

Scientific Services
for Metro Rail Operators

4-RAIL Services



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ASSESSMENT OF FLOOR-TECH I.S. AND FLOOR-TECH H.B. SUPPLIED BY THE THORTEX DIVISION OF E WOOD LTD.

Prepared for:

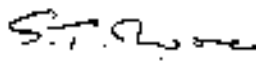
Thortex Division of E Wood Ltd.

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ASSESSMENT OF FLOOR-TECH I.S. AND FLOOR-TECH H.B. SUPPLIED BY THE THORTEX DIVISION OF E WOOD LTD.

1. Introduction

4-RAIL Services Limited was requested to carry out an independent assessment of two floor products currently being marketed by the Thortex Division of E Wood Limited as follows:

- Floor-Tech I.S. - a three component, solvent-free decorative screed.
- Floor-Tech H.B. - a two component, solvent-free high build floor coating.

The products are normally used in conjunction with a specific Thortex priming agent, dependant upon the substrate being treated as discussed in Section 3 of this document.

The assessment is carried out to reflect the technical requirements of end-users within the transport industry who are installing flooring materials in, for example electrical control rooms, tool rooms, escalator machine rooms, depot walkways, store-rooms, workshops etc. However basic principles apply to any similar areas in other industries where such flooring materials may be required.

The assessment addresses the following key points:

1. Definition of the Criteria of Acceptability for flooring materials.
2. Health hazards presented by the component parts of the products.
3. Performance tests on the two products.
4. Appraisal of the performance of the products offered by The Thortex Division of E Wood Limited against the Criteria of Acceptability.

2. Criteria of Acceptability for Flooring Materials

The following criteria have been defined as being the main governing factors for a flooring material to be considered fully acceptable for use in both interior and exterior applications:

1. The materials should provide resistance to slipping by foot traffic that is compliant with the requirements of whichever slip resistance standard specified by the premises manager or regulating body. The UK Slip Resistance Group, which comprises a number of experts from academic and commercial organisations, have defined levels of acceptable slip resistance for flooring materials used in public areas when assessed using the TRL Slip Tester fitted with a 4S rubber boot (see Section 4.2.2).
2. The materials should resist staining by common types of soiling agent encountered in the area which they are to be employed.
3. The materials should be resistant to cleaning chemicals commonly employed to remove soiling agents.

4. The materials should be readily cleanable using routine cleaning techniques/products. This can be tested in the laboratory and further established by a full trial and compilation of data as the products are used in different circumstances.
5. The materials should provide good resistance to permanent markers and spray paints if they are to be used at premises subjected to graffiti attack. This is best established in laboratory Graffiti Resistance Tests.
6. The materials should resist wear by abrasion to a level that is relevant to the concentration of foot traffic likely to be passing over the flooring in the various areas of application.
7. The product should be safe to use in areas that are enclosed, where there is poor ventilation or where the public are likely to have access during, or soon after, application of the flooring.
8. If the materials are to be used in areas with restricted ventilation (e.g. below ground stations, hallways, corridors and stair wells in any buildings) they should meet the fire safety requirements of whichever regulating body controls the premises. This is usually established by laboratory testing or data supplied by manufacturers.

3. Health Hazard Assessments

3.1 Floor-Tech I.S.

3.1.1 Composition

Floor-Tech I.S. is supplied as a three part system as defined below:

- Base component - a clear liquid consisting of low viscosity epoxy resins as the main declared ingredients.
- Activator - an amber coloured liquid consisting of amine and polyamine adducts with benzyl alcohol and nonyl phenol.
- Aggregate - solid consisting of silica quartz.

These are supplied in the required ratios and should be thoroughly mixed using a mechanical stirrer to yield a product with the optimum viscosity, cure time, finish etc. and a 1 hour pot life.

3.1.2 Application

Literature from The Thortex Division of E Wood Limited indicates that Floor-Tech I.S. is intended as a high performance decorative screed for the refurbishment of concrete, tiled, metal and some other floor surfaces. It is recommended for use in areas where hygiene standards are stringent and/or solvents are prohibited e.g. kitchens, canteens, hospitals, warehouses and factories manufacturing food, pharmaceutical or cosmetic products.

