assessment report

Bodycote

**Title:**

The Fire Resistance Performance of Hollow Section Columns Protected with SprayFilm WB3 Intumescent Coating at 532°C, 550°C, 650°C and 700°C

**WF Assessment Report No:**

144500: Issue 3

**Prepared for:**

**Cafco Europe Group SA (Trading as) Cafco International**

Bluebell Close
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Derbyshire
DE55 4RA

**Date: 25th April 2005**

warringtonfire global safety
TESTING

## TABLE OF CONTENTS

# Executive Summary

**Objective**

To provide an assessment of the ability of a waterborne intumescent coating system known as SprayFilm WB3 to fire protect structural steel hollow column sections for periods of fire resistance up to 120 minutes at critical steel temperatures of 532°C, 550°C, 650°C and 700°C.

**Report Sponsor**

**Cafco Europe Group SA (Trading as) Cafco International**

**Address**

Bluebell Close
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**Summary of Conclusions**

An assessment of the ability of a waterborne intumescent coating system known as SprayFilm WB3 to protect structural steel hollow section columns in accordance with BS 476: Part 21: 1987 for periods up to 120 minutes has been undertaken at critical steel temperatures of 532°C, 550°C, 650°C and 700°C.

The assessment method adopted for this report uses a graphical approach plotting inverse section factor against time to reach a specified steel temperature for a range of protection thicknesses. This method is commonly used in the UK for assessing the ability of reactive intumescent protection systems to fire protect structural steel.

Tables 1 to 4 show the results of the analysis of the data.

**Valid until**

1st April 2010

# Introduction

This report presents an assessment of the ability of a waterborne intumescent coating system known as SprayFilm WB3 to fire protect structural steel hollow sections.

The data, which forms the basis of this assessment, was obtained from tests in accordance BS 476: Part 21: 1987 on loaded steel hollow and I-section columns, a tall hollow-section column and short unloaded steel hollow-section columns, which were subjected to the heating conditions as specified in that standard.

This assessment relates to hollow rectangular and circular column sections protected with SprayFilm WB3 for periods of fire resistance of 30 minutes, 60 minutes, 90 minutes and 120 minutes, at critical steel temperatures of 532°C, 550°C, 650°C and 700°C.

**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

**Steel preparation**

It is assumed that the steel sections will be shot-blast cleaned and primed with a similar paint in a similar manner to that used for the sections tested under the test references given in this report.

**Primer**

This report assumes that nominal thickness of the primer paint will be similar to that for the tested sections.

**Loading**

It is assumed that the loads to be applied to the columns do not exceed the maximum calculated in accordance with BS 5950 for the critical steel temperature being utilised.

# Assessment procedure

**Principles**

Generally the loaded steel sections provide evidence about the adhesive properties of the coating (commonly referred to as 'stickability') and the critical temperatures at which structural instability occurs under standard fire test conditions.

The details of each specimen, i.e. the section factor (the ratio of the heated surface area to the volume of the section – A/V), the protection thickness and duration of heating required for the sections to reach the specified critical steel temperatures are used as data for the analysis.

The fire resistance of a protected steel section can be approximated as follows over a limited range of values:

FR $\alpha$ V/A at a constant protection thickness or

d $\alpha$ A/V at a constant fire resistance period

where;

| | | |
|---|---|---|
| FR | - | Fire resistance (in minutes) |
| A | - | Heated surface area of section |
| V | - | Volume of section |
| d | - | Thickness of protection material (in mm) |

The required thickness of protection for a given steel section for a particular fire resistance period is therefore assessed by means of a graphical plot of inverse section factor (V/A) against the time for the section to reach the critical steel temperature.

The assessment method outlined above is commonly used in the UK for assessing the ability of reactive intumescent protection systems to fire protect structural steel.

# Test Data

**Previous tests and assessments**

This report utilises previous WF assessment reports relating to the performance of SprayFilm WB3 that considered the performance of the product manufactured in the UK and mainland Europe. SprayFilm WB3 is a later version of SprayFilm WB2. WB3 is based on a very similar but improved formulation of WB2.

Assessments of the performance of SprayFilm WB2 for coating thicknesses up to 6mm and fire resistance periods of 30, 60 and 90 minutes have been carried out under references WFRC No. C127143 and WFRC No. 130550. An assessment of the performance of SprayFilm WB3 for coating thicknesses up to 6mm and fire resistance periods of 30, 60, 90 and 120 minutes has been carried out under reference WFRC No. 139822.

The data for a critical steel temperature of 532°C has been taken from assessment report WFRC No. 139822.

**Additional tests**

In order to establish performance results for coating thicknesses up to 6mm and for fire resistance periods up to 120 minutes reference is made to an additional test on an I-section loaded column with a coating thickness of 6.0mm (BRE No. TE 216164). A total of two tests on loaded I-section columns, one loaded test on a hollow column and a test on a tall hollow column have been carried out as well as two tests on short unloaded columns.

The loaded column tests referred to above and in the previous assessment reports demonstrate the ability of the coating to remain attached to the sections at elevated temperatures. The sections were loaded to produce the maximum permissible stress for the steel grade in terms of BS 449: Part 2: 1969.

**Unloaded tests**

Three additional short unloaded columns were tested (columns reference C20 to C22) to gain additional data points at coating thicknesses of 0.25mm and 0.4mm.

The complete data for both Sprayfilm WB2 and WB3 on loaded and unloaded sections is given in Appendix 1.

**Criteria for acceptability**

The following criteria for acceptability have been applied to the analysis to ensure that the predictions are valid:

a) For each short section the predicted time to reach each design temperature shall not exceed the time for the corrected temperature to reach the design temperature by more than 15%.

b) The mean value of all percentage differences in time as calculated in (a) shall be less than zero.

c) A maximum of 30% of individual values of all percentage differences in time as calculated in (a) shall be more than zero.

# Assessed Performance

**General comments**

Experience shows that data from fire resistance tests on steel sections protected with intumescent coatings, when presented graphically as inverse section factor against time to reach a particular steel temperature, tend to show a curved relationship. The data has been interpreted in this way. Where there is some variation in performance at a particular coating thickness, the curve has been drawn in a conservative manner.

**Stickability**

A total of two loaded I-section columns, a loaded SHS column and a tall SHS column protected with SprayFilm WB2 or WB3 have been tested in accordance with BS 476: Part 21. The coating thicknesses ranged from 1.46mm to 6mm. There was no detachment of the char material in any of the tests and the section performance was close to that expected.

Test evidence on a loadbearing hollow column protected with SprayFilm WB3 is not available therefore a conservative and justifiable approach must be adopted. The assessment is considered valid for the following reasons:

- A loaded column protected with SprayFilm WB2 has been tested under reference TE 210952 and it achieved a load bearing capacity of 85 minutes (steel temperature of 532$^{o}$C).

- Typically, the main area of concern associated with 'stickability' of intumescent coatings attached to hollow section columns is slumping of the material and splitting of the coating in areas of tight radii e.g. at the corners of a square section. Neither of these factors is related to the loading of the column.

- In essence these factors may be assessed using a tall unloaded column instead of a fully loaded one. This principle has been adopted in the voluntary European test and assessment procedure ENV 13381-4:2002.

- The tests included a tall rectangular hollow section with the nominal maximum thickness of SprayFilm WB3 and no loss, slumping or splitting of material was observed for a period of at least 170 minutes. Therefore confidence may be expressed in the ability of SprayFilm WB3 remaining attached to hollows sections for the maximum required period of 120 minutes.

- To reinforce this, reference is also made to the I-section column tested under reference TE 216164. This was coated with a 6mm thickness of SprayFilm WB3 and maintained loadbearing capacity for a period of 110 minutes. Current UK principles of assessment allow for an extrapolation in time of approximately 10% provided there is no significant detachment of the protection material on a loaded section. On the basis of the achieved performance of the loaded column being within 10% of 120 minutes it is considered acceptable to develop specifications for this period.

The tall column has shown no problem regarding slumping of the coating, nor significant detachment nor significant splitting of the char and therefore the maximum thickness for columns is associated with the maximum applied to the tall hollow section as tested i.e. in the region of 6.0mm.

**CHS columns**

Experience shows that intumescent coatings generally perform better on circular hollow sections compared with rectangular sections due to the effect of the tight radius of curvature at the corners. These tight corners can cause stress in the char as it expands in two directions. For circular sections the stress in the expanding char is more even, therefore the analysis is considered to be appropriate to both circular and rectangular sections.

It can be seen from the graphs in Figures 1 to 4 that there are a number of issues that are worthy of further discussion. These are considered as follows:

- The loaded column with 3.07mm of SprayFilm WB2 showed a lower performance compared with the sections coated with nominally 2.55mm of SprayFilm WB3, indicating the improved performance of the later version.

- The section with 2.473mm of material does not fit with the line drawn for a nominal thickness of 2.5mm. The data point shows a much better result than suggested by this line and has therefore been ignored in the analysis.

- There is a 'cluster' of data points for columns at higher section factors and thicknesses particularly at nominally 3.51mm and 4.7mm. There are only two data points for 4.7mm thickness and one was well below the anticipated performance. However there is good alignment between the majority of the data points at both 3.51mm and 6.0mm. Therefore the intercept associated with 4.7mm thickness has been omitted from the analysis.

