

NBS GCR 77-82

**Final Technical Report
IITRI Project J6340
Contract No. 4-36092**

**UL File USNC-62
Project 75NK7701**

**DETECTOR SENSITIVITY AND SITING
REQUIREMENTS FOR DWELLINGS -
PHASE 2**

**Prepared for:
U.S. National Bureau of Standards
Washington, D.C. 20234**

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REQUIREMENTS FOR DWELLINGS -
PHASE 2**

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Engineering Mechanics Division
IIT Research Institute

Contract No. 4-36092

Final Report

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1.0 INTRODUCTION:

The following Report will serve as a statement and evaluation of results obtained for supplementary fire experiments performed as an extension of contract No. 4-36092 (IITRI Project J6340). The primary purpose of this study is to determine how to properly site detectors and to evaluate their associated sensitivity requirements for a particular dwelling.

During the original work in 1974-75, 40 experiments were performed in two structures provided by the U.S. Department of the Interior, Indiana Dunes National Lake Shore. Ambient conditions for those experiments included summer conditions with the building air conditioned and winter conditions with the building heated and the furnace blower on or off. Fires were initiated in real furnishings at various locations throughout the residence, and comparisons were then made between operation of generic classes of detectors (at several locations and several sensitivity levels). Also, the hazards to life, including concentrations of CO and CO₂, temperature, and smoke density, were monitored and recorded. This information clearly defined several hazardous configurations of fire and detector locations previously thought safe. Proper detector sensitivity and location were determined for those cases.

The objective of the second phase of the program, detailed herein, was to gather information on fires under summer/fall conditions without air conditioning and to expand available information on high volume, two-story structures. Actual home furnishings were employed during most of the tests, along with an attempt to simulate furniture using mock-ups. As in the original research, a cross-section of detectors using detection principles currently available was chosen for use in these experiments. It was not the objective of this study to judge the individual detectors for their usefulness or to rank each manufacturer in order of response time. They were selected merely to represent the current level of technology available in residential type detectors.

As more and more jurisdictions make fire detectors mandatory in certain dwellings, it becomes increasingly important to assure that the standards that these jurisdictions are using for a reference are correct in their guidelines and recommendations. At the present time, unfortunately, there is very little actual field data to back up the current standards, which seem to be chiefly based on laboratory experience and engineering judgement. The following is an attempt to improve upon this situation.

2.0 EXPERIMENTAL PROCEDURE:

DESCRIPTION OF TEST BUILDINGS

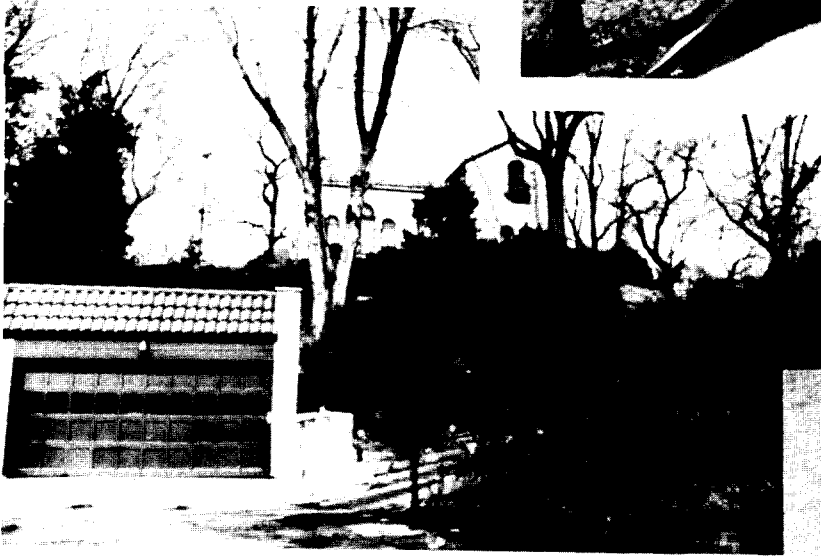
Two test buildings were available for this phase of the program. These homes, provided by the U.S. Department of the Interior, Dunes National Lake Shore, were scheduled for demolition as part of a land clearance program associated with the establishment and expansion of the Indiana Dunes National Lake Shore.

The first set of test fires were performed in a two-story brick structure having a basement. Interior walls on first and second stories of the residence were plaster on wood lathe and floors were hardwood. The basement walls were paneled with wood. The building had a gas forced-air heating system to which IITRI personnel fitted a central air conditioning unit for the late summer test conditions. Registers were located in every room with returns in all first floor rooms except the bathroom. There were no returns on the second floor. See Fig. 1 for photographs of the building and Appendix F for floor plans.

The second test site was a two-story brick structure selected primarily because of its large interior volume and the similarity of floor space on the first and second level. Fires in this residence were performed with the heating system operating, which consisted of hot water, baseboard convectors located in specific rooms throughout the residence. See Fig. 2 for photographs of the exterior and interior of the building, and Appendix G for floor plans.

Although the HVAC system for the first test site (J. R. Whitehouse residence) could have been somewhat larger in capacity, these two types of heating systems are fairly representative of the major types of heating systems most commonly used in residential buildings.

FIGURE 1
J.R. WHITEHOUSE
HOME



LIVING ROOM

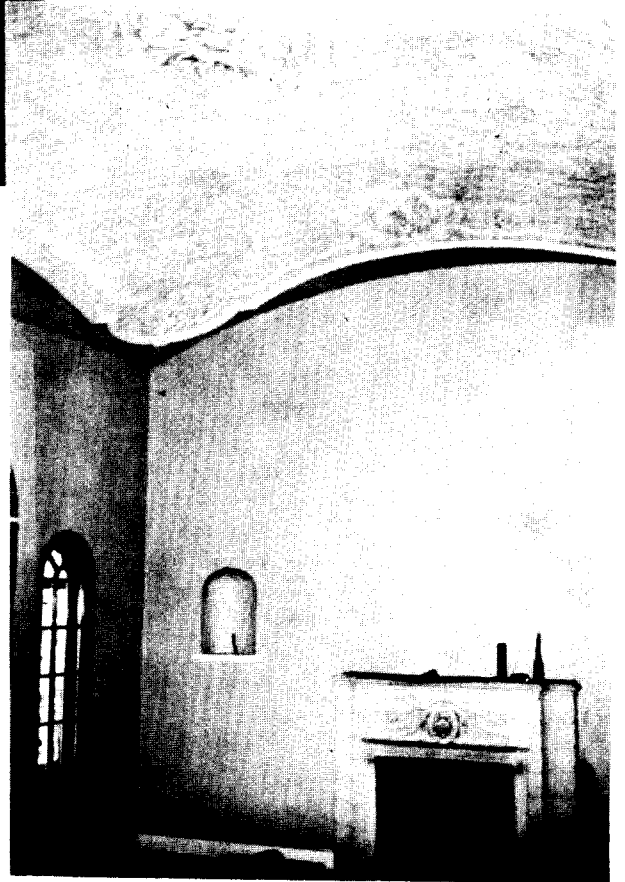


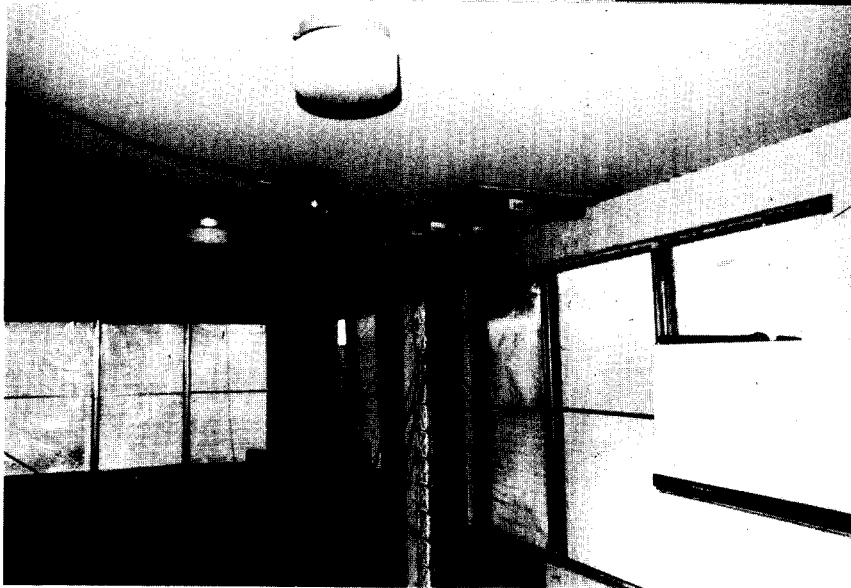
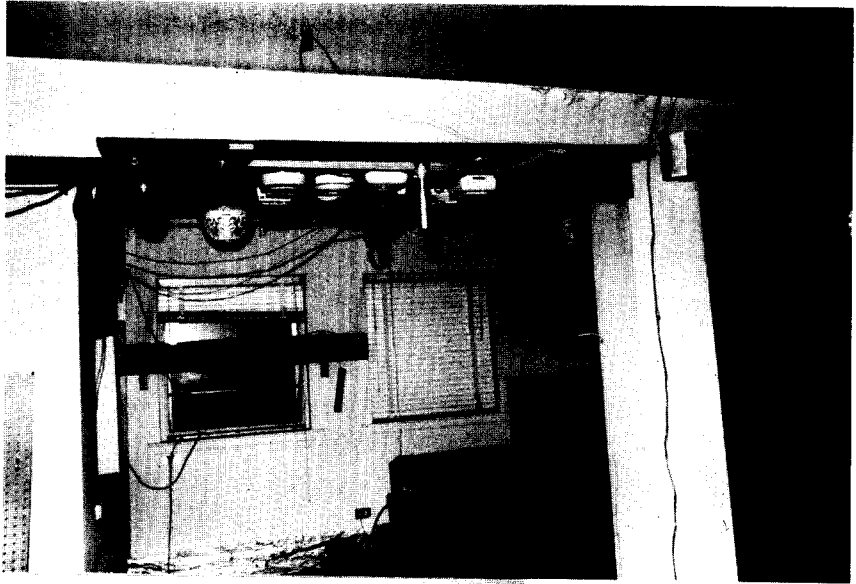
FIGURE 2.
WABASH AVENUE
HOME



LIVING ROOM
(FACING WEST)

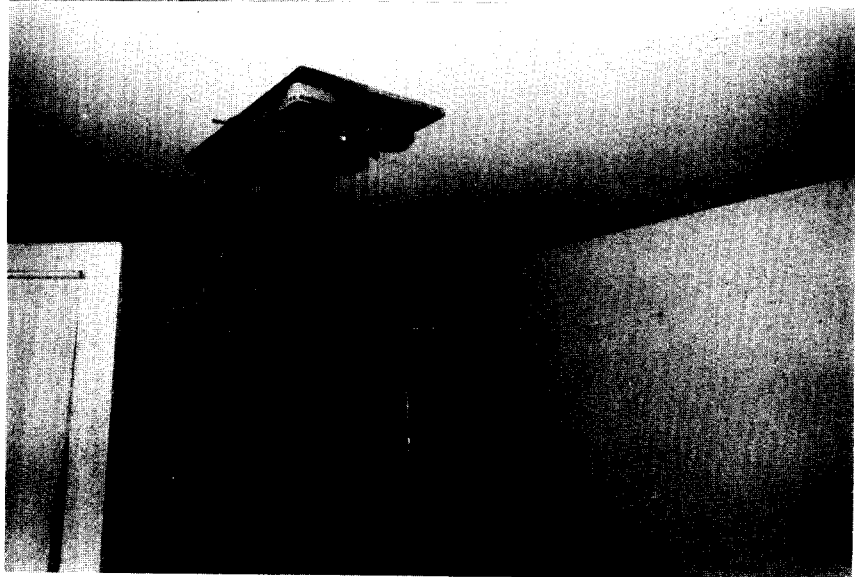


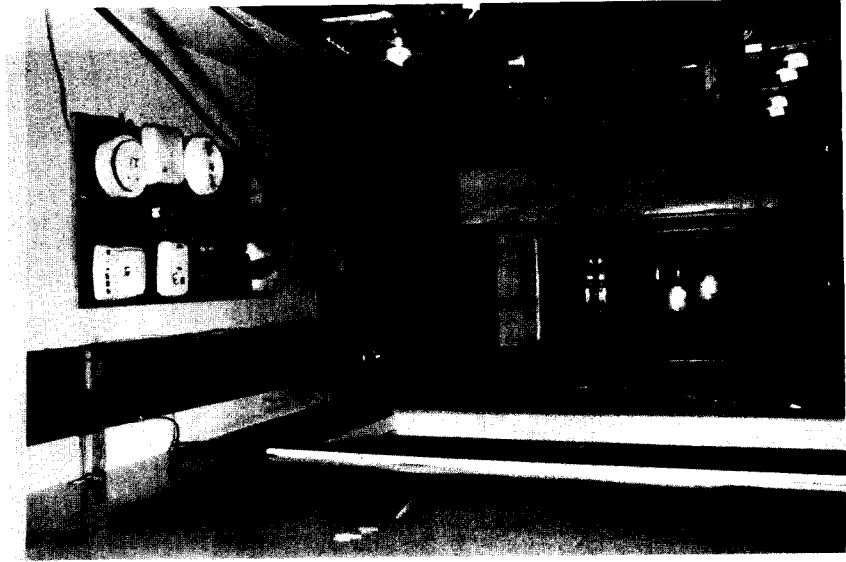
FIGURE 3.
DETECTOR BOARD -
LIVING ROOM (WABASH)



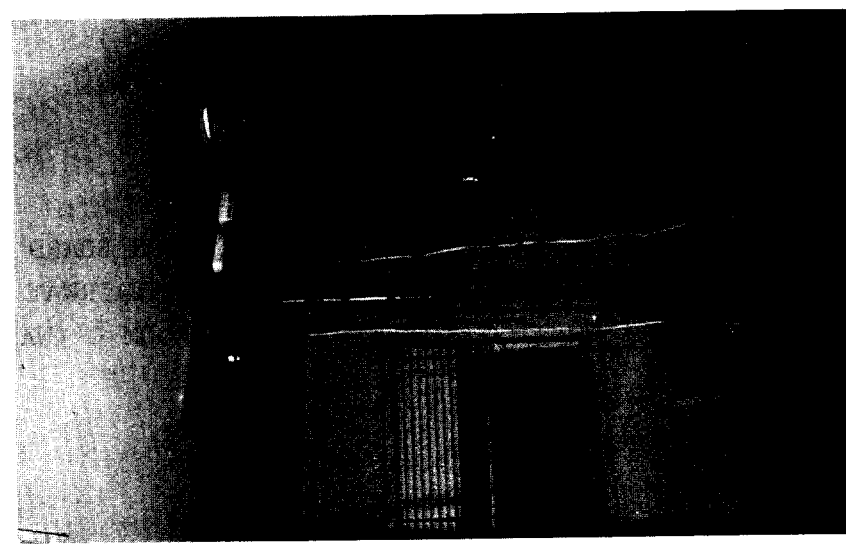
DETECTOR BOARD - TOP
OF STAIRWAY IN
GAMEROOM G (WABASH)

DETECTOR BOARD -
DEN D CEILING
(WABASH)

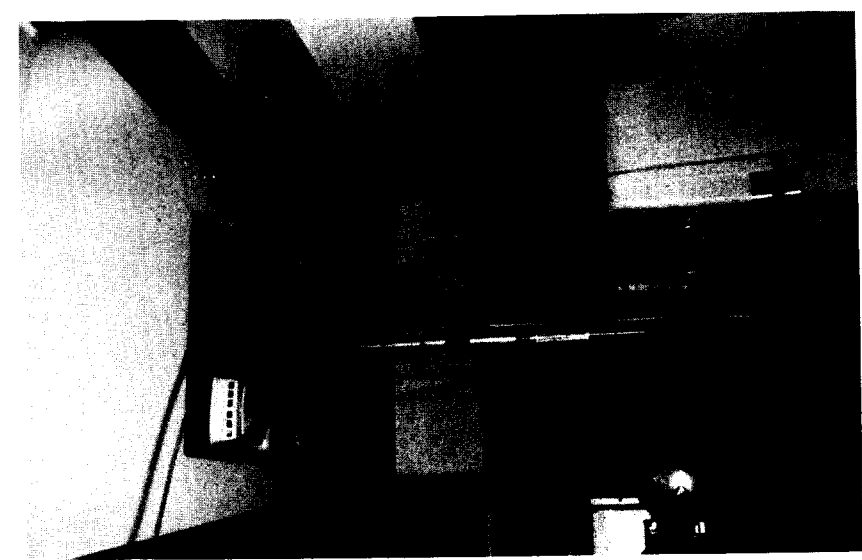




HALLWAY J



BEDROOM C



HALLWAY H

FIGURE 4.

DETECTOR BOARDS -
WABASH AVENUE

Obviously the data sample is too small to draw any significant correlations or major conclusions. However, it has been shown that a significant measure of escape time can be readily added to the scope of future fire experiments.

It is important to perform ancillary studies which will identify the contribution and potentiating or attenuating effects of the various smoke fractions so that a better correlation between animal behavior and human response to fire can be obtained.

In addition the behavior of firefighters being trained in a smoke filled room could be compared with the response of animals trapped in the same chamber. Such experiments would provide a wealth of data unobtainable from other sources. Experiments of this type can be readily performed at existing training facilities.

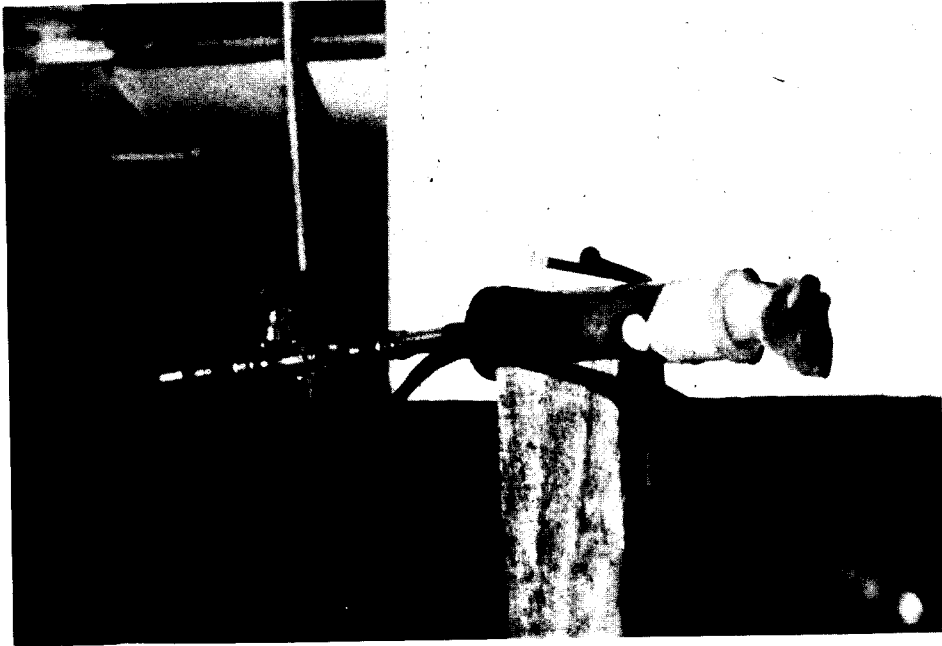


Fig. 1 Mouse in Place for Exposure to Fire Gases

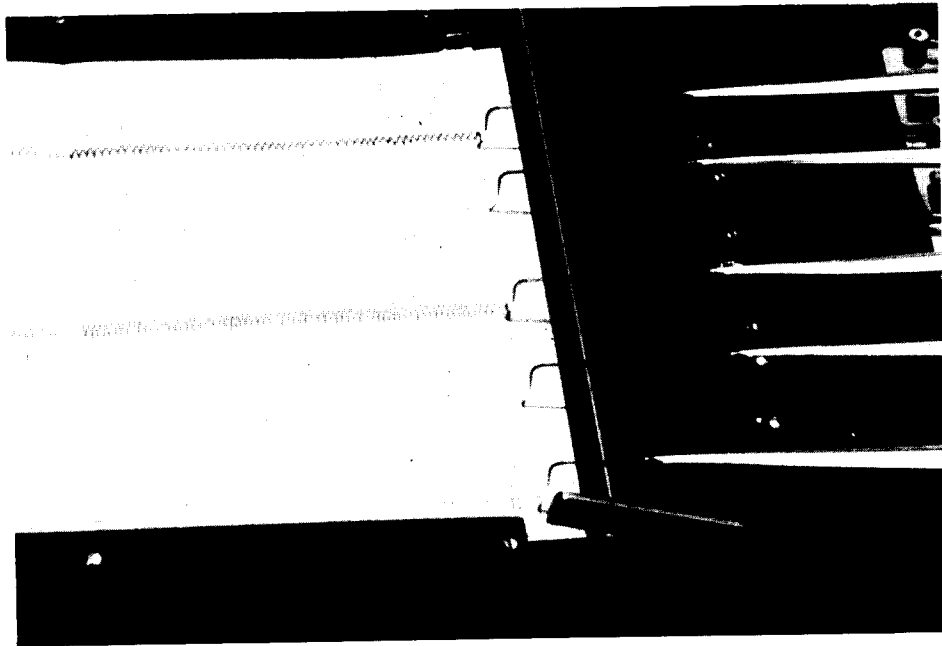


Fig. 2 Typical Control Respiration Rates (3 to 4/sec)
Prior to Test Initiation

PLAN

The approach taken upon return to the J. R. Whitehouse residence was to conduct experiments under summer conditions with the air conditioning system shut down just prior to start of the test, with all windows closed for some tests and in other tests having certain portions of certain windows open. The Wabash Avenue residence was utilized to examine the effect of the hot water baseboard heat while operating under spring conditions. Special attention was directed to the effect that the high internal volume, for both the first and second floors, would have on smoke spread and general detector response. An attempt was also made in this residence to simulate household furniture using certain combustibles placed in a mock-up configuration.

Detector locations in each residence were selected to conform to the levels of protection outlined in the 1975 edition of NFPA No. 74, Standard for Household Fire Warning Equipment published by the National Fire Protection Association. It was the intention of this study to employ detectors preset for 1 percent per foot obscuration, however, there seemed to be a large variation in the actual sensitivities recorded prior to the actual testing probably due to the difference in sensitivity testing performed by each manufacturer. See Appendix A for the sensitivity levels recorded before each set of tests. See Figs. 3 and 4 for photographs of the typical installation for the detector test boards.

Instrumentation for the experiments included 5-ft light beams for measuring smoke obscuration on the ceiling in the room of fire origin, on the ceiling at each detector location, and at the 5-ft level along each primary escape path and in representative bedrooms. Individual thermocouples and vertical thermocouple arrays were installed in the room of fire origin and the primary escape path and several representative locations throughout each dwelling. Tubing for the sampling of combustion gas levels was installed in the room of fire origin, primary escape path, and representative bedrooms.

Fires were initiated in the various rooms of the dwellings using combustible materials in fire modes (smoldering or flaming) typifying the respective rooms.

DETECTORS

The fire sensing techniques displayed by the detectors selected for this test series included ionization and photoelectric type smoke detectors, fixed-temperature heat detectors, and semiconductor gas sensors. More specifically, the ionization type detectors included both single and dual chamber types; the photoelectric detectors included open optics, rate compensation, and light scattering types; and the heat detectors included a spring-wound bell type and a freon powered type. The semiconductor crystal sensing elements in all the gas sensors were similar if not identical in construction and represented a range of sensitivities.

Prior to the start of each test series at each residence, the sensitivity of each detector (excluding the heat detectors) employed was determined by Underwriters Laboratories Inc. in accordance with the sensitivity test requirements of their applicable Standards. For the ionization and photoelectric type detectors, a preset sensitivity of 1 percent per foot obscuration was requested from the manufacturers. Variations in sensitivity did exist probably due to the difference in manufacturer's calibration techniques. The heat detectors employed were rated for a 50 ft spacing schedule. The semiconductor gas sensors were provided by the National Bureau of Standards.

For the actual sensitivities recorded for the applicable detectors for each test series refer to Appendix A.

3.0 RESULTS:

In total, 36 experiments were conducted in this program; 19 experiments at the J. R. Whitehouse test site, and 17 at the Wabash Avenue site. Narrative descriptions of all experiments are included in Appendix C.

Identification of the detectors used in the test series by generic type, sensitivity before each test series, and clock number is given in Appendix A, Table 1. Tables 2, 3, and 4 of Appendix A contain the experiment configurations for both test sites. A summary of detector operating times for the Whitehouse site is contained in Table 5 of Appendix A; Table 6 contains the operating times for those detectors employed at the Wabash Avenue site.

Appendix B has data summary sheets which have been generated for each test fire in each residence. Each sheet contains pertinent information including fire type, ambient conditions, experiment configuration, detector response and escape times, and the tenability limit for that fire. Detectors that were located at the same position in the residence were segregated by location and arranged in the order of maximum escape time.

During the test series at the Wabash Avenue site, the feasibility of using mice to determine escape time limits for humans was explored. The results obtained from that examination are contained in Appendix E.

Appendix H gives performance curves for the actual detectors employed during the test series. These curves indicate the frequency of success (ordinate) that each detector examined would provide for any required escape time (abscissa).

In Appendix J, curves showing the time histories of various measured quantities throughout both test buildings are given. These include light obscuration, temperature, and concentrations of combustion gases in the room of fire origin, bedrooms, and other positions along the primary escape route. On each graph, for the specific location monitored for the conditions above, the relative response times of the detectors at that location are also plotted.

4.0 DISCUSSION OF RESULTS:

RESPONSE TO FIRES

Supporting the earlier test series results, once again the smoke detectors (photoelectric and ionization types) responded well to all fires where actual home furnishings were used. As before, the photoelectric type detectors in general respond slightly better to the smoldering type fires, and the ionization type detectors respond slightly better to the flaming fires. The only point at which an appreciable change in sensitivity of these detectors may have taken place was immediately following those test fires where bare polyurethane foam was ignited and resulted in a flaming fire. After those tests, it seemed as though those detectors located in the immediate vicinity of the fire changed somewhat in sensitivity, that is, the photoelectric type detectors were slightly less sensitive and the ionization type detectors were slightly more sensitive.

To examine the effect of wall mounting versus ceiling mounting of detectors, a smoldering fire was performed at the Whitehouse residence (JR53) in the living room with certain windows open throughout the residence. To examine this effect in the extreme sense, the wall mounted detectors were placed at the 9 ft level in the living room and the ceiling mounted detectors were placed in the center of the ceiling 13 ft above the floor. For this particular test configuration and residence, five of the six wall mounted detectors responded on the average approximately 3 min prior to those detectors mounted at the ceiling. Even with this response difference, the least amount of escape time available from any detector in the living room was slightly over 20 min. These results tend to support the earlier test series results.

Escape potential curves for each detector used throughout the test series for each residence (excluding the semiconductor gas sensors) are given in Appendix H. These curves illustrate the frequency of success (ordinate) that each detector would provide for any required escape time (abscissa). Figures 21 and 22 of this Appendix illustrate escape time versus detector location for the last two fires performed at the Wabash site on the second floor. For this test series, curves were generated only for actual detectors and not theoretical. The results obtained for the Whitehouse tests tend to support the results of the earlier test series, that is, the curves follow closely. For the Wabash site no curves were generated for the hallway H detectors since the detectors at the top of the stairs in gameroom G were more effective in maximizing escape time. Thus, curves were generated for these detectors at the top of the stairs. Due to the unusual escape routes possible at the Wabash site, two escape times are given for those tests, one for the second floor bedrooms and the other for the first floor bedrooms.

In light of the success frequency curves described above, it should be remembered that the required escape time may vary considerably depending on size and configuration of the residence, and age and physical condition of the occupants. Times in the range of 2 to 5 min seem reasonable.

In regard to escape criteria, the critical values adopted as the limits beyond which escape may not be possible (except through windows) were an optical density of 0.07 per foot, a temperature of 150 F, or a time-averaged concentration of CO of 0.04 percent over a 1 hr period. In all but two of the 36 test fires, an optical density of 0.07 per foot was attained before any other condition. In the remaining two fires the temperature criteria of 150 F was reached first. Using these results the escape potential curves show that the actual detectors provide inadequate protection when fires and detectors are on different floors.

The results obtained in the Wabash Avenue site further emphasized the results of the earlier test series in that the escape times obtained from detectors installed on the second floor responding to first floor fires seem somewhat marginal. If one were to install detectors in compliance with NFPA No. 74 (1975), Standard for Household Fire Warning Equipment, there would be no detector on the first floor if there were no first floor bedrooms. The results of the experiments seem to indicate that this situation would result in marginal performance under many first floor fire conditions. Refer to Figs. 14 through 20 of Appendix H for these results.

In the earlier test series conducted in 1974-1975, all summer experiments were conducted with the HVAC system operating. It was noted in the Report generated for that earlier work that poor performance of the second floor detectors with first floor fires was accentuated in the summer, particularly for smoldering ignitions. The question was then posed as to whether a no-forced circulation condition would further emphasize this effect. From the recent results covered by this Report, it was shown that the no-forced circulation condition did not affect detector response any more than the forced circulation condition.

Once again, this study has confirmed the importance of regular maintenance and cleaning of the detector by the homeowner to maintain proper operation of the detector. On those tests following the fires that were initiated with bare polyurethane it was noticed that certain photoelectric detectors became less sensitive and certain ionization detectors became more sensitive due to the particulates given off by the polyurethane during combustion. Refer to the data summary sheets in Appendix B for Tests 72 through 76 for detectors from manufacturers P, N, and K.

Again supporting the first year test results, the last two tests performed at the Wabash Avenue site generated escape potential curves which tend to support the idea that in a long hallway if detectors are placed approximately every 30 ft, the escaped time potential is significantly increased. See Figs. 21 and 22 of Appendix H.

The heat detectors employed for this test series were the fixed-temperature type each rated for 50 ft spacing, however, one was a spring-wound bell type and the other a freon powered horn type. In each test that these detectors were used, they were located on the wall 6 in. from the ceiling to the top of the detector in the vicinity of the test fire. In effect, these detectors were at the same level as the smoke detector board in the room of fire origin. As in the earlier tests, these detectors were ineffective in providing any reasonable escape potential. As indicated in the data summary sheets in Appendix B, the heat detectors failed to respond to the majority of the fires performed. When they did respond, little or no escape time was given prior to occurrence of dangerous conditions along the primary escape path. Response from the smoke detectors far exceeded the heat detector response. For actual test results refer to Appendix B and the escape potential curves given in Appendix H for the J. R. Whitehouse residence.

At the Whitehouse residence, fires were performed under summer conditions with certain windows open to examine the effect that these open windows would have on detector response and spread of smoke or heat. The results indicate that escape time and detector operating times are affected by an equivalent amount so that the end result is satisfactory detector performance with adequate escape time. Refer to the data summary sheets in Appendix B for the Whitehouse fires.

The localized convection currents induced by the hot water, baseboard heating system in the Wabash site appeared to have little or no effect on detector response or smoke flow patterns during any of the experiments. Slight stratification levels were noticed during the experiments in this residence, but these levels did not adversely affect escape potential. In the Whitehouse residence, shutting the air conditioning system down just prior to commencement of the test did not create a situation any worse than when the air conditioning was operated throughout the test. This result may better explain one of the results noted during the first year tests. In the first year test it was observed that during fires conducted under summer condition, there was very little smoke in bedrooms with closed doors as compared to a similar experiment carried out under winter conditions. The explanation proposed in the first Report was that this was caused by the scavenging and filtering effect of the wet cooling coil of the air conditioner. With the latest results, it now appears that perhaps during the first year test the air conditioning system was circulating cool, clear air across the bottom part of the floor in the living room. Accumulation of smoke during those tests was in a space above that flow since the flow of cold air stabilized the temperature gradient which prevented the smoke from rising to the detector levels. In the latest test series, the shutdown of the air conditioning system prior to test commencement may have allowed the temperature gradient to disappear thus letting the smoke rise to each detector location in the living room.

At the Wabash Avenue site, an attempt was made at performing several synthesized fires. For these fires certain items of furniture were simulated with polyurethane bricks set up in a particular configuration such as a chair, a mattress on a frame above the floor, and a mattress directly on the floor. The four fires performed with these configurations burned for only 6-8 min. Obviously these fires were much faster than those where actual furnishings employing polyurethane were used. Therefore, it appears as though in order to use a simulated fire combustibile as attempted above, the configuration used must approximate the actual furniture construction much more closely. This statement is supported by the exercise described in the next paragraph.

The following table was generated to provide a comparison between the fires where actual furnishings with polyurethane were used and the fires where the bare polyurethane was used to simulate furniture. Tests 64 and 66 used actual furnishings with polyurethane; Tests 68-71 used the polyurethane bricks set up in a simulated configuration. The data under each test number is the response time sequence for detectors in the living room, bedroom C, and gameroom G.

Living Room						Bedroom C						Gameroom G					
Actual		Simulated				Actual		Simulated				Actual		Simulated			
64	66	68	69	70	71	64	66	68	69	70	71	64	66	68	69	70	71
F	K	G	F	K	P	F	K	K	K	K	G	F	K	G	K	K	K
K	F	N	K	F	N	K	G	N	G	F	P	K	G	N	F	F	F
S	S	K	G	G	F	S	F	G	N	G	N	P	F	K	G	N	N
	G	F	S	S	K	G	S	S	S	P	F	N	P	F	S	G	
P	N	S	N	P	S	P	N	P	F	S	K	G	N	S	N	S	S
N	P	E	P	N	E	N	P	F	P	N	S	S	S	E	E	P	P
E	E	P	E	E	G	E	E	E	E	E	E	E	E	P	P	E	E

Upon reviewing the above table, it is seen that for the two fires where actual furniture was used, the response time sequence is nearly identical except for slight reversing between four manufacturers. For all three locations the simulated fire response time sequence which most closely approximates the sequence obtained for the actual furnishings is in Test 70. Of all the simulated fires, the configuration in Test 70 comes closest to simulating the actual condition. For this test a 2 by 5 ft sheet of polyurethane was formed using 12 by 12 by 3 in. bricks of polyurethane and was then placed on a section of screen approximately 2 ft from the floor. The bottom and top portion of this polyurethane sheet was covered with cotton or acrylic type blankets. Therefore, the simulated configuration used in Test 70 does have some merit in that it produces a similar response time sequence as obtained in the fires where actual furnishings with polyurethane were used.

In the Wabash Avenue test series, a group of semiconductor gas sensors was initially placed on the ceiling in hallway J alongside the detector board containing the conventional detectors. Due to a lack of response at that location, prior to Test 65, this group was moved to the ceiling at the top of the stairway in gameroom G alongside the detectors at that location. For Tests 65 through 71 at the Wabash site, the gas sensors did not respond for the majority of the fires. When they did respond, their operation was erratic and very often the detector could not be reset for the next test. All four appeared to be very sensitive to transients induced on the same branch circuit by deenergizing or alarming detectors. If left deenergized over a 1 hr period, when reenergized, the same period of time was required before the sensor could be reset for the normal standby condition from alarm. Therefore, for this test series the sensors had to be energized overnight to assure the resetting operation for the next day's testing.

For the fires in the bedroom test series at the Wabash residence (72-76) where cotton innerspring mattresses were the test combustible, the response of three of the four semiconductor gas sensors was comparable to the response of the conventional detectors at the same location. The fourth detector (clock No. 36) displayed erratic behavior throughout the entire test series.

This detector was noted to have the highest calibration sensitivity and it is suspected that it was on the threshold of alarm at all times due to one or more elements of its background environment. For example, semiconductor gas sensors have been known to exhibit extreme sensitivity to aldehydes, at concentrations of several parts per billion.

Reviewing Tests 60-71 (and disregarding the high sensitivity detector on clock No. 36) it appears that the semiconductor detectors are less responsive to fires in polyurethane foams than to those in cellulosic fuels. Several Tests (65, 66, 67, and 70) appear to indicate that the semiconductor detectors are poisoned by smoke from synthetics and loose sensitivity to the cellulosic components of the mixed fuel source. In this regard, it should be noted that the units remained on overnight prior to initiation of Test 72 where good response occurred to a mattress fire.

In two of the fires performed at the Wabash site, the feasibility of using mice to determine escape time limits for humans was explored. For a more detailed description of the test configuration and results, refer to Appendix E, Sensory Irritation.

CONCLUSIONS

In general, the results stated in this Report support and expand on the results obtained in the original work.

1. A residential smoke detector of either the ionization or photoelectric type set at the sensitivity levels encountered during this study would provide adequate life saving potential under most real residential fire conditions when properly installed. Once again, even in the case of rapidly building flaming ignition fires the detectors would provide adequate warning before dangerous conditions were reached in the primary escape path.

2. Supporting the first year results, the fixed temperature heat detectors rated for 50 ft spacing (135 F) used in this test series, in the room of fire origin, provided little life saving potential. These detectors failed to respond to a majority of the fires and when they did respond they were considerably slower than smoke detectors located remotely from the fire.

3. Response time of detectors on the second floor for first floor fires should be considered inadequate. Thus, once again it appears that NFPA No. 74 should be revised to require at least one smoke detector on each level of a residence.

In addition to the above, the data taken at the Wabash residence strongly suggests that a detector used in the basement of a residence should be located on the basement ceiling and not at the top of the basement stairway.

4. Installation of one smoke detector at each end of a long central hall would significantly increase the escape time potential in comparison with one detector at one end of the hall. Both this and the previous study suggest installation of a smoke detector approximately every 30 ft in a long hallway.

5. As in the first year study, there is no apparent difference in life saving potential between ionization and photoelectric detectors under the fire conditions tested during this series. Although the photoelectric detectors in general respond better to a smoldering fire, and ionization type detectors in general respond better to a flaming fire, the time difference between these detectors are minimal when compared on an escape time and life saving potential basis.

6. The level of technology represented by the semiconductor gas sensors employed during this test series did not provide adequate life saving potential and reliable operation as compared to the conventional type detectors used. The sensors used were erratic in behavior and very sensitive to transients and contamination of the semiconductor crystal.

7. In the Whitehouse residence, having certain windows open while performing fires under summer conditions, did not adversely affect detector response time and escape potential.

8. The simulated polyurethane mock-ups did not produce a fire equivalent to those where actual furniture with polyurethane was used. The buildup of smoke and products of combustion was faster than in the actual furnishings fires. Evidently, the simple mock-ups used in this test series were not sufficient, and closer matching to the real item construction is required before fires of this configuration can be used.

5.0 RECOMMENDED AREAS FOR FURTHER STUDY:

Upon review of the results obtained for the research performed under this study, it is evident that basing Standards for fire detection location and sensitivity on laboratory data and engineering judgement is not sufficient to assure positive life saving potential. Accordingly, it is essential that these Standards be verified in additional actual field testing. After reviewing this year's results, the following items are proposed for further study.

1. Experiments should be performed in a split level residence to determine the protection level requirements for this type of building. Every level protection is not clearly defined for this building layout.

2. Detector response to fires originating in structural components due to electrical overload or improperly spaced flues, etc. should be examined. The Wabash Avenue site could serve this purpose since the site is to be demolished in the near future and these tests might cause significant structural damage. More specifically, experiments could be set up for exposed studding in a furnace room being overheated from a radiant source or overloading segments of wiring in stud spaces. The effect of fires exterior to wood joist construction could be studied by preparing exterior wall sections to inset in the overhead door spaces on either end of the "family room".

3. Since the HVAC system at the J. R. Whitehouse residence was marginal in capacity and did not adequately mix the cool air into each room, detector response to fires in a building having a high volume air conditioning system should be studied. For this testing a new site would have to be searched for, but if necessary the Whitehouse residence could be modified for this purpose.

4. Detector performance in commercial, industrial, and public buildings should be studied in regard to public and property protection.

5. Research should be performed to study the relationship between distance, volume, and required detector sensitivity in a large volume residence to determine if a more accurate method of siting detectors could be established.

6. Although touched upon in this year's study, further experimentation with monitoring the respiration rate of mice at different locations in a residence may prove to be a valuable tool to more accurately define escape criteria for humans.

7. Further study is needed of detectors exposed to synthesized fires in real residences. Although this was touched upon at the Wabash Avenue site for this test series, a more extensive study may aid development of a more accurate, meaningful bench test. The present bench test smoke generation methods could be duplicated as well as an examination carried out on other simple fire and/or smoke sources at full scale. Comparisons could then be made between these results and those with actual furnishings.

APPENDIX A

SUMMARIES OF

- Detector Identification
- Experiment Configuration
- Detector Response Times

TABLE 1

DETECTOR IDENTIFICATION

Type	Code	Clock Number	J. R. Whitehouse Measured Sensitivity Percent/Foot	Wabash Avenue Measured Sensitivity Percent/Foot	Remarks
Photo	P	1	1.37	1.80	Rate compensation circuitry. (On for all tests.)
		6	1.44	1.80	
		11	1.23	2.79	
		16	1.55	3.08	
Photo	N	2	1.16	1.38	Open optics. (LED source and discriminating circuit permits elimination of the light labyrinth.)
		7	1.34	2.64	
		12	1.23	1.80	
		17	1.13	1.80	
Ion	F	3	1.72	1.46	Dual Chamber Type. (Same model as used in Phase 1 experiment.)
		8	1.76	0.65	
		13	1.76	0.88	
		18	1.55	0.90	
Ion	K	4	1.23	1.10	Single chamber type.
		9	1.34	0.61	
		14	1.18	0.63	
		19	1.38	1.02	
Ion	S	5	2.38	1.00	Dual chamber type.
		10	1.80	1.18	
		15	2.97	1.34	
		20	2.01	1.55	
Photo	E	21	1.95	1.31	Light scattering type. (Same model as used in Phase 1 experiments.)
		22	1.87	1.55	
		23	1.98	3.43	
		24	1.82	1.74	

TABLE 1 (Cont'd)

DETECTOR IDENTIFICATION

Type	Code	Clock Number	J. R. Whitehouse Measured Sensitivity Percent/Foot	Wabash Avenue Measured Sensitivity Percent/Foot	Remarks
Thermal	BELL	25	135F	135F	Spring-wound type. UL Listed for 50 ft
		27	135F	Not Used	
Thermal	HORN	26	135F	135F	Freon-operated type. UL Listed for 50 ft
		28	135F	Not Used	
Ion	G	29	Not Used	1.55	Dual chamber type.
		30		1.53	
		31		1.23	
		32		1.36	
Taguchi	T	33	Not Used	10.38	Figaro gas sensor No. 308
		34		6.05	Figaro gas sensor No. 105
		35		2.30	Figaro gas sensor No. 109
		36		0.92	Figaro gas sensor No. 202

TABLE 2

SUMMARY OF EXPERIMENT CONFIGURATIONS
 TEST SERIES NO. 4: J. R. WHITEHOUSE RESIDENCE, SUMMER/FALL SCHEDULE (1975)

Experiment Number	Fire Location*	Ignition Type*	Closed		Open Windows	Fuel Summary
			Interior Doors	Doors		
41	L	S	----	----	----	Sofa section, cotton pad.
42	L	S	ABEF	----	----	Chair, foam rubber pad on seat and back, cotton on rest.
43	L	S	----	LABEF	LABEF	Sofa section, 1 in. cotton pad.
44	L	F	----	LABEF**	LABEF**	Chair, 3/8 in. cotton pad over jute, slipcover, metal wastebasket.
45	L	F	----	LABEF	LABEF	Sofa section, 1 in. cotton pad over jute, metal wastebasket.
46	L	S	----	----	----	Sofa, 1 in. cotton pad.
47	A	S	----	----	----	Innerspring mattress on box spring.
48	A	S	BEF	----	----	Innerspring mattress on box spring.
49	A	F	----	----	----	Box spring (1 in. cotton pad), metal wastebasket.
50	A	F*	----	LABEF	LABEF	Innerspring mattress, bedding, clothing.
51	A	S	----	LABEF	LABEF	Innerspring mattress, bedding, clothing.
52	A	S	----	LA'BEF	LA'BEF	Innerspring mattress, bedding, clothing.
53	L	S	----	ABEF	ABEF	Sofa section, 1/2 in. cotton pad over jute.
54	X	S	----	ABEF	ABEF	Sofa section, 1 in. cotton pad.
55	X	F	----	ABEF	ABEF	Chair, 3/4 in. cotton pad, metal wastebasket
56	X	S	----	----	----	Chair, 1/2 in. cotton pad over jute.
57	X	S	----	EF	EF	Center section of sofa, cotton pad.
58	X	F	----	ABEF	ABEF	Two chairs, 3/4 in. cotton over 1/4 in. jute, metal wastebasket
59	X	F	----	ABEF	ABEF	Two chairs, one as above, one 1 in. cotton over 1/2 in. jute, plastic wastebasket.

*, ** - See key on next page.

KEY FOR TABLE 2

F - Flaming Ignition.
S - Smoldering Ignition.
L - Living Room.

A&B - First Floor Bedrooms.
E&F - Second Floor Bedrooms.

X - Basement.

- * - Normally, smoldering ignition was accomplished on furniture item and flaming ignition on waste-basket contents. Experiment 50 was the exception since bedding flamed as calrod heater (used to induce smoldering) stuck to fabric and raised it during removal.
- ** - Air conditioning left on by mistake. Normal procedure for experiments with windows closed was to shut down air conditioning about 15 sec prior to start of ignition procedure. Normal windows open experiments had air conditioning off.

TABLE 3

WINDOW OPENINGS FOR TEST SERIES NO. 4
(J. R. WHITEHOUSE RESIDENCE)

Room	Window Location	H Inches	W Inches	h(sill) Inches	
Living Room	East Window/ South Wall	47-3/8	19-1/2	24-1/2	Screened
Bedroom A	East Window/ North Wall	63(61)	14-1/2	24	
A'	West Window/ North Wall	63(61)	14-1/2	24	
Bedroom B	East Wall	63(61)	15-1/4	24	
Bedroom E	East Wall	19-1/2	15-1/2	29-1/2	Screened
Bedroom F	East Wall	19-1/2	15-3/8	29-1/2	Screened

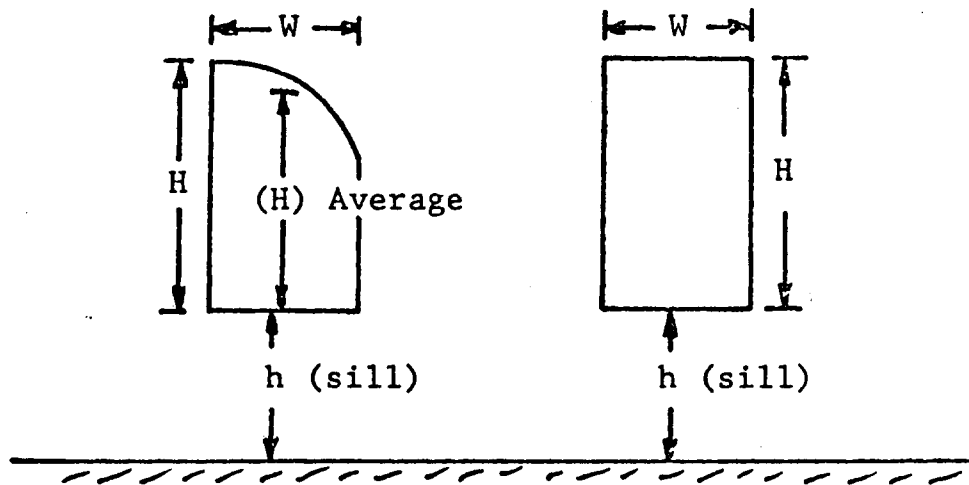


TABLE 4

SUMMARY OF EXPERIMENT CONFIGURATIONS
 TEST SERIES NO. 5: WABASH AVENUE RESIDENCE, SPRING SCHEDULE (1976)

Experiment Number	Fire Location*	Ignition Type	Detector Board Locations*					Fuel Summary
			I	II	III	IV	V	
60	L	S	J	G	L	C	J	Recliner chair, 1 in. cotton pad.
61	L	S	J	G	L	C	J	Recliner chair, 1/2 in. cotton pad, door to "D" accidentally closed.
62	L	S	J	G	L	C	J	Large rocker, 1/2 in. cotton pad.
63	L	F	J	G	L	C	J	Chair 1 in. cotton pad.
64	L	F	J	G	L	C	J	Chair, urethane foam pads, small exposed patch of foam ignited at front corner of seat.
65	L	S	J	G	L	C	G	Chair, 1 in. cotton back pad ignited, urethane foam seat pad.
66	L	F	J	G	L	C	G	Swivel rocker, urethane foam pads, small exposed patch of foam ignited on seat near back.
67	L	S	J	G	L	C	G	Sofa section, 3/4 in. cotton pad.
68	L	F	J	G	L	C	G	Bare urethane foam in chair configuration.
69	L	F	J	G	L	C	G	Bare urethane foam in bed configuration.
70	L	F	J	G	L	C	G	Cotton blanket wrapped urethane foam in bed configuration.
71	L	F	J	G	L	C	G	Bare urethane foam directly on floor, twin bed size.
72	C	S	J	G	L	F	G	Innerspring mattress, approx 5 lb bedding and clothes.
73	C	S	J	G	L	F	G	Innerspring mattress, approx 5 lb bedding and clothes.
74	C	F	J	G	L	F	G	Innerspring mattress, approx 5 lb bedding and clothes, metal wastebasket of assorted trash, newspaper.
75	Y	S	J	G	D	H	G	Innerspring mattress, approx 5 lb bedding and clothes.
76	Y	F	J	G	D	H	G	Innerspring mattress, approx 5 lb bedding and clothes, metal wastebasket of assorted trash, newspaper.

* - See key on next page.

KEY FOR TABLE 4

FIRE LOCATION:

L - Living Room.
C - First Floor Bedroom.
Y - Second Floor Bedroom.

IGNITION TYPE:

S - Smoldering.
F - Flaming.

DETECTOR BOARD LOCATIONS:

L - Living Room.
C - First Floor Bedroom.
G - Second Floor Game Room (Top Stairs).
H, J - Second Floor Halls.
F - First Floor Family Room (Bottom Stairs).
D - Second Floor Den.

DETECTOR BOARD IDENTIFICATION:

Board I - Detectors 1, 2, 3, 4, 5, 21, and 30.
Board II - Detectors 16, 17, 18, 19, 20, 24, and 29.
Board III - Detectors 6, 7, 8, 9, 10, 22, and 31.
Board IV - Detectors 11, 12, 13, 14, 15, 23, and 32.
Board V - Detectors 33, 34, 35, and 36.

TABLE 5 - SUMMARY OF DETECTOR PERFORMANCE
 TEST SERIES #4, J. R. WHITEHOUSE RESIDENCE, SUMMER/FALL 1975
 DETECTOR OPERATING TIMES FOR EACH TEST IN SECONDS

Location	Manuf. Code	Clock No.	Test No. (Ignition Room*)						
			41 (LR)	42 (LR)	43 (LR)	44 (LR)	45 (LR)	46 (LR)	
2nd Hall Ceiling	P	1	4116	3048	1882	307	491	1915	
	N	2	1223	3197	2776	217	298	2390	
	F	3	4685	3853	2780	220	313	2712	
	K	4	5555	5017	3110	217	378	3218	
	S	5	4728	3967	2794	229	303	2841	
	E	21	4442	3559	2695	253	480	2421	
1st Hall Ceiling	P	6	1837	1904	1073	192	213	935	
	N	7	1514	1021	872	141	219	877	
	F	8	2880	2332	1254	65	73	1310	
	K	9	3720	3482	1740	67	75	1799	
	S	10	3372	3322	1728	67	77	1535	
	E	22	2516	2028	1253	179	235	1161	
Top Basement Stairs	P	16	6613	4602	3549	428	1054	2940	
	N	17	6256	5385	3687	417	1057	3561	
	F	18	6843	(6388)	3802	360	996	3783	
	K	19	No	No	No	387	1051	(4893)	
	S	20	(7838)	(6388)	No	363	1018	4785	
	E	24	6656	No	4395	452	1028	4313	
Ignition Room (Living Room Wall)	P	11	2249	2008	868	140	192	808	
	N	12	1814	1691	822	96	154	928	
	F	13	2408	2523	1062	56	48	1140	
	K	14	3316	2918	1289	70	65	1494	
	S	15	2270	2140	1071	54	42	1099	
	E	23	2237	2041	997	170	226	1154	
BELL HORN		25	No	No	No	No	No	No	
		26	No	No	No	No	No	No	
			End of Test	7800	6300	4800	900	1500	4800

Key - No - No Operation.
 () - Detector Operated During Building Ventilation After End of Test.

* - LR - Living Room.
 A - Bedroom A.
 X - Basement

TABLE 5 - SUMMARY OF DETECTOR PERFORMANCE
 J. R. WHITEHOUSE RESIDENCE (Continued)
 DETECTOR OPERATING TIMES FOR EACH TEST IN SECONDS

Location	Manuf. Code	Clock No.	Test No. (Ignition Room*)					
			47 (A)	48 (A)	49 (A)	50 (A)	51 (A)	52 (A)
2nd Hall Ceiling	P	1	3421	2294	662	798	5068	3763
	N	2	3441	2700	637	731	4827	4337
	F	3	4099	3424	640	734	5554	5532
	K	4	4370	3652	641	754	5919	5752
	S	5	4106	3392	629	725	5701	4895
	E	21	3867	3149	677	949	5352	4459
1st Hall Ceiling	P	6	263	355	184	275	2028	2221
	N	7	990	330	225	386	1997	2345
	F	8	1121	1060	65	221	3931	2332
	K	9	3642	2541	72	245	4860	2387
	S	10	1222	1011	67	212	4246	2377
	E	22	1013	609	199	434	2348	2344
Top Basement Stairs	P	16	4587	3224	759	1077	7244	NO
	N	17	4815	3404	856	1205	(7519)	5235
	F	18	4493	3271	548	852	7147	NO
	K	19	4964	4017	766	1106	(7475)	NO
	S	20	4781	3867	770	926	(7468)	NO
	E	24	4705	3640	955	1576	(7543)	NO
Ignition Room (Bedroom ceiling)	P	11	943	348	214	168	1714	1117
	N	12	259	315	202	204	1320	869
	F	13	1162	771	35	152	3929	2270
	K	14	3517	2413	55	245	4418	2477
	S	15	1298	1229	26	140	3897	2263
	E	23	1478	1003	151	186	3512	2368
BELL	25	NO	NO	NO	NO	7419	NO	
HORN	26	NO	NO	NO	NO	7419	NO	
End of Test			5100	4200	1022	2100	7456	6000

Key - No - No Operation.
 () - Detector Operated During Building Ventilation After End of Test.
 [] - Detector Was Reset During Course of Test.
 * - LR - Living Room.
 A - Bedroom A.
 X - Basement

TABLE 5 - SUMMARY OF DETECTOR PERFORMANCE
J. R. WHITEHOUSE RESIDENCE (Concluded)

Location	Manuf. Code	Clock No.	Test No. (Ignition Room*)						
			53 (LR)	54 (X)	55 (X)	56 (X)	57 (X)	58 (X)	59 (X)
2nd Hall Ceiling	P	1	1456	2671	X	6914	3098	1615	585
	N	2	1496	2921	X	6906	3202	859	473
	F	3	1593	3323	X	7004	3425	1776	475
	K	4	1841	NO	X	(7237)	(3804)	2719	560
	S	5	1495	3365	X	7007	3431	873	464
	E	21	1383	3095	X	6833	3179	1774	568
1st Hall Ceiling	P	6	1472	1488	X	2693	1877	482	393
	N	7	1519	1552	X	2868	2162	600	441
	F	8	1241	1606	X	5433	2343	413	295
	K	9	1504	1970	X	5753	2967	509	353
	S	10	1434	1680	X	5638	2495	366	304
	E	22	1506	1634	X	4575	2353	611	427
Top Basement Stairs (For JR-53 Living Room Wall)	P	16	886	1130	X	3921	1255	290	306
	N	17	1056	1020	X	1845	919	261	288
	F	18	961	1266	X	4633	1421	144	116
	K	19	995	1509	X	5513	2255	168	122
	S	20	983	1392	X	5510	1870	161	128
	E	24	980	1327	X	4442	1365	384	342
Ignition Room (Basement ceiling except JR53 was LR ceiling)	P	11	963	812	X	2442	363	152	272
	N	12	865	1008	X	2574	796	150	253
	F	13	1136	966	X	2518	903	61	70
	K	14	1225	990	X	2516	1004	53	69
	S	15	1120	985	X	2504	846	58	71
	E	23	1168	1024	X	2505	815	208	281
	BELL-1	25	NO	NO	X	6844	3687	NO	433
	BELL-2	27	NO	NO	X	6844		NO	406
	HORN-1	26	NO	NO	X	6844	3668	NO	
	HORN-2	28	NO	NO	X	7100		NO	
	End of Test			2700	3840	X	7200	3800	3600

Note - Wind-Up Bell and Freon Horn #2 were mounted on the South wall of the basement.
Wind-Up Bell and Freon Horn #1 were mounted in the center of the basement.

Key - No - No Operation.
() - Detector Operated During Building Ventilation After End of Test.
[] - Detector Was Reset During Course of Test.
X - No Time Recorded Due to Premature resetting of Clock as a Result of a Power Interruption.
* - LR - Living Room, A - Bedroom A, X - Basement.

TABLE 6 - SUMMARY OF DETECTOR PERFORMANCE
 TEST SERIES NO. 5, WABASH AVENUE RESIDENCE, SPRING SCHEDULE 1976
 DETECTOR OPERATING TIMES FOR EACH TEST IN SECONDS

Location	Manuf. Code	Clock No.	Test No. (Ignition Room*)						
			60 (LR)	61 (LR)	62 (LR)	63 (LR)	64 (LR)	65 (LR)	
Hallway J Ceiling - Second Floor	P	1	3224	8138	(5257)	980	2256	2759	
	N	2	3423	8143	(5287)	1015	2258	NO	
	F	3	3423	8144	(5299)	1029	2272	(2842)	
	K	4	3423	8146	(5271)	918	2215	2748	
	S	5	3423	8137	(5299)	1016	2252	(2818)	
	E	21	3423	8203	(5316)	1152	2427	(2891)	
	G	30	NO	8145	NO	NA	2460	NO	
Living Room Ceiling - First Floor	P	6	2318	<u>2361</u>	<u>2354</u>	573	1114	1156	
	N	7	2157	2590	2381	533	1167	1007	
	F	8	2306	2347	<u>2170</u>	38	271	<u>1042</u>	
	K	9	<u>2434</u>	<u>2529</u>	<u>2212</u>	30	273	1096	
	S	10	2491	7619	3098	155	737	<u>1037</u>	
	E	22	3185	2675	2965	587	1177	1452	
	G	31	2520	8140	(5280)	183	NA	1215	
	Bedroom C Ceiling - First Floor	P	11	2746	2954	3429	551	1128	1874
		N	12	<u>2797</u>	<u>2900</u>	3002	537	1163	1776
		F	13	3048	7666	3926	201	750	2258
K		14	<u>2586</u>	2581	<u>2645</u>	64	803	2254	
S		15	3241	7676	4455	539	888	2264	
E		23	2573	7698	4257	608	1474	2299	
G		32	3225	8320	NO	519	1056	2281	
Game Room G Ceiling - Second Floor, Top of Stairs		P	16	3245	2556	4608	837	1666	2517
		N	17	3385	2734	4574	823	1685	2484
		F	18	3329	7762	5100	778	1618	2540
	K	19	3374	7762	4872	767	1630	2476	
	S	20	3394	7793	5114	783	1716	2568	
	E	24	3407	7796	5104	823	1801	2581	
	G	29	(3465)	7860	(5403)	NA	1703	2550	

TABLE 6 - SUMMARY OF DETECTOR PERFORMANCE (Cont'd)
 TEST SERIES NO. 5, WABASH AVENUE RESIDENCE, SPRING SCHEDULE 1976

Location	Manuf. Code	Clock No.	DETECTOR OPERATING TIMES FOR EACH TEST IN SECONDS					
			60(LR)	61(LR)	62(LR)	63(LR)	64(LR)	65(LR)
Living Room - First Floor	BELL	25	3440	7845	5005	775	NA	NA
	HORN	26	3440	7552	5025	784	NA	NA
Hallway J Ceiling - Second Floor (For W65 - W76 Game Room G Ceiling, Top of Stairs)	T	33	(3765)	8140	(5280)	1075	**	NO
	T	34	NO	8320	NO	1333	NO	NO
	T	35	NO	8135	(5290)	1065	2273	2540
	T	36	**	**	**	35	**	1460
End of Test			3440	8400	5210	1590	2581	2779

Key - NO - No Operation.
 () - Detector operated during building ventilation after end of test.
 [] - Detector was reset during course of test.
 ** - Detector could not be reset at start of test.
 NA - Detector not available for test.

* - LR - Living Room.
 C - Bedroom C - First Floor.
 Y - Bedroom Y - Second Floor.

TABLE 6 - SUMMARY OF DETECTOR PERFORMANCE
WABASH RESIDENCE (CONTINUED)

DETECTOR OPERATING TIMES FOR EACH TEST IN SECONDS		Test No. (Ignition Room*)						
		66 (LR)	67 (LR)	68 (LR)	69 (LR)	70 (LR)		
Location	Manuf. Code	Clock No.						
Hallway J Ceiling - Second Floor	P	1	(1219)	(5107)	NO	NO	(493)	
	N	2	NO	(5249)	NO	NO	(433)	
	F	3	(1218)	(5120)	(741)	(652)	(435)	
	K	4	(1181)	(5115)	(731)	(643)	(434)	
	S	5	(1215)	(5119)	(733)	(648)	(432)	
	E	21	(1313)	NO	NO	NO	NO	
	G	30	NO	NO	NO	NO	(450)	
Living Room Ceiling - First Floor	P	6	382	2049	88	120	122	
	N	7	345	2036	76	108	123	
	F	8	156	2315	56	53	46	
	K	9	136	2492	46	55	40	
	S	10	189	2570	63	79	69	
	E	22	472	2799	124	154	217	
	G	31	238	2700	60	60	57	
	Bedroom C Ceiling - First Floor	P	11	397	3172	104	136	122
		N	12	384	2965	92	122	137
		F	13	349	4606	105	132	104
		K	14	322	4577	91	114	99
S		15	352	4604	103	131	130	
E		23	545	4619	127	162	259	
G		32	333	4615	94	119	105	
Game Room G Ceiling - Second Floor, Top of Stairs		P	16	840	4510	220	210	277
		N	17	905	3559	171	189	239
		F	18	836	4686	176	187	232
		K	19	817	4692	172	185	220
		S	20	1075	4688	181	189	250
	E	24	1104	4687	203	205	294	
	G	29	825	4680	165	188	242	

TABLE 6 - SUMMARY OF DETECTOR PERFORMANCE
 WABASH RESIDENCE (CONTINUED)

DETECTOR OPERATING TIMES FOR EACH TEST IN SECONDS						
Location	Manuf. Code	Clock No.	Test No. (Ignition Room*)			
			66 (LR)	67 (LR)	68 (LR)	69 (LR)
Not Used	BELL	25	NA	NA	NA	NA
	HORN	26	NA	NA	NA	NA
Game Room G Ceiling -	T	33	NO	NO	NO	NO
Second Floor,	T	34	NO	NO	NO	NO
Top of Stairs	T	35	1085	4680	NO	NO
	T	36	**	**	45	90
End of Test			1140	4740	480	420

Key - NO - No operation.
 () - Detector operated during building ventilation after end of test.
 [] - Detector was reset during course of test.
 ** - Detector could not be reset at start of test.
 NA - Detector not available for test.

* - LR - Living Room.
 C - Bedroom C, First Floor.
 Y - Bedroom Y, Second Floor.

TABLE 6 - SUMMARY OF DETECTOR PERFORMANCE
WABASH RESIDENCE (CONCLUDED)

Location		DETECTOR OPERATING TIMES FOR EACH TEST IN SECONDS							
		Manuf. Code	Clock No.	71(LR)	72(C)	73(C)	74(C)	75(Y)	76(Y)
Hallway J Ceiling - Second Floor	P	1	438	4540	(6002)	1321	525	125	
	N	2	385	4440	(6008)	1337	373	64	
	F	3	387	4535	(6019)	1415	967	65	
	K	4	390	4495	5839	1375	671	21	
	S	5	387	4645	(6017)	1392	1144	65	
	E	21	NO	4771	(6097)	1460	927	150	
G	30	NA	NO	NO	1560	NA	75		
Living Room Ceiling - First Floor, (For W75 - W76 Den D Ceiling)	P	6	+137+	2832	3223	581	3795	491	
	N	7	+137+	2498	3824	340	3712	511	
	F	8	+137+	2745	3096	132	5153	483	
	K	9	+137+	2454	<u>2537</u>	89	4227	493	
	S	10	+137+	2936	3389	135	5674	493	
	E	22	154	<u>3055</u>	3744	485	5330	809	
	G	31	208	2795	3356	103	5672	480	
	Bedroom C Ceiling - First Floor, (For W72 - W74 Bottom of Stairway, For W75 - W76 Hallway H Ceiling)	P	11	+137+	2724	3126	451	4690	628
		N	12	+137+	1320	3080	509	6197	654
		F	13	+137+	2736	3303	325	(6996)	631
		K	14	+137+	3305	3688	422	(6989)	622
S		15	+137+	3155	3426	334	(7024)	692	
E		23	169	2896	3368	445	5669	894	
G		32	136	2989	3470	365	NO	690	
Game Room G Ceiling - Second Floor, Top of Stairs	P	16	197	3870	5055	1176	2666	422	
	N	17	178	3437	5349	1193	2330	204	
	F	18	173	3997	5271	1133	2736	164	
	K	19	170	3491	1323	133	2035	43	
	S	20	181	4110	5305	1161	3030	143	
	E	24	214	4108	5316	1177	2792	278	
	G	29	NA	4100	5306	1188	3562	161	

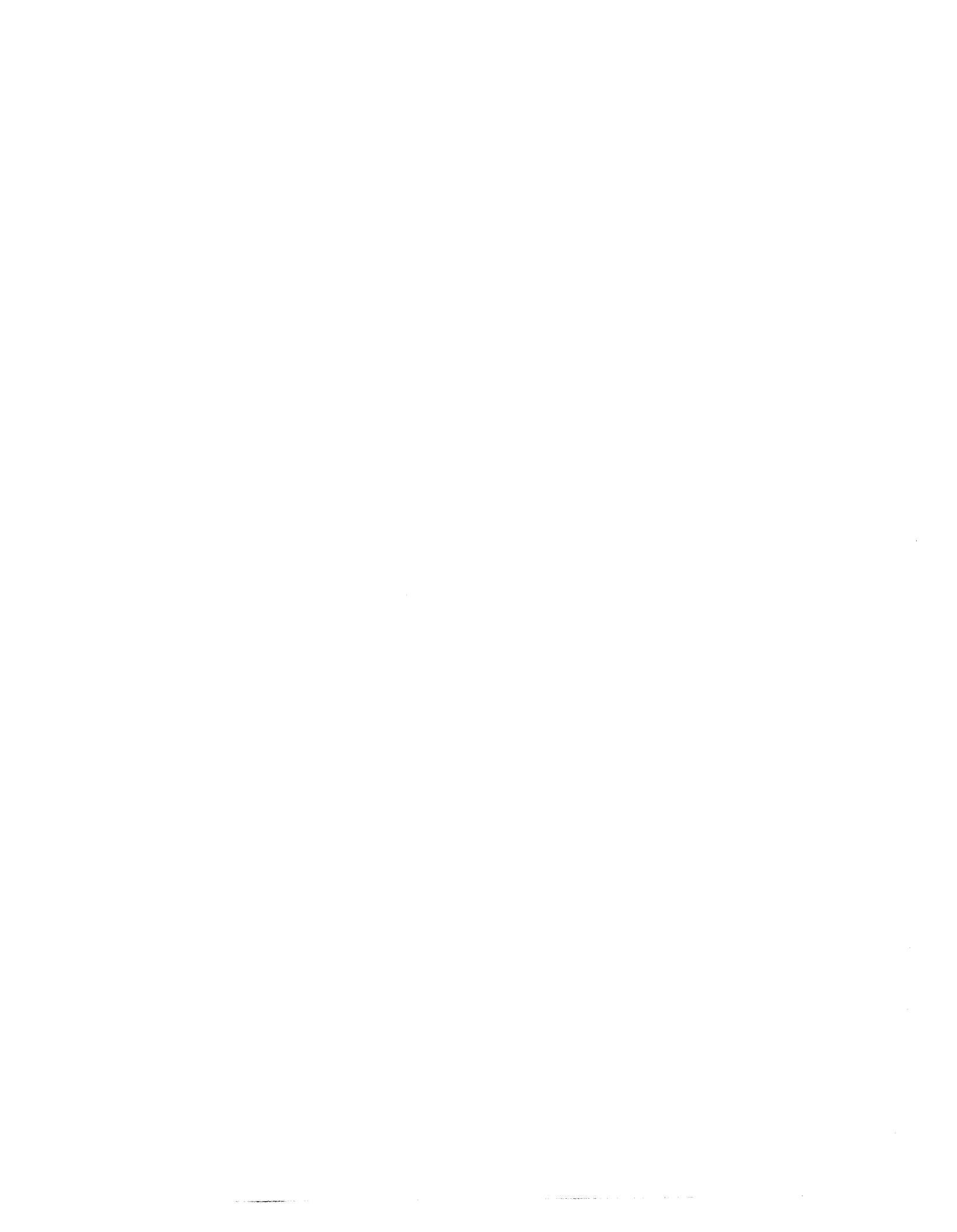
TABLE 6 - SUMMARY OF DETECTOR PERFORMANCE
WABASH RESIDENCE (CONCLUDED)

Location		DETECTOR OPERATING TIMES FOR EACH TEST IN SECONDS									
		Manuf. Clock		Test No. (Ignition Room*)							
Not Used	Code	No.	71(LR)	72(C)	73(C)	74(C)	75(Y)	76(Y)	77(Y)	78(Y)	79(Y)
	BELL	25	NA	NA	NA	NA	NA	NA	NA	NA	NA
	HORN	26	NA	NA	NA	NA	NA	NA	NA	NA	NA
Game Room G Ceiling -	T	33	**	3785	4460	1103	1430	180			
Second Floor,	T	34	NO	4150	5436	1145	3000	460			
Top of Stairs	T	35	**	3700	4530	1103	1610	236			
	T	36	**	**	3850	**	712	**			
End of Test			480	5100	5940	1589	6686	910			

Key - NO - No Operation.
 () - Detector Operated during building ventilation after end of test.
 [] - Detector was reset during course of test.
 ** - Detector could not be reset at start of test.
 NA - Detector not available for test.
 + - Identical times resulting from late energization of annunciator panel.

* - LR - Living Room.
 C - Bedroom C, First Floor.
 Y - Bedroom Y, Second Floor.

APPENDIX B
SUMMARY OF INDIVIDUAL EXPERIMENTS
DATA SUMMARY SHEETS



DATA SUMMARY

TEST NO:	Clock No.	Detector Code	Detector Type	Sensitivity (%-FT ⁻¹)	Alarm (Sec)	Escape Time (Secs)
41 -JR	2	N	Photo	1.37	1223	6097
FIRE TYPE:	1	P	Photo	1.16	4116	3204
S - Sofa Section	21	E	Photo	1.95	4442	2878
FIRE LOCATION:	3	F	Ion	1.72	4685	2635
Living Room	5	S	Ion	2.38	4728	2592
	4	K	Ion	1.23	5555	1765

First Floor Hall Ceiling Detectors

SEASON:	7	N	Photo	1.34	1514	5806
Fall	6	P	Photo	1.44	1837	5483
A/C OR HEAT:	22	E	Photo	1.87	2516	4804
A/C Shutdown Prior Ign.	8	F	Ion	1.76	2880	4440
BEDROOM DOORS CLOSED:	10	S	Ion	1.80	3372	3948
None	9	K	Ion	1.34	3720	3600

Top Basement Stairs Detectors

BASEMENT DOOR CLOSED:	17	N	Photo	1.13	6256	1064
No	16	P	Photo	1.55	6613	707
WINDOWS OPEN:	24	E	Photo	1.82	6656	664
None	18	F	Ion	1.55	6843	477
FLAMES AT:	20	S	Ion	2.01	After Test	None
None Secs	19	K	Ion	1.38	None	None

Fire Room Detectors

TENABILITY LIMIT:	12	N	Photo	1.23	1814	5506
7320 Secs	23	E	Photo	1.98	2237	5085
TEST ENDS:	11	P	Photo	1.23	2249	5071
7800 Secs	15	S	Ion	2.97	2270	5050
	13	F	Ion	1.76	2408	4912
	14	K	Ion	1.18	3316	4004
	25	BELL	Bell	-	None	None
	26	HORN	Horn	-	None	None

DATA SUMMARY

TEST NO:	Clock No.	Detector Code	Detector Type	Sensitivity (%-FT-1)	Alarm (Sec)	Escape Time (Secs)
42 -JR	1	P	Photo	1.37	3048	3252
S - Chair	2	N	Photo	1.16	3197	3103
FIRE LOCATION:	21	E	Photo	1.95	3559	2741
Living Room	3	F	Ion	1.72	3853	2447
	5	S	Ion	2.38	3967	2333
	4	K	Ion	1.23	5017	1283

First Floor Hall Ceiling Detectors

SEASON:	7	N	Photo	1.34	1021	5279
Fall	6	P	Photo	1.44	1904	4396
A/C OR HEAT:	22	E	Photo	1.87	2028	4272
A/C Shutdown Prior Ign.	8	F	Ion	1.76	2332	3968
BEDROOM DOORS CLOSED:	10	S	Ion	1.80	3322	2978
ABEF	9	K	Ion	1.34	3482	2818

Top Basement Stairs Detectors

BASEMENT DOOR CLOSED:	16	P	Photo	1.55	4602	1698
No	17	N	Photo	1.13	5385	915
WINDOWS OPEN:	18	F	Ion	1.55	After Test	-
None	20	S	Ion	2.01	After Test	-
FLAMES AT:	24	E	Photo	1.82	None	-
None Secs	19	K	Ion	1.38	None	-

Fire Room Detectors

TENABILITY LIMIT:	12	N	Photo	1.23	1691	4609
6300 Secs	11	P	Photo	1.23	2008	4292
(Estimated 8000 sec)	23	E	Photo	1.98	2041	4259
TEST ENDS:	15	S	Ion	2.97	2140	4160
6300 Secs	13	F	Ion	1.76	2523	3777
	14	K	Ion	1.18	2918	3382
	25	BELL	BELL	-	None	-
	26	HORN	HORN	-	None	-

DATA SUMMARY

Clock No.	Detector Code	Detector Type	Sensitivity (%-FT ⁻¹)	Alarm (Sec)	Escape Time (Secs)
<u>Second Floor Hall Ceiling Detectors</u>					
1	P	Photo	1.37	1882	2498
21	E	Photo	1.95	2695	1685
2	N	Photo	1.16	2776	1604
3	F	Ion	1.72	2780	1600
5	S	Ion	2.38	2794	1586
4	K	Ion	1.23	3110	1270

TEST NO:

43 -JR

FIRE TYPE:

S - Sofa Section

FIRE LOCATION:

Living Room

First Floor Hall Ceiling Detectors

7	N	Photo	1.34	872	3508
6	P	Photo	1.44	1073	3307
22	E	Photo	1.87	1253	3127
8	F	Ion	1.76	1254	3126
10	S	Ion	1.80	1728	2652
9	K	Ion	1.34	1740	2640

SEASON:

Fall

A/C OR HEAT:

None

BEDROOM DOORS CLOSED:

None

Top Basement Stairs Detectors

16	P	Photo	1.55	3549	831
17	N	Photo	1.13	3687	693
18	F	Ion	1.55	3802	578
24	E	Photo	1.82	4395	-15
19	K	Ion	1.28	None	None
20	S	Ion	2.01	None	None

BASEMENT DOOR CLOSED:

No

WINDOWS OPEN:

LABEL

FLAMES AT:

None Secs

Fire Room Detectors

12	N	Photo	1.23	822	3558
11	P	Photo	1.23	868	3512
23	E	Photo	1.98	997	3383
13	F	Ion	1.76	1062	3318
15	S	Ion	2.97	1071	3309
14	K	Ion	1.18	1289	3091
25	BELL	BELL	-	None	None
26	HORN	HORN	-	None	None

TENABILITY LIMIT:

4380 Secs

TEST ENDS:

4800 Secs

DATA SUMMARY

TEST NO:	Clock No.	Detector Code	Detector Type	Sensitivity (%-FT-1)	Alarm (Sec)	Escape Time (Secs)
44 -JR	2	N	Photo	1.16	217	253
FIRE TYPE:	4	K	Ion	1.23	217	253
F - Chair	3	F	Ion	1.72	220	250
FIRE LOCATION:	5	S	Ion	2.38	229	241
Living Room	21	E	Photo	1.95	253	217
	1	P	Photo	1.37	307	163

First Floor Hall Ceiling Detectors

SEASON:	8	F	Ion	1.76	65	405
Fall	9	K	Ion	1.34	67	403
A/C OR HEAT:	10	S	Ion	1.80	67	403
A/C on	7	N	Photo	1.34	141	329
BEDROOM DOORS CLOSED:	22	E	Photo	1.87	179	291
None	6	P	Photo	1.44	192	278

Top Basement Stairs Detectors

BASEMENT DOOR CLOSED:	18	F	Ion	1.55	360	110
No	20	S	Ion	2.01	363	107
WINDOWS OPEN:	19	K	Ion	1.38	387	83
LABEL	17	N	Photo	1.13	417	53
FLAMES AT:	16	P	Photo	1.55	428	42
0 Secs	24	E	Photo	1.82	452	18

Fire Room Detectors

TENABILITY LIMIT:	15	S	Ion	2.97	54	416
470 Secs	13	F	Ion	1.76	56	414
TEST ENDS:	14	K	Ion	1.18	70	400
900 Secs	12	N	Photo	1.23	96	374
	11	P	Photo	1.23	140	330
	23	E	Photo	1.98	170	300
	25	BELL	BELL	-	None	None
	26	HORN	HORN	-	None	None

DATA SUMMARY

Clock No.	Detector Code	Detector Type	Sensitivity (%-FT-1)	Alarm (Sec)	Escape Time (Secs)
<u>Second Floor Hall Ceiling Detectors</u>					
2	N	Photo	1.16	298	795
5	S	Ion	2.38	303	790
3	F	Ion	1.72	313	780
4	K	Ion	1.23	378	715
21	E	Photo	1.95	480	613
1	P	Photo	1.37	491	602

TEST NO:

45 -JR

FIRE TYPE:

F - Sofa Section

FIRE LOCATION:

Living Room

First Floor Hall Ceiling Detectors

8	F	Ion	1.76	73	1020
9	K	Ion	1.34	75	1018
10	S	Ion	1.80	77	1016
6	P	Photo	1.44	213	880
7	N	Photo	1.34	219	874
22	E	Photo	1.87	235	858

SEASON:

Fall

A/C OR HEAT:

None

BEDROOM DCORS CLOSED:

None

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Top Basement Stairs Detectors

18	F	Ion	1.55	996	97
20	S	Ion	2.01	1018	75
24	E	Photo	1.82	1028	65
19	K	Ion	1.38	1051	42
16	P	Photo	1.55	1054	39
17	N	Photo	1.13	1057	36

BASEMENT DOOR CLOSED:

No

WINDOWS OPEN:

LABEL

FLAMES AT:

0 Secs

Fire Room Detectors

15	S	Ion	2.97	42	1051
13	F	Ion	1.76	48	1045
14	K	Ion	1.18	65	1028
12	N	Photo	1.23	154	939
11	P	Photo	1.23	192	901
23	E	Photo	1.98	226	867
25	BELL	BELL	-	None	None
26	HORN	HORN	-	None	None

TENABILITY LIMIT:

1093 Secs

TEST ENDS:

1500 Secs

DATA SUMMARY

TEST NO:	Clock No.	Detector Code	Detector Type	Sensitivity (%-FT-1)	Alarm (Sec)	Escape Time (Secs)
46 -JR	1	P	Photo	1.37	1915	2335
	2	N	Photo	1.16	2390	1860
S - Sofa	21	E	Photo	1.95	2421	1829
	3	F	Ion	1.72	2712	1538
FIRE LOCATION:	5	S	Ion	2.38	2841	1409
Living Room	4	K	Ion	1.23	3218	1032

First Floor Hall Ceiling Detectors

SEASON:	7	N	Photo	1.34	877	3373
Fall	6	P	Photo	1.44	935	3315
A/C OR HEAT:	22	E	Photo	1.87	1161	3089
A/C Shutdown Prior Ign.	8	F	Ion	1.76	1310	2940
BEDROOM DOORS CLOSED:	10	S	Ion	1.80	1535	2715
None	9	K	Ion	1.34	1799	2451

Top Basement Stairs Detectors

BASEMENT DOOR CD SED:	16	P	Photo	1.55	2940	1310
No	17	N	Photo	1.13	3561	689
WINDOWS OPEN:	18	F	Ion	1.55	3783	467
None	24	E	Photo	1.82	4313	-63
FLAMES AT:	20	S	Ion	2.01	4785	-535
None Secs	19	K	Ion	1.38	After Test	None

Fire Room Detectors

TENABILITY LIMIT:	11	P	Photo	1.23	808	3442
4250 Secs	12	N	Photo	1.23	928	3322
TEST ENDS:	15	S	Ion	2.97	1099	3151
4800 Secs	13	F	Ion	1.76	1140	3110
	23	E	Photo	1.98	1154	3096
	14	K	Ion	1.18	1494	2756
	25	BELL	BELL	-	None	None
	26	HORN	HORN	-	None	None

DATA SUMMARY

TEST NO:	Clock No.	Detector Code	Detector Type	Sensitivity (%-FT-1)	Alarm (Sec)	Escape Time (Secs)
47 -JR	1	P	Photo	1.37	3421	839
	2	N	Photo	1.16	3441	819
FIRE TYPE:	21	E	Photo	1.95	3867	393
S - Mattress/Box Spring	3	F	Ion	1.72	4099	161
FIRE LOCATION:	5	S	Ion	2.38	4106	154
First Floor Bedroom (A)	4	K	Ion	1.23	4370	-110

First Floor Hall Ceiling Detectors

SEASON:	6	P	Photo	1.44	263	3997
Fall	7	N	Photo	1.34	990	3270
A/C OR HEAT:	22	E	Photo	1.87	1013	3247
A/C Shutdown Prior Ign.	8	F	Ion	1.76	1121	3139
BEDROOM DOORS CLOSED:	10	S	Ion	1.80	1222	3038
None	9	K	Ion	1.34	3642	618

-B7-

Top Basement Stairs Detectors

BASEMENT DOOR CLOSED:	18	F	Ion	1.55	4493	-233
No	16	P	Photo	1.55	4587	-327
WINDOWS OPEN:	24	E	Photo	1.82	4705	-445
None	20	S	Ion	2.01	4781	-521
FLAMES AT:	17	N	Photo	1.13	4815	-555
None Secs	19	K	Ion	1.38	4964	-704

Fire Room Detectors

TENABILITY LIMIT:	12	N	Photo	1.23	259	4001
4260 Secs	11	P	Photo	1.23	943	3317
TEST ENDS:	13	F	Ion	1.76	1162	3098
5100 Secs	15	S	Ion	2.97	1298	2962
	23	E	Photo	1.98	1478	2782
	14	K	Ion	1.18	3517	743
	25	BELL	BELL	-	None	None
	26	HORN	HORN	-	None	None

DATA SUMMARY

TEST NO:	Detector Code	Detector Type	Sensitivity (%-FT-1)	Alarm (Sec)	Escape Time (Secs)
48 -JR	P	Photo	1.37	2294	1101
	N	Photo	1.16	2700	695
FIRE TYPE:	E	Photo	1.95	3149	246
S - Mattress/Box Spring	S	Ion	2.38	3392	3
FIRE LOCATION:	F	Ion	1.72	3424	-29
First Floor Bedroom (A)	K	Ion	1.23	3652	-257

Second Floor Hall Ceiling Detectors

SEASON:	Detector Code	Detector Type	Sensitivity (%-FT-1)	Alarm (Sec)	Escape Time (Secs)
Fall	N	Photo	1.34	330	3065
A/C OR HEAT:	P	Photo	1.44	355	3040
A/C Shutdown Prior Ign.	E	Photo	1.87	609	2786
BEDROOM DOORS CLOSED:	S	Ion	1.80	1011	2384
BEF	F	Ion	1.76	1060	2335
	K	Ion	1.34	2541	854

Top Basement Stairs Detectors

BASEMENT DOOR CLOSED:	P	Photo	1.55	3224	171
No	F	Ion	1.55	3271	124
WINDOWS OPEN:	N	Photo	1.13	3404	-9
None	E	Photo	1.82	3640	-245
FLAMES AT:	S	Ion	2.01	3867	-472
None Secs	K	Ion	1.38	4017	-622

Fire Room Detectors

TENABILITY LIMIT:	N	Photo	1.23	315	3080
3395 Secs	P	Photo	1.23	348	3047
TEST ENDS:	F	Ion	1.76	771	2624
4200 Secs	E	Photo	1.98	1003	2392
	S	Ion	2.97	1229	2166
	K	Ion	1.18	2413	982
	BELL	BELL	-	None	None
	HORN	HORN	-	None	None

DATA SUMMARY

Clock No.	Detector Code	Detector Type	Sensitivity (%-FT-1)	Alarm (Sec)	Escape Time (Secs)
<u>Second Floor Hall Ceiling Detectors</u>					
5	S	Ion	2.38	629	181
2	N	Photo	1.16	637	173
3	F	Ion	1.72	640	170
4	K	Ion	1.23	641	169
1	P	Photo	1.37	662	148
21	E	Photo	1.95	677	133

TEST NO: 49 -JR
 FIRE TYPE: F - Box Spring
 FIRE LOCATION: First Floor Bedroom (A)

First Floor Hall Ceiling Detectors

8	F	Ion	1.76	65	745
10	S	Ion	1.80	67	743
9	K	Ion	1.34	72	738
6	P	Photo	1.44	184	626
22	E	Photo	1.87	199	611
7	N	Photo	1.34	225	585

SEASON: Fall
 A/C OR HEAT: A/C Shurdwn Prior Ign.
 BEDROOM DOORS CLOSED: None

Top Basement Stairs Detectors

18	F	Ion	1.55	548	262
16	P	Photo	1.55	759	51
19	K	Ion	1.38	766	44
20	S	Ion	2.01	770	40
17	N	Photo	1.13	856	-46
24	E	Photo	1.82	955	-145

BASEMENT DOOR CLOSED: No
 WINDOWS OPEN: None
 FLAMES AT: 0 Secs

Fire Room Detectors

15	S	Ion	2.97	26	784
13	F	Ion	1.76	35	775
14	K	Ion	1.18	55	755
23	E	Photo	1.98	151	659
12	N	Photo	1.23	202	608
11	P	Photo	1.23	214	596
25	BELL	BELL	-	None	None
26	HORN	HORN	-	None	None

TENABILITY LIMIT: 810 Secs
 TEST ENDS: 1022 Secs

DATA SUMMARY

TEST NO:	Detector Code	Detector Type	Sensitivity (%-FT-1)	Alarm (Sec)	Escape Time (Secs)
<u>Second Floor Hall Ceiling Detectors</u>					
5	S	Ion	2.38	725	770
2	N	Photo	1.16	731	764
3	F	Ion	1.72	734	761
4	K	Ion	1.23	754	741
1	P	Photo	1.37	798	697
21	E	Photo	1.95	949	546

First Floor Bedroom (A)

First Floor Hall Ceiling Detectors

10	S	Ion	1.80	212	1283
8	F	Ion	1.76	221	1274
9	K	Ion	1.34	245	1250
6	P	Photo	1.44	275	1220
7	N	Photo	1.34	386	1109
22	E	Photo	1.87	434	1061

SEASON:

Fall

A/C OR HEAT:

None

BEDROOM DOORS CLOSED:

None

Top Basement Stairs Detectors

18	F	Ion	1.55	852	643
20	S	Ion	2.01	926	569
16	P	Photo	1.55	1077	418
19	K	Ion	1.38	1106	389
17	N	Photo	1.13	1205	290
24	E	Photo	1.82	1576	-81

BASEMENT DOOR CLOSED:

No

WINDOWS OPEN:

LABEL

FLAMES AT:

120 Secs

Fire Room Detectors

15	S	Ion	2.97	140	1355
13	F	Ion	1.76	152	1343
11	P	Photo	1.23	168	1327
23	E	Photo	1.98	186	1309
12	N	Photo	1.23	204	1291
14	K	Ion	1.18	245	1250
25	BELL	BELL	-	None	None
26	HORN	HORN	-	None	None

TENABILITY LIMIT:

1495 Secs

TEST ENDS:

2100 Secs

DATA SUMMARY

Clock No.	Detector Code	Detector Type	Sensitivity (%-FT-1)	Alarm (Sec)	Escape Time (Secs)
<u>Second Floor Hall Ceiling Detectors</u>					
2	N	Photo	1.16	4827	2003
1	P	Photo	1.37	5068	1762
21	E	Photo	1.95	5352	1478
3	F	Ion	1.72	5554	1276
5	S	Ion	2.38	5701	1129
4	K	Ion	1.23	5919	911

TEST NO:
51-JR

FIRE TYPE:
S - Mattress

FIRE LOCATION:
First Floor Bedroom (A)

First Floor Hall Ceiling Detectors

7	N	Photo	1.34	1997	4833
6	P	Photo	1.44	2028	4802
22	E	Photo	1.87	2348	4482
8	F	Ion	1.76	3931	2899
10	S	Ion	1.80	4246	2584
9	K	Ion	1.34	4860	1970

SEASON:
Fall

A/C OR HEAT:
None

BEDROOM DOORS CLOSED:
None

Top Basement Stairs Detectors

18	F	Ion	1.55	7147	-317
16	P	Photo	1.55	7244	-414
20	S	Ion	2.01	After Test	None
19	K	Ion	1.38	After Test	None
17	N	Photo	1.13	After Test	None
24	E	Photo	1.82	After Test	None

BASEMENT DOOR CLOSED:
No

WINDOWS OPEN:
LABEL

FLAMES AT:
7380 Secs

Fire Room Detectors

12	N	Photo	1.23	1320	5510
11	P	Photo	1.23	1714	5116
23	E	Photo	1.98	3512	3318
15	S	Ion	2.97	3897	2933
13	F	Ion	1.76	3929	2901
14	K	Ion	1.18	4418	2412
25	BELL	BELL	-	7419	-589
26	HORN	HORN	-	7419	-589

TENABILITY LIMIT:
6830 Secs

TEST ENDS:
7456 Secs

DATA SUMMARY

Clock No.	Detector Code	Detector Type	Sensitivity (%-FT-1)	Alarm (Sec)	Escape Time (Secs)
<u>Second Floor Hall Ceiling Detectors</u>					
1	P	Photo	1.37	3763	>2237
2	N	Photo	1.16	4337	>1663
21	E	Photo	1.95	4459	>1541
5	S	Ion	2.38	4895	>1105
3	F	Ion	1.72	5532	>468
4	K	Ion	1.23	5752	>248

TEST NO: 52 -JR
 FIRE TYPE: S - Mattress
 FIRE LOCATION: First Floor Bedroom (A)

First Floor Hall Ceiling Detectors

6	P	Photo	1.44	2221	>3779
8	F	Ion	1.76	2332	>3668
22	E	Photo	1.87	2344	>3656
7	N	Photo	1.34	2345	>3655
10	S	Ion	1.80	2377	>3623
9	K	Ion	1.34	2387	>3613

SEASON: Fall
 A/C OR HEAT: None
 BEDROOM DOORS CLOSED: None

Top Basement Stairs Detectors

17	N	Photo	1.13	5235	>765
16	P	Photo	1.55	None	None
18	F	Ion	1.55	None	None
19	K	Ion	1.38	None	None
20	S	Ion	2.01	None	None
24	E	Photo	1.82	None	None

BASEMENT DOOR CLOSED: No
 WINDOWS OPEN: LA'BEF
 FLAMES AT: 5880 Secs

Fire Room Detectors

12	N	Photo	1.23	869	>5131
11	P	Photo	1.23	1117	>4883
15	S	Ion	2.97	2263	>3737
13	F	Ion	1.76	2270	>3730
23	E	Photo	1.98	2368	>3632
14	K	Ion	1.18	2477	>3523
25	BELL	BELL	-	None	None
26	HORN	HORN	-	None	None

TENABILITY LIMIT: >6000 Secs
 (Estimated 6500 sec)
 TEST ENDS: 6000 Secs

DATA SUMMARY

Clock No.	Detector Code	Detector Type	Sensitivity (%-FT-1)	Alarm (Sec)	Escape Time (Secs)
<u>Second Floor Hall Ceiling Detectors</u>					
21	E	Photo	1.95	1383	1277
1	P	Photo	1.37	1456	1204
5	S	Ion	2.38	1495	1165
2	N	Photo	1.16	1496	1164
3	F	Ion	1.72	1593	1067
4	K	Ion	1.23	1841	819

TEST NO:

53 -JR

FIRE TYPE:

S - Sofa Section

FIRE LOCATION:

Living Room

First Floor Hall Ceiling Detectors

8	F	Ion	1.76	1241	1419
10	S	Ion	1.80	1434	1226
6	P	Photo	1.44	1472	1188
9	K	Ion	1.34	1504	1156
22	E	Photo	1.87	1506	1154
7	N	Photo	1.34	1519	1141

SEASON:

Fall

A/C OR HEAT:

None

BEDROOM DOORS CLOSED:

None

Fire Room Wall Detectors

16	P	Photo	1.55	886	1774
18	F	Ion	1.55	961	1699
24	E	Photo	1.82	980	1680
20	S	Ion	2.01	983	1677
19	K	Ion	1.38	995	1665
17	N	Photo	1.13	1056	1604

BASEMENT DOOR CLOSED:

NO

WINDOWS OPEN:

ABEF

FLAMES AT:

2605 Secs

Fire Room Ceiling Detectors

12	N	Photo	1.23	865	1795
11	P	Photo	1.23	963	1697
15	S	Ion	2.97	1120	1540
13	F	Ion	1.76	1136	1524
23	E	Photo	1.98	1168	1492
14	K	Ion	1.18	1225	1435
25	BELL	BELL	-	None	None
26	HORN	HORN	-	None	None

TENABILITY LIMIT:

2660 Secs

TEST ENDS:

2700 Secs

DATA SUMMARY

TEST NO:	SEASON:	A/C OR HEAT:	BEDROOM DOORS CLOSED:	BASEMENT DOOR CLOSED:	WINDOWS OPEN:	FLAMES AT:	TENABILITY LIMIT:	TEST ENDS:
54 -JR	Fall	None	None	No	ABEF	None Secs	3145 Secs	3840 Secs
FIRE TYPE: S - Sofa Section								
FIRE LOCATION: Basement (X)								

Clock No.	Detector Code	Detector Type	Sensitivity (%-FT-1)	Alarm (Sec)	Escape Time (Secs)
<u>Second Floor Hall Ceiling Detectors</u>					
1	P	Photo	1.37	2671	474
2	N	Photo	1.16	2921	224
21	E	Photo	1.95	3095	50
3	F	Ion	1.72	3323	-178
5	S	Ion	2.38	3365	-220
4	K	Ion	1.23	None	None

First Floor Hall Ceiling Detectors

6	P	Photo	1.44	1488	1657
7	N	Photo	1.34	1552	1593
8	F	Ion	1.76	1606	1539
22	E	Photo	1.87	1634	1511
10	S	Ion	1.80	1680	1465
9	K	Ion	1.34	1970	1175

Top Basement Stairs Detectors

17	N	Photo	1.13	1020	2125
16	P	Photo	1.55	1130	2015
18	F	Ion	1.55	1266	1879
24	E	Photo	1.82	1327	1818
20	S	Ion	2.01	1392	1753
19	K	Ion	1.38	1509	1636

Fire Room Detectors

11	P	Photo	1.23	812	2333
13	F	Ion	1.76	966	2179
15	S	Ion	2.97	985	2160
14	K	Ion	1.18	990	2155
12	N	Photo	1.23	1008	2137
23	E	Photo	1.98	1024	2121
25/27	BELL	BELL	-	None	None
26/28	HORN	HORN	-	None	None

DATA SUMMARY

Clock No.	Detector Code	Detector Type	Sensitivity (%-FT-1)	Alarm (Sec)	Escape Time (Secs)
<u>Second Floor Hall Ceiling Detectors</u>					
21	E	Photo	1.95	6833	167
2	N	Photo	1.16	6906	94
1	P	Photo	1.37	6914	86
3	F	Ion	1.72	7004	-4
5	S	Ion	2.38	7007	-7
4	K	Ion	1.23	After Test	None

TEST NO:

56 -JR

FIRE TYPE:

S - Chair

FIRE LOCATION:

Basement (X)

First Floor Hall Ceiling Detectors

6	P	Photo	1.44	2693	4307
7	N	Photo	1.34	2868	4132
22	E	Photo	1.87	4575	2425
8	F	Ion	1.76	5433	1567
10	S	Ion	1.80	5638	1362
9	K	Ion	1.34	5753	1247

SEASON:

Fall

A/C OR HEAT:

A/C Shutdown Prior Ign.

BEDROOM DOORS CLOSED:

None

Top Basement Stairs Detectors

17	N	Photo	1.13	1845	5155
16	P	Photo	1.55	3921	3079
24	E	Photo	1.82	4442	2558
18	F	Ion	1.55	4633	2367
20	S	Ion	2.01	5510	1490
19	K	Ion	1.38	5513	1487

BASEMENT DOOR CLOSED:

NO

WINDOWS OPEN:

None

FLAMES AT:

5400 Secs

Fire Room Detectors

11	P	Photo	1.23	2442	4558
15	S	Ion	2.97	2504	4496
23	E	Photo	1.98	2505	4495
14	K	Ion	1.18	2516	4484
13	F	Ion	1.76	2518	4482
12	N	Photo	1.23	2574	4426
25/27	BELL	BELL	-	6844/6844	156/156
26/28	HORN	HORN	-	6844/7100	156/-100

TENABILITY LIMIT:

7000 Secs

TEST ENDS:

7200 Secs

DATA SUMMARY

Clock No.	Detector Code	Detector Type	Sensitivity (%-FT-1)	Alarm (Sec)	Escape Time (Secs)
<u>Second Floor Hall Ceiling Detectors</u>					
1	P	Photo	1.37	3098	557
21	E	Photo	1.95	3179	476
2	N	Photo	1.16	3202	453
3	F	Ion	1.72	3425	230
5	S	Ion	2.38	3431	224
4	K	Ion	1.23	After Test	None

TEST NO:

57 -JR

FIRE TYPE:

S - Sofa Section

FIRE LOCATION:

Basement (X)

First Floor Hall Ceiling Detectors

6	P	Photo	1.44	1877	1778
7	N	Photo	1.34	2162	1493
8	F	Ion	1.76	2343	1312
22	E	Photo	1.87	2353	1302
10	S	Ion	1.80	2495	1160
9	K	Ion	1.34	2967	688

SEASON:

Fall

A/C OR HEAT:

None

BEDROOM DOORS CLOSED:

None

-B16-

Top Basement Stairs Detectors

17	N	Photo	1.13	919	2736
16	P	Photo	1.55	1255	2400
24	E	Photo	1.82	1365	2290
18	F	Ion	1.55	1421	2234
20	S	Ion	2.01	1870	1785
19	K	Ion	1.38	2255	1400

BASEMENT DOOR CLOSED:

NO

WINDOWS OPEN:

EF

FLAMES AT:

3290 Secs

Fire Room Detectors

11	P	Photo	1.23	363	3292
12	N	Photo	1.25	796	2859
23	E	Photo	1.98	815	2840
15	S	Ion	2.97	846	2809
13	F	Ion	1.76	903	2752
14	K	Ion	1.18	1004	2651
25	BELL	BELL	-	3687	-32
26	HORN	HORN	-	3668	-13

TENABILITY LIMIT:

3655 Secs

TEST ENDS:

3800 Secs

DATA SUMMARY

TEST NO:	Detector Code	Detector Type	Sensitivity (%-FT-1)	Alarm (Sec)	Escape Time (Secs)
58 -JR	N	Photo	1.16	859	2151
FIRE TYPE:	S	Ion	2.38	873	2137
F - 2 Chairs (1 Burns)	P	Photo	1.37	1615	1395
FIRE LOCATION:	E	Photo	1.95	1774	1236
Basement (X)	F	Ion	1.72	1776	1234
	K	Ion	1.23	2719	291

Second Floor Hall Ceiling Detectors

SEASON:	Detector Code	Detector Type	Sensitivity (%-FT-1)	Alarm (Sec)	Escape Time (Secs)
Fall	S	Ion	1.80	366	2644
A/C OR HEAT:	F	Ion	1.76	413	2597
None	P	Photo	1.44	482	2528
BEDROOM DOORS CLOSED:	K	Ion	1.34	509	2501
None	N	Photo	1.34	600	2410
	E	Photo	1.87	611	2399

Basement Stairs Detectors

18	F	Ion	1.55	144	2866
20	S	Ion	2.01	161	2849
19	K	Ion	1.38	168	2842
17	N	Photo	1.13	261	2749
16	P	Photo	1.55	290	2720
24	E	Photo	1.82	384	2626

Fire Room Detectors

14	K	Ion	1.18	53	2957
15	S	Ion	2.97	58	2952
13	F	Ion	1.76	61	2949
12	N	Photo	1.23	150	2860
11	P	Photo	1.23	152	2858
23	E	Photo	1.98	208	2802
25	BELL	BELL	-	None	None
26	HORN	HORN	-	None	None

TENABILITY LIMIT:
3010 Secs
TEST ENDS:
3600 Secs

DATA SUMMARY

TEST NO:	Clock No.	Detector Code	Detector Type	Sensitivity (%-FT ⁻¹)	Alarm (Sec)	Escape Time (Secs)
59 -JR	5	S	Ion	2.38	464	148
FIRE TYPE:	2	N	Photo	1.16	473	139
F - 2 Chairs	3	F	Ion	1.72	475	137
FIRE LOCATION:	4	K	Ion	1.23	560	152
Basement (X)	21	E	Photo	1.95	568	44
	1	P	Photo	1.37	585	27

First Floor Hall Ceiling Detectors

SEASON:	8	F	Ion	1.76	295	317
Fall	10	S	Ion	1.80	304	308
A/C OR HEAT:	9	K	Ion	1.34	353	259
None	6	P	Photo	1.44	393	219
BEDROOM DOORS CLOSED:	22	E	Photo	1.87	427	185
None	7	N	Photo	1.34	441	171

Top Basement Stairs Detectors

BASEMENT DOOR CLOSED:	18	F	Ion	1.55	116	496
No	19	K	Ion	1.38	122	490
WINDOWS OPEN:	20	S	Ion	2.01	128	484
ABEF	17	N	Photo	1.13	288	324
FLAMES AT:	16	P	Photo	1.55	306	306
0 Secs	24	E	Photo	1.82	342	270

Fire Room Detectors

TENABILITY LIMIT:	14	K	Ion	1.18	69	543
612 Sec	13	F	Ion	1.76	70	542
TEST ENDS:	15	S	Ion	2.97	71	541
838 Secs	12	N	Photo	1.23	253	359
	11	P	Photo	1.23	272	340
	23	E	Photo	1.98	281	331
	25	BELL	BELL	-	433	179
	26	HORN	HORN	-	406	206

DATA SUMMARY

TEST NO.	Clock No.	Detector Code	Detector Type	Sensitivity (%-Ft-l)	Alarm (Secs)	First Floor		Second Floor	
						Escape Time (Secs)	Ignition Room)	Escape Time (Secs)	Escape Time (Secs)
60 - W	7	N	Photo	2.64	2157	748	748	Est.	1433
FIRE TYPE	8	F	Ion	0.65	2306	599	599	Est.	1294
S - Chair	6	P	Photo	1.80	2318	587	587	Est.	1282
FIRE LOCATION	9	K	Ion	0.61	2434	471	471	Est.	1166
Living Room	10	S	Ion	1.18	2491	414	414	Est.	1109
	31	G	Ion	1.23	2520	385	385	Est.	1080
	22	E	Photo	1.55	3185	-280	-280	Est.	415
	25	BELL	BELL	-	3440	-535	-535	Est.	160
	26	HORN	HORN	-	3440	-535	-535	Est.	160

First Floor Bedroom C Detectors

SEASON	23	E	Photo	3.43	2573	332	332	Est.	1027
Spring	14	K	Ion	0.63	2586	319	319	Est.	1014
BASEBOARD HOT WATER	11	P	Photo	2.79	2746	159	159	Est.	854
Heat On	12	N	Photo	1.80	2797	108	108	Est.	803
	13	F	Ion	0.88	3048	-143	-143	Est.	552
	32	G	Ion	1.36	3225	-320	-320	Est.	375
	15	S	Ion	1.34	3241	-336	-336	Est.	359

Second Floor Game Room Detectors

INTERIOR DOORS	16	P	Photo	3.08	3245	-	-	Est.	355
Open	18	F	Ion	0.90	3329	-	-	Est.	271
WINDOWS AND EXTERIOR DOORS	19	K	Ion	1.02	3374	-	-	Est.	226
Closed	17	N	Photo	1.80	3385	-	-	Est.	215
	20	S	Ion	1.55	3394	-	-	Est.	206
	24	E	Photo	1.74	3407	-	-	Est.	193
	29	G	Ion	1.55	After Test	-	-	No Estimate	

Second Floor Hall J Detectors

FLAMES AT	1	P	Photo	1.80	3224	-	-	Est.	376
3180 Secs	2	N	Photo	1.38	3423	-	-	Est.	177
1st FLOOR TENABILITY LIMIT	3	F	Ion	1.46	3423	-	-	Est.	177
2905 Secs	4	K	Ion	1.10	3423	-	-	Est.	177
2nd FLOOR TENABILITY LIMIT	5	S	Ion	1.00	3423	-	-	Est.	177
>3423 Secs (Estimated 3600)	21	E	Photo	1.31	3423	-	-	Est.	177
(Includes exit path)	30	G	Ion	1.53	None	-	-	No Estimate	
TEST ENDS	33	T	TGS	10.38	After Test	-	-	No Estimate	
3440 Secs	34	T	TGS	6.05	None	-	-	No Estimate	
	35	T	TGS	2.30	None	-	-	No Estimate	
	36	T	TGS	0.92	Not Resettable	-	-	No Data	

DATA SUMMARY

Clock No.	Detector Code	Detector Type	Sensitivity (%-Ft-l)	Alarm (Secs)	First Floor		Second Floor
					Living Room Detectors (Ignition Room)	Escape Time (Secs)	
8	F	Ion	0.65	2347	5453		5453
6	P	Photo	1.80	2361	5439		5439
9	K	Ion	0.61	2529	5271		5271
7	N	Photo	2.64	2590	5210		5210
22	E	Photo	1.55	2675	5125		5125
26	HORN	HORN	-	7552	248		248
10	S	Ion	1.18	7619	181		181
25	BELL	BELL	-	7845	-45		-45
31	G	Ion	1.23	8140	-340		-340

TEST NO
61 - W

FIRE TYPE

S - Chair

FIRE LOCATION

Living Room

SEASON

Spring

BASEBOARD HOT WATER

Heat On

First Floor Bedroom C Detectors

14	K	Ion	0.63	2581	5219		5219
12	N	Photo	1.80	2900	4900		4900
11	P	Photo	2.79	2954	4846		4846
13	F	Ion	0.88	7666	134		134
15	S	Ion	1.34	7676	124		124
23	E	Photo	3.43	7698	102		102
32	G	Ion	1.36	8320	-520		-520

-B20-

INTERIOR DOORS

Open

WINDOWS AND EXTERIOR DOORS

Closed

Second Floor Game Room Detectors

16	P	Photo	3.08	2556	-		5244
17	N	Photo	1.80	2734	-		5066
18	F	Ion	0.90	7762	-		38
19	K	Ion	1.02	7762	-		38
20	S	Ion	1.55	7793	-		7
24	E	Photo	1.74	7796	-		4
29	G	Ion	1.55	7860	-		-60

Second Floor Hall J Detectors

35	T	TGS	2.30	8135	-		-335
5	S	Ion	1.00	8137	-		-337
1	P	Photo	1.80	8138	-		-338
33	T	TGS	10.38	8140	-		-340
2	N	Photo	1.38	8143	-		-343
3	F	Ion	1.46	8144	-		-344
30	G	Ion	1.53	8145	-		-345
4	K	Ion	1.10	8146	-		-346
21	E	Photo	1.31	8203	-		-403
34	T	TGS	6.05	8320	-		-520
36	T	TGS	0.92	Not Resettable	-		No Data

FLAMES AT

7620 Secs

1st FLOOR TENABILITY LIMIT

7800 Secs

2nd FLOOR TENABILITY LIMIT

7800 Secs

(includes exit path)

TEST ENDS

8400 Secs

DATA SUMMARY

TEST NO.	Clock No.	Detector Code	Detector Type	Sensitivity (%-Ft-1)	Alarm (Secs)	First Floor		Second Floor	
						Room	Escape Time (Secs)	Room	Escape Time (Secs)
62 - W	8	F	Ion	0.65	2170	2380		2450	
FIRE TYPE	9	K	Ion	0.61	2212	2338		2408	
S - Chair	6	P	Photo	1.80	2354	2196		2266	
FIRE LOCATION	7	N	Photo	2.64	2381	2169		2239	
Living Room	22	E	Photo	1.55	2965	1585		1655	
	10	S	Ion	1.18	3098	1452		1522	
	25	BELL	BELL	-	5005	-455		-385	
	26	HORN	HORN	-	5025	-475		-405	
	31	G	Ion	1.23	After Test	None		-	

SEASON
Spring
BASEBOARD HOT WATER
Heat On

First Floor Bedroom C Detectors									
14	K	Ion	0.63	2645	1905			1975	
12	N	Photo	1.80	3002	1548			1618	
11	P	Photo	2.79	3429	1121			1191	
13	F	Ion	0.88	3926	621			694	
23	E	Photo	3.43	4257	293			363	
15	S	Ion	1.34	4455	95			165	
32	G	Ion	1.36	None	None			-	

INTERIOR DOORS
Open
WINDOWS AND EXTERIOR DOORS
Closed

Second Floor Game Room Detectors									
17	N	Photo	1.80	4574	-			46	
16	P	Photo	3.08	4608	-			12	
19	K	Ion	1.02	4872	-			-252	
18	F	Ion	0.90	5100	-			-480	
24	E	Photo	1.74	5104	-			-484	
20	S	Ion	1.55	5114	-			-494	
29	G	Ion	1.55	After Test	-			None	

FLAMES AT
4980 Secs
1st FLOOR TENABILITY LIMIT
4550 Secs
2nd FLOOR TENABILITY LIMIT
4620 Secs
(includes exit path)

Second Floor Hall J Detectors									
1	P	Photo	1.80	After Test	-			None	
4	K	Ion	1.10	After Test	-			None	
33	T	TGS	10.38	After Test	-			None	
2	N	Photo	1.38	After Test	-			None	
35	T	TGS	2.30	After Test	-			None	
3	F	Ion	1.46	After Test	-			None	
5	S	Ion	1.00	After Test	-			None	
21	E	Photo	1.31	After Test	-			None	
30	G	Ion	1.53	None	-			None	
34	T	TGS	6.05	None	-			None	
36	T	TGS	0.92	Not Resettable	-			None	No Data

TEST ENDS
5210 Secs

DATA SUMMARY

TEST NO.	Clock No.	Detector Code	Detector Type	Sensitivity (%-Ft-l)	Alarm (Secs)	First Floor		Second Floor	
						Escape	Time (Secs)	Escape	Time (Secs)
63 - W	9	K	Ion	0.61	30	775	-	-	920
FIRE TYPE	8	F	Ion	0.65	38	767	-	-	912
F - Chair	10	S	Ion	1.18	155	650	-	-	795
FIRE LOCATION	31	G	Ion	1.23	183	622	-	-	767
Living Room	7	N	Photo	2.64	533	272	-	-	417
	6	P	Photo	1.80	573	232	-	-	377
	22	E	Photo	1.55	587	218	-	-	363
	25	BELL	BELL	-	775	30	-	-	175
	26	HORN	HORN	-	784	21	-	-	166

First Floor Bedroom C Detectors

14	K	Ion	0.63	64	741	886
13	F	Ion	0.88	201	604	749
32	G	Ion	1.36	519	286	431
12	N	Photo	1.80	537	268	413
15	S	Ion	1.34	539	266	411
11	P	Photo	2.79	551	254	399
23	E	Photo	3.43	608	197	342

Second Floor Game Room Detectors

19	K	Ion	1.02	767	-	183
18	F	Ion	0.90	778	-	172
20	S	Ion	1.55	783	-	167
17	N	Photo	1.80	823	-	127
24	E	Photo	1.74	823	-	127
16	P	Photo	3.08	837	-	113

Second Floor Hall J Detectors

36	T	TGS	0.92	35	-	915
4	K	Ion	1.10	918	-	32
1	P	Photo	1.80	980	-	-30
2	N	Photo	1.38	1015	-	-65
5	S	Ion	1.00	1016	-	-66
3	F	Ion	1.46	1029	-	-79
35	T	TGS	2.30	1065	-	-115
33	T	TGS	10.38	1075	-	-125
21	E	Photo	1.31	1152	-	-202
34	T	TGS	6.05	1333	-	-383

SEASON
Spring
BASEBOARD HOT WATER
Heat On

INTERIOR DOORS
Open
WINDOWS AND EXTERIOR DOORS
Closed

FLAMES AT
0 Secs
1st FLOOR TENABILITY LIMIT
805 Secs (Temp. > 150 F)
2nd FLOOR TENABILITY LIMIT
950 Secs
(includes exit path)

TEST ENDS
1590 Secs

DATA SUMMARY

TEST NO.	Clock No.	Detector Code	Detector Type	Sensitivity (%-Ft-l)	First Floor		Second Floor
					Alarm (Secs)	Escape Time (Secs)	
64 - W	8	F	Ion	0.65	271	1624	2189
FIRE TYPE	9	K	Ion	0.61	273	1622	2129
F - Chair (foam pad)	10	S	Ion	1.18	737	1158	1665
FIRE LOCATION	6	P	Photo	1.80	1114	781	1288
Living Room	7	N	Photo	2.64	1167	728	1235
	22	E	Photo	1.55	1177	718	1225

First Floor Bedroom C Detectors

SEASON	13	F	Ion	0.88	750	1145	1652
Spring	14	K	Ion	0.63	803	1092	1599
BASEBOARD HOT WATER	15	S	Ion	1.34	888	1007	1514
Heat On	32	G	Ion	1.36	1056	839	1346
	11	P	Photo	2.79	1128	767	1274
	12	N	Photo	1.80	1163	732	1239
	23	E	Photo	3.43	1474	421	928

INTERIOR DOORS

Open

WINDOWS AND EXTERIOR DOORS

Closed

Second Floor Game Room Detectors

	18	F	Ion	0.90	1618	-	784
	19	K	Ion	1.02	1630	-	772
	16	P	Photo	3.08	1666	-	736
	17	N	Photo	1.80	1685	-	717
	29	G	Ion	1.55	1703	-	699
	20	S	Ion	1.55	1716	-	686
	24	E	Photo	1.74	1801	-	601

Second Floor Hall J Detectors

	4	K	Ion	1.10	2215	-	187
	5	S	Ion	1.00	2252	-	150
1st FLOOR TENABILITY LIMIT	1	P	Photo	1.80	2256	-	146
1895 Secs	2	N	Photo	1.38	2258	-	144
2nd FLOOR TENABILITY LIMIT	3	F	Ion	1.46	2272	-	130
2402 Secs	35	T	TGS	2.30	2273	-	129
(includes exit path)	21	E	Photo	1.31	2427	-	-25
	30	G	Ion	1.53	2460	-	-58
TEST ENDS	34	T	TGS	6.05	None	-	None
2581 Secs	33	T	TGS	10.38	Not Resettable	-	No Data
	36	T	TGS	0.92	Not Resettable	-	No Data

DATA SUMMARY

TEST NO.	Clock No.	Detector Code	Detector Type	Sensitivity (%-Ft-l)	First Floor		Second Floor	
					Alarm (Secs)	Escape Time (Secs)	Alarm (Secs)	Escape Time (Secs)
65 - W	7	N	Photo	2.64	1007	1083	1228	
FIRE TYPE	10	S	Ion	1.18	1037	1053	1198	
	8	F	Ion	0.65	1042	1048	1193	
S - Chair (foam seat/ cotton back)	9	K	Ion	0.61	1096	994	1139	
	6	P	Photo	1.80	1156	934	1079	
FIRE LOCATION	31	G	Ion	1.23	1215	875	1020	
	22	E	Photo	1.55	1452	638	783	

First Floor Bedroom C Detectors

12	N	Photo	1.80	1776	314	459
11	P	Photo	2.79	1874	216	361
14	K	Ion	0.63	2254	-164	-19
13	F	Ion	0.88	2258	-168	-23
15	S	Ion	1.34	2264	-174	-29
32	G	Ion	1.36	2281	-191	-46
23	E	Photo	3.43	2299	-209	-64

SEASON

Spring

BASEBOARD HOT WATER

Heat On

INTERIOR DOORS

Open

WINDOWS AND EXTERIOR DOORS

Closed

Second Floor Game Room Detectors

36	T	TGS	0.92	1460	-	775
19	K	Ion	1.02	2476	-	-241
17	N	Photo	1.80	2484	-	-249
16	P	Photo	3.08	2517	-	-282
18	F	Ion	0.90	2540	-	-305
35	T	TGS	2.30	2540	-	-305
29	G	Ion	1.55	2550	-	-315
20	S	Ion	1.55	2568	-	-333
24	E	Photo	1.74	2581	-	-346
33	T	TGS	10.38	None	-	-
34	T	TGS	6.05	None	-	-

Second Floor Hall J Detectors

4	K	Ion	1.10	2748	-	-513
1	P	Photo	1.80	2759	-	-524
5	S	Ion	1.00	After Test	-	None
3	F	Ion	1.46	After Test	-	None
21	E	Photo	1.31	After Test	-	None
2	N	Photo	1.38	None	-	None
30	G	Ion	1.53	None	-	None

FLAMES AT

2220 Secs

1st FLOOR TENABILITY LIMIT

2090 Secs

2nd FLOOR TENABILITY LIMIT

2235 Secs

(includes exit path)

TEST ENDS

2779 Secs

DATA SUMMARY

TEST NO.	Clock No.	Detector Code	Detector Type	Sensitivity (%-Ft-l)	Alarm (Secs)	First Floor		Second Floor	
						Living Room Detectors (Ignition Room)	Escape Time (Secs)	Escape Time (Secs)	Time (Secs)
66 - W	9	K	Ion	0.61	136	711	829		
FIRE TYPE	8	F	Ion	0.65	156	691	809		
F - Chair (foam pad)	10	S	Ion	1.18	189	658	776		
FIRE LOCATION	31	G	Ion	1.23	238	609	727		
Living Room	7	N	Photo	2.64	345	502	620		
	6	P	Photo	1.80	382	465	583		
	22	E	Photo	1.55	472	375	493		

First Floor Bedroom C Detectors

SEASON	14	K	Ion	0.63	322	525	643	
Spring	32	G	Ion	1.36	333	514	632	
BASEBOARD HOT WATER	13	F	Ion	0.88	349	498	616	
Heat On	15	S	Ion	1.34	352	495	613	
	12	N	Photo	1.80	384	463	581	
	11	P	Photo	2.79	397	450	568	
	23	E	Photo	3.43	545	302	420	

INTERIOR DOORS

Second Floor Game Room Detectors

Open	19	K	Ion	1.02	817	-	148	
	29	G	Ion	1.55	825	-	140	
WINDOWS AND EXTERIOR DOORS	18	F	Ion	0.90	836	-	129	
Closed	16	P	Photo	3.08	840	-	125	
	17	N	Photo	1.80	905	-	60	
	20	S	Ion	1.55	1075	-	-110	
	35	T	TGS	2.30	1085	-	-120	
	24	E	Photo	1.74	1104	-	-139	
FLAMES AT	33	T	TGS	10.38	None	-	None	
0 Secs	34	T	TGS	6.05	None	-	None	
	36	T	TGS	0.92	Not Resettable-	-	No Data	

Second Floor Hall J Detectors

1st FLOOR TENABILITY LIMIT	4	K	Ion	1.10	After Test	-	None	
847 Secs	5	S	Ion	1.00	After Test	-	None	
2nd FLOOR TENABILITY LIMIT	3	F	Ion	1.46	After Test	-	None	
965 Secs	1	P	Photo	1.80	After Test	-	None	
(includes exit path)	21	E	Photo	1.31	After Test	-	None	
	2	N	Photo	1.38	None	-	None	
TEST ENDS	30	G	Ion	1.53	None	-	None	
1140 Secs								

DATA SUMMARY

Clock No.	Detector Code	Detector Type	Sensitivity (%-Ft-l)	Alarm (Secs)	First Floor		Second Floor	
					Escape Time (Secs)	Room (Secs)	Escape Time (Secs)	Room (Secs)
Living Room Detectors (Ignition Room)								
7	N	Photo	2.64	2036	2504	Est.	2754	
6	P	Photo	1.80	2049	2491	Est.	2741	
8	F	Ion	0.65	2315	2225	Est.	2315	
9	K	Ion	0.61	2492	2048	Est.	2298	
10	S	Ion	1.18	2570	1970	Est.	2220	
31	G	Ion	1.23	2700	1840	Est.	2090	
22	E	Photo	1.55	2799	1741	Est.	1991	

TEST NO.
67 - W

FIRE TYPE

S - Sofa Section

FIRE LOCATION

Living Room

First Floor Bedroom C Detectors

12	N	Photo	1.80	2965	1575	Est.	1825	
11	P	Photo	2.79	3172	1368	Est.	1618	
14	K	Ion	0.63	4577	-37	Est.	213	
15	S	Ion	1.34	4604	-64	Est.	186	
13	F	Ion	0.88	4606	-66	Est.	184	
32	G	Ion	1.36	4615	-75	Est.	175	
23	E	Photo	3.43	4619	-79	Est.	171	

SEASON

Spring

BASEBOARD HOT WATER

Heat On

Second Floor Game Room Detectors

17	N	Photo	1.80	3559	-	Est.	1231	
16	P	Photo	3.08	4510	-	Est.	280	
29	G	Ion	1.55	4680	-	Est.	110	
35	T	TGS	2.30	4680	-	Est.	110	
18	F	Ion	0.90	4686	-	Est.	104	
24	E	Photo	1.74	4687	-	Est.	103	
20	S	Ion	1.55	4688	-	Est.	102	
19	K	Ion	1.02	4692	-	Est.	98	
33	T	TGS	10.38	None	-	None	None	
34	T	TGS	6.05	None	-	None	None	
36	T	TGS	0.92	Not Resettable	-	No Data	No Data	

INTERIOR DOORS

Open

WINDOWS AND EXTERIOR DOORS

Closed

FLAMES AT

4545 Secs

Second Floor Hall J Detectors

1	P	Photo	1.80	After Test	-	None	None	
4	K	Ion	1.10	After Test	-	None	None	
5	S	Ion	1.00	After Test	-	None	None	
3	F	Ion	1.46	After Test	-	None	None	
2	N	Photo	1.38	After Test	-	None	None	
21	E	Photo	1.31	None	-	None	None	
30	G	Ion	1.53	None	-	None	None	

1st FLOOR TENABILITY LIMIT

4540 Secs

2nd FLOOR TENABILITY LIMIT

>4740 Secs (estimated 4790)

(includes exit path)

TEST ENDS

4740 Secs

DATA SUMMARY

TEST NO.	Clock No.	Detector Code	Detector Type	Sensitivity (8-Ft-1)	First Floor		Second Floor	
					Alarm (Secs)	Escape Time (Secs)	Alarm (Secs)	Escape Time (Secs)
			<u>Living Room Detectors (Ignition Room)</u>					
29	G	Ion	1.55	165	-29			
17	N	Photo	1.50	171	-35		145	
19	K	Ion	1.02	172	-36		139	
18	F	Ion	0.90	176	-40		138	
20	S	Ion	1.55	181	-45		134	
24	E	Photo	1.74	203	-67		129	
16	P	Photo	3.08	220	-84		107	

<u>First Floor Bedroom C Detectors</u>							
14	K	Ion	0.63	91	45		219
12	N	Photo	1.80	92	44		218
32	G	Ion	1.36	94	42		216
15	S	Ion	1.34	103	33		207
11	P	Photo	2.79	104	32		206
13	F	Ion	0.88	105	31		205
23	E	Photo	3.43	127	9		183

<u>Second Floor Game Room Detectors</u>							
36	T	TGS	0.92	45	-		265
29	G	Ion	1.55	165	-		145
17	N	Photo	1.80	171	-		139
19	K	Ion	1.02	172	-		138
18	F	Ion	0.90	176	-		134
20	S	Ion	1.55	181	-		129
24	E	Photo	1.74	203	-		107
16	P	Photo	3.08	220	-		90
33	T	TGS	10.38	None	-		None
34	T	TGS	6.05	None	-		None
35	T	TGS	2.30	None	-		None

<u>Second Floor Hall J Detectors</u>							
4	K	Ion	1.10	After Test	-		None
5	S	Ion	1.00	After Test	-		None
3	F	Ion	1.46	After Test	-		None
1	P	Photo	1.80	None	-		None
2	N	Photo	1.38	None	-		None
21	E	Photo	1.31	None	-		None
30	G	Ion	1.53	None	-		None

68 - W
FIRE TYPE
F - Bare Foam Chair
FIRE LOCATION
Living Room

SEASON
Spring
BASEBOARD HOT WATER
Heat On

INTERIOR DOORS
Open
WINDOWS AND EXTERIOR DOORS
Closed

FLAMES AT
0 Secs

1st FLOOR TENABILITY LIMIT
136 Secs
2nd FLOOR TENABILITY LIMIT
310 Secs
(includes exit path)

TEST ENDS
480 Secs

DATA SUMMARY

TEST NO.	Clock No.	Detector Code	Detector Type	Sensitivity (%-Ft-l)	First Floor		Second Floor	
					Alarm (Secs)	Escape Time (Secs)	Alarm (Secs)	Escape Time (Secs)
	8	F	Ion	0.65	53	105	179	
	9	K	Ion	0.61	55	103	177	
<u>FIRE TYPE</u>	31	G	Ion	1.23	60	98	182	
F - Bare Foam Bed	10	S	Ion	1.18	79	79	153	
<u>FIRE LOCATION</u>	7	N	Photo	2.64	108	50	124	
Living Room	6	P	Photo	1.80	120	38	112	
	22	E	Photo	1.55	154	4	78	

<u>First Floor Bedroom C Detectors</u>								
	14	K	Ion	0.63	114	44	118	
	32	G	Ion	1.36	119	39	113	
	12	N	Photo	1.80	122	36	110	
	15	S	Ion	1.34	131	27	101	
	13	F	Ion	0.88	132	26	100	
	11	P	Photo	2.79	136	22	96	
	23	E	Photo	3.43	162	-4	70	

<u>Second Floor Game Room Detectors</u>								
	19	K	Ion	1.02	185	-	47	
	18	F	Ion	0.90	187	-	45	
	29	G	Ion	1.55	188	-	44	
	20	S	Ion	1.55	189	-	43	
	17	N	Photo	1.80	189	-	43	
	24	E	Photo	1.74	205	-	27	
	16	P	Photo	3.08	210	-	22	
	36	T	TGS	0.92	After Test	-	None	
	33	T	TGS	10.38	None	-	None	
	34	T	TGS	6.05	None	-	None	
	35	T	TGS	2.30	None	-	None	

<u>Second Floor Hall J Detectors</u>								
	4	K	Ion	1.10	After Test	-	None	
	5	S	Ion	1.00	After Test	-	None	
	3	F	Ion	1.46	After Test	-	None	
	1	P	Photo	1.80	None	-	None	
	2	N	Photo	1.38	None	-	None	
	21	E	Photo	1.31	None	-	None	
	30	G	Ion	1.53	None	-	None	

TEST NO.
69 - W

FIRE TYPE

F - Bare Foam Bed

FIRE LOCATION

Living Room

SEASON

Spring

BASEBOARD HOT WATER

Heat On

INTERIOR DOORS

Open

WINDOWS AND EXTERIOR DOORS

Closed

FLAMES AT

0 Secs

1st FLOOR TENABILITY LIMIT

158 Secs

(temperature > 1500F)

2nd FLOOR TENABILITY LIMIT

232 Secs

(includes exit path)

TEST ENDS

360 Secs

DATA SUMMARY

Clock No.	Detector Code	Detector Type	Sensitivity (%-Ft-l)	First Floor		Second Floor	
				Alarm (Secs)	Escape Time (Secs)	Alarm (Secs)	Escape Time (Secs)
<u>TEST NO.</u>							
9	K	Ion	0.61	40	204		269
8	F	Ion	0.65	46	198		263
31	G	Ion	1.23	57	187		252
10	S	Ion	1.18	69	175		240
6	P	Photo	1.80	122	122		187
7	N	Photo	2.64	123	121		186
22	E	Photo	1.55	217	27		92

70 - W

FIRE TYPE

F - Cotton Wrap/
Bare Foam Bed

FIRE LOCATION

Living Room

SEASON

Spring

BASEBOARD HOT WATER

Heat On

First Floor Bedroom C Detectors

14	K	Ion	0.63	99	145		210
13	F	Ion	0.88	104	140		205
32	G	Ion	1.36	105	139		204
11	P	Photo	2.79	122	122		187
15	S	Ion	1.34	130	114		179
12	N	Photo	1.80	137	107		172
23	E	Photo	3.43	259	-15		50

INTERIOR DOORS

Open

WINDOWS AND EXTERIOR DOORS

Closed

FLAMES AT

0 Secs

Second Floor Game Room Detectors

36	T	TGS	0.92	90	-		219
19	K	Ion	1.02	220	-		89
18	F	Ion	0.90	232	-		77
17	N	Photo	1.80	239	-		70
29	G	Ion	1.55	242	-		67
20	S	Ion	1.55	250	-		59
16	P	Photo	3.08	277	-		32
24	E	Photo	1.74	294	-		15
34	T	TGS	6.05	None	-		None
35	T	TGS	2.30	None	-		None
33	T	TGS	10.38	None	-		None

1st FLOOR TENABILITY LIMIT

244 Secs

(temperature > 150°F)

2nd FLOOR TENABILITY LIMIT

309 Secs

(includes exit path)

TEST ENDS

420 Secs

Second Floor Hall J Detectors

5	S	Ion	1.00	After Test	-		None
2	N	Photo	1.38	After Test	-		None
4	K	Ion	1.10	After Test	-		None
3	F	Ion	1.46	After Test	-		None
30	G	Ion	1.53	After Test	-		None
1	P	Photo	1.80	After Test	-		None
21	E	Photo	1.31	None	-		None

DATA SUMMARY

Clock No.	Detector Code	Detector Type	Sensitivity (%-Ft-1)	First Floor		Second Floor
				Alarm (Secs)	Escape Time (Secs)	
<u>Living Room Detectors (Ignition Room)</u>						
6	P	Photo	1.80	137	-21	97
7	N	Photo	2.64	137	-21	97
8	F	Ion	0.65	137	-21	97
9	K	Ion	0.61	137	-21	97
10	S	Ion	1.18	137	-21	97
22	E	Photo	1.55	154	-38	80
31	G	Ion	1.23	208	-92	26

TEST NO.

