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KORFIL INC.

File R10326-1
Project 82NK21480

February 28, 1983

REPORT

on

FIRE TEST CONDUCTED ON A
CONCRETE BLOCK WALL
CONSTRUCTED OF NOMINAL 8 X 8 X 16 IN.
BLOCKS WITH MOLDED POLYSTYRENE INSERTS

Korfil, Inc.
Chicopee, Massachusetts

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G E N E R A L

The subject of this Report is the fire resistance performance of a 2 h concrete block load bearing wall. The concrete blocks contained molded polystyrene inserts.

The object of the investigation was to determine the fire resistance rating and to quantify the amount of smoke emitted from the assembly during a fire endurance test conducted in accordance with Standard for Fire Tests of Building Construction and Materials, UL 263 (ASTM E119). The smoke emitted was quantified by measuring the obscuration to a light path of known intensity placed across the upper partition of the test assembly.

D E S C R I P T I O N

DESCRIPTION OF TEST ASSEMBLY:

MATERIALS

Concrete Masonry Units - The concrete masonry units used in the wall assembly were nominal 8 in. by 8 in. by 16 in. The units were manufactured from a concrete mix design consisting of cement and expanded slag coarse aggregate. The blocks had an equivalent thickness of 3.90 in. The masonry units meet the requirements of Standard UL 618, Concrete Masonry Units, for a 2 h fire resistance rating (Class D-2 units). The general details of the masonry units are shown on ILLS. 1 and 2.

Insulation - The nominal 1 in. thick molded polystyrene insulation was manufactured and supplied by Korfil, Inc. The insulation was molded and pre-cut to fit within the void areas of the concrete masonry unit. The polystyrene had an average density of 1.3 lb/ft³. Identification of proprietary materials was based upon the manufacturer's product literature.

The general appearance of the insulation is shown on ILL. 1.

Mortar - The mortar was composed of three parts of sand to one part of Portland cement (by volume) and to 15 percent (by volume) of hydrated lime.

CONSTRUCTION

The wall assembly was constructed within a 10 ft wide by 10 ft high masonry lined steel test frame. One molded polystyrene unit masonry insulation was placed in each core hole of each concrete masonry unit. A course of masonry units were laid on a bed of mortar placed on the sill of the test frame.

All concrete masonry units were laid with the core holes vertical and with the joints staggered with a full mortar bed and the usual end joining. All core holes formed staggered flues for the full height of the wall.

A clearance of about 3/4 in. was provided at the vertical edge on each end of the wall which was filled with mineral wool to prevent passage of flame.

Two holes, approximately 1-1/2 in. in diameter, were drilled into two masonry units in the lower corners of the assembly. The holes were covered and sealed with a clear plastic "window." The purpose of the "windows" were to view any physical changes of the molded polystyrene inserts that might occur during the fire resistance test.

The general appearance of the unexposed and exposed surfaces of the assembly before the fire and hose stream tests is shown on ILLS. 4 and 5.

T E S T R E C O R D N O. 1

FIRE ENDURANCE TEST:

The fire test was conducted in accordance with the Standard, Fire Tests of Building Construction and Materials, UL 263.

DESCRIPTION OF WALL ASSEMBLY

The concrete masonry wall was constructed in the test frame opening as described in the preceding section of this Report titled "Erection Of Test Assembly" and as shown on ILLS. 4 and 5.

METHOD

The standard equipment of Underwriters Laboratories Inc. for the fire test were conducted in accordance with Standard UL 263 (ASTM E119).

Prior to the fire exposure, the wall was loaded to 85 psi of gross cross-sectional area. This load was maintained throughout the fire exposure, during the hose stream test, and the subsequent cooling period. The horizontal deflections of the wall were measured throughout the test at the center and the quarter points and the vertical movement of the loading beam was measured by three extensometers placed under the beam.

The temperatures in the furnace were measured with twelve thermocouples placed 6 in. away from the exposed surface and symmetrically located in the furnace chamber as shown in ILL. 3.

The temperatures on the unexposed side of the wall were indicated by twelve thermocouples located as shown on ILL. 4.

The smoke measuring apparatus consisted of two photometers located along the longitudinal axis of a nominal 4 by 4 by 16 ft (four sided; longitudinal side and bottom open, approximately 12 ft above the floor) 1/2 in. thick plywood shroud. The open side of the shroud was placed against the assembly and the edges sealed.

Smoke rising from the assembly accumulated within the space created by the shroud, from the top downward and moved out to all edges of the open bottom. The photometers incorporating a 3 ft light path, were vertically oriented to reduce variations in measurements due to stratification of smoke within the shroud. The approximate circular light "spot" from the lamp was centered upon the sensing area (selenium disc) of the photovoltaic cell. A continuous record of the maximum 100 mV output of the photocell was kept using a multi-range, four decade recorder, providing transmittance versus time measurements.

Throughout the test, observations were made of the character of the fire and its control, the condition of the exposed and unexposed faces, the amount of smoke developed, and all developments pertinent to the performance of the wall as a fire barrier with reference to stability, heat transmission, and passage of flame and hot gases.

RESULTS

Observations During Application of Load - During application of the load, no cracks developed in the wall. No additional movement was noted after the full load of 85 psi was applied during the period prior to the start of the test.

The deflections of the wall and the vertical movement of the loading beam are shown in the following tables:

Maximum Horizontal Deflections During Loading, In.

<u>South Quarter</u>	<u>Center</u>	<u>North Quarter</u>
0	0	0

Maximum Horizontal Deflections During Fire Test, In.

<u>South Quarter</u>	<u>Center</u>	<u>North Quarter</u>
1/8	3/16	1/8

* - All movement was away from fire.

Maximum Vertical Movement During Loading, In.**

<u>South Quarter</u>	<u>Center</u>	<u>North Quarter</u>
0.060	0.060	0.060

Maximum Vertical Movement During Fire Test, In.**

<u>South Quarter</u>	<u>Center</u>	<u>North Quarter</u>
0.098	0.135	0.069

** - All movement of the loading beam was upward.

Character and Distribution of Fire - The furnace fire was luminous and well distributed throughout the test period. The furnace temperatures recorded during the fire test are shown on ILL. 3. The furnace fire was extinguished at 162 min.

Observations of the Unexposed Surface During Fire Exposure - A crack developed at the center of the wall at 18 min of exposure. Cracks developed at the south quarter point at 23 min and at the north quarter point at 27 min. At 90 min, the polystyrene inserts, as viewed through the clear plastic "windows," were still intact. By approximately 120 min, the polystyrene inserts were no longer visible, as they had melted with no flames occurring. No other apparent physical changes were noted throughout the test.

The test was terminated at 162 min.

Observations of the Exposed Surface During Fire Exposure - No apparent physical changes of the exposed surface were observed throughout the test. The fire test was terminated at 162 min.

Temperature of the Unexposed Surface - The individual temperatures that developed during the test are shown on Tables I through III. The thermocouple locations are shown on ILL. 4. The initial average temperature of the unexposed surface was 65 °F. The limiting average temperature was 315 °F based on a temperature rise of 250 °F. The limiting individual temperature was 390 °F based on a temperature rise of 325 °F.

The limiting average temperature of 315 °F was reached at 151 min. The limiting individual temperature of 390 °F was reached at 159 min. The limiting individual (Thermocouple No. 10) and limiting average temperatures (Thermocouple Nos. 1-12) are shown on Table IV.