- In Figure 1 at a steel temperature of 532°C, a small extrapolation in time for column reference C13 from 87 minutes to 90 minutes has been carried out to provide an intercept at 90 minutes for a nominal protection thickness of 1.8mm.

**Intercepts at 532°C**

From the graph in Figure 1 the following intercepts are considered appropriate:

| Coating thickness - mm | Section factor ($m^{-1}$) at: | | | |
|---|---|---|---|---|
| | 30 minutes | 60 minutes | 90 minutes | 120 minutes |
| 0.25 | 91 | | | |
| 0.4 | 152 | 47 | | |
| 0.6 | 345 | 92 | - | - |
| 1.0 | - | 120 | - | - |
| 1.8 | - | 244 | 60 | - |
| 2.5 | - | 286 | 95 | - |
| 3.5 | - | 357 | 185 | 98 |
| 6.0 | - | - | 270 | 135 |

The results of the analysis for beams at a critical steel temperature of 532°C are given in Table 1. The table also includes intermediate values for section factor and thickness obtained by linear interpolation. Where the section factor derived by the intercept is greater than the appropriate maximum of 320$m^{-1}$

this limiting section factor has been adopted.

**Intercepts at 550°C**

From the graph in Figure 2 the following intercepts are considered appropriate:

| Coating thickness - mm | Section factor ($m^{-1}$) at: | | | |
|---|---|---|---|---|
| | 30 minutes | 60 minutes | 90 minutes | 120 minutes |
| 0.25 | 97 | | | |
| 0.4 | 175 | 50 | | |
| 0.6 | 385 | 95 | - | - |
| 1.0 | - | 128 | - | - |
| 1.8 | - | 294 | 70 | - |
| 2.5 | - | 370 | 96 | - |
| 3.5 | - | - | 192 | 102 |
| 6.0 | - | - | 294 | 147 |

The results of the analysis for beams at a critical steel temperature of 550°C are given in Table 2. The table also includes intermediate values for section factor and thickness obtained by linear interpolation. Where the section factor derived by the intercept is greater than the appropriate maximum of 320$m^{-1}$ this limiting section factor has been adopted.

**Intercepts at 650°C**

From the graphs in Figures 3 and 3a the following intercepts are considered appropriate:

| Coating thickness - mm | Section factor ($m^{-1}$) at: | | | |
|---|---|---|---|---|
| | 30 minutes | 60 minutes | 90 minutes | 120 minutes |
| 0.25 | 133 | 54 | | |
| 0.4 | 270 | 70 | | |
| 0.6 | >400 | 143 | 70 | - |
| 1.0 | - | 213 | 83 | - |
| 1.8 | - | 400 | 119 | - |
| 2.5 | - | - | 175 | 79 |
| 3.5 | - | - | 238 | 133 |
| 6.0 | - | - | 370 | 204 |

The results of the analysis for columns at a critical steel temperature of 650°C are given in Table 3. The table also includes intermediate values for section factor and thickness obtained by linear interpolation. Where the section factor derived by the intercept is greater than the appropriate maximum of 320$m^{-1}$ this limiting section factor has been adopted.

**Intercepts at 700°C**

From the graphs in Figures 4 and 4a the following intercepts are considered appropriate:

| Coating thickness - mm | Section factor ($m^{-1}$) at: | | | |
|---|---|---|---|---|
| | 30 minutes | 60 minutes | 90 minutes | 120 minutes |
| 0.25 | 156 | 63 | | |
| 0.4 | 303 | 93 | | |
| 0.6 | 769 | 189 | 88 | - |
| 1.0 | - | 286 | 108 | - |
| 1.8 | - | 435 | 169 | 74 |
| 2.5 | - | - | 233 | 104 |
| 3.5 | - | - | 294 | 161 |
| 6.0 | - | - | 400 | 238 |

The results of the analysis for beams at a critical steel temperature of 700°C are given in Table 4. The table also includes intermediate values for section factor and thickness obtained by linear interpolation. Where the section factor derived by the intercept is greater than the appropriate maximum of 320$m^{-1}$ this limiting section factor has been adopted.

In each of the above graphical evaluations there was some scatter of the data points. Because of this the curves for each coating thickness were positioned conservatively, taking the overall spread of the data points into consideration as well as the specific points for each thickness. The loaded section data were included in each evaluation.

**Criteria for acceptability**

The column protected with SprayFilm WB2 under reference TE 210952 has been excluded from the criteria for acceptability analysis for the reasons stated earlier in this report. All other data points were included in the analysis and complied with the criteria.

# Conclusions

An assessment of the ability of a waterborne intumescent coating system known as SprayFilm WB3 to protect structural steel hollow section columns in accordance with BS 476: Part 21: 1987 for periods of fire resistance of 30 minutes, 60 minutes, 90 minutes and 120 minutes has been undertaken at critical steel temperatures of 532°C, 550°C, 650°C and 700°C.

The assessment method adopted for this report uses a graphical approach plotting inverse section factor against time to reach the specified steel temperatures for a range of protection thicknesses. This method is commonly used in the UK for assessing the ability of reactive intumescent protection systems to fire protect structural steel.

Tables 1 to 4 show the results of the analysis of the data. The analysis has been checked against the criteria for acceptability.

# 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 **Bodycote warringtonfire** the assessment will be unconditionally withdrawn and Cafco Europe Group SA 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 initially for a period of five years i.e. until 1st April 2010, 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.

# Summary of Supporting Data

**BRE No. TE 201952**

A report on a fire resistance test in accordance with BS 476: Part 21: 1987, Clause 6 performed on a specimen of a SHS steel column of serial size 200mm x 200mm x 10mm wall thickness. The steel column was protected on four sides with an intumescent coating system known as SprayFilm WB2.

The coating system comprised primer paint and the intumescent coating. Prior to the application of the coating system the column was grit blast cleaned to Swedish Standard SA 2.5. The mean total dry film thickness of the intumescent coating was 3.07mm and the column was loaded to produce the maximum allowable compressive stress calculated in accordance with BS 449: Part 2: 1969.

The specimen satisfied the performance criteria for loadbearing capacity defined in BS 476: Part 21: 1987 for a period of 85 minutes.

Test date : 3rd March 2001

Test sponsor : Cafco International

**BRE No. TE 208420**

A report on a fire resistance test in accordance with BS 476: Part 21: 1987, Clause 6 performed on a specimen of an I-shaped steel column of serial size 203mm x 203mm x 52kg/m. The steel column was protected on four sides with an intumescent coating system known as SprayFilm WB2.

The coating system comprised primer paint and the intumescent coating. Prior to the application of the coating system the column was grit blast cleaned to Swedish Standard SA 2.5. The mean total dry film thickness of the intumescent coating was 1.458mm and the column was loaded to produce the maximum allowable compressive stress calculated in accordance with BS 449: Part 2: 1969.

The specimen satisfied the performance criteria for loadbearing capacity defined in BS 476: Part 21: 1987 for a period of 83 minutes.

Test date : 30th May 2002

Test sponsor : Cafco International

**WARRES No. 131765**

A report on a fire test to the furnace heating conditions of BS 476: Part 20: 1987, performed on a number of short unloaded columns protected with an intumescent coating system known as SprayFilm WB3. The coating system comprised primer paint and the intumescent coating. Prior to the application of the coating system the sections were grit blast cleaned to Swedish Standard SA 2.5.

Test date : 3rd June 2003

Test sponsor : Cafco International

**WARRES No. 131766**

A report on a fire test to the furnace heating conditions of BS 476: Part 20: 1987, performed on a number of short unloaded columns protected with an intumescent coating system known as SprayFilm WB3. The coating system comprised primer paint and the intumescent coating. Prior to the application of the coating system the sections were grit blast cleaned to Swedish Standard SA 2.5.

Test date : 6th June 2003

Test sponsor : Cafco International

**BRE No. TE 216164**

A report on a fire resistance test in accordance with BS 476: Part 21: 1987, Clause 6 performed on a specimen of an I-shaped steel column of serial size 152mm x 152mm x 30kg/m. The steel column was protected on four sides with an intumescent coating system known as SprayFilm WB3.

The coating system comprised primer paint and the intumescent coating. Prior to the application of the coating system the column was grit blast cleaned to Swedish Standard SA 2.5. The mean total dry film thickness of the intumescent coating was 6.04mm and the column was loaded to produce the maximum allowable compressive stress calculated in accordance with BS 449: Part 2: 1969.

The specimen satisfied the performance criteria for loadbearing capacity defined in BS 476: Part 21: 1987 for a period of 110 minutes.

Test date : 5th May 2004

Test sponsor : Cafco International

# Summary of Secondary Supporting Data

**WFRC No. C139822**

Assessment report covering the ability of SprayFilm WB3 intumescent coating to fire protect structural steel hollow section columns in terms of BS 476: Part 21: 1987 for periods up to 120 minutes and coating thicknesses up to 6mm.

Report date : June 2004

Report sponsor : Cafco International

**WFRC No. C127143**

Assessment report covering the ability of SprayFilm WB2 intumescent coating to fire protect structural steel I-sections and hollow sections in terms of BS 476: Part 21: 1987.

Report date : 30th September 2002

Report sponsor : Cafco International

**WFRC No. 133413**

Assessment report covering the ability of SprayFilm WB3 intumescent coating to fire protect structural steel hollow sections in terms of BS 476: Part 21: 1987.

