LEIGHS PAINTS®

FIRETEX®

Firetex M93

Firetex M93

Epoxy Passive Fire Protection

Application and Installation Manual

General Details

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Firetex M93 Application Manual Revision Control

The purpose of this manual is to ensure correct installation (application) of Firetex M93 and Firetex H180 Scrim. For the safe handling and use of Firetex M93 reference must also be made to both the Technical and Safety Data Sheets.

Firetex M93 is fully tested and certified and while this manual is not intended as a source for the determination of Firetex M93 loadings or other specification criteria, such information is available to design architects and engineers on request.

The information contained in this manual is based upon independent test data, comprehensive research and field experience, and is considered to be accurate at the time of publication. However, the contents will be subject to revision from time to time due to our policy of continuously improving our products, processes and service.

Only the electronic copy of this manual is a ‘controlled document’ and all paper versions are ‘uncontrolled’. Thus the user is advised to ensure they have the latest issue of the manual by contacting Leighs Paints International Business Unit.

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Leighs Paints do not assume responsibility for any direct or consequential damages resulting from the use of Firetex M93 unless expressly agreed in writing

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2	2	24/10/08	GGB	Changes to application section 4.0
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Firetex M93 Application Manual Contents

1.0 Introduction

Firetex M93 is a solvent free, thick film epoxy intumescent coating, providing an uncompromising solution for the fire protection of many different types of structure in the most demanding environments. It is very closely related to Firetex M90, which has been successfully used on over 2000 major projects worldwide.

Epoxy intumescent coatings have major advantages in durability, weight, ease of application and aesthetics. As a result they have become the fire protection method of choice and offer design architects and engineers a highly adaptable PFP solution, which is both practical and functional.

1.1 What is Firetex M93 and where is it used?

Firetex M93 is used to enhance the fire resistance of structural materials by providing a layer of insulation, which is formed as a result of a chemical reaction initiated by fire. This insulation reduces the rate of heat transfer and extends the time period for which the structural material can resist the weakening effects of the heat.

Passive fire protection is predominantly used:

- To insulate structural steel elements against damage or collapse in a fire, thus maintaining the integrity of the structure and allowing evacuation and fire fighting measures to be effected.

- To insulate ‘walls’ and ‘decks’ reducing the rate at which these structures weaken or transfer heat. Such ‘divisions’ are used to isolate accommodation areas and safe havens from production, storage and utility areas, providing the maximum opportunity for escape in the event of fire.

Firetex M93 is designed to protect against the very severe fires that are associated with the combustion of hydrocarbon fuels (oil, methane, LNG, LPG, etc.). Additionally the aggressive production environments normally associated with these industries require Firetex M93 to be extremely durable.

Whilst Firetex M93 has excellent durability, it is normal to use a suitable anti-corrosive primer and a good quality topcoat.

Mechanical reinforcement may also be required in the form of a specially designed fire resistant scrim. Full details are contained in Section 3.

The aim of this manual is to provide relevant technical information to the applicator of Firetex M93, helping to ensure that the completed project is fit for purpose. Since product failure could threaten life in

an emergency fire situation, applicators must not deviate from our recommendations without express written agreement from Leighs Paints.

1.2 Product Quality Assurance

Leighs Paints operate Quality Systems to ISO 9000:2000 and are a BSI registered firm. All raw materials are subjected to Quality Testing before being released for manufacture. Representative batches of Firetex M93 are routinely selected from production and subjected to hydrocarbon fire testing.

1.3 Technical Support

Leighs Paints have a technical support network second to none in the industry. Our International Business Unit, staffed by engineers, chemists, former applicators and other industry professionals, coordinate the front line technical and sales focus for Firetex M93. To support our customers in the field we have a dedicated Technical Service Department, working in conjunction with a dedicated Fire Research Department, staffed by degree and PhD qualified scientists.

2.0 Surface Preparation and Priming

All surfaces to be protected by Firetex M93 must be correctly prepared and primed. It is anticipated that most substrates will be steel and hence the majority of the detail in this manual refers to this substrate. Surface preparation and painting should be carried out in line with 'best industry practice' as indicated in many publications by institutions such as NACE, SSPC, ICORR, ISO, etc. The standards of surface preparation contained herein are to be considered minimum requirements. Where other client company specifications or product technical data sheets demand a higher level then the higher level should be adopted.

Details of reinforcement methods are given in Section 3.

2.1 Surface Defect Repair & general painting conditions

All surface defects, including weld splatter, cracks, surface laminations and deep pitting likely to be detrimental to the protective paint system must be removed. All fins at saw cuts; burrs and sharp edges shall be removed by grinding to a minimum radius of 2mm (0.08"). Welds must be inspected for condition, as these are often a source of corrosion. Undercut welds, blow holes, discontinuous seams and other defects must be rectified. As uneven welds are likely to be the source of corrosion they will need to be ground smooth. It is not necessary to grind flush.

In addition to other specified environmental parameters, painting must not take place outside the following conditions:

Minimum air temperature	3°C (37°F)
Maximum relative humidity	85%
Minimum steel temperature	3°C (37°F) above dew point temperature.

Ideally both steel and air temperature should be above 5°C (41°F). Curing time will be significantly extended below 10°C (50°F) and will effectively cease below 5°C (41°F). Conversely curing time will be reduced at temperatures above 10°C (50°F). Refer to technical data sheet for details.

2.2 Blast Cleaning – steel substrates

All surfaces must be clean, dry and free from surface contamination prior to abrasive blast cleaning to a minimum standard Sa 2.5 ISO 8501-1: 1988 (BS7079: Part A1: 1989) (NACE No.2 / SSPC-SP10). Blast

profile should generally be in the range of 30-75 microns (1.2 to 3 mils). After blasting all dust and arising must be removed from the cleaned surface by vacuum cleaner, oil free airline or brush.

2.3 Repair / Touch - Up

For small areas of repair/touch up where blast cleaning is not possible, the primer/M93 system can be applied to surfaces prepared to a minimum standard of St 3 ISO 8501-1: 1998 (BS7079: Part A1: 1989) (SSPC-SP3) at the time of coating.

Suitable power tools should be used but wire brushes are not recommended as they can cause surface polishing.

Alternative methods of surface preparation used in maintenance painting are UHP and Wet Abrasive Blasting. These methods are discussed below:

2.3.1 UHP Water Jetting (Hydroblasting)

This method of surface preparation uses water at pressures in excess of 35,000 psi (2400 Bar). As it cannot provide a blast profile it is not suitable for new, previously un-blasted steel. It is, however, a very effective tool for maintenance where a previously blasted substrate is available, whether previously painted or not. Where the existing profile is exposed, the surface roughness must be measured to ensure that it meets the requirements stated in section 2.2 of this manual.

Minimum standard of surface cleanliness in accordance with NACE No. 5/SSPC-SP 12 (and NACE Vis 7/SSPC-VIS 4), is WJ-2 (very thorough cleaning). In practice there is likely to be some flash rusting occurring after UHP preparation has been completed. The maximum degree of flash rusting allowed is that described as ‘Light Flash Rusting (L)’ in the above SSPC/NACE standard. Any loose, powdery flash rust must be removed with a ‘stiff bristle’ brush.

2.3.2 Low pressure ‘precision’ wet blasting.

This is a technique of wet abrasive blasting using a relatively low volume of water, grit and air pressure. The technique is very controllable with little interference to ‘other trades’ and provides a blast profile similar to that obtained with dry grit blasting. While theoretically suitable for new steel it is more often used as a maintenance tool for the removal of old coatings.

There is currently no published international standard and so our requirements for surface preparation are a mix of ISO 8501-1 and NACE No. 5/SSPC-SP 12. The degree of cleanliness required is equivalent to Sa 2.5 as described in ISO 8501-1 and allowable flash rusting should be no more than 'Light Flash Rusting (L) as described in NACE No. 5/SSPC-SP 12. Any loose, powdery flash rust must be removed with a 'stiff bristle' brush.

Since no standard exists a reference area should be established to the satisfaction of all interested parties.

2.4 Priming

It is essential in a fire situation that Firetex M93 remains adhered to the substrate for the duration of the expected protection period. In most cases the substrate will be primed and hence the adhesion of M93 to the primer must be verified.
For this reason only primers & coating systems satisfactorily tested and qualified by Leighs Paints shall be used under Firetex M93.

The method of primer qualification is the same whether manufactured by Leighs or by other coating companies. Coatings manufacturers are encouraged to seek qualification of their primers for use under Firetex M93 and an overview of the qualification process is given below. Further information is available from Leighs Paints.

A complete, up to date list of qualified primers, both Leighs Paints own products and those of other paint manufacturers, is available from our web site at www.leighspaints.co.uk, or by contacting us.

2.4.1 Primer Qualification

The qualification process consists essentially of impact and adhesion testing under various climatic conditions designed to establish any potential weaknesses in the total system composition. A pass/failure criterion is established based on Leighs extensive knowledge of coatings and PFP, and against benchmarks set by our own products.

For certain types of product additional fire testing is carried out and Leighs Paints can advise.

The qualification process is free of charge, requiring the primer manufacturer to provide either a 'wet sample' of the relevant product for us to apply, or a minimum of four plates prepared and coated with the primer as per the relevant site conditions.

In all cases the relevant application form (see Appendix 1) should be completed and sent to Leighs Paints along with either the wet samples or the test plates. A copy of the form may be sent in advance by fax, email or post and contact details are given at the front of this document.
Where wet samples are supplied then both the MSDS and Technical Data Sheet for each product MUST be supplied to ensure correct application and safe handling. If the project specified primer DFT is different from that quoted on the technical data sheet, then it is this thickness that should be identified on the application form.

Where test plates are provided these should be approximately 200mm x 150mm (8" x 6") with a minimum thickness of 3mm (0.12") and preferably 5mm thick (0.2"). Plates thinner than this are likely to give a 'false fail' result when impact tested. The actual thickness of each coat applied to the plates should be identified, since in a multi-coat system we would only be able to confirm the total DFT.

If panels are supplied rather than wet paint, then it is strongly recommended that an additional set of four plates be provided with the primer applied at the maximum thickness expected on the project. Otherwise qualification will be restricted to the nominal specified DFT and there will be no scope to accommodate over application on site.

Unless tested and otherwise stated then approvals for all primer systems will be limited to 150 microns DFT (6 mils). For zinc rich epoxy systems a tie coat will be required and total primer/tie-coat thickness will be limited to 125 microns DFT (5 mils).

An application form for primer qualification is included in Appendix 1 and may be photocopied if more than one submission is required.