71 - W

FIRE TYPE

F - Bare Foam on Floor

FIRE LOCATION

Living Room

SEASON
Spring

BASEBOARD HOT WATER
Heat On

First Floor Bedroom C Detectors

32	G	Ion	1.36	136	-20	98
11	P	Photo	2.79	137	-21	97
12	N	Photo	1.80	137	-21	97
13	F	Ion	0.88	137	-21	97
14	K	Ion	0.63	137	-21	97
15	S	Ion	1.34	137	-21	97
23	E	Photo	3.43	169	-53	65

INTERIOR DOORS
Open

WINDOWS AND EXTERIOR DOORS
Closed

Second Floor Game Room Detectors

19	K	Ion	1.02	170	-	64
18	F	Ion	0.90	173	-	61
17	N	Photo	1.80	178	-	56
20	S	Ion	1.55	181	-	53
16	P	Photo	3.08	197	-	37
24	E	Photo	1.74	214	-	20
34	T	TGS	6.05	None	-	None
33	T	TGS	10.38	Not Resettable	-	No Data
35	T	TGS	2.30	Not Resettable	-	No Data
36	T	TGS	0.92	Not Resettable	-	No Data

FLAMES AT
0 Secs

1st FLOOR TENABILITY LIMIT
116 Secs

2nd FLOOR TENABILITY LIMIT
234 Secs

(includes exit path)

Second Floor Hall J Detectors

2	N	Photo	1.38	385	-	-151
3	F	Ion	1.46	387	-	-153
5	S	Ion	1.00	387	-	-153
4	K	Ion	1.10	390	-	-156
1	P	Photo	1.80	438	-	-204
21	E	Photo	1.31	None	-	None

TEST ENDS
480 Secs

DATA SUMMARY

TEST NO.	Clock No.	Detector Code	Detector Type	Sensitivity (%-Ft-l)	Living Room Detectors		Second Floor Escape Time (Secs)
					Alarm (Secs)	Time (Secs)	
72 - W	9	K	Ion	0.61	2454	1171	1985
FIRE TYPE	7	N	Photo	2.64	2498	1127	1942
S - Mattress	8	F	Ion	0.65	2745	880	1695
FIRE LOCATION	31	G	Ion	1.23	2795	827	1645
First Floor Bedroom C	6	P	Photo	1.80	2832	793	1608
	10	S	Ion	1.18	2936	689	1504
	22	E	Photo	1.55	3055	570	1385

SEASON
Spring
BASEBOARD HOT WATER
Heat On

First Floor Family Room Detectors							
12	N	Photo	1.80	1320	2305	3120	
11	P	Photo	2.79	2724	901	1716	
13	F	Ion	0.88	2736	889	1704	
23	E	Photo	3.43	2896	729	1544	
32	G	Ion	1.36	2989	636	1451	
15	S	Ion	1.34	3155	470	1285	
14	K	Ion	0.63	3305	320	1135	

INTERIOR DOORS
Open
WINDOWS AND EXTERIOR DOORS
Closed

Second Floor Game Room Detectors							
17	N	Photo	1.80	3437	-	1003	
19	K	Ion	1.02	3491	-	949	
35	T	TGS	2.30	3700	-	740	
33	T	TGS	10.38	3785	-	655	
16	P	Photo	3.08	3870	-	570	
18	F	Ion	0.90	3997	-	443	
29	G	Ion	1.55	4100	-	340	
24	E	Photo	1.74	4108	-	332	
20	S	Ion	1.55	4110	-	330	
34	T	TGS	6.05	4150	-	290	
36	T	TGS	0.92	Not Resettable	-	No Data	

FLAMES AT
3750 Secs

1st FLOOR TENABILITY LIMIT
3625 Secs
2nd FLOOR TENABILITY LIMIT
4440 Secs
(includes exit path)

Second Floor Hall J Detectors							
2	N	Photo	1.38	4440	-	0	
4	K	Ion	1.10	4495	-	-55	
3	F	Ion	1.46	4535	-	-95	
1	P	Photo	1.80	4540	-	-100	
5	S	Ion	1.00	4645	-	-205	
21	E	Photo	1.31	4771	-	-331	
30	G	Ion	1.53	None	-	None	

TEST ENDS
5100 Secs

DATA SUMMARY

Clock No.	Detector Code	Detector Type	Sensitivity (%-Ft-1)	Alarm (Secs)	First Floor		Second Floor	
					Escape Time (Secs)	Escape Time (Secs)	Escape Time (Secs)	Escape Time (Secs)
<u>Living Room Detectors</u>								
9	K	Ion	0.61	2537	1528	2423		
8	F	Ion	0.65	3096	969	1864		
6	P	Photo	1.80	3223	842	1737		
31	G	Ion	1.23	3356	709	1604		
10	S	Ion	1.18	3389	676	1571		
22	E	Photo	1.55	3744	321	1216		
7	N	Photo	2.64	3824	241	1136		

TEST NO. 73 - W

FIRE TYPE S - Mattress

FIRE LOCATION First Floor Bedroom C

First Floor Family Room Detectors

12	N	Photo	1.80	3080	985	1880		
11	P	Photo	2.79	3126	939	1834		
13	F	Ion	0.88	3303	762	1657		
23	E	Photo	3.43	3368	697	1592		
15	S	Ion	1.34	3426	639	1534		
32	G	Ion	1.36	3470	595	1490		
14	K	Ion	0.63	3688	377	1272		

SEASON Spring

BASEBOARD HOT WATER Heat On

Second Floor Game Room Detectors

19	K	Ion	1.02	1323	-	3637		
36	T	TGS	0.92	3850	-	1110		
33	T	TGS	10.38	4460	-	500		
35	T	TGS	2.30	4530	-	430		
16	P	Photo	3.08	5055	-	-95		
18	F	Ion	0.90	5271	-	-311		
20	S	Ion	1.55	5305	-	-345		
29	G	Ion	1.55	5306	-	-346		
24	E	Photo	1.74	5316	-	-356		
17	N	Photo	1.80	5349	-	-389		
34	T	TGS	6.05	5436	-	-476		

INTERIOR DOORS Open

WINDOWS AND EXTERIOR DOORS Closed

FLAMES AT 4080 Secs

Second Floor Hall J Detectors

4	K	Ion	1.10	5839	-	-879		
1	P	Photo	1.80	After Test	-	None		
2	N	Photo	1.38	After Test	-	None		
5	S	Ion	1.00	After Test	-	None		
3	F	Ion	1.46	After Test	-	None		
21	E	Photo	1.31	After Test	-	None		
30	G	Ion	1.53	None	-	None		

1st FLOOR TENABILITY LIMIT 4065 Secs

2nd FLOOR TENABILITY LIMIT 4960 Secs

(includes exit path)

TEST ENDS 5940 Secs

DATA SUMMARY

Clock No.	Detector Code	Detector Type	Sensitivity (%-Ft-1)	Alarm		Second Floor Escape Time (Secs)
				(Secs)	Time (Secs)	
<u>Living Room Detectors</u>						
9	K	Ion	0.61	89	1003	1111
31	G	Ion	1.23	103	989	1097
8	F	Ion	0.65	132	960	1068
10	S	Ion	1.18	135	957	1065
7	N	Photo	2.64	340	752	860
22	E	Photo	1.55	485	607	715
6	P	Photo	1.80	581	511	619

TEST NO.
74 - W

FIRE TYPE

F - Mattress

FIRE LOCATION

First Floor Bedroom C

SEASON

Spring

BASEBOARD HOT WATER

Heat On

First Floor Family Room Detectors

13	F	Ion	0.88	325	767	875
15	S	Ion	1.34	334	758	866
32	G	Ion	1.36	365	727	835
14	K	Ion	0.63	422	670	778
23	E	Photo	3.43	445	647	755
11	P	Photo	2.79	451	641	749
12	N	Photo	1.80	509	583	691

INTERIOR DOORS

Open

WINDOWS AND EXTERIOR DOORS

Closed

FLAMES AT

0 Secs

Second Floor Game Room Detectors

19	K	Ion	1.02	133	-	1067
33	T	TGS	10.38	1103	-	97
35	T	TGS	2.30	1103	-	97
18	F	Ion	0.90	1133	-	67
34	T	TGS	6.05	1145	-	55
20	S	Ion	1.55	1161	-	39
16	P	Photo	3.08	1176	-	24
24	E	Photo	1.74	1177	-	23
29	G	Ion	1.55	1188	-	12
17	N	Photo	1.80	1193	-	7
36	T	TGS	0.92	Not Resettable	-	No Data

1st FLOOR TENABILITY LIMIT

1092 Secs

2nd FLOOR TENABILITY LIMIT

1200 Secs

(includes exit path)

TEST ENDS

1589 Secs

Second Floor Hall J Detectors

1	P	Photo	1.80	1321	-	-121
2	N	Photo	1.38	1337	-	-137
4	K	Ion	1.10	1375	-	-175
5	S	Ion	1.00	1392	-	-192
3	F	Ion	1.46	1415	-	-215
21	E	Photo	1.31	1460	-	-260
30	G	Ion	1.53	1560	-	-360

DATA SUMMARY

Clock No.	Detector Code	Detector Type	Sensitivity (%-Ft-l)	Alarm (Secs)	First Floor		Second Floor	
					Escape Time (Secs)	Time (Secs)	Escape Time (Secs)	Time (Secs)
<u>Second Floor Den Detectors</u>								
7	N	Photo	2.64	3712	-342			1648
6	P	Photo	1.80	3795	-425			1565
9	K	Ion	0.61	4227	-857			1133
8	F	Ion	0.65	5153	-1783			207
22	E	Photo	1.55	5330	-1960			30
31	G	Ion	1.23	5672	-2302			-312
10	S	Ion	1.18	5674	-2304			-314

Second Floor Hall H Detectors

11	P	Photo	2.79	4690	-1320			670
23	E	Photo	3.43	5669	-2299			-309
12	N	Photo	1.80	6197	-2827			-837
14	K	Ion	0.63	After Test	None			None
13	F	Ion	0.88	After Test	None			None
15	S	Ion	1.34	After Test	None			None
32	G	Ion	1.36	None	None			None

INTERIOR DOORS

Open

WINDOWS AND EXTERIOR DOORS

Closed

FLAMES AT
5405 Secs

NEARSIDE TENABILITY LIMIT

3370 Secs

FARSIDE TENABILITY LIMIT

5360 Secs

(includes exit path)

TEST ENDS

6686 Secs

DATA SUMMARY

TEST NO.	Clock No.	Detector Code	Detector Type	Sensitivity (%-Ft-l)	Alarm (Secs)	First Floor		Second Floor	
						Escape Time (Secs)	Den Detectors	Escape Time (Secs)	Time (Secs)
76 - W	31	G	Ion	1.23	480	-140		80	
FIRE TYPE	8	F	Ion	0.65	483	-143		77	
F - Mattress	6	P	Photo	1.80	491	-151		69	
FIRE LOCATION	9	K	Ion	0.61	493	-153		67	
Second Floor Bedroom Y	10	S	Ion	1.18	493	-153		67	
	7	N	Photo	2.64	511	-171		49	
	22	E	Photo	1.55	809	-469		-249	

SEASON
Spring
BASEBOARD HOT WATER
Heat On

Second Floor Hall H Detectors

14	K	Ion	0.63	622	-282	-62
11	P	Photo	2.79	628	-288	-68
13	F	Ion	0.88	631	-291	-71
12	N	Photo	1.80	654	-314	-94
32	G	Ion	1.36	690	-350	-130
15	S	Ion	1.34	692	-352	-132
23	E	Photo	3.43	894	-554	-334

INTERIOR DOORS

Open

WINDOWS AND EXTERIOR DOORS

Closed

FLAMES AT

0 Secs

Second Floor Game Room Detectors

19	K	Ion	1.02	43	297	517
20	S	Ion	1.55	143	197	417
29	G	Ion	1.55	161	179	399
18	F	Ion	0.90	164	126	396
33	T	TGS	10.38	180	160	380
17	N	Photo	1.80	204	136	356
35	T	TGS	2.30	236	104	324
24	E	Photo	1.74	278	62	282
16	P	Photo	3.08	422	-82	138
34	T	TGS	6.05	460	-120	100
36	T	TGS	0.92	Not Resettable	No Data	No Data

NEAR SIDE TENABILITY LIMIT

340 Secs

FAR SIDE TENABILITY LIMIT

560 Secs

(includes exit path)

TEST ENDS

910 Secs

Second Floor Hall J Detectors

4	K	Ion	1.10	21	319	539
2	N	Photo	1.38	64	276	496
3	F	Ion	1.46	65	275	495
5	S	Ion	1.00	65	275	495
30	G	Ion	1.53	75	265	555
1	P	Photo	1.80	125	215	435
21	E	Photo	1.31	150	190	410

APPENDIX C
NARRATIVE DESCRIPTIONS OF FIRES



J. R. WHITEHOUSE TEST SERIES:

The test narratives found on the following pages describe full-scale fire tests which were a continuation of the Indiana Dunes Research Project. Nineteen experiments were conducted at the J. R. Whitehouse test site on East Lake Park Avenue between September 15 and September 24, 1975. These were conducted under conditions which represented late summer and fall conditions. The experiments included fires initiated just after shut down of the air conditioning system and fires initiated with certain windows opened and air conditioning off. Test numbering continues that of the previous years work. (Ref. *)

The instrumentation employed to start this test series was as follows:

The first detector board, with detectors 1, 2, 3, 4, 5, and 21, was located on the ceiling in the second floor hall outside the bedrooms. Also in that hall were 5-ft light beams at the 5-ft level and at the ceiling, along with one gas sampling tube located at the 5-ft level. Bedroom E contained one gas sampling tube at 5-ft. Bedroom F contained a 5-ft light beam and one gas sampling tube at 5-ft.

The second detector board was located on the ceiling of the first floor hall just outside the bedrooms, with detectors 6, 7, 8, 9, 10, and 22. Five-foot light beams were situated at the 5-ft level and at the ceiling in the hall. That hall also had one gas sampling tube at 5-ft. Bedrooms A and B each contained a 5-ft light beam and a gas sampling tube at the 5-ft level.

The third detector board location, with detectors 11, 12, 13, 14, 15, and 23, was located about 9-ft high on the north wall in the living room. A 5-ft light beam was situated at the 8 ft level and a gas sampling tube was located 3-ft below the light beam. Just below the light beam two thermally operated devices were mounted in the form of a wind-up bell and a freon horn.

The fourth detector board, with detectors 16, 17, 18, 19, 20, and 24 was located on the ceiling at the head of the basement stairway.

Thermocouples in vertical arrays were located in the living room and each hall.

*Bukowski, R. W., Waterman, T. E., Christian, W.J.,
"Detector Sensitivity and Siting Requirements for
Dwellings", IITRI Project J6340, August, 1975.

LIVING ROOM SERIES

Test No. 41, in the living room, was a smoldering ignition of the back of a sofa section having no cushion. The upholstery was a nylon pile with cotton and rayon backing placed over cotton padding. For this and subsequent smoldering fires, the ignition source was a 500 w charcoal igniter with approximately 20 in. of exposed cal-rod and energized from 120 v ac. At the commencement of each test the charcoal igniter was energized and placed immediately upon the test furniture. The location and time of application is described for each test.

Prior to the start of this test all windows were closed and all interior doors were allowed to remain open. The air conditioning system was operated so that a defined differential was established between the temperature inside the residence and the outside ambient temperature. Approximately 15 sec prior to the start of the ignition procedure the air conditioning was shut down. The test was started at 3:00 p.m., Monday, September 15.

Weather Conditions - Wind, very calm. Partly cloudy with occasional drops of rain. Relative humidity, 72 percent. Temperature, 59.5 F.

<u>Time After Ignition, Sec</u>	<u>Test No. 41 - Observations</u>
32	First smoke noted. Upholstery apparently melting.
90	Heavy smoldering. Smoke rising to ceiling in steady column.
120	Ignition source removed from back of sofa. U-shaped char near seat left from source. Apparent sweet smell from smoldering.
600	Char spreading unevenly in spikes from char.
630	No heavy stratification. Smoke rising to approximately the 10-ft level and moving to the center of the room. The charred sections are moving slowly down the sectional upholstery. Material is melting at the fringe areas of the char.
1800	Smoke drifting slowly from slits in the upholstery of the furniture back. The smoke seems to reach the detector location in the first floor hall before that on the wall in the living room.
1980	Smoke barely visible in first floor hallway.

Time After
Ignition, Sec

Test No. 41 - Observations (Cont'd)

3000 Moderate smoldering from the charred areas. U-shaped mark completely consumed by charring.

3180 Smoke build-up in the living room stratifying at the 3-ft level.

3780 Charred area apparently producing a small amount of heat since the upper portions of the char are slightly brown.

4020 Interior portions of the char opening up revealing inside of the sectional. Smoke build-up in the living room is very irritating to the nose.

4200 Only two detectors have alarmed on the second floor hallway. No detector at the head of the basement stairway has alarmed to this point.

4440 Smoldering appears from the juncture of the sofa back and seat.

5040 Visible char area is a circle approximately 2-ft in diameter located on the back of the furniture.

5400 The detector board located on the living room wall is barely perceptible as viewed from the front vestibule, approximately 20-ft from that location.

5460 Small section of char falls to the seat portion. Heavy smoldering from the hole in the main char area.

6180 Char starting to move down the arm of the furniture.

6360 Char area extends down to the seat portion for 4 to 5 in.

6480 One detector at the head of the basement has alarmed at this point. Using the basement as an escape route is questionable at this point however. The wall-mounted detectors in the living room are no longer visible.

6780 The interior padding of the sectional is falling from the inside of the hole in the center of the main char area. Charring has reached the top of the sectional completely covering approximately one-half of the furniture back. Smoke issuing from all charred sections.

7680 Char fanned attempting to produce flaming. No flame results.

7800 Test terminated.

Upon entering the residence after Test No. 41, the basement was relatively clean with little or no smoke in that area. Heavy smoke build-up in the kitchen and first floor hallway make it difficult to breath and see. The smoke build-up on the second floor was uniform with no apparent stratification; this area was on the borderline of being passable.

Test No. 42 was identical to Test No. 41 except all bedroom doors were closed. At the start of the test the charcoal igniter was energized and placed at the lower right portion of the back of a chair complete with integral cushion. Upholstery was a rayon pile on cotton backing. The arms were padded with cotton and the seat and back with foam rubber. This was not discovered until during the test. The test was started at 10:00 a.m., Tuesday, September 16.

Weather Conditions - Wind, calm. Cloudy. Relative humidity, 76.2 percent. Temperature, 64 F.

<u>Time After Ignition, Sec</u>	<u>Test No. 42 - Observations</u>
75	First smoke noted.
120	Ignition source removed. Column of smoke rising to the ceiling and slowly drifting to the edge of the room.
180	Slight smoldering.
240	Smell indicative of rubber. Further investigation disclosed a rubber cushion used in the chair, along with rubber backing.
900	Charred areas spreading uniformly in an upward direction. Smoldering is moderate and the column of smoke produced reaches the ceiling in the living room.
1380	Moderate smoldering. Lower half of the U-shaped mark is completely charred and a 3 in. diameter circular char is located on the left portion of the char.
1695	Slight smoke build-up in living room. No apparent stratification. Relatively no movement of the smoke in the living room.
1860	Smoldering issuing from the back of the seat cushion. White char areas now visible in the interior sections of the char.
1980	Smoke very irritating to eyes and nose. U-shaped area completely charred. Moderate smoldering.

Time After
Ignition, Sec

Test No. 42 - Observations (Cont'd)

2700	Most smoldering at the bottom portion of the back of the chair.
3000	All detectors have alarmed in the living room at this point except for the thermally operated devices.
3300	Upholstery flap created by the U-shaped char curls out revealing the interior rubber cushion.
3360	Smoldering appears on the seat cushion.
3480	Power discontinued to those detectors located in the living room. (To decrease noise; all have alarmed.)
3600	Moderate to heavy smoldering. Charred area is half-way up the back of the chair.
4620	Char area is three-fourths of the way up the back of the chair. Heavy smoke build-up in living room.
4980	Charred area resembles silhouette of a house with the apex of the roof reaching the top of the back of the chair. Small char area located on the seat cushion - most smoldering in this area. The detector board located on the wall cannot be seen from across the room.
5040	All detectors alarmed in the residence except for several detectors located at the head of the basement stairway.
6300	Test terminated.

Upon entering the residence after test termination, the basement stairway was fairly clean, as was the kitchen and basement area. Bedroom B was relatively clean. Smoke build-up in the first floor hallway was stratified so that passage was possible at a low level (about 3-ft). Bedroom A was relatively clean also. Smoke build-up in the stairway leading to the second floor level was heavy. There was a small amount of smoke in the second floor bedrooms from the floor up to the 1-1/2-ft level; each room was clean for the remainder of the way to the ceiling.

For Test No. 43 in the living room series all bedroom doors were opened and certain portions of certain windows throughout the residence were opened as described in Tables 2 and 3. The test furniture was a cotton upholstered sofa section with integral cushion having approximately 1 in. of cotton padding on the seat and back. Before the test commencement air flow of about 2-ft per sec was noted out the living room window. At the start of the test the charcoal igniter was energized and placed approximately 1 in. from the left hand joint of the sectional. Test was started at 2:00 p.m., Tuesday, September 16.

Weather Conditions - Wind, NNE, calm, 2 mph. Sunny and clear. Relative humidity, 68 percent. Temperature, 67 F.

<u>Time After Ignition, Sec</u>	<u>Test No. 43 - Observations</u>
54	First smoke noted. Smoke column rising directly to the ceiling.
120	Ignition source removed. Smoldering somewhat diminished after removal of source.
210	Wind direction through the living room window apparently changed, blowing into the window, causing three detectors in the living room to alarm simultaneously. Air velocity was 3 to 4-ft per sec in the window of Bedroom A - for Bedroom B it was 2-ft per sec and variable - at Bedroom E it was approximately 1-ft per sec out - at Bedroom F the velocity was less than 1-ft per sec in.
650	Detector No. 11 which alarmed at 171 sec and detector No. 15 which alarmed at 186 sec were both reset on the annunciator clock panel. In this situation a deep sleeper may have not been awakened by these detectors which alarmed momentarily as a result of the quick inrush of wind through the living room window.
750	Column of smoke from the test furniture drifting toward the north wall of the living room. Air shuffling in and out of living room window.
840	Slight stratification noted at the 3-ft level in the living room.
1020	Moderate smoke drifting in every direction in the living room.
1500	Triangular-shaped char section starting up the back of the sectional.

Time After
Ignition, Sec

Test No. 43 - Observations (Cont'd)

1635 Relatively clean in the living room from the floor to the 3-ft level. Above that, the smoke is uniform.

1800 Bedroom A clear. Small amount of build-up in Bedroom B. Kitchen area clear. Small build-up in first floor hallway. Moderate build-up in the living room. All detectors except those located at the head of the basement stairway have alarmed.

1920 Char area on the back of the furniture is a 6 in. radius semicircle; approximately the same area on the seat. Internal sections of furniture cannot be seen.

2100 Small rupture visible on the back of the sectional, approximately 2 by 1 in.

2820 Apparently a gust of smoke found its way through the first floor hallway and up the stairway to the second level, since three detectors alarmed within 10 sec of each other at the second floor hallway location.

3120 Most smoldering coming from the fringe areas of the semicircles. Moderate to heavy smoke generation.

3160 Basement area clean. Small amount of build-up noted at the top of the basement stairway. Approximately 75 percent of the char area open exposing interior. Moderate to heavy smoke generation.

3600 Bedroom A clear. Living room build-up heavy and first floor hallway and kitchen area moderately heavy. Build-up in Bedroom B moderate. Build-up on the second floor hallway fairly heavy along with the build-up in both bedrooms on the second level. Smoke moving slowly from the first floor hallway to the kitchen. Wind leakage from the north keeping area at the head of the basement stairway clean.

3890 Apparently a gust due to wind occurred at the head of the basement stairway since three detectors which were in alarm, momentarily went out of alarm, and 10 sec later alarmed again.

3960 Detectors on the wall of the living room cannot be viewed from the front living room windows. Heavy smoke build-up in that area.

Time After
Ignition, Sec

Test No. 43 - Observations (Cont'd)

4320	Heat generation from the char area. Flaps of upholstery waving due to hot air rising from the char.
4440	40 percent transmission along light beams in both hallways.
4500	Char area covers 50 percent of the back of the furniture. 25 percent of the seat charred. Smoke generated from outer fringe areas of chars. Large gaping holes in both char areas revealing cotton padding.
4800	Test terminated.

Upon entering the residence after Test No. 43 termination, the basement was clear, but the stairway leading to the first floor was heavy. Only small amount of smoke was visible in the kitchen however. First floor hallway was passable at the 5-ft level. Very little smoke build-up in Bedroom A. Heavy smoke build-up in Bedroom B and in both second level bedrooms. Build-up in those rooms was fairly uniform; no apparent stratification. Heavy smoke build-up in the living room was very irritating to the eyes and nose.

Test No. 44 was identical to No. 43 with the same windows open. A flaming fire was initiated in the living room by igniting assorted trash material in a metal waste basket which was approximately 18 in. high with a 1-ft by 8 in. elliptical opening. The waste basket was placed next to the right arm of a chair with slipcover and upholstery covering 1/4 in. thick cotton over jute. A seat cushion was included. The slipcover was all cotton. The upholstery was wool pile (mohair) on a cotton base. One section of a newspaper was draped over the arm so that the edge of the section was approximately 6 in. from the top of the waste basket. The test was started at 4:30 p.m., Tuesday, September 16. Ignition was commenced by lighting a piece of trash paper with a cigarette lighter and placing the flaming paper in the top of the waste basket.

Weather Conditions - Wind, NE, 150-200 fpm. Sunny and clear. Relative humidity, 68 percent. Temperature, 67 F.

Time After
Ignition, Sec

Test No. 44 - Observations

15 3 in. yellow flame noted; small amount of smoke.
27 Fringe of newspaper starting to burn; rapidly spreading to other areas of the paper.
37 Inside portion of the arm starting to burn. Flames issuing from newspaper, chair arm, and waste basket, 7 to 8 in. in height.
75 Ashes floating in the area above the fire. Newspaper almost completely consumed. Large gaping hole in chair arm.
120 Paper consumed. 1-ft diameter hole in back of chair arm beginning to burn. Paper still flaming in waste basket. Not much smoke generation.
150 Inside sections of the arm padding visible. Entire arm in flames. Paper still burning in waste basket. Small amount of smoke generation from newspaper.
180 Flames increasing on chair arm, coming from the underside. Large portion of padding falling from chair arm. Trash in waste basket still burning. Flames from left hand portion of chair back coming from chair arm approximately 1 to 2-ft high.
240 Relatively no smoke generation. Flames at bottom skirt, inside chair arm, and in waste basket, also on left side of rear of chair.
290 Heavy smoke from the top back of chair. Flames from back bottom of the chair moving up the back. Very dense smoke layering down from ceiling to 3-ft level. Approximately 1-ft high flames on chair back. Material at chair starting to curl up. Small smoke columns forming on back of chair. 6 in. high flames from waste basket. Flame height increasing from back of chair to 2 to 3-ft. Inside portions of back starting to flame. Heavy smoke issuing from back. Most flames on back of chair. Small hole opening in front of chair with smoke issuing from that area.
360 Small flaming portion drops from chair back. Smoke heavy from ceiling to 3-ft level. Detector board can not be seen from the front window of the living room.
420 Heavy smoke from chair arm. Small flaming in waste basket.

Time After
Ignition, Sec

Test No. 44 - Observations (Cont'd)

435	Three flaps on chair back waving from heat generated by char section.
465	Small flames on the chair arm and inside arm. Most of smoldering from inside of chair arm.
495	Smoke stratifying at 3-ft level and light haze from 3-ft level to living room floor.
525	6 in. high flames from inside sections of chair arm. 1-ft high flames from newspaper ashes. No visible flaming from chair back, but heavy smoldering.
555	No visible flaming from waste basket. Flames increasing on top and interior of arm.
560	Flames appearing on left portion of chair rear.
580	Seat cushion ignited, 1-ft high flames.
630	Seat cushion has 6 in. high flames, 1 in. high flames from interior section of arm, and 6 in. high flames from waste basket.
700	Moderate smoke generation from side of seat cushion. 1 to 2-ft high flames from waste basket.
740	1 to 2-ft high flaming on right side of the chair and 2-ft high flames from waste basket. No flaming of sofa arm or chair back.
810	Seat cushion still burning with 1-ft high flames, along with chair back. 1-ft high flaming from waste basket.
855	6 in. high flames starting up the back of the chair. 1-ft high flames from waste basket. Small flames on interior of arm. No flames on rear of chair.
900	Test terminated.

Upon entering the residence after test termination, the living room was filled completely with smoke. Smoke was heavy in every room of the house on the first and second levels. There was a small amount of smoke build-up in the basement, but it was relatively clean. The basement stairway and dining room had heavy build-ups. It was found that the air conditioning had been left on inadvertently throughout this test.

Test No. 45 was identical to Test No. 44, except for the test furniture employed. The test furniture for this test was a sofa section with no cushion having 1 in. cotton pad over a thin layer of jute. Upholstery was an acetate design on a cotton and rayon base. A waste basket of trash was located next to the arm of the sectional and one section of a newspaper was again draped across the arm so that the edge of the section was approximately 8 in. from the top of the waste basket. The test was started at 10:15 a.m., Wednesday, September 17 by igniting a piece of newspaper and placing it in the top of the waste basket of trash.

Weather Conditions - Wind, steady, SSW, 450 fpm. Cloudy. Relative humidity, 79 percent. Temperature, 66.5 F.

<u>Time After Ignition, Sec</u>	<u>Test No. 45 - Observations</u>
15	4 to 5 in. high flames from waste basket.
25	1-ft high flames from waste basket.
75	Edge of paper on chair arm starting to burn with small flames. 1 to 2-ft high flames from the waste basket. Sectional arm burning with 1-ft high flames.
120	No visible smoke. Some ashes flying around above fire area. Flaming from waste basket 6 in. high. Flaming on sectional arm 1-ft high. Small flames from edge of newspaper.
180	Small amount of smoke generation. Flames dying down on the sectional arm and in the waste basket; 3 to 4 in. high. Air velocity at the living room window alternating in and out from zero to 1-ft per sec.
240	Very little flaming from newspaper section. Flaming on sectional arm 6 in. high. Flames in waste basket 3 to 4 in. high.
300	1-ft diameter circular rupture on side of sectional arm. Very little smoke generation.
375	Side of arm burned away; no padding inside arm chamber. Thus, fuel for fire now approximately 6 to 8 in. from waste basket. 6 in. to 1-ft high flames making their way from front to back on side of sectional arm.
540	Wood at base of back of arm ignited, 2 to 3 in. high flames.

Time After
Ignition, Sec

Test No. 45 - Observations (Cont'd)

675 Moderate smoke generation. Flames in waste basket 1-ft high.

720 Flames around back corner of chair.

730 Front skirt of sectional ignited.

750 6 in. high flames from char section on right side of base of seat cushion.

770 Embers visible around bottom of base of sectional. Flaming around corner of chair ceases.

795 Small smoke column from juncture of seat and sectional arm. Moderate smoke generation.

840 Little flaming.

855 Back flap of upholstery ignited, 1 to 2-ft high flames starting at right hand section.

870 Flames about 3-ft high on right hand section of back.

910 1 to 1-1/2-ft flames moving across back of chair. One-third of back of chair opened and exposed.

970 Half of back of chair exposed.

985 Front section of chair beginning to burn.

995 Flames across back of chair. All interior sections flaming.

1020 Flap on sectional back ignites and swings to unignited material. Flame height approximately 2 to 3 ft. Interior section flame height 6 in.

1060 Flames from flap only 6 in. high. Smoke generation from the waste basket.

1090 Bottom upholstery on left side ignites (facing rear of the chair).

1095 Front of chair ignites. Flame along 6 in. section is 1-ft high.

1140 Wood burning at steady pace at rear base of chair.

1170 Smoke build-up heavy in living room from ceiling to 3-ft level.

1260 Only slightly glowing embers now visible in chair back. All flaming ceased. Heavy smoldering from sectional arm, back, and front.

1380 Wind velocity from south at 2 to 3 mph causing smoke to exit all four bedroom windows at slow pace.

Time After
Ignition, Sec

Test No. 45 - Observations (Cont'd)

1440	Heavy wind gust through living room window blowing smoke toward north wall.
1500	Test terminated.

Upon entering the residence after test termination, a large quantity of smoke was noted exiting Bedroom A window. Very little smoke in the basement, however, smoke was heavy in the basement stairway. Visibility in the kitchen, dining room, and first floor hallway was approximately 10-ft. Most of the smoke was exiting through the opened north side doors of the building and the east bedroom windows. Examining the newspaper section that was draped on the arm of the sectional showed only 3 to 4 in. of that paper burned leaving other parts uncharred. Smoke was heavy in all bedrooms on the first floor and in the stairway to the second floor. Smoke was also heavy in the second level bedrooms. No stratification visible in any of the bedrooms. Build-up was fairly uniform.

For the next test in the living room series, Test No. 46, all windows and exterior doors were closed and the air conditioning system was allowed to operate in order to obtain a temperature differential between indoor and outdoor conditions. Just before commencement of the test, the air conditioning was shut down. All interior doors remained open. The test furniture was an 80 in. couch without cushions. The upholstery was a nylon design on a cotton and rayon base. Padding was approximately 1 in. thick cotton over a thin layer of jute. On the couch arms, cotton covered excelsior. All interior sections were empty having just springs. A smoldering fire was initiated at the lower left portion of the sofa back at the intersection with the sofa arm. The test was started at 2:00 p.m., Wednesday, September 17.

Weather Conditions - Wind, steady, SSW, 350 fpm. Partly cloudy. Relative humidity, 69 percent. Temperature, 72 F.

Time After
Ignition, Sec

Test No. 46 - Observations

75 First smoke noted.
120 Charcoal igniter removed.
150 Smoke column rising to ceiling and immediately dropping to 5-ft level.
240 Smoke near living room windows is heated and rising rapidly. Smoke in the other areas of the living room very still.
360 Slight smoldering from edges of char. Smoke column rising to ceiling and falling to 3-ft level.
630 Char spreading uniformly from U-shaped area. Moderate smoke generation.
960 Width of char lines approximately 1 in.
1380 U-shaped mark completely filled. Charring moving in all directions.
1500 U-shaped mark opens up exposing interior of sofa. All detectors in living room in alarm at this point.
1620 Small circular char on top of left arm. Smoke from two slashes in rear of sofa.
1920 Smoke build-up uniform in living room - no stratification. All detectors in living room and first floor hallway in alarm at this point. Smoke very irritating to the eyes.
2040 Main char on sofa back is 1-ft in diameter.
2460 Smoke uniformly spread on first floor. No distinct stratification. Very irritating to eyes and nose. Interior of chair now exposed in area of main char.
3240 All detectors in living room, first floor hallway, and second floor hallway had alarmed at this point.
3600 Main char area 2-ft in diameter. Semi-circular char 1-ft in radius on seat of the sofa. 6 in. diameter char on sofa arm. Heavy smoke build-up on first floor; however, still passable.
4080 Main circular char (2-1/2 to 3-ft in diameter) now at top of sofa back.
4800 Test terminated.

Upon entering the residence after test termination, smoke build-up was heavy in all rooms of the residence except for the basement level.

BEDROOM SERIES

Test No. 47 was the first test of the bedroom series conducted in the northwest corner of Bedroom A on the first floor. That detector board mounted on the living room wall in the previous tests was moved into the bedroom and mounted in the approximate center of the room on the ceiling. The thermally actuated devices were mounted on the south wall of the bedroom 6 in. from the ceiling. The light beam and thermocouple array (vertical profile) were ceiling mounted near the detectors.

A smoldering fire was initiated on a cotton spread which was placed on a cotton innerspring mattress lying on a box spring. The air conditioning was shut down several seconds before the test was started. All windows and exterior doors remained closed throughout the test. The test was started at 11:30 a.m., Thursday, September 18.

Weather Conditions - Wind, WSW, 200 fpm. Sunny with scattered clouds. Relative humidity, 74 percent. Temperature, 69.5 F.

<u>Time After Ignition, Sec</u>	<u>Test No. 47 - Observations</u>
80	First smoke. Column rising to ceiling. Moderate smoldering.
120	Igniter removed leaving U-shaped mark on spread.
165	Very little smoldering.
255	Two detectors in ignition room alarm as a result of puff of smoke generated during initiation of the fire.
300	Igniter reapplied to increase smoldering.
305	Smoldering redevelops.
330	Igniter again removed.
520	Detectors 6, 11, and 12 reset on the clock annunciator panel.
600	Slight smoldering from edges of char.
900	Char areas spreading uniformly.
1800	Char fills U-shaped mark. Smoke build-up uniform throughout Bedroom A. No stratification and smoke very light.
2400	Char area is a circle 1-ft in diameter on spread with 6 in diameter hole exposing interior of mattress. Most smoldering coming from edges of circle.
2700	Smoldering gradually increasing.
2820	Swirling above the smoldering, in a counter-clockwise direction, resembles a miniature tornado. Located primarily on north side of char.

Time After
Ignition, Sec

Test No. 47 - Observations (Cont'd)

3240	Small amount of smoke in Bedroom B. Quite heavy in Bedroom A. Not much smoke build-up in first floor hallway or other areas of house. Smoke seems to be drifting below detectors in first floor hallway.
3540	Char section reaches edge of mattress. Smoldering coming from that area is moderate and gradually increasing. Char area now 1-1/2-ft in diameter.
3720	Smoke trails from side of mattress moving toward north wall of Bedroom A.
4200	Char area 2-ft in diameter. Moderate to heavy smoldering from all areas. Still have smoke trails from edge of mattress.
4500	Smoke build-up in burn room is thick from ceiling to 2-ft level.
4740	Heavy smoldering. Detector board (about 15-ft away from the bedroom window) can not be seen.
5100	Test terminated.

Smoldering was quite heavy in the burn room at termination. Upon examination of the box spring, there was a 2-ft diameter char on that item also. Smoke build-up in all areas of the house was heavy and very irritating to the eyes and nose. The basement area only had a slight amount of smoke.

Test No. 48 was the second in the Bedroom A series. For this test doors to Bedrooms B, E, and F were closed. Several seconds before the test commencement the air conditioning was again shut down. The test furniture was a cotton padding filled innerspring mattress placed on top of a box spring. A cotton spread was placed over a portion of the corner of the mattress. Two shirts, a pair of pants, and a rag were placed along the perimeter of the cotton spread. The fire was initiated by placing the charcoal igniter on the spread to produce smoldering. The test was started at 3:00 p.m., Thursday, September 18.

Weather Conditions - Wind, NNW, 100 fpm. Sunny and clear. Relative humidity, 80 percent. Temperature, 69.5 F.

Time After
Ignition, Sec

Test No. 48 - Observations

150	Charcoal igniter removed.
180	Charcoal igniter reapplied and reenergized.
233	First smoke noted, rising to ceiling at slow rate.
300	Igniter again removed. Heavy smoldering. As the source is removed, the smoldering decreases rapidly.
320	Only slight smoldering.
360	Detectors alarmed in burn room due to "puff" of smoke produced by application of igniter.
900	Char spread uniform from U-shaped mark. Light smoke.
1200	Circular char 1-ft in diameter. Light smoke from center of circle. Light, hazy build-up in ignition room.
1380	Bedroom B clear. Slight build-up in Bedroom A.
1800	6 in. diameter hole in center of char area.
2100	Char spreading over edge of mattress. Smoldering increasing, probably due to increased draft at edge of mattress.
2700	Char area 2 by 2-1/2-ft extending over edge of mattress. Most smoldering at edge of mattress, gradually increasing.
2760	Tornado-shaped smoke column from edge of mattress. Heavy smoldering at that point.
3180	Smoke from edge of mattress drifting to north wall of Bedroom A.
3180	Smoke build-up in the first floor hallway very irritating to the nose and eyes. Visibility still good.
3480	Smoke generation moderate to heavy. Most of smoldering at edge of hole in char area.
3600	Heavy smoke build-up in burn room. Heavy smoldering.
3780	Char area 2-1/2-ft in diameter extending over edge of mattress. Most smoldering from edge.
4020	Smoke build-up in ignition room still heavy. 35 percent transmission on ceiling photobeam. 62 percent transmission on wall photobeam.
4200	Test terminated.

After termination, defined stratification at the 3-1/2-ft level in the ignition room and first floor hallway. The second level hallway was completely filled with dense smoke. Very little smoke was found in the upper bedrooms. Bedroom B had light, hazy smoke, fairly uniform throughout the room.

Test No. 49, in Bedroom A, was conducted with all interior doors open - all windows closed. A waste basket full of trash was placed near the side of a mattress box spring with a section of newspaper draped over the edge of the mattress approximately 6 in. from the top of the waste basket. Flaming was started by lighting a piece of paper and dropping it in the top of the waste basket. Test No. 49 was started at 5:00 p.m., Thursday, September 18.

Weather Conditions - Wind, calm. Sunny and clear. Relative humidity, 82 percent. Temperature, 68.5 F.

<u>Time After Ignition, Sec</u>	<u>Test No. 49 - Observations</u>
25	Flames 6 in. to 1-ft high in waste basket.
90	Flames 6 in. above top of waste basket.
135	Small puff of smoke from waste basket.
165	More smoke from waste basket.
340	Flames barely visible out of top of the waste basket. Moderate smoke.
450	Section of newspaper ignited and placed in waste basket.
495	First visible flaming on newspaper section draped over mattress; flames are yellow, 6 in. high, all along paper edge.
520	Slight smoke drifting from newspaper fold away from flames.
555	Some smoke appearing at edges of the mattress. Apparently smoke is penetrating mattress interior.
575	Black smoke generated from burning newspaper. Flames are 2 to 3 in. high. Flames from waste basket are 6 in. high.
600	6 in. flames on one corner of mattress.
610	6 in. high yellow flames from one corner of newspaper. Smoke issuing from slashes around edges of mattress.
705	Small area of flames coming from one-half of newspaper section; 2 to 3 in. high. Smoke issuing from sides of mattress.
750	Defined level of smoke at 3-ft level, heavy to ceiling.

Time After
Ignition, Sec

Test No. 49 - Observations (Cont'd)

795	Large amount of smoke from top section of mattress diagonally opposite newspaper section. 6 in. high flames half way along top edge of mattress.
810	Smoke very dense in ignition room.
825	Only visible flames are from top edge of mattress.
870	1-ft high flames around top right-hand edge of mattress.
900	Time clock cannot be seen at distance of 15-ft. Visible flames underneath mattress.
1020	Test terminated.

Upon entering the residence after termination, all areas in the house were dense with smoke.

Test No. 50 was the next test in Bedroom A. Windows were again opened as described in the living room series. All interior doors were opened. A smoldering fire was attempted on a cotton innerspring mattress covered with a cotton spread and three other articles of clothing laid on the perimeter of the spread. The mattress itself was cotton filled and placed on an aluminum frame so that the bottom of the mattress was approximately 1-1/2-ft off the floor. The charcoal igniter was placed on the spread. The air conditioning was not operated prior to starting the test. Test was started at 10:30 a.m., Friday, September 19.

Weather Conditions - Wind, south, steady at 180 fpm. Cloudy. Rained in morning, occasional drops during test. Relative humidity, 94 percent. Temperature, 66.5 F.

Time After
Ignition, Sec

Test No. 50 - Observations

80	First smoke noted.
95	Smoke column rising to ceiling with moderate generation.
120	Removal of igniter lifts spread and it bursts into flames.
140	Flaming continuing.
180	Flames visible from area of char now spreading uniformly from U-shaped mark. Flames are yellow and 1/2 in. high all around mark.
225	Slight smoldering from char area.
250	U-shaped mark completely charred. Char is 1-ft in diameter. Slight flaming.

Time After
Ignition, Sec

Test No. 50 - Observations (Cont'd)

300 Smoldering increasing with glowing embers around hole that develops in mattress.

360 Char area extends over side of mattress. Hole in bedspread is 6 in. in diameter.

375 Light smoke generation.

465 All detectors in Bedroom A and first floor hallway had alarmed at this point. No visible flames from 1-ft square char area. Only slight smoldering.

540 Edge of bedspread started to flame with a height of 5 to 6 in., burning along edge in both directions.

590 Flame fronts 1-ft apart on edge of spread.

610 Flames at head of spread, yellow and 6 in. high. Smoldering from main char section.

630 Edge of spread being blown by air currents due to heat of char.

636 Full length of spread burning. Pair of pants on fire with yellow flames 2 to 3 in. high.

730 Dress at back portion of spread in flames, yellow, 1 in. high. Pants have 2 in. high yellow flames, and mattress has 3 in. high yellow flames from the spread.

790 All smoldering coming from top section of spread and area over edge of mattress. Flames visible from pants, dress, and top of the spread.

870 Flames at pants, left side of spread, middle of char area 1 in. yellow flames from white dress along north edge of spread. West edge of spread has 2 in. yellow flames. Most of smoldering from middle of char area and edge of mattress.

925 The north edge of dress has 2 in. high yellow flames traveling along that edge. Only one small 1 in. high flame visible from pants on east edge of spread. Spread itself has yellow 2 in. high flames. Heavy smoldering from main char area.

1030 1 in. high flames at west edge of dress and spread. 2 in. high flames from pants. The sweater on northeast edge of spread not ignited at this point.

1110 Distinct stratification at 3-ft level. Smoke very dense from that level to ceiling.

Weather Conditions - Wind, NNE, 100 fpm. Cloudy, started to rain 48 min into test. Relative humidity, 96 percent. Temperature, 61 F.

<u>Time After Ignition, Sec</u>	<u>Test No. 51 - Observations</u>
53	First smoke.
90	Igniter removed, smoldering diminishes to slight.
145	Cotton spread is draped over char mark on mattress left by igniter.
180	Slight breeze from first floor hallway into Bedroom A.
240	Slight smoking throughout spread.
330	Brown areas appearing on spread, slight smoke generation.
435	Smoke drifting to north side of room.
695	Smoldering is slight on north side of bedroom. Not irritating to nose.
750	Instrumentation shows slight smoke build-up at 5-ft level in Bedroom A and holding. Char area 2 by 4 in. rounded at corners and slightly brown. Smoke coming from darkest end of char and drifting to north wall at 20 deg angle from floor.
1140	Wind blowing into north window of Bedroom A. Smoke blowing in north-northeast direction. Char area 3 in. diameter.
1800	Char circular and 1-ft diameter. Slight to moderate smoke generation.
1940	Smoldering traveling down two folds in bedspread.
2040	Smoke generation increased to moderate.
2310	Smoke drifting vertically to ceiling.
2820	Char reaches edge of mattress. Moderate smoldering at char fringes.
2895	Slight rain drizzle developing out-of-doors.
3000	Defined layer of smoke at 6-ft level in Bedroom A slowly drifting downward and stabilizing at 5-ft. Layer very light and hazy.
3120	Air flow out of Bedroom A window, smoke drifting slowly out top half of window. Smoke layer getting denser at 5-ft level in burn room.
3210	Swirling effect from char center in counter-clockwise direction drifting slowly and vertically to ceiling.

Time After
Ignition, Sec

Test No. 51 - Observations (Cont'd)

3300 Circular char 1-1/2-ft diameter and 2 in. over edge of mattress.

3450 Moderate smoke generation, drifting in northerly direction.

3540 Smoke increase at edge of mattress.

3840 Moderate to heavy smoldering - heavier at mattress edge. Smoke drifting in northerly direction. Large gusts of wind entering Bedroom A window.

3975 Edge of char increasing in length.

4140 Char extends across width of mattress - most of smoldering from south edge of mattress.

4440 Northern edge of char area visibly smoldering. 30 percent of bedspread charred.

4680 Only slight smoke build-up in living room. Moderate to heavy smoldering at edge of mattress.

5040 Heavy smoldering. Build-up very irritating to eyes and nose in Bedroom A.

5100 Heavy smoke generation from area of dress.

5220 Slight smoke build-up in living room; steady air flow through window. Most of the smoke in first floor hall moving rapidly into Bedroom B; not much entering living room. Smoke traveling at 5 to 6-ft level. Build-up in Bedroom B quite heavy.

5430 Smoke build-up in living room gradually increasing. Char area over mattress edge is 2-ft in length. Heavy smoke generation from that point. Smoke build-up in Bedroom B is uniform.

5580 Smoldering through depth of mattress. Shreds of charred material hanging from bottom of mattress. Smoke swirling in counter-clockwise direction above center of char area.

5670 5-ft high light beams show 77 percent transmission in second floor hallway, 82 percent in first floor hallway, and 50 percent in Bedroom A.

5760 Air flow fluctuating in and out at living room window.

5820 60 percent of bedspread charred. Heavy generation from all fringe areas.

Time After
Ignition, Sec

Test No. 51 - Observations (Cont'd)

5880	Smoldering on bottom of mattress gradually increasing from moderate to heavy.
6120	Smoke build-up in Bedroom B much heavier than in living room.
6210	Light transmission at the 5-ft level 75 percent in second floor hallway, 80 percent in first floor, and 44 percent in burn room.
6300	Heavy white smoke from fringe areas of char, probably due to large hole which developed in middle of char extending completely through mattress. In burn room at 3 to 4-ft level, air clear and visibility good.
6480	Dining room and top of basement stairs relatively clean. Kitchen has light haze. Visibility upstairs good, but acridity very bad.
6720	Heavy smoke pouring from Bedroom A window.
7080	Smoke in first floor hallway barely embracing one end of 5-ft high light beam. Smoke in kitchen was at 6-ft level. Smoke flows through doorways from first floor hallway to connecting compartment to kitchen. Appearance of water flowing over dams.
7200	Light haze in upper part of dining room. Heavy smoldering from mattress.
7380	Bottom of the mattress falls to floor and bursts to flames, yellow and 6 in. high. Heavy smoke generation. Heavy flames from chars, 6 in. to 1-ft high at char hole.
7440	6 in. high flames around interior of char hole.
7456	Test terminated.

Upon termination of the test, approximately one-half of the mattress was in flames, 1-1/2-ft high and yellow.

Test No. 52 was identical to Test No. 51 except the westerly window on the north wall of Bedroom A was open and the easterly window closed. Any air flow through the bedroom would then have to pass directly over the test mattress. Just before test commencement, air flow through the living room window was slight. There was a slight draft in the Bedroom A window. Test was started at 11 a.m., Monday, September 22.

Weather Conditions - Wind, west, 200-250 fpm, gust to 450-500 fpm. Cloudy. Relative humidity, 74 percent. Temperature, 54.5 F.

Time After
Ignition, Sec

Test No. 52 - Observations

55 Slight acrid odor.
66 First smoke.
75 Smoke column pushed to south side of room.
120 Igniter removed. Char mark covered with pair
of pajamas.
180 Slight smoke being generated at slow rate
underneath pajamas. Smoke drifting in all
directions in burn room.
405 Smoldering sufficient that smoke drifts slowly
out lower half of bedroom window.
455 Large gust of wind through Bedroom A window
moves smoke.
1020 Char area is a 1-ft by 6 in. rectangle. Smoke
irregularly drifts in and out of window.
1275 Glowing embers on pajamas in center of char.
Moderate smoke generation.
1950 Charring spreads to lightweight jacket placed
next to pajamas. Light to moderate
smoldering.
2120 Moderately heavy smoldering. Smoke swirling
in counterclockwise column. Glowing embers
still visible in char section.
2520 Living room clear.
2580 First floor level clear. Smoke from burn
room cascading under bedroom door lintel
and up to hall ceiling detectors. No
visible smoke at 5-ft level at that location.
2820 Two-thirds of char area in ashes. Glowing
embers visible on fringe areas. Char is
rectangle, 1-1/2 by 2-ft.
3600 Char is a 2-ft diameter circle. Smoldering
at outer fringes. Approximately 75 percent
of char is ashes, exposing inner mattress.
Moderate smoldering.
3900 Smoldering on underside of mattress.
4500 Char circular and 3-ft diameter. Moderate to
heavy smoldering. Large gusts of wind
through Bedroom A window.
4800 Char extends to edge of mattress.
5400 Char on side of mattress near window is
6 in. long by 3 in. high. Slight
smoldering.
5580 Heavy smoldering.
5700 Low heat generation felt 2-ft from char.
Heavy smoldering on underside of mattress.

Time After
Ignition, Sec

Test No. 52 - Observations (Cont'd)

5880	Flames 6 in. to 1-ft high and yellow along side of mattress; spreading along lightweight jacket. Very dense white smoke from fringes of flame on jacket.
6000	Flames 6 in. to 1-ft high around half of circular char. Test terminated.

At test termination, all exit routes throughout the residence were heavy with smoke.

LIVING ROOM

For Test No. 53 all burn room instrumentation was moved back to the living room. The detector board located in the center of the ceiling in Bedroom A was moved to the center of the ceiling in the living room. The board from the head of the basement stairway was mounted just above the light beam on the north wall of the living room at approximately the 9-ft level. The mechanically-operated devices were mounted 6 in. from the top of the ceiling. All bedroom windows as previously described were open. The window in the living room was closed. All interior doors were open. The test furniture was a sofa section with one cushion. The padding in the sectional back was 1/2 in. cotton covered with upholstery of rayon pile on cotton/rayon backing. The cushion was innersprings covered by 1/2 in. cotton and thin cotton/acetate material. For this test the charcoal igniter was placed at the lower left portion of the sectional back with one bar slightly below the top of the cushion. There was a 1/2 in. gap between the igniter and the seat cushion. The test was started at 3:00 p.m., Monday, September 22.

Weather Conditions - Wind, west, steady at 500 fpm. Sunny and clear. Relative humidity, 64 percent. Temperature, 60 F.

Time After
Ignition, Sec

Test No. 53 - Observations

67 First smoke.
90 Igniter removed. Smoke column rising to ceiling and dispersing.
120 No visible smoldering.
180 Iron reapplied (hot upon application). Smoke column rising to ceiling at moderate rate.
210 Igniter removed; smoldering somewhat diminishes.
225 Smoke column shifts slightly to south.
360 Slight smoldering increase.
390 Smoke build-up at living room windows, slowly drifting and hanging at 7 to 7-1/2-ft level.
720 Light to moderate smoldering. Char area spreading upward on back of sectional in uniform manner.
750 Back of seat cushion has a char 5 in. in length.
810 Light smoke visible in living room, no stratification.
840 Moderate smoldering.
960 Moderate smoke generation from back of cushion in a steady rapid stream rising to ceiling.
1110 All wall mounted detectors in living room in alarm.
1230 All detectors located in living room alarmed.
1320 Smoke build-up in living room uniform to 8-ft, slightly heavier above. Smoke slightly irritating to nose and eyes.
1800 The U-shaped mark filled in by charring. Moderate smoldering, smoke flow rate very rapid. Char area is 1-ft radius semicircle on back of sectional. Char area on seat cushion cannot be distinguished from viewer's perspective.
2180 Faint ember glow at intersection of cushion and back. Char on cushion is 1-ft radius semicircle extending 3 to 4 in. over top of seat cushion. Moderate to heavy smoldering.
2460 Glowing no longer visible. High rate of smoking suggests heavy smoldering somewhere in furniture interior.
2495 Smoke from underneath sides of cushion.
2580 Char area moving up back of sectional. Slight glow noted at seat cushion edge.

Time After
Ignition, Sec

Test No. 53 - Observations (Cont'd)

2605	First flame noted - yellow, 1-ft high at edge of seat cushion.
2625	Heavy smoke generation and 6 in. high, yellow flames from char area.
2640	6 in. high, yellow flames restricted to one edge of seat cushion.
2670	Flames visible from base of chair. Flames spreading down side of chair, 1-ft in height.
2700	Test terminated.

Upon entering the residence after test termination, flames were located down the edge of the sectional and were 1-ft high and yellow. Small flames visible underneath the sectional. Smoke build-up in the living room was extremely heavy. Little or no smoke in the basement and at the top of the basement stairway. Slight build-up in the kitchen area and dining room. First floor hallway was slightly heavier with moderate build-up in the first floor bedrooms. Visibility was quite good on the first floor level except in the living room. Smoke level on the second floor was moderate.

BASEMENT SERIES

Test No. 54 was the first in the basement series. Those detectors mounted on the ceiling in the living room in the previous test were installed on the center beam of the basement which extended approximately 10 in. down from the ceiling. The detector board was mounted at the bottom of the beam so that it was flush with the side nearest the fire bay area. Those detectors mounted on the wall in the living room were replaced at the top of the basement stairway. A 5-ft light beam supporting a thermocouple array was placed adjacent to the detector board in the basement. One gas-sampling tube was located on the west wall. Two samples of each thermally-actuated device were mounted approximately 10-ft from the fire and 6 in. from the ceiling; one each in the center of the basement on the center column and the other two on the south wall in the fire bay area. All bedroom windows were allowed to remain open for this test as previously described; the living room window remained closed. All interior doors of the residence were open. The test furniture was a sectional sofa having an odd cushion.

The sectional material was acetate pile on cotton/rayon base covering 1 in. of cotton batting over burlap. The cushion was acetate design on cotton/rayon base covering 1 in. of cotton batting over springs. A smoldering fire was initiated by placing the charcoal igniter at the left portion of the sectional back about 1 in. below the top of the cushion but not touching that cushion. The fire was started at 9:45, Tuesday, September 23.

Weather Conditions - Wind, south, 300-400 fpm. Sunny and clear. Relative humidity, 65 percent. Temperature, 62 F.

<u>Time After Ignition, Sec</u>	<u>Test No. 54 - Observation</u>
72	First smoke.
90	Igniter removed. A small puff of smoke results. Smoldering diminishes to slight.
150	Igniter reapplied. Smoke column rising directly to ceiling, spreading uniformly throughout living room.
165	Igniter removed. Smoldering continues.
240	Slight smoldering. Smoke follows contour of sectional back and rises directly to ceiling.
540	Smoldering increasing slightly. Char area spreading uniformly upward. Smoke column rising vertically to ceiling.
660	Slight build-up of smoke in living room from ceiling to 5-ft level.
885	Column of smoke at right rear of sectional. Charred area completely covers U-shaped mark. Moderate smoldering. Smoke pouring from slash in rear of sectional.
930	Two distinct columns of smoke visible; one at front of sectional and one at rear. These columns are approximately 3-ft apart.
975	Fire bay area filled with smoke. Smoke rolling over 10 in. beam in center of basement where detector board is mounted. Distinct stratification at 6-ft height.
1080	Smoldering moderate to heavy from char areas.
1200	More smoke build-up in fire bay area than in bays away from fire. Distinct stratification in fire bay, very dense smoke from 5-ft level up. All detectors in basement in alarm.
1260	Heavy smoldering. Smoke build-up very dense above 5-ft level. Visibility very poor.

Time After
Ignition, Sec

Test No. 54 - Observation (Cont'd)

1500	Living room clear. Slight build-up in kitchen and dining room area from 5-ft level and up. Very slight smoke build-up in first floor hallway. Other areas of house are clear.
1620	Defined stratification at 3-ft level in basement - very dense smoke above. Still passable below 3-ft level. Smoke slowly drifting up stairway to first floor.
1800	Test furniture not visible from 25-ft. Smoke build-up slightly denser in fire bay area about 5-ft level.
1980	Light transmission level 10 percent over 5-ft distance at basement beam.
2160	Living room and Bedroom B clear. Slight smoke build-up in Bedroom A and at 5-ft level in first floor hallway. Smoke uniform in dining room and kitchen, slightly heavy. Basement build-up extremely heavy.
2700	Transmission level at 5-ft was 90 percent in second floor hallway; 60 percent in first floor hallway. Still an escapable route from bedrooms.
3300	Large quantity of smoke exiting Bedroom A window. No stratification in Bedroom A. Small quantity of smoke exiting Bedroom B window.
3510	Basement temperature, 78 F.
3840	Test terminated.

Upon entering the residence after test termination, smoke build-up in the living room was moderate to heavy, marginally passable. The same goes for the other rooms in the residence except the basement where build-up was extremely heavy. It should be noted that the test furniture never flamed during this test.

Test No. 55 was obviated by loss of detector operating times.

Test No. 56 was the next test in the basement series. Prior to starting the test fire, the air conditioning system was operated so that a temperature differential could be established between indoor and outdoor conditions. All exterior doors and windows were closed. All interior doors were open. A smoldering fire was initiated on a rocking chair by placing the charcoal igniter in the lower right portion of the back of the chair with the lower arm of the igniter at the top of the seat cushion, but not touching the cushion. The test furniture itself was 1/2 in. cotton batting over jute upholstered with rayon pile on cotton/rayon base. The cushion was 1/2 in. cotton over springs upholstered with nylon pile on cotton/rayon base. The test was started at 2:30 p.m., Tuesday, September 23.

Weather Conditions - Wind, ESE, steady at 200 fpm. Partly cloudy. Relative humidity, 56 percent. Temperature, 67.5 F.

<u>Time After Ignition, Sec</u>	<u>Test No. 56 - Observations</u>
65	First smoke.
75	Smoke column follows contour of chair, rises to ceiling.
85	Moderate smoldering.
90	Igniter removed. Smoldering diminishes.
120	No visible smoldering.
150	Hot igniter reapplied in same area.
154	Heavy smoke column produced rising directly to ceiling.
165	Igniter again removed. Smoldering diminishes to slight.
420	Light haze in burn room.
900	Small thin column of smoke originating from char, rising directly to ceiling. Char spreading uniformly up back of chair.
1500	Half of U-shaped mark filled by char. Slight smoldering via thin smoke column from char.
2400	Igniter reapplied to same area. (Igniter heated up 30 sec before application.) Char is 6 in. diameter.
2425	First smoking from this application noted.
2460	Igniter again removed. Heavy smoldering until removal - smoldering diminishes rapidly upon removal.
2490	No smoldering apparent from seat cushion.
2550	Cushion smoking slightly.

Time After
Ignition, Sec

Test No. 56 - Observations (Cont'd)

2580 All detectors in burn room in alarm.
3600 Light to moderate smoldering from char on seat cushion. No smoldering from chair back. Slight build-up in burn room.

3810 Char area fanned to increase smoldering.
3840 Fanning ceased.
3820 Char again fanned.
3900 Fanning ceased. Moderate smoldering from seat cushion.

4260 Smoldering from all top sections of seat cushion.

4380 Igniter preheated.
4440 Igniter applied to a different location - left portion of back at base of seat cushion.
4500 Igniter removed and applied to seat cushion.
4560 Igniter removed. Heavy smoldering diminishes to moderate upon removal. Layer of smoke in fire bay area from 6 ft level up. Clear to floor.

4980 Smoldering fanned.
5010 Fanning ceased.
5040 Fanned for 30 sec.
5100 Char on seat cushion 1-ft square in right corner. Moderate smoldering.

5400 Cigarette lighter applied to upholstery at lower right flap at base of chair.
5407 1 in. high flame at point of application.
5430 Flames move up arm of chair.
5440 Flames 6 in. high, orange in color.
5450 1-ft high flames on each arm.
5505 Flames 6 in. high.
5730 Flames 10 in. high, yellow, along front edge of seat cushion.

5835 6 in. high flames on right bottom edge of chair arm.
6000 10 in. high flames along front edge of seat cushion. Flames on back portion of chair arm 3 to 4 in. high. Visibility very poor in basement.

6120 Flames on front of cushion have decreased leaving 1 in. flame. Flames on top of chair arm 2 to 3 in. in height.

6300 Small, slender 5 in. high flame on rear of chair arm.
6315 1-ft high flames on arm. Back of chair also in flames; flame height difficult to determine due to dense smoke build-up in burn room.

Time After
Ignition, Sec

Test No. 56 - Observations (Cont'd)

6844	Large burst of flame from back of chair. Temperature rising very quickly in burn room. Freon operated horn on beam and both bells alarm.
7100	The second freon operated horn (mounted on south wall) alarms due to another large burst of flame.
7200	Test terminated. Visibility near zero in the basement.

Test No. 57 was the next test in the basement series. For this test, the only windows open in the residence were on the second floor. For this test, only one set of bells and horns were used, and these were located in the center of the basement on the center beam. The test furniture was a sofa section having no arms. The back portion of the furniture was upholstered with a thick cotton covering a 1/4 in. cotton pad over animal hair. The seat cushion was 1 in. cotton over springs upholstered with a wool design on cotton base. A smoldering fire was initiated by placing the charcoal igniter at the lower left portion of the back of the sectional approximately 1 in. from the top of the seat cushion, and just touching the cushion. The test was started at 10:00 a.m., Wednesday, September 24.

Weather Conditions - Wind, north, 400-450 fpm, gusting to 650 fpm. Sunny and clear. Relative humidity, 64 percent. Temperature, 60 F.

Time After
Ignition, Sec

Test No. 57 - Observations

80	First smoke.
120	Igniter removed.
150	Light to moderate smoke generation, following contour of sectional and rising to ceiling.
210	Moderate smoke throughout fire bay area at 6-ft level and up.
360	Smoke cascading under 10 in. beam running across center of basement. Light smoke build-up stratifying at 4-ft level.
420	Light haze reaches opposite end of basement. Defined stratification at 4-ft level more prominent in fire bay than in opposite bay.
510	Glowing ember noted at lower left portion of char. Char areas spreading uniformly.

Time After
Ignition, Sec

Test No. 57 - Observations (Cont'd)

600 Smoke build-up heavier in fire bay and slowly drifting to east wall of basement. Light layer at 4-ft level still prevalent. Moderate to heavy smoldering.

660 Smoke level rising to 5-ft level.

690 Smoke build-up drops once again to 4-ft level.

720 Light gray smoke generation at moderate to heavy rate. Most of smoldering at intersection of sectional back and cushion.

780 Smoke build-up in fire bay approximately twice that in other bay.

920 Glowing embers noted at top of char. Heavy smoldering from intersection of seat and back.

1200 Char on sectional back 1-ft in diameter. Smoke level in opposite bay more defined at 5-ft level and slowly dropping.

1440 No defined stratification at this point. Smoke build-up now fairly uniform in basement, however, slightly heavier at ceiling. Smoke slowly drifting or hanging with very little movement.

2100 Visibility at 30-ft very poor; at 10-ft very good. Basement passable close to floor. Char area 2-ft diameter circle extending to left edge of test furniture.

2340 Smoke very irritating to eyes in basement.

2700 The 12 in. diameter time clock near sofa can not be viewed from 30-ft.

2920 Both test furniture and time clock still not visible from 30-ft.

3190 Transmission level at 5-ft in second floor hall was 92 percent - first floor hall was 80 percent.

3290 Flames at intersection of back and cushion, 6 in. in height.

3333 Rapid build-up. Flames difficult to view, estimated 1-ft in height.

3388 Flames appear to be moving up back of sectional. Approximate flame height, 1-1/2 to 2-ft.

3465 Smoke build-up beginning to spread quickly through basement.

3600 Quick burst of flame from sectional back.

3687 Basement temperature, 180 F.

3800 Test terminated.

Upon entering the residence after termination, the build-up in the living room was uniform and slightly heavy. Build-up in Bedroom A was also heavy, along with that area in the kitchen and dining room. Suprisingly, Bedroom B was relatively heavy. The first floor hallway was passable at low levels close to the floor. The basement was untenable.

Test No. 58 was also conducted in the basement. For this test all bedroom windows were allowed to remain open in the manner previously described. The living room window was again closed. All interior doors were open. The test furniture for this test was two matching chairs having wooden legs, each chair having 3/4 in. cotton covering a thin layer of jute covering springs. Upholstery was a thin cotton/cotton-rayon weave. The chairs were placed side by side with a wastebasket full of trash placed between them. Chairs were spaced approximately 1-ft apart. The wastebasket was touching the right chair and approximately 1 in. from the left chair. A newspaper section was draped over the left arm of the right-hand chair extending about 1-ft from the top of the wastebasket. A flaming fire was initiated by placing a lit match in the top of the wastebasket. The test was started at 11:50 a.m., Wednesday, September 24.

Weather Conditions - Wind, NE, 100-300 fpm, gusting to 450 fpm. Sunny and clear. Relative humidity, 58 percent. Temperature, 62 F.

<u>Time After Ignition, Sec</u>	<u>Test No. 58 - Observations</u>
15	2 to 3 in. high flames at top of wastebasket.
30	Flame area 6 by 3 in. with a height of 2 to 3 in.
60	Slight smoking.
85	Smoking increasing. Flame height 4 in.
120	Arm of right-hand chair on fire. Flame height 3-ft from wastebasket.
220	Light column of smoke from arm with flames 2 to 3 in. high. Wastebasket flames yellow and 6 in. high.
205	Edge of newspaper on fire. 1-ft high flames from wastebasket. 2 to 3 in. high flames on arm of right-hand chair.
275	5 in. high flame on back of arm of right-hand chair. 1-ft high flames from wastebasket. Slight smoldering from newspaper.
315	Burst of flame at left base of right-hand chair nearest wastebasket.
325	Flames on right chair arm 1-ft high.

Time After
Ignition, Sec

Test No. 58 - Observations (Cont'd)

350 3 in. high flame on right chair arm. 1-ft high flame from wastebasket. Defined level of smoke in fire bay at 5-ft level.

385 Flames over top edge of arm on right-hand chair 1 in. high. Flames from wastebasket 1-ft in height.

420 Stratification dropping slowly to 4-1/2-ft level in fire bay.

430 Moderate to heavy smoldering from arm of right-hand chair. Flames in wastebasket 1-ft high. No flaming from newspaper.

600 All detectors in basement, at head of basement stairway, and in first floor hallway had alarmed at this point.

635 Moderate smoldering from wastebasket and chair arm. No visible flames except those extending 1 in. above top of wastebasket.

690 Flames continuing on inside of arm of right-hand chair. Slight flaming from wastebasket.

800 Well-defined smoke layer in entire basement at 5-ft level.

840 Occasional flicker of flames from wastebasket extending 2 to 3 in. above top.

850 Heavy dark gray smoke from wastebasket.

900 Defined layer at 5-ft level growing denser. Smoke laying lazily in room with very little movement.

990 Small candle-like flame at interior of arm on right-hand chair. No other flames visible.

1020 Moderate to heavy smoke from wastebasket.

1200 Defined smoke layer at 4-1/2-ft level - light haze to floor.

1380 Left-hand chair removed from fire area since no smoldering or flaming could be distinguished. Right-hand chair ignited on back with cigarette lighter.

1415 2 to 3-ft high flames from back of chair.

1450 Flames diminish to 6 in. high over top of chair.

1485 Piece of flaming material drops to floor, underneath chair, with 2 to 3 in. high flames.

1500 Stratification no longer evident. Dense, uniform build-up in basement.

1512 No visible flaming from chair.

1535 Flames again visible from rear of chair.

Time After
Ignition, Sec

Test No. 58 - Observations (Cont'd)

1635	Flames diminish. Heavy smoldering. No stratification at this point.
1790	Flames from wastebasket 1-ft high.
1820	No flames from wastebasket.
1920	Visibility at 30-ft was good for light-shaded objects, but poor for darker shades.
2010	Light blue flame visible at rear of chair.
2100	3 in. flame along left side of seat cushion and arm of chair.
2225	Time clock viewed with difficulty from 30-ft.
2400	Only two candle-like flames visible at front of chair with a height of 1 in.
2700	Second hand of clock no longer distinguishable.
2738	All flames died down except for one small 6 in. high flame on chair arm.
2860	Both minute and second hand of time clock not distinguishable at this point. 2 to 3 in. high flames on chair arm.
2990	No visible flames White clock face not visible at this point.
3025	3 in. high flames on chair arm.
3212	Flames on seat cushion and chair arm 6 in. high.
3333	No visible flaming.
3423	1-ft high flames on back of chair.
3530	Crackling heard from fire area, but no flames visible due to dense smoke build-up in basement.
3600	Test terminated.

Upon entering the residence after termination, the basement build-up was extremely heavy. Moderate smoke build-up noted in the living room, no stratification. Heavy smoke issuing from the kitchen into the first floor hallway. Build-up in Bedroom A was slightly heavier than in Bedroom B, but both only moderate. Build-up was heavy and uniform on the second level.

Test No. 59 was the last fire in the test series at the J. R. Whitehouse residence. For this test, two chairs were placed side by side approximately 1-ft apart. Between the two chairs a plastic wastebasket was placed, filled with assorted trash. The wastebasket was 10 in. in diameter and 15 in. high. The side of the wastebasket was marked and separated into four divisions so that the amount of burning of the wastebasket could be monitored throughout the test. A section of newspaper was draped over the right arm of the left-hand chair and was approximately 1-ft above the wastebasket. For this test, all bedroom windows were open and living room window closed as previously described. The edge of the wastebasket was approximately 1/2 in. from the edge of each chair. The left-hand chair was that salvaged from Test No. 58. The right-hand chair was 1 in. of cotton over 1/2 in. jute upholstered with a rayon pile yarn on a cotton ground warp and filling. A flaming fire was initiated by placing a lit match in the top of the wastebasket. The test was started at 2:30 p.m., Wednesday, September 24.

Weather Conditions - Wind, ENE, 100-300 fpm, gusting to 450 fpm. Sunny and clear. Relative humidity, 51 percent. Temperature, 65 F.

<u>Time After Ignition, Sec</u>	<u>Test No. 59 - Observations</u>
13	3 in. high flames at front of wastebasket.
20	Flames diminish.
40	6 in. high flames from front of wastebasket.
55	Slight smoking, rising rapidly to ceiling from wastebasket.
75	Side of the right-hand chair in flames. Front of wastebasket begins to melt down to lower one-fourth section.
90	Flames 2-ft high from wastebasket and edge of chair.
105	Flames 3-ft high from wastebasket. Front of the wastebasket melted away to floor level.
120	Left-hand chair arm chars.
140	Newspaper in flames - 1-ft high and yellow. Wastebasket flames 2-ft in height. Frame of wastebasket completely melted away. 1-ft high flames on right-hand chair.
190	6 in. high flames from wastebasket, 1-ft high flames from one arm of each chair, and 3 in. high flames along one edge of newspaper.

Time After
Ignition, Sec

Test No. 59 - Observations (Cont'd)

220 Moderate smoldering from underneath newspaper section.

240 Wastebasket melted into a puddle, stringing down from trash that filled basket. 1-ft high flames in that area. Wastebasket burned away before trash.

300 Ashes flying up from area of wastebasket. Puddle from wastebasket burning with 3 in. high flames along with 6 in. high flames from trash. 1-ft high flames on left-hand chair and 6 in. high flames on right-hand chair arm. 3 in. high flames from newspaper.

330 Moderate smoke generation from right-hand chair arm.

340 Most of flaming from left-hand chair 1-ft in height along arm.

360 Heavy ashes in vicinity of test area.

390 Heavy black smoke build-up in fire bay area.

420 2-ft high flames from right-hand chair arm.

440 Half of left-hand chair back charred with flaming along fringe areas. 1-ft high flames on that arm.

450 Heavy smoldering from back of left-hand chair. Flames on chair arm 2 to 3-ft in height. Flames from puddle of plastic 6 in. in height.

470 Smoke build-up in fire bay began to spread to other bay in main basement.

510 Heavy dense smoke build-up at 3-ft level.

525 3-ft high flames between chairs.

540 Moderate smoking of left-hand chair.

550 2-ft high flames from back of left-hand chair.

570 4-ft high flames from back of left-hand chair. Heavy, gray smoke generation from right-hand chair. Smoke build-up in basement was at 2-1/2-ft level.

620 Visibility very poor at 2 ft level to ceiling at short distance. Build-up slowly drifted down during course of fire.

635 The second hand of time clock no longer visible.

655 Very dense, black smoke in basement, making fire area difficult to describe.

675 Zero visibility in burn room.

838 Test terminated. Temperature extremely high and visibility zero at point of termination.

Upon entering the residence after termination, smoke build-up was heavy in all areas of the house with no apparent stratification. Basement was untenable and the test furniture had flames reaching to the ceiling making it hazardous to extinguish the fire.

WABASH AVENUE TEST SERIES:

Test fires Nos. 60 through 76 were performed at the Wabash Avenue residence between May 3 and May 11, 1976. These were conducted under conditions which represented spring conditions with the heating system operating. The heating system for this residence consisted of hot water baseboard convectors.

The instrumentation employed for this test series was as follows:

The first detector board (I), with Detectors 1, 2, 3, 4, 5, 21, and 30, was located on the ceiling in Hallway J on the second floor just outside Bedroom Z. Next to this, a group of Taguchi Semiconductor gas sensors (V), were mounted with Detectors 33, 34, 35, and 36. A 5-ft light beam and gas sampling tube was placed on the ceiling near these boards. In Bedroom Z (second floor), there was a 5-ft light beam and gas sampling at the 5-ft level.

The second primary detector board (II), with Detectors 16, 17, 18, 19, 20, 24, and 29, was located in Gameroom G (second level) on the ceiling at the top of the stairway. Five-foot light beams and gas sampling tubes were placed on the ceiling and at the 5-ft level in the same room.

Board III, with Detectors 6, 7, 8, 9, 10, 22, and 31, was located on the first floor in the living room. The board was mounted on the underside of a 1-ft square beam which ran through the center of the living room. The board was located in that portion of the room nearest the front of the residence. A freon horn and wind-up bell (thermal detectors) were mounted on the fire side of that same beam with the top of each unit 6 in. from the ceiling. Five-foot light beams and gas sampling tubes were located on the beam next to the detectors, and at the 5-ft level. A 5-ft light beam and gas sampling tube was located at the 5-ft level in Family Room F. No instrumentation in the kitchen.

The fourth detector board (IV), with Detectors 11, 12, 13, 14, 15, 23, and 32, was located on the ceiling in the center of Bedroom C on the first floor. In Bedroom A, there was a 5-ft light beam and gas sampling tube at the 5-ft level. There was no instrumentation in Bedroom B or C.

Thermocouple arrays were located at each 5-ft light beam located at the ceiling.

LIVING ROOM SERIES

Test fire No. 60, in the southern bay of the living room, (near Bedroom B), was a smoldering ignition of a recliner chair having rayon warp upholstery with rayon filling over 1 in. cotton padding. For all the tests described hereafter, all bedroom doors were open and all windows to the outside were closed. Doors between the family room, kitchen, and living room on level one were also open.

The fire was initiated by energizing the 500 w charcoal igniter at time zero and placing it at the right back portion of the recliner (facing front of test furniture). Test was started at 6:00 p.m., Monday, May 3, 1976.

Weather Conditions - Wind, NNW, steady at 250 fpm.

<u>Time After Ignition, Sec</u>	<u>Test Fire No. 60 - Observations</u>
70	First smoke noted.
90	Charcoal igniter removed. Smoldering diminishes rapidly upon removal.
180	Hot iron placed again in same area on test furniture for 30 sec. Smoke noted immediately.
240	Slight smoldering.
360	Slight smoke drifting to west wall of living room. Slight haze in southern bay at 6-ft level. Noticeable odor.
900	Slight to moderate smoldering. Faint haze at 4-ft level in area above test furniture in living room. Smoke still drifting in westerly direction.
1080	Stratification in southern bay of living room at 4-ft level. Level of stratification is slowly dropping.
1200	Stratification at 4 to 6-ft level. Above and below layer is relatively clear and not irritating to eyes or nose.
1380	Moderate smoldering. U-shaped mark left by charcoal igniter is almost a complete char.
1680	Stratification confined to southern bay of living room.
1780	Stratification slowly rising in what appears to be two different levels, one at 5-1/2-ft level, other at 6-1/2-ft level.
1860	Slight haze noted in first floor family room.
2340	Most of smoke buildup in southern bay from 5-ft level up, slightly dense. Smoldering is moderate to heavy.

Time After
Ignition, Sec

Test Fire No. 60 - Observations (Cont'd)

2640 All detectors in living room had alarmed at this point.

2760 Embers sighted at lower right edge of char area. Heavy smoldering at this point. South bay of living room has slightly heavier buildup than north bay. Smoke beginning to fill all areas of living room. At 5-ft level, smoke very irritating to eyes.

3000 Dense smoke buildup in living room from 6-ft level to ceiling, irritating to eyes and nose. Haze in family room gradually increasing.

3180 6 in. high flames noted from char area.

3210 1-ft high flames along back edge of seat cushion.

3300 Flames edging up back of chair, 2-ft high at seat cushion.

3360 White, billowy smoke from left edge of chair. 1 to 2-ft high flames from back of chair.

3423 Entire chair in flames. Entire chair in flames. Freon operated horn and wind-up bell operate simultaneously. Maximum flame height on chair was 3-ft.

3440 Test terminated.

Upon entering the residence after test termination, smoke was heavy moving up the stairway to the second floor, but not too heavy on the second level. Hallway J had little or no smoke buildup. Where there was buildup upstairs, it was uniform throughout the room. The first floor at test termination was heavy with smoke. Escape was possible at the 2 to 3-ft level from the floor.

Test No. 61 was similar to Test No. 60. The test furniture was a recliner upholstered in cotton/nylon on a rayon warp over 1/2 in. cotton padding. A smoldering ignition was initiated at 11:00 a.m., Tuesday, May 4, 1976.

Weather Conditions - Wind, west, calm. Relative humidity, 33 percent. Temperature, 67 F.

Time After
Ignition, Sec

Test Fire No. 61 - Observations

80	First smoke noted. Material is melting.
120	Charcoal igniter removed from test furniture. Smoldering diminishes to slight. Smoldering drifts to west wall of room.
300	At 15-ft, first faint smell of burning material is noted.
600	Small, glowing embers noted around fringe of U-shaped char. Smoldering slight.
660	Slight stratification noticed at 4-ft level in south bay of living room, just above test furniture area.
870	Layer of stratification slowly rising and falling from 4-5-ft level.
1065	Layer of stratification has risen to 5-1/2-ft level throughout entire living room. Near kitchen, smoke is more irritating to eyes and nose than in rest of living room. Area above and below stratification is very clear.
1200	Layer of smoke somewhat denser in western half of living room at 6-ft level. Layer 1-2-ft thick.
1380	U-shaped char now filled in and circular in shape. Char area has moved down to intersection with seat cushion and melting can be noted at that point. Layer of smoke between 5 and 6-ft from floor. Areas above and below are clear. Layer of stratification still denser in western portion of living room. Smoldering still only slight.
1620	Smoke drifting in westerly direction toward exit area of kitchen. Air very clear at entrance of Bedrooms A and B.
2100	Char area on lower right hand side of back of chair is approximately 1-ft by 6 in. There is 4 in. long by 2 in. wide strip on right back edge of seat cushion. Only slight smoldering. Layer of smoke now 2-ft deep, from 5 to 7-ft level in living room.
2340	The detectors that had alarmed in living room reset themselves for approximately 1 min and then start alarming again. This probably due to slow smoke buildup.
2640	Smoldering moderate.
2760	Buildup light and uniform in family room on first floor and up stairway.

Time After
Ignition, Sec

Test Fire No. 61 - Observations (Cont'd)

3000 Very slow buildup rate causing detectors to alarm intermittently. Detector 6, living room, not actuating for alarm crisply, but slowly stuttering.

3240 Buildup in living room more uniform; however, still slightly denser from 5-ft level to ceiling.

3300 Relatively little buildup in Bedroom C, however, detectors alarming.

3360 Uniform, light smoke buildup in kitchen.

3480 We now have situation where Detector 11 in Bedroom C is in alarm, but Detector 6 in living room is intermittent. (Same model.)

3900 Very little smoke buildup in Hallway J.

4080 Exit from living room by crawling on floor would be very uncomfortable at this point. Smoke very irritating to eyes and nose even at floor level. Visibility still fair in living room.

4320 Horizontal 1/4 in. diameter rib in upholstery seems to be hampering progress of char area on back of chair.

4980 Only smoldering is at char area on seat cushion. Little or no smoldering at back of test furniture.

5100 Little or no visible smoke in second floor Hallway J. Slight, uniform smoke buildup in game room. Buildup in first floor living room is now more uniform, stratification not noticeable; same for family room on first level. Smoke not visible on first level. Smoke not visible but very irritating to eyes and nose in this area.

5520 Pieces of clothing placed on char area to produce more smoldering. Smoldering slight.

6300 Smoldering increase to moderate.

6900 Moderate smoldering from uppermost part of pile of clothing.

7200 Detectors in living room, approximately 10-ft from fire, are still only alarming intermittently.

7260 Clothing lifted several inches, char fanned to induce more smoldering.

7320 Entire chair fanned to induce more smoldering.

7620 First flames noted, as result of fanning. Flames are 6 in. high, orange in color, on clothing. Flames gradually growing in intensity.

Time After
Ignition, Sec

Test Fire No. 61 - Observations (Cont'd)

7680	2-ft high flames along back of test furniture. Smoke buildup extremely dense from 4-ft level to ceiling in living room. Temperature is 155 F.
7740	Intense flaming of top center portion of chair back.
7980	75 percent of chair in flames, 1 to 2-ft high. Black dense smoke in room from 4-ft level to ceiling.
8040	Flames starting to decrease in height. Visibility nearly zero.
8280	The clock cannot be seen from outside eastern window. Flames visible from test furniture.
8400	Test terminated.

At test termination, 6 in. high flames were visible from the test furniture. Upon attempting to enter the front door of the residence through the family room, the smoke buildup was so dense as to be difficult to penetrate. The same remark applies to the back door of the residence where the test furniture was removed from the house. All areas of the second floor level were also very dense with smoke.

Test No. 62 was a smoldering fire in the living room. The test furniture was a rocking chair with cotton pile on rayon/cotton warp upholstery over 1/2 in. of cotton padding. For this test, the charcoal igniter was placed at the right-hand corner of the seat cushion (facing the front of the chair). The test was started at 3:00 p.m., Tuesday, May 4, 1976.

Weather Conditions - Wind, south, 400-550 fpm, gusting to 1200 fpm. Relative humidity, 36 percent. Temperature, 66 F.

Time After
Ignition, Sec

Test Fire No. 62 - Observations

65	First smoke noted.
120	Charcoal igniter removed. Smoldering diminishes from moderate to slight.
300	Smoldering only slightly visible.
1500	Slight smoke stratification at 5-ft level in south bay of living room.
1800	Smoke very irritating to eyes and nose at 5-ft level in living room. No noticeable smoke in Bedroom A, B, or C.
1920	Smoke noticeable in light beam at ceiling of living room.
1980	Moderate smoldering.

Time After
Ignition, Sec

Test Fire No. 62 - Observations (Cont'd)

2160	Smoke is drifting toward exit directly under detector board near kitchen.
2430	Most smoke buildup in south bay from 6-ft level to ceiling.
2820	Smoke buildup in Bedrooms A, B, and C very light. Uniform buildup in family room.
3000	Moderate smoldering.
3180	Embers noticed at intersection of chair arm and seat cushion.
3300	Small, glowing ember noticed at top of chair arm.
3600	Heavy smoldering from seat cushion and chair arm. Smoke buildup in living room is heavy from 7-ft level to ceiling, moderately heavy throughout remaining area. Visibility still excellent.
3840	Smoke buildup heavy from 6-ft level to ceiling in living room. Buildup light and uniform in bedrooms and family room on first floor. Smoke seems to be halting at top of stairway and not moving throughout second level.
4200	Level of smoke slowly dropping from 6-ft level down. Visibility very poor.
4500	The test furniture is just visible at a distance of 25-ft.
4980	First flames noted. 1-2-ft high on edge of arm. Flames gradually growing in intensity making their way along top edge of chair. Right-half portion of chair in flames.
5100	190 F in living room. Flames are 1-ft high.
5120	White, billowy smoke issuing from area of flames.
5210	Test terminated as a result of large flames on chair. Estimate is that flashover of fully furnished room would occur within minutes.

Upon entering the residence, after termination, the first floor area was filled with dense smoke. On the second level, smoke buildup was uniform, not very heavy, and very irritating to the eyes and nose.

Test fire No. 63 was a flaming fire in the same test area of the living room. For this test, an oval metal waste can approximately 1-ft by 6 in. by 1-1/2-ft high was filled with assorted paper and placed on the floor approximately 3 in. from the right side of an overstuffed chair. The chair was upholstered in rayon/cotton pile on a cotton warp over a 1 in. cotton pad. The fire was started by placing a match to the paper exposed at the top of the waste can.

The test was started at 6:00 p.m., Tuesday, May 4, 1976.

Weather Conditions - Wind, south, 250-350 fpm, gusting to 900 fpm. Relative humidity, 31 percent. Temperature, 64 F.

<u>Time After Ignition, Sec</u>	<u>Test Fire No. 63 - Observations</u>
10	6 in. high flames from top of waste can.
20	1-ft high flames from waste can.
75	Slight smoldering on arm of chair.
240	6 in. high flames from top of waste can. Slight smoldering on arm of chair. No photoelectric detector has alarmed at this point in living room.
270	Flaming diminished. Moderate smoldering.
320	More newspaper added to waste can in attempt to ignite chair.
340	2-ft high flames from waste can.
420	Slight smoke buildup in south bay of living room from 6-ft level to ceiling.
435	Section of newspaper laid over chair arm.
465	1-ft high flames on right arm of chair.
505	Bottom of chair blows out, apparently due to small gas explosion in interior of right arm of chair.
570	Flames along back side of chair.
630	Interior of chair arm exposed, flaming. Dense smoke buildup in living room from 5-ft level to ceiling.
720	2-ft high flames from inside of chair arm and on back of chair. Flaming is gradually growing in intensity. Smoke buildup in living room is very heavy.
810	Smoke very dense in living room, from 3-ft level to ceiling. Temperature 195 F near ceiling.
900	50 percent of test chair in flames, 1-ft high. Dense smoke emitted from chair. Temperature 160 F near ceiling.

Time After
Ignition, Sec

Test Fire No. 63 - Observations (Cont'd)

1020	2-ft high flames from rear of chair. Other areas in flames are approximately 6 in. to 1-ft in height.
1065	Entire back of chair in flames, 1-ft in height.
1140	Temperature is 175 F near living room ceiling.
1260	3-ft high flames from right-hand side of the chair. Temperature 195 F near ceiling. Visibility very poor.
1320	Temperature 200 F. Transmission level on second floor was 46 percent at 5-ft level.
1500	Visibility poor in living room. Smoke in second floor game room at 5-ft level allowed 42 percent transmission. Living room ceiling temperature was 185 F.
1590	Test terminated.

Prior to Test No. 64, the sensitivity potentiometer on Detector 14 located in Bedroom C was turned counterclockwise just enough so that the detector would not keep false alarming.

Test No. 64 was a flaming fire in the living room. The test furniture was a chair with polyurethane foam padding. Upholstery was rayon/acetate pile on rayon/acetate backing. The cushion was a solid biscuit of polyurethane, the back cushion contained crumbled polyurethane. Other areas of the chair contained a thin pad of cotton. The furniture was ignited by applying a cigarette lighter to a small bare spot exposing the polyurethane at the front of the seat cushion. Test was started at 10:00 a.m., Wednesday, May 5, 1976.

Weather Conditions - Wind, SSW, 300-500 fpm, gusting to 900 fpm. Relative humidity, 46 percent. Temperature, 78 F.

Time After
Ignition, Sec

Test Fire No. 64 - Observations

30 6 in. high flame at edge of seat cushion.
150 No visible smoke. Flame height approximately
3 to 4 in.
250 First slight smoking noted from area of flame.
430 Moderate smoking now visible from flame area.
Smoke is puffing up intermittently.
480 Right arm of chair starting to char. Flame
height approximately 6 in. on seat cushion.
495 Right arm of chair ignited, 6 in. flames,
gradually growing in intensity.
540 As soon as arm of chair ignited, flaming
progressed at a rapid rate. Flame height
is approximately 1-ft from seat cushion
and chair arm. Black smoke being emitted
from test area, whereas before it was white.
600 Smell of bitter almonds now noticeable in
living room 20-ft from test furniture.
840 Flames traveling toward back of chair. Flame
height on chair arm is 3 in., flame height
on polyurethane-filled cushion is 6 in.
915 Smoke issuing from underneath chair.
1110 3 in. high flame along intersection of seat
cushion and chair arm. Smoke issuing from
flame increasing. Flames visible along
underside of chair.
1170 Heavy white smoke issuing from underneath
chair.
1260 Flame intensity increasing in area where
char started. Flames have reached back
portion of seat cushion containing crumbled
urethane foam. As soon as this occurred,
intensity of flaming increased rapidly.
Flame height increasing to approximately
2-ft on back portion of cushion.
1380 Flame height increasing rapidly on chair back,
1 to 2-ft in height. Facing front of chair,
left-hand portions of both cushions are in
flames.
1620 Both cushions entirely in flames. Flame
height approximately 1-ft. Heavy white
smoke issuing from right chair arm.
1740 Right arm of chair completely burned through
revealing frame of chair. Left arm starting
to flame rapidly.

Time After
Ignition, Sec

Test Fire No. 64 - Observations (Cont'd)

1800	90 percent of chair in flames. Temperature increasing in living room.
1980	Visibility decreasing in living room. Temperature decreasing to 185 F in living room. Smoke level on second floor game room at 5-ft is 80 percent transmission.
2160	Entire chair in flames with majority of flaming on back of chair. Visibility very poor in living room.
2400	Burn-through of bottom portion of chair reveals lower part of wooden frame. Flames on 95 percent of chair ranging from 1-ft to 2-ft in height. Most of flaming on front portion of chair.
2520	Flaming increasing rapidly. Flames are 5 to 6-ft in height and entire chair in flames.
2581	Test terminated. At termination, intense flaming and heat generation causing plastic straps on venetian blinds to melt and drop blinds in living room. All areas of first floor are saturated with smoke.

Prior to Test No. 65, mice were placed into respiration rate monitoring holders located near the 5-ft high light beams in the first floor living room (north wall) and second floor game room (south wall). In addition, Detector Board V (Detectors 33-36) was relocated from Hallway J to the ceiling at the top of the stairway in the game room.

Test No. 65 was initiated in a chair in the living room. The chair was upholstered in rayon pile on rayon backing. The seat cushion is a sandwich with urethane foam core and facings of polyester fibers. The back is padded with 1 in. cotton. A smoldering fire was initiated on the back just above the seat cushion. The test was started at 12:00 noon, Wednesday, May 5, 1976.

Weather Conditions - Wind, SSW, 300-500 fpm, gusting to 900 fpm. Relative humidity, 46 percent. Temperature, 78 F.

Time After
Ignition, Sec

Test Fire No. 65 - Observations

90 First smoke noted.
120 Igniter removed. Smoldering diminishes rapidly.
180 Slight smoldering. A puff of smoke resulting from removal of igniter stratified at 6-ft level above test furniture.
480 Stratification forming at 6-ft level above test furniture.
780 Smoke buildup in south bay is from 5-1/2-ft level to ceiling.
930 Moderate smoldering.
1200 Smoke buildup in south bay from 6-ft level to the ceiling, starting to pour over beam into north bay. Clear air from 6-ft level down to floor.
1320 Smoke reaches east wall near windows and drops quickly to 4-ft level. Char area has opened up revealing ashes of inside of cushion back. At intersection of back and seat cushion, edge of seat cushion is beginning to char. Moderate to heavy smoldering.
1500 Smoke attempting to enter Bedroom C is forced back by air flow through first floor.
1560 Smoke beginning to pour into Bedrooms A and B.
1620 In Bedroom A, distinct stratification noted from 3-ft level to ceiling. Just outside that bedroom door, stratification is at 6-ft level. In kitchen, smoke buildup is from 6-ft to ceiling. Rapid smoke movement out kitchen door to family room. Buildup in family room is uniform throughout room.
1775 In Bedroom C, smoke is moving under door lintel into room.
1800 Small embers noted at intersection of chair arm and seat cushion. Heavy smoldering.
1920 Smoke level near kitchen exit way approximately 1-ft below light beam. Glowing embers noted around char area.
2010 Small ashes visible in area of test furniture. These ashes rise above test furniture, above smoke level, and then fall to floor. Heavy smoldering.
2100 Smoke is irritating to eyes at 2-ft level in living room.
2220 First flames notes.

Time After
Ignition, Sec

Test Fire No. 65 - Observations (Cont'd)

2250 Flames along right portion of chair near intersection of seat and back, approximately 3-ft in height.

2340 Most flames are from area of seat cushion.

2400 Flame area is concentrated in right-hand area of seat cushion.

2410 White billowy smoke visible from left rear of seat cushion.

2460 1-ft high flames starting at left side of back.

2490 Flame area confined to seat cushion and up both sides of back.

2610 Temperature is 200 F near ceiling of ignition room. Transmission level at ceiling of second floor game room 60 percent.

2779 Test terminated. At test termination, flame height approximately 4-ft on all areas of test furniture.

Test fire No. 66 was located in the living room. A flaming fire was initiated on a swivel rocking chair, upholstered in rayon on a nylon/cotton backing. The seat cushion was a block of polyurethane foam. Back padding was 1/2 in. polyurethane foam over cotton. Chair arms were padded with cotton. The fire was initiated on the chair seat adjacent to the back. There, a cigarette lighter was applied to a small area of exposed foam. Test was started at 2:00 p.m., Wednesday, May 5, 1976.

Weather Conditions - Wind, south. Light rain drizzle.
Temperature, 68 F.

Time After
Ignition, Sec

Test Fire No. 66 - Observations

10 1/2 in. flame from exposed polyurethane.

45 3 in. high flames extending up chair back. Gradually growing in intensity.

80 Flames spreading up back of chair, 6 in. in height.

120 Flame is halfway up back of chair. Flame height, 5 to 6 in.

165 Flames are three-fourths of way up chair back, and extending downward toward front of seat cushion approximately 6 in.

180 Flames reach top of chair back. Black smoke issuing from flames.

Time After
Ignition, Sec

Test Fire No. 66 - Observations (Cont'd)

240	One-third of right-hand side of chair back in flames. A 6 by 6 in. square section on right-hand back of seat cushion also in flames. Flame height approaching 1-ft.
360	Right half of chair in flames. Smoke issuing from bottom of chair. Flame height 1-1/2 ft.
420	Smoke buildup in south bay of living room is stratified at 6-ft level, extending to ceiling.
450	Facing front of chair, right arm starting to flame. Two-thirds of chair back in flames, 1-ft in height.
630	Approximately one-half of seat cushion in flames. Right arm still flaming. Left side of chair back has 1-ft high flames from seat to top. Brownish-white smoke issuing from bottom of chair.
750	Heavy white smoke issuing from bottom of chair.
795	Flaming embers dropping from bottom of chair. Heavy white smoke growing denser. Flaming limited to left-hand arm and seat cushion, approximately 6 in. high.
900	Flaming decreasing. Smoldering increasing rapidly with heavy white smoke emitted. Evidently, polyurethane melting and falling to floor underneath chair and still flaming.
1020	Flame height reaching 2 to 3-ft, increasing in intensity.
1025	Flames reaching to 5 and 6-ft level.
1030	Entire chair in flames, maximum height 4-ft.
1140	Test terminated.

Test Fire No. 67 at the Wabash site was once again located in the living room. The test furniture was a sofa section with odd cushion. The sofa was upholstered in cotton/nylon pile on rayon backing covering a 3/4 in. cotton pad. The seat cushion was upholstered in metallic fiber pile on rayon backing over cotton padding. The cushion had a slip cover of cotton fabric. A smoldering fire was initiated at 10:00 a.m., Thursday, May 6, 1976.

Weather Conditions - Wind, north, 600-700 fpm, gusting to 900 fpm. Rain during entire test. Temperature, 41 F.

Time After
Ignition, Sec

Test Fire No. 67 - Observations

0 Charcoal igniter is energized and placed on right-hand portion of sectional back, approximately 3 to 4 in. below top of seat cushion at intersection. Igniter does not touch cushion.

75 First smoke noted.

120 Puff of smoke upon removal of igniter. Smoldering diminishes rapidly.

180 Puff of smoke above test area stratifying at 6-1/2-ft level.

210 No visible smoldering.

300 The charcoal igniter (after being energized for approximately 1 min) placed once again on same char area.

330 Charcoal igniter removed. Another puff of smoke, drifts toward west wall of living room.

510 1-ft layer of stratification starting to take shape at 5 to 6-ft level. Slight smoldering.

675 Layer of stratification moving slightly to west wall of living room.

720 Smoke buildup in living room decreasing to point of being barely noticeable. Slight smoldering. Smoke still moving toward west wall, at a more rapid pace than in previous tests.

930 Smoldering increasing slightly.

1650 Smoldering increasing to moderate stage. Smoke from furniture is pushing up through 5-ft level of stratification and then settling back down to that level.

2160 Smoke from test furniture punching through 5-ft layer of stratification and staying at ceiling.

2700 No visible smoke in Bedroom C. Smoke buildup is contained in living room, kitchen, family room, and up stairway.

2940 Smoke beginning to enter Bedroom C area. Majority of smoke buildup in south bay of living room from 5-ft to ceiling. Air movement toward kitchen area.

3300 Smoke beginning to fill entire living room. The heavier concentration of smoke is from 5-ft level to ceiling.

3600 Moderate smoldering. Smoke irritating to eyes at 3-ft level, north wall of living room.

Time After
Ignition, Sec

Test Fire No. 67 - Observations (Cont'd)

3720	Char area on sectional back approximately 1-ft diameter, small char areas on arm and seat cushion.
4440	Heavy smoldering. Char area halfway up sectional back. Most smoldering coming from intersection of back and seat.
4560	Heaviest smoke buildup from 5-ft level to ceiling.
4545	First flame noted. Flames increasing to a height of 2-ft on right side of sectional.
4620	4-ft high flames from rear of chair, increasing in intensity. Right half of sectional back in flames.
4740	Test terminated. Flames were 2 to 3-ft high on sectional back. No flaming on front edge of seat cushion or chair arm. Smoke buildup very dense, and temperature steadily increasing on first floor.

Test Fire No. 68 was located in the living room. The test material was eight sheets of polyurethane foam, approximately 12 by 12 by 3 in., placed together on a bent screen to simulate a chair. Four sheets represented the back, and four sheets the seat cushion. The simulated chair was ignited with a cigarette lighter applied 1 in. from the intersection of the seat cushion and the back. Test was started at 2:00 p.m., Thursday, May 6, 1976.

Weather Conditions - Wind, north, 500-650 fpm, gusting to 900 fpm. Rain. Temperature, 37 F.

Time After
Ignition, Sec

Test Fire No. 68 - Observations

17	Back of simulated chair igniting rapidly, flames spreading up back and reaching top at approximately 30 sec.
50	2-ft high flames up right half of chair back. (Flames spreading more rapidly than if there had been upholstery.)
90	Foam starting to fall from back in flaming particles. Entire chair back in flames, reaching to ceiling. Smoke buildup in ignition room from 5-ft level to ceiling. Buildup very dense and black. The air underneath is clear.
180	No material left from simulated chair back. 2-ft high flames from seat cushion on all areas. 2-ft high flames at both sides of chair from floor where polyurethane has melted forming puddles.
220	Heavy black smoke from 4-ft level to ceiling in living room and family room.
270	2-ft high flames on floor from melted polyurethane. Small flames from material left on simulated chair.
300	Entire living room becoming filled with dense smoke.
390	Two small pools of melted polyurethane still burning on floor. Small flames on simulated cushion.
420	No flaming from cushion. 6 in. high flames from pools of polyurethane on floor.
480	Test terminated. At termination, 3 in. high flames from melted pools. Very dense smoke buildup in living room and family room from 3-ft level to ceiling. Buildup not too heavy from 3-ft level to floor.

Test Fire No. 69 was the next fire in the living room series. The test material was once again 12 by 12 by 3 in. sheets of polyurethane. For this test, a 24 by 60 in. sheet of polyurethane was formed on a flat screen approximately 2-ft off the floor. Fire was started by applying a cigarette lighter flame to the top right corner of the front sheet. Test was started at 3:00 p.m., Thursday, May 6, 1976.

Weather Conditions - Wind, north, 500-650 fpm, gusting to 900 fpm. Rain. Temperature, 39 F.

Time After
Ignition, Sec

Test Fire No. 69 - Observations

5	3 in. high flames at top part of right-hand corner.
20	6 in. high flames.
25	Polyurethane starting to melt, flaming particles dripping to floor.
85	Right, front sheet entirely in flames and spreading to second sheet.
105	Four sheets are flaming, majority of flaming on right-hand portion. Flaming particles still dripping to floor.
120	4-ft high flames. One-half of layer in flames. Smoke buildup in living room from 5-ft to ceiling, very dense black smoke.
160	Smoke pouring through doorway to family room at 5-ft level.
180	Entire test layer in flames reaching to ceiling. Melted pools burning on floor where flaming particles have dropped.
210	Dense layer of smoke from 3-1/2-ft level to ceiling.
240	Flaming decreases. Smoke buildup dropping rapidly to floor in living room and family room.
360	Test terminated. At termination, 6 in. high flames on portion of screen and small flaming areas on floor from melted polyurethane. Visibility at 3-ft level down to floor still fairly good.

Test Fire No. 70 was again in the living room using polyurethane sheets in the same arrangement as Test No. 69 except two cotton receiving blankets were placed across the entire top of the layer and the layer was resting on a cotton towel and an acrylic type blanket. This test layer was ignited at the front portion on the top center. Test was started at 4:00 p.m., Thursday, May 6, 1976.

Weather Conditions - Wind, north, 500-650 fpm, gusting to 900 fpm. Rain. Temperature, 39 F.

Time After
Ignition, Sec

Test Fire No. 70 - Observations

15	Flames through cotton blanket on top of polyurethane. Sparkling from the acrylic blanket.
60	Front portion of layer is in flames. Maximum flame height 1-ft. Flaming particles dripping to floor.
95	Acrylic blanket burned free and one edge dropped to floor.
135	2-ft high flames at front end of test bed. 1-ft high flames from pool of melted polyurethane on floor.
180	Heavy smoke buildup in living room from 5-ft level to ceiling.
210	5-ft high flames from front portion of test bed. One-third in flames Dripping and streaming particles falling to floor.
255	Flames reaching ceiling.
285	Dense smoke buildup from 4-ft to ceiling in living room and family room. Entire bed now in flames reaching to ceiling. High temperatures in living room.
360	Slight flaming at back portion of bed. Flame height from 6 in. to 1-1/2-ft.
420	Test terminated. Flaming has ceased.

Test Fire No. 71 was once again in the living room. The test furniture was various widths of polyurethane foam with a nominal thickness of 4 in. all placed in line on a gypsum board lying on the floor. The gypsum board was 4 by 6-ft and the layer of polyurethane covered an area in the center of the board approximately 5 by 2-ft. The fire was initiated by applying a cigarette lighter flame to the top-half, right-hand corner of the polyurethane layer. Test was started at 10:00 a.m., Friday, May 7, 1976.

Weather Conditions - Wind, north, 500-600 fpm. Relative humidity, 81 percent. Temperature, 50 F.

Time After
Ignition, Sec

Test Fire No. 71 - Observations

20	6 in. high flame on right portion of foam layer. Flame is traveling diagonally across layer.
60	1-ft high flames from right front corner, covering approximately one-half of layer, 6 in. down the side.
75	Flames spreading across width of layer. Dense black smoke emitted from flame area.
100	Dense smoke stratifying from 6-ft to ceiling in living room only. Smoke beginning to flow into family room via northeast doorway.
120	Approximately one-half of foam layer in flames, 3-ft maximum height.
150	Layer of smoke in living room has stratified from 4-ft to ceiling. Smoke entering family room and bedroom areas.
180	75 percent of foam layer in flames. Maximum flame height, 4-ft.
200	From 4-ft to floor, air relatively clean.
210	Entire foam layer in flames. Maximum flame height, 5-ft.
255	Flaming starting to decrease. Flame height, 3-ft.
285	Layer extending from 4-ft to floor (previously clear) beginning to fill with smoke. Visibility still fair in this area.
300	Maximum flame height 1-ft.
360	Melted polyurethane still burning on gypsum board with height of 1-ft.
480	Test terminated.

BEDROOM C SERIES

Test Fire No. 72 was the first test in the Bedroom C series. Prior to the start of this test, Detector Board IV which had been located in that bedroom was relocated to the bottom of the stairway in the family room. For this test, a cotton innerspring mattress covered with 5 lb of blankets and other items of clothing was placed on a metal frame, 1-ft off the floor. A smoldering fire was initiated by energizing the charcoal igniter at the start of the test, placing it directly on the mattress for 2 min, then removing the igniter and covering the char with one of the blankets. The test was started at 12:00 noon, Friday, May 7, 1976.

Weather Conditions - Wind, north, 600-800 fpm, gusting to 1500 fpm. Relative humidity, 75 percent. Temperature, 50 F.

Time After
Ignition, Sec

Test Fire No. 72 - Observations

0 Charcoal igniter energized and placed directly on left corner of top of mattress.

48 First smoke noted.

120 Charcoal igniter removed.

135 Puff of smoke resulting from smoldering is moving through bedroom door leading to living room. Slight smoldering visible from edge of blanket covering char.

330 Light brown char starting to show through blanket.

420 Smoke starting to come from char area on blanket instead of underneath edges. Slight smoldering. Brown char on blanket slowly getting darker.

720 Char area on blanket becoming black. 6 in. diameter circle.

840 Slight to moderate smoke from blanket char area and underneath edge.

940 Slight material ripping can be heard from char area.

1050 Char area 1-ft diameter circle, very black, with moderate smoldering. Smoke still drifting in direction of door to living room.

1320 Most smoke is drifting through doorway into living room. Once in living room is stratifying from 6-ft to ceiling in both bays. It should be noted that south bay is not filling with smoke before north bay as in previous tests. This buildup only a light haze stratifying at 3-ft level in living room. The route taken by smoke is once again toward kitchen door, but it is bypassing detector location in living room.

1500 Smoldering from fringe of 1-ft diameter char on blanket moves toward center of char, then upward toward ceiling.

1740 At 2-ft level in bedroom, smoke is irritating to eyes.

1980 Char area 1-1/2-ft in diameter and starting to creep over edge of mattress.

2040 Smoke buildup in living room is uniform throughout height.

2070 Smoke buildup in family room and up stairway is uniform.

Time After
Ignition, Sec

Test Fire No. 72 - Observations (Cont'd)

2220 Char area beginning to creep over mattress edge, extending halfway down edge.

2250 Very little buildup in Bedroom C and adjoining bathroom. Smoke is very acrid. Moderate smoldering.

2400 2-ft diameter char area on mattress top. Char on side of mattress approximately 1 in. from bottom and 1-ft long. Uniform smoke buildup in Bedroom C. No apparent stratification.

2550 Char reaching bottom of mattress. Small hole has opened up on side of mattress revealing inner sections.

2580 Small slit has opened on top of mattress.

2670 First smoldering from underneath mattress.

2700 Small glowing embers around open hole on side of mattress.

3180 Smoke rising around both sides of mattress. Evidently an area underneath mattress, below the char, is starting to burn.

3600 Moderate to heavy smoldering.

3750 First flames noted. 2-ft high flames from char area. Small flames around char fringe.

3840 6 in. high flames around char fringe.

4020 Area of original char starting to open up with 6 in. high flames from interior. 2-ft high flames from one edge of char fringe.

4200 White billowy smoke rolling over edge of mattress from underneath. 1-ft high flaming from center of mattress and along three sides of edge.

4380 2-ft high flames from front edge of mattress. Approximately 25 percent of mattress is charred.

4800 4-ft high flames along edge, near wall, coming from underneath mattress.

5100 Test terminated. At termination, there were 4-ft high flames from mattress along east wall of bedroom.

Test Fire No. 73 was located in Bedroom C. A smoldering mattress fire was initiated with approximately 5 lb of bedding and clothing on top of a cotton innerspring mattress. Once again the charcoal igniter was applied directly to the mattress for 2 min and then the char covered with a blanket. The test was started at 12:00 noon, Monday, May 10, 1976.

Weather Conditions - Wind, SSW, 400-500 fpm. Relative humidity, 42 percent. Temperature, 74 F.

Time After
Ignition, Sec

Test Fire No. 73 - Observations

80	First smoke noted.
120	Charcoal igniter removed.
160	First smoke coming through acrylic blanket over char. Ripping of material can be heard from char area.
220	Char noticeable on blanket. Smoke is drifting toward door leading to living room.
600	Brown, U-shaped char on blanket, slight to moderate smoldering. Smoke is drifting more vertically to bedroom ceiling.
660	Large quantity of smoke drifting into living room on east wall, underneath beam through center of room, and out door leading to family room. This is a slightly different route than previously taken by smoldering. A light haze developing in family room, uniform throughout area. Small quantity of smoke can be noted, however, in 5-ft light beam located next to detectors in living room.
900	Minimal smoke buildup in Bedroom C. Most smoke drifting into living room.
1230	Circular char is 10 in. diameter. Slight to moderate smoldering at fringe areas.
1680	Slight smoke buildup in Bedroom C. In living room, there are two layers of stratification, one at 3-ft level and one from 5-ft to ceiling. Light hazy buildup above and below these layers. No noticeable buildup in Bedroom A or B.
1800	Slight to moderate smoldering. Char area is square with 1-ft sides. Slight ripping of material can be heard from char area.
2100	In Bedroom C, smoke beginning to irritate eyes and nose at 2-ft level. Char area 15 in. diameter circle. Detector 9 in living room has been chirping intermittently as result of very slow buildup. Char creeping over mattress edge.
2280	Slight smoke at right end of mattress from underneath clothing. Either smoke has traveled underneath all material on top of mattress or has traveled through interior of mattress and is coming out through slits in mattress. Either way, a distance of approximately 5-ft has been traveled by smoke.

Time After
Ignition, Sec

Test Fire No. 73 - Observations (Cont'd)

2460 Detector 9 is chirping once every 5 sec.
2580 Char halfway down side of mattress, slowly melting blanket away. Moderate smoldering. Char area expanding by melting process.
3360 Char area on blanket is 2-ft, semicircle, has reached bottom of mattress edge. Moderate to heavy smoldering.
3600 Smoke dense in Bedroom C. Small flying ashes above char.
3780 Side of mattress has opened revealing mattress interior.
4080 Small gas explosion from char area producing 1-ft high flames from mattress hole.
4090 2-ft high flames on mattress top. Smoldering along side of mattress increasing. Most flaming from inside mattress.
4200 Char area 2-ft diameter. 1-ft high flames from hole in center of char. 2 in. high flames along fringe of char.
4440 Small flames on north edge of mattress. 3 in. high flames along east edge of char. 1-ft high flames from large opening at middle of char.
4740 White billowy smoke issuing from mattress side. The north corner of mattress has 1-ft high flames. Also, 1-ft high flames from center of char.
4980 Flames gradually growing in intensity.
5400 Approximately 25 percent of mattress in flames.
5580 2 to 3-ft high flames from opening in main char area. 6 in. high flames moving along south part of char toward south window of room.
5940 Test terminated.

At termination, the first floor was saturated with heavy smoke in all areas. Buildup was fairly heavy on the second level.

Test No. 74, in Bedroom C, involved a cotton innerspring mattress with various items of clothing on top, along with a wastebasket of assorted paper placed on the floor near the mattress edge. To start the test, a newspaper section was placed on the mattress edge and draped 6 in. over the wastebasket. The paper in the wastebasket was then ignited with a cigarette lighter. Test was started 5:00 p.m., Monday, May 10, 1976.

Weather Conditions - Wind, south, 200-300 fpm. Relative humidity, 39 percent. Temperature, 75 F.

<u>Time After Ignition, Sec</u>	<u>Test Fire No. 74 - Observations</u>
17	Paper draped over wastebasket gives off white puff of smoke and 1-ft high flames.
40	2-ft high flames from newspaper section. Very little flaming from wastebasket.
60	Flying ashes in bedroom. 1-ft high flames from newspaper section. Same from wastebasket.
75	Flaming visible on side of mattress and along top edge.
240	Most flaming on mattress has subsided. 6 in. high flames from wastebasket. Small flaming at bottom of side of mattress.
375	The wastebasket is moved closer to edge of mattress so that flaming is directly underneath mattress edge.
405	6 in. high flames from top edge of mattress as a result of moving wastebasket. The length of flaming 1-1/2-ft across edge.
480	Heavy, white billowy smoke from char area. 6 in. high flames on edge of mattress. 1-ft high flames from wastebasket.
540	Fire spreading down edge of mattress with 4-ft length of flaming and smoldering.
660	Flaming along entire side of mattress. Flame height approximately 3 to 6 in. Most of flaming in area of char.
810	2-ft high flames from area of original char.
840	Heavy smoldering from southwest corner of mattress.
855	6 in. high flames on north edge of mattress, burning along mattress edge.
1020	Heavy smoldering from west edge of mattress. Flames around fringe of original char, 2-ft high.
1260	2-ft high flames along west edge of mattress.
1350	4-ft high flames on southwest corner of mattress.
1500	Approximately 50 percent of mattress is charred.
1589	Test terminated.

At test termination, the first floor was laden with dense smoke. The second level buildup was passable. Buildup was slightly heavier on the west side of the second level than on the east.

BEDROOM Y SERIES

Test No. 75 was the first fire in the Bedroom Y Series on the second floor. Prior to the start of this test, all instrumentation from the first level was relocated at various positions on the second level.

In Bedroom Y there was a 5-ft light beam on the ceiling with a thermocouple array alongside. Gas sampling tubes were located on the south wall and the ceiling. In Hallway J, there were 5-ft light beams on the ceiling and at the 5-ft level near the detector board. A gas sampling tube was located at the 5-ft level in that hall. In Bedroom Z, there was a 5-ft light beam at the 5-ft level with a gas sampling tube located in the center of the beam. No instrumentation in Den S. In the Game Room G, 5-ft light beams were located on the ceiling near the detector board and at the 5-ft level. Gas sampling tubes were located at the 5-ft level and the ceiling, near the center of both beams. Thermocouple arrays were located at the detector board locations in Hallway J and the game room. Detector Board III, Detectors 6, 7, 8, 9, 10, 22, and 31, was relocated on the ceiling of Den D. In Hallway H, Detector Board IV was relocated on the ceiling, with Detectors 11-15, 23, and 32. Light beams were located at the ceiling and at the 5-ft level in that hall. Gas sampling tubes were located in the center of both those beams.

Test No. 75 was a mattress fire located in Bedroom Y. A smoldering ignition was initiated by energizing a charcoal igniter at 0 sec, placing it directly on the mattress, removing the igniter, and then covering the resulting char with an article of clothing. The articles of clothing on the mattress included two shirts, one sweater, one slip, a pair of pajamas, and a bathrobe.

The test was started at 10:00 a.m., Tuesday, May 11, 1976.

Weather Conditions - Wind, north, 800-950 fpm. Relative humidity, 65 percent. Temperature, 53 F.

