NRC Form 17A
(10-76)

U. S. NUCLEAR REGULATORY COMMISSION

ROUTING SLIP

Organization

TO	NAME	MAIL STOP	NAME	
	Fire Protection R.G.			
	R. Tedesco			
	V. Benaroya			
	P. Matthews			
	R. Ferguson			
	E. Sylvester			
	Steve Scott (2)			

REMARKS

☐ As Requested
☐ Correction
☐ File
☐ Information
☐ See Me
☐ Approval/Signature
☐ Comment/Concurrence
☐ Necessary Action
☐ Note and Return
☐ Per Conversation
☐ Answer/Acknowledge for
Signature of ______

FROM (Name)	OFFICE	DATE
Gary Bennett		PHONE

781101 0137

INTERIM REPORT

Accession No.
UL-USNC83 QL-1

Contract Program or Project Title: Cable Tray Fire Tests

Subject of This Document: Full Scale Fire Test No. 1

Type of Document: Quick-Look Report

Authors: L. J. Przybyla
W. J. Christian

Date of Document: October 6, 1978

Responsible NRC Individual and NRC Office or Division:

Mr. Ronald Feit
Research Support Branch
Division of Reactor Safety Research

This document was prepared primarily for preliminary or internal use. It has not received full review and approval. Since there may be substantive changes, this document should not be considered final.

Underwriters Laboratories Inc.
333 Pfingsten Road
Northbrook, Illinois 60073

Prepared for
Sandia Laboratories
P. O. Box 5800
Albuquerque, New Mexico 87185
07-9116

NOTICE

Abstract

This is a brief synopsis of a full scale fire test conducted at Underwriters Laboratories Inc. on September 15, 1978. The purpose of the test was to proof test a cable system including mineral wool fire barriers and fixed automatic fire detection and suppression systems as used with a typical vertical cable tray configuration. An open pool fire involving liquid hydrocarbon fuel was used in the test.

Table of Contents

List of Figures

List of Tables

FULL SCALE FIRE TEST NO. 1

Test Procedure

A. DESCRIPTION:

The test assembly was constructed as shown in Figure 1. The various items which comprised the test assembly are described as follows.

1. Corner-Ceiling Assembly - A corner-ceiling assembly, approximately 20 ft by 20 ft by 15 ft high was used to simulate a corner-room situation as shown in Figure 1. The walls consisted of steel framing with 1/2 in. thick Marinite boards forming the interior surface. The suspended ceiling consisted of a steel angle grid system which supported nominal 4 ft by 4 ft by 1/2 in. thick Marinite panels. The interior surfaces of the walls were painted flat black. Several observation windows were provided.

2. Cable Trays - The five cable trays used in the test configuration were open ladder type and nominally 18 in. wide. The side channels were 4 in. deep with 3/4 in. flanges and fabricated from 0.065 in. thick galvanized steel. The 0.065 in. thick galvanized steel tray rungs were 1 in. wide with 3/4 in. legs, and were welded to the side channels at 9 in. intervals.

3. Cable - The 3-conductor cable employed in this test had 0.468 in. outside diameter and 600 v rating. The conductors were No. 12 AWG stranded copper. The conductor insulation was 0.027 in. thick polyethylene with a polyvinylchloride jacket, a core wrap, and a 0.063 in. thick polyvinylchloride cable jacket.

4. Cable Fasteners - Ties formed from No. 16 SWG steel wire were used to group the cables and fasten the cables to the tray rungs.

5. Fire Pan - A steel pan approximately 25 sq ft in area was formed from cold rolled steel as shown in Figure 1 and was used as the containment vessel for the liquid fuel.

6. Fire Barrier - The barrier installed about each cable tray consisted of an assembly of mineral wool blanket pieces as shown in Figure 2. The mineral wool blanket was 1 in. thick and had a density of 7.8 pcf. The various blanket pieces were fastened with 3/4 in. wide 0.023 in. thick coated steel bands and band clips.

7. Automatic Sprinklers - Upright automatic sprinklers were located as shown in Figure 1. All sprinklers were nominally identical with standard orifices (1/2 in. diameter) and a 165 F temperature rating.

8. Automatic Fire Detectors - Two spot-type smoke detectors were installed at the ceiling within the corner as shown in Figure 1. One was an ionization chamber type and one was a photoelectric type.

B. METHOD:

Cable segments in lengths of about 31 ft were bundled together in groups of eight and fastened together with steel wire ties at approximately three-foot intervals. The cable bundles were installed in each 15 ft tray with seven bundles forming the back layer against the tray rungs. The cable bundles were folded back at the bottom of the tray to form a front layer of seven bundles. All cable bundles were attached to the top and bottom tray rungs with steel wire ties.

The cable trays were installed in the steel fire pan and located within the corner-ceiling assembly as shown in Figure 1. The trays were installed with the cable ends above the suspended ceiling level. Since the cable bundles were bent at midlength, loops of cable bundles appeared at the base of each cable tray. The distances between the loops and the base of the tray varied from approximately 3 in. to 6 in.

All cables were energized at low voltage during the test. All conductors with the same color code within each tray were connected in parallel to provide three circuits per tray. During the test each circuit carried low current (milliamps), and was monitored continuously for shorts between conductors or shorts between conductors and tray.

Each tray was wrapped with a mineral wool fire barrier as shown in Figure 2. The mineral wool was installed according to the manufacturer's specifications. The barrier used an outer layer of 1 in. thick wool wrapped around each tray for its entire length from floor to ceiling. Additional pieces covered 1) the entire front surface of the cable bundle along the vertical overlapping joint of the outer layer, 2) the back surface of the cable bundle and tray at horizontal butt joints of the outer layer, 3) the horizontal butt joints of the outer layer, and 4) the ceiling and floor butt joints. The insulation was secured with steel bands located at 12 in. intervals along the tray length.

Three open-head sprinklers were located 12 in. below the ceiling and at the positions shown in Figure 1. Each sprinkler was connected to a separate manually operated water supply. Three dummy sprinkler heads without connection to the water supply were suspended near each open head. During the test the three dummy heads were monitored electrically to determine the times at which the fusible links activated. It was intended that only after activation of all three dummy heads at one location would the water system be manually operated. The water system was designed to produce a pressure of 35 psig at each open head.

Two automatic smoke detectors were located at the ceiling 15 ft from each wall as shown in Figure 1. Each detector was monitored during the test to determine the time of actuation.

Temperatures within the cable trays were measured with seven thermocouples located within each tray as shown in Figure 3. Air temperatures between cable trays over the fire pan, and near each open head sprinkler were measured with stainless-steel-sheathed, Type K thermocouples as shown in Figure 4.

The appearance of the test assembly prior to the fire test is shown in Figure 5.

The test was initiated by pouring 2 gal of heptane uniformly into the pan from four separate containers and igniting the heptane by torch ten seconds afterwards. Throughout the test, visual observations were recorded of flame distribution and other developments pertinent to the fire performance of the cable tray assemblies. The test was concluded after all related fire activity had ceased. Photoelectric coverage included 35 mm slides and 8 mm movies. Video tape recording was used as a backup for the movies.

Results

A. TEST RESULTS:

1. Visual Observations During Test -

Time (Min:Sec)	Description
0:10	Flaming appeared uniform over the entire pan area with a maximum flame height of 4 ft. Appearance of test assembly is shown in Figure 6.
1:30	All flames now issued from the base of mineral wool on each cable tray. (It appeared the heptane had been soaked up by the wool, and was burning slowly in wick fashion.) Maximum flame height was approximately 3 ft except between trays 1 and 3. Maximum flame height between these two trays was 6 ft. Appearance of test assembly is shown in Figure 7.
4:00	Flame height between trays 1 and 3 decreased to 3 ft.
5:00-23:00	Flaming continued but intensity and height gradually diminished.
23:35	A loud report was heard and a burst of flame issued from base of tray 3. Wool wrapping on tray 3 between 6 ft and 10 ft about the floor appeared to have slipped from its fasteners causing openings in the vertical and horizontal joints.
24:00-40:00	Flaming continued to diminish gradually.
40:00	All flaming ceased.

2. Detector Events Record - Detector actuations occurred as follows:

Type	Actuation Time (Min:Sec)
Ionization	0:11
Photoelectric	0:14

3. Sprinkler Events Record - The time at which the fusible links activated are shown in Table 1.

4. Air Temperatures - Temperatures of the air between the cable trays and near the sprinklers are shown in Tables 2-6 and Figures 9-10.

5. Cable Tray Temperatures - Temperatures within each cable tray are shown in Tables 7-11. A summary of maximum cable tray temperatures is shown in Table 14.

6. Circuit Integrity Record - At 3 min, 13 sec a short circuit between conductors 1 and 3 in cable tray 3 was indicated. Also, at 3 min, 55 sec erratic measurements were recorded for the conductors in tray 1 indicating the existance of intermittant short circuits.

B. POST TEST RESULTS:

1. Post Test Visual Observation - The mineral wool was blackened about the base of each tray and extended upward approximately 1 ft on trays 1, 2, and 4. On tray 3, the blackened area extended to approximately 4 ft above the floor. The interior surface of the wool appeared unchanged, except for small areas of light brown near the base in trays 1, 2, 3, and 4 as shown in Figure 11.

