The Loss Prevention Council
LPC Laboratories
Melrose Avenue, Borehamwood, Hertfordshire, WD6 2BJ. UK
Telephone: 0181 207 2345 Fax: 0181 207 6305

TE 92515

TEST REPORT

Title: Ad-hoc fire test on a Metaloterm MF chimney system when subjected to an internal fire.

Client: Ontop BV,
Oude Veerseweg 23,
4332 SH Middelberg,
Nederland.

Date: 6 September 1999

The Loss Prevention Council
LPC Laboratories
Melrose Avenue, Borehamwood, Hertfordshire, WD6 2BJ. UK
Telephone: 0181 207 2345 Fax: 0181 207 6305

CONTENTS

SUMMARY

An ad-hoc fire test was carried out on a Metaloterm MF insulated stainless-steel chimney system of 250mm internal diameter and 300mm external diameter. Sections of the system were mounted horizontally with one end penetrating a dense concrete block wall into a gas-fired furnace. The hot furnace gases passed through the chimney. The temperature of these gases at the entrance of the chimney system, was controlled to follow the heating regime specified in B.S. 476 : Part 20 : 1987. The test was carried out on 19 March 1999 for a duration of 245min.

Throughout the test there was no failure under the integrity criteria adopted from B.S. 476 : Part 20 : 1987, in either the chimney system or the penetration seal arrangement at the furnace wall.

1 OBJECTIVE

To determine the performance of a Metaloterm MF chimney system, when subjected to an ad-hoc fire test with an internal fire.

2 CONSTRUCTION

2.1 General

A dense concrete block wall, 215mm thick, was erected within a furnace test frame, 1460mm x 1460mm. The wall had a centrally positioned square aperture, 315mm x 315mm, over which was secured on each side of the wall stainless-steel plates, 550mm x 550mm, with a 305mm diameter hole. One end of the chimney fitted through the aperture and protruded nominally 100mm into a gas-fired furnace. The chimney ran away from the furnace horizontally with one section angled upwards at 43.5° followed by a further horizontal section.

The chimney was approximately 4.7m long and was connected at the end remote from the furnace to an exhaust fan using a flexible steel tube. The fan was used to draw the furnace gases down the chimney at the start of the test and was then turned off after approximately 3min.

The chimney system is shown in Figure 1 and before the test in Plates 1 to 3.

2.2 Components

2.2.1 Metaloterm MF chimney sections

Each chimney section was double walled, with a 250mm internal diameter and a 25mm insulated cavity. The external diameter was 300mm. The inner wall was manufactured from 0.4mm-thick 316 stainless steel and the outer wall from 0.4mm-thick 304 stainless steel. The seams in both walls were continuously welded. The cavity was filled with Rockwool Granulate type 002.005 mineral wool of nominal density 100-150kg/m^3 - Asbestos free with 2.4% organic material as stated by the sponsor. At one end of each section the insulation was rebated by 30mm and at the other end the insulation was flush with the casing and the outer casing had an arrangement of ridges rolled around it. The chimney arrangement is shown in Figure 1. Individual chimney components are shown in Figures 2 to 9.

2.2.2 Locking band MFKB 025

Each locking band was 58mm wide and of sufficient diameter to wrap around the outside chimney casing. They were manufactured from 0.4mm-thick stainless steel and were secured with two jubilee-clip screw fixings. The locking band details is shown in Figure 8, and the method of fixing in Figure 9.

2.3 Assembly

The chimney sections, comprising a combination of MF100, MF50 and MFB43 lengths and elbows were arranged relative to the furnace as detailed in Figure 1.

Each section was connected to the next by sliding the end with rebated insulation over the non-rebated end with the ridges ensuring a snap connection. A locking band MFBK 025 was then secured over the joint. Details are shown in Figures 8 and 9. The rebated end of each chimney section was placed furthest from the furnace as shown in Plate 2.

The chimney was supported at three locations as shown in Figure 1 using stainless steel pipe clamps, clamped around the outer casing and secured to upstands.

The end of the chimney protruding into the furnace was finished with an MFMA top stub and is shown in Plate 1. This was a 100mm long section of chimney with the insulation capped at one end.

2.4 Penetration seal

The chimney penetrated the furnace wall through a 315mm x 315mm aperture. Each side of the wall a stainless steel plate, 550mm x 550mm square x 1.5mm thick with a 305mm diameter central aperture was secured at 160mm centres with twelve M10 stainless steel studs around the perimeter.

The void bounded by the stainless steel plates, chimney section and wall was infilled with ceramic blanket. The joints between the steel plates and the chimney section were sealed with cement.

Immediately adjacent to and abutting against the outer faces of each of the stainless steel plates secured to the wall faces through which the chimney passed, stainless steel MFK B025 locking bands were secured to the chimney to minimise movement of the chimney relative to the seal.

3 TEST PROCEDURE

3.1 General

The test was carried out on 19 March 1999 and was witnessed by Messrs R Buttery and S Waters from H Docherty Ltd. and Mr G Stok of Ontop BV. The ambient temperature at the start of the test was 15°C.

3.2 Furnace control

Four stainless steel sheathed chromel/alumel thermocouples were suspended centrally within the chimney outside the furnace at positions shown in Figure 1. They were labelled S1 to S4. The furnace was controlled so that the temperature recorded by thermocouple S1 followed the time/temperature curve specified in B.S. 476 : Part 20 : 1987[1]. The temperatures recorded by thermocouples S1 to S4 together with the standard curve are shown plotted against time in Figure 10.

3.3 Furnace pressure

A pressure sensor was mounted in the mouth of the chimney in the furnace. The pressure in the furnace was controlled so that the pressure recorded was above that in the laboratory in order to ensure passage of hot gases down the chimney, and to provide conditions to enable the monitoring for failure of integrity. The pressure was maintained at 20 $\pm$ 2Pa. The fan connected to the end of the system via the flexible tube was used for the first 3min of the test to draw furnace gases along the chimney, it was then turned off.

3.4 Temperature measurements

The temperature of the outside surface of the chimney and the penetration seal was monitored by fifteen chromel/alumel thermocouples, each soldered to a copper disc and covered with an insulating pad, 30mm x 30mm x 2mm thick, and positioned as shown in Figure 1.

4 RESULTS

4.1 Observations

Observations made during the test are given in Table 1. See Figure 1 for joint numbers used in observations.

Table 1 Observations

Time min : s	Observations
0 : 00	Test started, fan switched on.
3 : 06	Fan switched off.
4 : 00	Slight smoke emissions from base of plate on unexposed face of wall and at joints 1 and 3.
10 : 00	Very slight smoke emissions from joints 1,3,4 and 5.
19 : 00	Fails insulation at 150mm off wall. Temperature exceeding 201°C (rising).
30 : 00	Still slight smoke emissions from joints 1 and 5. Very slight smoke emissions from periphery of plate on unexposed face of the wall.
35 : 00	Light straw colouration developing in some regions of chimney system.
65 : 00	Straw colouration has developed over most of chimney system.
70 : 00	Minimal smoke emissions from joints 1,3,4 and 5. Moisture condensing on block wall joints adjacent to plate on the unexposed face of the wall.

Table 1 Observations (continued)

Time min : s	Observations
77 : 00	Steam emissions at periphery of plate on the unexposed face increasing.
96 : 00	No significant change.
141 : 00	Still slight steam emissions from the periphery of the plate on the unexposed face of the wall. No smoke emissions from any joints except very slight from joint 6.
170 : 00	No significant change. Only very slight smoke emissions from joint 6, and slight steam emission from plate periphery on the unexposed face of the wall.
207 : 00	No significant change.
240 : 00	No significant change. General photograph taken (Plate 4).
245 : 00	Test stopped at the request of the sponsor.

The chimney is shown after the test in Plates 5 and 6.

4.2 Temperature measurements

The temperatures recorded on the outer surfaces of the chimney and at the penetration seal are shown plotted against time in Figures 11 to 14.

The maximum temperature measured was 413°C recorded by thermocouple 2 after 234min.

