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Title:

The Fire Performance of Tuffa
Protective Covers to Domestic
& Non-Domestic Oil Storage
Tanks

WF Assessment Report No:

180983B Issue 3

Prepared for:

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Date:

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Executive Summary

Objective	This report presents an appraisal of the fire performance of the Tuffa protective covers to oil storage tanks in terms of the integrity and insulation performance requirements of BS 476: Part 22: 1987 when fitted to external oil storage tanks for domestic and non-domestic applications, when fitted to internal oil storage tanks for domestic applications up to 3500 litres and when fitted to internal oil storage tanks for non-domestic applications.
Report Sponsor	TUFFA UK Ltd
Address	Dovefields Industrial Estate Derby Road Uttoxeter Staffordshire ST14 8SW
Summary of Conclusions	Should the recommendations given in this report be followed, it can be concluded that the Tuffa protective covers, which enclose the sides, top and underside of the oil storage tank with a non-combustible construction, provide a fire resistance of 60 minutes in terms of the integrity and insulation criteria of BS 476: Part 22: 1987.
Valid until	1 st April 2019

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Introduction

This report presents an appraisal of the fire performance of the Tuffa protective covers for external oil storage tanks for domestic and non-domestic applications, when fitted to internal oil storage tanks for domestic applications up to 3500 litres and when fitted to internal oil storage tanks for non-domestic applications.

The proposal is for the covers to be non-combustible and to provide a barrier with a fire resistance of 60 minutes, in terms of the integrity and insulation criteria of BS 476: Part 22: 1987, between the tank and an adjacent fire source.

FTSG

The data referred to in the supporting data section has been considered for the purpose of this appraisal which has been prepared in accordance with the Fire Test Study Group Resolution No. 82: 2001.

Assumptions

Tank location and size

It is assumed that the tank is situated either externally to the building in which the appliance is installed and that the storage capacity of the tank is a maximum of 3500 litres in a domestic application and either less than or greater than 3500 litres for non-domestic applications or that the tank is situated within a building and that the storage capacity of the tank is a maximum of 3500 litres for domestic applications and either less than or greater than 3500 litres for non-domestic applications.

Supporting construction

It is assumed for external tanks that the tank is installed on or over a non-combustible base that extends out at least 300mm from all sides of the tank, except that if the tank is closer than 300mm to a building wall or fire screen wall which has the degree of fire protection required for the tank, the base need only extend as far as the wall. Types of acceptable base are:

- Concrete at least 100mm thick;
- Paving stones at least 42mm thick positioned closely to each other on level ground;
- Stonework at least 42mm thick.

Fire resisting tank chamber

It is assumed that, for tanks situated within, on, or over a non-domestic building, the tank is enclosed within a fire resisting tank chamber with a fire resistance, as specified in Section 10.7.4 of BS 5410-2: 2013. The chamber is required to be constructed of brick, concrete or other suitable material, with the enclosure, doors and windows having the periods of fire resistance given in Table 11 (of the standard). Examples of suitable types of construction are set out in Table 12 (of the standard).

Proposals

Covers

The Tuffa protective covers are constructed with Tuffa FireStop 60 barrier material. The Tuffa FireStop 60 barrier consists of three identical layers of material. Each layer of material consists of one layer of 'E' glass needlefelt blanket, nominally 5mm thick x 700g/m² weight encased within 50µm aluminium foil, enclosed within two layers of 420g/m² woven 'E' glass fabric,

0.4mm thick, rendered temperature resistant by the application of a proprietary chemical treatment. The whole is assembled together using a small amount of thermoplastic adhesive. The composite barrier is 15mm nominal thickness and 5.4kg/m² weight.

The covers are constructed to enclose the sides, top and underside of the tank. At vertical joints in the barrier material, the two materials are folded for 50mm and stapled together, either each layer separately or through all the layers simultaneously. At horizontal joints each layer of the material is jointed separately. For each layer the core blankets are overlapped by at least 50mm and the 'E' glass fabric, on each face, are folded for at least 50mm and stapled together. The staples used are 12mm stainless steel staples at 50mm nominal centres. The jointing method is shown in Figure 1. The covers are designed for tanks with a maximum cover height (drop) of 4m.