Time After
Ignition, Sec

Test Fire No. 75 - Observations

75 First smoke noted.
120 Charcoal igniter removed and shirt placed over char.
140 Brown char showing through shirt. Slight smoldering.
300 U-shaped char on shirt. Slight smoke slowly drifting to ceiling, no general direction.
720 Funnel-shaped column of smoke at one end of char. No apparent stratification. All smoke seems to be rising to ceiling in Bedroom Y and Hallway J.
840 Char is 6 in. circle.
1440 Moderate smoke buildup in Bedroom Y. Smoke beginning to enter game room. No smoke buildup visible in west portion of second level. Swirling effect above char area very prevalent for this test. Reason unknown. Smoke buildup in Hallway J irritating to eyes and nose at all heights. No apparent stratification.
1800 Char area 1-ft in diameter, moderate smoldering. Smoke buildup in Bedroom Y uniform throughout room and irritating to eyes and nose. Smoke still entering into game room, light haze developing around door. No buildup noticeable in west half of second level.
1920 Char has reached edge of mattress.
2520 Moderate smoldering from 2-ft diameter circular char. Char extended halfway down edge of mattress.
3000 Fairly heavy smoke buildup in Bedroom Y.
3300 Smoke beginning to enter Hallway H and Den D. No smoke in downstairs area.
3420 Char area taking shape of 2-ft square on mattress.
3660 Light haze developing uniformly in west half of second level. No stratification anywhere on second level. No smoke buildup whatsoever on first floor.
3840 Heavy smoldering.
4200 Visibility poor in Bedroom Y.
4260 Opening has appeared in middle of original char.
4440 Glowing embers in open char area.

Time After
Ignition, Sec

Test Fire No. 75 - Observations (Cont'd)

4980	Char area approximately 2 by 3-ft rectangle. Large gaping hole in center extending through side of mattress. Heavy smoldering.
5400	Visibility very poor at a distance of 10-ft in Bedroom Y.
5405	First flames noted, approximately 1-ft in height. Flames spreading rapidly around fringe areas of char.
5580	Approximately 75 percent of mattress in flames or charred. Flame height does not exceed 1-ft.
5760	Most flaming has ceased. 1 to 2 in. high flames in isolated spots around char. Heavy smoldering.
5940	Flames starting to increase slightly. Three separate flame locations at least 2-ft from each other.
6000	1-ft high flames from west edge of mattress.
6686	Test terminated.

Upon entering the residence after termination, there was no visible smoke buildup on the first level. On the second level, the east portion, including Hallway J, was saturated with dense smoke. Buildup in Hallway H was very dense, but passable at low levels near the floor.

Test No. 76 was once again in Bedroom Y on the second level. A flaming mattress fire was initiated by placing a wastebasket of assorted trash near the edge of the mattress, placing a newspaper section on the mattress edge hanging over the top of the wastebasket, and lighting a match and dropping it in the wastebasket. The articles of clothing included two sweaters, a pair of trousers, a dress, and two sets of pajamas. The assorted trash included newspaper, napkins, and an egg carton. Prior to the start of the test Detectors 4 and 19 in Hallway J and at the top of the stairs respectively, were false alarming intermittently approximately once every 30 sec. Test was started at 4:00 p.m., Tuesday, May 11, 1976.

Weather Conditions - Wind, north, 400-550 fpm, gusting to 1100 fpm. Relative humidity, 64 percent. Temperature, 51 F.

Time After
Ignition, Sec

Test Fire No. 76 - Observations

30	1-ft high flames from trash can and newspaper section.
45	One-half of newspaper section in flames.
60	Edge of mattress flaming.
90	Newspaper section entirely in flames. 1-ft high flames from trash can.
165	All detectors in Hallway J alarmed at this point. Flaming confined to rectangular area on mattress approximately 1-1/2 by 2-ft, and also on side of mattress. 6 in. high flames from wastebasket. Smoke buildup in Bedroom Y from 4-ft level to ceiling is fair. Layer is slowly dropping to floor.
300	Buildup in Bedroom Y and Hallway J from 4-ft to ceiling. Not very heavy. Flames spreading toward all areas of mattress with maximum height of 1-ft. 1-ft high flames from the wastebasket.
360	Smoke irritating to eyes and nose at 3-ft level in Hallway J.
420	Window at east end of game room discovered open, was closed.
435	1-ft high flames along center of mattress. Heavy white billowy smoke visible from edge. Flame height, maximum of 2-ft.
480	Flames visible from wastebasket.
540	Maximum flame height 2-ft at western portion of mattress. 1-ft high flames in center portion of mattress. 6 in. high flames at eastern edge.
600	2-ft high flames on south side of mattress. Heavy white billowy smoke on north edge of mattress in area where flame originated. Visibility poor in bedroom.
690	Most flaming confined to south edge of mattress with maximum flame height of 2-ft. Small flames still visible from wastebasket.
720	Heavy smoldering.
780	2-ft high flames from south edge of mattress. This is the only visible flaming.
910	Test terminated.



APPENDIX D

ESCAPE CRITERIA

In order to judge adequacy of the warning provided by various detectors used in this study, measurements were made of temperatures, carbon monoxide concentrations, and light obscuration at 5 ft above the floor in bedrooms and along routes of escape to ground level doors. Critical values adopted as the limits beyond which escape would not be possible were optical density of 0.07 per ft, temperature of 150 F, or a time-averaged concentration of CO of 0.04 percent over a 1 hr period. The basis for these choices are given in the following paragraphs.

CRITICAL SMOKE LEVEL:

Presently, there does not appear to be any completely satisfactory way to specify the tenability limits in terms of optical properties of smoke. The situation would be complicated enough if only light transmission through smoke were important, but the effects of respiratory and eye irritation on behavior and visual acuity are also involved.

Table 1 shows some frequently-cited values of critical smoke level from the literature. Obviously, a wide range of smoke densities is represented there. Among References 1, 4, 6, and 7, at least a rough consensus can be found for a critical optical density of 0.07 per ft over a viewing distance of about 15 ft, when only light obscuration is involved.

References 3 and 5 cite critical smoke densities which are said to take account of eye irritation. The optical density of 0.002 per ft derived from Reference 3 is probably unreasonably low because it represents the unset of apprehension rather than the limit of endurance of the observers. The optical density of 0.07 per ft derived from Reference 5 is said to be based on the results of the Los Angeles School Burns No. 2 (8). Nowhere in those results is a critical value of 20 percent light transmission over a 10 ft path length to be found. As a matter of fact, Reference 8 mentions only that 80 percent obscuration is the critical value for tenability, but identifies neither the location nor the length of the light path. From the information given in Reference 8 and its predecessor study (9), it is possible to surmise that the light beam subject to 80 percent obscuration might have been as short as 11 ft or as long as 60 ft. It appears most probable that the light beam involved a double traverse of a corridor 10-15 ft wide, or a path length of 20-30 ft.

The critical optical density for that case would be 0.023 to 0.035 per ft. On this basis, it appears more reasonable to assign a critical optical density of about 0.03 per ft to the results of the Los Angeles School Burns. Rasbash (10) reassessed his earlier work and later work by Jin (11, 12, 13) and concluded that his original correlation (1) represents a useful worst condition which includes in an approximate way the effects of eye irritation. From a study of behavior of people in fires by Wood (14), he also judged that a minimum visibility for escape from fire is about 30 ft, and that this corresponds to an optical density of 0.08 per meter or 0.025 per ft. Thus, the best estimates now possible suggest limits of 0.03 to 0.07 per ft for the critical optical density.

For the dwelling fire situation, escape routes are not usually long and are familiar to occupants. Thus, it appears reasonable to adopt a critical smoke level of 0.07 per ft along escape routes.

Table 1 - Frequently-Cited Critical Smoke Levels

Source	Minimum Light Transmission (Percent)	Viewing Distance (Foot)	Optical Density Per Foot	Criterion Applied
Rasbash (1)	10 10.5 12.6	10 15 20	0.10 0.065 0.045	(Empirical correlation* of visibility of illuminated objects)
Kingman, et al (2)	5	2	0.65	Visibility of sign held 4 ft away and illuminated by hand-held lamp in smoke-filled room
Shern (3)	80		0.002	Apprehension in observers without OBA in smoke-filled room
Shern (3)	60		0.0044	Judgement of observers with OBA in smoke-filled room
Gross, et al (4)	16	10	0.079	Assumed value
Los Angeles Fire Department (5)	20	10	0.070	Visibility and eye irritation of observers in smoke-filled corridor
Bono and Breed (6)	10	11.3	0.088	Visibility of illuminated exit signs photographed from outside smoke-filled room
Malhotra (7)	11	14.8	0.064	Visibility of illuminated signs observed from outside smoke-filled room

*Correlation: $V = 1.40/D^{.767}$
 where
 D is optical density per meter
 V is distance of vision in meters

CRITICAL CARBON MONOXIDE CONCENTRATIONS:

The toxicology of carbon monoxide is probably better understood and more fully reported than that of other constituents of fire gases, nevertheless there are areas of considerable disagreement concerning its effects. This is true particularly for long term exposure to low concentrations of carbon monoxide. Table 1 shows the physiological effects of carbon monoxide as reported by various sources. A reasonable 1 hr limit of 0.04 percent may be inferred from these data.

Since all of the data in Table 1 are for situations wherein carbon monoxide concentration does not vary with time, it is reasonable to expect that the minimum concentration allowable in a fire situation will be greater than 0.04 percent. This is because the carbon monoxide concentration will be near zero at the start of the fire, and will increase with time as fire gases permeate the space. If the carbon monoxide concentration increases linearly with time, the maximum concentration attained will be twice the average concentration.

The treatment due to Minchin (23) suggests that the average carbon monoxide concentration, rather than the maximum, is the appropriate indicator of physiological response. Thus, it appears that a logical 1 hr limit for a fire situation in which carbon monoxide increases linearly with time would be one having a maximum average carbon monoxide concentration of 0.04 percent.

The data indicate that carbon monoxide concentration does in fact increase almost linearly with time during the time periods of interest, and a time-average concentration of 0.04 percent has been chosen as the critical level.

TABLE 1

ALLOWABLE CARBON MONOXIDE LEVELS FROM VARIOUS SOURCES

Reference	Carbon Monoxide Percent	Exposure	Physiological Effect
Bowes and Field (15)	0.1	1 hr	Unstated
Pryor, et all (16)	0.04	4 hr	Lethal
	0.04	2 hr	Collapse
	0.04	1 hr	Headache
	0.03	3 hr	Collapse
	0.03	1.5 hr	Headache
	0.02	4-5 hr	Collapse
Yuill (17)	0.02	2-3 hr	Headache
	1.5	5 sec	Lethal
	0.3	5 min	Lethal
	0.15	30 min	Lethal
Gross, et al (18) (Based on References 19, 20, and 21)	0.045	2 hr	Lethal
	0.005	8 hr	None
	1.0	2-5 min	Lethal
Autian (22)	0.01	8 hr	None
Minchin (23)	0.1	45 min	Collapse
	0.05	90 min	Collapse

CRITICAL TEMPERATURE:

The maximum temperatures to which humans may be exposed are not well defined, and thus are subject to considerable controversy. Yuill's (17) data showing a 4 hr limit of 130 F indicates that the appropriate temperature limit for escape from a dwelling must be somewhat higher. The value of 150 F was adopted as the criteria of untenability in Reference 9, and this appears to be the minimum which could be considered applicable to the present experiments.

REFERENCES

- (1) Rasbash, D. J., "Smoke and Toxic Products Produced at Fires", Trans, J. Plastics Inst., Jan. 1967, p. 55.
- (2) Kingman, F. E. T., Coleman, F. H., and Rasbash, D. J., "The Products of Combustion in Burning Buildings", Brit. J. Appl. Chem., Vol. 3, 1953, p. 463-8.
- (3) Shern, J. H., "Smoke Contribution Factor in the Fire Hazard Classification of Building Materials", ASTM STP422, 1967.
- (4) Gross, D., Loftus, J. J., and Robertson, A. F., "A Method for Measuring Smoke from Burning Materials", ASTM STP422, 1967.
- (5) Anonymous, "Fire Detection Systems in Dwellings", Quarterly of NFPA, 65 No. 3, January 1963, p. 201.
- (6) Bono, J. A. and Breed, B. K., "Study of Smoke Ratings Developed in Standard Fire Tests in Relation to Visual Observations", Underwriters Laboratories Bulletin of Research No. 56, 1965.
- (7) Malhotra, H. L., "Movement of Smoke on Escape Routes, Part 1 - Instrumentation and Effect of Smoke on Visibility, Joint Fire Research Organization", Fire Research Note 651, January 1967.
- (8) Anonymous, "Operation School Burning No. 2", NFPA, Boston, 1961.
- (9) Anonymous, "Operation School Burning", NFPA, Boston, 1959.

- (10) Rasbash, D. J., "Sensitivity Criteria for Detectors Used to Protect Life", 7th International Seminar on Problems of Automatic Fire Detection, I.E.N.T., Aachen, Germany, March 5 and 6, 1975.
- (11) Jin, T., "Visibility Through Fire Smoke I", Fire Research Institute, Japan, July, 1969.
- (12) Jin, T., "Visibility Through Fire Smoke II", Report of Fire Research Institute of Japan 33, 1971.
- (13) Jin, T., "Visibility Through Fire Smoke III", Bull. of Japanese Assoc. Fire Science and Eng., 22, 1972.
- (14) Wood, P. G., "The Behavior of People in Fires", JFRO, Borehamwood, England, Fire Research Note No. 953.
- (15) Bowes, P. C. and Field, P., "The Assessment of Smoke Production by Building Materials in Fires - 2. Test Method Based on Smoke Accumulation in a Compartment", Joint Fire Research Organization, Fire Research Note 749, (March 1969).
- (16) Pryor, A. J., Johnson, D. E., and Jackson, N. N., "Hazards of Smoke and Toxic Gases Produced in Urban Fires" SWRI Report No. 03-2402, OCD Work Unit 2537B, Contract DAHC 20-70-0212 (September 1969).
- (17) Yuill, C. H., "The Life Hazard of Bedding and Upholstery Fires", Journ. Fire and Flammability, Vol. 1 (October, 1970) p. 312.
- (18) Gross, D., Loftus, J. J., Lee, T. G., and Gray, V. E., "Smoke and Gases Produced by Burning Aircraft Interior Materials", NBS Building Science Series 18 (February, 1969).
- (19) Henderson, Y. and Haggard, H. W., "Noxious Gases" (Rheinhold, New York 1943).

- (20) Elkins, H. B., "The Chemistry of Industrial Toxicology" (John Wiley and Sons, New York 1959).
 - (21) American Conference on Government Industrial Hygienists, Document of Threshold Values (1966 Edition), Cincinnati, Ohio.
 - (22) Tian, J., "Toxicologic Aspects of Flammability and Combustion of Polymeric Materials", Journ. Fire and Flammability, Vol. 1 (July 1970) P. 239.
 - (23) Minchin, L. T., "Mild Carbon Monoxide Poisoning as an Industrial Hazard", Ind. Chem., Vol. 30 (1954) P. 381.
- Heskestad, G., "Escape Potentials From Apartments Protected By Fire Detectors In High-Rise Buildings", FMRC Serial Number 21017. Department of HUD, Contract Number H-2034R, June, 1974.



APPENDIX E
SENSORY IRRITATION

The escape criteria discussed in Appendix D consider:

- visual obscuration
- excessive temperatures
- excessive CO concentration

A strong argument can be made that these are incomplete in that irritating particles or gases may interfere with the ability of the resident to function properly in attempting to flee his burning home. Irritation to the eyes reducing vision can be postulated as implicit in the 0.07 OD/ft selected as critical. However, irritation of the upper respiratory tract causing sneezing, coughing and choking is not specifically covered by any one of the stated escape criteria and cannot be related to some simple combination of their effects.

A simple experiment for assessing sensory irritation has been developed by Alarie (1,2). In it, the respiration rates of mice exposed to fire gases are used to predict the level of response of humans to the same exposure. Essentially, the concentration of gases causing a 50 percent reduction in mouse breathing rate (RD₅₀) is determined and used to "quantitatively speculate" on the effects on humans as shown in Table I.

Table I Effects of Fire Gases on Mice and Men
According to Alarie (1,2)

Results for Mice	Probable Human Response
Concentration = RD ₅₀	Intolerable, rapidly incapacitating
Concentration = 1/10 RD ₅₀	Slightly irritating, burning sensation of eyes-nose-throat
Concentration = 1/100 RD ₅₀	Tolerable, slight or no irritating sensation

The experimental procedure is to restrain the mice in simple cylinders with a seal/collar at the neck and a pressure transducer at the rear. This whole body plethysmograph successfully restrains the mouse with his head exposed to all fire gases reaching his position. Respiration rate is thus measured without attaching instrumentation directly to the mouse. This is accomplished by monitoring the residual volume (or pressure) of the containment cylinder.

To examine Alarie's concept for field use, IITRI (H. Wakeley) undertook a small independent effort to place mice in two of the detector/fire experiments of this series (W-65 and W-66). For each experiment, one mouse was placed at the 5 ft high light beam

in the first floor family room and one mouse was placed at the 5 ft high light beam in the second floor game room. Fig. 1 shows a typical installation of a mouse in the cylindrical holder. Fig. 2 is an example of the record for both mice prior to one of the tests. The control respiration rate (no irritants) varies from about 3 to 4/second for each mouse and is determined prior to the fire; but, after the mouse has been in place for sufficient time to relax to a relatively steady level.

Both fires to which mice were exposed were initiated in the Wabash Ave. Living Room. W-65 was a smouldering ignition of the cotton padded back of a chair with urethane foam seat cushion. W-66 was flaming ignition of a chair fully padded with urethane foam.

Respiration rates and fire smoke and gas data are shown in Figs. 3,4,5 and 6.

The mean respiration rate for each subject obtained prior to the test is shown as a dotted line across each figure bounded by lines representing a range of plus or minus three standard deviations from the mean respiration rate. The area enclosed represents the bound for a 99 percent confidence in difference from control values. It should be noted that most statistics should not be applied to the test described because successive measures on a single subject are involved.

During the first series of tests (W65) the record was followed visually as the fire progressed. When it appeared that respiration rate of the downstairs mouse had been depressed significantly the mouse was removed to determine whether recovery was immediate or delayed. Recovery to above control rates was immediate. The high respiration rate during recovery may be attributable to a number of factors including exposure to the toxic gases and the alarm reaction elicited by first time exposure. It is interesting that after the subject was replaced in the test environment, respiration rate did not drop to the previous observed levels although it did remain at the lower 99 percent level of the control rate until the room was finally cleared of smoke when the response rate increase momentarily. It is wise not to over-interpret the results of a single test.

Examining the results of the remaining three tests it appears that respiration rate invariably decreases as light transmittance decreases. Inspecting the results of test W66 for the downstairs mouse, the marked increase in respiration following increase in CO₂ level resembles the pattern observed in test W65 downstairs. It is possible that increased CO₂ concentrations tend to stimulate respiration in spite of the attenuation attributable to irritants and other gases. This effect if it is in fact present, could be attributable to the stimulation of baroreceptors specifically sensitive to CO₂.

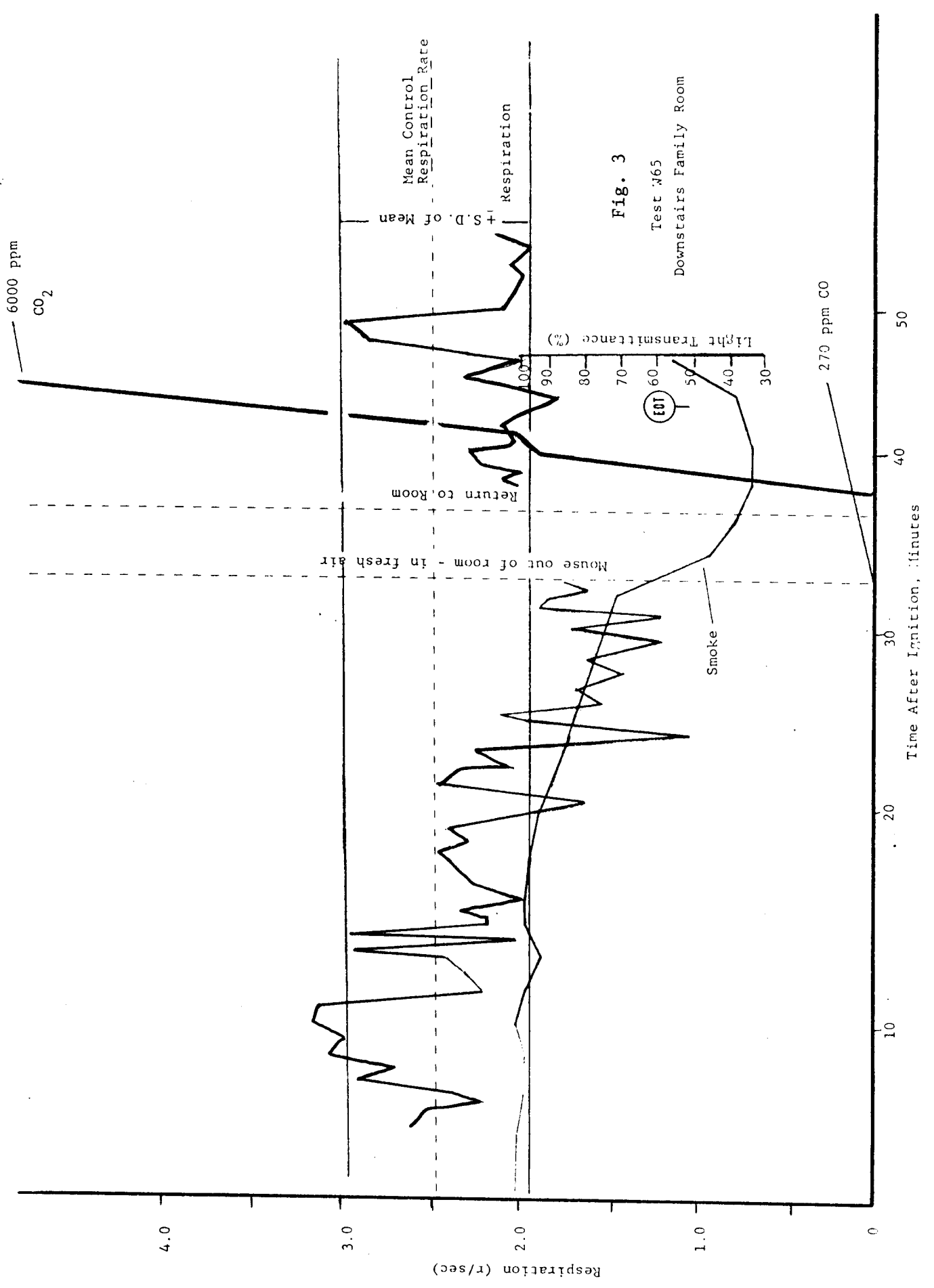


Fig. 3
Test #65
Downstairs Family Room

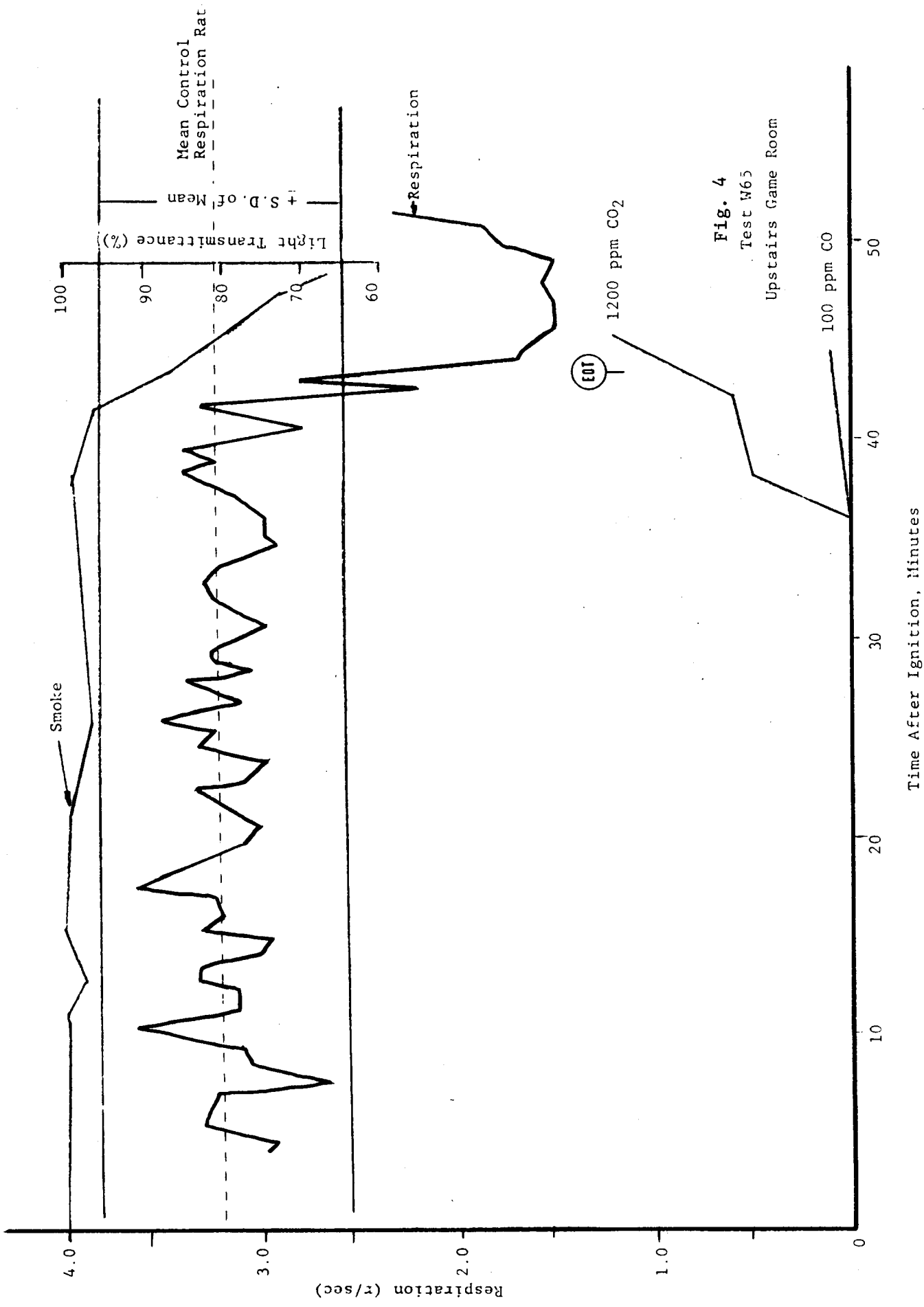


Fig. 4
 Test W65
 Upstairs Game Room

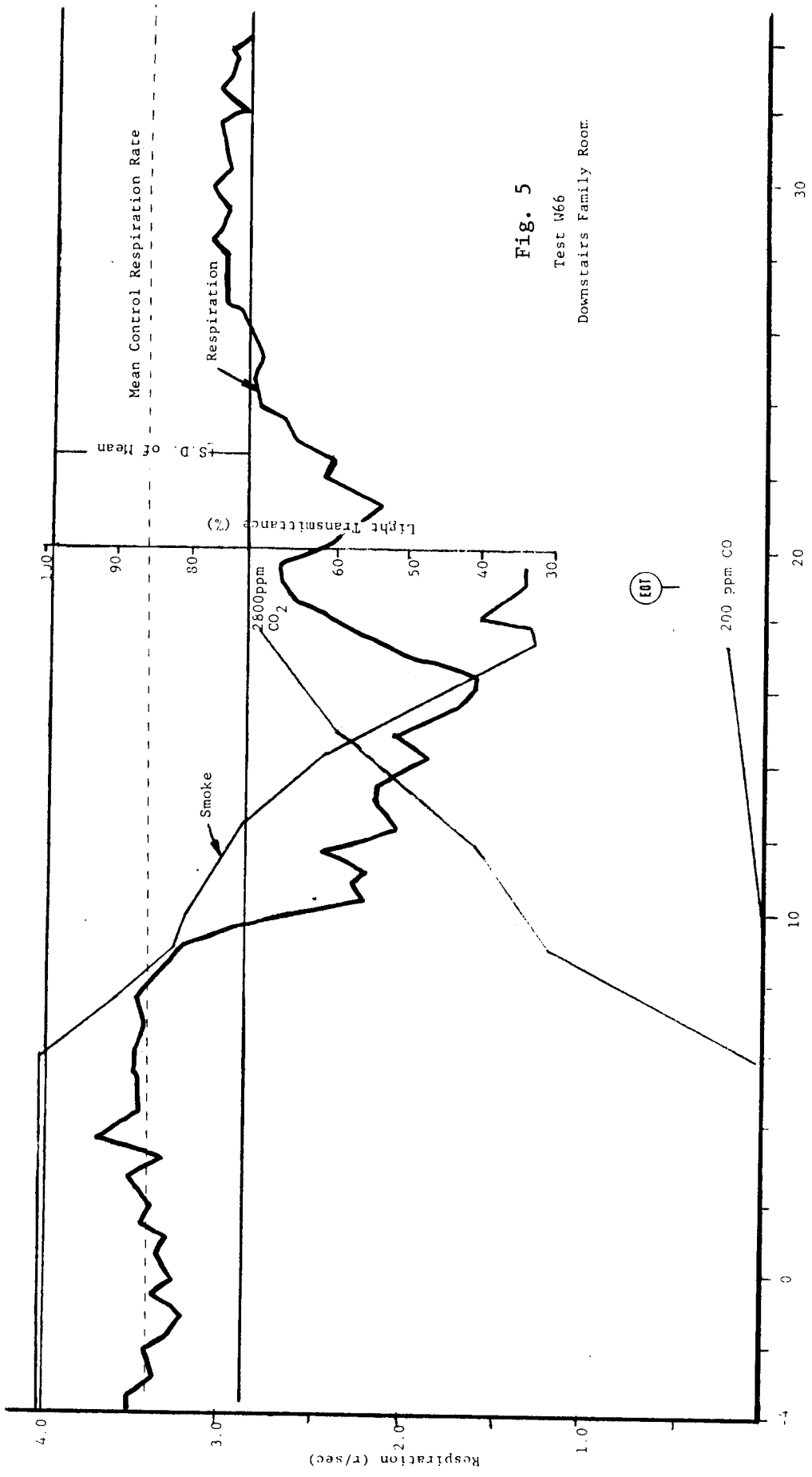
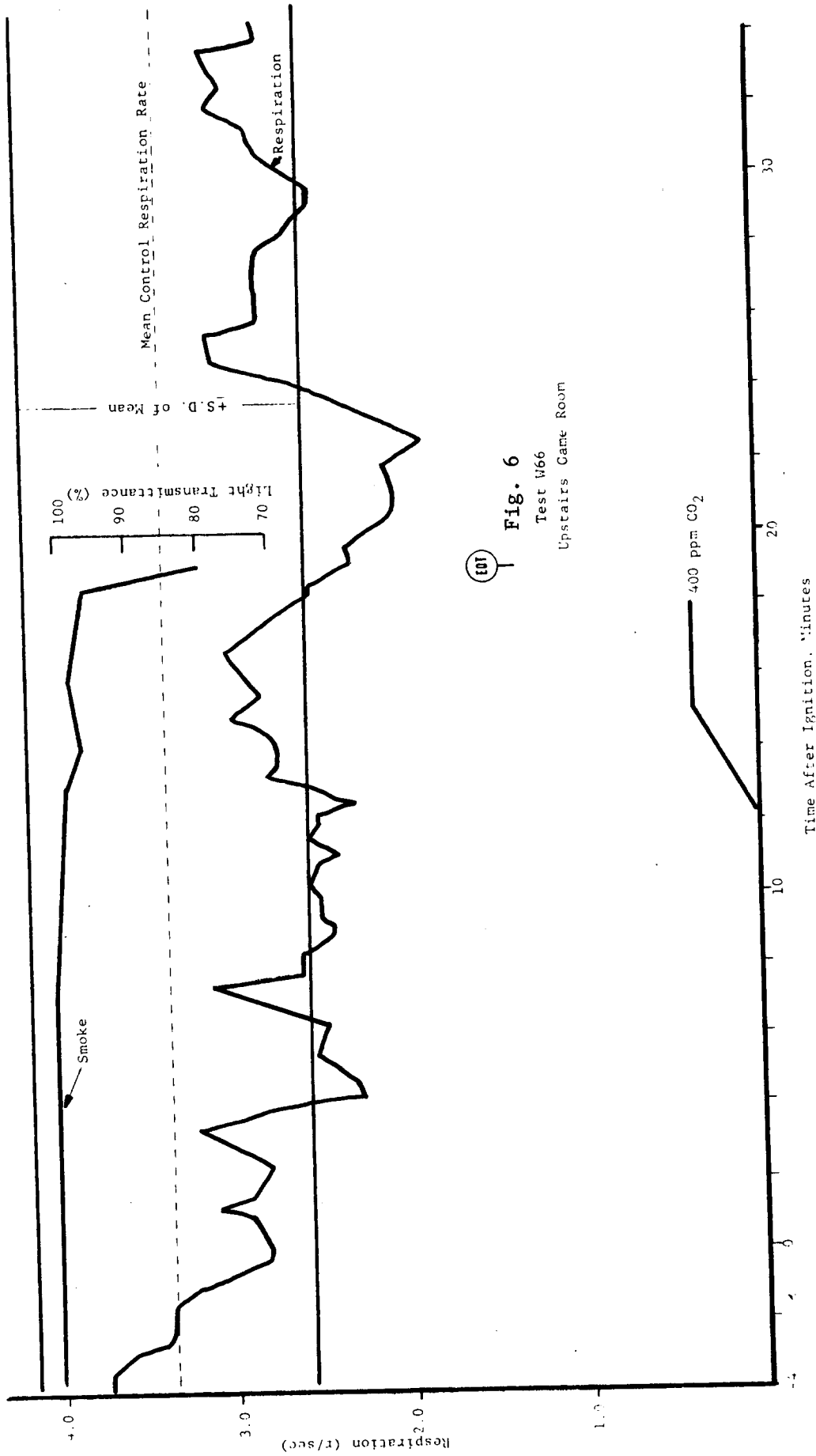


Fig. 5
 Test W66
 Downstairs Family Room



101
Fig. 6
 Test W66
 Upstairs Game Room

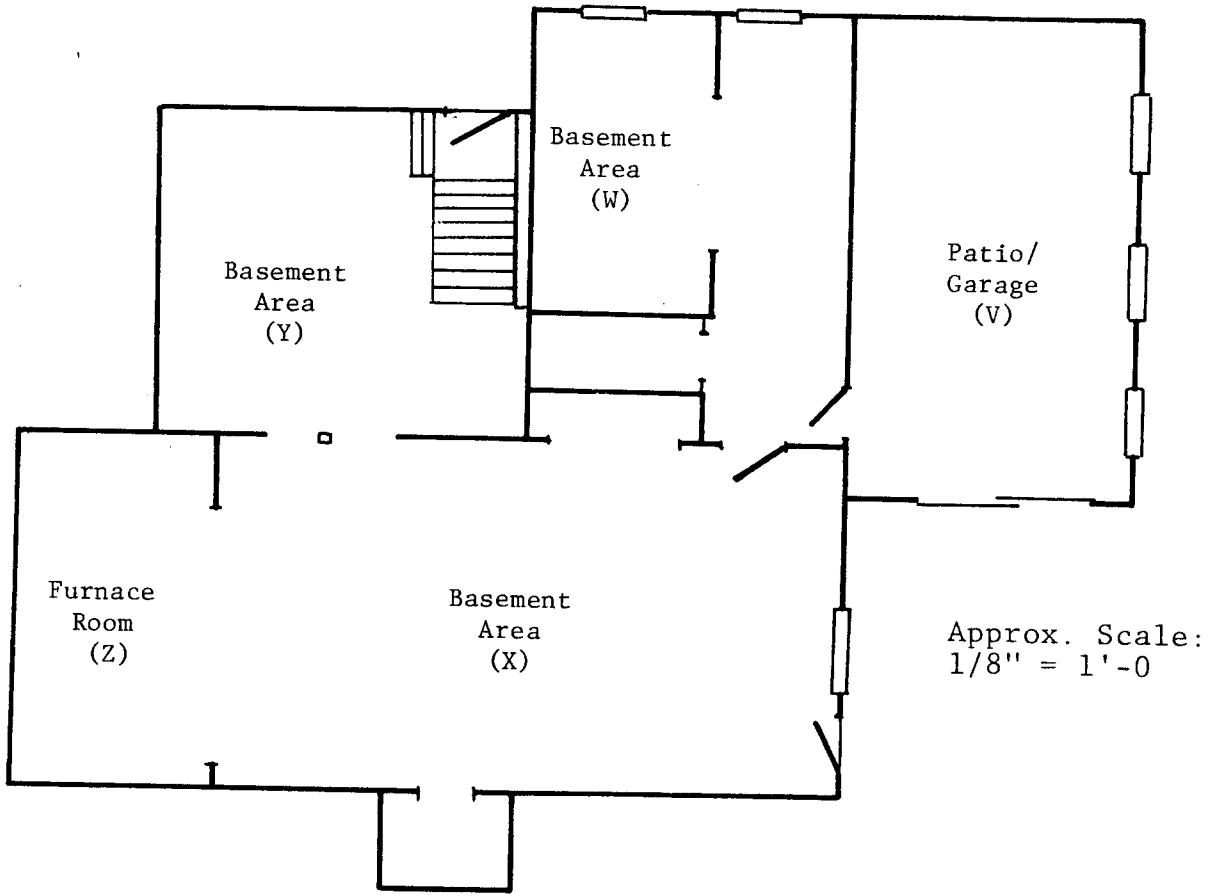
REFERENCES

1. Alarie, Y., "Sensory Irritation by Airborne Chemicals," CRC Critical Reviews in Toxicology 2(299), 1973.
2. Alarie, Y.C., et al., "Sensory Irritation Evoked by Polyurethane Decomposition Products," JFF/Combustion Toxicology 2, pp 139, May 1975.

APPENDIX F

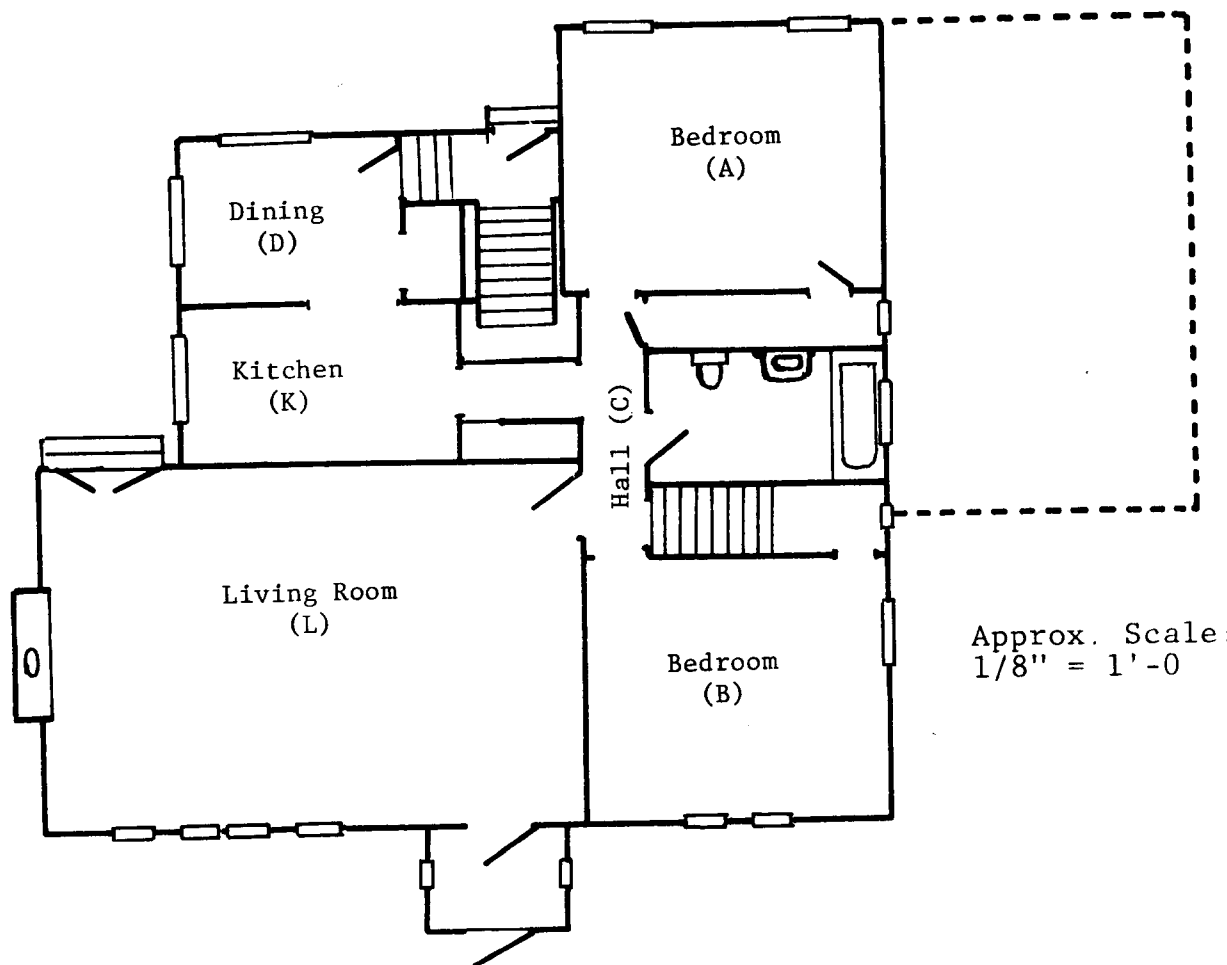
**FLOOR PLANS OF TEST BUILDING
SHOWING DETECTOR, FIRE, AND
INSTRUMENT LOCATIONS**

WHITEHOUSE TEST SITE



BASEMENT FLOOR PLAN - J.R. WHITEHOUSE RESIDENCE

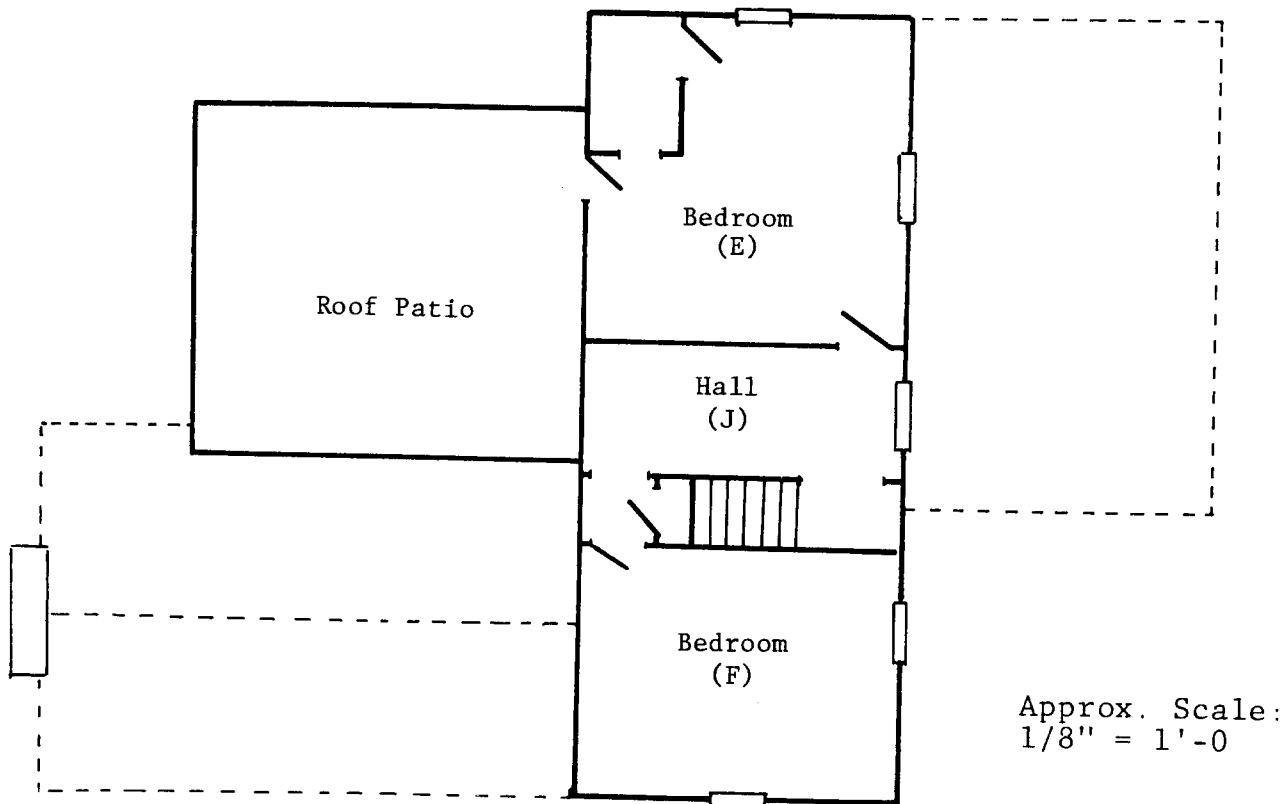
Fig. 1 ROOM IDENTIFICATION



Approx. Scale:
 1/8" = 1'-0

1ST FLOOR PLAN - J.R. WHITEHOUSE RESIDENCE


Fig. 2 ROOM IDENTIFICATION





2ND FLOOR PLAN - J.R. WHITEHOUSE RESIDENCE


Fig. 3 ROOM IDENTIFICATION


KEY


 Ceiling Light Beam (Smoke)
- on I-Beam, 8 In. Below Ceiling

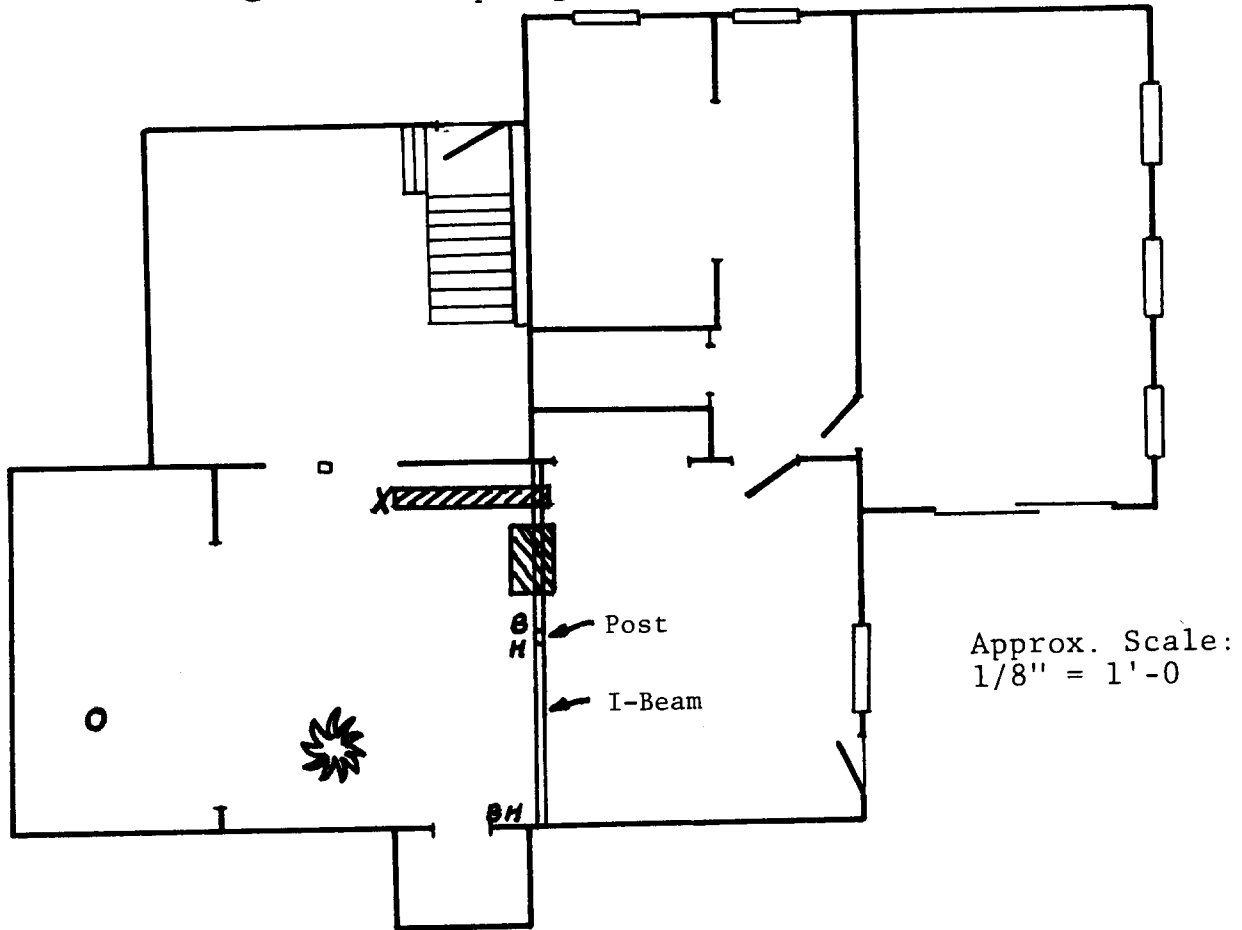
 Temperature Profile

 Fire Location

 Detector Board

 Thermal Detectors, Top 6 in. Below Ceiling
(bell, horn)






 Gas Sampling Location at 5 Ft

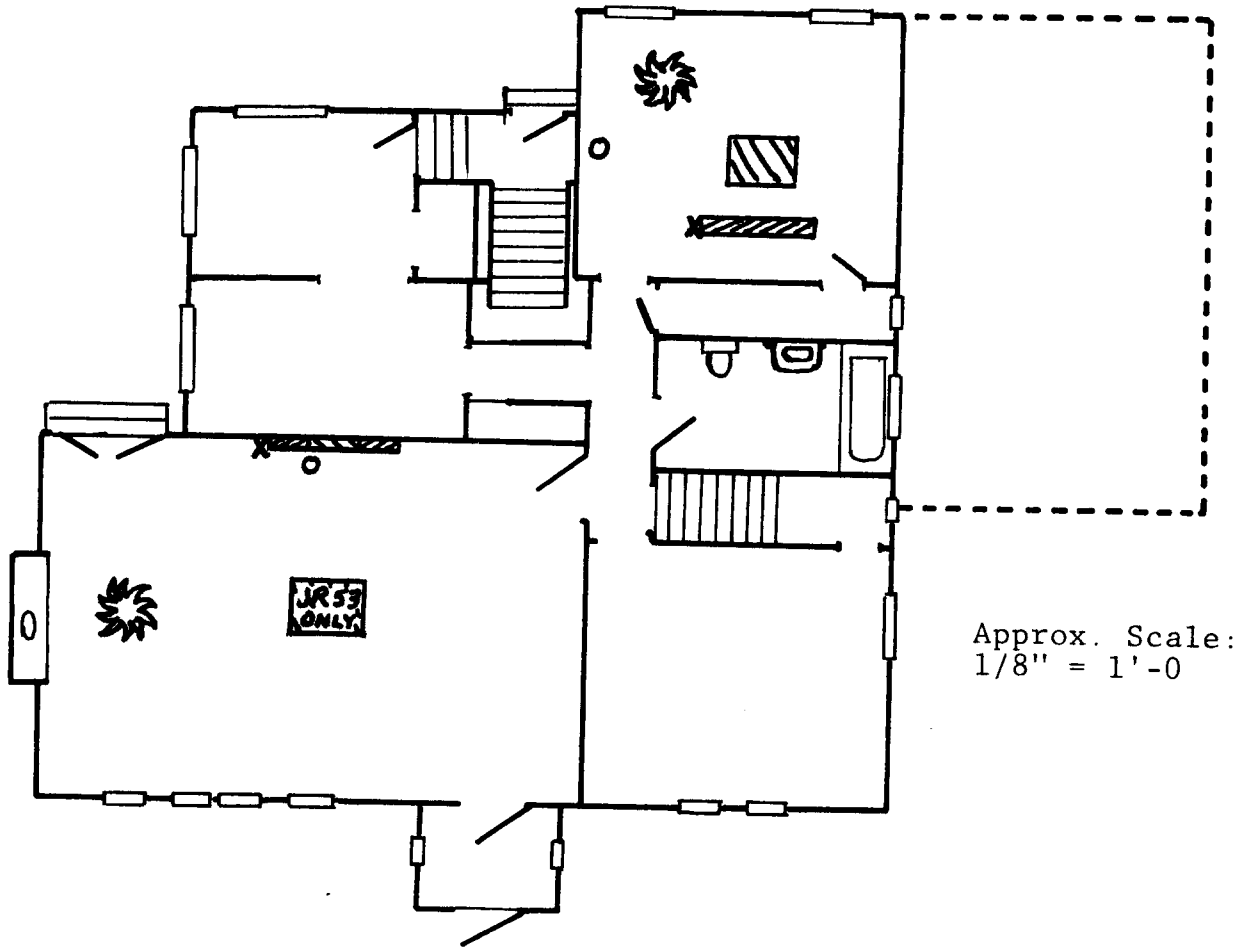


BASEMENT FLOOR PLAN - J.R. WHITEHOUSE RESIDENCE

Fig. 4 FIRE LOCATIONS AND PORTABLE IGNITION ROOM INSTRUMENTATION

KEY

-  Light Beam (Smoke): Bedroom Ceiling, Living Room Wall at 8 Ft
-  Temperature Profile
-  Fire Location
-  Detector Board: Bedroom Ceiling, Living Room Wall at 8 Ft
-  Gas Sampling Location at 5 Ft



1ST FLOOR PLAN - J.R. WHITEHOUSE RESIDENCE

Fig. 5 FIRE LOCATIONS AND PORTABLE IGNITION ROOM INSTRUMENTATION

KEY

▨ Ceiling Light Beam (Smoke)

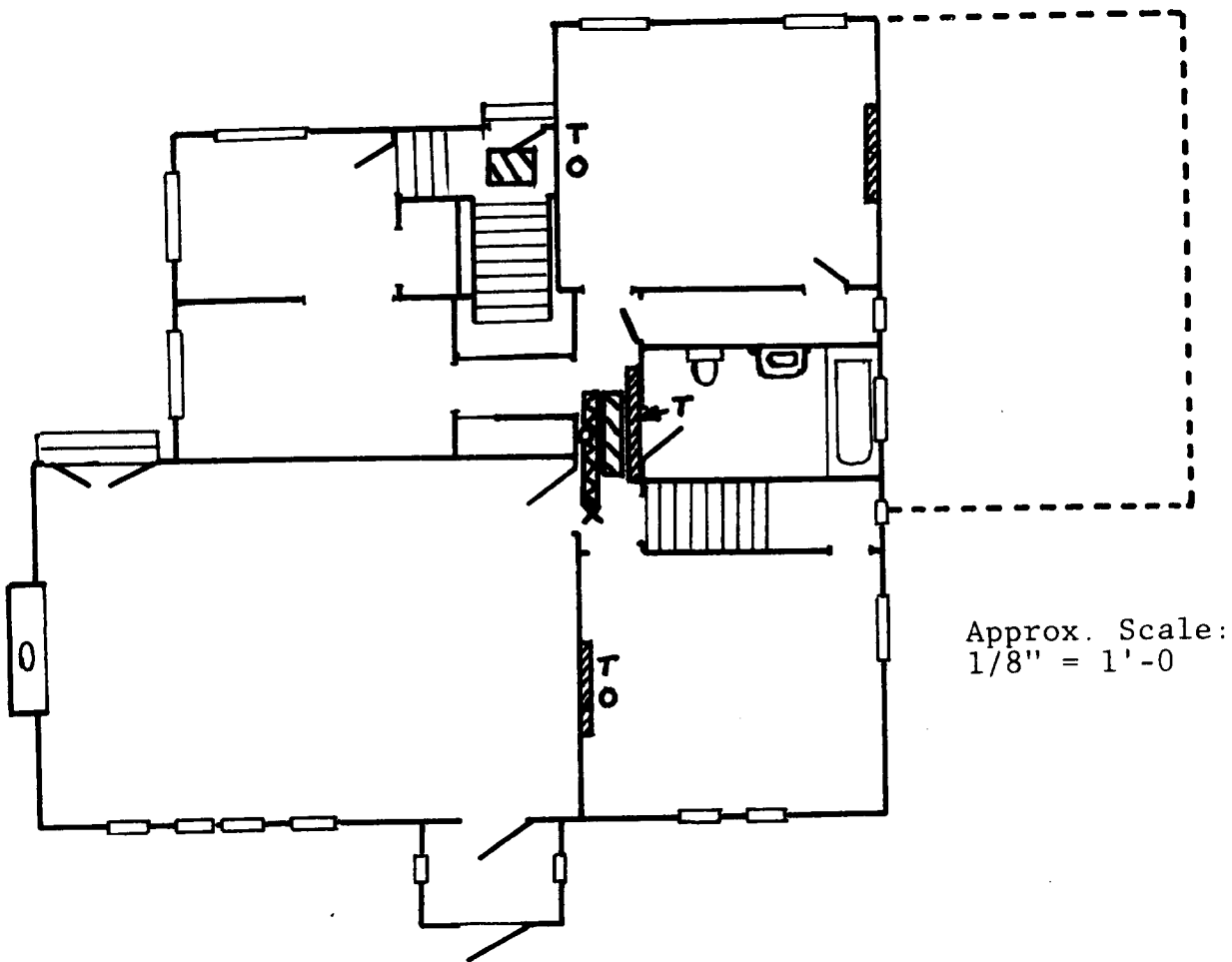
▩ 5 Ft High Light Beam (Smoke)

X Temperature Profile

T Temperature at 5 Ft

▧ Detector Board

○ Gas Sampling Location at 5 Ft



1ST FLOOR PLAN - J.R. WHITEHOUSE RESIDENCE

Fig. 6 FIXED DETECTOR BOARD AND INSTRUMENT LOCATIONS

KEY



Ceiling Light Beam (Smoke)



5 Ft High Light Beam (Smoke)



Temperature Profile



Temperature at 5 Ft



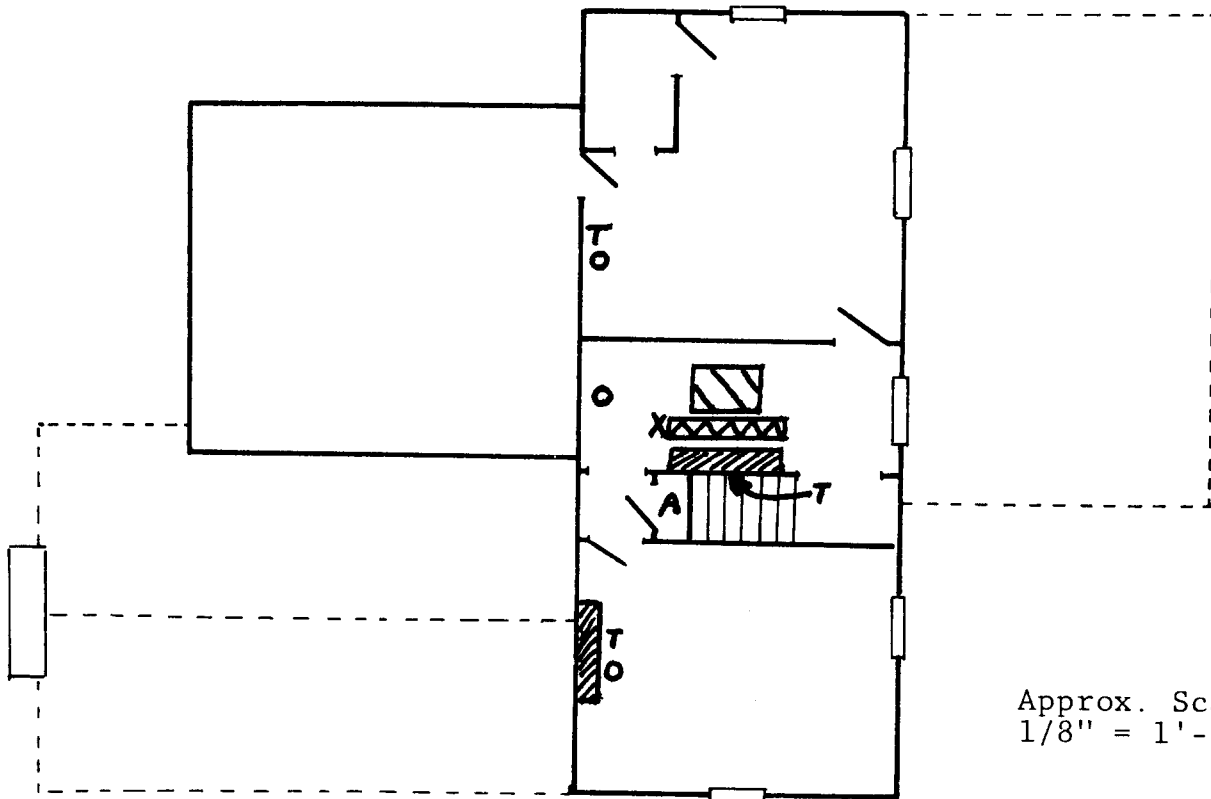
Detector Board



Gas Sampling Location



Attic Temperature



Approx. Scale:
1/8" = 1'-0

2ND FLOOR PLAN - J.R. WHITEHOUSE RESIDENCE

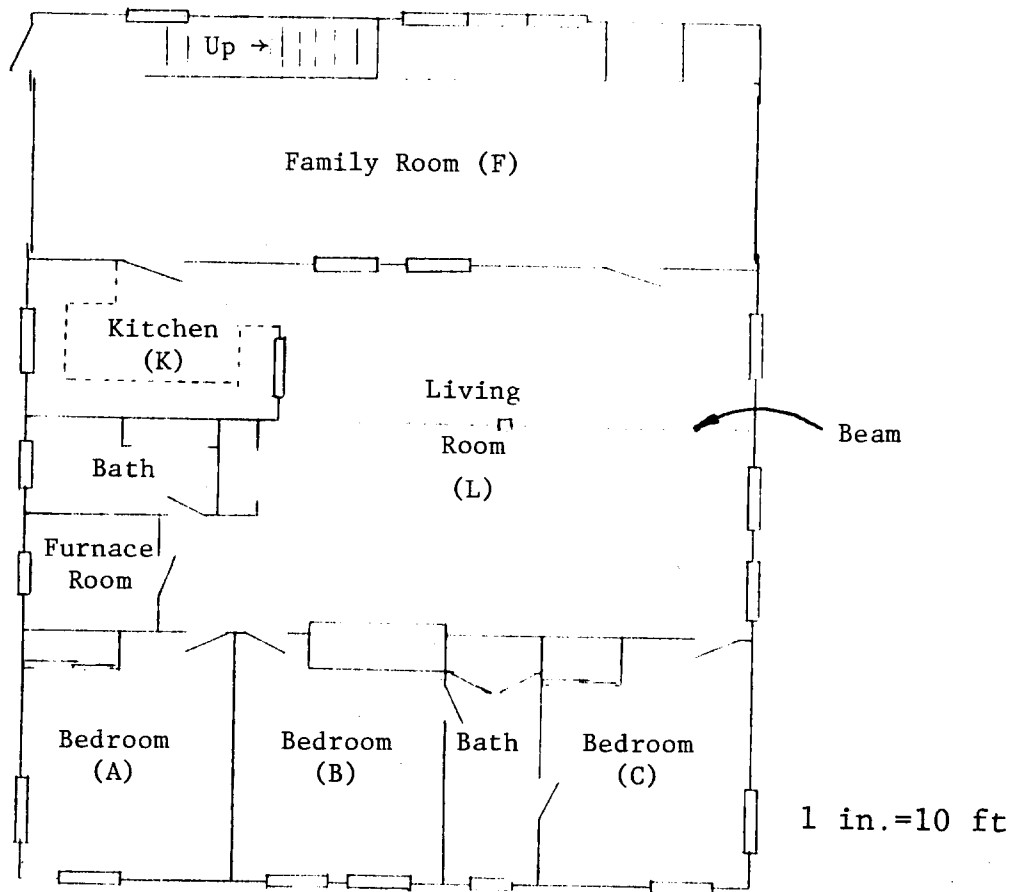
Fig. 7 FIXED DETECTOR BOARD AND INSTRUMENT LOCATIONS



APPENDIX G

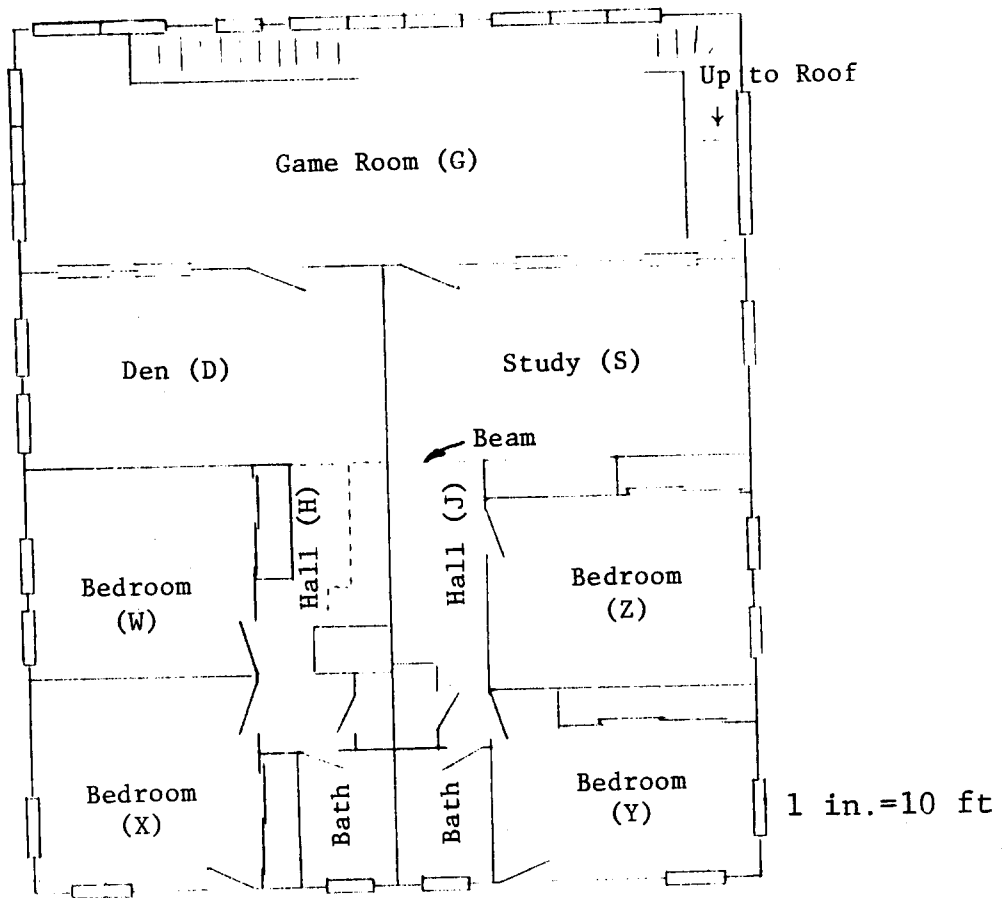
**FLOOR PLANS OF TEST BUILDING
SHOWING DETECTOR, FIRE, AND
INSTRUMENT LOCATIONS**

WABASH TEST SITE



1st Floor Plan - Wabash Avenue Residence









Fig. 1 ROOM IDENTIFICATION

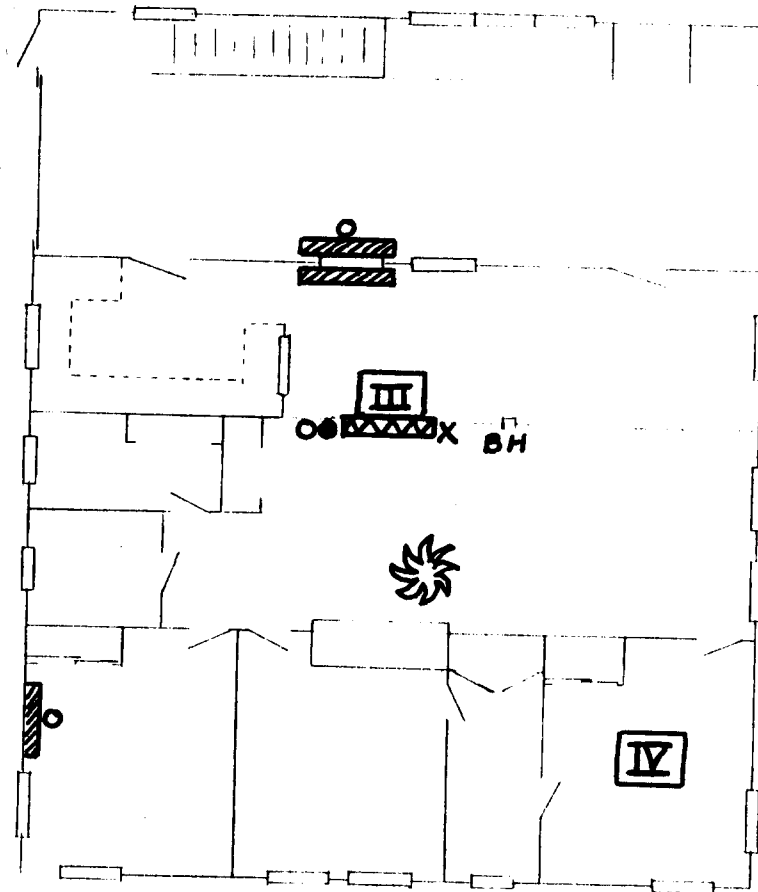


2nd Floor Plan - Wabash Avenue Residence

Fig. 2 ROOM IDENTIFICATION

KEY


- | | | | |
|---|------------------------------|---|--|
|  | Light Beam (Smoke) on I-Beam |  | Detector Board on I-Beam (IV on Ceiling) |
|  | Light Beam (Smoke) at 5 Ft |  | Gas Sampling at 5 Ft |
|  | Temperature Profile |  | Gas Sampling at Ceiling |
|  | Fire Location |  | Thermal Detectors |





1st Floor Plan - Wabash Avenue Residence


Fig. 3 FIRE, DETECTOR AND INSTRUMENT LOCATIONS, W-60 TO W-71


KEY


 Light Beam (Smoke)
at Ceiling

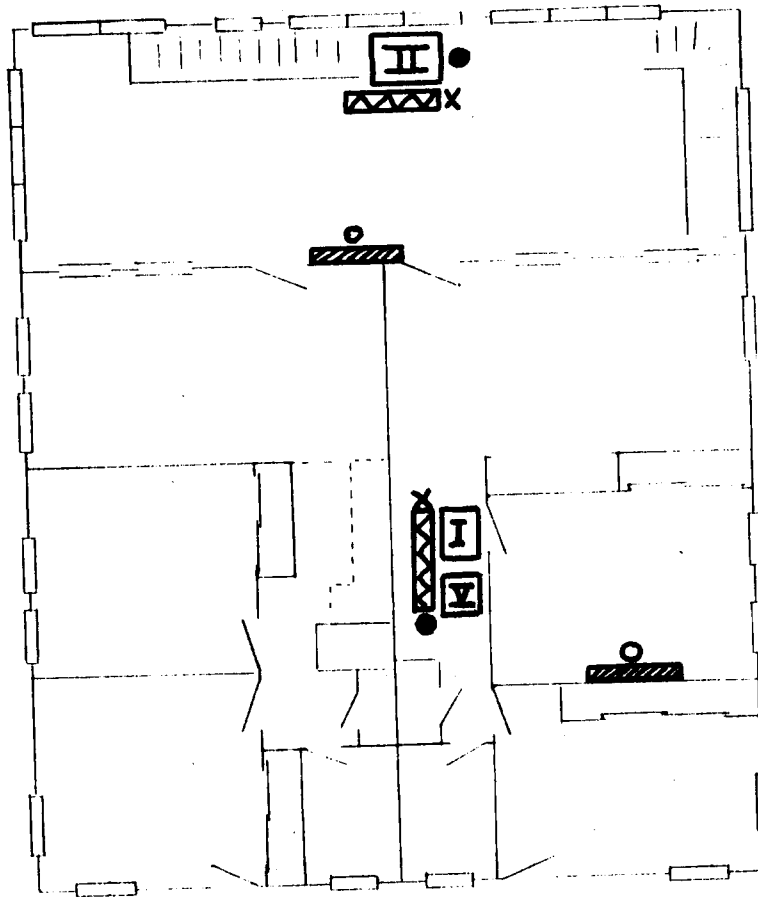
 Detector Board (Typical)

 Light Beam (Smoke)
at 5 Ft

 Temperature Profile

 Gas Sampling at 5 Ft






 Gas Sampling at Ceiling

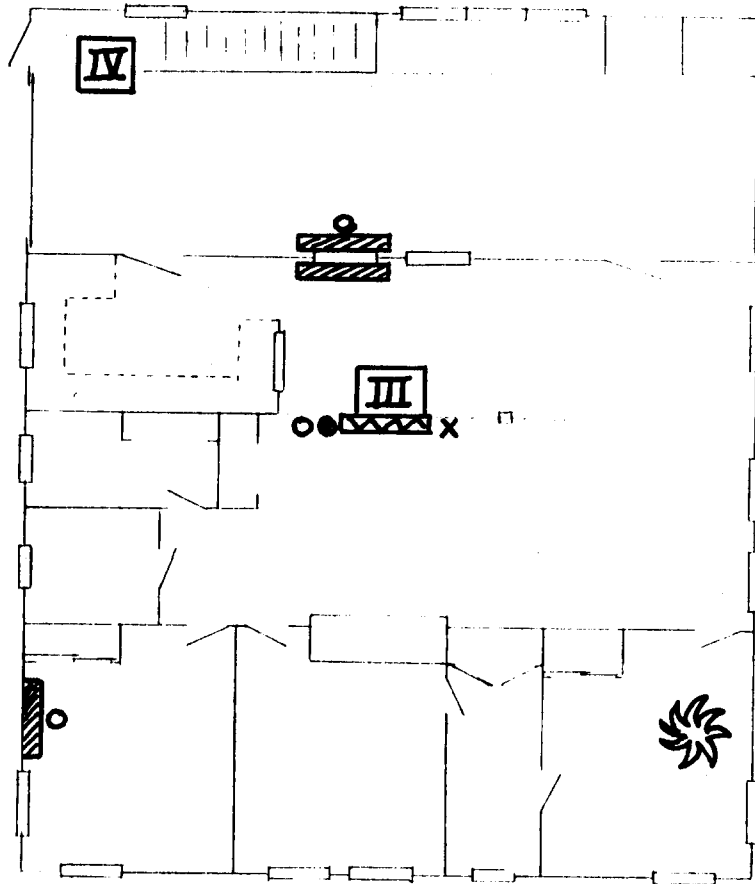


2nd Floor Plan - Wabash Avenue Residence

Fig. 4 DETECTOR AND INSTRUMENT LOCATIONS,
W-60 TO W-64

KEY

- | | |
|--|--|
|  Light Beam (Smoke) on I-Beam |  Detector Board on I-Beam |
|  Light Beam (Smoke) at 5 Ft |  Detector Board on Ceiling |
| X Temperature Profile | ○ Gas Sampling at 5 Ft |
|  Fire Location | ● Gas Sampling at Ceiling |



1st Floor Plan - Wabash Avenue Residence

Fig. 5 FIRE, DETECTOR AND INSTRUMENT LOCATIONS, W-72 TO W-74

KEY



Light Beam (Smoke)
at Ceiling



Detector Board (Typical)

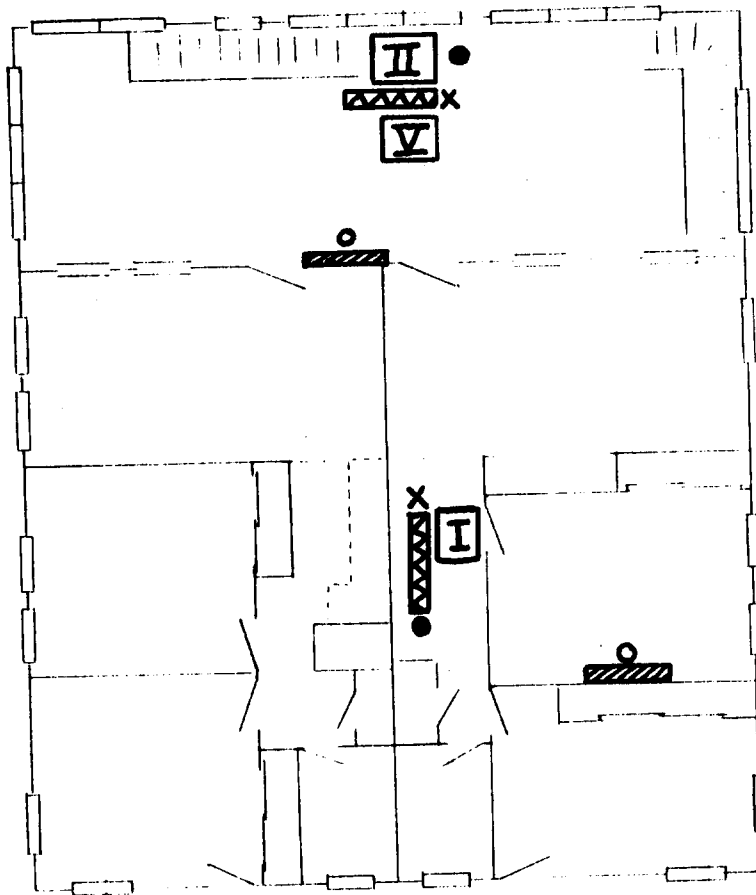


Light Beam (Smoke)
at 5 Ft



Temperature Profile

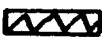






- Gas Sampling at 5 Ft
- Gas Sampling at Ceiling

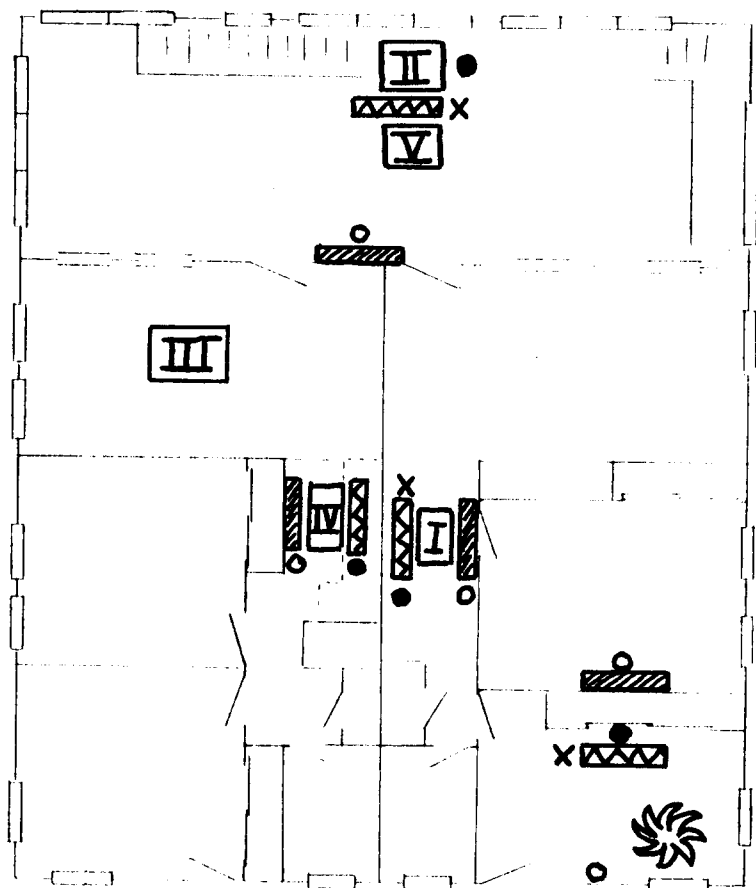


2nd Floor Plan - Wabash Avenue Residence

Fig. 6 DETECTOR AND INSTRUMENT LOCATIONS
W-65 TO W-74

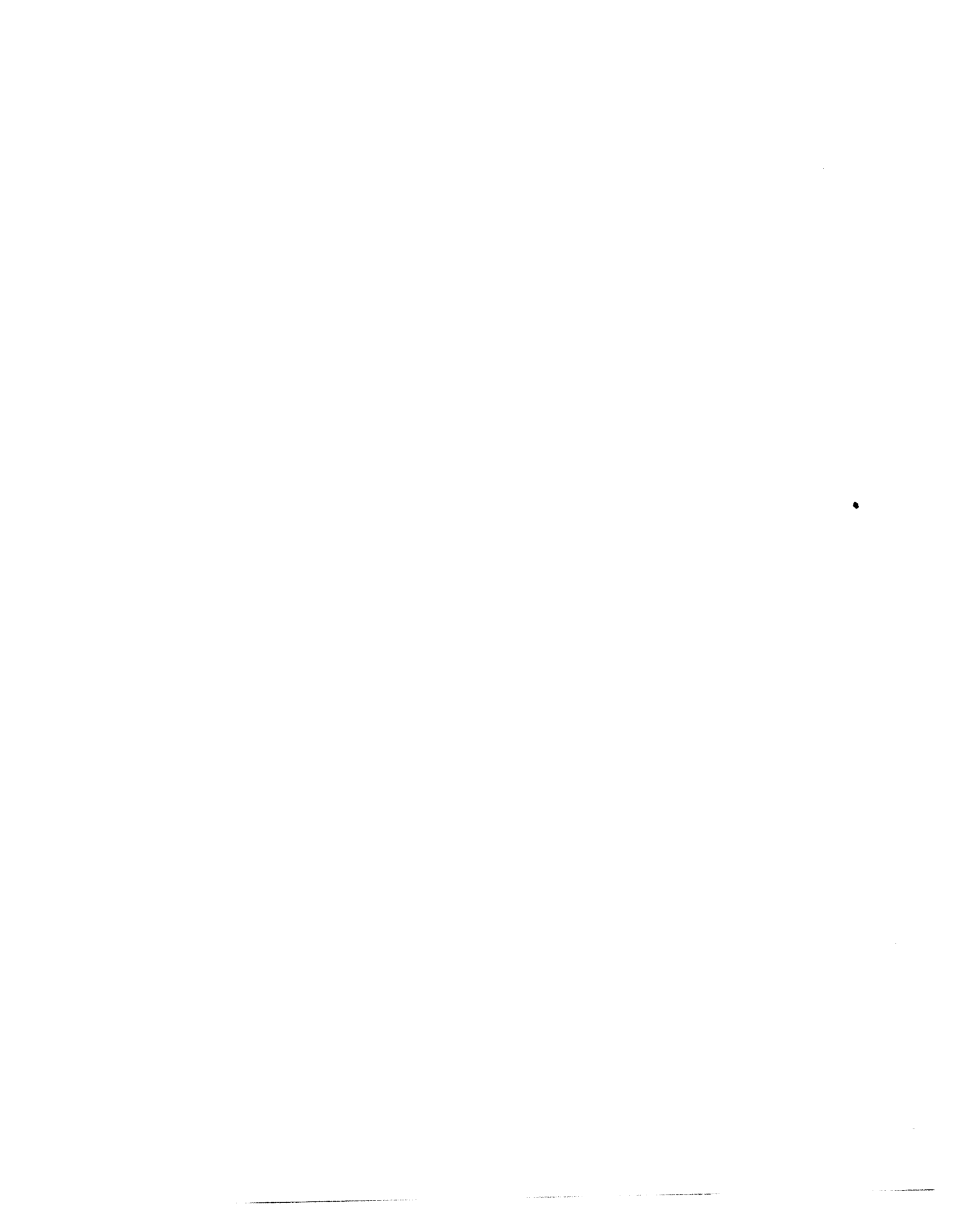
KEY

- | | |
|--|--|
|  Light Beam (Smoke)
at Ceiling |  Detector Board (Typical) |
|  Light Beam (Smoke)
at 5 Ft |  Temperature Profile |
|  Gas Sampling at 5 Ft |  Fire Location |
|  Gas Sampling at Ceiling | |



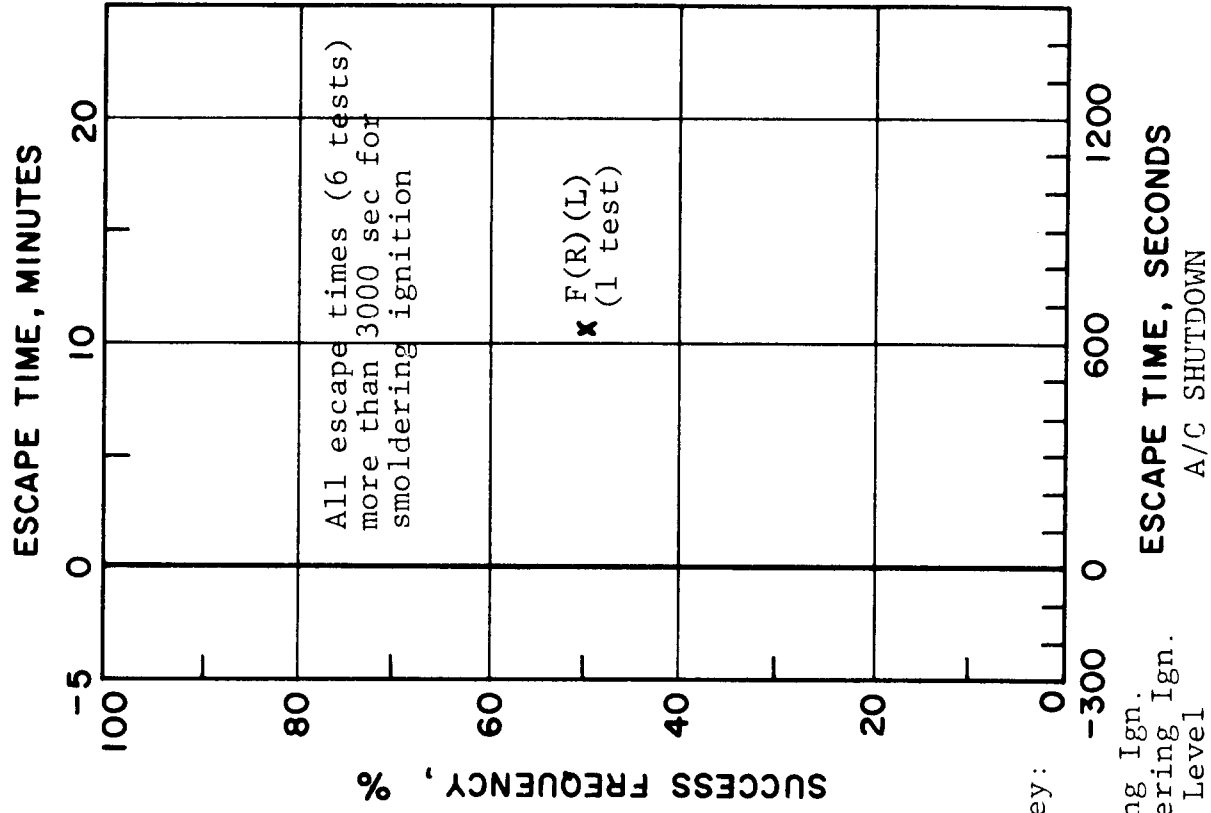
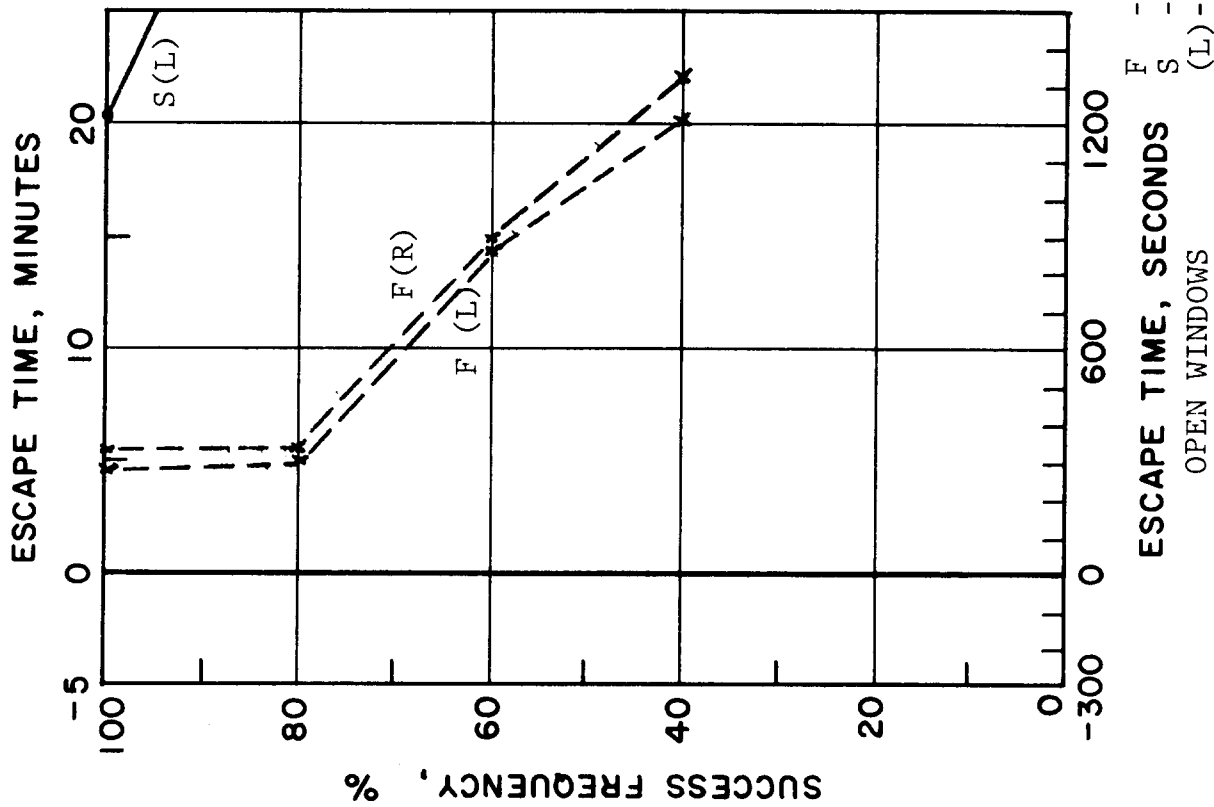
2nd Floor Plan - Wabash Avenue Residence

Fig. 7 FIRE, DETECTOR AND INSTRUMENT
LOCATIONS W-75 AND W-76
(all instrumentation on 2nd floor)



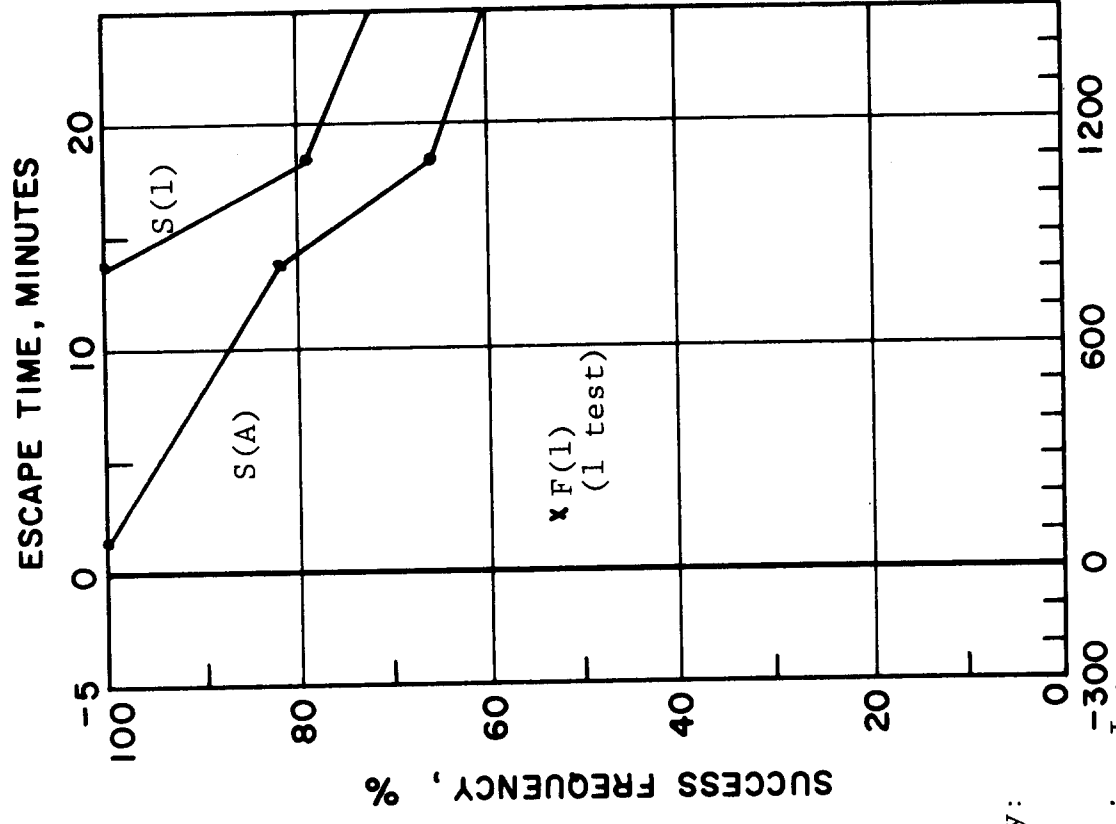
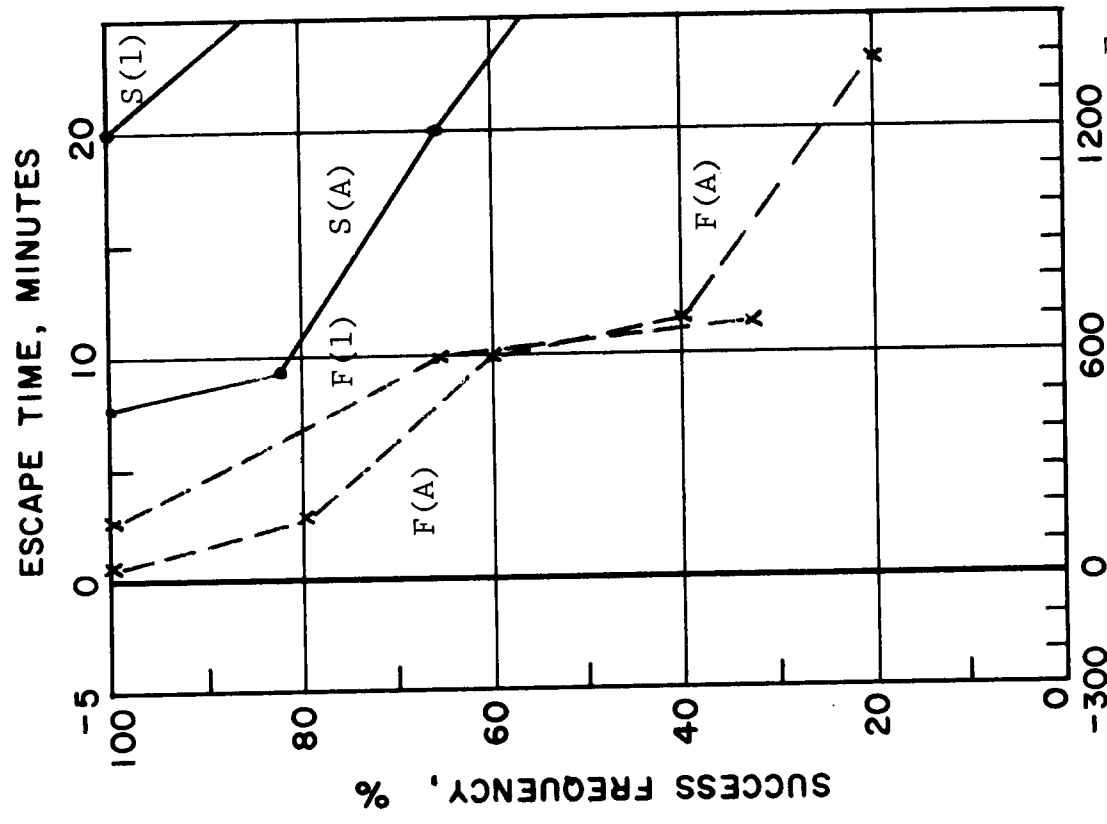
APPENDIX H
ESCAPE POTENTIAL CURVES





Key:
 F - Flaming Ign.
 S - Smoldering Ign.
 (L) - Every Level
 (R) - Every Room

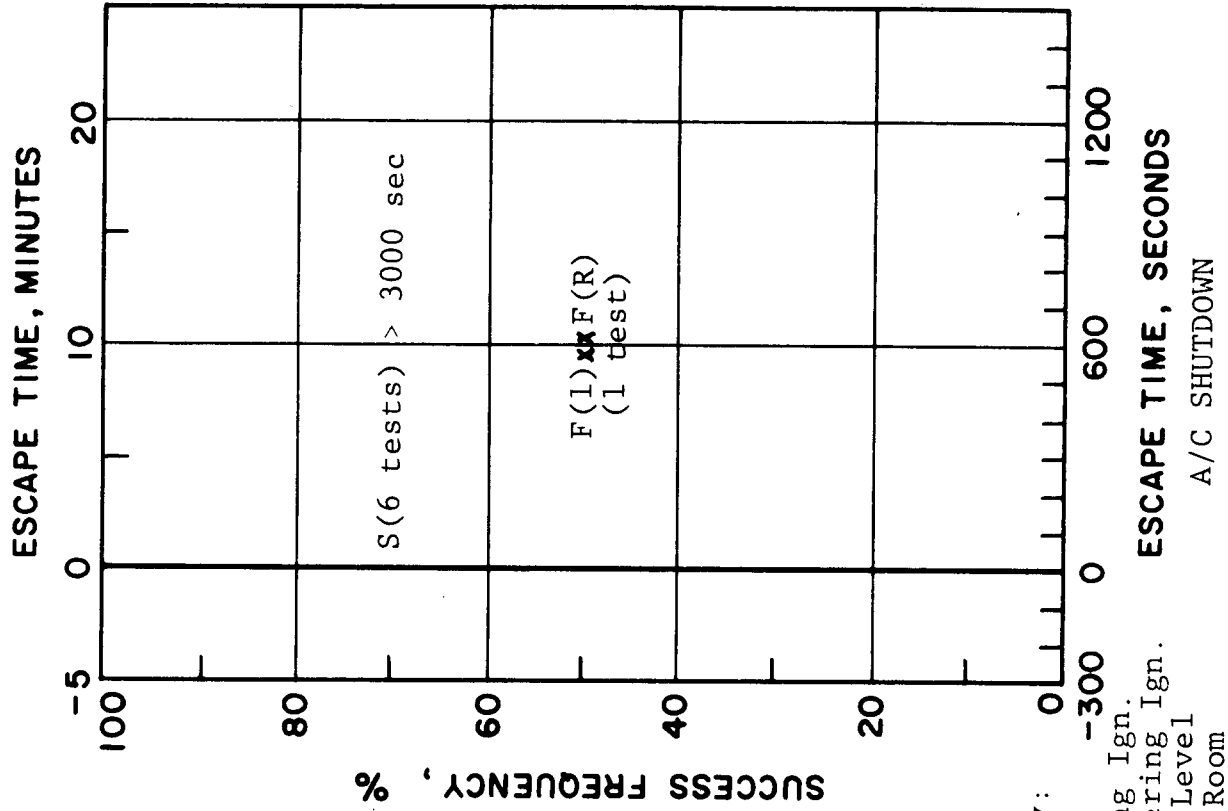
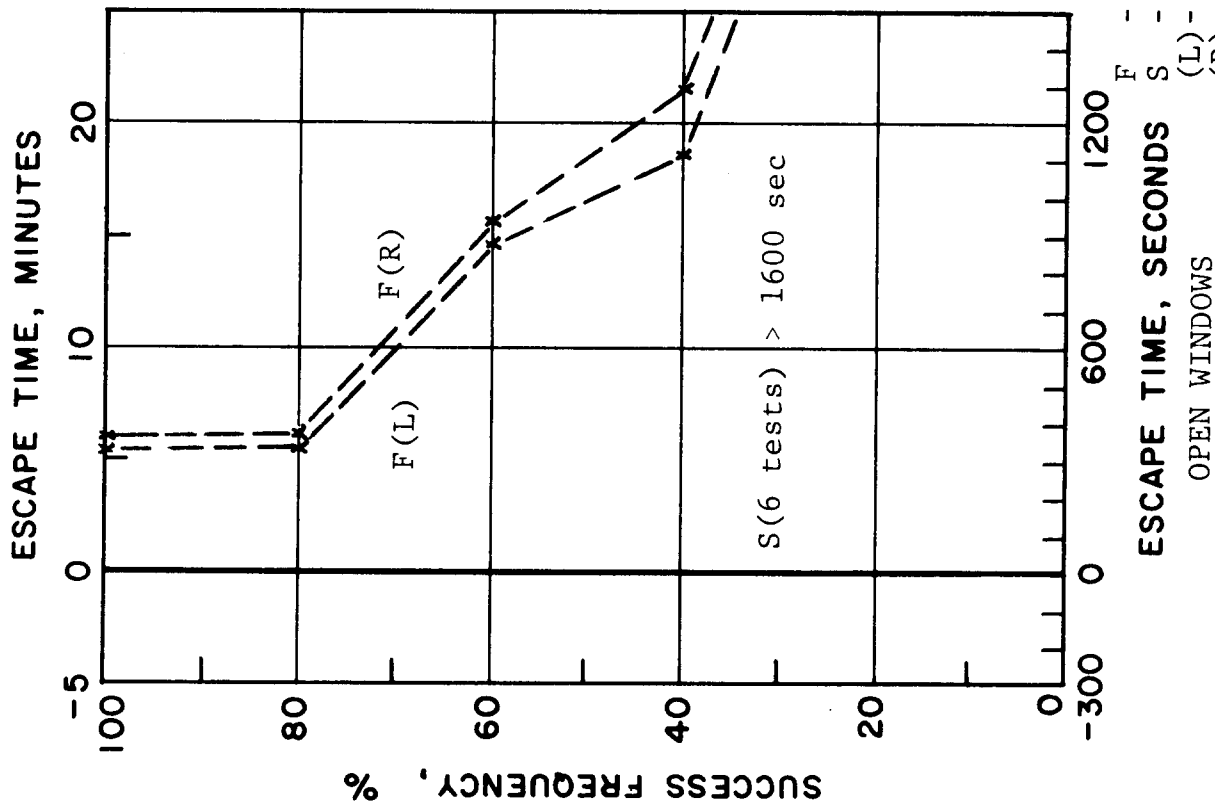
ESCAPE POTENTIAL, DETECTOR P
 (J.R. Whitehouse Residence)



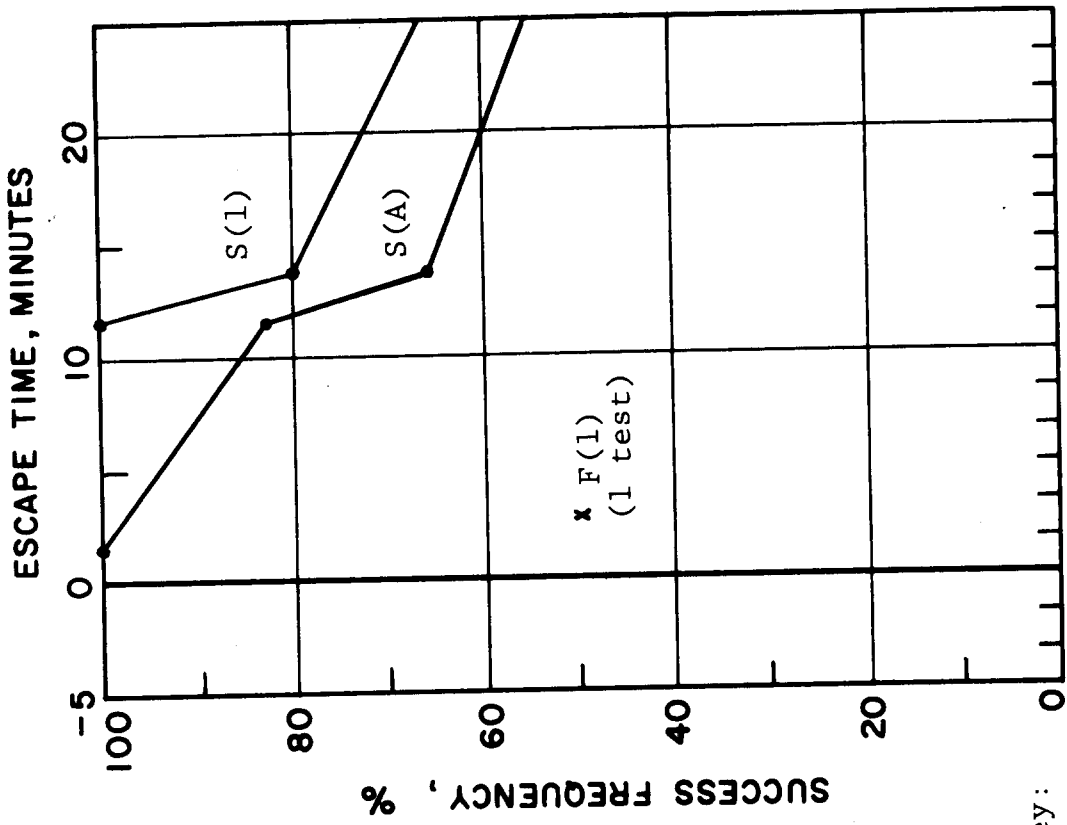
Key:

- F - Flaming Ign.
- S - Smoldering Ign.
- (A) - All Fires
- (1) - First Floor Fires

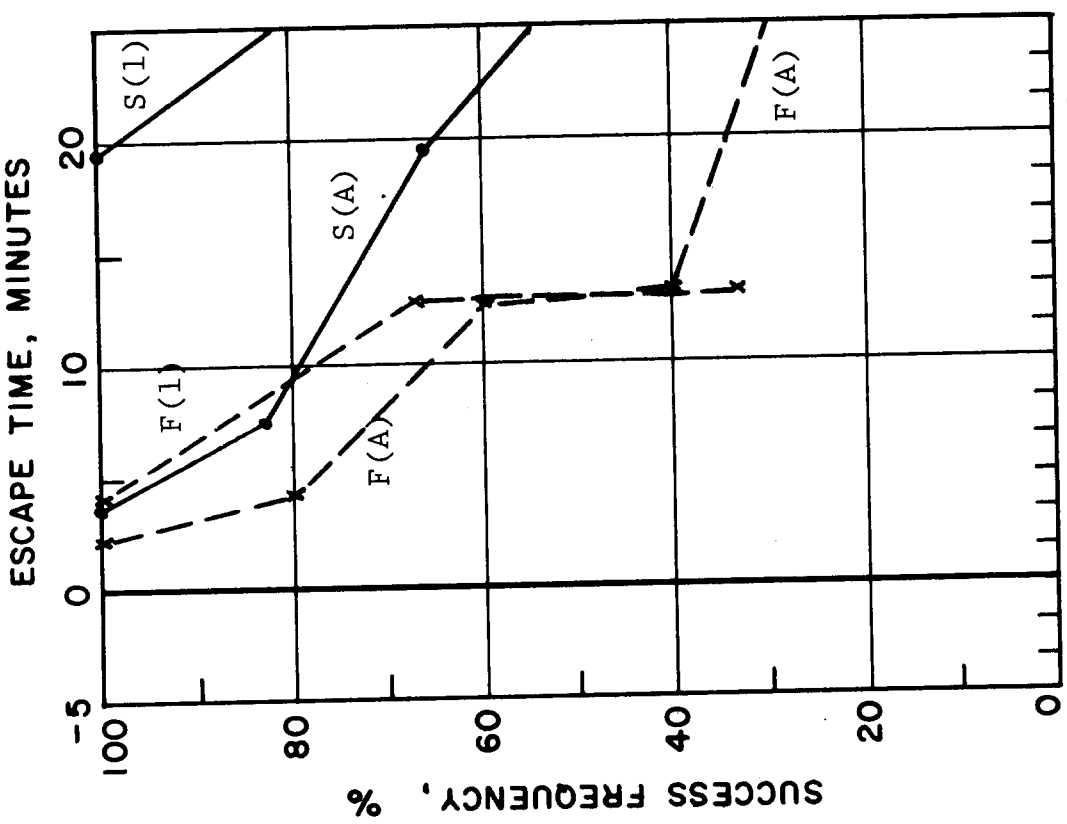
ESCAPE POTENTIAL, DETECTOR P ON 2ND FLOOR ONLY
 (J.R. Whitehouse Residence)



ESCAPE POTENTIAL, DETECTOR N
 (J.R. Whitehouse Residence)

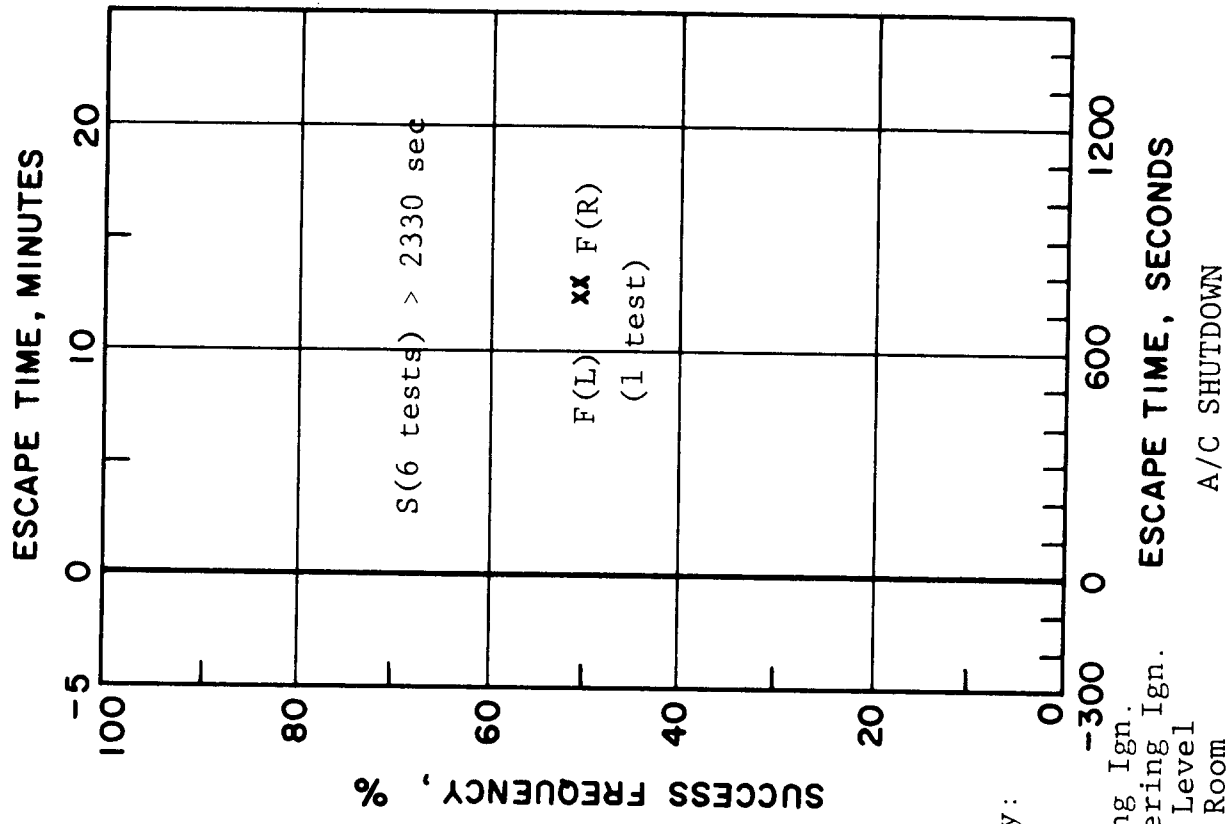
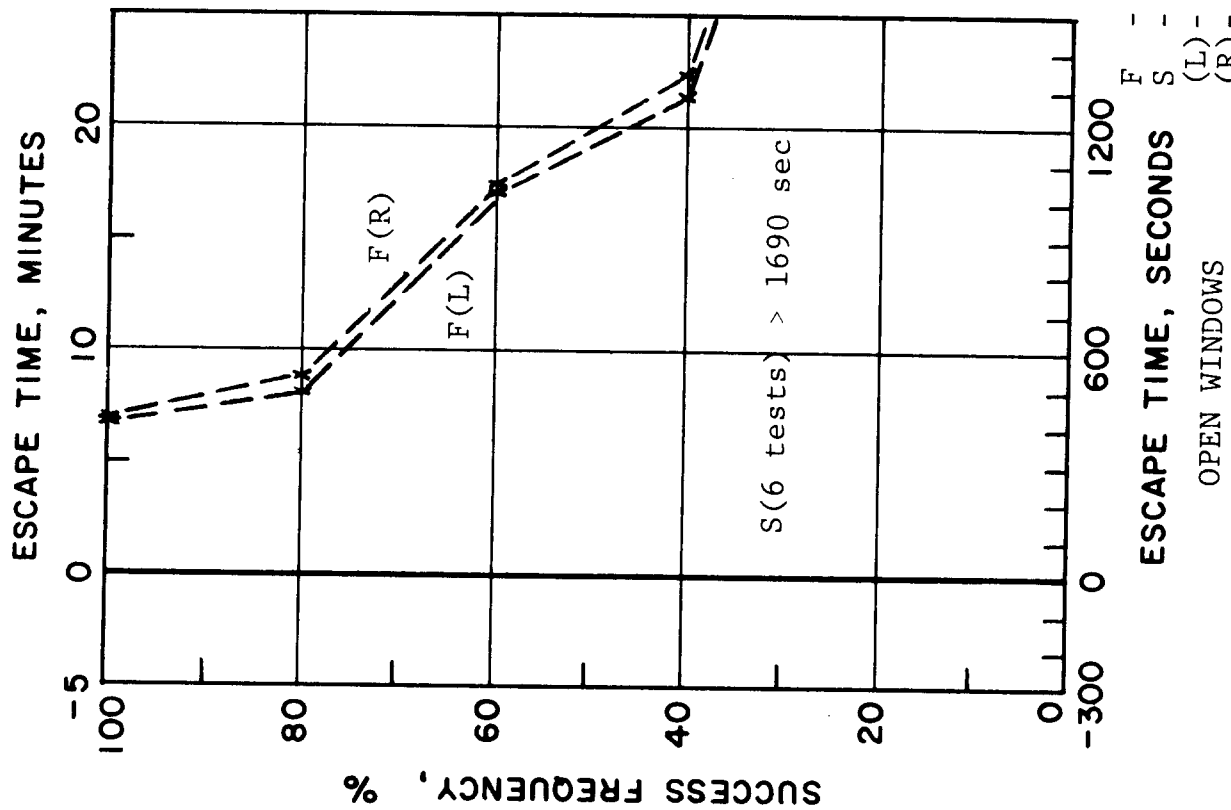


Key: F - Flaming Ign.
 S - Smoldering Ign.
 (A) - All Fires
 (1) - First Floor Fires



Key: F - Flaming Ign.
 S - Smoldering Ign.
 (A) - All Fires
 (1) - First Floor Fires

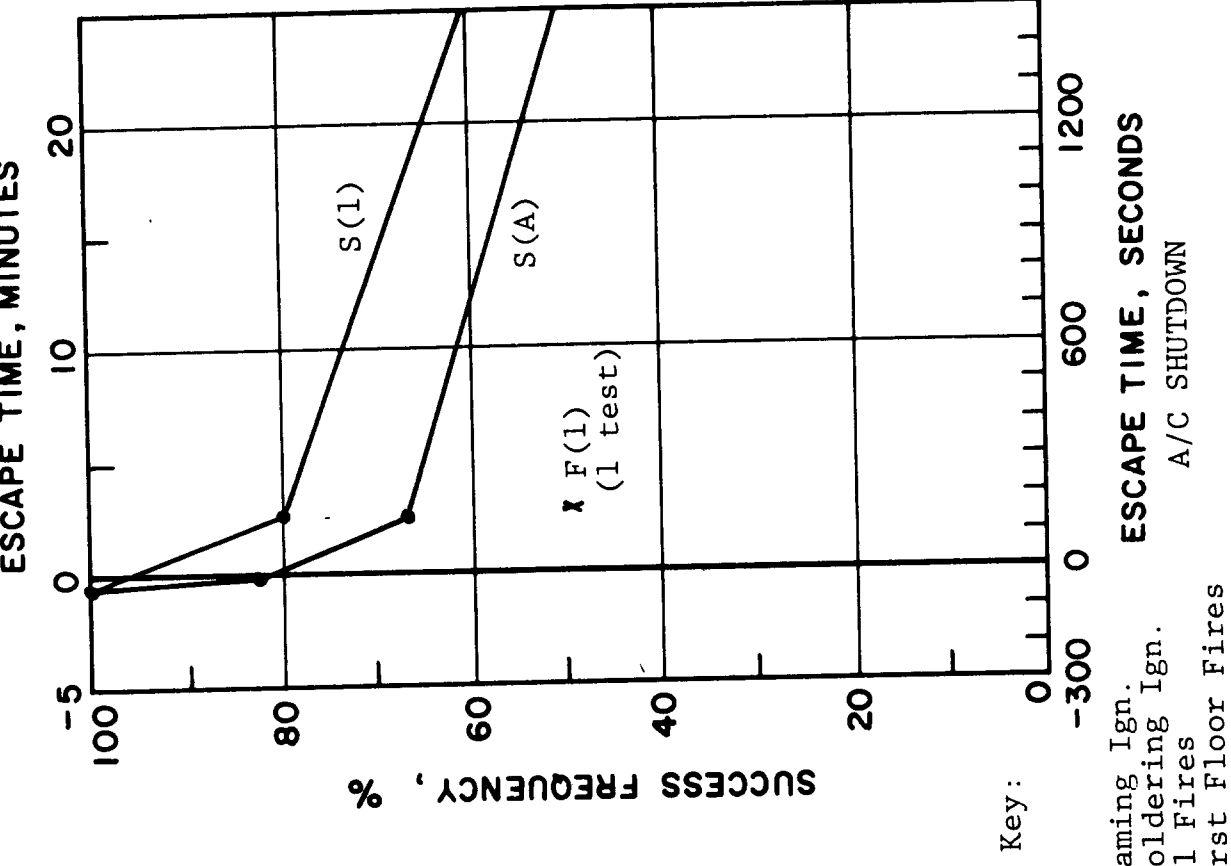
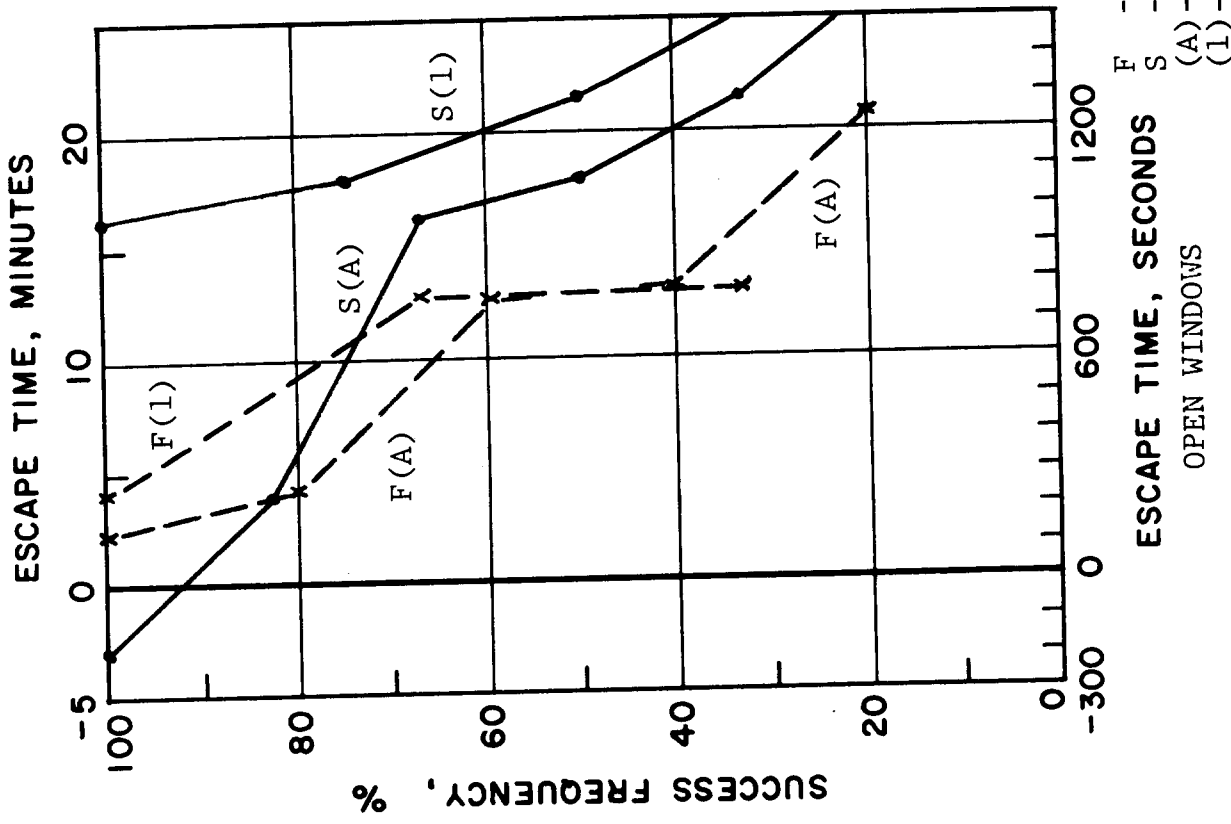
ESCAPE POTENTIAL, DETECTOR N ON 2ND FLOOR ONLY
 (J.R. Whitehouse Residence)



Key:

- F - Flaming Ign.
- S - Smoldering Ign.
- (L) - Every Level
- (R) - Every Room

ESCAPE POTENTIAL, DETECTOR F
(J.R. Whitehouse Residence)