5 PERFORMANCE CRITERIA

The performance criteria adopted for the test were with respect to integrity of the chimney and were as follows:

> The presence and formation of cracks, holes, or other openings in the test specimen outside the furnace (or through the fire-stopping at the dividing wall), through which flames or hot gases can pass shall constitute integrity failure.
>
> For interpretation of the integrity criteria the definition of impermeability from B.S. 476 : Part 20 : 1987[1] has been adopted.

Failure shall be deemed to have occurred when flames or hot gases cause flaming or glowing of a cotton fibre pad or when sustained flaming for not less than 10s is observed on the unexposed face (outside the chimney and furnace). The cotton pad is considered unsuitable in the vicinity of locations where the specimen temperature exceeds 300°C and in this case failure shall be deemed to have occurred when either:

1) the 6mm-diameter gap gauge can penetrate a through gap such that the end of the gauge projects into the furnace (or chimney) and the gauge can be moved in the gap for a distance of at least 150mm or;

2) the 25mm-diameter gap gauge can penetrate a through gap such that the end of the gauge projects into the furnace (or chimney).

6 CONCLUSION

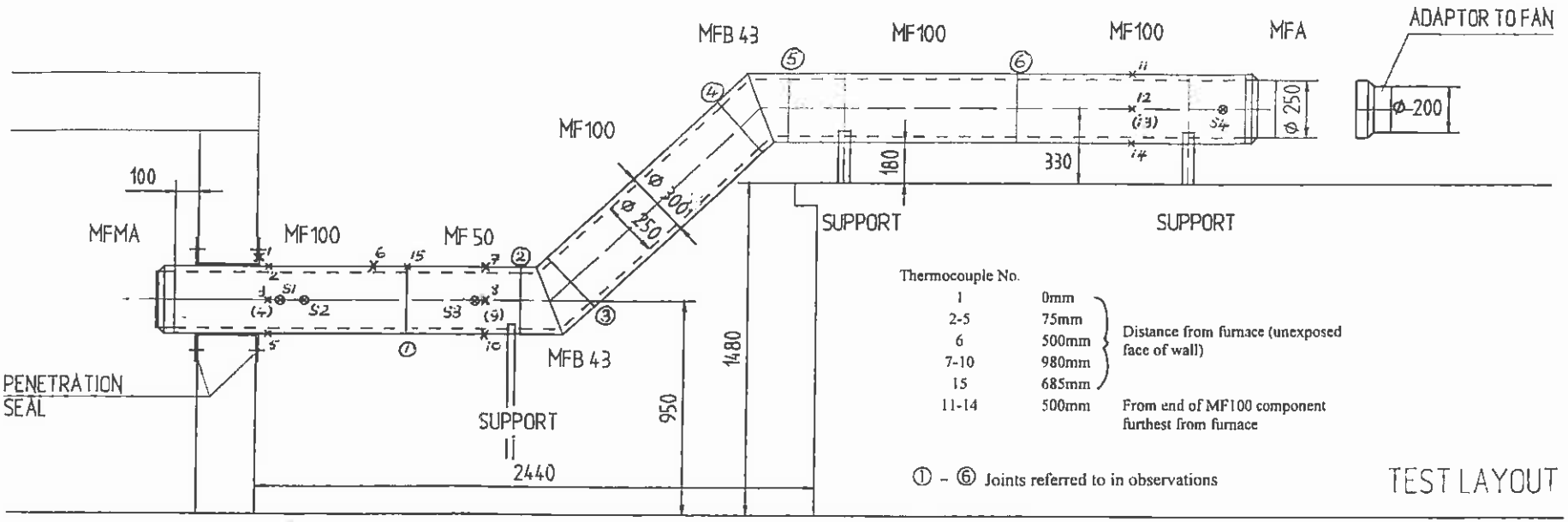
An ad-hoc fire test was carried out on a Metaloterm MF chimney system as described in this report. Hot furnace gases passed through the chimney. The temperature of these gases was controlled to follow the heating regime specified in B.S. 476 : Part 20 : 1987.

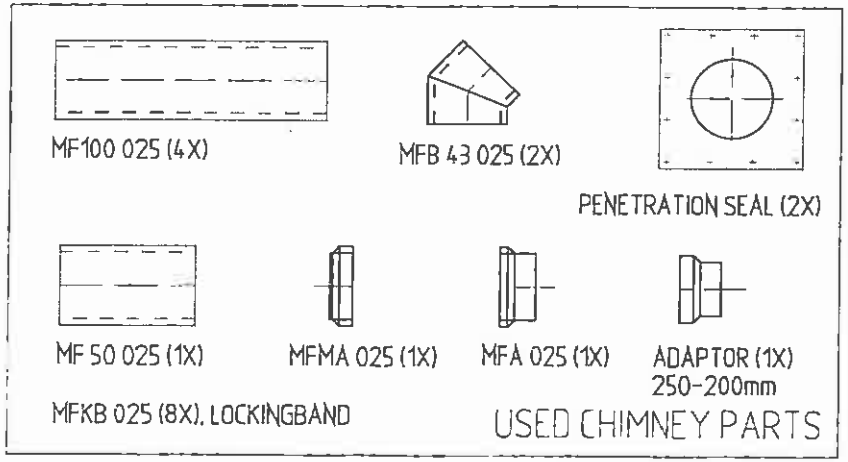
Throughout the test, of 245min duration, there was no failure of integrity as defined in this report, in either the chimney system or the penetration seal arrangement at the furnace wall.

This report covers a test which was conducted to a procedure which is not the subject of any British Standard specifications, but the test utilised the general principles of fire resistance testing given in B.S. 476 : Part 20. Since fire tests are the subject of a continuing Standardisation process, and because existing standards are the subject of review and possible amendment and new interpretations, it is recommended that the report be referred back to the test laboratory after a period of two years to ensure that the methodology adopted and the results obtained remain valid in the light of the situation prevailing at that time.

7 REFERENCE

1 Fire tests on building materials and structures. Part 20. Method for determination of the fire resistance of elements of construction (general principles). British Standard 476 : Part 20 : 1987. British Standards Institution, London, 1987.





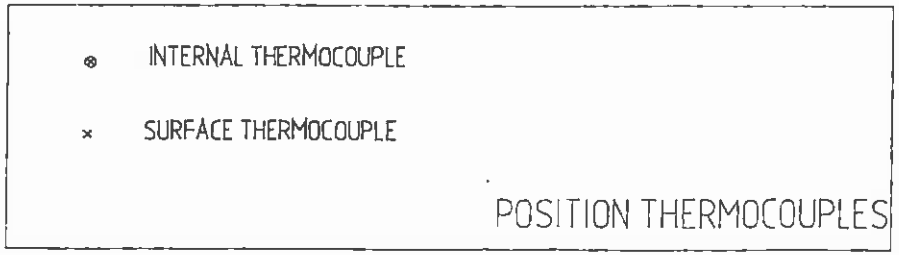


Figure 1 Test layout showing thermocouple locations

Amerikaanse projectie	Getek.: GST	Wijziging: Revisie	Opmerkingen:
	Maateenheid: mm	Gewijz. door: Tekenaar	
	Datum: 08/03/99	Vrijgave:	
Ontop B.V. Postbus 135 4330 AC Middelburg - Nederland Telefoon (0118) 63 30 41 Fax (0118) 61 37 82		Benaming: FIRE TEST LAYOUT MF 250	Tekeningnr.: LPC2 / Form.: A3

