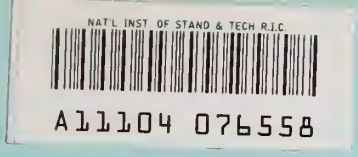

NBSIR 84-2969

Evaluation of Thimble - Chimney Connector (Wall Pass-Through) Systems for Solid Fuel Burning Appliances

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National Bureau of Standards
National Engineering Laboratory
Center for Fire Research
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Prepared for:

Consumer Product Safety Commission
Bethesda, MD 20016

and

U.S. Department of Energy
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U.S. DEPARTMENT OF COMMERCE, Malcolm Baldrige, *Secretary*
NATIONAL BUREAU OF STANDARDS, Ernest Ambler, *Director*

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EVALUATION OF THIMBLE - CHIMNEY CONNECTOR (WALL PASS-THROUGH) SYSTEMS FOR SOLID FUEL BURNING APPLIANCES

Joseph J. Loftus
Richard D. Peacock

Abstract

This report is part of an ongoing project at the National Bureau of Standards (NBS) to evaluate the fire safety of solid fuel burning appliance installations in residential homes and buildings. Previous work included evaluations of different protection devices designed to shield room walls and ceilings from the effects of radiant energy from hot appliance and chimney connector pipe surfaces, the objective being to determine which systems would help maintain surface temperatures on combustibles within code recommended temperature levels.

For this segment a total of 17 different thimble-chimney connector (wall pass-through) systems connected to chimney connector pipes from a stove were evaluated for their ability to provide thermal protection for combustibles (wood studs and headers, etc.) in room walls.

Flue gases passing through the thimbles were monitored over a range of 538 to 649°C (1000 to 1200°F) and temperature rise measurements were made on the surfaces of the combustibles located in proximity to the

thimbles. Code acceptable temperature rise values were found for 9 of the 17 thimble systems tested at the 538°C (1000°F) exposure, for 6 thimbles at 593°C (1100°F) and for 4 thimbles at 649°C (1200°F).

Keywords: ceilings, chimneys, fire codes, fire protection, fire tests, interior finishes, radiant energy, residential buildings, stoves, walls.

1. INTRODUCTION

The Consumer Product Safety Commission and the Department of Energy have sponsored research at the Center for Fire Research in the National Bureau of Standards to investigate fire hazard problems associated with the use of solid fuel burning appliances (stoves) in one- and two- family homes and other residential occupancies.

Scenarios leading to house fires are all too predictable, i.e.: the consumer (1) failed to provide for code recommended clearances or air space between stove surfaces and room walls, (2) failed to observe recommended clearances between chimney connector pipes and room walls and/or ceilings, or (3) cut a hole through a room wall to allow for passage of a thimble (wall pass-through) or chimney connector pipe to a chimney but failed to allow for sufficient clearances between combustibles in the room wall and the exhaust piping system. In some cases, the consumer may even compound the hazard by "framing out" the pass-through with wood studs and headers.

Scenarios no. 1 and 2 above were reproduced in the Center for Fire Research laboratories and evaluations were made of the relation and effects of clearances and radiant energy from hot stove surfaces and chimney connectors on unprotected and protected room walls and ceilings [1,2][1]. Briefly, these reports cite a number of different protection systems that were found useful in helping to reduce thermal effects on exposed surfaces of the room members. Particularly effective were those systems which used a sheet metal plate or two sheet metal plates with an insulative layer between them mounted in front of a wall or ceiling and separated from the room surface by a 25 mm (1 in) air space.

This report relates the results of reproducing scenario no. 3 in the laboratory and making evaluations of the effects of clearances and radiant energy from hot thimble systems on the surface temperature of combustibles in room walls. Clearly, systems found to offer thermal protection to the combustibles would help to reduce ignitions leading to house fires, injury, and significant property damage.

2. BACKGROUND

Recent fire statistics [3] show an alarming increase in the number of house fires in the United States related to wood heating. In 1978 there were 68,000 fires with an estimated dollar loss of $134 million, while in 1981 the number totaled 130,000 fires with a loss of $265 million. This marked increase is attributed to the growing installation and use of wood burning stoves in homes throughout the United States and the fact that most homes are made of combustible construction.

[1]Numbers in brackets refer to references given at the end of this report.

Wood framing in close proximity to hot wall pass-through systems is highly susceptible to ignition because flue gases passing through thimbles can easily develop temperatures in excess of 593°C (1100°F) [4] and because the ignition temperature of wood is approximately 200°C (392°F). The constant heating of wood over a long period of time also presents a hazard problem because wood may undergo chemical changes resulting in a lowered ignition temperature [5,6]. MacLean [7,8] reports charring of wood samples at temperatures as low as 93°C (200°F) and concludes that wood should not be exposed to temperatures appreciably higher than 66°C (150°F) for long periods. There have been numerous documented fires involving the ignition of wood members near low pressure steam pipes [9] suggesting that wood exposed to long term low level heating should not be exposed to temperatures higher than 100°C (212°F). Based on this evidence, building and fire codes recommend that wood should not be exposed to temperatures higher than 100°C (212°F) and that wood framing around interior chimneys be separated from the chimney by an air space of at least 51 mm (2 in) [4].

3. LIMITING SAFE TEMPERATURES ON COMBUSTIBLE SURFACES

Limiting safe temperatures on combustible surfaces in proximity to thimble (wall pass-throughs) leading to chimneys are based on the following Underwriters Laboratories Listings for heat producing appliances and methods for setting clearances between appliances and combustible surfaces.

- maximum temperature rise of 65°C (117°F) above room temperature on exposed combustible surfaces; and

- maximum temperature rise of 50°C (90°F) above room temperature on unexposed combustible surfaces, such as beneath or behind a shield.

The 50°C (90°F) temperature rise limitation for unexposed combustible surfaces was used for the thimble evaluation tests.

4. TEST APPARATUS AND PROCEDURES

Figure 1 shows the mock-up gas fired stove used for the testing program. The fire box used with the stove consisted of a radiant panel made of porous refractory material mounted in a cast iron frame which allows for the combustion of gas on its surface. Natural gas mixed with air from a blower was used as fuel for the stove. Venting for the stove was provided by a 152 mm (6 in) diameter chimney connector pipe system (figure 2) which entered the wall thimbles at a location approximately 1.32 m (52 in) from the floor. The stove was positioned 915 mm (36 in) away from the test room wall for all tests. A chromel alumel (24 gauge, 0.5 mm, 0.020 in) thermocouple was used to measure flue gas temperatures. It was positioned inside the chimney connector pipe at its center and at a point where the wall thimble and connector pipe were joined approximately 89 mm (3.5 in) from the room walls. Figure 3 shows the location of 12 (evenly spaced) 24 gauge chromel alumel thermocouples attached to the exposed or protected surfaces of the combustibles (wood studs and headers) located in the room wall and in proximity to the thimble or wall pass-through. Gas flows to the stove were monitored so that the stove surface temperatures were maintained at 350, 400, and 450°C (662, 752 and 842°F). At these temperatures, flue gases exiting through the connector pipe-thimble

systems generated temperatures in the pipe of 538, 593, and 649°C (1000, 1100, and 1200°F).

5. WALL THIMBLE SYSTEMS

Table 1 lists and describes the 17 different thimble (wall pass-through) systems evaluated in this test series. Shown are the system number, type, the number of air channels used in a thimble, the air space or clearance between the thimble and combustibles, and whether a sheet metal liner was used to cover the exposed surfaces of the combustibles. Sketches of the thimble systems are shown in figures 4 to 20. The tubular sheet metal thimbles used for system nos. 3 to 7 were fabricated by the Center for Fire Research while the tubular metal thimbles used in system nos. 13 to 17 were commercially available, listed chimney sections. The square sheet metal thimble (no. 1) also was constructed by the Center, as were the brick masonry patches used for system nos. 8 and 9. The chimney masonry block (no. 12) was a factory made item. An examination of table 1 shows that the same tubular (2 air channel) thimble was used for system nos. 5, 6, and 7. Nos. 5 and 7 used glass fiber insulation between the thimble and combustible surfaces. In the case of no. 5, the insulation thickness was 76 mm (3 in) and, in no. 7 it was 152 mm (6 in). System no. 6 utilized an air separation of 152 mm (6 in) between the surfaces. Sheet metal liners (28 gauge, 0.38 mm, 0.015 in) were used to cover surfaces of combustible for tests with thimble system nos. 3 to 7.

6. TEST RESULTS

Figures 4A to 20A show plots of surface temperature rise (°C) for each of 12 different thermocouple locations on the combustible surfaces. The highest values are shown for locations 6 and 7 directly above the hot thimble and (except for 4A the square thimble plot) the lowest for locations 2 and 11 beneath (and farthest away) from the thimble. Peak values can be attributed to the convection of buoyant gases in the case of air separation between the combustible and thimble and to conduction of heat in those cases where solid material such as brick patches separated the thimble from the combustible material. In every case, plots for the air separation systems show cyclic temperature rise patterns. Vertically mounted combustibles (to each side of the thimbles) registered almost median temperature rise values at locations 3, 4, 9 and 10. While the vertical members separated from the thimble by the brick patches showed surface temperatures only slightly less than the peak temperatures recorded for the horizontal combustible headers located above the thimbles.

1. Wall pass-through systems failing all of the exposure temperature tests were: Nos. 1, 2, 3, 4, 12, 13, 14, and 16.

2. Wall pass-through systems passing 538°C (1000°F) tests were: Nos. 5, 6, 7, 8, 9, 10, 11, 15, and 17.

3. Wall pass-through systems passing 593°C (1100°F) tests were: Nos. 7, 9, 10, 11, 15, and 17.

4. Wall pass-through systems passing 649°C (1200°F) tests were: Nos. 7, 9, 10, and 17.

7. DISCUSSION

7.1 Failing Wall Pass Through Systems

Wall pass-through system nos. 1, 2, 3, 4, 12, 13, 14 and 16 failed all exposure tests due to a lack of sufficient air space (clearance) or insulation between the thimble and combustible surfaces in the room walls. In the case of no. 1, the combustibles were in direct contact with the sheet metal thimble. For system no. 2, a chimney connector pipe passed through a wall at 76 mm (3 in) clearance to the combustibles. In no. 12, a chimney connector passed through a chimney masonry block with provision for 38 mm (1.5 in) air clearance between the pipe and the block. Tubular system nos. 3 and 4 had one and two air channels, respectively; but the 76 mm (3 in) clearance between the thimbles and combustibles was not enough to provide adequate thermal protection for the combustibles. System nos. 13 and 14 were commercial chimney sections with two air channels and one insulated channel, respectively. Each failed tests at 51 mm (2 in) clearances, as did no. 16, a sheet metal (two air channel) system at the same clearance.

7.2 Systems Passing 538°C (1000°F) Exposure Tests

Passing systems were nos. 5, 6, 7, 8, 9, 10, 11, 15 and 17. As previously described, system nos. 5, 6, and 7 used the same two air channel thimble for each test. No. 5 had a 76 mm (3 in) thick layer of glass fiber

insulation between the thimble and combustible surfaces. No. 6 used 152 mm (6 in) air space and no. 7 had the benefit of 152 mm (6 in) thick layer of glass fiber insulation.

System nos. 8 and 9 met the temperature rise requirements because brick masonry patches provided 203 and 305 mm (8 and 12 in) brick separations, respectively, to combustible materials. Thimble nos. 10 and 11 passed the exposure tests because they enjoyed large air space separations to combustibles. In the case of no. 10, the distance was 457 mm (18 in) while for no. 11, the separation was 229 mm (9 in) between the connector pipe and a sheet metal sleeve protecting the combustible materials. Thimble no. 15 qualified because it consisted of an insulated tubular chimney section having an ID of 203 mm (8 in). This oversize pipe section provided for a 25 mm (1 in) air clearance all around a 152 mm (6 in) diameter chimney connector pipe. Thimble no. 17 was the same thimble as used in system 14 which failed all exposure tests except that its clearance to combustibles was 229 mm (9 in).

7.3 Systems Passing 593°C (1100°F) Exposure Tests

Passing systems were nos. 7, 9, 10, 11, 15, and 17. When tested at 593°C (1100°F), the above previously described thimbles continued to offer thermal protection for the combustibles located in proximity to them. System nos. 17, 9 and 10 allowed a 36, 38 and 38°C rise, respectively, on the surfaces of combustibles, no. 7 permitted a rise to 42°C while nos. 11 and 15 showed 50°C (just passing) levels.

Missing from the 593°C (1100°F) listing were systems nos. 5, 6, and 8. These systems failed to meet the code requirements by narrow margins; i.e., 4, 2, and 1°C, respectively, above the 50°C (90°F) code recommended temperature rise limitation.

7.4 Systems Passing 649°C (1200°F) Exposure Tests

Passing systems at the 649°C (1200°F) exposure were nos. 7, 9, 10 and 17. No. 7 had the 152 mm (6 in) thick glass fiber insulation, no. 9 had the benefit of a 304 mm (12 in) layer of brick, no. 10 used the code recommended air clearance to combustibles of 457 mm (18 in) and no. 17 benefited from its 229 mm (9 in) clearance. Missing from this listing were systems nos. 11 and 15, which had passed exposure tests at 538 and 593°C (1000 and 1100°F). Thimble no. 11 failed to meet the temperature rise limit by 8°C and no. 15 by 11°C.

7.5 Effect of Sheet Metal Liners on Surface Temperature Rise

To determine the relation of metal liners in direct contact with combustibles to surface temperature rise on combustibles, a two air channel thimble was selected for tests. In one case, the wall pass-through system (no. 6) was separated from the combustibles (covered and uncovered) by a 152 mm (6 in) air space; and, in another (system no. 5), it was protected by a 76 mm (3 in) thick layer of glass fiber insulation. Figure 21 shows a comparison of results for system no. 6. Here it is shown that the uncovered (unlined) combustible members developed lower temperatures on their surfaces for all of the exposure tests as indicated in the following listing.

		Temperature Rise, °C		
	Exposure	Covered	Uncovered	% Decrease
System No. 6	538°C (1000°F)	42	39	7
	593°C (1100°F)	52	44	15
	649°C (1200°F)	68	58	15

On the basis of compliance with recommended code limitations for temperature rise, covered materials qualify for the 538°C (1000°F) exposure while the uncovered would be acceptable for 538 and 593°C (1000 and 1100°F) exposures. Concerning system no. 5, an examination of the data in Figure 22 shows that the uncovered combustible members developed lower temperatures for every exposure and location except for positions 6 and 7 (top header) where recorded temperatures were identical in the 593° and 649°C (1100 and 1200°F) exposures.

8. CONCLUSIONS

From an analysis of results of evaluation tests on 17 different thimble or wall pass-through systems it was found that the NFPA Code 211 recommendations for temperature rise on the surfaces of partitions and combustibles in room walls was met by a total of nine systems when the exposure level (as recommended by the code) was 538°C (1000°F).

When the exposure level was upgraded to 593°C (1100°F) the number of passing systems was reduced to six and on one further upgrade to 649°C (1200°F) the number of systems which limited surface temperature rise to 50°C (90°F) or less was four.

Impetus for testing at the upgraded temperature levels was given by the fact that flue gas temperatures can reach as high as 648°C (1200°F) in a thimble or wall pass-through system.

Briefly, those passing all test exposures to 649°C (1200°F) were:

#17 A commercial insulated chimney connector section at 229 mm (9 in) clearance.

#10 A single wall metal chimney connector at 475 mm (18 in) clearance.

#9 A brick masonry patch measuring 304 mm (12 in).

#7 A tubular sheet metal thimble with two air channels and a 152 mm (6 in) layer of fiberglass between the thimble and combustible surfaces.

Systems passing tests to the 593°C (1100°F) exposure level were:

#11 A single wall chimney connector separated from room wall combustibles by a 229 mm (9 in) air space and a sheet metal sleeve protector.

#15 A commercial insulated chimney connector with a diameter of 203 mm (8 in) which served as a pass through for a 152 mm (6 in) diameter single wall chimney connector. Clearance to combustibles was 51 mm (2 in).

Systems passing tests at the 538°C (1000°F) exposure level included all of the above plus the following:

#8 A brick masonry patch measuring 203 mm (8 in).

#6 A tubular sheet metal thimble with two air channels and a clearance of 152 mm (6 in) from combustibles.

#5 A tubular sheet metal thimble with two air channels and a 76 mm (3 in) thick layer of fiberglass between the thimble and combustible surfaces.

Building and fire code officials may wish to use the information generated by these evaluation tests when considering an update of recommendations for installation and use of wall pass-through systems and of clearances to room wall combustibles.

9. RECOMMENDATIONS

With the introduction of new and numerous solid fuel burning appliances in the marketplace and with new technology directed toward more efficient burning and conservation of fuel it is quite possible that flue gas temperatures in chimney connectors will approach values as high as 649°C (1200°F). It thus appears desirable that the level of thermal protection for room wall combustibles should be upgraded to ensure that the combustible materials can withstand the effects of radiant heat transfer from hot thimbles or wall pass-throughs if the thimble were to reach 649°C (1200°F). Possible text for model

building code specifications for room wall combustibles protection is detailed below.

(1) Connections for residential type appliances may pass through walls or partitions constructed of combustible materials if the connector system selected or fabricated is installed in accordance with the conditions and clearances recommended in table 3. If the connector is made of sections of listed factory built chimney, it shall be installed in accordance with conditions of the listing and the manufacturer's instructions. Any material used to close up an opening for the connector shall be noncombustible material.

10. REFERENCES

[1] Loftus, J.J., Evaluation of Wall Protection Systems for Wood Heating Appliances, Nat. Bur. Stand. (U.S.) NBSIR 82-2506; 1982 May, 61 p.

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[3] Harwood, B. and Kale, D., Fires Involving Fireplaces, Chimneys and Related Appliances, U.S. Consumer Product Safety Commission, 1981 September, 30 p.

[4] Standard for Chimneys, Fireplaces, Vents and Solid Fuel Burning Appliances, NFPA 211-1984, National Fire Protection Association, Quincy, MA.

[5] McKinnon, G.P., Ed., Fire Protection Handbook, 15th Edition, National Fire Protection Association, Boston, MA, p. 4-9 to 4-15 (1981).

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[7] MacLean, J.D., Effect of Heat on Properties and Serviceability of Wood: Experiments on Thin Wood Specimen, Forest Products Laboratory Report No. R1471, Madison, WI (1951).

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[9] Matson, A.F., Dufori, R.E. and Brun, J.F., Performance of Type B Gas Vents for Gas Fired Appliances, Part II, Survey of Available Information on Ignition of Wood Exposed to Moderately Elevated Temperatures, Underwriters Laboratories, Inc., Bulletin of Research, No. 51, Northbrook, IL (May 1959).

TABLE 1

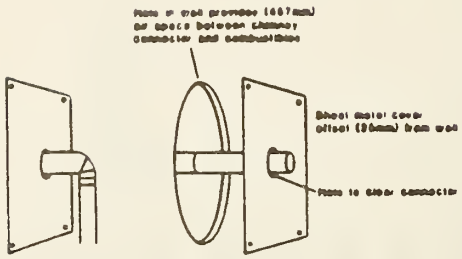
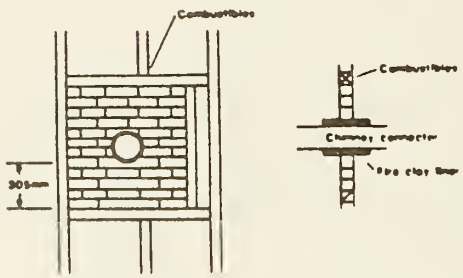
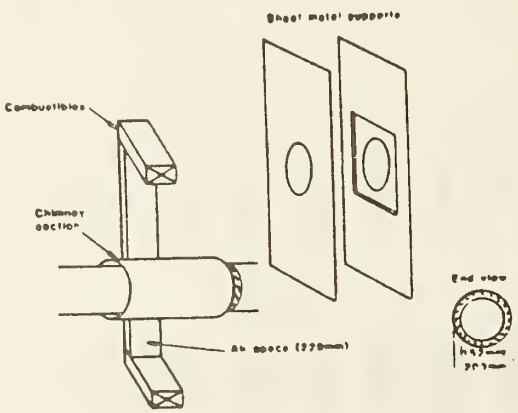
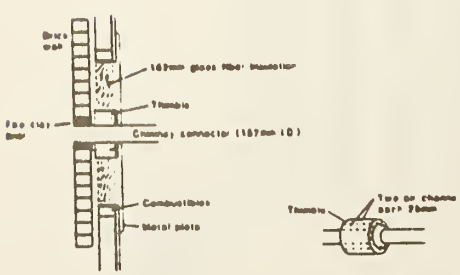
Thimble System	Type	Air Channels	Air Clearance To Combustibles		Metal Liner
			mm	in	
1	Square (457x457mm) Vented	None	0	0	None
2	Chimney Connector (152mm) ID	None	76	3	None
3	Tubular Sheet Metal	1	76	3	Yes
4	Tubular Sheet Metal	2	76	3	Yes
5	Tubular Sheet Metal	2	(76 mm Glass Fiber in Void)		Yes
6	Tubular Sheet Metal	2	152	6	Yes
7	Tubular Sheet Metal	2	(152 mm Glass Fiber in Void)		Yes
8	Brick Masonry Patch (203mm)	None	0	0	None
9	Brick Masonry Patch (304mm)	None	0	0	None
10	Chimney Connector (152mm) ID	None	457	18	None
11	Chimney Connector (152mm) ID	None	259	9	None
12	Chimney Masonry Block	None	38	1.5	None
13	Commercial Chimney Section	2	51	2	None
14	Commercial Ch. Sec. (insulated)	None	51	2	None
15	Commercial Ch. Sec. (insulated) 203mm ID	None	51	2	None
16	Tubular Sheet Metal	2	51	2	None
17	Commercial Ch. Sec. (insulated)	None	229	9	None

TABLE 2
Thimble Test Results

Thimble No.	Peak Temperature Rise °C (°F) on Combustibles Surfaces for Flue Gas Temperatures of 538°C °C	(1000°F) °F	593°C °C	(1100°F) °F	649°C °C	(1200°F) °F
1	96	205	108	226	130	206
2	110	230	139	282	164	327
3	77	171	93	199	113	235
4	54	129	70	158	94	201
5	46	115	54	129	63	145
6	42	108	52	126	68	154
7	36	97	42	108	46	115
8	37	99	51	124	65	149
9	30	86	38	100	45	113
10	34	93	38	100	48	118
11	43	109	50	136	59	138
12	74	165	97	207	110	230
13	82	180	94	201	116	241
14	66	151	78	172	95	203
15	40	104	50	122	61	142
16	61	142	77	171	89	192
17	33	91	36	97	48	118