The substrate is usually primed using Thortex Floor-Tech S.P. Primer and, whilst the primer is still wet, the mixed Floor-Tech I.S. should be poured onto the required area and levelled out with a trowel.

3.1.3 Hazard Identification

The base component and activator of Floor-Tech I.S. are classified as 'IRRITANT' and 'CORROSTVE' respectively under the Chemical (Hazard Identification for Packaging and Supply) Regulations 1996 i.e. the CHIPS Regulations. The aggregate has no hazard classification under CHIPS.

4-RAIL Services Limited recommend that the following precautions and use of personal protective equipment should always be observed when handling both the separate components and the mixed product:

- (a) Suitable eye protection i.e. goggles should be worn to protect against splashing.
- (b) Suitable lightweight chemically resistant gloves should be worn to protect the hands and lower arms.
- (c) Cotton or cotton/synthetic overalls should be worn to protect the rest of the body.
- (d) The two components of the product should be stored in sealed containers away from naked flames, sparks or sources of ignition.
- (e) Operators should refrain from smoking.
- (f) Efforts should be made to ensure that there is good ventilation to the area in which the product is being used.

If accidental eye contact occurs, rinse the patient's eyes immediately with copious amounts of clean water whilst medical attention is sought. If skin contact occurs, any contaminated clothing should be removed and the skin washed with soap and water whilst medical attention is sought.

In the unlikely event of ingestion keep the patient at rest and obtain immediate medical attention.

Should adverse effects of inhalation become evident (e.g. headache, tiredness, dizziness etc.) remove the patient to fresh air and keep at rest whilst immediate medical assistance is sought.

3.1.4 Market Comparison

The composition of Floor-Tech I.S. presents no greater risk than most resin-based floor screeds currently available within the flooring materials market; the solvent free nature of the product does however render it considerably less hazardous than solvent based resin screeds.

3.2 Floor-Tech H.B.

3.2.1 Composition

Floor-Tech H.B. is supplied as a two part system as defined below:

- Base component - a liquid consisting of low viscosity epoxy resins with an aliphatic ether derivative as the main declared ingredients.
- Activator - a clear liquid consisting of methylene di (cyclohex)amine in benzyl alcohol.

These should be thoroughly mixed in the ratio as supplied using a mechanical stirrer to yield a workable product with a pot life of 45 minutes and optimum viscosity, cure time and finish.

Slip resistance of the coating can be improved by the addition of Thortex Grip, an aggregate additive which can either be stirred into the mixed base/activator or scattered onto the surfaces immediately after application of Thortex H.B.

3.2.2 Application

Literature from The Thortex Division of E Wood Limited indicates that Floor-Tech H.B. is intended as an anti-slip floor coating for the coating of concrete, tiled, metal, painted and some other floor surfaces particularly in industrial areas where a high level of adhesion, chemical resistance and abrasion resistance is required.

Substrates should always be primed using either Thortex Floor-Tech S.P. Primer for porous substrates or Thortex Uni-Tech G.P. Primer for non-porous substrates.

The mixed Floor-Tech H.B. can then be applied using either brush or roller methods.

3.2.3 Hazard Identification

The base and activator components of Floor-Tech H.B. are classified as 'IRRITANT' and 'HARMFUL' respectively under the Chemical (Hazard Identification for Packaging and Supply) Regulations 1996 i.e. the CHIPS Regulations. 4-RAIL Services Limited recommend that the following precautions and use of personal protective equipment should always be observed when handling both the separate components and the mixed product:

- (a) Suitable eye protection i.e. goggles should be worn to protect against splashing.
- (b) Suitable lightweight chemically resistant gloves should be worn to protect the hands and lower arms.
- (c) Cotton or cotton/synthetic overalls should be worn to protect the rest of the body.
- (d) The two components of the product should be stored in sealed containers away from naked flames, sparks or sources of ignition.
- (e) Efforts should be made to ensure that there is good ventilation to the area in which the product is being used.

If accidental eye contact occurs, rinse the patient's eyes immediately with copious amounts of clean water whilst medical attention is sought. If skin contact occurs, any contaminated clothing should be removed and the skin washed with soap and water; seek medical attention if irritation persists.

In the unlikely event of ingestion keep patient at rest and obtain immediate medical attention.