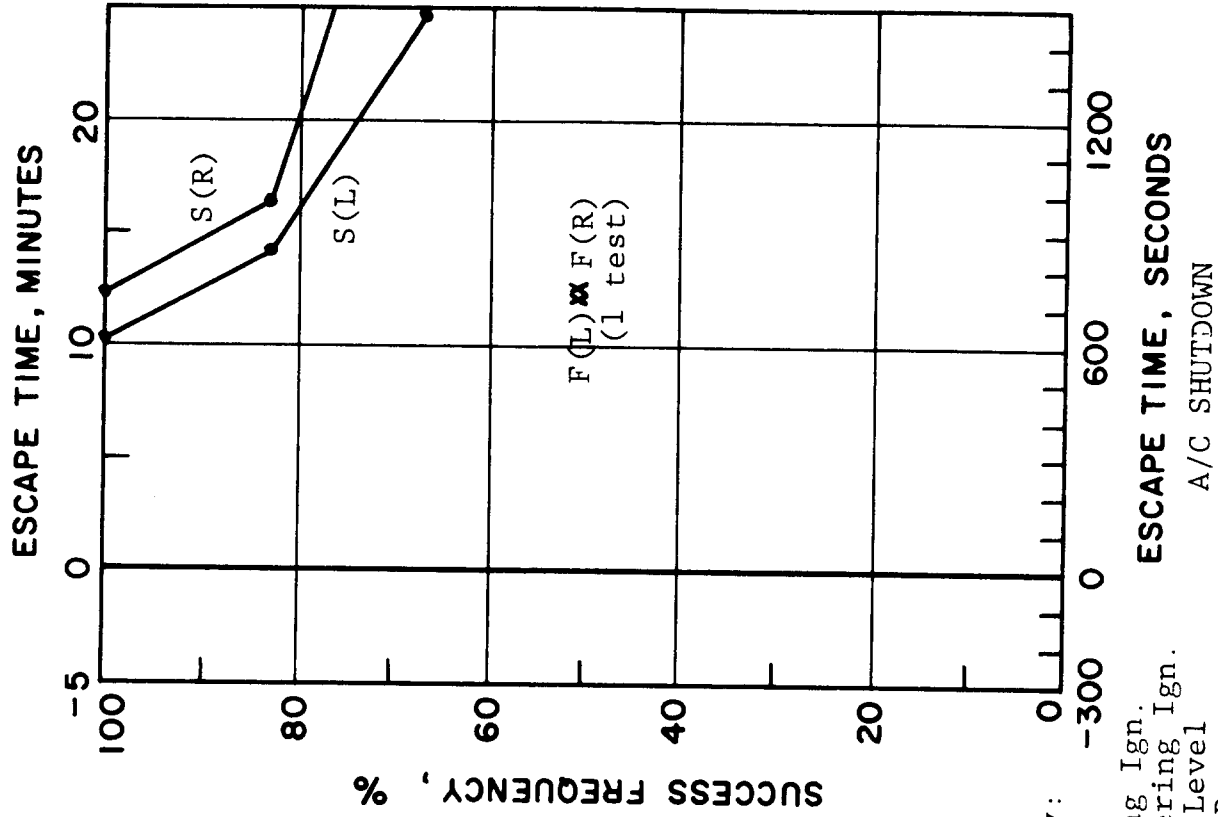
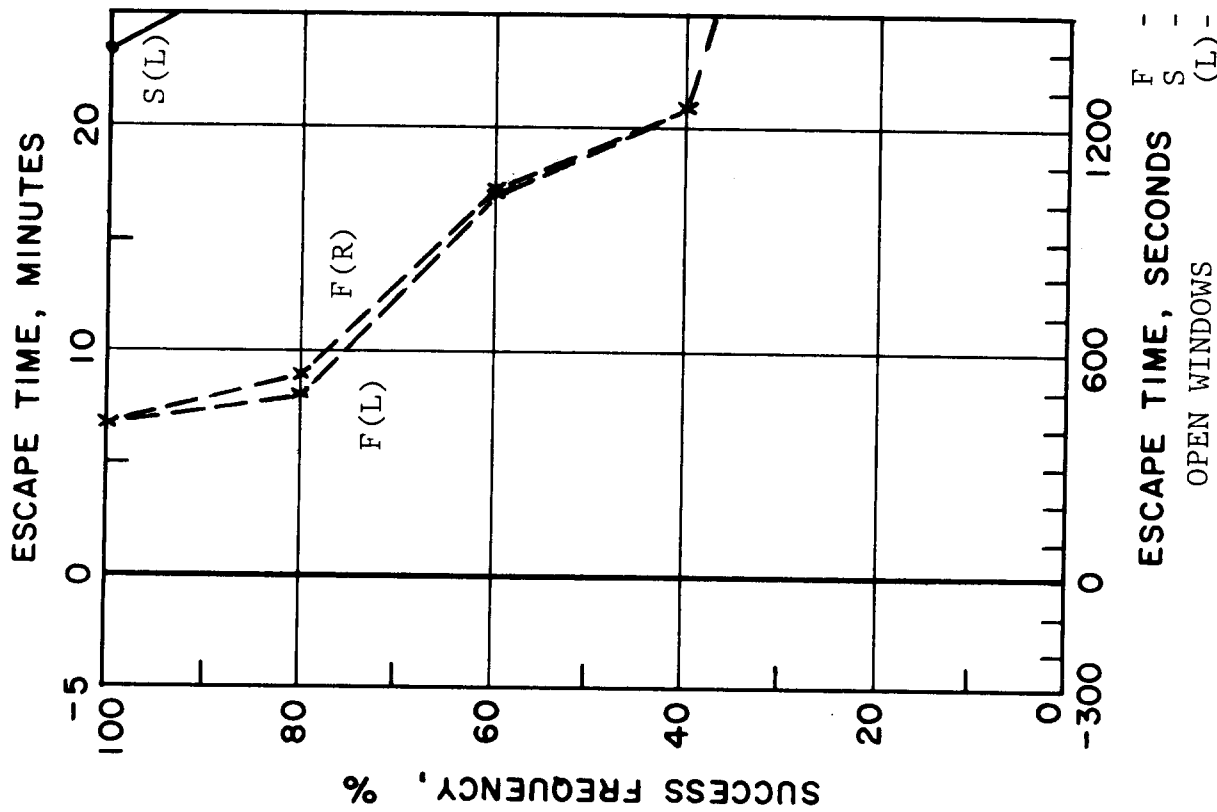
Key:

F - Flaming Ign.
 S - Smoldering Ign.
 (A) - All Fires
 (1) - First Floor Fires

OPEN WINDOWS

ESCAPE POTENTIAL, DETECTOR F ON 2ND FLOOR ONLY
 (J.R. Whitehouse Residence)

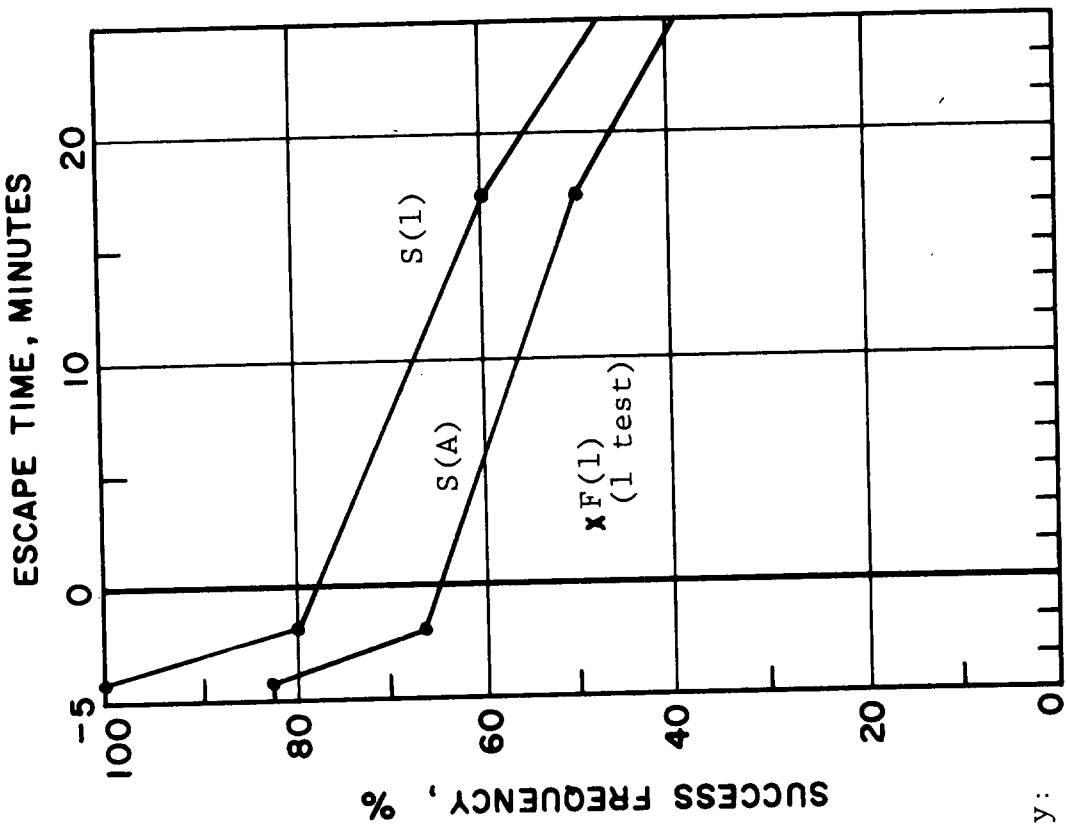
ESCAPE TIME, SECONDS
 A/C SHUTDOWN



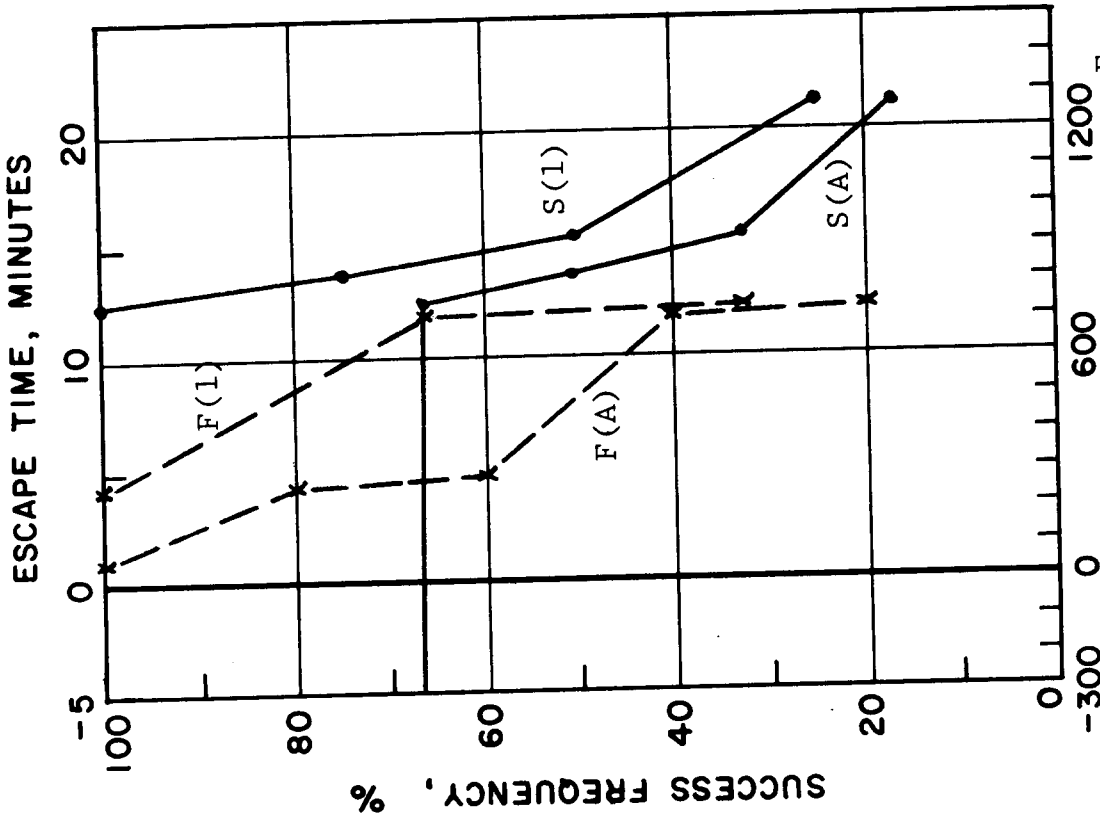
Key:

- F - Flaming Ign.
- S - Smoldering Ign.
- (L) - Every Level
- (R) - Every Room

ESCAPE POTENTIAL, DETECTOR K
(J.R. Whitehouse Residence)

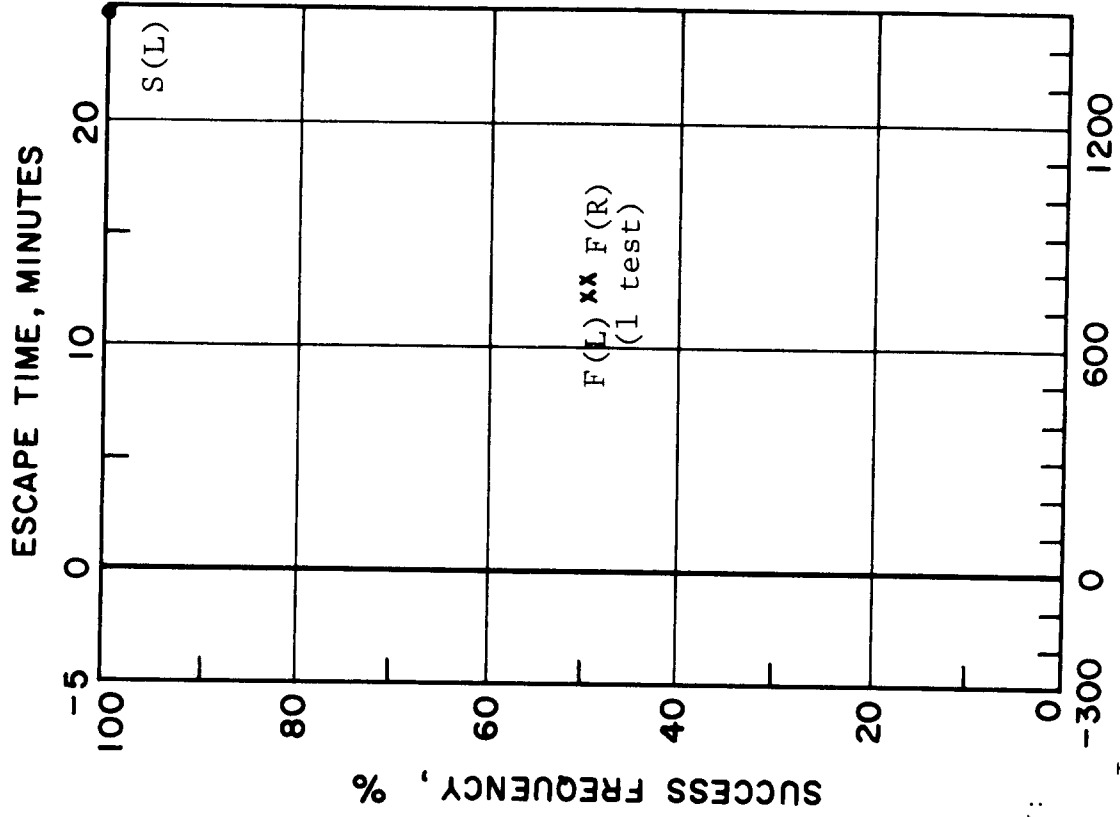
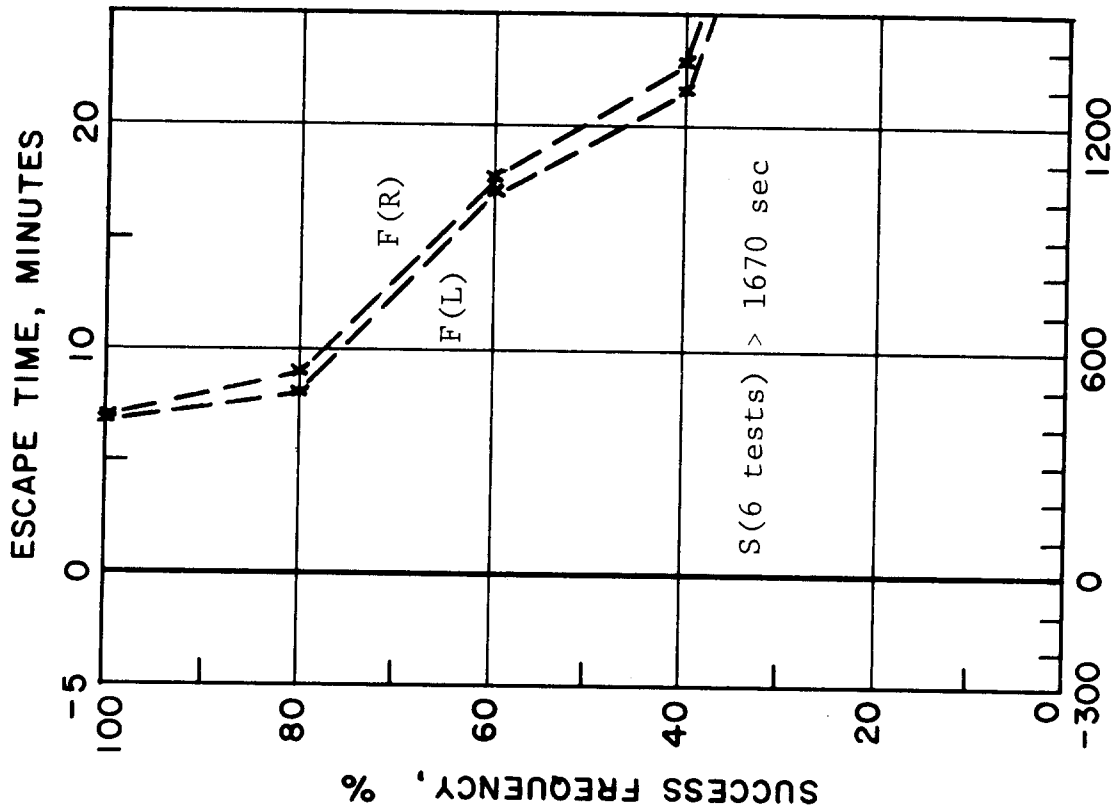


Key:
 F - Flaming Ign.
 S - Smoldering Ign.
 (A) - All Fires
 (1) - First Floor Fires
 A/C SHUTDOWN



OPEN WINDOWS

ESCAPE POTENTIAL, DETECTOR K ON 2ND FLOOR ONLY
 (J.R. Whitehouse Residence)



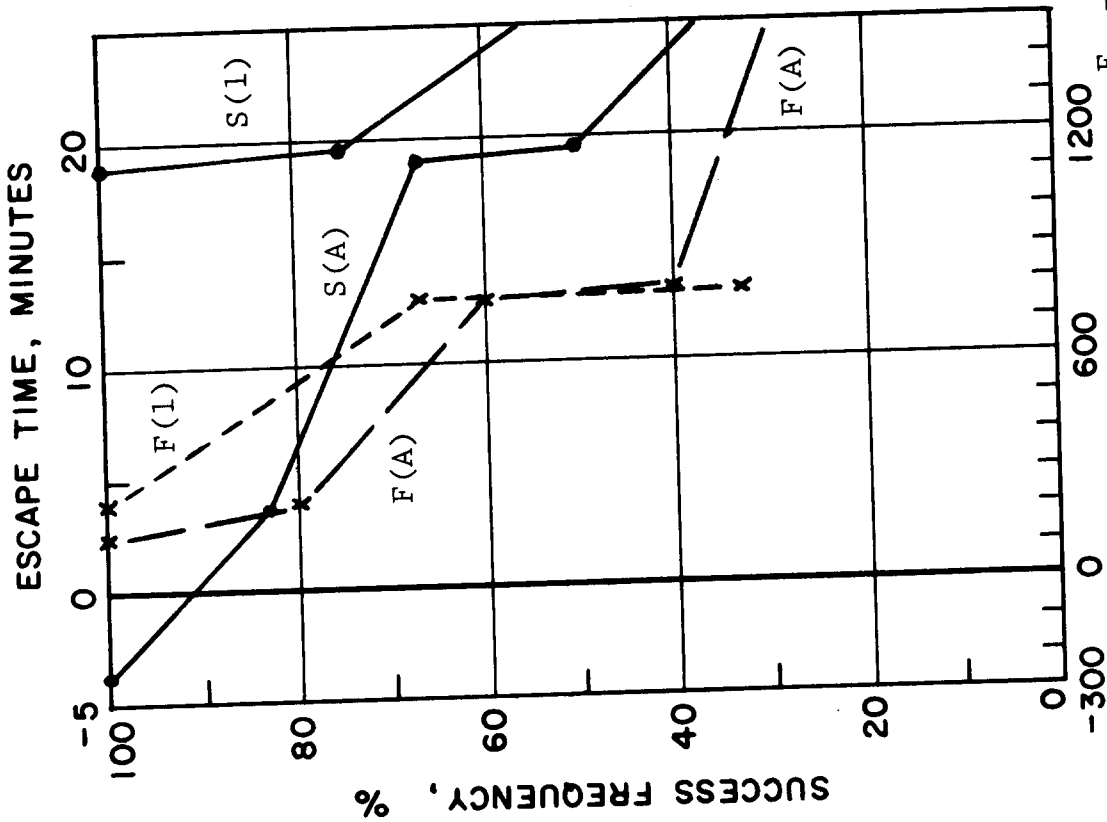
Key:

F - Flaming Ign.
 S - Smoldering Ign.
 (L) - Every Level
 (R) - Every Room

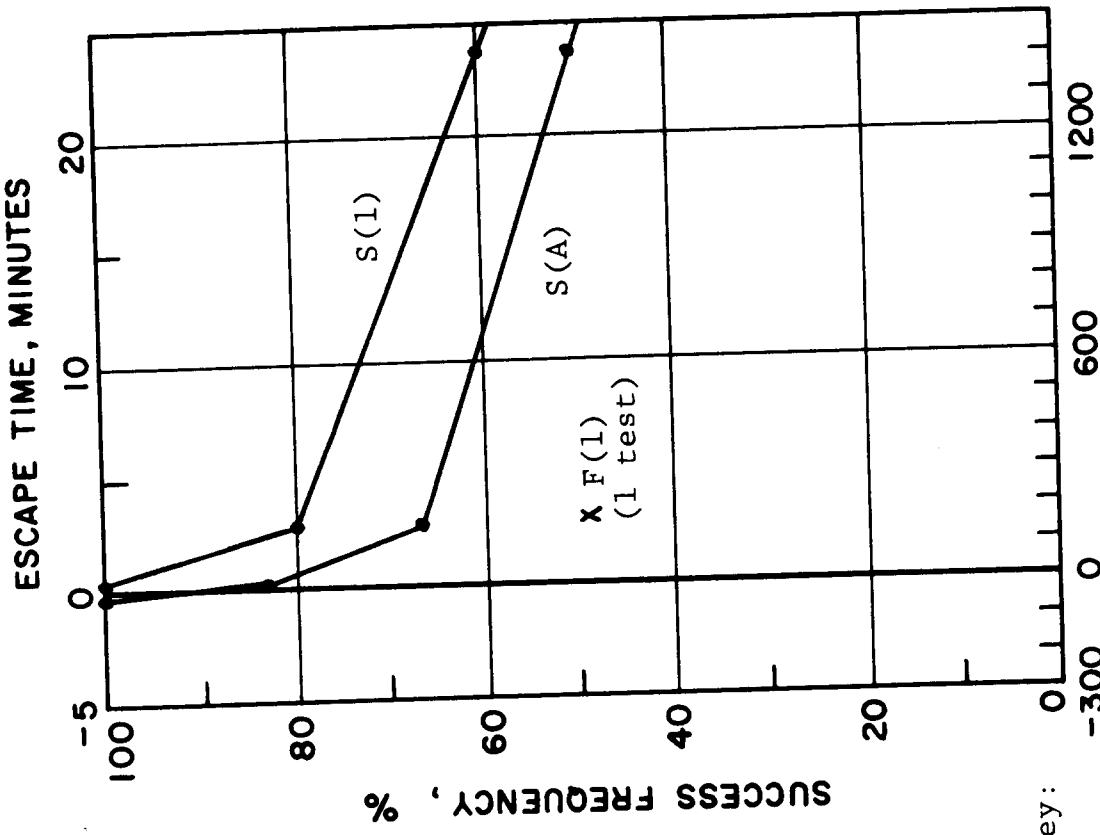
ESCAPE TIME, SECONDS
 OPEN WINDOWS

ESCAPE TIME, SECONDS
 A/C SHUTDOWN

ESCAPE POTENTIAL, DETECTOR S
 (J.R. Whitehouse Residence)



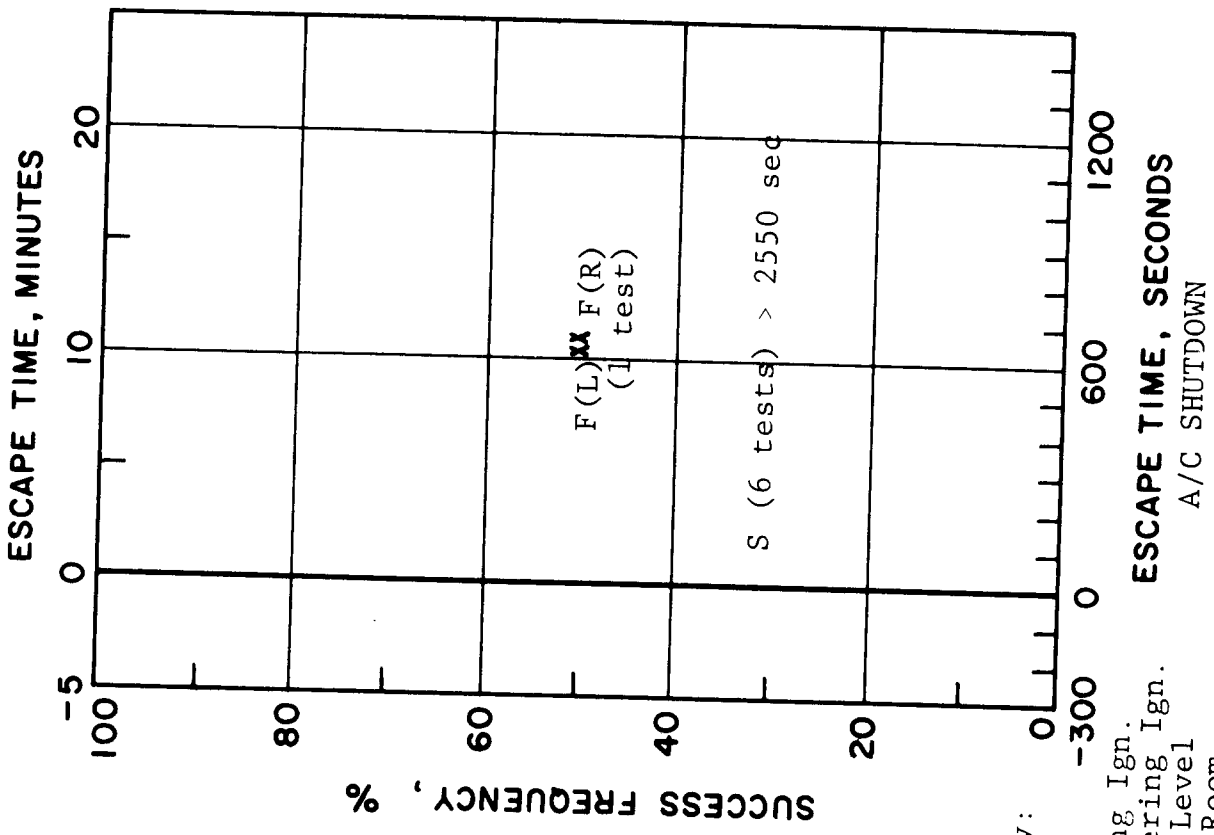
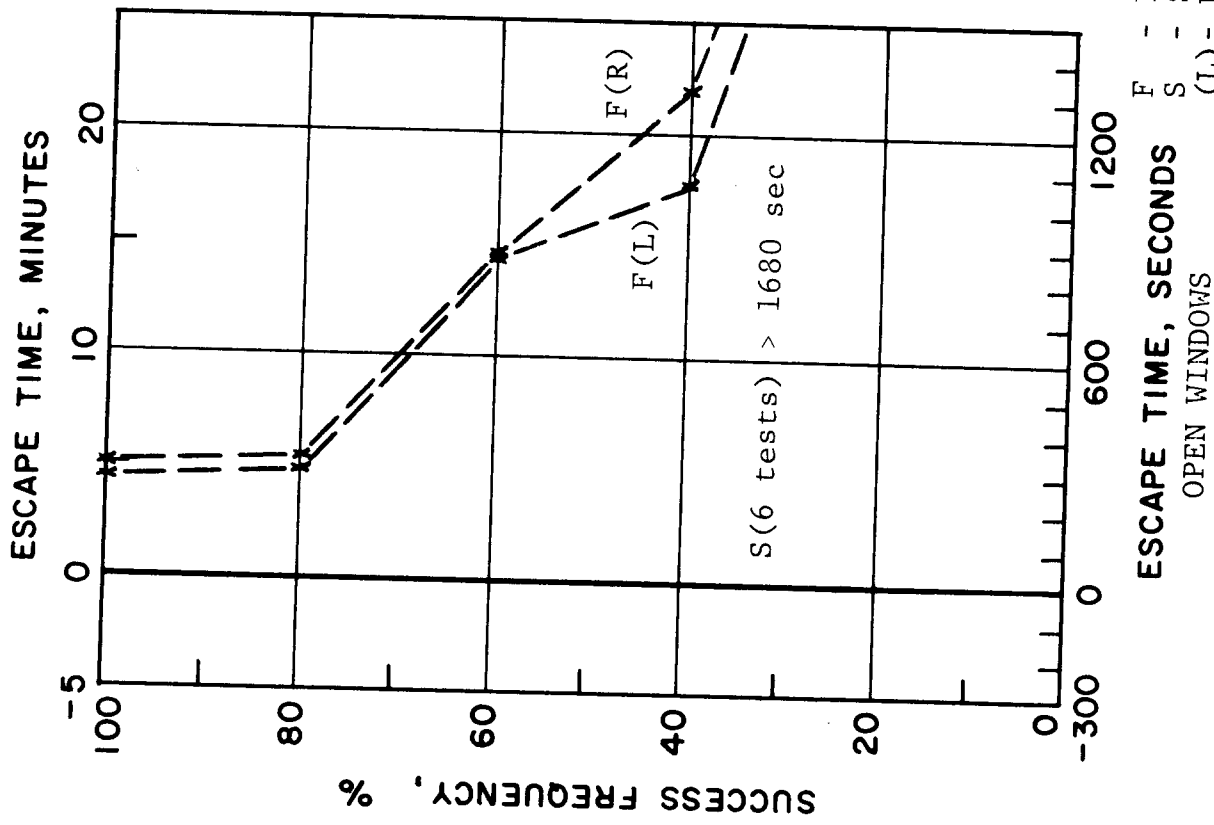
ESCAPE TIME, SECONDS
OPEN WINDOWS



ESCAPE TIME, SECONDS
A/C SHUTDOWN

Key:
 F - Flaming Ign.
 S - Smoldering Ign.
 (A) - All Fires
 (1) - First Floor Fires

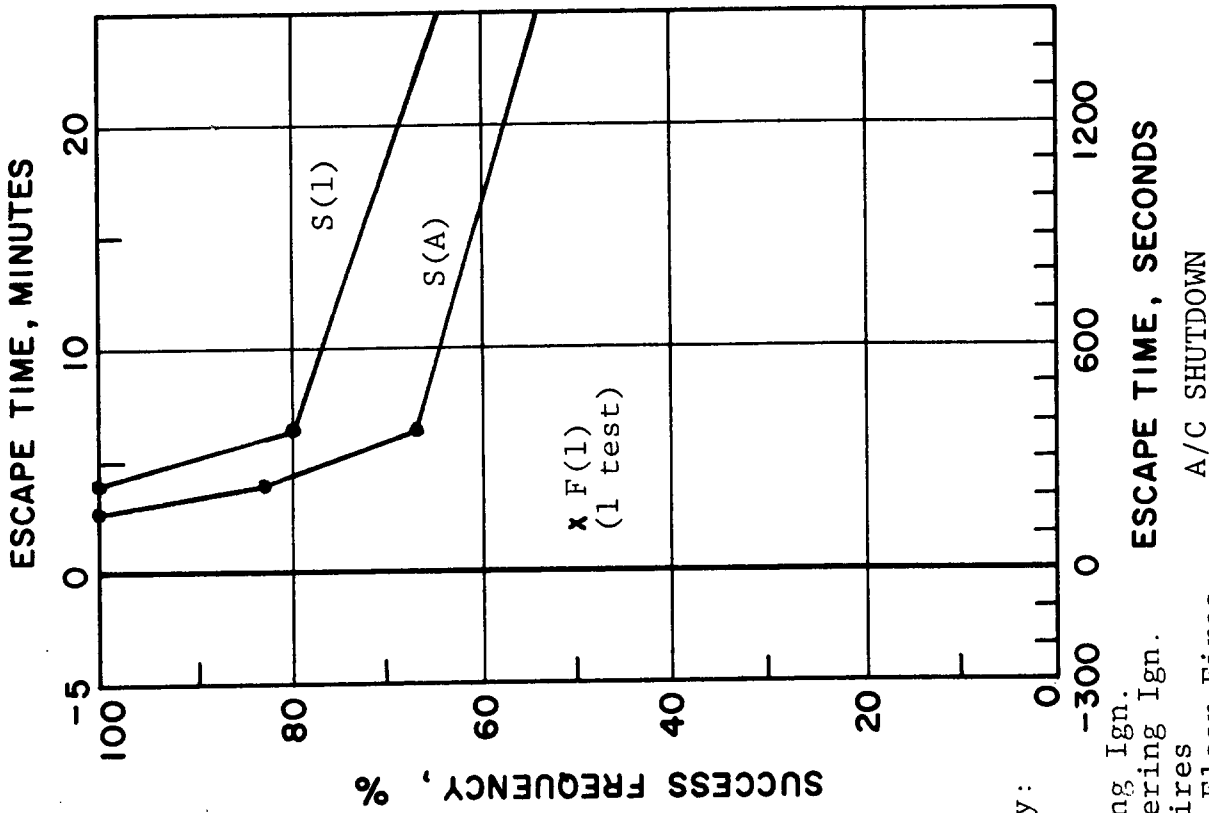
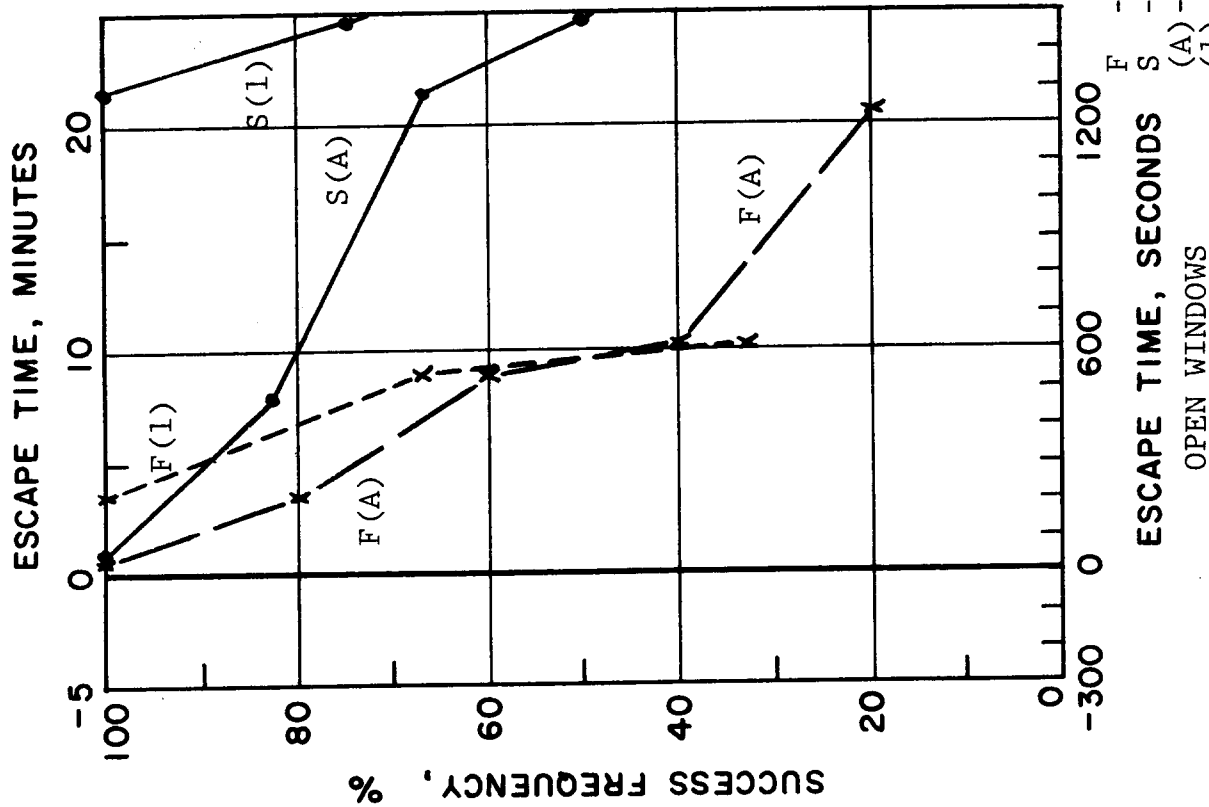
ESCAPE POTENTIAL, DETECTOR S ON 2ND FLOOR ONLY
 (J.R. Whitehouse Residence)



Key:

- F - Flaming Ign.
- S - Smoldering Ign.
- (L) - Every Level
- (R) - Every Room

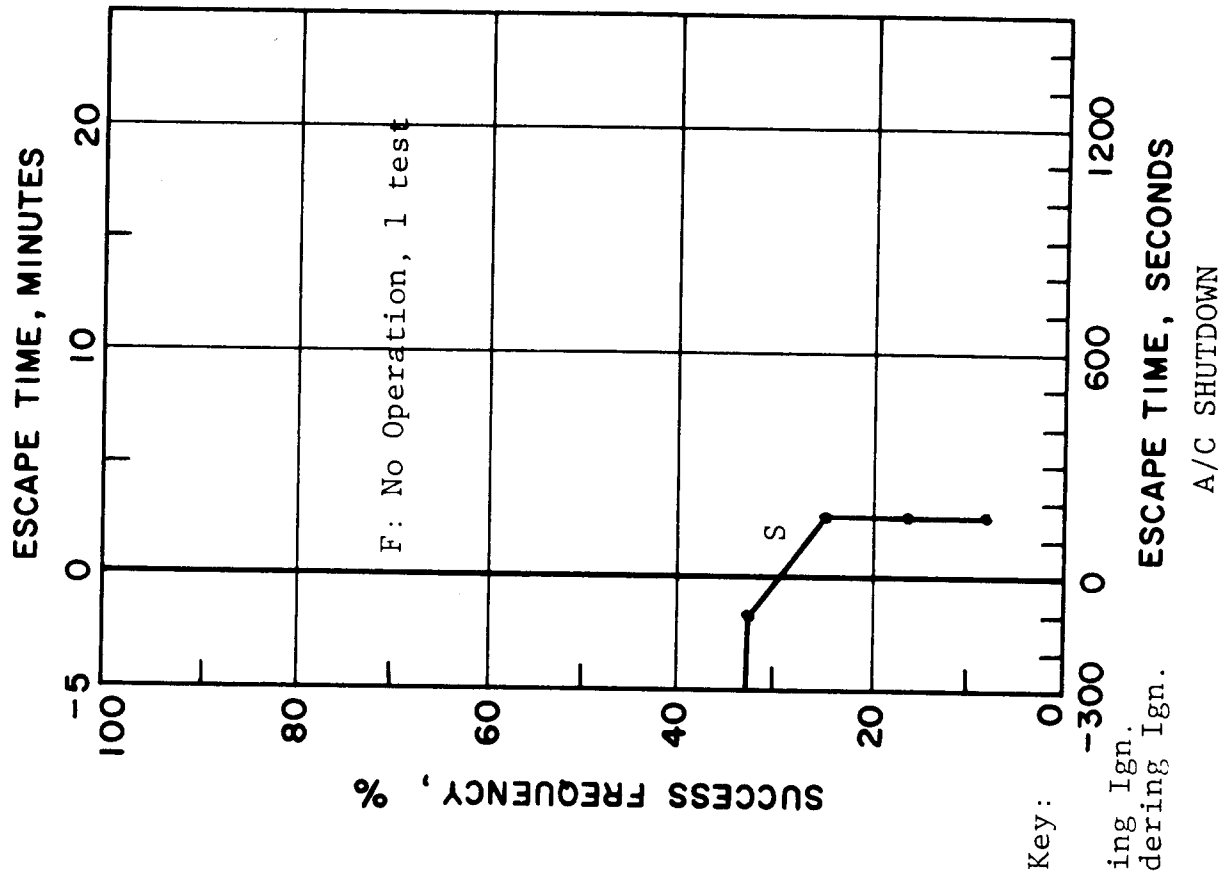
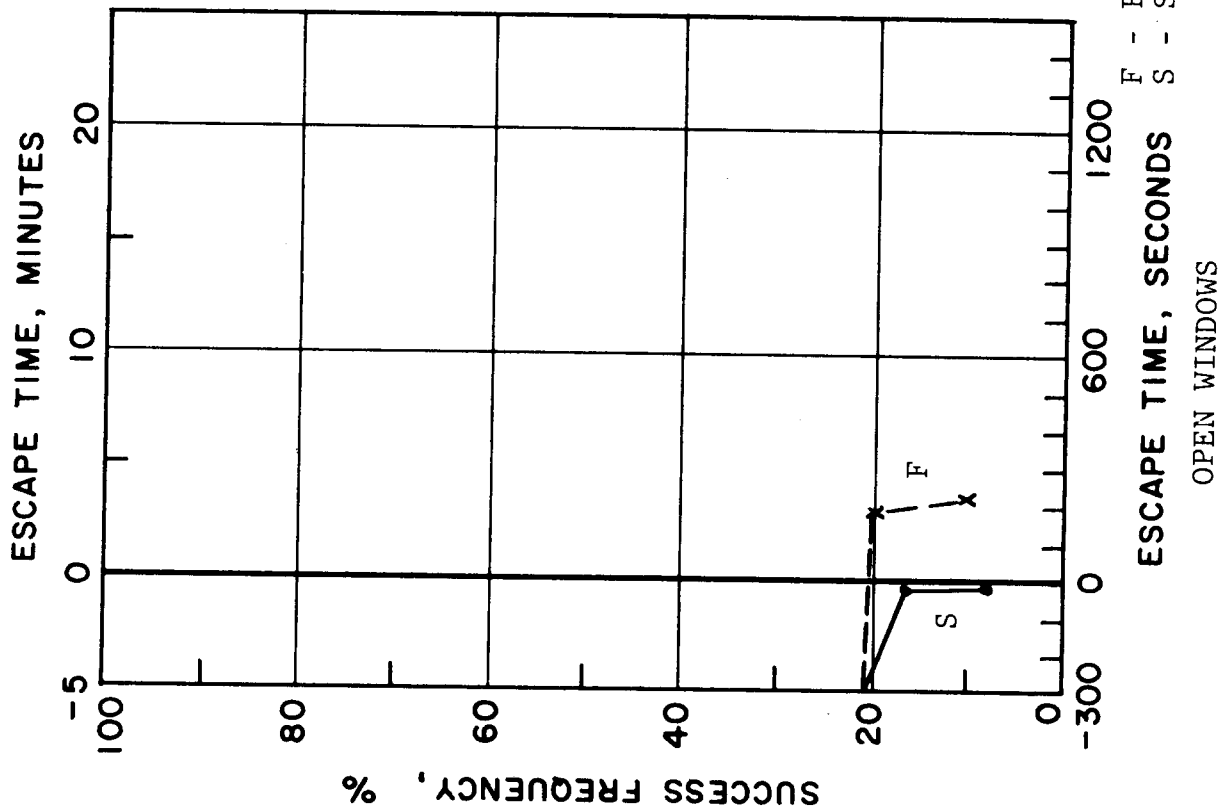
ESCAPE POTENTIAL, DETECTOR E
(J.R. Whitehouse Residence)



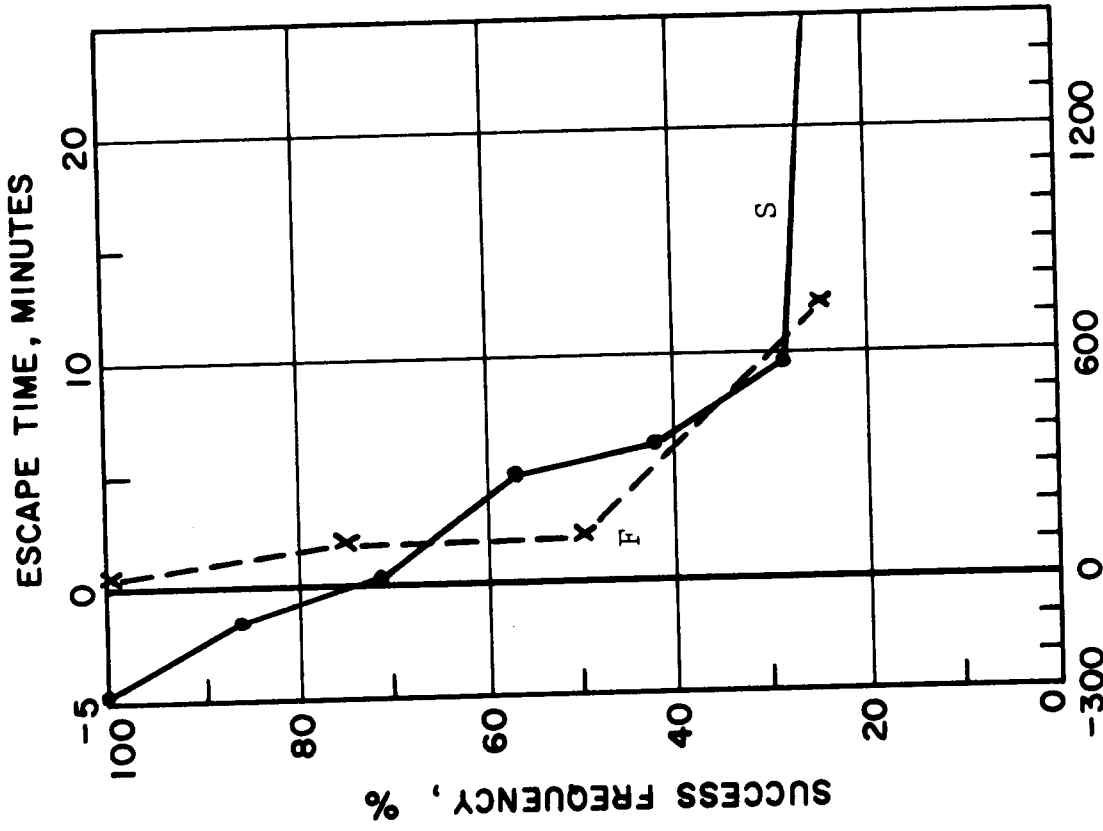
Key:

F - Flaming Ign.
 S - Smoldering Ign.
 (A) - All Fires
 (L) - First Floor Fires
 OPEN WINDOWS
 ESCAPE TIME, SECONDS
 ESCAPE TIME, MINUTES
 ESCAPE TIME, SECONDS
 ESCAPE TIME, MINUTES
 A/C SHUTDOWN

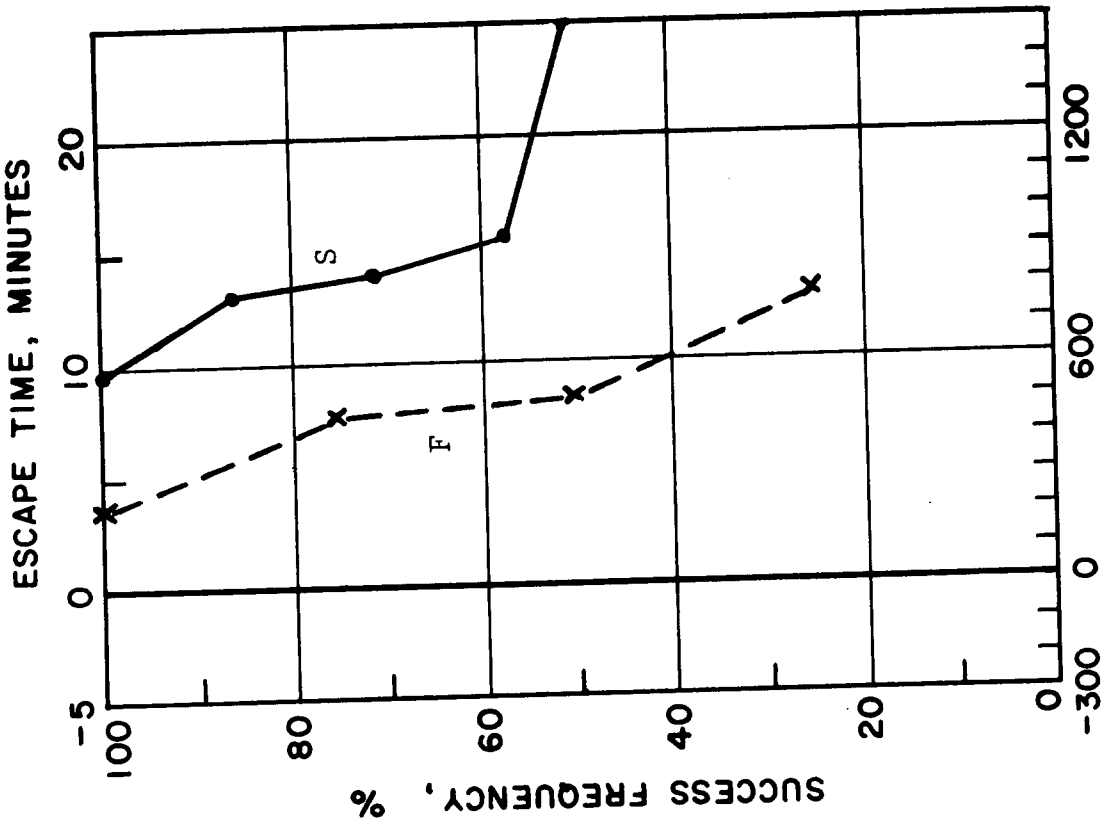
ESCAPE POTENTIAL, DETECTOR E ON 2ND FLOOR ONLY
 (J.R. Whitehouse Residence)



ESCAPE POTENTIAL, THERMAL DETECTORS, EVERY ROOM
 (J.R. Whitehouse Residence)

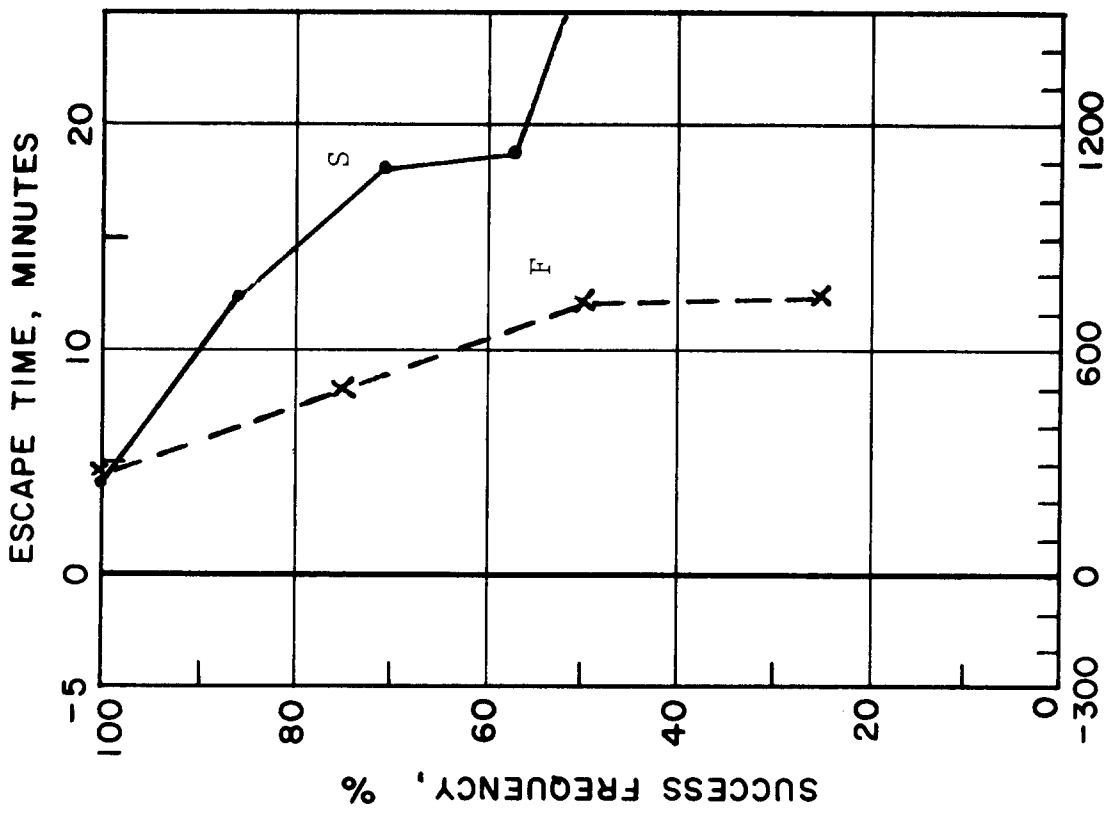


ESCAPE TIME, SECONDS
 Detector in Game Room
 (2nd Floor Escape Only)

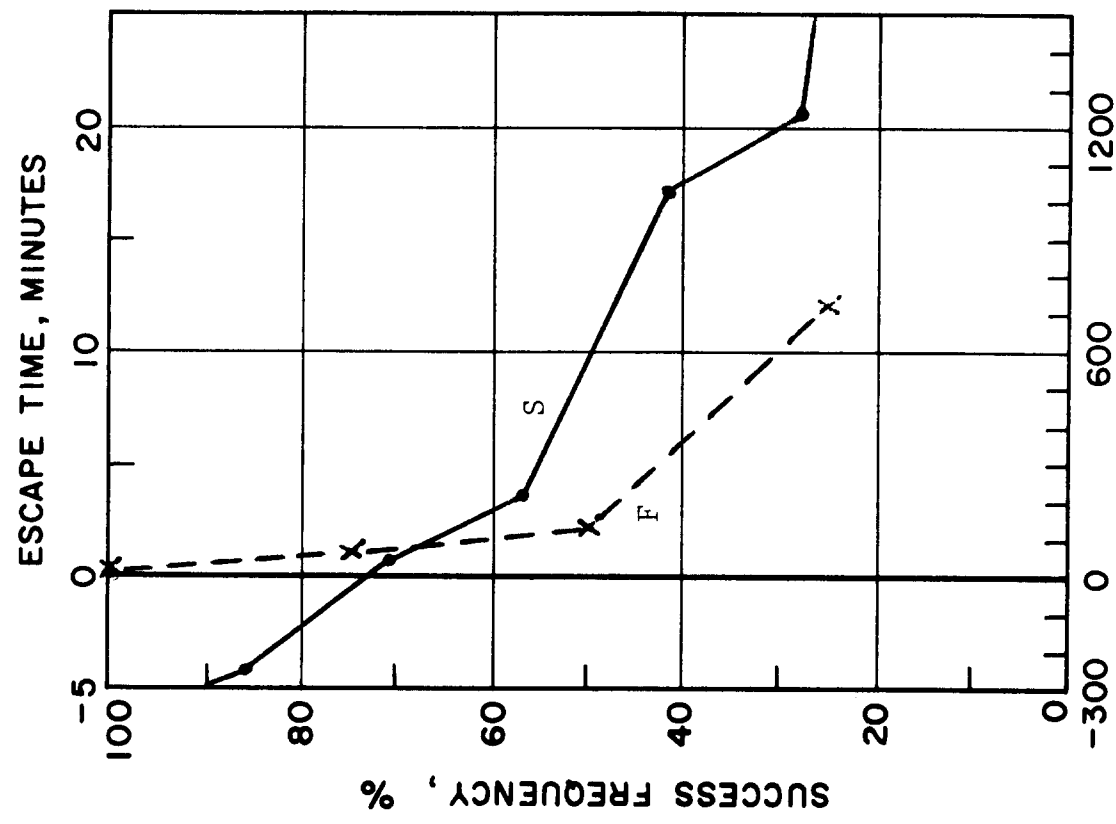


ESCAPE TIME, SECONDS
 Every Level Protection
 (Based on Living Room Detector)

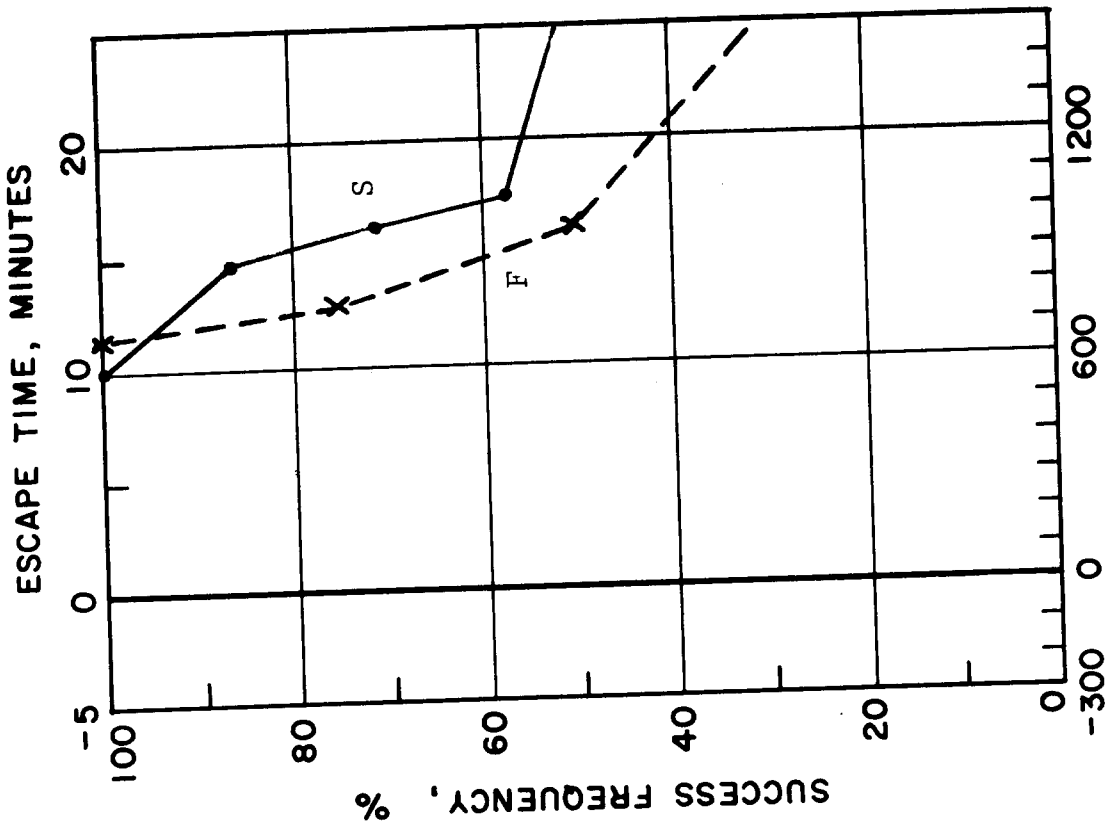
ESCAPE POTENTIAL, DETECTOR P
 (Wabash Avenue Residence, 1st Floor Fires)



ESCAPE POTENTIAL, DETECTOR N
 (WABASH AVENUE RESIDENCE, 1ST FLOOR FIRES)



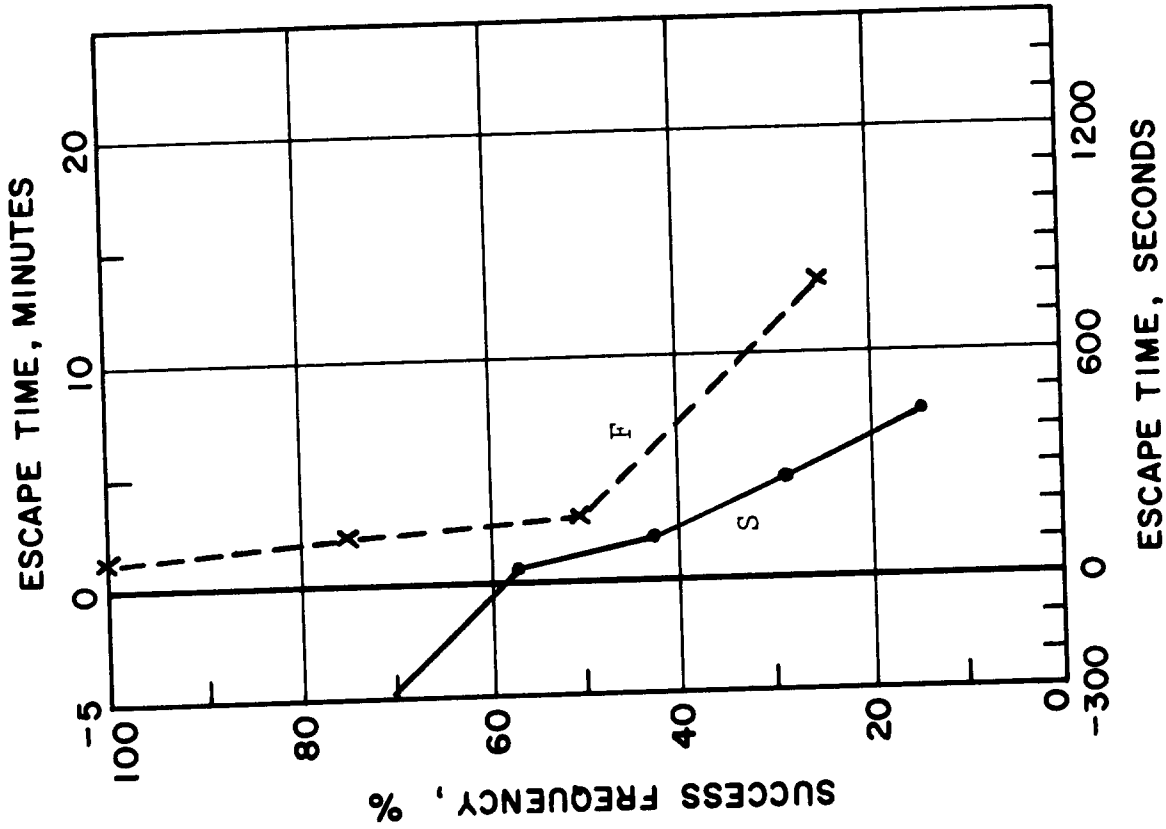
ESCAPE POTENTIAL, DETECTOR N
 (WABASH AVENUE RESIDENCE, 1ST FLOOR FIRES)



ESCAPE TIME, SECONDS

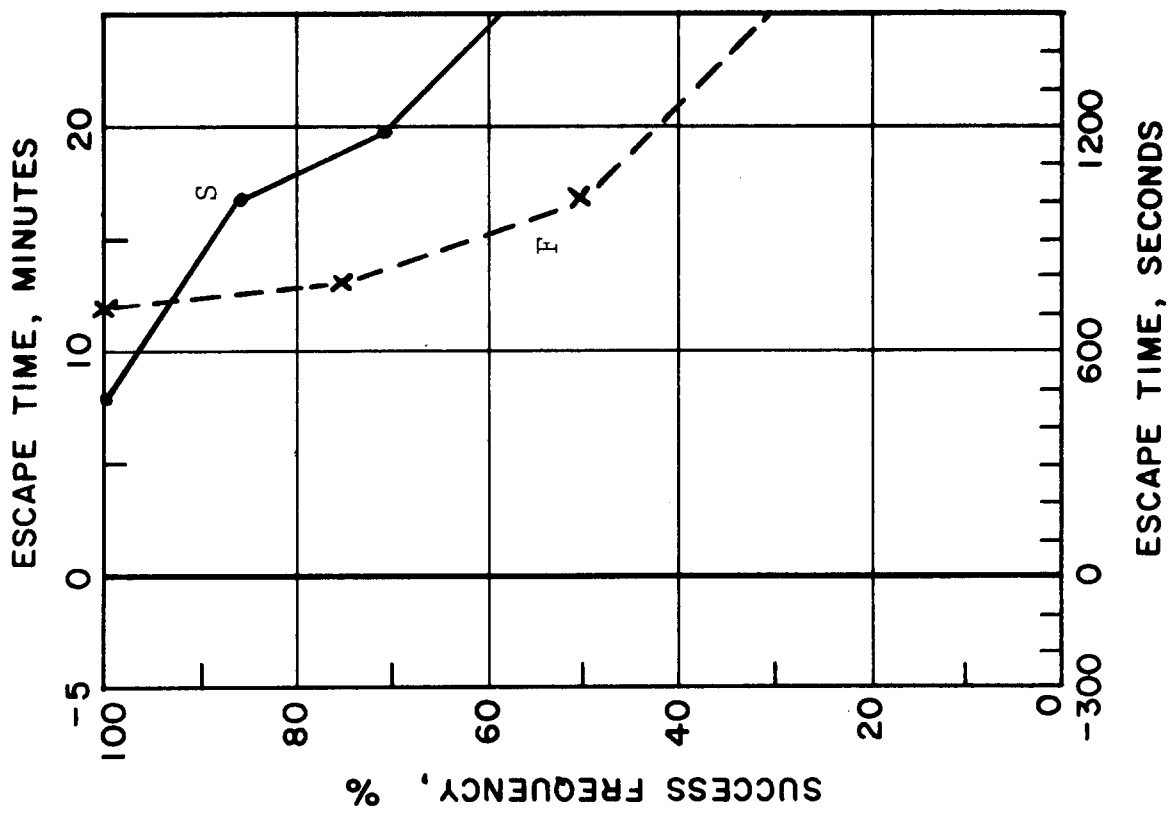
Every Level Protection
(Based on Living Room Detector)

ESCAPE POTENTIAL, DETECTOR F
(WABASH AVENUE RESIDENCE, 1ST FLOOR FIRES)



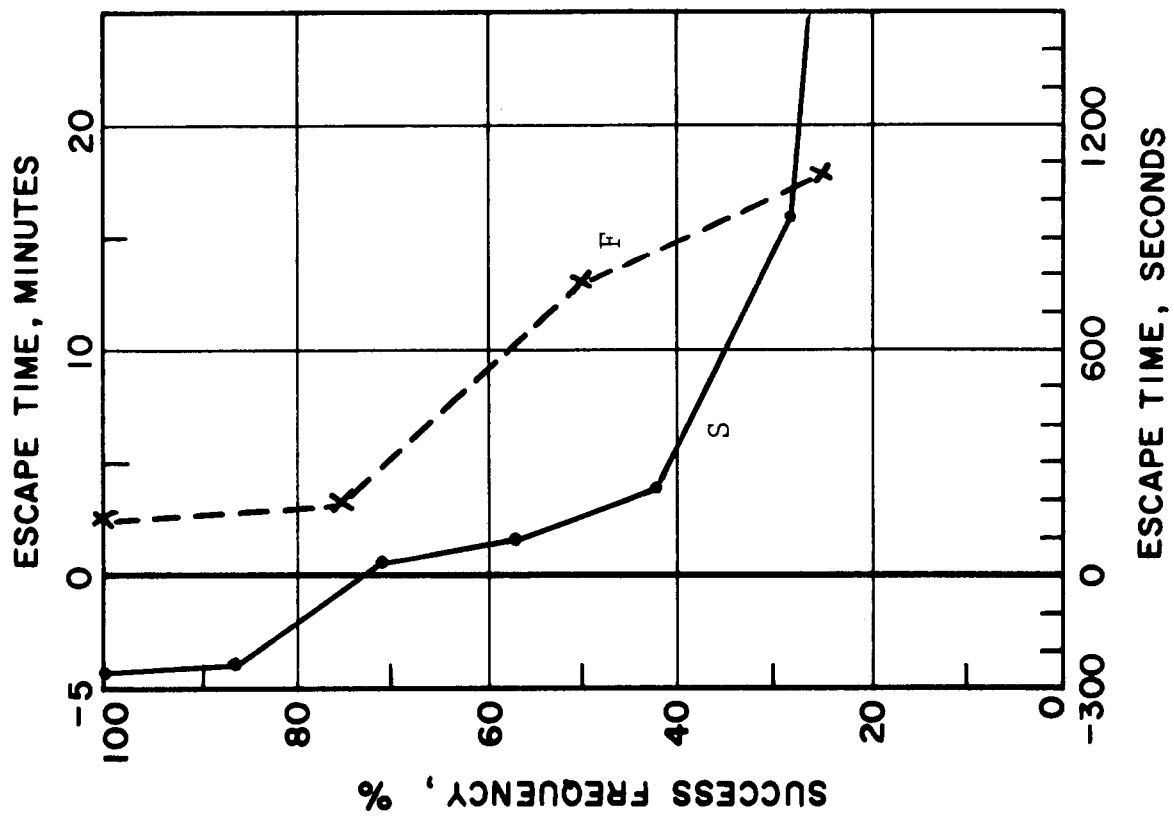
ESCAPE TIME, SECONDS

Detector in Game Room
(2nd Floor Escape Only)

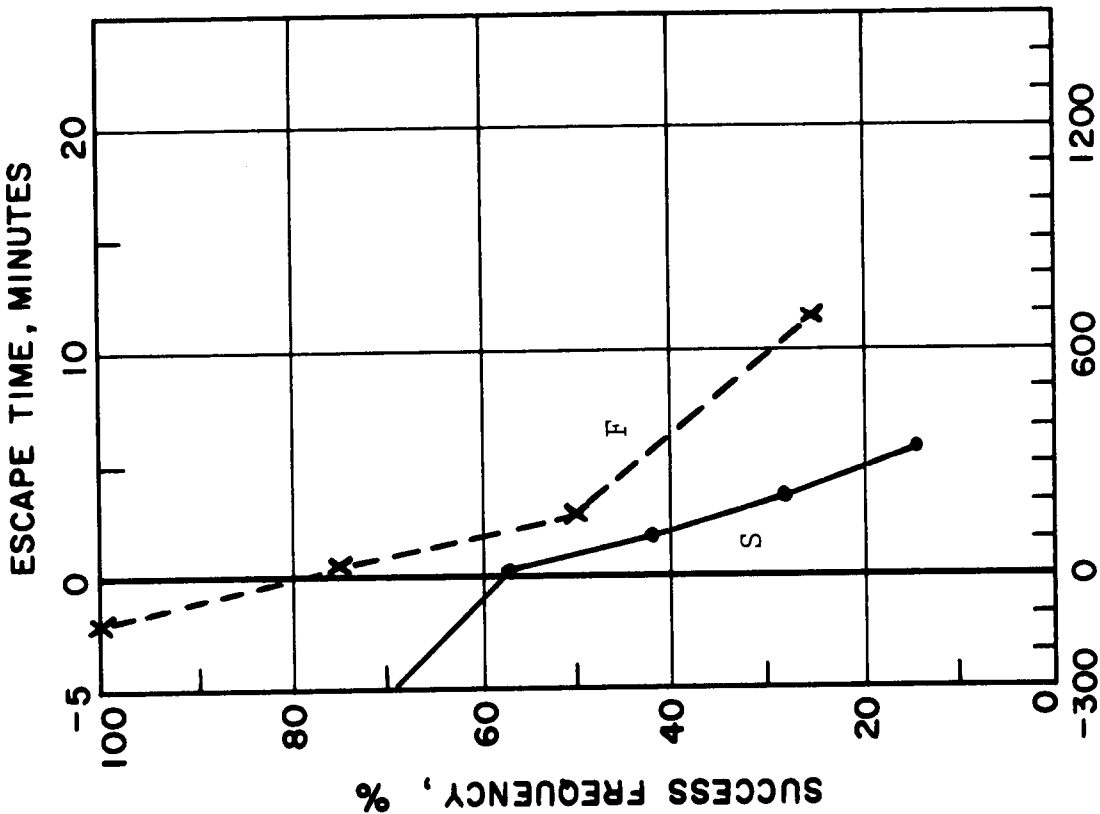


Every Level Protection
(Based on Living Room Detector)

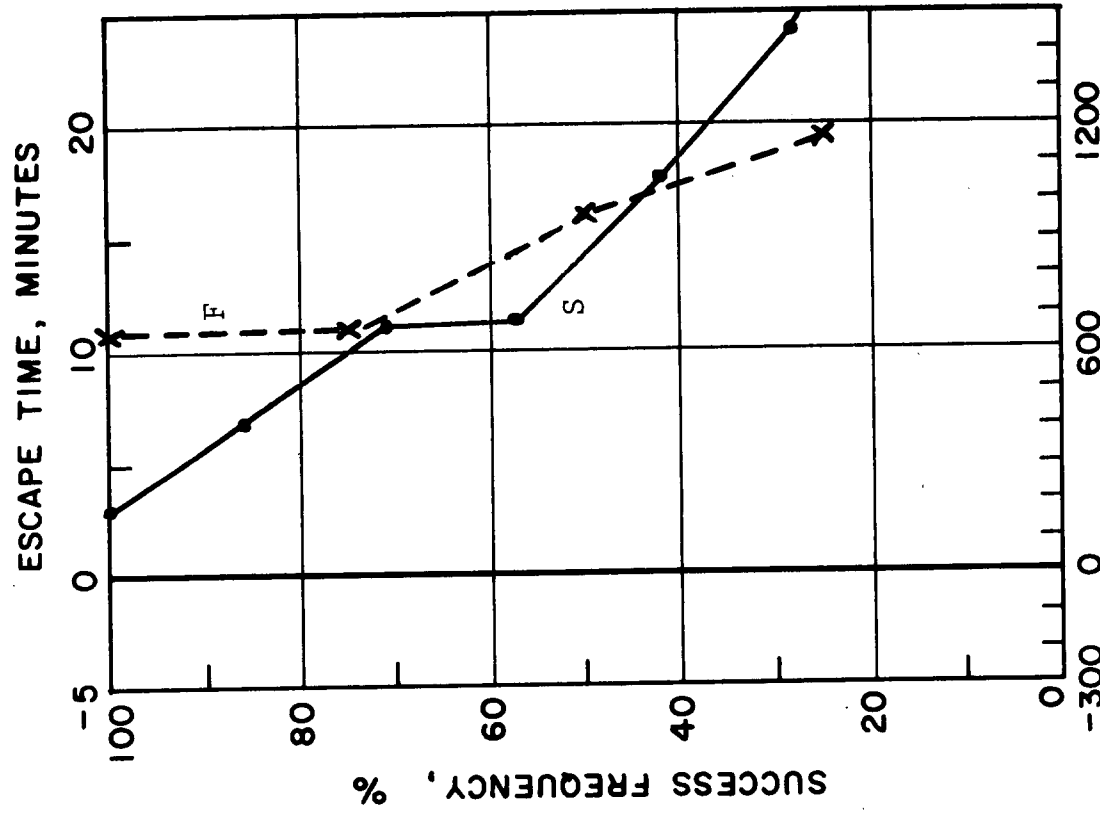
ESCAPE POTENTIAL, DETECTOR K
(WABASH AVENUE RESIDENCE, 1ST FLOOR FIRES)



Detector in Game Room
(2nd Floor Escape Only)

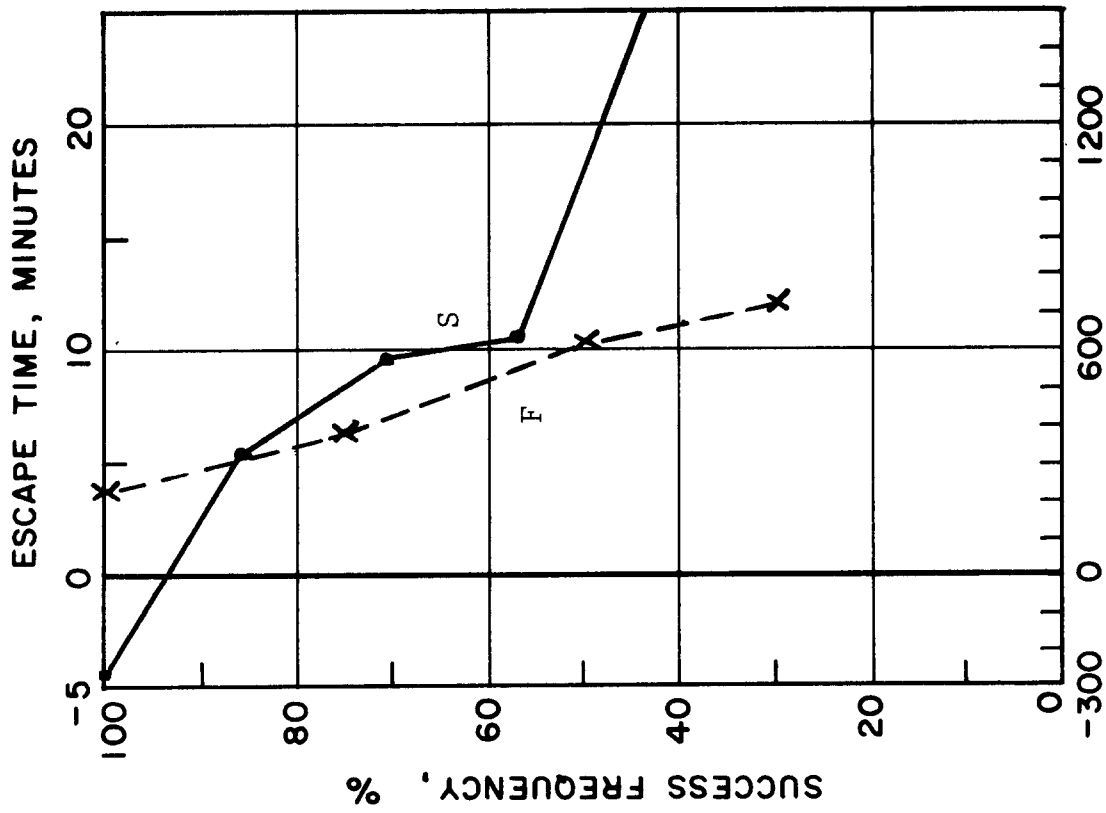


ESCAPE TIME, SECONDS
Detector in Game Room
(2nd Floor Escape Only)



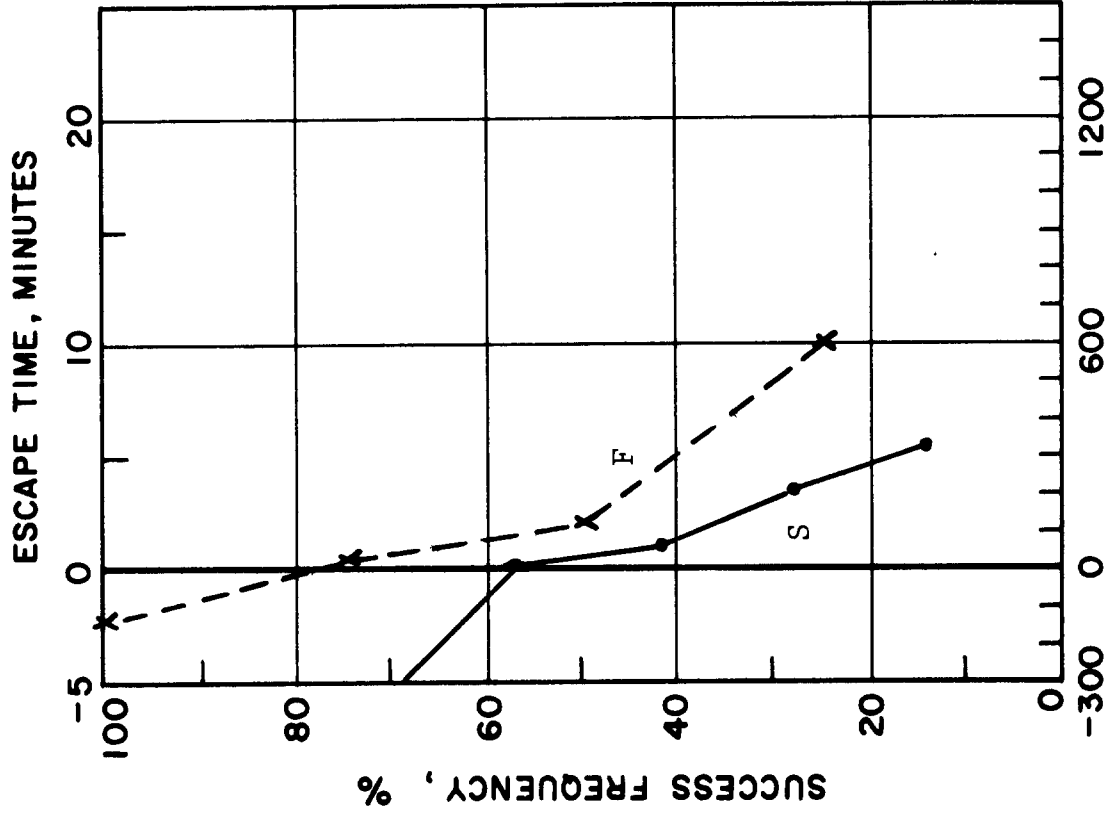
ESCAPE TIME, SECONDS
Every Level Protection
(Based on Living Room Detector)

ESCAPE POTENTIAL, DETECTOR S
(WABASH AVENUE RESIDENCE, 1ST FLOOR FIRES)

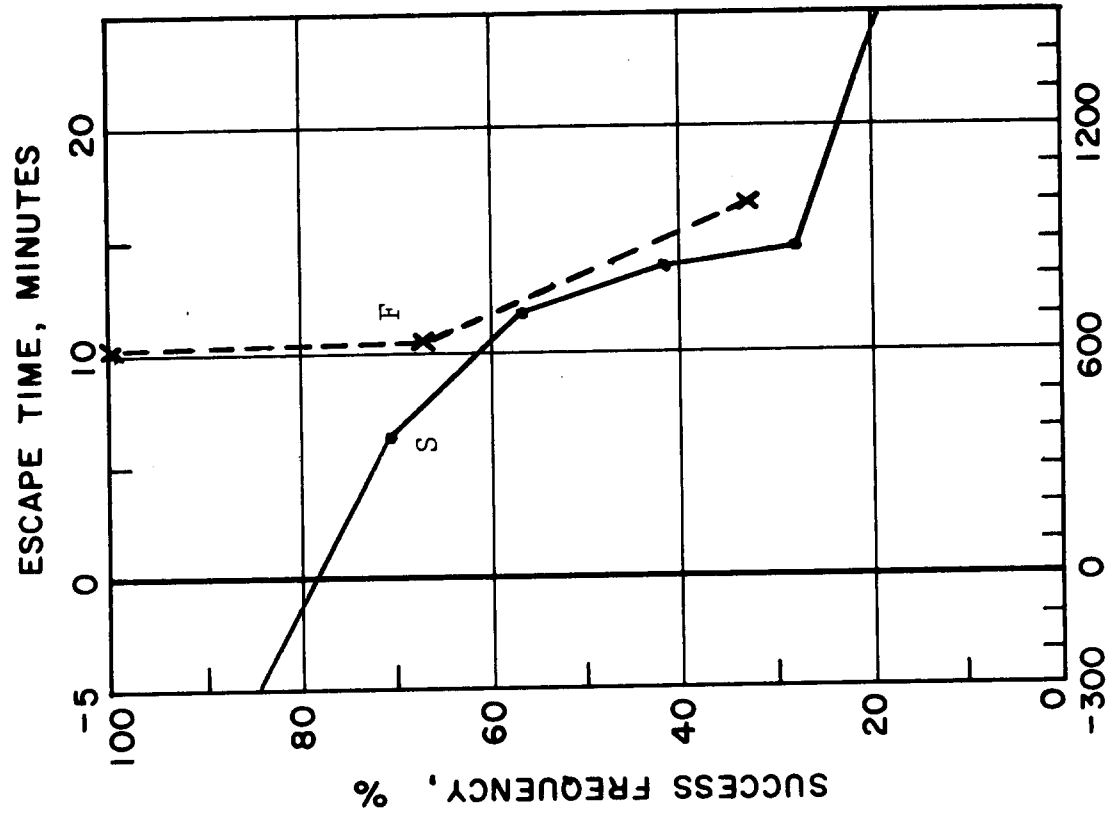


ESCAPE TIME, SECONDS
 Every Level Protection
 (Based on Living Room Detector)

ESCAPE POTENTIAL, DETECTOR E
 (WABASH AVENUE RESIDENCE, 1ST FLOOR FIRES)



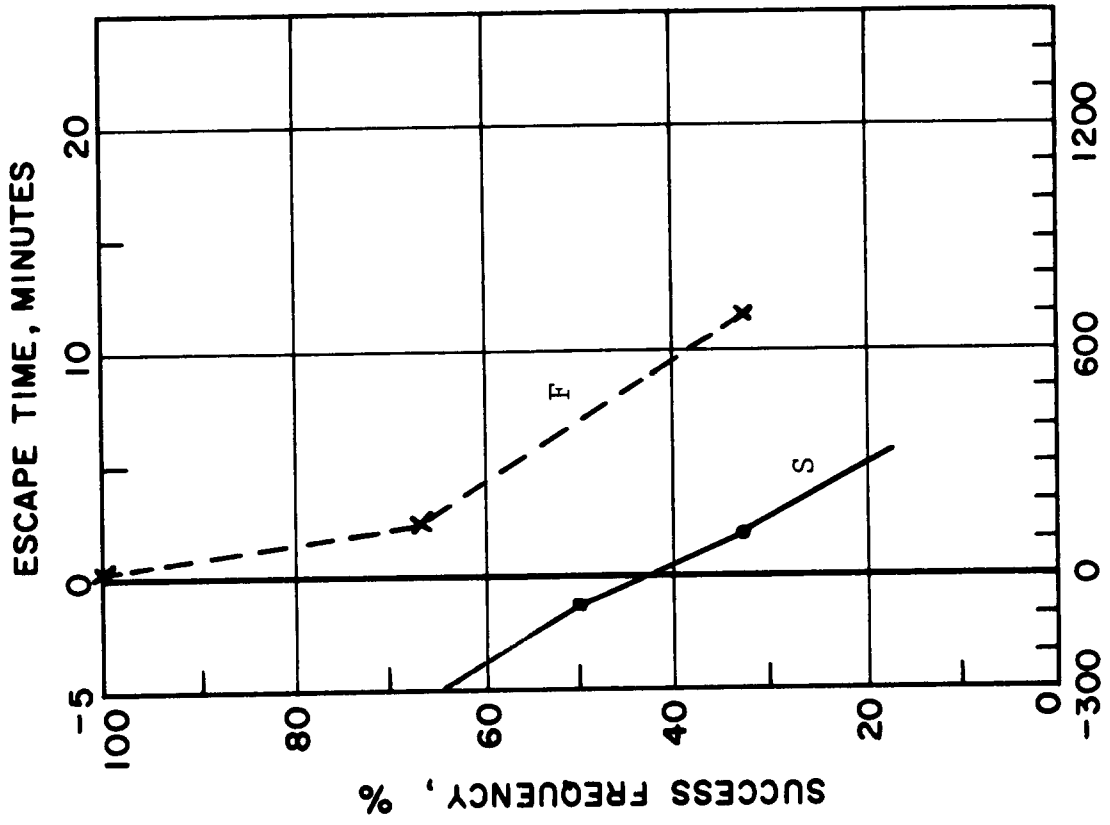
ESCAPE TIME, SECONDS
 Detector in Game Room
 (2nd Floor Escape Only)



ESCAPE TIME, SECONDS

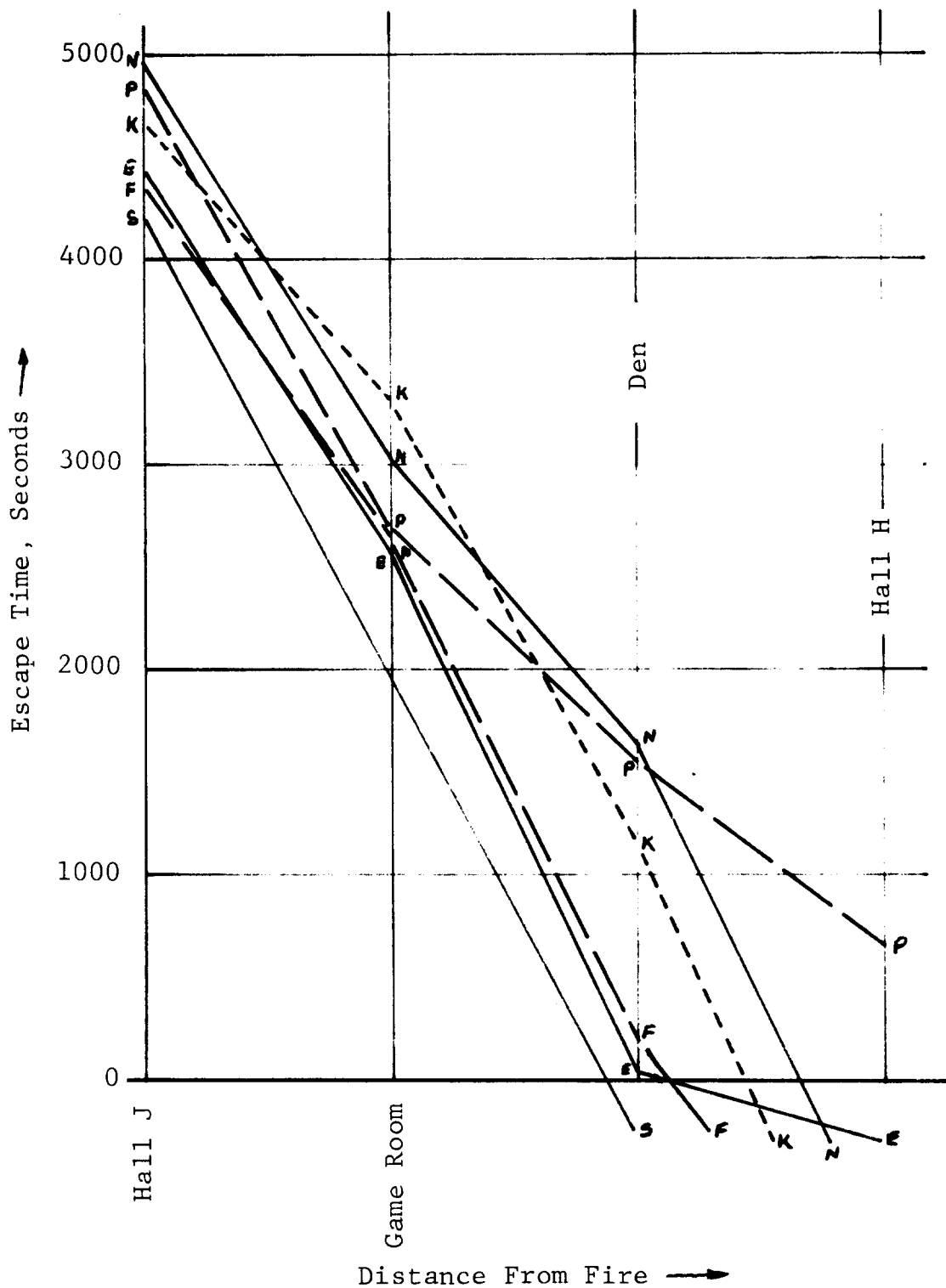
Every Level Protection
(Based on Living Room Detector)

ESCAPE POTENTIAL, DETECTOR G
(WABASH AVENUE RESIDENCE, 1ST FLOOR FIRES)

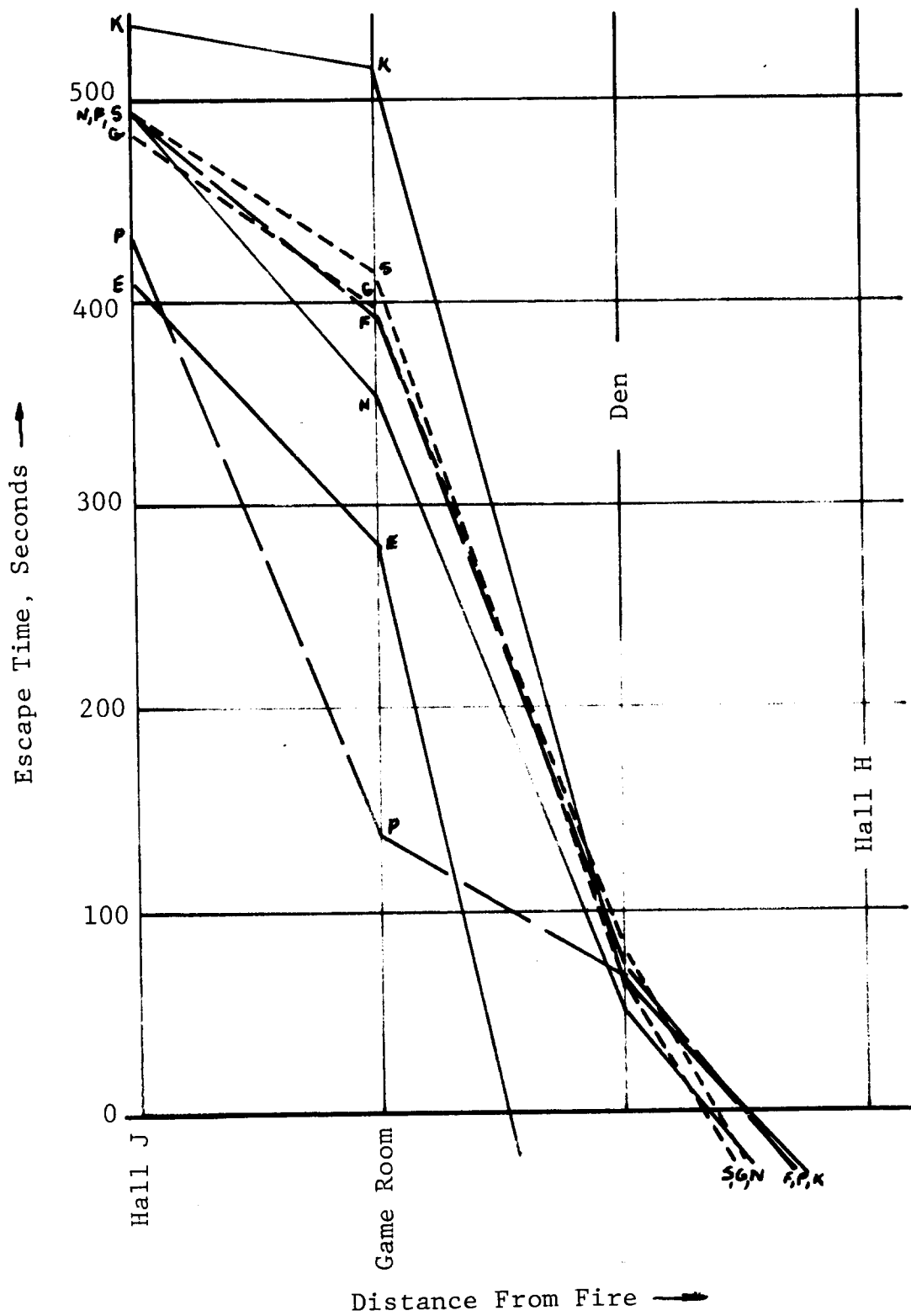


ESCAPE TIME, SECONDS

Detector in Game Room
(2nd Floor Escape Only)



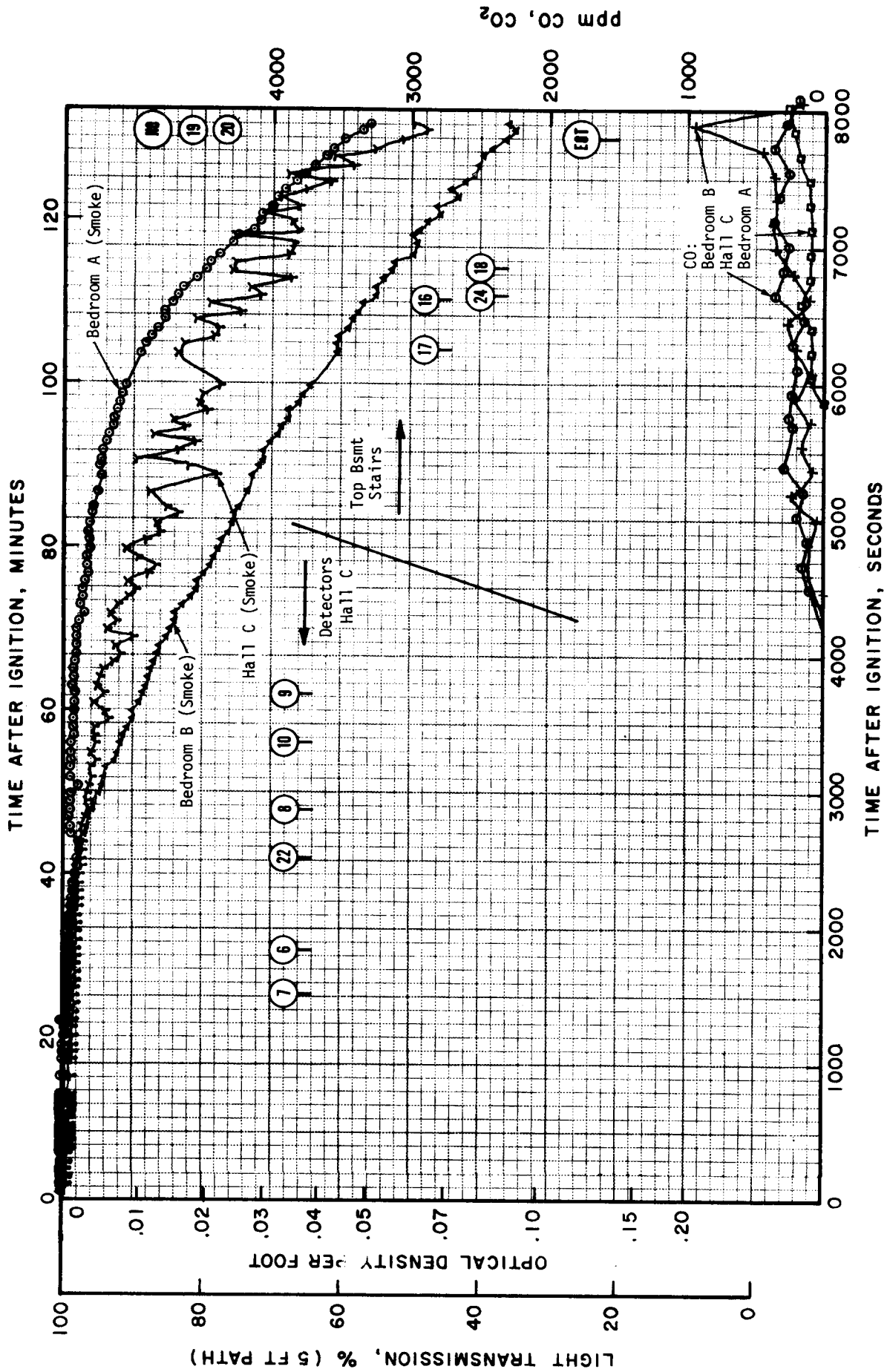
ESCAPE TIME VS LOCATION OF DETECTORS
 W-75, SMOULDERING IGNITION
 (ESCAPE FROM FAR SIDE OF 2ND FLOOR)



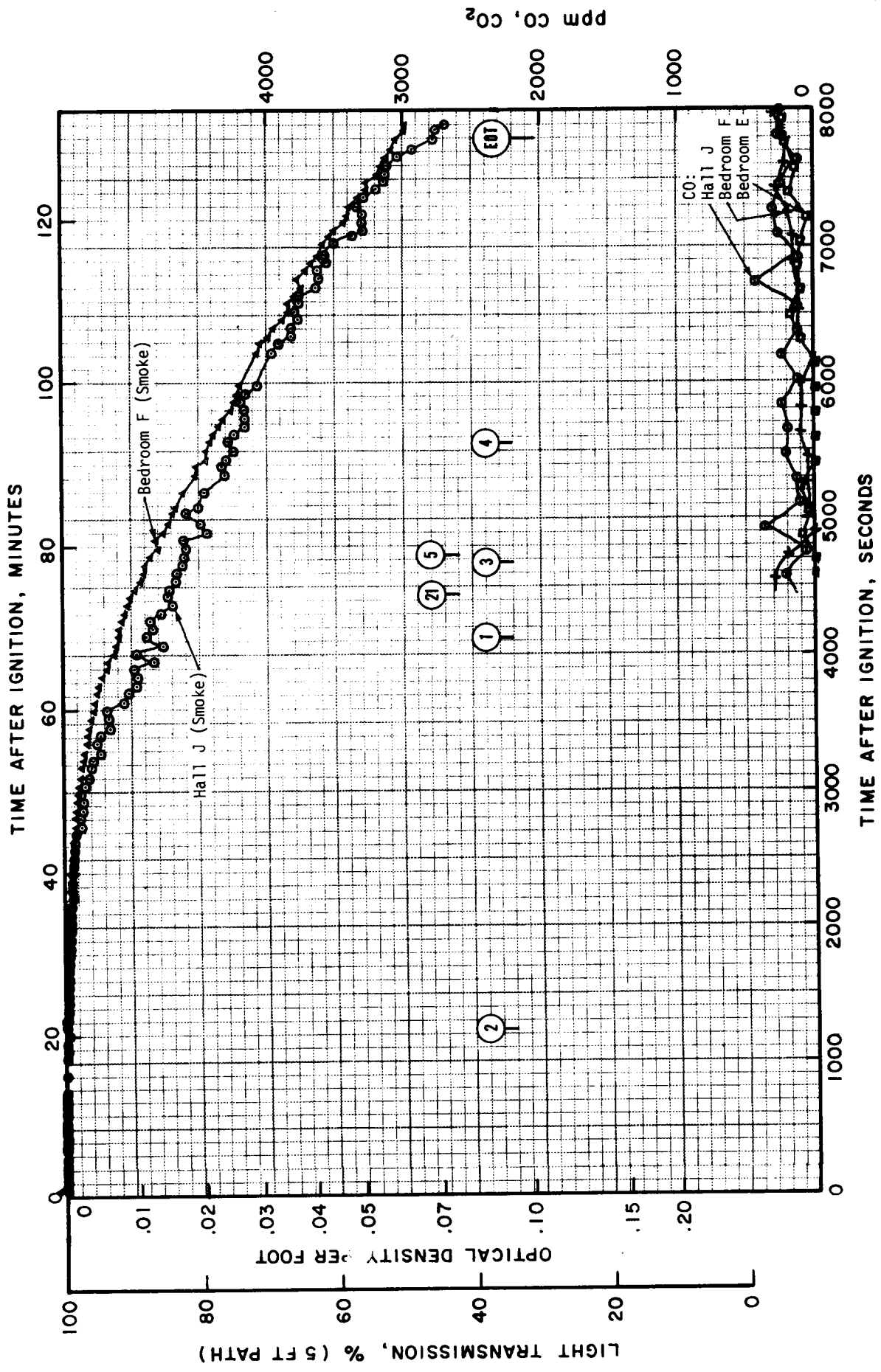
ESCAPE TIME VS DETECTOR LOCATION
 W-76, FLAMING IGNITION
 (ESCAPE FROM FAR SIDE OF 2ND FLOOR)

APPENDIX J

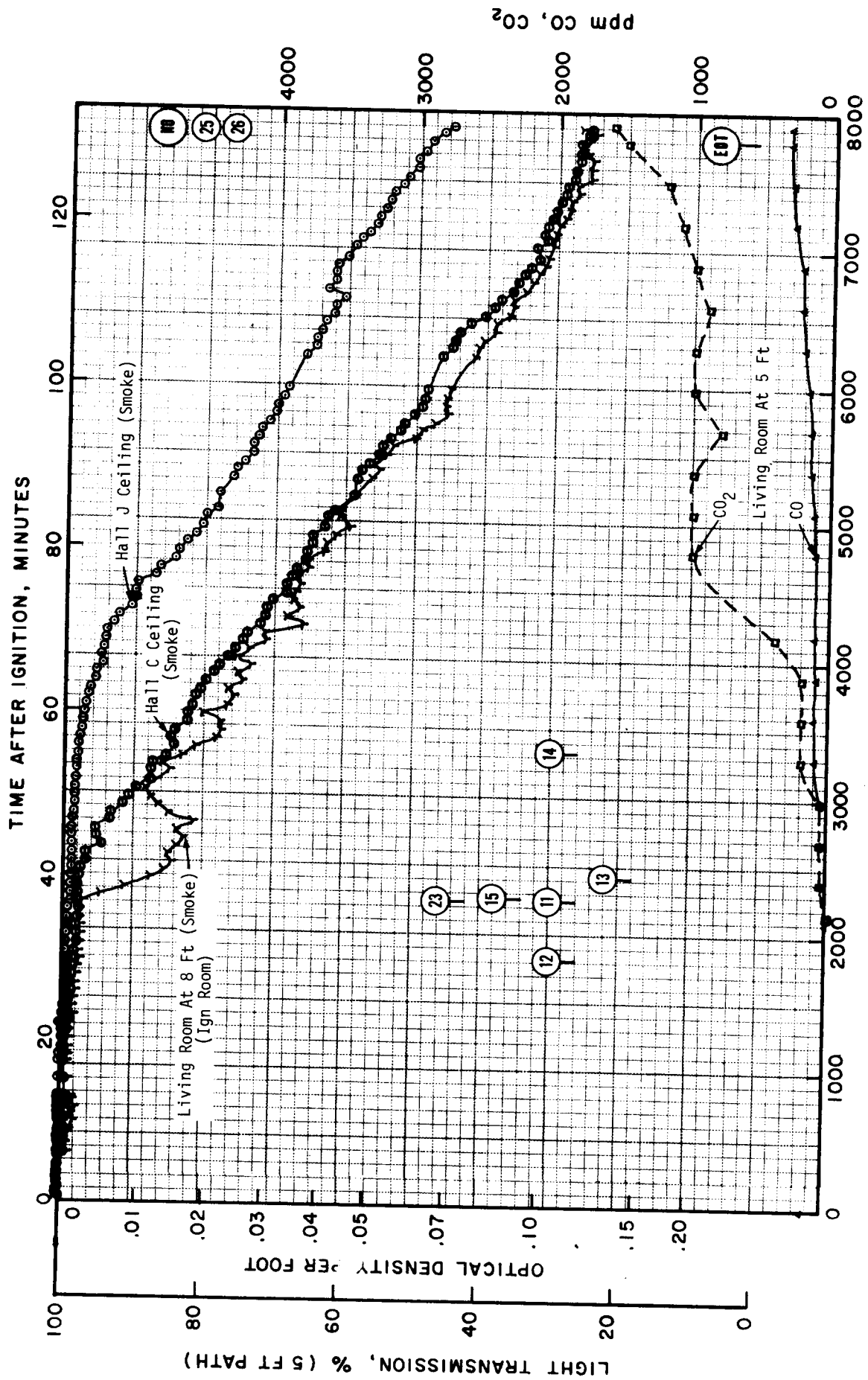
TIME HISTORIES OF SMOKE, TEMPERATURE,
AND GAS CONCENTRATIONS



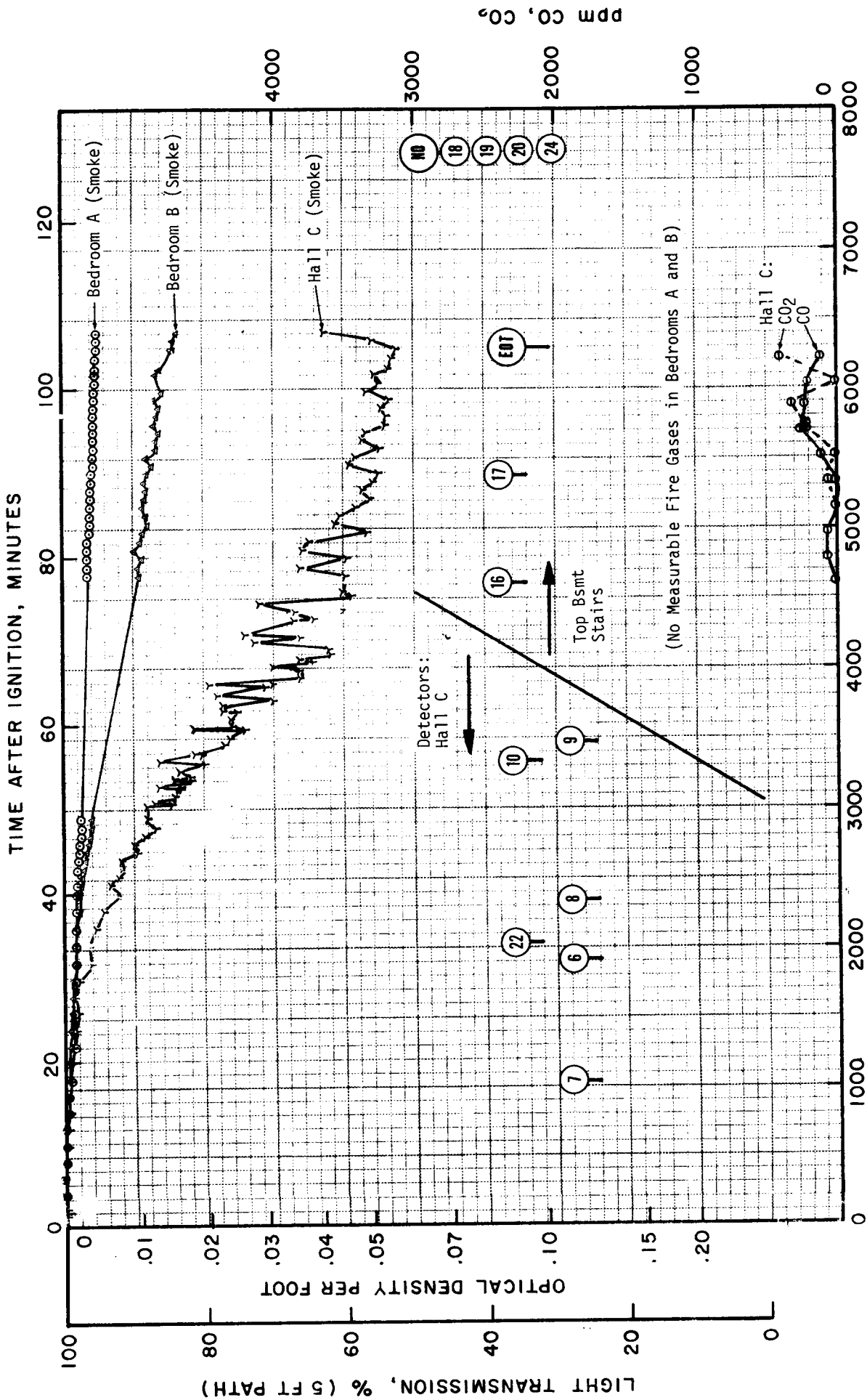
CONDITIONS ON 1ST FLOOR AT 5 FT, JR-41



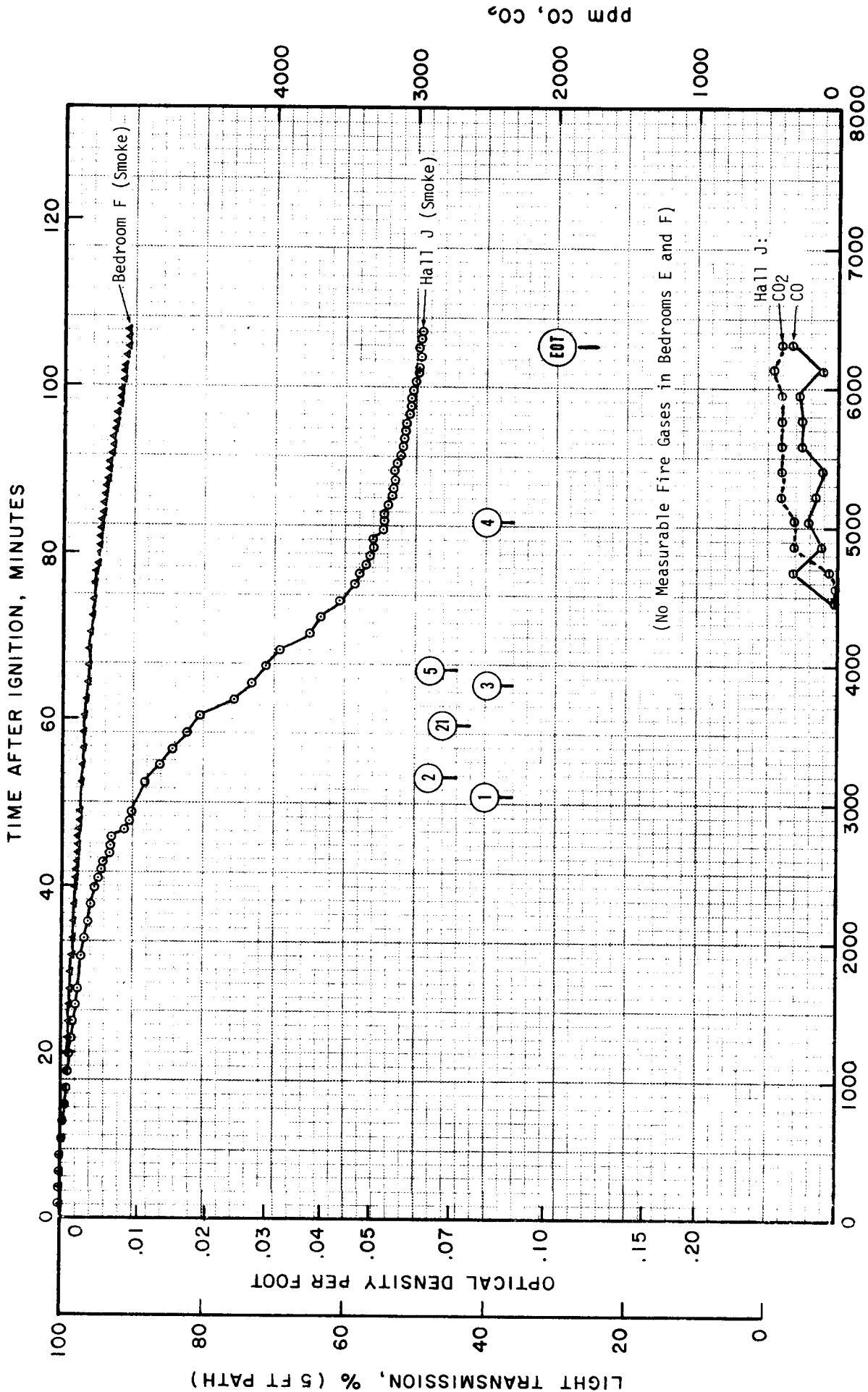
CONDITIONS ON 2ND FLOOR AT 5 FT, JR-41



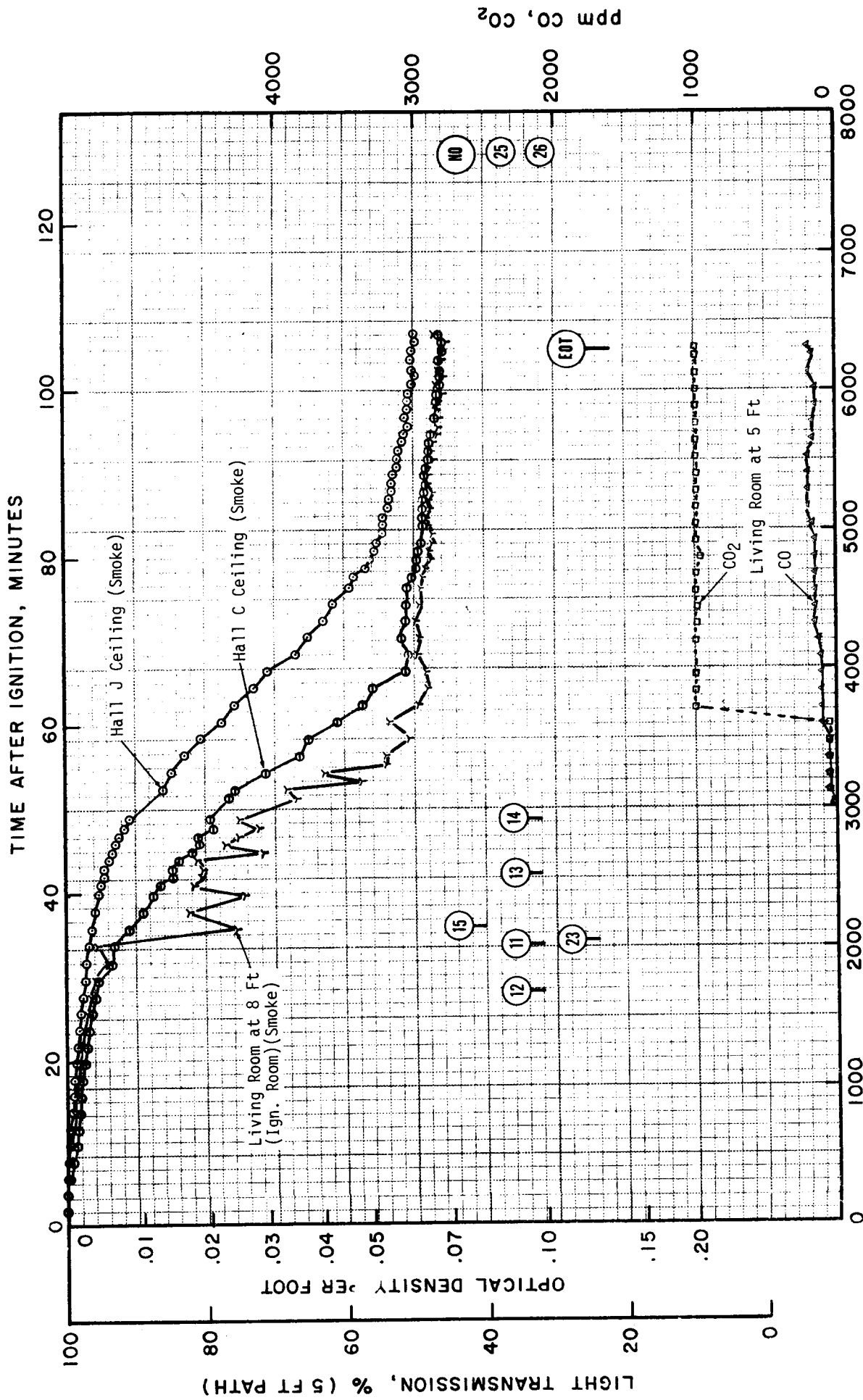
VARIOUS CONDITIONS, JR-41



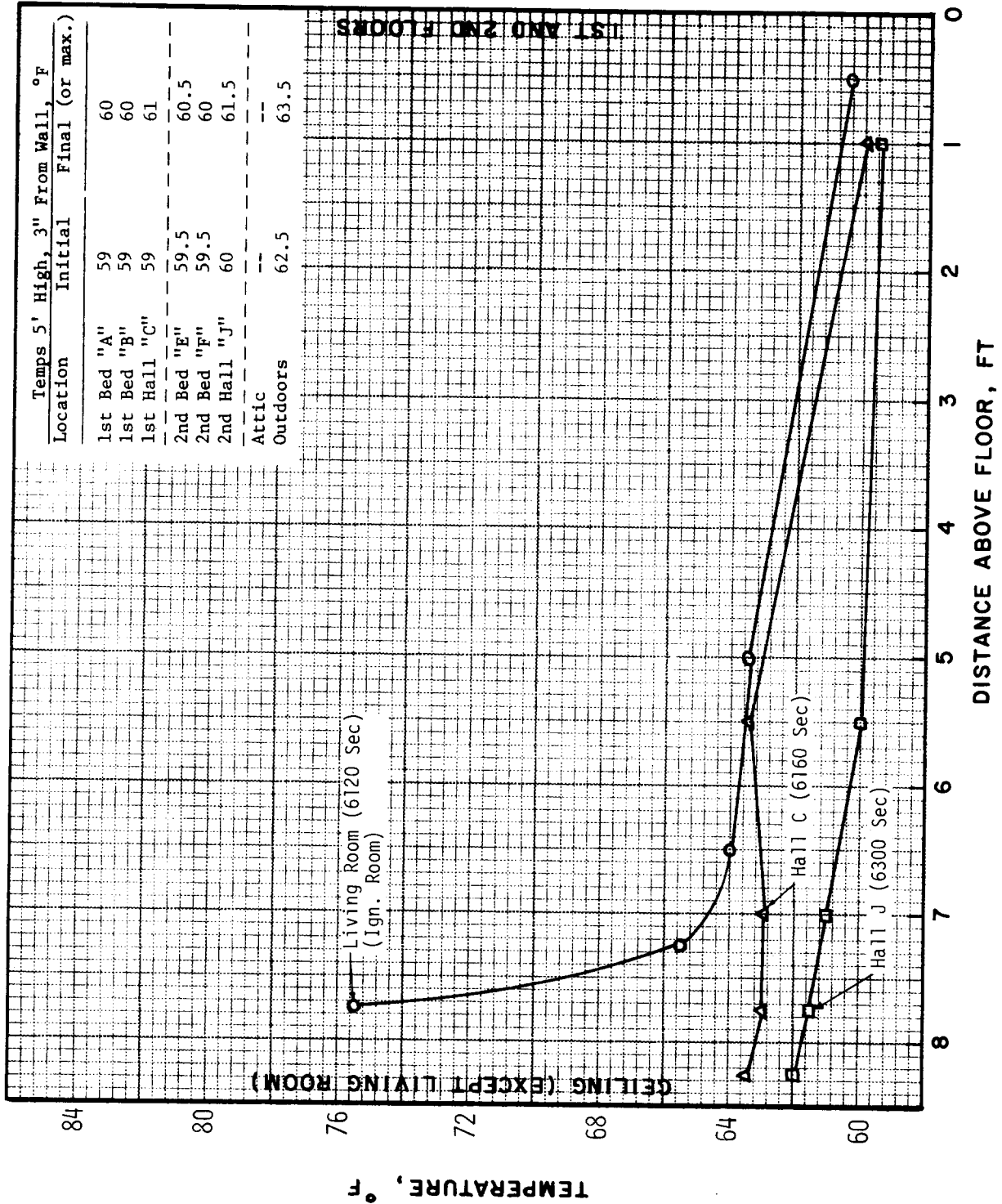
TIME AFTER IGNITION, SECONDS
 CONDITIONS ON 1ST FLOOR AT 5 FT, JR-42