TABLE 3
Chimney Connector Systems and Clearances from Room Wall Combustibles
for Residential Heating Appliances

Continuous Flue Gas Temperature to 649°C (1200°F)

System	Clearances	mm/in
	152 mm (6 in) I.D. sheet metal chimney connector - single wall 0.61 mm (0.024 in) thick	457/18
	90 mm (3.5 in) thick brick masonry wall - brick separation 305 mm (12 in) to combustibles	304/12
	152 mm (6 in) I.D. metal commercial chimney section with a 25 mm (1 in) thick insulated channel	229/9
	152 mm (6 in) I.D. sheet metal chimney connector - single wall 0.61 mm (0.024 in) thick with two 25 mm (1 in) air channels, separated from combustibles by a 152 mm (6 in) thick layer of glass fiber insulation	152/6

1. Insulation material used as part of clearance reduction system shall have a thermal conductivity of 4.88 kg.-cal/hr m^2 °C (1.0 BTU-in/Sq ft-hr-°F) or less

TABLE 3 - Continued

Continuous Flue Gas Temperature to 593°C (1100°F)

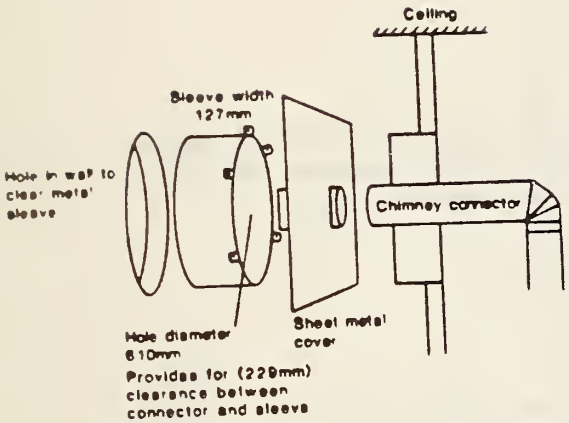
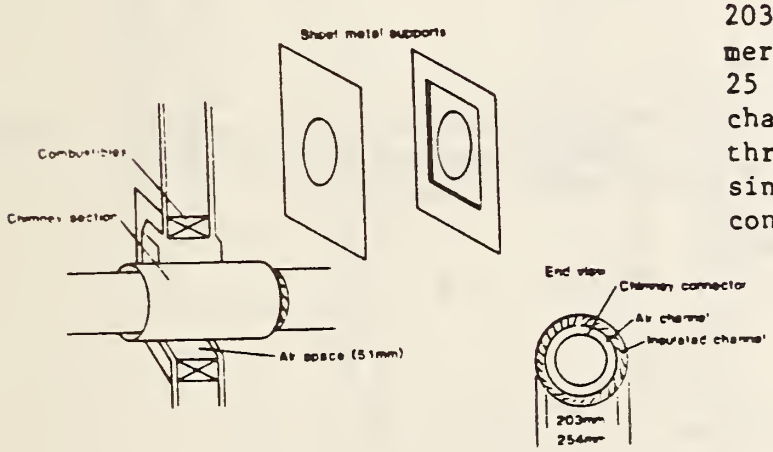
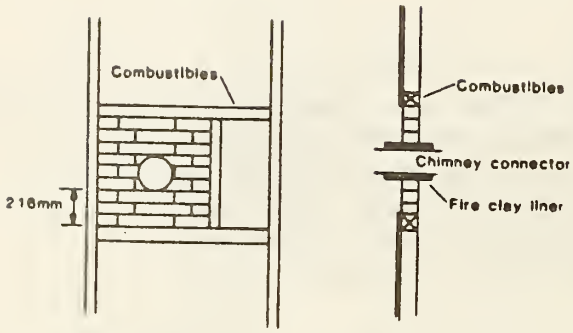
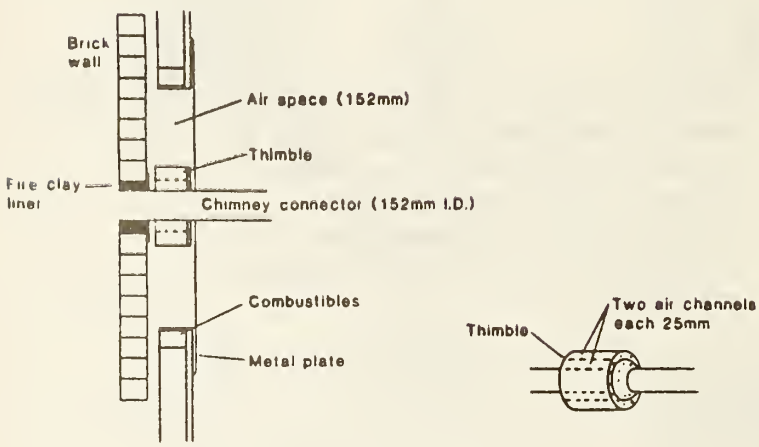
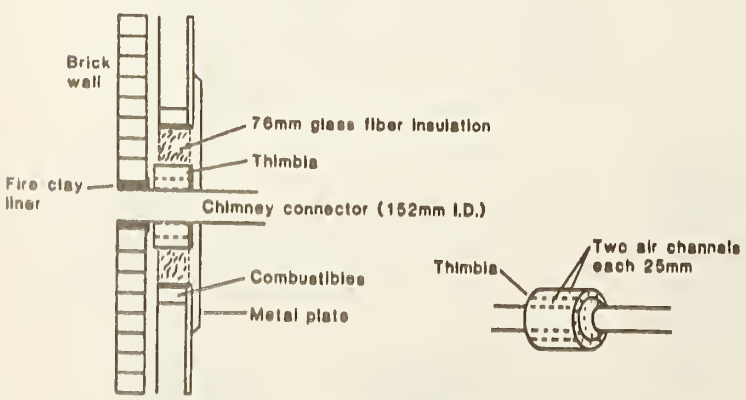
System	Clearances	mm/in
	152 mm (6 in) I.D. single wall sheet metal chimney connector separated from combustibles by a 229 mm (9 in) air space and a 0.61 mm (.024 in) 24 gage sheet metal sleeve protector	229/9
	203 mm (8 in) I.D. metal commercial chimney section with a 25 mm (1 in) thick insulated channel, serving as a pass through for a 152 mm (6 in) I.D. single wall sheet metal chimney connector	51/2

TABLE 3 - Continued

Continuous Flue Gas Temperature to 538°C (1000°F)

System	Clearances	mm./in
	90 mm (3.5 in) thick brick masonry wall - brick separation 203 mm (8 in) to combustibles	203/8
	152 mm (6 in) I.D. sheet metal chimney connector with two 25 mm (1 in) air channels	152/6
	152 mm (6 in) I.D. sheet metal chimney connector with two 25 mm (1 in) air channels separated from combustibles by a 76 mm (3 in) thick layer of glass fiber insulation.	76/3

2. All clearances and thicknesses are minimums; larger clearances and thicknesses are acceptable.

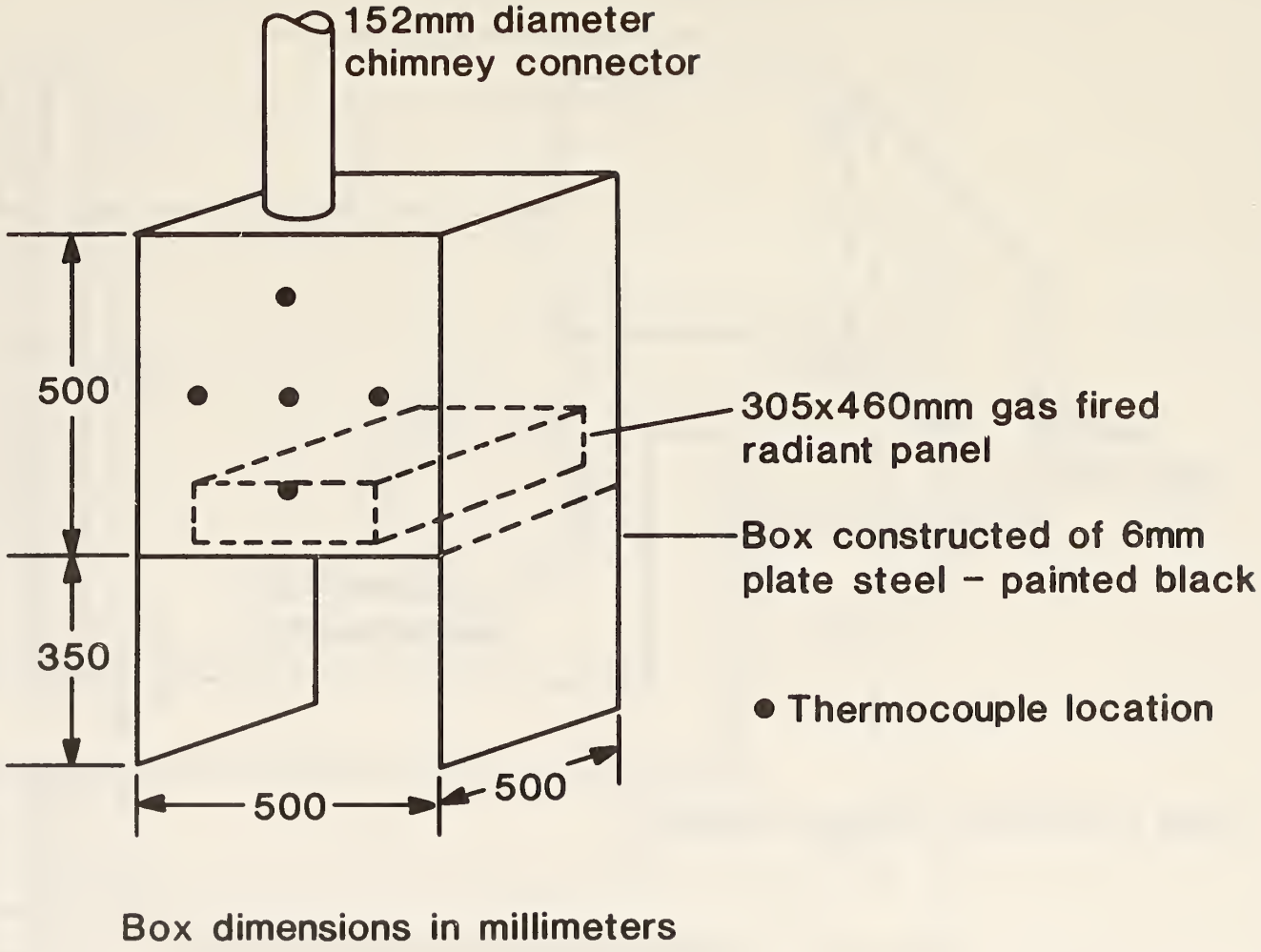


Figure 1. Appliance Construction Details for Gas Fired Stove Used in Thimble Tests

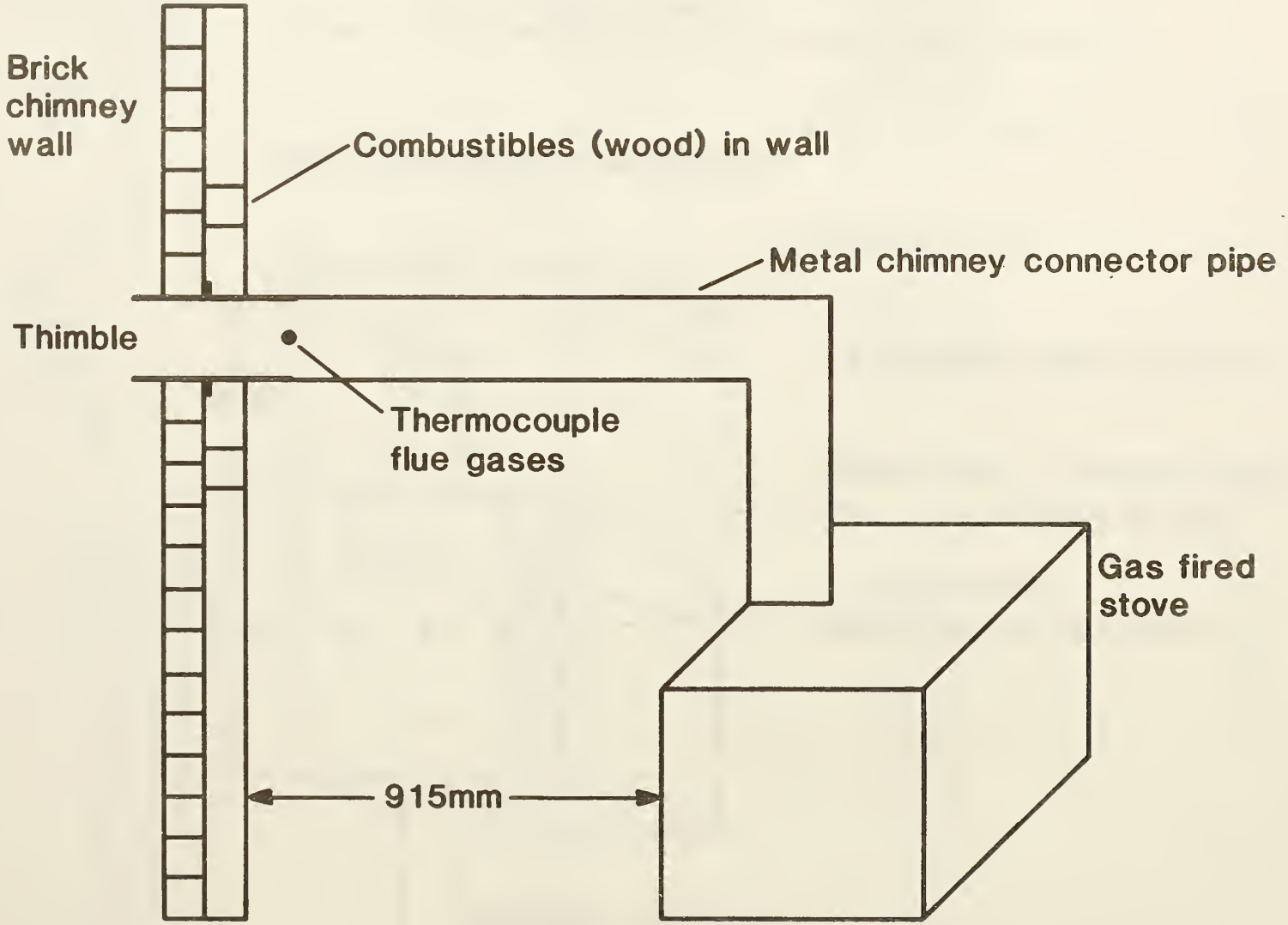


Figure 2. Thimble (Wall Pass Through) Testing Apparatus

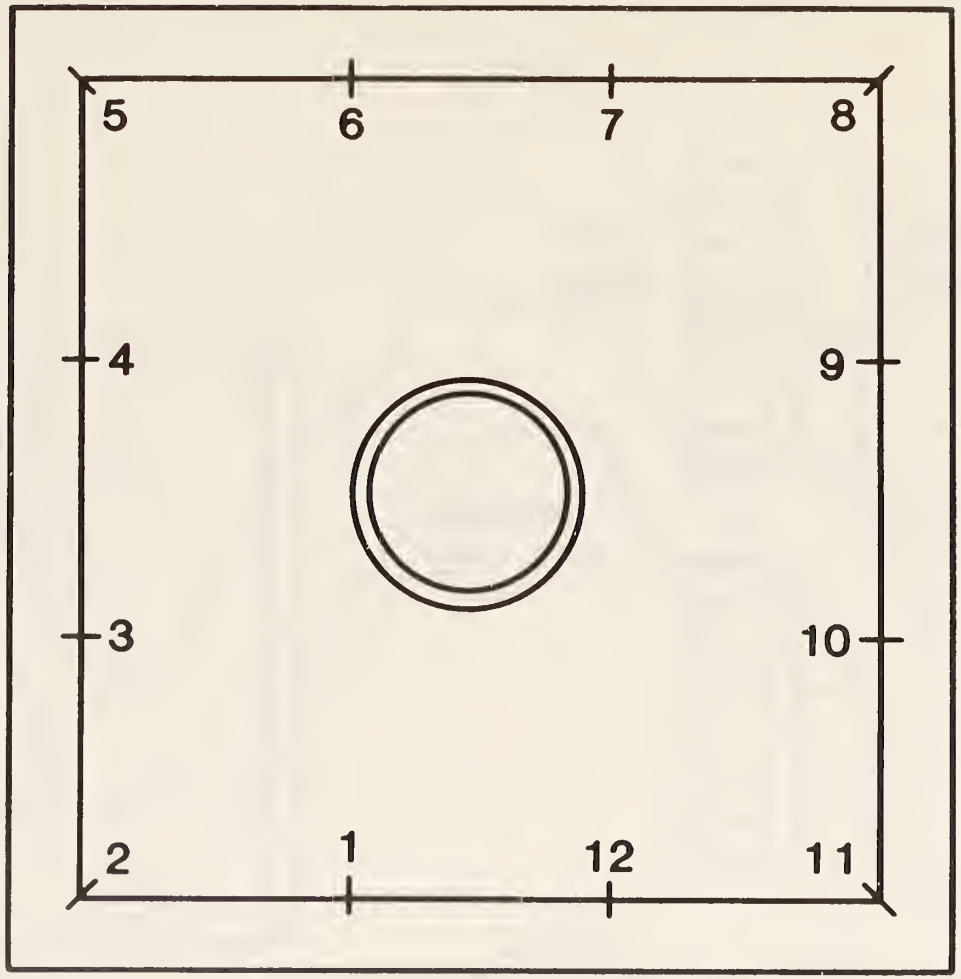


Figure 3. Thermocouple Locations on Wood Studs and Headers for Thimble (Wall Pass Through) Tests

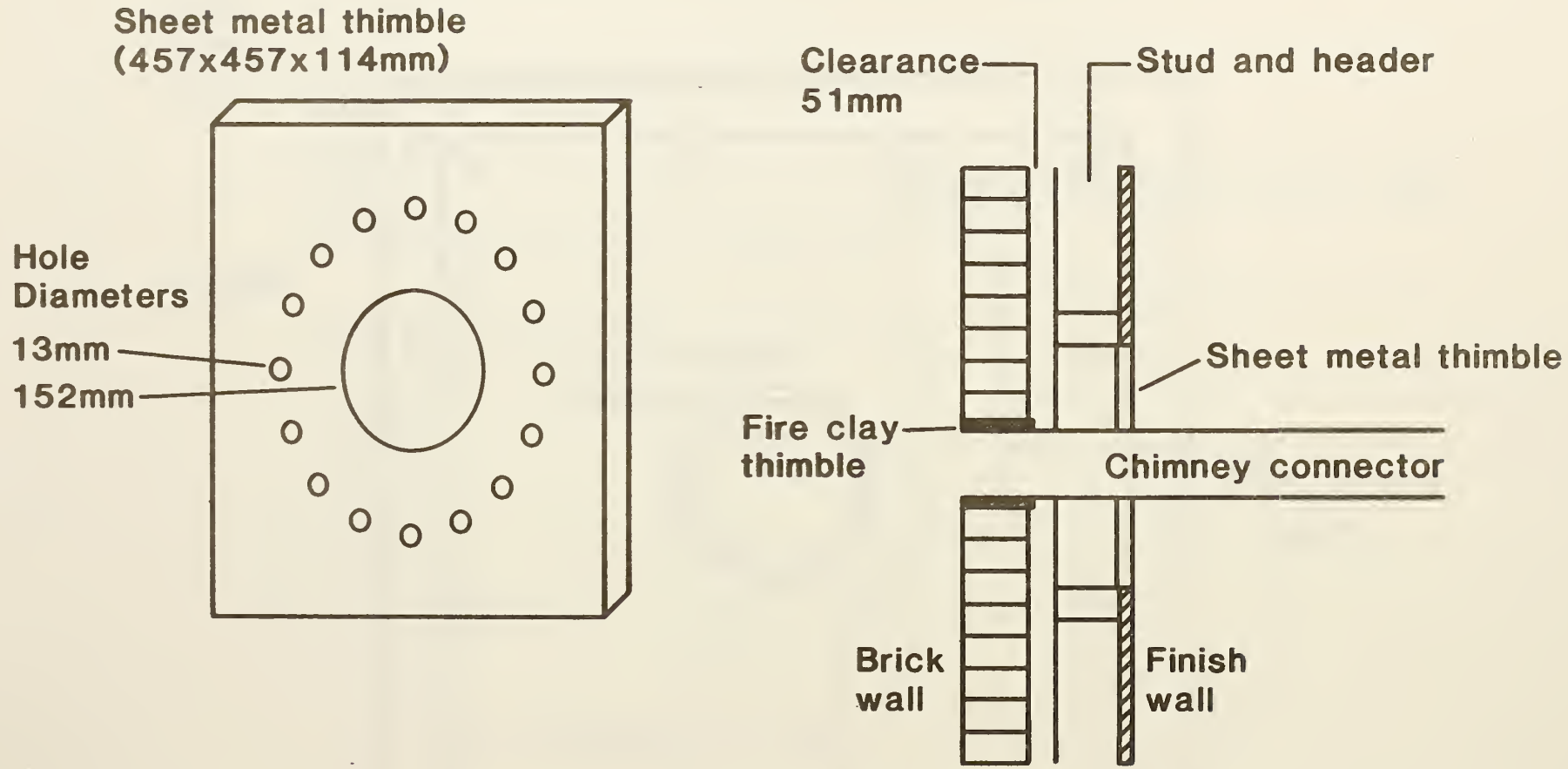


Figure 4. Square (Sheet Metal) Thimble - Ventilated Combustibles in Contact with Thimble