Access hatch

The top of the Tuffa protective cover is fitted with an access hatch to allow access to the fill pipe, vent and level indicator. The maximum clear opening size of the hatch is 258mm x 138mm. The steel framework of the hatch is constructed with lipped steel channels, 41mm wide x 21mm deep x 1.5mm thick, which are welded together at the corners. The lower (fixed) part of the hatch frame sits on top of the tank. The upper part is hinged to the lower part with steel hinges. The Tuffa FireStop 60 barrier material extends around the edges of both parts of the frame and is clamped to the frame with steel strip, minimum 12mm wide x 0.9mm thick, screwed to the frame with minimum M4 steel self-tapping screws at 100mm maximum centres. The hinges are fastened to the lower part of the hatch frame, through the barrier material, with M6 bolts. The hinges are welded or bolted to the upper part of the frame. The hatch is held in the closed position by a steel quick release catch. Figure 2 shows the general construction of the hatch.

Pipe penetrations

The Tuffa protective cover encloses the complete tank. At one location the steel outlet pipe from the tank penetrates through the tank cover. At this location a Tuffa Firestop penetration seal is fitted. There are no other penetrations through the cover. However the penetration may also include a copper tube, maximum 10mm diameter, and an electrical signal cable, maximum 10mm diameter, tied to the steel pipe.

At the location of the penetration a slot or feather circle is cut through the Tuffa FireStop barrier material to allow the pipe to pass through. Tuffa collars, made of the same Tuffa FireStop 60 barrier material, are wrapped around the pipe on the inside of the cover, extending up to the tank, and on the outside of the cover for a minimum distance of 300mm. The collars are fitted tightly around the pipes by fastening the edges together using 12mm stainless steel staples at 100mm nominal centres. Beads of Tuffa high temperature adhesive, 2 x 6mm beads, are used to attach the flange of each collar to the cover. Any visible gaps are sealed with Tuffa high temperature adhesive. The flanges of the collars are stapled to the cover with one 16mm stainless steel staple on each side. The maximum steel pipe size is 35mm external diameter.

Basic Test Evidence

Tuffa FireStop

The test referenced Faverdale No. FTCR/96/0057 and described briefly in the supporting data section of this report describes a fire resistance test conducted on a vertical Tuffa FireStop 30 cavity barrier. The test shows that the barrier is

able to provide an integrity performance of at least 60 minutes.

The test referenced WF No. 155327 and described briefly in the supporting data section of this report describes an indicative fire resistance test conducted on a vertical Tuffa FireStop 60 cavity barrier. The test shows that the barrier is capable of providing an integrity and insulation performance of 60 minutes.

The test referenced AFTF No. 080502 and described briefly in the supporting data section of this report describes a fire resistance test conducted on a vertical Tuffa FireStop 'E' glass coated fabric cavity barrier. The test shows that the barrier is able to provide an integrity performance of over 60 minutes.

Penetrations

The test referenced WARRES No. 69612 and described briefly in the supporting data section of this report describes a fire resistance test conducted on a 1m x 1m Tuffa FireStop 30 cavity barrier when penetrated by two cable trays and two steel pipes. Each service was fitted with an uninsulated Tuffa collar on the fire face of the barrier. The test shows that the penetrated barrier assembly is able to provide an integrity performance of 60 minutes.

The test referenced Beele No. 17-07-07/1 and described briefly in the supporting data section of this report describes a fire resistance test conducted on a steel bulkhead clad with Tuffa FireStop 60 barrier material when penetrated by a steel pipe. The service was fitted with a Tuffa FireStop 60 penetration seal on the non-fire face of the bulkhead. The test shows that the penetrated seal assembly is able to provide an integrity performance of 60 minutes and an insulation performance of 49 minutes with a 200mm-long collar.

Assessed Performance

BS 5410-1

The guidance provided in BS 5410: Part 1, Section 6, on the accommodation for oil storage tanks has been adopted for this assessment for oil storage tanks that are situated externally to a building or within a building for domestic applications up to 3500 litres.