In all cable trays except tray 5, thermal damage of cables was observed near the base. A summary of damage is shown in Table 12. Cable damage in tray 3 is shown in Figures 11 and 12. Cable damage in tray 2 is shown in Figure 13.

2. Circuit Integrity Results - The erratic measurements recorded by tray 1 were determined to be the result of inadvertant contact between connectors above the ceiling. Trays 1, 2, 4, and 5 were examined after the test to determine the insulation resistance between conductors and between conductor and trays. All resistances were normal except for that between one conductor and tray 2, which was less than 100,000 ohms. Insulation resistance was measured with a "megger" at 500 v.

3. Sprinkler Operation Test Results - The dummy sprinklers which did not operate during the test were subjected to air-oven operation tests in accordance with Standard UL199. Results of these tests are shown in Table 13.

Table 1 - Link Activation Time

Location	Sprinkler No.	Link Activation Time (Min:Sec)
1	1A	0:52
1	1B	0:54
1	1C	N
2	2A	N
2	2B	N
2	2C	N
3	3A	N
3	3B	N
3	3C	N

N - Link did not activate during test.

Table 2 - Air Temperatures (Sprinklers 1, 2, And 3)

Time (Min:Sec)	Locations 1	2	3
0:00	69.7	70.1	70.0
0:27	234.7	225.0	187.9
0:57	235.4	223.4	196.8
1:27	186.4	176.7	165.3
1:57	178.0	160.8	153.6
2:27	165.2	148.5	143.4
2:57	-	138.1	-
3:27	158.4	137.0	140.1
3:57	156.2	140.4	133.3
4:27	149.2	130.4	128.3
4:57	142.1	125.3	124.8
5:57	137.4	125.1	119.3
6:57	129.4	120.6	115.9
7:57	123.3	116.8	112.8
8:57	115.1	111.5	108.5
9:57	112.0	109.7	102.2
15:57	96.0	100.7	94.1
19:57	92.9	95.0	90.5
28:44	81.7	83.4	79.9
39:27	77.9	77.6	76.0

TABLE 3
Air Temperatures (^{o}F)

Time (Min:Sec)	T. C. Location					
	1	2	3	4	5	6
Pre-test	73.8	73.8	73.8	74.1	74.1	74.1
0:31 - 0:33	215.4	229.8	235.6	162.3	171.7	167.8
1:01 - 1:03	338.4	354.9	369.2	204.5	224.0	220.0
2:01 - 2:03	381.5	389.0	400.4	219.9	245.6	263.5
2:31 - 2:33	353.5	357.1	371.7	202.7	218.8	218.7
3:31 - 3:33	275.0	271.1	292.8	158.6	174.7	171.6
4:01 - 4:03	358.3	319.8	337.7	232.1	255.7	251.9
4:31 - 4:33	323.7	319.2	329.3	257.9	283.3	284.8
5:01 - 5:03	287.9	287.4	319.4	236.0	253.0	254.7
6:01 - 6:03	231.3	230.2	252.5	201.0	220.2	220.0
7:01 - 7:03	209.3	206.7	224.1	203.0	214.3	219.3
8:01 - 8:03	208.8	206.7	226.2	174.9	185.1	187.2
9:01 - 9:03	170.9	177.1	195.2	176.9	190.8	192.5
10:01 - 10:03	170.5	171.5	191.1	163.4	171.0	174.2
12:01 - 12:03	136.3	141.9	155.1	150.1	157.6	157.3
20:01 - 20:03	92.1	92.9	95.8	99.1	100.6	102.6
35:01 - 35:03	81.9	82.3	82.9	82.9	82.5	82.8

TABLE 4
Air Temperatures

Time (Min:Sec)	T. C. Location 7	8	9	10	11	12
Pre-test	73.6	73.5	73.6	74.1	74.2	74.1
0:34 - 0:37	1528.6	1329.6	1222.4	474.0	477.6	471.6
1:04 - 1:07	1133.5	1041.3	1022.0	437.5	447.7	460.2
1:34 - 1:37	1605.7	1554.4	1576.8	518.1	533.8	519.1
2:04 - 2:07	1143.0	1112.0	1162.7	484.8	518.1	521.7
2:34 - 2:37	1288.7	1239.3	1283.9	439.6	452.6	460.1
	—	—	—	—	—	—
3:34 - 3:37	987.8	928.3	918.7	344.4	338.9	343.5
4:04 - 4:07	588.3	551.7	552.5	322.9	328.6	325.0
4:34 - 4:37	457.0	430.0	440.7	331.8	334.7	336.3
5:04 - 5:07	394.8	378.0	380.8	299.7	298.8	303.4
6:04 - 6:07	405.2	389.7	407.1	303.7	301.4	309.6
7:04 - 7:07	372.0	354.2	364.1	285.0	290.4	291.1
8:04 - 8:07	269.1	253.9	265.5	242.0	240.7	240.7
9:04 - 9:07	227.7	213.8	218.8	211.7	210.3	201.1
10:04 - 10:07	198.0	184.1	183.9	194.1	186.8	186.4
16:04 - 16:07	136.3	130.9	133.5	141.6	141.8	143.1
20:04 - 20:07	208.1	192.8	199.0	136.7	135.0	138.1
22:04 - 22:07	143.4	137.5	140.2	120.6	120.1	121.6
35:04 - 35:07	94.8	91.6	91.0	91.3	90.1	90.0

TABLE 5
Air Temperatures

Time (Min:Sec)	T.C. Location 13	14	15	16	17	18
Pre-test	74.1	73.9	7[illegible].9	74.4	74.4	73.8
0:37 - 0:39	579.1	518.4	473.5	182.7	196.7	213.5
1:37 - 1:39	382.8	323.7	278.0	149.9	156.1	182.8
2:07 - 2:09	368.5	300.3	257.2	140.1	148.3	187.9
2:37 - 2:39	260.9	221.0	192.3	129.8	138.3	160.5
3:37 - 3:39	234.2	215.7	201.2	118.8	122.6	118.3
4:07 - 4:09	245.5	212.9	183.5	123.6	125.3	110.2
4:37 - 4:39	205.0	175.8	154.9	122.0	126.1	141.4
5:07 - 5:09	193.0	162.1	141.4	118.9	124.1	141.2
6:07 - 6:09	199.9	184.1	172.1	114.7	119.7	103.8
7:07 - 7:09	206.8	173.8	147.7	117.6	123.6	147.9
8:07 - 8:09	192.7	159.3	139.4	107.1	111.4	123.6
9:07 - 9:09	166.4	140.6	119.7	103.7	104.1	120.5
10:07 - 10:09	154.6	130.4	115.5	105.9	106.5	106.4
16:07 - 16:09	161.4	127.0	105.0	98.4	98.4	103.3
20:07 - 20:09	114.4	105.7	98.4	93.9	95.4	96.1
35:07 - 35:09	84.5	81.9	81.4	82.0	81.9	83.1

TABLE 6
Air Temperatures (°F)

Time (Min:Sec)	T.C. Locations 19	20	21	22	23	24
Pre-test	744	737				
0:10	134.1	1632				
0:40	206.1	211.6				
1:10	182.4	171.1				
1:40	164.3	212.2				
2:10	164.1	217.4				
2:40	144.3	170.5				
3:40	123.8	131.3				
4:10	128.6	122.8				
4:40	127.6	160.0				
5:10	129.2	165.8				
6:10	121.4	117.2				
7:10	126.3	162.0				
8:10	114.0	147.3				
9:10	105.7	132.7				
10:10	106.5	118.4				
16:10	99.7	121.8				
20:10	97.5	102.4				
35:10	82.1	83.5				
Pre-test			744	74.1	73.1	73.1
0:25			333.7	178.5	172.7	167.8
0:55			253.5	166.3	149.3	145.6
1:25			224.9	141.1	137.1	133.3
1:55			238.6	136.5	128.7	126.1
2:25			244.0	130.0	123.6	123.3
3:25			204.5	122.3	117.2	113.9
4:25			150.6	114.6	109.8	109.2
5:25			170.4	113.2	108.9	106.8
6:25			166.8	114.7	107.4	106.0
7:25			181.0	117.2	112.2	109.2
8:25			171.5	112.0	107.1	104.4
9:25			155.5	108.1	101.7	105.0
10:25			136.2	103.7	99.3	97.5

TABLE 6 (cont'd)
Air Temperatures (^{o}F)

Time (Min:Sec)	T.C. Locations					
	19	20	21	22	23	24
15:25			146.7	103.9	101.2	99.5
20:25			103.0	88.7	86.9	86.2
35:25			80.0	76.9	76.5	76.7