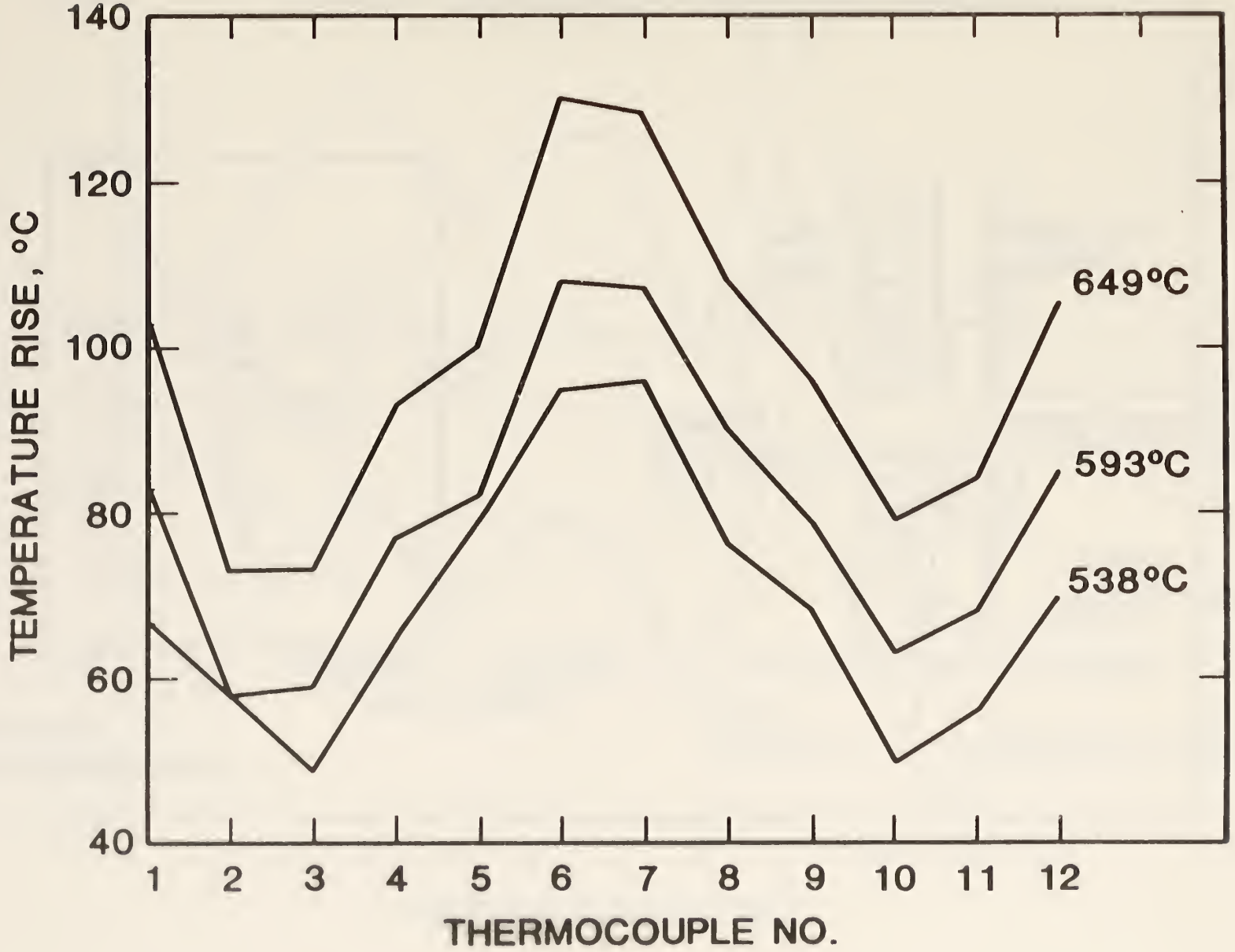
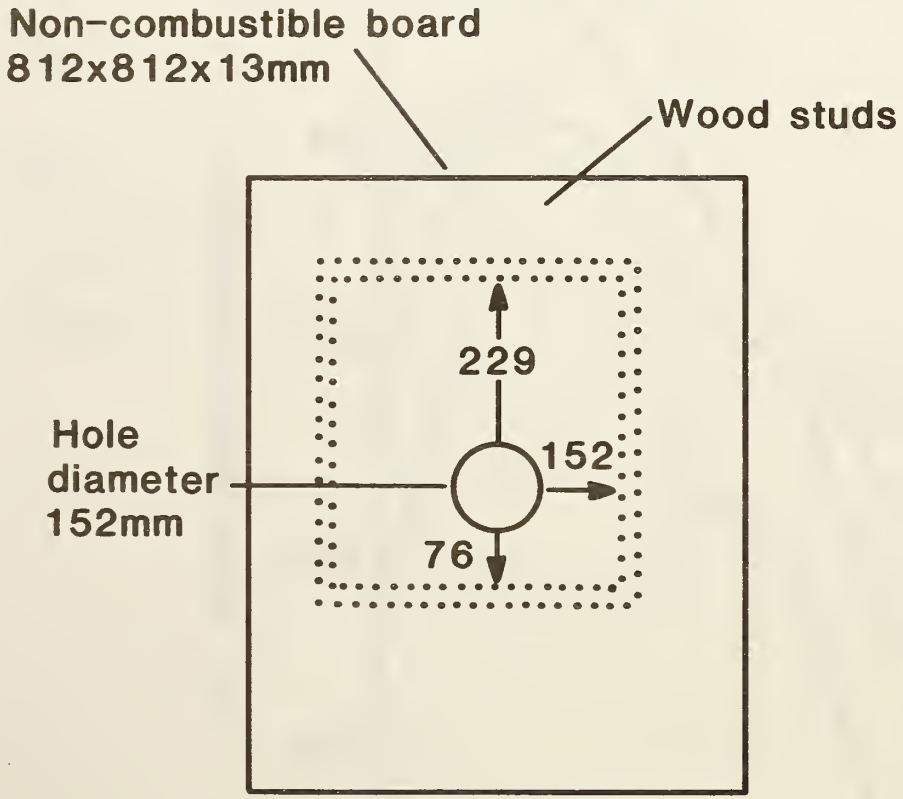


Figure 4(A). Square (Sheet Metal) Thimble - Ventilated Combustibles in Contact with Thimble



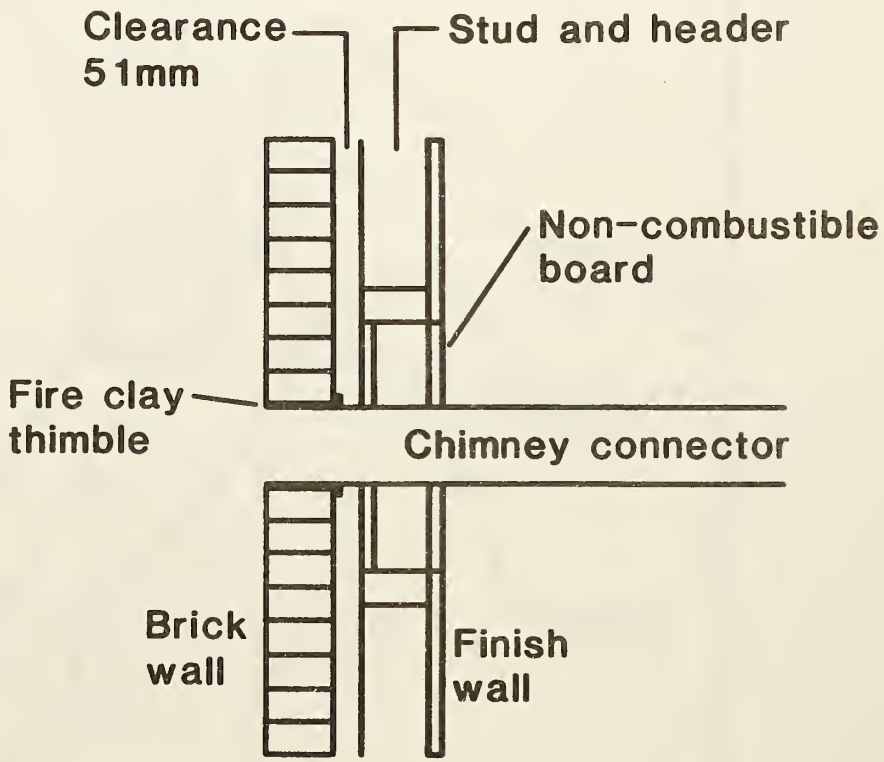


Figure 5. Chimney Connector - Through a Wall Combustibles at Various Distances from Connector

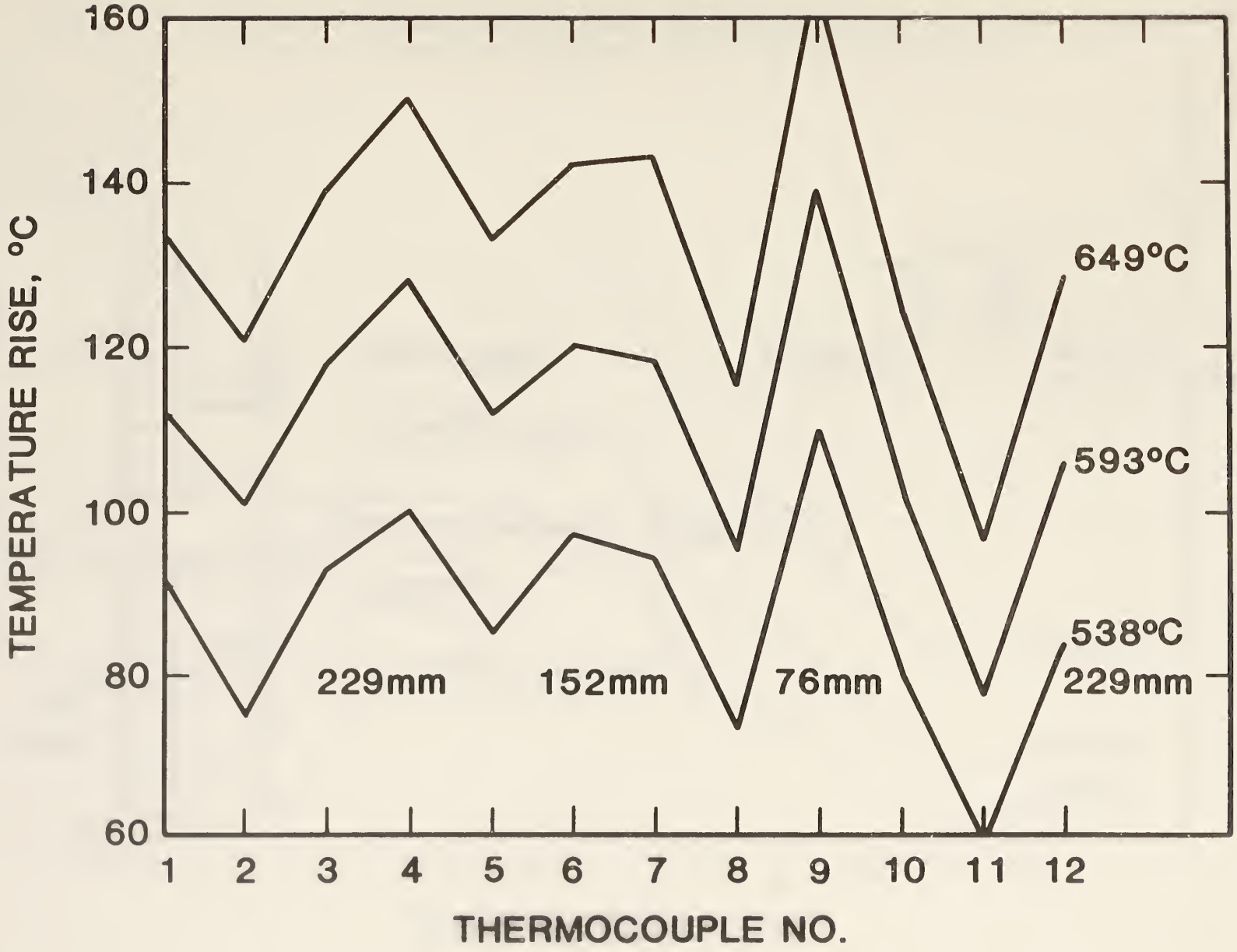


Figure 5(A). Chimney Connector Combustibles at Various Distances

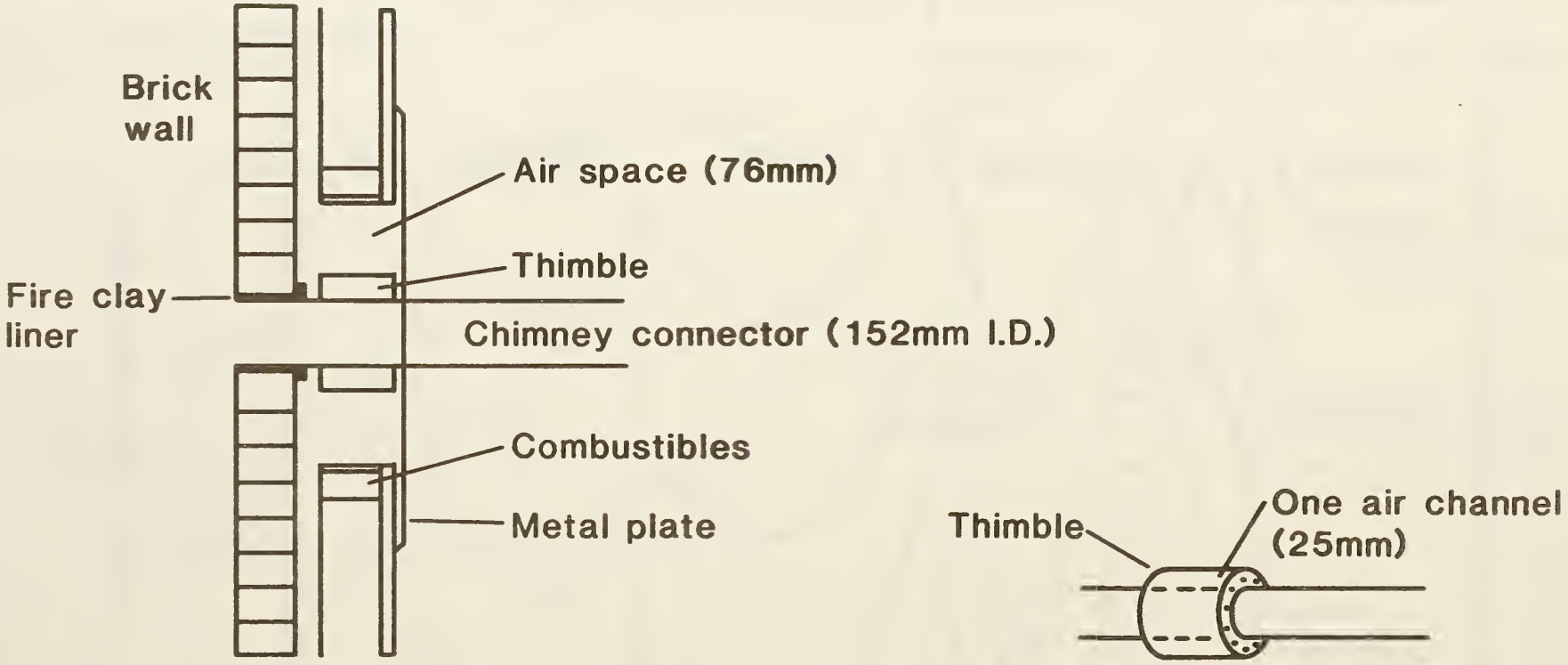


Figure 6. Sheet Metal Thimble - One Air Channel Combustibles - Metal Lined - 76 mm (3 in) from Thimble

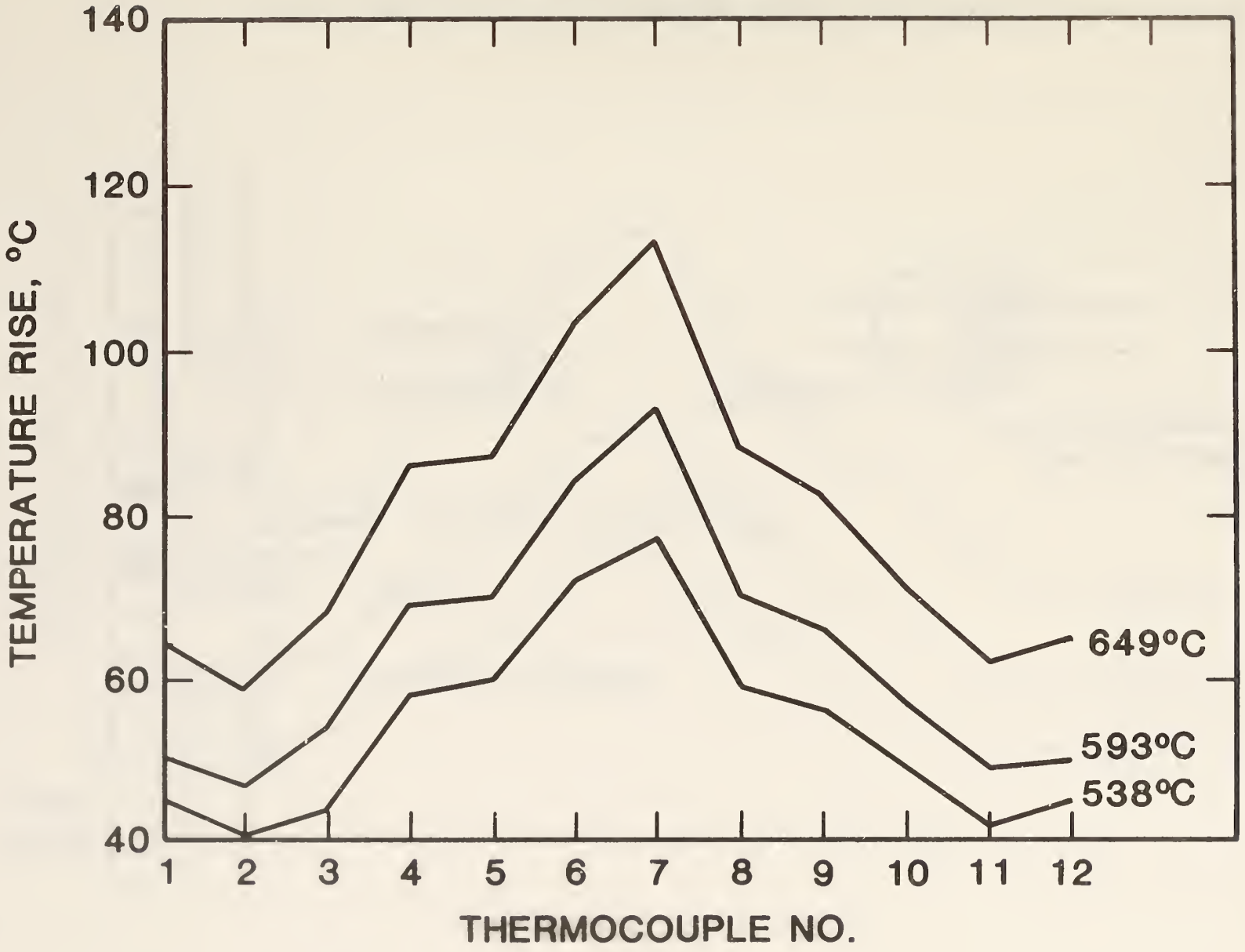


Figure 6(A). One Air Channel Thimble Combustibles With Metal Liners

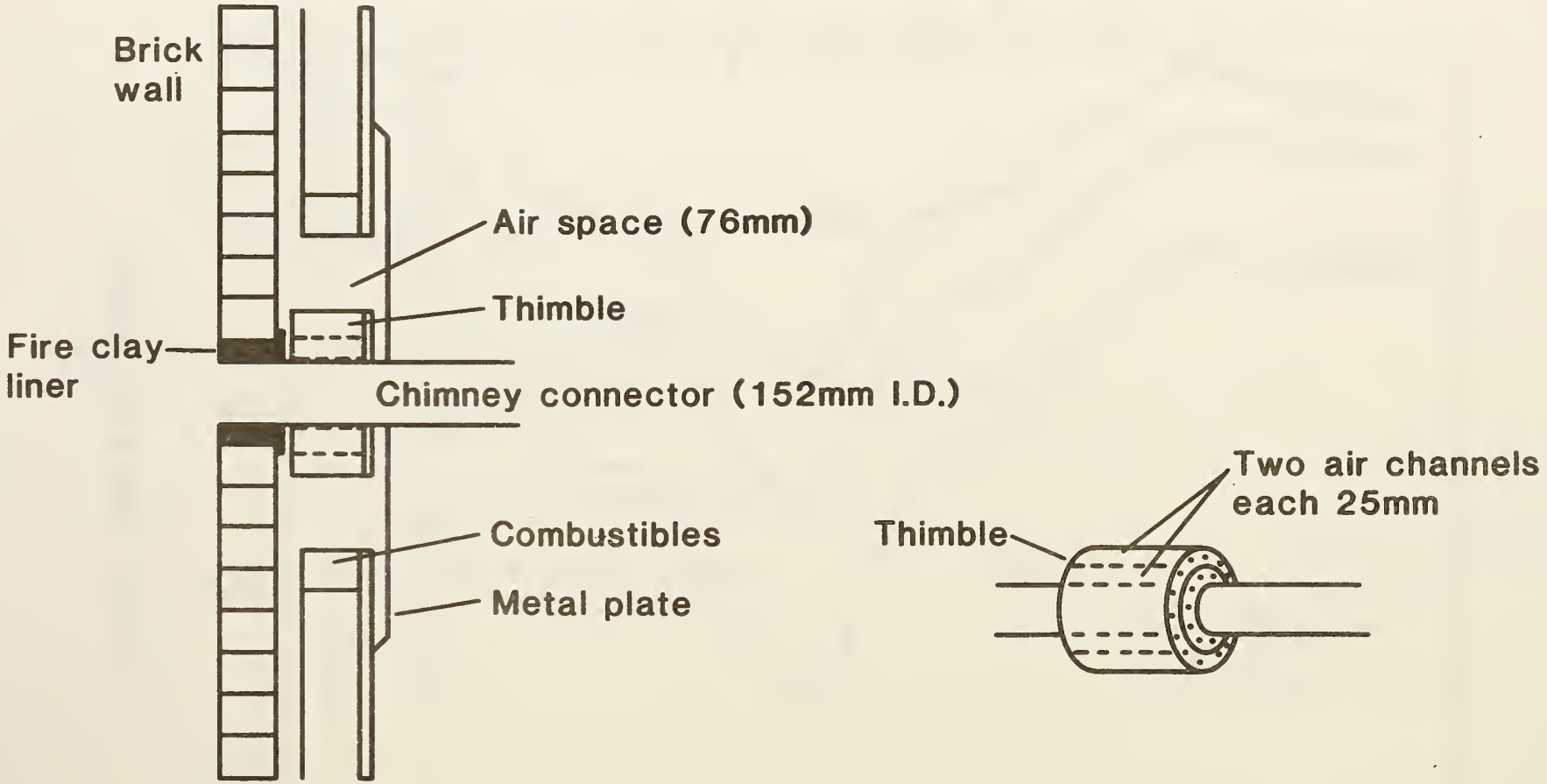


Figure 7. Sheet Metal Thimble - Two Air Channel Combustibles - Lined - 76 mm (3 in) from Thimble