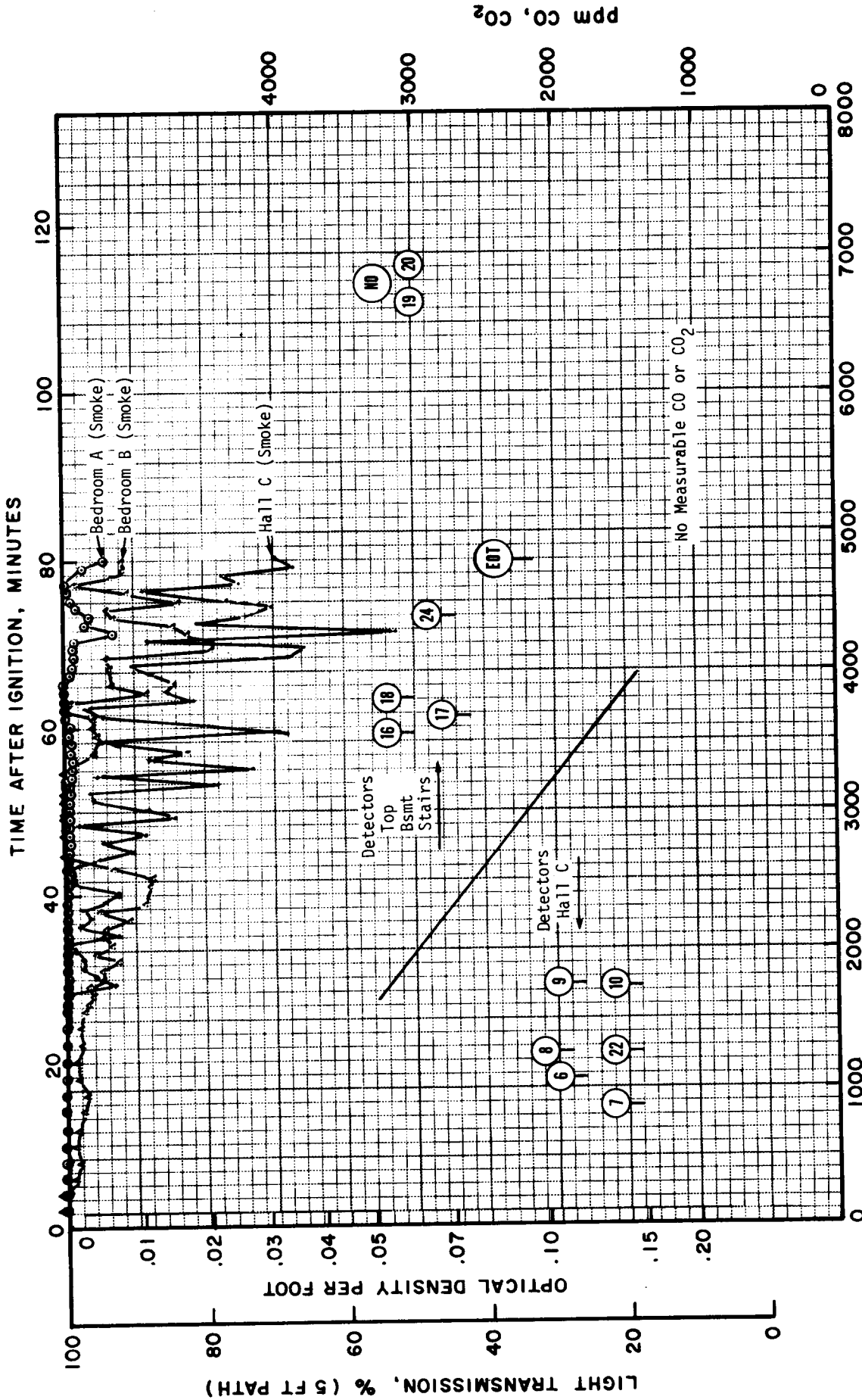
CONDITIONS ON 2ND FLOOR AT 5 FT, JR-42



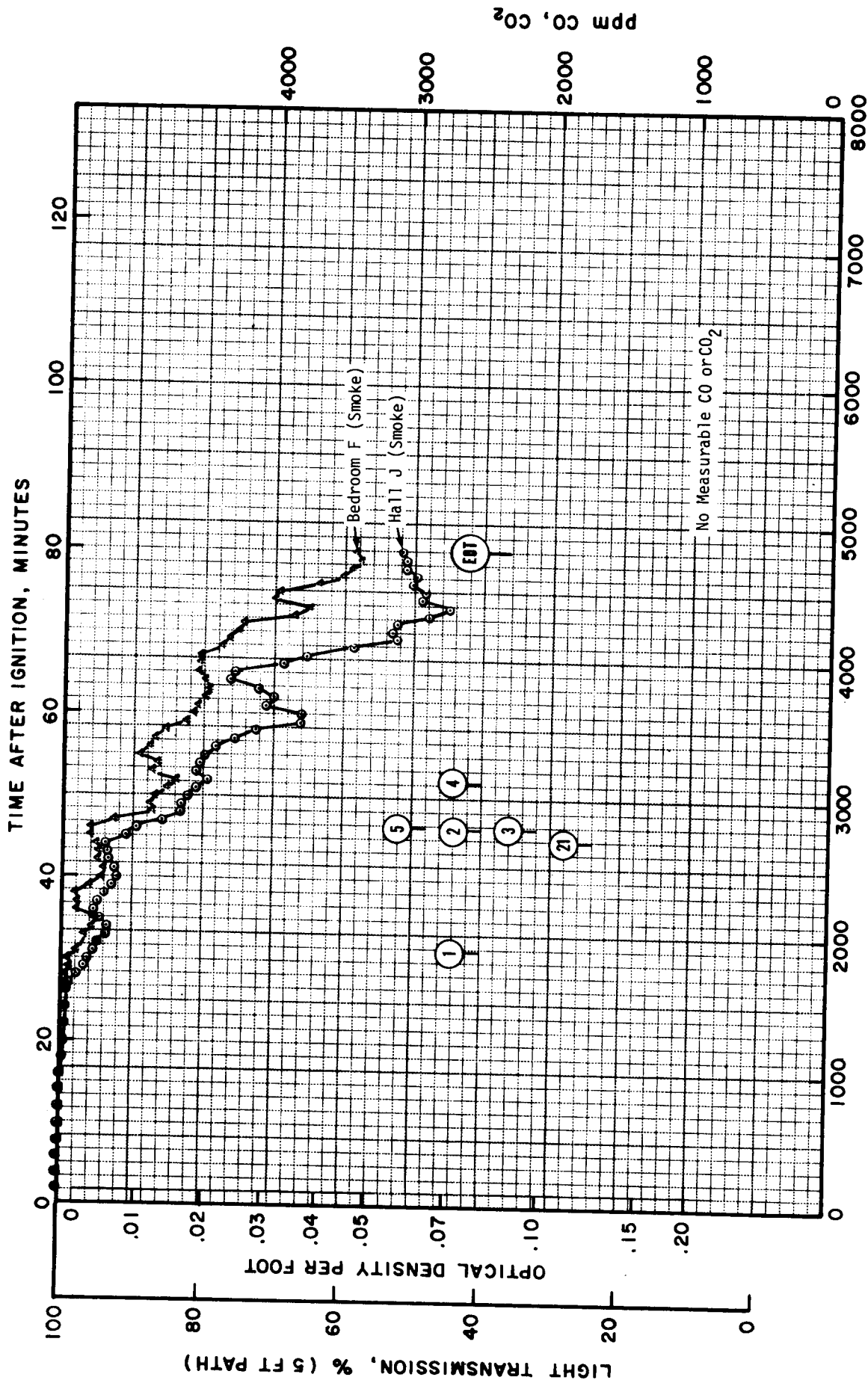
VARIOUS CONDITIONS, JR-42



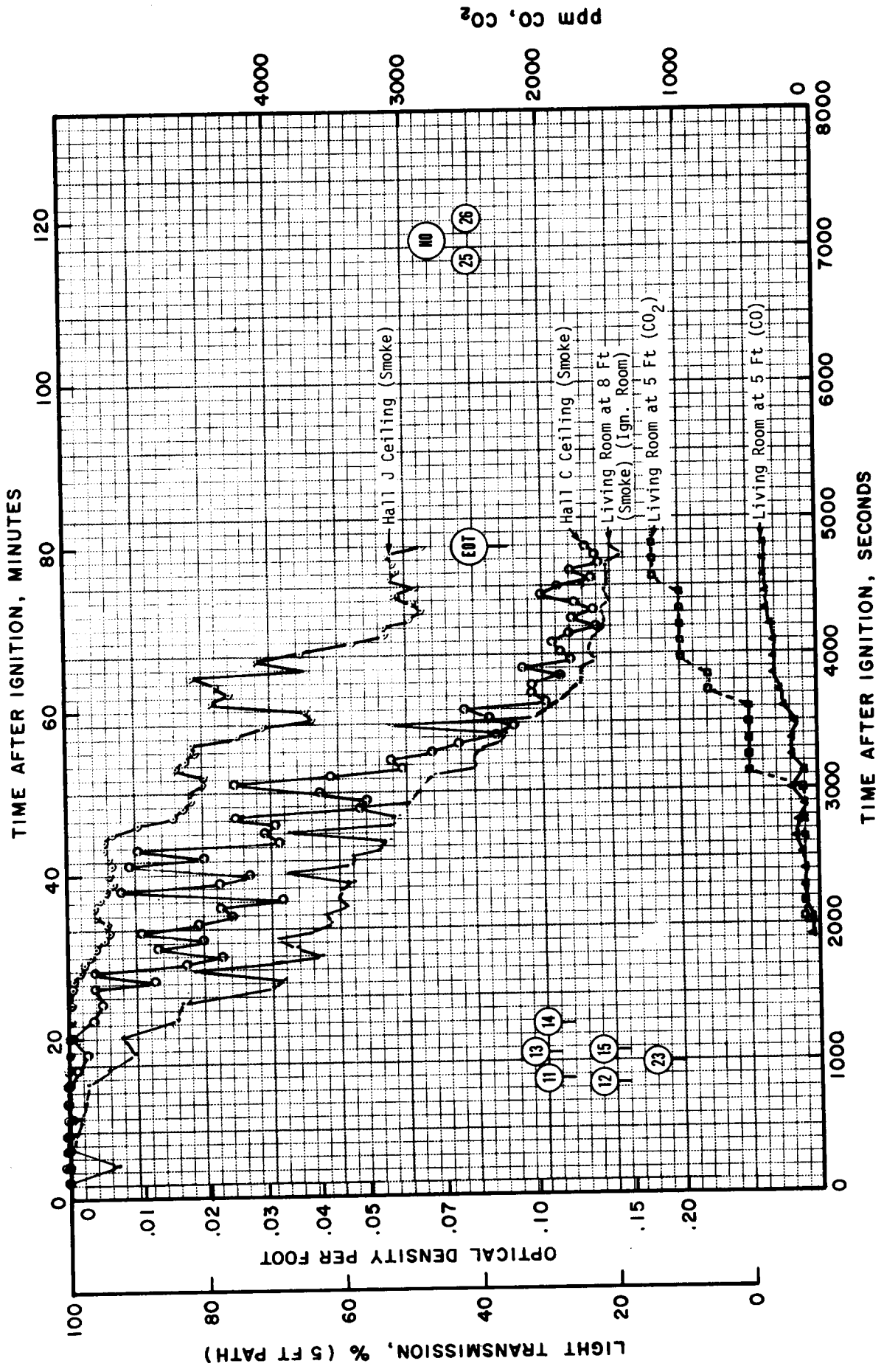
MAXIMUM TEMPERATURE PROFILES, JR-42



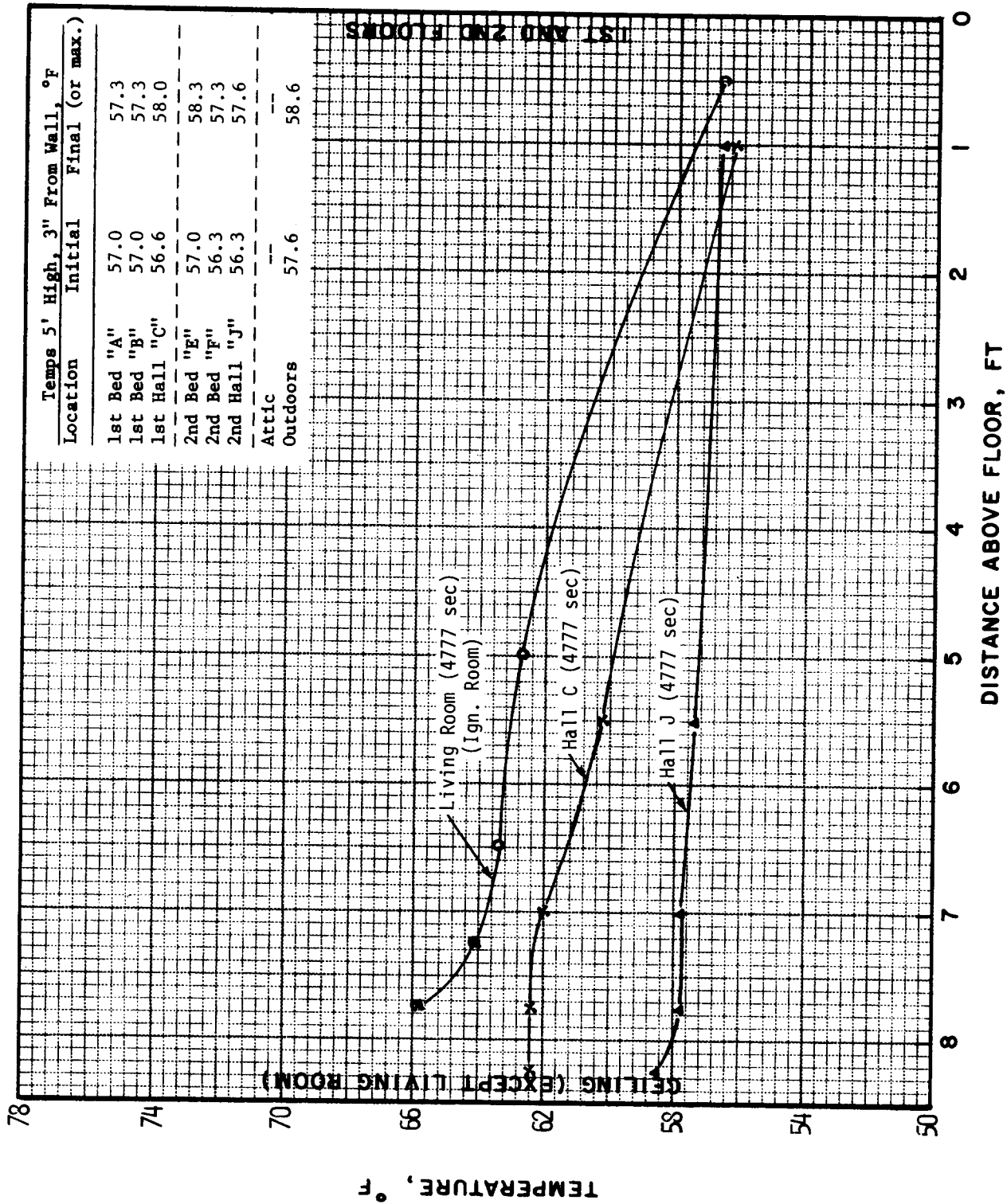
CONDITIONS ON 1ST FLOOR AT 5 FT, JR-43



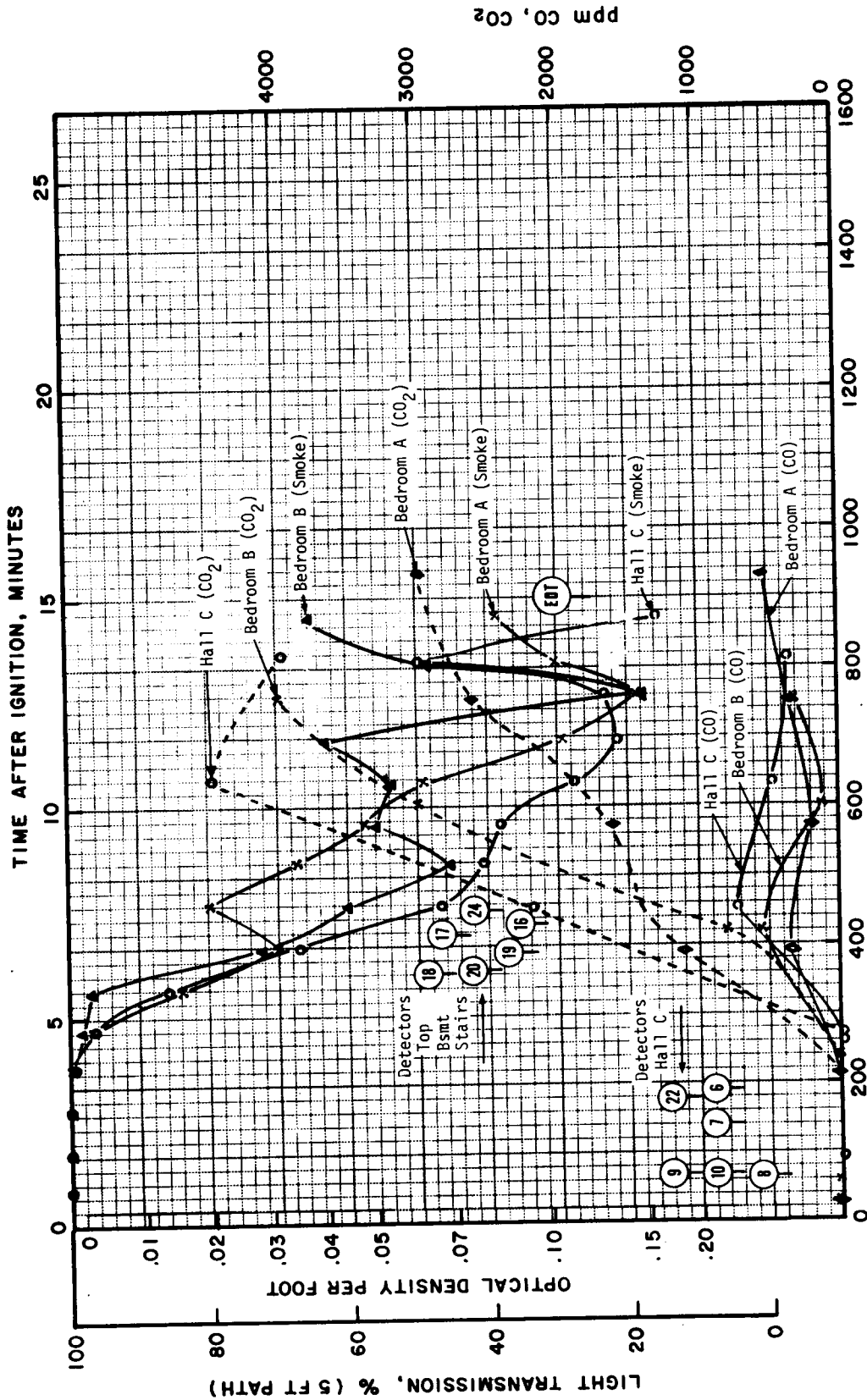
CONDITIONS ON 2ND FLOOR AT 5 FT, JR-43



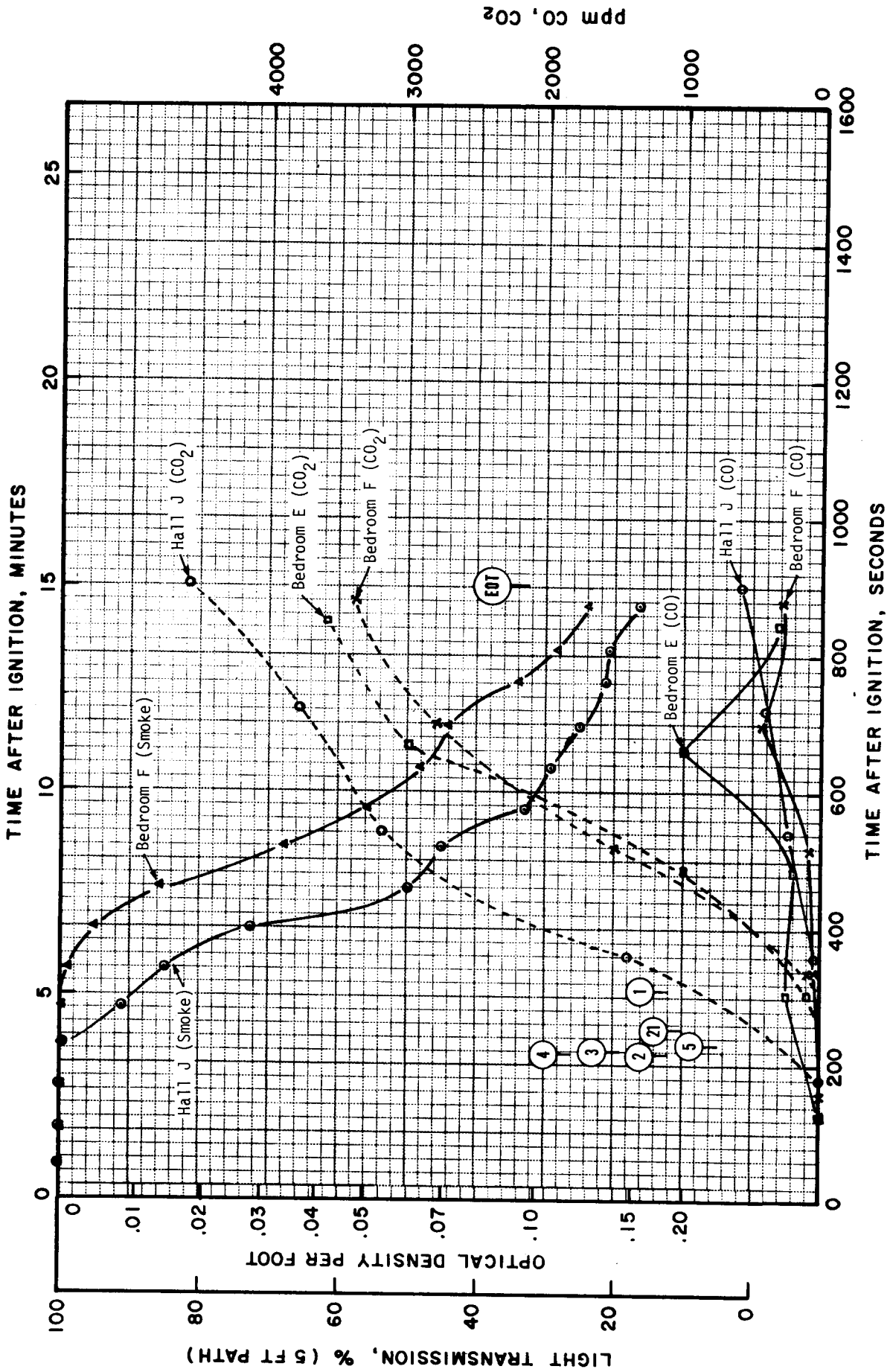
VARIOUS CONDITIONS, JR-43



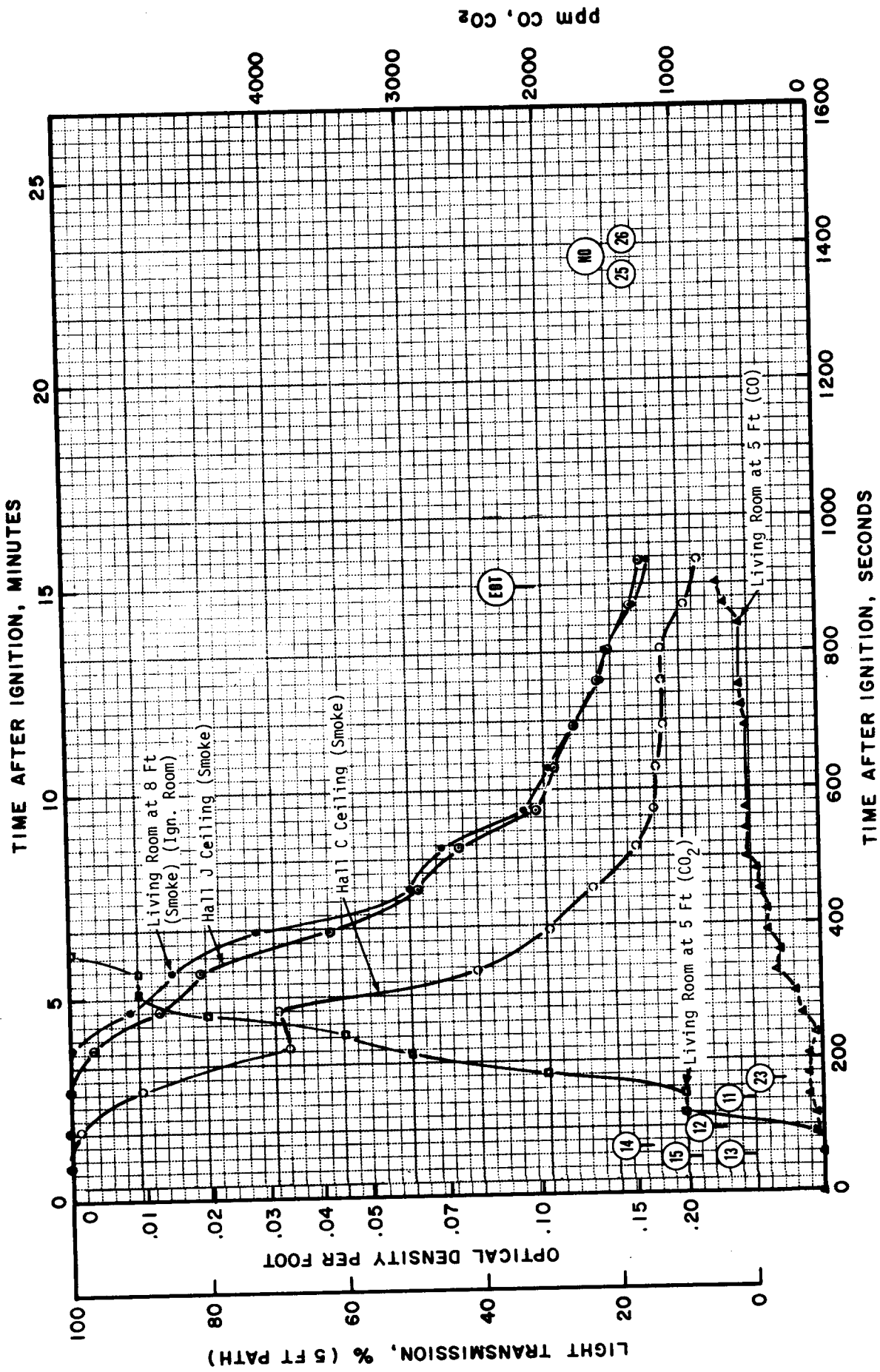
MAXIMUM TEMPERATURE PROFILES, JR-43



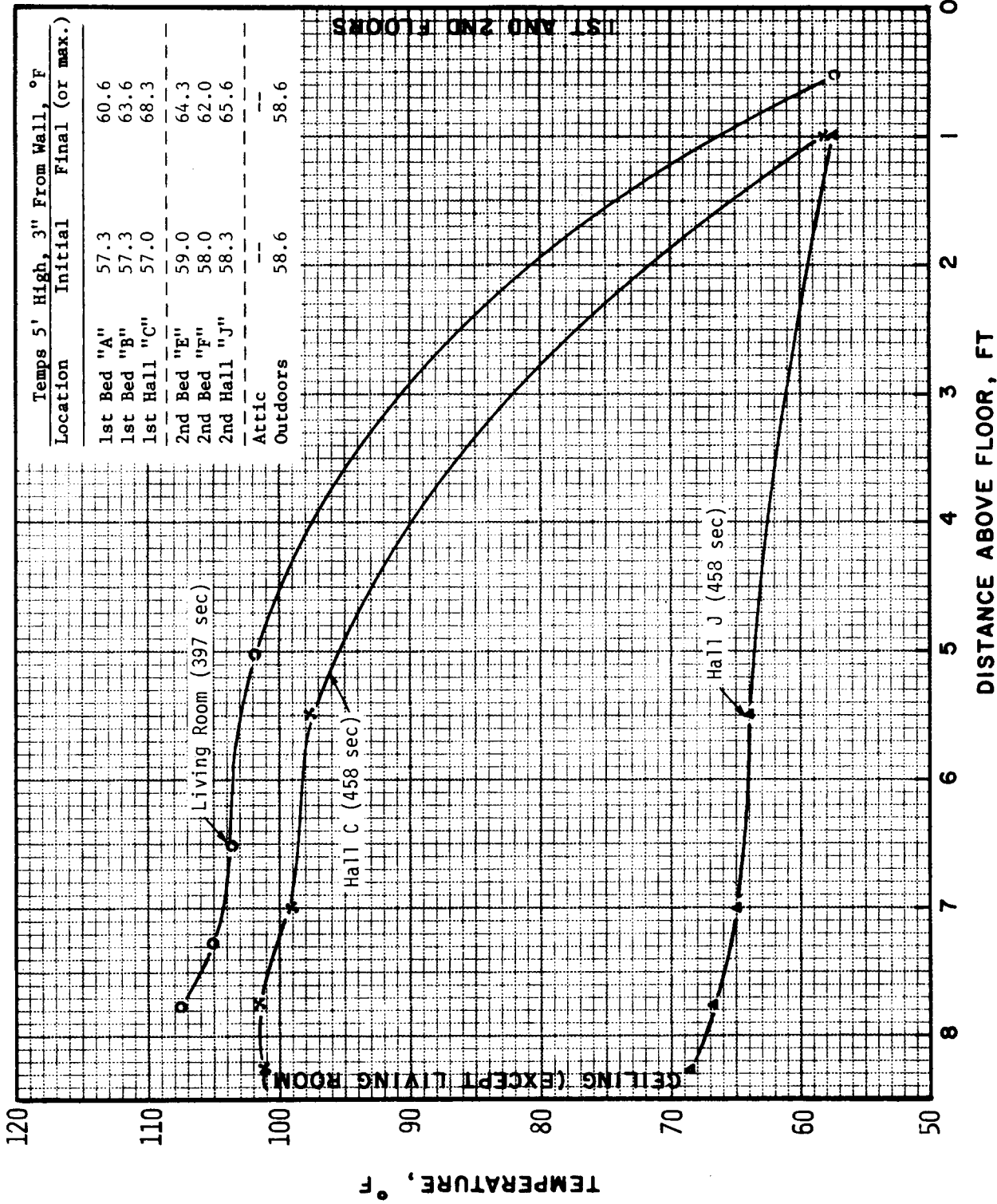
TIME AFTER IGNITION, SECONDS
 CONDITIONS ON 1ST FLOOR AT 5 FT, JR-44



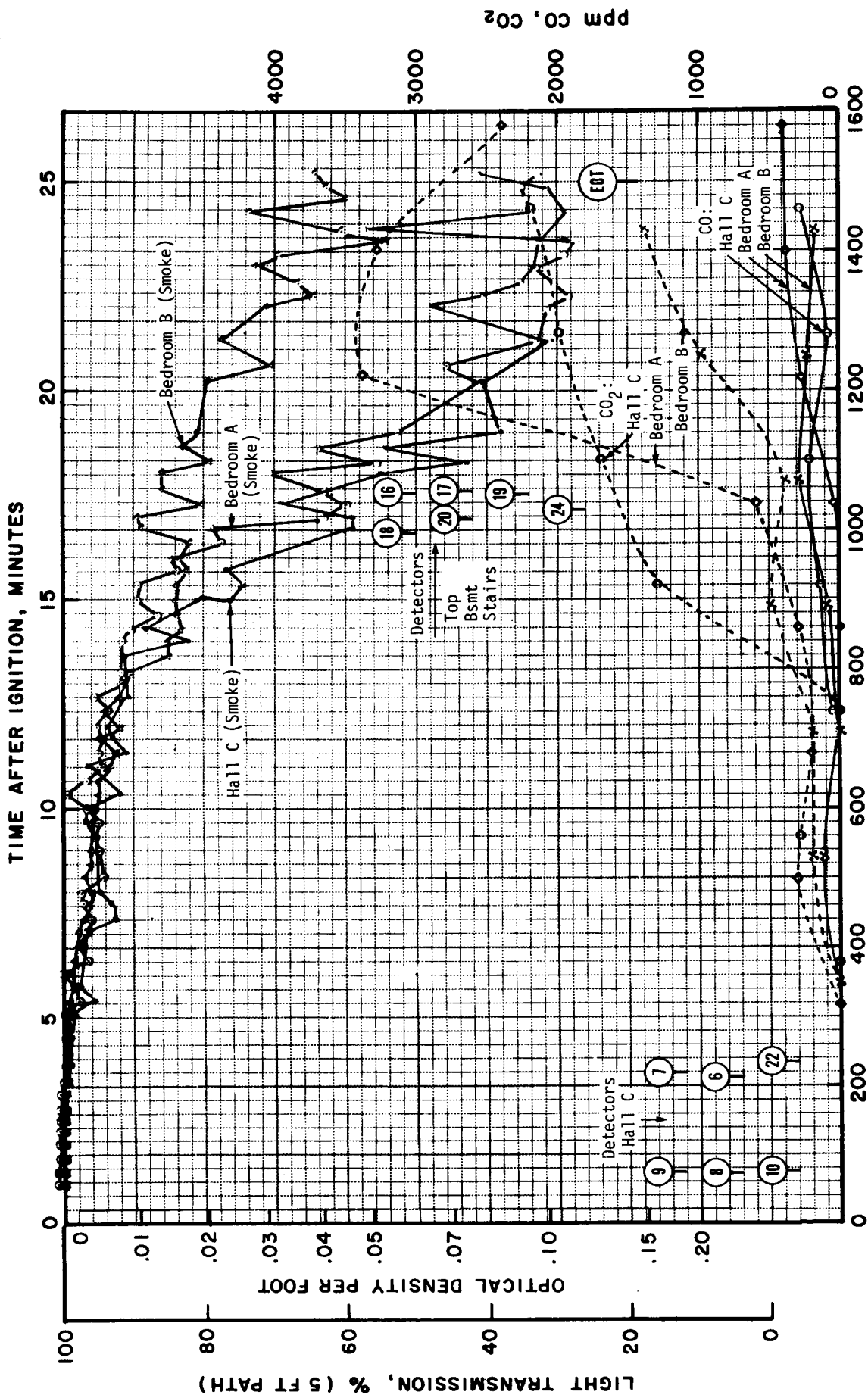
CONDITIONS ON 2ND FLOOR AT 5 FT, JR-44



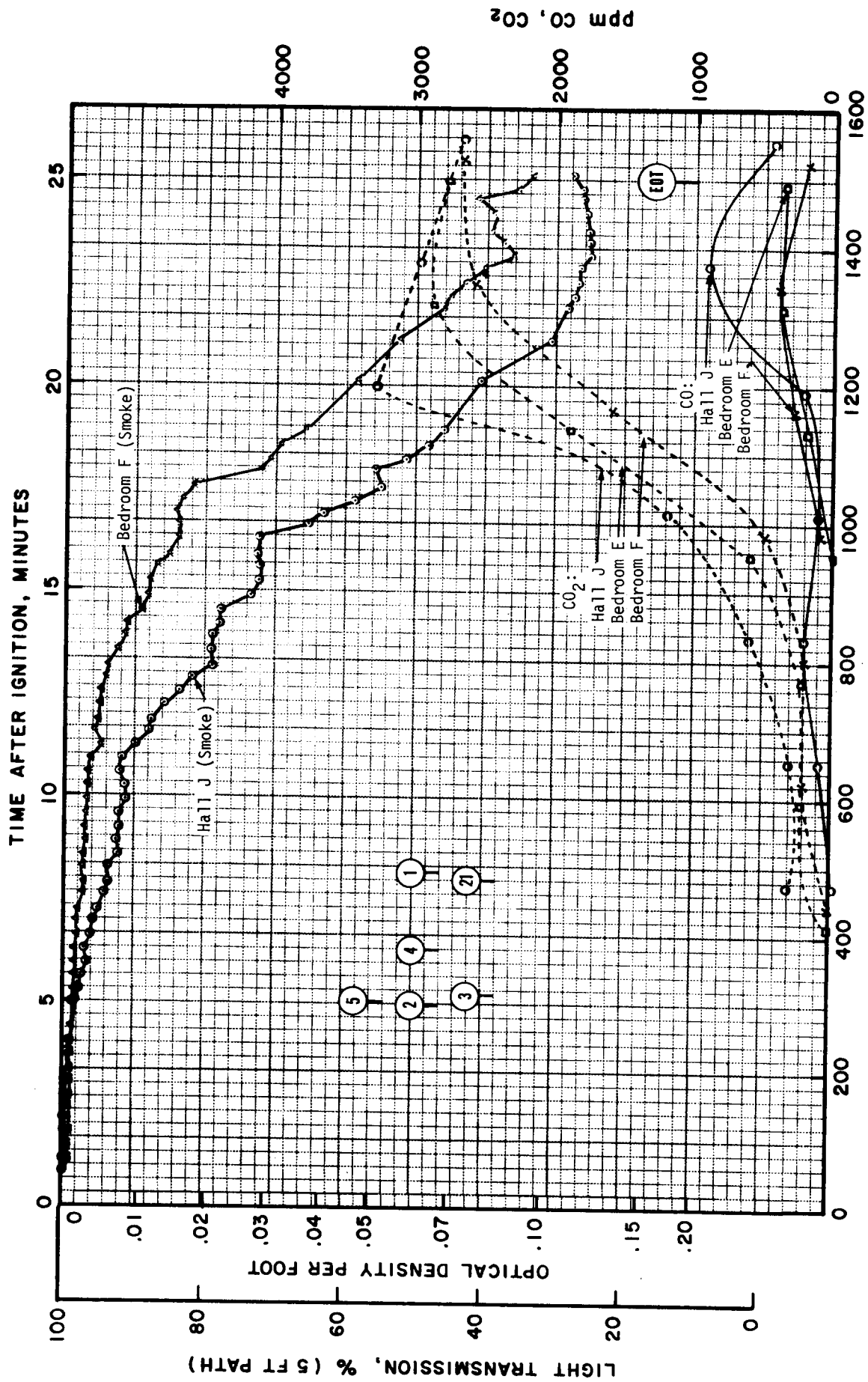
VARIOUS CONDITIONS, JR-44



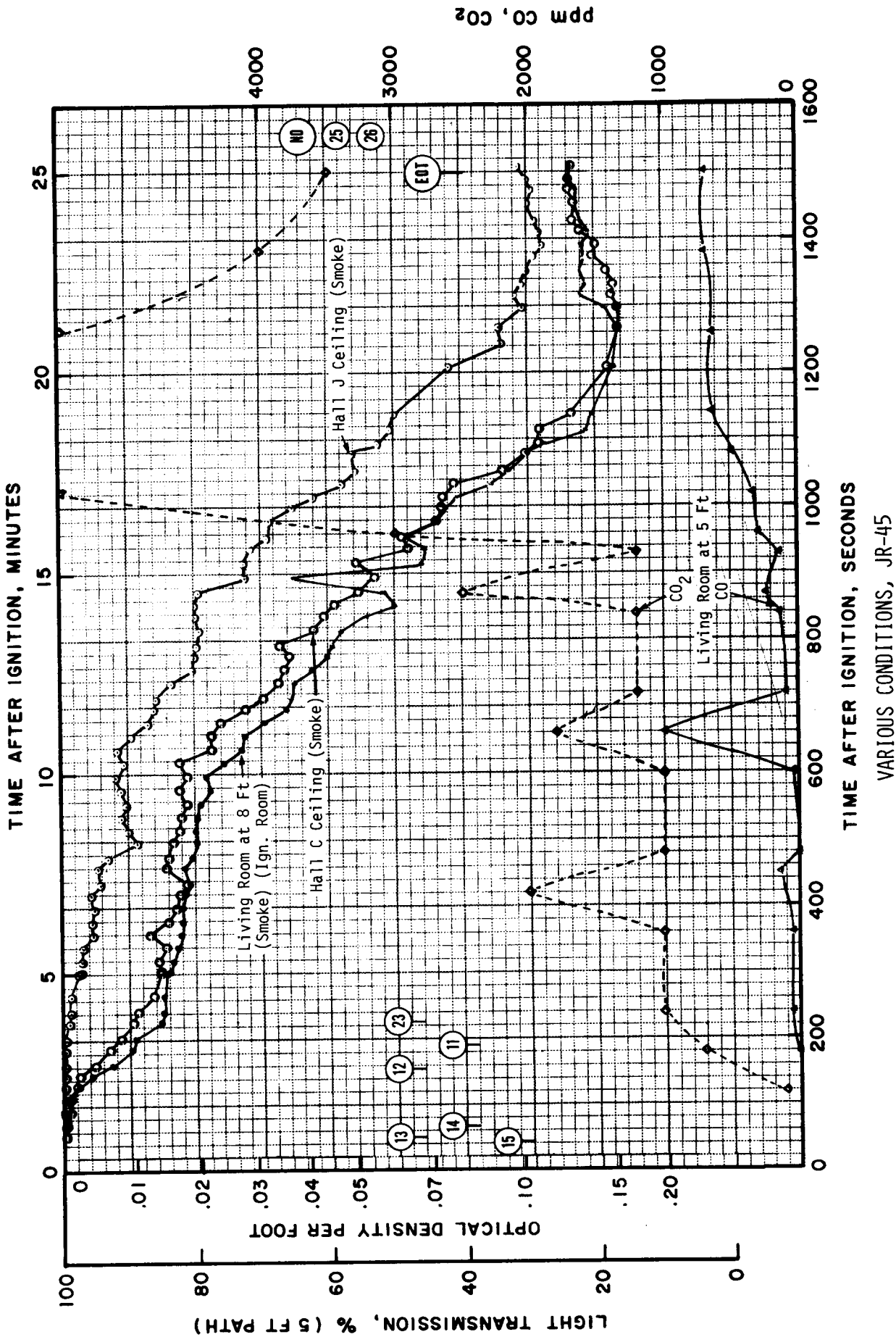
MAXIMUM TEMPERATURE PROFILES, JR-44

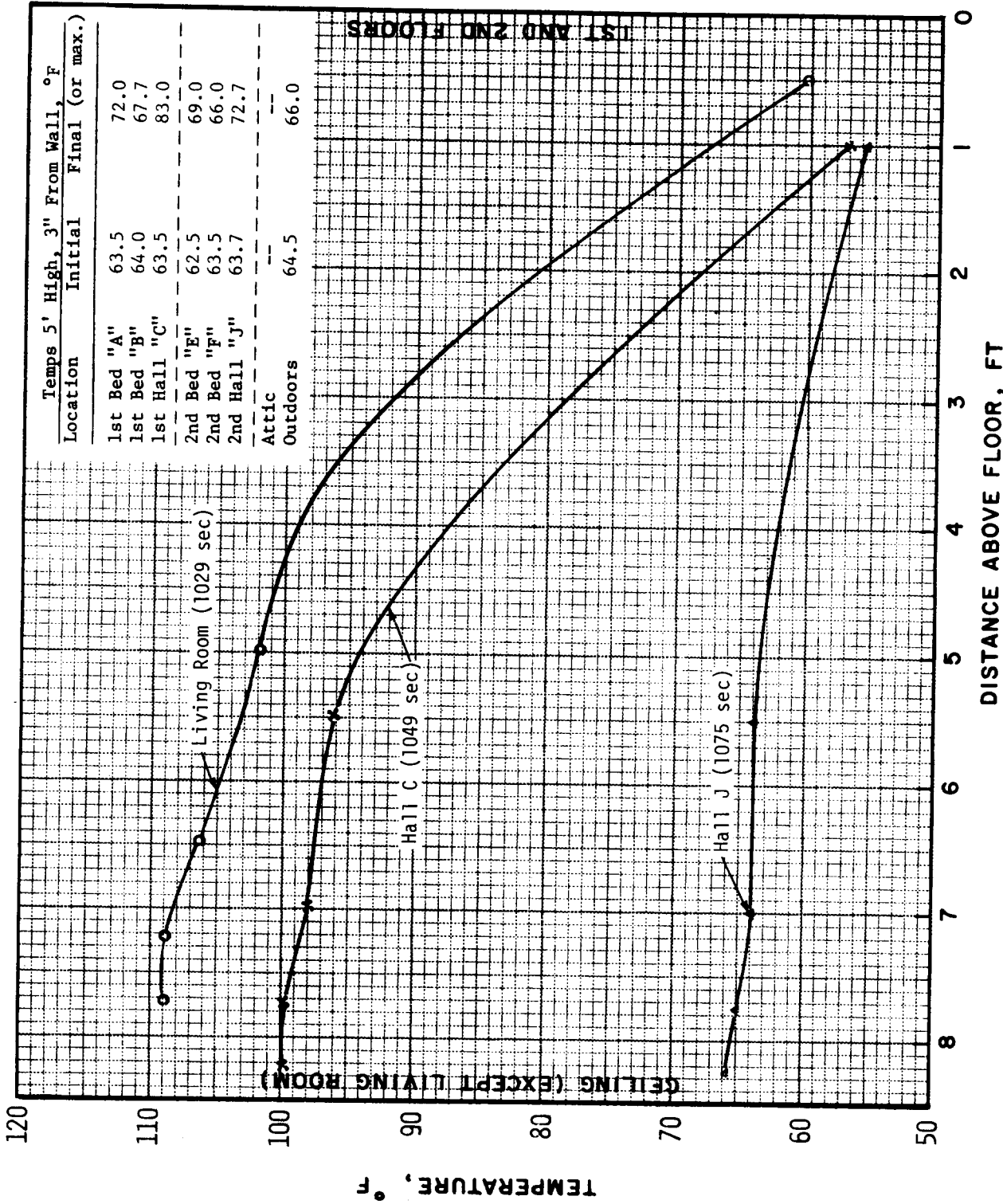


TIME AFTER IGNITION, SECONDS
 CONDITIONS ON 1ST FLOOR AT 5 FT, JR-45

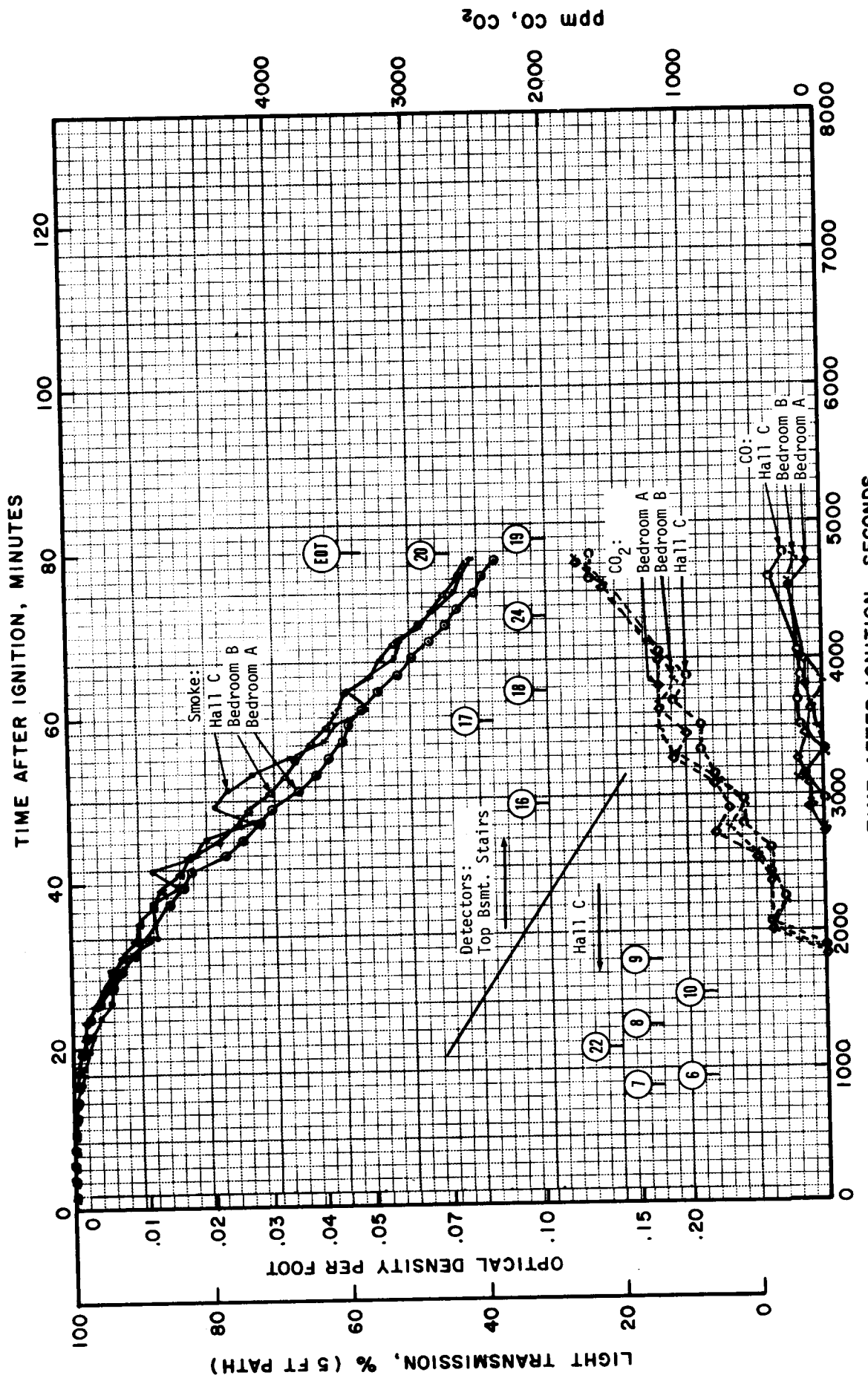


CONDITIONS ON 2ND FLOOR AT 5 FT, JR-45



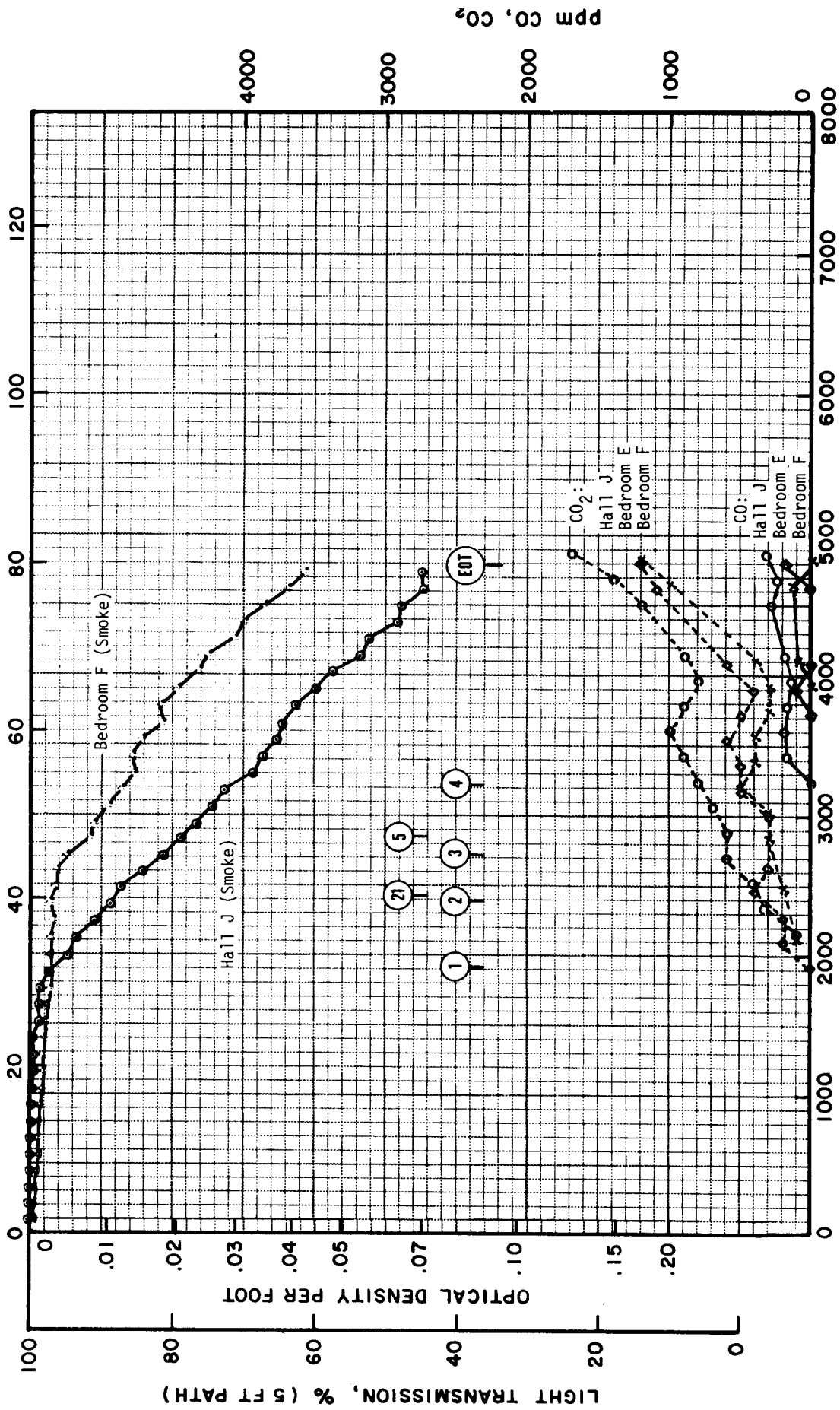


MAXIMUM TEMPERATURE PROFILES, JR-45



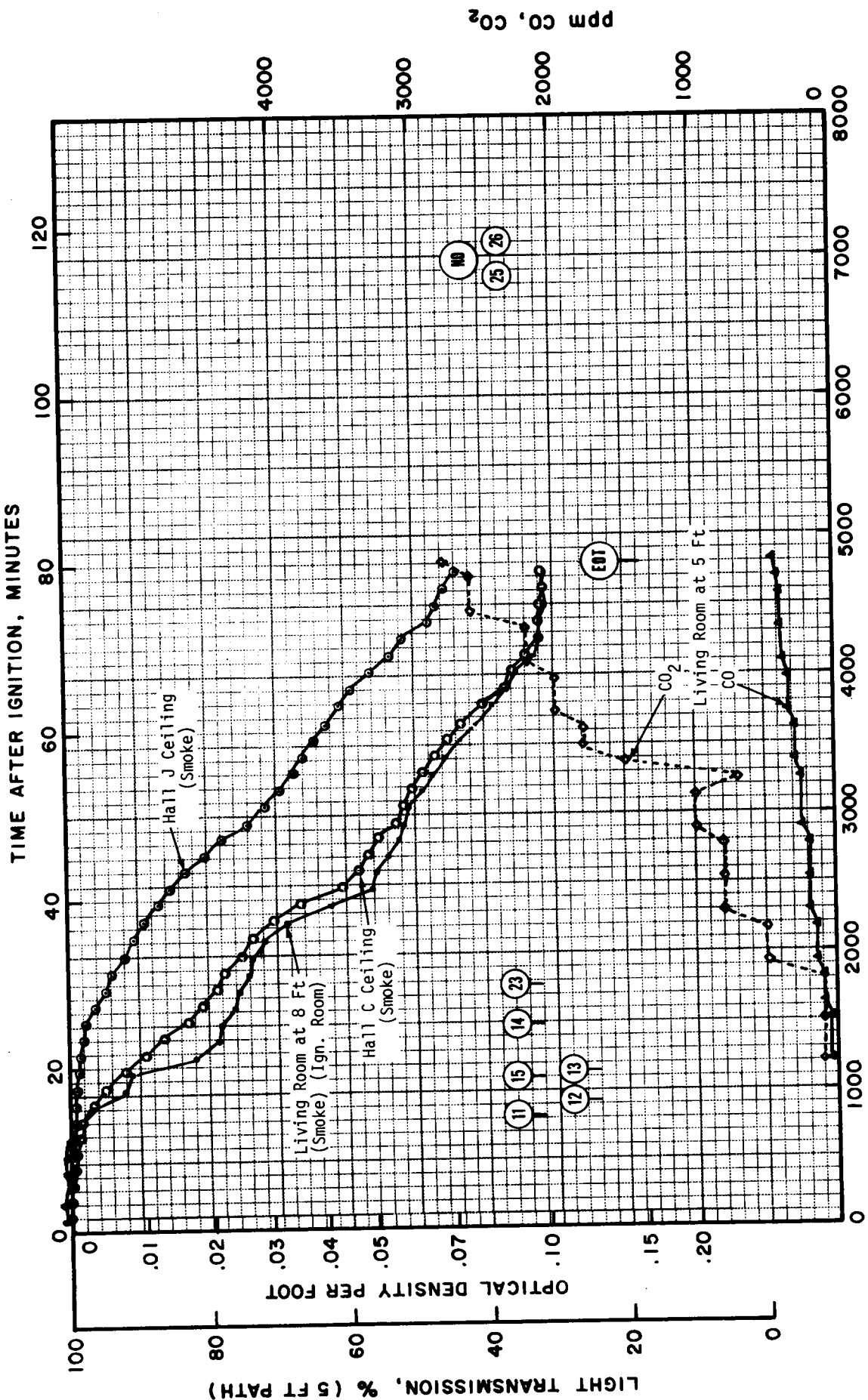
TIME AFTER IGNITION, SECONDS
 CONDITIONS ON 1ST FLOOR AT 5 FT, JR-46

TIME AFTER IGNITION, MINUTES

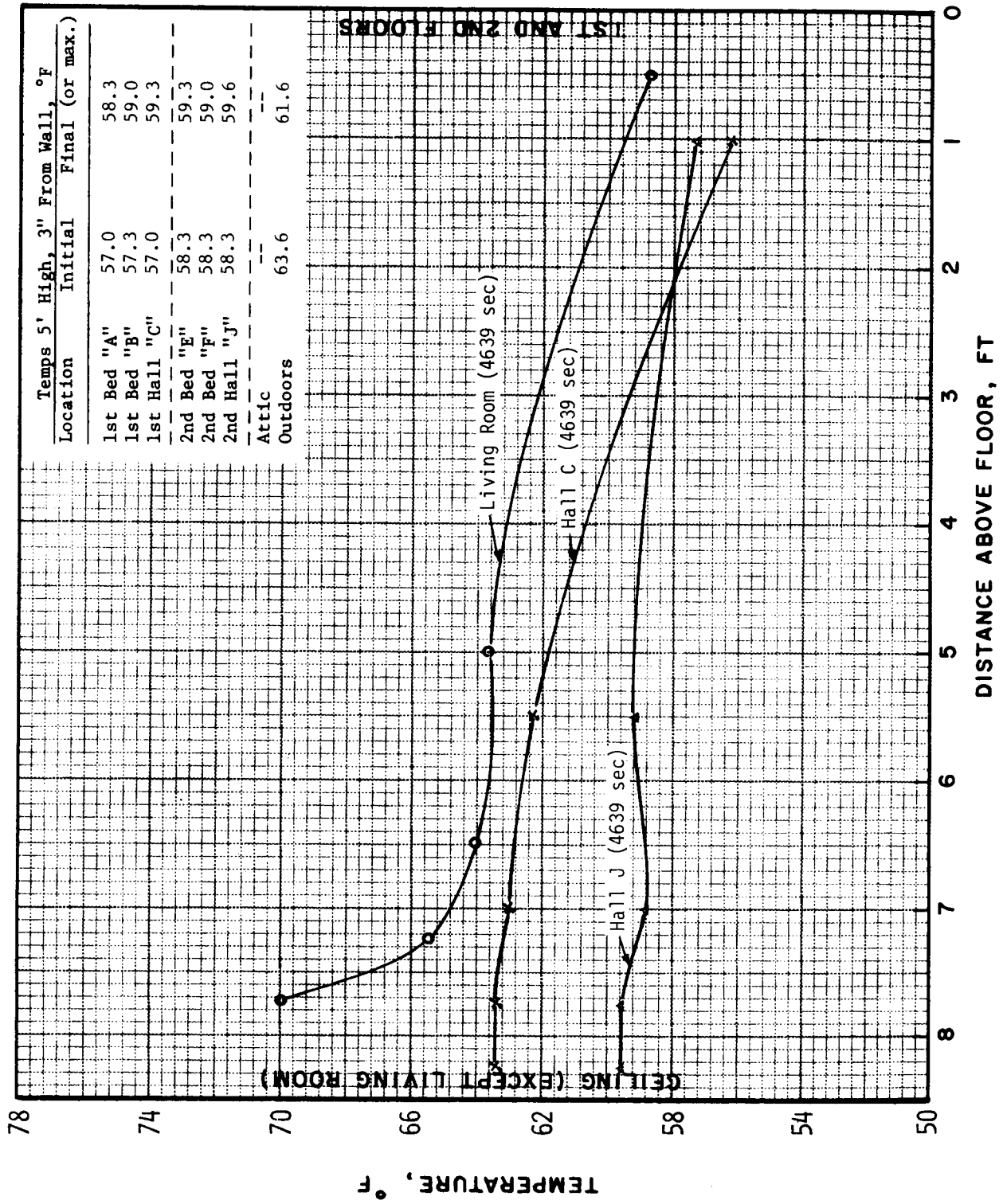


TIME AFTER IGNITION, SECONDS

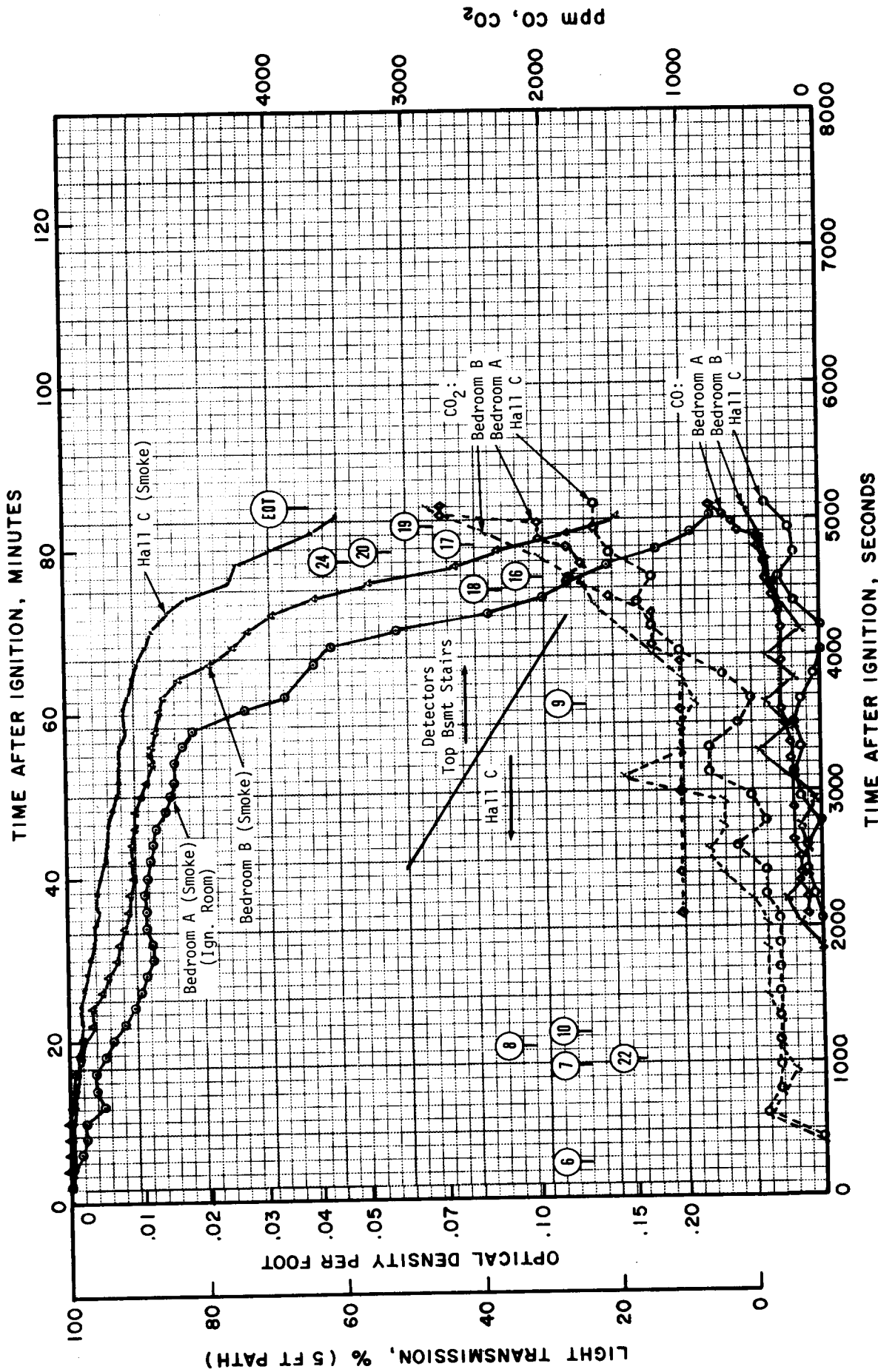
CONDITIONS ON 2ND FLOOR AT 5 FT, JR-46



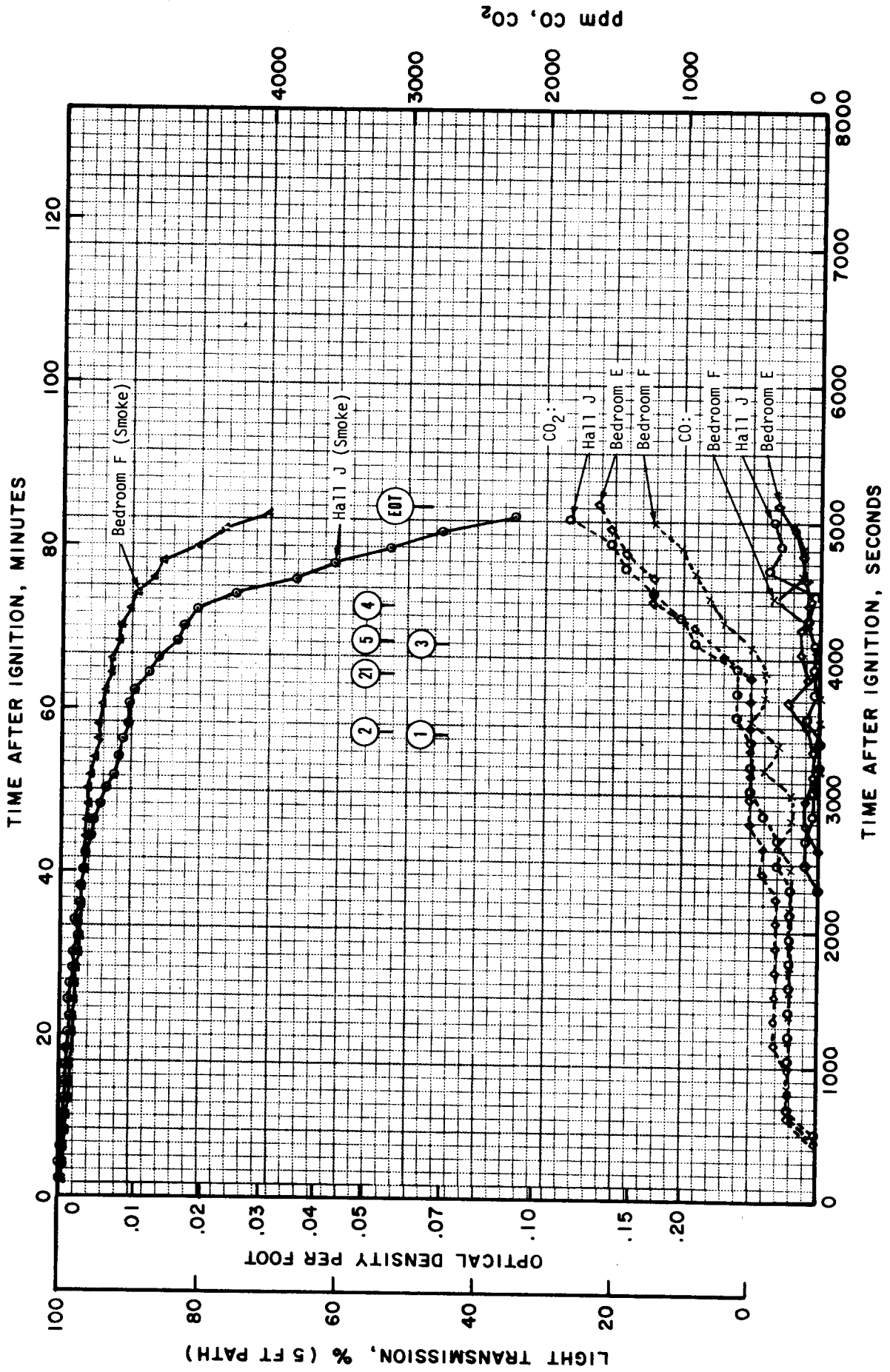
TIME AFTER IGNITION, SECONDS
 VARIOUS CONDITIONS, JR-46



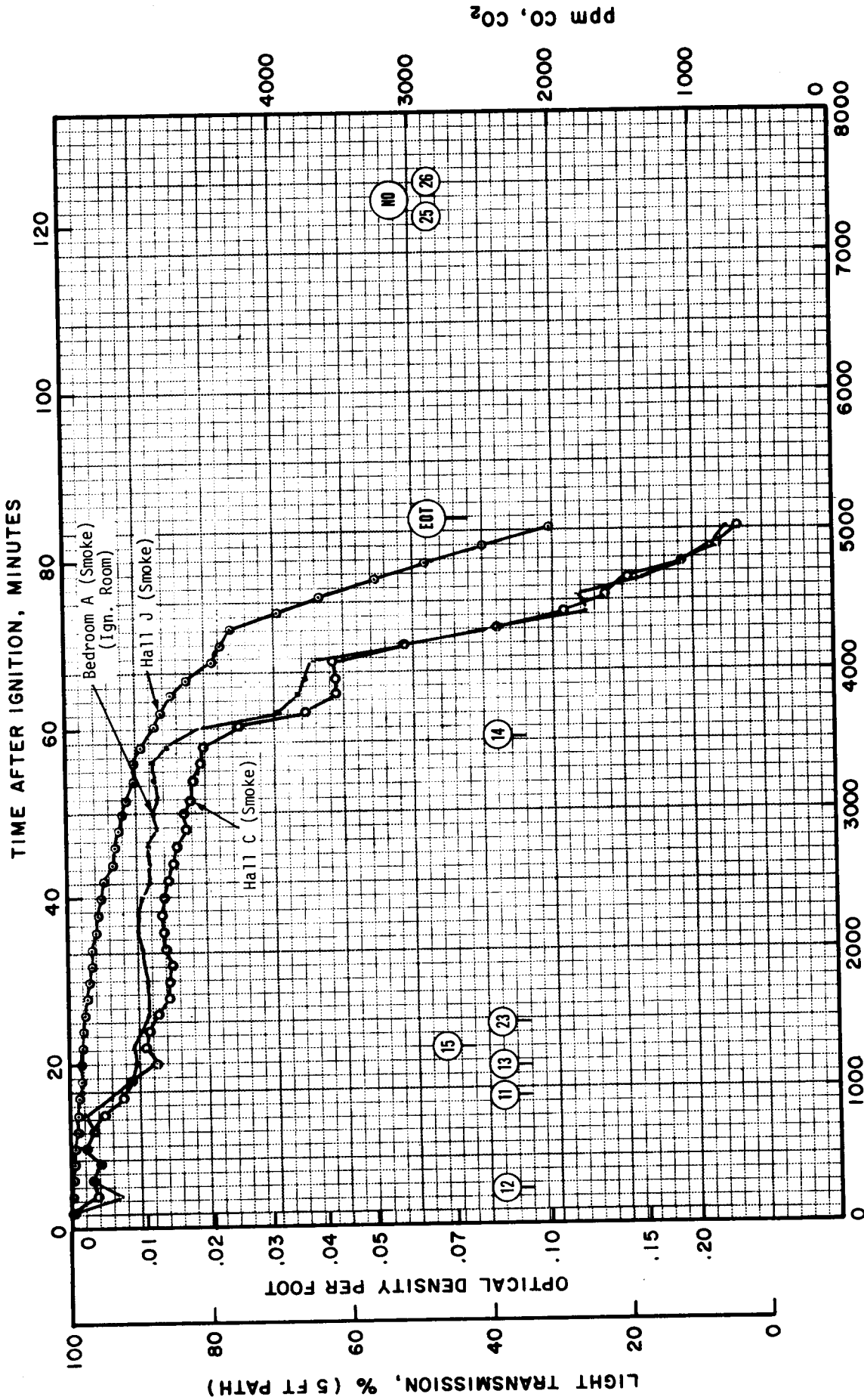
MAXIMUM TEMPERATURE PROFILES, JR-46



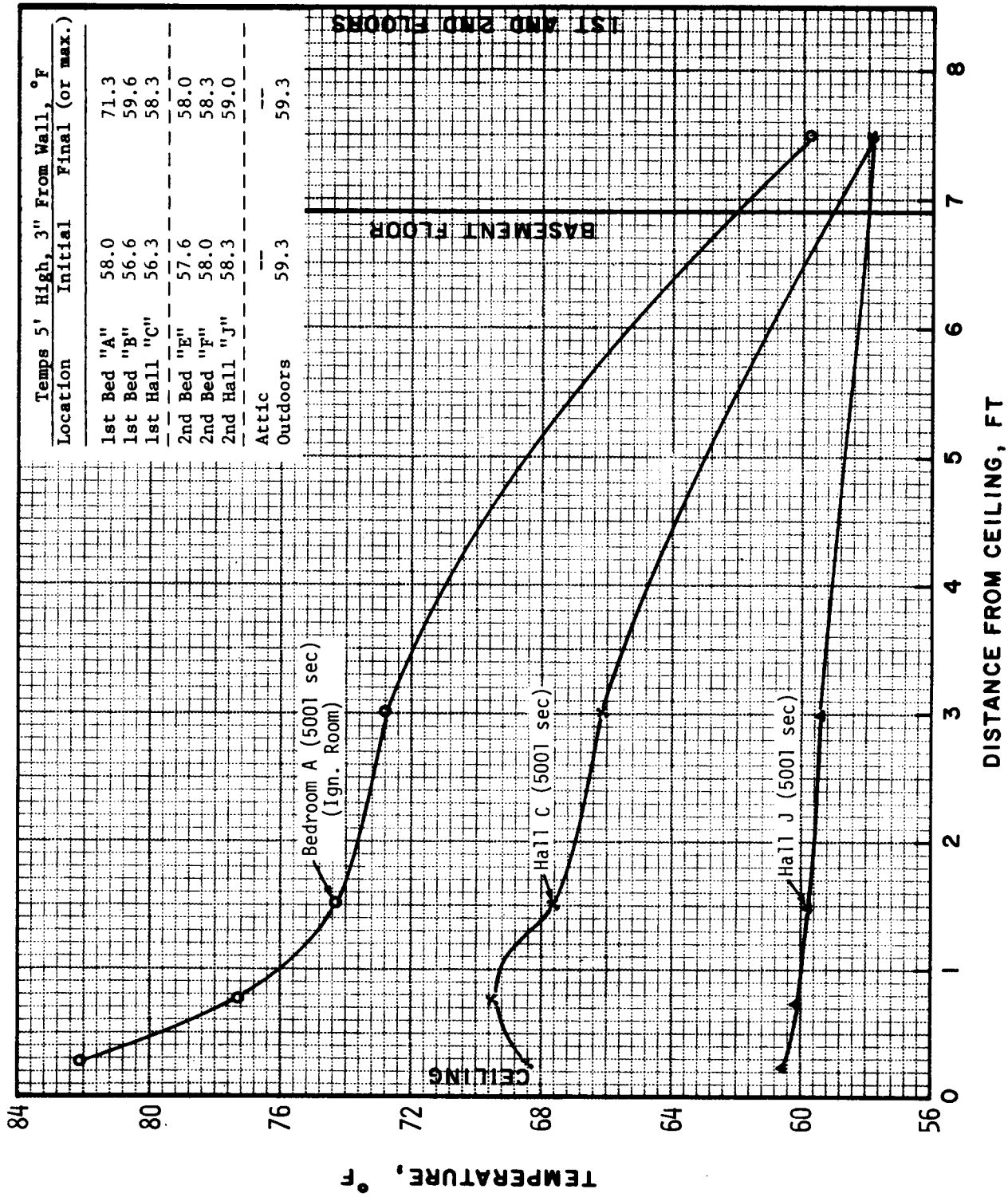
TIME AFTER IGNITION, SECONDS
 CONDITIONS ON 1ST FLOOR AT 5 FT, JR-47



CONDITIONS ON 2ND FLOOR AT 5 FT, JR-47



TIME AFTER IGNITION, SECONDS
 VARIOUS CONDITIONS AT CEILING, JR-47



Temps 5' High, 3" From Wall, °F

Location	Initial	Final (or max.)
1st Bed "A"	58.0	71.3
1st Bed "B"	56.6	59.6
1st Hall "C"	56.3	58.3
2nd Bed "E"	57.6	58.0
2nd Bed "F"	58.0	58.3
2nd Hall "J"	58.3	59.0
Attic	--	--
Outdoors	59.3	59.3

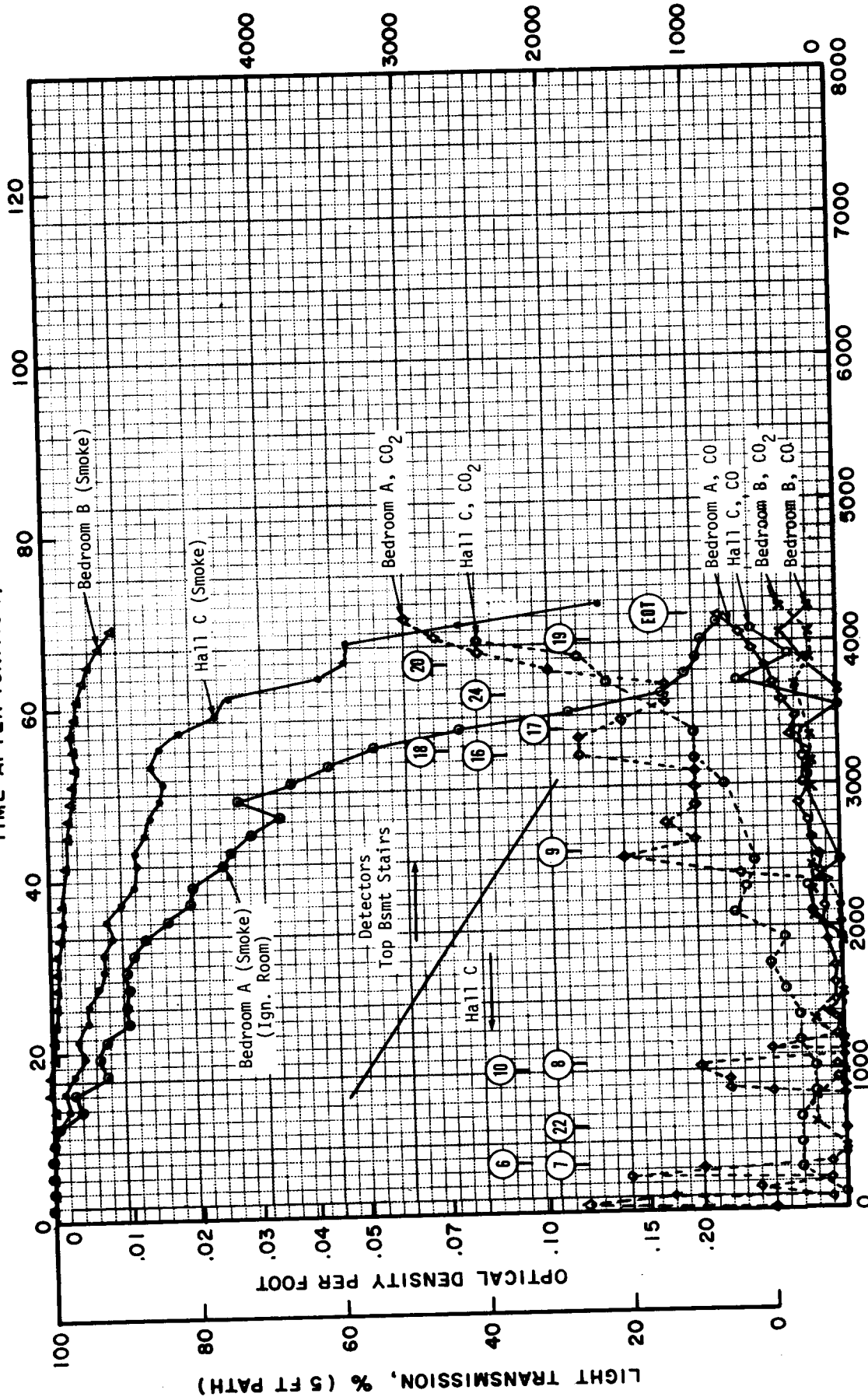
1ST AND 2ND FLOORS

BASEMENT FLOOR

CEILING

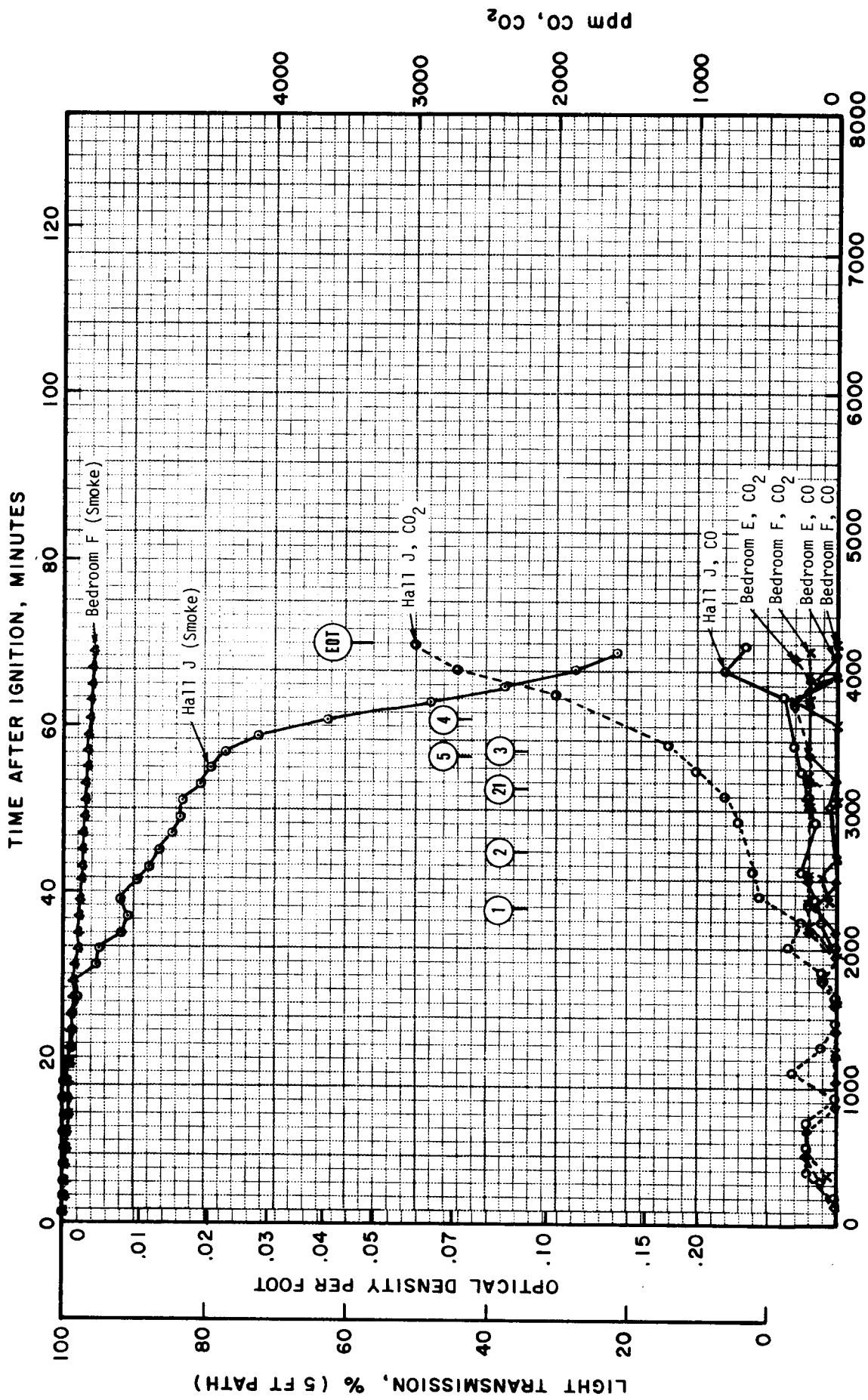
MAXIMUM TEMPERATURE PROFILES, JR-47

TIME AFTER IGNITION, MINUTES

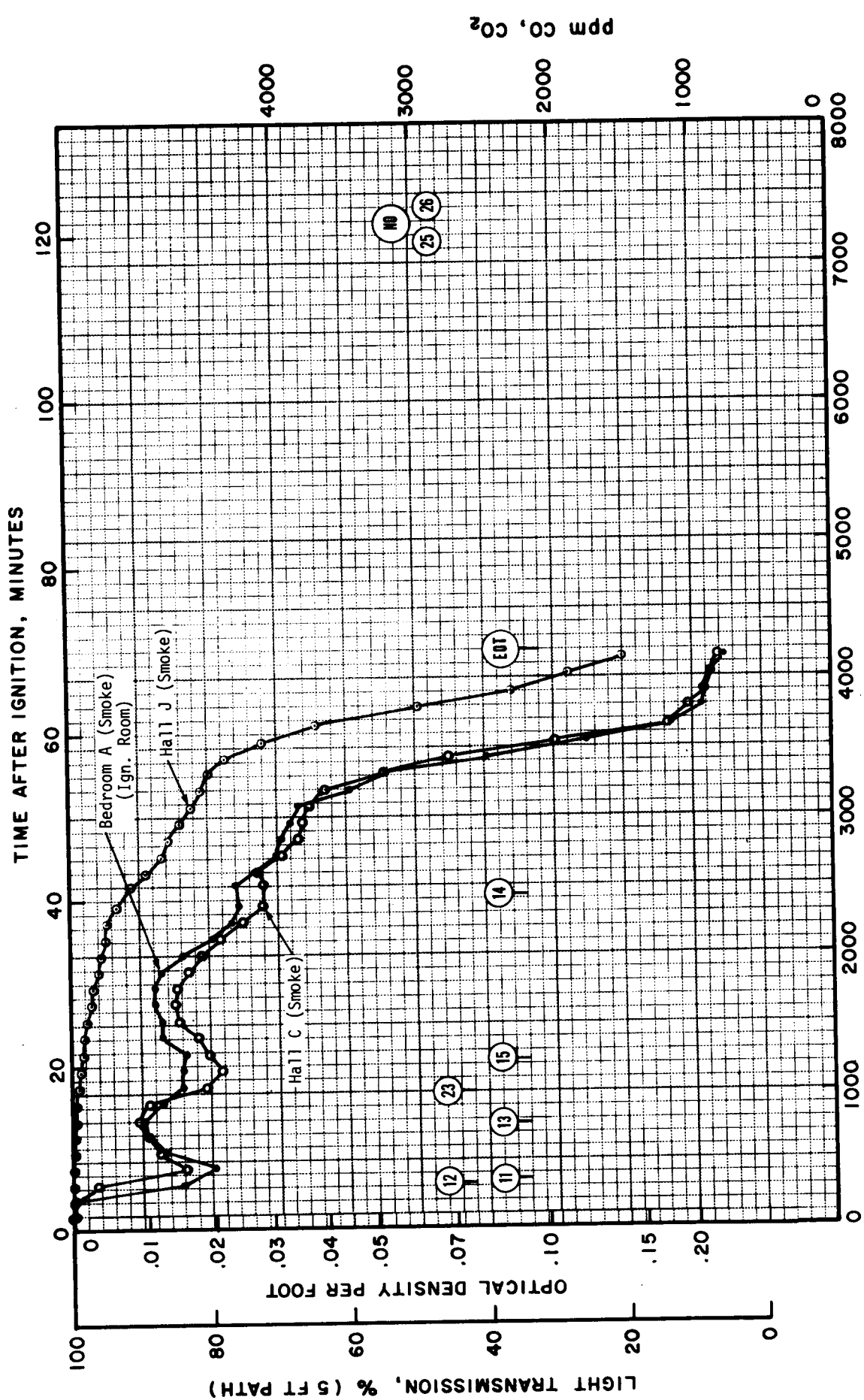


TIME AFTER IGNITION, SECONDS

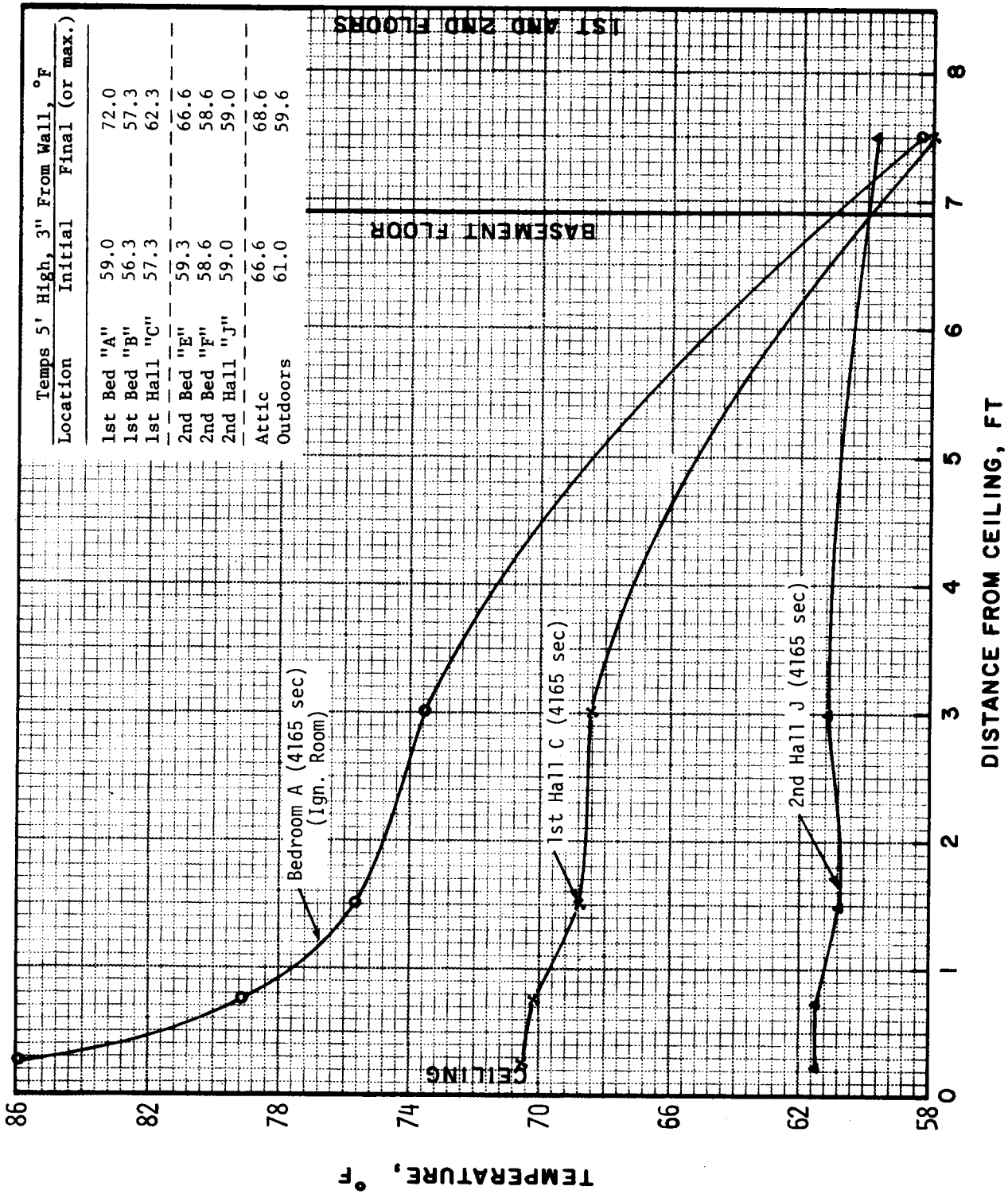
CONDITIONS ON 1ST FLOOR AT 5 FT, JR-48



TIME AFTER IGNITION, SECONDS
 CONDITIONS ON 2ND FLOOR AT 5 FT, JR-48



TIME AFTER IGNITION, SECONDS
 VARIOUS CONDITIONS AT CEILING, JR-48



Temps 5' High, 3" From Wall, °F

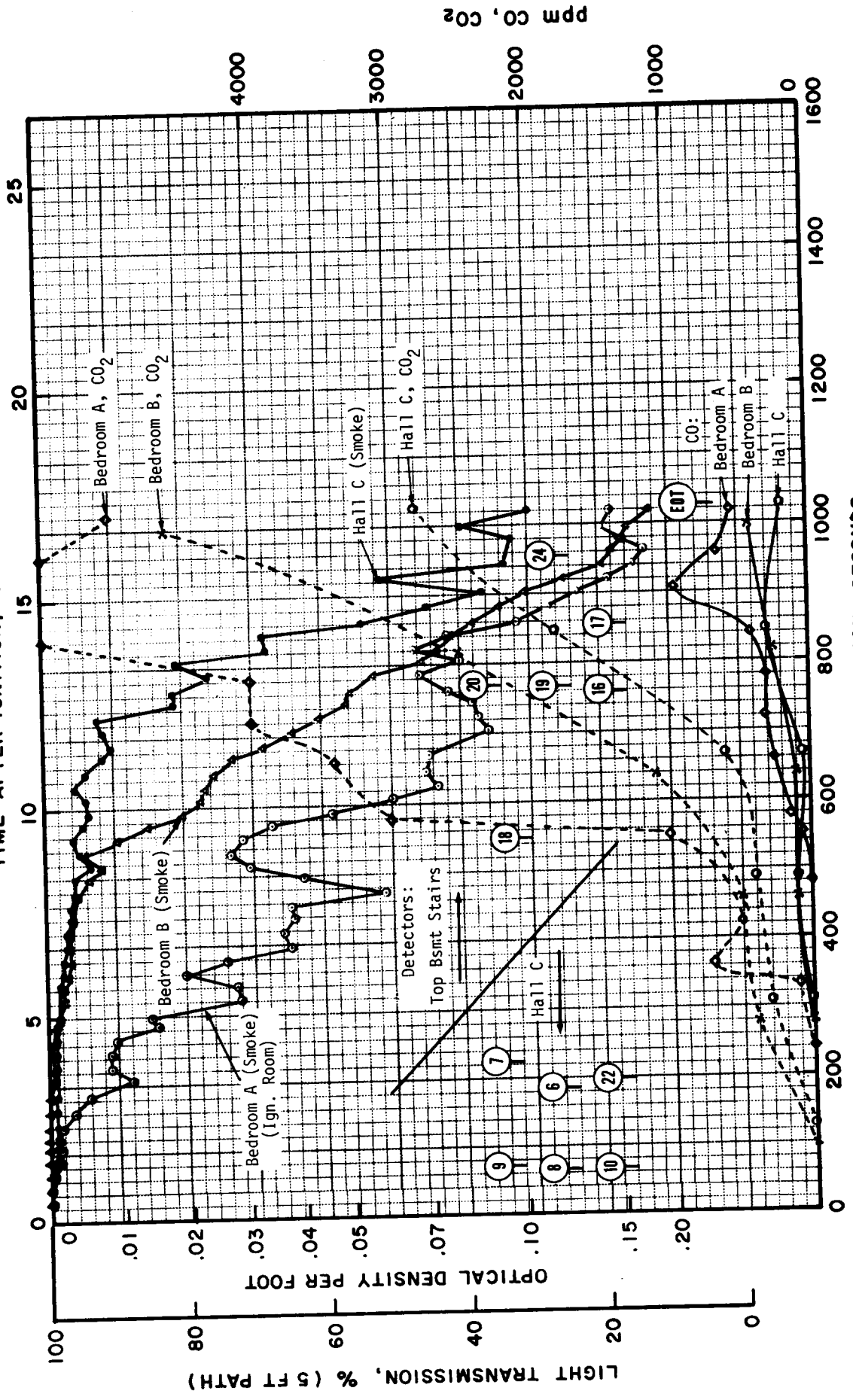
Location	Initial	Final (or max.)
1st Bed "A"	59.0	72.0
1st Bed "B"	56.3	57.3
1st Hall "C"	57.3	62.3
2nd Bed "E"	59.3	66.6
2nd Bed "F"	58.6	58.6
2nd Hall "J"	59.0	59.0
Attic	66.6	68.6
Outdoors	61.0	59.6

1ST AND 2ND FLOORS

BASEMENT FLOOR

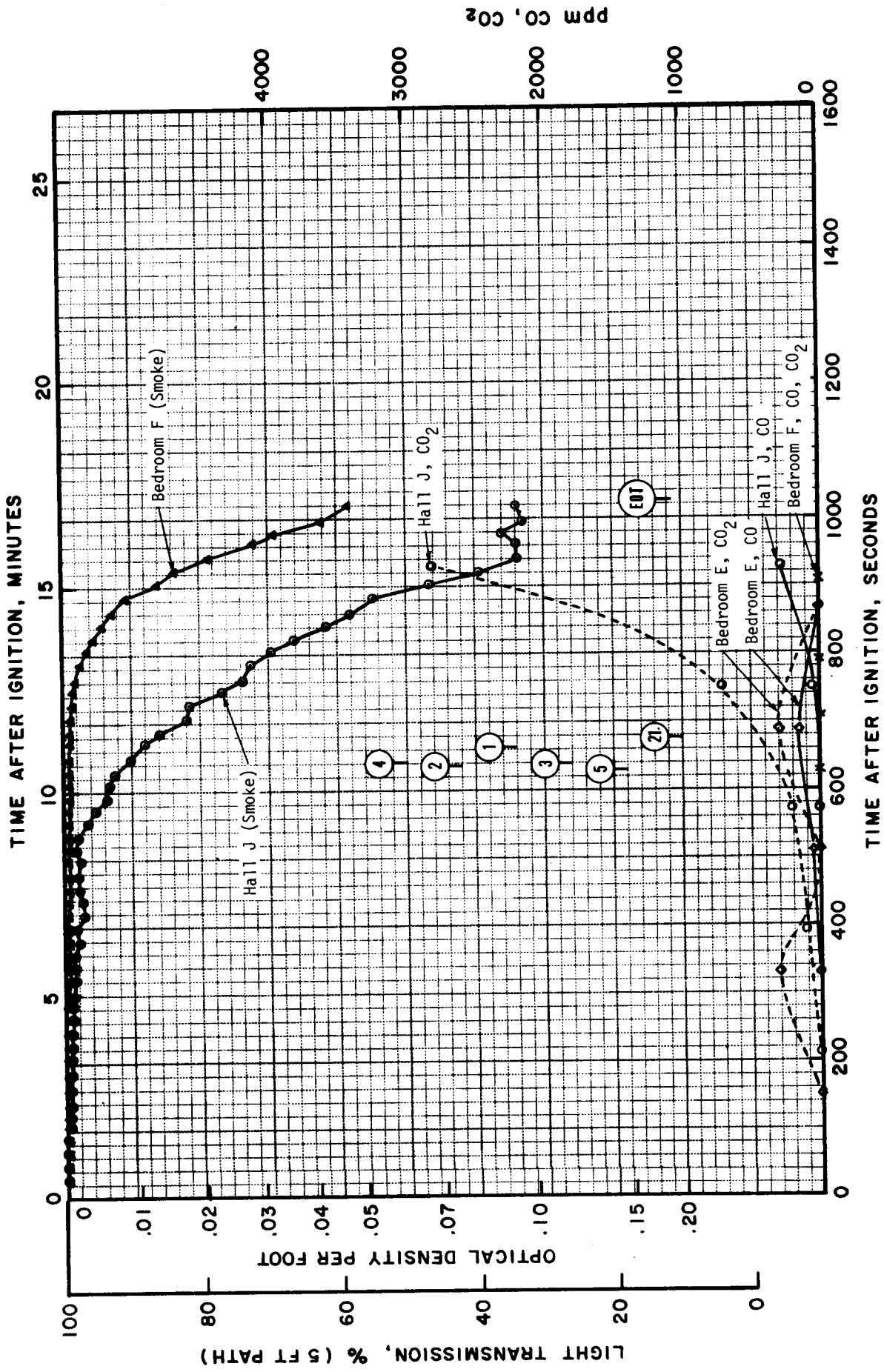
MAXIMUM TEMPERATURE PROFILES, JR-48

TIME AFTER IGNITION, MINUTES

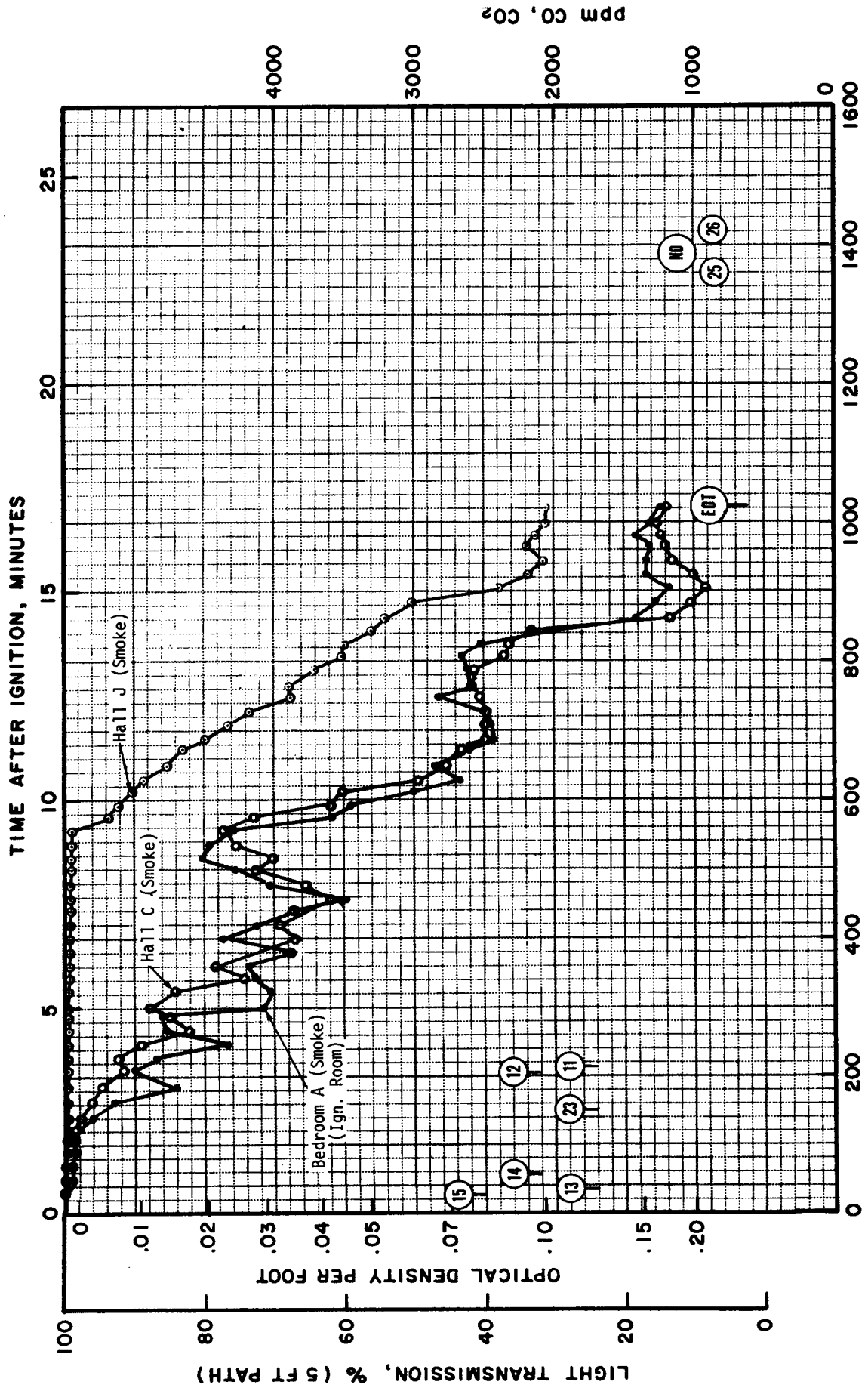


TIME AFTER IGNITION, SECONDS

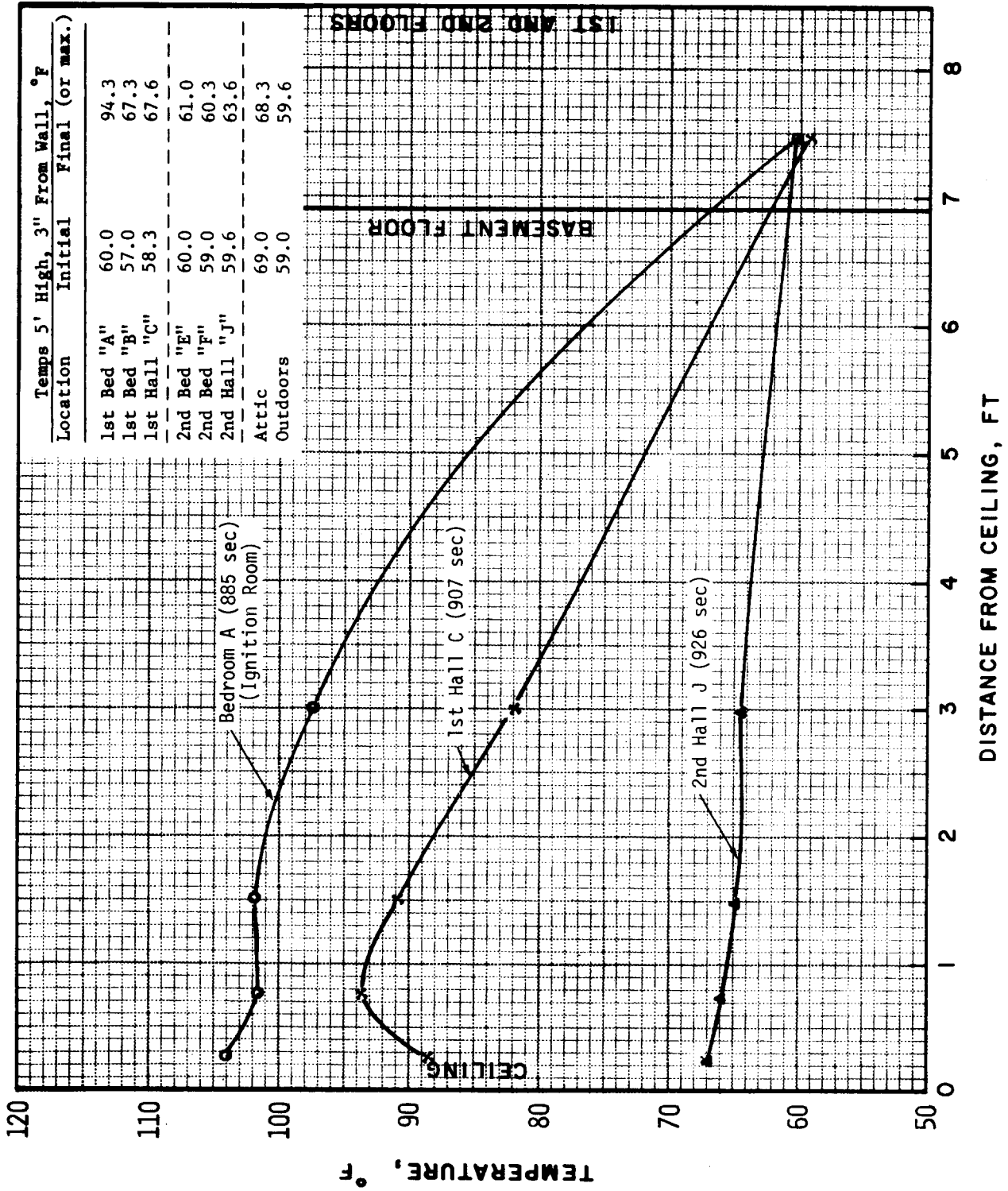
CONDITIONS ON 1ST FLOOR AT 5 FT, JR-49



CONDITIONS ON 2ND FLOOR AT 5 FT, JR-49

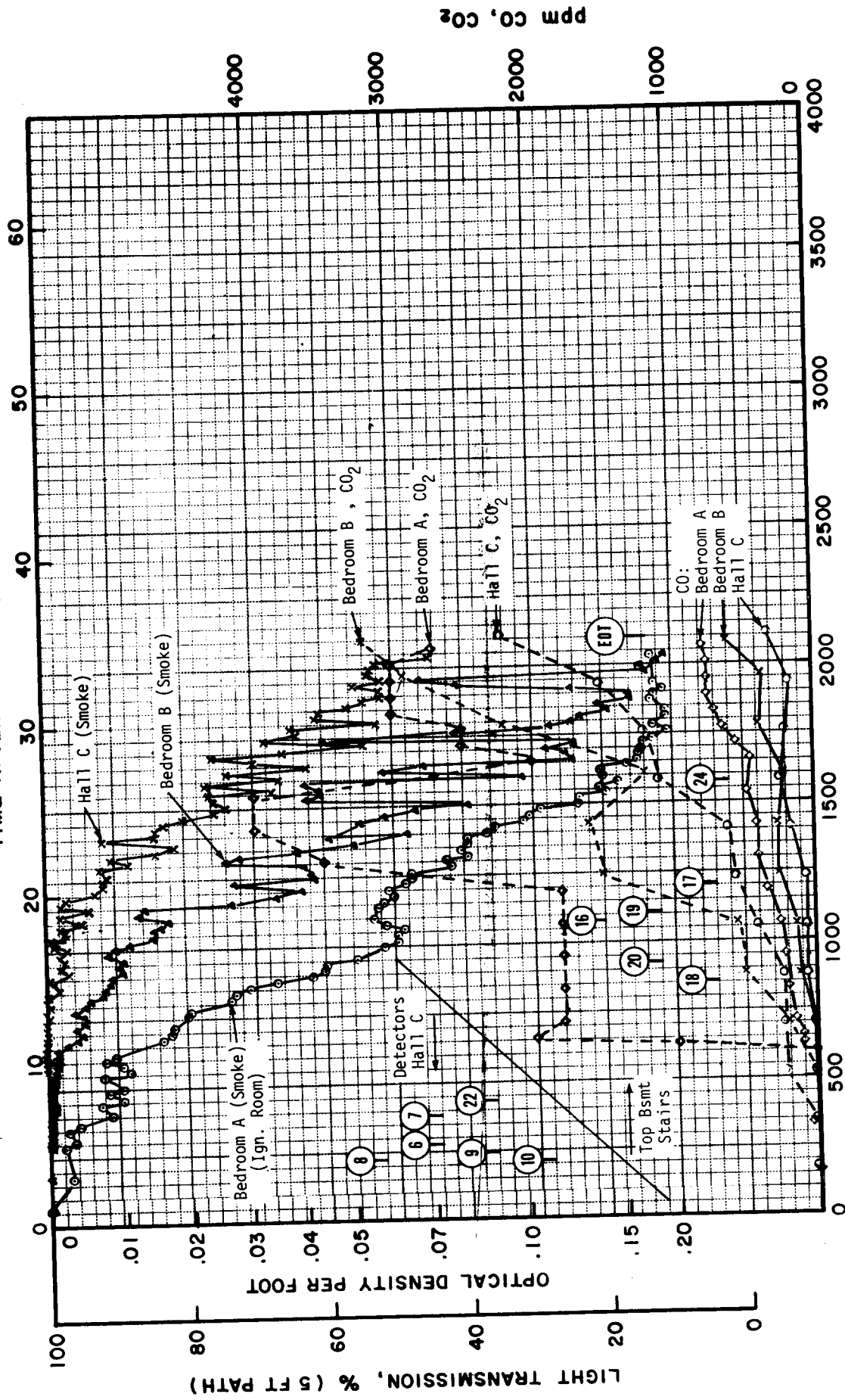


VARIOUS CONDITIONS AT CEILING, JR-49



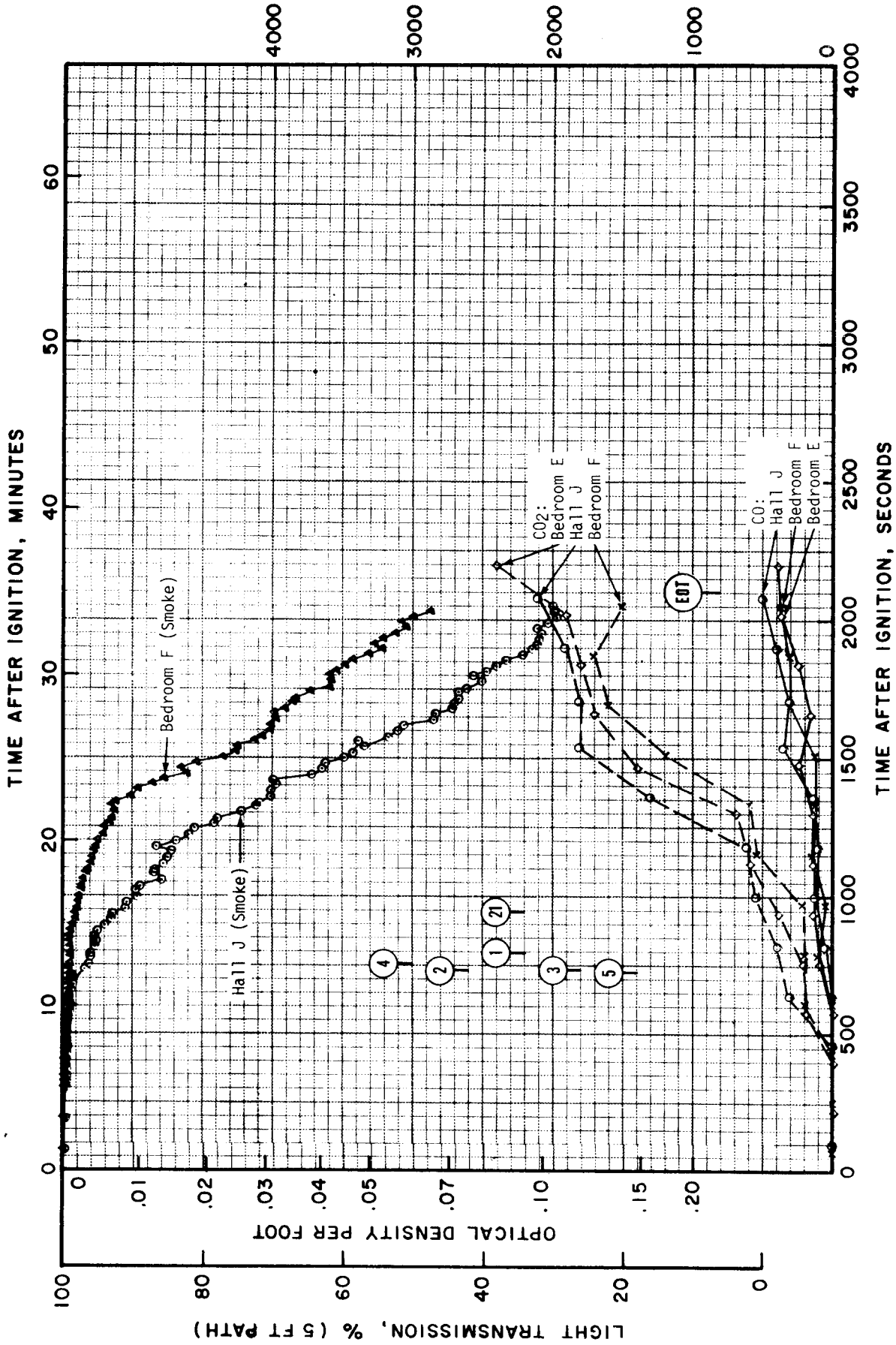
MAXIMUM TEMPERATURE PROFILES, JR-49

TIME AFTER IGNITION, MINUTES



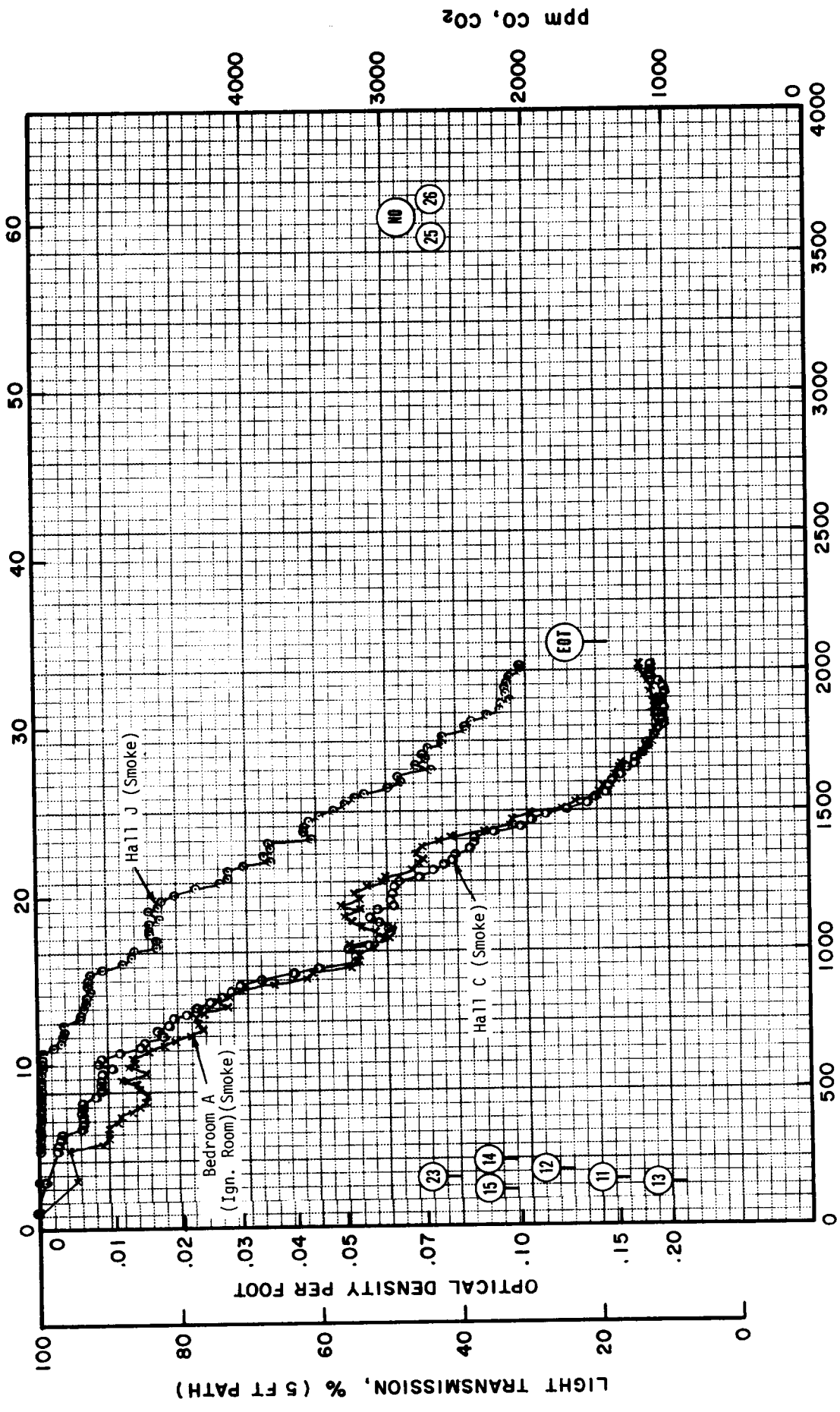
TIME AFTER IGNITION, SECONDS

CONDITIONS ON 1ST FLOOR AT 5 FT, JR-50



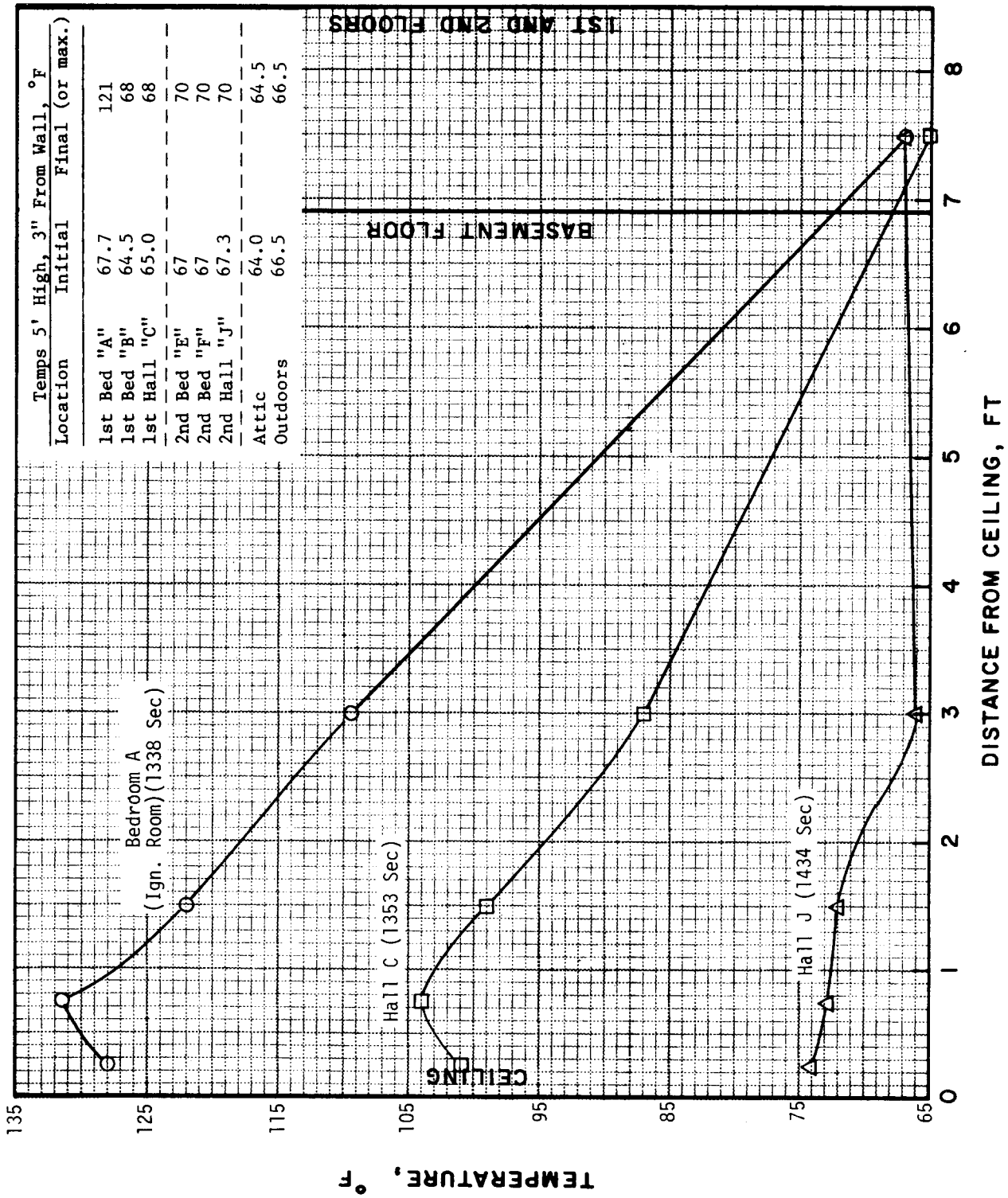
CONDITIONS ON 2ND FLOOR AT 5 FT, JR-50

TIME AFTER IGNITION, MINUTES



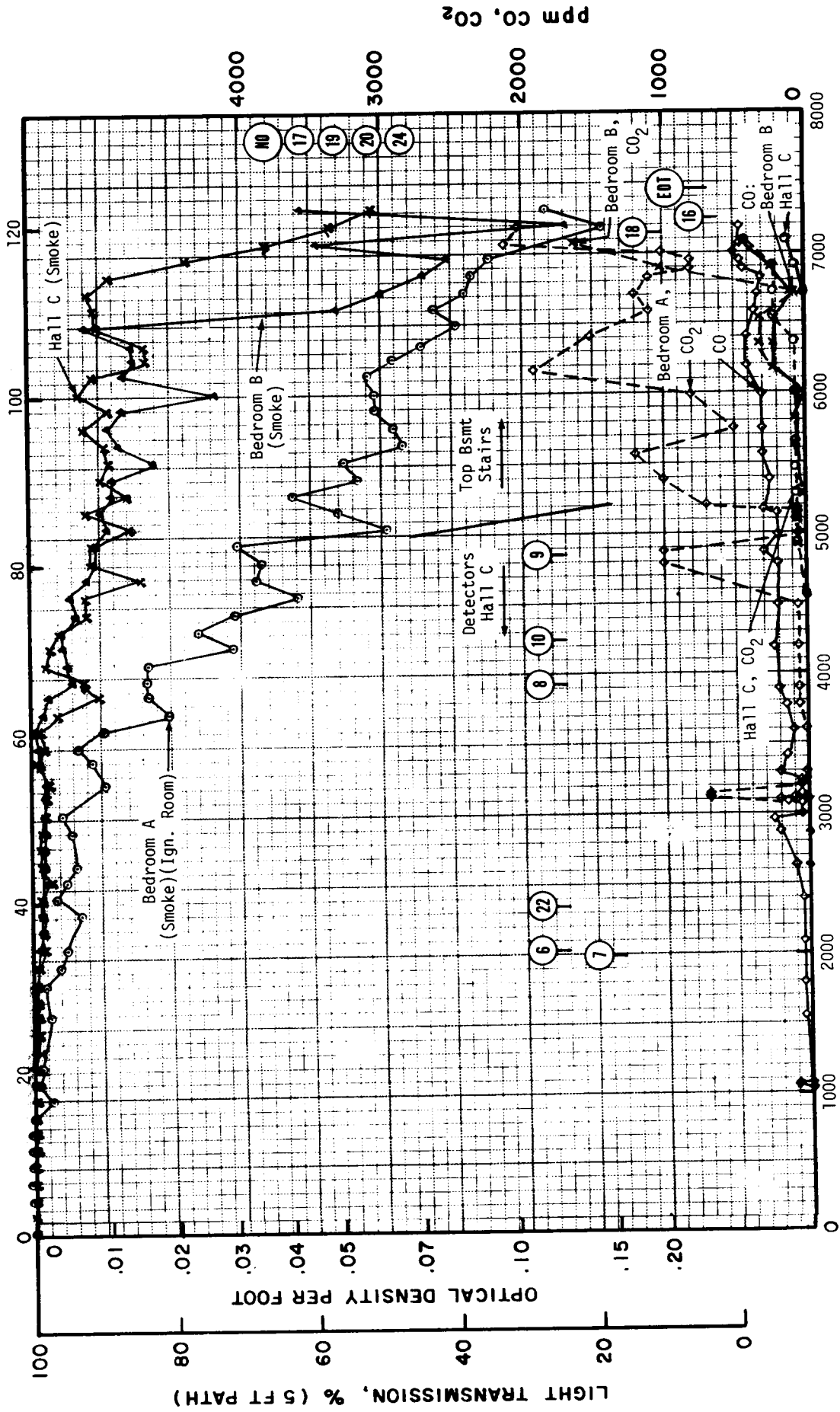
TIME AFTER IGNITION, SECONDS

VARIOUS CONDITIONS AT CEILING, JR-50



MAXIMUM TEMPERATURE PROFILES, JR-50

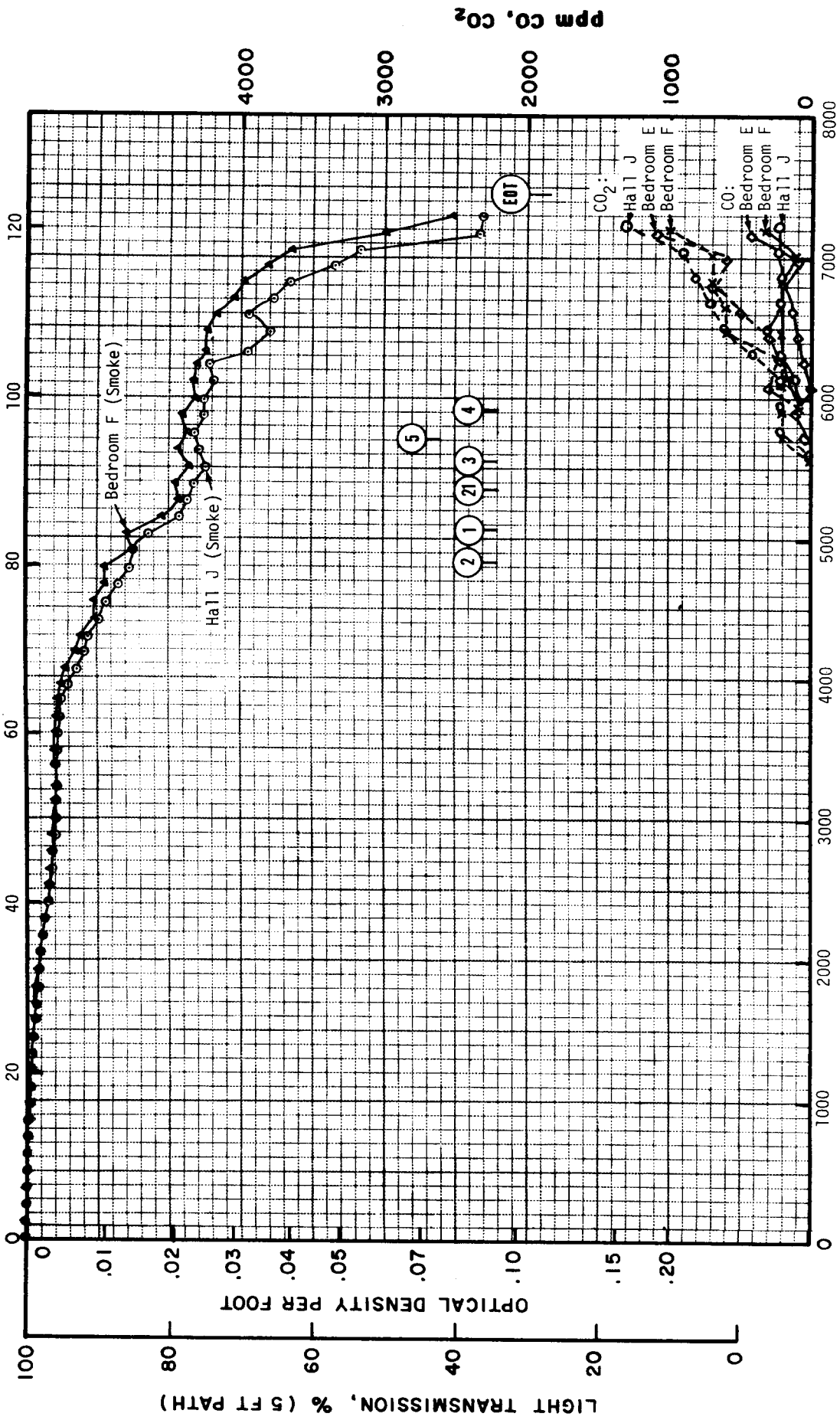
TIME AFTER IGNITION, MINUTES



TIME AFTER IGNITION, SECONDS

CONDITIONS ON 1ST FLOOR AT 5 FT, JR-51

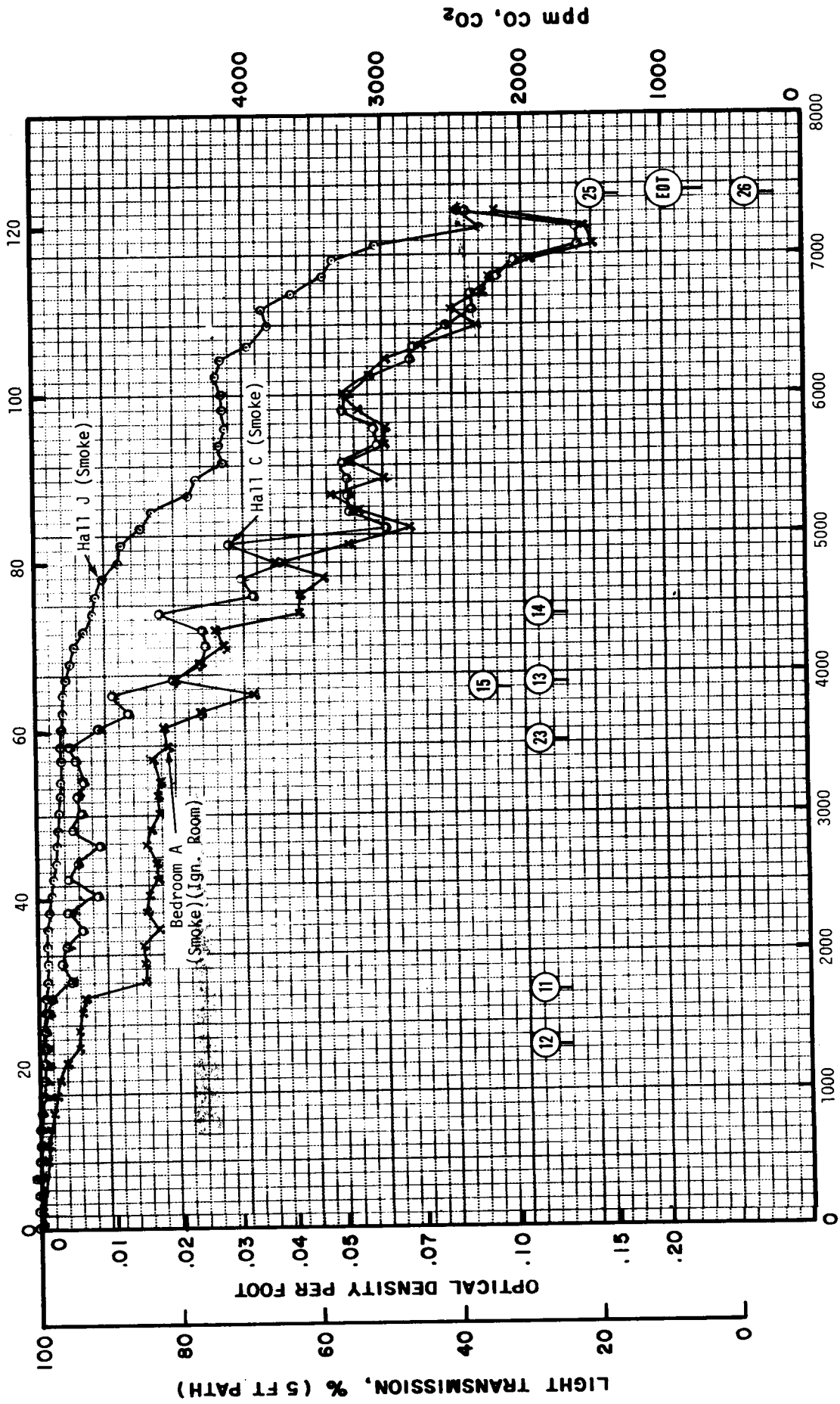
TIME AFTER IGNITION, MINUTES



TIME AFTER IGNITION, SECONDS

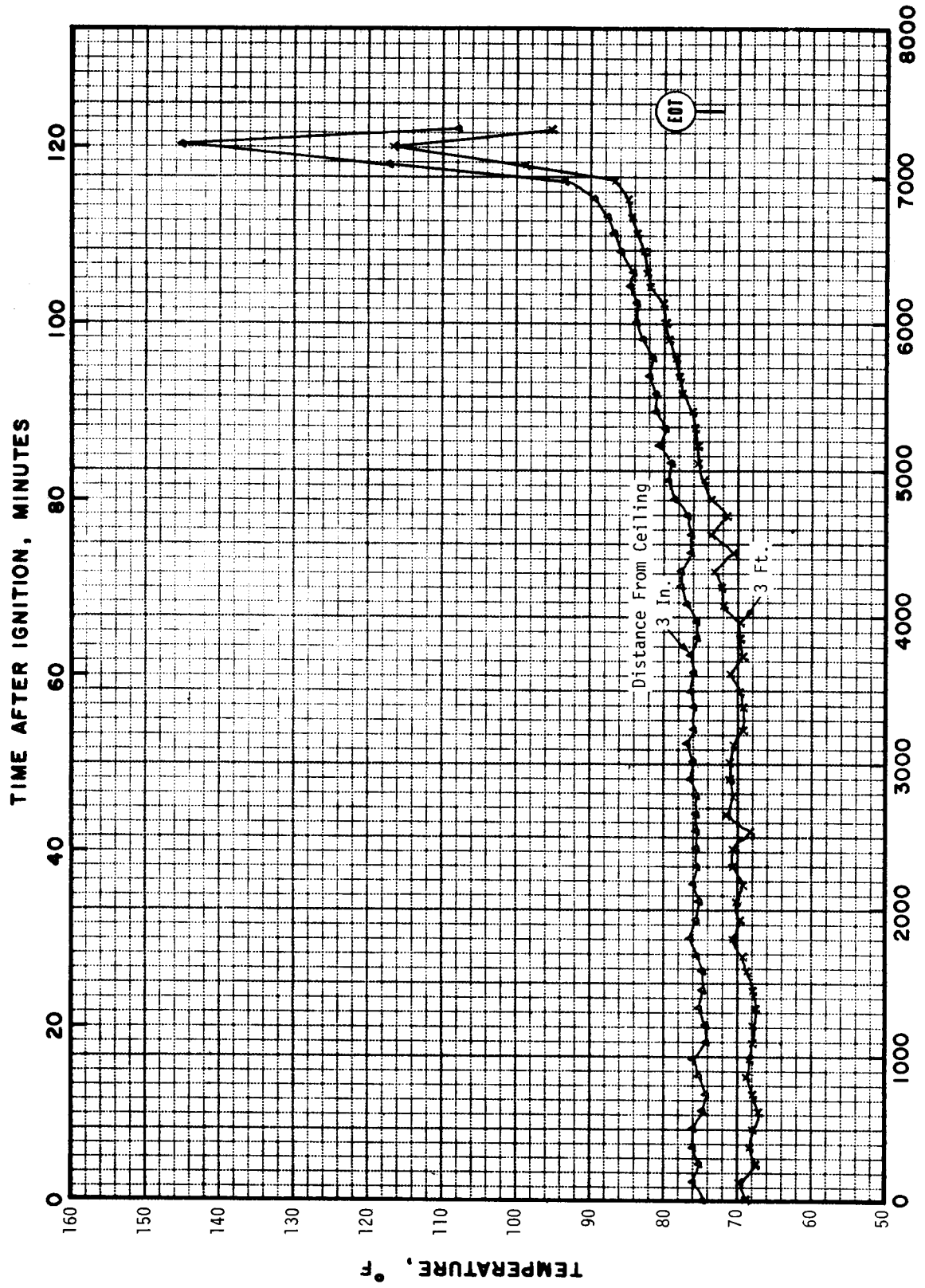
CONDITIONS ON 2ND FLOOR AT 5 FT, JR-51

TIME AFTER IGNITION, MINUTES

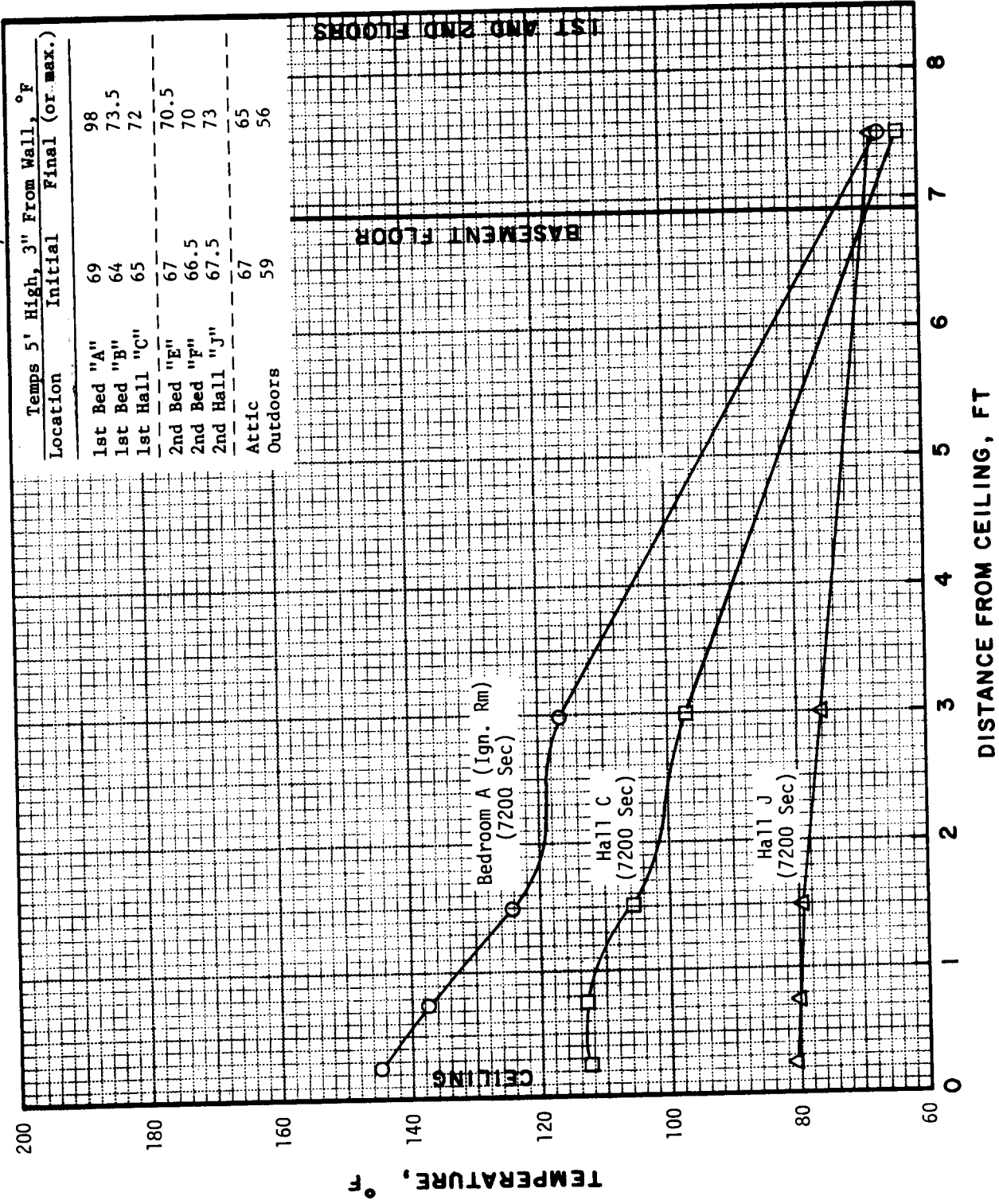


TIME AFTER IGNITION, SECONDS

VARIOUS CONDITIONS AT CEILING, JR-51



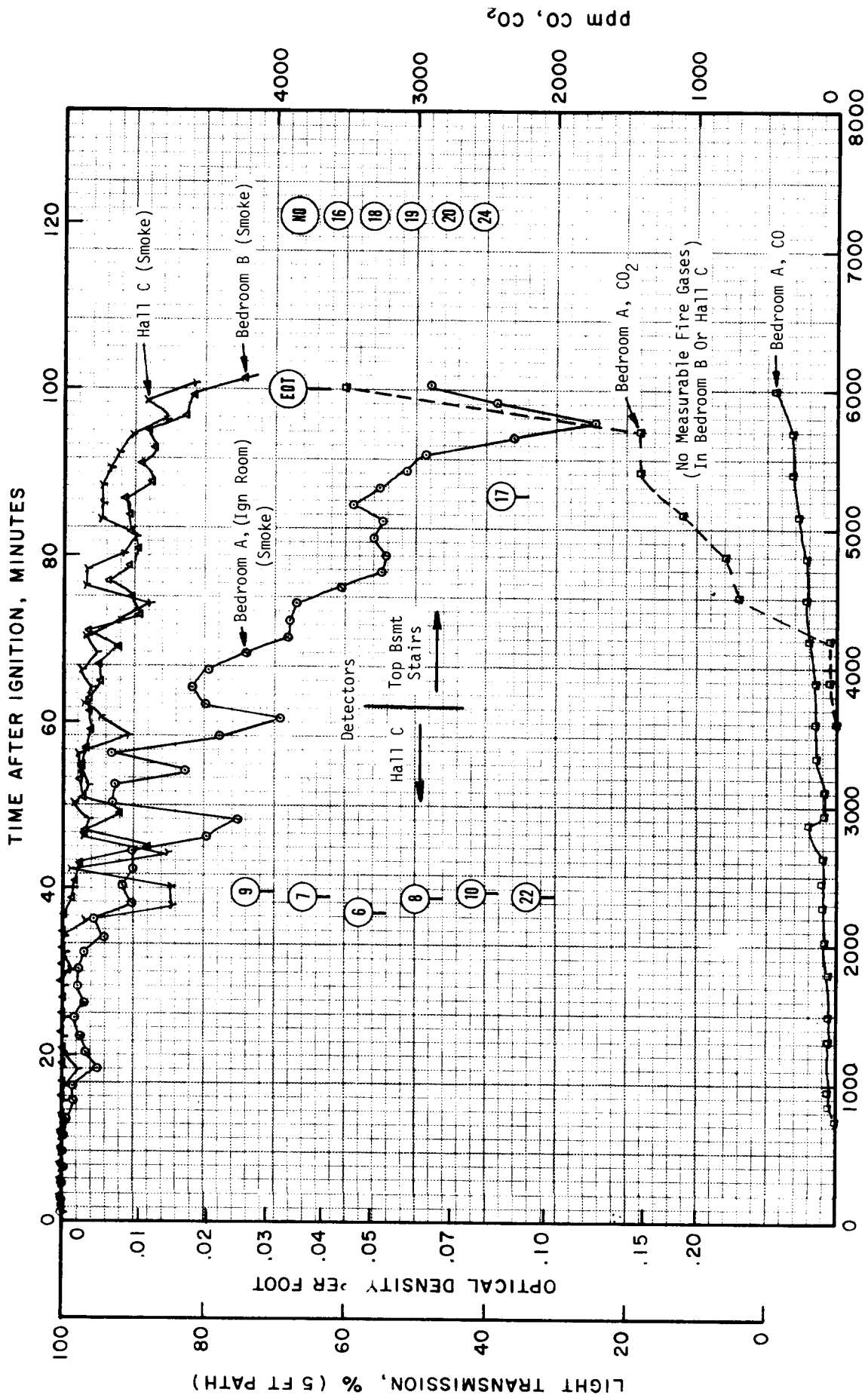
TEMPERATURES IN IGNITION ROOM (BEDROOM A), JR-51