Report date : 10th July 2003

Report sponsor : Cafco International

**ENV 13381-4: 2002**

Test methods for determining the contribution to the fire resistance of structural members – Part 4: Applied protection to steel members.

# Declaration by Cafco Europe Group SA

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 **Bodycote warrington**fire to withdraw the assessment.

Signed:

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For and on behalf of:

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# Signatories

Responsible Officer

R H Earle* - Technical Consultant

Approved

P W Crewe* - Senior Technical Consultant

* For and on behalf of **Bodycote warrington**fire.

Issue 2 – includes extra data at 0.25mm and 0.4mm coating thickness. The analysis was also checked using the criteria for acceptability.

Issue 3 – includes a critical steel temperature of 550°C (19th December 2006).

Report Issued:25th April 2005

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

***Figure 1 Graph of time v's inverse section factor at 532°C with additional data***

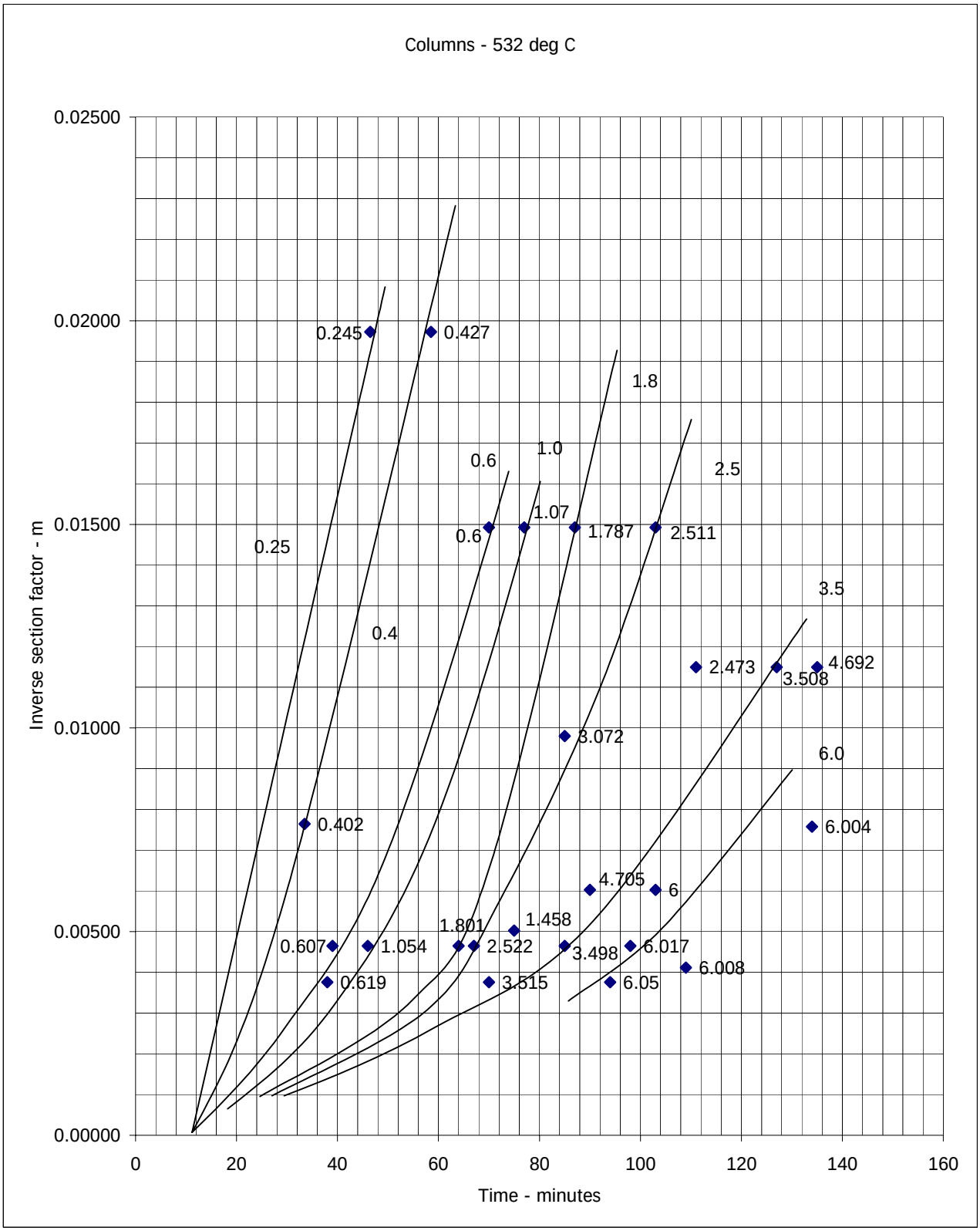


***Figure 2 Graph of time v's inverse section factor at 550°C with additional data***

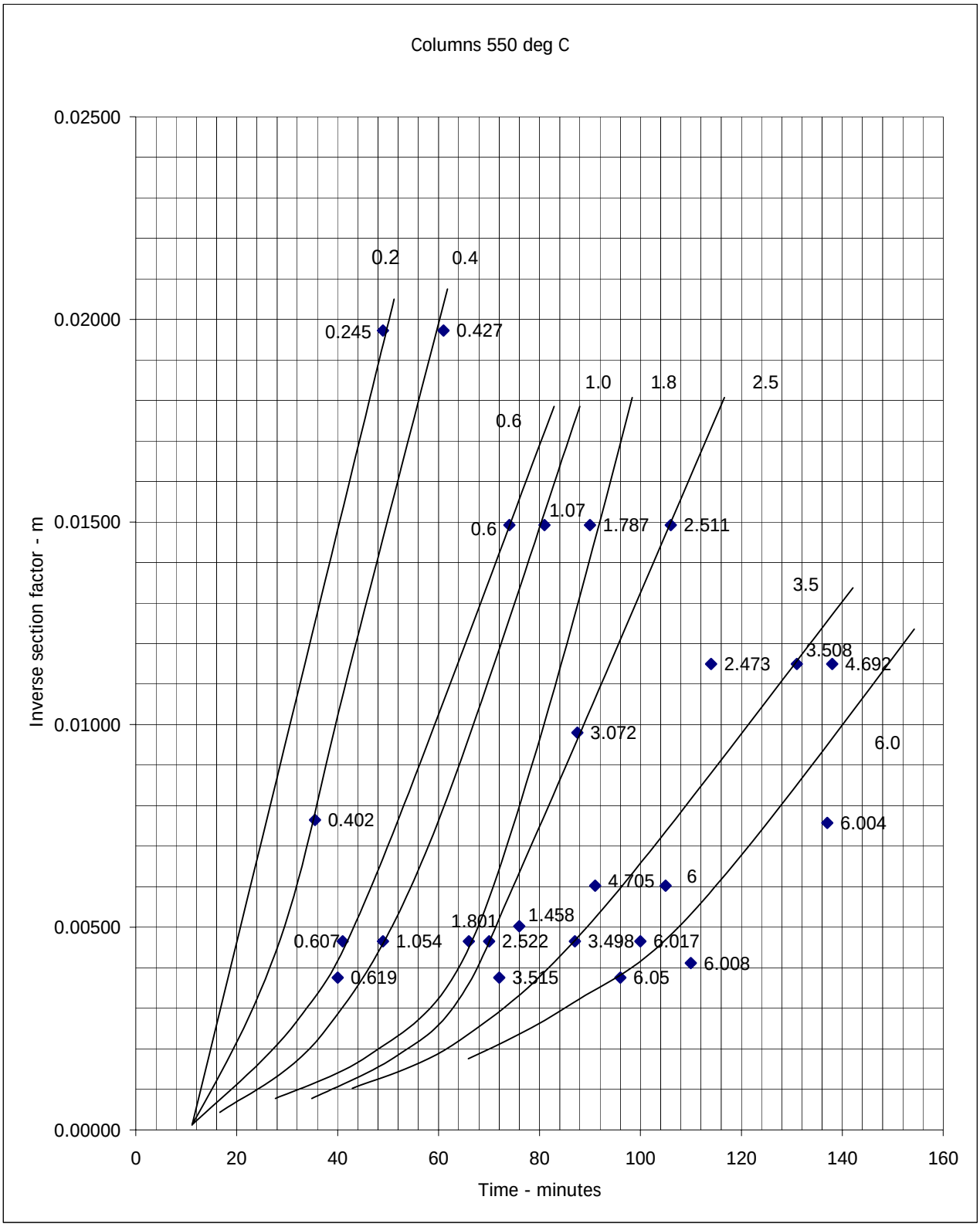


***Figure 3 Graph of time v's inverse section factor at 650°C***

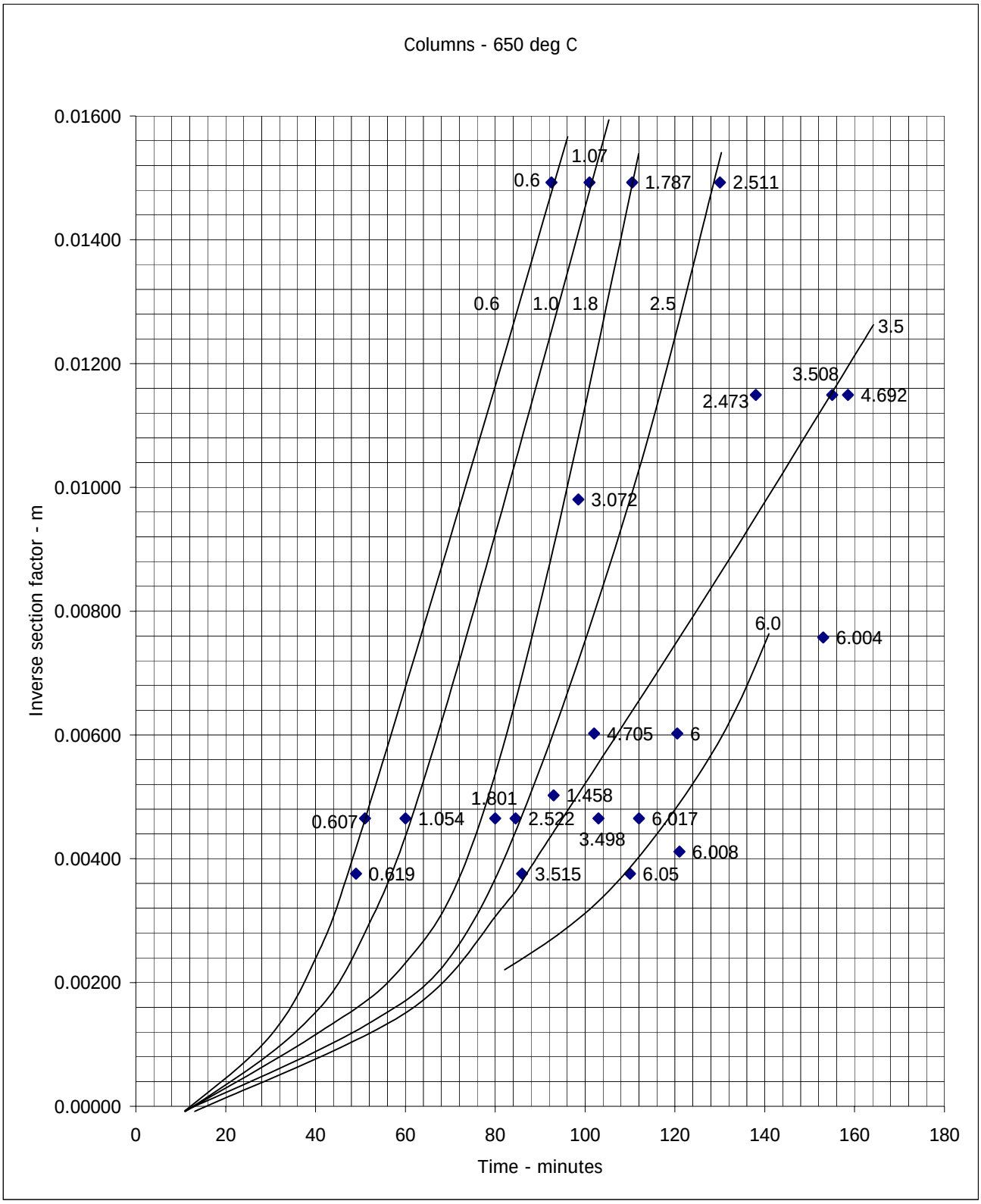


