NATIONAL BUREAU OF STANDARDS REPORT

1320

FIRE-ENDURANCE AND HOSE-STREAM TESTS OF PARTITIONS OF VERMICULITE-GYPSUM PLASTER ON METAL LATH AND ON GYPSUM LATH

By

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U. S. DEPARTMENT OF COMMERCE
NATIONAL BUREAU OF STANDARDS

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NBS PROJECT **NBS REPORT**

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Fire Protection Section
Building Technology Division

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ABSTRACT

The results of fire-endurance tests and hose-stream tests on the various partitions in a group of five are reported. Only two constructions are represented in the group however. They are a studless type partition of vermiculite-gypsum plaster on each side of gypsum lath and a partition of the same plaster on each side of metal lath.

The results of the fire-endurance tests showed good consistency within the group. Hose-stream tests on two duplicate partitions indicated that these met the requirements of this test for their respective fire-endurance limits. An additional hose-stream test conducted at the end of a fire-endurance test proved unsatisfactory for a longer fire-endurance limit.

I. INTRODUCTION

Five solid partitions, all of nominal 2 1/2-in. thickness, were subjected to fire-endurance and/or hose-stream tests. Two of the partitions were 16 ft wide and 10 ft high, while the other three were 10 ft wide and 10 ft high. These tests were made in cooperation with the Vermiculite Institute in order to establish fire-resistance limits for the various constructions.

2. MATERIALS

The gypsum lath, gypsum plaster, and plaster aggregate were provided by the sponsor. The remainder of the materials were provided by the contractor.

2.1 Plaster and Aggregate

The plasters used were two orders of a widely distributed brand of fibered gypsum and the aggregate was an expanded vermiculite. The chemical compositions and physical properties of the plasters were determined in accordance with the methods prescribed by Federal Specifications SS-P-401 and SS-P-402. Additional tests for physical properties were made using a sample of the vermiculite aggregate. The results of the chemical and physical tests are given in table 1.

The compressive strengths of 2-in. cubes of the plaster batches applied to the partitions averaged 648 lbs per sq in. for the scratch coats and 413 lbs per sq in. for the brown coats.

2.2 Gypsum Lath

The gypsum lath used was representative of the long length varieties available. Its nominal dimensions were 1/2-in. thick, 2 ft wide, and 10 ft long. The results of strength tests (ASTM Designation C26-42 and C37-42) are given in table 2.

Table 1. Chemical and physical properties of fibered gypsum plaster

Chemical Analysis	Tests 298-301	Test 307
	%	%
$CaSO_4 \cdot 1/2\ H_2O$ (from loss)	88.2	94.9
$CaSO_4 \cdot 1/2\ H_2O$ (from insol.)	92.8	94.6
$CaSO_4 \cdot 1/2\ H_2O$ (from SO_3)	93.1	93.6
$CaSO_4 \cdot 1/2\ H_2O$ (average)	91.4	94.4

Physical Tests	Tests 298-301		Test 307
	SS-P-401	SS-P-402	
Consistency	49	19	
Time of set	9 hr	7 hr	3 1/2 hr
Consistency for strength	49	21 1/3	
Tensile strength	310 lb/in.^{2}	250 lb/in.^{2}	260 lb/in.^{2}
Compressive strength	1920 lb/in.^{2}	1320 lb/in.^{2}	1600 lb/in.^{2}

Physical Tests with Vermiculite Aggregate	Tests 298-301	Test 307
Consistency	94.8	
Time of set[1/]	4 1/2 hr	2 1/4 hr
Tensile strength	105 lb/in.^{2}	80 lb/in.^{2}
Compressive strength	210 lb/in.^{2}	280 lb/in.^{2}

1/ It is believed that these low times of set are actually times of quick stiffening observed in previous experience with vermiculite aggregate in gypsum plaster.

Table 2. Characteristics of gypsum lath.

	Thickness		Breaking Load			
	Nominal	Measured (avg)	Parallel to fiber avg	Parallel to fiber min	Across fiber avg	Across fiber min
	in.	in.	lb	lb	lb	lb
	1/2	.500	43.2	42.4	154.8	153.8
ASTM req.	1/2	.500 ± .031	40	40	100	100

2.3 Metal Lath

The metal lath was a nominal 2.5 lb/per sq d diamond mesh flat expanded metal lath.

2.4 Other Metal Products

The support for the metal lath was provided by 3/4- by 1/2-in. 16 ga channels (3/4-in. cold rolled furring channels) which also provided the bottom support for the gypsum lath. Other support for the gypsum and metal lath was provided by 6-in. wide strips of 2.5 lb per sq yd diamond mesh flat expanded metal lath bent lengthwise in the center (cornerite). All ties were made with 18 ga soft annealed galvanized wire. The bottom of the plaster was protected by a pair of 2- by 1/2-in. channels or a pair of 2 1/2-in. wide formed sheet metal strips placed one on each side of the base of the partition as shown in the construction drawings.

3. CONSTRUCTION

The partitions were constructed by a local contractor's employees with supervision by a representative of the sponsor

and personnel of the National Bureau of Standards. The workmanship was of good quality and representative of that ordinarily obtainable. The construction details are shown in figures 1 and 2.

3.1 Tests 298, 299, and 307

The construction details for tests 298, 299, and 307 differed only in the area of the face of the partition, all being built to the same design which called for metal lath supported by channels and plaster sufficient to form a partition of 2 1/2-in. nominal thickness. The partition for test 298 was 16 ft wide by 10 ft ~~long~~ high; those for the other two tests were 10 ft square.

