The Loss Prevention Council
LPC Laboratories
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TE 87819

TEST REPORT

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

Client: Climatec Chimney Products,
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Maidstone Road,
Sidcup,
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Date: 2 August 1996

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SUMMARY

An ad-hoc fire test was carried out on a Metaloterm AT insulated stainless-steel chimney system of 200mm internal diameter and 275mm 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 was controlled to follow the heating regime specified in B.S. 476 : Part 20 : 1987. The test was carried out on 7 June 1996 for a duration of 240min.

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 AT chimney system, when subjected to an ad-hoc fire test with an internal fire.

2 CONSTRUCTION

2.1 General

A dense concrete block wall, 190mm thick, was erected within a furnace test frame, 1460mm x 1460mm. The wall had a centrally positioned circular aperture, nominally 285mm in diameter. 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 45° followed by a further horizontal section.

The chimney was approximately 4.7m long and was connected at the end 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.

The chimney system is shown in Figure 1 and before the test in Plates 5 and 6.

2.2 Components

2.2.1 Metaloterm AT chimney sections

Each chimney section was double walled, with a 200mm internal diameter and a 37.5mm insulated cavity. The external diameter was 275mm. 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 white coloured insulation with blue flecks. It was stated by the sponsor to be Insulfrax mineral fibre with a density of 160kg/m^3. At one end of each section the insulation was rebated by 30mm and the outer casing had a series of barbs pressed into it. 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 sections are shown in Plates 1 and 2.

2.2.2 Locking band ATAB

Each locking band was 120mm 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. A locking band is shown in Plate 3.

2.3 Assembly

The chimney sections, comprising a combination of AT100, AT30 and ATB45 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 the barbs over the end with the ridges ensuring a snap connection. A locking band ATAB was then secured over the joint. Details are shown in Figure 2. The end with the barbs was always placed furthest from the furnace.

The chimney was supported at three locations as shown in Figure 1 using stainless steel pipe clamps, clamped around the outer casing. These were 25mm wide x 2.4mm thick, with two halves bolted together and hung from adjustable floor-mounted "goal-post" type frames with M10 studding.

The end of the chimney protruding into the furnace was finished with an ATMA top stub and is shown in Plate 4. 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 with a nominal 5mm clearance all round. Each side of the wall a stainless steel plate, 530mm x 530mm square x 1.45mm thick with a 280mm diameter central aperture was secured at 160mm centres with M8 stainless steel studding around the perimeter.

Outside the furnace a stainless steel pipe clamp, 25mm wide x 2.4mm thick, was welded to the stainless steel plate. Each half of the clamp was welded at one position each side of the aperture and the two halves secured around the chimney with M5 bolts.

3 TEST PROCEDURE

3.1 General

The test was carried out on 7 June 1996 and was witnessed by Messrs R Buttery and A Sparks representing the sponsor and Mr P de Keizer of Ontop BV. The ambient temperature at the start of the test was 25°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 A1 to A4. The furnace was controlled so that the temperature recorded by thermocouple A1 followed the time/temperature curve specified in B.S. 476 : Part 20 : 1987[1]. The temperatures recorded by thermocouples A1 to A4 together with the standard curve are shown plotted against time in Figure 3.

3.3 Furnace pressure

A pressure sensor was mounted in the mouth of the duct 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 duct, 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 ducts via the flexible tube was used for the first 3min of the test to draw furnace gases along the ducts, 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 thirteen 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.

Table 1 Observations

Time min	Observations
0	Test started.
3	Fan switched off.
20	Wisps of steam from joints and penetration.
166	Outer casing of first section from furnace wall becoming gold coloured.
240	No further significant changes. Test terminated.

The chimney is shown after the test in Plate 7.

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 4 to 6.

The maximum temperature measured was 390°C recorded by thermocouple 4 after 235min. For two periods during the test the data logger failed to record temperatures. For these periods temperatures shown in Figures 4 to 6 are by interpolation.

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 AT 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 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.