2.4.2 Zinc Silicate Priming System

The use of zinc silicate primers under epoxy PFP should be treated with extreme caution because of their inherent mechanical weakness and known failures within the industry. Zinc silicates are prone to 'splitting' within the film when subjected to impact damage, especially when over-coated with high build, high strength films. This tendency is more prevalent when primer DFT is high and/or when temperatures are low. Consequently very high levels of site control over both application & dry film thickness are essential, as is knowledge of the lowest conceivable operating temperature in service.

It is for this reason that zinc silicate is not normally recommended under Firetex M93, although a view can be taken on a project specific basis and after testing as noted above.

2.4.3 Over-coating of approved primers with Firetex M93

Before application of M93, ensure the primer to be coated is dry and free from all traces of surface contaminants, especially grease and soluble salts. Ensure that the over-coating time/temperature intervals are in line with the primer manufacturers data sheet and the Firetex M93 approval.

2.4.4 Application of Firetex M93 to Bare Steel

It is also possible to apply M93 directly to blast cleaned steel, but in such instances it is essential that the M93 be applied within 4 hours of blasting, in a controlled environment (RH <60%; Air temperature >15°C (60°F); Steel temperature minimum 3°C (37°F) above dew point). Areas of mechanical damage to the Firetex M93 must be repaired immediately to ensure corrosion protection of steel is maintained.

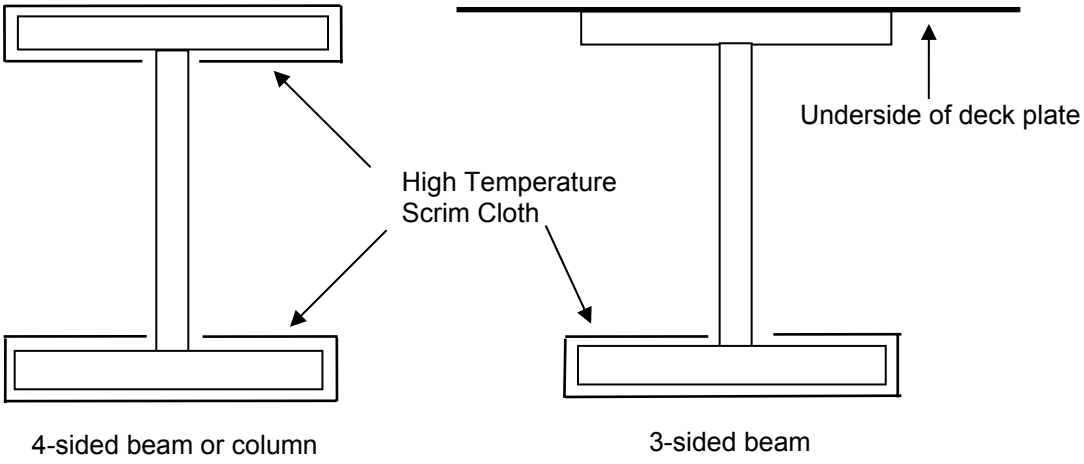
3.0 Reinforcement

3.1 Reinforcement Systems

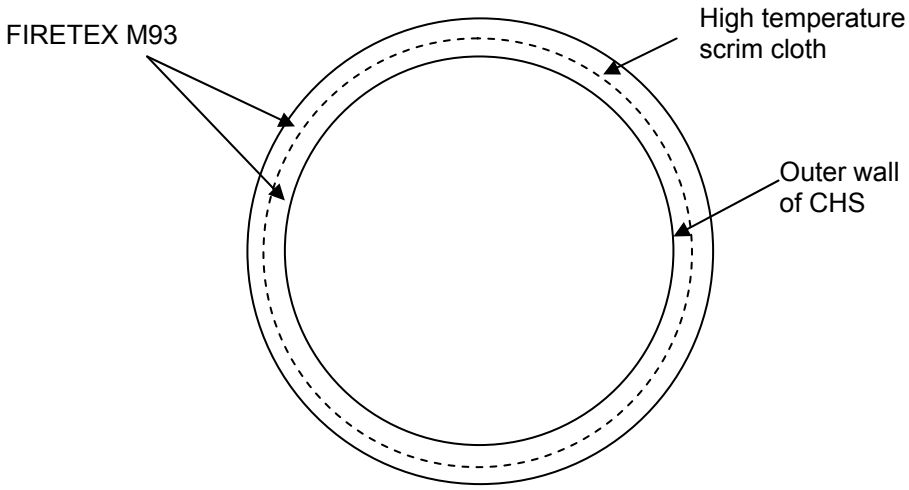
When Firetex M93 reacts in a fire the char developed needs to be reinforced by the incorporation of a high temperature scrim cloth. This is incorporated at the time of application at approximately mid-film depth.

In all instances the substrate must have been prepared in accordance with Section 2.

Diagram showing location of high temperature scrim cloth on typical H-section



Note: For 'hollow section' elements Firetex H180 scrim cloth shall be wrapped fully around the circumference/perimeter with an overlap nominally 50mm (2").



Where lengths of Firetex H180 scrim overlap, it is essential to ensure good bonding between layers by fully ‘wetting out’ the scrim cloth.

Two methods of installation can be used depending on the total film thickness required, the complexity of the job and the applicators preference in terms of number of ‘jobsite visits’.

A) Apply one coat of Firetex M93 to approximately one half of the total thickness required. While M93 is still wet, install the scrim cloth ensuring it is fully ‘wetted out’. Within the same application shift apply a ‘thin coat’ (typically 1mm (40 mils) but need not be exact) such that the scrim cloth is ‘sealed’. Allow to cure sufficiently such that meaningful film thickness measurements can be taken and then apply the final coat to achieve the desired specification thickness.

B) Apply approximately one third of the total thickness of Firetex M93 required and allow to cure sufficiently to take meaningful film thickness measurements. Subsequently apply a thin wet coat (about 1mm (40 mils)) Firetex M93 and then install into this the scrim cloth, ensuring that it is fully ‘wetted out’. While still wet apply a further thin coat and allow to cure sufficiently such that meaningful film thickness measurements can be taken. The aim is to get this ‘mid part’ of the film to be about one third the total required thickness. Finally apply the final coat to achieve the desired specification thickness.

Note: Firetex H180 cloth scrim must be installed in the correct ‘direction’. The thicker wire strand must run across the flange and around the ‘toe’ of an H-section. For hollow section, the thicker wire strand must run around the circumference / perimeter of the profile.

4.0 Application

The Firetex M93 data sheet also contains vital information regarding application parameters and must be read in conjunction with this manual. A copy of the data sheet can be obtained from Leighs Paints or from our web site at www.leighspaints.co.uk.

Firetex M93 can be applied through a Plural Component Airless Spray unit that utilizes a minimum 10" Air Motor (contact Leighs Paints for a list of suitable equipment). Firetex M93 is supplied in 60kg kits (approx. 132 lbs) for this purpose.

It is also possible to hand apply Firetex M93 by trowel or float. The contractor must determine if this is cost effective for larger areas.

The mixing ratio is 2 parts base to 1 part additive by volume (2:1 by weight), irrespective of pack size.

The practical density of Firetex M93 is 1.1 kg/ltr +/- 0.03% (9.17 lb/USgal) after application by plural component airless spray (for further detail see Technical Data Sheet, available from our web site).

The Base component is coloured White and the Additive component is coloured Blue. When correctly mixed a homogeneous Pale Blue colour should be achieved, free from streaks of either white or darker blue.

Regular wet film thickness checks should be made during the application process.

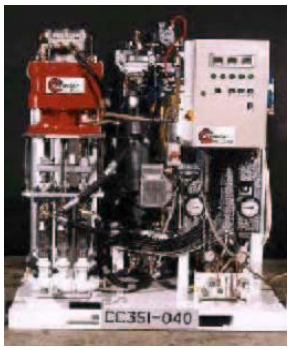
4.1 Storage

For plural component spray application it is strongly recommended that both base and additive are stored at 30-35^{o}C (86-95 ^{o}F) for at least 24 hours prior to use. Base and additive may be stored for up to 3 months in closed containers under these conditions. Storage at these temperatures will reduce the inherent viscosity of the product facilitating airless spray application.

Base and additive may be stored at these temperatures for the duration of the shelf life quoted on the technical data sheet.

Shelf life quoted on the technical data sheet is based on the date of manufacture, which can be found in a small rectangular box on the right hand side of the container front label.

4.2 Plural Component Application Procedure



Covercat 351
A typical Plural Pump for EPFP

Dispense components from the 60kg (approx. 132 lbs) plural component kits into the holding tanks; ideally using ram assisted shovel feed pumps.

Typical temperature settings (varies with ambient temperature):

Base 50-55^{o}C (122-131^{o}F)
Additive 50-55^{o}C (122-131^{o}F)
Line heaters (if fitted) 50-55^{o}C (122-131^{o}F)

The components should be circulated through the metering cylinders (and line heaters) until the base has reached 50°C (122^{o}F) and additive has reached 55°C (131^{o}F) .

Switch on main pump for approximately 10 minutes at an input pressure of 20 p.s.i.

Empty a minimum of 20 litres (5 US gal) of base and 10 litres (2.5 US gal) of additive through the sampling valves (if the equipment does not have sampling valves then the hoses before the mixing block should be disconnected). Material should be kept clean and unmixed so that it can be re-used.

Carry out weight ratio check with input pressure on main pump at 30psi (See 4.2.1). If weight ratio check is satisfactory commence spraying.

Note: The above temperatures and are for guidance and will vary for different spray equipment. Whatever equipment is used, the minimum mixed M93 temperature for good atomisation using a 10-inch motor is 50°C (122^{o}F).

4.2.1 Weight Ratio Checks

Weight ratio checks should be carried out at the start of each day, and whenever there has been a break in spraying of more than one hour. Firetex M93 should have a weight ratio in the range 1.9:1 and 2.1:1 Base:Additive. Spray application should not be started until the correct weight ratio has been achieved.

Procedure

Weigh 2 clean and empty containers.

If spray equipment does not have sampling valves, disconnect hoses before mixer block.

Discharge a minimum of 20 litres (5 US gal) base and 10 litres (2.5 US gal) additive into the pre-weighed containers for the ratio check, ensuring the materials are kept clean and unmixed so that they can be re-used.

Re-weigh containers, subtract weight of original empty container and calculate ratio of base to additive.

4.2.2 Spray Tips and Operating Pressure

Nozzle Size: 0.89-1.09mm (0.035”-0.043”)

Fan angle: 50 deg.

Operating Pressure: 210 kg/cm3 (3000 psi)

The above is given as a guide only.