Plots of the average and maximum temperatures recorded on the unexposed surface of the test assembly are shown in ILL. 6.

Smoke Obscuration - At the start of the test, the light path was not obscured by the presence of smoke. As the test progressed, the light path was gradually obscured by the presence of smoke.

At 120 min, the smoke obscured 13 percent of the light path. At 162 min, the smoke obscured 24 percent of the light path.

Plots of the individual and average smoke obscuration recorded during the fire test are shown in ILLS. 7 and 8.

HOSE STREAM TEST:

DESCRIPTION OF SAMPLES

The hose stream was applied to the exposed surface of the wall assembly approximately 1 min after the fire endurance test. The appearance of the exposed surface immediately after the fire test and prior to the application of the hose stream is shown on ILL. 9.

METHOD

The test was conducted in accordance with the Standard for Fire Tests of Building Construction and Materials, UL 263. Because the wall assembly was subjected to a 2 h fire exposure, the assembly was subjected to the action of a 30 psi hose stream applied with 1-1/8 in. nozzle at a perpendicular distance of 20 ft from the center of the test assembly and on a line approximately normal to the center of the test assembly. The hose stream was applied to wall assembly for 150 s.

RESULTS

The exposed surface of the wall was uniformly incandescent when the assembly was withdrawn from the furnace and before application of hose stream.

The wall withstood the hose stream test, while under load, without developing through openings or penetration of the water stream.

C O N C L U S I O N S

The following conclusions represent the judgement of Underwriters Laboratories Inc., based upon the results of the examination and test presented in this Report as they relate to established principles and previously recorded data.

FIRE RESISTANCE PROPERTIES:

It is judged that the load bearing concrete wall assembly with molded polystyrene inserts, constructed in the manner herein described, will afford 2 h protection against passage of flame and dangerous transmission of heat.

Passage of flame through the unexposed surface of the test assembly did not occur during the 2 h fire exposure. Transmission of heat through the assembly did not raise the temperature of the unexposed surface at any one point more than 325 °F above the initial temperature and the average temperature did not exceed 250 °F above the initial temperature during the 2 h fire exposure.

At 2 h, the generation of smoke from the assembly obscured the passage of light by an average of 13 percent.

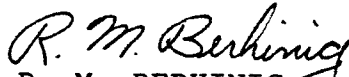
The wall assembly withstood the hose stream test, while under load, without developing through openings or penetration of the water stream.

Report by:

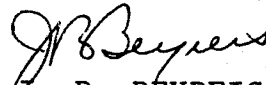


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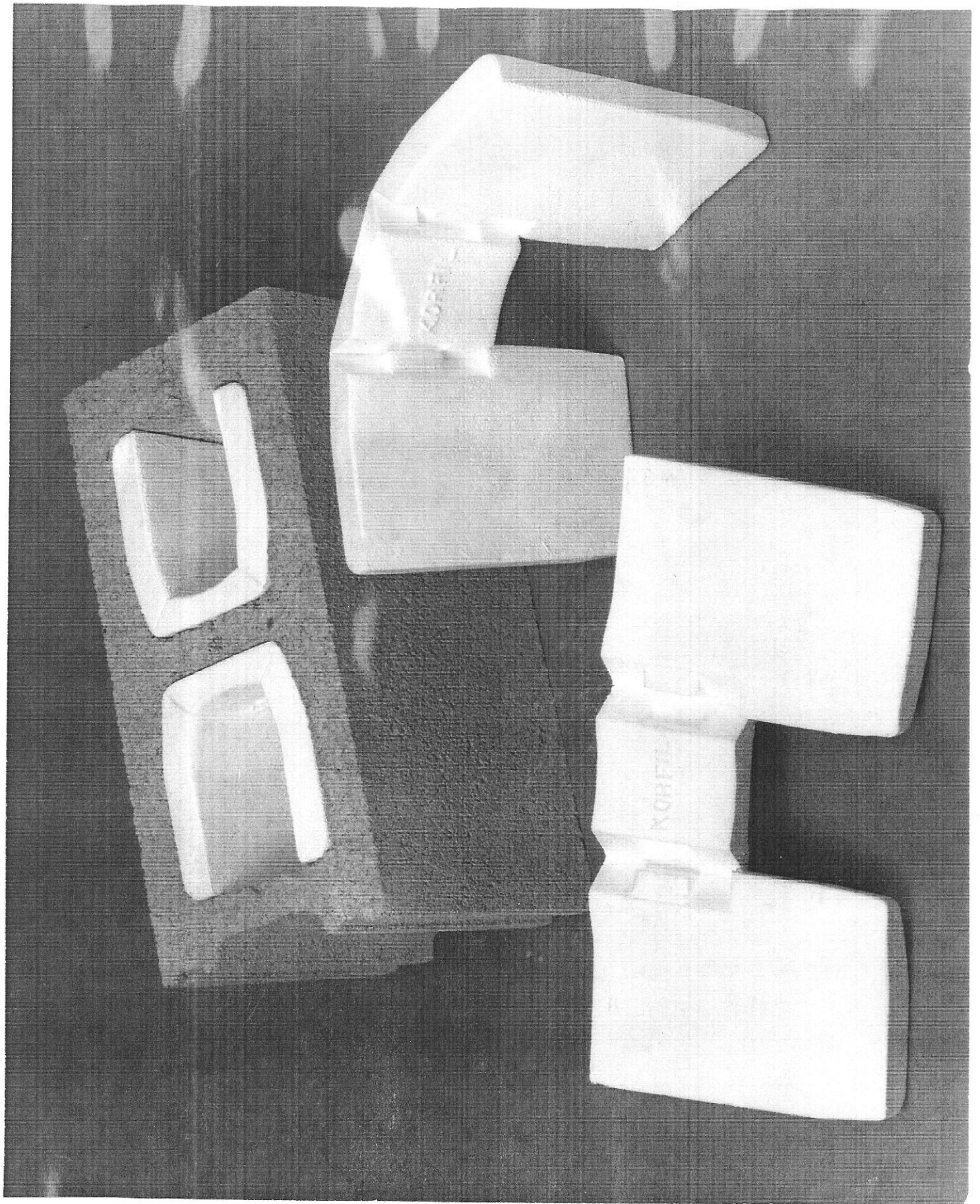
TP/RMB/JRB:pr

Illustrations

<u>ILL. No.</u>	<u>Description</u>
1	Concrete Masonry Unit and Polystyrene Insert
2	General Details of Concrete Masonry Unit
3	Furnace Temperature
4	Appearance of Unexposed Surface Before Test
5	Appearance of Exposed Surface Before Test
6	Plot of Average and Maximum Individual Unexposed Surface Temperatures
7	Plot of Individual Smoke Obscuration
8	Plot of Average Smoke Obscuration
9	Appearance of Exposed Surface After Test