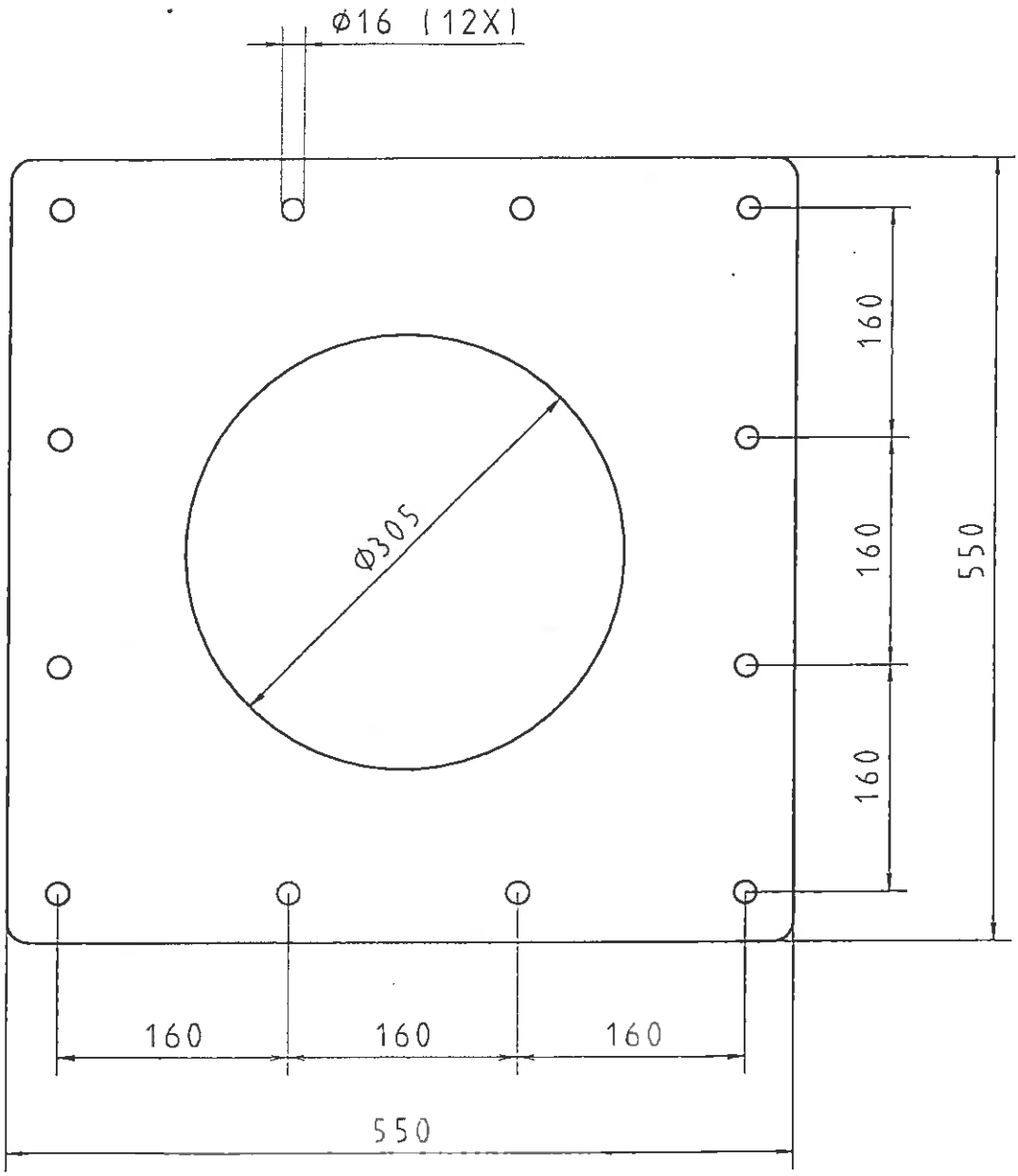


Figure 2 Seal plate details

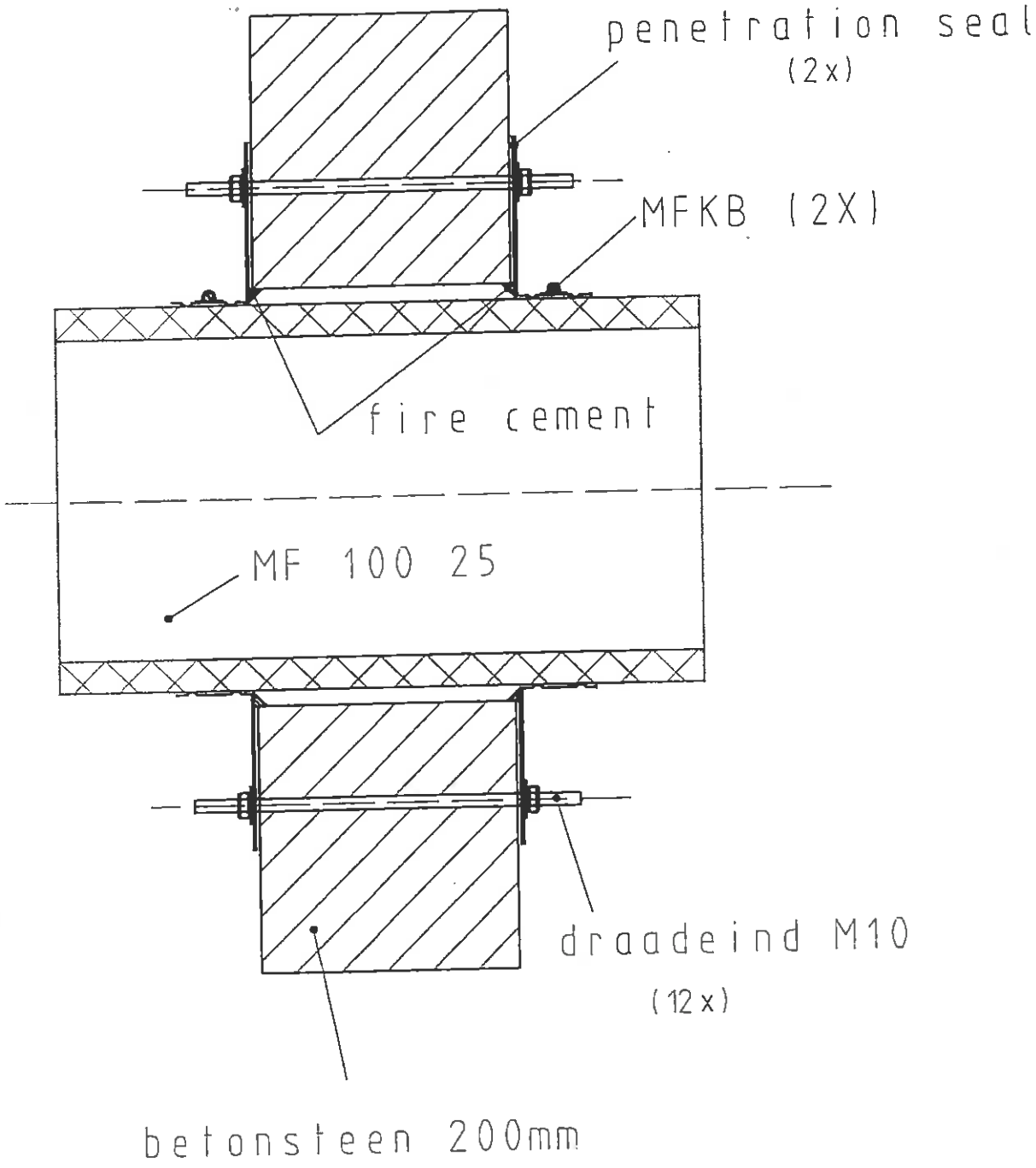
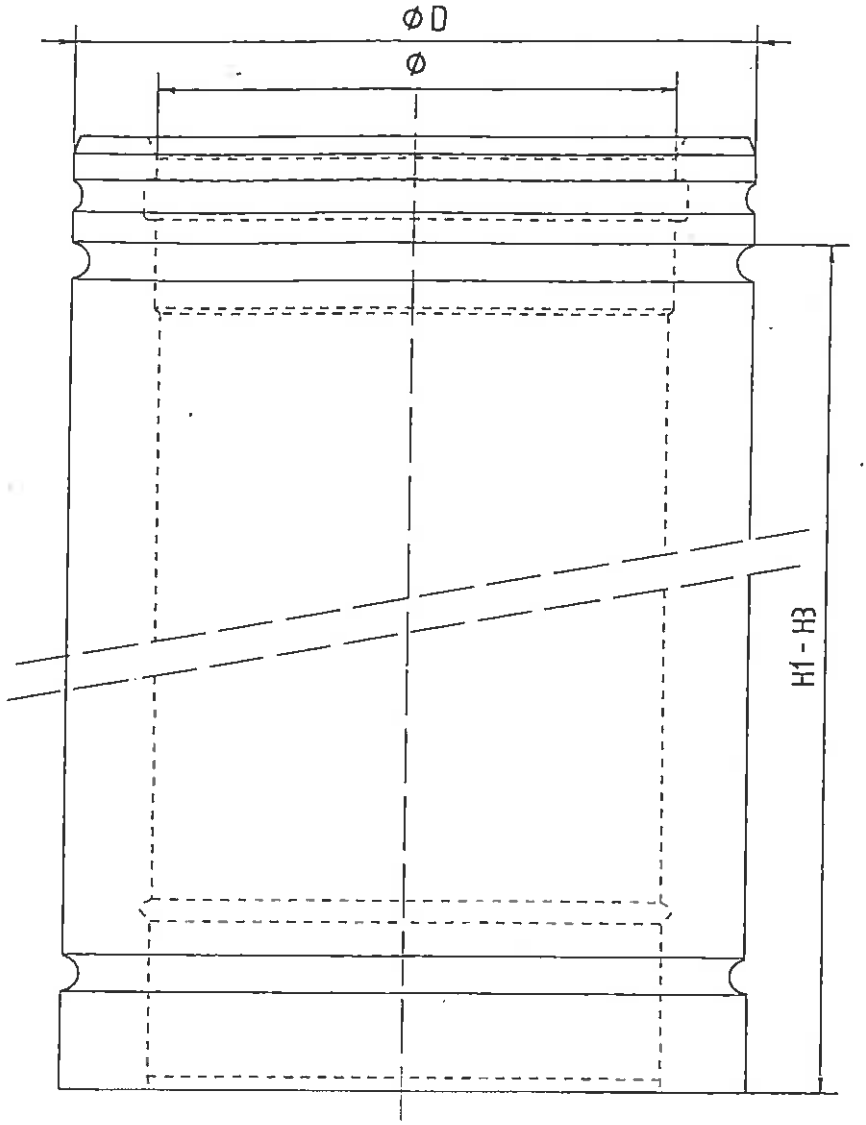
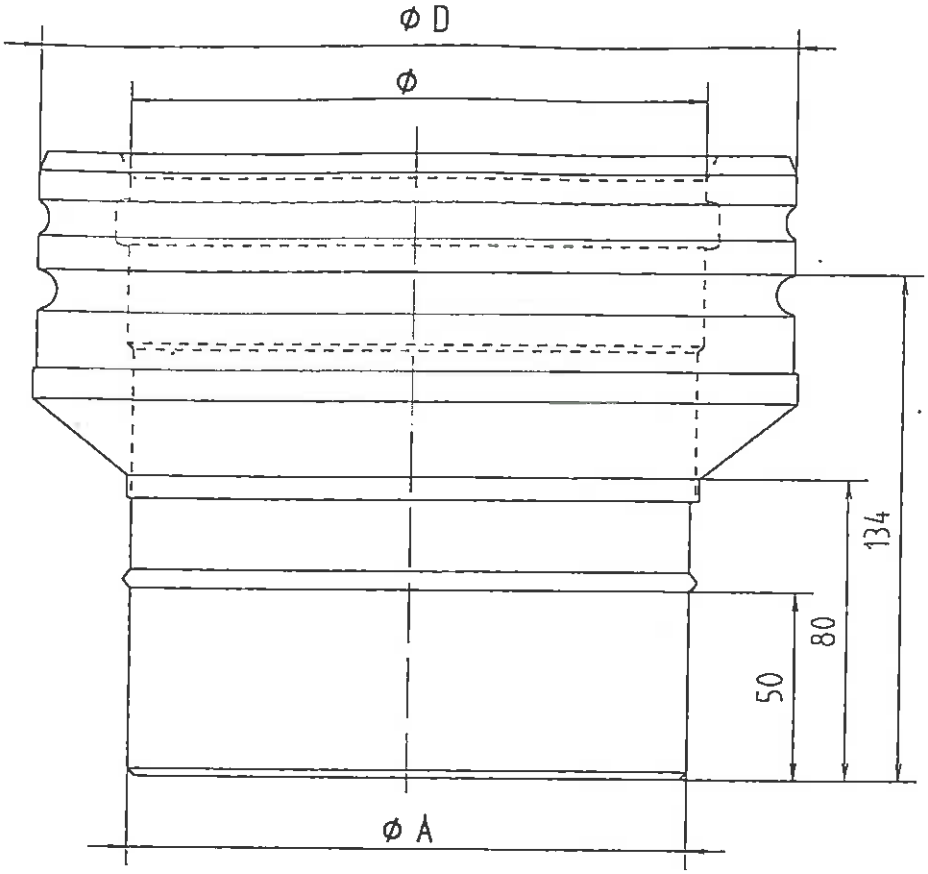