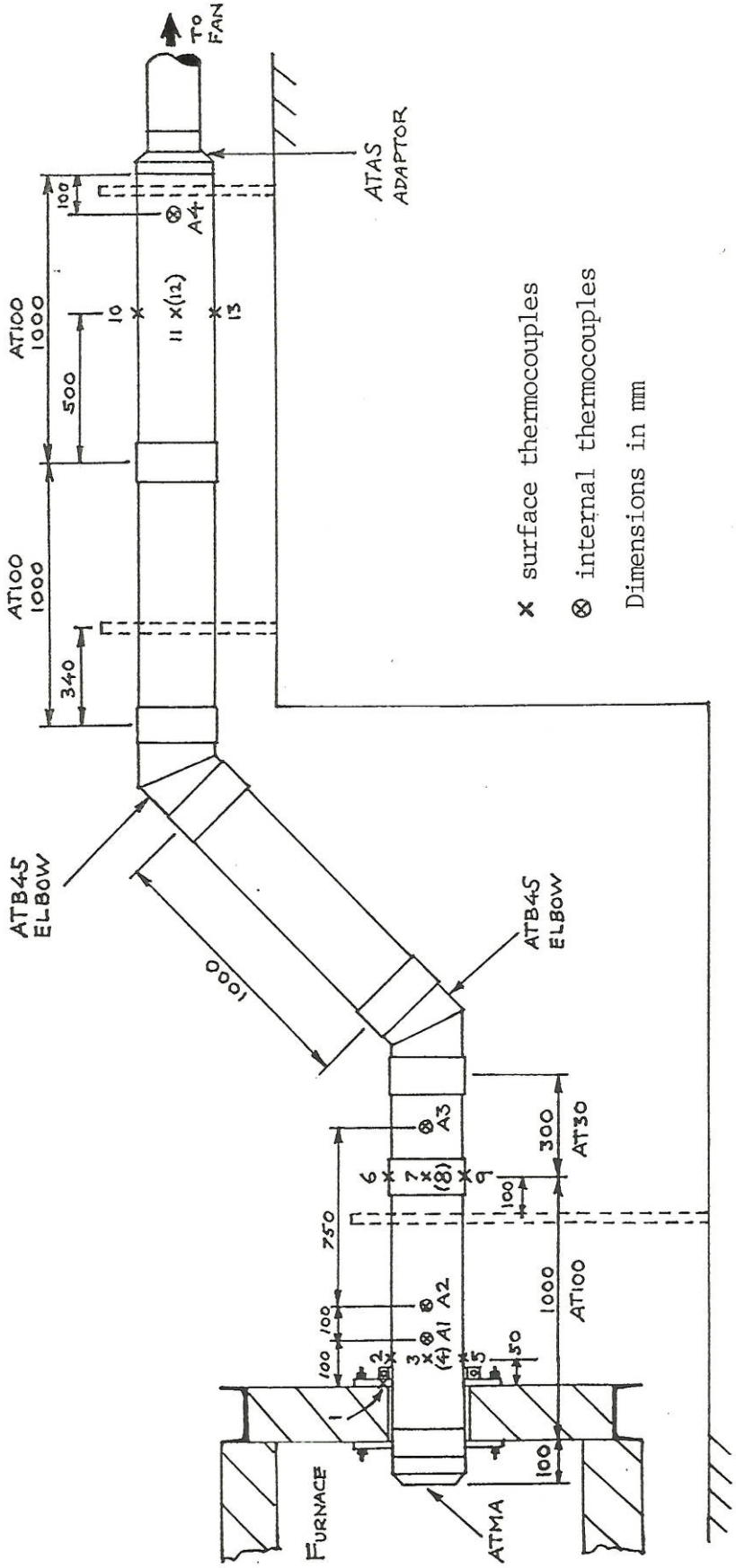

Figure 1 Arrangement of chimney sections and thermocouple positions

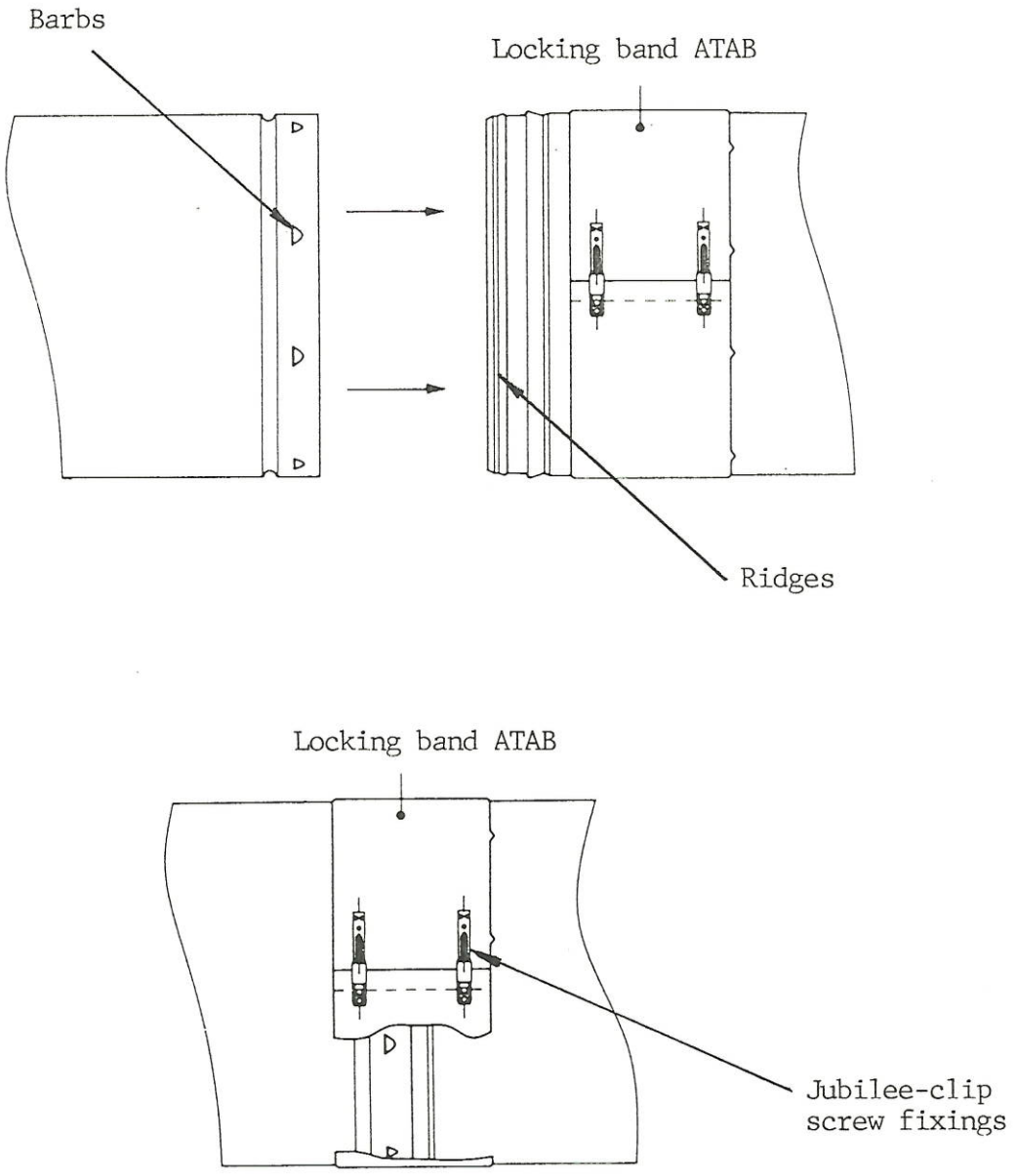

Figure 2 Jointing system for Metaloterm AT chimney sections