4.2.3 Spraying

It is possible to apply Firetex M93 in one coat to a minimum thickness of 1mm (0.04”) and a maximum thickness of 7mm (0.276”). This can be achieved in one of two ways:

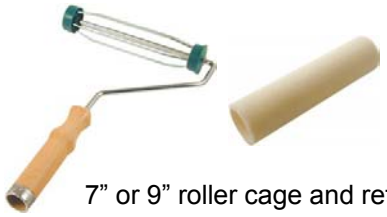
(a) By applying the M93 as more of a jet than a fan, then smoothing off with a trowel or float prior to rolling, to obtain a smooth finish.

(b) By applying the M93 with a normal spray pattern. It may still be necessary to roller to obtain a smooth finish. This method of application will require the pump to be operating at its maximum working pressure.

4.2.4 Flushing of Equipment

Hot water can be used very effectively for flushing out lines and equipment, but care should be taken, as water will not dissolve epoxy resin based materials. If a true solvent is desirable for equipment maintenance then the use of Cleanser Thinner No.C30 is recommended. If preferred equipment can be cleaned with a blend of 1:1 volume, Xylene (CAS No: 1330-20-7, EINECS No. 215-535-7):Methyl Ethyl Ketone (CAS No: 78-93-3, EINECS No: 201-159-0), but a final flush out with Leighs Thinner No. C30 should precede further use of Firetex M93.

4.3 Finishing after Spray Application



7” or 9” roller cage and refill

Long handled ‘radiator’ roller

Following spray application of Firetex M93 a trowel should be used to eliminate any voids and then a roller to attain a smooth uniform finish, unless a ‘stipple finish’ is required. Firetex M93 can be ‘dry rolled’ without solvent or material ‘pick up’. The optimum time will be temperature dependent but for most projects it has been found to be in the region of 10 to 20 minutes after spraying. A medium pile simulated sheepskin roller has been found to give good results but other short or medium ‘nap’ synthetic rollers may be suitable. It is recommended that suitability of roller be established on a small area prior to use.

Spray mist bottle

If preferred, solvent can be used to ‘dampen’ the roller as per normal site practice for application of epoxy PFP but one must ensure that the roller is suitable for use with strong solvents. The quantity of solvent used should be kept to a minimum and if H&S considerations allow a ‘spray mist bottle’ is a useful tool in this respect. The solvent used should be Leighs Thinner Number C30. Care should be taken to ensure that all residual solvent has evaporated from the film before applying subsequent layer of M93 or topcoat. Failure to do so could lead to solvent entrapment within the film and subsequent coating failure.

All horizontal flat surfaces must be finished to provide a slight incline designed to shed water and prevent pooling.

4.4 Hand Application

It is also possible to apply Firetex M93 by trowel, plaster trowel or other similar tool, and then smooth off using a roller as detailed in section 4.4

Hawk / Board

Plaster Trowel / Float

Gauging Trowel

Plaster's Darby

Care should be taken to avoid air entrapment in the M93, and as this is a relatively slow method of application, do not mix more product than can be easily applied within the pot life of M93.

If this method is used for large areas then the applicator must be confident that they can manage this within the working pot life.

As with all epoxy products, high temperature will significantly reduce the working pot life.

4.5 Warm Climate Application

4.5.1 Plural Component Application

In general terms, application will be in accordance with the guidelines given in Section 4.2 above, but additional consideration should be given to the following:

a) Heat loss along the fluid line will be less and hence it may be possible or necessary to reduce the temperature of the base and additive holding tanks.

b) The warmer the air temperature, the shorter will be the working life after application for trowel and rolling finishing.

c) The use of holding tanks under pressure is not recommended, as this can cause condensation inside the tanks, which in turn will cause the M93 to gel, and application will be virtually impossible.

d) For application onto steelwork above 50ºC (122ºF) contact Leighs Paints for guidance. Under no circumstances should the steel substrate be above 75ºC (167ºF).

e) Relative humidity should be below 85% and substrate temperature at least 3ºC (37°F) above the dew point and free from other surface contamination. Above 85% relative humidity, consult Leighs Paints.

4.5.2 Single Component Application

This would have to be carried out at the applicators own discretion, as at higher ambient temperatures there is a significant risk that the material will cure within the spray unit.

Method of application will be in accordance with the guidelines given in Section 4.3 above, but additional consideration should be given to the points raised above in Section 4.6.1 **b**, **d** and **e** above as these will also apply.

4.5.3 Hand Application

Application by this method will still be in accordance with Section 4.5 but additional consideration should be given to the points raised above in Section 4.6.1 **b**, **d** and **e** as these will also apply.

4.6 Removal and Repair Procedure

(See diagram Appendix 3)
Where it is possible, areas to be removed should be cut and sliced using angle grinders and then mechanically chopped and scraped using hand held pneumatic chisels.
Where dust from the use of angle grinders is not acceptable, removal can be achieved by cutting vertically into the surface using an appliance such as the Desoutter Circular Saw. This has a depth setting so that it can be set to cut without going into the steel. The use of the circular saw blade with this tool produces shavings rather than dust. The area for removal should be marked and cut out around the boundary.
Horizontal and vertical cuts should be made within the area to give a ‘cross-hatch’ pattern. A hand held pneumatic chisel with a slightly blunt blade can then be used to remove the Firetex M93 without damaging the steel surface.

An alternative and very effective method is the use of Ultra High Pressure (UHP) water jetting.

After removal of Firetex M93 prepare the surface to a minimum standard of St.3 (BS.7079 Part A1 1989) (SSPC-SP3), as detailed in Section 2.3, immediately prior to coating.
The edges of the repair should be feathered down to the reinforcement (if present) so that the mesh within the repair patch can be overlapped with the existing mesh for a minimum of 50mm (2”).

Apply primer and fire protection system as per the specification.

4.7 Welding

Welding cannot be carried out in areas previously coated with Firetex M93 until it has been removed. Using one of the methods discussed above remove the Firetex M93 to a distance of at least 200mm (8”) in all directions from the point of welding and on both sides of the steel if applicable.
In certain instances, it may be necessary to remove more than 200mm (8”), and this can be determined at the time of welding by observing any discolouration, blistering or lifting, or excessive softening of the M93. If such defects occur the M93 should be cut away to the point where the defect no longer occurs. It may also be possible to remove less than 200mm (8”), on occasions where only small items are being welded onto a main section, but again this can be best determined at the time of welding.
If in doubt the temperature of the steel immediately adjacent to the Firetex M93 termination line should not exceed 80^{o}C (176 ^{o}F) for more than 5 minutes and should not exceed 120^{o}C (248 ^{o}F) under any circumstances.

4.8 Overcoating

Solvent must not be used to clean or soften the surface of Firetex M93 prior to over coating with itself or with a topcoat.

Cleaning of contaminated surfaces between coats will be achieved by thorough washing with detergent, followed by rinsing with clean fresh water and drying. If contamination cannot be removed by this method, consult Leighs Paints.

On occasions it may occur that Firetex M93 has already been top coated when it is subsequently determined that additional M93 is required. In certain cases, depending on the topcoat applied, it may not be necessary to fully remove all the topcoat. In ALL such cases consult Leighs Paints.

4.9 Exposed Top Flanges

Some designs may not allow for the coating of top flanges. This decision would form part of the fire and safety case analysis and is determined by the client’s engineer. It is not a decision that can be made by Leighs Paints.

Where the design allows for the omission of fire proofing to the top flange then appropriate procedures must be taken to ensure correct termination of Firetex M93.

4.10 Preformed Castings

Please consult Leighs Paints.

5.0 Coat Back

Secondary steelwork and non-protected under deck areas need to be protected to an extent with Firetex M93 to prevent heat transfer into the primary structure. There is no agreed standard for the determination of coat-back required. However a commonly adopted industry 'norm' is to coat-back along secondary steelwork for a distance of 450mm (18"). It is normally considered that the distance should be measured from the point at which the secondary member connects to the primary. Typical drawings are given in Appendix 7 Coatback.

Please note, however, that Leighs Paints have data on other coat-back distances and alternative recommendations may be given. These will be project specific and dependent on the view of both the client and the verification society. If distances other than 450mm (18") are considered appropriate then please contact Leighs Paints.

Typical Firetex M93 coatback scenario on underside of deck

6.0 Thickness Control and Measurement

One of the most important aspects of quality control in the use of Firetex M93 is the attainment of correct dry film thickness.

The proposals given below are those considered appropriate by Leighs Paints, however, where these proposals differ from project requirements, the client's advice must be sought in determining which documentation takes precedence.

Classification & Verification Organisations such as Lloyd's Register, Det Norske Veritas, etc. issue certified thickness tables for Firetex M90 and other epoxy PFP products. The values found in these tables are normally defined as 'minimum thickness'. Thus strict interpretation would mean that no area of a PFP project would be allowed to have any thickness below that stated on the certificate.

In practice one will always achieve a 'normal distribution' of applied product thickness and attainment of a 'minimum' thickness across all areas of a project is very difficult to achieve in a timely and cost effective manner. Thus one really needs to consider what if any, 'normal variation' may be allowed to take account of the realities of PFP application. In doing this it is necessary to also consider how the 'certified tables' are derived.

The data used to create the 'certified tables' originates from a large number of fire tests on many specimen steel plate and structural section. Each specimen is coated with the fire protection product applied using spray equipment similar to that used on site. Consequently each steel specimen has an inherent 'normal distribution' of applied product thickness, just as it would on a 'real project'. The 'mean' PFP thickness from each of these specimens is used to derive the certified tables of Hp/A against product thickness. From this point onwards the thickness stated becomes a 'minimum' value.

Thus one finds inherent variation in the applied product thickness on both the test specimens and on the 'real project' due to the practical nature of the application method. It is also a case that the lower the epoxy PFP thickness the shorter the fire protection time on a given steel section size.

Thus recognizing that variation in thickness is inherent in both the original test data and on the 'real project' one needs to define an acceptable limit that can be practically achieved on site but will not compromise product performance and safety. The aim during application should be to control thickness as tightly as possible and achieve a result as close as possible to the design value.

The following proposals for thickness measurement and tolerance are in line with those broadly adopted by the intumescent fire protection industry within the UK civil building sector.

6.1 Methods of Measurement

For high film thickness epoxy PFP two types of method are typically employed:

- Destructive - The ‘drill depth gauge’
- Non-destructive - The electromagnetic gauge

6.1.1 Destructive Method

Drilling holes and the use of a calibrated depth gauge is acceptable provided all damage is repaired after measurements have been taken.