TABLE 7
Cable Tray Temperatures
Tray 1

Time (Min:Sec)	T.C. Locations 1	2	3	4	5	6	7
Pre-test	74.2	74.1	73.1	73.1	78.7	73.1	73.4
0:42	74.4	73.7	73.4	73.1	82.6	73.1	73.4
1:12	74.3	73.7	73.1	73.1	87.5	73.1	73.4
1:42	74.4	73.8	73.3	73.1	92.0	73.1	73.4
2:12	74.5	73.9	73.5	73.1	96.6	73.2	73.5
2:42	74.6	74.0	73.7	73.2	100.8	73.4	73.5
3:42	74.7	74.3	73.9	74.1	107.8	73.4	73.6
4:12	74.8	74.6	74.1	74.9	110.9	73.4	73.6
5:12	74.9	75.2	74.6	76.3	116.8	73.4	73.6
6:12	75.0	90.8	75.5	76.3	121.4	73.6	73.7
7:12	74.9	79.8	76.3	74.2	123.9	43.6	73.6
8:12	74.9	80.1	77.3	74.7	122.5	73.7	73.6
9:12	74.9	80.8	79.3	75.0	123.9	73.7	73.6
10:12	74.8	81.3	82.1	75.4	124.7	73.7	73.6
20:12	75.2	118.9	118.7	79.5	106.8	75.5	73.7
36:12	76.7	134.5	131.9	89.5	81.5	78.9	74.6
48:38	77.1	130.8	126.9	95.3	73.5	80.5	75.4
60:13	77.3	126.3	121.8	98.2	70.0	81.5	76.1
105:12	77.3	111.9	110.4	99.9	66.8	83.4	77.7

TABLE 8
Cable Tray Temperatures
Tray 2

Time (Min:Sec)	T.C. Locations 1	2	3	4	5	6	7
Pre-test	72.2	73.7	73.8	72.7	72.9	76.3	72.8
0:45	72.3	73.8	73.8	72.6	72.9	77.3	72.8
1:15	72.3	73.9	74.0	104.4	79.7	78.2	73.2
1:45	72.3	74.1	74.2	86.3	76.7	79.7	73.5
2:15	72.2	74.4	74.6	82.0	75.7	81.6	73.6
2:45	72.1	74.8	75.0	80.4	75.3	84.1	73.7
3:45	72.1	75.7	75.9	79.3	75.2	90.0	73.8
4:15	72.1	76.3	76.7	79.4	75.4	93.4	73.8
5:15	72.1	78.0	78.5	110.0	87.0	99.2	74.2
6:15	72.1	79.4	80.7	94.2	86.8	105.4	74.4
7:15	72.1	80.7	82.5	90.1	88.4	112.7	74.8
8:15	72.2	80.7	84.3	92.8	94.9	116.8	75.3
9:15	72.3	82.0	86.0	119.8	112.0	117.9	76.3
10:15	72.3	84.8	87.7	101.8	106.7	123.0	76.8
16:15	72.0	99.2	98.6	109.7	121.2	134.0	80.7
20:15	71.3	104.9	102.9	113.0	127.3	133.8	85.0
35:15	70.3	113.9	112.6	115.7	137.4	113.1	100.5
60:16	69.4	115.1	118.5	125.1	137.9	81.6	109.5
105:15	68.2	108.8	116.3	121.7	125.1	55.3	113.2
150:15	68.9	102.8	108.8	115.0	115.5	48.5	112.8

TABLE 9
Cable Tray Temperatures
Tray 3

Time (Min:Sec)	T.C. Locations						
	1	2	3	4	5	6	7
Pre-test	73.9	73.1	73.6	73.5	73.0	73.3	73.5
0:50	73.9	73.4	73.6	73.8	73.8	73.7	75.0
1:20	74.0	73.5	73.8	74.6	74.3	74.3	76.9
1:50	74.1	73.8	74.1	75.1	75.0	75.4	77.3
2:20	74.1	74.1	74.3	75.5	75.3	75.9	79.2
2:50	74.1	74.3	74.5	76.0	75.7	76.3	80.5
3:50	74.2	74.6	74.8	79.2	76.9	77.3	82.4
4:20	74.2	74.7	74.9	83.1	79.7	76.5	84.5
5:20	74.3	74.9	75.0	91.1	91.0	84.1	95.7
6:20	74.4	75.0	75.1	91.0	85.0	80.2	89.4
7:20	74.4	74.9	75.3	91.0	84.6	79.4	89.7
8:20	74.5	75.0	75.5	110.2	94.1	88.6	115.6
9:20	74.8	76.2	75.6	106.2	92.4	85.6	112.6
10:20	74.7	75.5	75.9	105.1	92.6	84.7	115.9
20:20	75.4	76.9	79.1	119.0	102.5	87.8	101.9
35:20	76.3	81.5	81.4	133.1	121.3	107.7	106.0
60:21	76.6	88.1	81.2	141.1	130.4	113.9	107.0
105:20	77.4	94.3	80.9	132.0	132.0	116.8	108.0
150:20	78.8	96.2	82.1	118.2	123.9	118.0	107.8

TABLE 10
Cable Tray Temperatures
Tray 4

Time (Min:Sec)	T.C. Locations						
	1	2	3	4	5	6	7
Pre-test	73.8	73.7	74.2	74.2	73.4	74.0	73.7
2:23	74.4	73.0	74.6	74.9	73.1	73.9	73.9
4:23	74.7	73.7	75.2	78.4	72.9	73.9	74.3
7:23	79.0	75.8	75.3	84.9	71.5	73.9	75.4
20:23	81.1	77.0	75.5	127.1	66.5	74.2	81.3
30:23	96.3	83.8	81.8	130.4	64.8	74.5	83.5
35:23	99.2	83.1	79.7	128.9	62.2	75.1	87.3
40:23	102.4	84.8	80.5	127.9	61.4	75.5	89.0
60:24	111.3	81.7	83.2	129.7	56.0	74.9	93.4
105:23	120.6	96.7	87.5	114.9	42.9	77.9	95.7
150:23	120.7	98.0	89.7	104.5	44.4	79.2	95.4

TABLE 11
Cable Tray Temperatures
Tray 5

Time (Min:Sec)	T.C. Locations						
	1	2	3	4	5	6	7
Pre-test	73.6	73.7					
6:24	73.9	75.2					
14:24	74.2	78.8					
20:24	74.7	83.8					
35:24	76.3	91.3					
60:24	79.0	95.3					

Table 12 - Summary Of Cable Damage

Tray No.	Description
1	Cable material at bottom of bundle loop melted and charred.
2	Cable material of all cables in contact with bottom tray rung melted.
3	Cable material at bottom of bundle loop and along tray side channels melted and charred. Greatest amount of cable damage occurred in tray 3.
4	Cable material at bottom of bundle loop melted and charred.
5	No cable damage observed.

Table 13 - Results Of Air-Oven Tests Of Dummy Sprinklers

Sprinkler No.	Operation Time (Min:Sec)	Temp (°F)
1C	2:50	250
2A	3:40	272
2B	3:10	260
2C	3:38	265
3A	3:10	260
3B	3:36	265
3C	3:12	262

TABLE 14 – SUMMARY OF CABLE TRAY TEMPERATURES

MAXIMUM TEMPERATURES

WITHIN CABLE TRAY

TRAY NO.	TC LOCATION	TEMPERATURE (^{O}F)	TIME (MIN:SEC)
1	2	133	40:00
2	6	135	18:00
3	4	141	60:00
4	4	130.4	25:00
5	6	99.0	78:00