In section 6.3, 'Methods of tank protection', the standard states that 'It is considered unlikely that a fire will originate from the stored oil and it is the purpose of these recommendations to ensure that a fire which may originate from a building or other external source is not transmitted to the tank contents or, if a fire occurred, its effects are limited'. The standard lists a number of ways by which adequate safety may be achieved. One of these ways is by enclosing the tank with a non-combustible fire resisting construction that will provide a barrier between the tank and the fire. The barrier must also prevent the passage of direct radiated heat from the fire. The standard also states that for tanks located within a building 'tanks should never be installed in a habitable area'.

BS 5410-2, tanks outside buildings

The guidance provided in BS 5410-2, Section 10.7.2, on the accommodation for oil storage tanks above ground away from or outside buildings (other than over or upon the roof) has been adopted for this assessment for oil storage tanks for non-domestic applications.

In section 10.7.2.2 the standard states that a fire-resisting tank chamber or fire screen walls are essential, except:

- a) where the tank is 2m away from any building or similar structure on the same site and from any adjoining site, and the quantity of oil to be stored does not exceed 3500 litres; or
- b) where the tank is more than 6m from such a boundary and adjoining site, where the quantity of oil to be stored exceeds 3500 litres.

The standard goes on to state that in all cases other than the exceptions referred to in a) and b), above, protection from any building or similar structure on the same site and from any adjoining site should be as follows:

- Where the quantity of oil to be stored does not exceed 3500 litres, in all cases a fire screen wall, as described in b) below, should be provided between the tank and any adjoining site within 2m. In addition, either:
 - a) the walls of any building or similar structure on the same site within 1.8m in any direction from any part of the tank should have at least 1 hour fire resistance and should be imperforate; or
 - b) a fire screen wall should be provided between the tank and the building or similar structure, this wall having at least 1 hour fire resistance and extending not less than 900mm beyond the ends and uppermost parts of the tank.
- Where the oil to be stored exceeds 3500 litres, in all cases a fire screen wall, as described in b) below, should be provided between the tank and any adjoining site within 6m. In addition, either:
 - a) the walls of any building or similar structure on the same site within a distance of 6m in any direction from any part of the tank should have at least 2 hours fire resistance and should be imperforate where they are within 1.8m in any direction on the tank; any openings in the walls between 1.8m and 6m from the tank should be fitted with 1 hour fire resisting glazing or 1 hour fire resisting self-closing doors; or
 - b) a fire screen wall should be provided between the tank and the building or similar structure; it should have at least 1 hour fire resistance and extend not less than 900mm beyond the ends and uppermost parts of the tank.

BS 5410-2, tanks within buildings

The guidance provided in BS 5410-2, Section 10.7.4, on the accommodation for oil storage tanks has been adopted for this assessment for oil storage tanks that are situated within, on, or over a building for non-domestic applications.

In section 10.7.4.2 the standard states that:

- Tanks within, on, or over a building should be enclosed within a fire resisting tank chamber constructed of brick, concrete or other suitable material and with the enclosure, doors and windows having the periods of fire resistance given in Table 11 (of the standard). Examples of suitable types of construction are set out in Table 12 (of the standard).
- Any tank having a capacity greater than 3500 litres within a building should, wherever practicable, be situated at the lowest level in the building. When a tank is situated at any level in a building other than the lowest, the whole of the structure supporting the tank chamber should be constructed

to a standard of fire resistance not less than that recommended for the tank chamber or for the remainder of the building, whichever is the greater.

- A tank chamber within a building should, wherever practicable, be situated against an external wall and be accessible from the open air.
- Tank chambers should either be provided with internal bunds in accordance with 10.7.7 (of the standard), or the chamber itself should be constructed so as to be impervious to oil, or the tanks within them should be of the integrally banded type conforming to OFS T100 [N2] or OFS T200 [N1].

It is assumed for this assessment report that the requirements for the siting and installation of the oil storage tank described in BS 5410-2 have been complied with.

Risk assessment

It is recommended that a risk assessment be carried out to determine sources of potential fire hazard.

Tuffa FireStop

A non-combustibility test was carried out in accordance with BS 476: Part 4: 1970 on samples of Tuffa FireStop barrier material (TE 201288). The samples did not exceed the limits imposed by the standard for flaming and temperature rise. The material was therefore deemed to be non-combustible.