6.1.2 Non-destructive Method

The use of magnetic induction or eddy current gauges for the measurement of paint film thickness has been common for many years. More recently gauges have become available that will measure up to 50mm (2”) thickness of coating on ferrous or non-ferrous substrates. *E.g. Dualscope MP4 with EK50 Probe from Fischer Instruments.*

6.2 Calibration of Electromagnetic gauge

In all case the manufacturers instructions should be used to determine the correct method for use and calibration. Where electromagnetic gauges are concerned particular note should be taken regarding their limited accuracy at edges and corners.

Magnetic gauges should be capable of providing accurate readings at a thickness in excess of the maximum DFT to be measured. Ideally the gauge should be capable of storing data and determining statistical information (mean, minimum, maximum, etc.).

Calibration should be carried out using the designated smooth steel plate provided with the instrument. Smooth plastic shims specifically designed for calibration and traceable to a national standard must be used. Two shims should be chosen, one having a thickness no more than 50% above the maximum, the other no more than 50% below the minimum of the DFT range to be measured. Gauge accuracy should be determined by measuring, on the smooth steel calibration plate, a further traceable calibration shim of known thickness within the previously calibrated range.

Primer DFT should be determined prior to application of Firetex M93.

Firetex M93 DFT should be determined prior to application of topcoat. Failure to do this may require topcoat to be removed should the DFT's prove to be under specification. Where reinforcement is required mid-film, or where more than one coat is to be applied it may be considered appropriate, or dictated by project specification, to measure the Firetex M93 at an intermediate stage. Knowledge of the interim DFT will allow greater control of the subsequent coats of Firetex M93.

6.3 Frequency of Measurements

The following information is given for guidance only and does not seek to over-ride any project specific requirement for dry film thickness measurement. Where possible reference should always be made to client project specifications or standards such as NACE, SSPC, BS, ISO, etc.

6.3.1 Structural Steelwork

As a minimum all open (H, T or channel section) or closed profile (SHS) structural members should have thickness readings taken every 1m (3') along the length of each coated face. In the case of CHS readings should be taken on at least 4 equidistant points around the circumference and every 1m (3') along the length of the section.

6.3.2 Flat Plate, Decks and Bulkheads

As a minimum on flat plate and large diameter vessels two or three thickness readings should be taken every $1m^2$ ($10ft^2$). If deck and bulkheads are 'stiffened' then readings should be taken at no more than 1m (3') intervals along the length of the flat area between the stiffeners. The stiffeners themselves should be measured as per channel sections in 6.2.1 above.

6.4 Acceptance Criteria

6.4.1 The average of all readings in the defined measurement area must be equal to or greater than the specified M93 thickness.

6.4.2 Where any single thickness reading is found to be less than 80% of the specified thickness, further readings in the area of the low reading should be taken as follows:

6.4.2.1 Where the webs, flange or other face is wide enough then three, nominally equidistant readings should be taken at a distance of 150 - 300mm (6" – 12") away from the low reading.

6.4.2.2 Where the web, flange or other face is not wide enough to allow the above, then two nominally equidistant readings should be taken at a distance of 150 - 300mm (6" – 12") away from the low reading.

6.4.2.3 For CHS, 2 additional readings should be taken nominally equally spaced at a distance of 150 - 300mm (6" – 12") from the low reading along the length of the CHS.

6.4.3 If one or more of these additional readings are also less than 80% of the specified thickness further readings should be taken to establish the extent of the low area. The whole area should then be brought up to the required thickness by application of more Firetex M93.

6.4.4 Individual thickness readings of less than 50% of the specified thickness are not acceptable.

6.4.5 Maximum thickness of Firetex M93.
Where Firetex M93 has been applied without the use of solvent thinning, application significantly above the required target value does not normally pose a problem. Since Firetex M93 may be specified at target DFT's from 4mm to 24mm (0.16" to 0.94") one can see that there is a wide scope for allowable variation in over application. For the purposes of providing some broad guidance, the average of all readings in the defined measurement area should not exceed the specified DFT by more than 10%. No individual reading in the defined measurement area should exceed the specified DFT by more than 50%. However, depending on the specified thickness, the method of application and the end use requirement, it may be possible to allow the average of all readings to exceed the specified DFT by a considerable margin. This must only be done with the client's permission by raising a 'variation request'. They will in turn seek Leighs opinion.

6.5 Reinforcement and DFT Measurement

All quoted Firetex M93 DFT's include scrim cloth wherever they have been used.

If cloth-scrim reinforcement is used then direct readings can be taken.

7.0 Topcoat Selection

7.1 Approved top coats for Firetex M93

Although Firetex M93 has a high degree of exterior durability in its own right, performance, longevity and decorative appearance will be enhanced if a topcoat is applied. Suitable topcoats are discussed below and detailed in the table given at Appendix 2.

7.2 Splash Zones and Immersion

Firetex M93 has been specifically designed to have excellent resistance to salt water immersion conditions and can therefore be used in splash zones. Firetex M93 has been fire tested on structural steel after immersion (with and without topcoat) with no reduction in fire resistance properties. However to provide maximum protection in all such situations a topcoat of Epigrip M922 Glass Flake epoxy should be applied at a minimum dry film thickness of 400 microns (16 mils). The M922 should be taken 250mm (10”) past the termination of the M93. As our immersion test programme is ongoing please consult Leighs Paints for any immersion applications. See also table Appendix 2.

7.3 Non-Skid Surfaces

On occasions, it may also be necessary to apply non-skid coatings on to Firetex M93. In all such instances it is imperative that the correct thickness of Firetex M93 has been applied, and that all surfaces to be coated are dry and free from all surface contaminants. Suitable non-skid systems are given in the table at Appendix 2.

Appendix 1 - Primer Qualification Form

Paint Manufacturers Name:				
Technical data sheet supplied? *Safety Data Sheet supplied?*	YES / NO (Delete as appropriate) YES / NO (Delete as appropriate)			
Sample plate details:	Steel or other ?	Size LxWxT(mm or inch)?		
	Coat 1	*Coat 2*	*Coat 3*	*Coat 4*
Product name				
Product Reference: Base Additive				
Colour/Color				
Batch number: Base Additive				
Thinners: Reference Vol. % added				

Panel No.	*Coat No.*	*DFT (μm or mils)*	*Date applied*	*Curing conditions (^{o}C(^{o}F) / %RH)*	*Application method*
# 1	1				
	2				
	3				
	4				
# 2	1				
	2				
	3				
	4				
# 3	1				
	2				
	3				
	4				
# 4	1				
	2				
	3				
	4				

Appendix 2 Approved Topcoats for Firetex M93

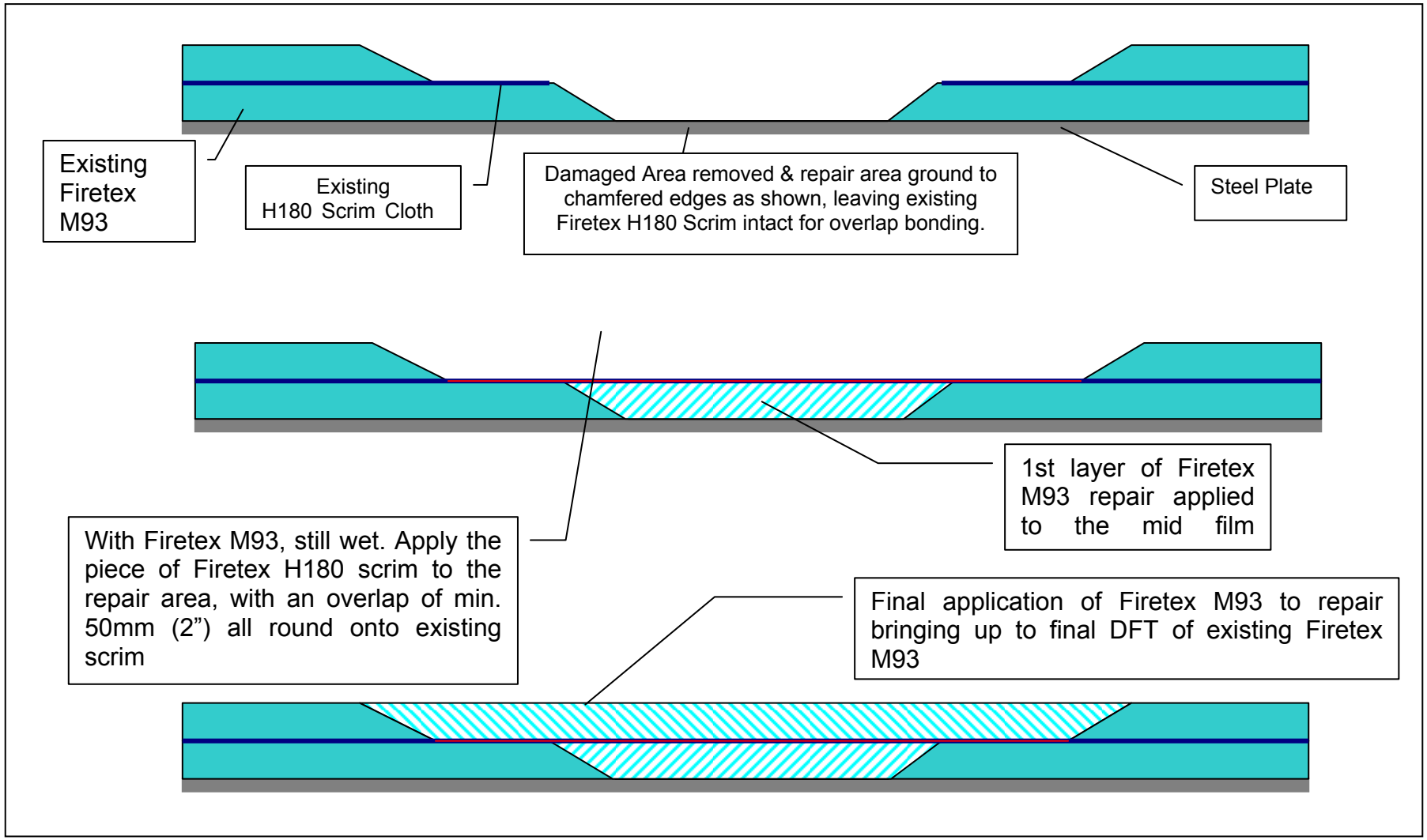
		Required dry film thickness (microns)/(mils)		
Topcoat	*Product type*	*General use*	*Splash / Immersion*	*Decks*
Firetex M75	Modified PU	50 (2)	-	-
Resistex C137V2	Over-coatable PU	50 (2)	50* (2)*	-
Resistex C237V2	Over-coatable PU	50 (2)	-	-
Resistex K651	Aliphatic PU	50 (2)	-	-
Epigrip M262	Epoxy gloss	75 (3)	75* (3)*	-
Epigrip M922	Epoxy glass flake	-	400 (16)	-
Epidek M339	Epoxy deck coating	-	-	400 (16)
Epidek M153	Epoxy deck screed	-	-	2 – 3 mm (80 -120 mils)

All dry film thickness measurements are nominal

- Topcoat type not applicable for that environment

* Over M922 as a cosmetic coat

Appendix 3 - Firetex M93 Repair Sketch



Appendix 4 - Pull-off Adhesion Test Procedure – Firetex M93

This test shall be carried out on the pre-qualification sample with subsequent testing on production areas to be defined in the project Quality Procedures. This test may also be considered appropriate to help to resolve any disputes relating to quality of application.