Figure 3 Penetration seal details



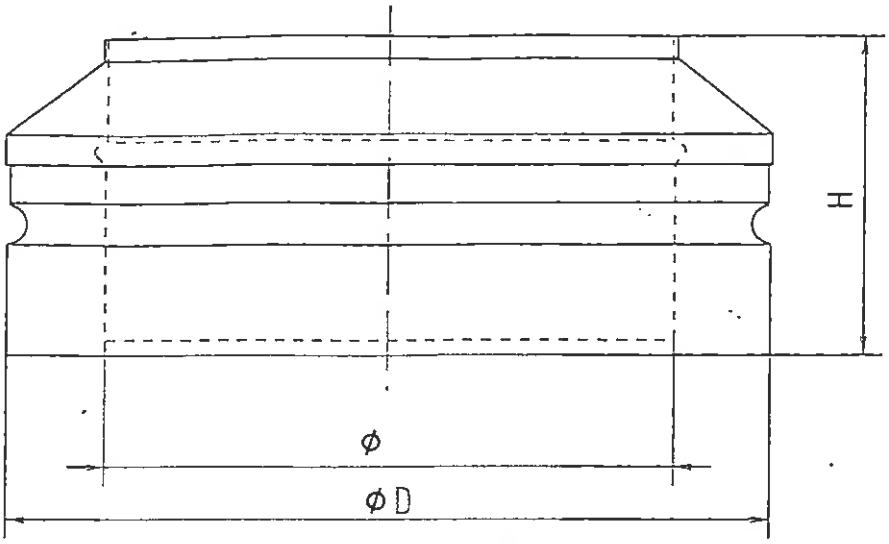
Ø	80	100	130	150	180	200	250
D:	130	150	180	200	230	250	300
H1:	250	250	250	250	250	250	250
H2:	500	500	500	500	500	500	500
H3:	1000	1000	1000	1000	1000	1000	1000