The performance of the vertical Tuffa FireStop 'E' glass coated fabric (a single layer of material nominally 0.34mm thick), when subjected to the standard fire resistance test, has been demonstrated in test AFTF No. 080502 where a 3m x 3m barrier incorporating two vertical joints satisfied the integrity criteria of the standard for 113 minutes. There was no failure of the material in the test; one joint in the fabric began to open near the top of the curtain due to the incorrect fitting of the fixing staples at that location.

The Tuffa FireStop 30 fire barrier consists of two outer layers of 'E' glass coated fabric separated by two needlefelt 450g/m² core blankets. The performance of the vertical Tuffa FireStop 30 cavity barrier system, when subjected to the standard fire resistance test, has been demonstrated in test No. FPCR/96/0057 where a 3m x 3m barrier incorporating two vertical joints achieved an integrity performance of 73 minutes and an insulation performance of 17 minutes. After 14 minutes of the test the barrier was subjected to a simulated blast condition due to a malfunction of the furnace control system. The barrier remained intact, satisfying the integrity criteria of the standard, but it is thought that the abnormally high pressure to which the barrier was subjected may have damaged the material of the barrier, resulting in a lower than expected insulation performance.

The Tuffa FireStop 60 fire barrier consists of three identical layers of material. Each layer of material consists of one layer of needlefelt 700g/m² core blanket enclosed between two layers of 'E' glass coated fabric. Although the Tuffa FireStop 60 barrier material has not been subjected to a fire resistance test at a size of 3m x 3m, the 'E' glass coated fabric and the Tuffa FireStop 30 barrier material have shown that they are able to satisfy the integrity criteria of the test standard for at least 60 minutes at that size. Therefore it is expected that the Tuffa FireStop 60 barrier material would provide an integrity performance of 60 minutes if tested at a size of 3m x 3m as each layer of needlefelt 700g/m² core blanket is supported by two layers of 'E' glass coated fabric, compared to two layers of needlefelt 450g/m² core blanket supported by two layers of 'E'

glass coated fabric for the Tuffa FireStop 30.

In order to further investigate the insulation performance of the Tuffa FireStop 60 barrier material, an indicative fire test was carried out (WF No. 155327) where thermocouples were attached to the non-fire face of a 1000mm high x 1000mm wide sample of the vertical barrier. The barrier satisfied the mean temperature rise requirement of the test standard for 62 minutes and the maximum temperature rise requirement for 65 minutes.

Access hatch

The construction of the access hatch assembly consists of two robust steel frames, one forming the lower hatch framework and the other the hatch cover. The Tuffa FireStop 60 barrier material is securely fastened to both frames. The size of the hatch is small, having a maximum clear opening of 258mm x 138mm. The hatch cover overlaps the lower hatch frame by 21mm plus twice the thickness of the barrier material on each of the four sides. The hinges and catch hold the cover securely in position, slightly compressing the two layers of barrier material. Some distortion of the steel framework may occur when exposed to fire. However, because of the small size of the hatch and the robust construction, the distortion is expected to be small and not result in the development of any through gaps.

Penetrations

A steel outlet pipe is connected to the tank. Where the pipe passes through the cover a Tuffa FireStop penetration seal is fitted.

The performance of the basic Tuffa FireStop penetration seal system, when subjected to the standard fire resistance test, has been demonstrated in test referenced WARRES No. 69612. In this test, conducted on a 1m x 1m Tuffa FireStop barrier when penetrated by two cable trays and two steel pipes, each pipe service was fitted with an uninsulated Tuffa collar, 300mm-long, on the fire face of the barrier. The collars consisted of the outer glass fabric of the Tuffa FireStop barrier material without the internal insulating layers of needlefelt blanket. The test has demonstrated that the Tuffa FireStop penetration seal system, when fitted to steel pipes passing through the Tuffa FireStop barrier, is able to provide an integrity performance of 60 minutes. It has also shown that the addition of a small copper pipe and a small electrical signal tied to the metal pipe would not adversely affect the fire performance.