Tables

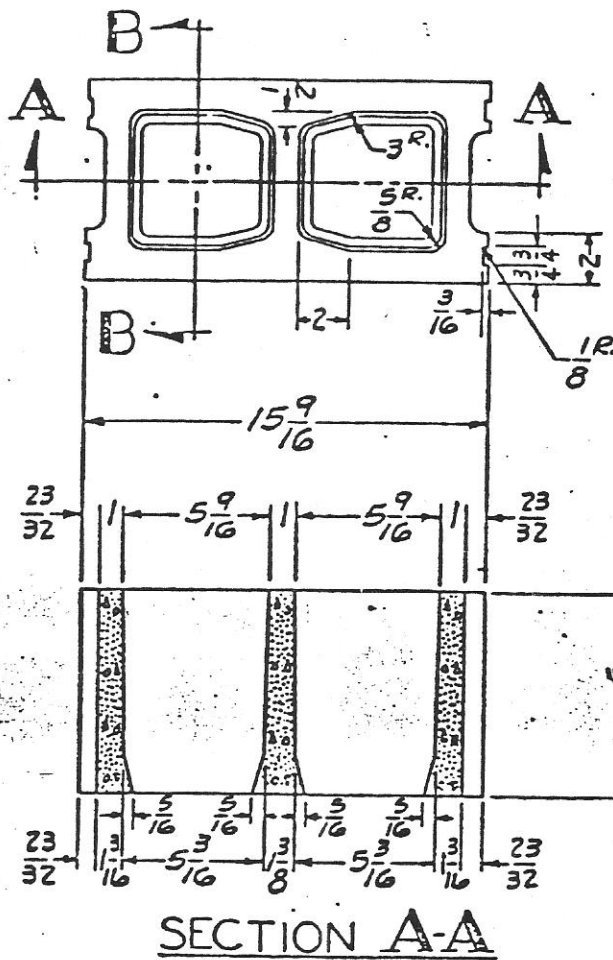
<u>Number</u>	<u>Description</u>
I	Unexposed Surface Temperatures, Thermocouple Nos. 1-4
II	Unexposed Surface Temperatures, Thermocouple Nos. 5-8
III	Unexposed Surface Temperatures, Thermocouple Nos. 9-12