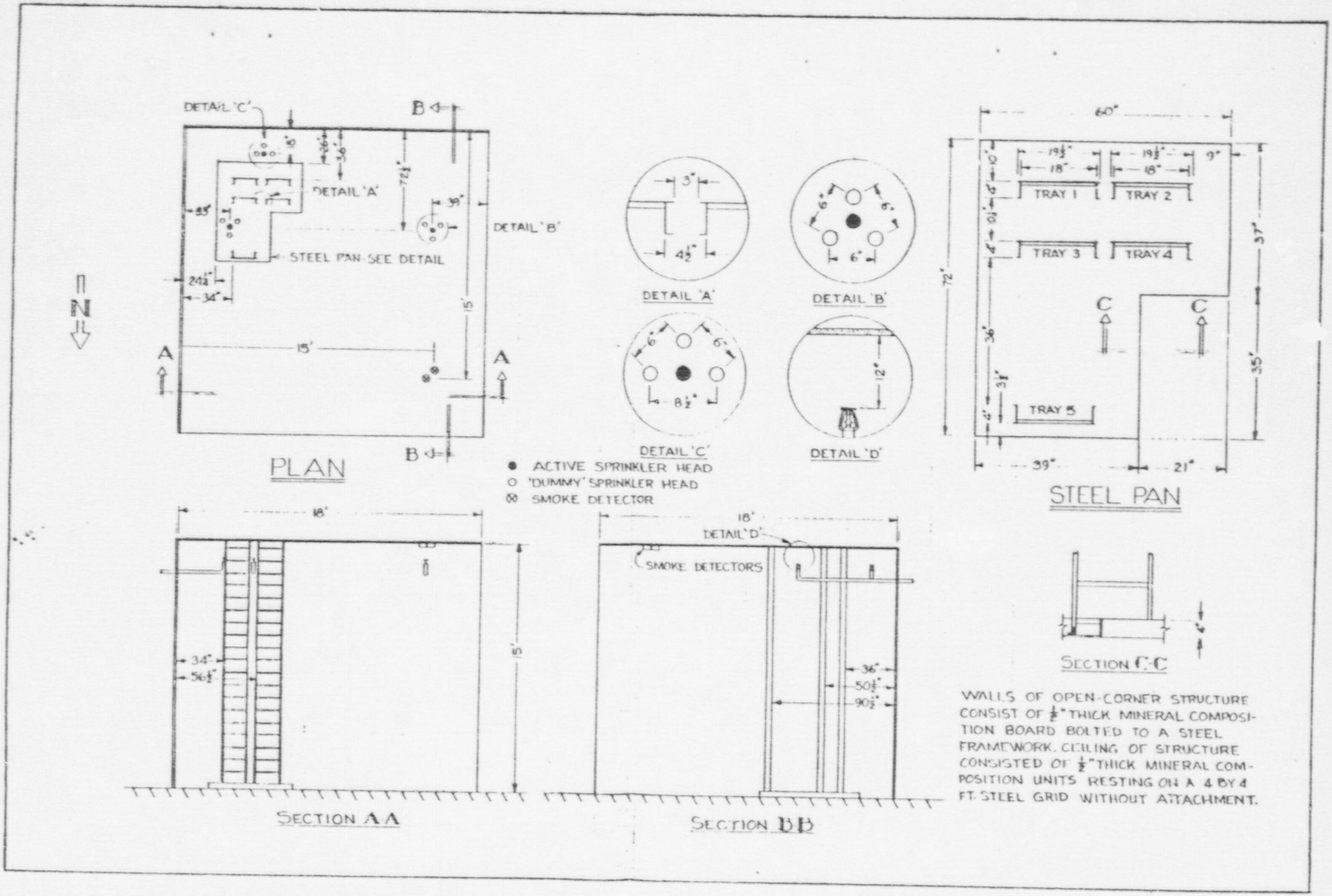
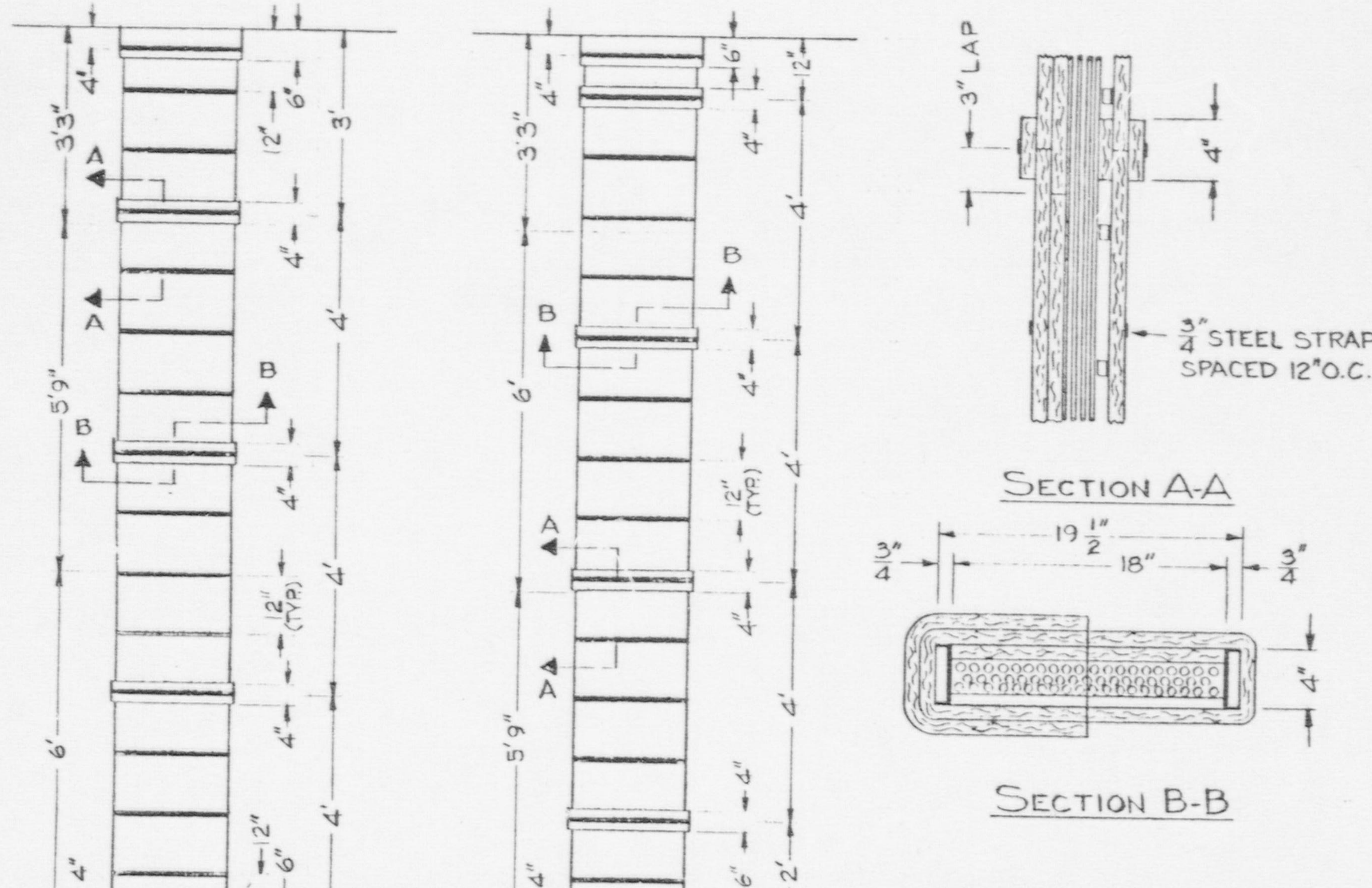