The test referenced Beele No. 17-07-07/1 describes the fire resistance test that was conducted on a steel bulkhead clad with Tuffa FireStop 60 barrier material when penetrated by a 160mm-diameter steel pipe. The service was fitted with a Tuffa FireStop 60 penetration seal on the non-fire face of the bulkhead. The test shows that the penetrated seal assembly is able to provide an integrity performance of 60 minutes and an insulation performance of 49 minutes with a 200mm-long collar. The maximum temperature rise limit (+180°C) was not exceeded on the barrier or on the collar during the 60-minute test. However, it was exceeded after 49 minutes on the steel pipe at the end of the collar.

The maximum temperature rise on the tested steel pipe at 60 minutes was 215°C. Therefore, in order to ensure that the maximum temperature rise on the steel pipes does not exceed 180°C for a 60-minute standard fire exposure, the length of the collar fitted to the pipe outside the cover has been extended to 300mm and a collar also fitted to the pipe inside the cover up to the tank. Also the size of pipe fitted to the tanks, maximum 35mm external diameter, is much less than the tested pipe size of 160mm-diameter. Smaller diameter

protected steel pipes usually achieve a longer insulation performance than large steel pipes in the standard fire test. Also the heat conduction down a small copper pipe and a small electrical signal cable would be very small compared to the steel pipe.

Covers

The fire tests have demonstrated that the covers are non-combustible and form a 60-minute fire resisting barrier around the sides, top and underside of the tank.

Conclusions

The Tuffa protective covers enclosing the sides, top and underside of external oil storage tanks for domestic and non-domestic applications, of internal oil storage tanks for domestic applications up to 3500 litres and of internal oil storage tanks for non-domestic applications, as described in the proposals section of this report, are constructed with a non-combustible fire barrier material with a fire resistance of 60 minutes in terms of the integrity and insulation criteria of BS 476: Part 22: 1987 when tested as a vertical or horizontal cavity barrier. The covers therefore enclose the sides, top and underside of the oil storage tank with a non-combustible construction with a fire resistance of 60 minutes, given the requirements and limitations stated in this report.

Validity

This assessment is issued on the basis of test data and information available at the time of issue. If contradictory evidence becomes available to Exova Warringtonfire the assessment will be unconditionally withdrawn and TUFFA UK Ltd will be notified in writing. Similarly the assessment is invalidated if the assessed construction is subsequently tested because actual test data is deemed to take precedence over an expressed opinion. The assessment is valid for a period of five years i.e. until 1st April 2019, after which time it is recommended that it be returned for re-appraisal.

The appraisal is only valid provided that no other modifications are made to the tested construction other than those described in this report.

This report was reviewed on 12th February 2014. It has been confirmed by TUFFA UK Ltd that there have been no changes to the material specifications and methods of construction of the protective covers. The data used for the original appraisal has been re-examined and found to be satisfactory. Since issuing the original report there have been no relevant changes to the fire testing standard upon which the assessment was based, or testing experience, that could affect the opinion expressed. The procedures adopted for the original assessment have also been re-examined and are consistent with those currently in use.

Summary of Primary Supporting Data

Faverdale No. FTCR/96/0057

This report describes a fire resistance test in accordance with BS 476: Part 22: 1987 that was carried out on a vertical Tuffa FireStop 30 cavity barrier assembly for a heating period of 73 minutes. The assembly, 3000mm high x 3000mm wide, comprised Tuffa FireStop 30 barrier material clamped between 0.5mm-thick steel channel and angle sections at the head and sides. Two vertical joints in the material were included in the barrier.

The cavity barrier assembly satisfied the integrity criterion for 67 minutes and the insulation criterion for 17 minutes.

Test date : 26th June 1996

Test sponsor : Another company who has given written permission to TUFFA UK Ltd to use the report.

AFTF No. 080502

This report describes a fire resistance test in accordance with BS 476: Part 22: 1987 that was carried out on a vertical Tuffa FireStop 'E' glass coated fabric cavity barrier assembly for a heating period of 115 minutes. The assembly, 3000mm high x 3000mm wide, comprised a single layer of Tuffa FireStop 'E' glass coated fabric, 0.34mm nominal thickness, clamped between 0.5mm-thick steel channel and angle sections at the head and sides. Two vertical joints in the material were included in the barrier.

