Transfire
Services Limited

3, Flowers Industrial Estate
Latimer Road
Luton
Bedfordshire LU1 3XA
Telephone: +44 (0) 1582 483 007
Facsimile: +44 (0) 1582 483 073
Email: info@transfire.com

Reference: *TSL0241-BE-R178031*

Sponsored by: *Beta Cable Management Systems Limited*
Newtown Trading Estate
Northway Lane
Tewkesbury
Glos. GL20 8JG

Issue Date: *9th November 2005*

Prepared by: *B Enina (Fire Technologist)*

Signature: .....

Certified by: *Hush J Patel (Senior Consultant)*

Signature: .....

TEST REPORT

TSL NO. R18031

Fire Testing of 'Noryl LS175', in accordance with the London Underground Limited Engineering Standard 2-01001-002: Issue A1: December 2003.

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CONDITIONS OF ISSUE OF REPORTS.

QUERIES OR FURTHER INFORMATION.

ANY QUERIES OR REQUESTS FOR ADDITIONAL INFORMATION ON THE SUBJECT OF THIS REPORT SHOULD BE ADDRESSED TO THE AUTHOR WHO MAY BE CONTACTED AT THE ADDRESS GIVEN ON THE TITLE PAGE.

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1. INTRODUCTION

Fire Testing of 'Noryl LS175', in accordance with the London Underground Limited Engineering Standard 2-01001-002: Issue A1: December 2003.

Sample specimen of black, plastic compound, referenced 'Noryl LS175' was submitted on 19 October 2005, by Paul Stanway of Beta Cable Management Systems Limited, for fire testing, in accordance with the London Underground Limited Engineering Standard 2-01001-002: Issue A1: December 2003.

Following client's instruction apply to this task:

Purchase Order	: Letter dated 26th October 2005

2. MATERIAL DESCRIPTION

The description of the material given below has been prepared from information provided by the sponsor of the test. All values quoted are nominal, unless tolerances are given.

3mm thick plaques of black, plastic compound material, referenced 'Noryl LS175', supplied by Beta Cable Management Systems Limited.

The Laboratory sample reference is TSL0241.

3. CONDITIONING OF SPECIMENS

The specimens were received on 19th October 2005.

Prior to test the specimens were conditioned to constant mass at a temperature of 23 ± 2°C and a relative humidity of 50 ± 5%.

4. TEST METHOD

4.1 SMOKE EMISSION

The specimen samples, referenced TSL0241 was tested for smoke emission on 31st October 2005, in accordance with BS6853: 1999: D8.3 – "Code of Practice for Fire Precautions in the design and construction of passenger carrying trains".

4.2 FLAMMABILITY OXYGEN INDEX

The above cable sheathing compound was tested for flammability temperature on 1st November 2005, in accordance with BS EN ISO 4589-Part 3: 1996, Plastics – Determination of burning behaviour by oxygen index. Elevated - temperature index test.

4.3 TOXIC FUME EMISSION

4.3.1 QUALITATIVE ANALYSIS

The above specimen samples were tested on 31st October 2005, for qualitative elemental analysis using scanning electron microscopy and energy dispersive X-Rays.

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4.3..2 QUANTITATIVE ANALYSIS

The above specimen samples were tested on 28th October 2005, for quantitative analysis of Nitrogen, Carbon and Sulphur using Carlo Erba EA1108 Elemental analyser'.

4. RESULTS

The tests relate to the behaviour of test specimens of the products under particular conditions of test; they are not intended to be the sole criterion for assessing the potential fire hazard of the product in use. In particular, differences in the thickness, orientation or design may significantly affect fire performance and care should be taken to ensure that any differences between the test conditions and application conditions are not adversely significant.

4.1 SMOKE EMISSION

The measured absorbance A_m is calculated in accordance with the Beer-Lambert Law as follows:

$$A_m = \log_{10} (I_o / I_t)$$

Where: I_o = Initial Luminous intensity
I_t = transmitted Luminous intensity

A_m is converted to Standard absorbance A_o (Figures 1-3; Page 9-10), using the equation:

$$A_o = (A_m \times V) / (n \times L)$$

Where: V = volume of the cube ($27m^3$)
L = optical path length (3m)
N = is the number of units comprising the specimen.