(a) Lath Foundation and Lath

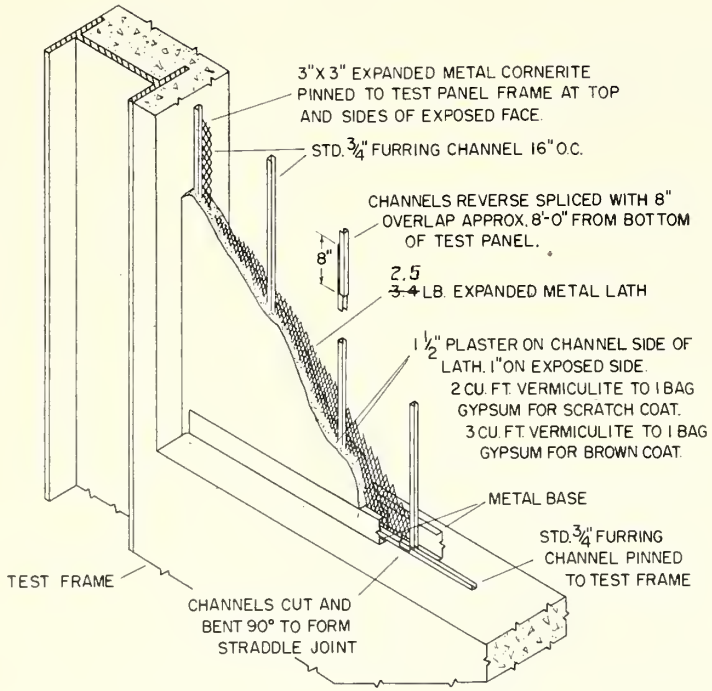
Lengths of 3/4-in. cold rolled furring channel were secured to the inside faces of the test frame opening. Channels were then erected vertically 16-in. o.c. and secured to those already placed across the top and bottom. Since the channel came in 8 ft 8 in. lengths, it was necessary to overlap two pieces of channel for each 10 ft height. Additional support was provided by the cornerite on the to-be-exposed face all across the top and down each side. A framework of horizontal channels and 2 x 4's was erected for temporary support during the application of the lath and scratch coat plaster.

The expanded metal lath was tied to the channel with single ties of wire approximately 6-in. apart. The long dimension of the lath was horizontal and each lath lapped its neighbor about 3-in. The laths were tied along the lap joints and to the cornerite along the top and sides.

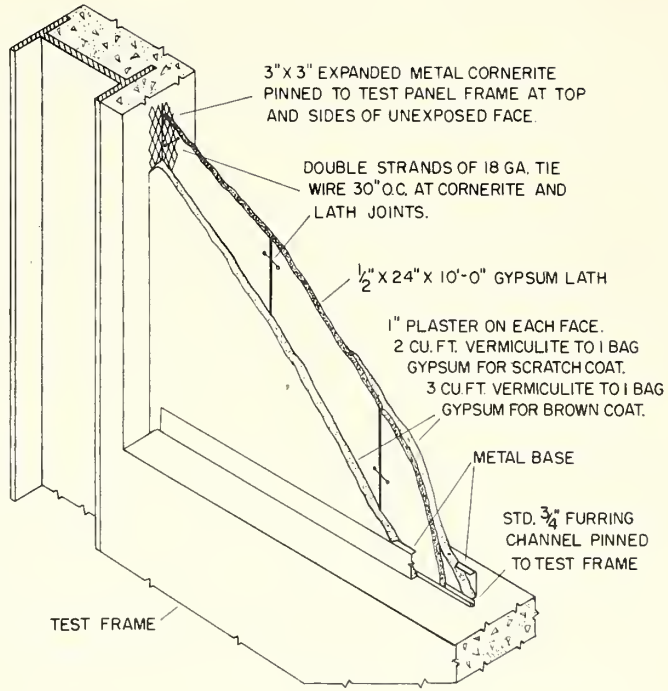
The channel or metal strip for the protection of the bottom of the plaster was mounted as shown in figure 1 and secured by various methods, including bolts, at the discretion and request of the sponsor.

(b) Plastering

The grounds were set for the desired thickness of plaster, 1-in. between the lath and the exposed face and the remainder backing the lath. The scratch coat plaster, mixed 2 cu ft of vermiculite to each 100 lb bag of gypsum plaster (1 1/2 cu ft), was applied to each side of the lath and allowed to set. Then the temporary framework of 2 x 4's and horizontal channels was removed and the brown coat, mixed 3 cu ft of vermiculite per 100 lb bag of gypsum plaster, was applied to each side. After the brown coat had set a 1/16-in. white finish coat of 3 parts of lime putty to 1 part of gaging plaster by volume was applied to each side to bring the surface out to the grounds. The space inside the metal protection at the bottom was filled with the scratch coat plaster.



CONSTRUCTION DETAILS FOR TESTS 298, 299, AND 307



CONSTRUCTION DETAILS FOR TESTS 300 AND 301

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Fig 1. Construction details of the test partitions.