The cavity barrier assembly satisfied the integrity criteria of the standard for 113 minutes.

Test date : 29th May 2002

Test sponsor : Another company who has given written permission to TUFFA UK Ltd to use the report.

WF No. 155327

This report describes an indicative fire resistance test adopting the appropriate procedures and performance criteria of BS 476: Part 20: 1987 on a vertical Tuffa FireStop 60 cavity barrier assembly for a heating period of 67 minutes. The assembly, 1000mm high x 1000mm wide, comprised Tuffa FireStop 60 barrier material clamped between 0.5mm-thick steel channel and angle sections on all four edges.

The cavity barrier assembly satisfied the adopted integrity criterion for 67 minutes (no failure) and the insulation criterion for 62 minutes.

Test date : 5th June 2006

Test sponsor : TUFFA UK Ltd.

**WARRES No.
69612**

This report describes a fire resistance test in terms of the adopted integrity and insulation performance criteria of BS 476: Part 22: 1987 that was carried out on a 1m x 1m Tuffa FireStop 30 cavity barrier when penetrated by two cable trays and two steel pipes, for a heating period of 66 minutes. Each service was fitted with an uninsulated Tuffa collar on the fire face of the barrier.

The barrier assembly satisfied the adopted integrity criteria for 66 minutes and the adopted insulation criteria for 15 minutes.

Test date : 10th October 1996

Test sponsor : Another company who has given written permission to TUFFA UK Ltd to use the report.

**Beele No. 17-07-
07/1**

This report describes a fire resistance test adopting the heating conditions and performance criteria of IMO Resolution A.754(18) that was carried out on a vertical steel bulkhead, 1600mm x 1600mm x 6mm thick, protected on the non-fire face with Tuffa FireStop 60 barrier material for a heating period of 60 minutes. The bulkhead was penetrated by a 160mm-diameter steel pipe protected with a Tuffa FireStop 60 penetration seal fitted with a 200mm-long collar on the non-fire side.

The bulkhead assembly satisfied the adopted smoke and flame (integrity) criteria for 60 minutes and the insulation criteria for 60 minutes on the bulkhead and 49 minutes on the pipe penetration.

Test date : 17th July 2007

Test sponsor : Another company who has given written permission to TUFFA UK Ltd to use the report.

**LPC/BRE No. TE
201288**

This report describes a non-combustibility test in accordance with BS 476: Part 4: 1970 on samples of Tuffa FireStop barrier material.

The samples did not exceed the limits imposed by the standard for flaming and temperature rise. The material was therefore deemed to be non-combustible.

Test date : 18th August 2000

Test sponsor : Another company who has given written permission to TUFFA UK Ltd to use the report.

Summary of Secondary Supporting Data

BS 5410-1:1997 British Standard 5410 – Code of practice for oil firing. Part 1: Installations up to 45kW output capacity for space heating and hot water supply purposes. British Standards Institution, 1997.

BS 5410-2:2013 British Standard 5410 – Code of practice for oil firing. Part 2: Installations over 45kW output capacity for space heating, hot water and steam supply services. British Standards Institution, 2013.

Declaration by TUFFA UK Ltd

We the undersigned confirm that we have read and complied with the obligations placed on us by the UK Fire Test Study Group Resolution No. 82: 2001.

We confirm that the component or element of structure, which is the subject of this assessment, has not to our knowledge been subjected to a fire test to the Standard against which the assessment is being made.

We agree to withdraw this assessment from circulation should the component or element of structure be the subject of a fire test to the Standard against which this assessment is being made.

We are not aware of any information that could adversely affect the conclusions of this assessment.

If we subsequently become aware of any such information we agree to cease using the assessment and ask Exova Warringtonfire to withdraw the assessment.

Signed:

For and on behalf of:

Signatories


Responsible Officer R H Earle* - Certification Engineer


Approved A Kearns* - Technical Manager

* For and on behalf of Exova Warringtonfire.

Report first issued: 1 st April 2009

Issue 2 – addition of access hatch – 10th August 2009.

Issue 3 – addition of oil storage tanks within non-domestic buildings and reference to BS 5410-2: 2013 and report reviewed – 12th February 2014.