Should adverse effects of inhalation become evident (e.g. headache, tiredness, dizziness etc.) remove the patient to fresh air and keep at rest whilst immediate medical assistance is sought.

3.1.4 Market Comparison

The composition of Floor-Tech H.B. presents no greater risk than most high build floor coatings currently available within the flooring materials market; the solvent free nature of the product does however render it considerably less hazardous than solvent based coatings.

4. Laboratory Assessments

4.1 Sample Descriptions

974095/ 1 & 2

30cm x 30 cm panels of Thortex Floor-Tech I.S. - green matrix with black and white aggregate.

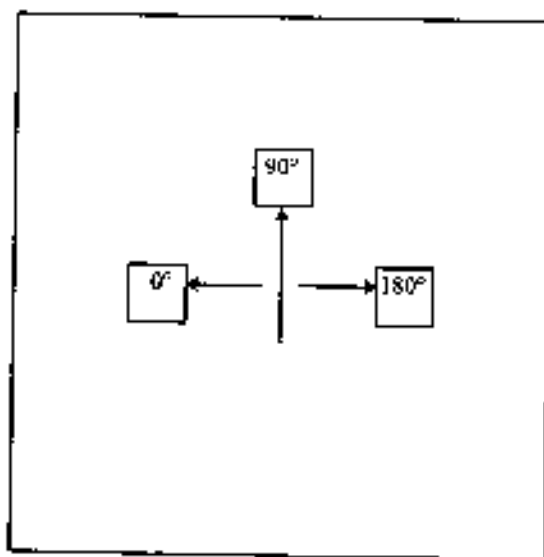
974095 / 3 & 4

30cm x 30cm panels of Thortex Floor-Tech II.B. - red matrix with aggregate.

4.2 TRL Slip Resistance Test

4.2.1 **Method**

The slip resistance of both sample floorings was measured with a portable slip tester designed by the Transport Research Laboratory (TRL) employing 4-RAIL Services Limited Test Method 4R-AK(U-M125). Measurements were conducted under both dry and wet conditions in two/three directions for Floor-Tech I.S. (as shown in the diagram below) and one direction for Floor-Tech II.B. using the standard FOUR S contact rubber as specified by the Rubber and Plastics Research Association and adopted as standard methodology by the UK Slip Resistance Group.



4.2.2 **Test Criteria**

As discussed in Section 1 of this document the UK Slip Resistance Group have defined a levels of acceptable slip resistance for flooring materials used in public areas when assessed using the TRL Slip Tester fitted with a 4S rubber boot as defined below:

< 25	Dangerous
25 - 34	Marginal
35 - 64	Satisfactory
> 65	Excellent

4.2.3 Results

	Floor-Tech I.S.		Floor-Tech H.B.	
	Recorded Values	Average	Recorded Values	Average
Dry Conditions	<p>Sample 1</p> <p>0°: 58,58,58,58,58</p> <p>90°: 58,59,59,59,59</p> <p>180°: 59,59,59,59,59</p> <p>Sample 2</p> <p>0°: 60,60,60,60,60</p> <p>180°: 58,58,58,58,58</p>	59	<p>Sample 1</p> <p>0°: 61,61,61,61,61</p> <p>Sample 2</p> <p>0°: 59,59,59,59,59</p>	60
Wet Conditions	<p>Sample 1</p> <p>0°: 35,35,35,34,34</p> <p>90°: 31,31,31,31,31</p> <p>180°: 36,36,36,36,36</p> <p>Sample 2</p> <p>0°: 37,37,37,37,37</p> <p>180°: 36,36,36,36,36</p>	36	<p>Sample 1</p> <p>0°: 37,36,36,36,36</p> <p>Sample 2</p> <p>0°: 39,39,39,39,39</p>	38

Under the test criteria defined in Section 4.2.2 above both Floor-Tech I.S. and Floor-Tech H.B. have achieved a 'satisfactory' classification under the UK Slip Resistance Group criteria and they would therefore be acceptable for use in public areas subject to approval by whichever regulating body sets the specifications. Floor-Tech I.S. is at the lower limit of the satisfactory classification and consequently 4-RAIL Services Limited recommend caution in using the material in very heavily trafficked areas as wear may result in a reduction of slip resistance.