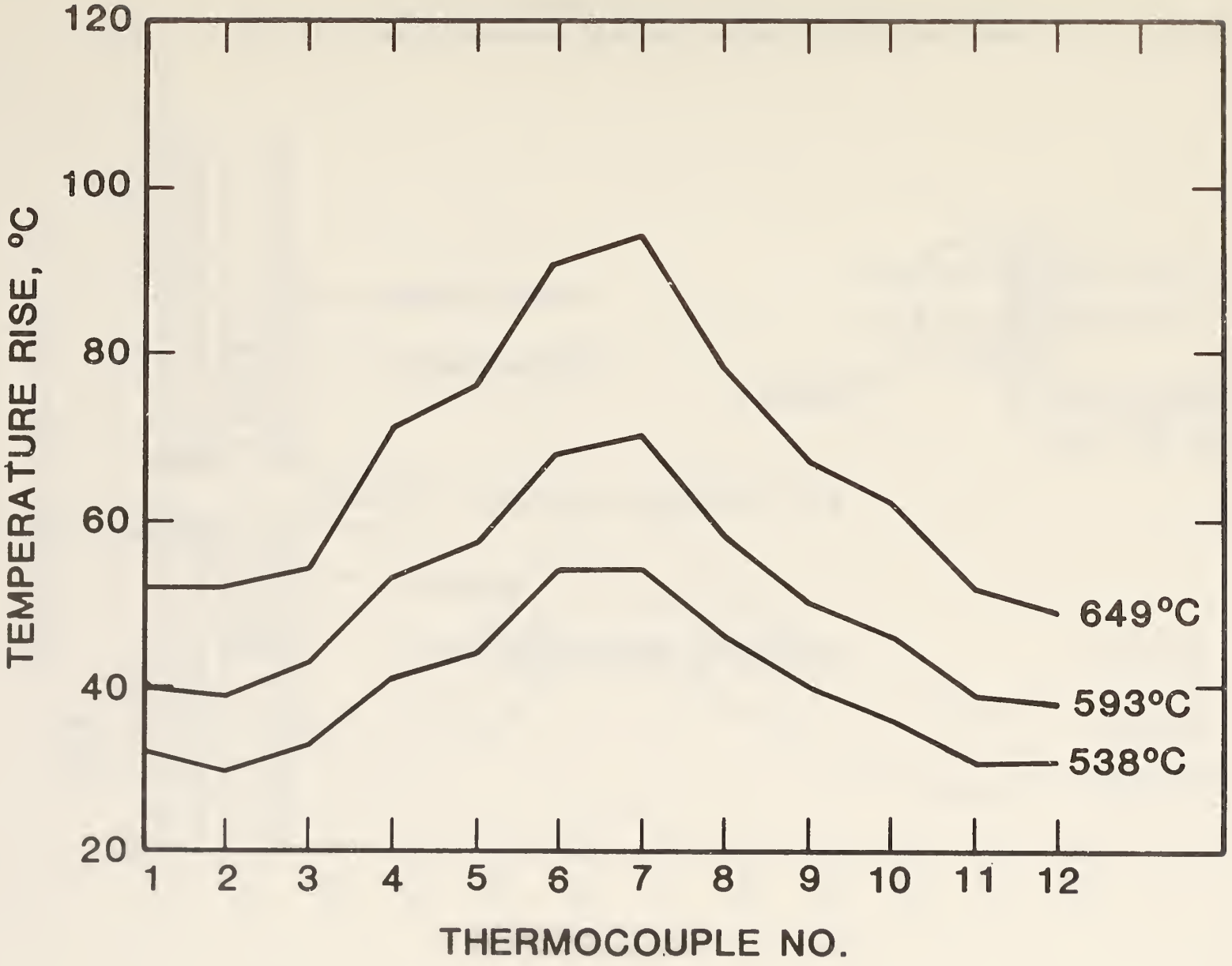


Figure 7(A). Two Air Channel Thimble Combustibles with Metal Liners

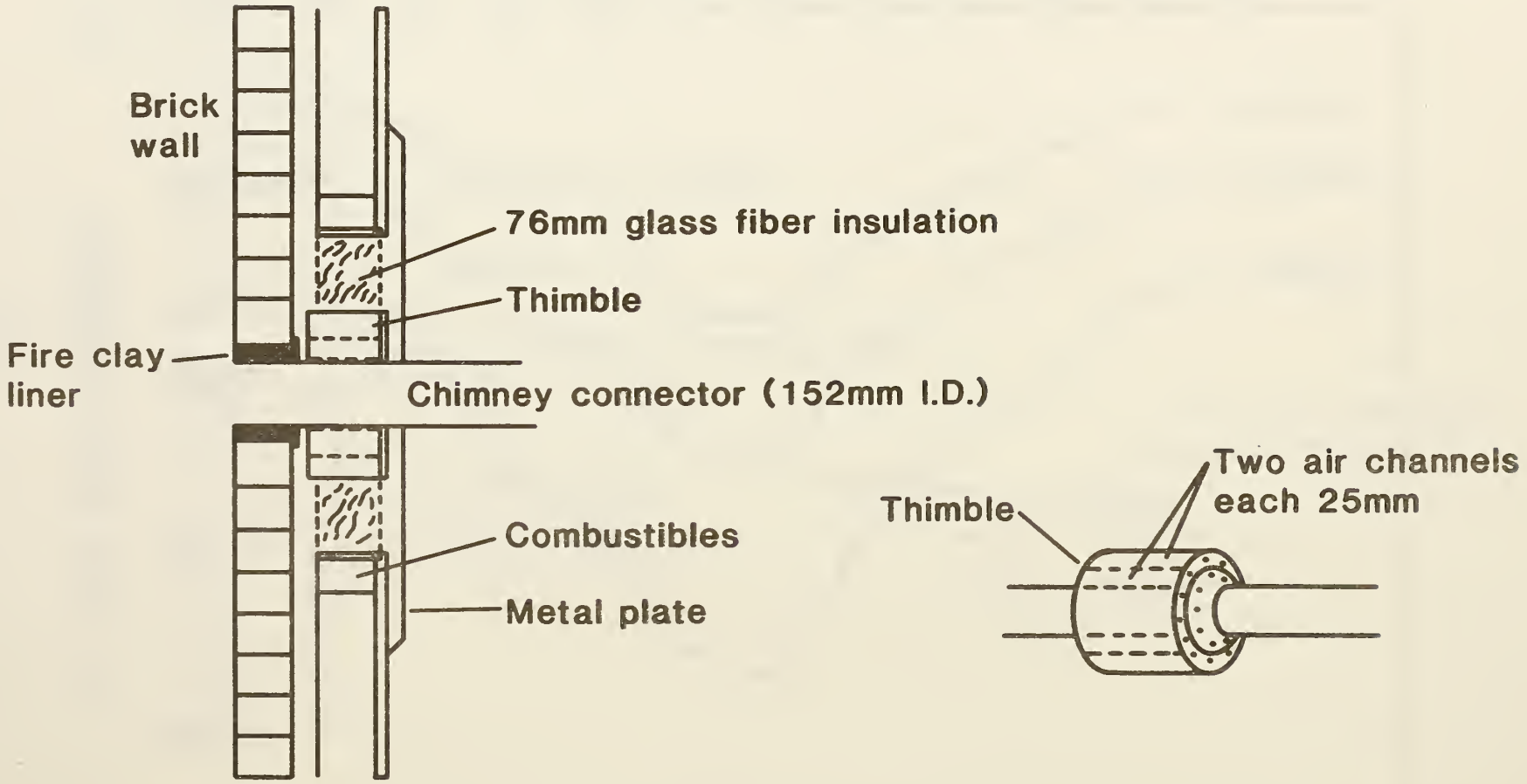


Figure 8. Two Air Channel Thimbles - 76 mm (3 in) Glass Fiber Insulation Combustibles with Metal Liners

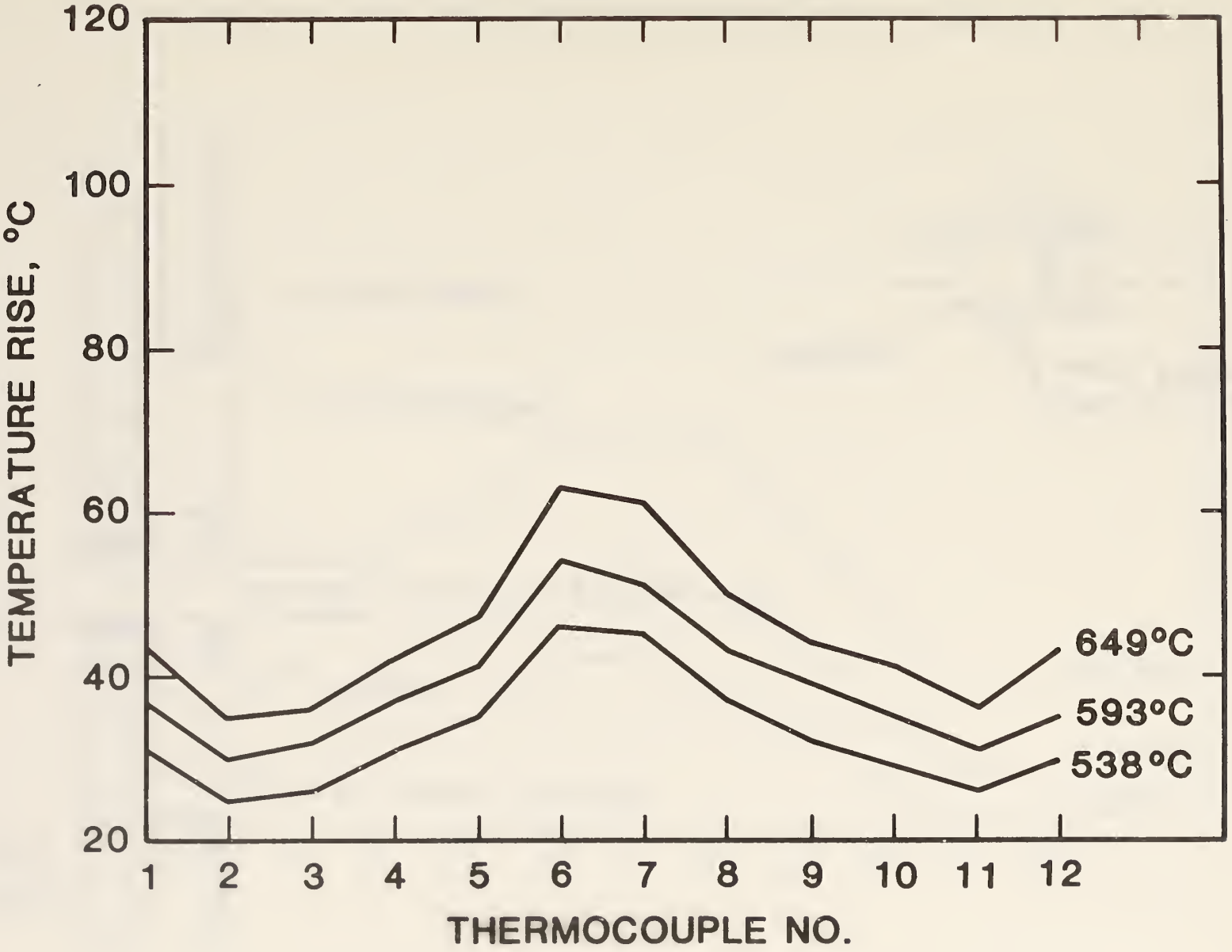


Figure 8(A). Two Air Channel Thimble - 76 mm (3 in) Glass Fiber Insulation Combustibles with Metal Liners

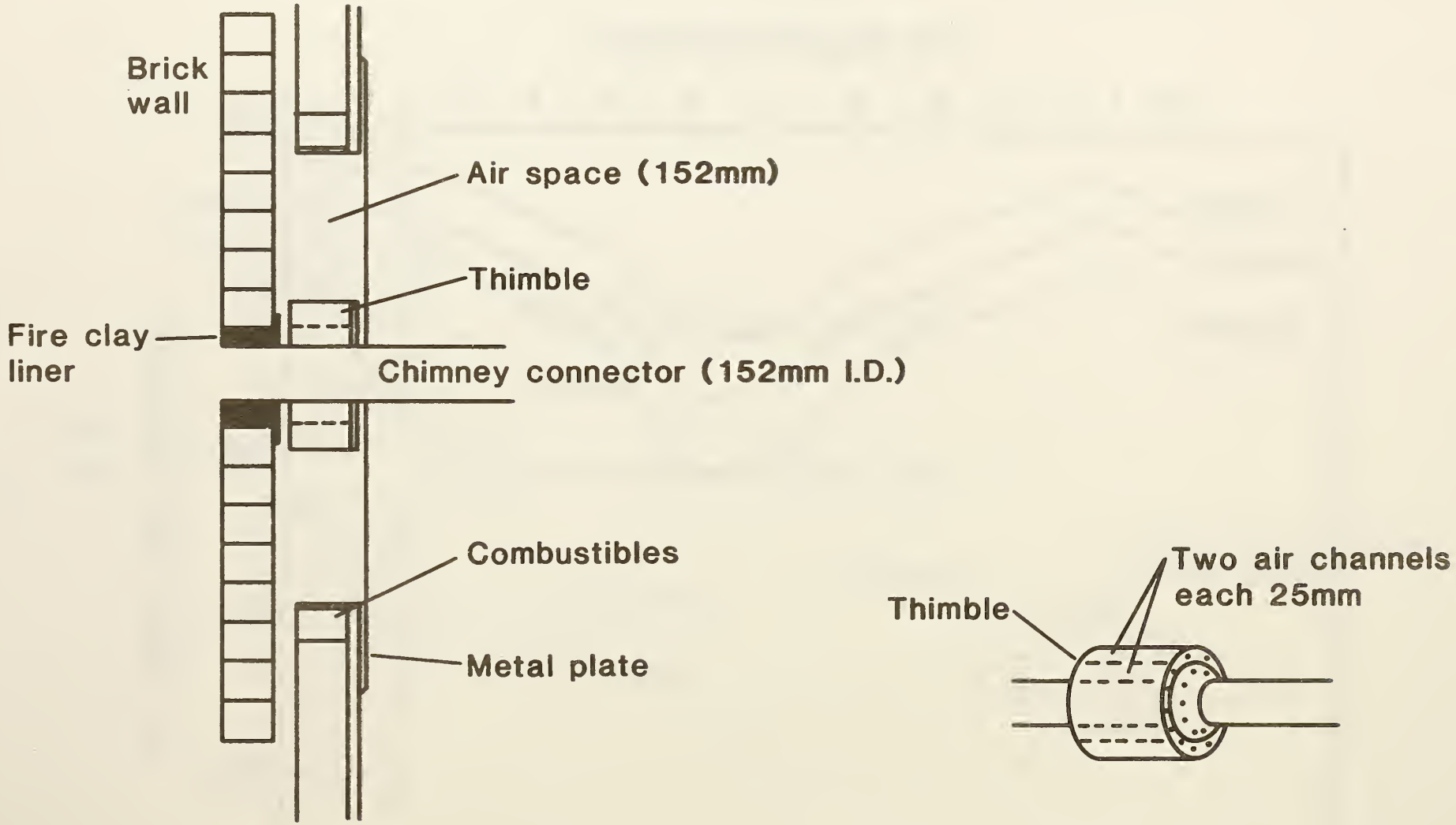


Figure 9. Sheet Metal Thimble - Two Air Channels Combustibles - Metal Lined - 152 mm (6 in) from Thimble

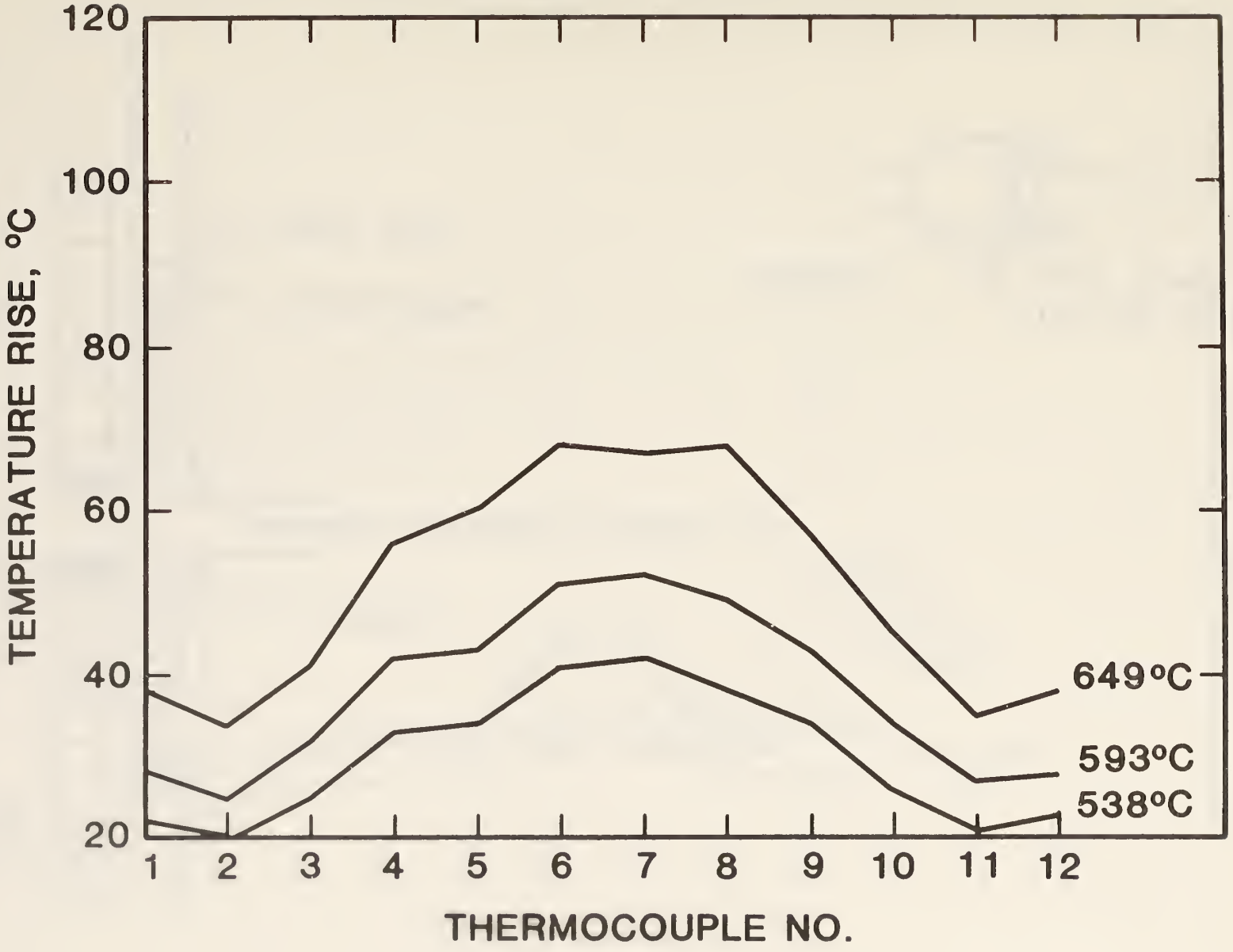


Figure 9(A). Two Air Channel Thimble - 152 mm (6 in) Air Space to Combustibles with Metal Liners

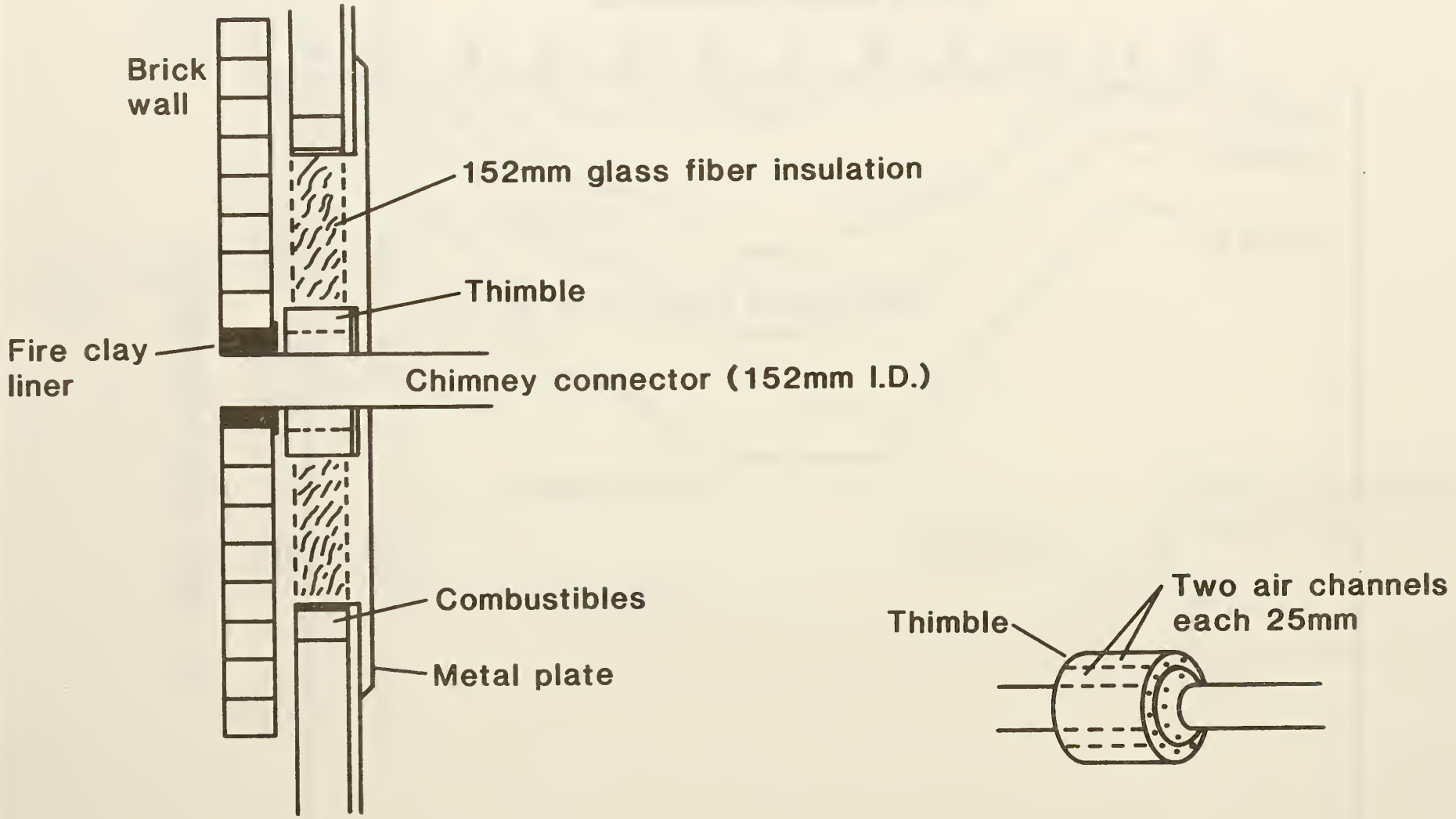


Figure 10. Two Air Channel Thimble - 152 mm (6 in) Glass Fiber Insulation Combustibles with Metal Liners