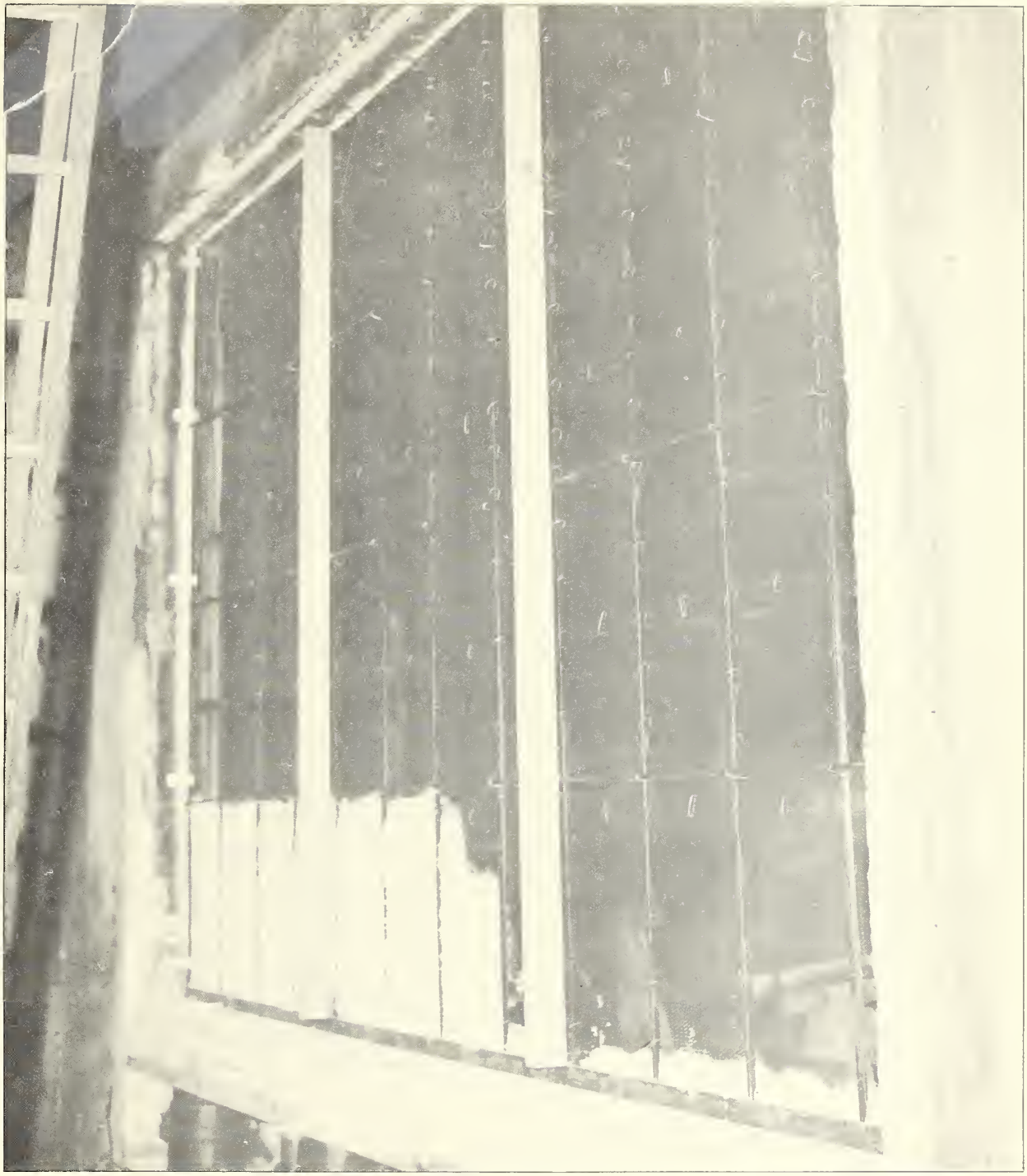

Fig 2. Partition for test 298 at start of plastering. The wood members and horizontal channels were temporary bracing.

3.2 Tests 300, 301

The construction details of the two partitions differed only in the area of the face of each, that for test 300 being 16 ft wide by 10 ft high while that for test 301 was 10 ft square. Both were built from the same design which called for 1-in. of plaster on each side of 1/2-in. gypsum lath.

(a) Lath Foundation and Lath

Lengths of 3/4-in. furring channel were secured to the bottom of the test frame opening and cornerite was attached to the sides and top of the opening. The 10 ft lengths of 1/2-in. gypsum lath were erected vertically with the bottom ends in the open side of the channel and one face of the tops against the vertical leg of the cornerite. Each of the end laths was similarly against cornerite along one edge. The laths were tied together at 2 1/2-ft intervals along their joints and to the cornerite at the ends and top. The metal for the protection of the bottom of the plaster was secured by bolts at the direction of the sponsor.

A temporary framework of steel channels was erected against one face of the gypsum lath to provide support during the scratch coat plastering.

(b) Plastering

The grounds were set for 1-in. of plaster on each side of the 1/2-in. gypsum lath and the scratch coat, mixed 2 cu ft of vermiculite per 100 lb bag of gypsum plaster, was

applied to each side, scratched, and allowed to set. During the application of the scratch coat, the space inside the metal protection at the bottom was completely filled. After the scratch coat plaster had set, the framework of channels was removed and the brown coat, mixed 3 cu ft of vermiculite per 100 lb bag of gypsum plaster, was applied. The 1/16-in. white coat, mixed 3 parts of lime putty to 1 part of gaging plaster by volume, was applied to give 1-in. of plaster on each side and a total thickness of 2 1/2-in. for the partition.

3.3 Seasoning and Measuring

The various test specimens were allowed to age from 34 to 55 days before test. During the aging period and after the specimens had approached equilibrium conditions, measurements of the actual thickness were made by drilling small holes (1/4-in. or less diam) and measuring through them. The 16- by 10 ft partitions, intended for fire endurance testing, were drilled at the nine points determined by the intersections of the horizontal and vertical center lines and quarter point lines. The 10- by 10 ft partitions intended for fire- and hose-stream tests, were drilled only at the center point with the exception of the partition for test 307 which had been very carefully checked during construction by the representative of the sponsor. Once the measurements were taken, the holes were filled with plaster.

Table 3. Measured Thicknesses of Partitions

Test No.	Size ft	One-point in.	Average (9) in.	Max in.	Min in.
298	16 x 10	---	2.45	2 1/2	2 7/16
299	10 x 10	2 3/8	--	--	--
300	16 x 10	---	2.25	2 7/16	2 3/16
301	10 x 10	2 1/2	--	--	--
307 2/	10 x 10	--	2.71	2 25/32	2 5/8

4. Test Method and Equipment

The tests were conducted in accordance with the Standard Methods of Fire Tests of Building Construction and Materials of the American Standards Association, ASA No. A2.1-1948 (ASTM Designation: E119-47).

4.1 Wall-Testing Furnace

The tests were made in a furnace having a combustion chamber 2 1/2-ft deep, 16-ft long, and 19 1/2-ft high. The chamber extended 6 ft below the burners in order to provide room for debris that might fall from the test specimen and block the burners. The details of the construction of the furnace are given in figure 3. One side of each partition was exposed to fires controlled to conform closely to the standard method which specified temperatures as follows:

2/ These measurements for test 307 taken several weeks after the test.

1,000°F at 5 min

1,300°F at 10 min

1,550°F at 30 min

1,700°F at 1 hr

1,850°F at 2 hr

and increasing 75 deg F per hour, thereafter. The test fire was produced by 92 gas burners. The fire-endurance tests were continued until one of the following criteria that limit fire resistance was obtained: (a) fire damage sufficient to allow the passage of flame or gas hot enough to ignite cotton waste, (b) the transmission of heat through the partition sufficient to raise the average temperature on its unexposed surface 250 deg F as measured by five or more thermocouples under 6-in. square 0.4-in. thick felted asbestos pads, or (c) a 325 deg F rise at any one of the above thermocouples.

4.2 Temperature Measurements

The temperatures inside the furnace, and on the unexposed surfaces of the partitions subjected fire-endurance tests were measured at regular intervals by chromel-alumel thermocouples and indicating potentiometers. The nine thermocouples in the furnace were protected by porcelain insulators and encased in wrought iron pipes sealed at one end. Those on unexposed surfaces were protected by asbestos sleeving and a length of 6-in., including the junction, was coiled under 6-in.