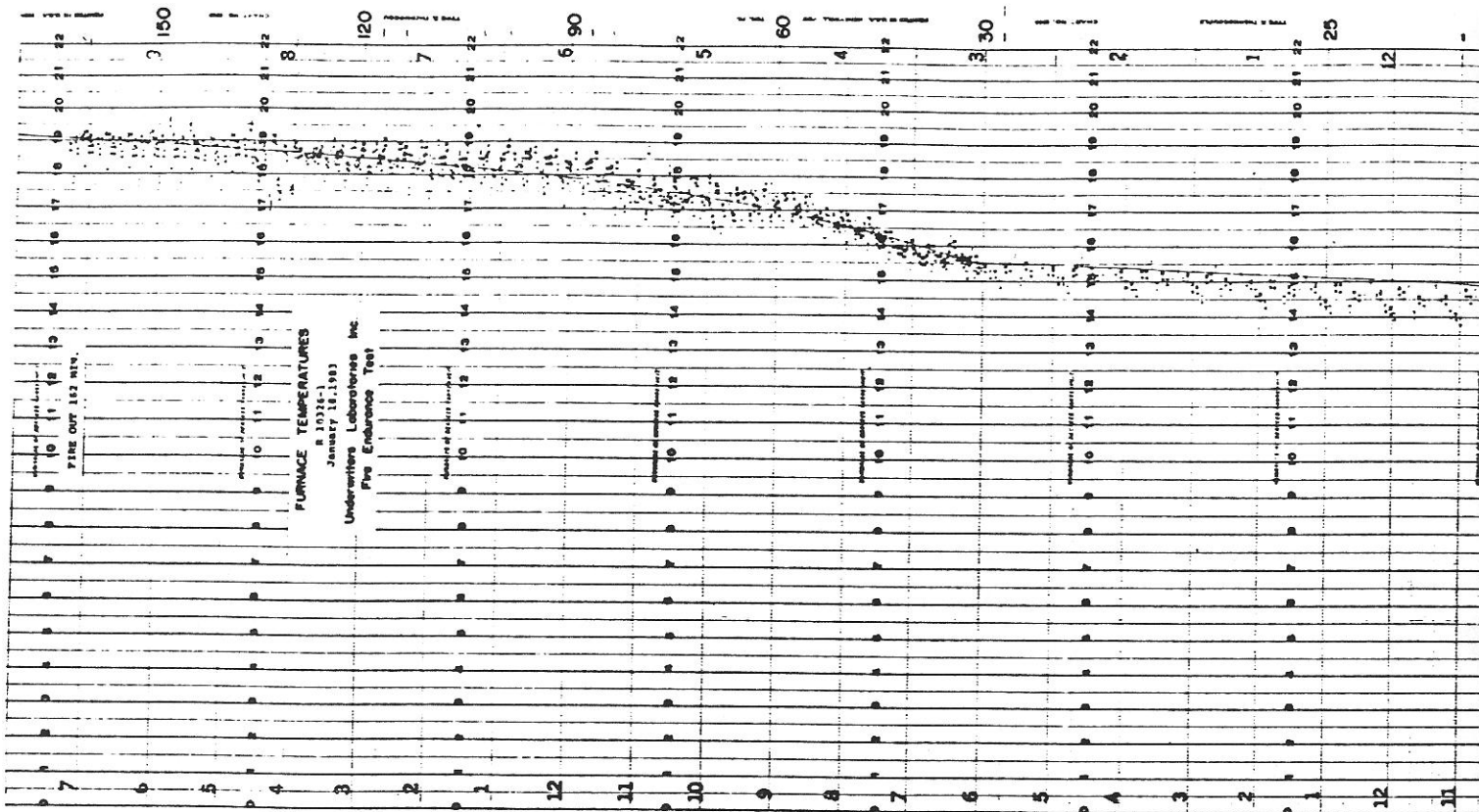
STANDARD

CLASS I

ASTERISK (*) BEFORE PART NO.
INDICATES NORMALLY AVAILABLE
FROM STOCK

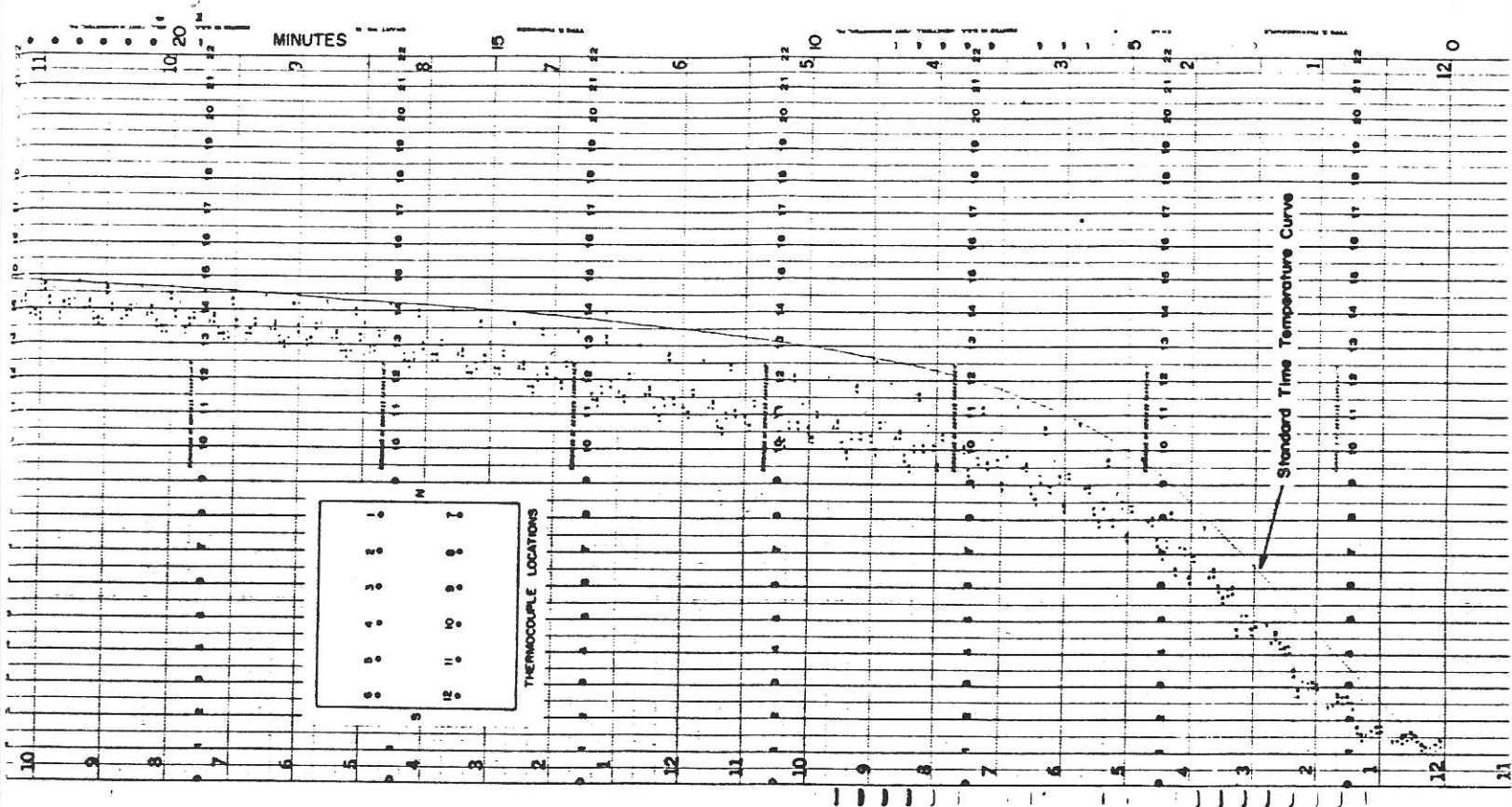


- Unit No. - 46602
- Nominal Size - 8 x 8 x 16
- Actual Size - 7 5/8 x 7 5/8 x 15 9/16
- Style - Type "C" 2 Core