The test shall be carried out generally in accordance with ISO 4624 “Paints and varnishes – Pull-Off Test for Adhesion” (ASTM 4541 – Pull off Strength of Coatings Using Portable Adhesion Testers).

The minimum acceptable cohesive strength is 3MPa (435psi) with failure at the Scrim interface.

Tests shall only be carried out on cured fireproofing.

In the event that there is an adhesion failure at the interface of the primer and the Firetex M93, the total system shall be removed and reinstated as per this application manual’s requirements.

The following method for testing shall be followed:

a. Only specifically designed, pneumatic or hydraulic pull-off adhesion test equipment is suitable. It is important that the same test equipment is used throughout the project to ensure that consistent and meaningful results are obtained.

b. Select the areas to be tested and then lightly abrade to remove any glaze from the surface

c. Lightly abrade the underside of a test dolly from the adhesion test kit and apply the recommended adhesive. Bond the dolly to the prepared area and leave until adhesive is fully cured (refer to the adhesive manufacturers data). The adhesive for bonding the dolly to the test surface shall be cyanoacrylate or two-component high strength epoxy, since they have a short curing time. The adhesive strength shall be recognized to be stronger than 9Mpa (1305psi) to reduce adhesive failure during the test. (Scotch 3M 2000 meets this criteria).

d. Place the small-toothed hollow cutter (20mm to 25mm (0.8” to 1.0”) diameter) from the test kit into the chuck of a hand held, variable speed battery-operated drill.

e. Using a slow speed setting carefully cut (at 90° to the surface) around into the fireproofing around the dolly.

f. Ensure that the adhesion tester gauge is set to zero and attach the ‘pull-off head’ to the dolly. Using the hydraulic pump supplied with the test kit, apply steady pressure until the dolly is removed, or until the gauge reaches the top of the scale (whichever is sooner).

g. Record the value from the gauge and the mode of failure (adhesive or cohesive) expressed as a percentage of the total area directly under the dolly. Record also the area tested, thickness of PFP, the adhesive and equipment used as well as any other observations.

h. The report should be signed by all parties present at the test.

i. Once testing is complete repair the core test area by filling the hole created with Firetex M93 material.

The results shall be expressed using the following guidelines:

- The test Dolly and the test surface shall be examined to determine the mode (cohesive or adhesive) and the percentage of failure.
- Record the mode of failure as indicated below. Record the value from the test equipment gauge.
- If the adhesive fails without any coating detachment and the value obtained is greater than that required, then the result is to be quoted as ‘glue failure’ along with the actual gauge reading. Adhesion of the coating system is at least equal to the value obtained at glue failure.
- If the adhesive fails without any coating detachment and the value obtained is lower than that required, then the test is void and must be repeated in an area close to the original.

The following Key Code shall be used on the test report for description type of failure:-

A = Adhesive Failure (the bond between the Dolly and the PFP surface)

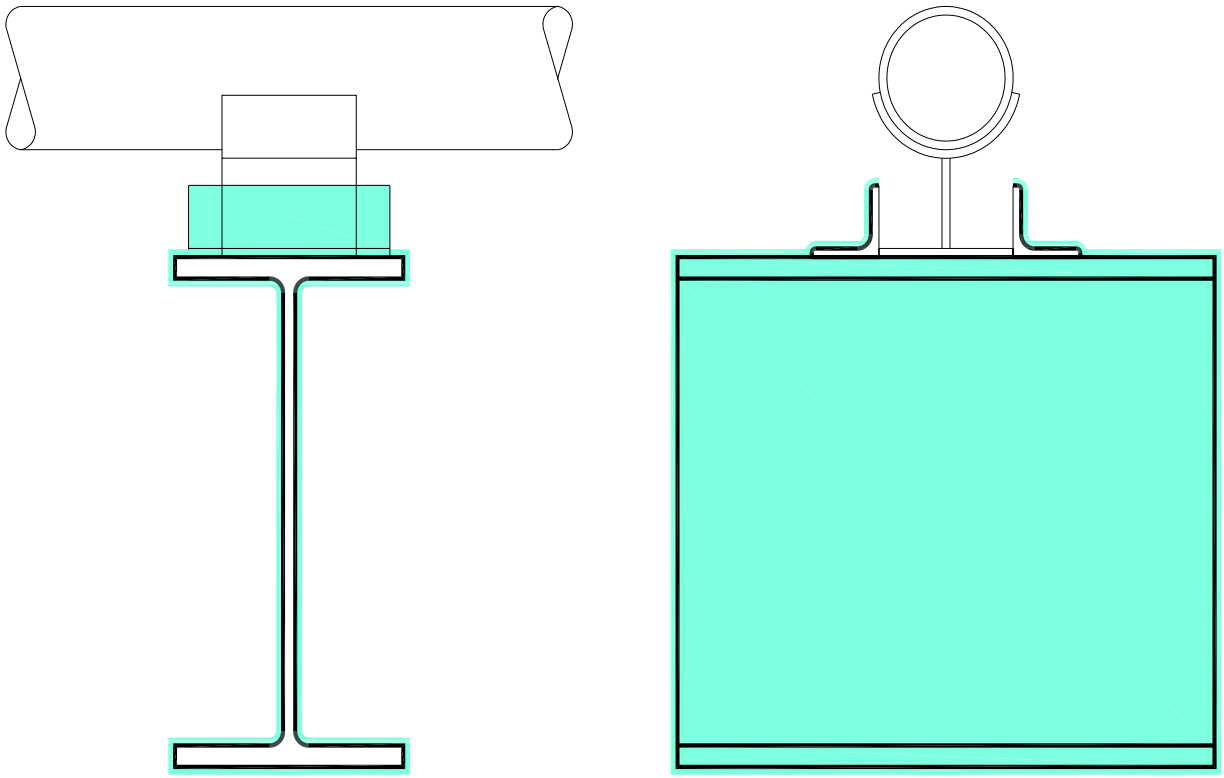
B = Cohesive Failure (failure within the PFP coating)

C = Adhesion Failure (failure between the PFP coating and the primed substrate)

P = Cohesive Failure (a failure within the primer coating).

Appendix 5 Typical Termination Details – Pipe Supports

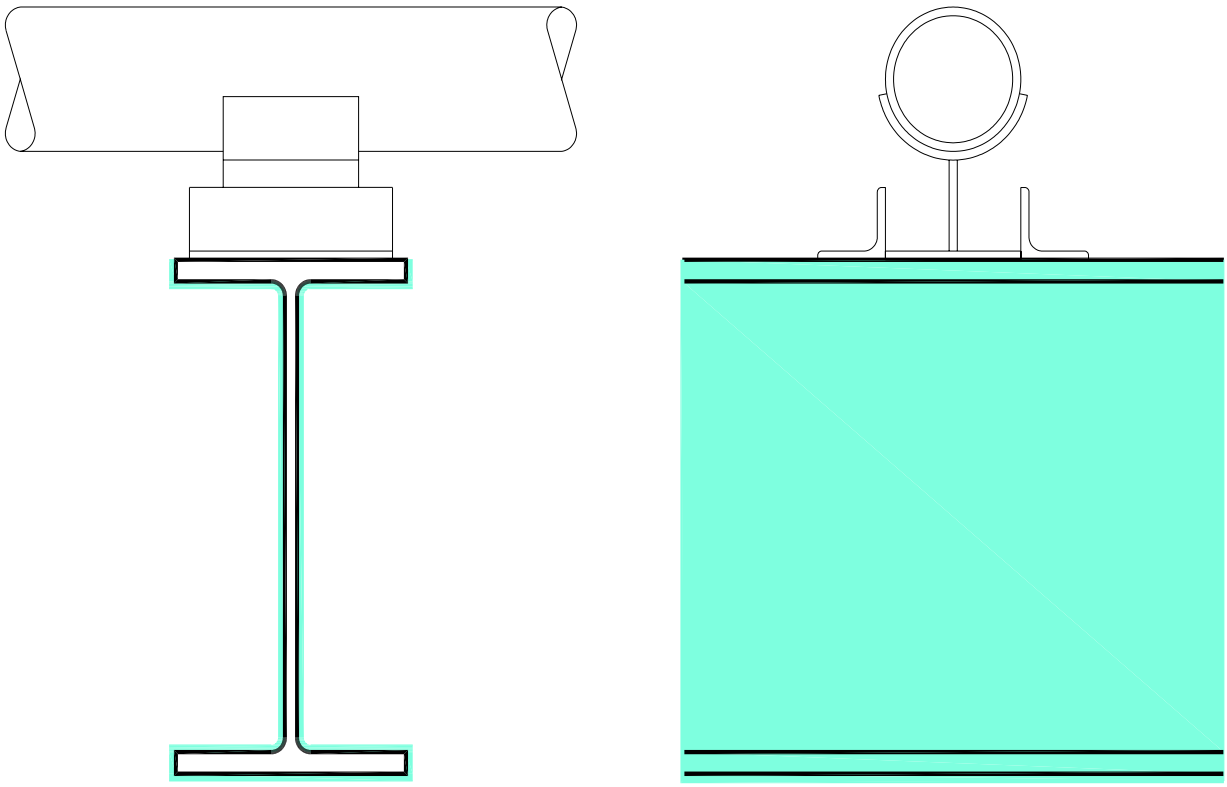
5.1 Typical detail for sliding pipe support where top of beam exposed to fire or radiant heat



PFP applied to beam and guides to achieve fire rating based on Hp/A (W/D) and fire scenario specified.
Pipe shoe support may also fire protection in its own right.

Note: Pipe support sliding face is left clear of PFP.