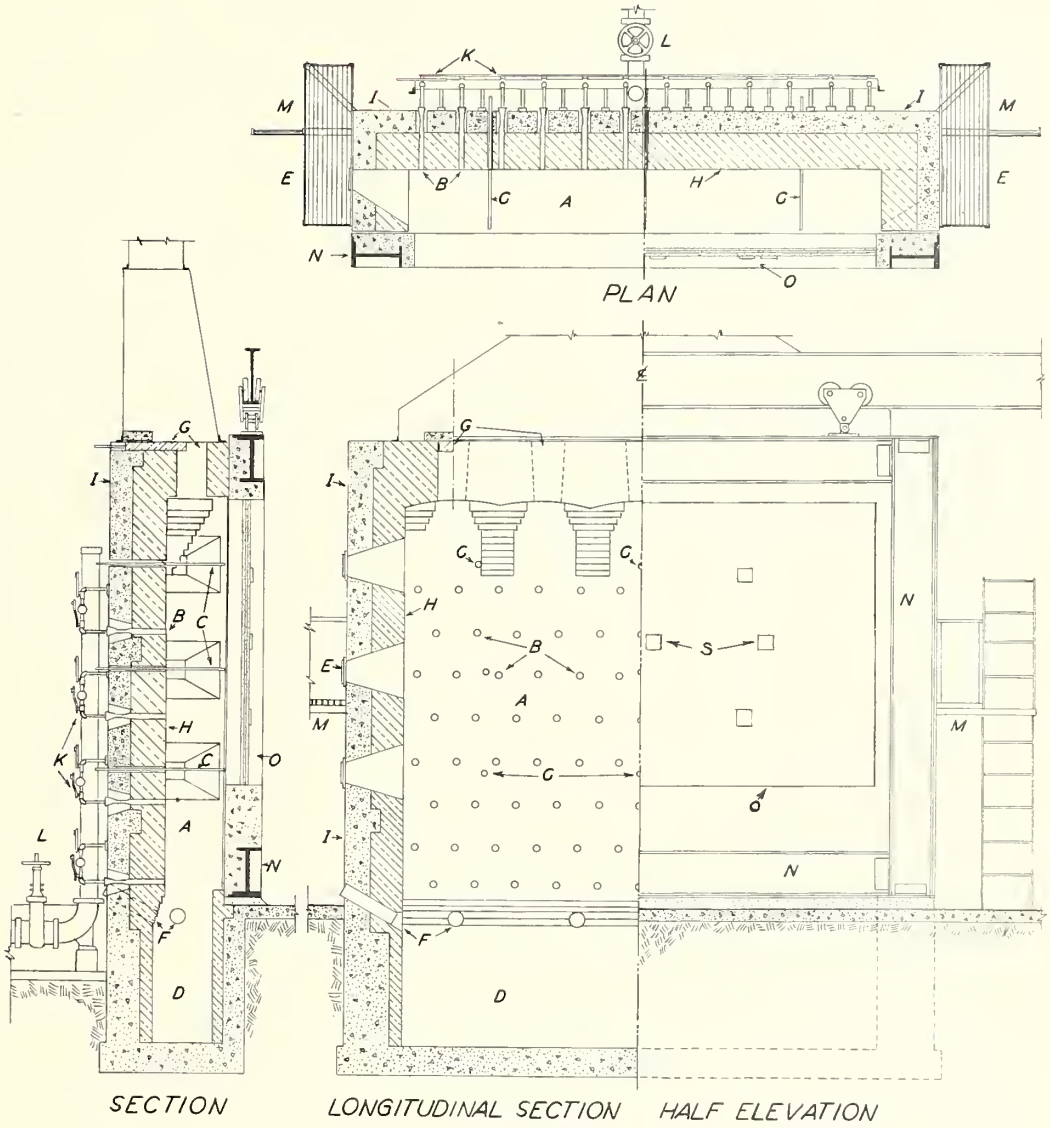

Fig 3. Panel test furnace.

A, furnace chamber; B, burners; C, thermocouple protection tubes; D, pit for debris; E, observation windows; F, air inlets; G, flue outlets and dampers; H, firebrick furnace lining; I, reinforced concrete furnace shell; K, gas cocks; L, control valve; M, ladders and platforms to observation windows; N, movable fireproofed test frame; O, test partition; S, asbestos felted pads covering thermocouples on unexposed surface of test partition.

square asbestos pads. The locations of thermocouples are given in figure 3. No surface thermocouples were located within 6-in. of the points at which holes were drilled for thickness measurements.

4.3 Deflections

The deflections of the partitions were measured during the tests at nine locations on the unexposed surfaces. They were obtained at frequent intervals by measuring from the surface to wires hung in front of the test partition. One of these wires was opposite the vertical center line of the partition and one opposite the quarter point on each side of the center line.

4.4 Hose Stream

To qualify for fire-endurance limits of 1-hr or more, partitions are required to be subjected to a hose-stream test. This test is ordinarily made by subjecting a duplicate partition to a fire exposure equal to half the desired fire-resistance limit or half the fire-endurance limit of the original partition, but not more than 1 hr. The partition is then removed from the test furnace and immediately exposed to the impact, erosion, and cooling effects of a fire hose stream directed first at the middle and then at all parts of the exposed face, changes in direction being made slowly. An optional program permits having the hose-stream test made on the sample subjected to the fire-endurance test and imme-

diately following the expiration of the fire-endurance test. This option was followed in test 299.

The stream is delivered through a 2 1/2-in. hose discharging through a National Standard Playpipe equipped with 1 1/8-in. discharge tip. The water pressure and duration of application are governed by the fire exposure period. For the three hose-stream tests (299, 301, 307), the stream was delivered from a pressure of 30 lb/sq in. and applied to the 100 sq ft of each partition for 2 1/2 min.

5. RESULTS OF TESTS

5.1 Test 298

Fire-endurance test of a 16 ft wide by 10 ft high solid partition of vermiculite-gypsum plaster on both sides of metal lath to give an overall thickness of 2 1/2-in. (nominal).

(a) Test Log

Test Time	Observation
02	Full height hairline crack on vertical center line, unexposed side.
10	Diagonal hairline cracks in bottom corners plus three verticals in south half.
13	Metal channel on fire-exposed side bulges out from partition near south end.
14	Hairline cracks in unexposed side are closing.