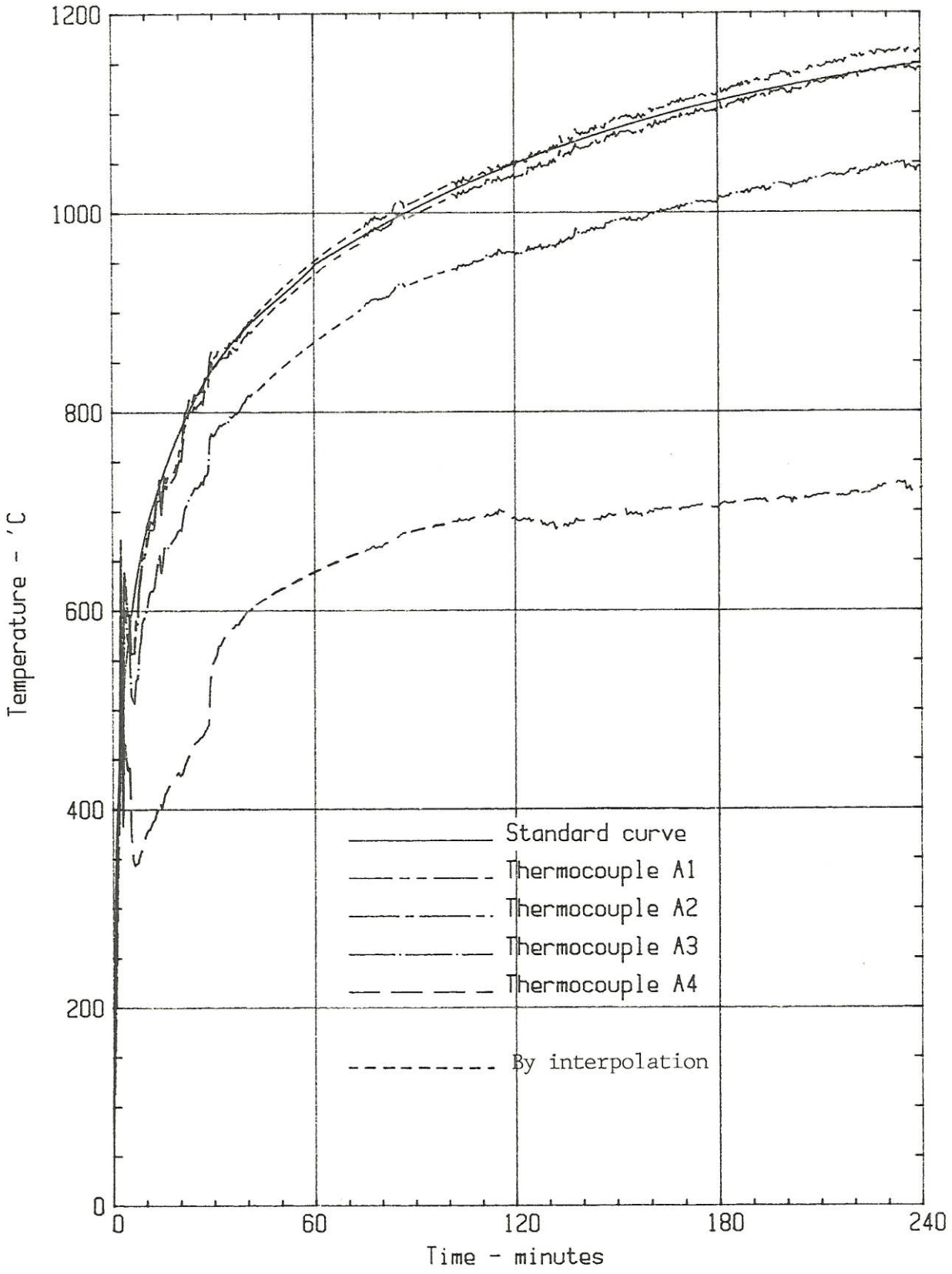

Figure 3 - Temperatures inside flue

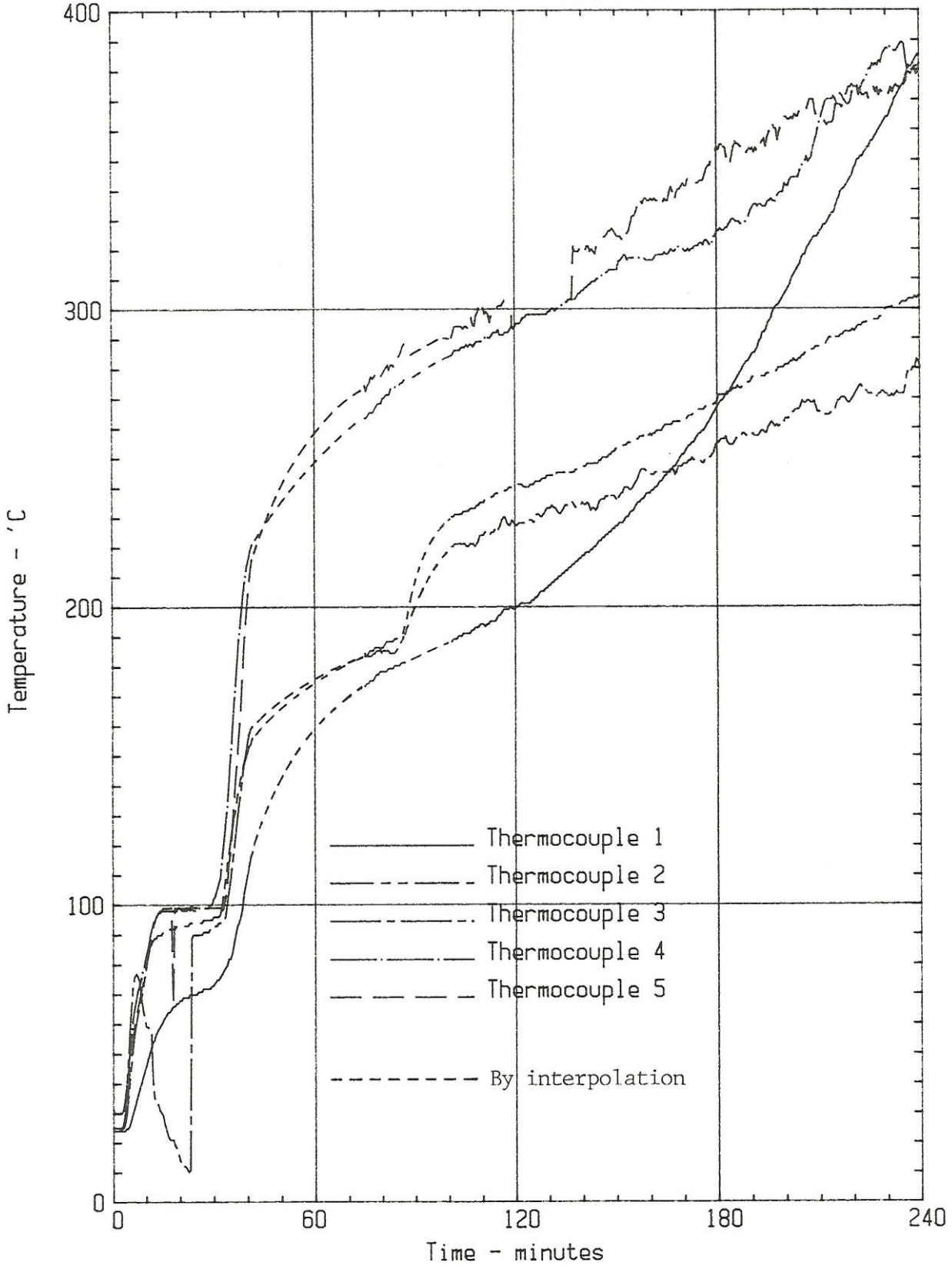

Figure 4 - Temperatures on outer surfaces