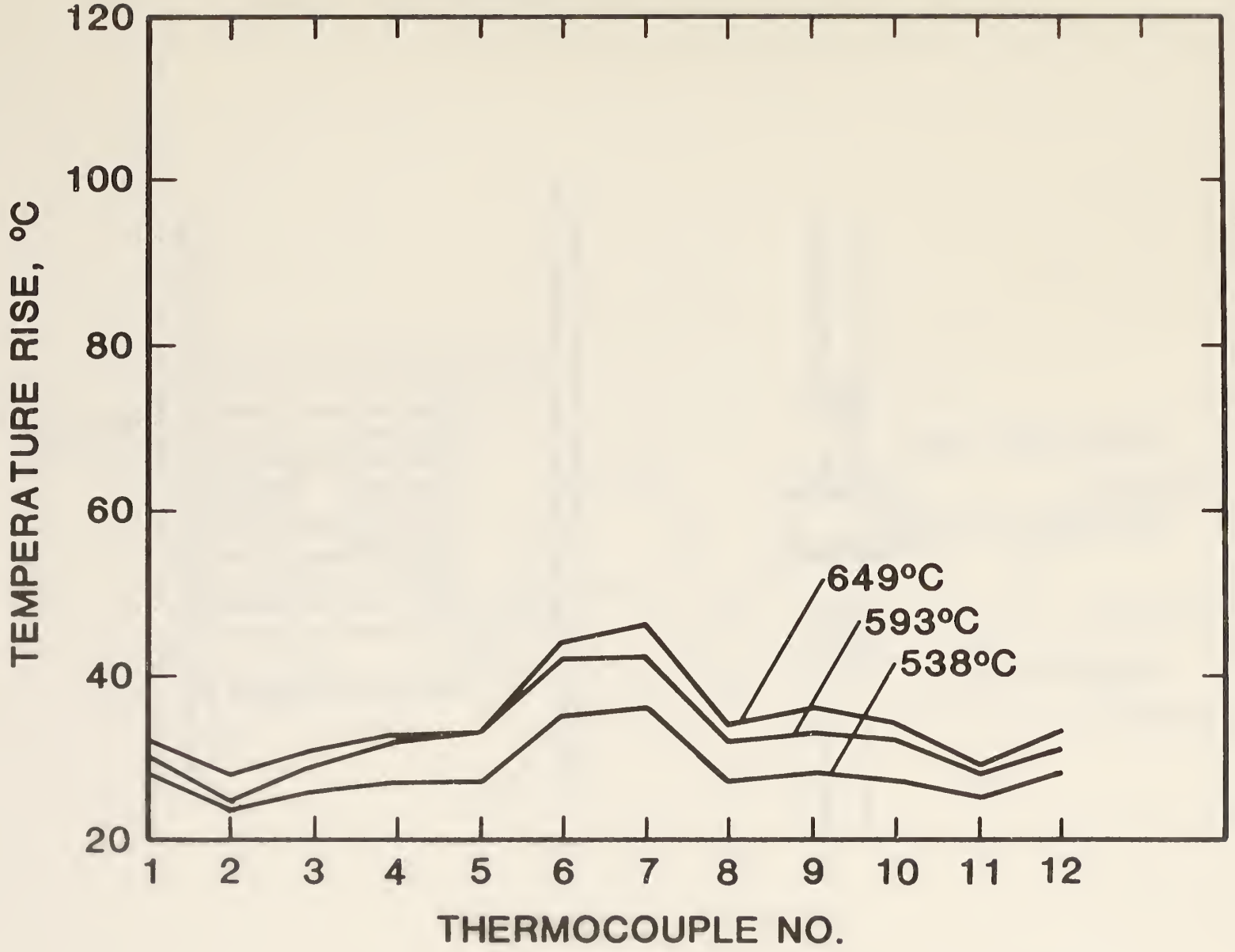


Figure 10(A). Two Air Channel Thimble - 152 mm (6 in) Glass Fiber Insulation Combustibles with Metal Liners

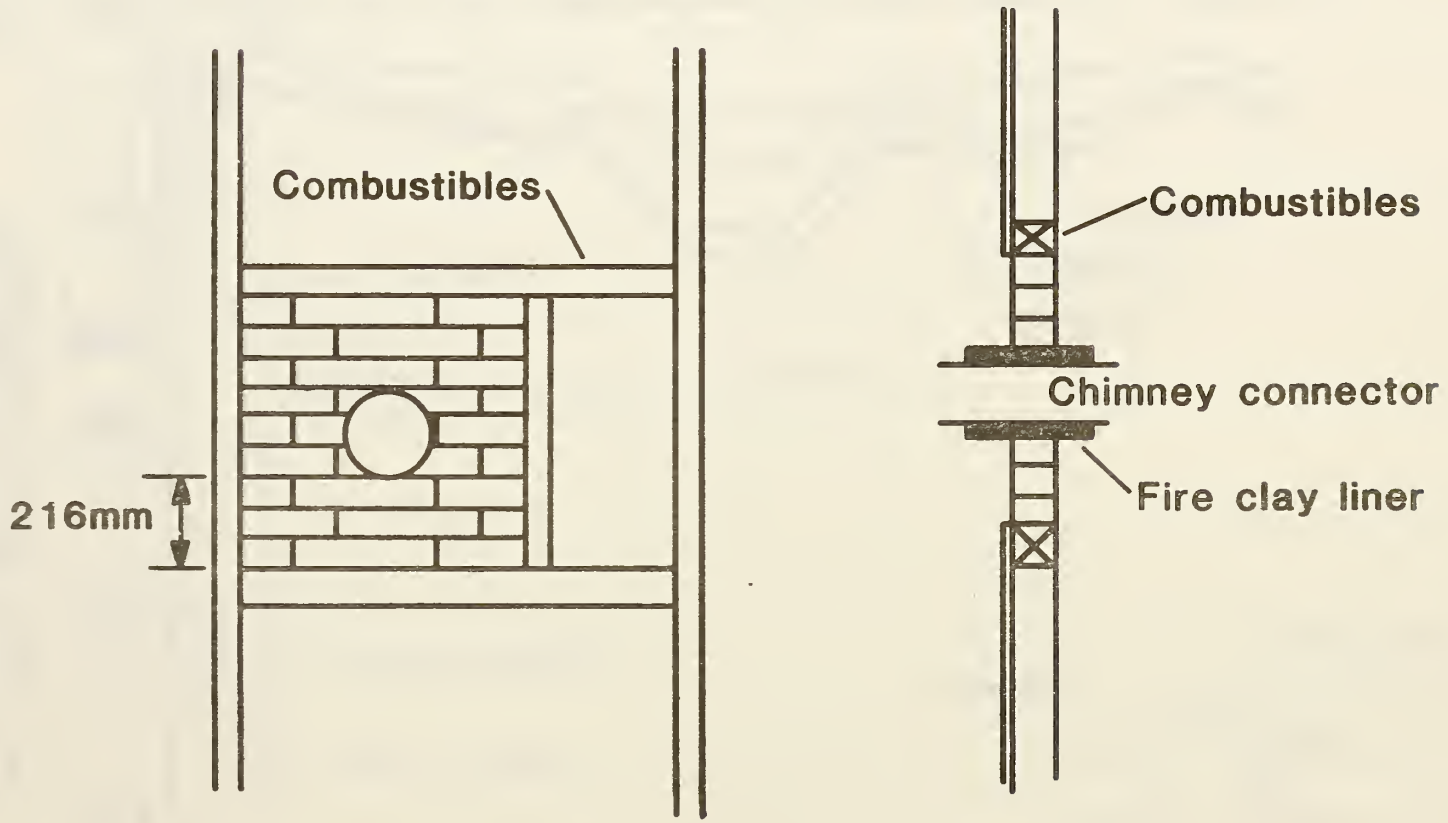


Figure 11. Brick Masonry Patch - 216 mm (8 in) Brick Separation to Combustibles

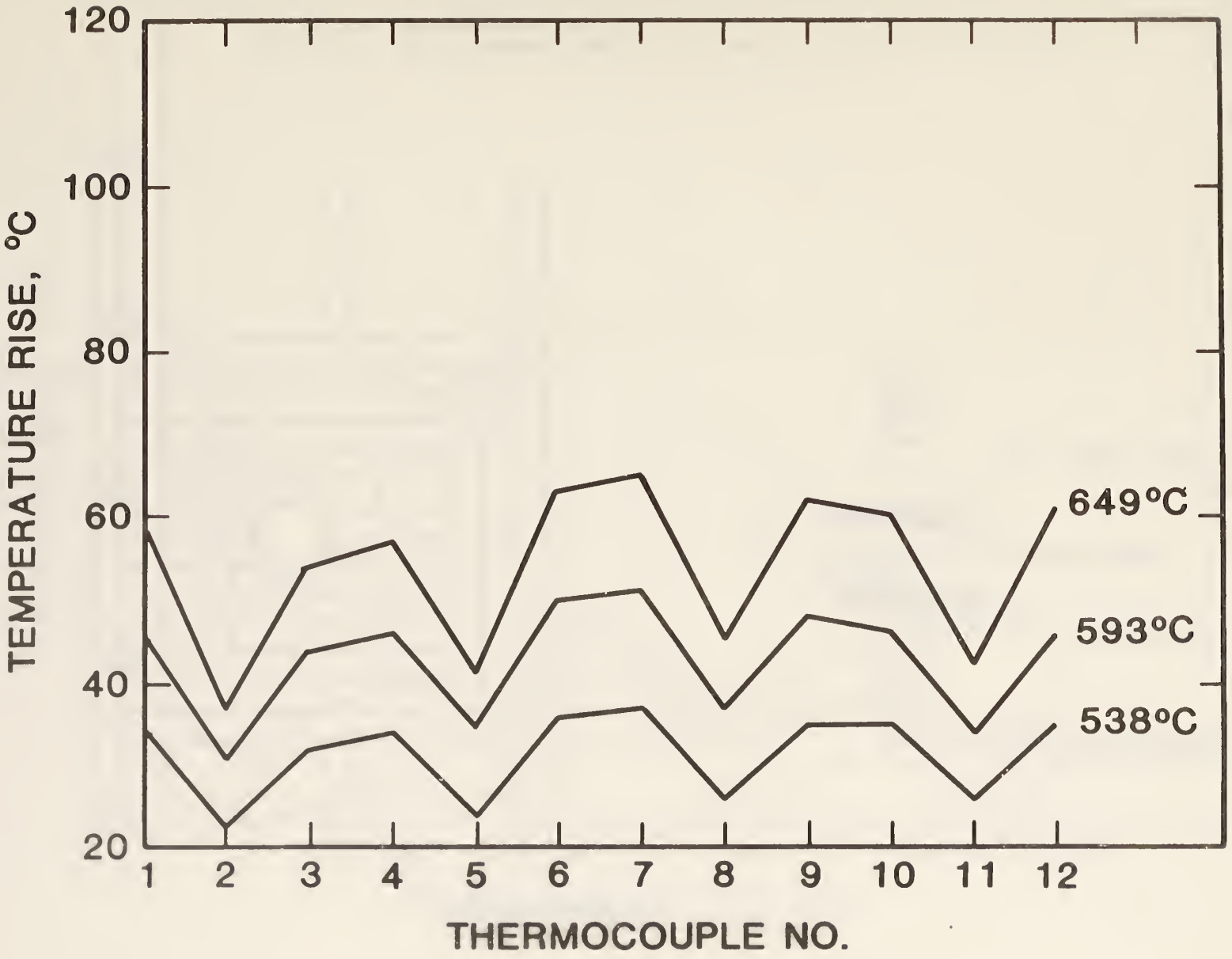


Figure 11(A). Brick Masonry Patch - Separation 216 mm (8 in) to Combustibles in contact with Bricks

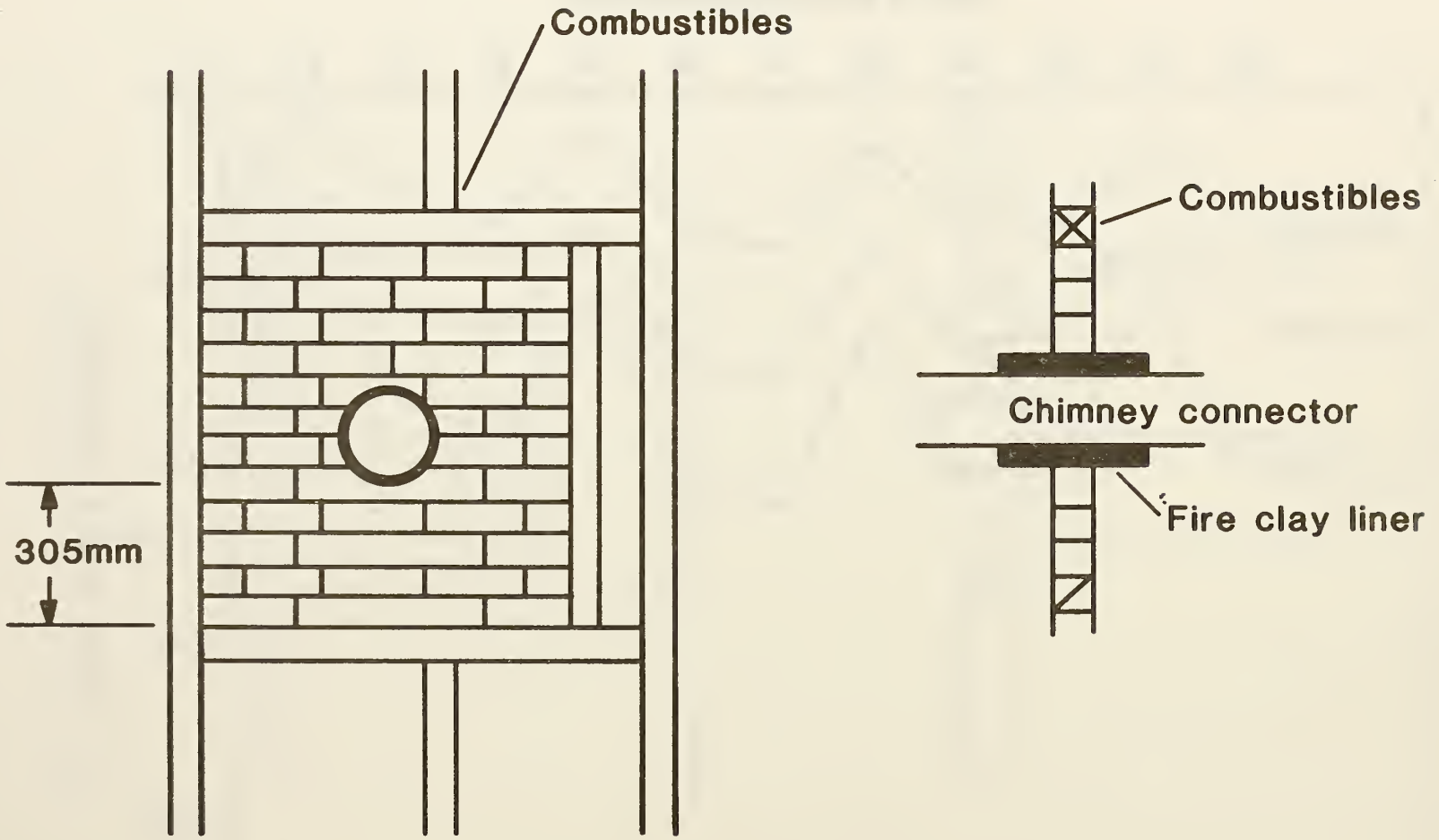


Figure 12. Brick Masonry Patch - 305 mm (12 in) Brick Separation to Combustibles

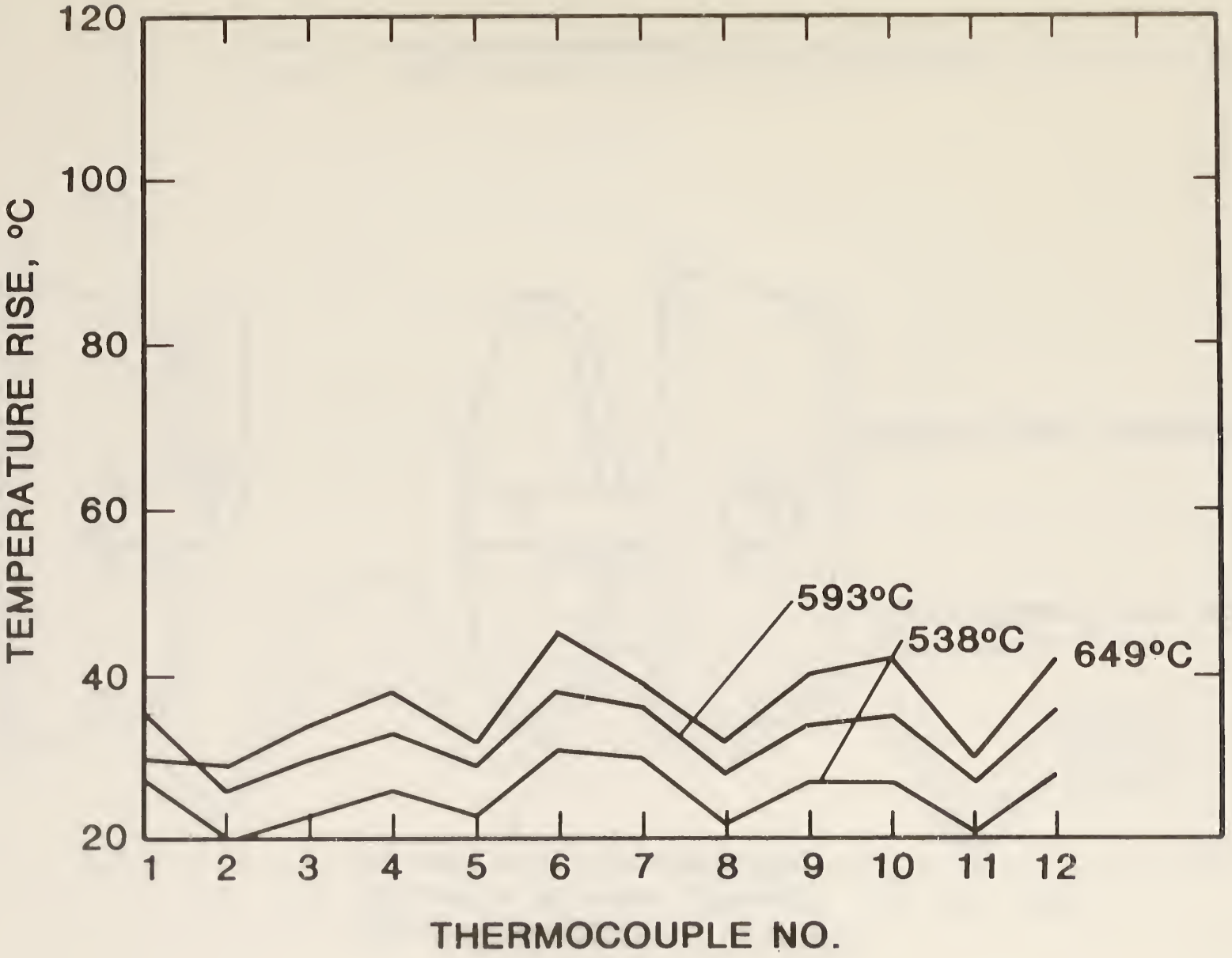


Figure 12(A). Brick Masonry Patch - Separation 305 mm (12 in) to Combustibles in contact with Brick