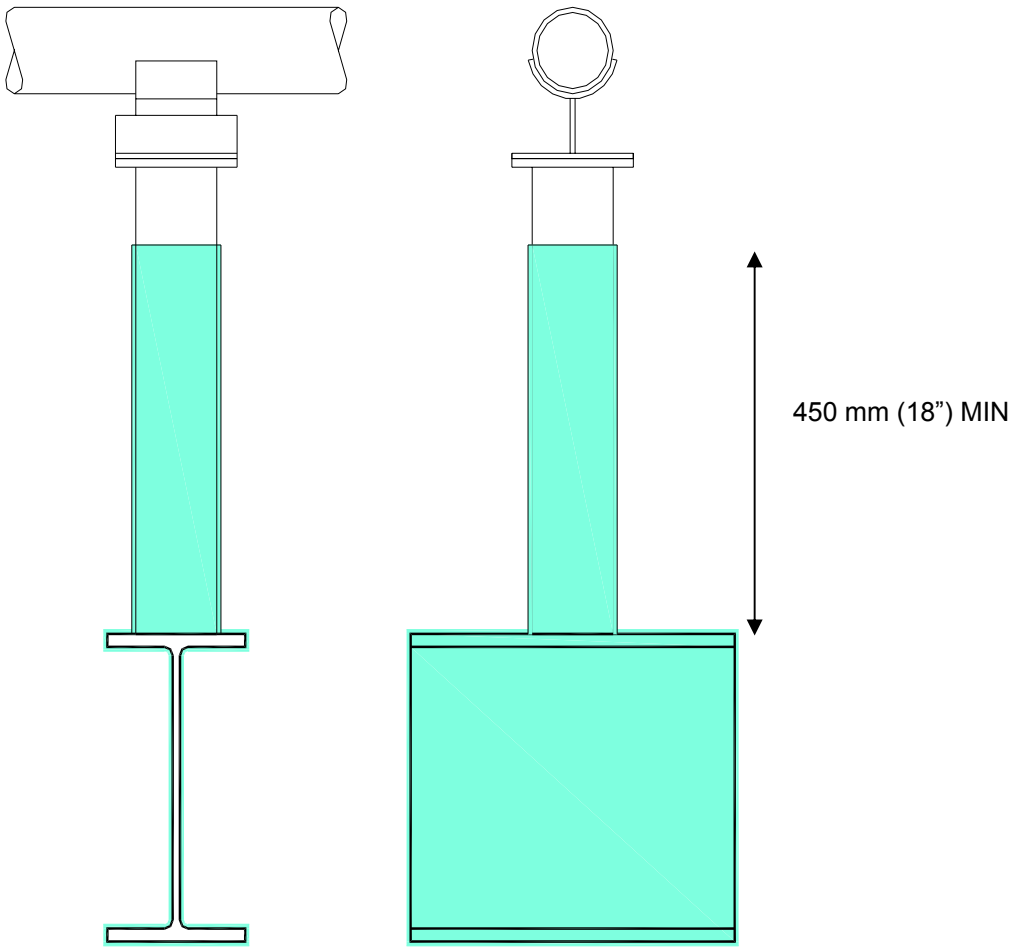
5.2 Typical detail for sliding pipe support where top of beam is not exposed to fire or radiant heat, or is cooled by deluge



The design may be used where the top flange of the beam is not exposed to fire or radiant heat, or is cooled by deluge. The decision to fire protect this top face or not, is part of the safety case assessment and as such is the responsibility of the design team, not Leighs Paints.

PFP applied to beam to achieve fire rating based on Hp/A (W/D) and fire scenario specified.

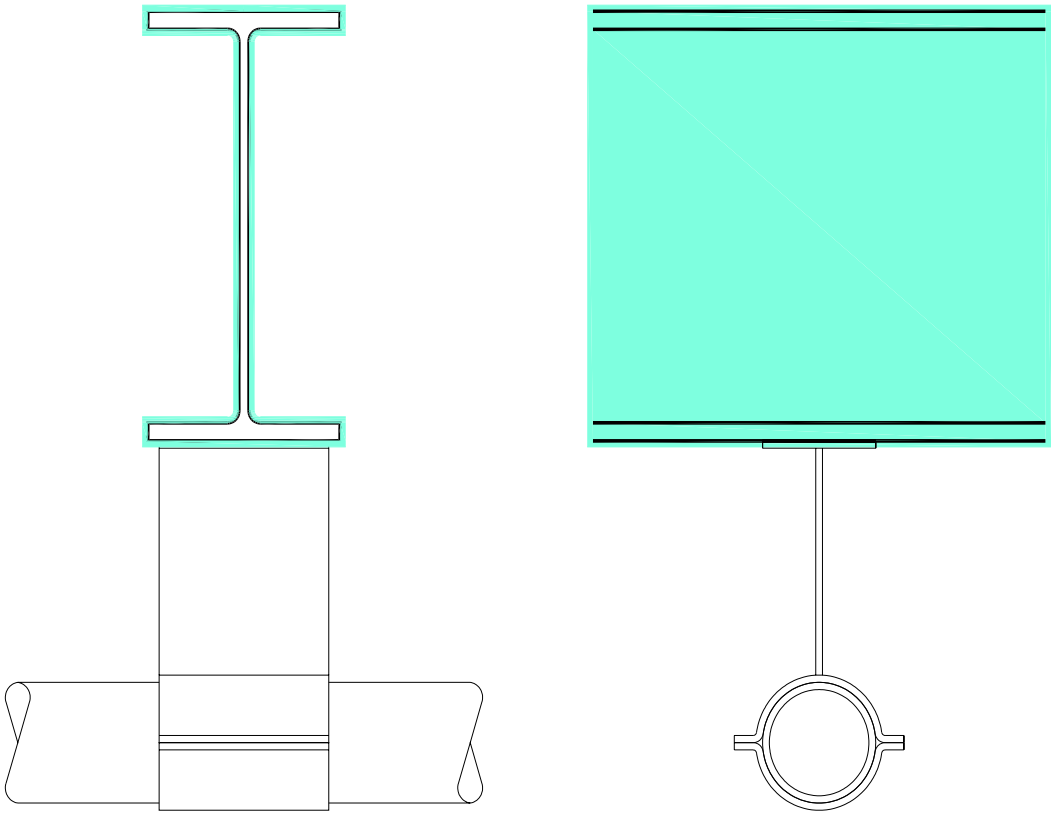
5.3 Typical detail for fixed pipe support where top of beam is exposed to fire or radiant heat



PFP applied to beam and supports to achieve fire rating based on Hp/A (W/D) and fire scenario specified. Pipe support may need to be completely fireproofed or only ‘coatback’ protected. If coatback then minimum 450mm (18”) and thickness to be as per main beam.

Note: Pipe support sliding face is left clear of PFP.

5.4 Typical detail for fixed pipe hanger

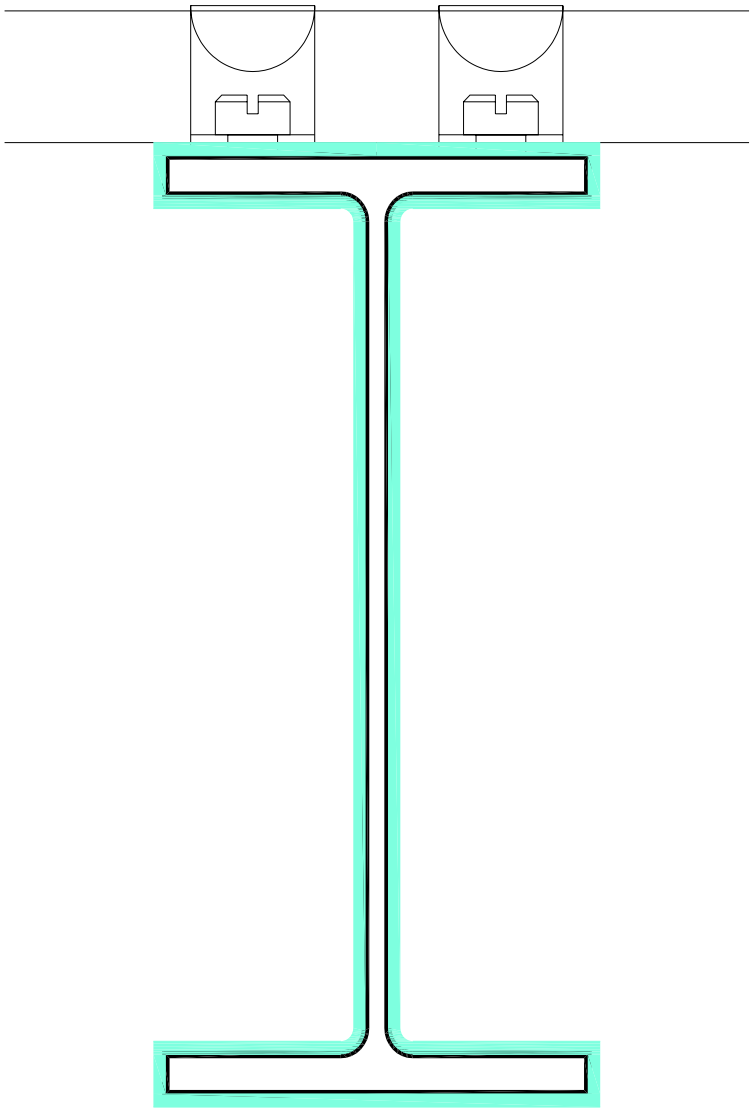


PFP applied to beam and supports to achieve fire rating based on Hp/A (W/D) and fire scenario specified. Coatback protection only required when hanger cross-section is greater than 3000mm^2 (4.65 sq. inch). Where coatback required distance is 450mm (18”) and thickness to be as per main beam.

Hanger may need to be fully fire protected in its own right.

Appendix 6 Typical Termination Details – Grated Decks

6.1 Standard detail or protection of top of beam exposed to fire

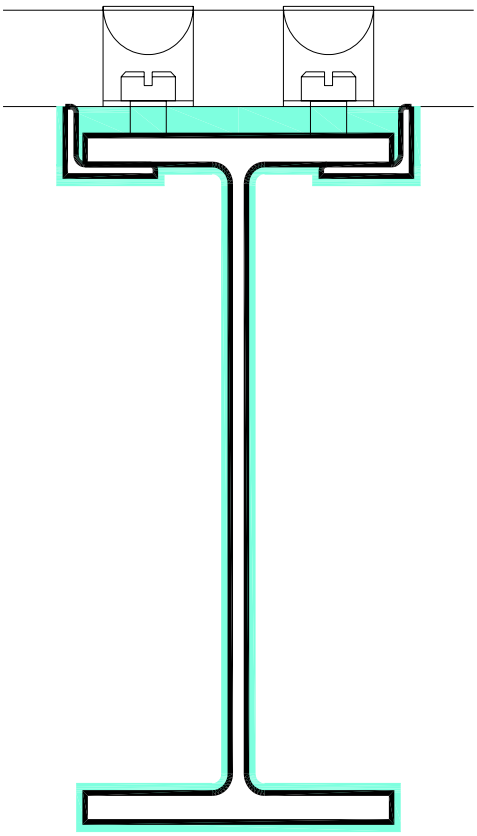


In this design the deck grating is supported by the Firetex M90 and is suitable for general walkways. Firetex M90 should be rolled smooth and level.