- Face Sheel - 1 1/4"
- Web - 1 In.
- Description - Open Ends Both Ends (O.E.B.E.) With Extra Mortar Bed (X.M.B.)



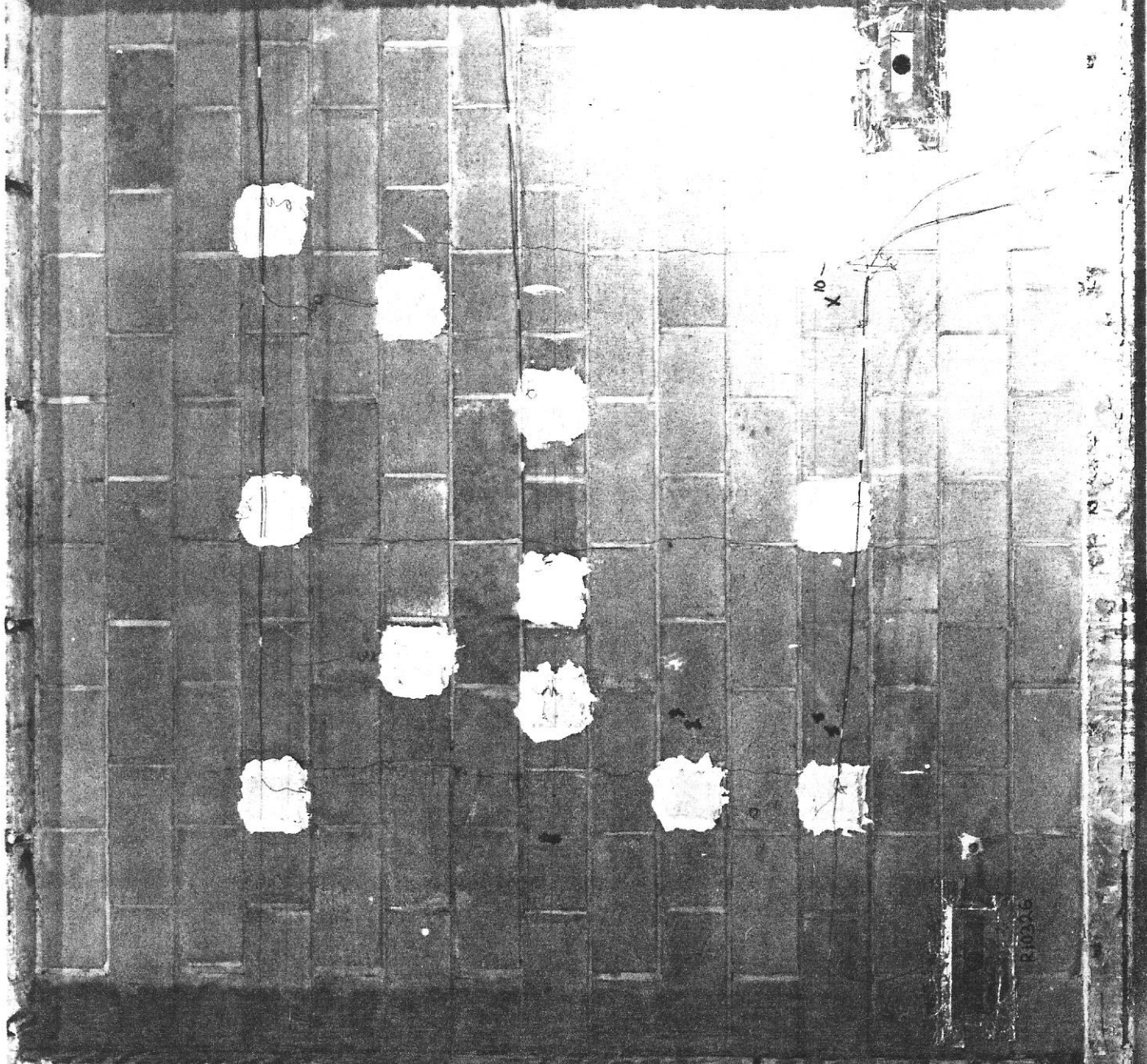
FURNACE TEMPERATURES
 R 10024-1
 January 18, 1983
 Underwriters Laboratories Inc.
 Fire Endurance Test

FIRE OUT 152 MIN.