Test Time	Observation
28	Metal channel on fire-exposed side bulges out from partition near north end.
30	Vertical crack 3 ft long from base at south quarter point of exposed surface.
42	Vertical crack 8-in. long from the base at center point of exposed surface.
52	Diagonal hairline cracks reappear in lower corners of unexposed surface.
58	Steam from 1/16-in. crack in lower north corner of unexposed surface.
1:05	Diagonal cracks in all corners plus verticals along center line and 1 ft north of center line of unexposed surface.
1:26	Horizontal crack 6 ft long and 1/16-in. or less wide at center height of exposed surface. Cracks in unexposed surface 1/16 in. or less.
1:28	Lower two-thirds of unexposed surface darkened (apparently moisture) except over the vertical channels.
1:34	Five horizontal cracks across unexposed surface.
1:56	Partition "dished" toward flames; cracks over most of unexposed surface; only two fine cracks in exposed surface.
2:11	Gas off.

(b) Condition after test

The partition had deflected towards the furnace chamber, showing a very pronounced "dishing" effect. The deflections of the center point are shown in figure 4. Both the exposed and unexposed surfaces showed considerable numbers of cracks but none of the cracks were as much as 1/8-in. wide. No plaster had fallen.

(c) Temperatures

The initial temperature was 81°F (27°C). The furnace temperatures are indicated by F and the unexposed surface temperatures by S in figure 5. The severity of the fire exposure, as measured by the ratio of the area under the curve of average furnace temperatures to the area under the reference curve, was 100.2 percent. Failure was determined by a rise in temperature at one point of the unexposed surface of 325 deg F (181 deg C), occurring at 1 hr 51 min. At that time the average furnace temperature was 1841°F (1005°C).

5.2 Test 299

Fire-endurance and hose-stream test of a 10- by 10 ft solid partition of vermiculite-gypsum plaster on both sides of metal lath to give an overall thickness of 2 1/2-in.. (nominal).

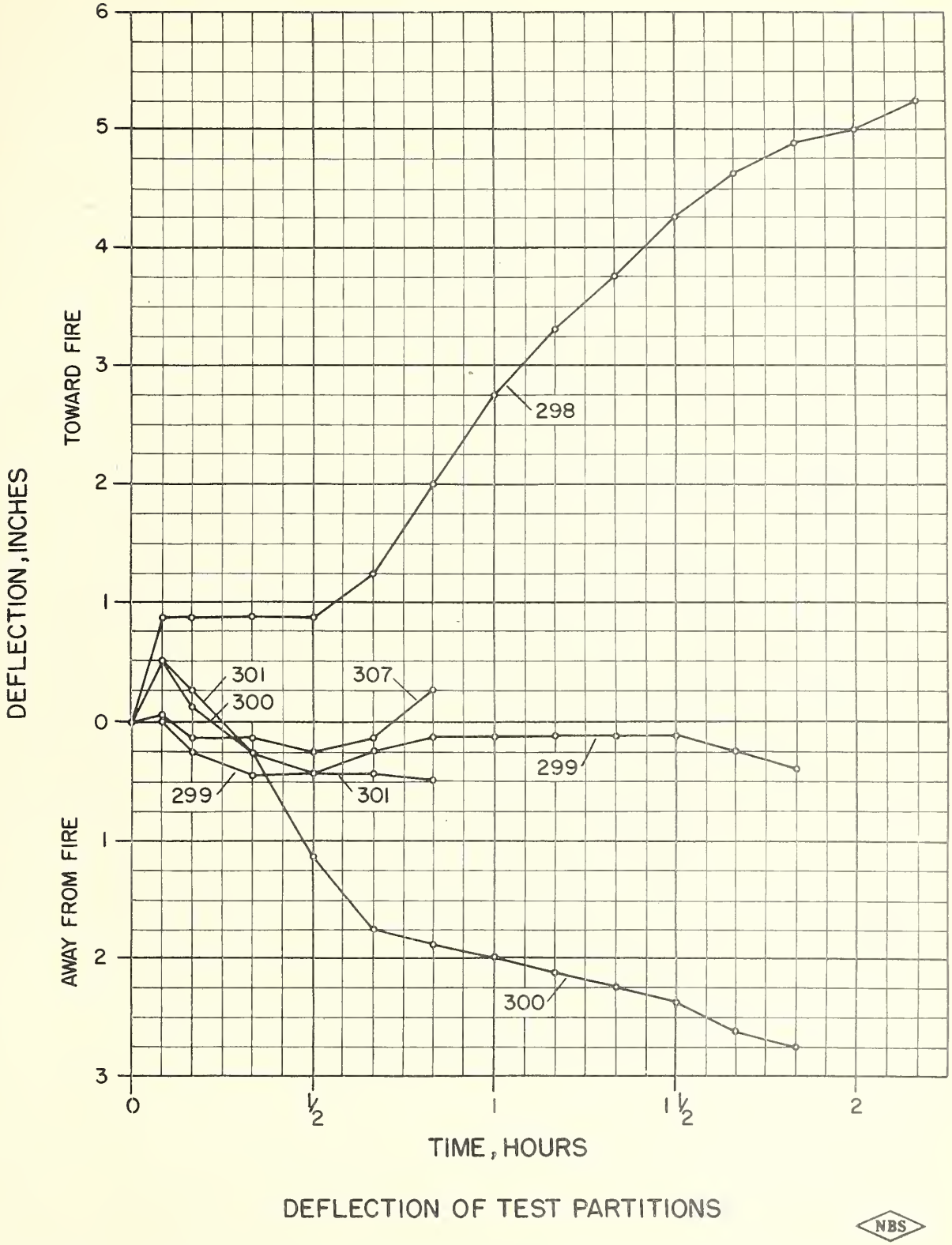

Fig 4. Deflections of the midpoints of the partitions during the tests.