FIGURE 1 – TEST ASSEMBLY



CABLE TRAY INSULATION

LOADED CABLE TRAY T/C INSTALLATION

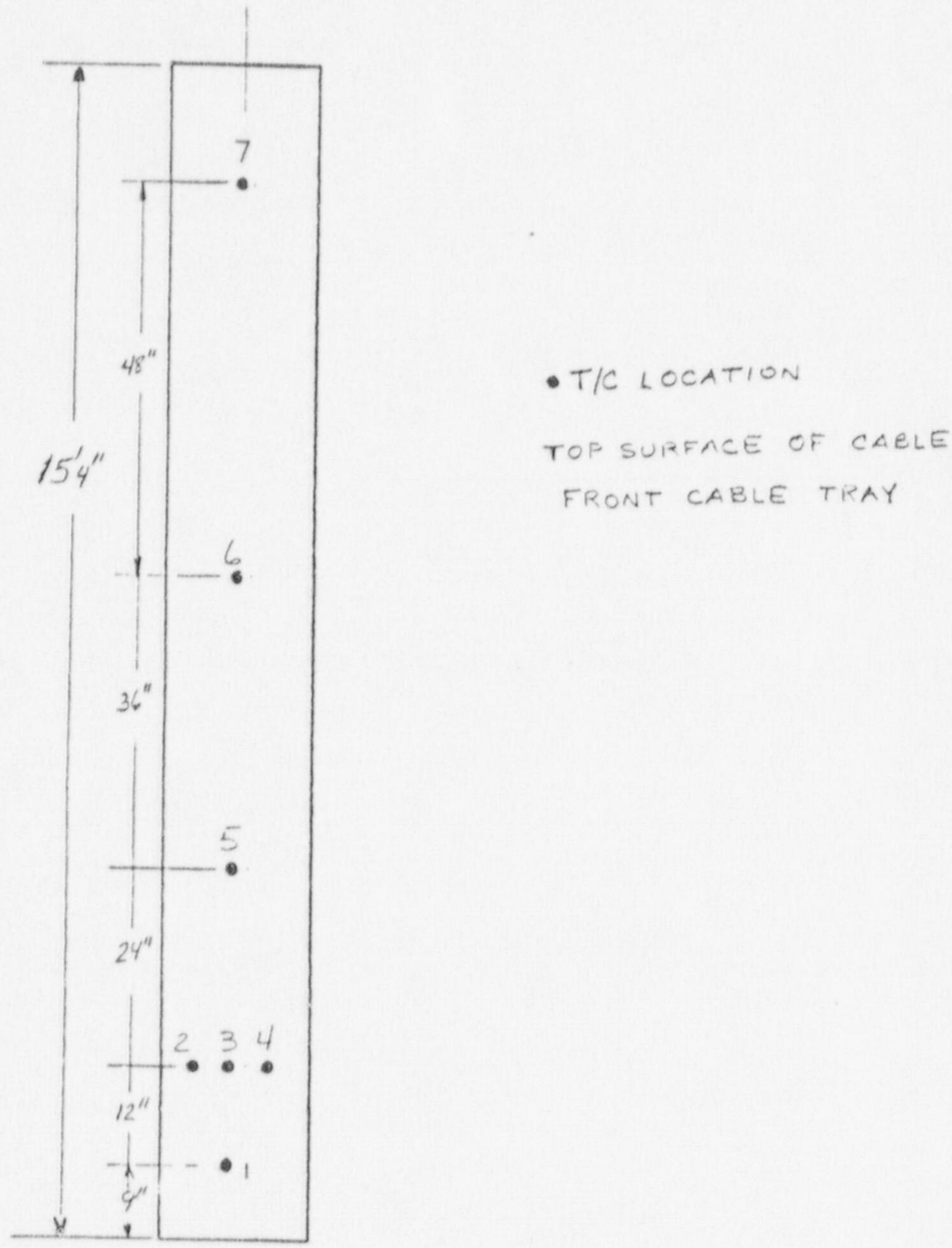


FIGURE 3 – CABLE TRAY THERMOCOUPLE LOCATIONS

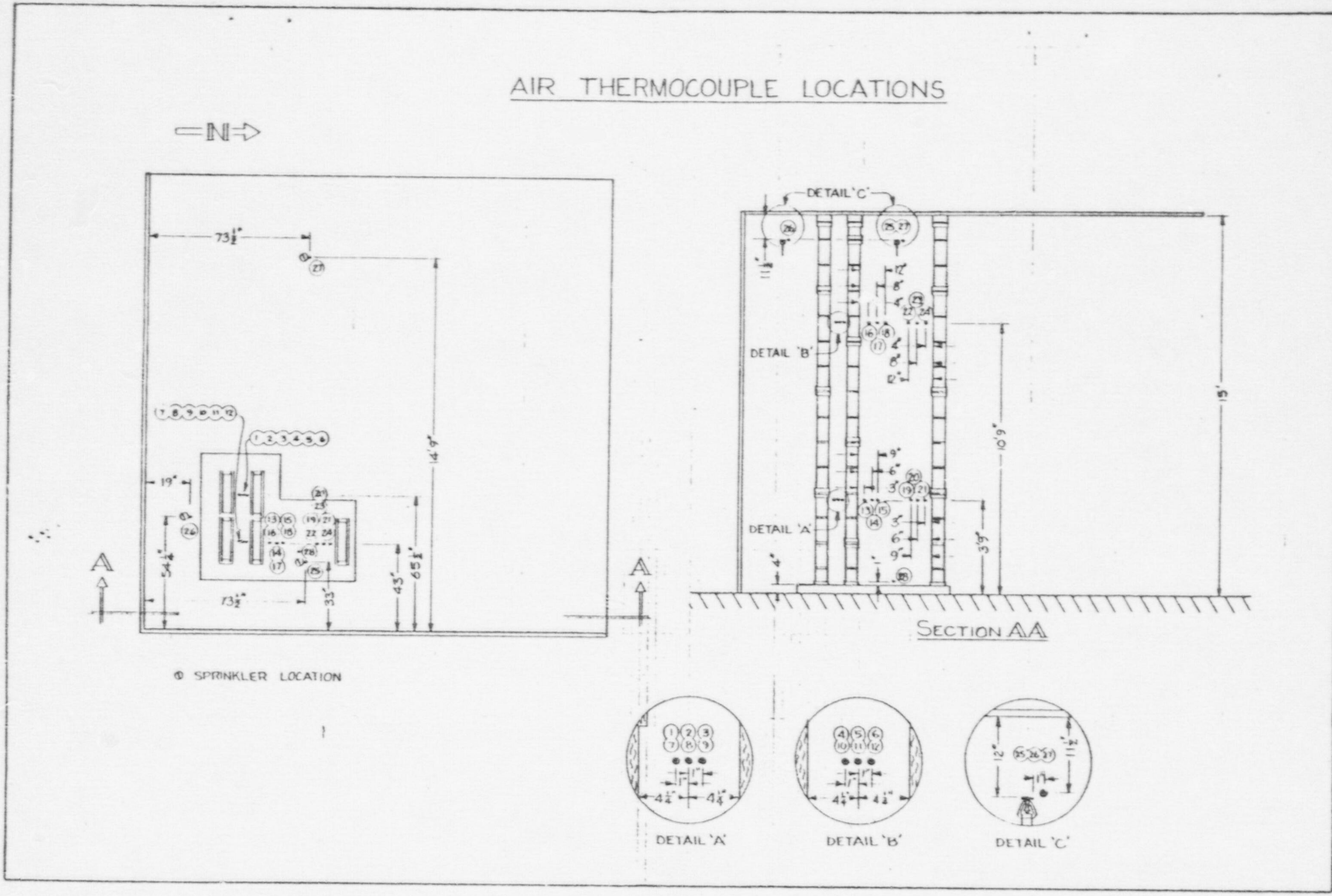


FIGURE 4 - AIRTHERMOCOUPLE LOCATIONS