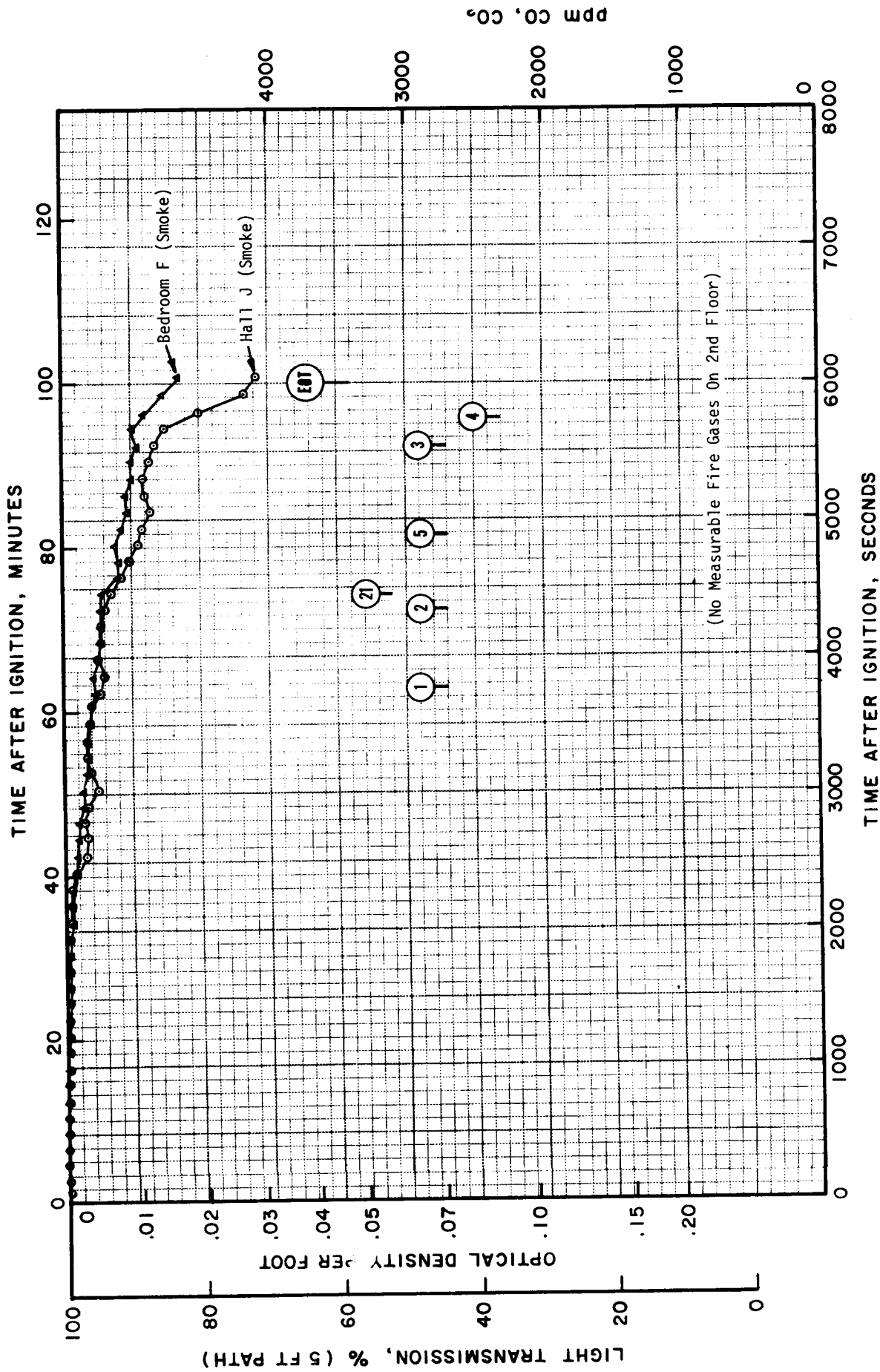
Temps 5' High, 3" From Wall, °F

Location	Initial	Final (or max.)
1st Bed "A"	69	98
1st Bed "B"	64	73.5
1st Hall "C"	65	72
2nd Bed "E"	67	70.5
2nd Bed "F"	66.5	70
2nd Hall "J"	67.5	73
Attic	67	65
Outdoors	59	56

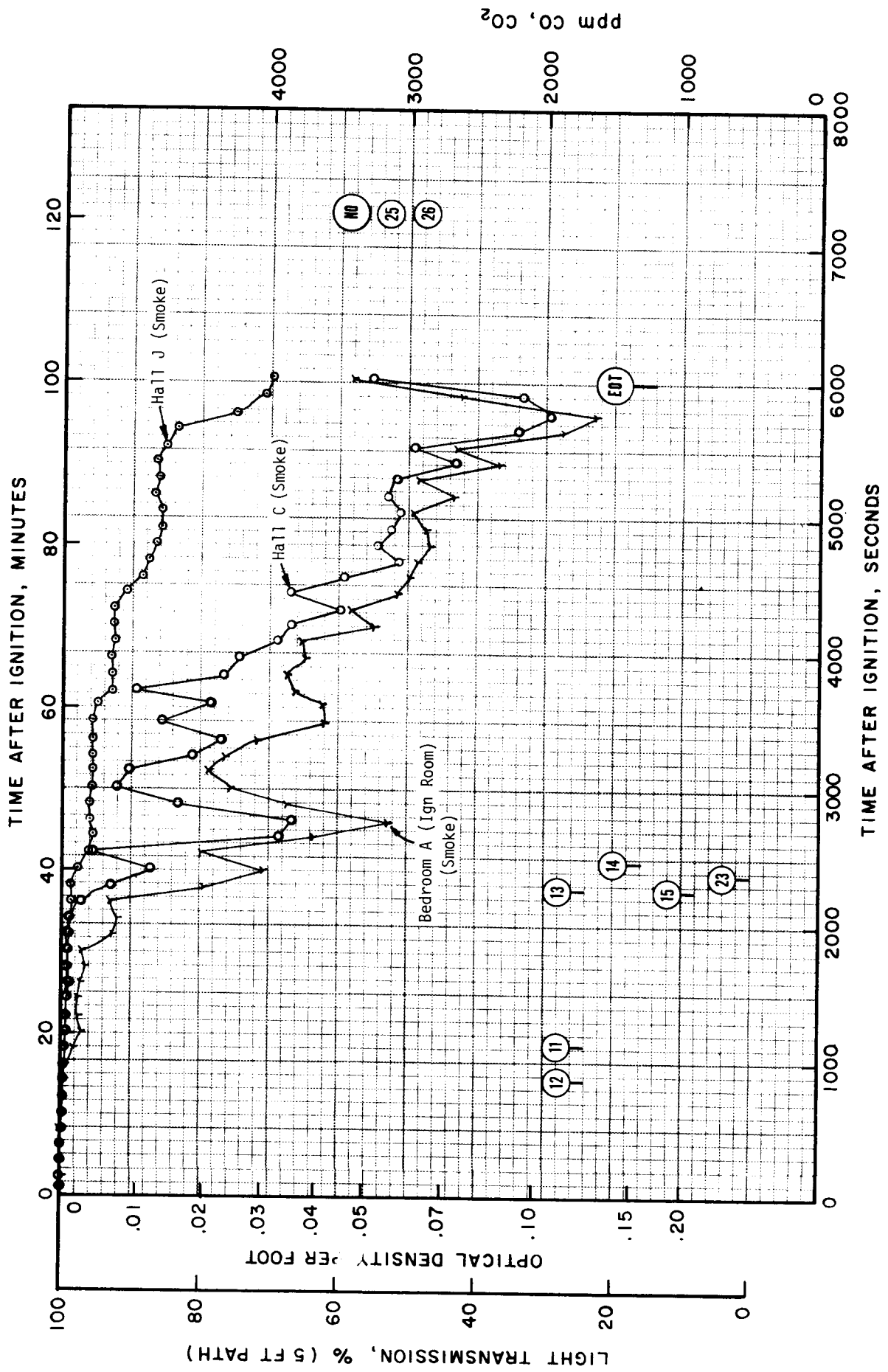
MAXIMUM TEMPERATURE PROFILES, JR-51



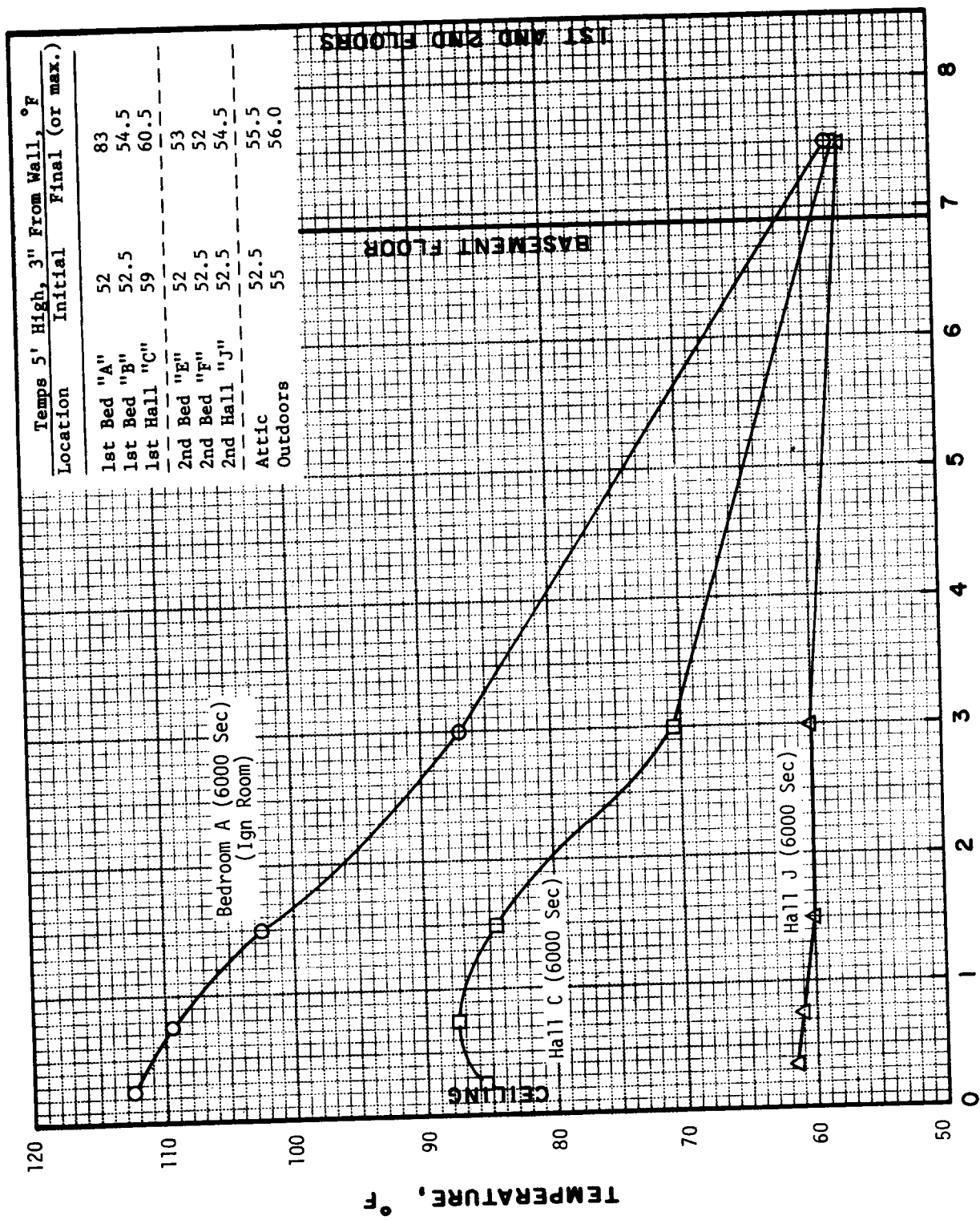
CONDITIONS ON 1ST FLOOR AT 5 FT, JR-52



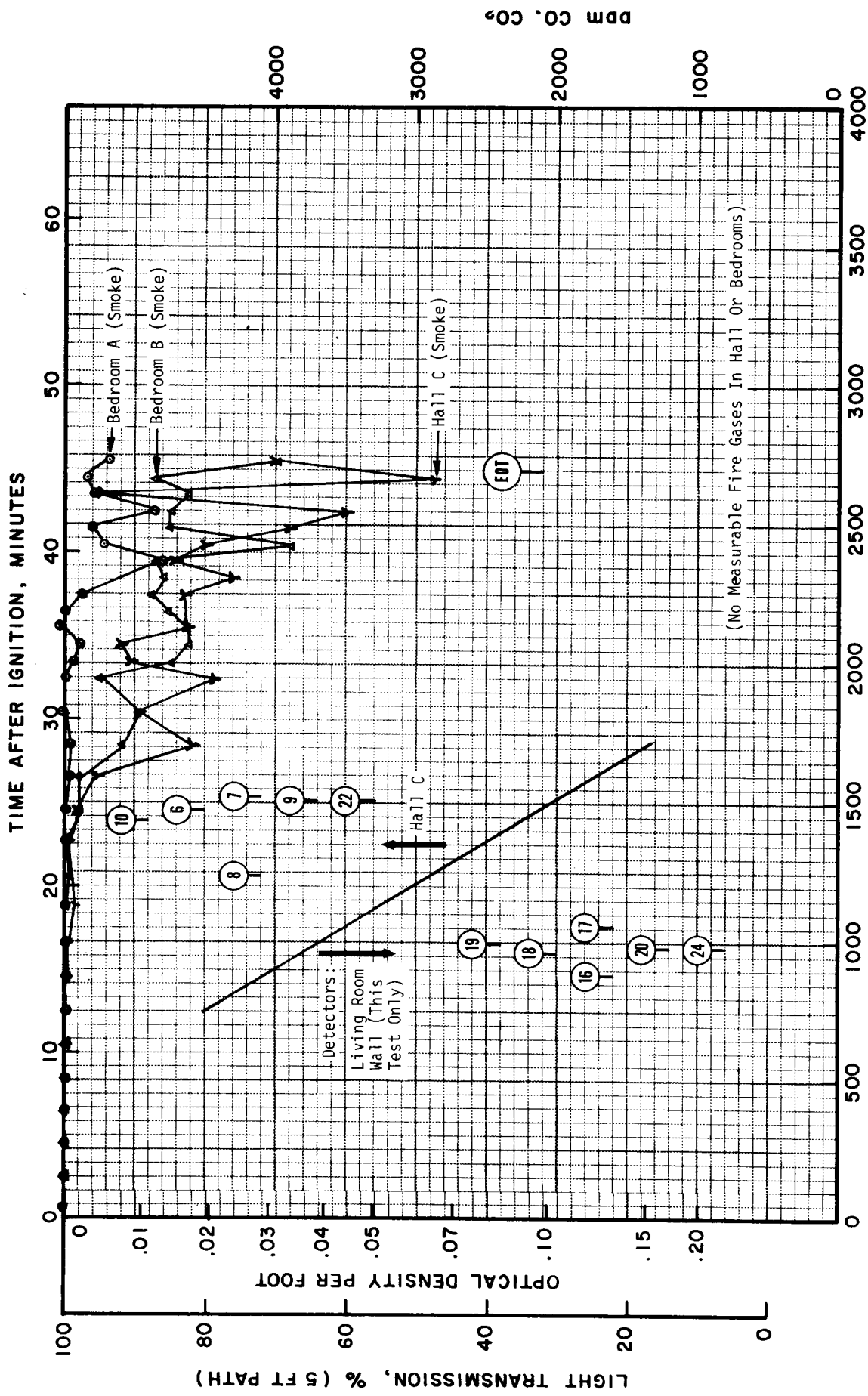
CONDITIONS ON 2ND FLOOR AT 5 FT, JR-52



VARIOUS CONDITIONS AT CEILING, JR-52

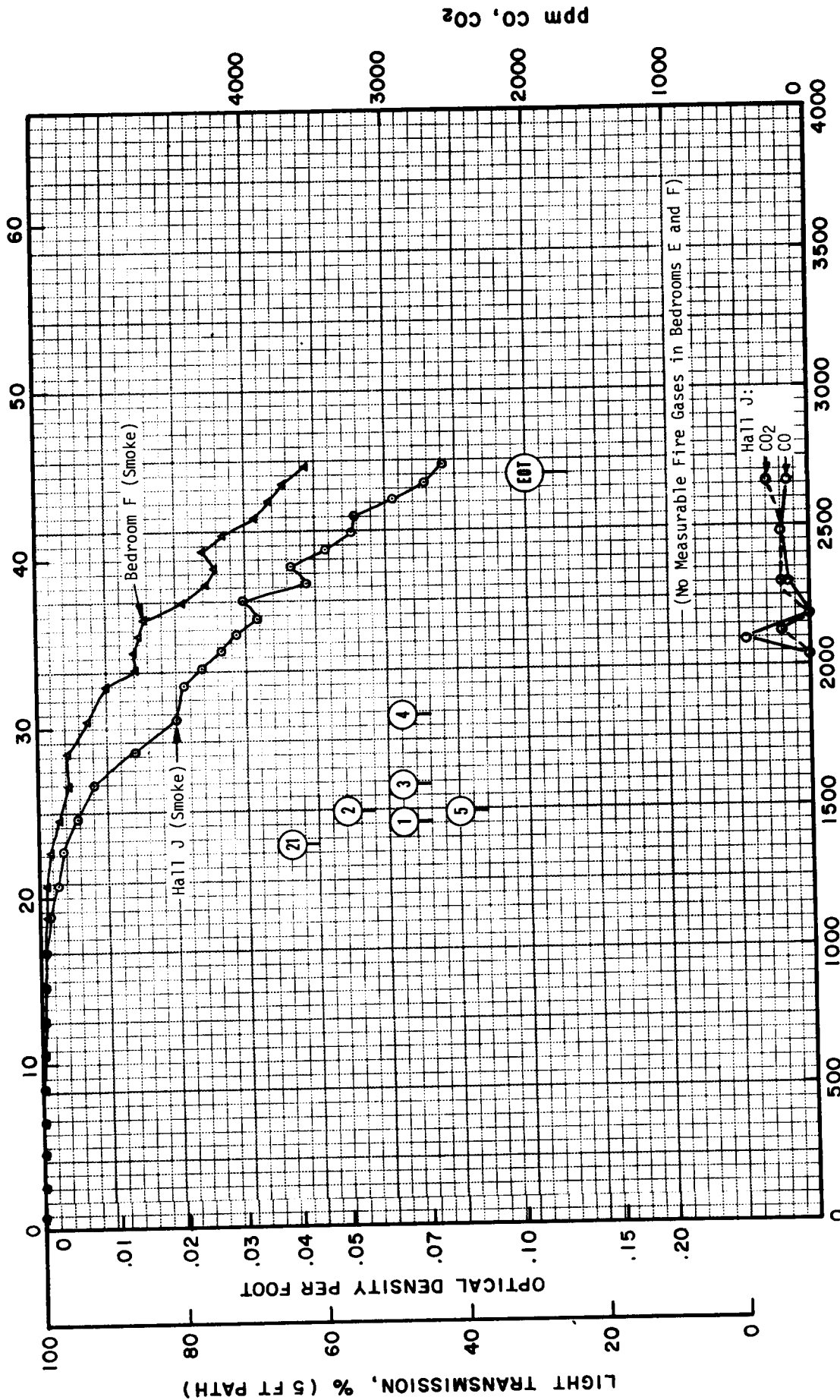


MAXIMUM TEMPERATURE PROFILES, JR-52



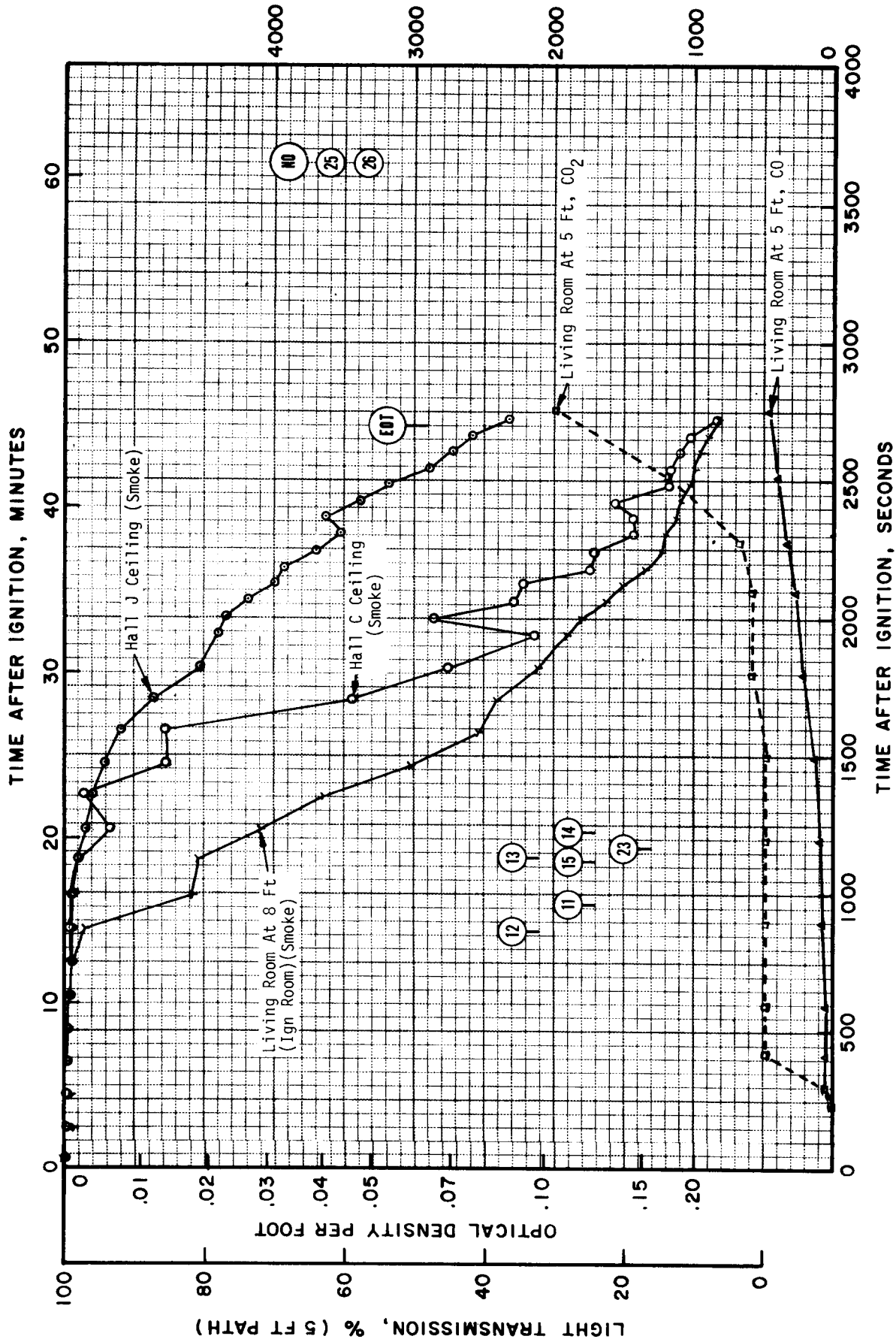
CONDITIONS ON 1ST FLOOR AT 5 FT, JR-53

TIME AFTER IGNITION, MINUTES

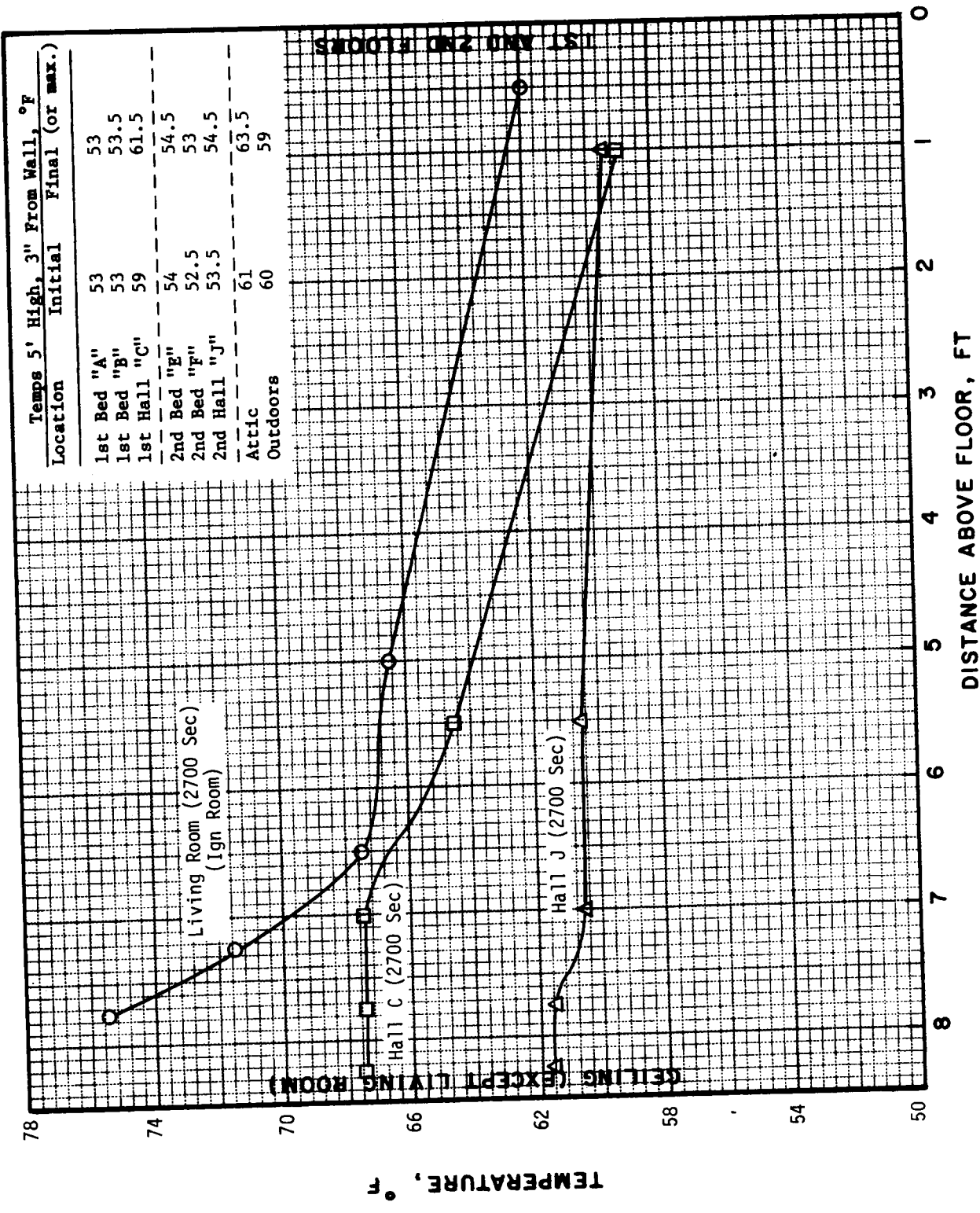


TIME AFTER IGNITION, SECONDS

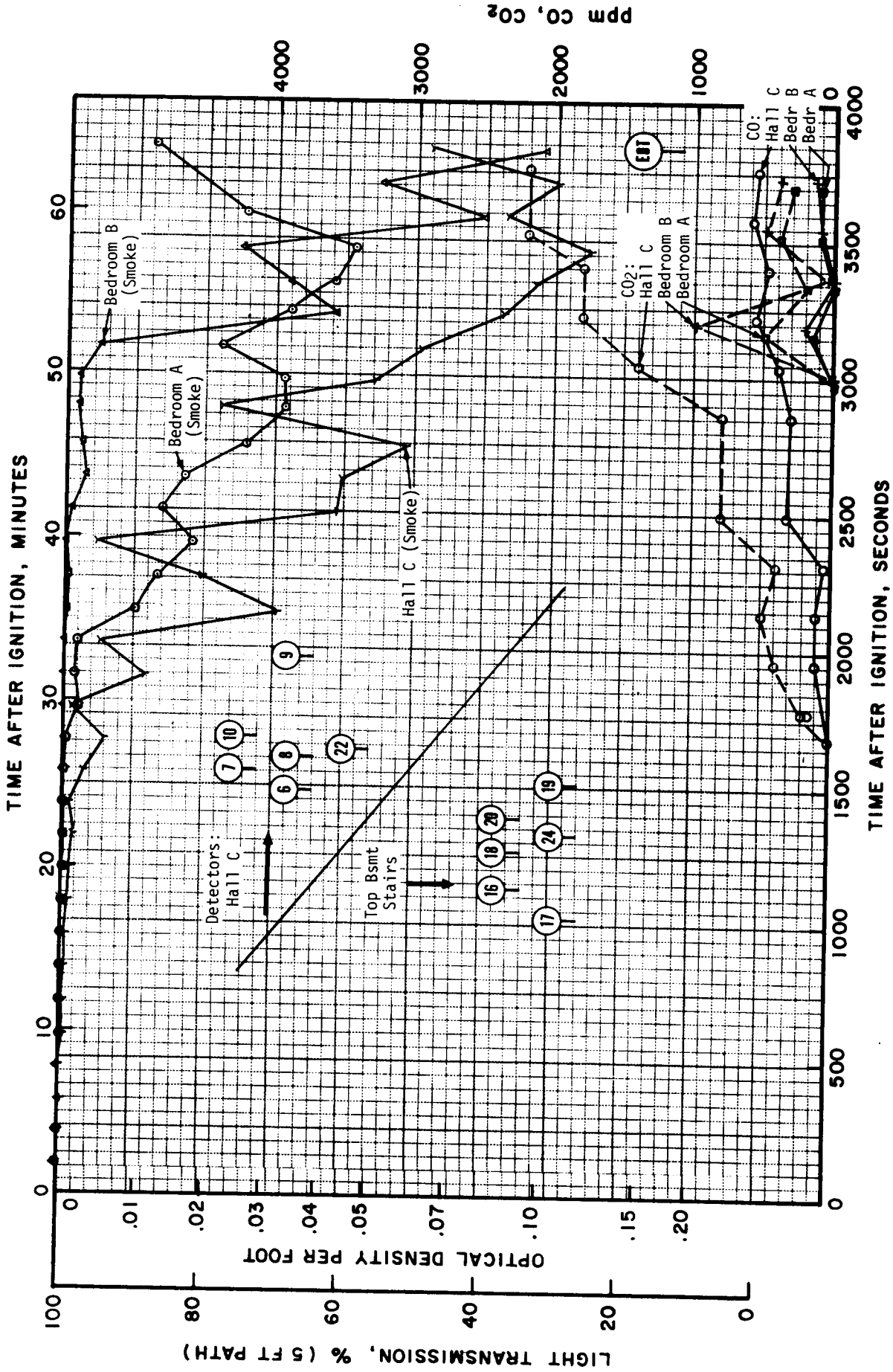
CONDITIONS ON 2ND FLOOR AT 5 FT, JR-53



VARIOUS CONDITIONS, JR-53

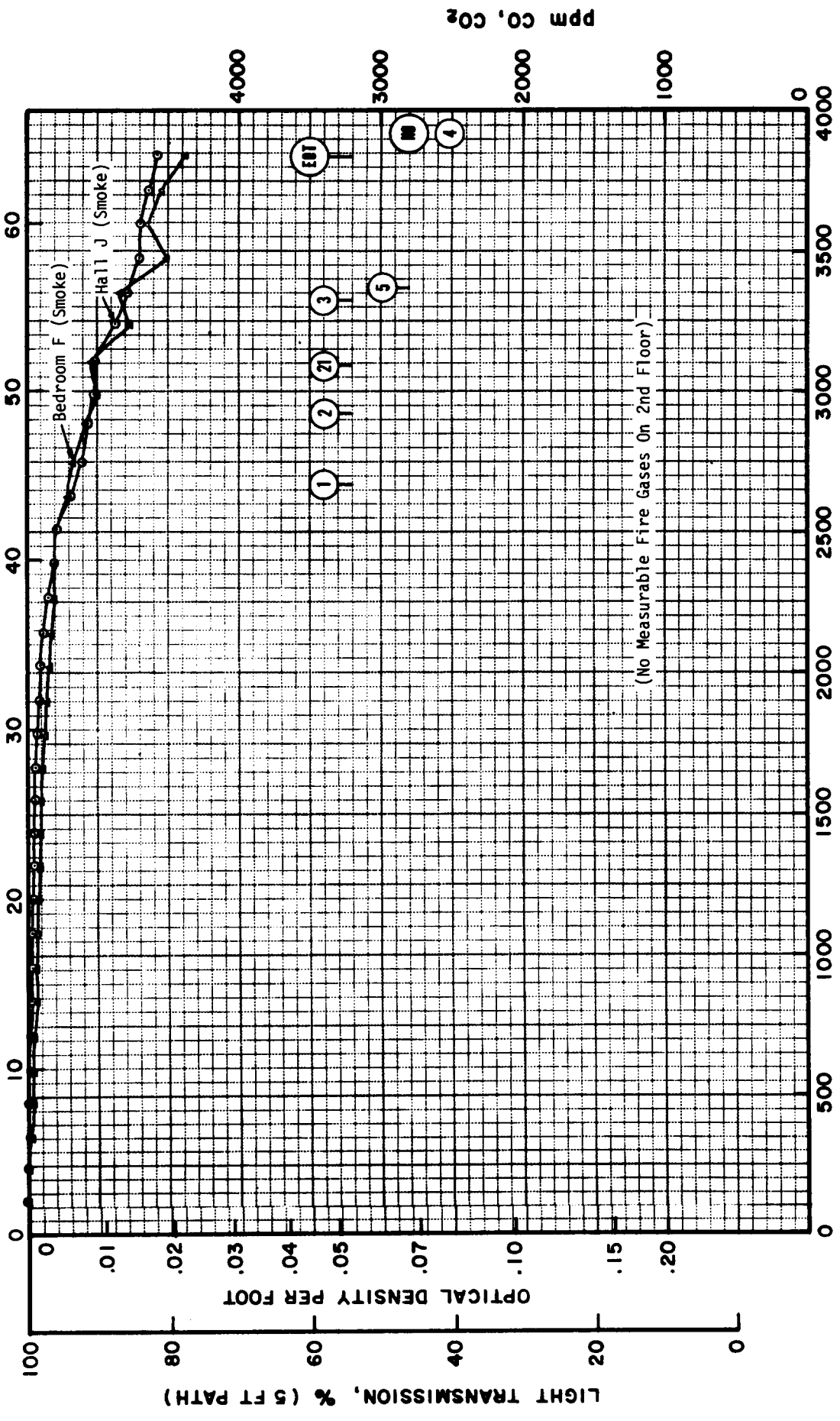


MAXIMUM TEMPERATURE PROFILES, JR-53



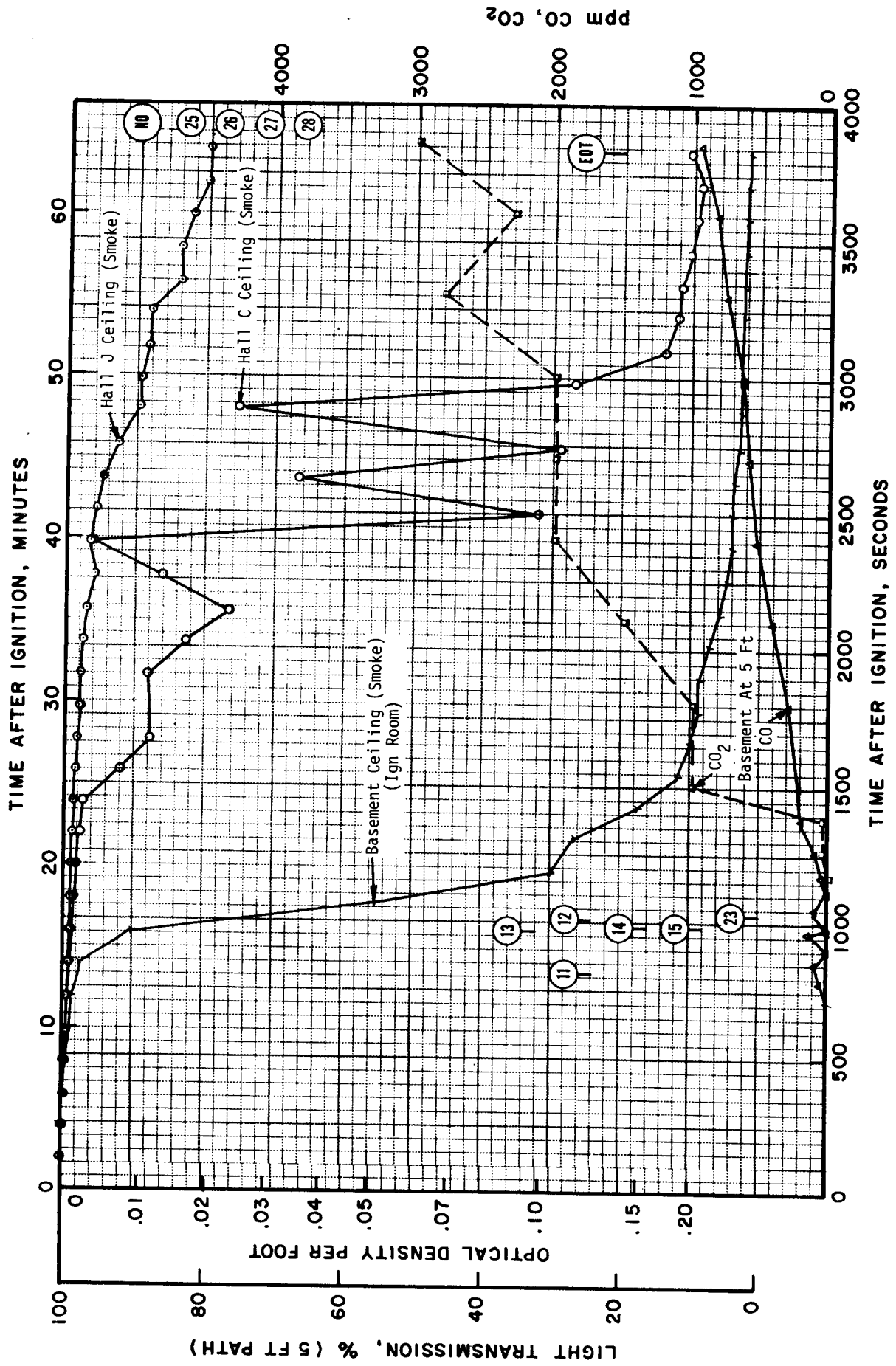
CONDITIONS ON 1ST FLOOR AT 5 FT, JR-54

TIME AFTER IGNITION, MINUTES

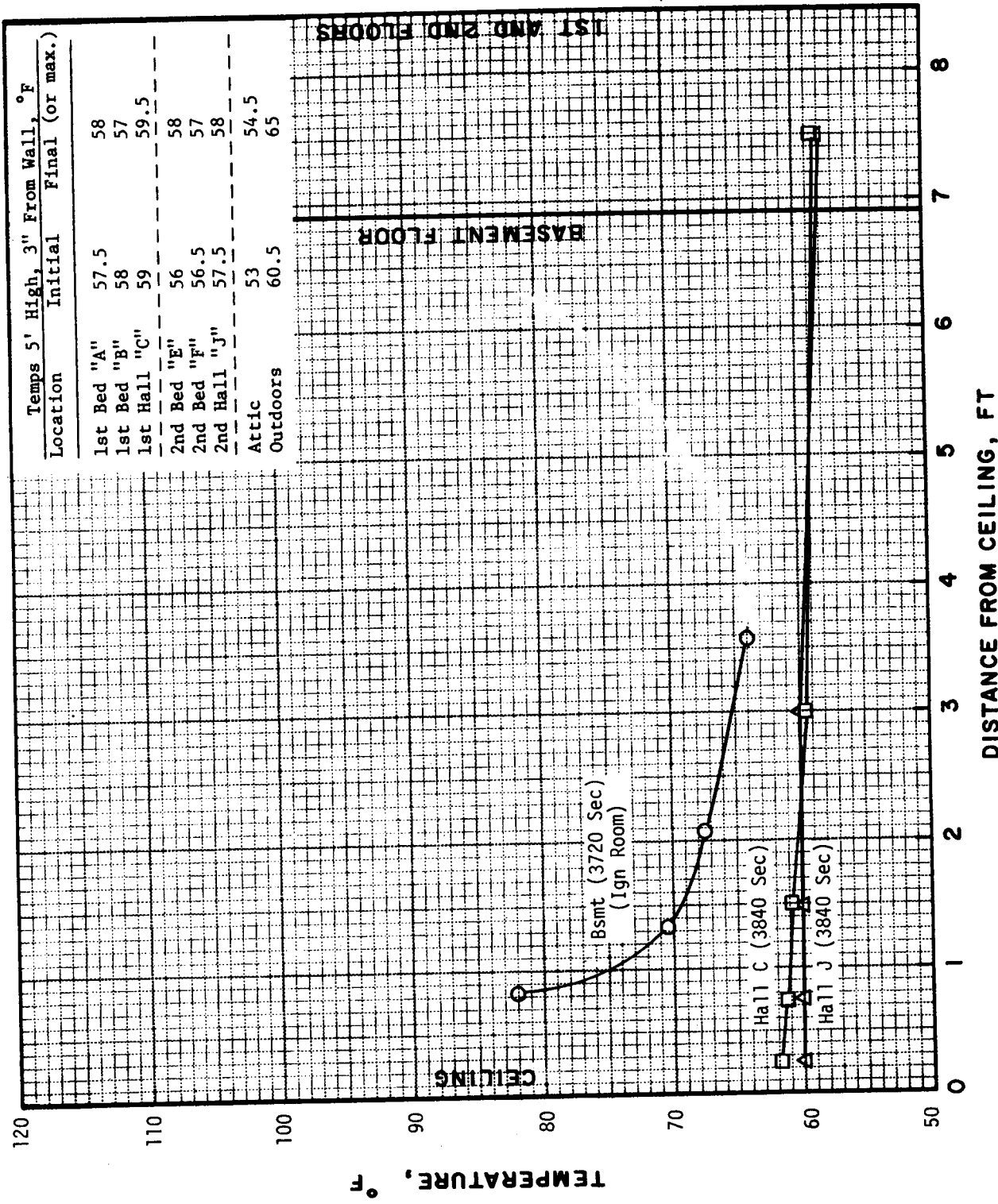


TIME AFTER IGNITION, SECONDS

CONDITIONS ON 2ND FLOOR AT 5 FT, JR-54



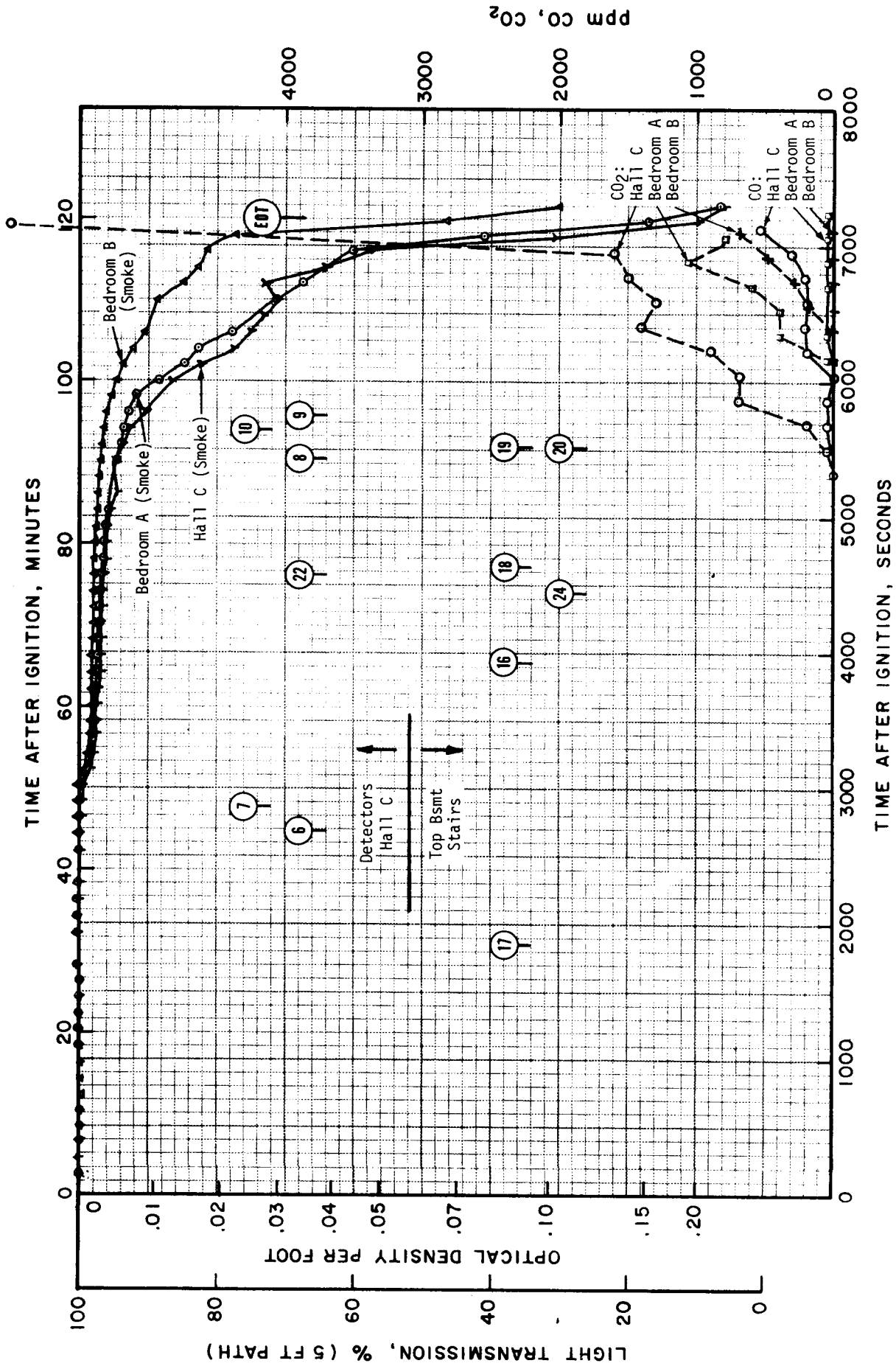
VARIOUS CONDITIONS, JR-54



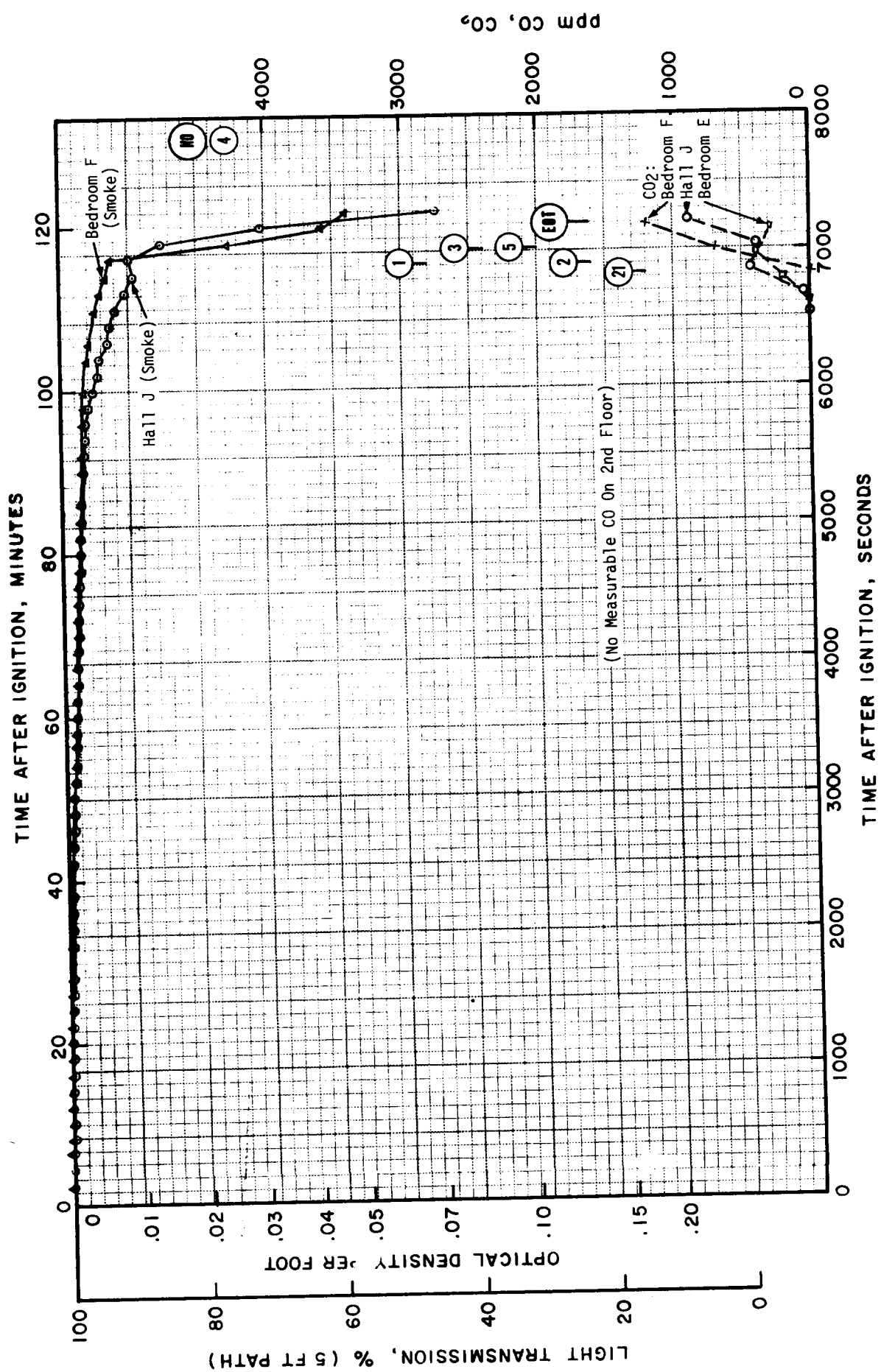
Temps 5' High, 3" From Wall, °F

Location	Initial	Final (or max.)
1st Bed "A"	57.5	58
1st Bed "B"	58	57
1st Hall "C"	59	59.5
2nd Bed "E"	56	58
2nd Bed "F"	56.5	57
2nd Hall "J"	57.5	58
Attic	53	54.5
Outdoors	60.5	65

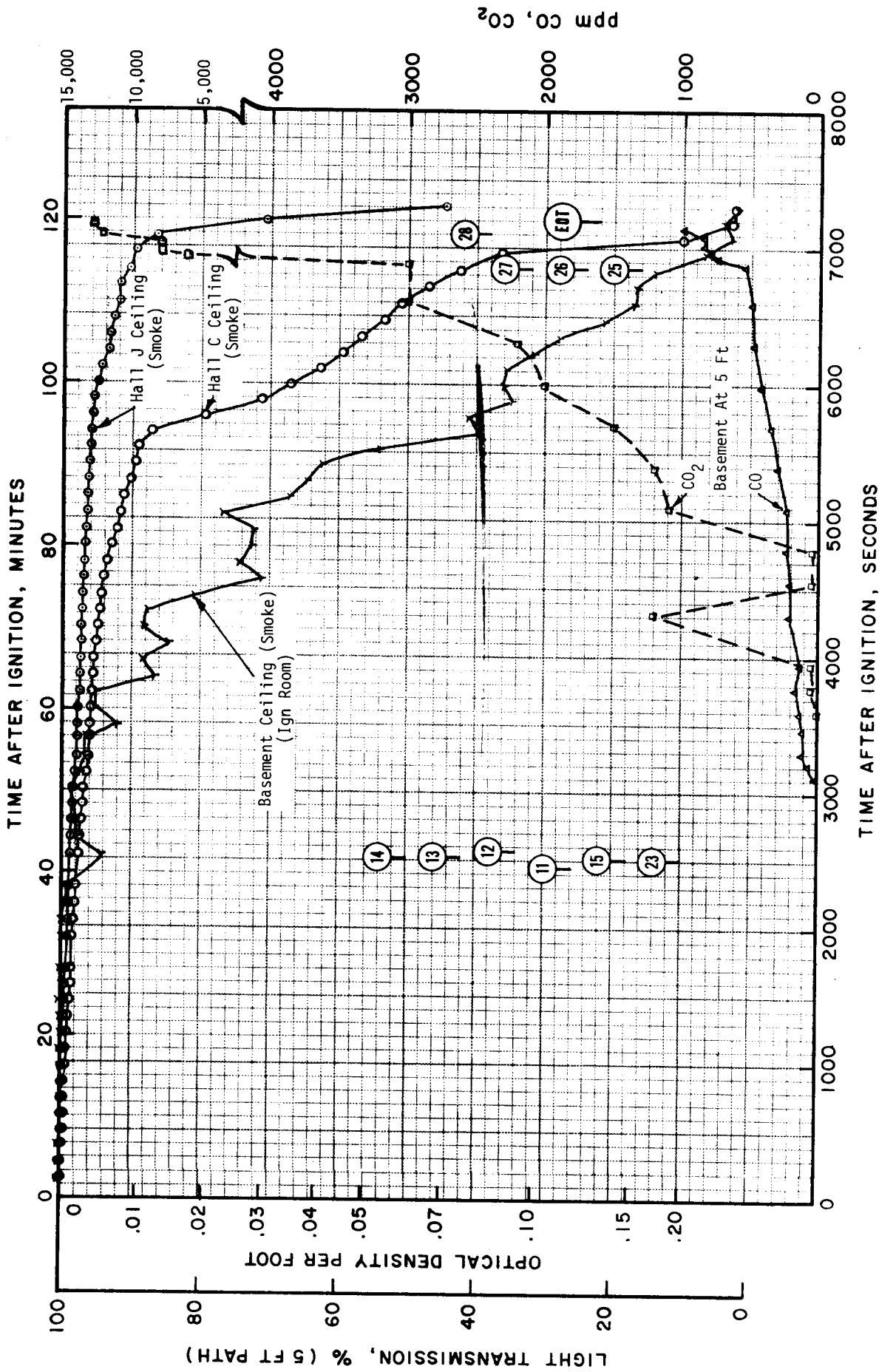
MAXIMUM TEMPERATURE PROFILES, JR-54



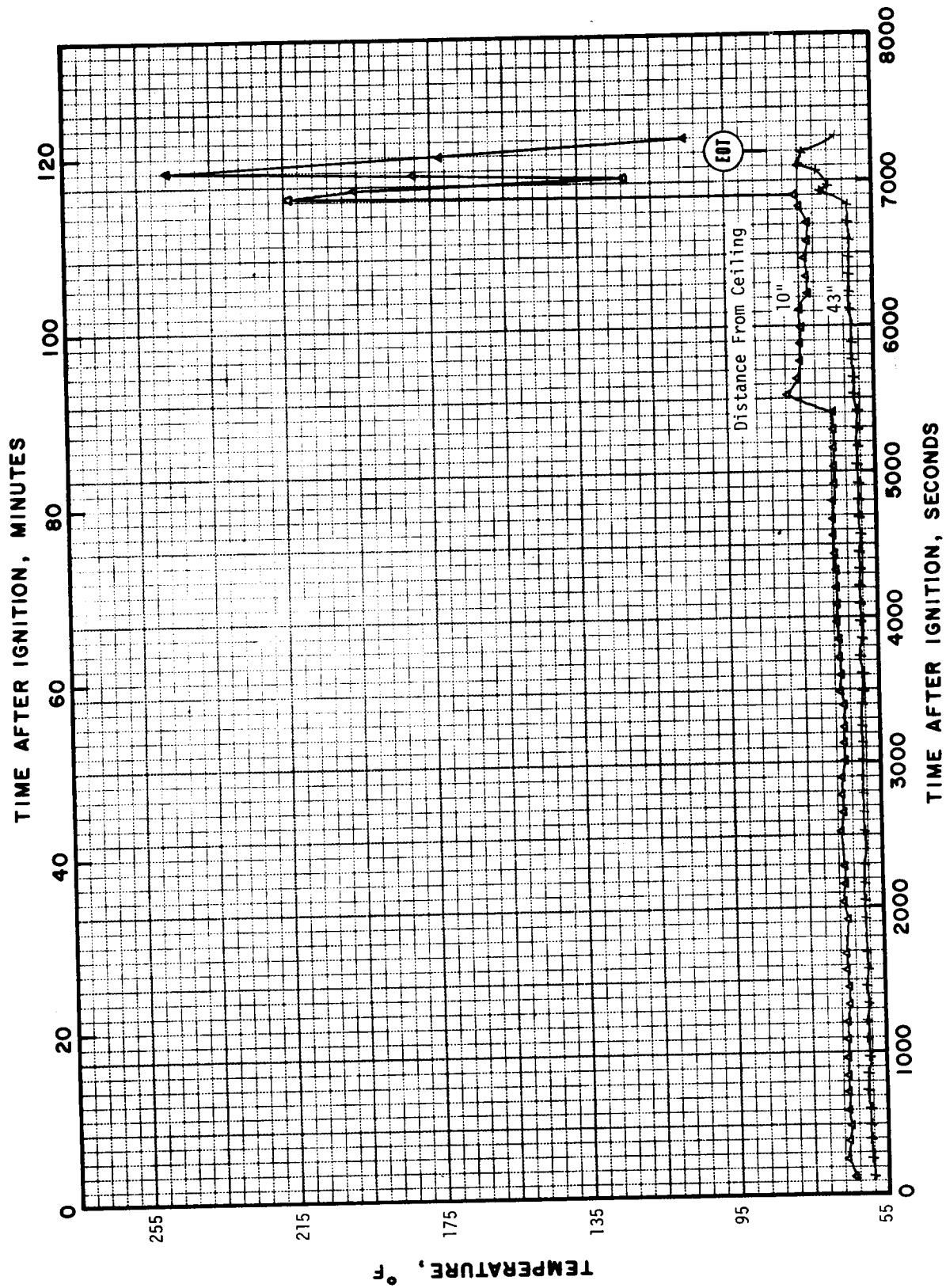
CONDITIONS ON 1ST FLOOR AT 5 FT. JR-56



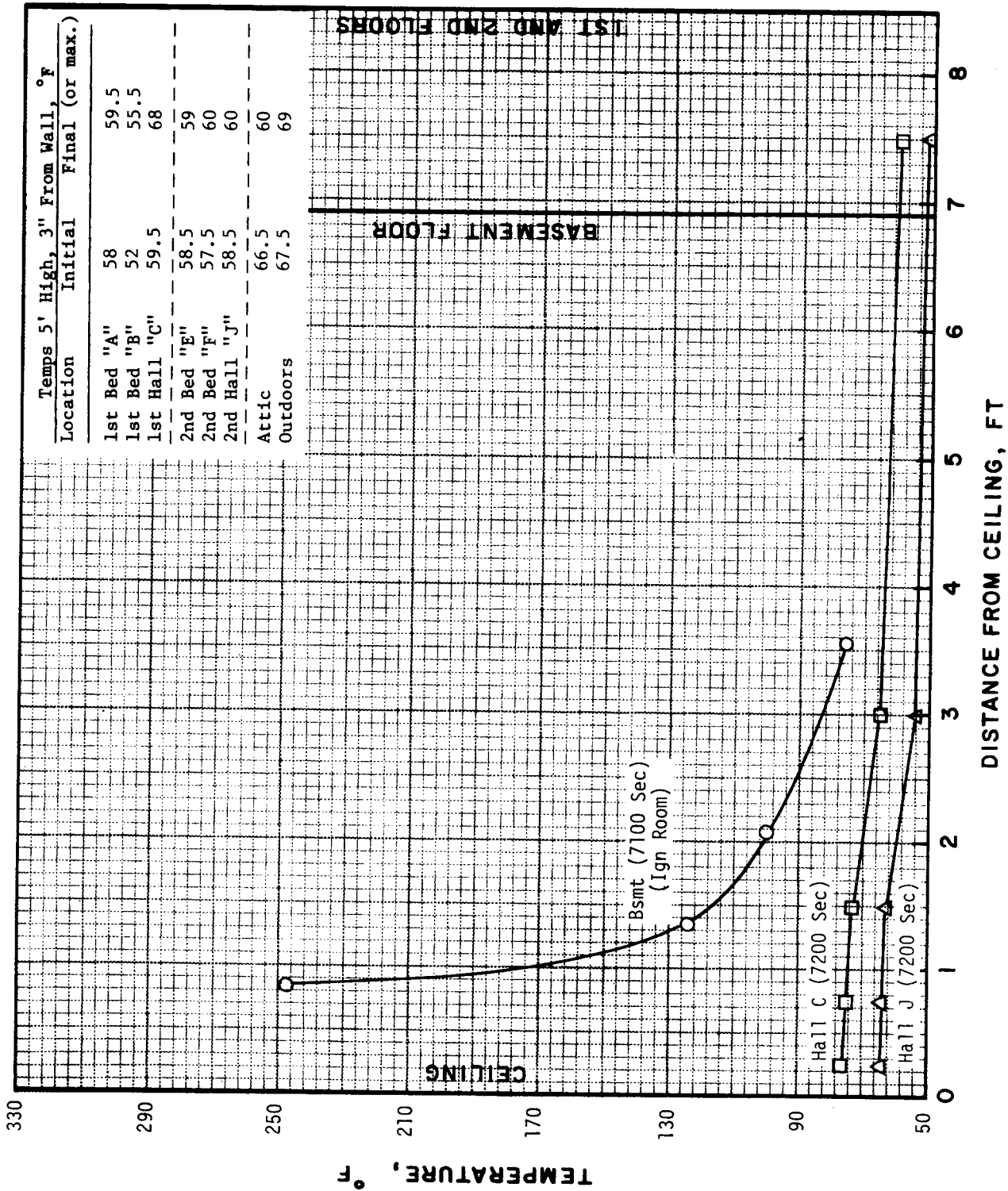
CONDITIONS ON 2ND FLOOR AT 5 FT, JR-56



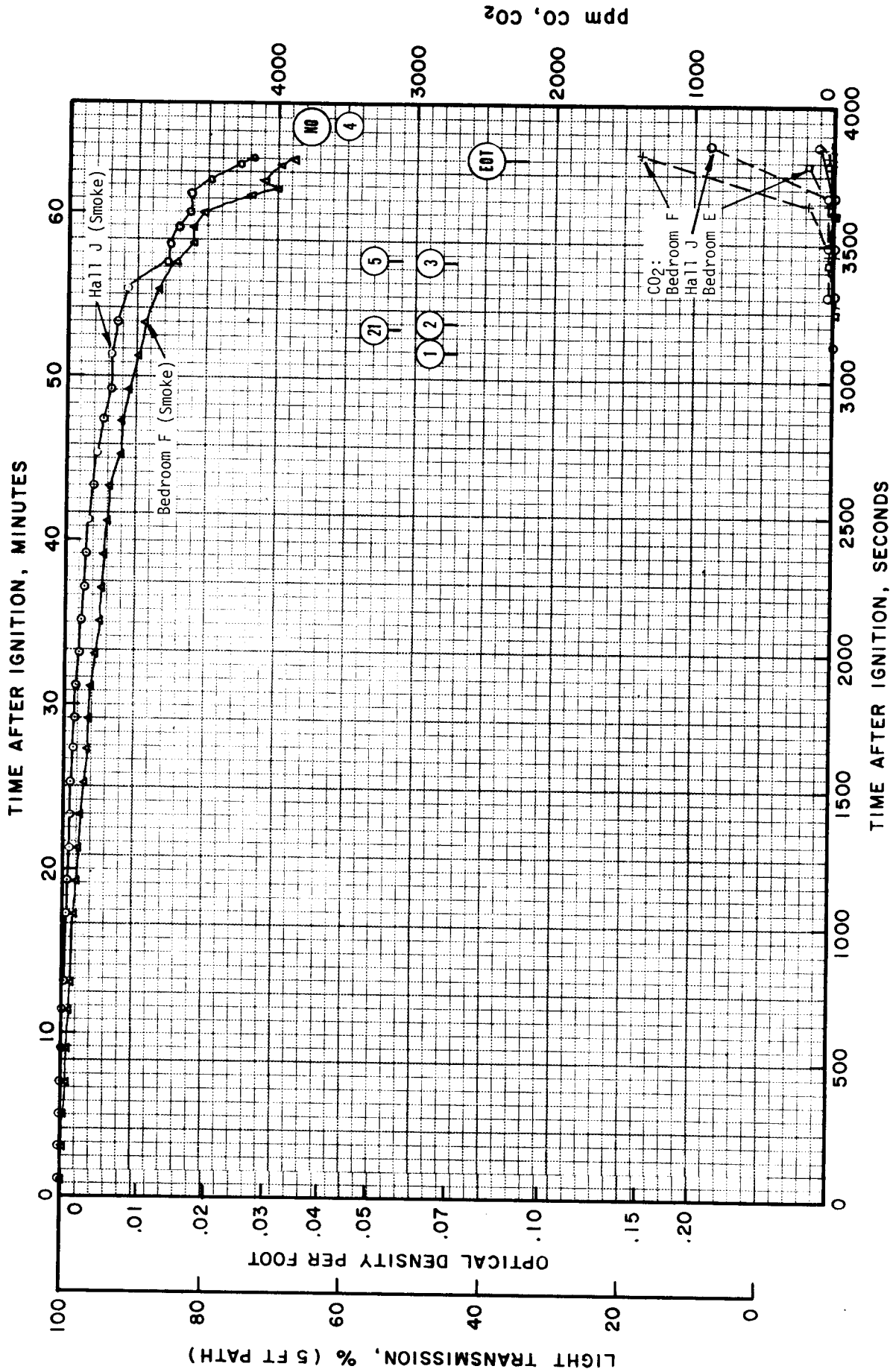
VARIOUS CONDITIONS, JR-56



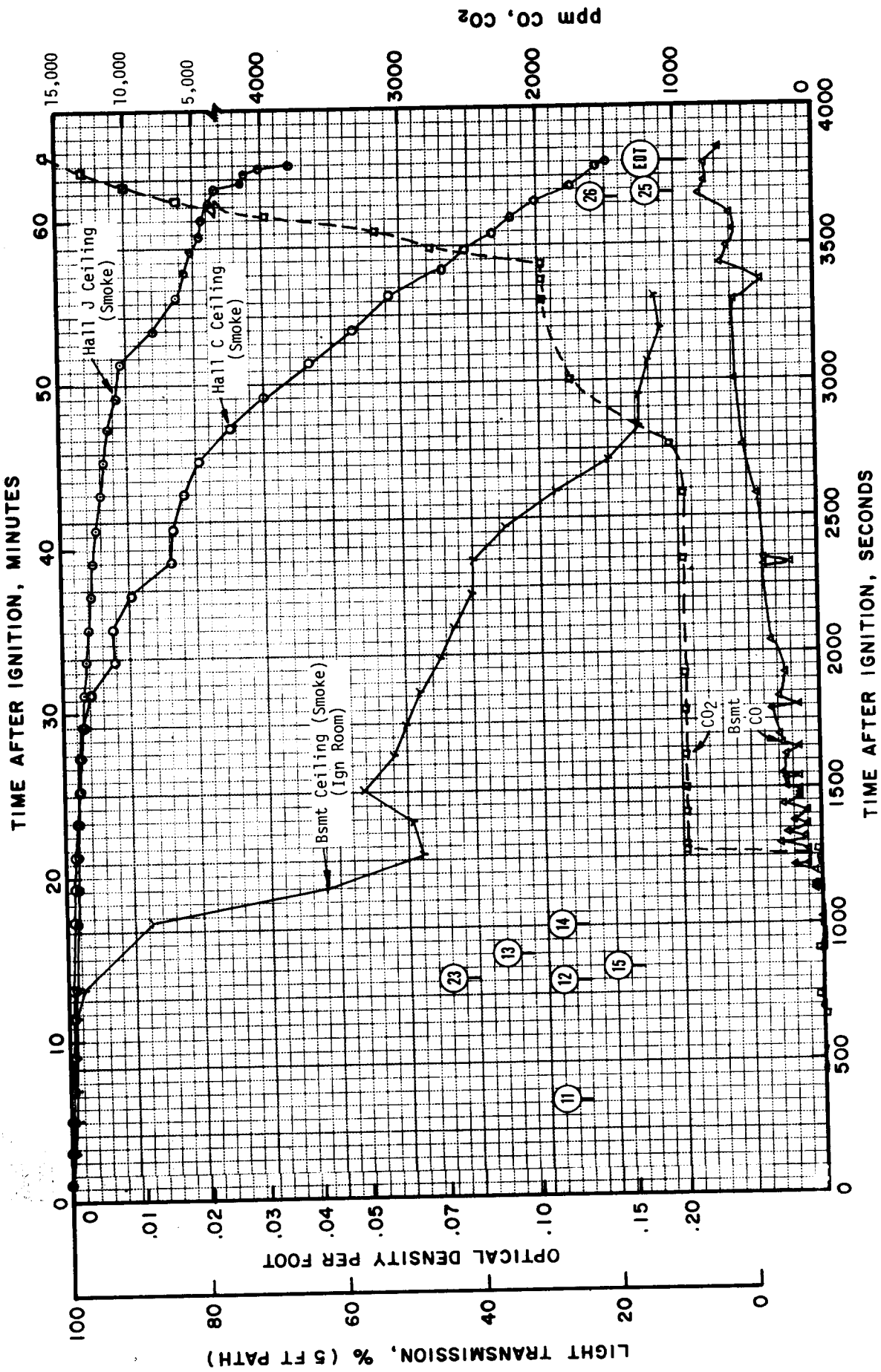
TEMPERATURES IN BASEMENT (IGNITION ROOM), JR-56



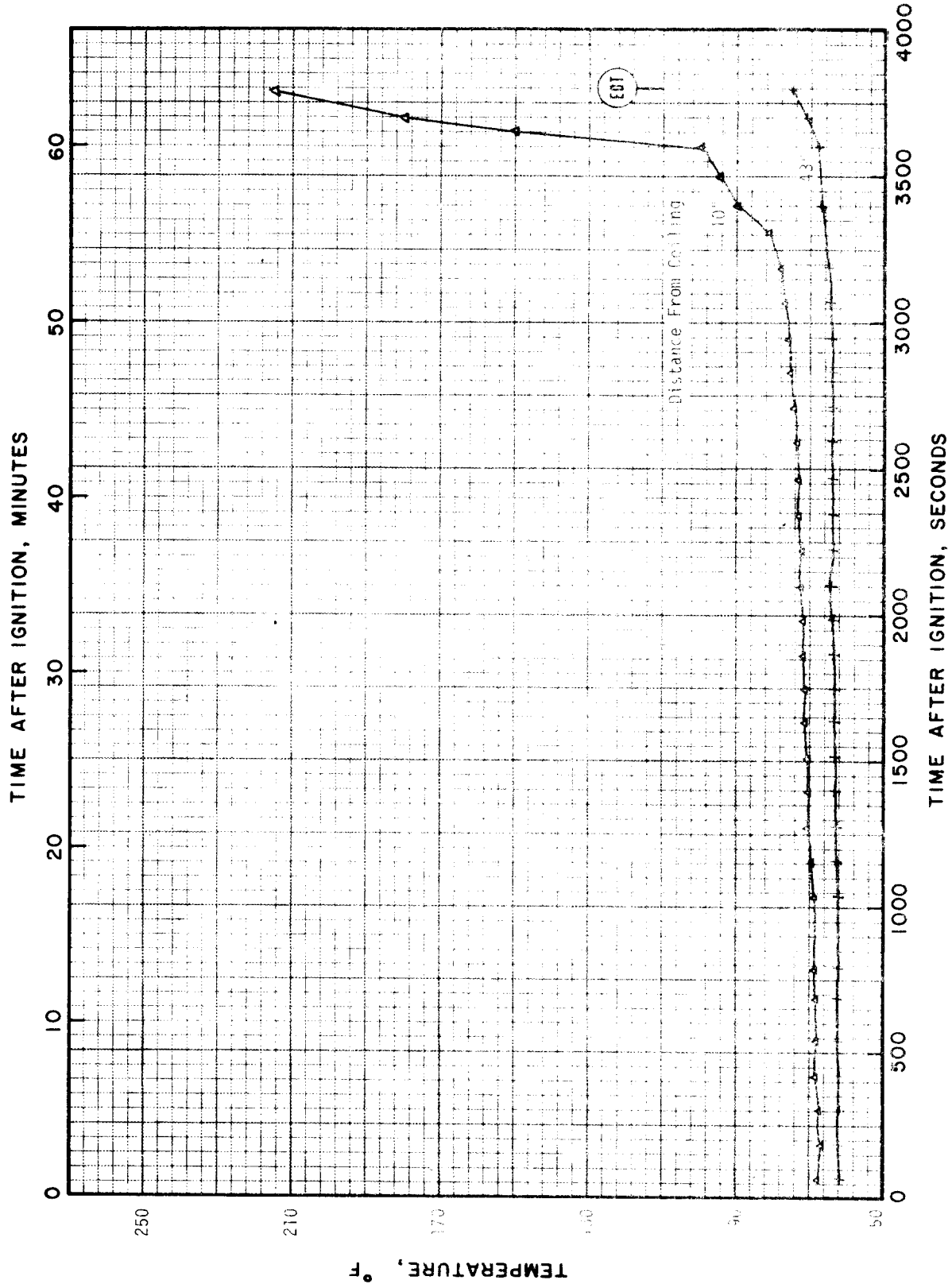
MAXIMUM TEMPERATURE PROFILES, JR-56



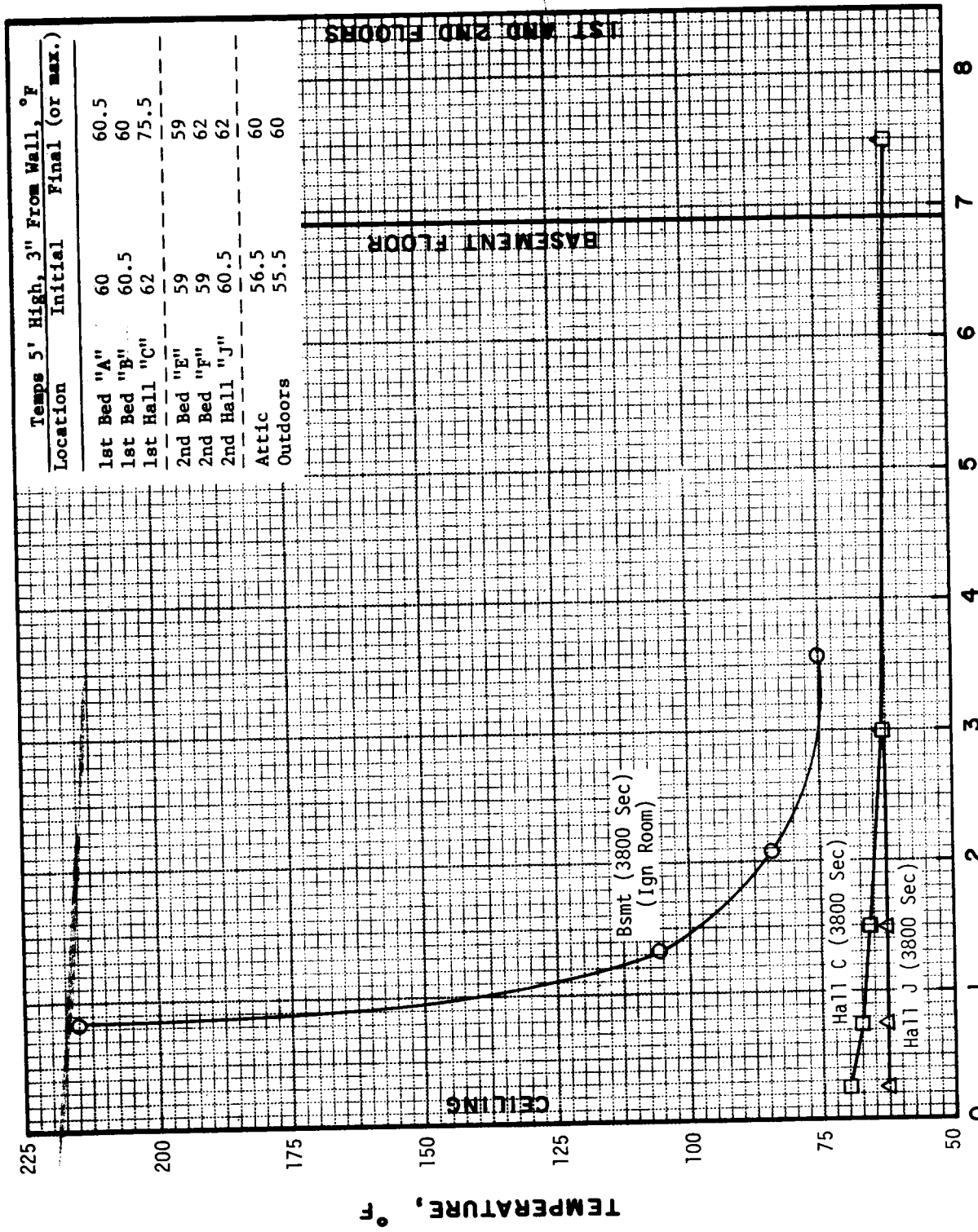
CONDITIONS ON 2ND FLOOR AT 5 FT, JR-57



VARIOUS CONDITIONS, JR-57



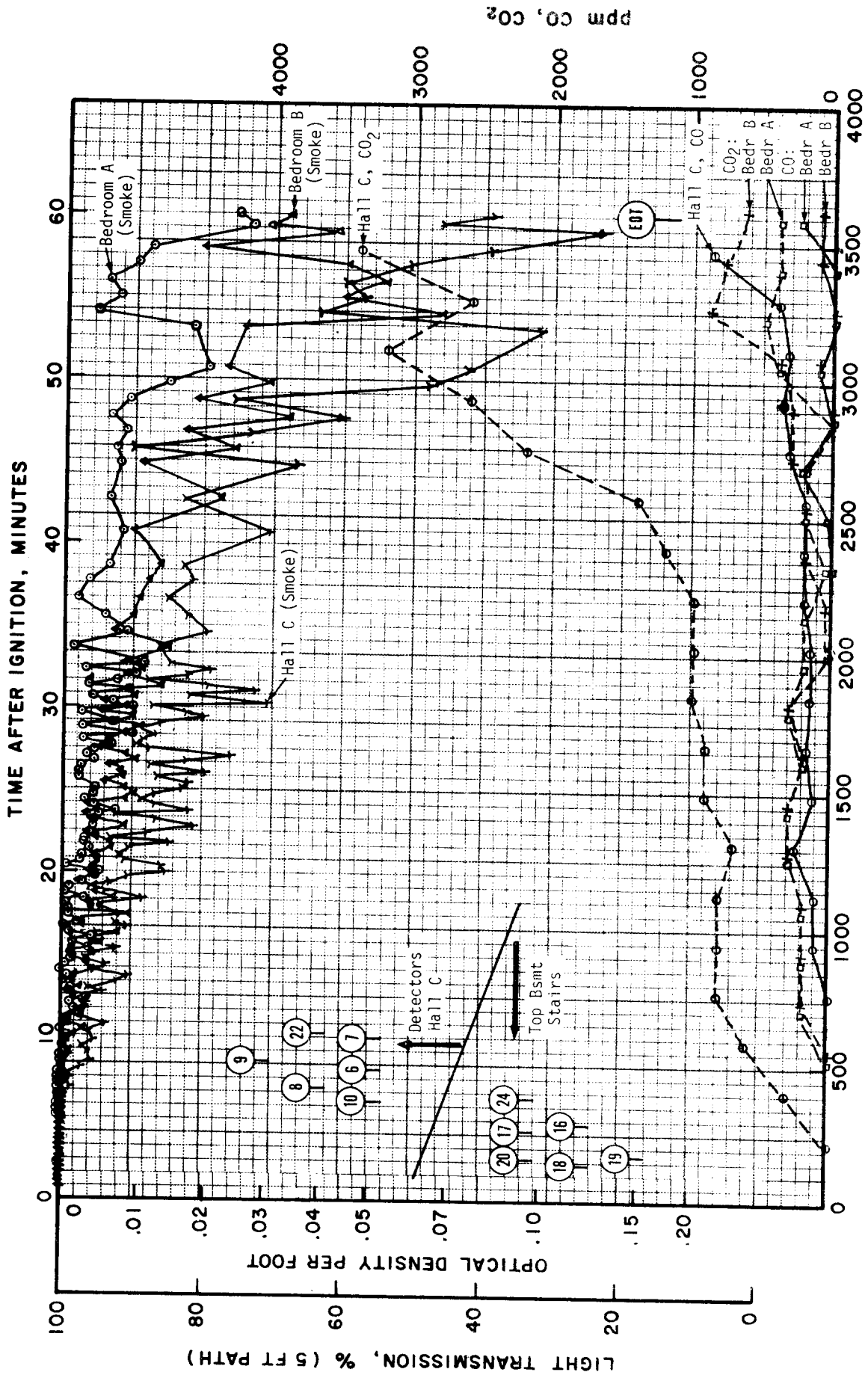
TEMPERATURES IN BASEMENT (IGNITION ROOM), JR-57



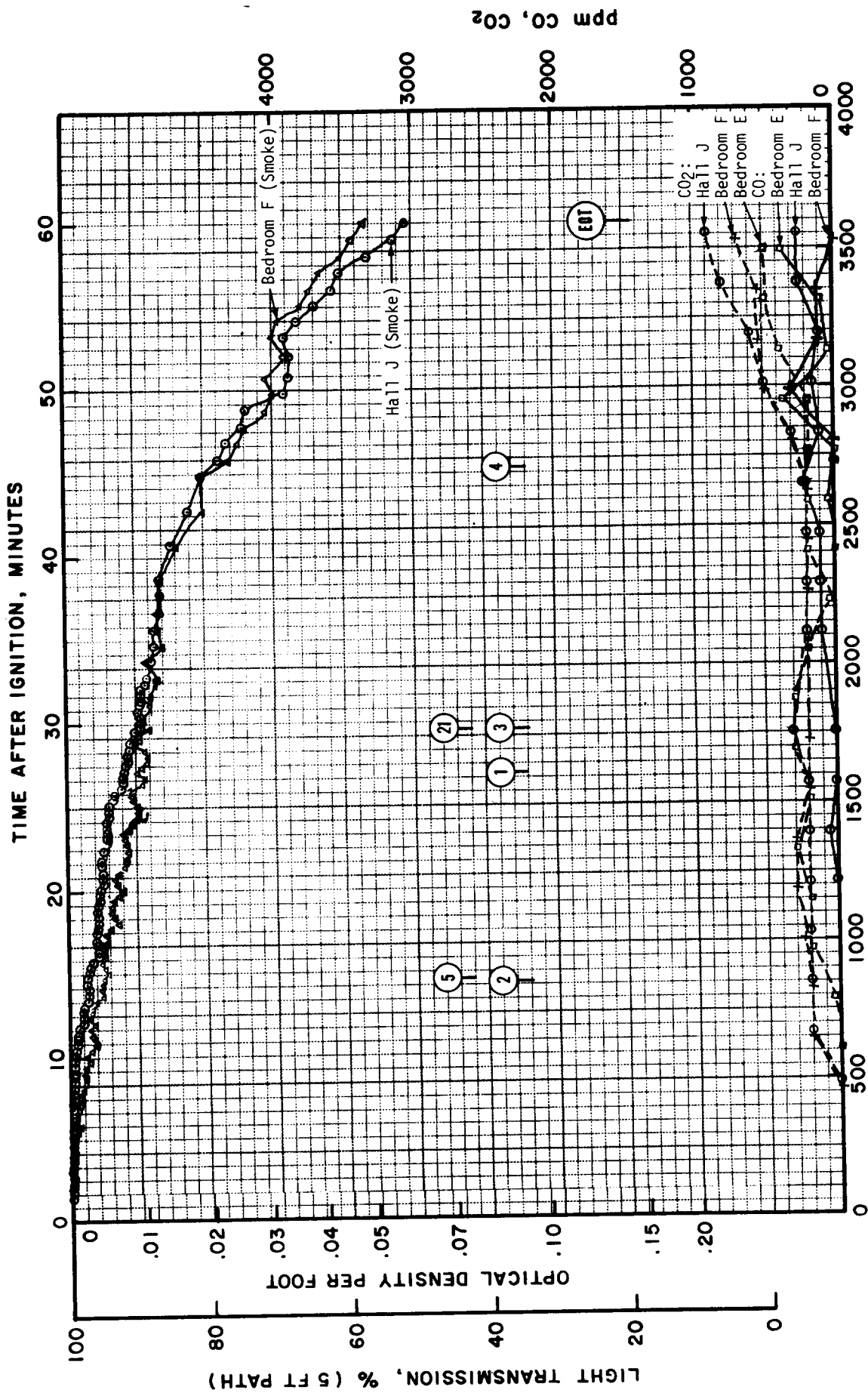
Temps 5' High, 3" From Wall, °F		
Location	Initial	Final (or max.)
1st Bed "A"	60	60.5
1st Bed "B"	60.5	60
1st Hall "C"	62	75.5
2nd Bed "E"	59	59
2nd Bed "F"	59	62
2nd Hall "J"	60.5	62
Attic	56.5	60
Outdoors	55.5	60

DISTANCE FROM CEILING, FT

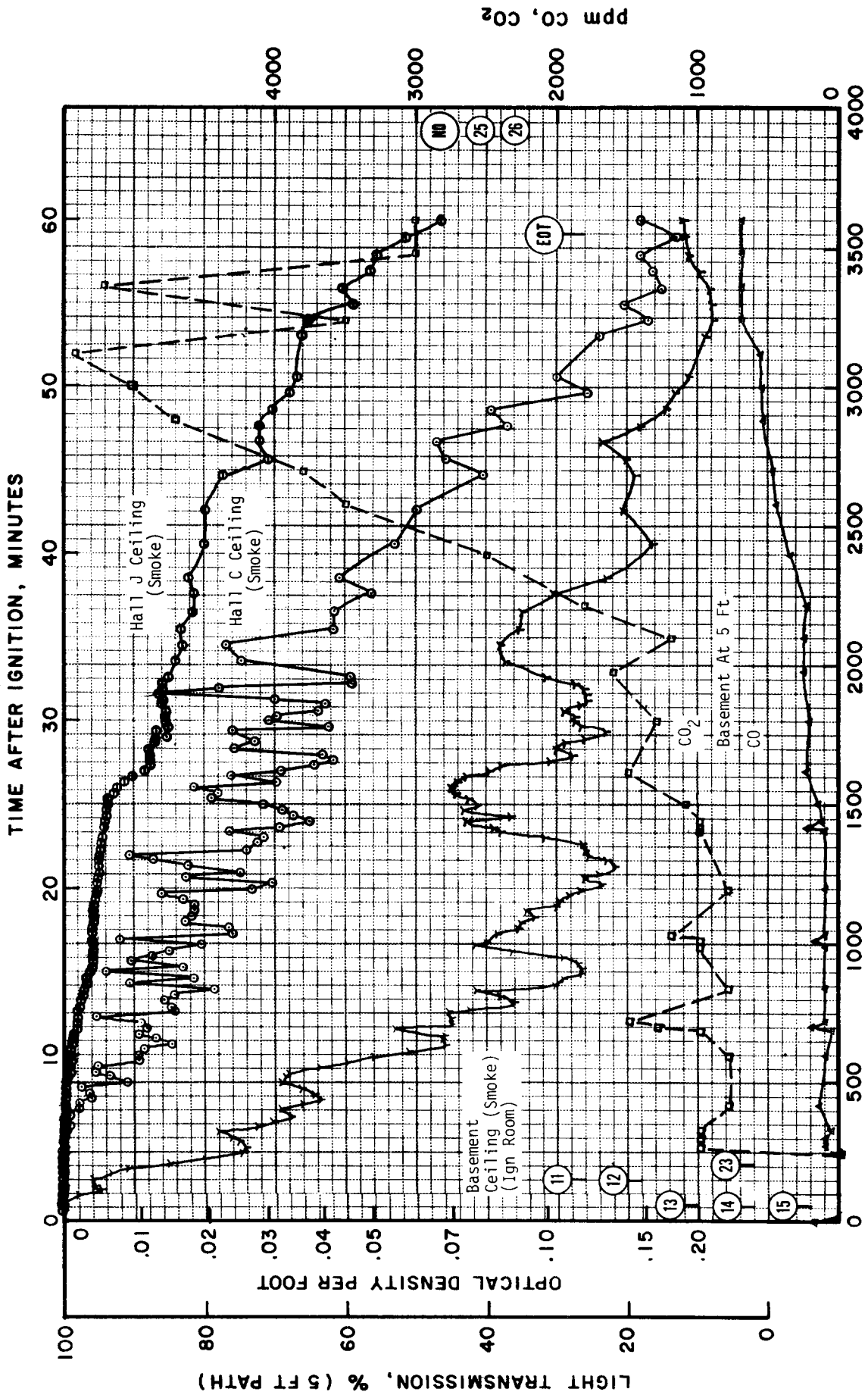
MAXIMUM TEMPERATURE PROFILES, JR-57



CONDITIONS ON 1ST FLOOR AT 5 FT, JR-58

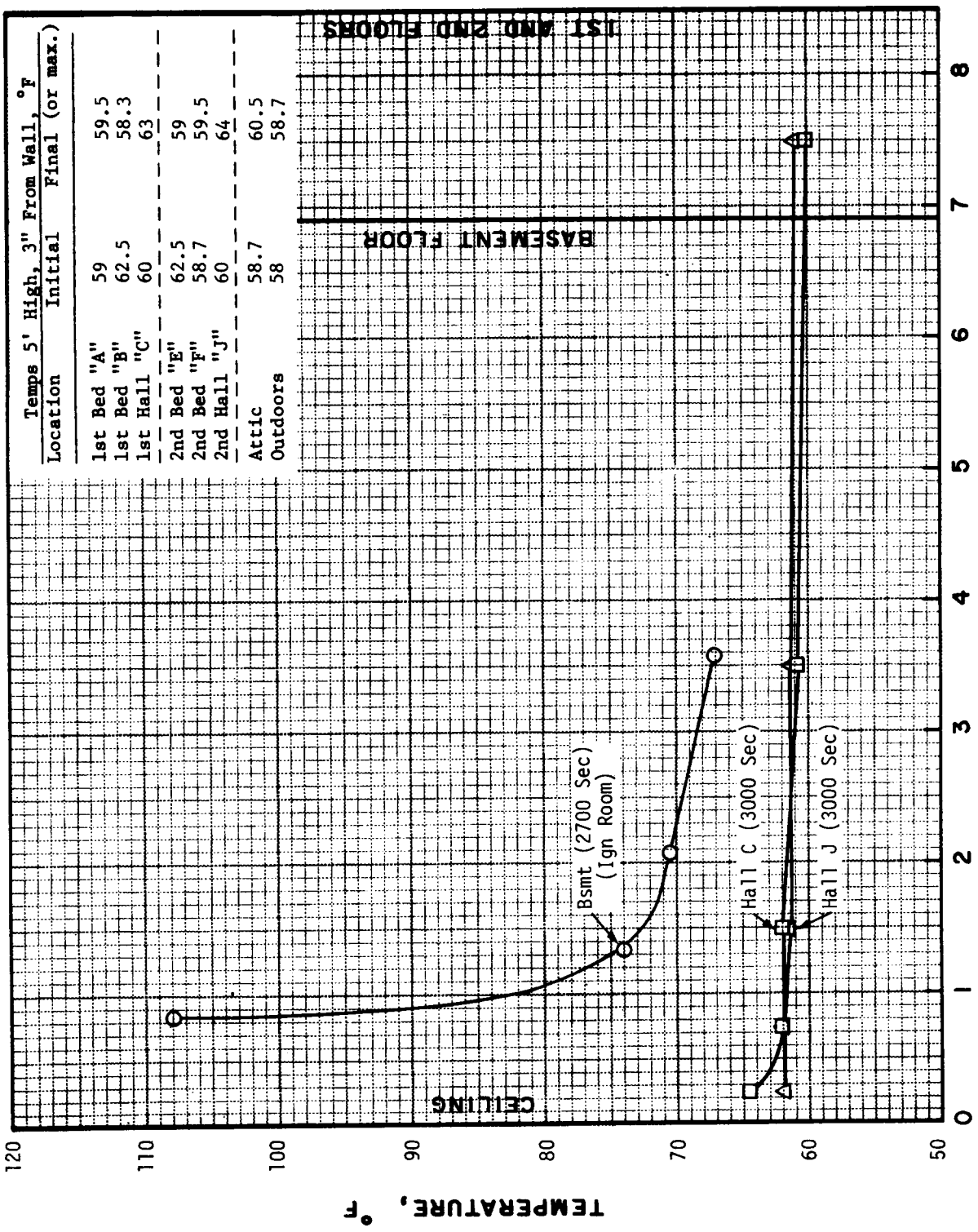


TIME AFTER IGNITION, SECONDS
 CONDITIONS ON 2ND FLOOR AT 5 FT., JR-58



VARIOUS CONDITIONS, JR-58

VARIOUS CONDITIONS, JR-58



CEILING

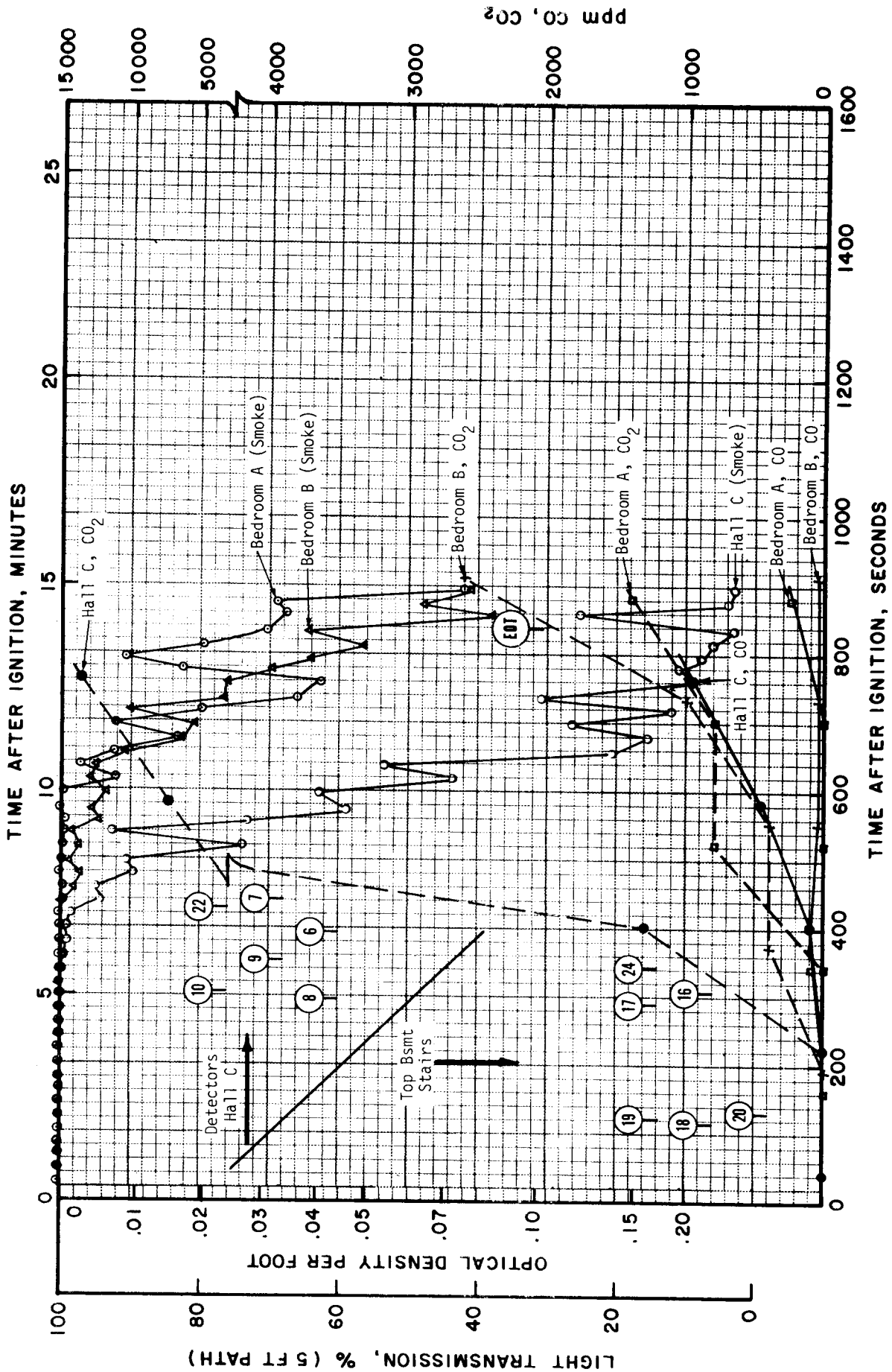
BASMENT FLOOR

1ST AND 2ND FLOORS

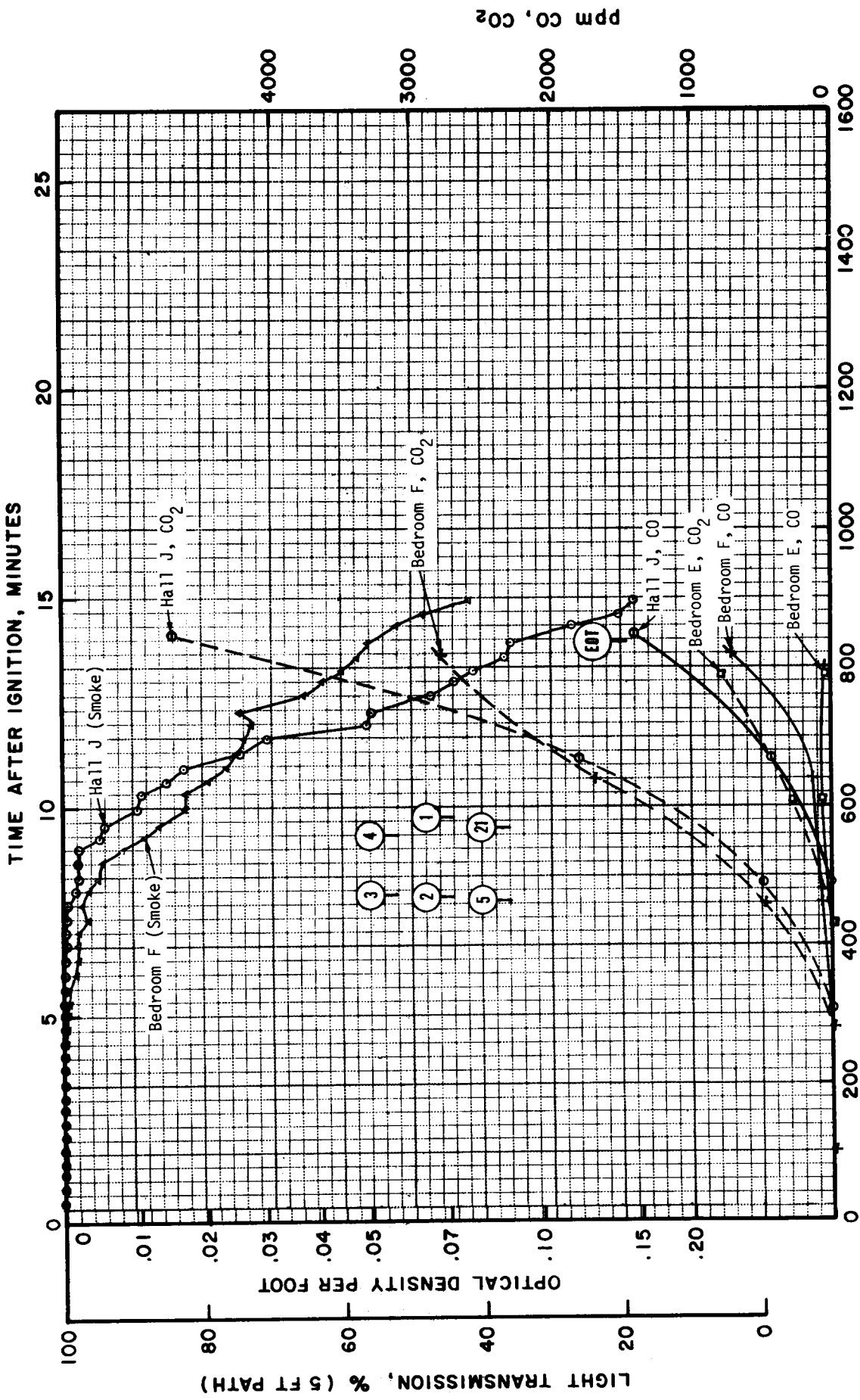
TEMPERATURE, °F

DISTANCE FROM CEILING, FT

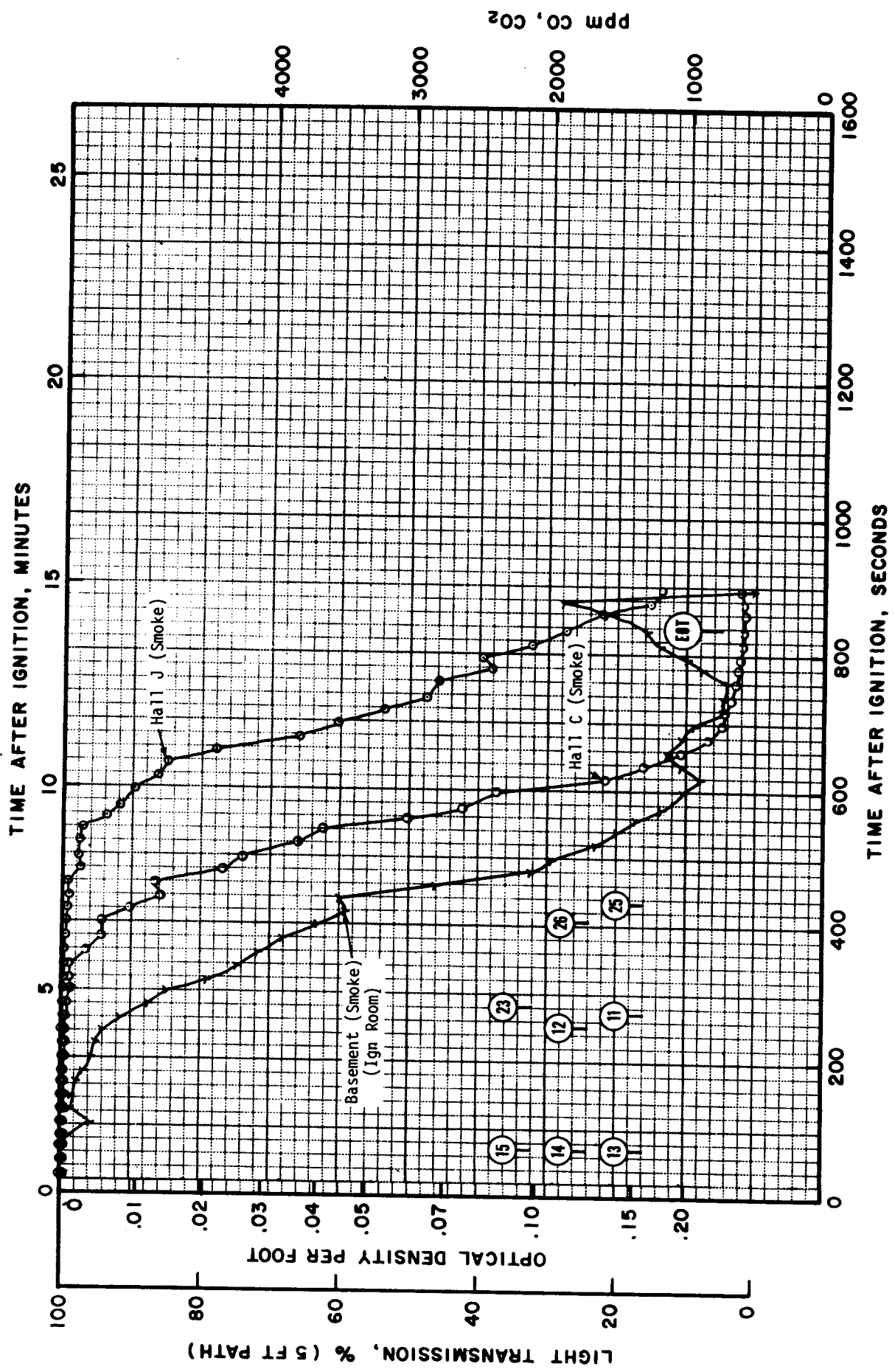
MAXIMUM TEMPERATURE PROFILES, JR-58



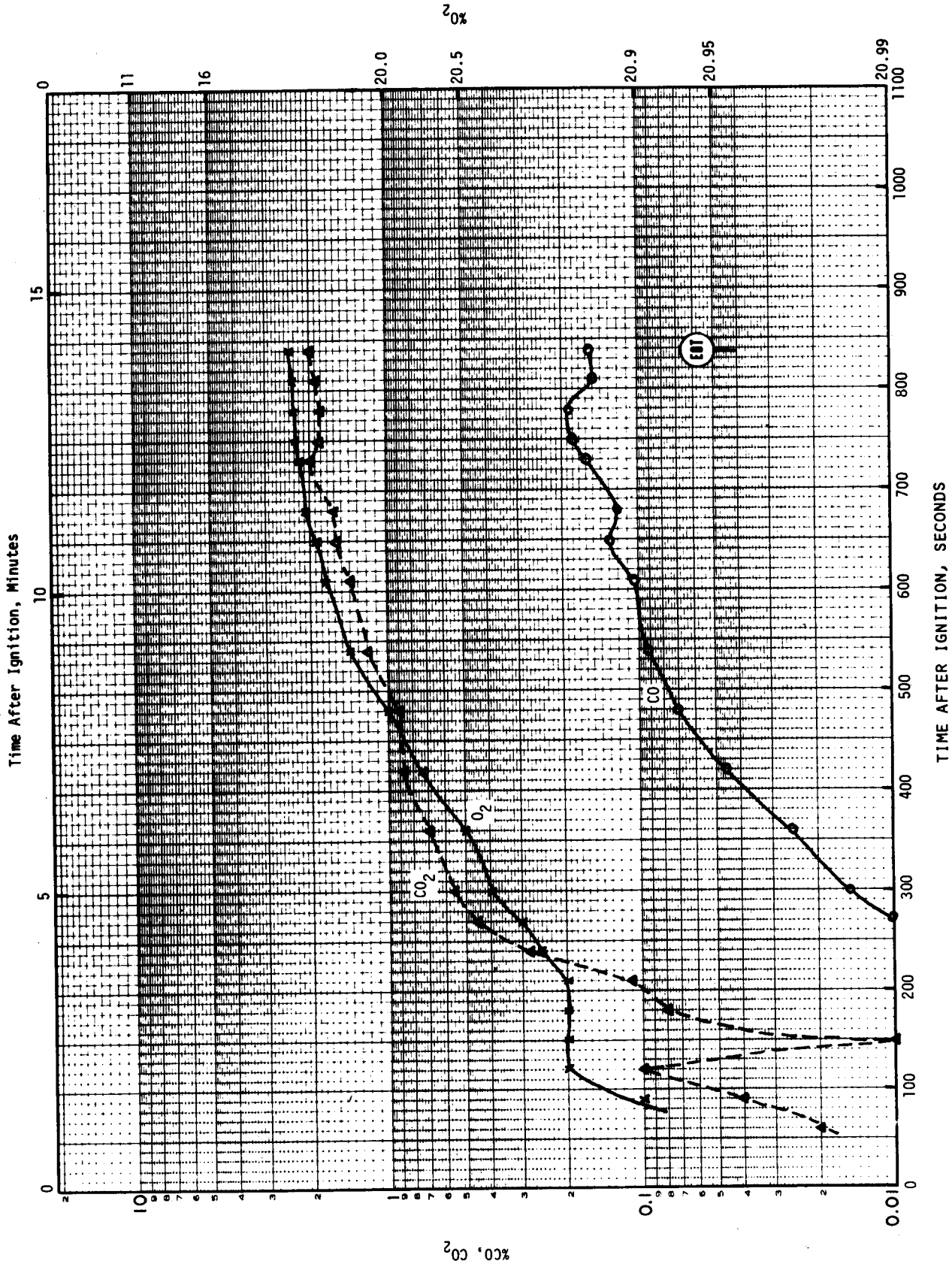
CONDITIONS ON 1ST FLOOR AT 5 FT, JR-59



TIME AFTER IGNITION, SECONDS
 CONDITIONS ON 2ND FLOOR AT 5 FT, JR-59

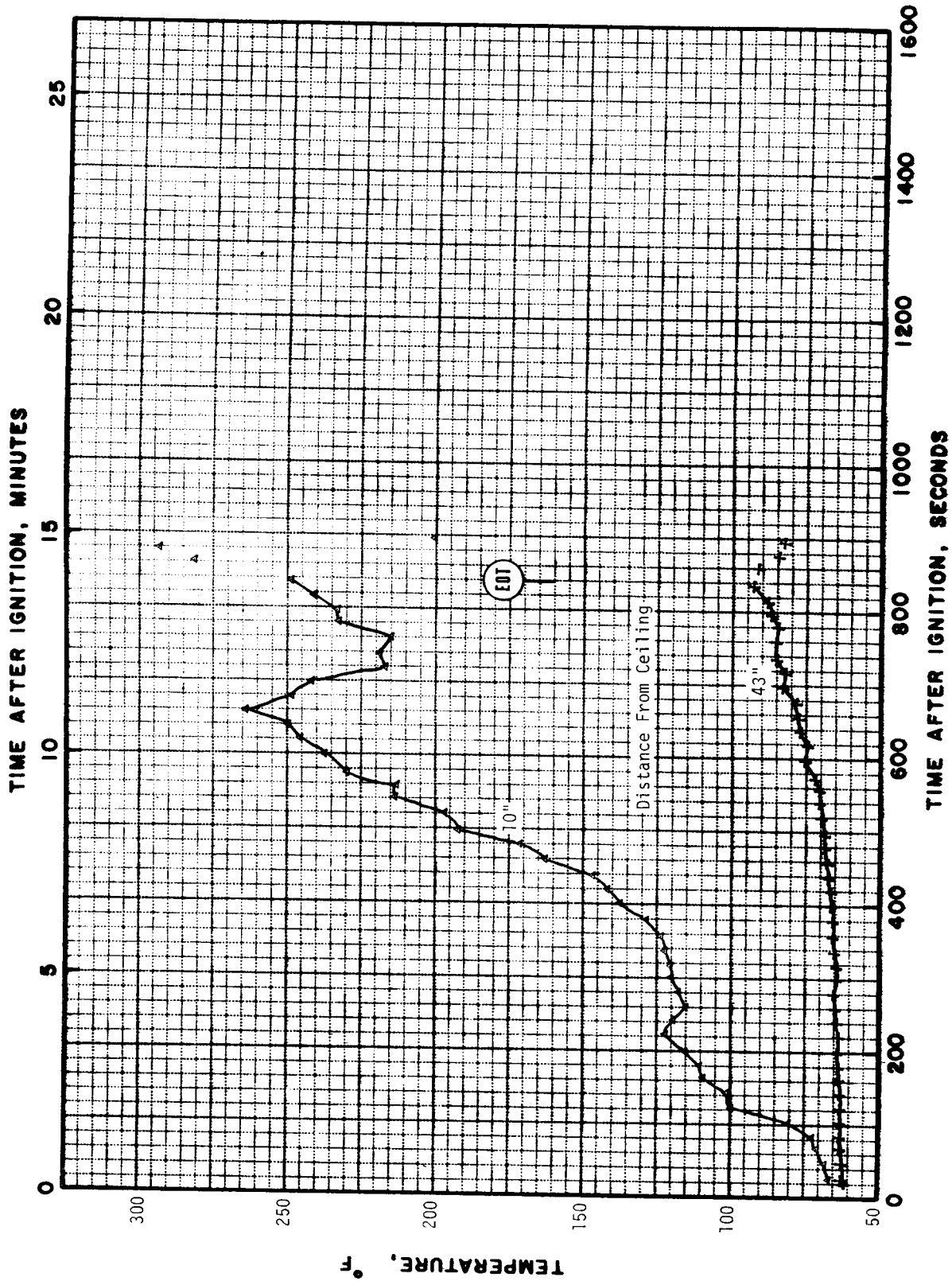


VARIOUS CEILING CONDITIONS, JR-59

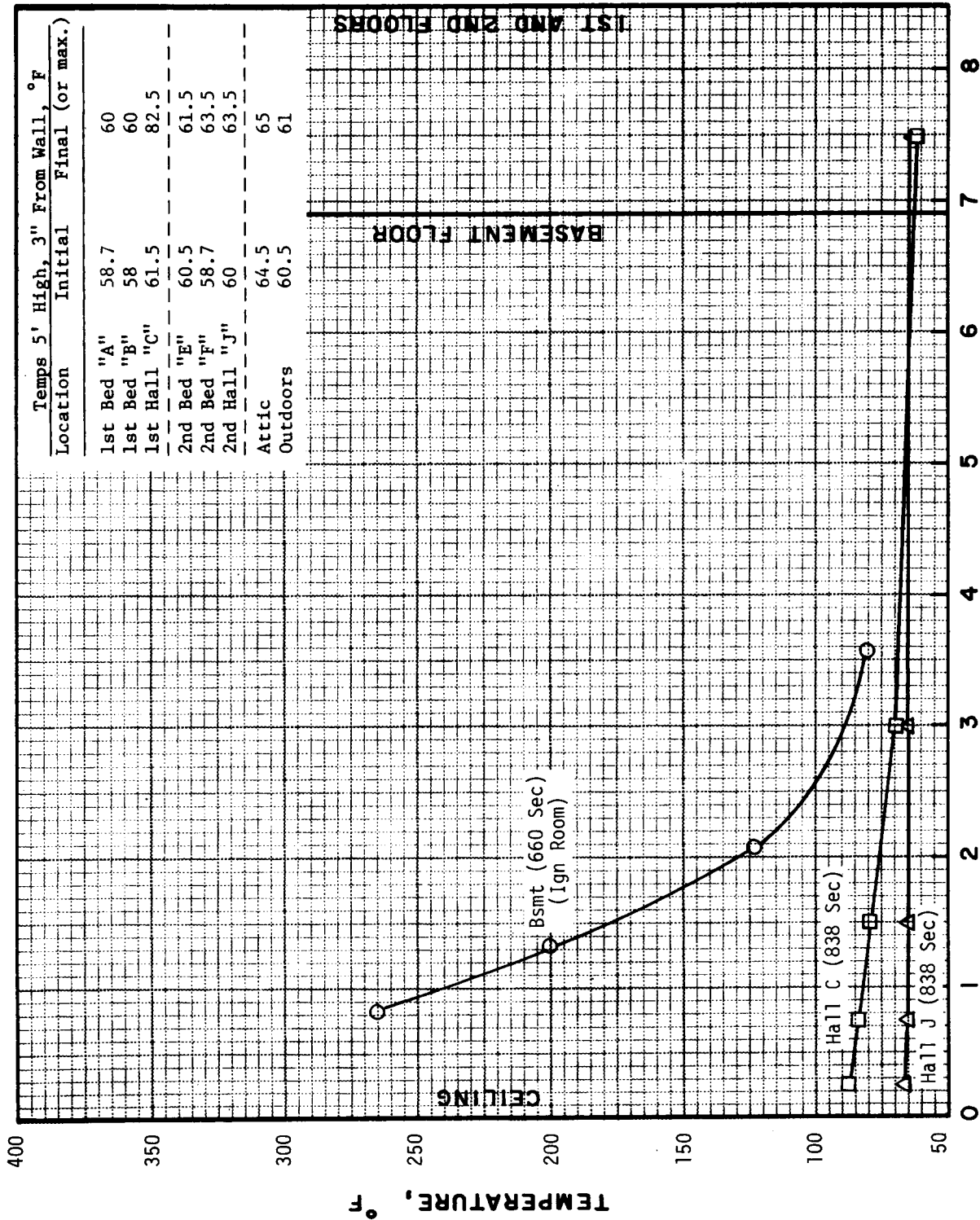


GASES IN BASEMENT (IGN. ROOM) AT 5 FT, JR-59

% CO, CO₂



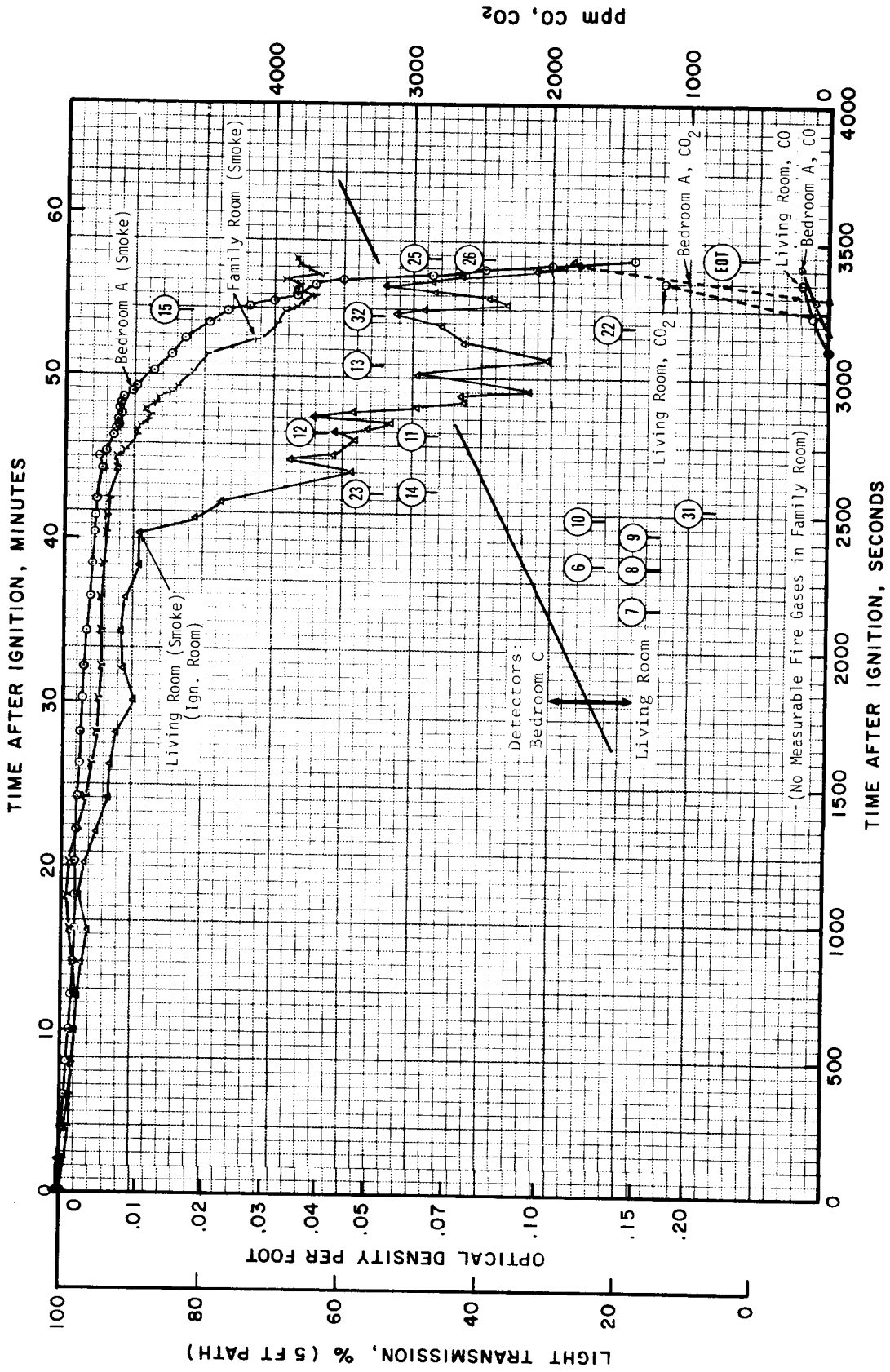
TEMPERATURES IN BASEMENT (IGNITION ROOM), JR-59