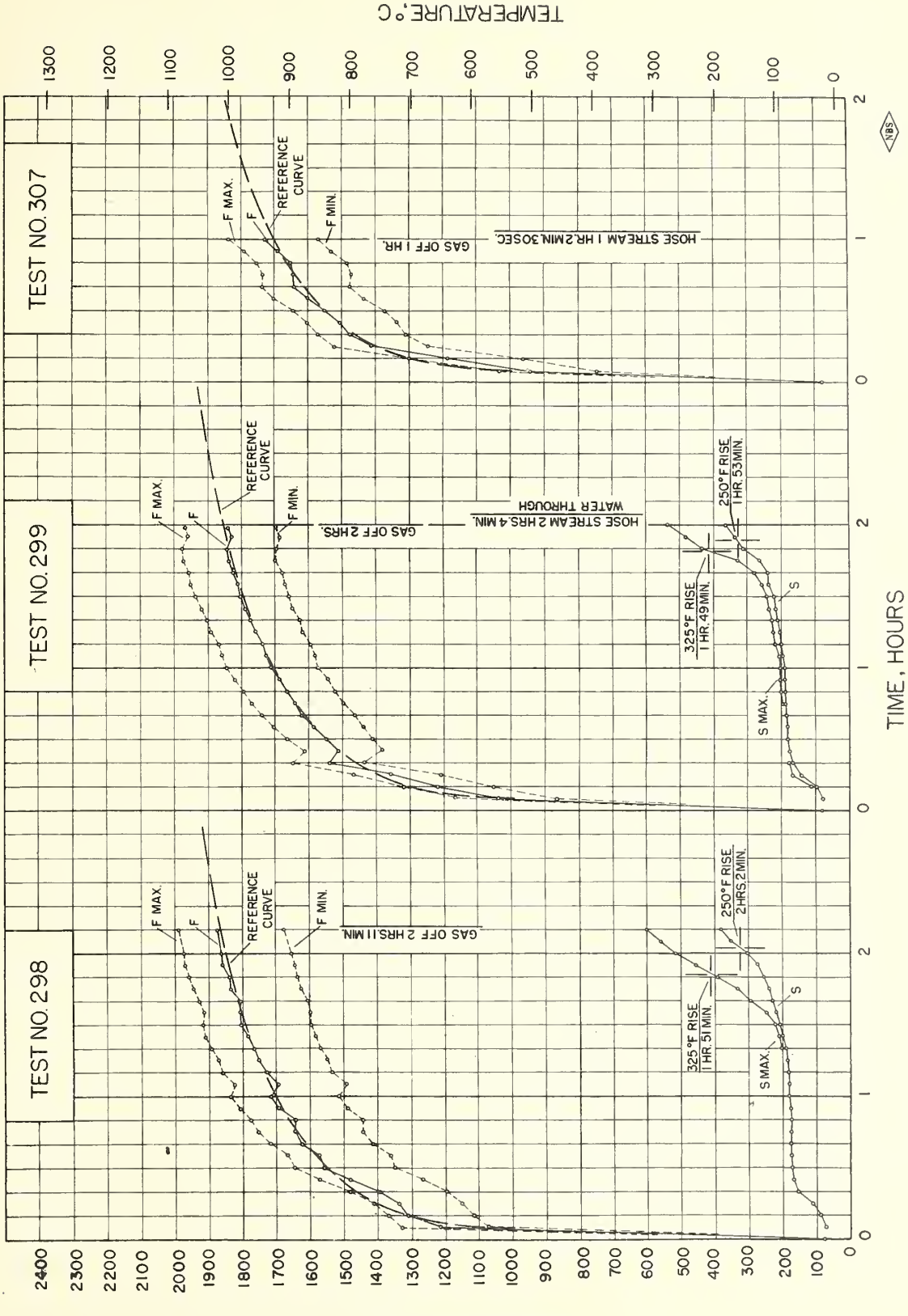

Fig 5. Curves of temperatures observed during the tests of the partitions of plaster on metal lath. F, F_{max}, and F_{min} refer to average, maximum, and minimum furnace temperatures respectively. S and S_{max} refer to average and maximum temperatures on the unexposed surface.

(a) Test Log

Test Time	Observation
02 1/2	Vertical hairline crack near center line of unexposed surface.
08	Several hairline cracks over unexposed surface; 5-in. vertical crack near south quarter point of exposed surface.
10	Flame from crack in exposed surface.
18	Less flame, black smoke from crack in exposed face.
21	Metal base bulged toward flames for about 1 ft near north end of exposed side.
23	Flame stopped and smoke almost stopped from crack in exposed surface. Several hairline cracks in unexposed surface are outlined by moisture in plaster.
53	Crack in exposed surface glowing; cracks in unexposed surface less than 1/16-in. wide.
1:10	Except for outline of vertical channels and some cracks, most of the unexposed surface is darkened, apparently by moisture.

Test Time	Observation
1:20	Horizontal cracks across unexposed surface about midheight are 1/16-in. wide; others less.
1:35	Horizontal crack across exposed surface near top.
2:00	Gas off.
2:04	Hose stream applied to exposed surface for 2 1/2 min.

(b) Condition after test

Following the hose-stream test, the exposed surface white coat and brown coat plasters were badly eroded and, in some places, even the scratch coat was partly eroded. The metal lath was exposed for about 6 ft along a vertical line about 2 ft from the north end and varying from 1- to 6-in. wide. It was also exposed along two narrow horizontal cracks and two small spots at the south edge. See figure 6. The unexposed surface had a vertical crack opposite the 6 ft eroded portion of the fire-exposed side. See figure 7. Water had passed through the partition along this crack. The partition was bowed away from the direction from which the flames and hose stream had been directed.

(c) Temperatures

The initial temperature was 81°F (27°C). The furnace and unexposed surface temperatures are indicated by F and S, respectively, in figure 5. The severity of the fire exposure