The stud welding for the grating is done prior to application of Firetex M90 and masking sleeves used to protect these while Firetex M90 is applied. Alternatively cured Firetex M90 may be removed using a hole-saw and Hilti XB-T fastenings installed & the hole repaired using Firetex M90.

Alternatively the grating can be filled with Firetex M90 above the flange but this uses excessive material and the grating will be firmly bonded to the beam and so no longer removable.

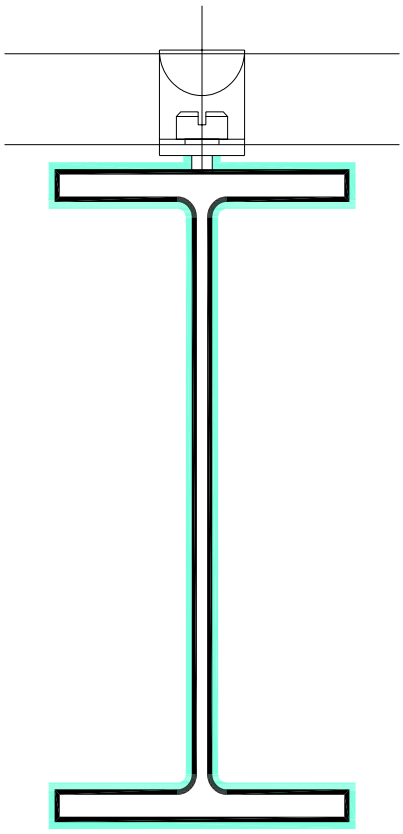
6.2 Alternative detail for heavy duty protection of top of beam exposed to fire



In this design the deck grating is supported partly by the up-stand angle and the Firetex M90. The angles also provide a guide to level the Firetex M90 to a known thickness. This option allows for a greater load to be supported but a structural engineer must approve this.

The stud welding for the grating is done prior to application of Firetex M90 and masking sleeves used to protect these while Firetex M90 is poured and levelled. Alternatively cured Firetex M90 may be removed using a hole-saw and Hilti XB-T fastenings installed & the hole repaired using Firetex M90.

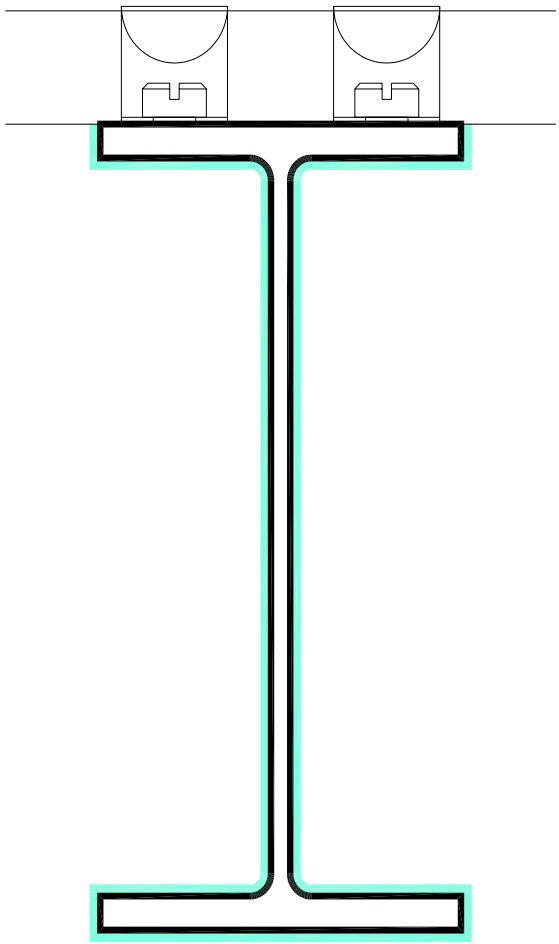
6.3 Alternative detail for protection of top of beam exposed to fire



The principle of this design is to elevate the level of the grating above the top surface of the beam by ay approximately 12 to 15mm (0.48” to 0.6”). This allows the beam to be fully protected, while allowing drainage through the grating.

At the design stage the beam height is lowered by typically 12 – 15mm (0.48” to 0.6”) and then ‘Tee’ section is welded to the top flange, bringing the flange face back to the correct level. Loadings must be verified by a structural engineer.

6. 4 Standard detail for unprotected top flange where it is not exposed to Fire and radiant heat, or is cooled by deluge

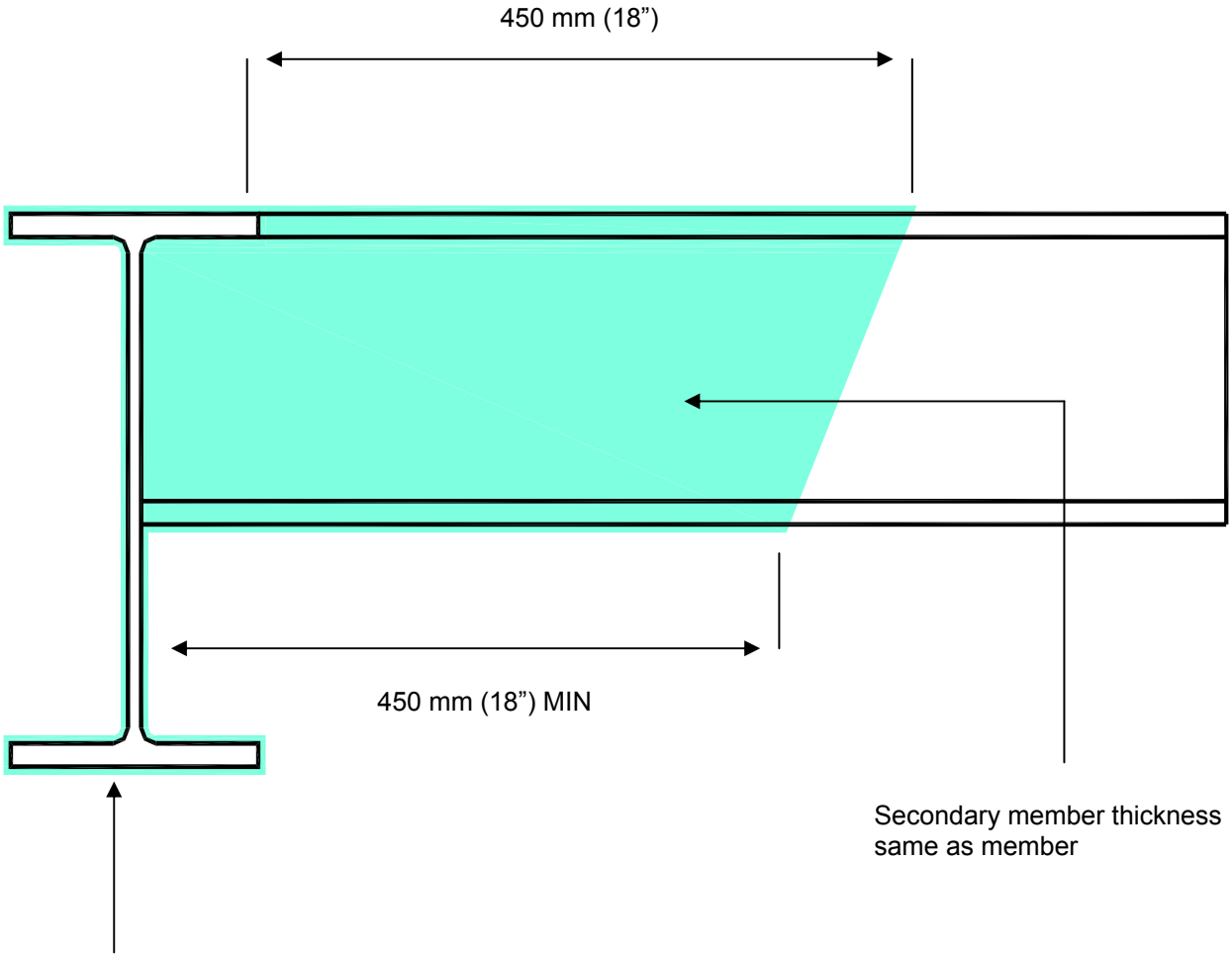


The design may be used where the top flange of the beam is not exposed to fire or radiant heat, or is cooled by deluge. The decision to fire protect this top face or not, is part of the safety case assessment and as such is the responsibility of the design team, not Leighs Paints.