***Figure 3a Additional data at 650°C***

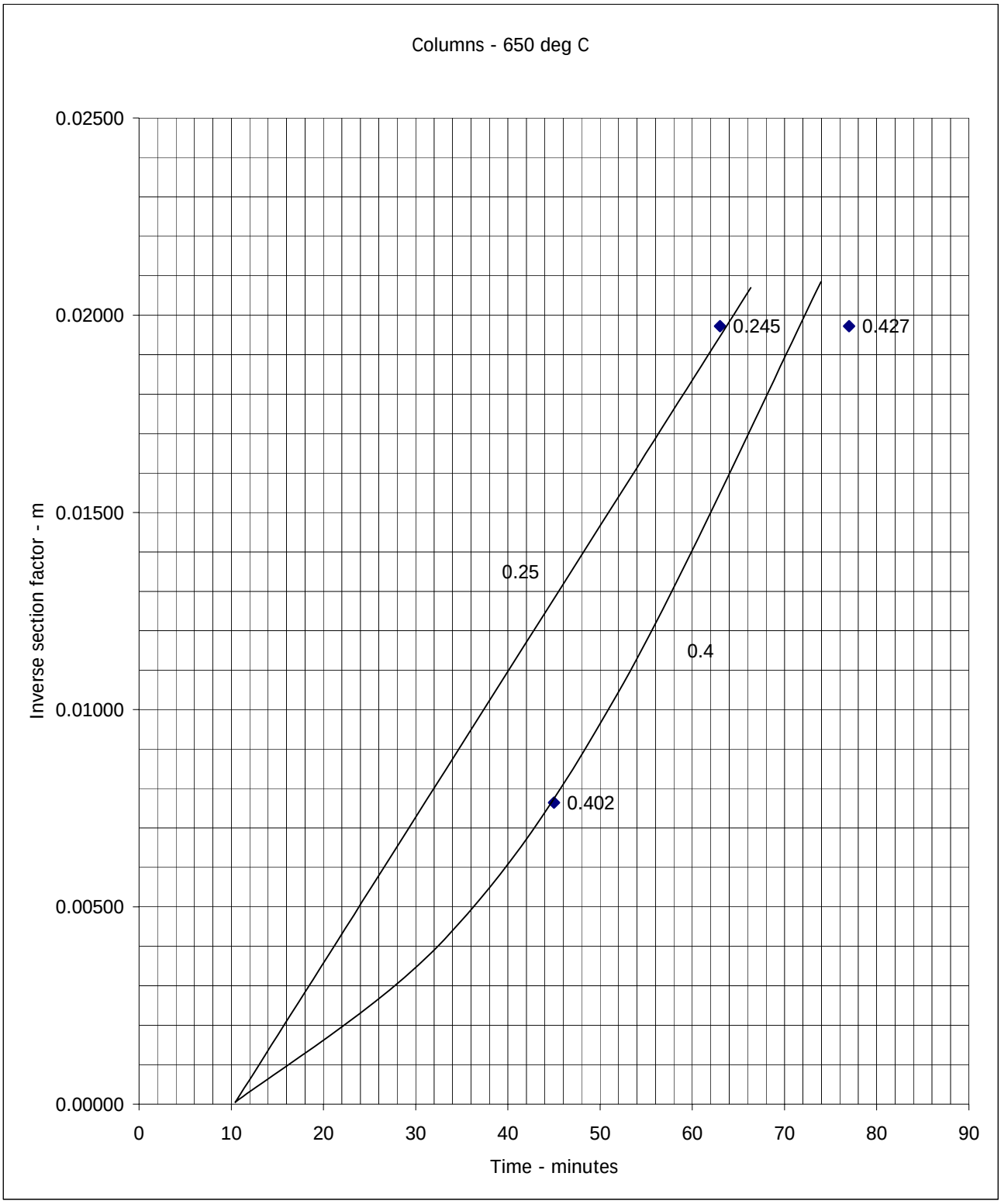


***Figure 4 Graph of time v's inverse section factor at 700°C***

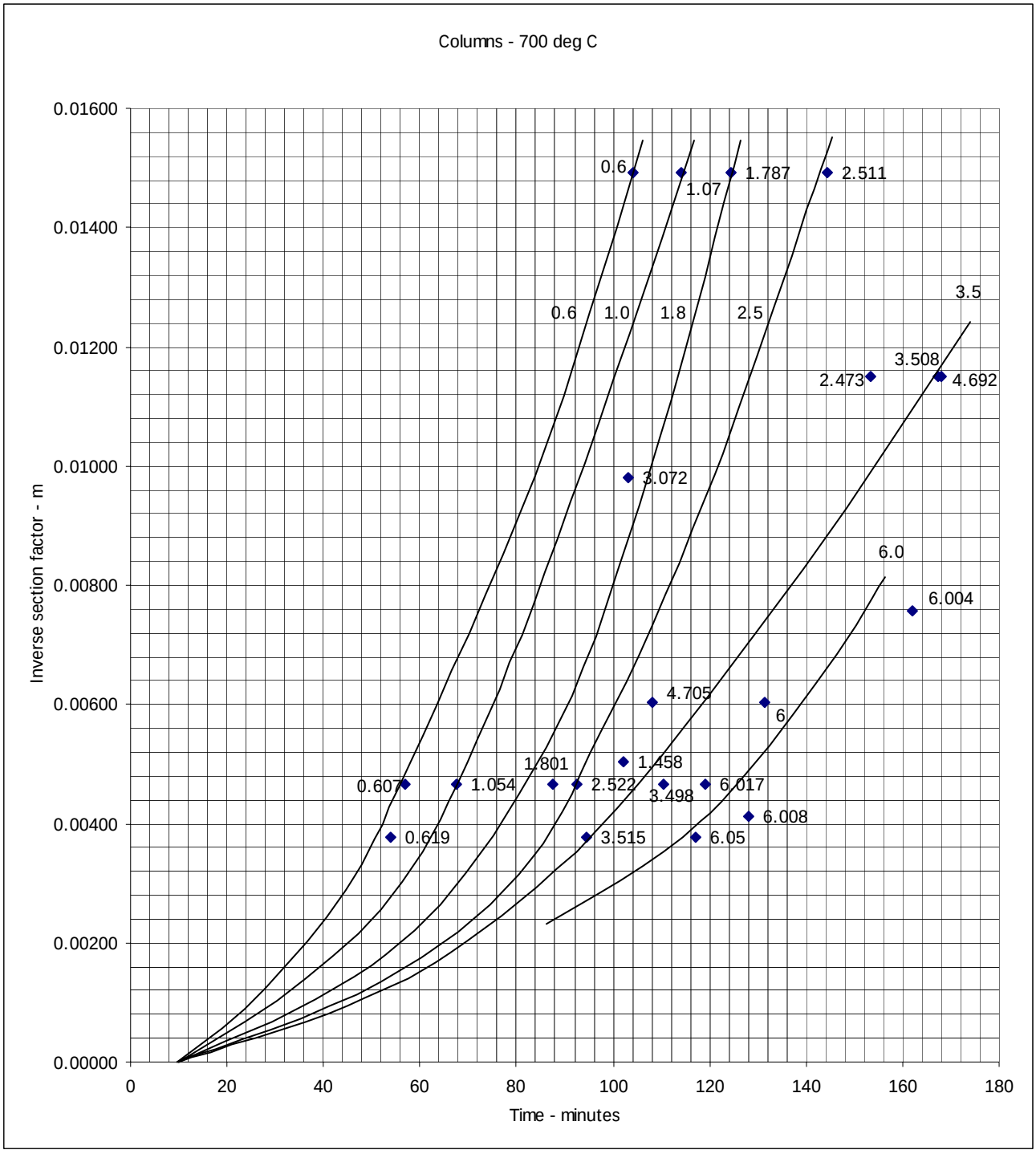
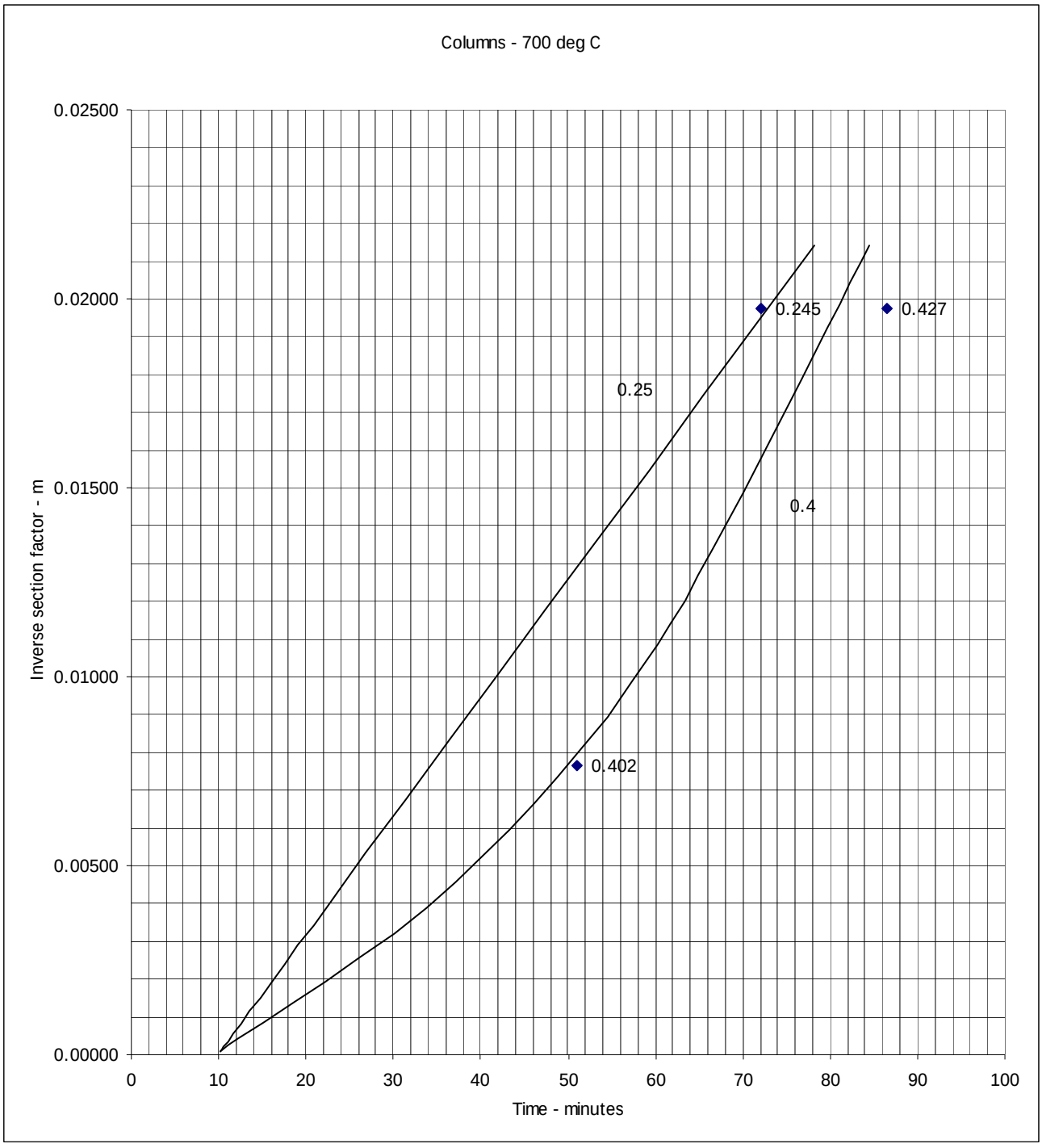


***Figure 4a Additional data at 700°C***



## *Performance Tables 1 to 4*

**Table 1 Hollow section columns at 532°C critical temperature**

| Section factor – $m^{-1}$ | Coating thickness - mm | | | |
|---|---|---|---|---|
| | 30 minutes | 60 minutes | 90 minutes | 120 minutes |
| | | | | |
| 40 | 0.23 | 0.40 | 1.80 | 3.50 |
| 45 | 0.23 | 0.40 | 1.80 | 3.50 |
| 50 | 0.23 | 0.41 | 1.80 | 3.50 |
| 55 | 0.23 | 0.44 | 1.80 | 3.50 |
| 60 | 0.23 | 0.46 | 1.80 | 3.50 |
| 65 | 0.23 | 0.48 | 1.90 | 3.50 |
| 70 | 0.23 | 0.50 | 2.00 | 3.50 |
| 75 | 0.24 | 0.52 | 2.10 | 3.50 |
| 80 | 0.24 | 0.55 | 2.20 | 3.50 |
| 85 | 0.25 | 0.57 | 2.30 | 3.50 |
| 90 | 0.25 | 0.59 | 2.40 | 3.50 |
| 95 | 0.26 | 0.64 | 2.50 | 3.50 |
| 100 | 0.27 | 0.71 | 2.56 | 3.64 |
| 105 | 0.28 | 0.79 | 2.61 | 3.97 |
| 110 | 0.30 | 0.86 | 2.67 | 4.31 |
| 115 | 0.31 | 0.93 | 2.72 | 4.65 |
| 120 | 0.32 | 1.00 | 2.78 | 4.99 |
| 125 | 0.33 | 1.03 | 2.83 | 5.32 |
| 130 | 0.35 | 1.06 | 2.89 | 5.66 |
| 135 | 0.36 | 1.10 | 2.94 | 6.00 |
| 140 | 0.37 | 1.13 | 3.00 | 6.34 |