4.3 Cleanability

4.3.1 Method

The test was carried out to 4-Rail Services Limited Test Procedure 4R-GT-M129 in which three soiling agents were applied to the surface of the samples and left for 72 hours.

Removal of the soiling was attempted using a solution of 2% v/v alkaline hard surface cleaner in cold water.

4.3.2 Results

Soiling Agent	Floor-Tech I.S.	Floor-Tech H.B.
Synthetic soiling agent (track grease/tunnel dust paste)	Slight yellow stain remains.	Complete removal.
Cooking oil	Complete removal.	Complete removal.
Cola drink	Complete removal.	Complete removal.

Floor-Tech I.S. performs well against normal lighter types of soiling but is discoloured by the presence of heavier engineering soiling. 4-RAIL Services Limited therefore recommend that this flooring material is primarily used in areas where it will be exposed to lighter soiling types. In areas where high levels of grease or industrial soiling may be encountered it is possible that Floor-Tech I.S. may suffer discoloration which could effect the aesthetic appeal of the floor.

Floor-Tech H.B. showed good resistance to all types of soiling and would therefore be suitable for use in both industrial and general applications.

4.4 Graffiti Resistance Tests

4.4.1 Graffiti Resistance Test Method

The test was carried out to 4-Rail Services Limited Test Procedure 4R-GT-IP3. Testing was carried out over one cycle according to the procedure.

Graffiti Markers

- Edding 850 Red Marker
- Pentel F50 Blue Marker
- Buntlack Black Spray Paint
- Edding 850 Black Marker
- Edding 500 Green Marker
- Buntlack Silver Spray Paint

Removal Agents

- Super Graffiti Removal Gel (ex. Performance Chemicals Ltd.)
- Graffiti Gone Solvent (ex. Performance Chemicals Ltd.)

4.4.2 Data Manipulation

A system of scoring by visual assessment was used to classify the extent to which each mark remained on the test surface, and also whether the surface had been physically altered or damaged.

Scores were allocated for each graffiti remover on each test surface and the data was analysed as described in the Test Procedure to yield Overall Performance Scores for each coating.

4.4.3 Test Criteria

The table below gives a rough guide to the interpretation of the Overall Performance Score:

Overall Performance Score	Classification
16.0	Excellent
15.9 - 13.0	Very good
12.9 - 11.0	Good
10.9 - 7.0	Fair
6.9 - 4.0	Poor
Under 4.0	Very poor

For a graffiti resistant material to be considered suitable for use in areas where frequent graffiti attacks are expected, it should achieve an 'excellent' or 'very good' classification for the selected number of test cycles. However for use in an area where graffiti attack is unlikely a 'good' classification or better will be satisfactory.

4.4.4 Results

	Floor-Tech I.S.		Floor-Tech H.B.	
	Graffiti Removal Gel	Graffiti Gone Solvent	Graffiti Removal Gel	Graffiti Gone Solvent
Red marker	2	2	4	4
Blue marker	4	4	4	4
Black marker	3	3	4	4
Green marker	4	4	4	4
Black paint	4	4	4	4
Silver paint	4	4	4	4
Overall Removal Score	3.5		4.0	
Surface Damage Score	4.0		4.0	
Overall Performance Score	14.0		16.0	

Under the acceptability criteria defined in Section 4.4.3 above Floor-Tech I.S. is classified as 'very good' and Floor-Tech H.B. classified as 'excellent'; therefore both would be suitable for use in areas where graffiti attack is likely.

4.5 Chemical Resistance Tests

4.5.1 Method

The test was carried out to 4-Rail Services Limited Test Procedure 4R-GT-1P2 in which six commonly found chemical agents were applied to the surface of the samples and left for 72 hours.

The agents were then washed off with cold water and inspected for damage.