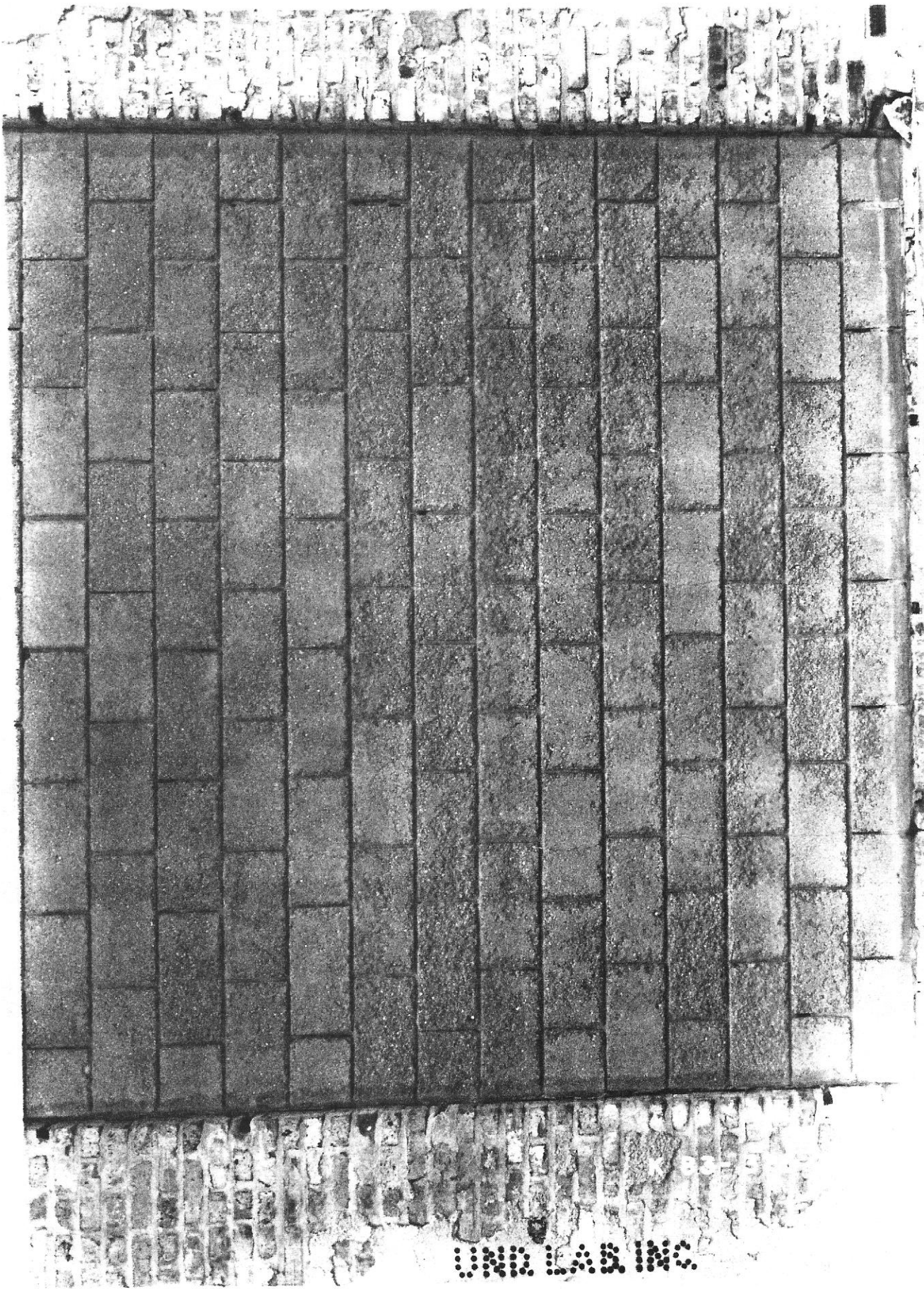


R10326-1

ILL. 4



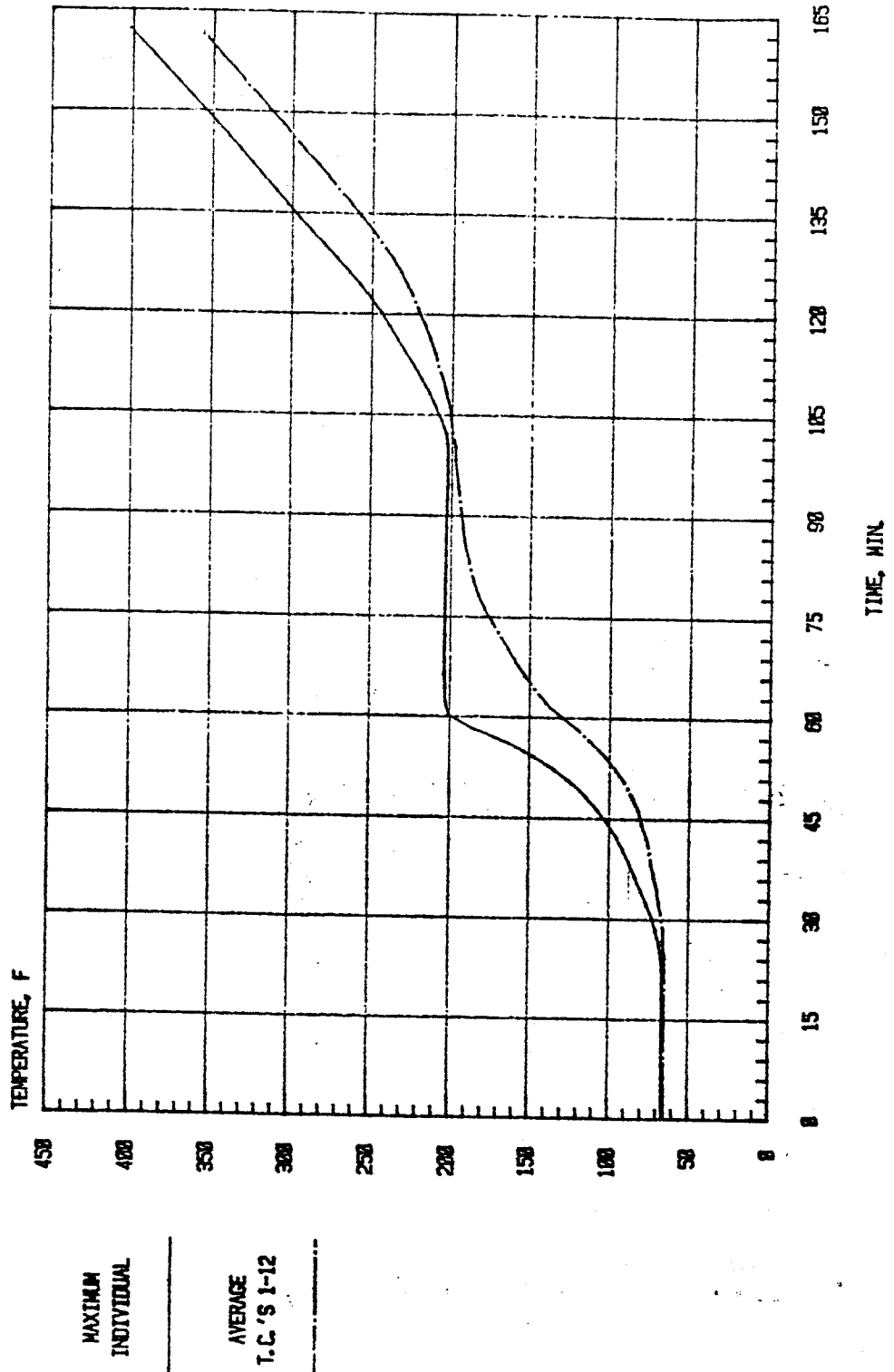
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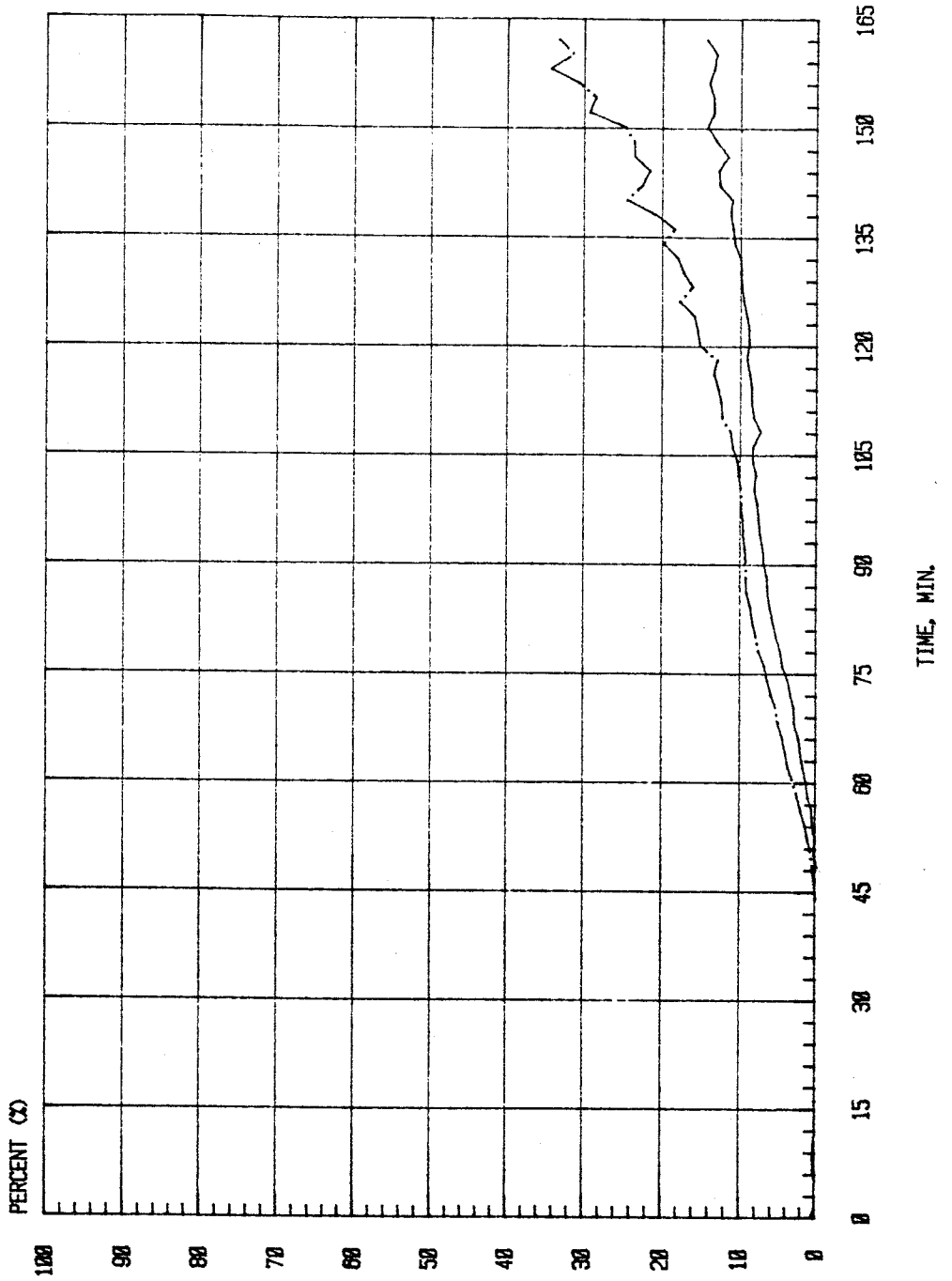
UNEXPOSED SURFACE TEMPERATURES