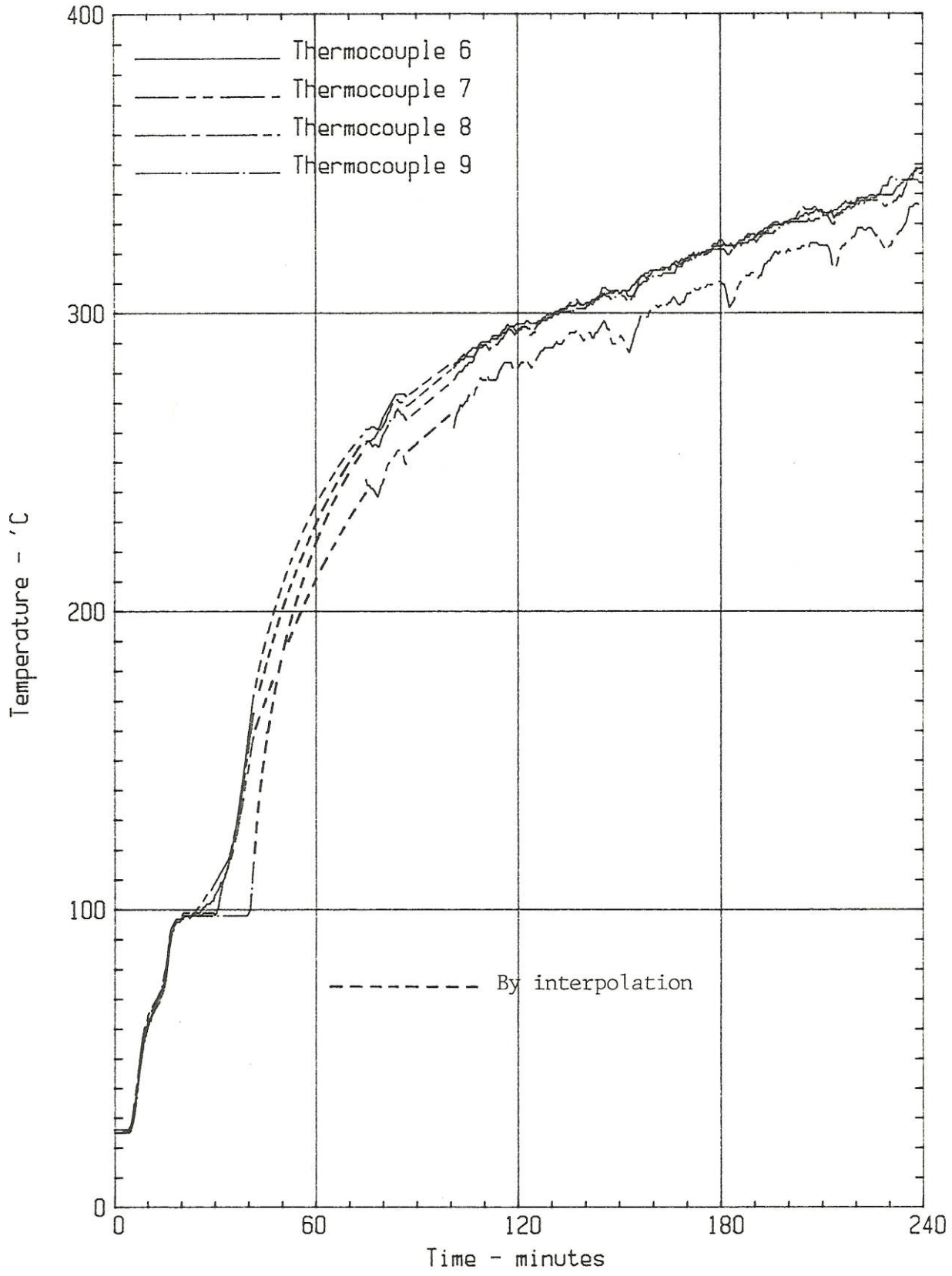

Figure 5 - Temperatures on outer surfaces

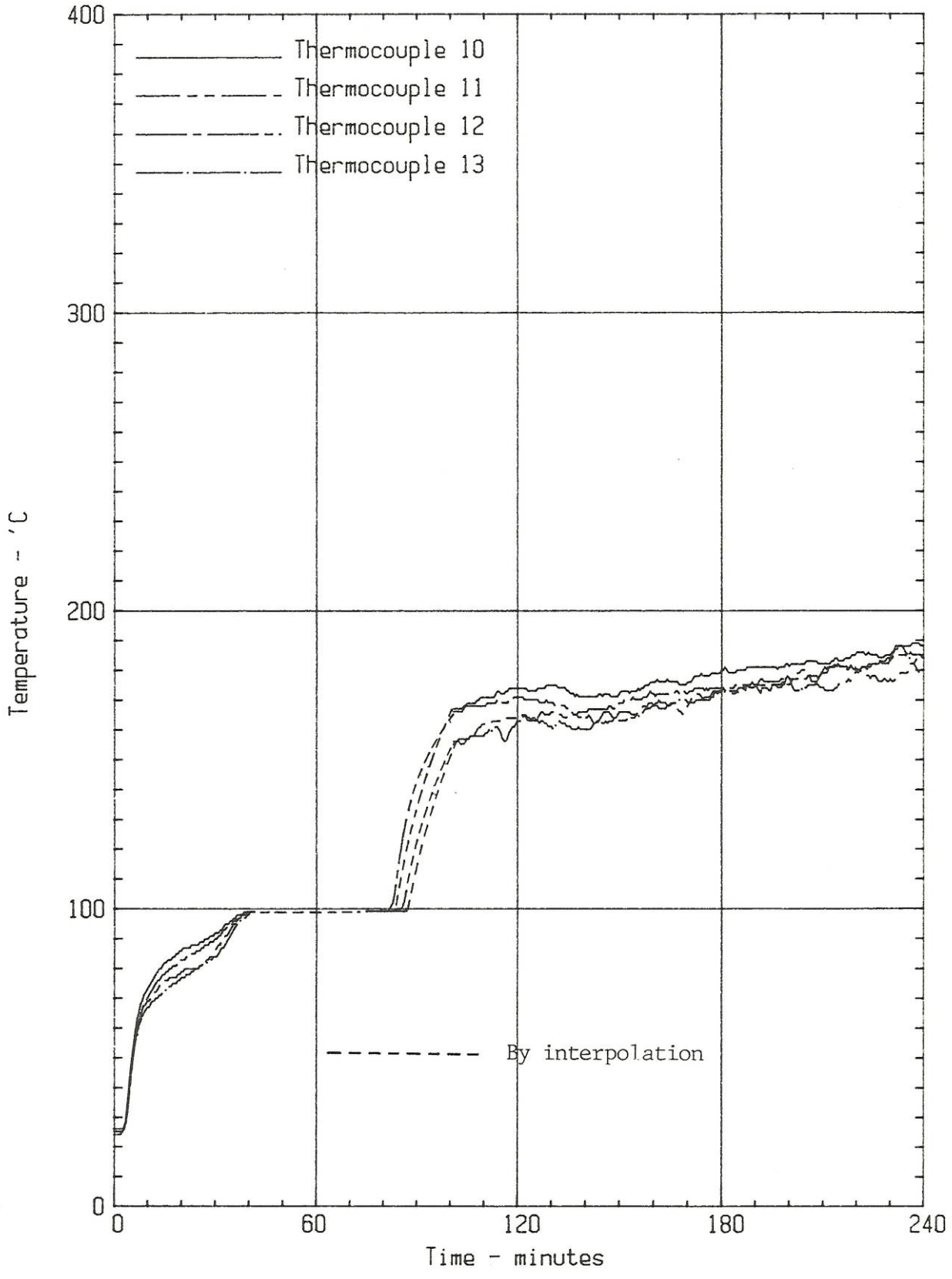

Figure 6 - Temperatures on outer surfaces

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Plate 1 Metaloterm AT100 chimney section showing flush insulation at one end

(Neg.No. 43/61/3)

Plate 2 **Metaloterm AT30 chimney section showing rebated insulation at one end**

(Neg.No. 43/61/5)

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Plate 3 Metaloterm ATAB locking band

(Neg.No. 43/61/7)

Plate 4 End of chimney inside furnace before test

(Neg.No. 43/61/23)