| 145 | 0.38 | 1.16 | 3.06 | - |
| 150 | 0.40 | 1.19 | 3.11 | - |
| 155 | 0.40 | 1.23 | 3.17 | - |
| 160 | 0.41 | 1.26 | 3.22 | - |
| 165 | 0.41 | 1.29 | 3.28 | - |
| 170 | 0.42 | 1.32 | 3.33 | - |
| 175 | 0.42 | 1.35 | 3.39 | - |
| 180 | 0.43 | 1.39 | 3.44 | - |
| 185 | 0.43 | 1.42 | 3.50 | - |
| 190 | 0.44 | 1.45 | 3.65 | - |
| 195 | 0.44 | 1.48 | 3.79 | - |
| 200 | 0.45 | 1.52 | 3.94 | - |

**Table 1 continued**

| Section factor – $m^{-1}$ | Coating thickness - mm | | | |
|---|---|---|---|---|
| | 30 minutes | 60 minutes | 90 minutes | 120 minutes |
| 205 | 0.45 | 1.55 | 4.09 | - |
| 210 | 0.46 | 1.58 | 4.24 | - |
| 215 | 0.47 | 1.61 | 4.38 | - |
| 220 | 0.47 | 1.65 | 4.53 | - |
| 225 | 0.48 | 1.68 | 4.68 | - |
| 230 | 0.48 | 1.71 | 4.82 | - |
| 235 | 0.49 | 1.74 | 4.97 | - |
| 240 | 0.49 | 1.77 | 5.12 | - |
| 245 | 0.50 | 1.81 | 5.26 | - |
| 250 | 0.50 | 1.90 | 5.41 | - |
| 255 | 0.51 | 1.98 | 5.56 | - |
| 260 | 0.51 | 2.07 | 5.71 | - |
| 265 | 0.52 | 2.15 | 5.85 | - |
| 270 | 0.52 | 2.23 | 6.00 | - |
| 275 | 0.53 | 2.32 | 6.15 | - |
| 280 | 0.53 | 2.40 | 6.29 | - |
| 285 | 0.54 | 2.48 | 6.44 | - |
| 290 | 0.54 | 2.56 | 6.59 | - |
| 295 | 0.55 | 2.63 | - | - |
| 300 | 0.55 | 2.70 | - | - |
| 305 | 0.56 | 2.77 | - | - |
| 310 | 0.56 | 2.84 | - | - |
| 315 | 0.57 | 2.91 | - | - |
| 320 | 0.57 | 2.98 | - | - |