The calculated results (rounded up to 3 d.p) are as follows:

Sample Reference	Test Mass (g)	Test	Result Ao(abs) m^2/g
TSL0241	28.23 28.36	1 2	0.0886 0.0962
		Average	0.0924
		Standard Deviation	0.00537

5.2 FLAMMABILITY TEMPERATURE INDEX

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Sample Reference	Result (°C)
TSL0241	353

5.3 TOXIC FUME EMISSION

5.3.1 QUALITATIVE ANALYSIS

The elements detected are given below as seen by Figures 4; Page 11

Sample reference	Elements detected
TSL0241	Carbon, Oxygen, Phosphorus

5.3.2 QUANTITATIVE ANALYSIS

Sample reference	% Nitrogen	% Carbon	% Sulphur
TSL0241	<0.11	75.5	<0.22

The above results are expressed as a percentage wt/wt.

REQUIREMENTS

The Engineering Standard states that "For unrestricted use of a material, covered by Standard 2-01001-002: Issue A1: December 2003, neither it nor its constituents shall have deliberately incorporated by selection, addition or modification any significant amounts of organically bound halogens, nitrogen, sulphur or phosphorus; typical chemical groups proscribed are:-

C-X (where X = Halogen)
C-N
C-P
C-O-P
C-S
C-O-S

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Trace levels of such chemical groups are acceptable – the criterion for "trace level" shall be that the summation of the weight for weight percentage of the chemical group divided by the atomic weight for the group shall not exceed 0.015. i.e.

$$\sum \frac{w/w\% \ of \ \ Chemical \ Group}{Atomic \ weight \ of \ \ Group} \leq 0.015$$

The calculated toxicity index for the specimen sample 'Noryl LS175 is a value of 0.0147 based on the maximum recoverable standard.

6. CONCLUSION

The compliance criterion for Category '-/EQ/l' (Equipment/Limited, dispered) of the London Underground Limited Engineering Standard 2-01001-002: Issue A1: March 2003 is a smoke emission value Ao(abs) <0.02, Flammability Temperature Index value of >300^{o}C and Toxicity Index of <0.015. The material described in section 2 of this report meets the toxic fume emission and flammability requirements, but fails to meet the smoke emission requirement.

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OBSERVATIONS

SAMPLE REFERENCE TSL0241

TEST 1.

Time (min.sec)	Observations
0 – 1.30	Specimen intumesces
1.30-3.00	Specimen flames sporadically.
3.00	Flaming ceases.
3.00-40.00	Nothing signicicant

TEST 2.

Time (min.sec)	Observations
0 – 1.40	Specimen intumesces
1.40-4.00	Specimen flames sporadically.
4.00	Flaming ceases.
4.00-40.00	Nothing signicicant

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Figure 1: Variation of Absorbance (Ao) with Time of two specimens (specimen No.1)