Figure 4 MF component details



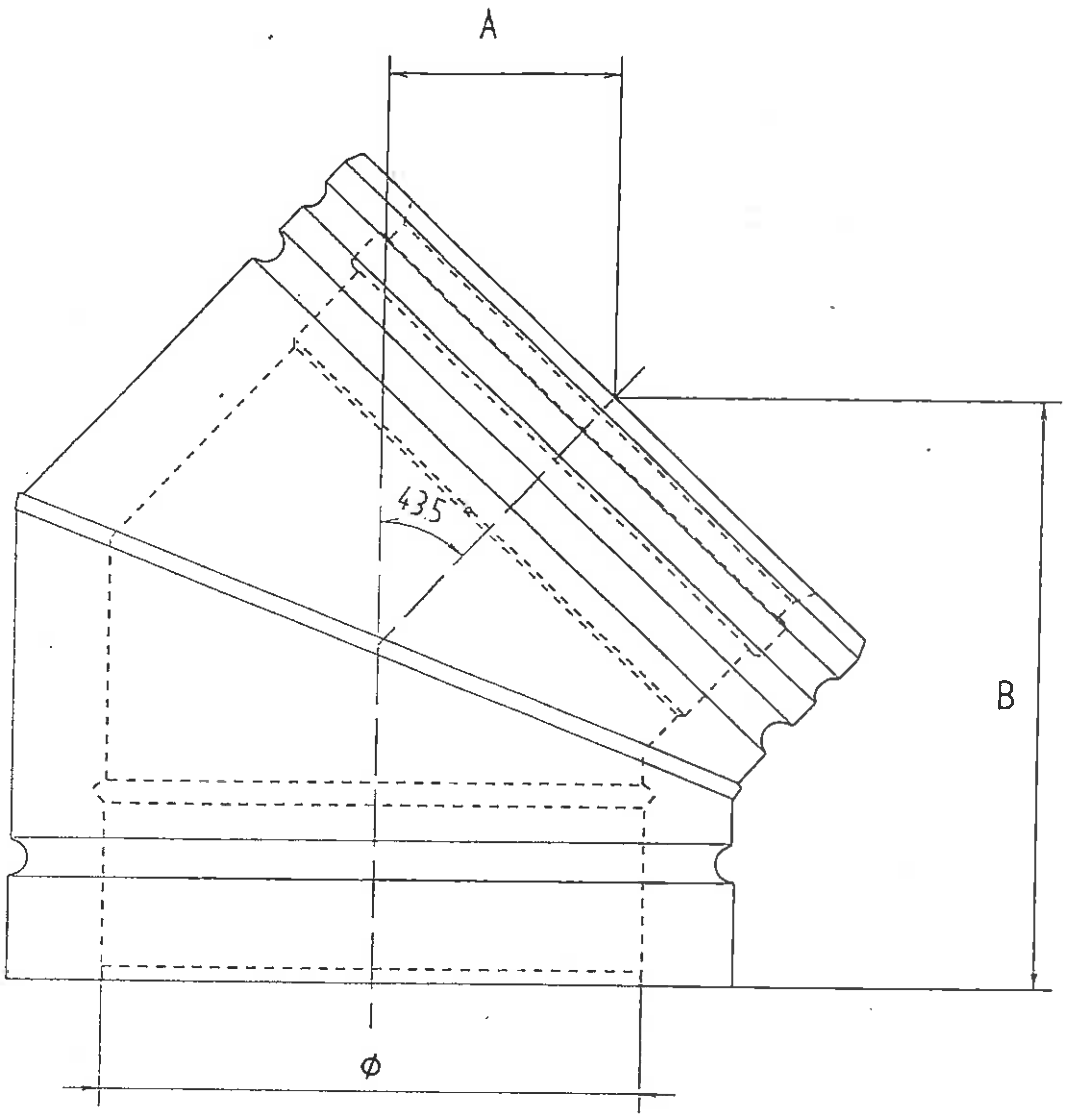
ø	80	100	130	150	180	200	250
A:	80	100	130	150	180	200	250
D:	130	150	180	200	230	250	300

Figure 5 MFA component details



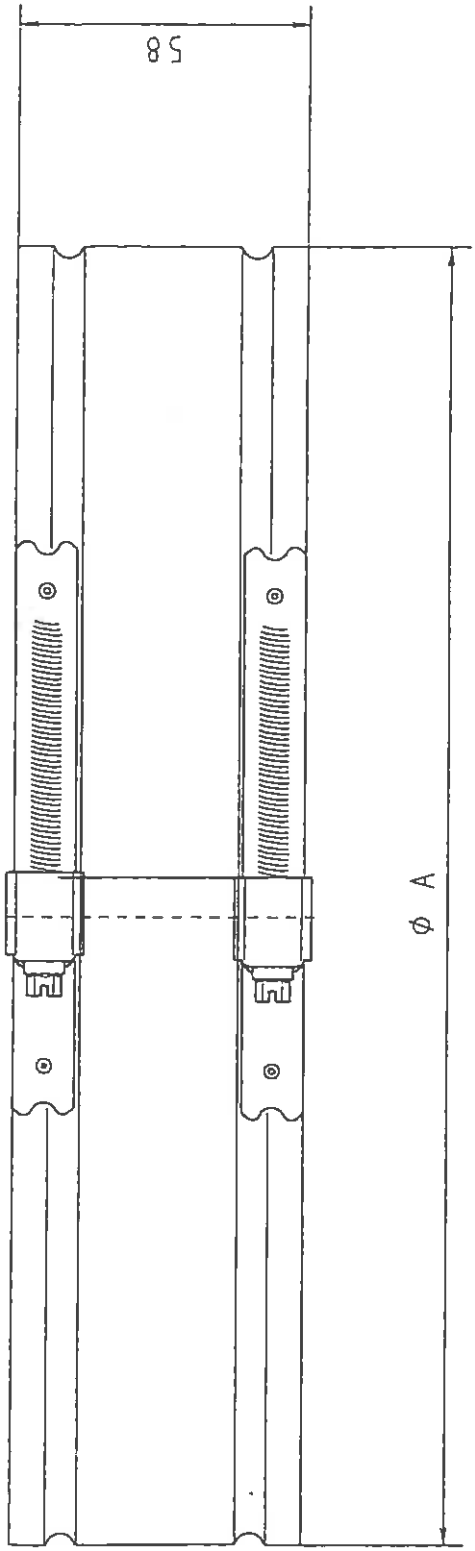
ϕ	80	100	130	150	180	200	250
H:	82	82	82	82	82	82	82