**Table 2 Hollow section columns at 550°C critical temperature**

| Section factor – $m^{-1}$ | Coating thickness - mm | | | |
|---|---|---|---|---|
| | 30 minutes | 60 minutes | 90 minutes | 120 minutes |
| | | | | |
| 40 | 0.23 | 0.40 | 1.80 | 3.50 |
| 45 | 0.23 | 0.40 | 1.80 | 3.50 |
| 50 | 0.23 | 0.40 | 1.80 | 3.50 |
| 55 | 0.23 | 0.42 | 1.80 | 3.50 |
| 60 | 0.23 | 0.44 | 1.80 | 3.50 |
| 65 | 0.23 | 0.47 | 1.80 | 3.50 |
| 70 | 0.23 | 0.49 | 1.80 | 3.50 |
| 75 | 0.24 | 0.51 | 1.93 | 3.50 |
| 80 | 0.24 | 0.53 | 2.07 | 3.50 |
| 85 | 0.25 | 0.56 | 2.20 | 3.50 |
| 90 | 0.25 | 0.58 | 2.34 | 3.50 |
| 95 | 0.25 | 0.60 | 2.47 | 3.50 |
| 100 | 0.26 | 0.66 | 2.54 | 3.50 |
| 105 | 0.27 | 0.72 | 2.59 | 3.67 |
| 110 | 0.28 | 0.78 | 2.65 | 3.94 |
| 115 | 0.28 | 0.84 | 2.70 | 4.22 |
| 120 | 0.29 | 0.90 | 2.75 | 4.50 |
| 125 | 0.30 | 0.96 | 2.80 | 4.78 |
| 130 | 0.31 | 1.02 | 2.85 | 5.06 |
| 135 | 0.32 | 1.03 | 2.91 | 5.33 |
| 140 | 0.33 | 1.06 | 2.96 | 5.61 |
| 145 | 0.34 | 1.08 | 3.01 | 5.89 |
| 150 | 0.35 | 1.11 | 3.06 | 6.17 |
| 155 | 0.36 | 1.13 | 3.11 | 6.44 |
| 160 | 0.37 | 1.15 | 3.17 | - |
| 165 | 0.38 | 1.18 | 3.22 | - |
| 170 | 0.39 | 1.20 | 3.27 | - |
| 175 | 0.40 | 1.23 | 3.32 | - |
| 180 | 0.40 | 1.25 | 3.38 | - |
| 185 | 0.41 | 1.27 | 3.43 | - |
| 190 | 0.41 | 1.30 | 3.48 | - |
| 195 | 0.42 | 1.32 | 3.57 | - |
| 200 | 0.42 | 1.35 | 3.70 | - |

**Table 2 continued**

| Section factor – $m^{-1}$ | Coating thickness - mm | | | |
|---|---|---|---|---|
| | 30 minutes | 60 minutes | 90 minutes | 120 minutes |
| 205 | 0.43 | 1.37 | 3.82 | - |
| 210 | 0.43 | 1.40 | 3.94 | - |
| 215 | 0.44 | 1.42 | 4.06 | - |
| 220 | 0.44 | 1.44 | 4.19 | - |
| 225 | 0.45 | 1.47 | 4.31 | - |
| 230 | 0.45 | 1.49 | 4.43 | - |
| 235 | 0.46 | 1.52 | 4.55 | - |
| 240 | 0.46 | 1.54 | 4.68 | - |
| 245 | 0.47 | 1.56 | 4.80 | - |
| 250 | 0.47 | 1.59 | 4.92 | - |
| 255 | 0.48 | 1.61 | 5.04 | - |
| 260 | 0.48 | 1.64 | 5.17 | - |
| 265 | 0.49 | 1.66 | 5.29 | - |
| 270 | 0.49 | 1.68 | 5.41 | - |
| 275 | 0.50 | 1.71 | 5.53 | - |
| 280 | 0.50 | 1.73 | 5.66 | - |
| 285 | 0.50 | 1.76 | 5.78 | - |
| 290 | 0.51 | 1.78 | 5.90 | - |
| 295 | 0.51 | 1.80 | 6.02 | - |
| 300 | 0.52 | 1.86 | 6.15 | - |
| 305 | 0.52 | 1.90 | 6.27 | - |
| 310 | 0.53 | 1.95 | 6.39 | - |
| 315 | 0.53 | 1.99 | 6.51 | - |
| 320 | 0.54 | 2.04 | - | - |

**Table 3 Hollow section columns at 650°C critical temperature**

| Section factor – $m^{-1}$ | Coating thickness - mm | | | |
|---|---|---|---|---|
| | 30 minutes | 60 minutes | 90 minutes | 120 minutes |
| | | | | |
| 40 | 0.23 | 0.25 | 0.60 | 2.50 |
| 45 | 0.23 | 0.25 | 0.60 | 2.50 |
| 50 | 0.23 | 0.25 | 0.60 | 2.50 |
| 55 | 0.23 | 0.26 | 0.60 | 2.50 |
| 60 | 0.23 | 0.31 | 0.60 | 2.50 |
| 65 | 0.23 | 0.35 | 0.60 | 2.50 |
| 70 | 0.23 | 0.40 | 0.60 | 2.50 |
| 75 | 0.23 | 0.41 | 0.75 | 2.50 |
| 80 | 0.23 | 0.43 | 0.91 | 2.52 |
| 85 | 0.23 | 0.44 | 1.06 | 2.61 |
| 90 | 0.23 | 0.45 | 1.16 | 2.70 |
| 95 | 0.23 | 0.47 | 1.27 | 2.80 |
| 100 | 0.24 | 0.48 | 1.38 | 2.89 |
| 105 | 0.24 | 0.50 | 1.49 | 2.98 |
| 110 | 0.24 | 0.51 | 1.60 | 3.07 |
| 115 | 0.24 | 0.52 | 1.71 | 3.17 |
| 120 | 0.24 | 0.54 | 1.82 | 3.26 |
| 125 | 0.25 | 0.55 | 1.88 | 3.35 |
| 130 | 0.25 | 0.56 | 1.94 | 3.44 |
| 135 | 0.25 | 0.58 | 2.00 | 3.54 |
| 140 | 0.26 | 0.59 | 2.06 | 3.75 |
| 145 | 0.26 | 0.61 | 2.13 | 3.92 |
| 150 | 0.27 | 0.64 | 2.19 | 4.10 |
| 155 | 0.27 | 0.67 | 2.25 | 4.27 |
| 160 | 0.28 | 0.70 | 2.31 | 4.45 |
| 165 | 0.29 | 0.73 | 2.38 | 4.63 |
| 170 | 0.29 | 0.75 | 2.44 | 4.80 |
| 175 | 0.30 | 0.78 | 2.50 | 4.98 |
| 180 | 0.30 | 0.81 | 2.58 | 5.15 |
| 185 | 0.31 | 0.84 | 2.66 | 5.33 |
| 190 | 0.31 | 0.87 | 2.74 | 5.51 |
| 195 | 0.32 | 0.90 | 2.82 | 5.68 |
| 200 | 0.32 | 0.93 | 2.90 | 5.86 |

**Table 3 continued**

| Section factor – $m^{-1}$ | Coating thickness - mm | | | |
|---|---|---|---|---|
| | 30 minutes | 60 minutes | 90 minutes | 120 minutes |
| 205 | 0.33 | 0.95 | 2.98 | 6.04 |
| 210 | 0.33 | 0.98 | 3.06 | 6.21 |
| 215 | 0.34 | 1.01 | 3.13 | 6.39 |
| 220 | 0.35 | 1.03 | 3.21 | 6.56 |
| 225 | 0.35 | 1.05 | 3.29 | - |
| 230 | 0.36 | 1.07 | 3.37 | - |
| 235 | 0.36 | 1.09 | 3.45 | - |
| 240 | 0.37 | 1.12 | 3.53 | - |
| 245 | 0.37 | 1.14 | 3.63 | - |
| 250 | 0.38 | 1.16 | 3.73 | - |
| 255 | 0.38 | 1.18 | 3.82 | - |
| 260 | 0.39 | 1.20 | 3.92 | - |
| 265 | 0.39 | 1.22 | 4.01 | - |
| 270 | 0.40 | 1.24 | 4.11 | - |
| 275 | 0.40 | 1.27 | 4.20 | - |
| 280 | 0.40 | 1.29 | 4.30 | - |
| 285 | 0.41 | 1.31 | 4.39 | - |
| 290 | 0.41 | 1.33 | 4.48 | - |
| 295 | 0.41 | 1.35 | 4.58 | - |
| 300 | 0.41 | 1.37 | 4.67 | - |
| 305 | 0.41 | 1.39 | 4.77 | - |
| 310 | 0.42 | 1.41 | 4.86 | - |
| 315 | 0.42 | 1.44 | 4.96 | - |
| 320 | 0.42 | 1.46 | 5.05 | - |