4.5.2 Results

Chemical Agent	Floor-Tech I.S.	Floor-Tech H.B.
20% v/v solution of alkaline detergent.	No surface damage	No surface damage
20% v/v solution of phosphoric acid based detergent/descaler.	No surface damage	No surface damage
Citrus terpene based chewing gum remover.	Surface became slightly yellow	No surface damage
Hydrocarbon based degreasing agent.	Surface became rough and flaky	No surface damage
Synthetic soiling agent (track grease/tunnel dust paste).	Surface became slightly yellow	No surface damage
Ethylene glycol based de-icing agent.	Surface became slightly white	No surface damage

Floor-Tech I.S. displayed a tendency to become discoloured by engineering soiling, chewing gum remover and de-icing fluid; contact with hydrocarbon based degreasing agent caused the surface to become irreversibly damaged. 4-RAIL Services Limited therefore recommend that Floor-Tech I.S. is primarily chosen for use in areas where lighter duty cleaning products and chemical agents are encountered e.g. warehouses, hospitals, food manufacturing areas etc. (as defined in Section 3.1.2)

Floor-Tech H.B. resisted all chemical agents and therefore 4-RAIL Services Limited recommend that the material could be considered for use in most areas including those in heavier engineering and industrial environments.

4.6 Wear Resistance

4.6.1 Method

Wear resistance tests were carried out using the Taber Abrasion technique according to ASTM - D4060-84 and 4-RAIL Services Limited Test Method 4R-GT-131. Two appropriately shaped samples of material was cut from both main samples, drilled centrally and introduced onto the rotating tables of the instrument.

Each sample was rotated at a constant speed whilst a load of 1kg was applied via two abrasive stone wheels (Grade H22 - Calibrade). The weight loss from each sample was determined at intervals of 500 cycles for Floor-Tech I.S. and 250 cycles for Floor-Tech H.B.

The Criteria of Acceptability usually exercised for flooring materials is as follows:

- For thick screeds, ceramic floor tiles, terrazzo, concrete etc. there should be a cumulative weight loss of no greater than 10 grams over 2500 cycles.
- For floor paints and thin screeds there should be a cumulative weight loss of no more than 10 grams over 1000 cycles.

4.6.2 Results

1. Floor-Tech I.S.

Cycles Completed	Sample A		Sample B	
	Weight of Sample	Cumulative weight loss	Weight of Sample	Cumulative weight loss
0	266.15	-	264.76	-
500	265.64	0.51	264.50	0.26
1000	264.80	1.35	264.01	0.75
1500	263.77	2.38	263.43	1.33
2000	262.62	3.53	262.68	2.08
2500	261.36	4.79	261.97	2.79

Both samples fell well below the maximum allowable cumulative weight loss of 10 grams over 2500 cycles and would therefore be suitable for use in areas where there is heavy foot or mechanical traffic.

2. Floor-Tech H.B.

Cycles Completed	Sample A		Sample B	
	Weight of Sample	Cumulative weight loss	Weight of Sample	Cumulative weight loss
0	58.89	-	52.04	-
250	58.75	0.14	51.76	0.28
500	58.68	0.21	51.59	0.45
750	58.56	0.33	51.38	0.66
1000	58.35	0.54	51.16	0.88

Both samples fell well below the maximum allowable cumulative weight loss of 10 grams over 1000 cycles and would therefore be suitable for use in areas where there is heavy foot or mechanical traffic.

5. Conclusions

This assessment has addressed all items defined in the Criteria of Acceptability (see Section 2) except that of fire safety requirements, Item 8, which was not included in this test programme.

Floor-Tech I.S. performed adequately in most tests providing good resistance to wear and staining by lighter soiling agents. The slip resistance is at the lower limit of the 'satisfactory' classification and the material exhibited a tendency to become stained by engineering soil and some chemical reagents. 4-RAIL Services Limited therefore consider that Floor-Tech I.S. is a product most suitable for use in areas where foot traffic and engineering traffic is light and agree with the manufacturer that it is ideal for use in kitchens and canteens within the staff accommodation of depots, stations and other rail premises. Similarly it will be suitable for use in hospitals, warehouses and factories manufacturing food, pharmaceutical or cosmetic products.

Floor-Tech H.B. performed well in all tests and therefore fully satisfies Items 1 - 7 of the Criteria of Acceptability. It should therefore be suitable for use in areas requiring medium to heavy duty performance including all of the areas commonly requiring the use of high build resin floor coatings in the rail industry (as defined in Section 1). It provides good resistance to chemical reagents, wear, slipping, and staining by soiling agents which consequently renders it a strong candidate for use in engineering areas including railway depots, workshops and manufacturing areas in a wide range of industries.