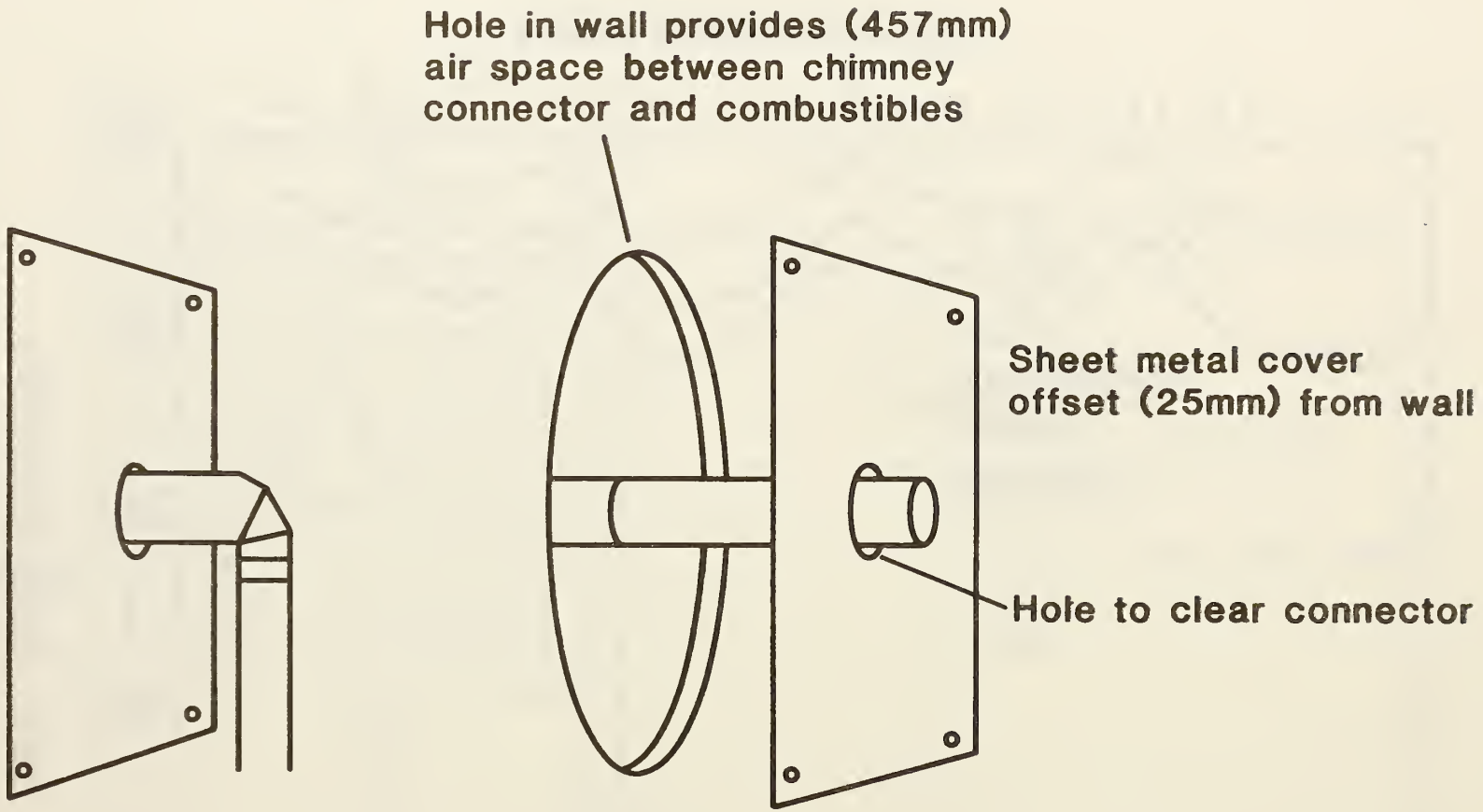


Figure 13. Chimney Connector Through a Wall Combustibles (457 mm) from Connector

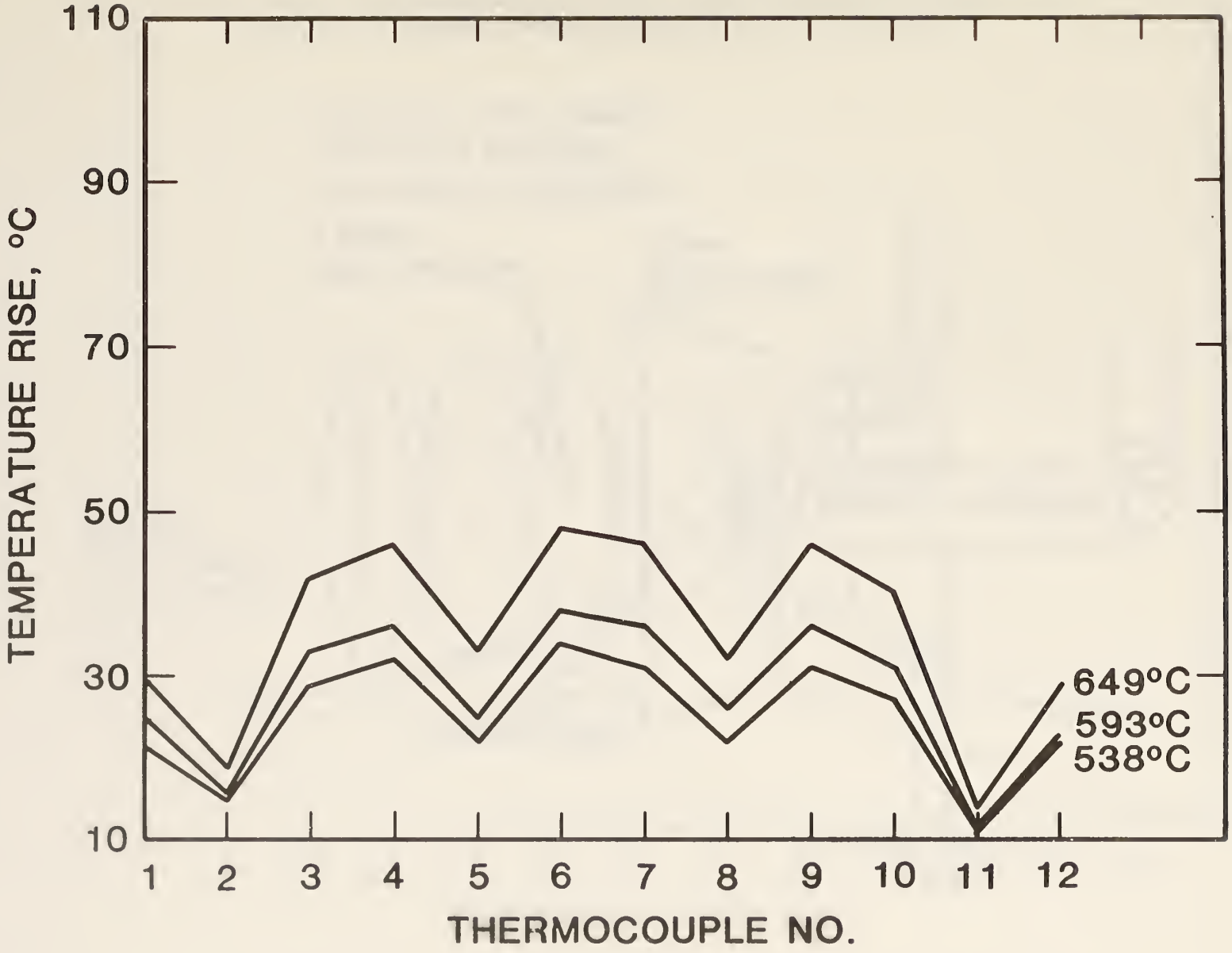


Figure 13(A). Chimney Connector - 457 mm (18 in) Air Space to Combustibles

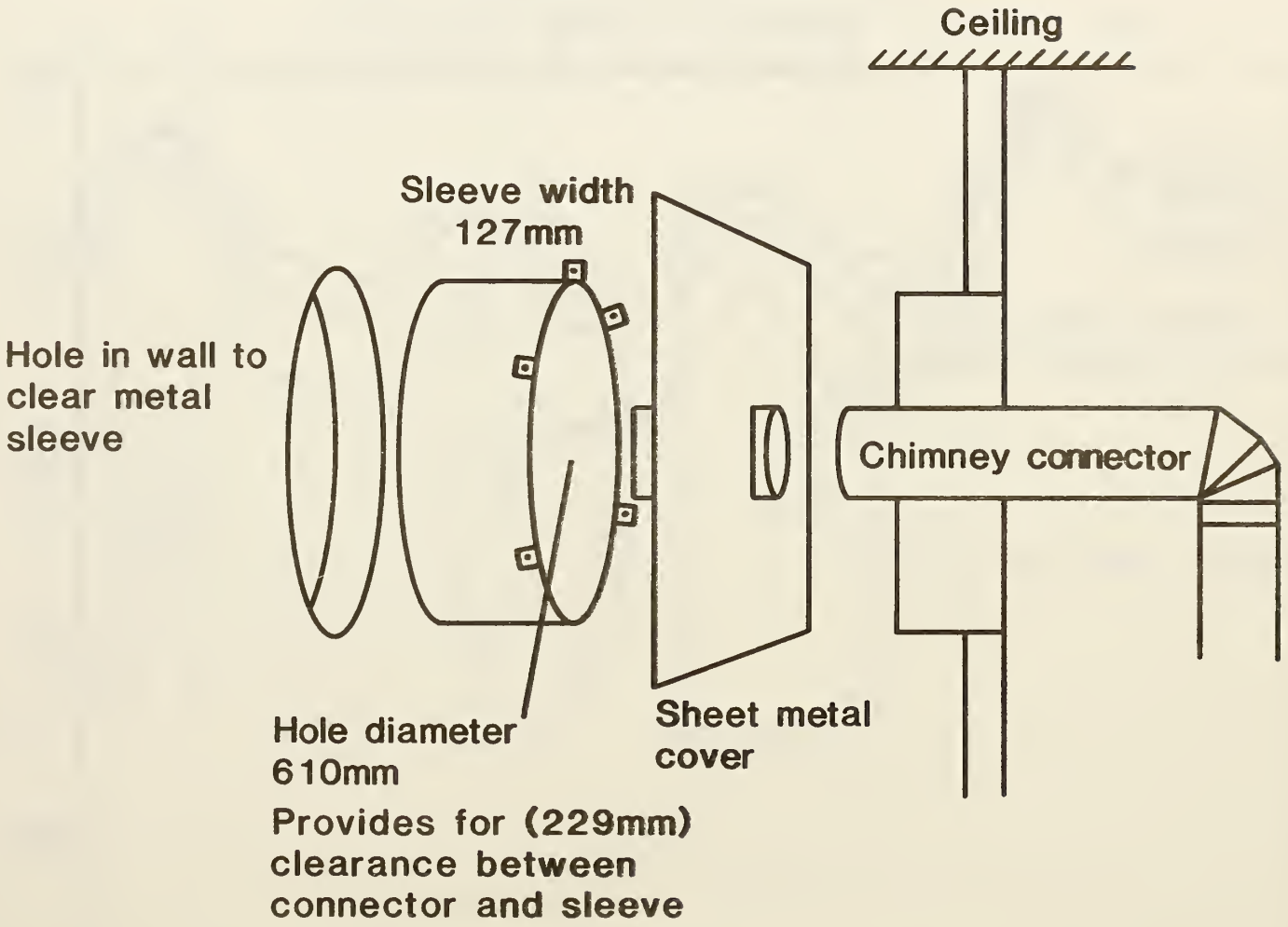


Figure 14. Chimney Connector Through a Wall Combustibles Protected by a Metal Sleeve and 229 mm (9 in) Air Space

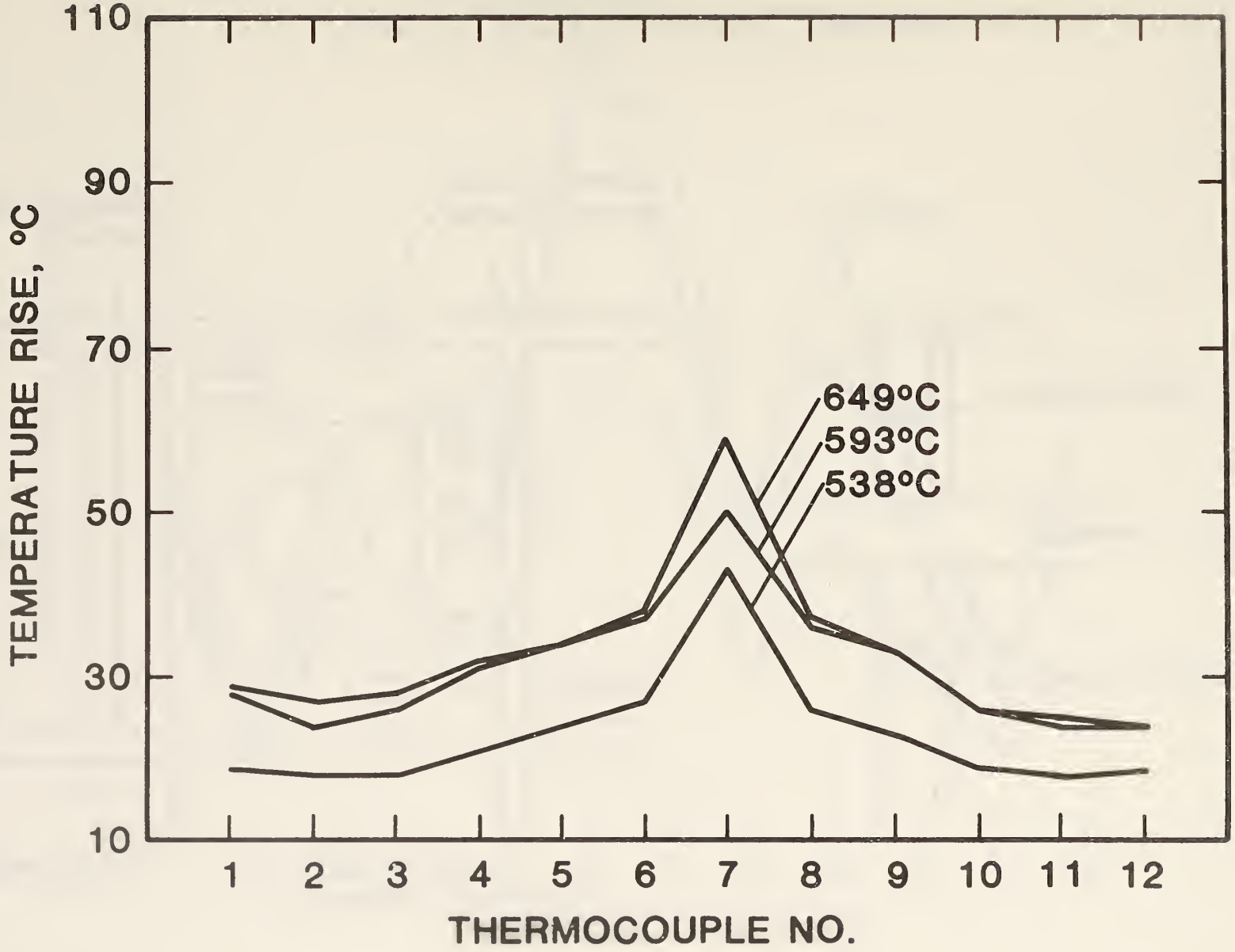


Figure 14(A). Chimney Connector - 229 mm (9 in) Air Space to Combustibles Protected by a Metal Sleeve

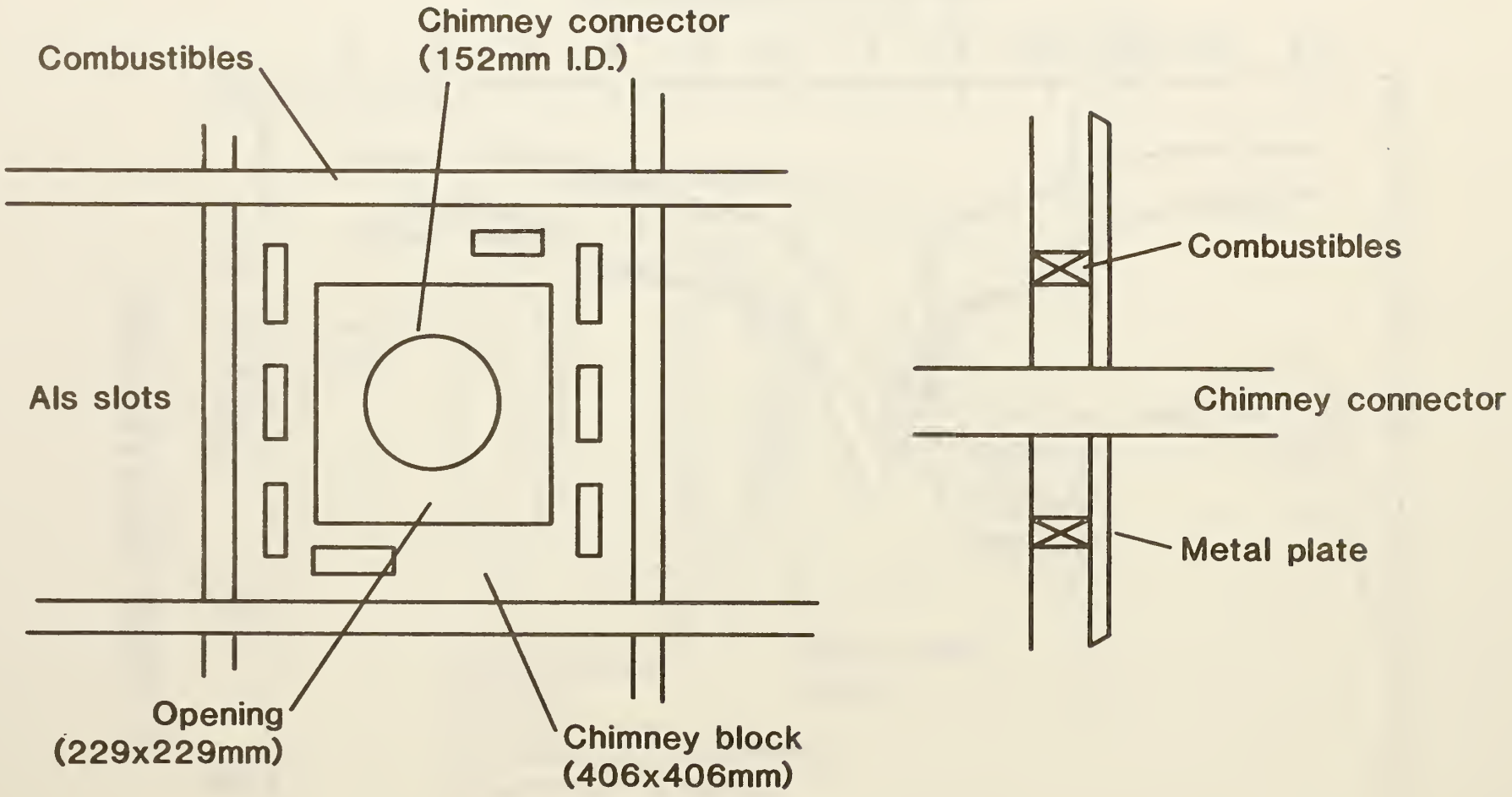


Figure 15. Chimney Masonry Block - Combustibles Contact Block

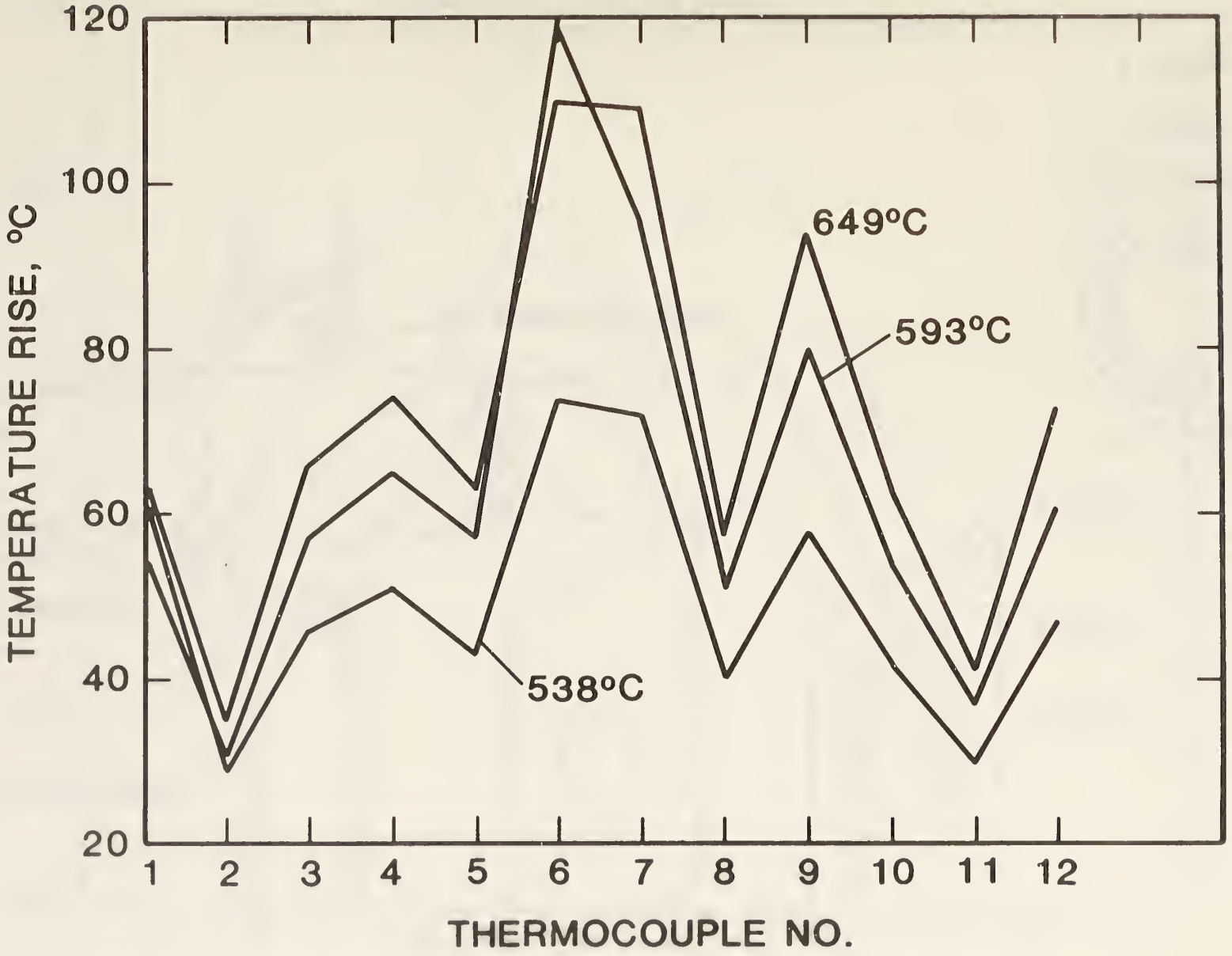


Figure 15(A). Chimney Masonry Block - 38 mm (1.5 in) Air Space Between Block and Connector - Combustibles in Contact with Block

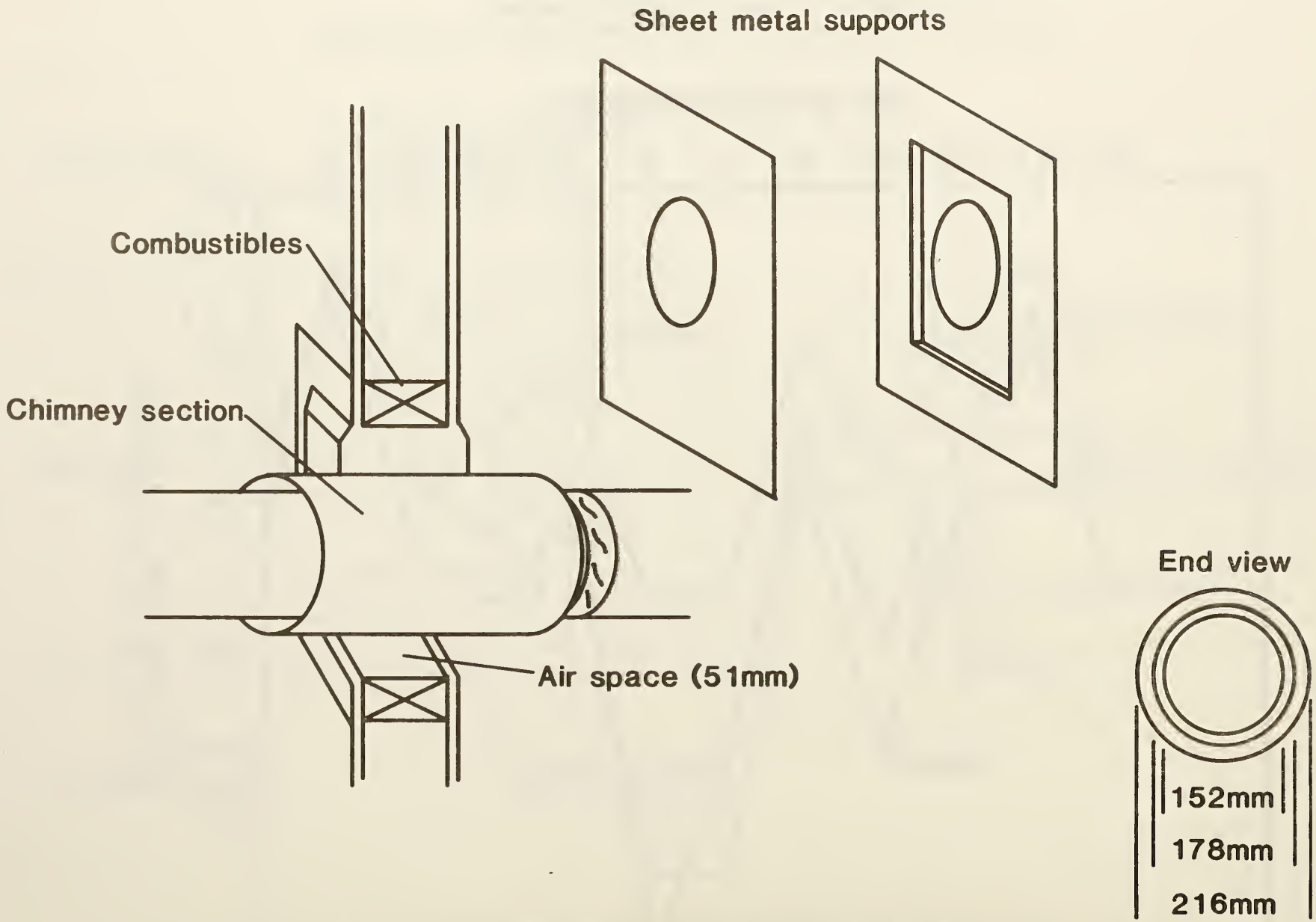


Figure 16. Commercial Chimney Section - Two Air Channels
Combustibles 51 mm from Section