**Table 4 Hollow section columns at 700°C critical temperature**

| Section factor – $m^{-1}$ | Coating thickness - mm | | | |
|---|---|---|---|---|
| | 30 minutes | 60 minutes | 90 minutes | 120 minutes |
| | | | | |
| 40 | 0.23 | 0.25 | 0.50 | 1.80 |
| 45 | 0.23 | 0.25 | 0.51 | 1.80 |
| 50 | 0.23 | 0.25 | 0.52 | 1.80 |
| 55 | 0.23 | 0.25 | 0.53 | 1.80 |
| 60 | 0.23 | 0.25 | 0.54 | 1.80 |
| 65 | 0.23 | 0.25 | 0.55 | 1.80 |
| 70 | 0.23 | 0.29 | 0.56 | 1.80 |
| 75 | 0.23 | 0.31 | 0.57 | 1.82 |
| 80 | 0.23 | 0.34 | 0.59 | 1.94 |
| 85 | 0.23 | 0.36 | 0.60 | 2.06 |
| 90 | 0.23 | 0.39 | 0.64 | 2.17 |
| 95 | 0.23 | 0.41 | 0.74 | 2.29 |
| 100 | 0.23 | 0.41 | 0.84 | 2.41 |
| 105 | 0.23 | 0.43 | 0.94 | 2.52 |
| 110 | 0.23 | 0.44 | 1.03 | 2.61 |
| 115 | 0.23 | 0.45 | 1.09 | 2.69 |
| 120 | 0.24 | 0.46 | 1.16 | 2.78 |
| 125 | 0.24 | 0.47 | 1.22 | 2.87 |
| 130 | 0.24 | 0.48 | 1.29 | 2.96 |
| 135 | 0.24 | 0.49 | 1.35 | 3.04 |
| 140 | 0.25 | 0.50 | 1.42 | 3.13 |
| 145 | 0.25 | 0.51 | 1.49 | 3.22 |
| 150 | 0.25 | 0.52 | 1.55 | 3.31 |
| 155 | 0.25 | 0.53 | 1.62 | 3.39 |
| 160 | 0.25 | 0.54 | 1.68 | 3.48 |
| 165 | 0.26 | 0.55 | 1.75 | 3.63 |
| 170 | 0.26 | 0.56 | 1.81 | 3.79 |
| 175 | 0.27 | 0.57 | 1.87 | 3.95 |
| 180 | 0.27 | 0.58 | 1.92 | 4.12 |
| 185 | 0.28 | 0.59 | 1.98 | 4.28 |
| 190 | 0.28 | 0.60 | 2.03 | 4.44 |
| 195 | 0.29 | 0.62 | 2.08 | 4.60 |
| 200 | 0.29 | 0.65 | 2.14 | 4.77 |

**Table 4 continued**

| Section factor – $m^{-1}$ | Coating thickness - mm | | | |
|---|---|---|---|---|
| | 30 minutes | 60 minutes | 90 minutes | 120 minutes |
| 205 | 0.30 | 0.67 | 2.19 | 4.93 |
| 210 | 0.31 | 0.69 | 2.25 | 5.09 |
| 215 | 0.31 | 0.71 | 2.30 | 5.25 |
| 220 | 0.32 | 0.73 | 2.36 | 5.42 |
| 225 | 0.32 | 0.75 | 2.41 | 5.58 |
| 230 | 0.33 | 0.77 | 2.47 | 5.74 |
| 235 | 0.33 | 0.79 | 2.52 | 5.90 |
| 240 | 0.34 | 0.81 | 2.61 | 6.06 |
| 245 | 0.34 | 0.83 | 2.70 | 6.23 |
| 250 | 0.35 | 0.83 | 2.78 | 6.39 |
| 255 | 0.35 | 0.87 | 2.86 | 6.55 |
| 260 | 0.36 | 0.89 | 2.94 | - |
| 265 | 0.36 | 0.91 | 3.02 | - |
| 270 | 0.37 | 0.93 | 3.11 | - |
| 275 | 0.37 | 0.95 | 3.19 | - |
| 280 | 0.38 | 0.98 | 3.27 | - |
| 285 | 0.38 | 1.00 | 3.35 | - |
| 290 | 0.39 | 1.02 | 3.43 | - |
| 295 | 0.39 | 1.05 | 3.52 | - |
| 300 | 0.40 | 1.08 | 3.64 | - |
| 305 | 0.40 | 1.10 | 3.76 | - |
| 310 | 0.40 | 1.13 | 3.88 | - |
| 315 | 0.41 | 1.16 | 4.00 | - |
| 320 | 0.41 | 1.18 | 4.11 | - |

## *Appendix 1 Section test data used for the assessment*

**Data for analysis at 532°C**

| Test no. | Section ref: | Section size mmxmmxmm or kg/m | A/V $m^{-1}$ | dft mm | Time to 532°C minutes | V/A m | Coating |
|---|---|---|---|---|---|---|---|
| TE201952 | LH1 | 200 x 200 x 10 | 102 | 3.072 | 85 | 0.00980 | WB2 |
| TE216164 | LC1 | 152 x 152 x 30 | 243 | 6.008 | 109 | 0.00412 | WB3 |
| TE208420 | LC2 | 203 x 203 x 52 | 199 | 1.458 | 75 | 0.00503 | WB2 |
| W131766 | TC1 | 200 x 200 x 6.3 | 166 | 6.00 | 103 | 0.00602 | WB3 |
| W131766 | C2 | 150 x 100 x 8.0 | 132 | 6.004 | 134 | 0.00758 | WB3 |
| W131766 | C3 | 140 x 140 x 5.0 | 215 | 6.017 | 98 | 0.00465 | WB3 |
| W131766 | C4 | 100 x 100 x 4.0 | 266 | 6.05 | 94 | 0.00376 | WB3 |
| W131766 | C5 | 200 x 200 x 6.3 | 166 | 4.705 | 90 | 0.00602 | WB3 |
| W131766 | C6 | 200 x 200 x 12.5 | 87 | 4.692 | 135 | 0.01149 | WB3 |
| W131766 | C7 | 200 x 200 x 12.5 | 87 | 3.508 | 127 | 0.01149 | WB3 |
| W131766 | C8 | 140 x 140 x 5.0 | 215 | 3.498 | 85 | 0.00465 | WB3 |
| W131766 | C9 | 100 x 100 x 4.0 | 266 | 3.515 | 70 | 0.00376 | WB3 |
| W131766 | C10 | 200 x 200 x 16.0 | 67 | 2.511 | 103 | 0.01493 | WB3 |
| W131765 | C11 | 200 x 200 x 12.5 | 87 | 2.473 | 111 | 0.01149 | WB3 |
| W131765 | C12 | 140 x 140 x 5.0 | 215 | 2.522 | 67 | 0.00465 | WB3 |
| W131765 | C13 | 200 x 200 x 16.0 | 67 | 1.787 | 87 | 0.01493 | WB3 |
| W131765 | C14 | 140 x 140 x 5.0 | 215 | 1.801 | 64 | 0.00465 | WB3 |
| W131765 | C15 | 200 x 200 x 16.0 | 67 | 1.07 | 77 | 0.01493 | WB3 |
| W131765 | C16 | 140 x 140 x 5.0 | 215 | 1.054 | 46 | 0.00465 | WB3 |
| W131765 | C17 | 200 x 200 x 16.0 | 67 | 0.60 | 70 | 0.01493 | WB3 |
| W131765 | C18 | 140 x 140 x 5.0 | 215 | 0.607 | 39 | 0.00465 | WB3 |
| W131765 | C19 | 100 x 100 x 4.0 | 266 | 0.619 | 38 | 0.00376 | WB3 |
| W159443 | C20 | 400 x 400 x 20.0 | 50.7 | 0.427 | 58.5 | 0.01972 | WB3 |
| W159443 | C21 | 400 x 400 x 20.0 | 50.7 | 0.245 | 46.5 | 0.01972 | WB3 |
| W159443 | C22 | 180 x 180 x 8.0 | 131 | 0.402 | 33.5 | 0.00765 | WB3 |