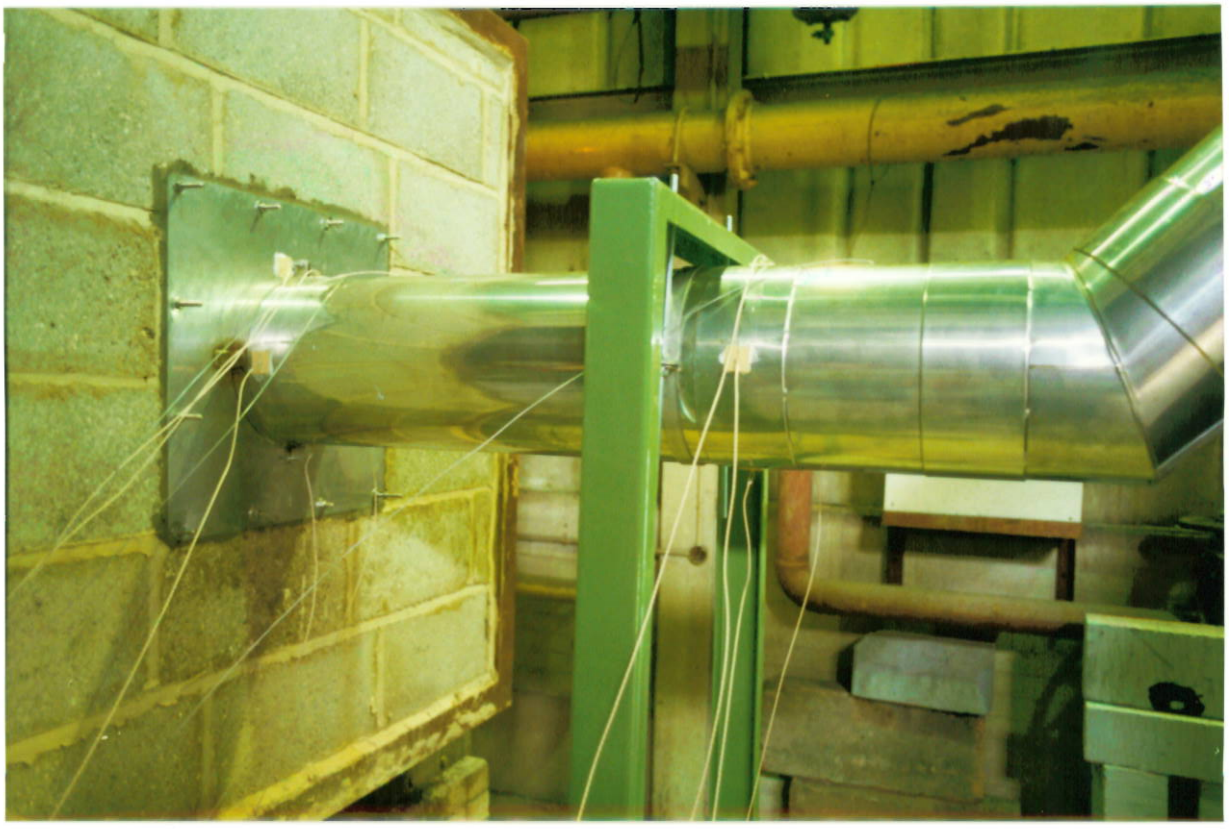

Plate 5 Chimney and penetration seal outside furnace before test

(Neg.No. 43/61/28)

Plate 6 **Chimney outside furnace before test**