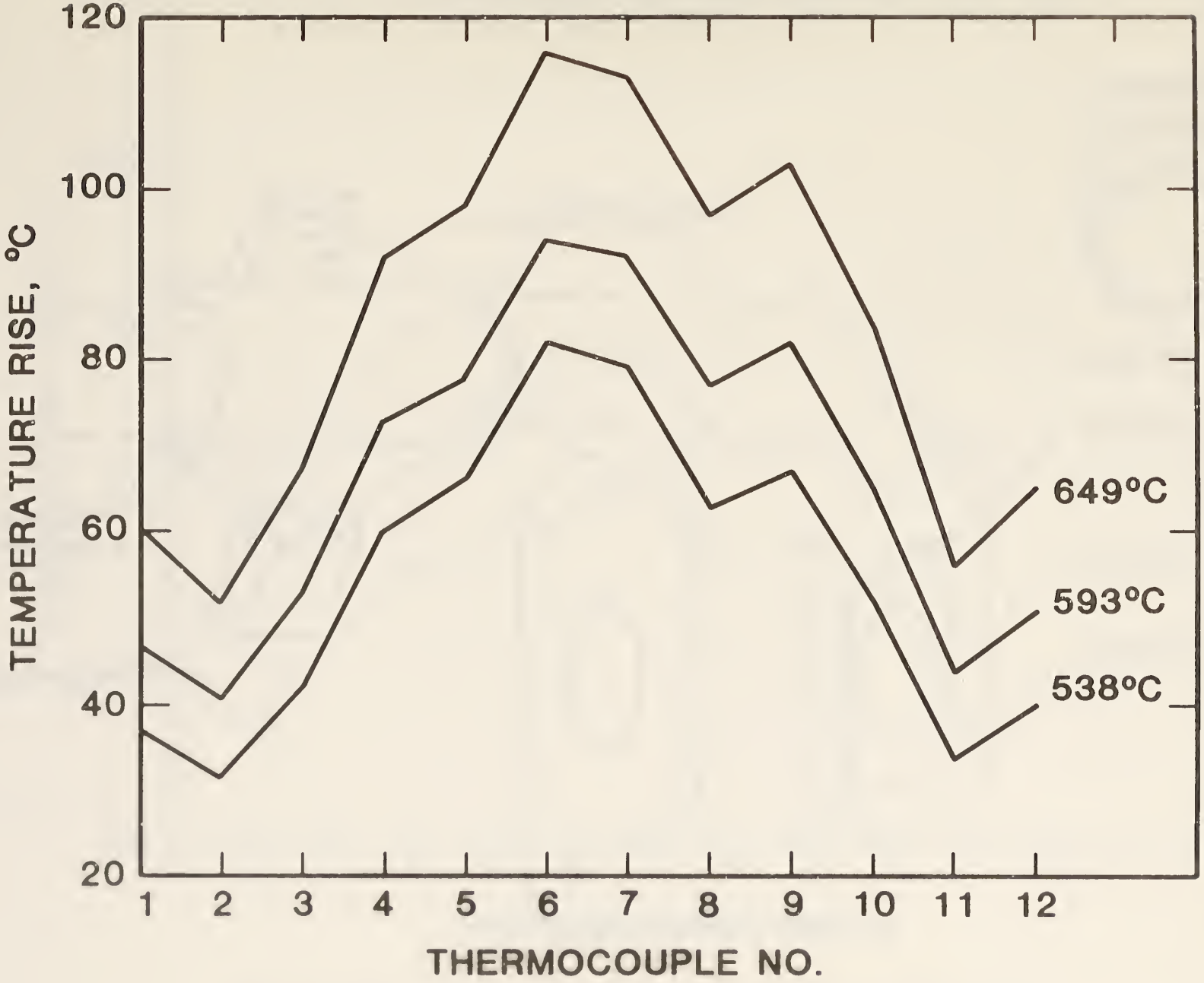


Figure 16(A). Two Air Channel Thimble - 51 mm (2 in) Air Space to Combustibles with No Protection

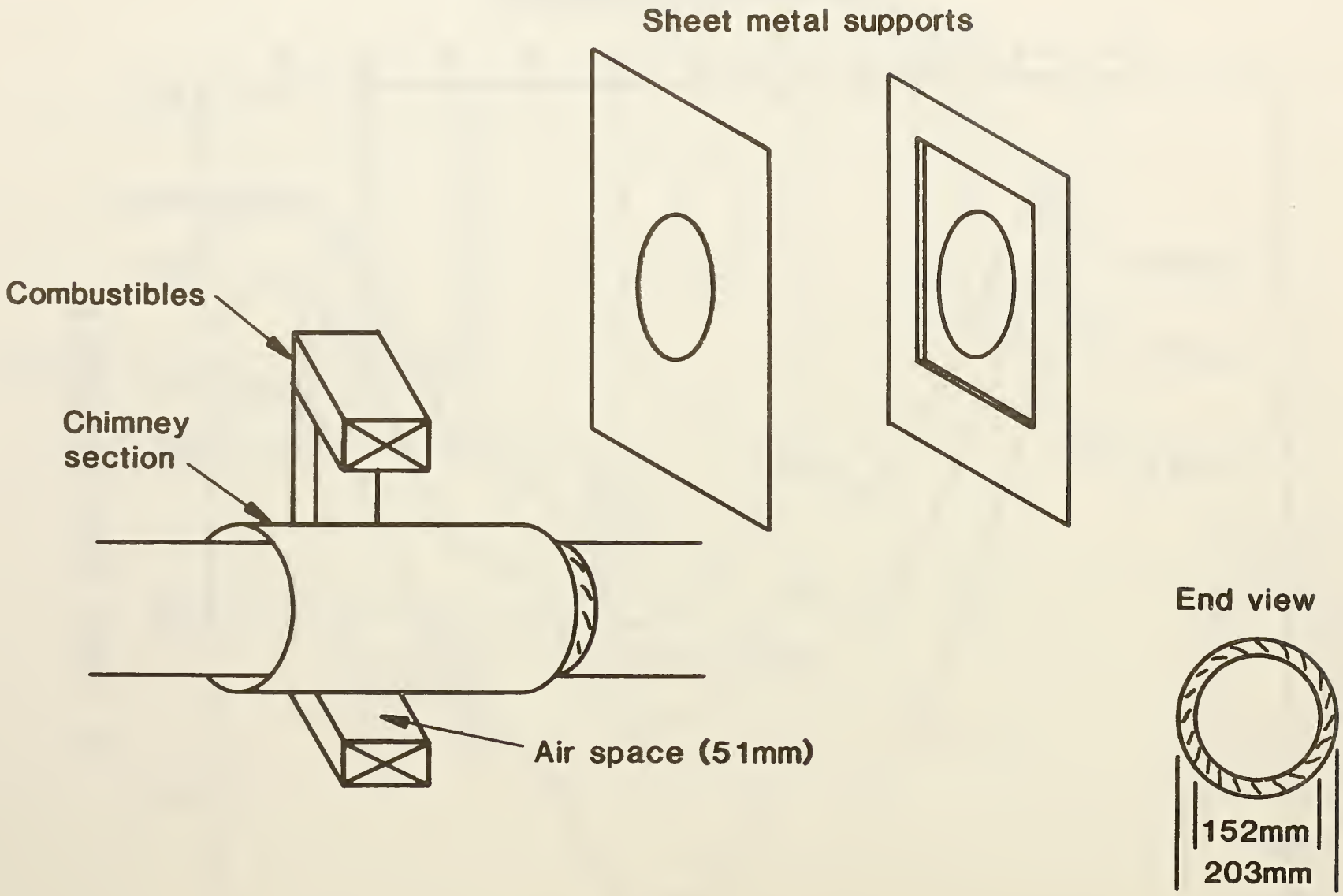


Figure 17. Commercial Chimney Section - Insulated Channel (25 mm) Combustibles 51 mm (2 in) from Section

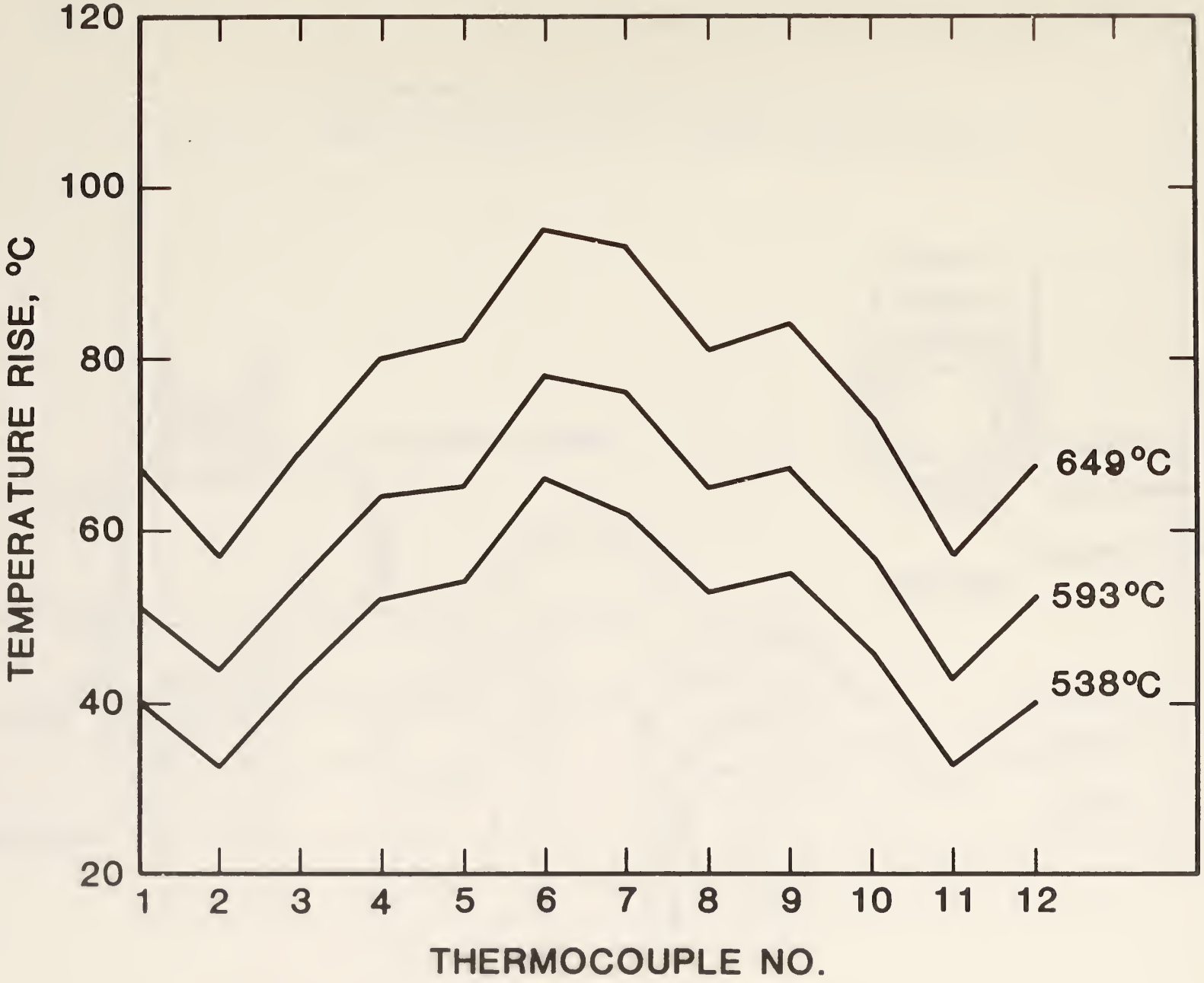


Figure 17(A). Commercial Insulated Chimney Section 152 mm (6 in) ID
Combustibles Unprotected - Air Space 51 mm

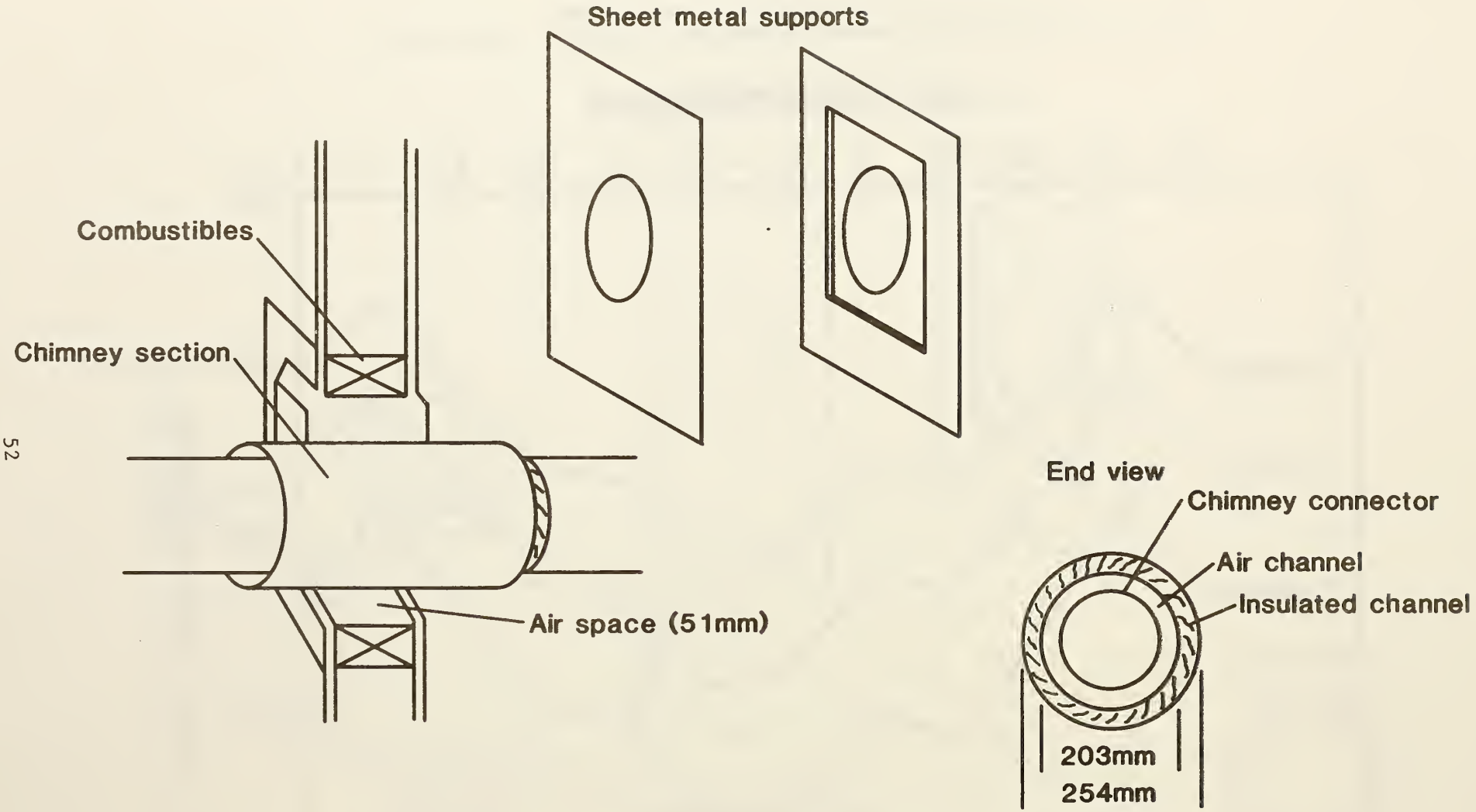


Figure 18. Commercial Chimney Section - Insulated Channel (25 mm) (1 in) Section ID (203 mm) (8 in) Combustibles 51 mm from Section

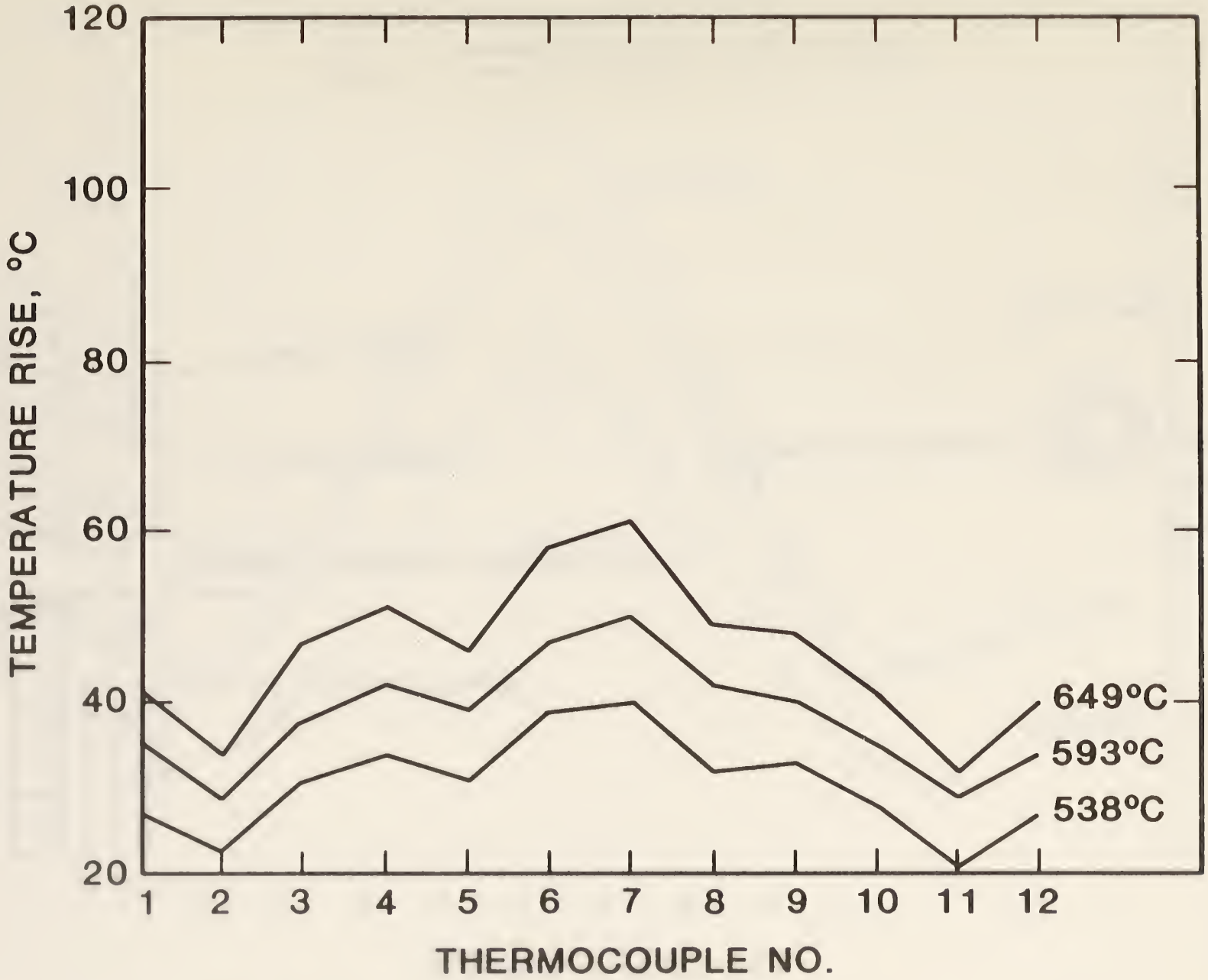


Figure 18(A). Commercial Insulated Chimney Section 203 mm (6 in) ID
Combustibles Unprotected - Air Space 51 mm (2 in)