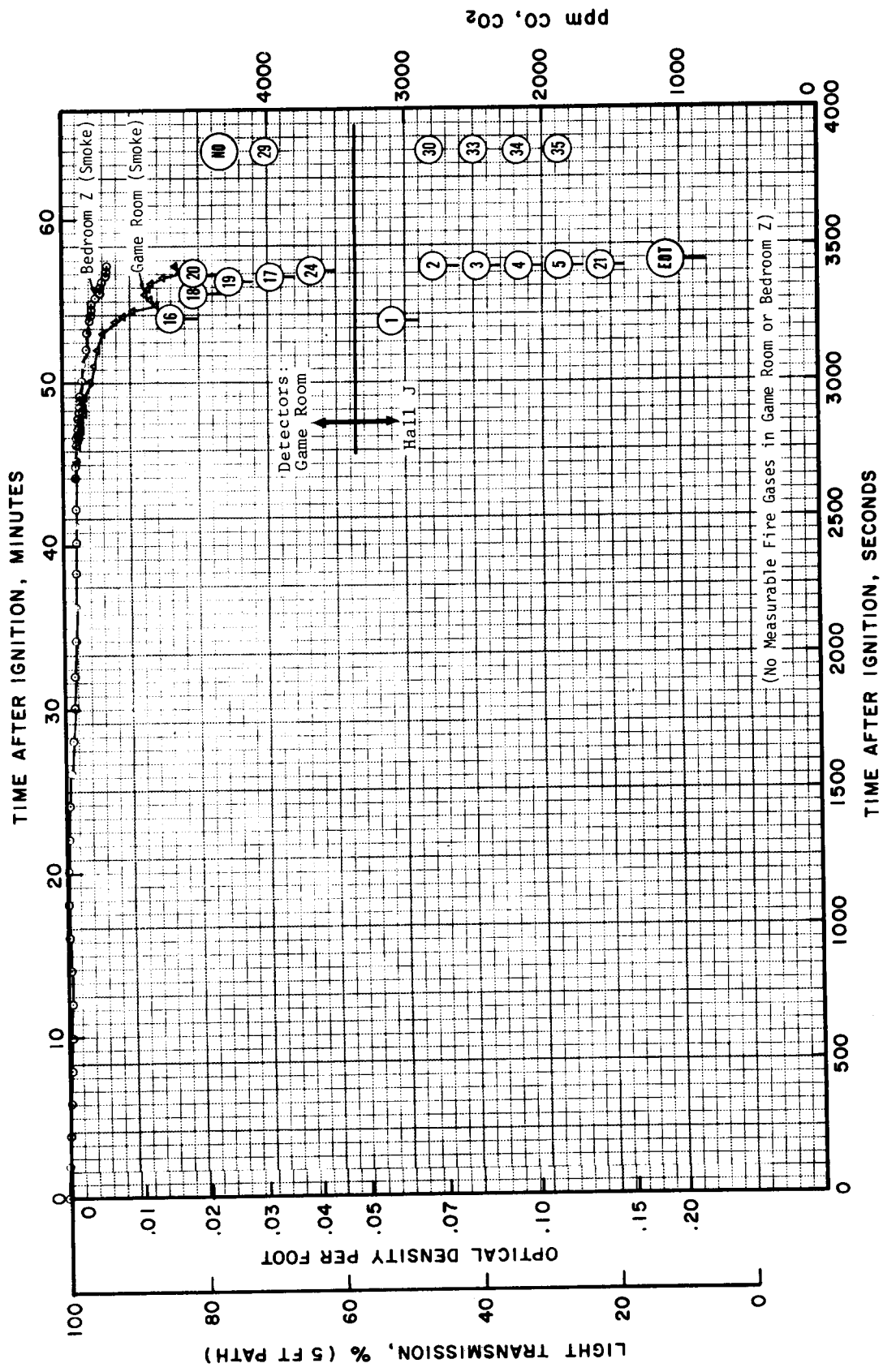
Temps 5' High, 3" From Wall, °F

Location	Initial	Final (or max.)
1st Bed "A"	58.7	60
1st Bed "B"	58	60
1st Hall "C"	61.5	82.5
2nd Bed "E"	60.5	61.5
2nd Bed "F"	58.7	63.5
2nd Hall "J"	60	63.5
Attic	64.5	65
Outdoors	60.5	61

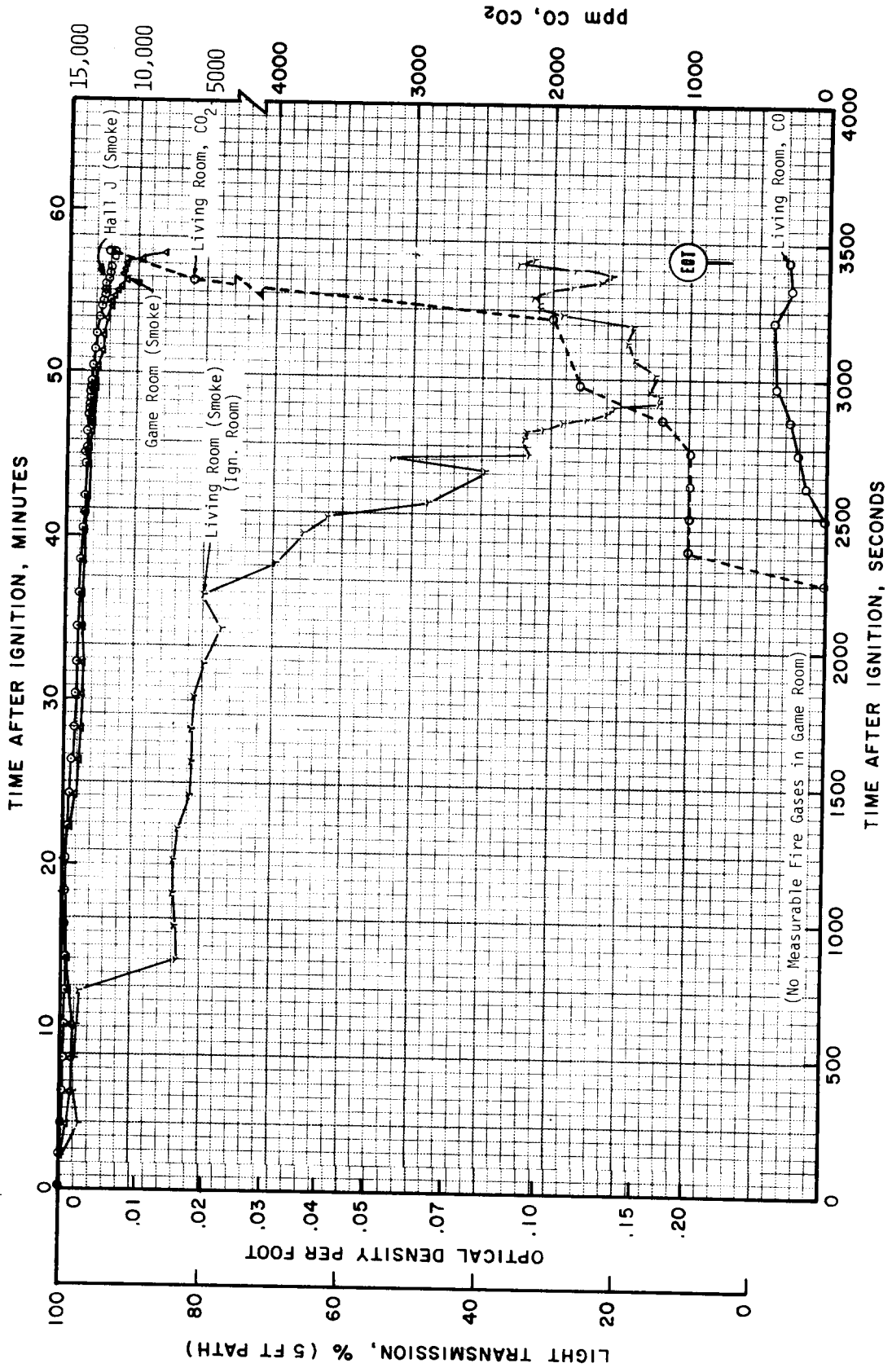
MAXIMUM TEMPERATURE PROFILES, JR-59



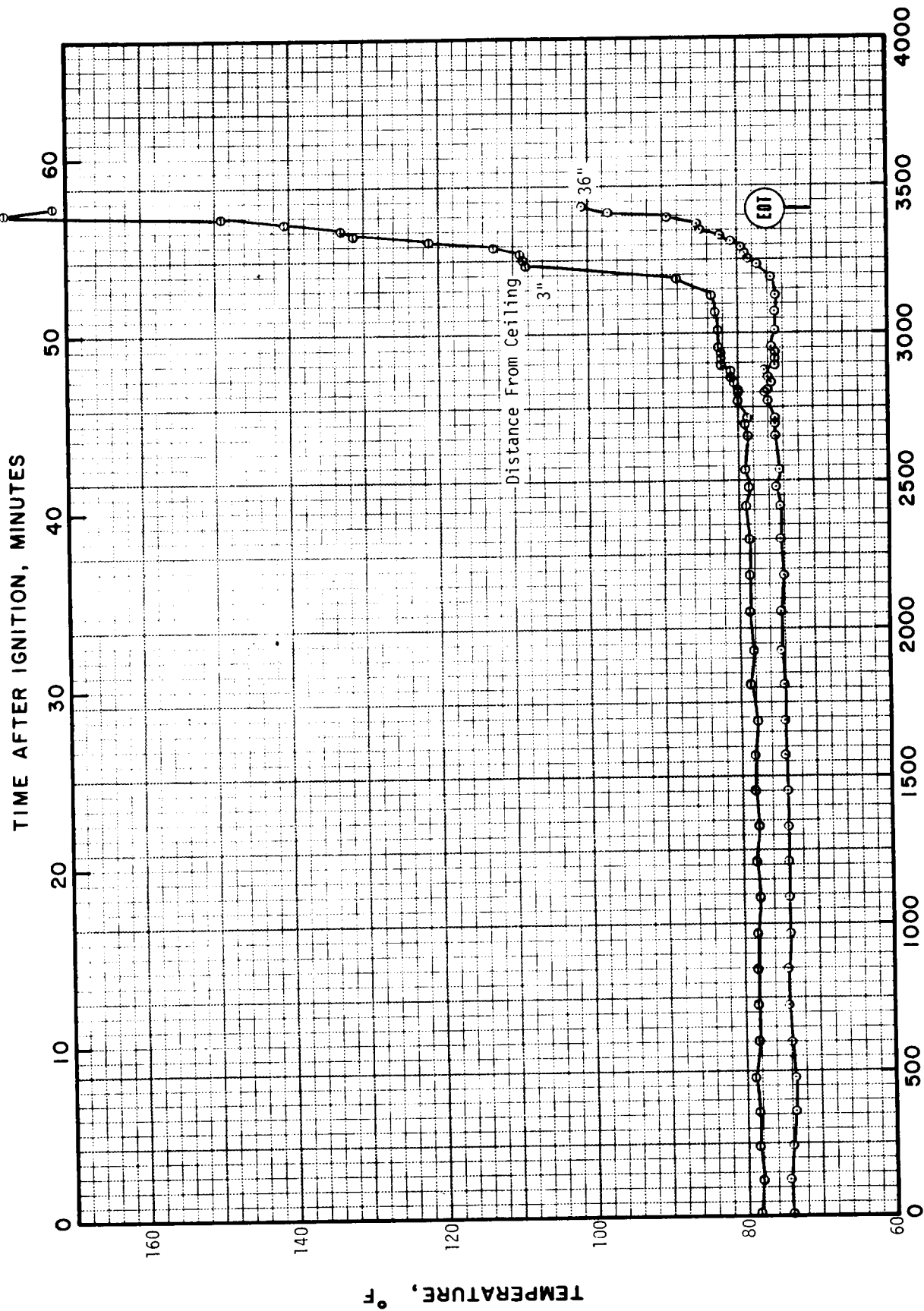
CONDITIONS ON 1ST FLOOR AT 5 FT, W-60



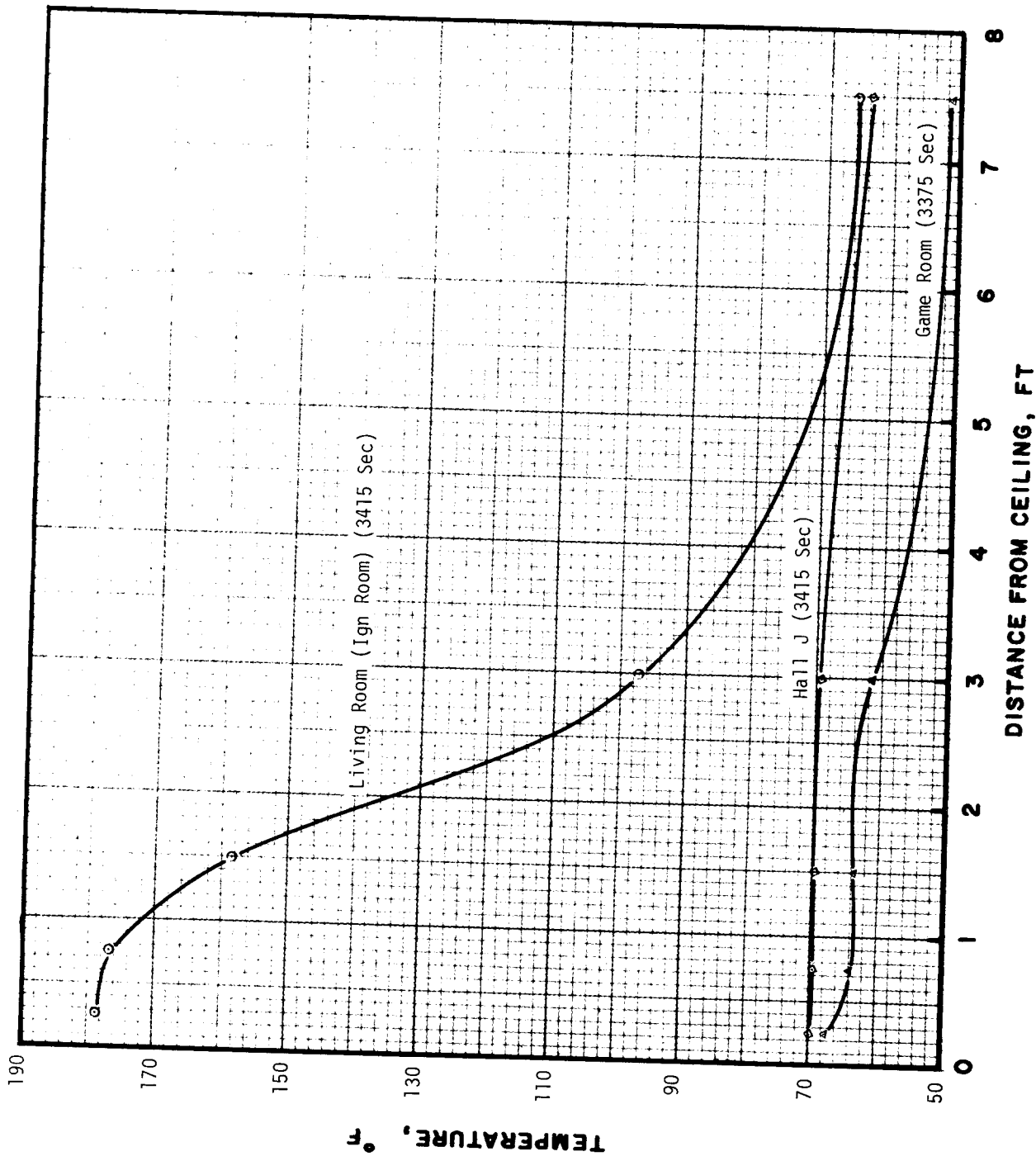
CONDITIONS ON 2ND FLOOR AT 5 FT, W-60



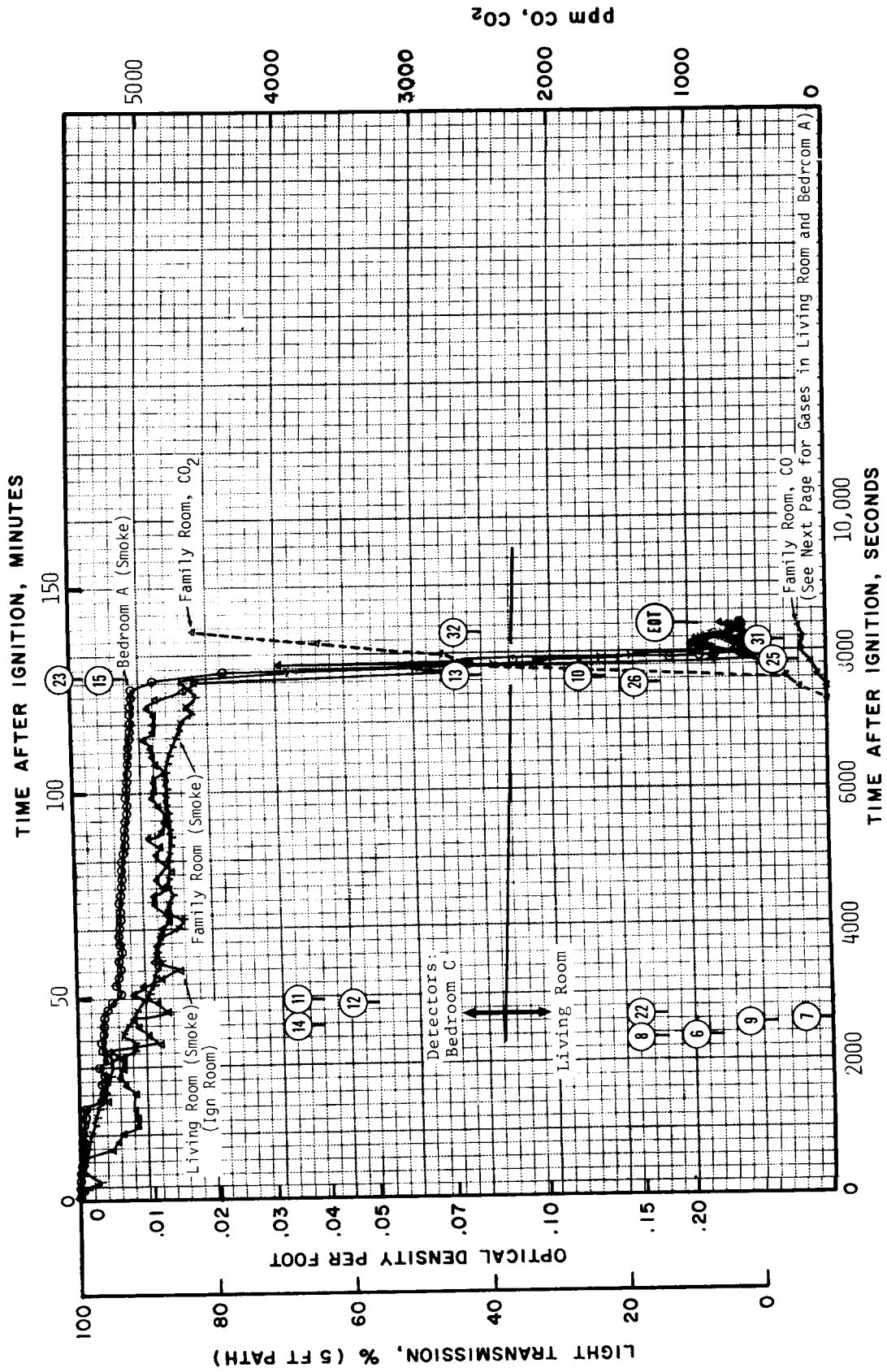
VARIOUS CEILING CONDITIONS, W-60



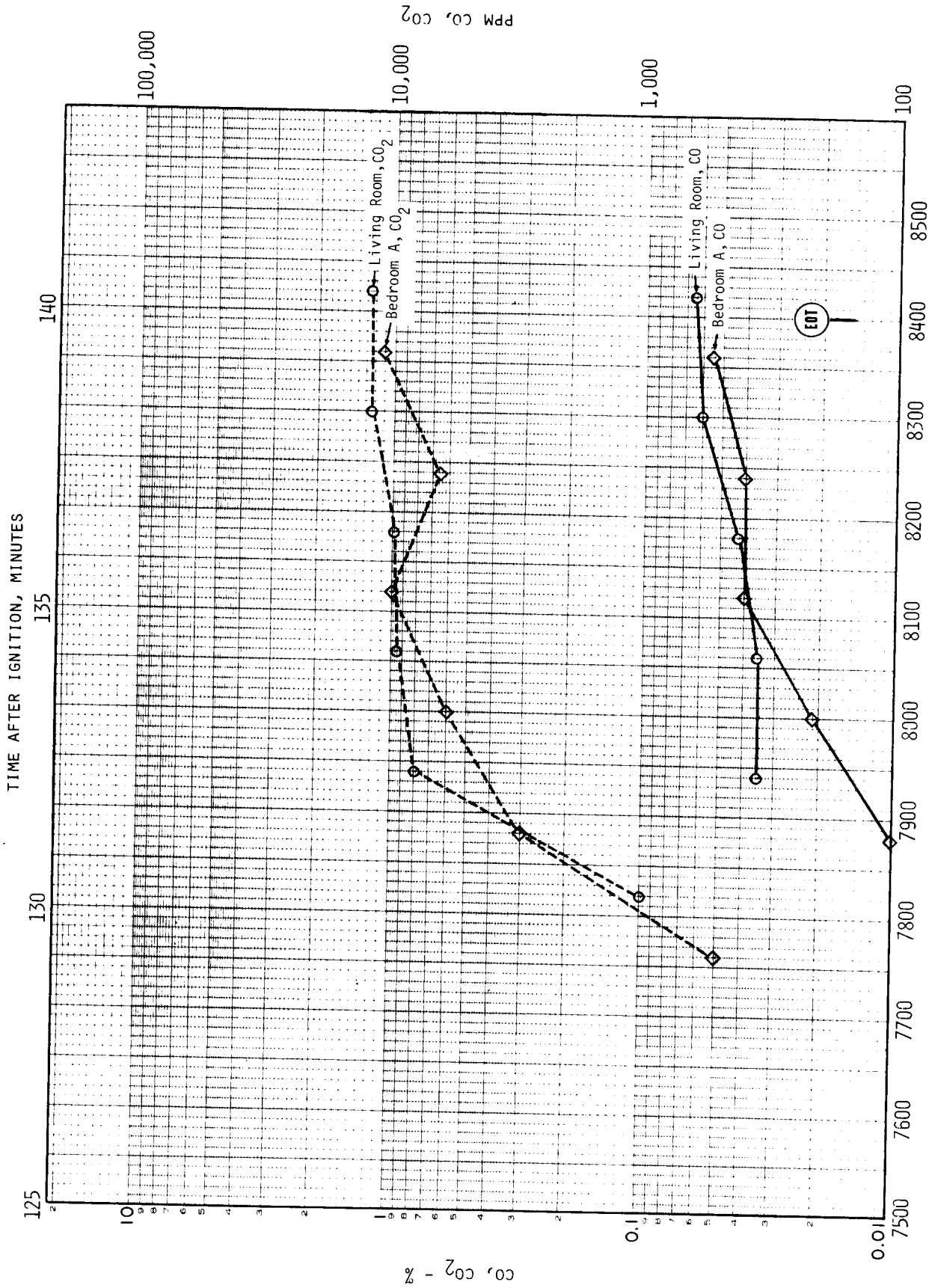
TEMPERATURES IN LIVING ROOM (IGNITION ROOM), W-60



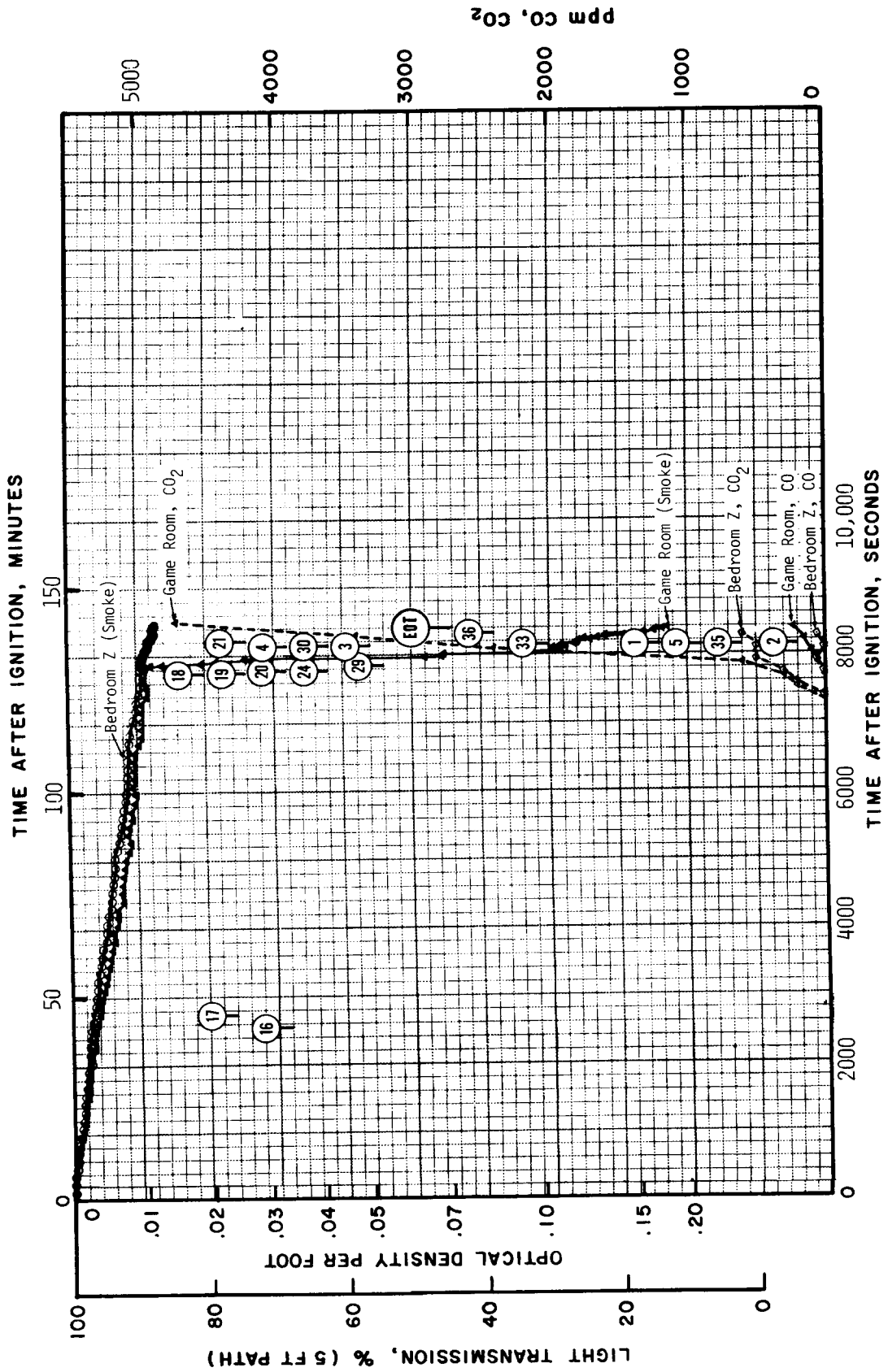
MAXIMUM TEMPERATURE PROFILES, W-60



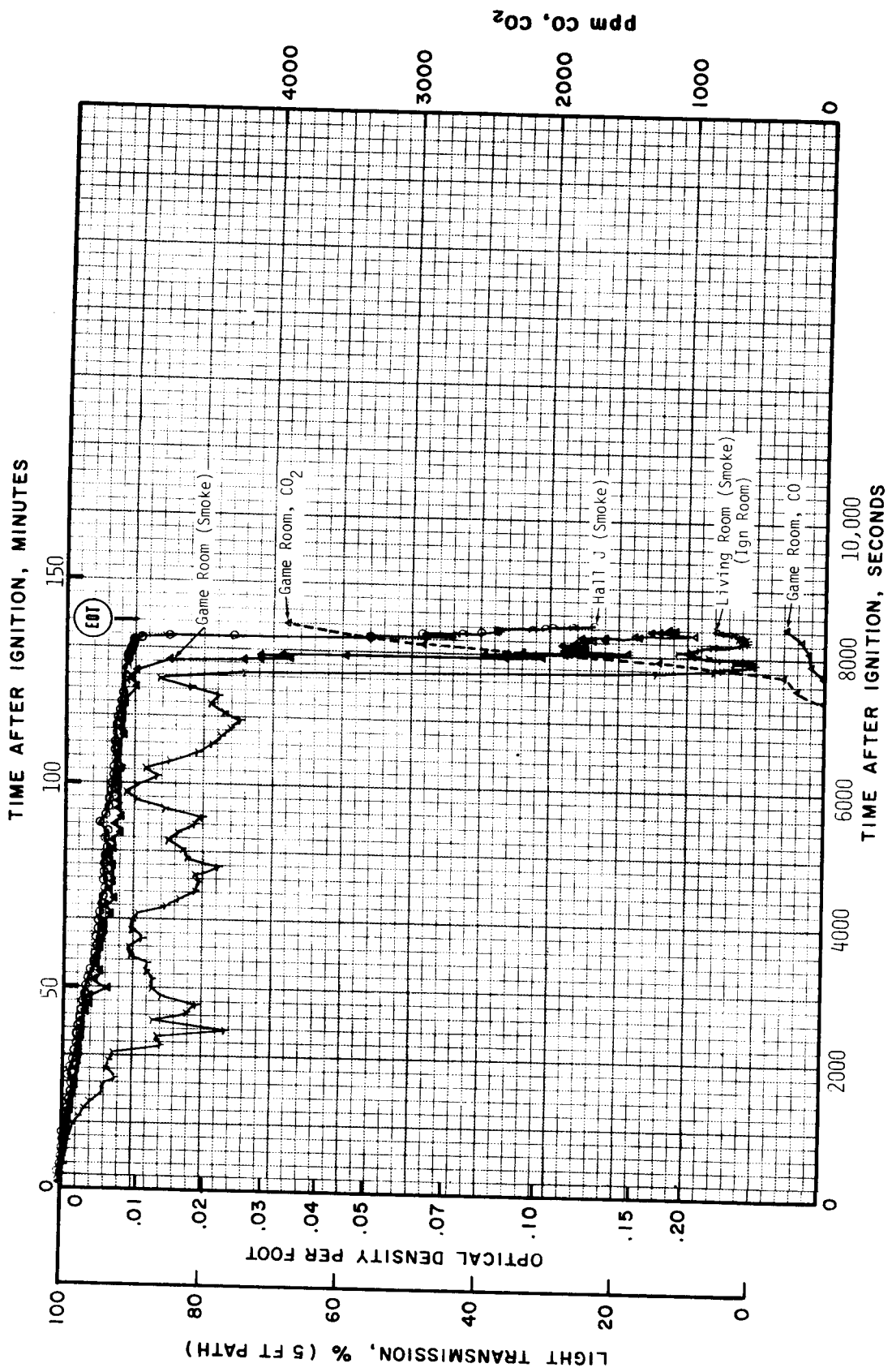
CONDITIONS ON 1ST FLOOR AT 5 FT, W-61



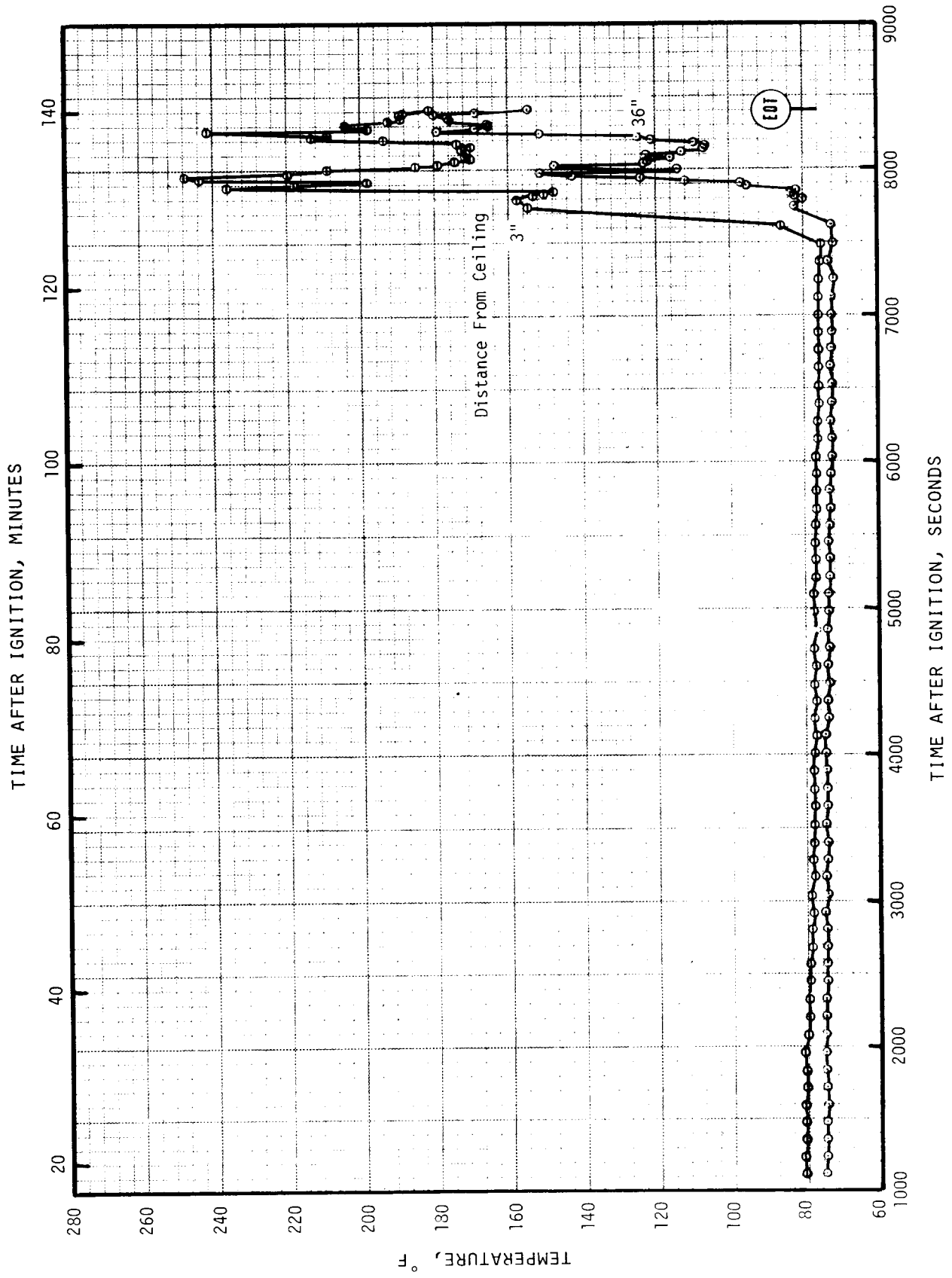
TIME AFTER IGNITION, SECONDS
GASES ON 1ST FLOOR AT 5 FT, W-61



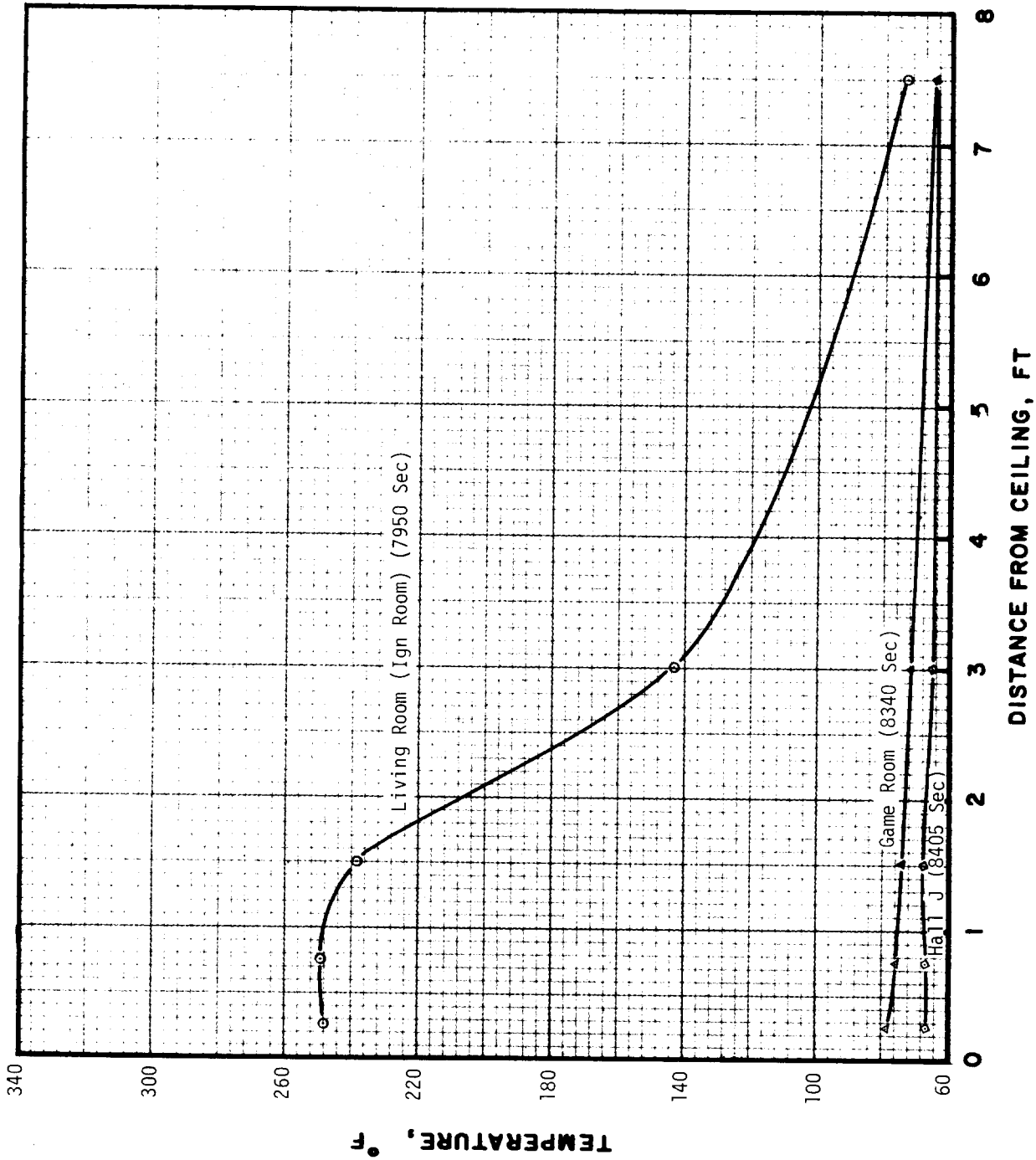
CONDITIONS ON 2ND FLOOR AT 5 FT, W-61



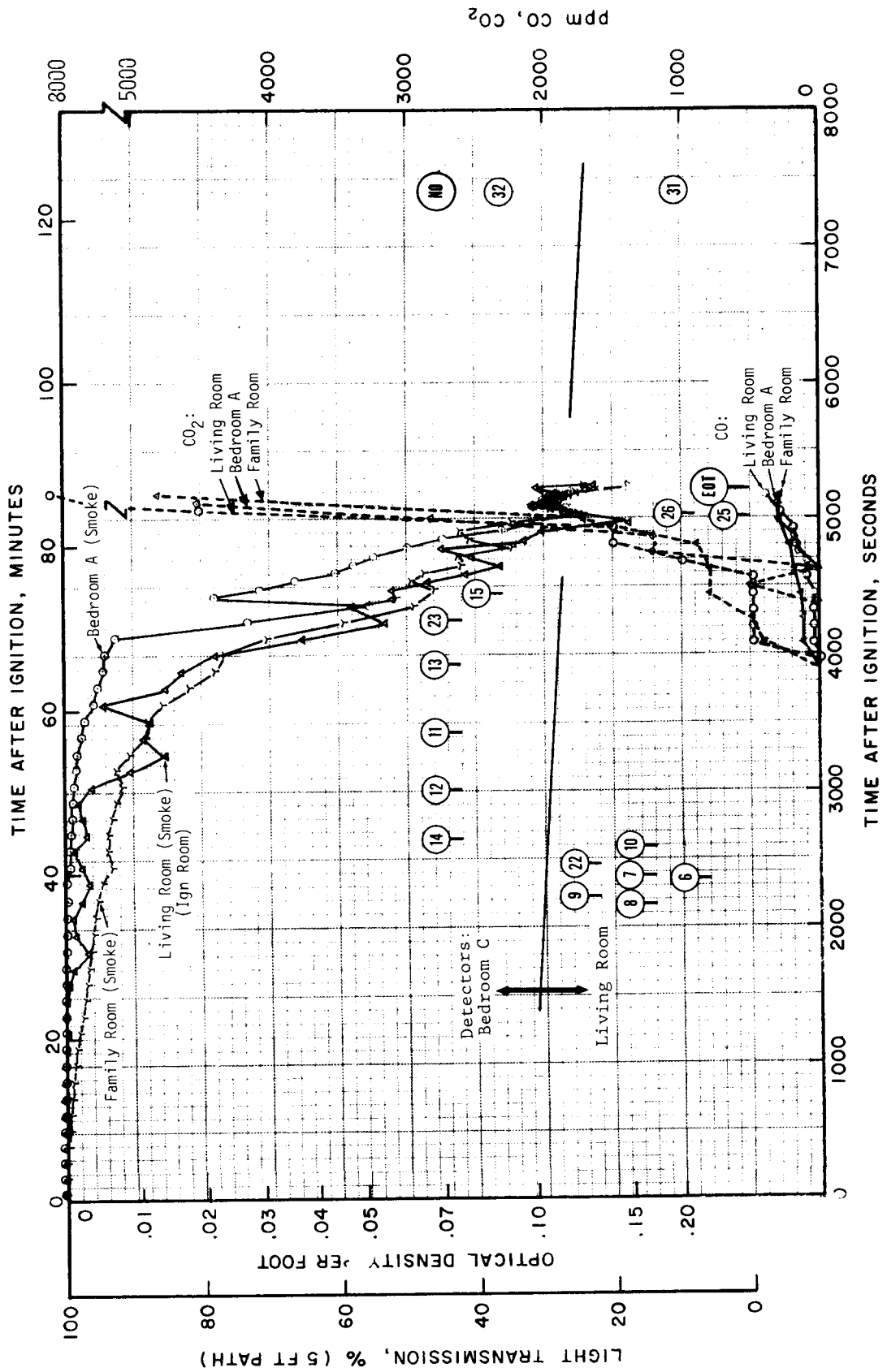
VARIOUS CEILING CONDITIONS, W-61



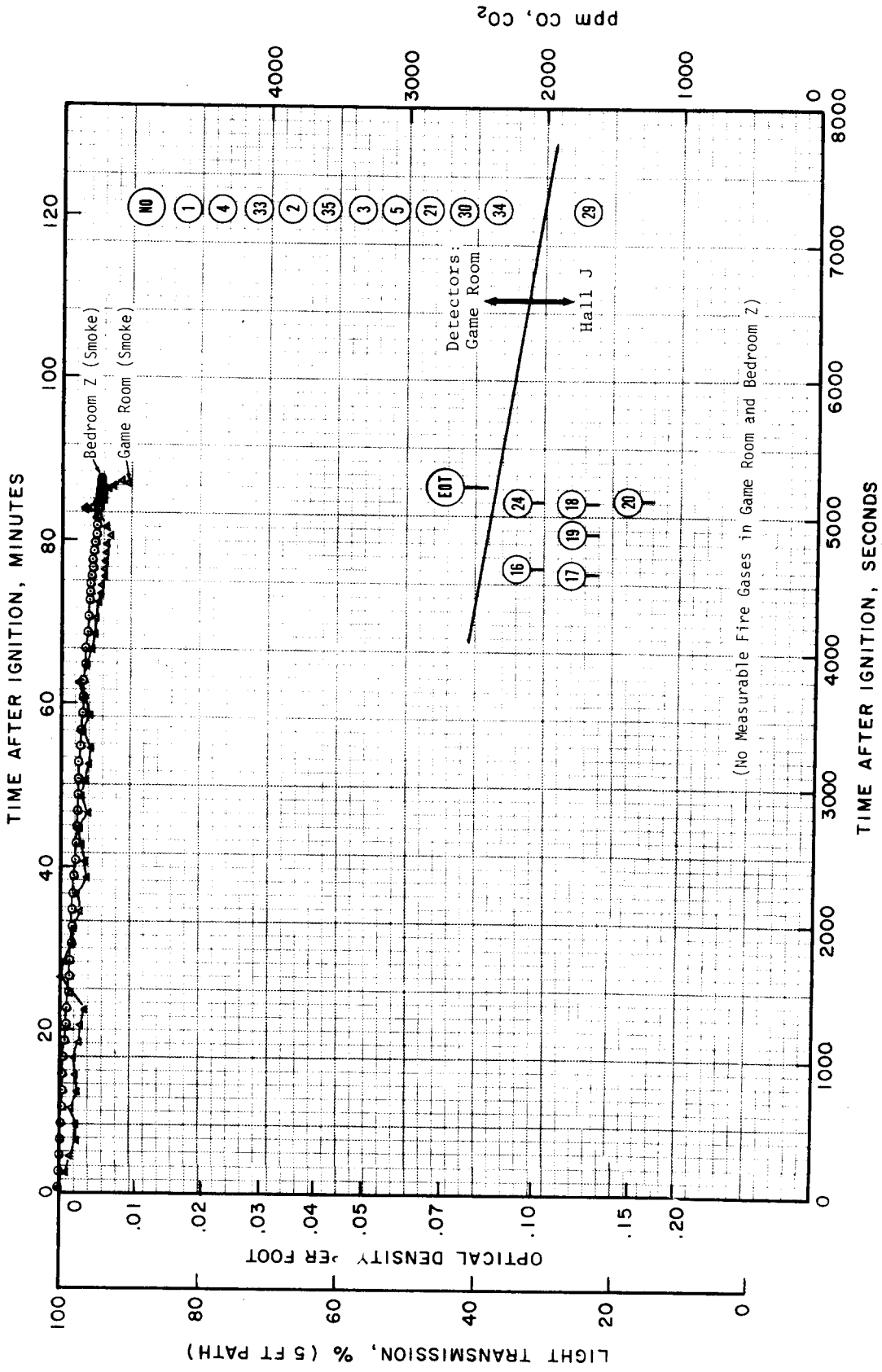
TEMPERATURES IN LIVING ROOM (IGNITION ROOM), W-61



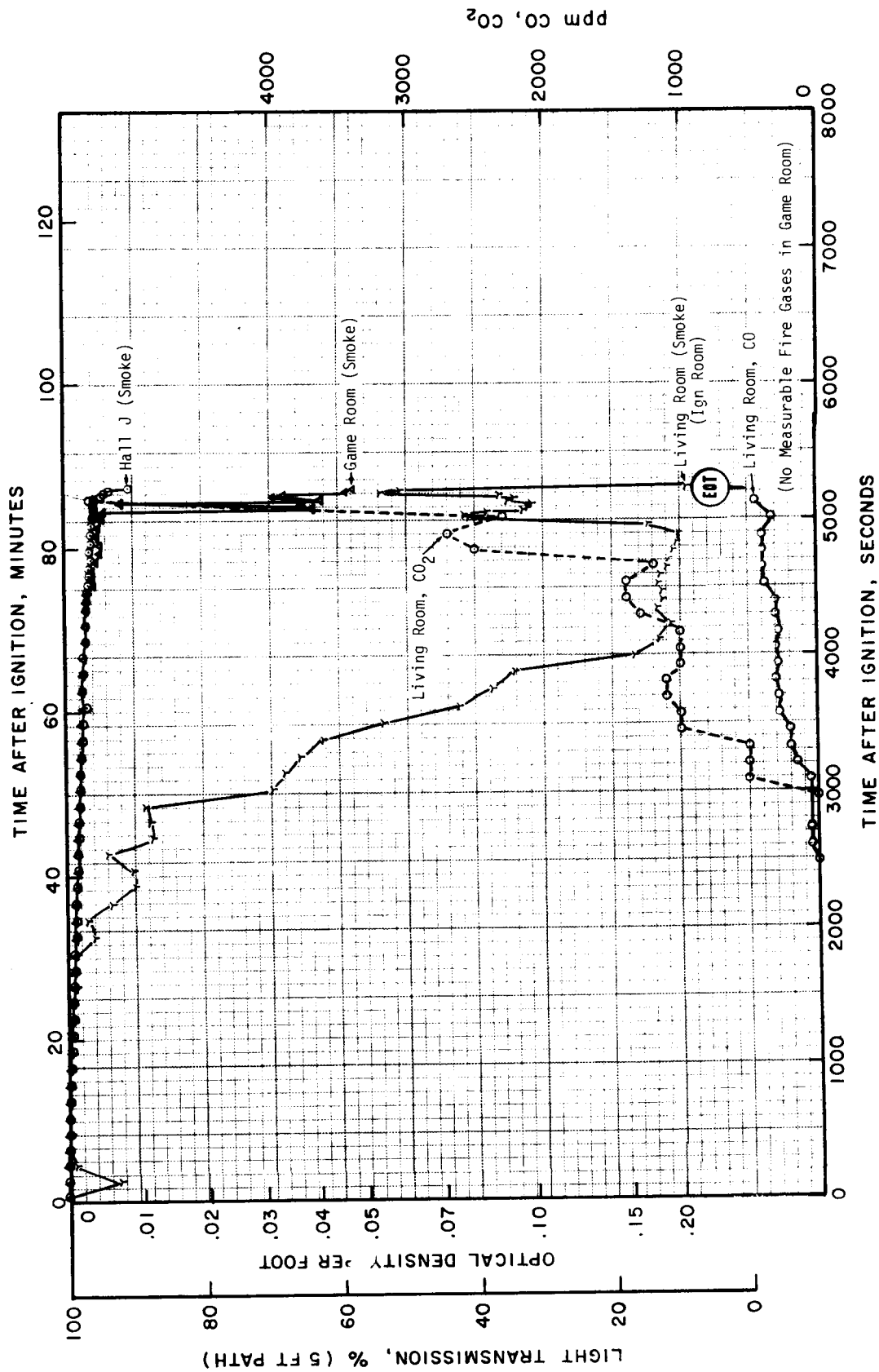
MAXIMUM TEMPERATURE PROFILES, W-61



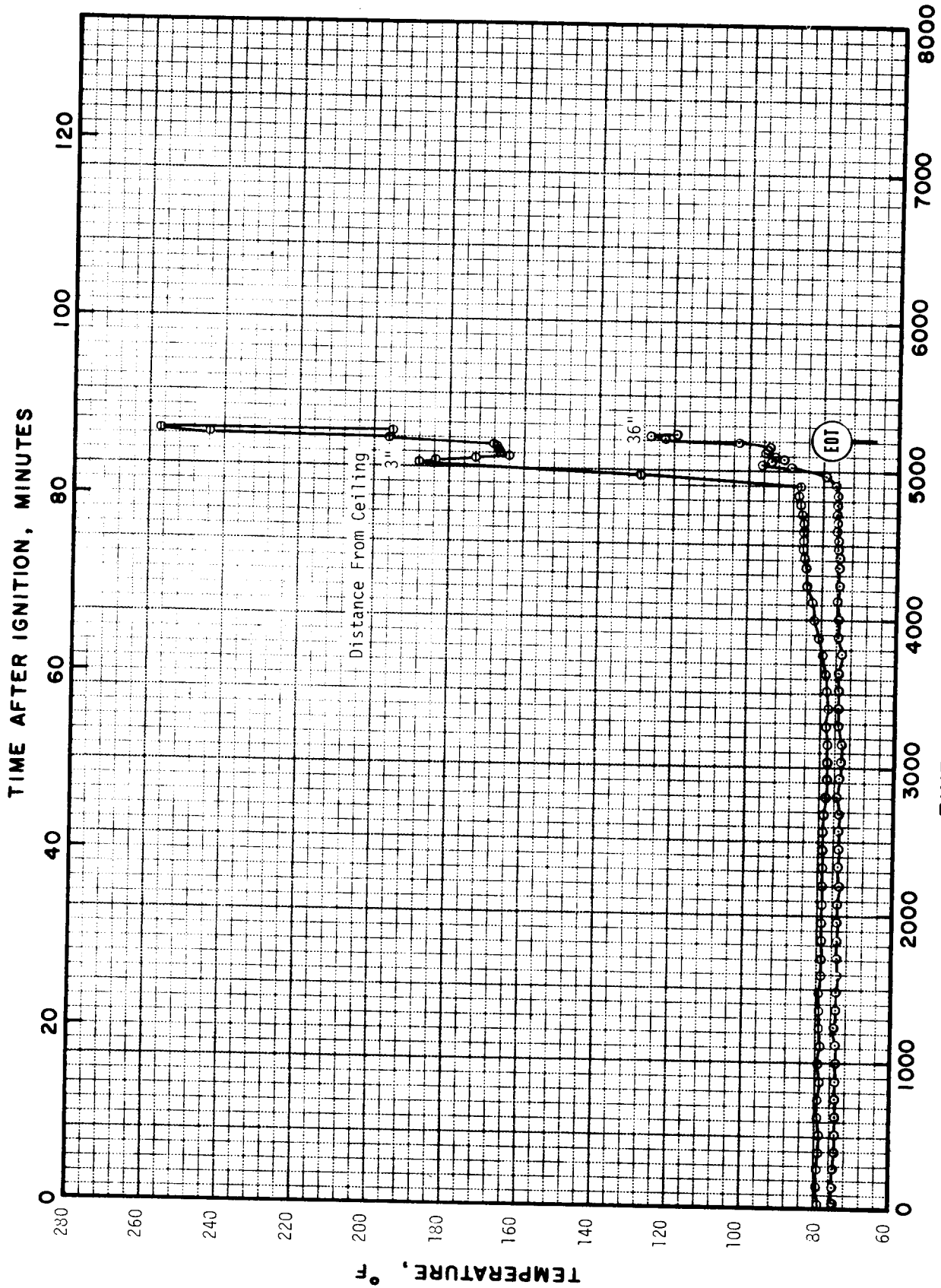
CONDITIONS ON 1ST FLOOR AT 5 FT, W-62



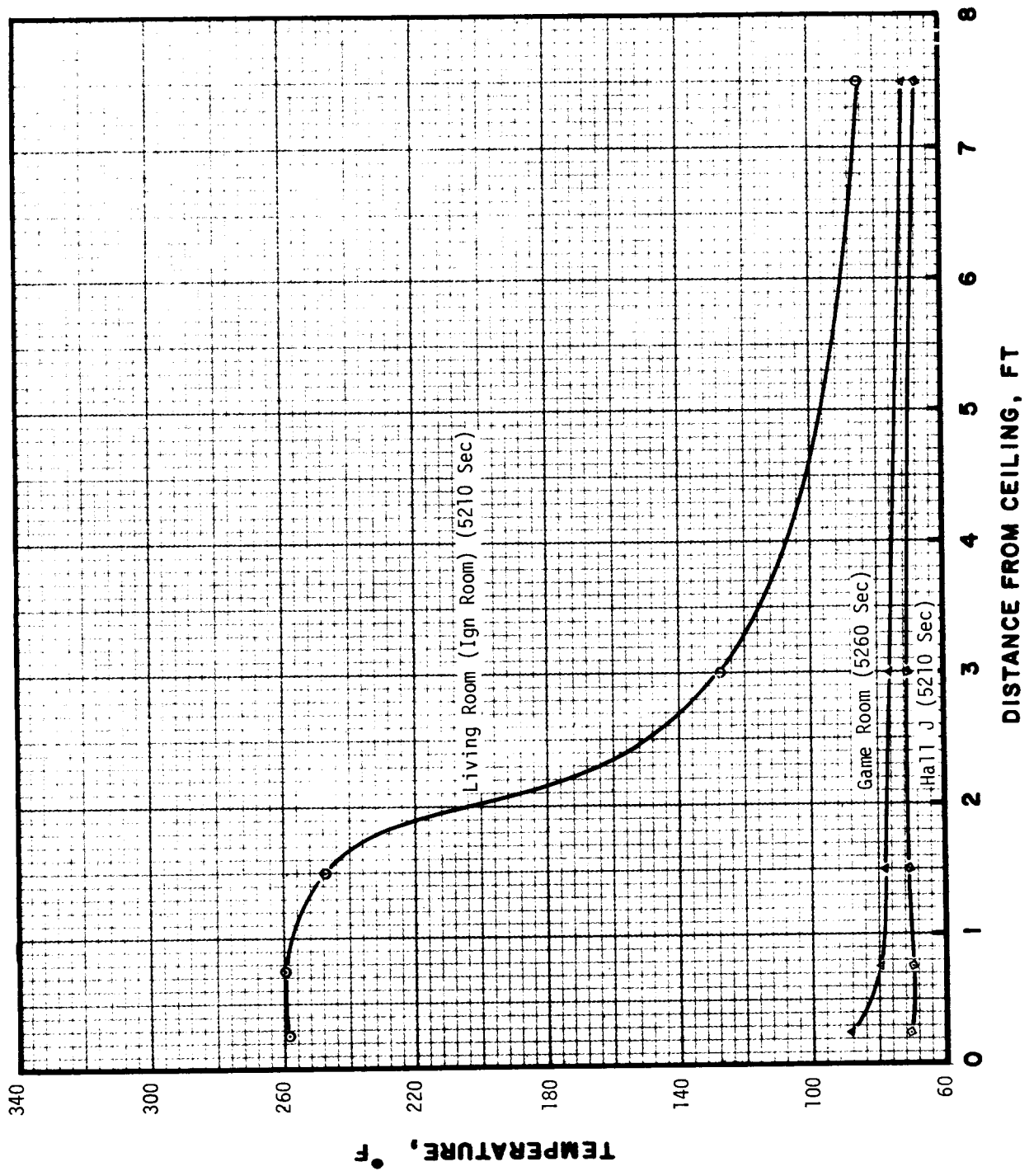
CONDITIONS ON 2ND FLOOR AT 5 FT, W-62



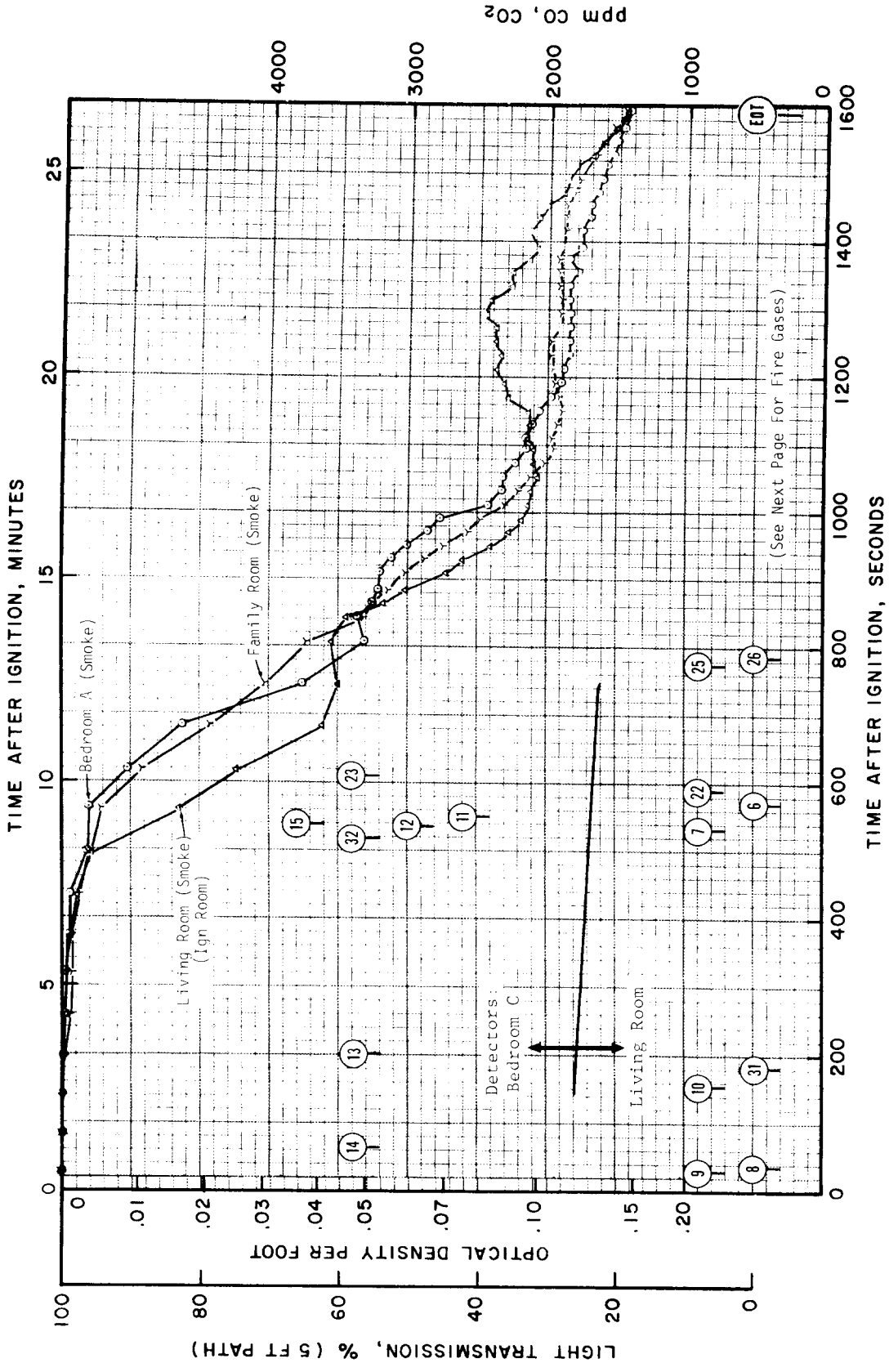
VARIOUS CEILING CONDITIONS, W-62



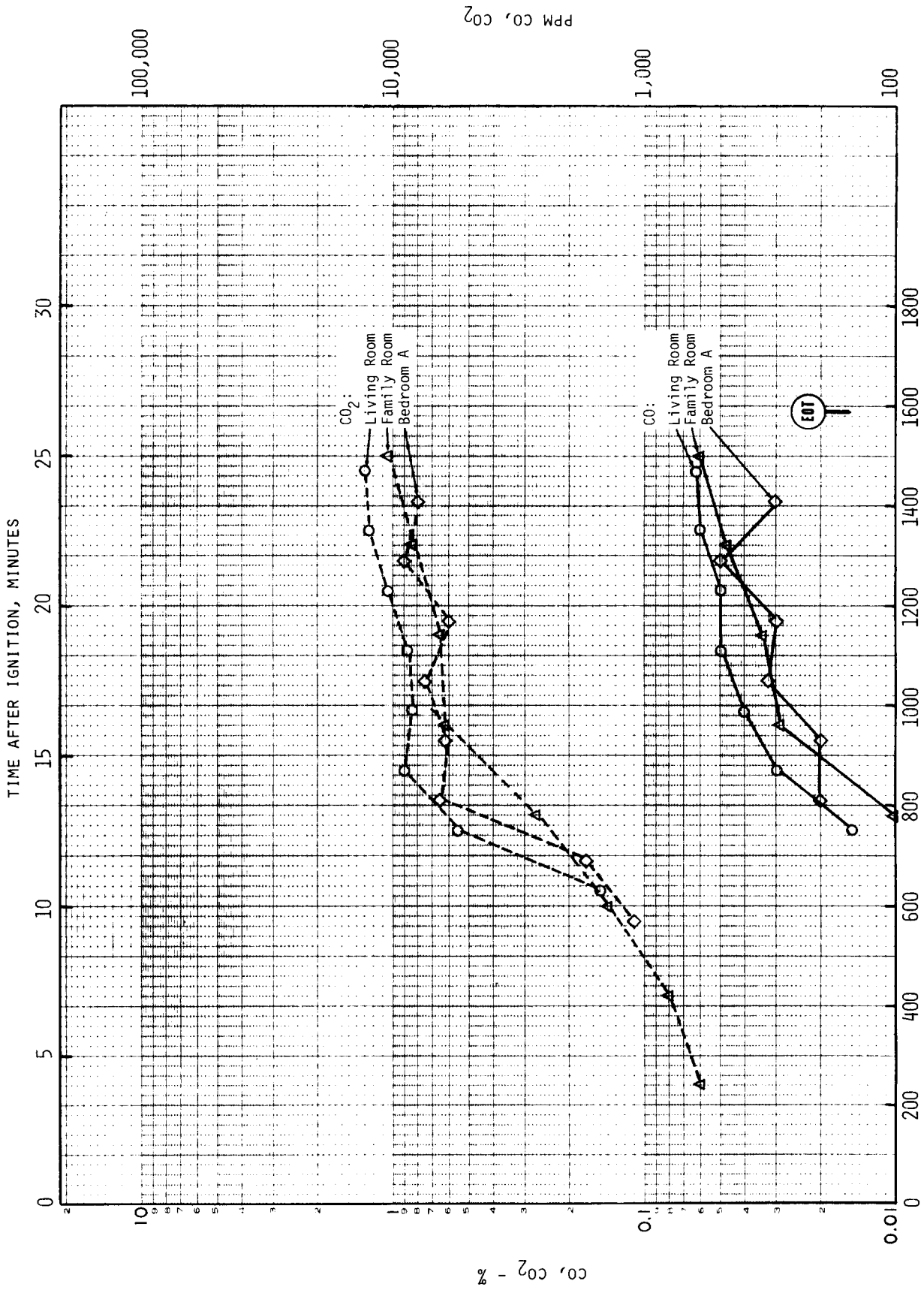
TEMPERATURES IN LIVING ROOM (IGNITION ROOM), W-62



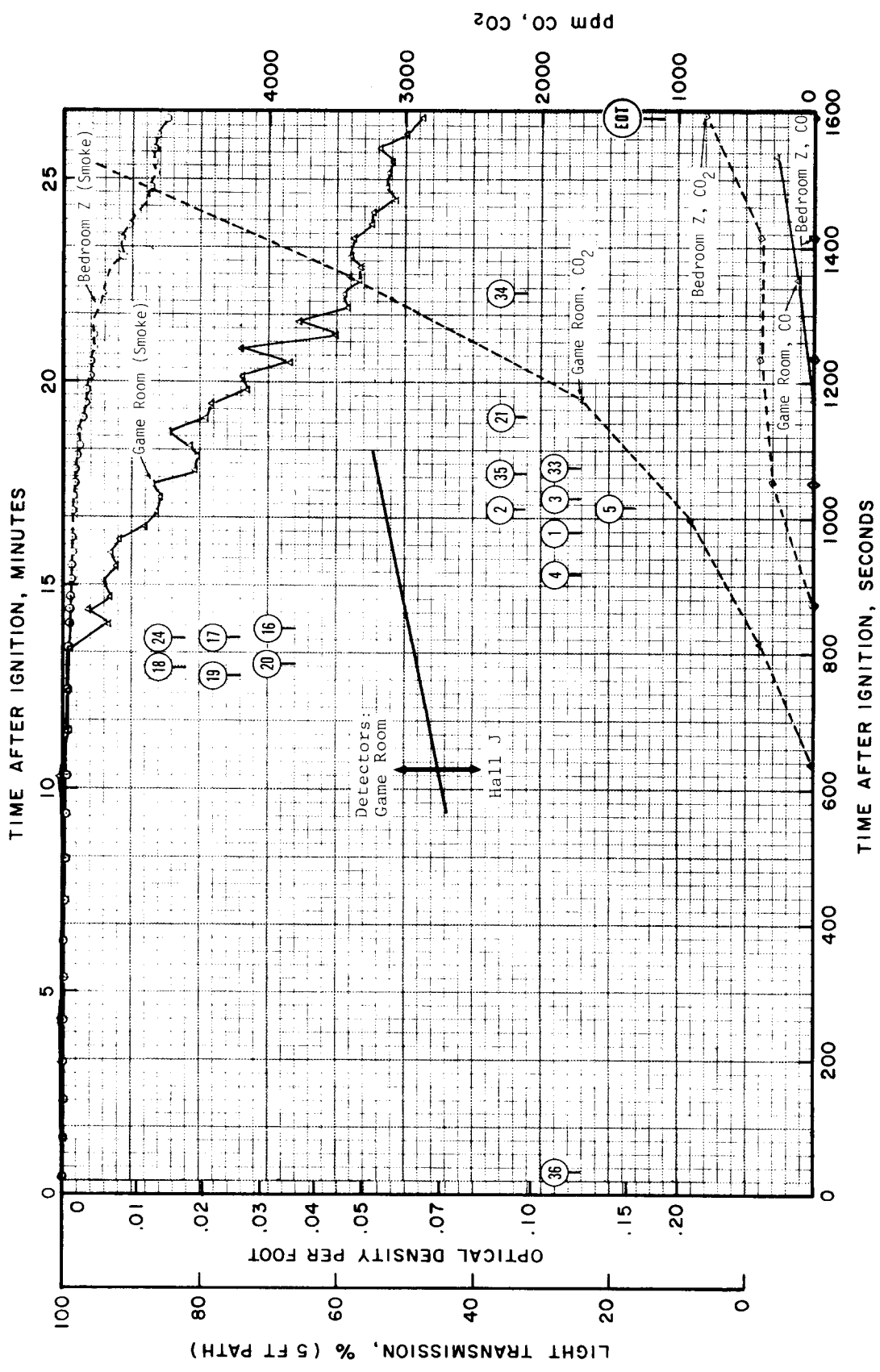
MAXIMUM TEMPERATURE PROFILES, W-62



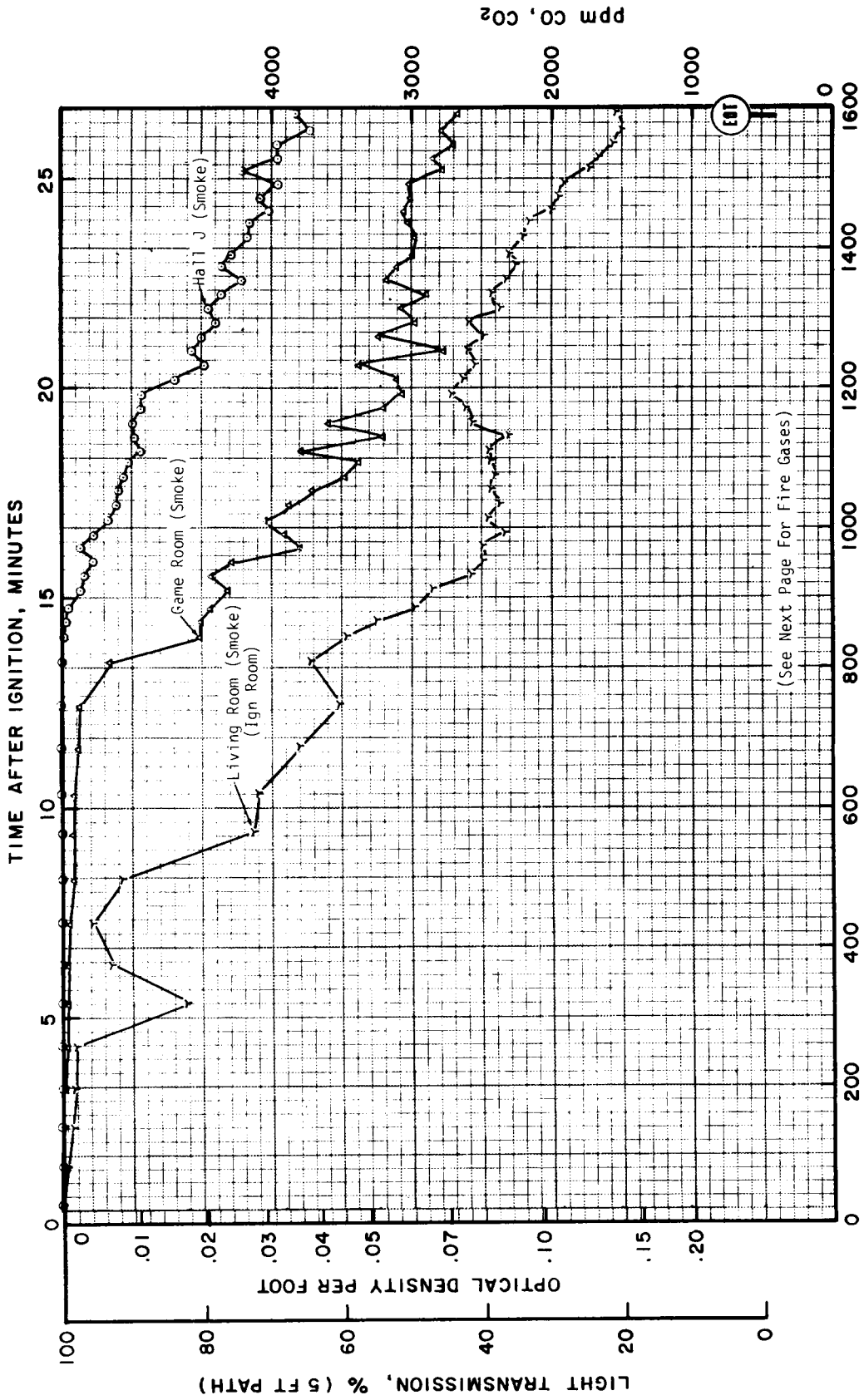
CONDITIONS ON 1ST FLOOR AT 5 FT, W-63



GASES ON 1ST FLOOR AT 5 FT, W-63

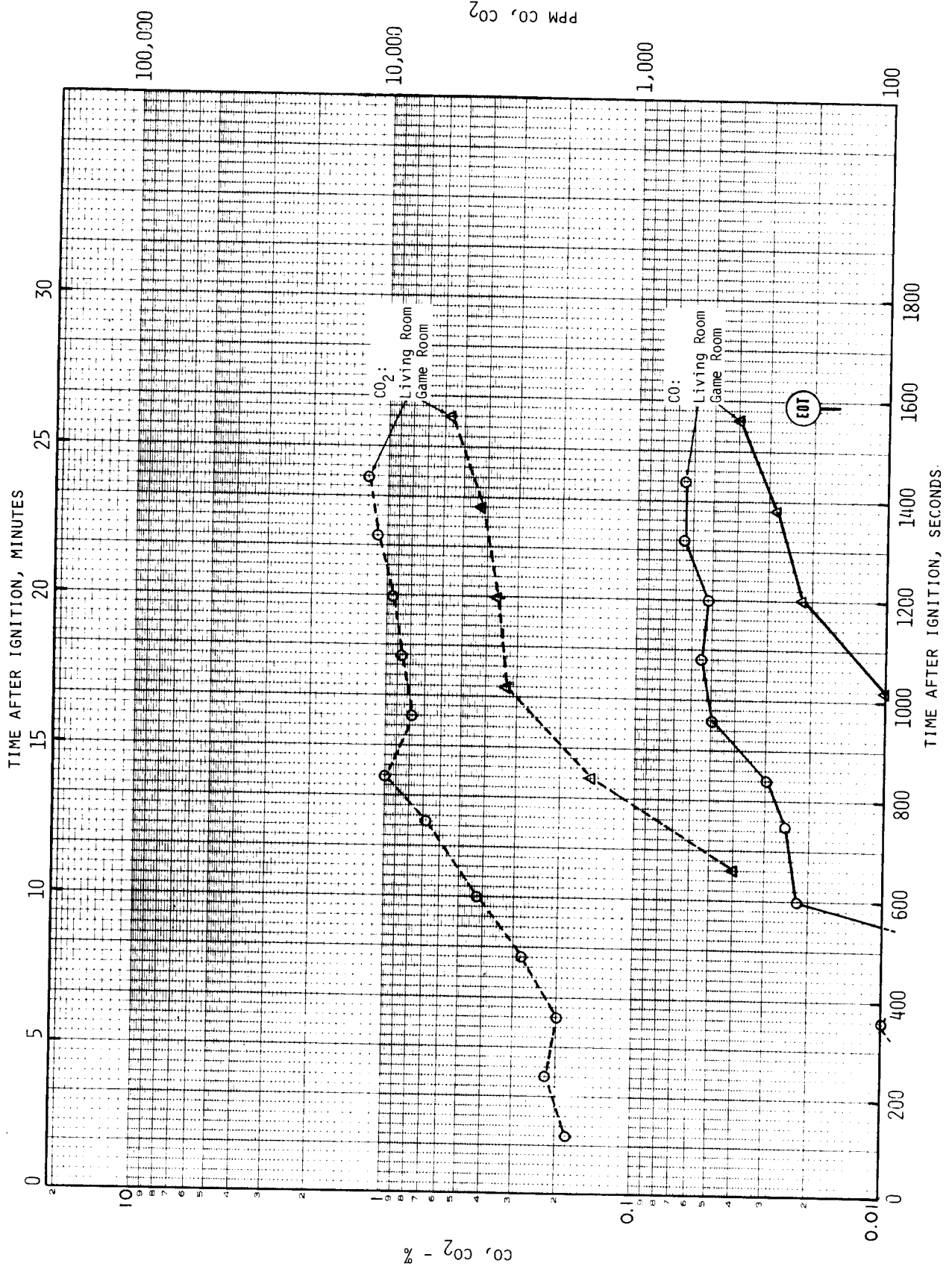


CONDITIONS ON 2ND FLOOR AT 5 FT, W-63



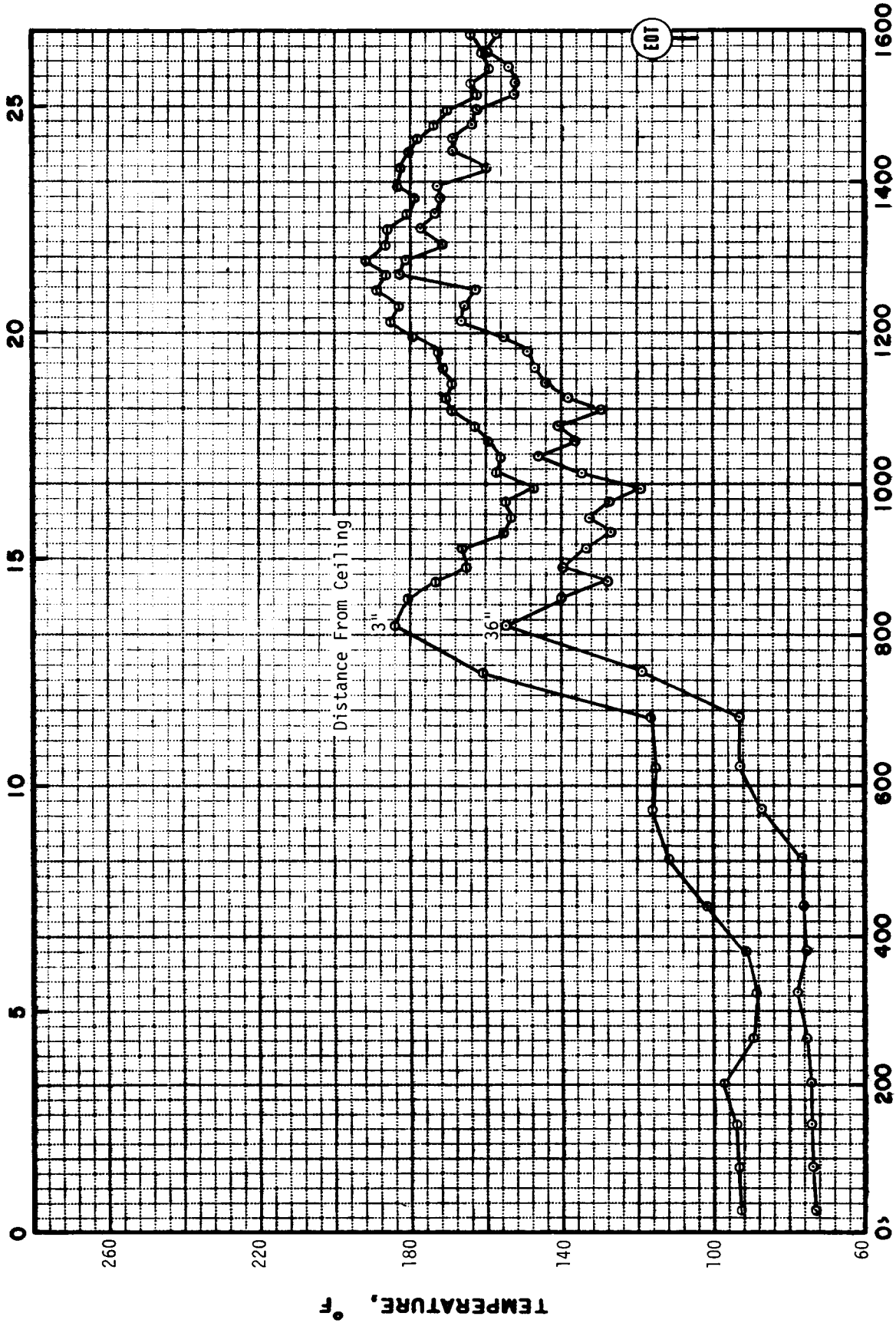
(See Next Page For Fire Gases)

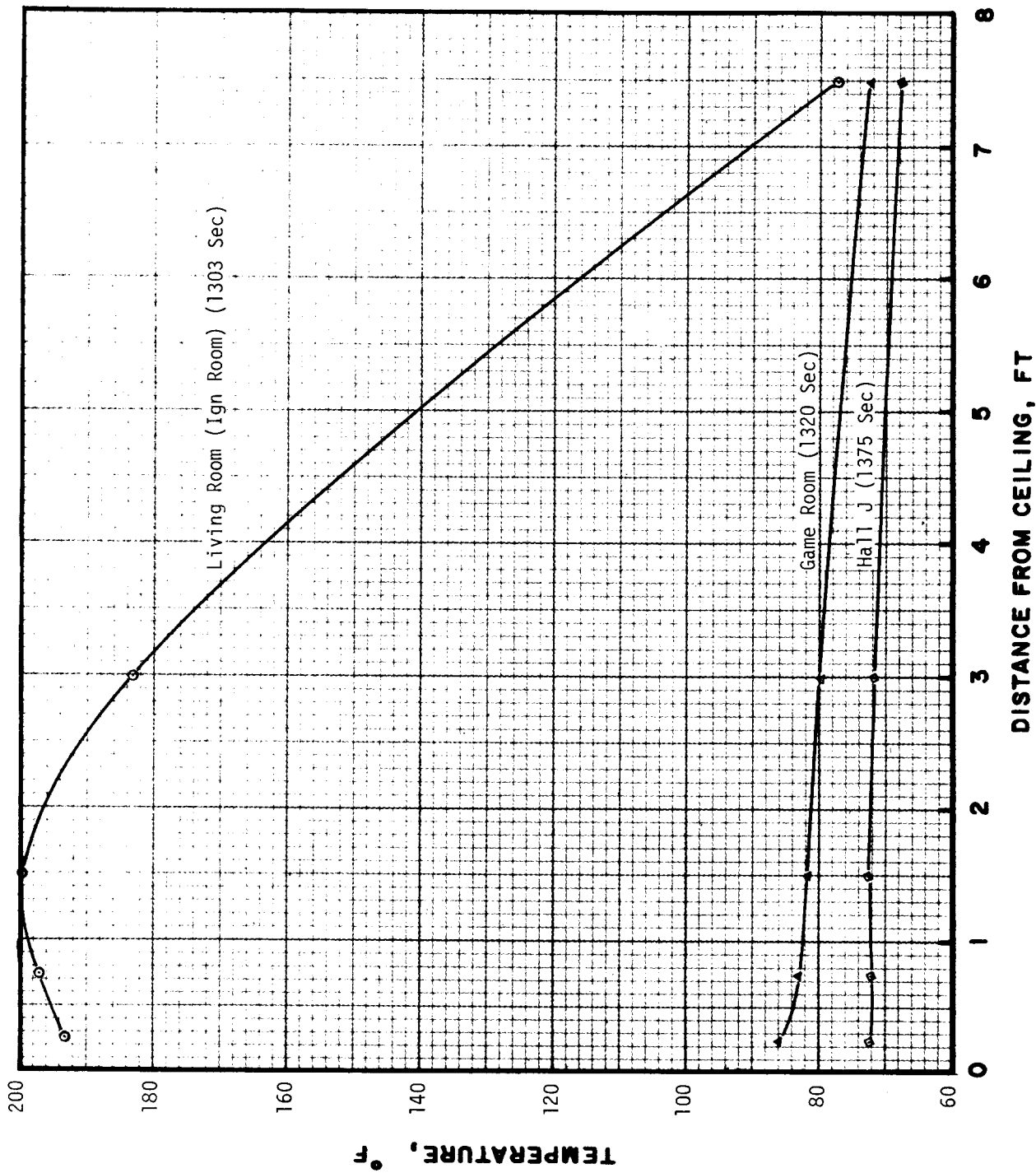
VARIOUS CEILING CONDITIONS, W-63



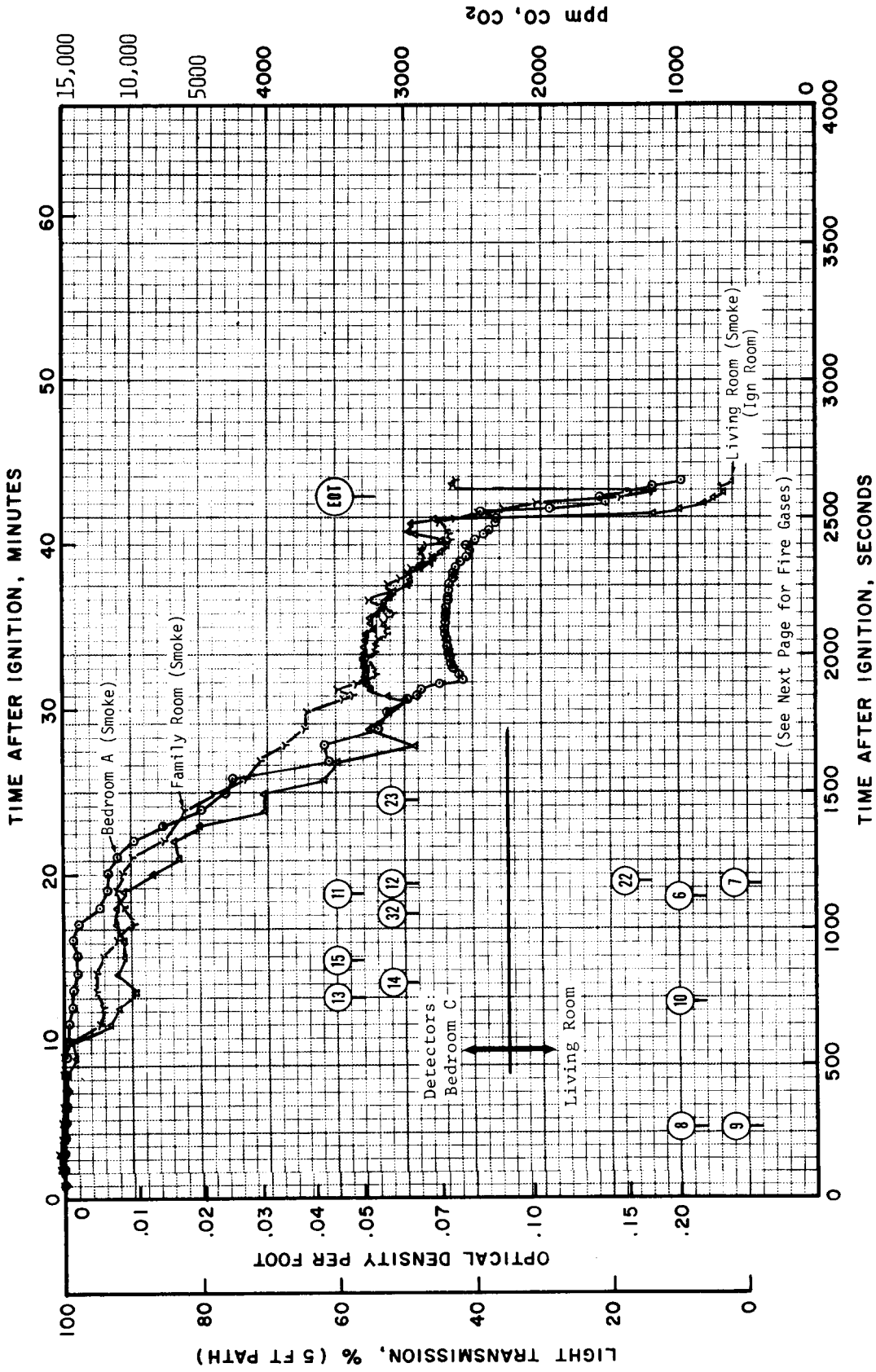
CEILING GASES, W-63

TIME AFTER IGNITION, MINUTES

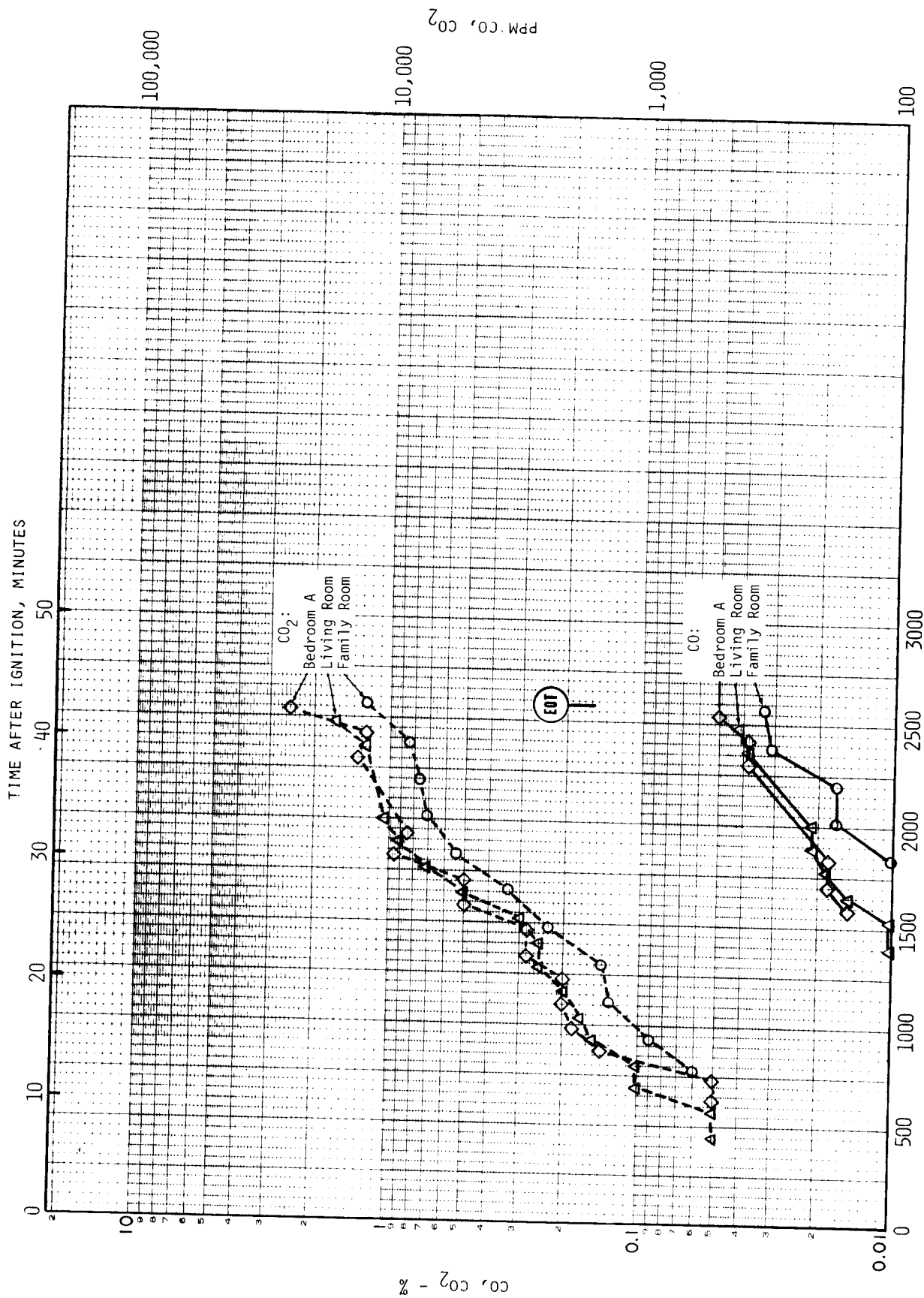




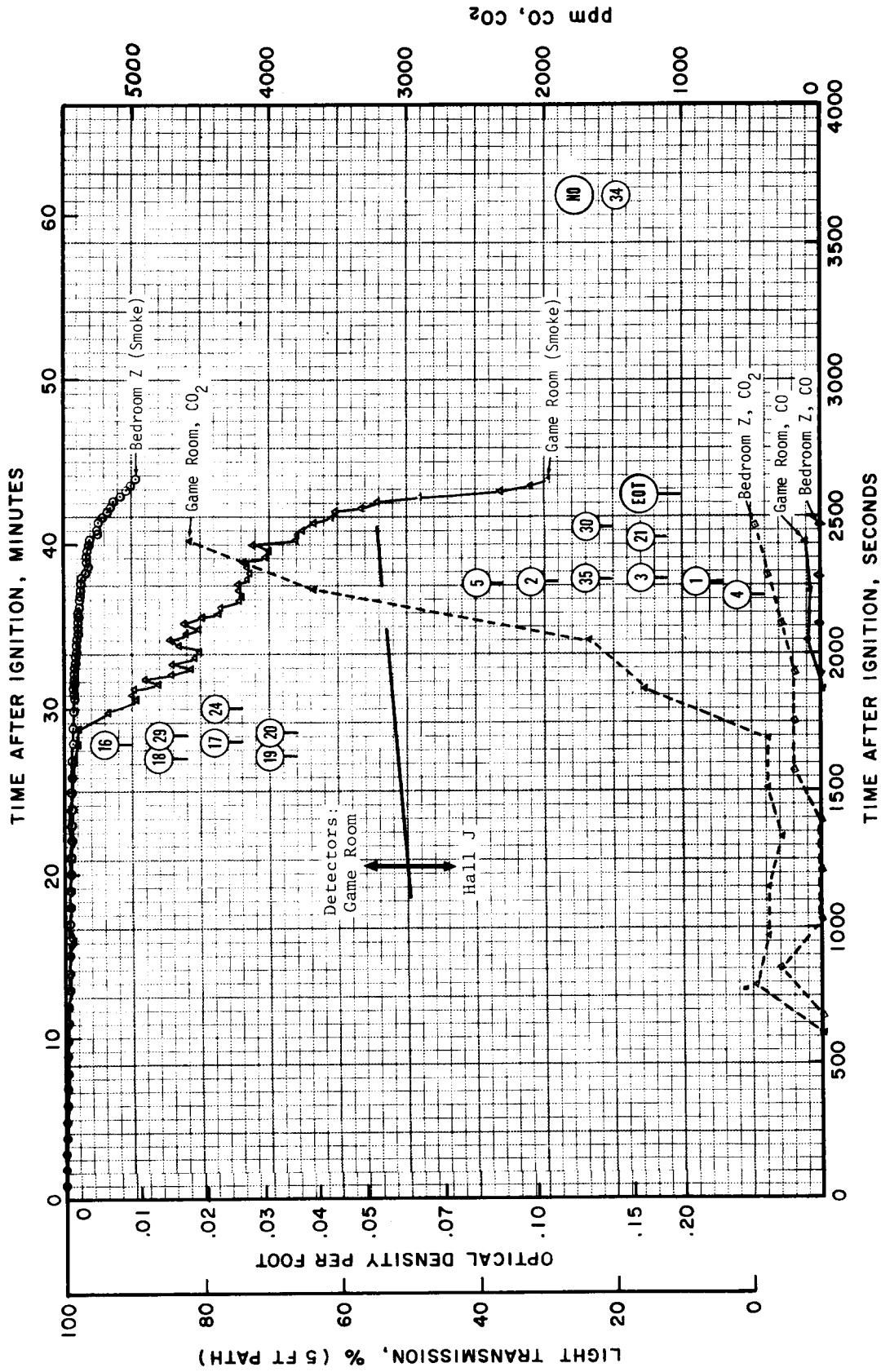
MAXIMUM TEMPERATURE PROFILES, W-63



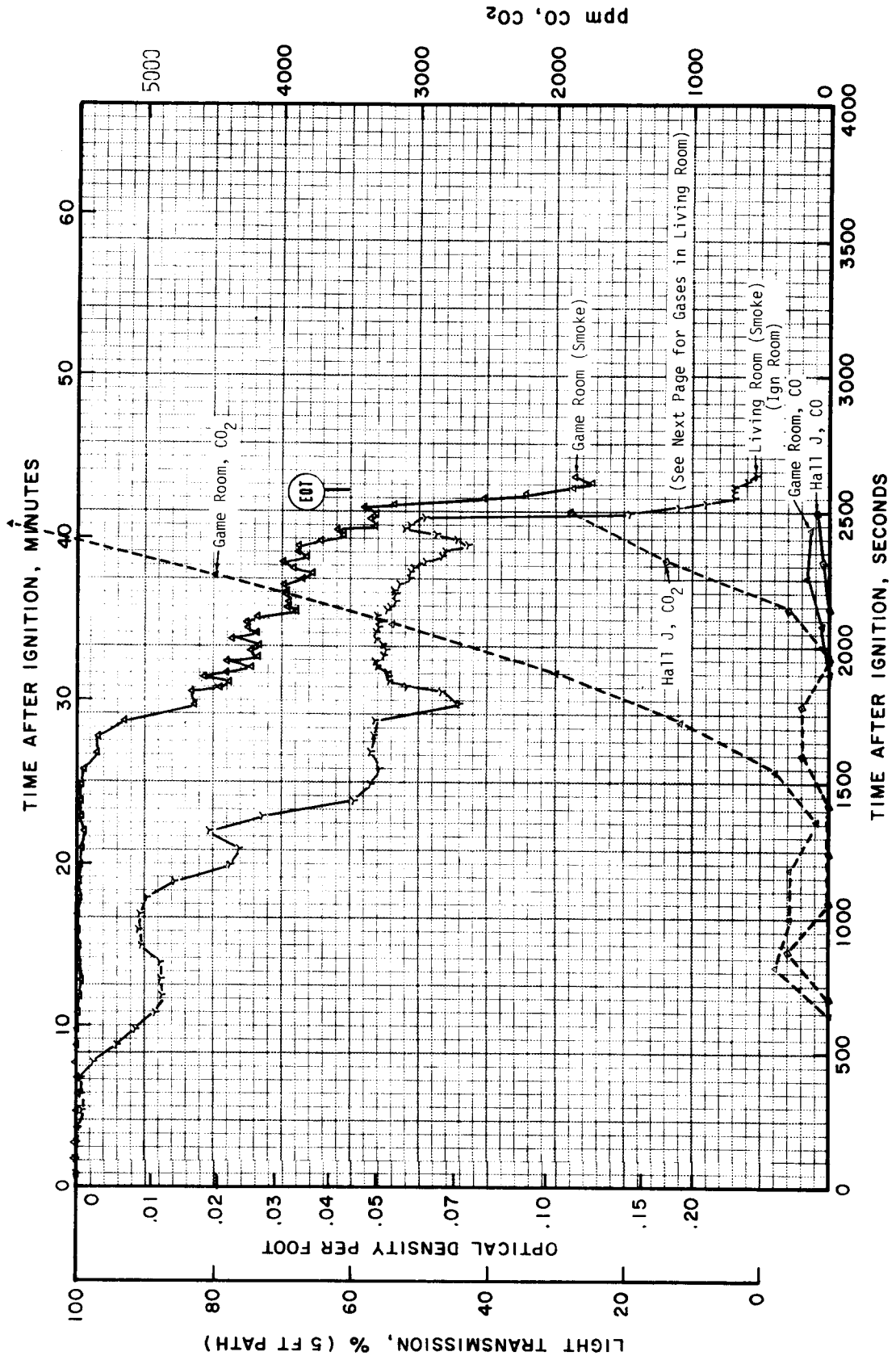
CONDITIONS ON 1ST FLOOR AT 5 FT, W-64



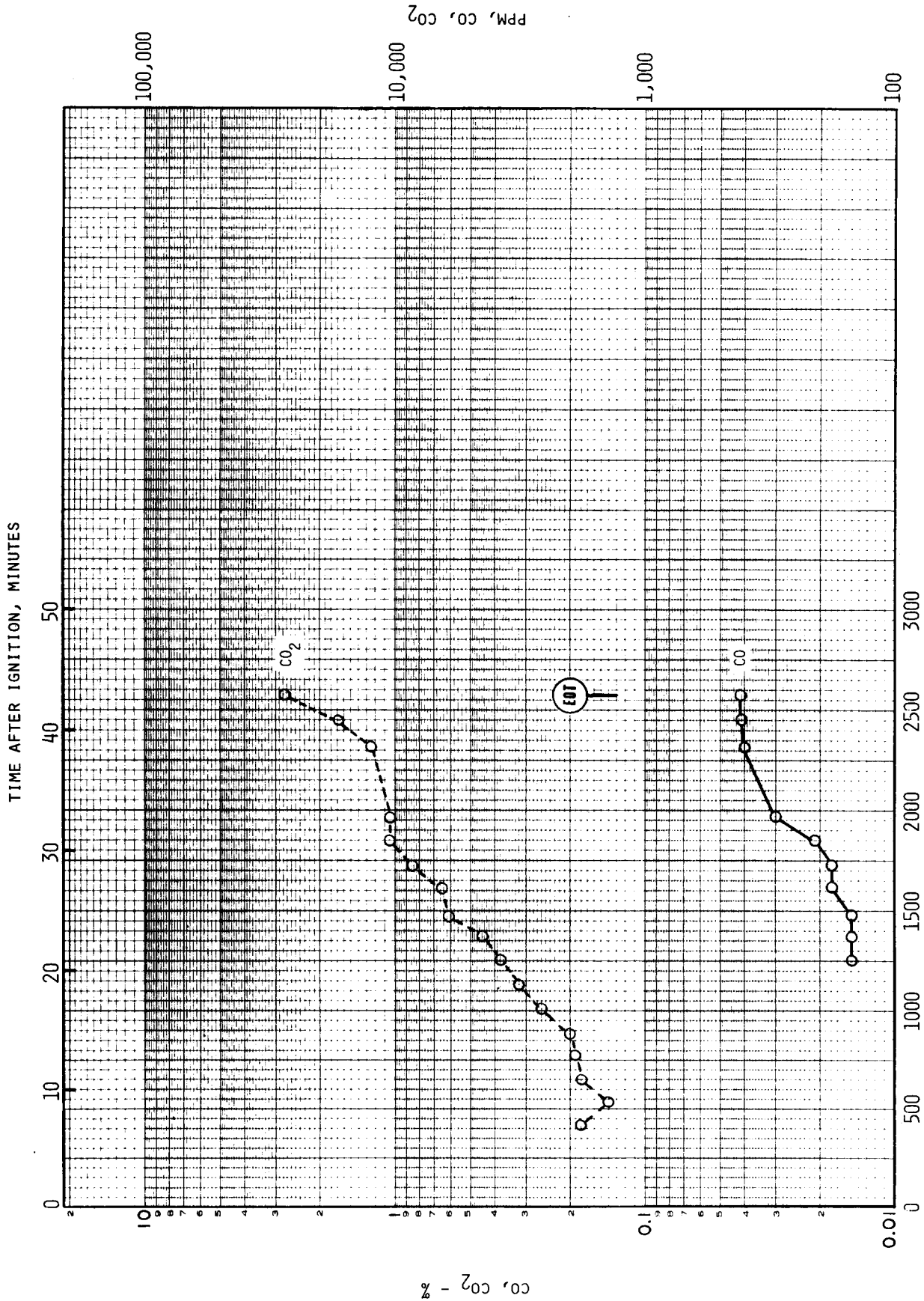
TIME AFTER IGNITION, SECONDS
 GASES ON 1ST FLOOR AT 5 FT. W-64



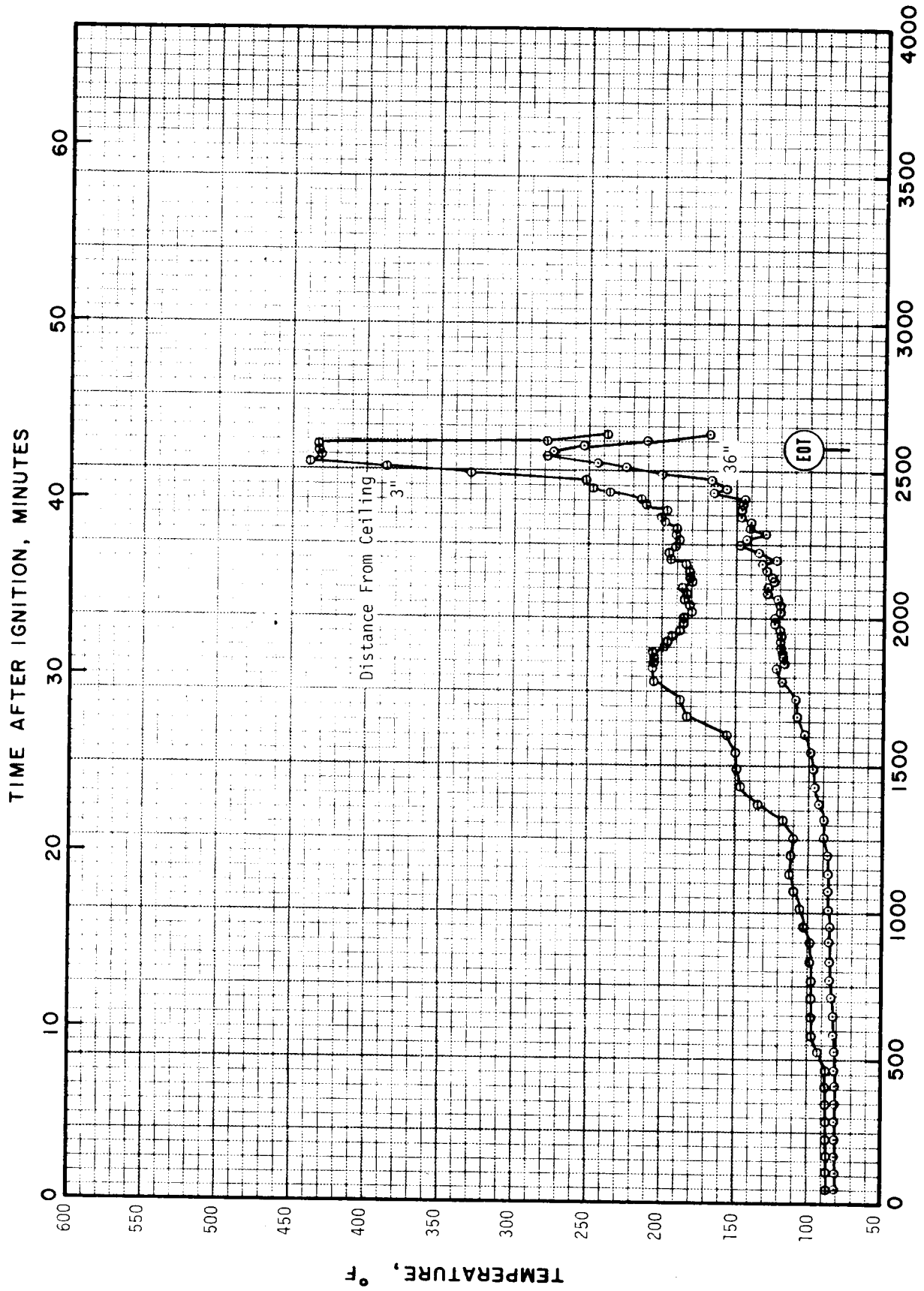
CONDITIONS ON 2ND FLOOR AT 5 FT, W-64



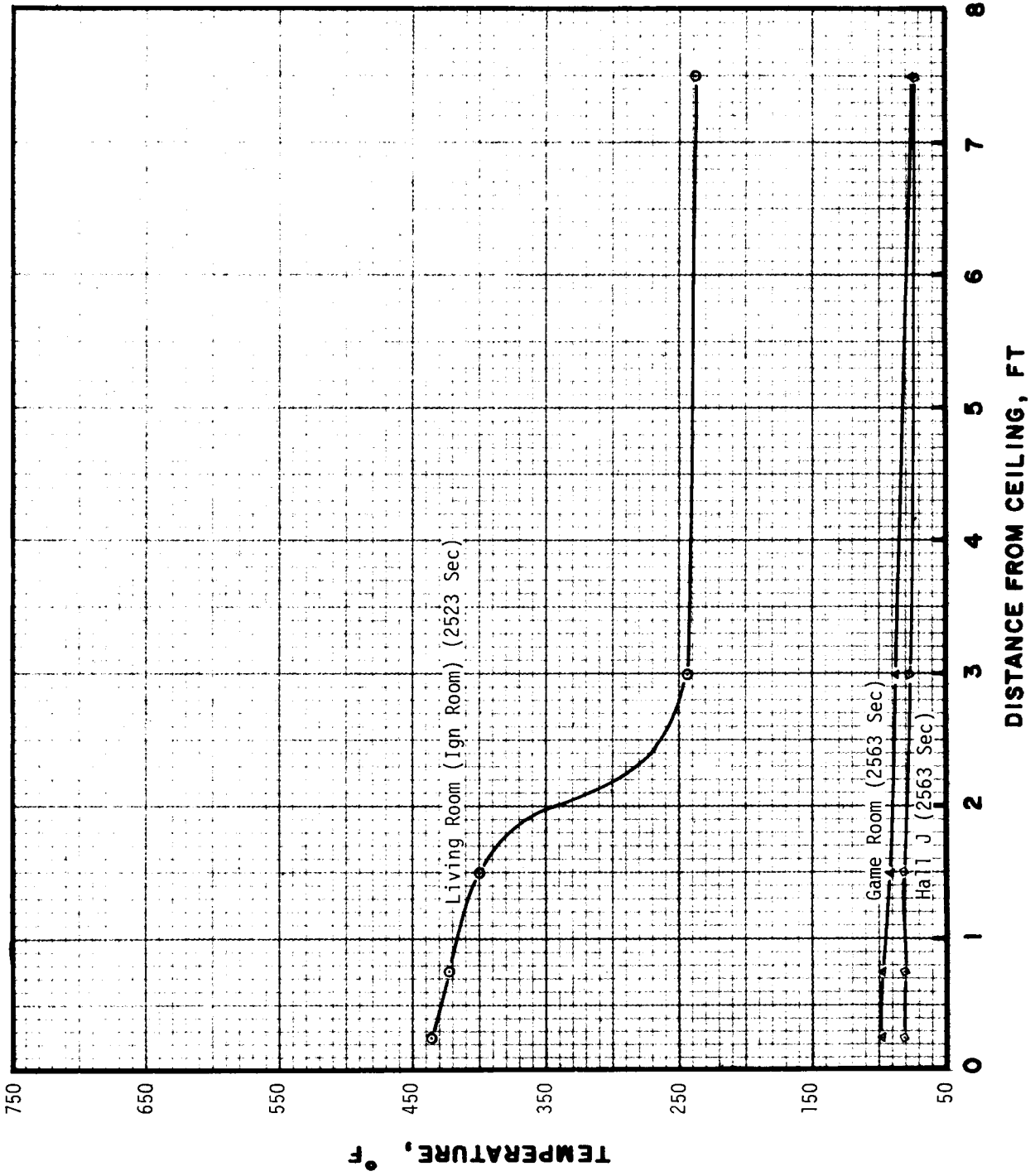
VARIOUS CEILING CONDITIONS, W-64



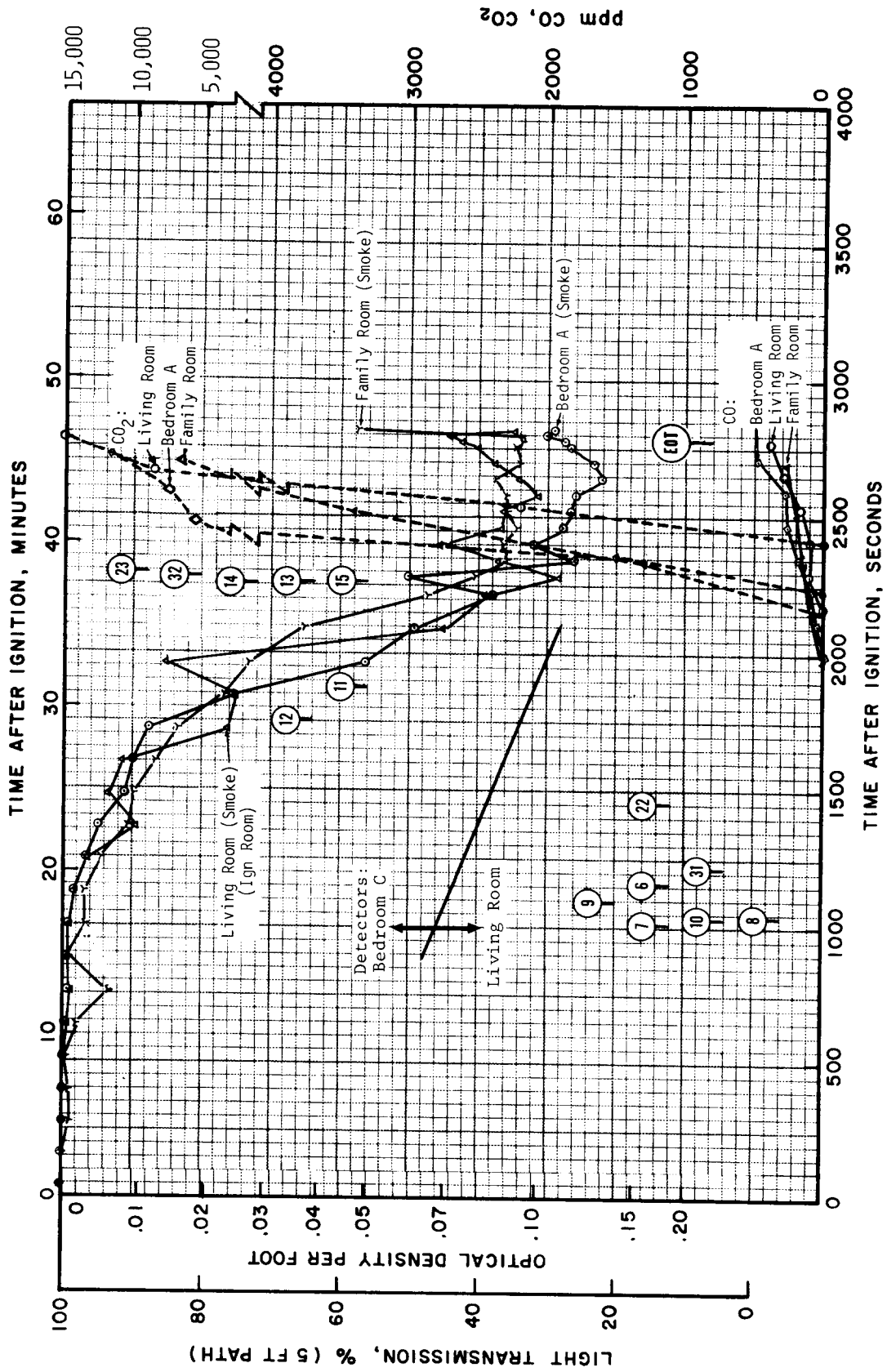
TIME AFTER IGNITION, SECONDS
 CEILING GASES IN LIVING ROOM, W-64