TEST DATE: JANUARY 18, 1963



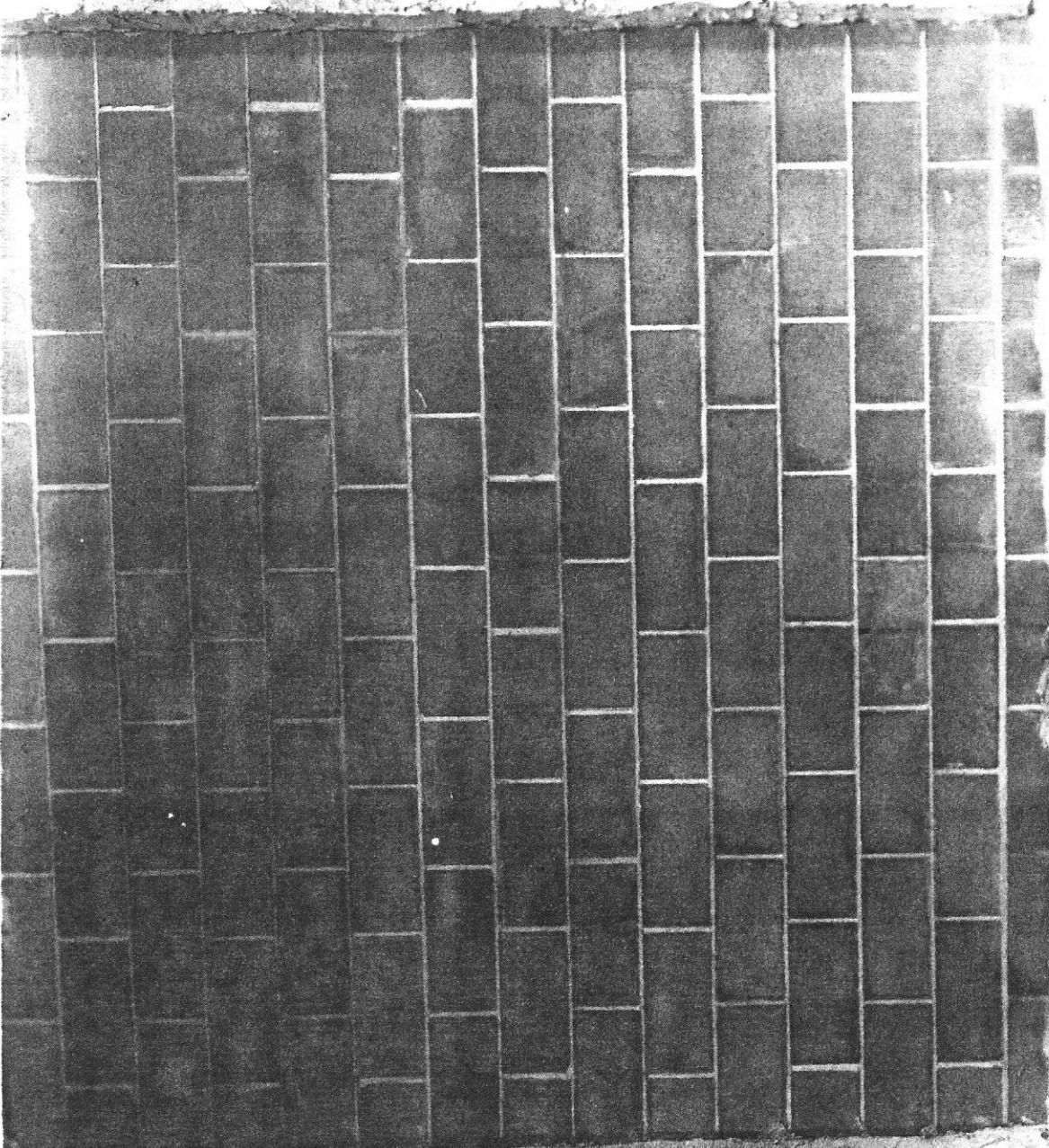
SMOKE OBSCURATION

TEST DATE: JANUARY 18, 1983



#400

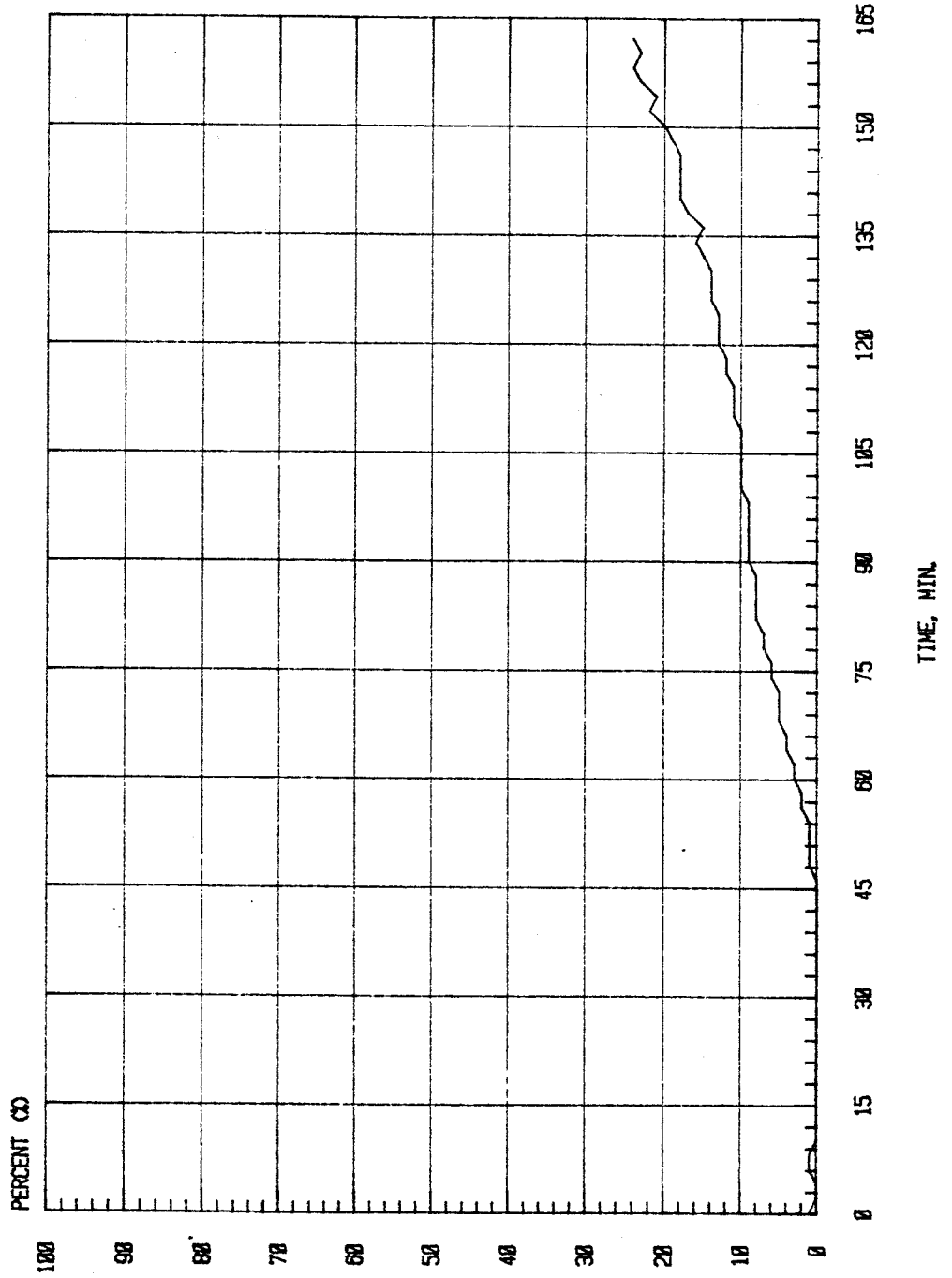
#401



UNA LAB INC.

SMOKE OBSCURATION

TEST DATE: JANUARY 18, 1983



AVERAGE
#400 & #401

KORFIL INC. WALL ASSEMBLY
UNEXPOSED SURFACE TEMPERATURE

DIAM (INS.)	1	2	3	4
TIME (MIN.)				
.13	65.8	66	66.3	65.9
2.13	65.9	66	66.4	66
4.13	65.9	66.1	66.4	66
6.13	65.9	66	66.4	66
8.13	65.9	66.1	66.4	66
10.13	66	66.1	66.5	66.1
12.13	65.9	66.1	66.4	66
14.13	66	66.2	66.4	66
16.13	66	66.1	66.4	66
18.13	65.9	66.1	66.4	66
20.13	66	66.2	66.5	66.1
22.13	66.1	66.4	66.7	66.1
24.13	66.2	66.7	67.4	66.2
26.13	66.2	67.3	68.7	66.3
28.13	66.4	68.5	70.8	66.5
30.13	66.6	70.2	73.4	66.8
32.13	67	72.4	76.6	67.2
34.13	67.4	75.3	80.2	67.8
36.13	68	78.9	83.9	68.6
38.13	68.7	82.6	87.5	69.4
40.13	69.8	86.9	91.4	70.6
42.13	71.3	91.3	95.6	71.9
44.13	73.5	97.2	101.1	73.2
46.13	76.7	104.8	107.6	74.8
48.13	82.7	113.7	115	77.6
50.13	91.4	123.6	123	82.5
52.13	101.7	134.5	131.7	89
54.13	113.5	147.4	141.7	96.4
56.13	126.8	163.9	154.1	104.6
58.13	143.1	185.2	171.6	113.7
60.13	164.9	200.9	194.1	124.1
62.13	193	203.1	202.7	136.4
64.13	203.3	203.4	203.3	151.5
66.13	203.7	203.4	203.2	170.7
68.13	203.7	203.4	203.1	191.8
70.13	203.7	203.5	203.2	199.5
72.13	203.5	203.4	203.2	199.9
74.13	203.6	203.5	203	199.7
76.13	203.5	203.4	203	199.7
78.13	203.4	203.3	202.9	199.7
80.13	203.3	203.3	202.9	199.7
82.13	203.1	203.1	202.6	199.5
84.13	203.2	203.2	202.7	199.7
86.13	203	203.1	202.7	199.8
88.13	202.9	203	202.6	199.7
90.13	202.8	202.8	202.4	199.6

TABLE NO. I

KURFIL INC. WALL ASSEMBLY
UNEXPOSED SURFACE TEMPERATURE

CHAR(NOS.)	1	2	3	4
TIME(MIN.)				
92.13	202.7	202.7	202.3	199.8
94.13	202.5	202.6	202.2	200
96.13	202.6	202.6	202.2	200.6
98.13	202.7	202.5	202	201.1
100.13	203	202.5	201.8	202
102.13	203.9	202.6	202	203.4
104.13	205.2	203	202	205.2
106.13	207	203.9	202.7	207.5
108.13	209.1	205.2	203.5	210
110.13	211.4	207.2	205.1	212.8
112.13	214	209.5	207	215.9
114.13	216.7	212	209.1	218.8
116.13	219.4	214.8	211.4	221.4
118.13	221.9	217.8	213.9	225.2
120.13	223.9	220.7	216.6	231.1
122.13	226	223.1	219.2	237.9
124.13	230.6	225.2	221.5	244.8
126.13	237.5	228	223.2	251.6
128.13	244.9	234	224.9	258.8
130.13	252.7	242.1	228.8	266.7
132.13	261.4	250.1	235.3	274.8
134.13	270.7	258.9	242.1	282.9
136.13	280.1	268.3	248.9	290.7
138.13	289.8	277.9	256.6	298.5
140.13	299.1	287.4	265	306.2
142.13	308.1	296.8	273.9	313.9
144.13	316.9	305.8	283	321.4
146.13	325.4	314.7	292	328.8
148.13	333.6	323.2	300.5	336.1
150.13	341.7	331.6	308.8	343.4
152.13	349.5	339.9	316.9	350.5
154.13	357.3	348	325	357.8
156.13	365	355.9	332.9	364.7
158.13	372.5	363.5	340.6	371.7
160.13	380.2	371.2	348.3	378.8
162.12	387.7	378.9	355.9	385.7