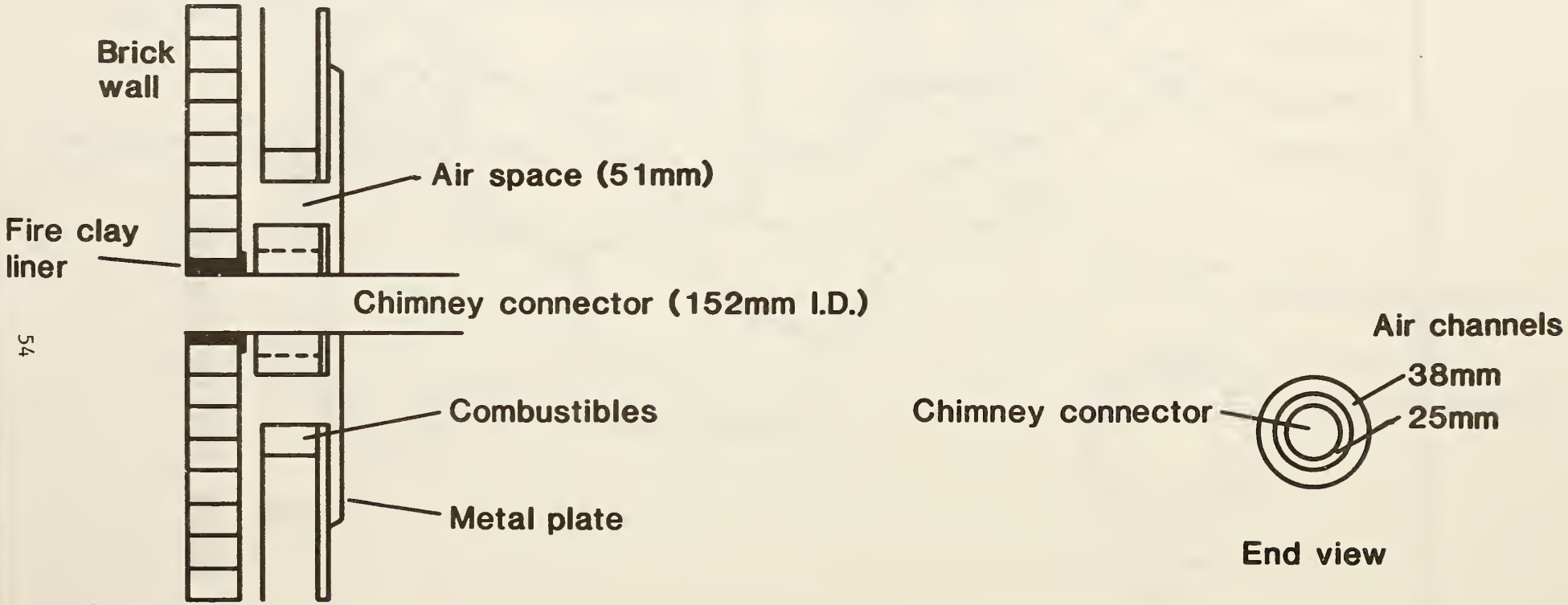


Figure 19. Sheet Metal Thimble - Two Air Channels
Combustibles 51 mm (2 in) from Thimble

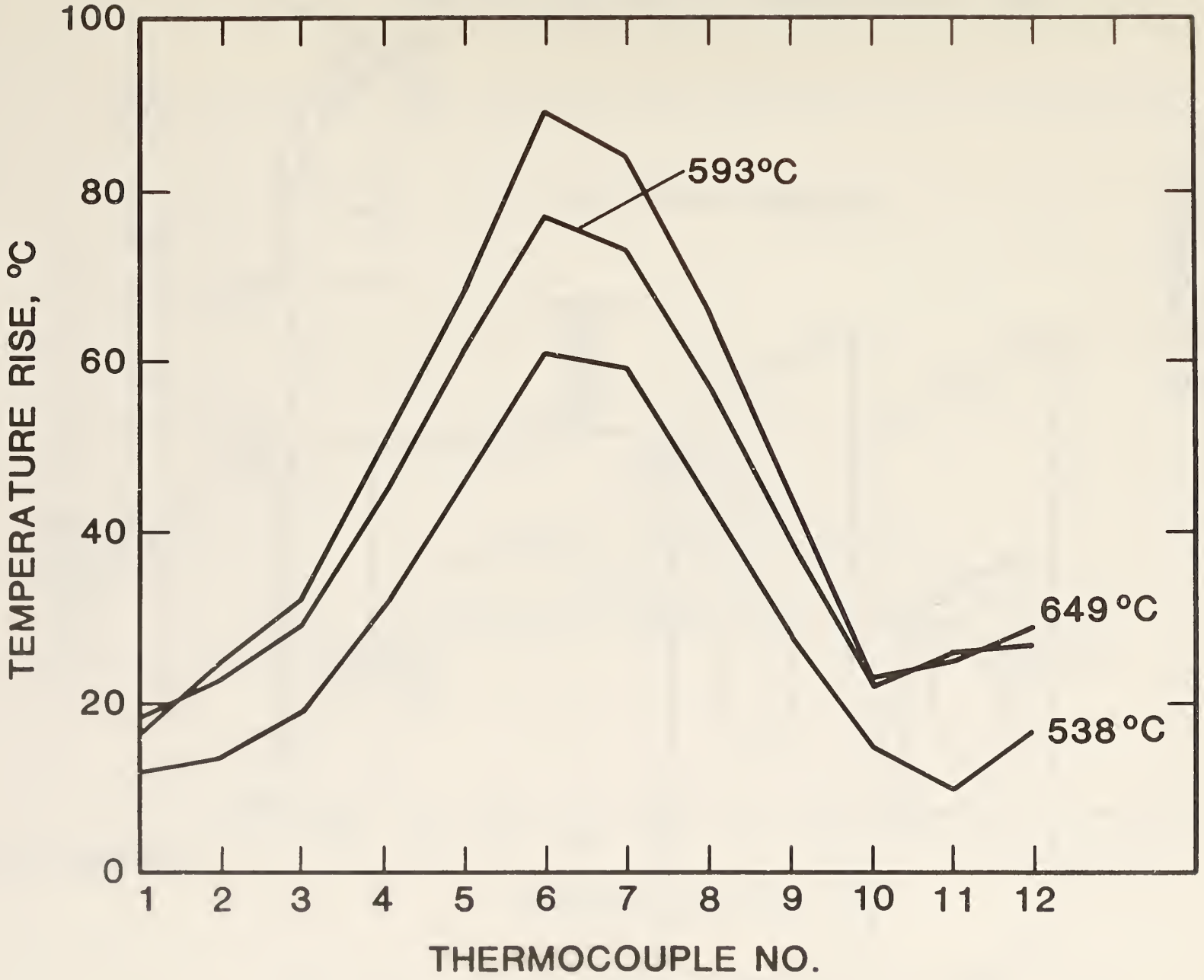


Figure 19(A). Two Air Channel (Sheet Metal) Thimble - 51 mm (2 in) Air Space to Combustibles with No Protection

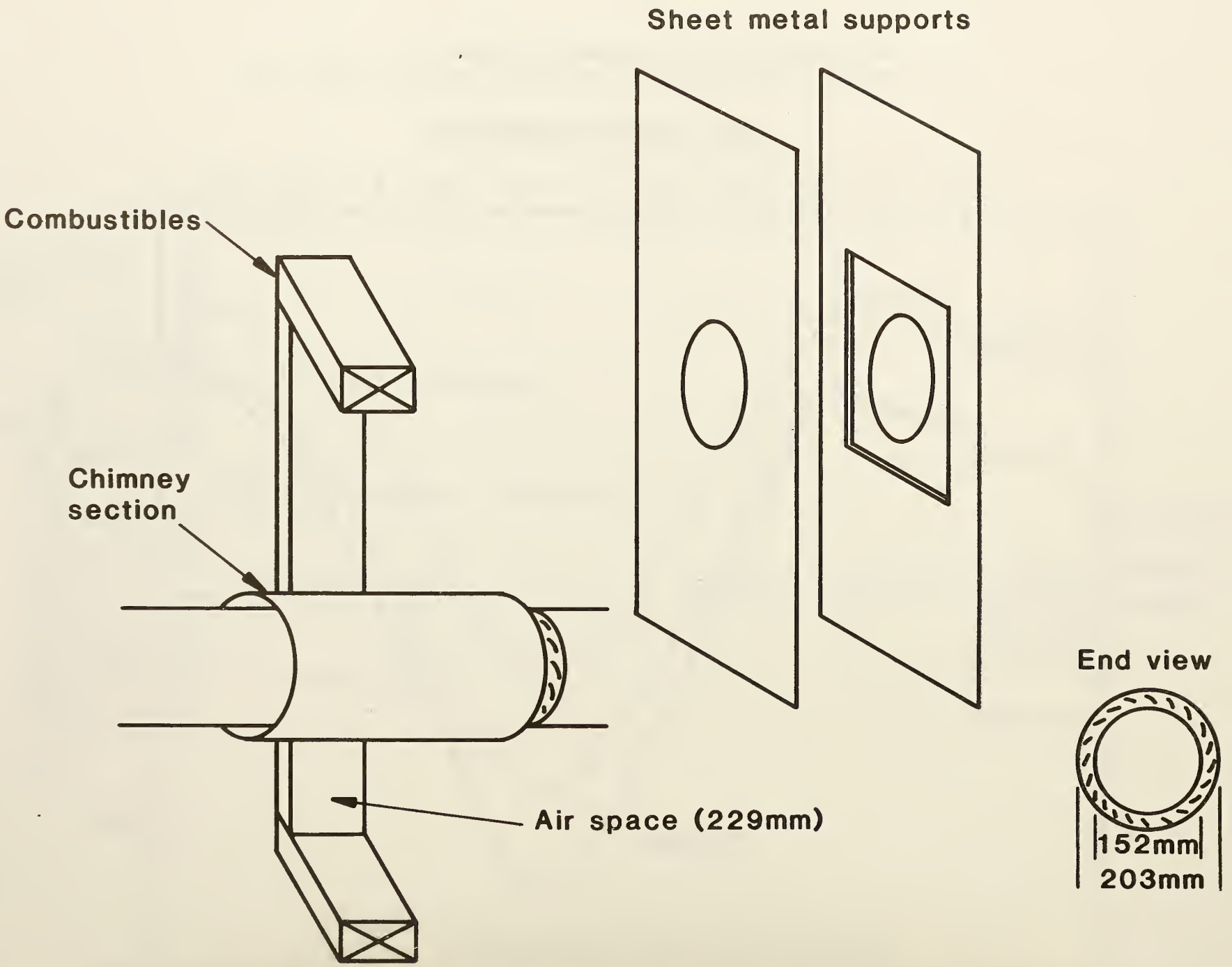


Figure 20. Commercial Chimney Section - Insulated Channel 25 mm - Combustibles 229 mm from Section

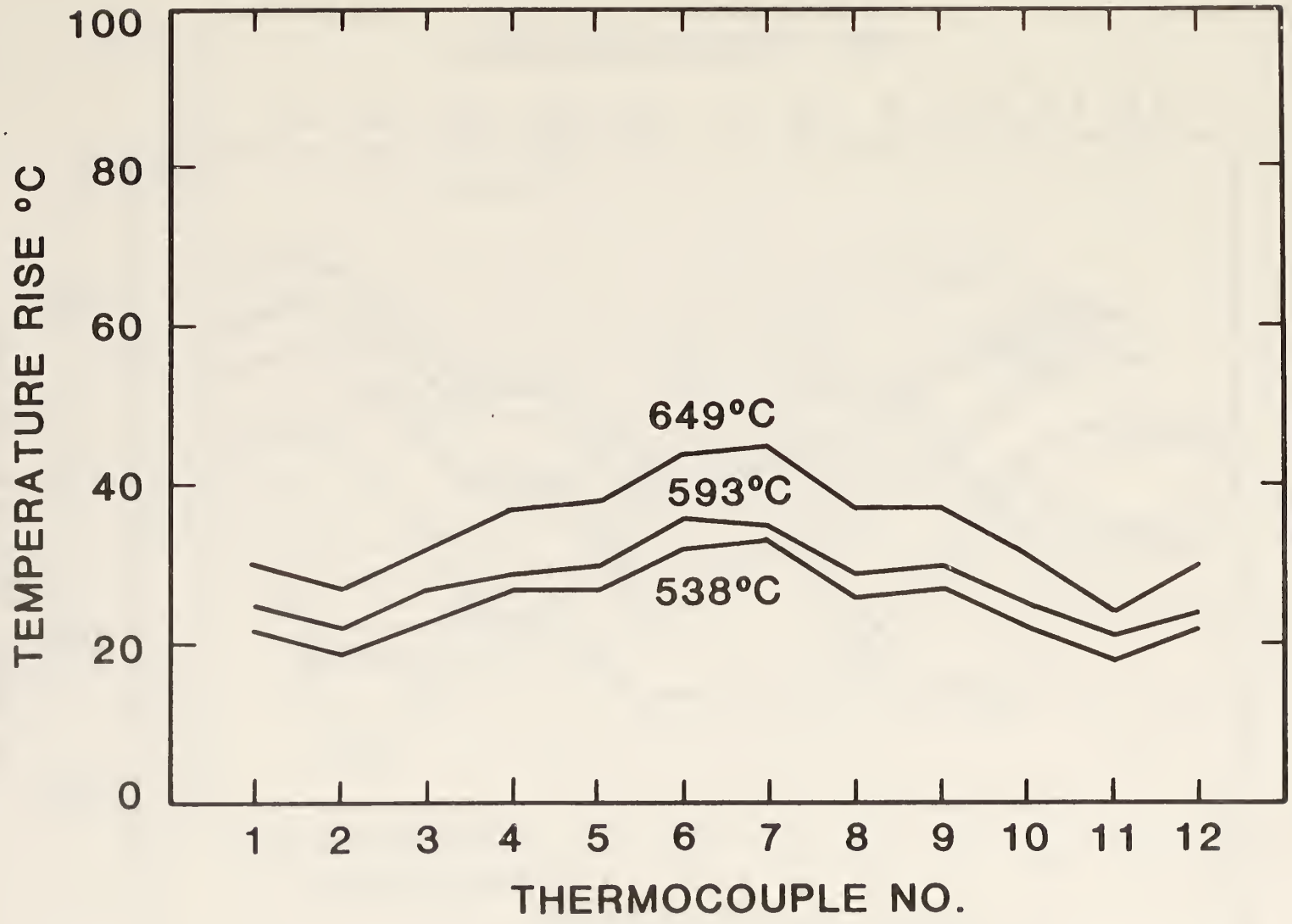


Figure 20(A). Commercial Chimney Section - Insulated Channel 25 mm - Combustibles 229 mm from Section

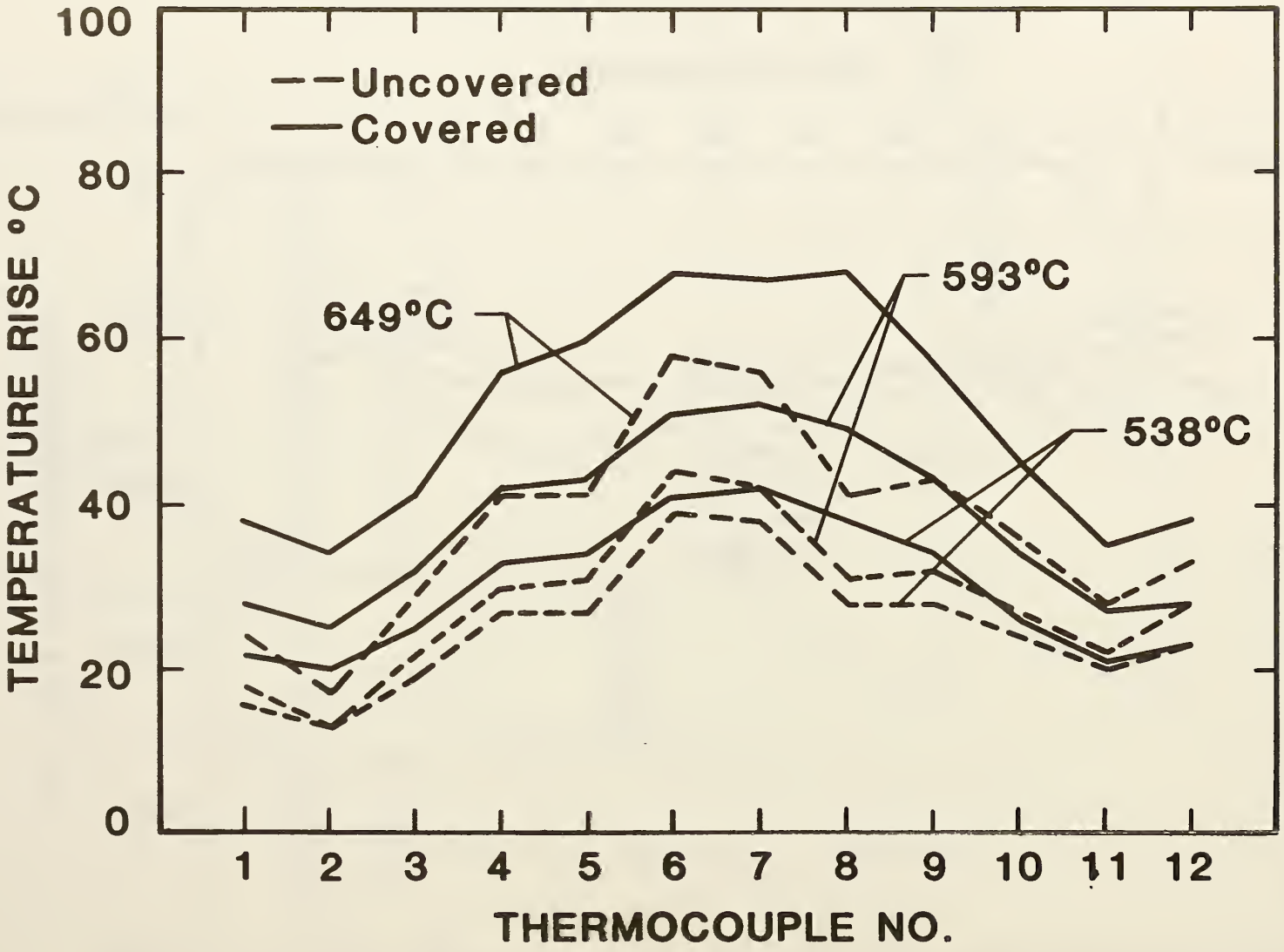


Figure 21. Effect of Sheet Metal Liner on Surface Temperature of Combustibles - Thimble System No. 6

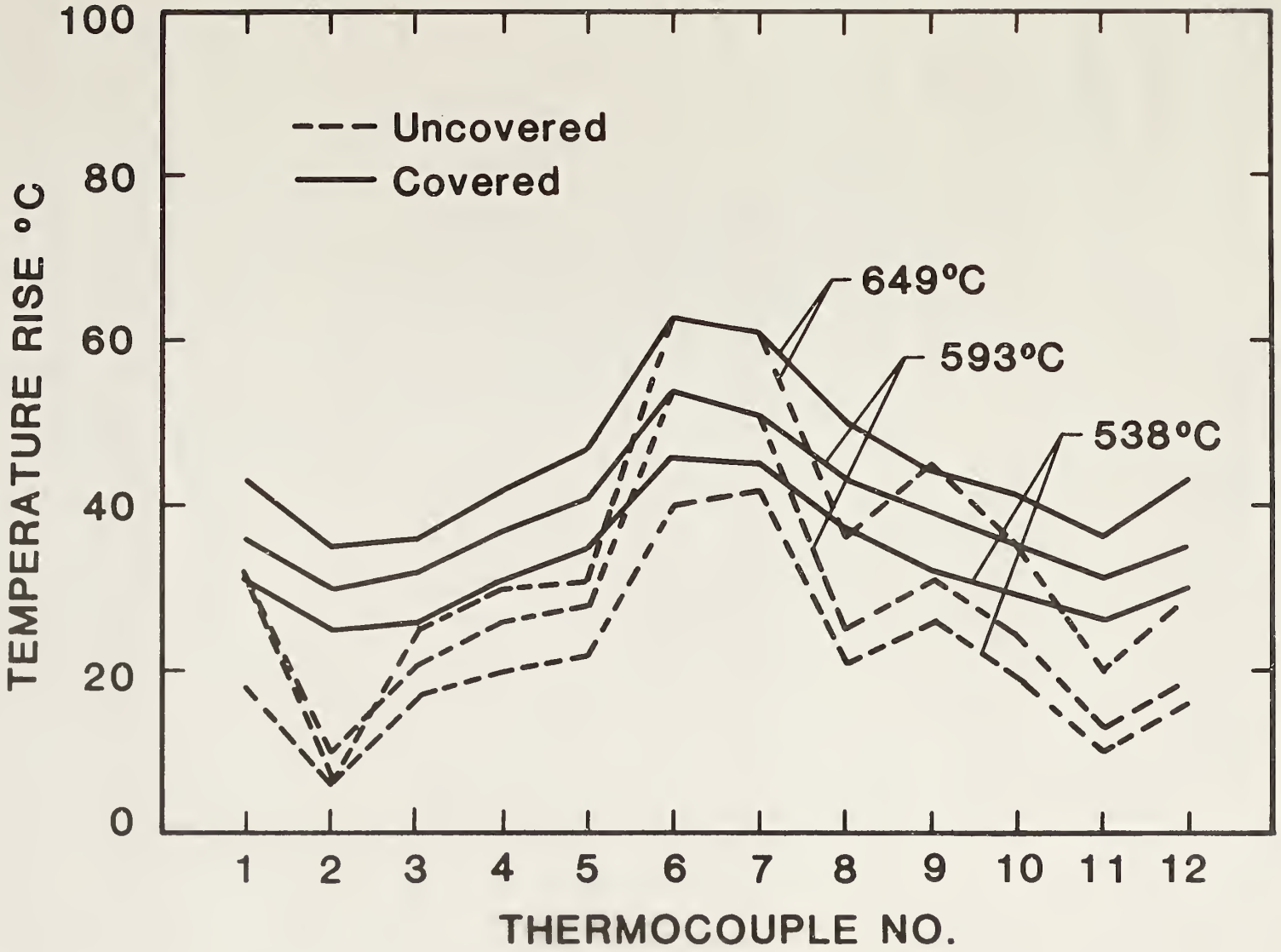


Figure 22. Effect of Sheet Metal Liner on Surface Temperature of Combustibles - Thimble System No. 5

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5. AUTHOR(S)

Joseph J. Loftus and Richard D. Peacock

6. PERFORMING ORGANIZATION (If joint or other than NBS, see instructions)

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10. SUPPLEMENTARY NOTES

☐ Document describes a computer program; SF-185, FIPS Software Summary, is attached.

11. ABSTRACT (A 200-word or less factual summary of most significant information. If document includes a significant bibliography or literature survey, mention it here)

This report is part of an ongoing project at the National Bureau of Standards (NBS) to evaluate the fire safety of solid fuel burning appliance installations in residential homes and buildings. Previous work included evaluations of different protection devices designed to shield room walls and ceilings from the effects of radiant energy from hot appliance and chimney connector pipe surfaces, the objective being to determine which systems would help maintain surface temperatures on combustibles within code recommended temperature levels. For this segment a total of 17 different thimble-chimney connector (wall pass-through) systems connected to chimney connector pipes from a stove were evaluated for their ability to provide thermal protection for combustibles (wood studs and headers, etc.) in room walls. Flue gases passing through the thimbles were monitored over a range of 538 to 649°C (1000 to 1200°F) and temperature rise measurements were made on the surfaces of the combustibles located in proximity to the thimbles. Code acceptable temperature rise values were found for 9 of the 17 thimbles systems tested at the 538°C (1000°F) exposure, for 6 thimbles at 593°C (1100°F) and for 4 thimbles at 649°C (1200°F).

12. KEY WORDS (Six to twelve entries; alphabetical order; capitalize only proper names; and separate key words by semicolons)

chimneys; fire codes; radiant energy; residential buildings; stoves; walls; wood.

13. AVAILABILITY

☒ Unlimited

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