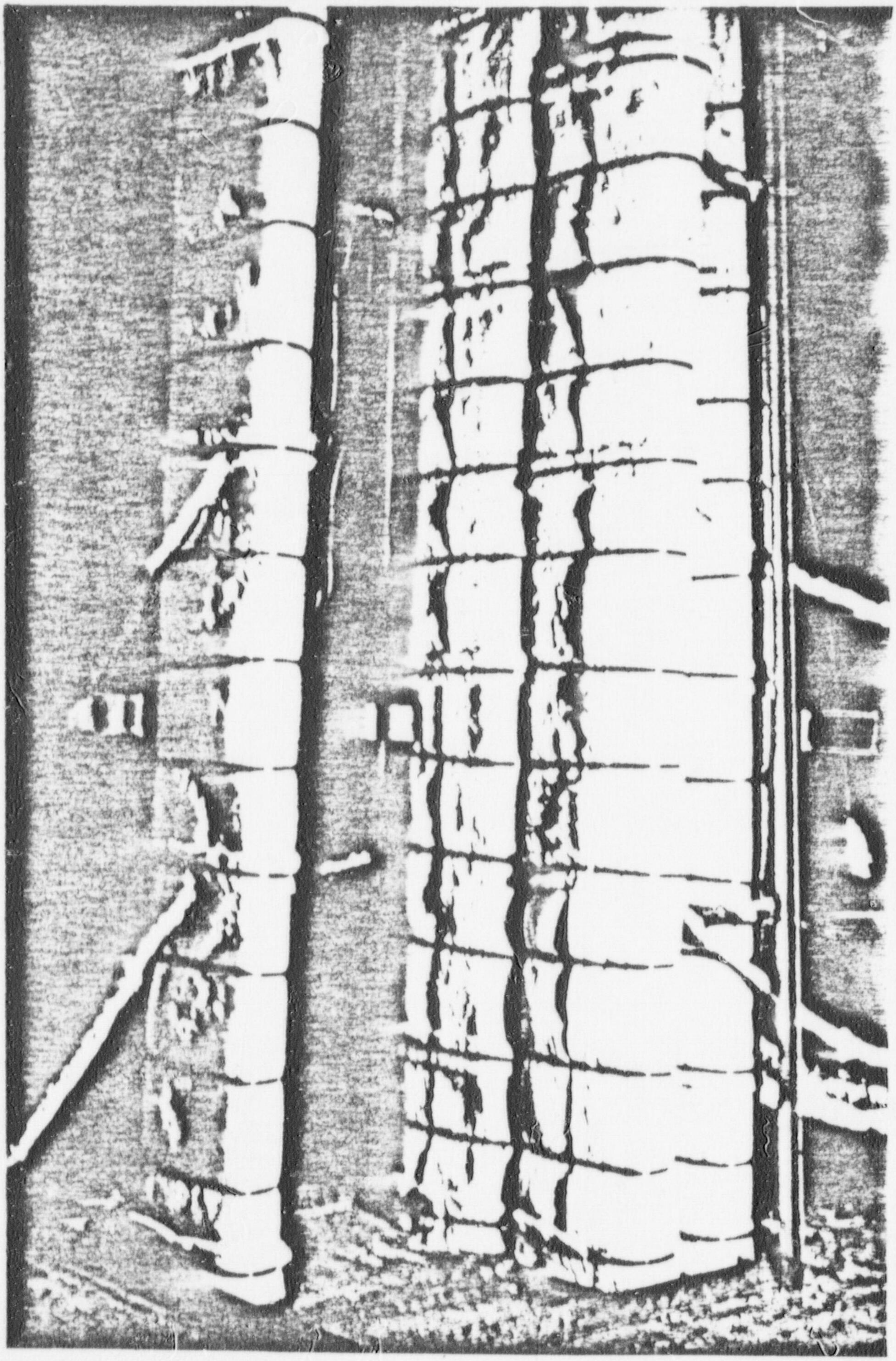


FIGURE 5 - TEST ASSEMBLY PRIOR TO FIRE TEST

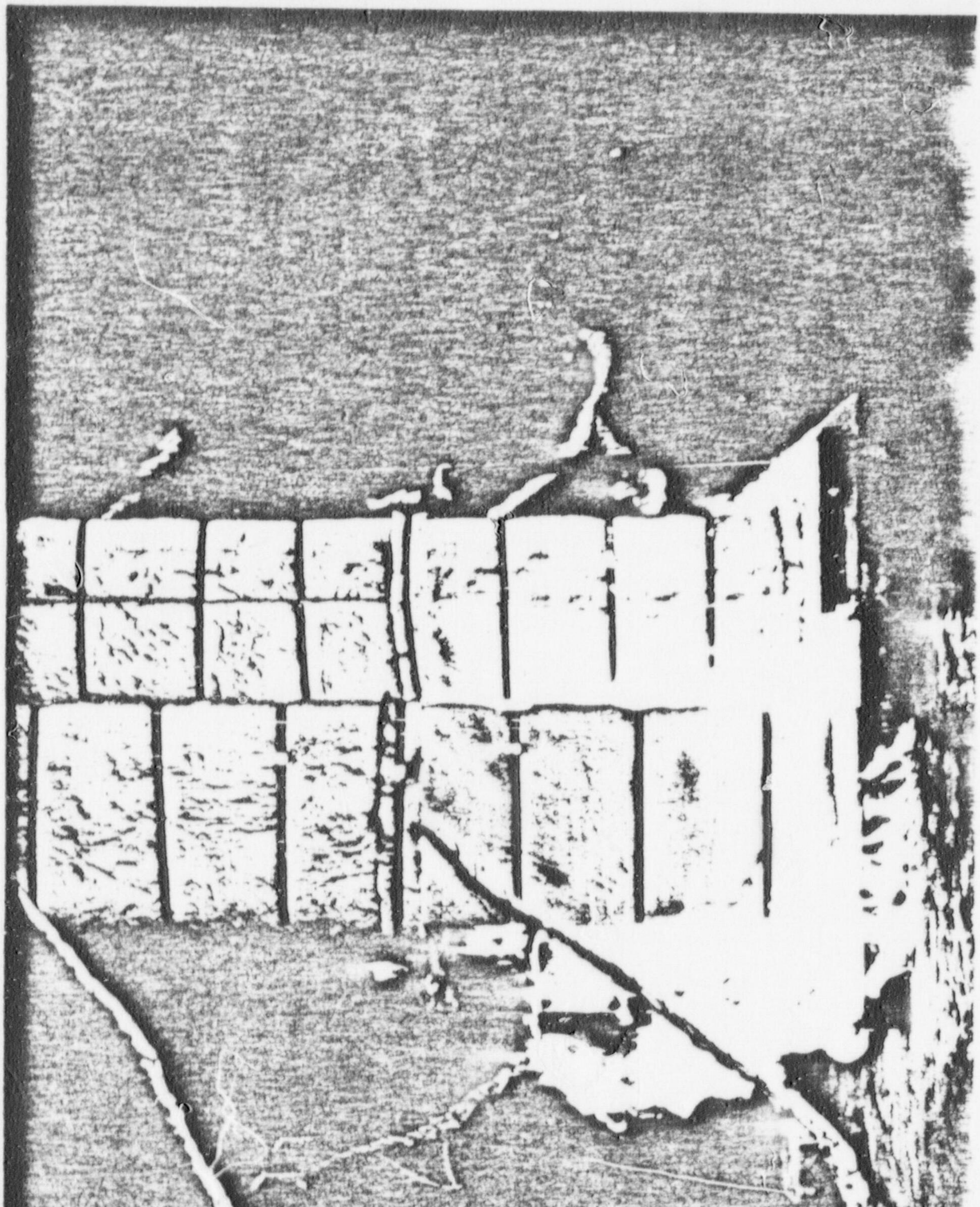


FIGURE 6 - TEST ASSEMBLY AT TEN SECONDS

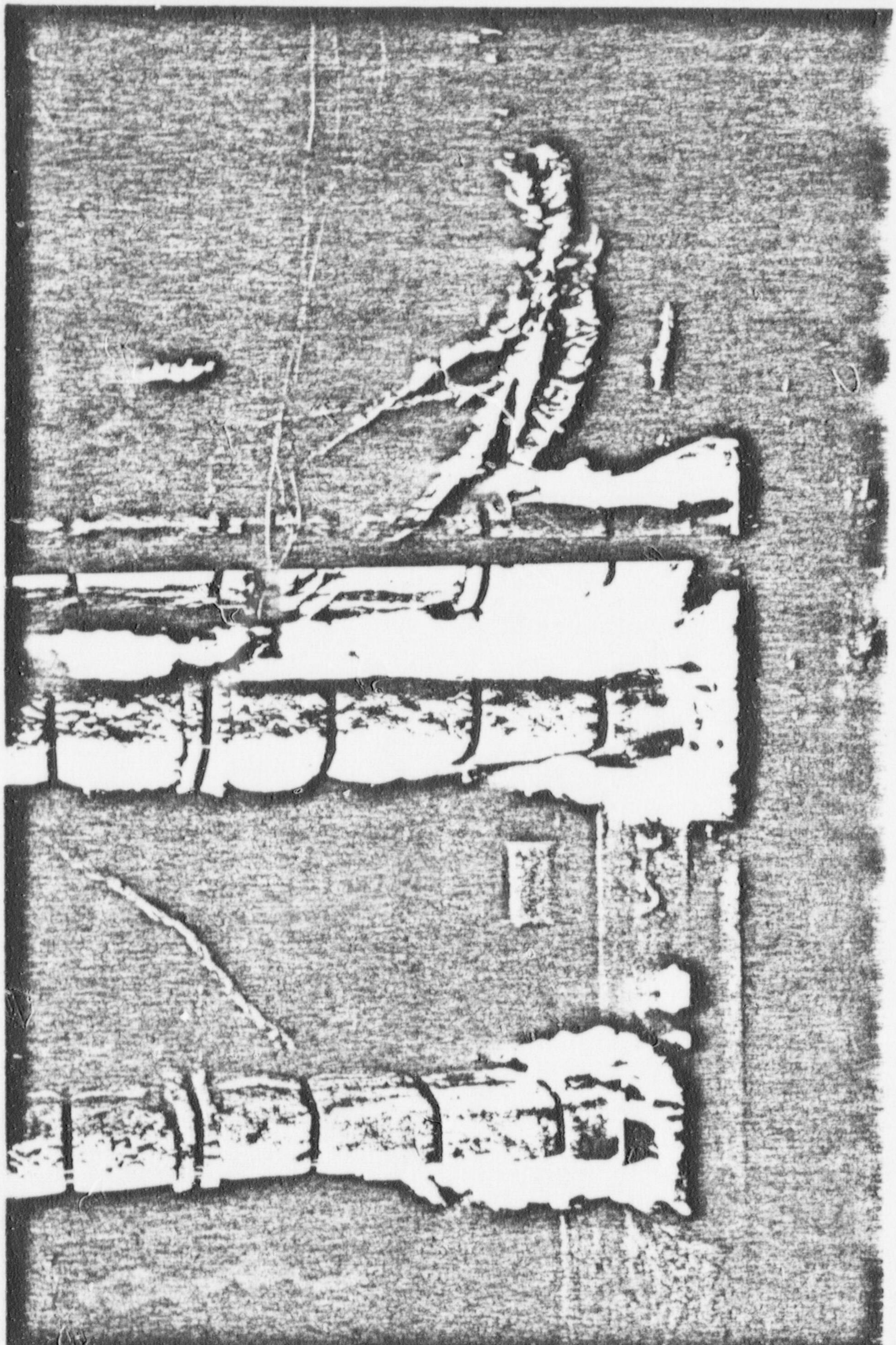
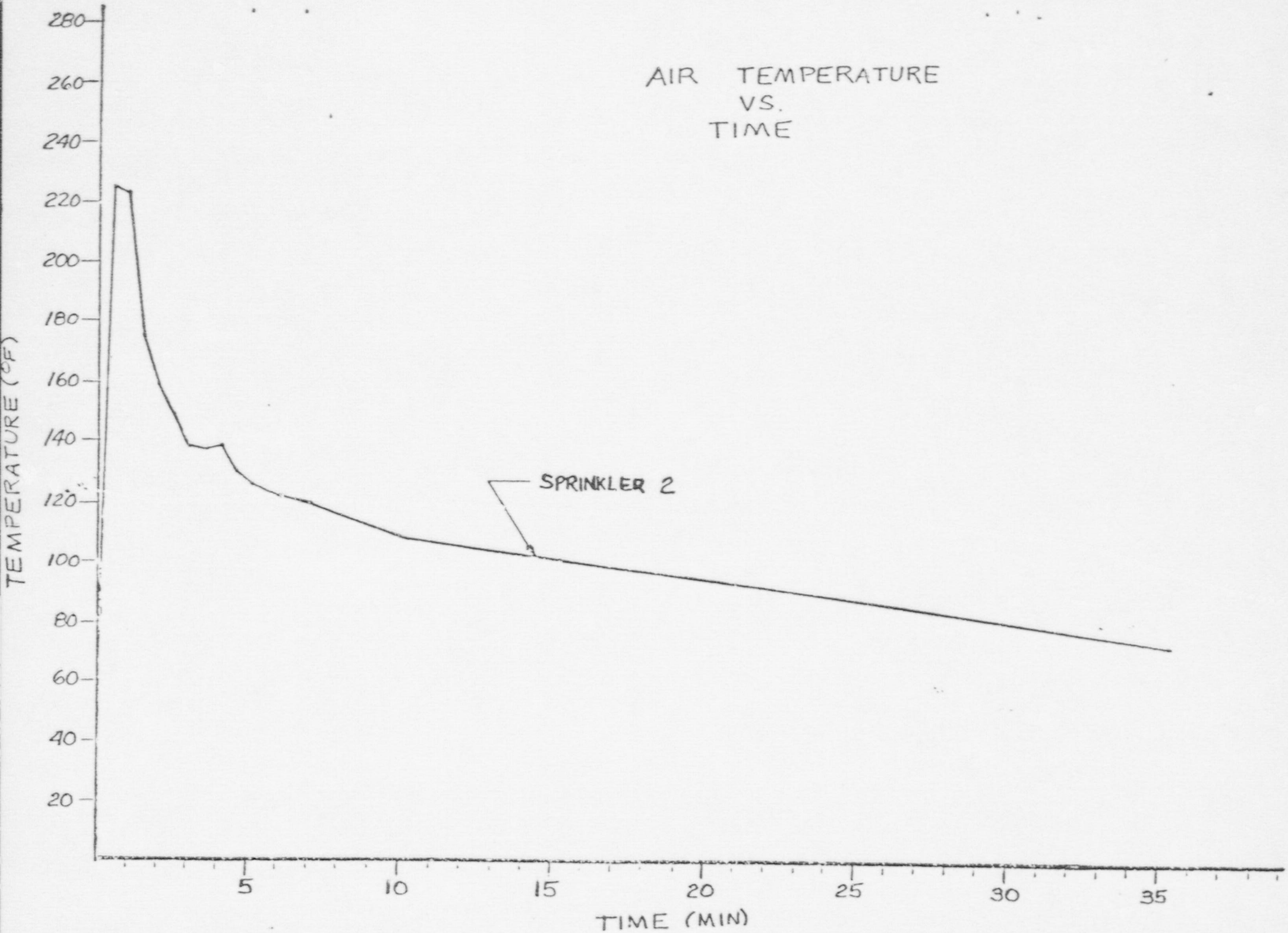


