceptable. Any stronger solutions must be diluted further before discharge to be acceptable.

Effluent below a pH value of 5 should not be discharged. Hence, small discharges of BPS 7320 Aluminium Cleaner will need to be well diluted. If a

significant use of this product were to occur, then neutralisation of effluent will be required.

7.0 CONFORMITY OF SUPPLY

The Managing Director of Trion Tensid AB has supplied a letter to state that since original assessment for London Underground in 1997, there has not been a change in the composition of products and, hence, test certification from consultants such as Taylor Woodrow and Warrington Fire remains valid.

8.0 QUALITY ASSURANCE

In terms of quality assurance, Trion Tensid AB has attained compliance with the requirements of ISO 9001-2000. The company has also met environmental standards with regard to ISO 14001.

9.0 CONCLUSIONS

The graffiti removal agents, AKS 221 Liquid and Thixo, AKS 27, AKS 33+, AKS 560, AKS 3+, AKS 5 SR and AKS 5 SR TIXO and cleaning agents Window Cleaner, BPS 7320 Aluminium Cleaner and TCS 25 are acceptable for use within Metronet Rail provided that users take the appropriate health and safety precautions e.g. wearing personal protective equipment as required. In addition, users will need to take into account the nature of any waste waters before making any discharge to drains.

Testing has also shown that the graffiti removal agents, as listed above, generally have a very good efficacy and are effective in use on a wide range of surfaces, including powder coated substrates as found in rolling stock as well as on masonry type substrates. The assessment has shown that not only are the appropriate products capable of removing spray paints and felt tip pen inks, they are also capable of dealing with leather dyes. In all cases, however, users need to follow manufacturer's instructions and be trained in the appropriate techniques e.g. avoiding wiping over dissolved graffiti, using clean cloths and washing surfaces after application. Users should also carry out appropriate product trials with respect to their particular applications.

Various assessments of graffiti resistance have demonstrated that the coatings AKS 3502, AKS 3503 and AKS 3510 are 'fit for purpose' and can beneficially be applied to masonry substrates such as brick and concrete and, for AKS 3510 in particular, to be applied to powder coated substrates to bring about a general enhancement and improvement in graffiti resistance.

The anti-graffiti coating systems, AKS 3503 and AKS 3510, have met London Underground requirements for fire performance in accordance with Engineering Standard 2-01001-002 'Fire Safety Performance of Materials' and, therefore,

these products can be installed without restriction in below ground locations, premises and other fixed locations, and within rolling stock interiors, as appropriate.

Since AKS 3500 and AKS 3502 are simply thinner versions of AKS 3503, then these coatings are also deemed compliant with LU fire performance requirements.