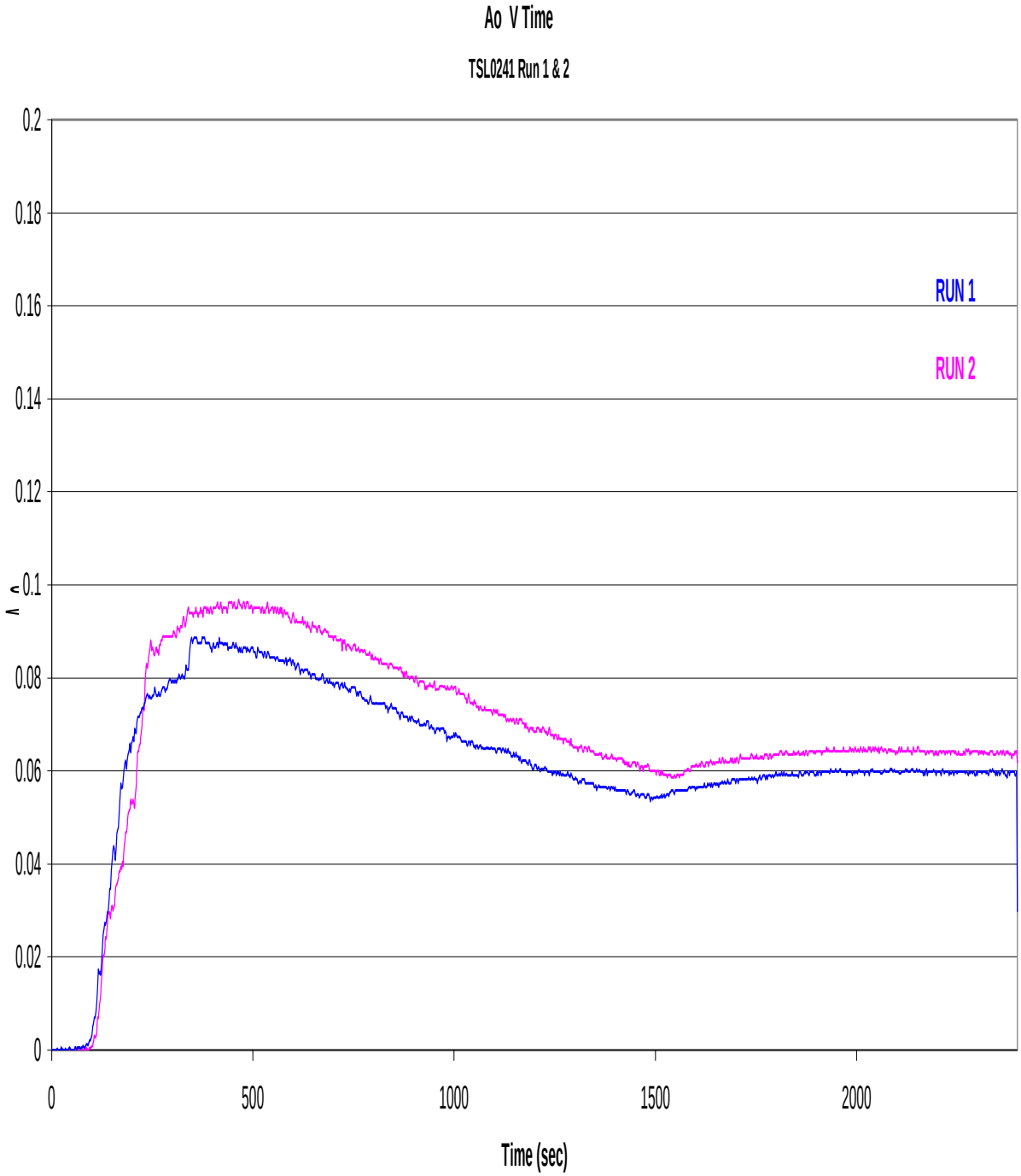

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Figure 2: Variation of Absorbance (Ao) with time (specimen No: 1)