**Data for analysis at 550°C**

| Test No. | Section ref | Section size mmxmmxmm or kg/m | A/V $m^{-1}$ | Dft mm | Time to 550°C minutes | V/A m | Coating |
|---|---|---|---|---|---|---|---|
| TE201952 | LH1 | 200 x 200 x 10.0 | 102 | 3.072 | 87.5 | 0.00980 | WB2* |
| TE216164 | LC1 | 152 x 152 x 30 | 243 | 6.008 | 110 | 0.00412 | WB3 |
| TE208420 | LC2 | 203 x 203 x 52 | 199 | 1.458 | 76 | 0.00503 | WB2 |
| W131766 | TC1 | 200 x 200 x 6.3 | 166 | 6.00 | 105 | 0.00602 | WB3 |
| W131766 | C2 | 150 x 100 x 8.0 | 132 | 6.004 | 137 | 0.00758 | WB3 |
| W131766 | C3 | 140 x 140 x 5.0 | 215 | 6.017 | 100 | 0.00465 | WB3 |
| W131766 | C4 | 100 x 100 x 4.0 | 266 | 6.05 | 96 | 0.00376 | WB3 |
| W131766 | C5 | 200 x 200 x 6.3 | 166 | 4.705 | 91 | 0.00602 | WB3 |
| W131766 | C6 | 200 x 200 x 12.5 | 87 | 4.692 | 138 | 0.01149 | WB3 |
| W131766 | C7 | 200 x 200 x 12.5 | 87 | 3.508 | 131 | 0.01149 | WB3 |
| W131766 | C8 | 140 x 140 x 5.0 | 215 | 3.498 | 87 | 0.00465 | WB3 |
| W131766 | C9 | 100 x 100 x 4.0 | 266 | 3.515 | 72 | 0.00376 | WB3 |
| W131766 | C10 | 200 x 200 x 16.0 | 67 | 2.511 | 106 | 0.01493 | WB3 |
| W131765 | C11 | 200 x 200 x 12.5 | 87 | 2.473 | 114 | 0.01149 | WB3 |
| W131765 | C12 | 140 x 140 x 5.0 | 215 | 2.522 | 70 | 0.00465 | WB3 |
| W131765 | C13 | 200 x 200 x 16.0 | 67 | 1.787 | 90 | 0.01493 | WB3 |
| W131765 | C14 | 140 x 140 x 5.0 | 215 | 1.801 | 66 | 0.00465 | WB3 |
| W131765 | C15 | 200 x 200 x 16.0 | 67 | 1.07 | 81 | 0.01493 | WB3 |
| W131765 | C16 | 140 x 140 x 5.0 | 215 | 1.054 | 49 | 0.00465 | WB3 |
| W131765 | C17 | 200 x 200 x 16.0 | 67 | 0.6 | 74 | 0.01493 | WB3 |
| W131765 | C18 | 140 x 140 x 5.0 | 215 | 0.607 | 41 | 0.00465 | WB3 |
| W131765 | C19 | 100 x 100 x 4.0 | 266 | 0.619 | 40 | 0.00376 | WB3 |
| W159443 | C20 | 400 x 400 x 20.0 | 50.7 | 0.427 | 61 | 0.01972 | WB3 |
| W159443 | C21 | 400 x 400 x 20.0 | 50.7 | 0.245 | 49 | 0.01972 | WB3 |
| W159443 | C22 | 180 x 180 x 8.0 | 131 | 0.402 | 35.5 | 0.00765 | WB3 |

**Data for analysis at 650°C**

| Test No. | Section ref | Section size mmxmmxmm or kg/m | A/V $m^{-1}$ | Dft mm | Time to 650°C minutes | V/A m | Coating |
|---|---|---|---|---|---|---|---|
| TE201952 | LH1 | 200 x 200 x 10.0 | 102 | 3.072 | 98.5* | 0.00980 | WB2* |
| TE216164 | LC1 | 152 x 152 x 30 | 243 | 6.008 | 121 | 0.00412 | WB3 |
| TE208420 | LC2 | 203 x 203 x 52 | 199 | 1.458 | 93 | 0.00503 | WB2 |
| W131766 | TC1 | 200 x 200 x 6.3 | 166 | 6.00 | 120.5 | 0.00602 | WB3 |
| W131766 | C2 | 150 x 100 x 8.0 | 132 | 6.004 | 153 | 0.00758 | WB3 |
| W131766 | C3 | 140 x 140 x 5.0 | 215 | 6.017 | 112 | 0.00465 | WB3 |
| W131766 | C4 | 100 x 100 x 4.0 | 266 | 6.05 | 110 | 0.00376 | WB3 |
| W131766 | C5 | 200 x 200 x 6.3 | 166 | 4.705 | 102 | 0.00602 | WB3 |
| W131766 | C6 | 200 x 200 x 12.5 | 87 | 4.692 | 158.5 | 0.01149 | WB3 |
| W131766 | C7 | 200 x 200 x 12.5 | 87 | 3.508 | 155 | 0.01149 | WB3 |
| W131766 | C8 | 140 x 140 x 5.0 | 215 | 3.498 | 103 | 0.00465 | WB3 |
| W131766 | C9 | 100 x 100 x 4.0 | 266 | 3.515 | 86 | 0.00376 | WB3 |
| W131766 | C10 | 200 x 200 x 16.0 | 67 | 2.511 | 130 | 0.01493 | WB3 |
| W131765 | C11 | 200 x 200 x 12.5 | 87 | 2.473 | 138 | 0.01149 | WB3 |
| W131765 | C12 | 140 x 140 x 5.0 | 215 | 2.522 | 84.5 | 0.00465 | WB3 |
| W131765 | C13 | 200 x 200 x 16.0 | 67 | 1.787 | 110.5 | 0.01493 | WB3 |
| W131765 | C14 | 140 x 140 x 5.0 | 215 | 1.801 | 80 | 0.00465 | WB3 |
| W131765 | C15 | 200 x 200 x 16.0 | 67 | 1.07 | 101 | 0.01493 | WB3 |
| W131765 | C16 | 140 x 140 x 5.0 | 215 | 1.054 | 60 | 0.00465 | WB3 |
| W131765 | C17 | 200 x 200 x 16.0 | 67 | 0.6 | 92.5 | 0.01493 | WB3 |
| W131765 | C18 | 140 x 140 x 5.0 | 215 | 0.607 | 51 | 0.00465 | WB3 |
| W131765 | C19 | 100 x 100 x 4.0 | 266 | 0.619 | 49 | 0.00376 | WB3 |
| W159443 | C20 | 400 x 400 x 20.0 | 50.7 | 0.427 | 77 | 0.01972 | WB3 |
| W159443 | C21 | 400 x 400 x 20.0 | 50.7 | 0.245 | 63 | 0.01972 | WB3 |
| W159443 | C22 | 180 x 180 x 8.0 | 131 | 0.402 | 45 | 0.00765 | WB3 |

* - extrapolated

**Data for analysis at 700°C**

| Test No. | Section ref | Section size mmxmmxmm or kg/m | A/V $m^{-1}$ | Dft mm | Time to 700°C minutes | V/A m | Coating |
|---|---|---|---|---|---|---|---|
| TE201952 | LH1 | 200 x 200 x 10.0 | 102 | 3.072 | 103* | 0.00980 | WB2* |
| TE216164 | LC1 | 152 x 152 x 30 | 243 | 6.008 | 128* | 0.00412 | WB3* |
| TE208420 | LC2 | 203 x 203 x 52 | 199 | 1.458 | 102 | 0.00503 | WB2 |
| W131766 | TC1 | 200 x 200 x 6.3 | 166 | 6.00 | 131.5 | 0.00602 | WB3 |
| W131766 | C2 | 150 x 100 x 8.0 | 132 | 6.004 | 162 | 0.00758 | WB3 |
| W131766 | C3 | 140 x 140 x 5.0 | 215 | 6.017 | 119 | 0.00465 | WB3 |
| W131766 | C4 | 100 x 100 x 4.0 | 266 | 6.05 | 117 | 0.00376 | WB3 |
| W131766 | C5 | 200 x 200 x 6.3 | 166 | 4.705 | 108 | 0.00602 | WB3 |
| W131766 | C6 | 200 x 200 x 12.5 | 87 | 4.692 | 168 | 0.01149 | WB3 |
| W131766 | C7 | 200 x 200 x 12.5 | 87 | 3.508 | 167.5 | 0.01149 | WB3 |
| W131766 | C8 | 140 x 140 x 5.0 | 215 | 3.498 | 110.5 | 0.00465 | WB3 |
| W131766 | C9 | 100 x 100 x 4.0 | 266 | 3.515 | 94.5 | 0.00376 | WB3 |
| W131766 | C10 | 200 x 200 x 16.0 | 67 | 2.511 | 144.5 | 0.01493 | WB3 |
| W131765 | C11 | 200 x 200 x 12.5 | 87 | 2.473 | 153.5* | 0.01149 | WB3* |
| W131765 | C12 | 140 x 140 x 5.0 | 215 | 2.522 | 92.5 | 0.00465 | WB3 |
| W131765 | C13 | 200 x 200 x 16.0 | 67 | 1.787 | 124.5 | 0.01493 | WB3 |
| W131765 | C14 | 140 x 140 x 5.0 | 215 | 1.801 | 87.5 | 0.00465 | WB3 |
| W131765 | C15 | 200 x 200 x 16.0 | 67 | 1.07 | 114 | 0.01493 | WB3 |
| W131765 | C16 | 140 x 140 x 5.0 | 215 | 1.054 | 67.5 | 0.00465 | WB3 |
| W131765 | C17 | 200 x 200 x 16.0 | 67 | 0.6 | 104 | 0.01493 | WB3 |
| W131765 | C18 | 140 x 140 x 5.0 | 215 | 0.607 | 57 | 0.00465 | WB3 |
| W131765 | C19 | 100 x 100 x 4.0 | 266 | 0.619 | 54 | 0.00376 | WB3 |
| W159443 | C20 | 400 x 400 x 20.0 | 50.7 | 0.427 | 86.5 | 0.01972 | WB3 |
| W159443 | C21 | 400 x 400 x 20.0 | 50.7 | 0.245 | 72 | 0.01972 | WB3 |
| W159443 | C22 | 180 x 180 x 8.0 | 131 | 0.402 | 51 | 0.00765 | WB3 |

* - extrapolated

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