(Neg.No. 43/61/25)

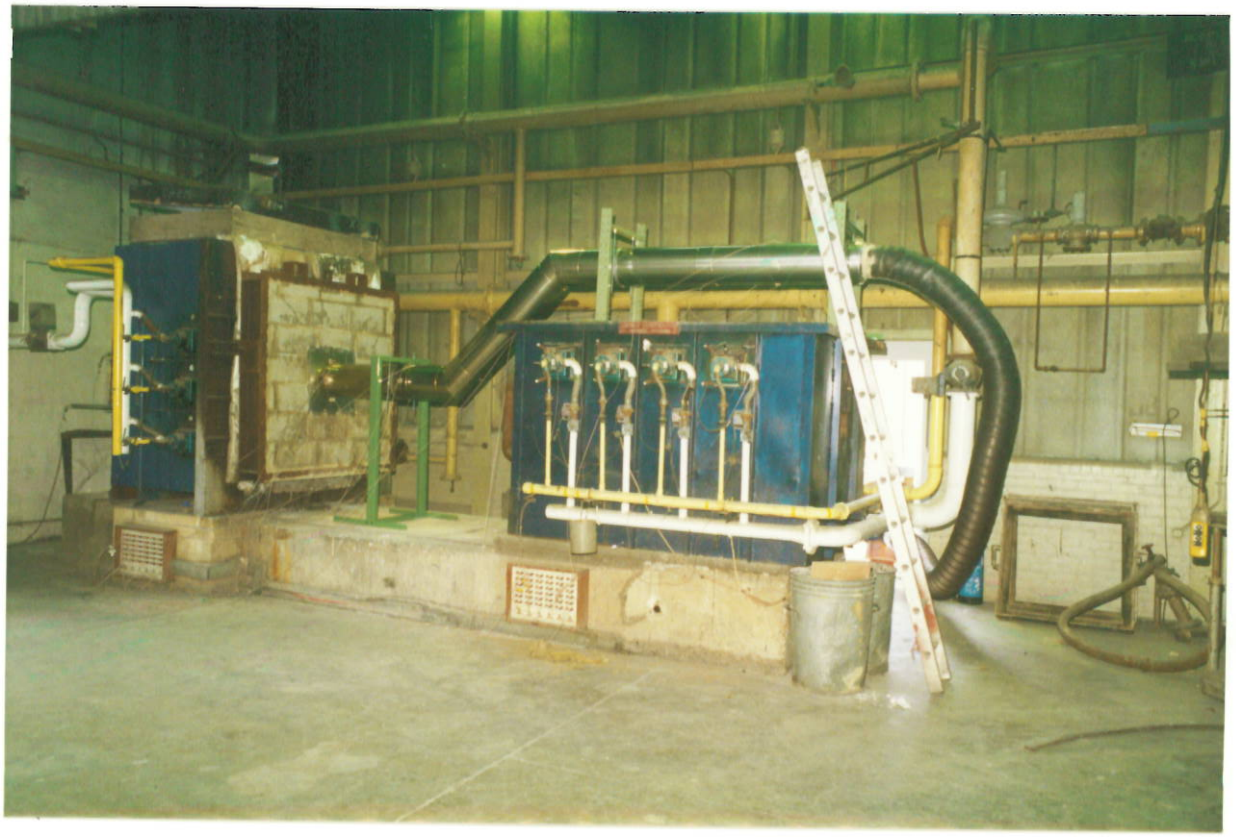

Plate 7 Chimney outside furnace after 240min test duration

(Neg.No. 43/61/33)

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