Figure 6 MFMA component details



Ø	80	100	130	150	180	200	250
A:	55	58	62	65	69	72	79
B:	138	146	155	164	172	181	198

Figure 7 MFB43 component details



ϕ	Maat A
80	132
100	152
130	182
150	202
180	232
200	252
250	302

Figure 8 MFKBS locking band details

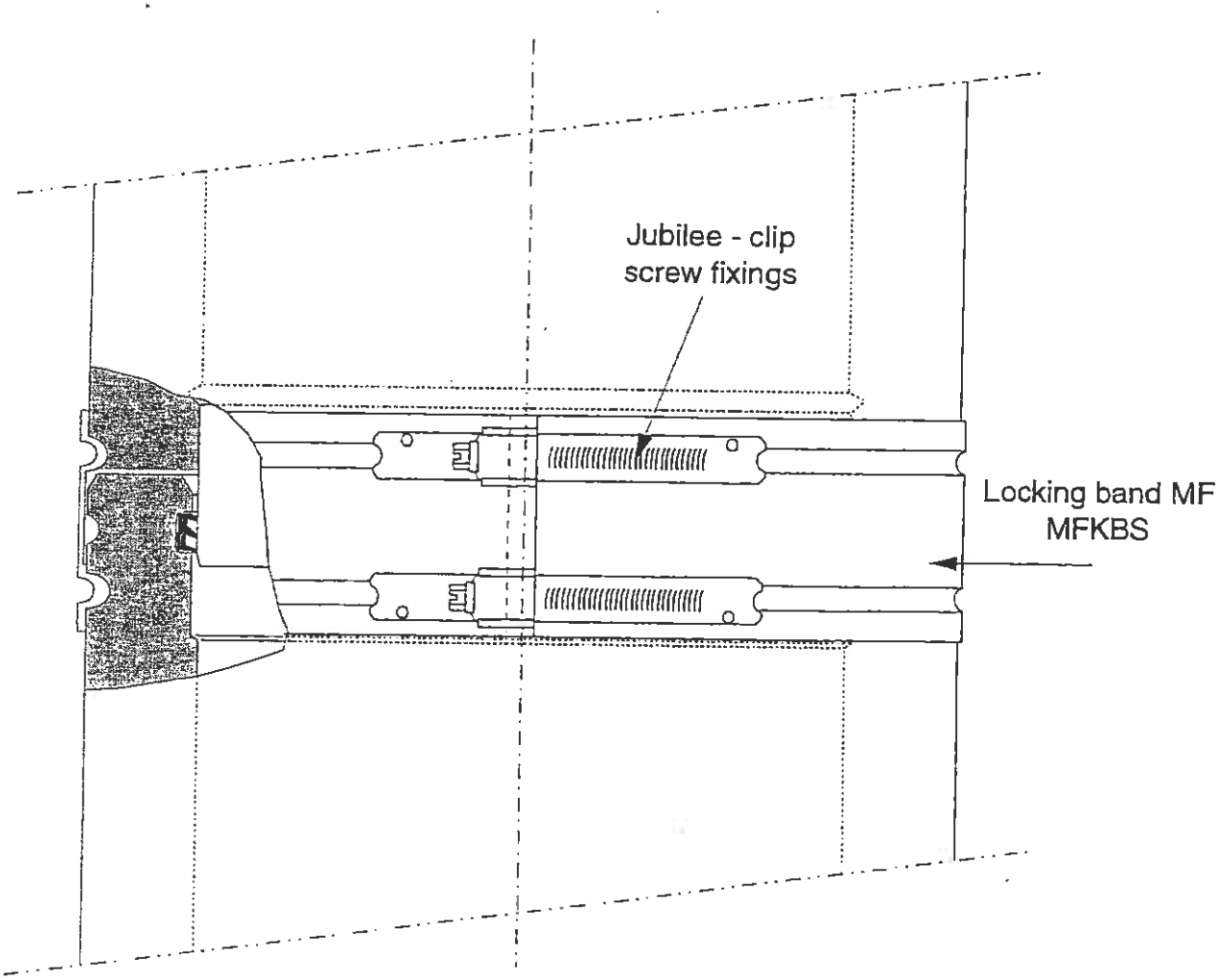


Figure 9 Jointing system for Metaloterm MF chimney sections

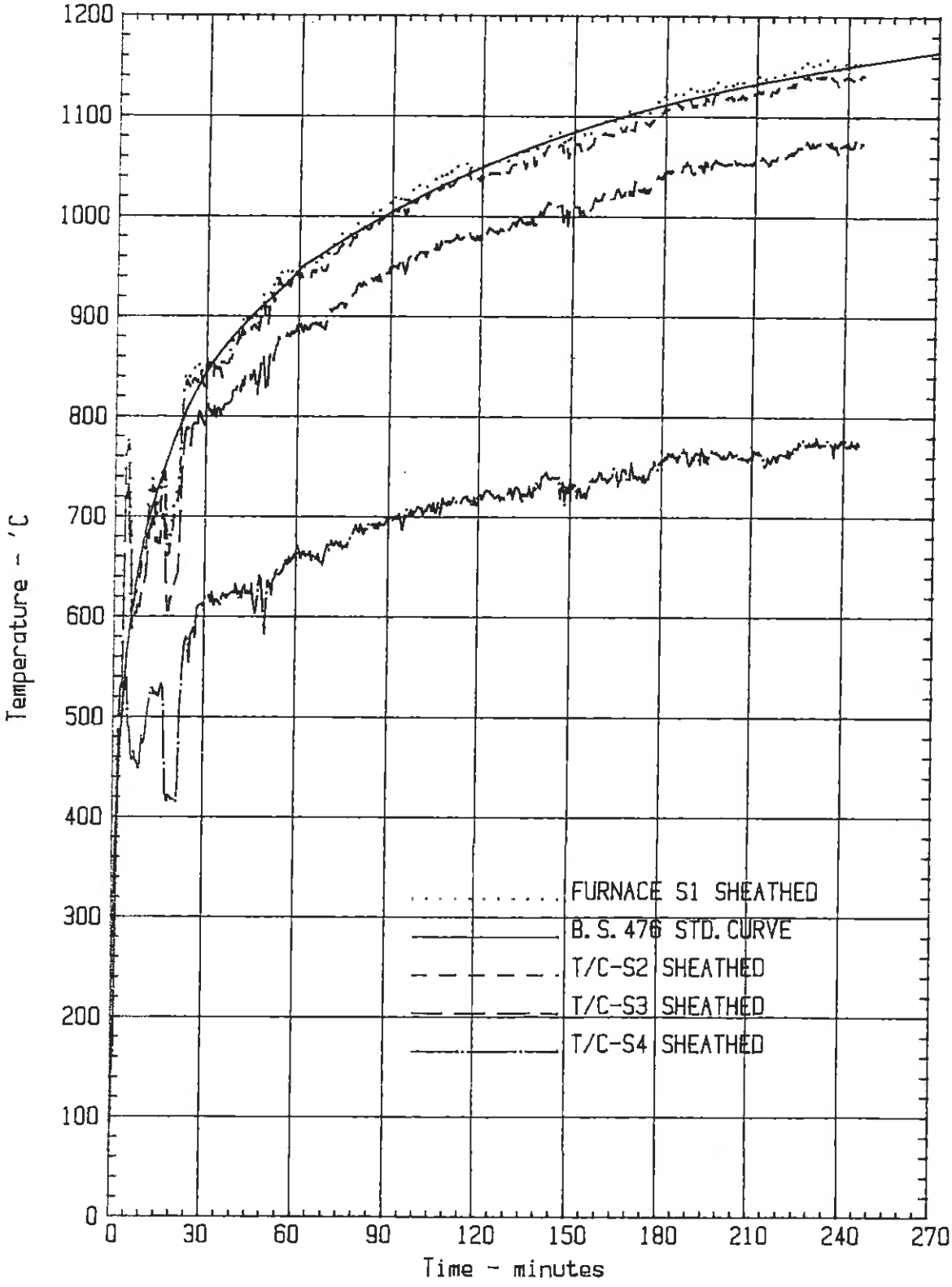


Figure 10 Standard heating curve and internal flue temperatures

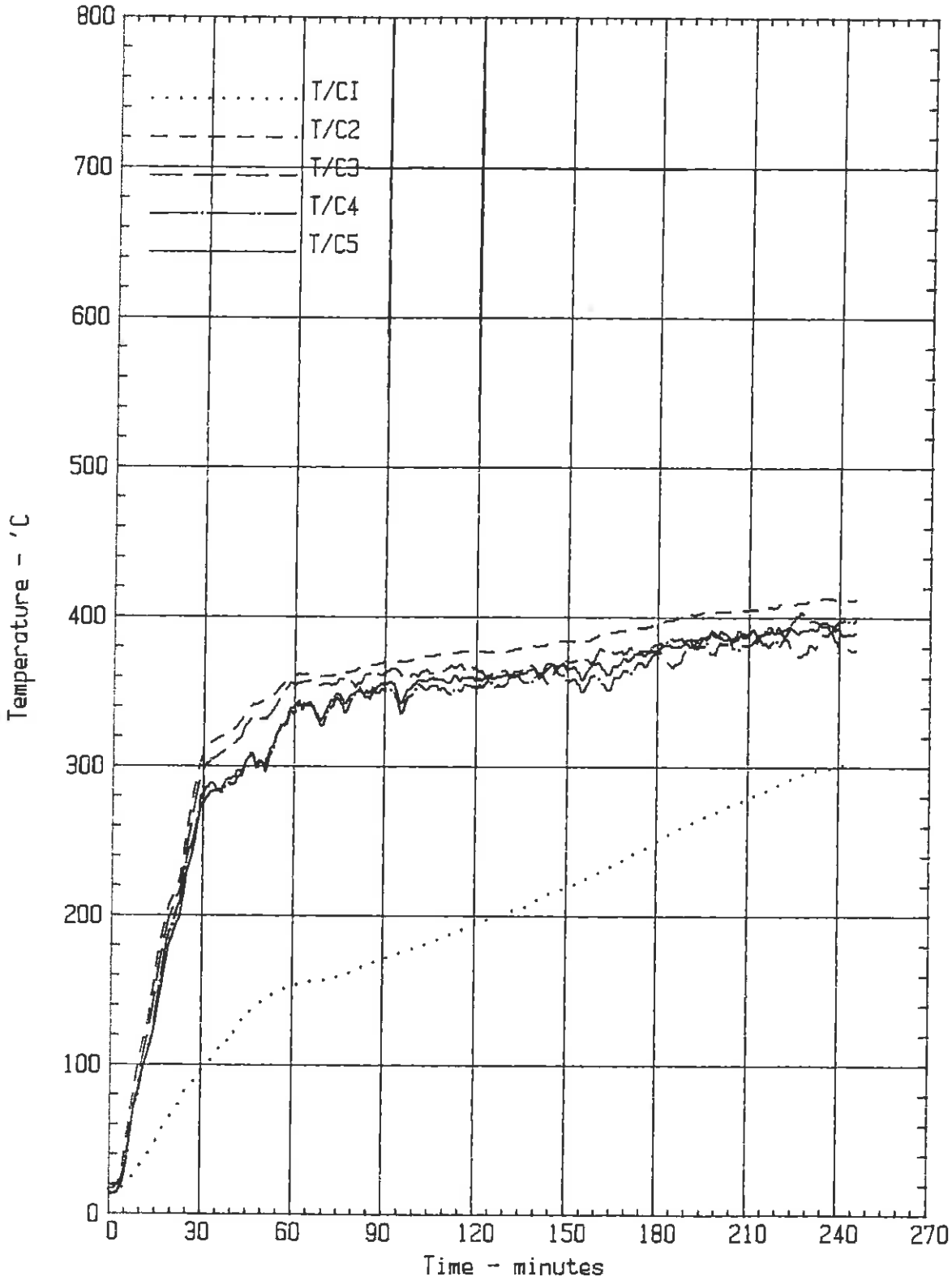


Figure 11 Flue external surface temperatures

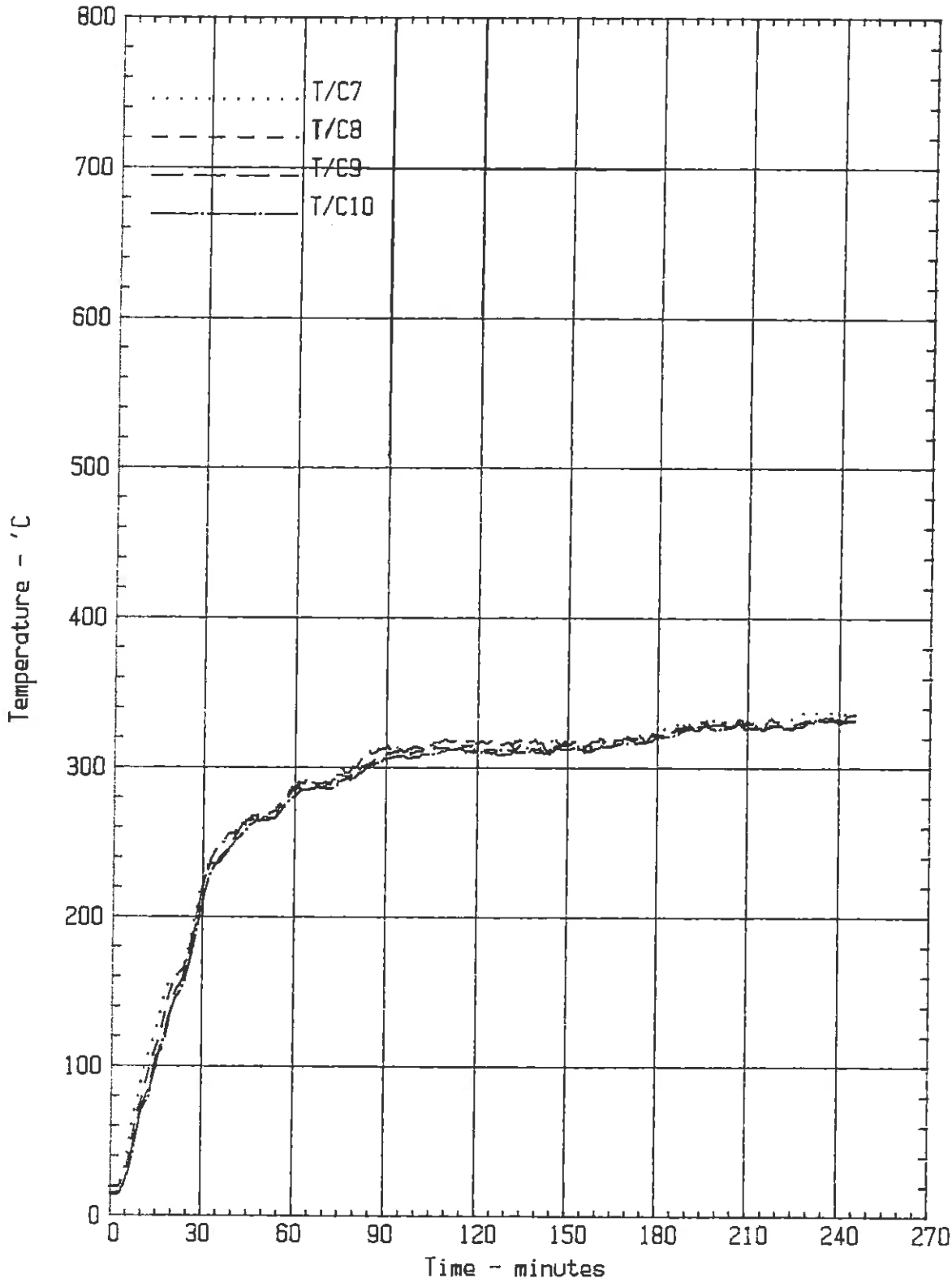