The assessment report is not valid unless it incorporates the declaration duly signed by the applicant.

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Figure 1 Jointing methods for barrier material

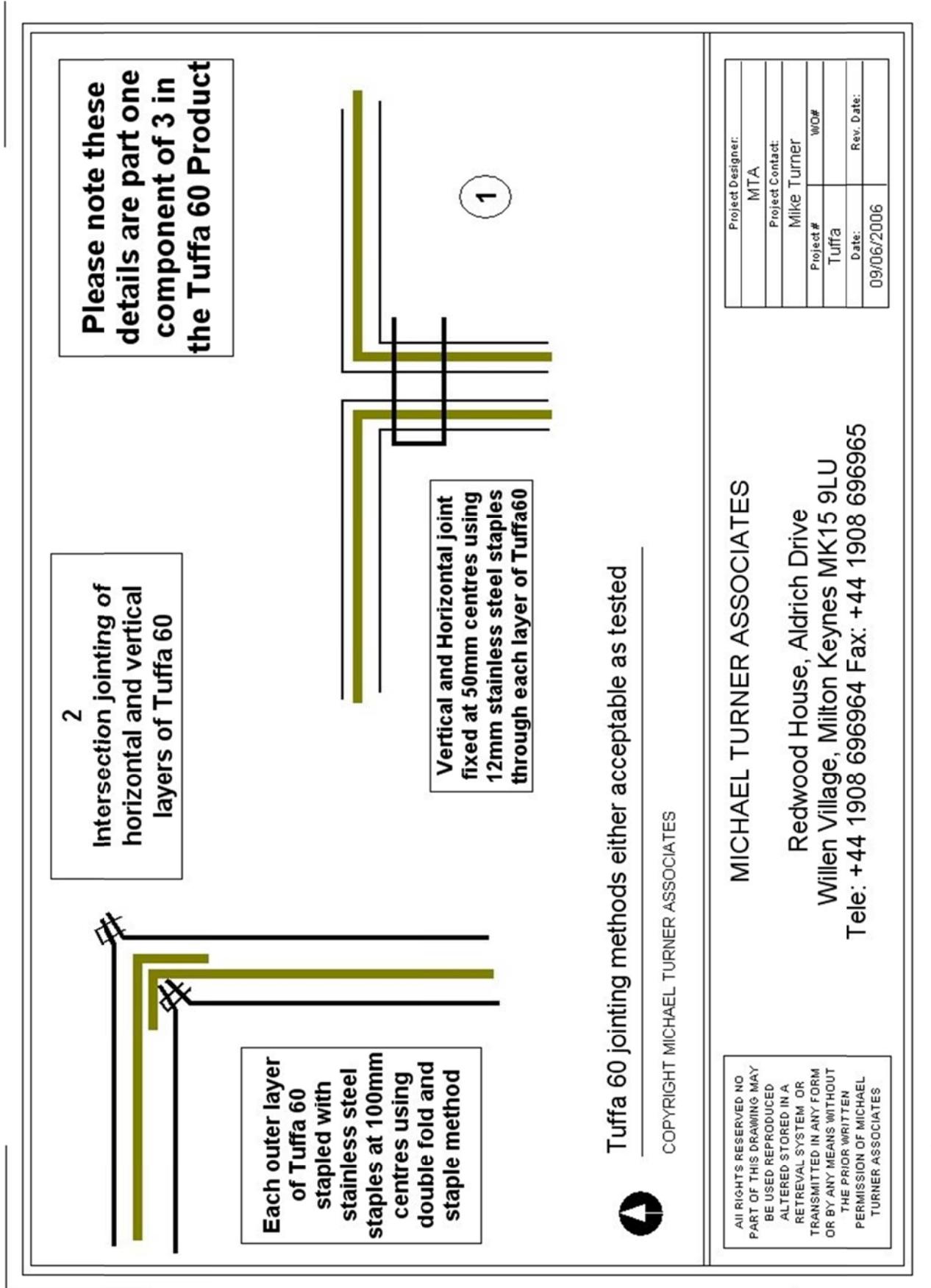


Figure 2 Construction of access hatch