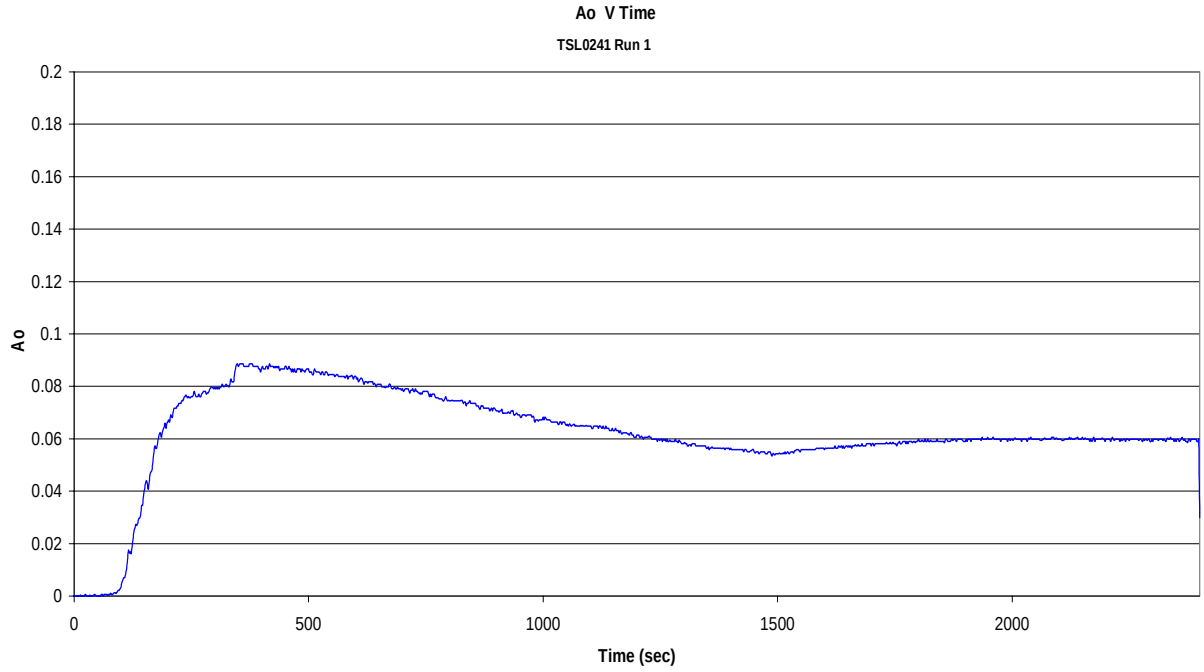

Figure 3: Variation of Absorbance (Ao) with time (specimen No: 2)

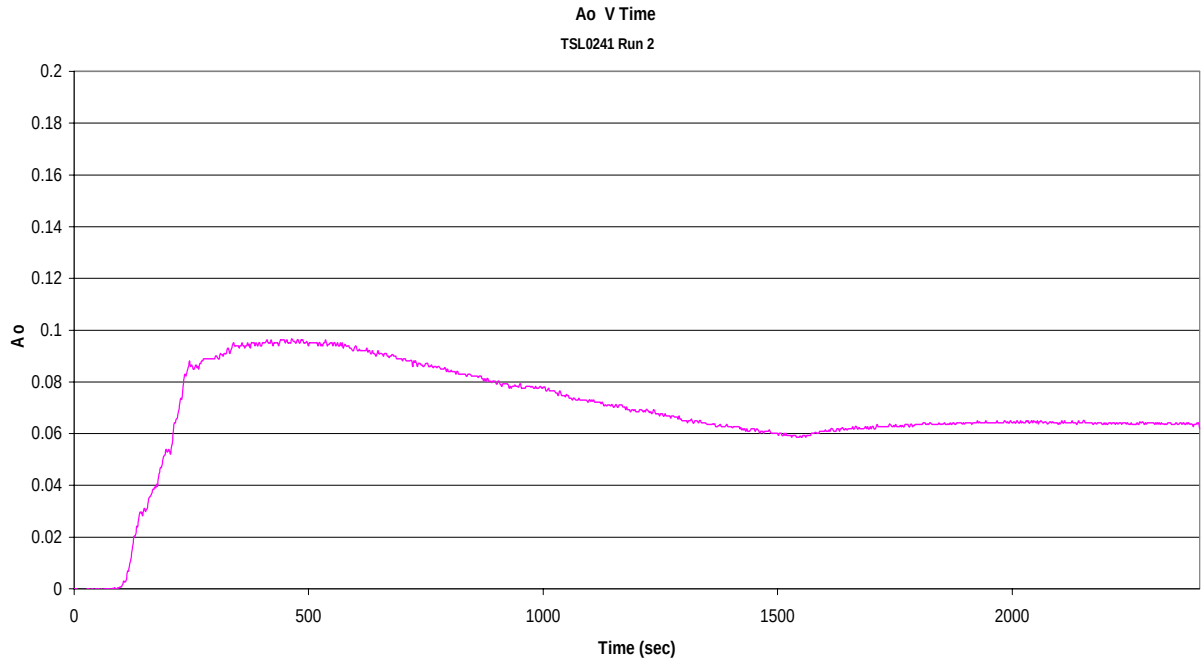

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Figure 4: X-ray spectrum for 'Noryl LS175' plastic compound. Laboratory sample reference: TSL0241