Figure 12 Flue external surface temperatures

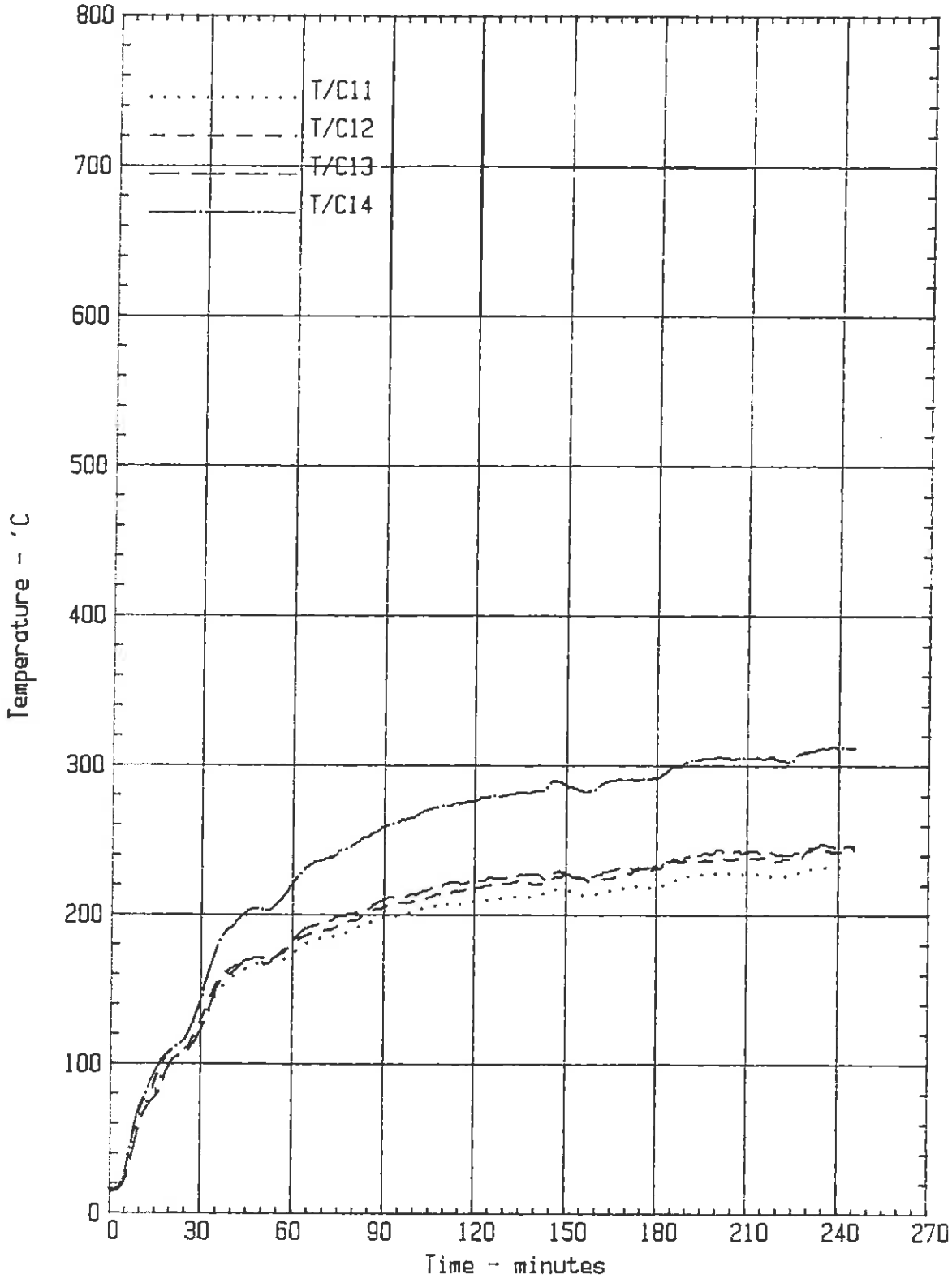


Figure 13 Flue external surface temperatures

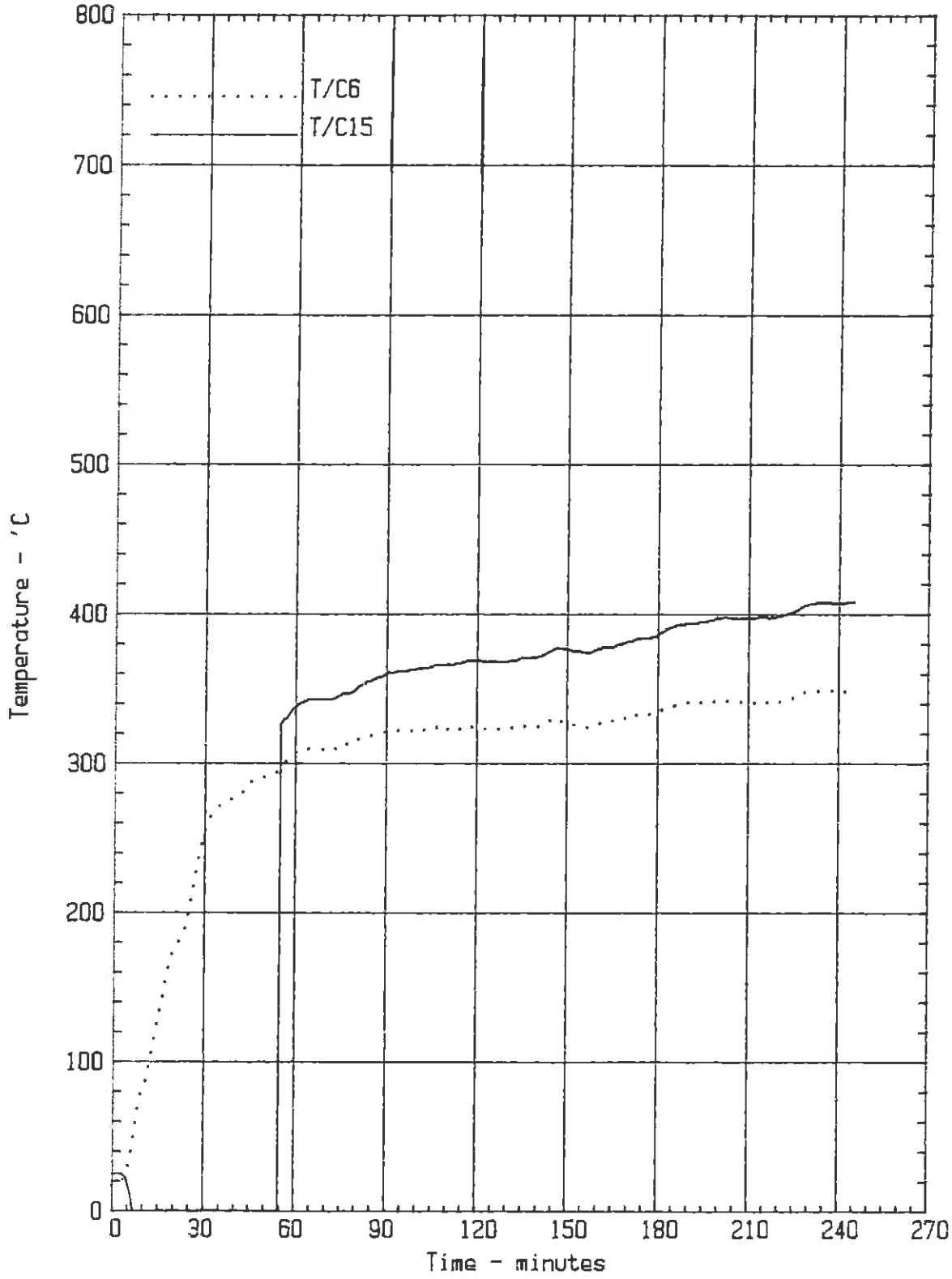


Figure 14 Flue external surface temperatures

Plate 1 End of chimney and seal inside furnace before test

(Neg.No. 002)

Plate 2 Detail of unexposed face of seal and chimney sections – MF100 (in place) and MF50 (free standing)

(Neg.No. 004)

Plate 3 Chimney and penetration seal outside furnace before test

(Neg.No. 009)

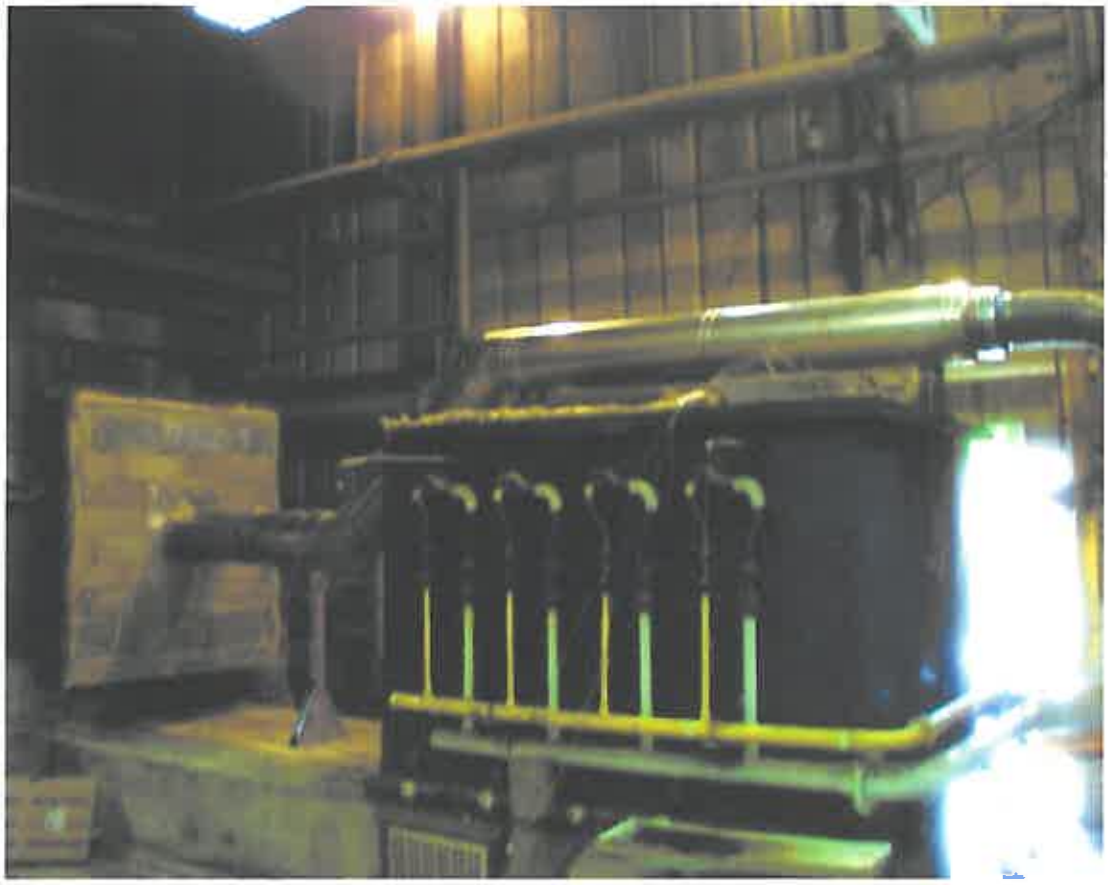


Plate 4 Chimney and penetration system at 240min

(Neg.No. 0010)

Plate 5 Chimney and penetration seal immediately after furnace shutdown at 246min

(Neg.No. 0013)

Plate 6 Showing typical condition of chimney system immediately after furnace shutdown at 246min

(Neg.No. 0016)

The Loss Prevention Council
LPC Laboratories
Melrose Avenue, Borehamwood, Hertfordshire, WD6 2BJ. UK
Telephone: 0181 207 2345 Fax: 0181 207 6305

TE 92515

Test and report by:

T.D. Waters
Technical Officer

TDW/MB
6 September 1999

Approved by:

R.A. Jones
Section Manager, Building Products

P.J. Field
Laboratory Manager