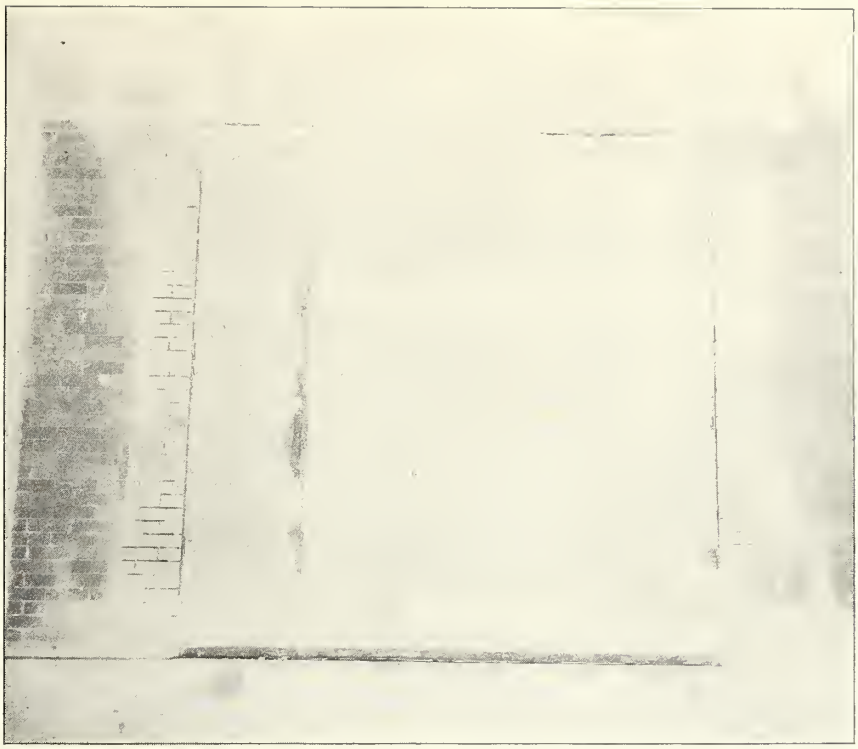

Fig 6. Test 299. Exposed surface of partition after fire endurance and hose stream tests.

Fig 7. Test 299. Unexposed surface of partition after fire endurance and hose stream tests.

was 100.2 percent. Failure was determined by a rise in temperature at one point of the unexposed surface of 325 deg F (181 deg C), occurring at 1 hr 49 min. At that time the average furnace temperature was 1839°F (1004°C).

5.3 Test 307

Fire- and hose-stream test of a 10- by 10 ft solid partition of vermiculite-gypsum plaster on both sides of metal lath to give an overall thickness of 2 1/2-in.

(a) Test Log

Test Time	Observation
03	Vertical hairline cracks near north end of unexposed surface.
14	Some white coat plaster spalling from exposed surface.
17	Five-in. vertical crack near top center of exposed surface. Hairline cracks in unexposed surface have closed.
23	More white coat plaster spalling from exposed surface.
51	Vertical cracks near each end of unexposed surface.
1:00	Gas off.
1:02 1/2	Hose stream applied to exposed surface for 2 1/2 min.

(b) Condition after test.

Following the hose-stream test, the exposed surface white coat plaster was gone from at least three-quarters of the area but the brown and scratch coats were largely intact. The metal lath was exposed in one spot 1 ft wide by 2-in. high as shown in figure 8. The plaster of the unexposed surface was intact and dry, no water having passed through the partition.

(c) Temperatures

The initial temperature was 79°F (26°C). The furnace temperatures are indicated by F in figure 5. The fire exposure severity was 99.4 percent. The highest average furnace temperature was 1733°F (945°C), at the end of the fire exposure.

5.4 Test 300

Fire-endurance test of a 16 ft wide by 10 ft high solid partition of 1-in. of vermiculite-gypsum plaster on each side of 1/2-in. gypsum lath to give an overall thickness of 2 1/2-in. (nominal).

(a) Test Log

Test Time	Observation
03	Vertical hairline crack in unexposed surface 2 ft south of center (corresponds to joint between two laths).

Fig 8. Test 307. Exposed surface of partition after fire and hose stream test.

Test Time	Observation
10	Vertical hairline cracks in unexposed surface along lines of three joints between laths.
25	Hairline cracks in unexposed surface have closed.
41	Metal base bowed toward flames near north end of exposed side.
43	Several short cracks in random directions along a vertical path about 2 ft from the south end of the exposed surface.
45	An L-shaped crack with each leg 2 ft long at midheight and 4 ft from south end in the exposed surface.
47	A crack in the form of an inverted T at midheight 4 ft from north end in exposed surface.
52	Vertical crack 3 ft long in exposed surface 6 ft from south edge.
55	Horizontal cracks in exposed surface 1 ft from top and at midheight.
1:05	Inverted T and L-shaped cracks 1/8- to 1/4-in. wide, slight bulge at each.

Test Time	Observation
1:25	Vertical crack 6 ft long in unexposed surface 6 ft from south edge, opposite similar crack in exposed surface.
1:39	Plaster offset 3/8 in. along inverted T crack in exposed surface. Horizontal crack near top 1/4- to 3/8-in. wide.
1:46	At inverted T and L-shaped cracks in exposed surface, plaster below crack offset 3/8- to 1/2-in. from that above.
1:50	Asbestos pad over thermocouple near north quarter point on horizontal center line (no. 6) fell.
1:53	Cotton waste glows after being held over junction of horizontal and vertical cracks 6 ft from south edge at mid-height.
1:57	Plaster offset 1- to 1 1/4-in. towards flames at L-shaped and inverted T cracks in exposed surface. Unexposed surface has horizontal cracks at mid-height and upper quarter point and vertical ever 2 ft.
2:00	Gas off.

(c) Condition after test

Both surfaces contained numerous long cracks. Most of the vertical cracks were spaced uniformly at 2 ft intervals corresponding to the joints between laths. Despite the numerous cracks, no plaster fell except small amounts of white coat from the exposed surface. The partition had deflected away from the flames during the test, as shown in figure 4.

(c) Temperatures

The initial temperature was 72°F (22°C). The furnace and unexposed surface temperatures are indicated by F and S, respectively, in figure 9. The severity of the fire exposure was 100 percent. Failure was determined by a rise in temperature of 325 deg F (181 deg C) at one point on the unexposed surface and ignition of cotton waste over a crack at another point, both occurring at 1 hr 53 min. At that time the average furnace temperature was 1842°F (1006°C).

5.5 Test 301

Fire- and hose-stream test of a 10 ft square, solid partition of 1-in. of vermiculite-gypsum plaster on each side of 1/2-in. gypsum lath.

(a) Test Log

Test Time	Observations
08	Several hairline cracks along edges and in corners plus two verticals, one on each side of center and 1 ft therefrom, in unexposed surface.
15	Metal base bowed toward flames at north end of exposed side.
19	Hairline cracks in unexposed surface almost closed.
35	Thin black smoke from 1 1/2-in. crack 1 to 2 ft below and north of center in exposed surface.
37	Light brown discoloration of unexposed surface along hairline cracks.
40	Several smoking cracks radiating from previous crack in exposed surface, covering an area of 1 1/2 ft diameter which is also bulging.
50	Crack in exposed surface 1/4 in. wide at center of radiating cracks.
1:00	Gas off.
1:02 1/2	Hose stream applied for 2 1/2 min.