FIGURE 7- TEST ASSEMBLY AT NINETY SECONDS



AIR TEMPERATURE
VS.
TIME
TEMPERATURE (°F)
280
260
240
220
200
180
160
140
120
100
80
60
40
20
SPRINKLER 2
5
10
15
20
25
30
35
TIME (MIN)

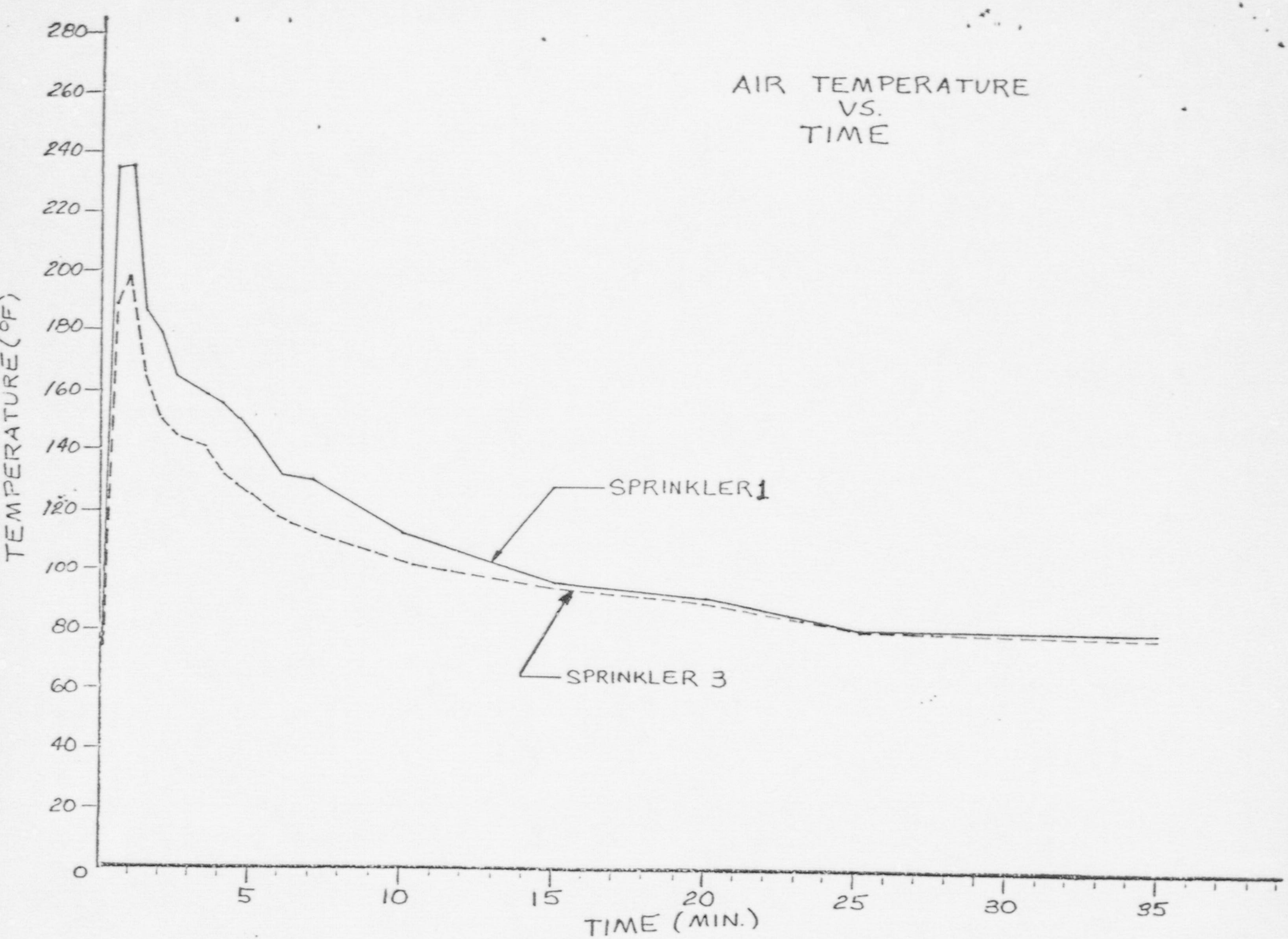


FIGURE 9 - AIR TEMPERATURE VERSUS TIME (SPRINKLER 3)