TABLE NO. I A

KORFIL INC. WALL ASSEMBLY
UNEXPOSED SURFACE TEMPERATURE

CHAN (NOS.)	5	6	7	8
TIME (MIN.)				
.13	66.1	65.1	64.7	64.2
2.13	66.2	65.1	64.8	64.2
4.13	66.1	65.2	64.8	64.2
6.13	66.2	65.3	64.9	64.3
8.13	66.2	65.3	64.9	64.3
10.13	66.2	65.3	64.9	64.4
12.13	66.2	65.3	64.9	64.3
14.13	66.2	65.3	64.9	64.4
16.13	66.1	65.3	64.9	64.4
18.13	66.1	65.3	64.9	64.4
20.13	66.2	65.4	65	64.4
22.13	66.3	65.4	65	64.4
24.13	66.5	65.4	65	64.4
26.13	67.3	65.5	65.1	64.6
28.13	68.5	65.7	65.2	64.9
30.13	70.3	65.8	65.3	65.4
32.13	72.3	66	65.4	66.3
34.13	74.7	66.3	65.7	67.5
36.13	76.8	66.7	65.9	68.7
38.13	78.7	67	66.1	69.7
40.13	80.6	67.7	66.6	70.7
42.13	82.3	68.6	67.1	71.5
44.13	83.9	69.8	67.8	72.2
46.13	86.1	71.7	68.4	72.6
48.13	91	75.4	69.4	73.3
50.13	97.9	80.4	70.9	74.3
52.13	106.2	86.4	73.6	76.3
54.13	115.1	93.1	78.2	79.6
56.13	125.5	100	84.1	83.9
58.13	137.2	107	90.5	88.8
60.13	152.5	114.3	97.2	94.1
62.13	172.3	121.9	104.1	99.7
64.13	189	129.8	111.1	105.3
66.13	195	138.3	118.4	111.1
68.13	196.9	147.8	126	116.9
70.13	198	158.3	133.8	122.8
72.13	198.2	169.8	142.1	128.8
74.13	198.2	181.8	150.6	134.7
76.13	198.2	193.2	158.7	140.5
78.13	198.2	200	166.6	146.1
80.13	198.1	201.6	174.2	151.7
82.13	197.9	201.6	180.5	157
84.13	198.1	201.7	185.9	162.2
86.13	198.3	201.7	190.5	167.1
88.13	198.2	201.6	193.4	172
90.13	198.1	201.4	194.9	176.4

TABLE NO. II

KORFIL INC. WALL ASSEMBLY
UNEXPOSED SURFACE TEMPERATURE

CHAN (NOS.)	5	6	7	8
TIME (MIN.)				
92.13	198.2	201.4	195.6	180.5
94.13	198.4	201.3	196	184.3
96.13	199	201.4	196.3	187.8
98.13	199.8	201.3	196.5	191
100.13	201	201.2	196.8	193.8
102.13	202.8	201.5	197.6	196.3
104.13	205	201.3	198.7	198.9
106.13	207.6	201.7	200.3	201.6
108.13	210.3	202.2	202.2	204.5
110.13	213.2	203.3	204.6	207.6
112.13	216	204.9	207.1	210.9
114.13	218.8	207.1	209.7	214.7
116.13	223.5	209.5	212.4	218.9
118.13	229.9	212.1	214.9	223.3
120.13	236.6	215	216.9	227.8
122.13	243.4	217.9	219	232.3
124.13	250.7	220.6	222.8	236.7
126.13	258.3	222.9	228	241.5
128.13	266.1	225.2	233.6	246.5
130.13	274.1	229.9	239.5	252.1
132.13	282	236.4	245.8	258.4
134.13	289.6	243.4	252.6	265
136.13	297.3	250	259.9	271.4
138.13	304.9	257.2	267.8	278.1
140.13	312.4	265	275.6	284.5
142.13	319.9	273.8	283.5	290.9
144.13	327.4	282.8	291.4	297.5
146.13	334.8	291.6	299.1	304.1
148.13	342	300	306.4	310.5
150.13	349.4	308.3	313.8	317
152.13	356.7	316.4	321	323.5
154.13	364.2	324.3	328	330.1
156.13	371.5	332	334.9	336.8
158.13	378.7	339.7	341.9	343.4
160.13	385.9	347.5	348.9	350.3
162.12	393.2	355.1	355.9	357

TABLE NO. II A

KORFIL INC. WALL ASSEMBLY
UNEXPOSED SURFACE TEMPERATURE

CHAN (NOS.)	9	10	11	12
TIME (MIN.)				
.13	64.4	64.5	65.1	65.3
2.13	64.4	64.5	65.1	65.5
4.13	64.5	64.5	65.2	65.5
6.13	64.5	64.6	65.3	65.5
8.13	64.5	64.6	65.2	65.4
10.13	64.6	64.7	65.3	65.5
12.13	64.6	64.6	65.2	65.4
14.13	64.6	64.7	65.3	65.5
16.13	64.6	64.7	65.4	65.5
18.13	64.6	64.6	65.3	65.4
20.13	64.6	64.7	65.4	65.5
22.13	64.6	64.7	65.7	65.6
24.13	64.7	64.8	66.3	65.7
26.13	64.8	65	67.7	66.1
28.13	65	65.1	69.8	66.8
30.13	65.4	65.6	72.5	68
32.13	66.1	66.2	75.3	69.4
34.13	67	67.5	78.4	71.1
36.13	68	69.2	81.1	72.8
38.13	68.8	71.4	83.7	74.7
40.13	69.8	73.8	86	76.7
42.13	70.8	76.1	88.3	79
44.13	71.8	78.3	90.4	81.3
46.13	72.7	80	92.5	83.6
48.13	74.1	81.8	95	86.1
50.13	76.1	83.4	97.6	89
52.13	79.5	86	100.9	92.7
54.13	84	89.7	104.5	96.7
56.13	88.9	94.4	108.6	101.3
58.13	94.2	99.8	113.3	106.1
60.13	99.5	105.4	118.3	111.3
62.13	105	111.3	123.7	116.7
64.13	110.3	117	129.4	122.1
66.13	115.6	122.9	135.8	128
68.13	121.1	128.9	143.2	134.2
70.13	126.6	134.8	152.5	141
72.13	132.1	141	164.7	148.6
74.13	137.6	146.9	178.9	157
76.13	142.8	152.6	191.4	166.1
78.13	148	158.1	197.3	175.5
80.13	153	163.5	198.7	183.9
82.13	157.7	168.4	198.6	189.9
84.13	162.2	173	199.1	193.7
86.13	166.5	177.4	199.1	196
88.13	170.4	181.3	198.9	197
90.13	174.1	184.9	195.6	197.8

TABLE NO. III