(b) Condition after test

Nearly all the white, brown, and scratch coats of plaster were eroded from the exposed surface by the hose stream. In

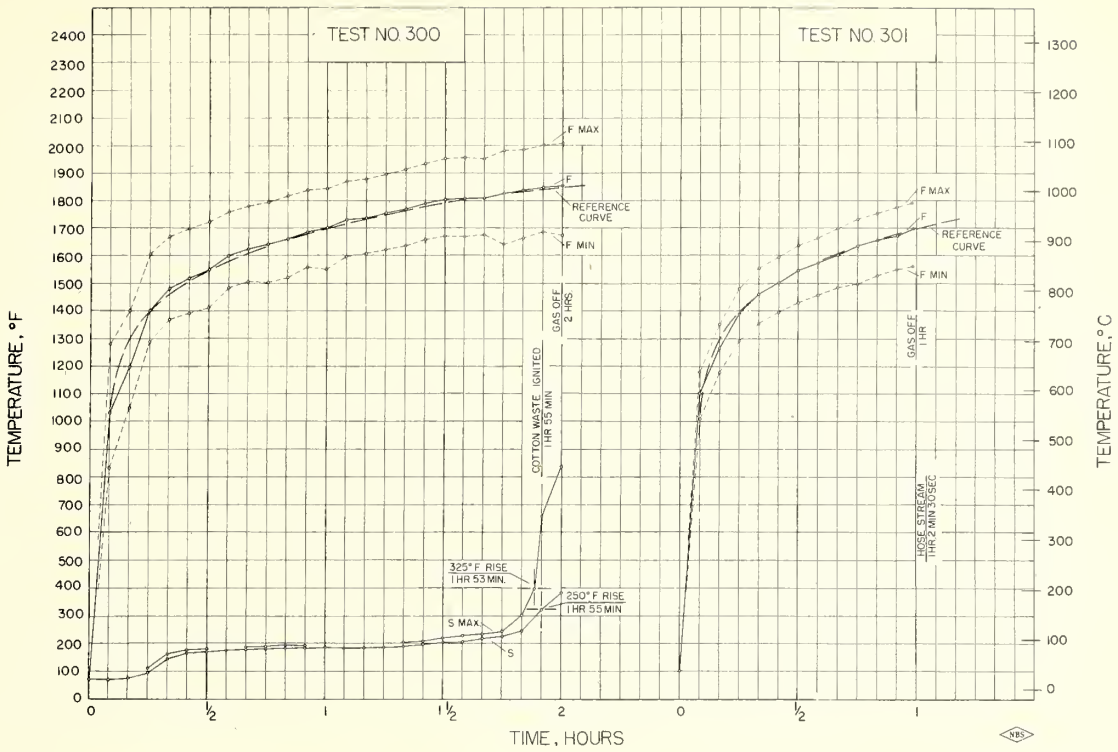

Fig 9. Curves of temperatures observed during the tests of partitions of plaster on gypsum lath. F, F_{max}, and F_{min} refer to average, maximum, and minimum furnace temperatures respectively. S and S_{max} refer to average and maximum temperatures on the unexposed surface.

Fig 10. Test 301. Exposed surface of partition after fire and hose stream test.

addition, the gypsum lath was eroded in several small spots but none larger than 1 ft square. See figure 10. The plaster on the unexposed side of the lath was not damaged by the hose stream and no water passed through the partition.

(c) Temperatures

The initial temperature was 100°F (38°C). The furnace temperatures are indicated by F in figure 9. The fire exposure severity was 100.3 percent. The average furnace temperature was 1674°F (912°C) just before the end of the fire exposure.

6. DISCUSSION

In each of the tests 298, 299, and 300, the specimens failed to exhibit a 2-hour fire resistance period by only a few minutes. In each case the partition was slightly thinner than the nominal 2 1/2-in. thickness intended. Extrapolation of the data provides an indication of results to be expected from partitions of the full 2 1/2-in. thickness.

While the relationship between fire-endurance and structure thickness for complex partitions is not too well understood, it has been customary to express this relationship for simple partition structures as:

$$R_2 = R_1\left(\frac{T_2}{T_1}\right)^{1.7}$$

where:

R_1 = Fire resistance period for the structure tested

R_2 = Derived fire-resistance period

T_1 = Thickness of specimen tested

T_2 = Thickness of specimen for which the derived resistance period is required.

Using this formula and the average partition thickness the derived fire-resistance periods listed in Table 4 may be obtained.

Table 4. Derived fire-resistance periods 2 1/2-in. partitions.

Test No.	Average thickness	Observed fire-endurance	Derived fire-endurance
	in.	hr:min	hr:min
298	2.45	1:51	1:55
299	2.38*	1:49	1:59
300	2.25	1:53	2:15

*Only one thickness measurement was made on this panel.

These derived fire-resistance periods may be considered as estimates of the performance of partitions built in a similar manner to those tested but having average thicknesses of 2.50 in., the designed thickness of these partitions.

7. SUMMARY

The partitions of plaster on metal lath of tests 298, 299, and 307, were subjected to fire-endurance tests in the first two instances and reached the end point of a 325 deg F temperature rise at one point on the unexposed surface at 1 hr 51 min and 1 hr 49 min, respectively. These specimens would qualify for derived fire-resistance periods of 1 hr 55 min and 1 hr 59 min, based on an average thickness of 2.50 in. The second specimen, test 299, was subjected to a hose-stream test following the fire endurance, as permitted in the optional program of the ASTM Standard Test Methods for walls and partitions (ASTM E119-47 par. 9(c)) and failed to prevent the passage of water through it. The third test of the group, test 307, was a fire exposure of 1 hour followed by a hose stream application in which no water passed through the partition. This latter specimen meets the ASTM test requirements for a hose-stream test on a specimen qualifying for a 2 hour fire-endurance limit.

The partitions of vermiculite-gypsum plaster on gypsum lath of tests 300 and 301, were subjected to a fire-endurance

test in the first instance and a fire exposure and hose-stream test in the latter. The former test reached the end point of a 325 deg F rise at one point on the unexposed surface at 1 hr 53 min. This specimen would qualify for a derived fire-resistance period of 2 hr 15 min, based on an average thickness of 2.50 in. The latter test, with the hose stream applied following 1 hr fire exposure was satisfactory, no water passing through the partition. This latter specimen meets the ASTM test requirements for a hose-stream test on a specimen qualifying for a 2 hr fire-endurance limit.

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