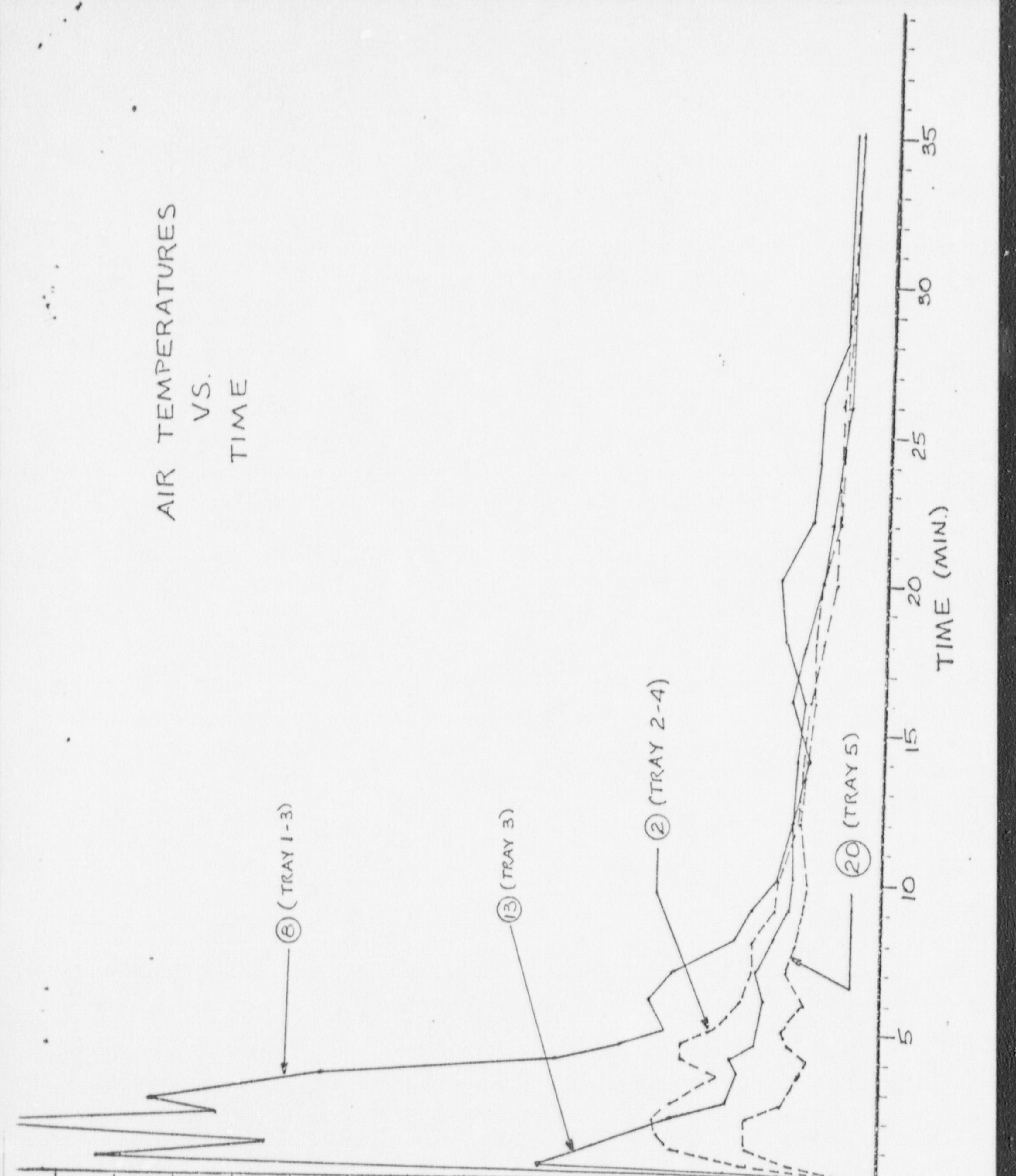


FIGURE 10 - AIR TEMPERATURE VERSUS TIME

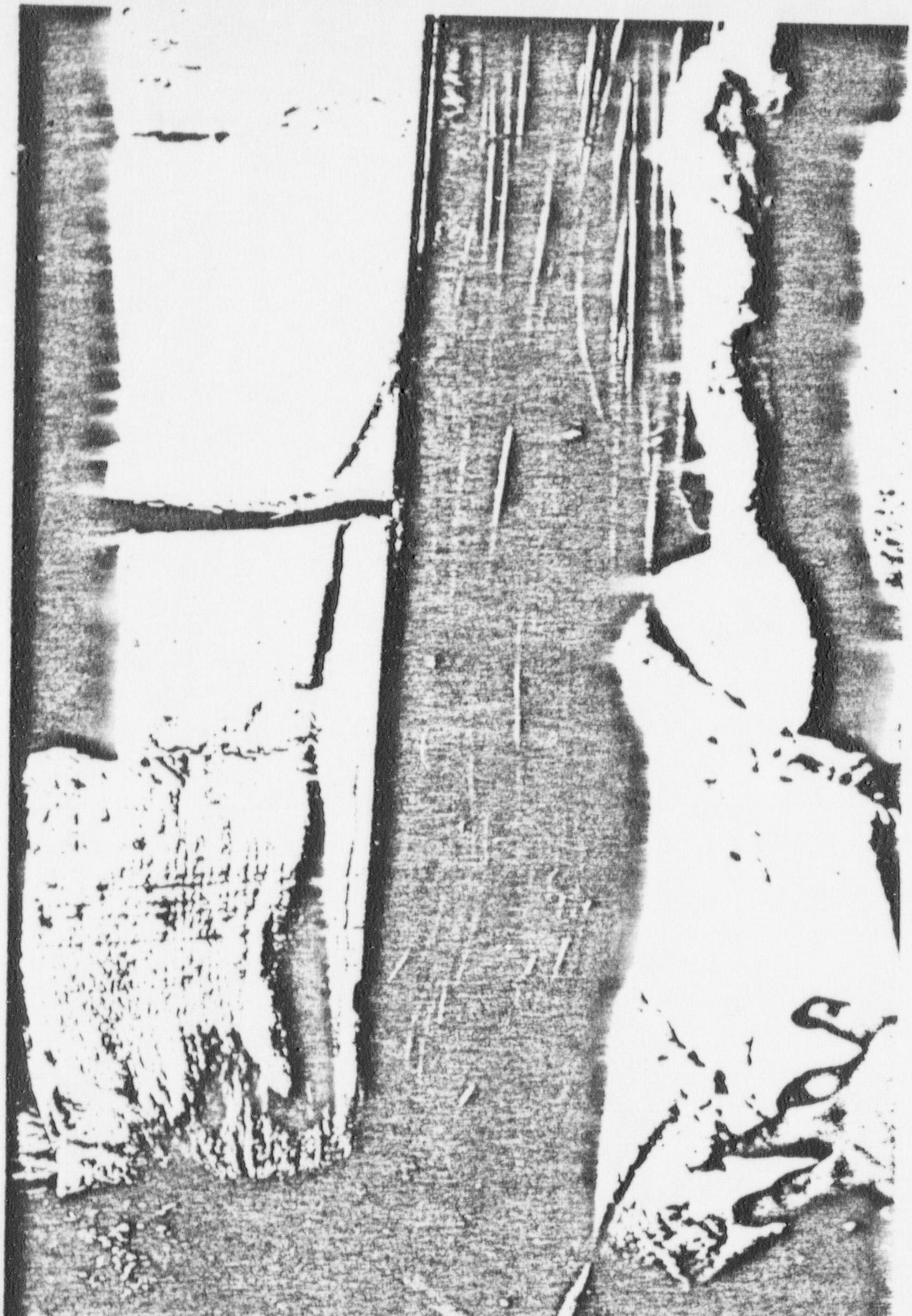


FIGURE 11 – TRAY 3 AFTER TEST

FIGURE 12 - TRAY 3 AFTER TEST

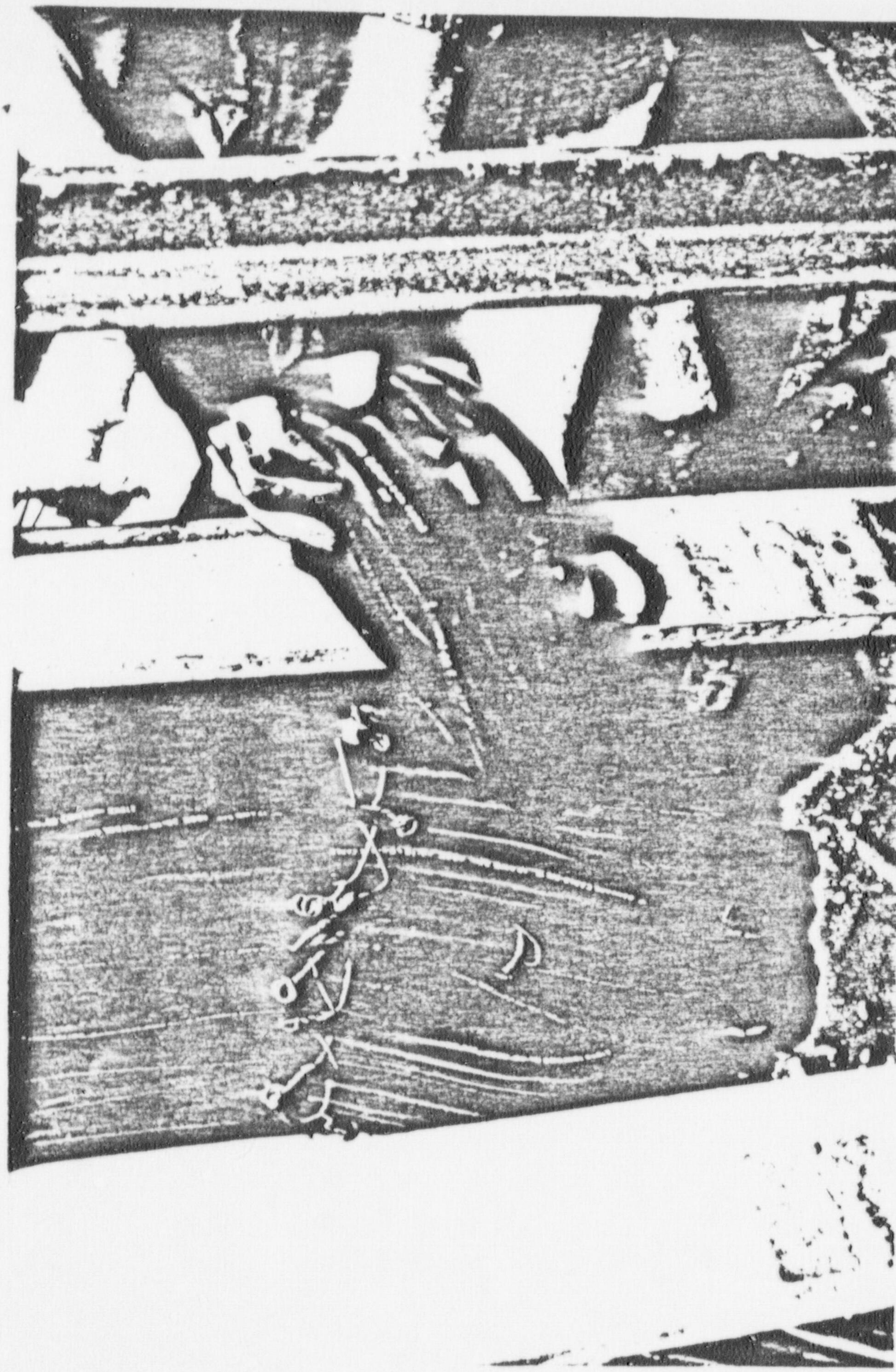


FIGURE 13 - TRAY 2 AFTER TEST