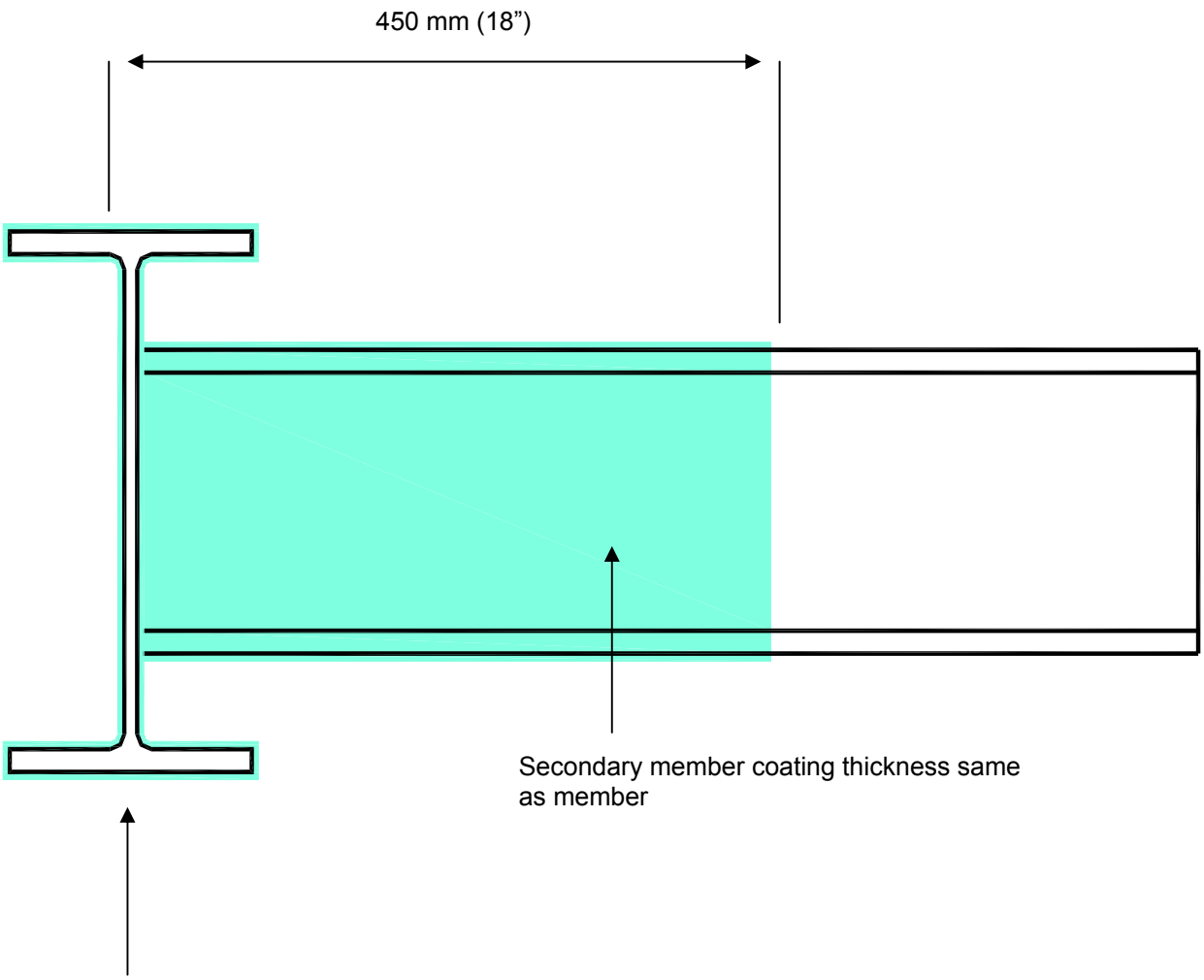
In cases where it is deemed that no fire protection is required on the top flange then the grating is installed as normal. It is general industry practice to use the 4-sided Hp/A (W/D) calculation to determine the PFP thickness, and use this thickness in the remaining ‘three sides’ to provide a safety factor, although this is a decision to be made by the project team on a case by case basis.

Appendix 7 Typical Coatback Details

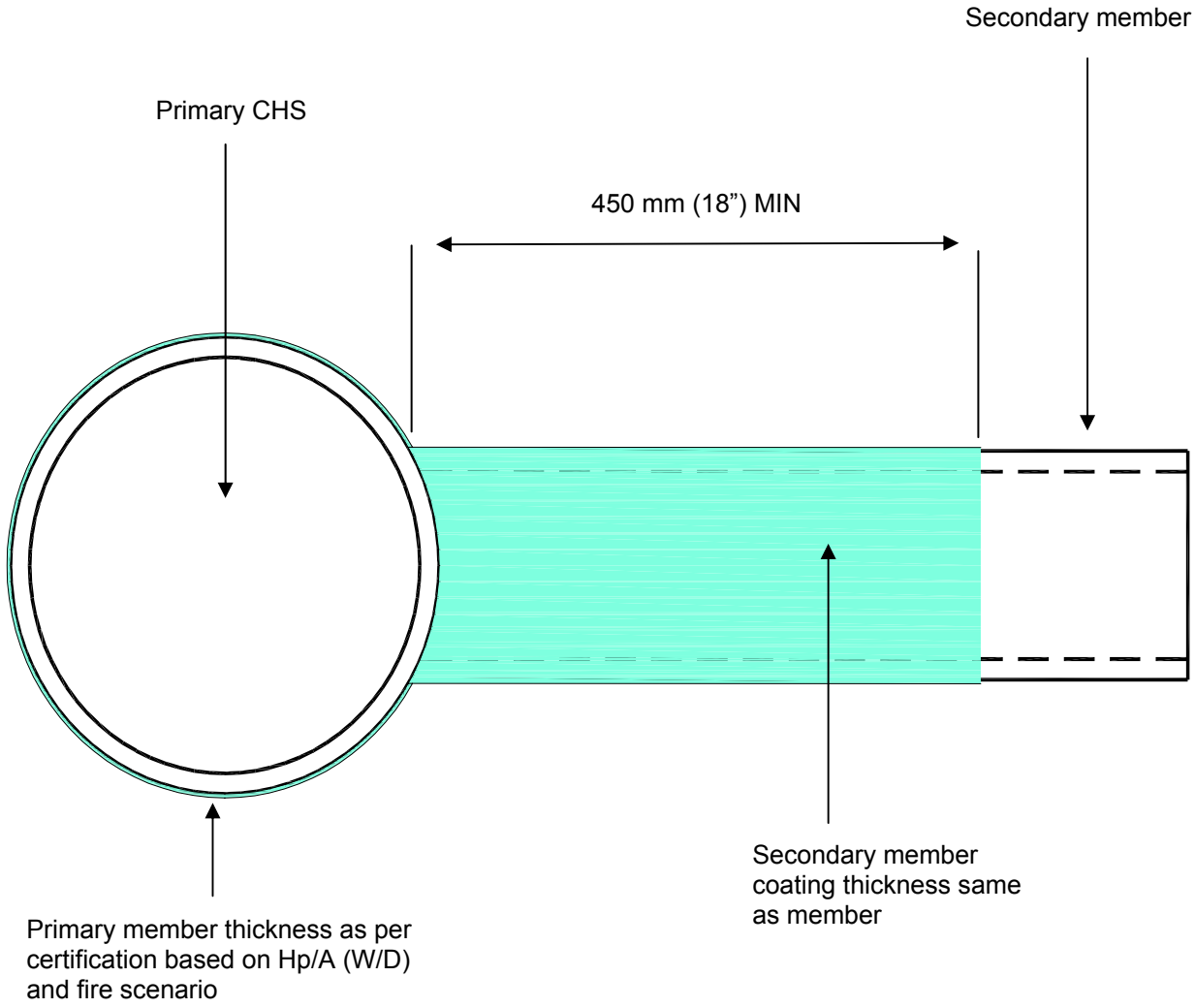
7.1 I-section to I-section with level top flange



7.2 I-section to I-section within web

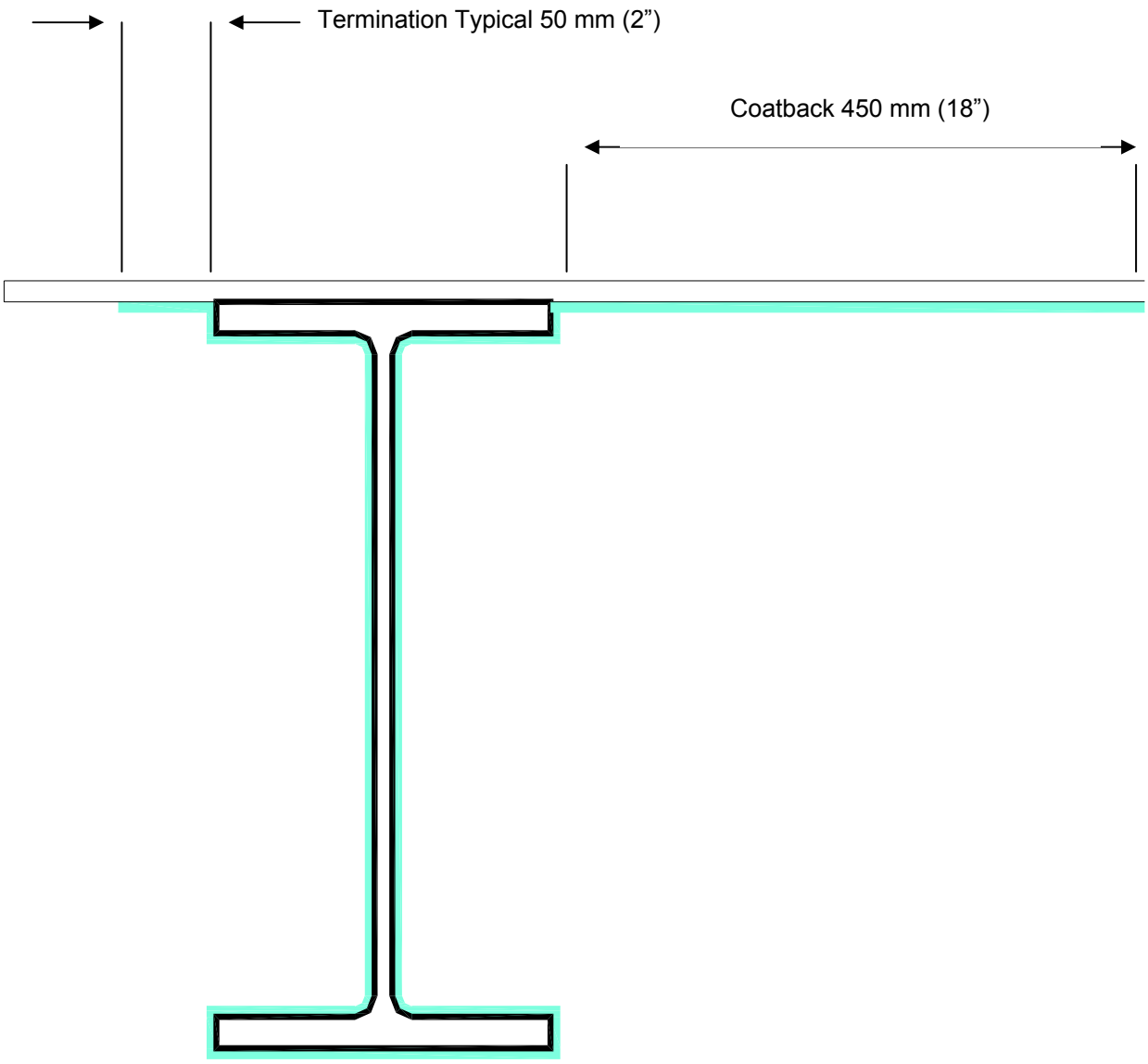


7.3 CHS to CHS



Coating may follow profile of primary member or be finished off square

7.4 I-Beam under plated deck



Coatback thickness same as that used on primary member