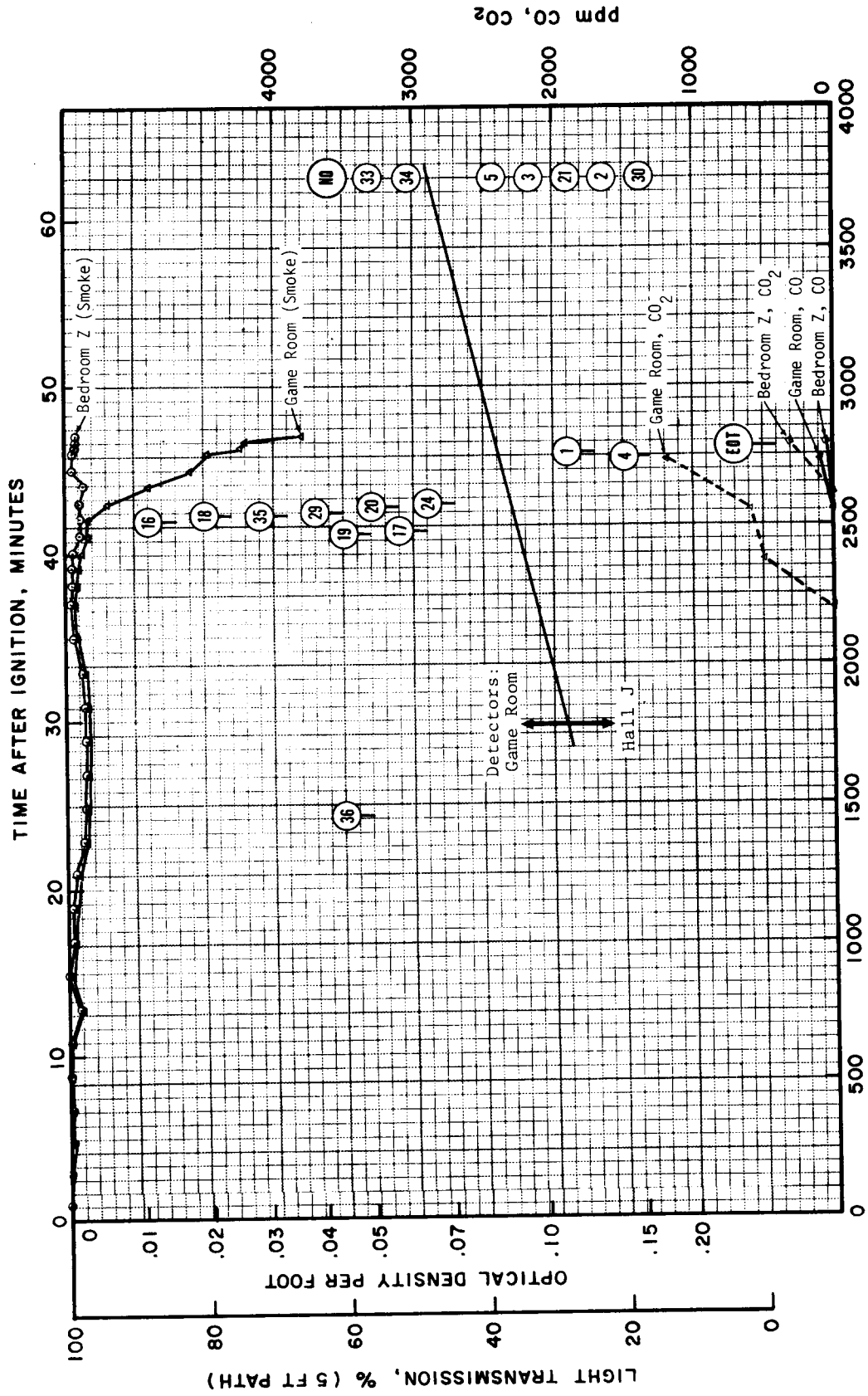
TEMPERATURES IN LIVING ROOM (IGNITION ROOM), W-64



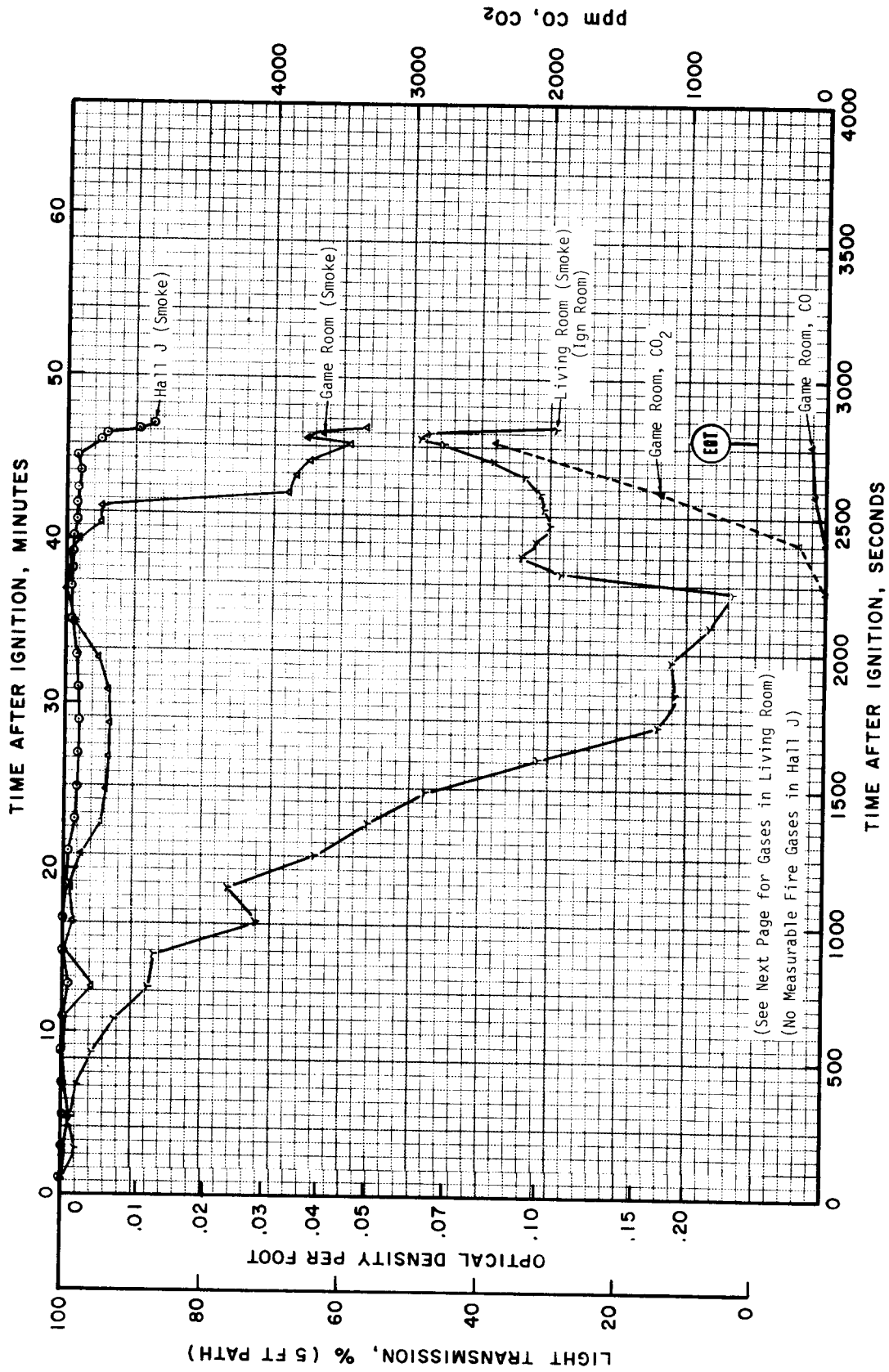
MAXIMUM TEMPERATURE PROFILES, W-64



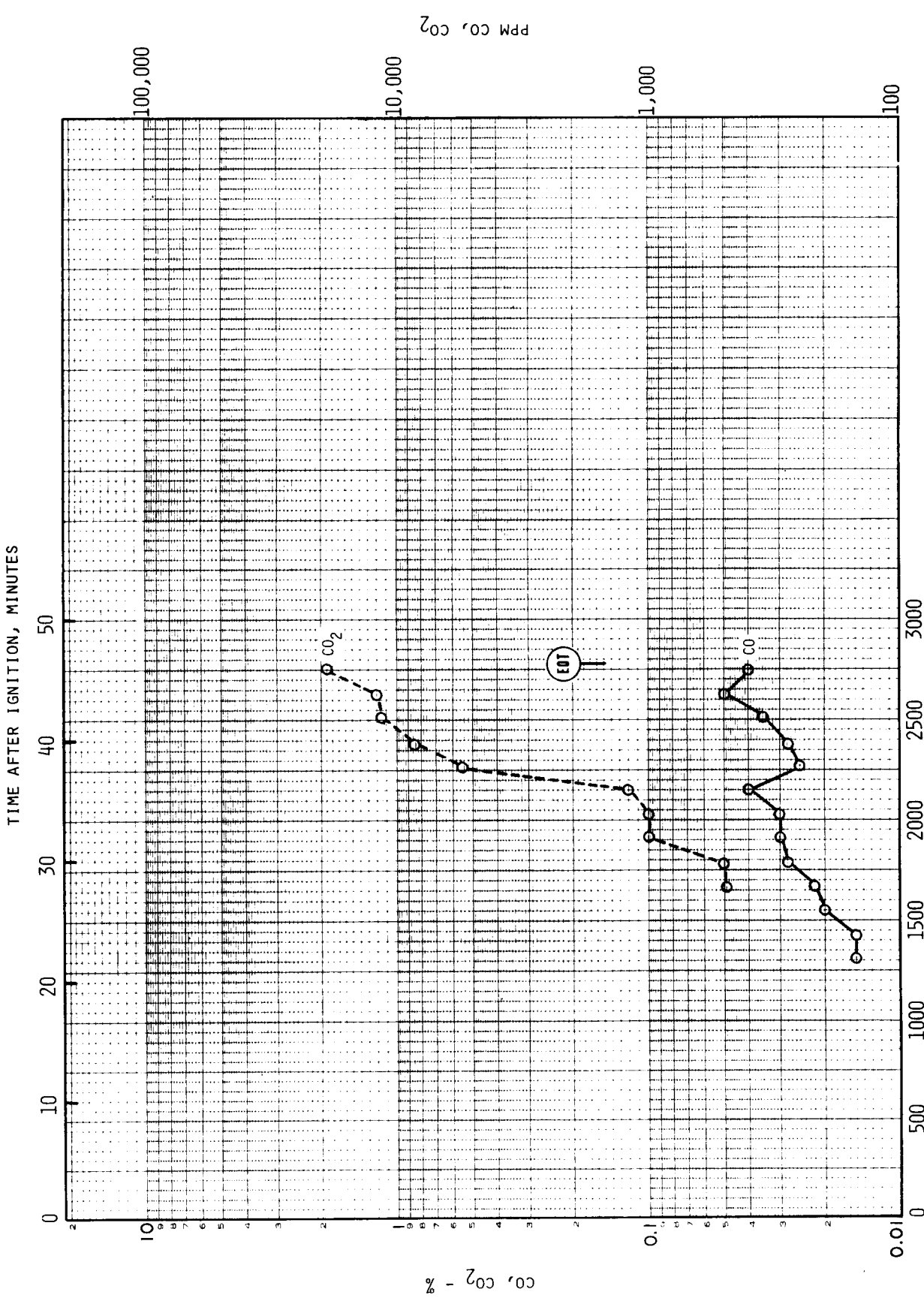
CONDITIONS ON 1ST FLOOR AT 5 FT, W-65



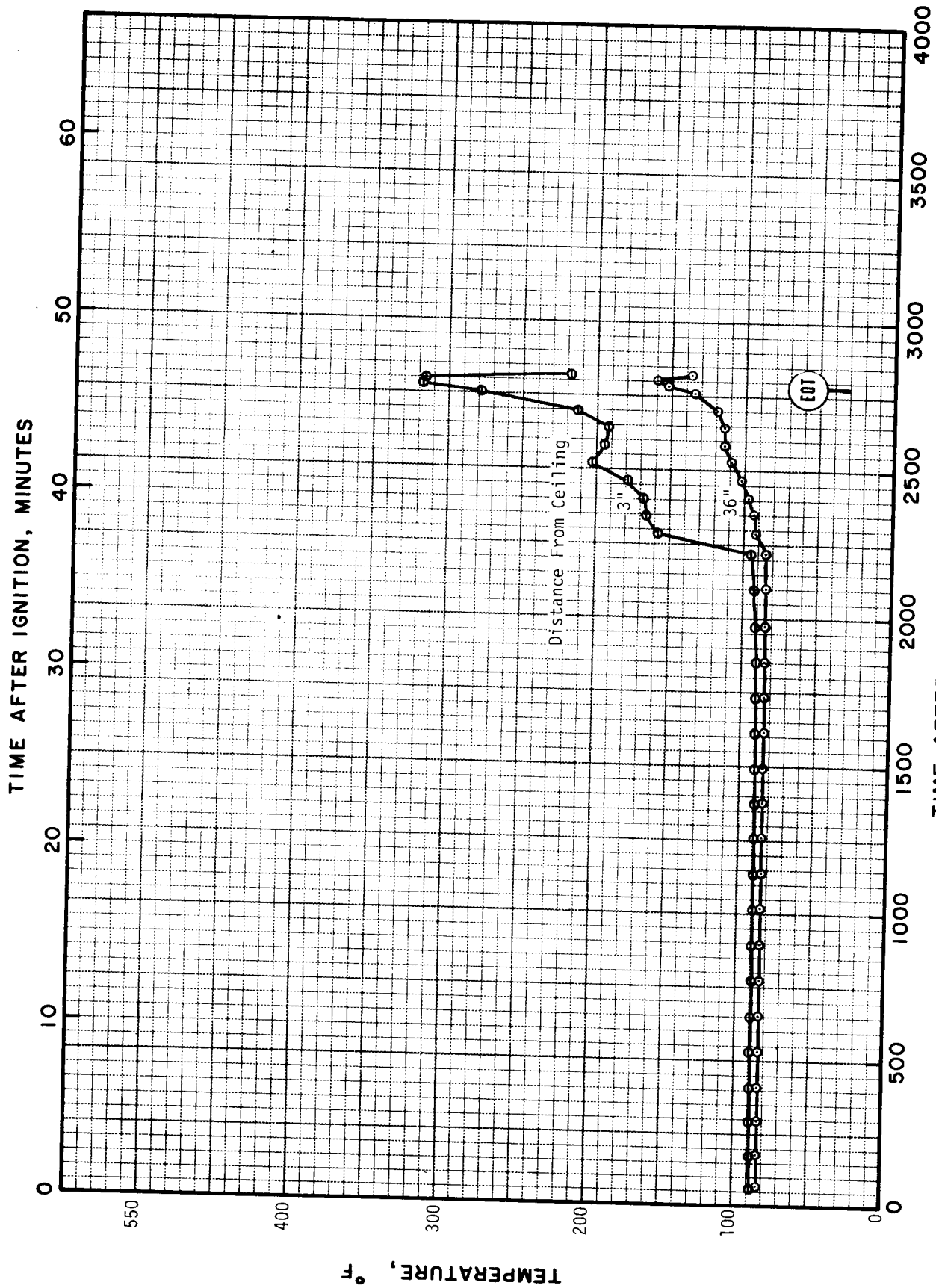
CONDITIONS ON 2ND FLOOR AT 5 FT, W-65



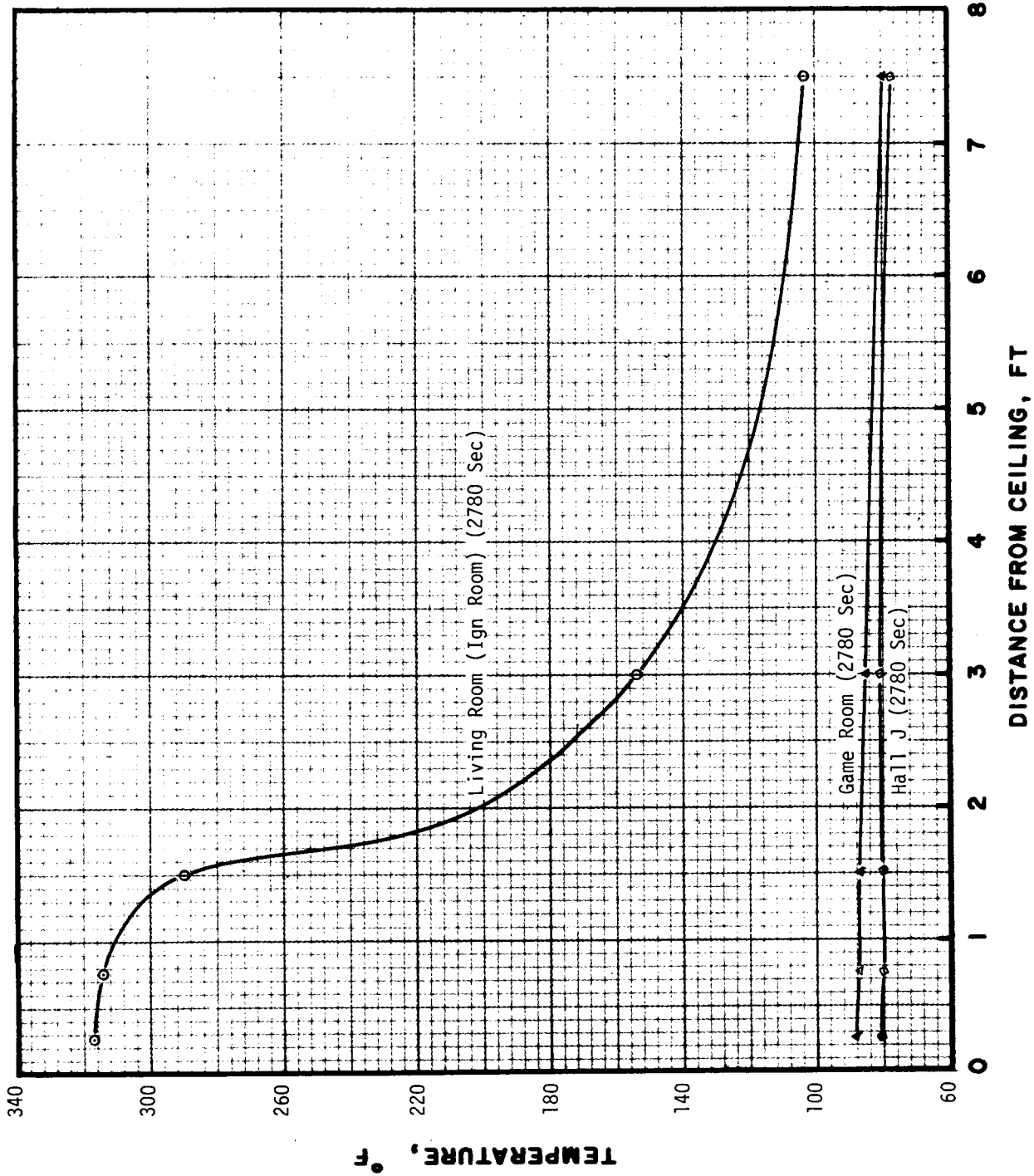
VARIOUS CEILING CONDITIONS, W-65



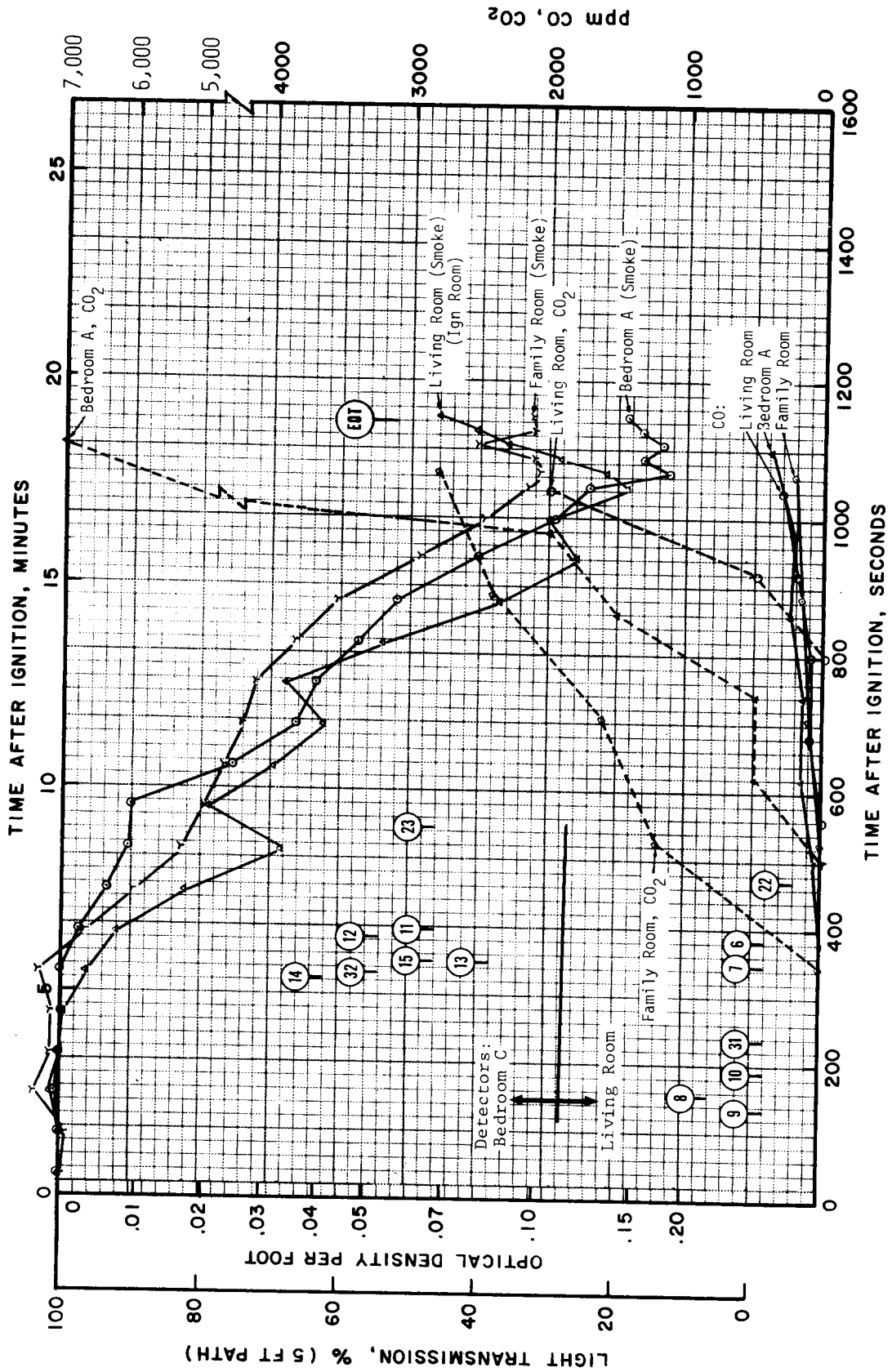
TIME AFTER IGNITION, SECONDS
 CEILING GASES IN LIVING ROOM, W-65



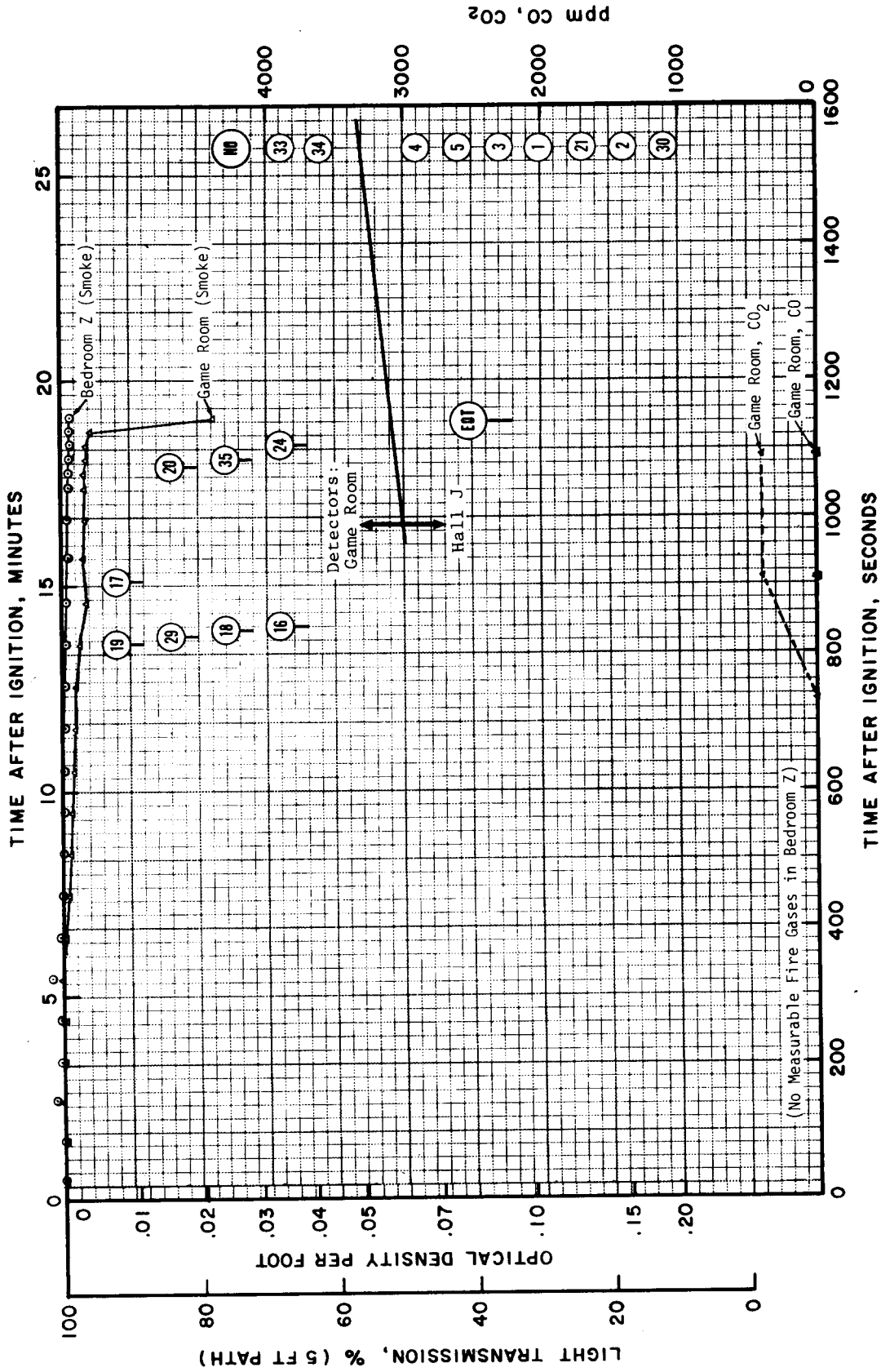
TEMPERATURES IN LIVING ROOM (IGN ROOM), W-65



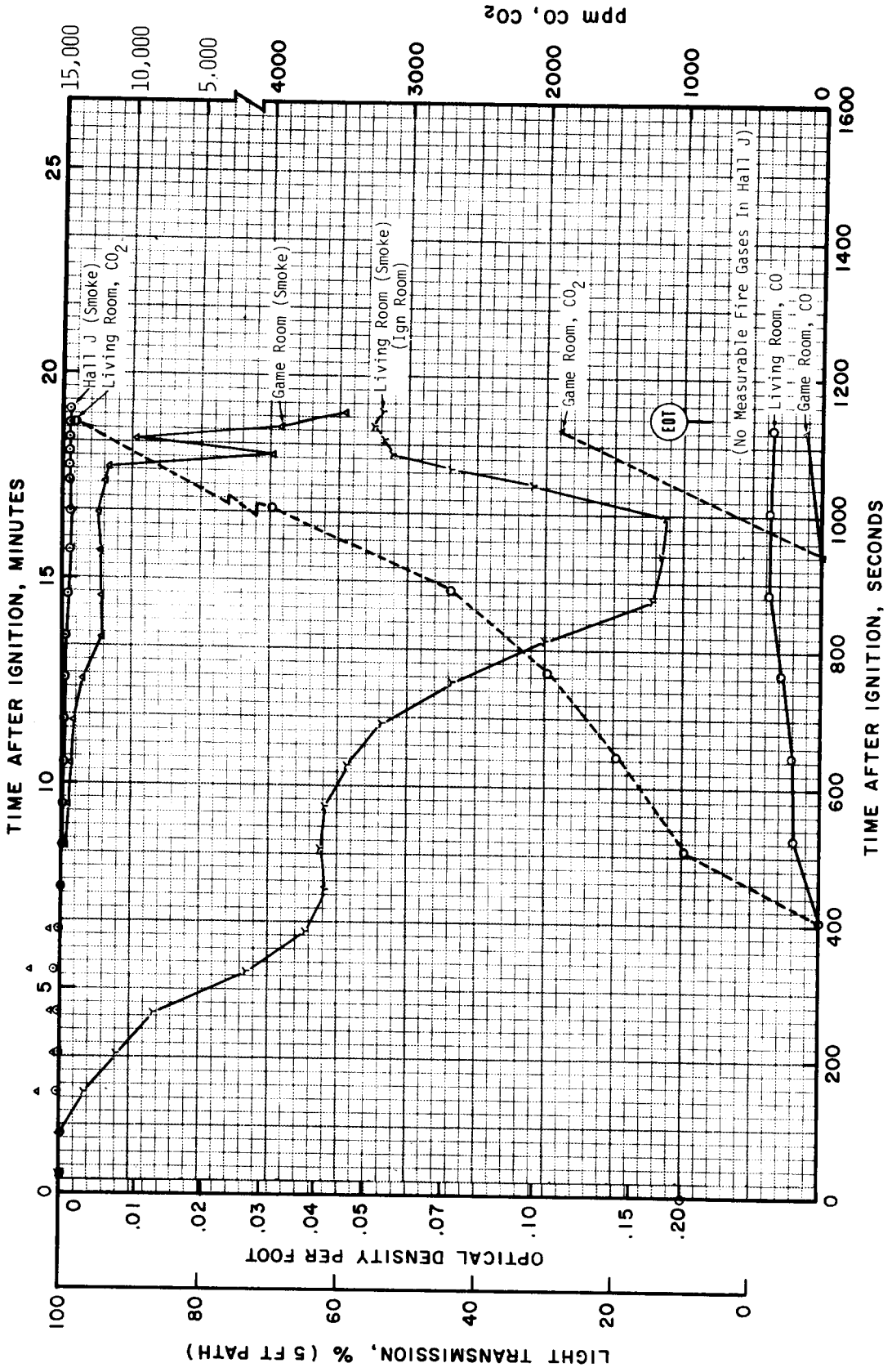
MAXIMUM TEMPERATURE PROFILES, W-65



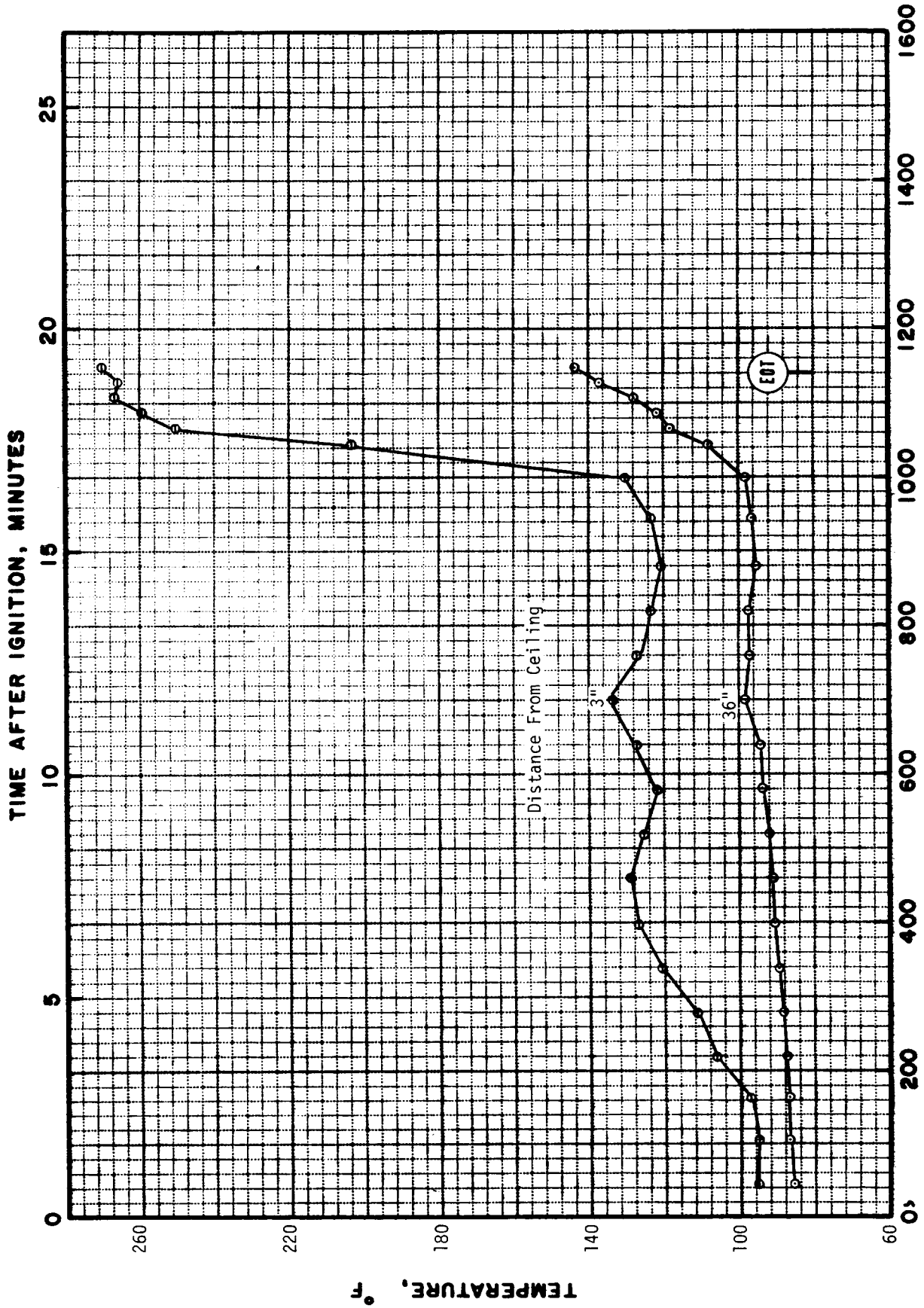
CONDITIONS ON 1ST FLOOR AT 5 FT, W-66



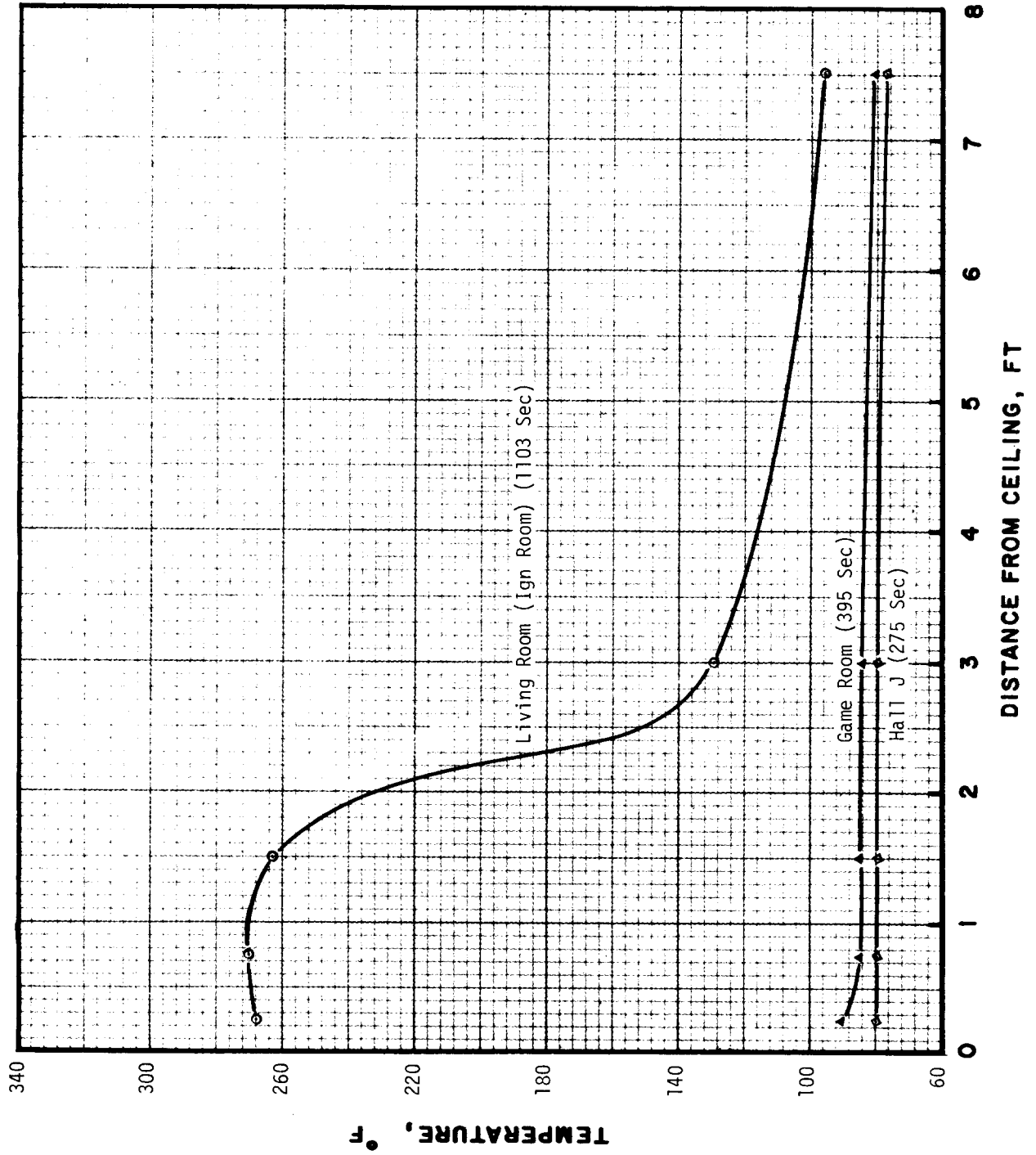
CONDITIONS ON 2ND FLOOR AT 5 FT, W-66



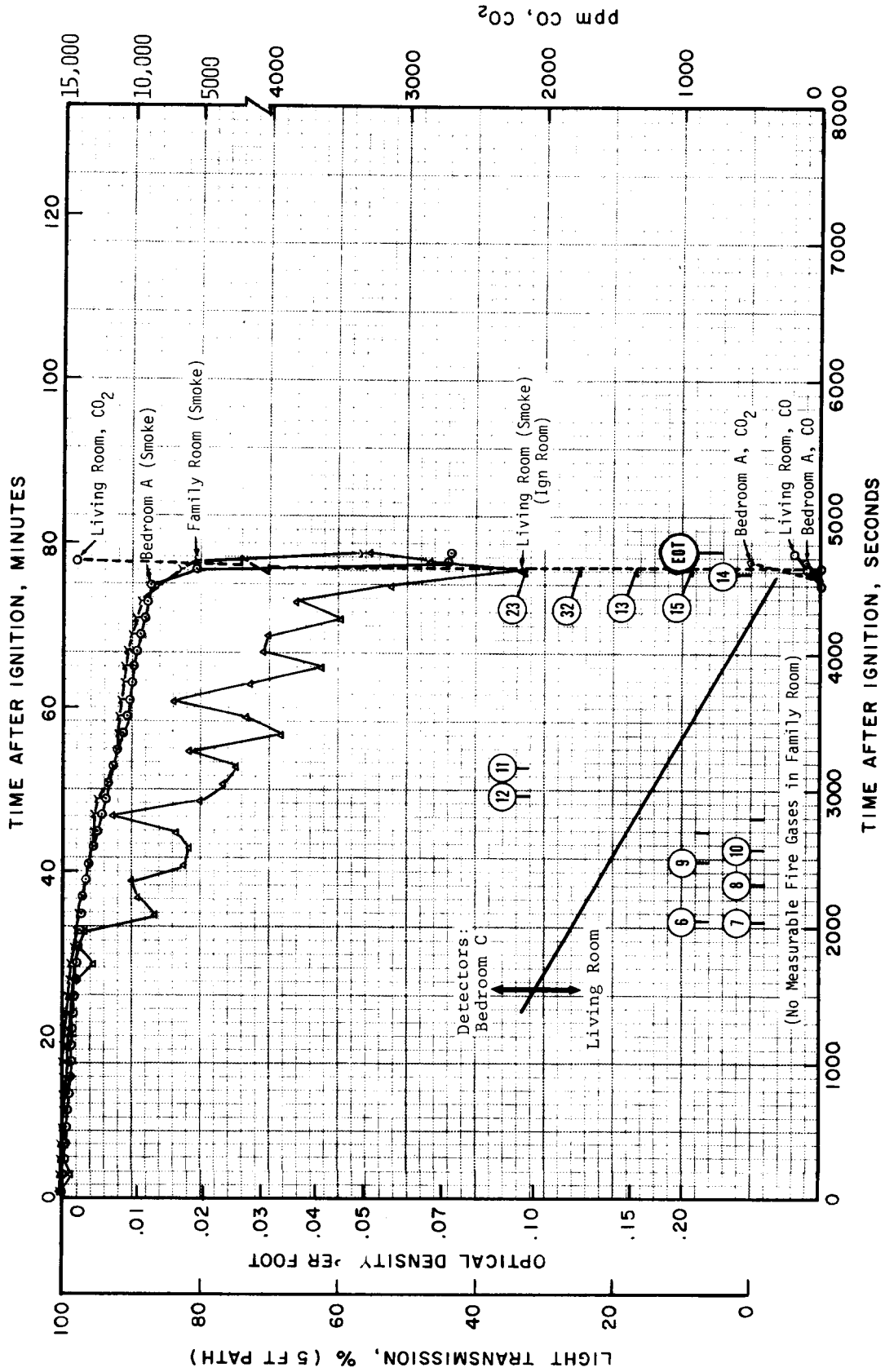
VARIOUS CEILING CONDITIONS, W-66



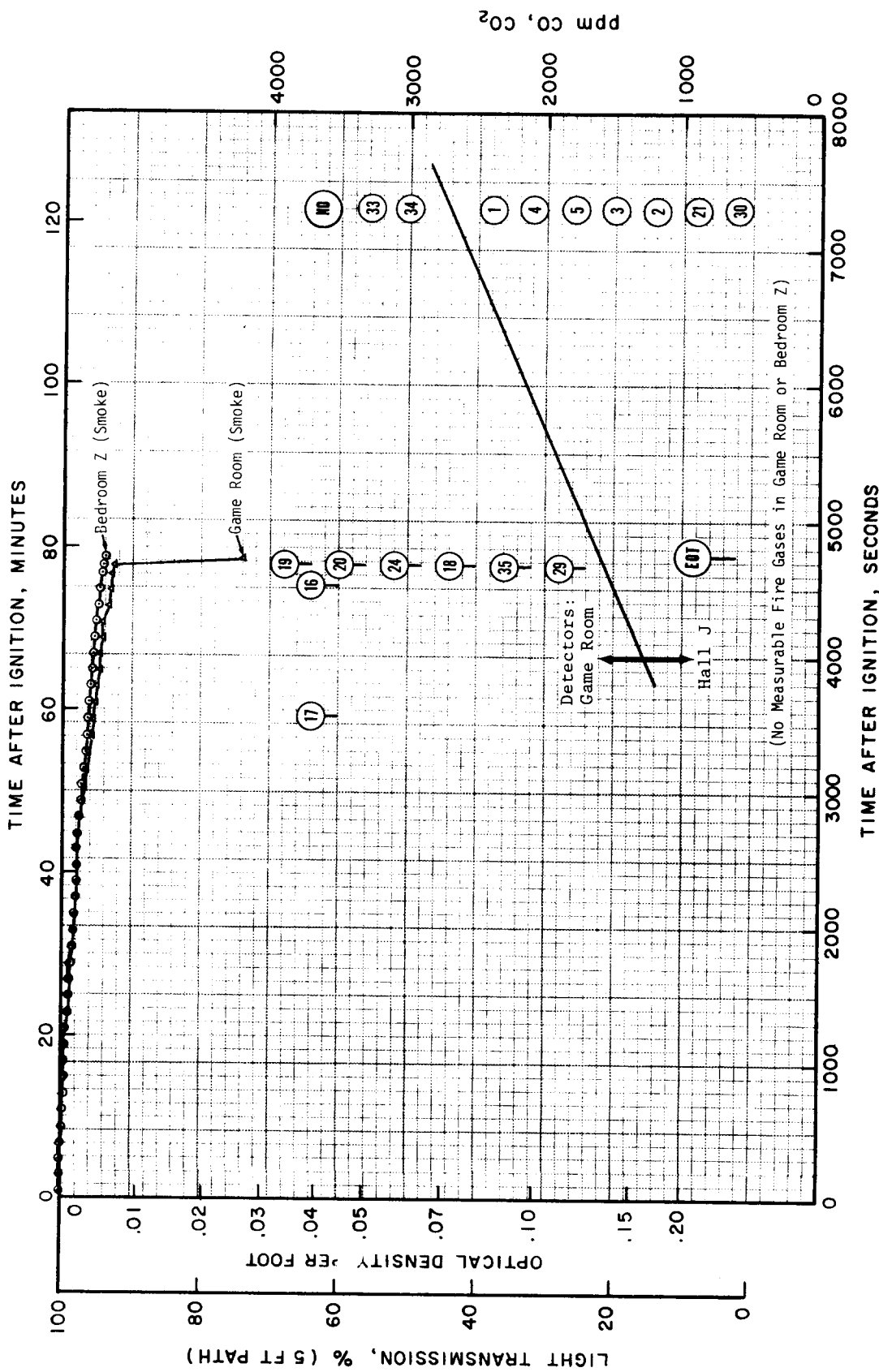
TEMPERATURES IN LIVING ROOM (IGN ROOM), W-66



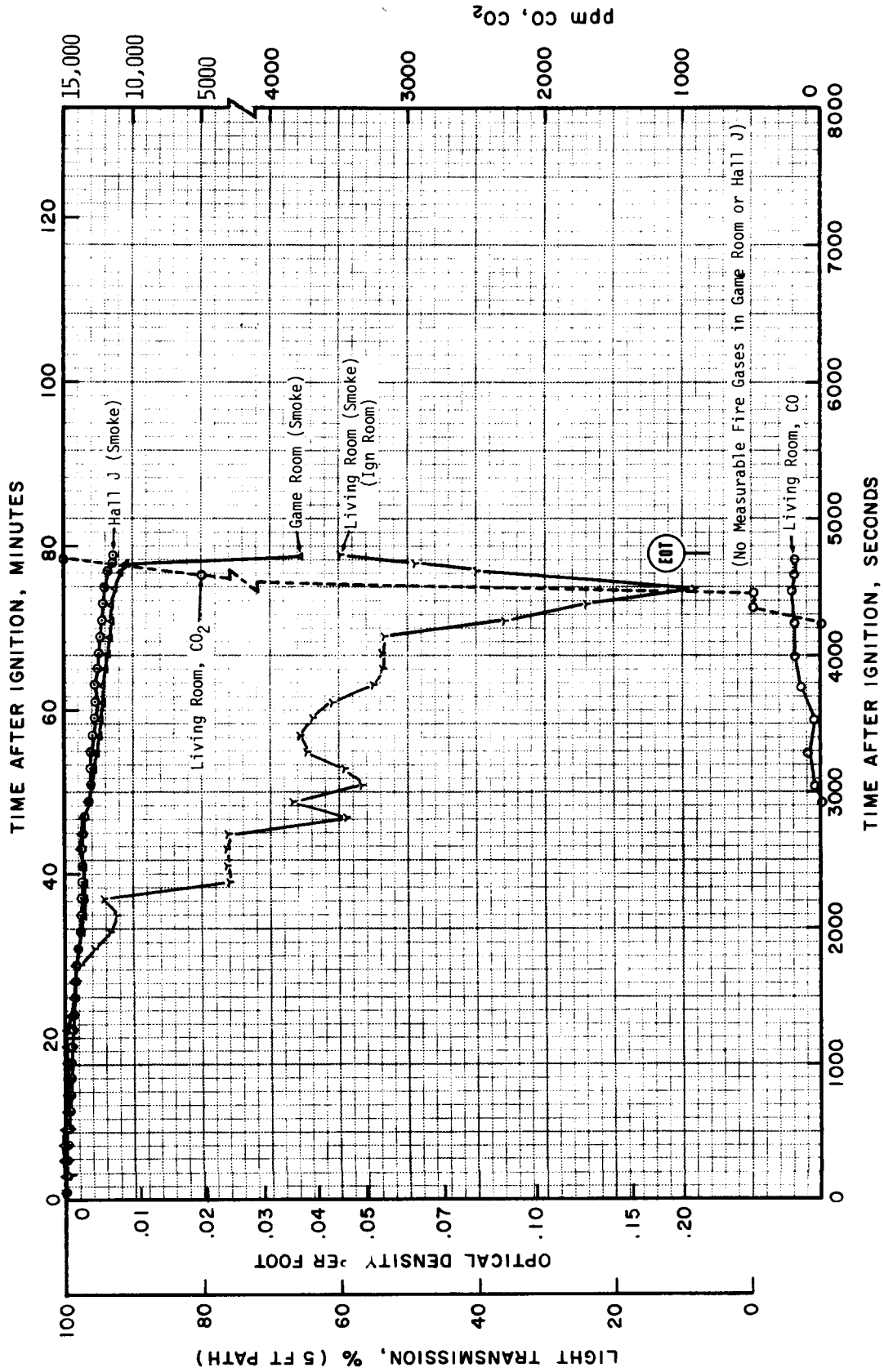
MAXIMUM TEMPERATURE PROFILES, W-66



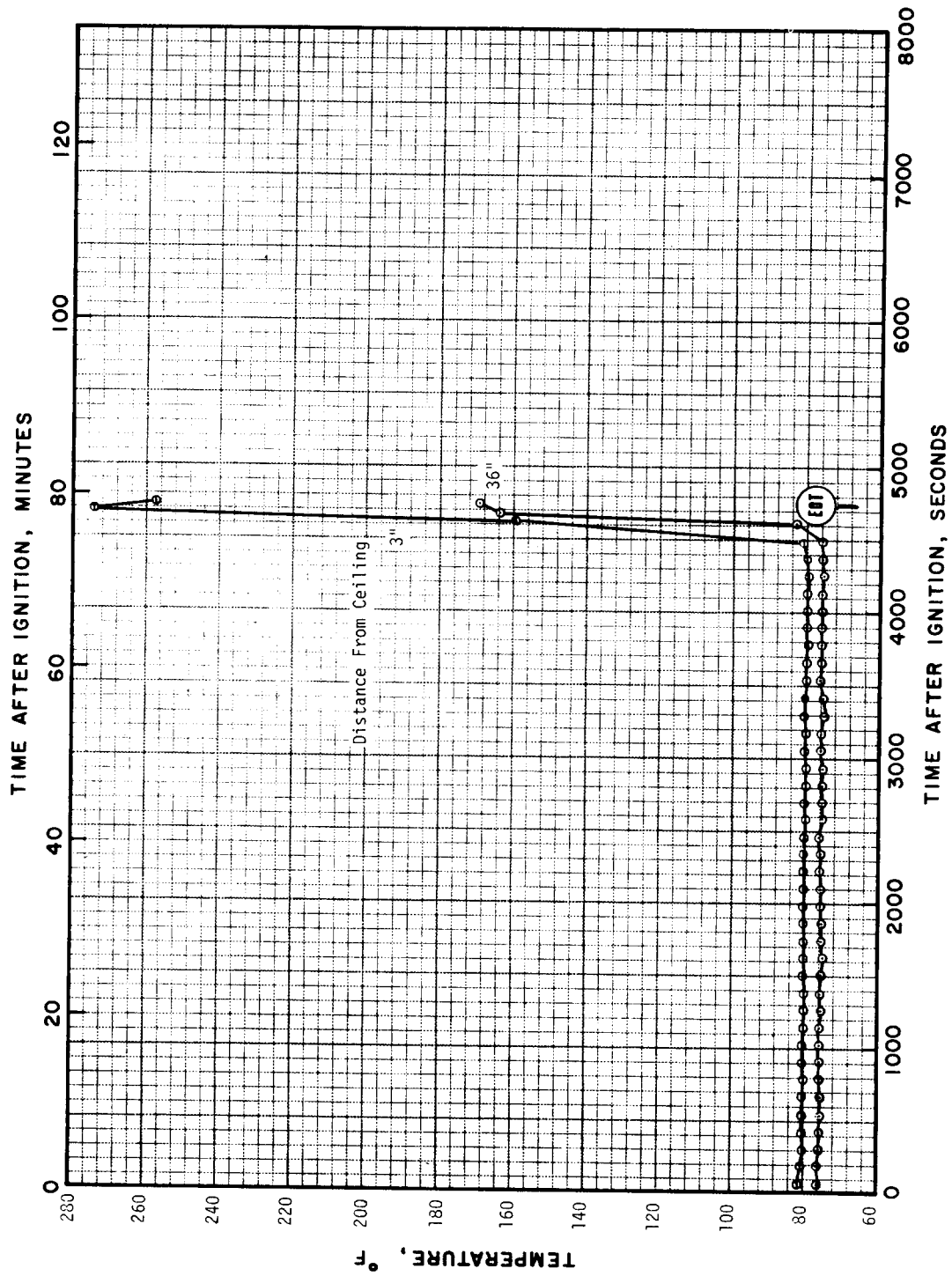
CONDITIONS ON 1ST FLOOR AT 5 FT, W-67



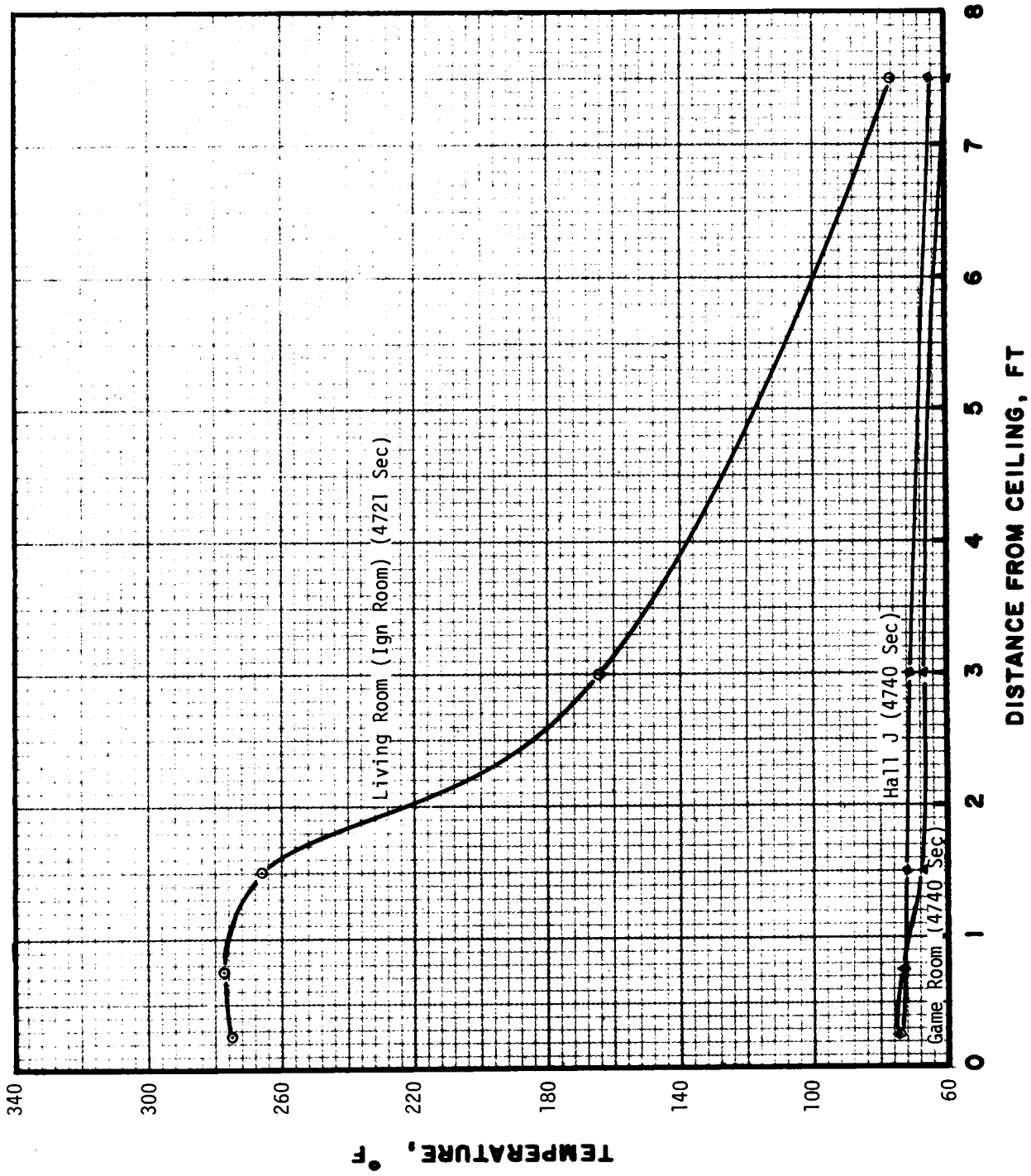
CONDITIONS ON 2ND FLOOR AT 5 FT, W-67



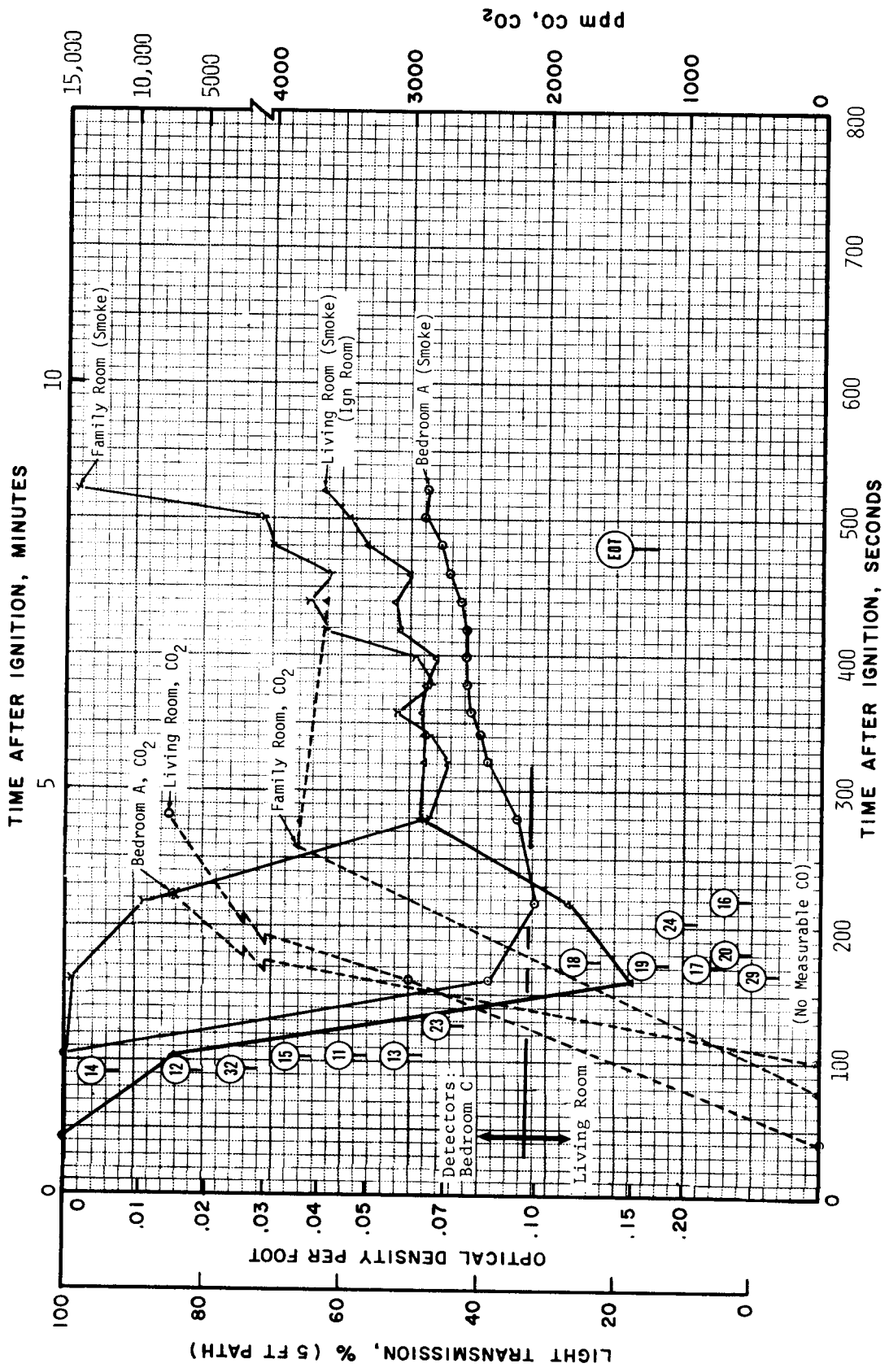
VARIOUS CEILING CONDITIONS, W-67



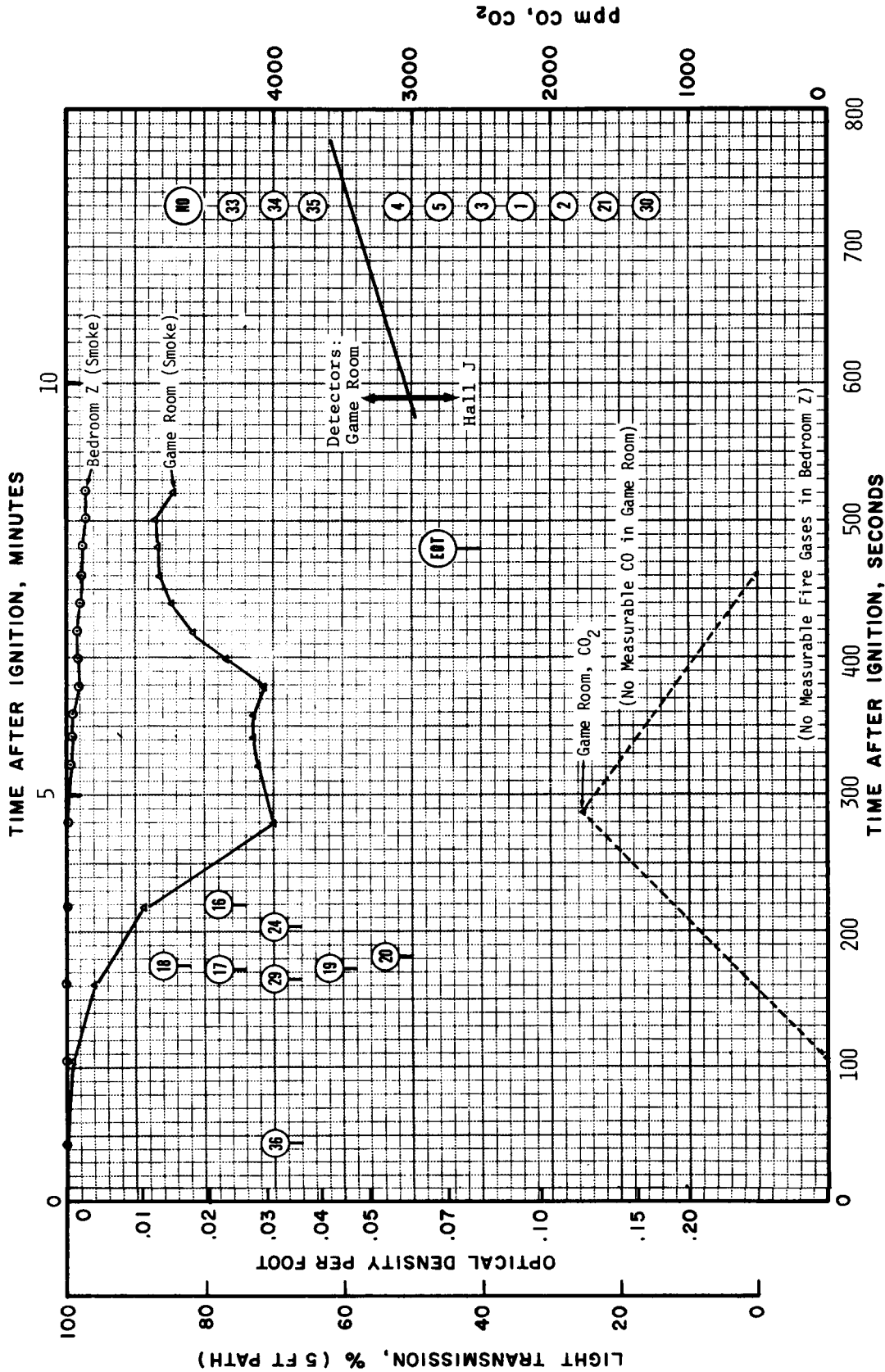
TEMPERATURES IN LIVING ROOM (IGNITION ROOM), W-67



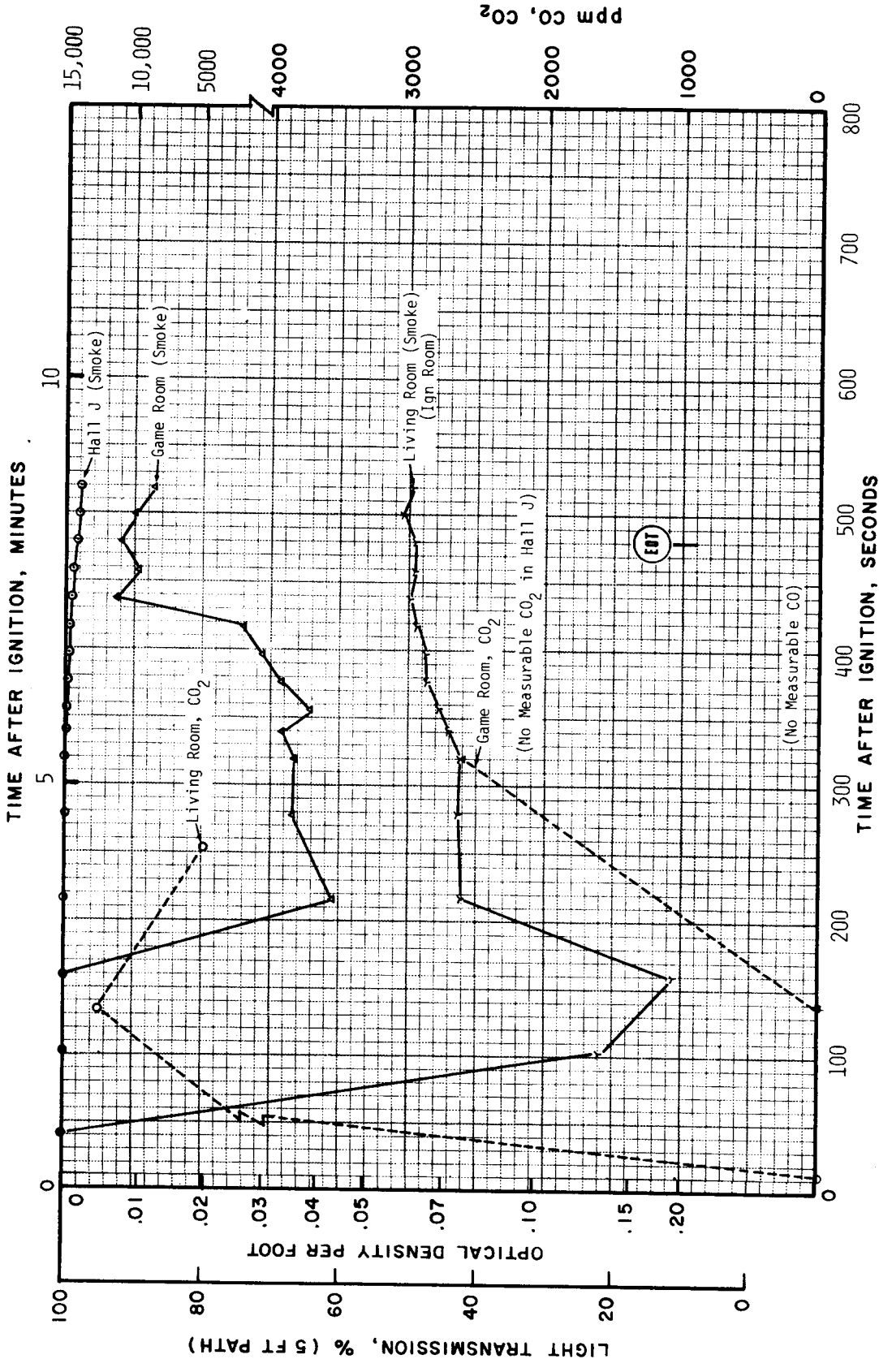
MAXIMUM TEMPERATURE PROFILES, W-67



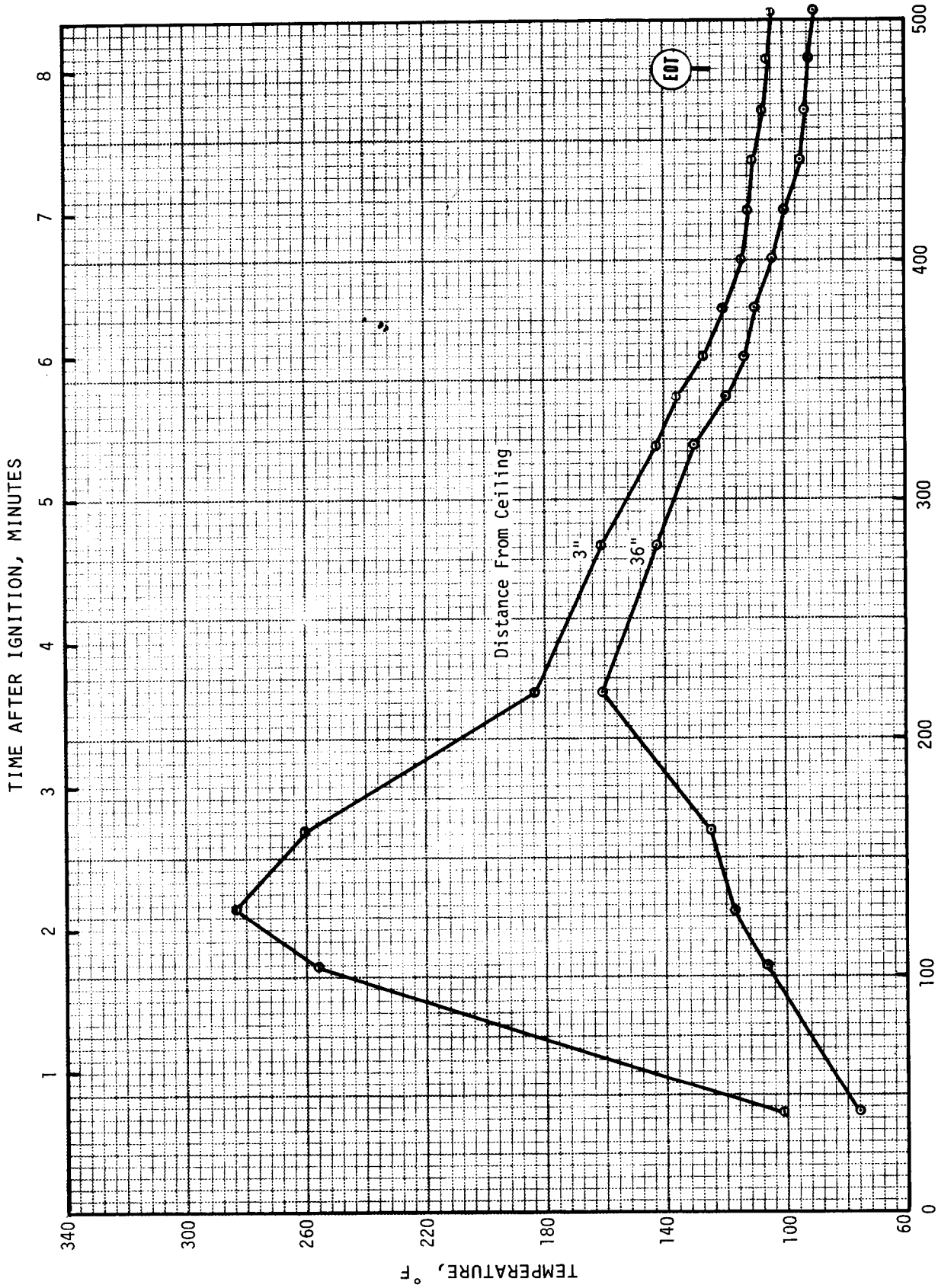
CONDITIONS ON 1ST FLOOR AT 5 FT, W-68



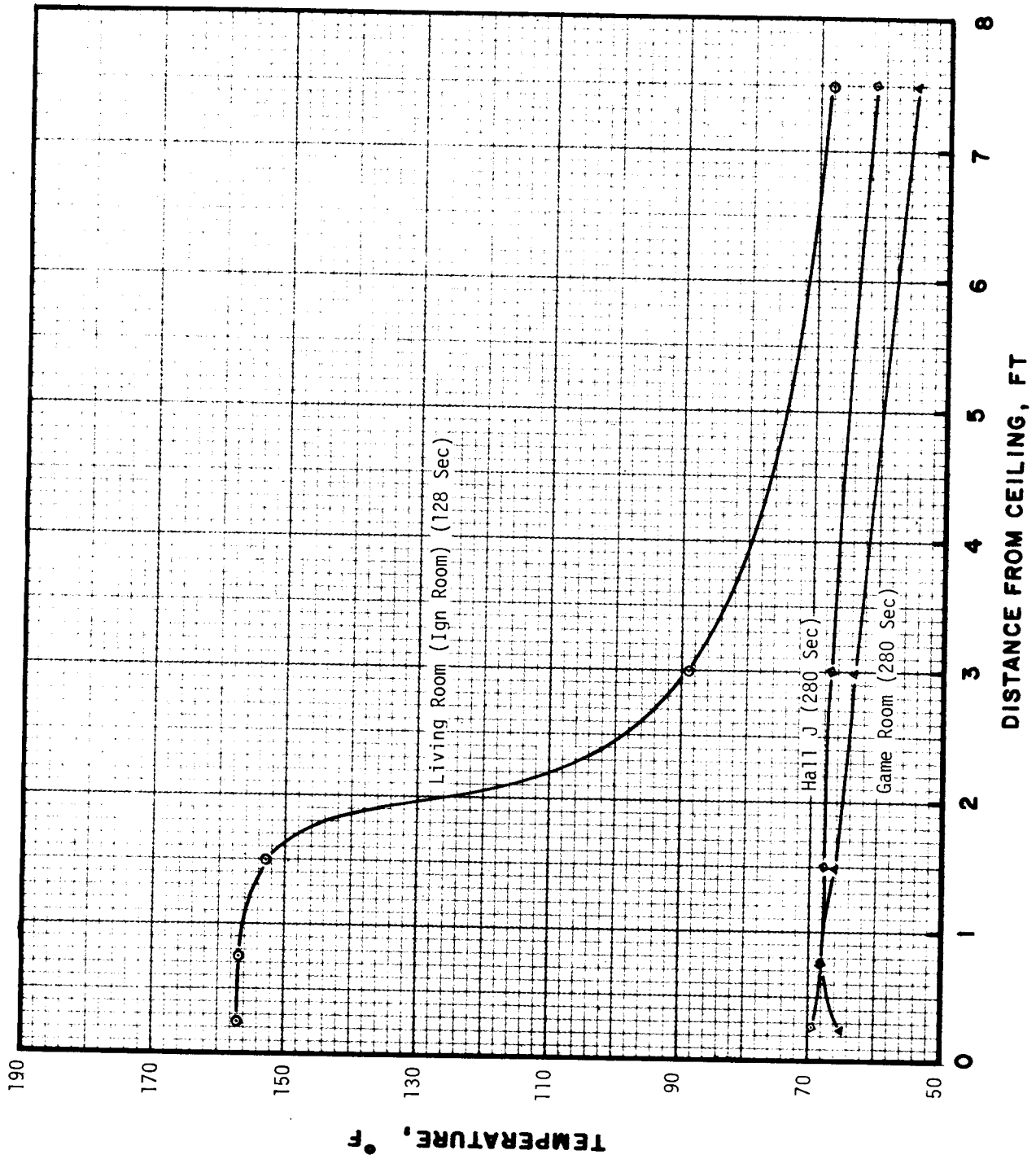
CONDITIONS ON 2ND FLOOR AT 5 FT, W-68



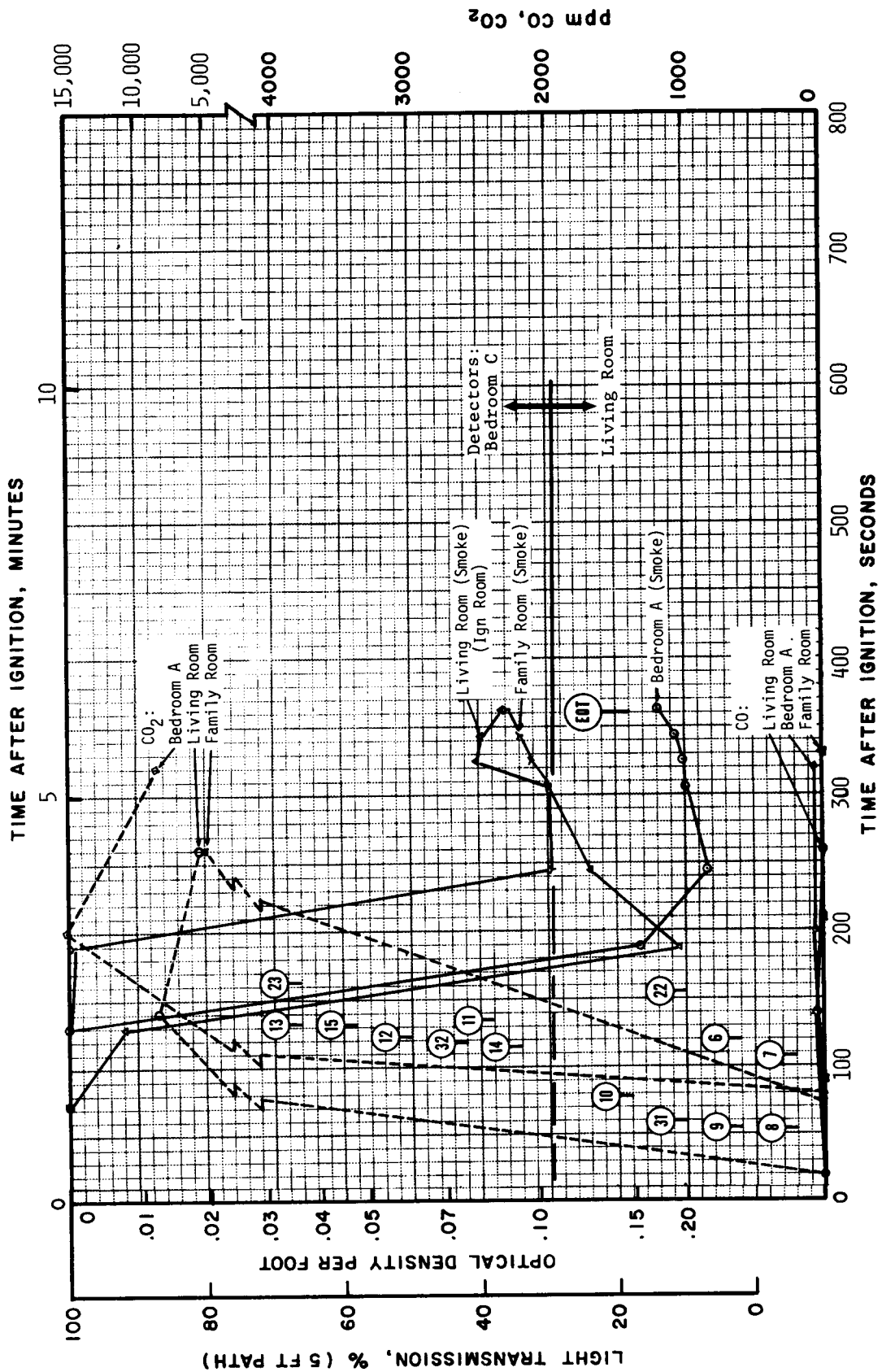
VARIOUS CEILING CONDITIONS, W-68



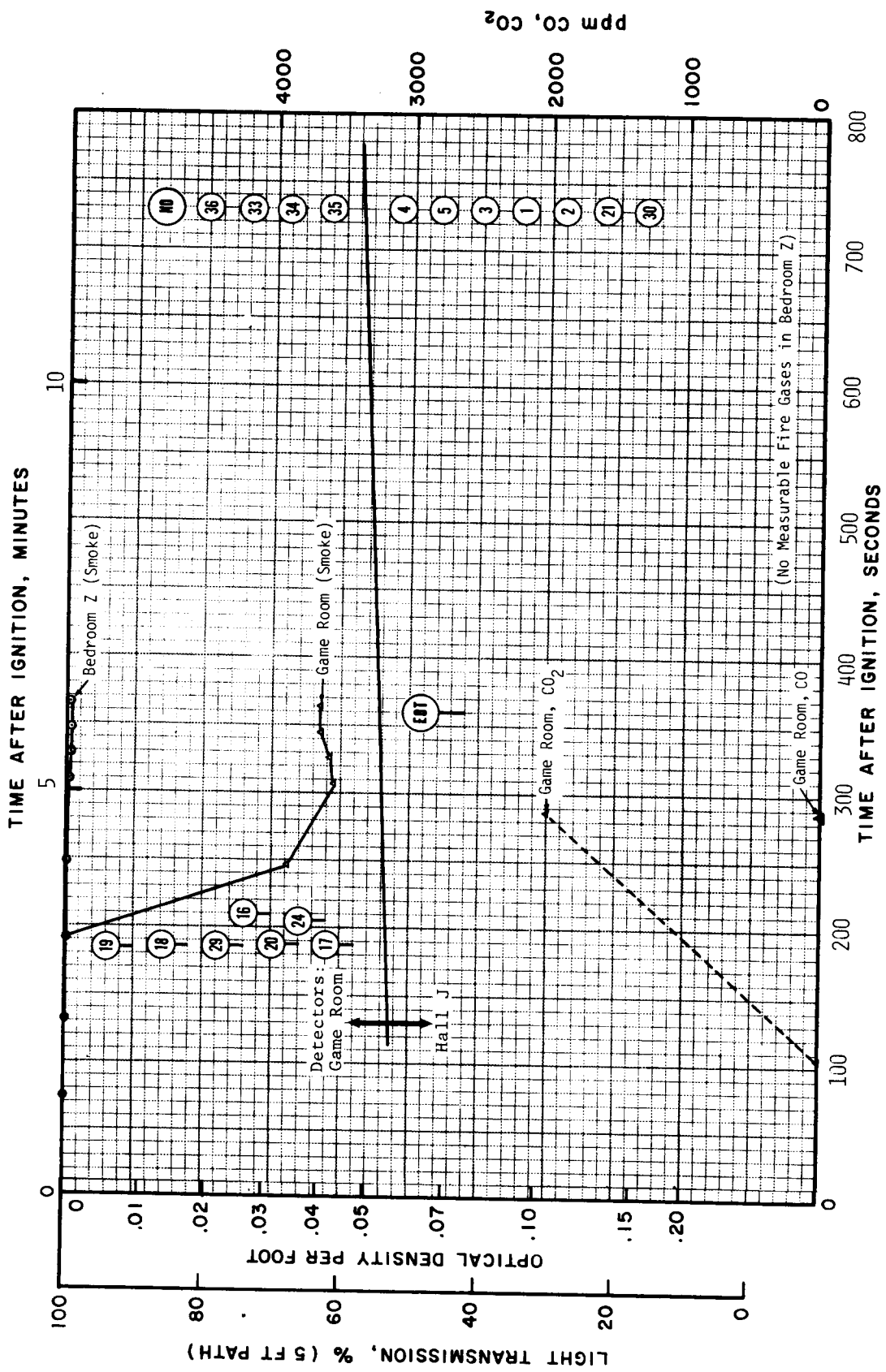
TEMPERATURES IN LIVING ROOM (IGN ROOM), W-68



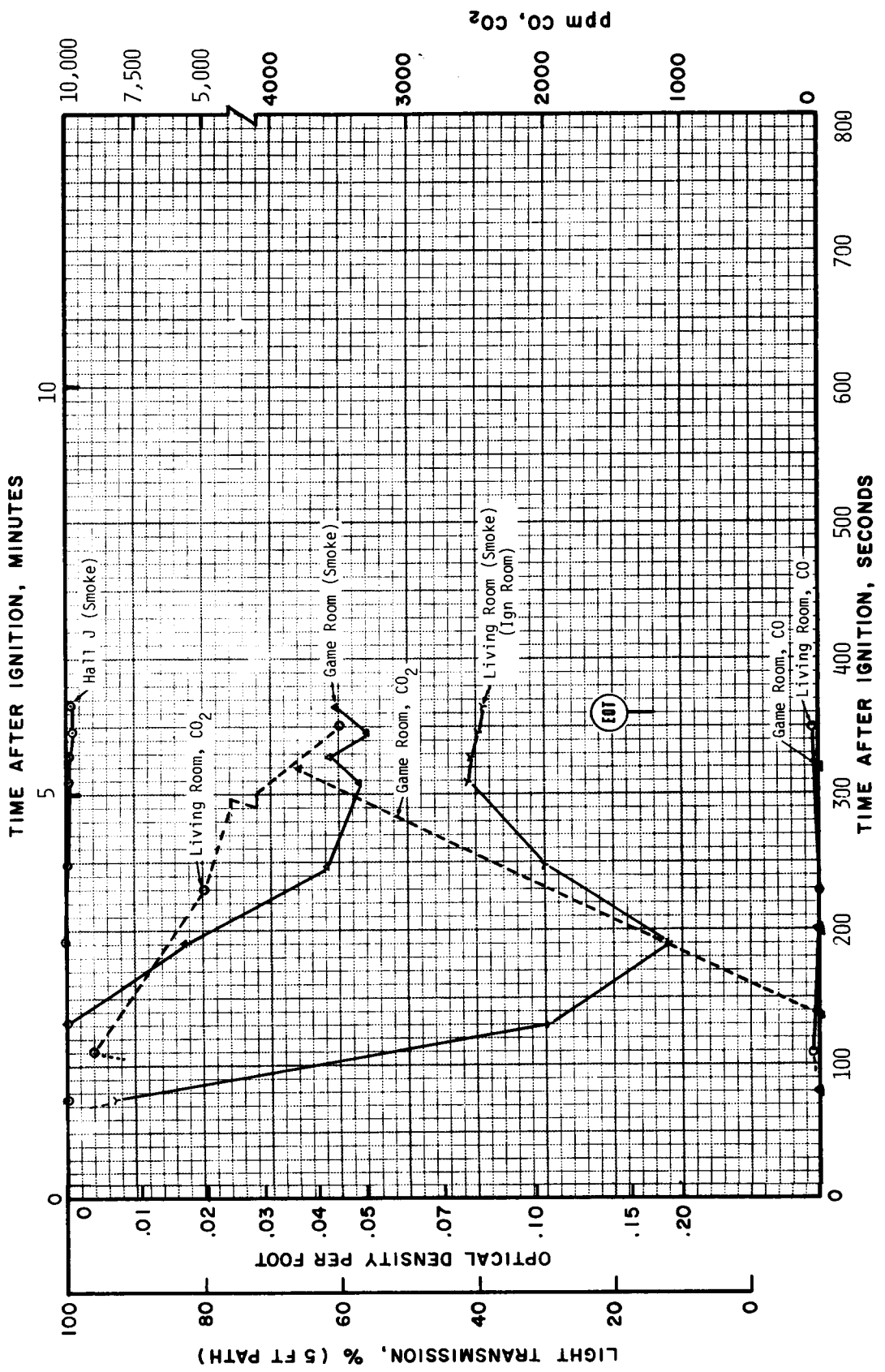
MAXIMUM TEMPERATURE PROFILES, W-68



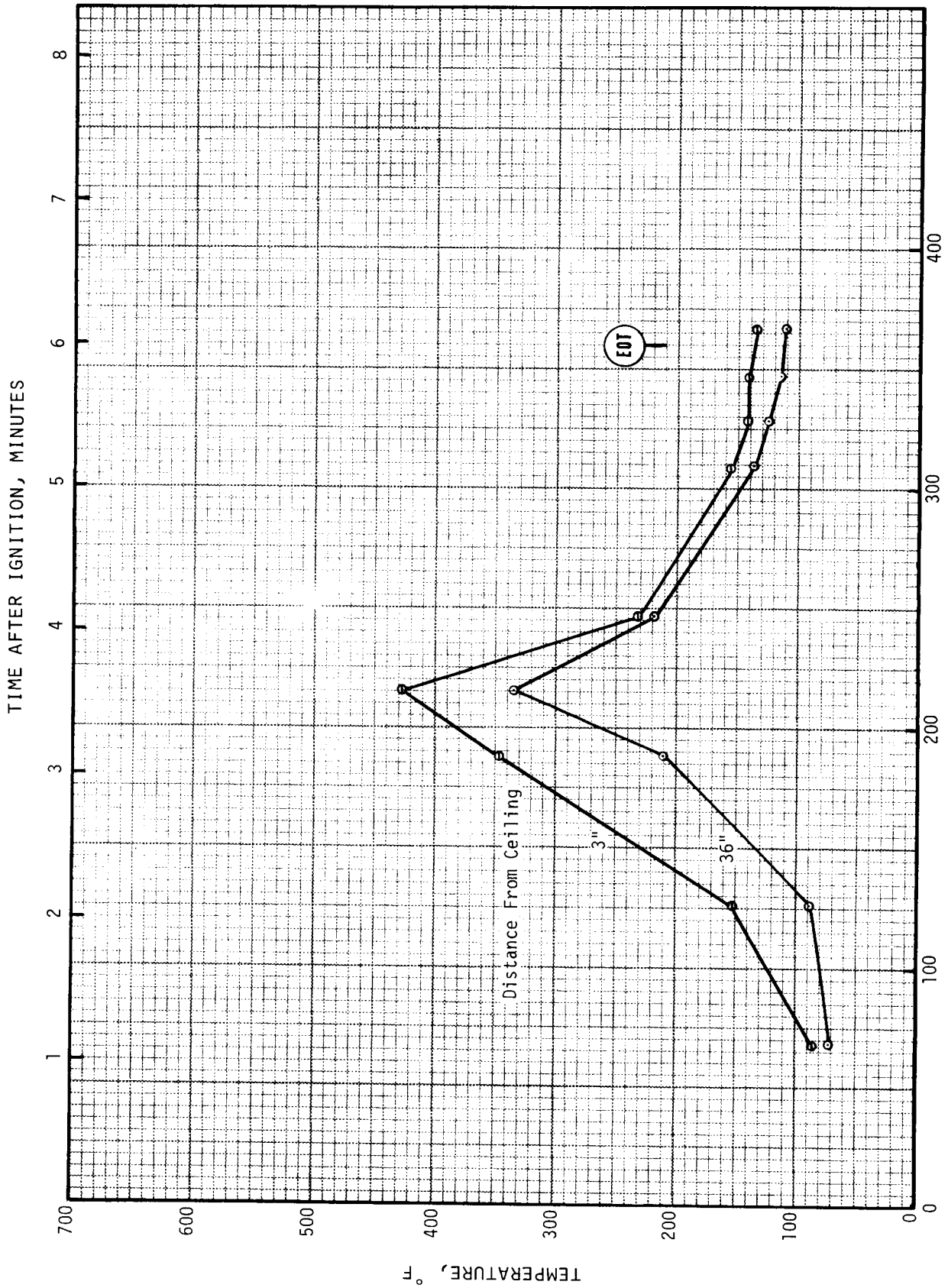
CONDITIONS ON 1ST FLOOR AT 5 FT, W-69



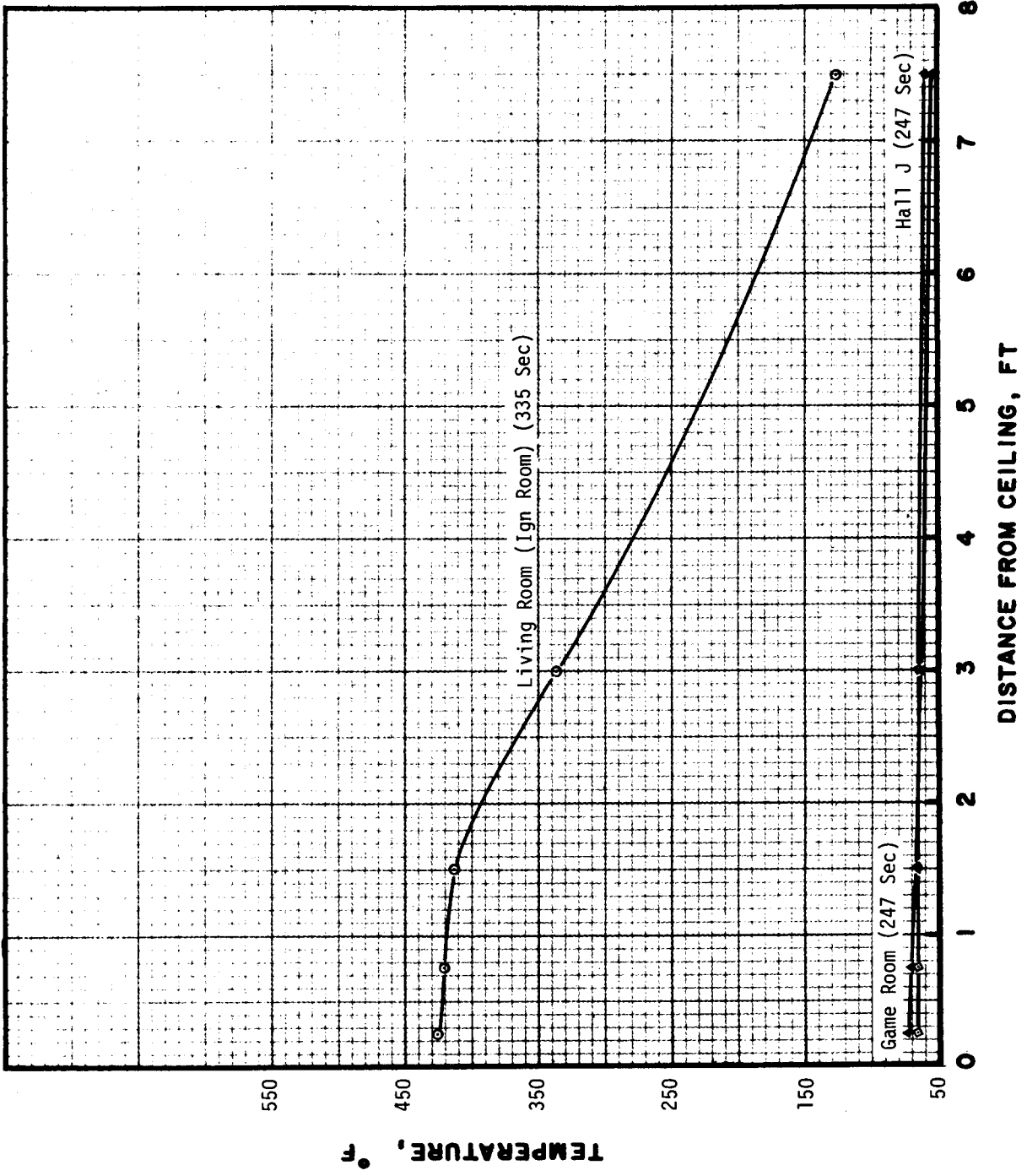
CONDITIONS ON 2ND FLOOR AT 5 FT, W-69



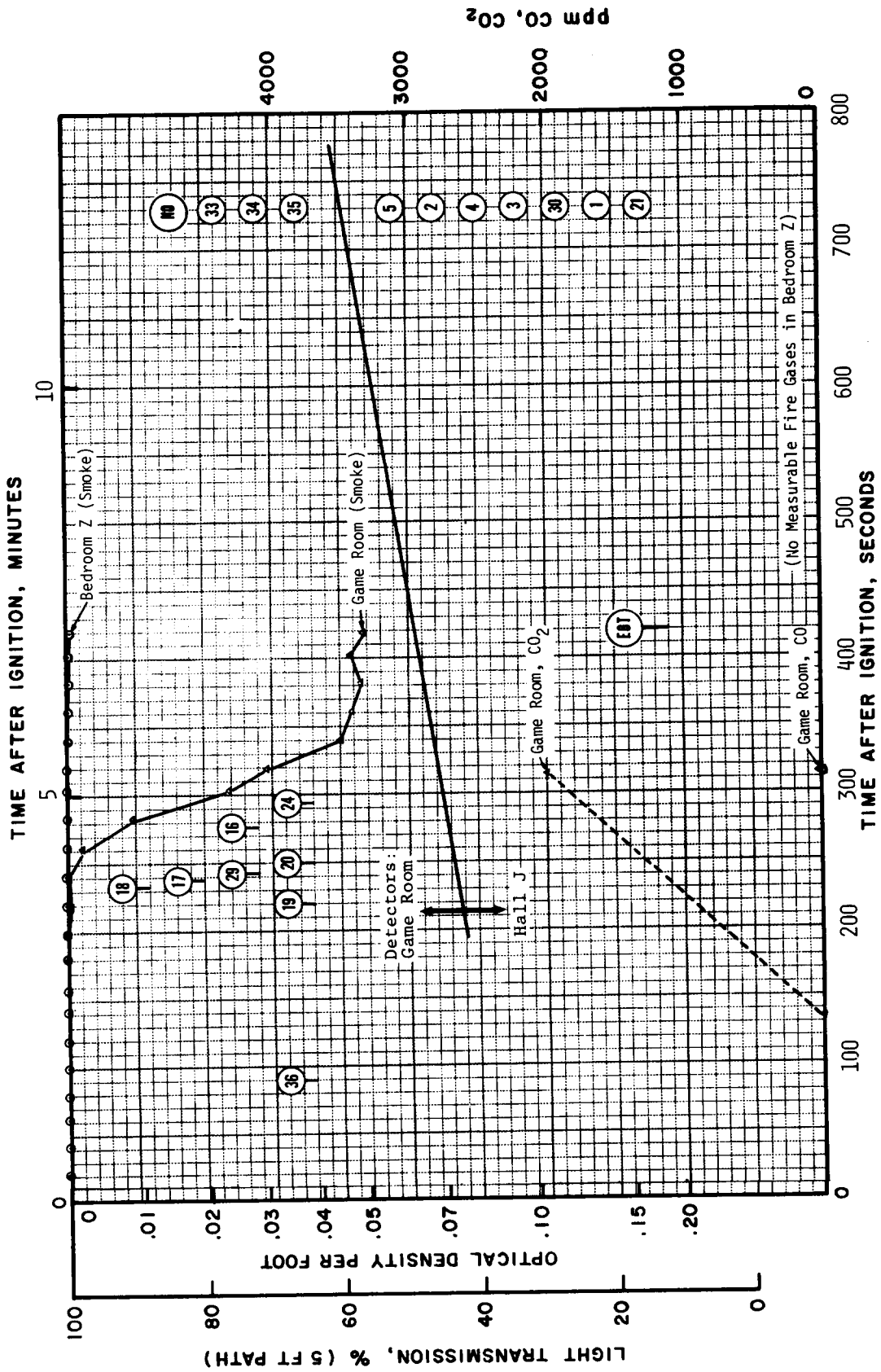
VARIOUS CEILING CONDITIONS, W-69



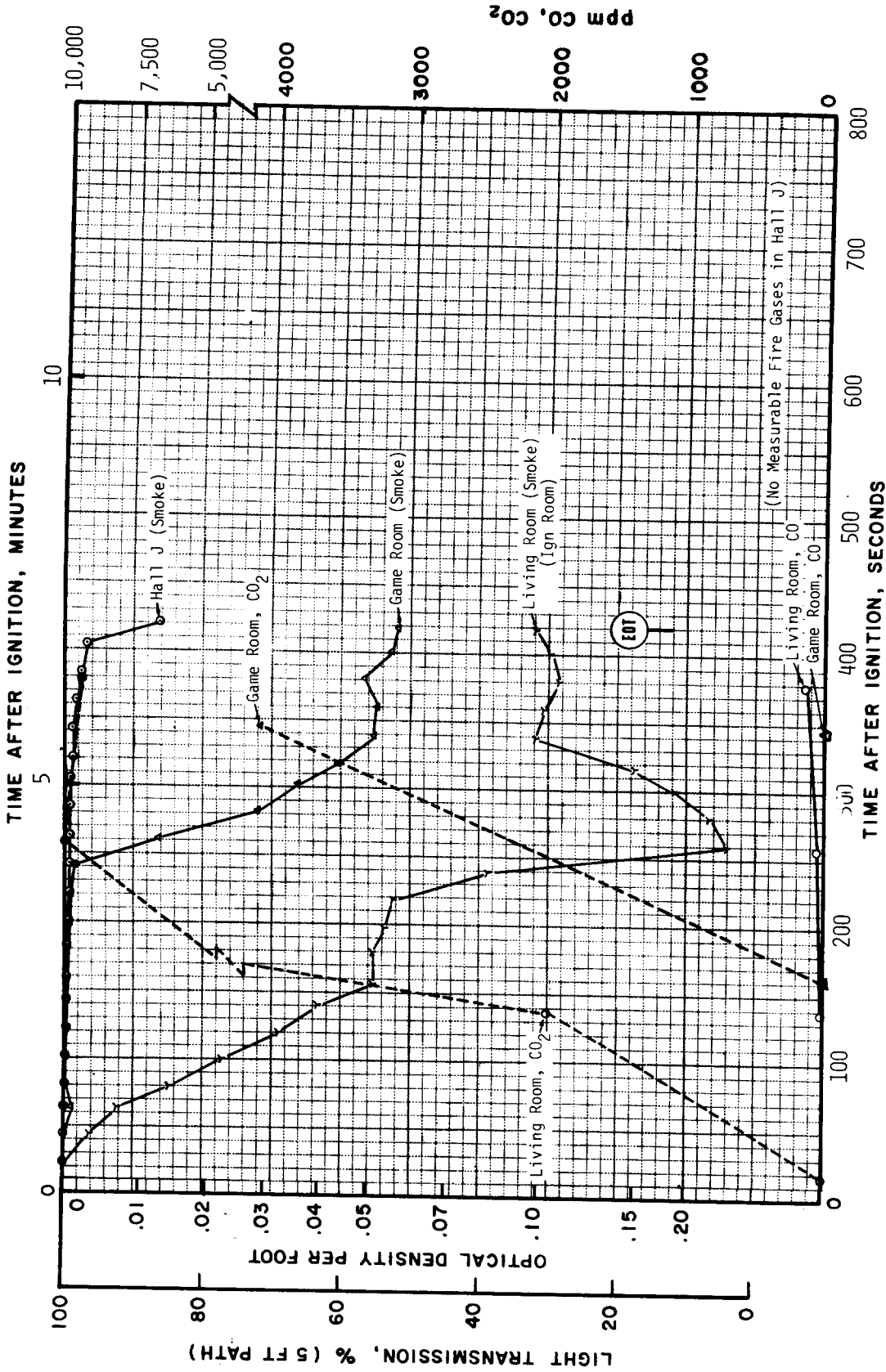
TEMPERATURES IN LIVING ROOM (IGN ROOM), W-69



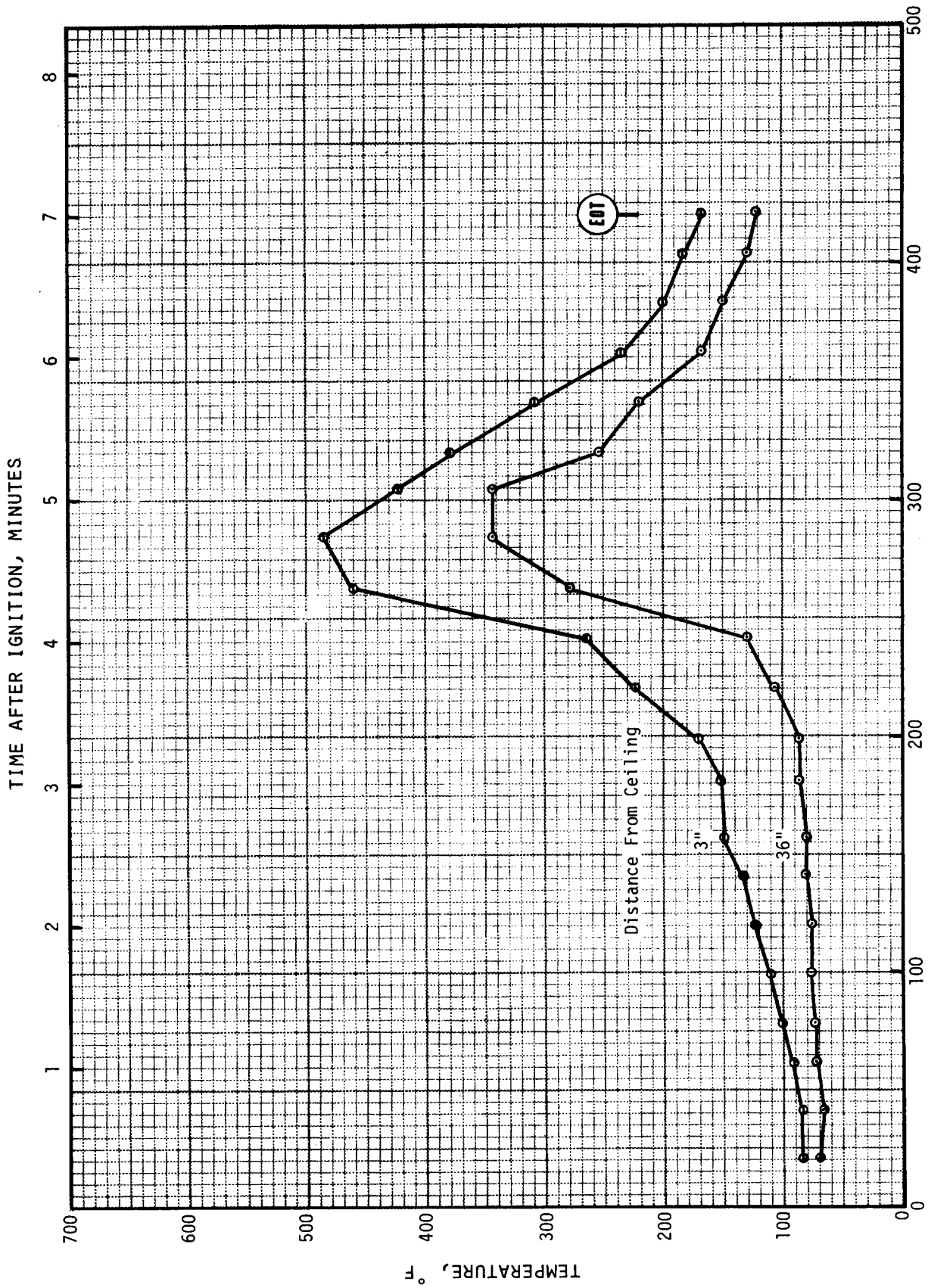
MAXIMUM TEMPERATURE PROFILES, W-69



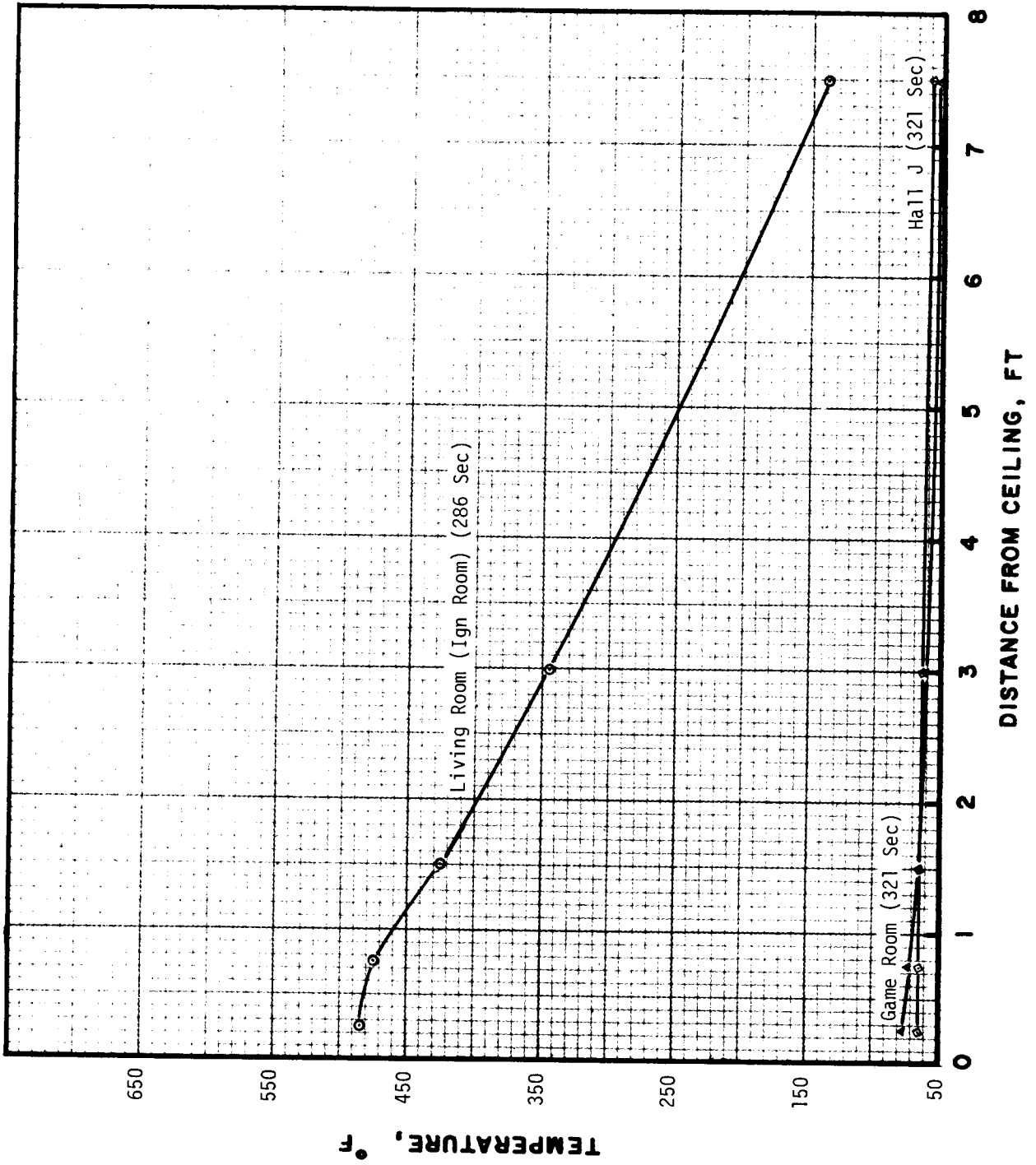
CONDITIONS ON 2ND FLOOR AT 5 FT, W-70



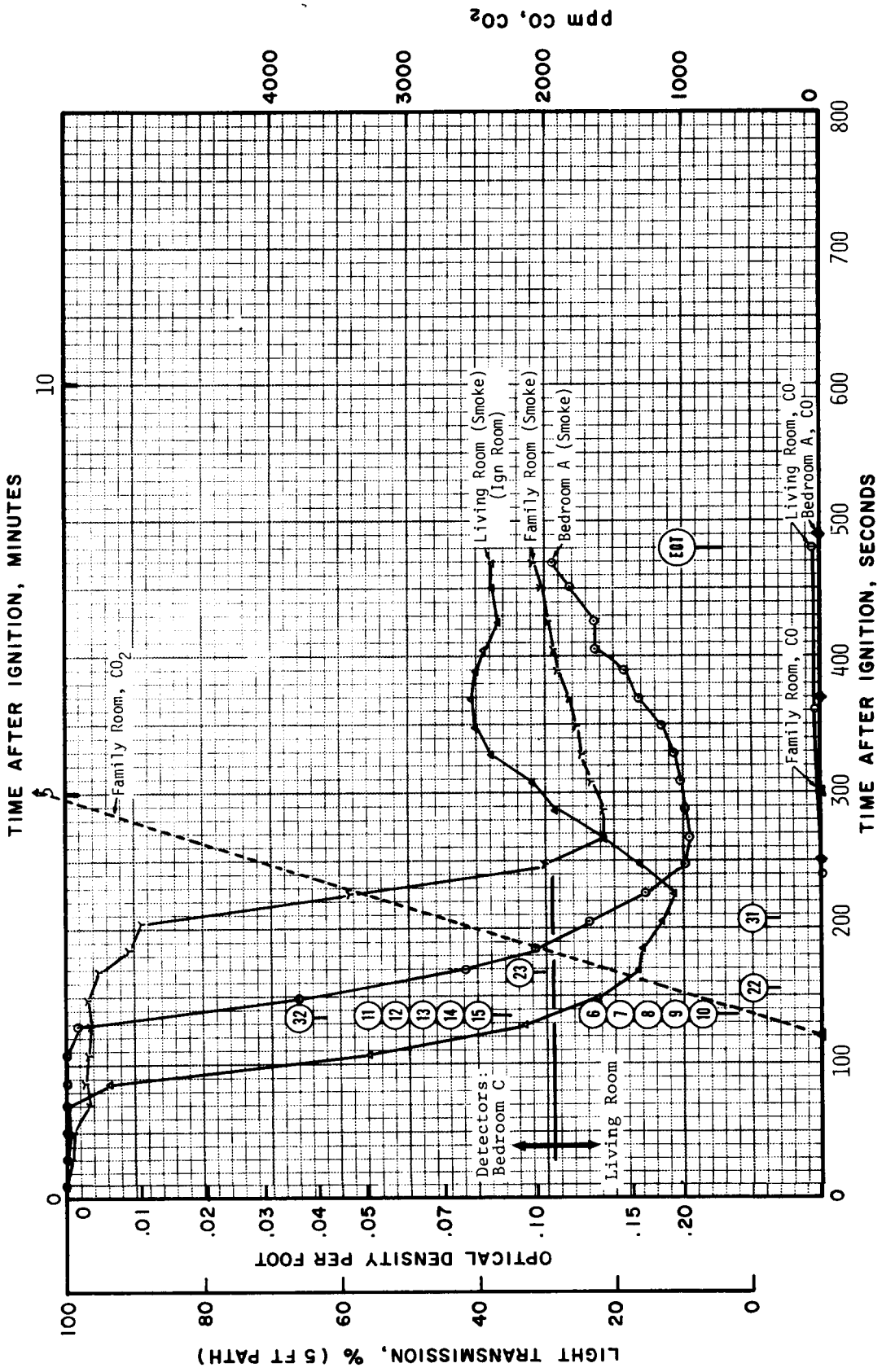
VARIOUS CEILING CONDITIONS, W-70



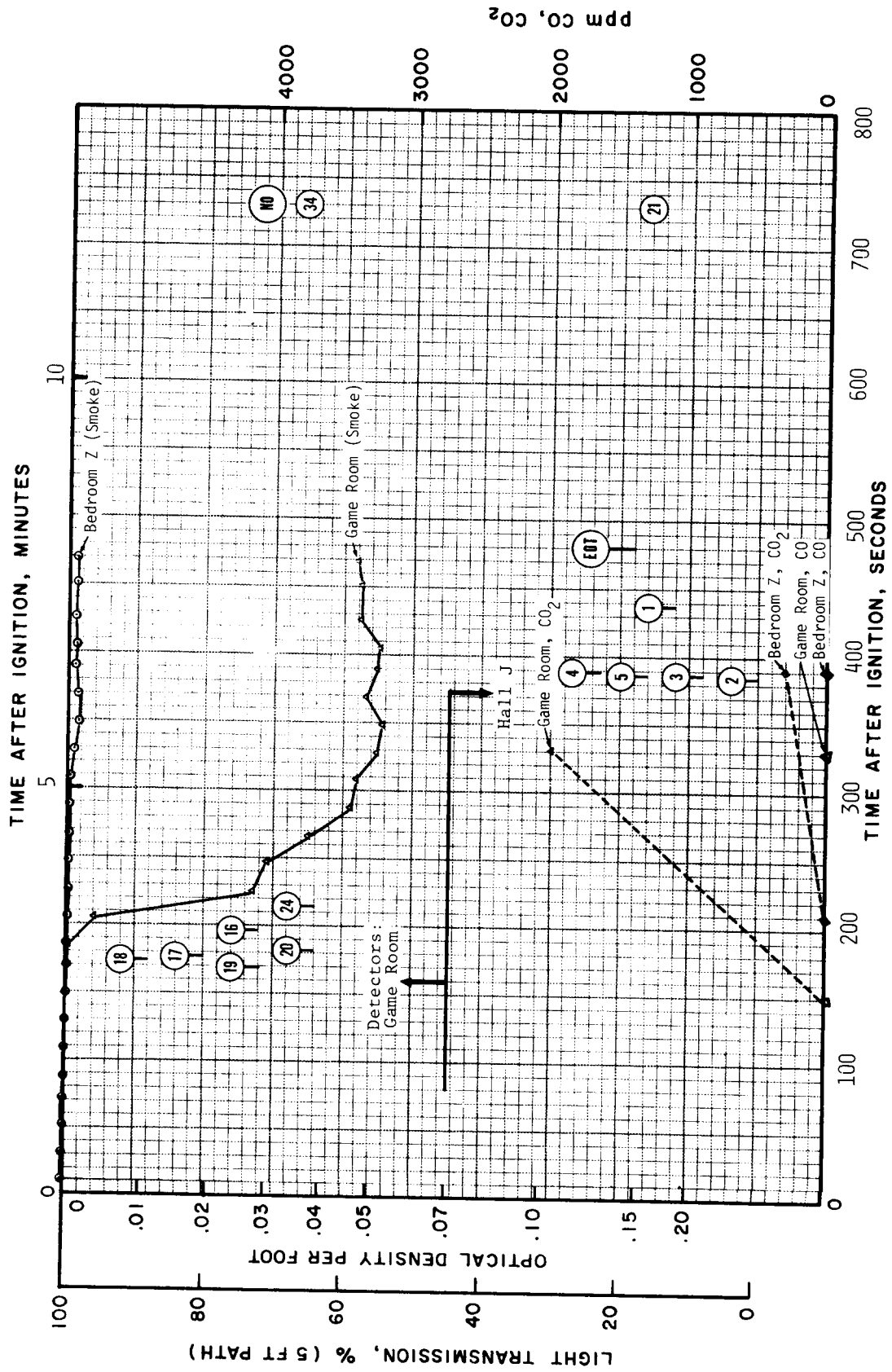
TIME AFTER IGNITION, SECONDS
 TEMPERATURES IN LIVING ROOM (IGN ROOM), W-70



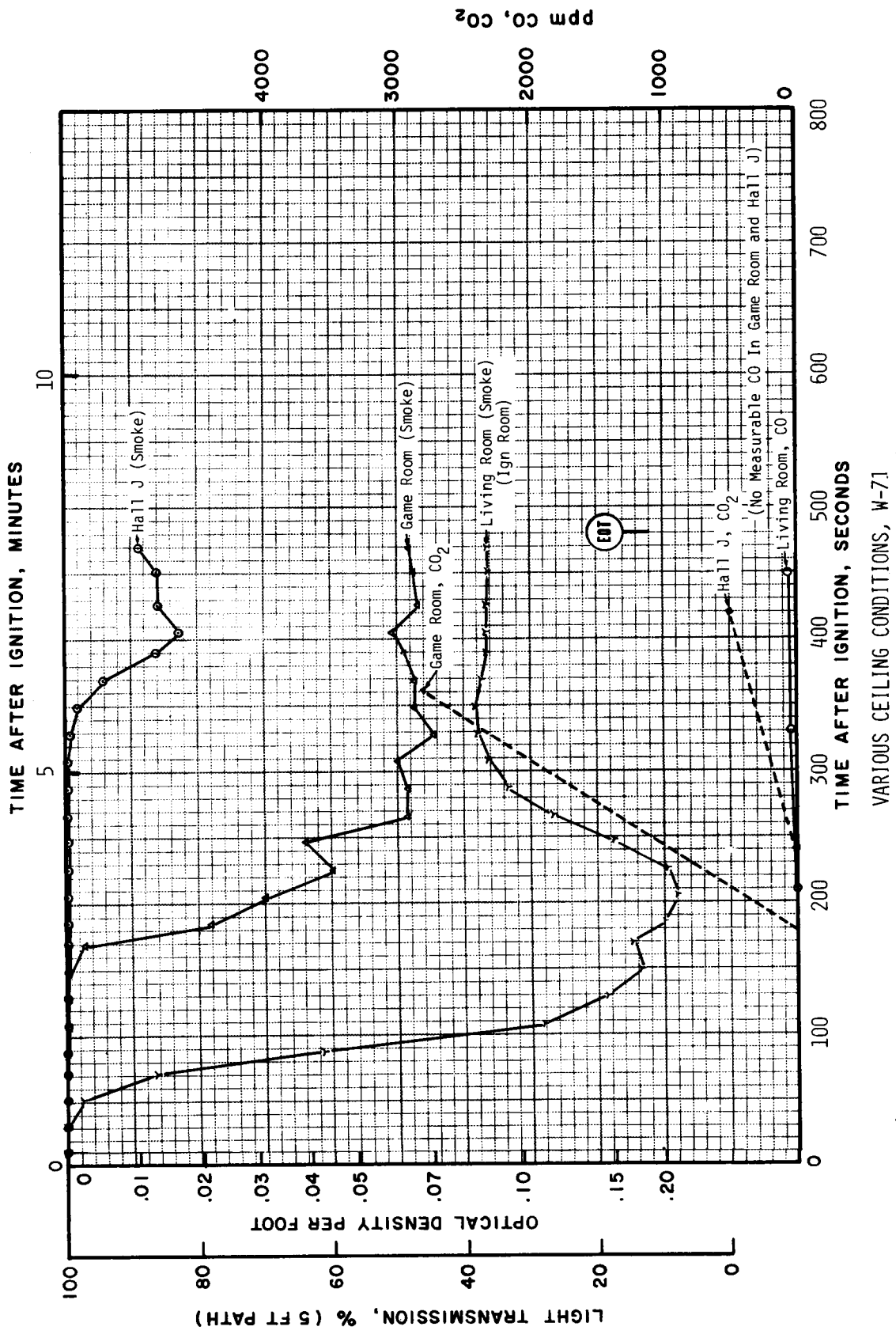
MAXIMUM TEMPERATURE PROFILES, W-70

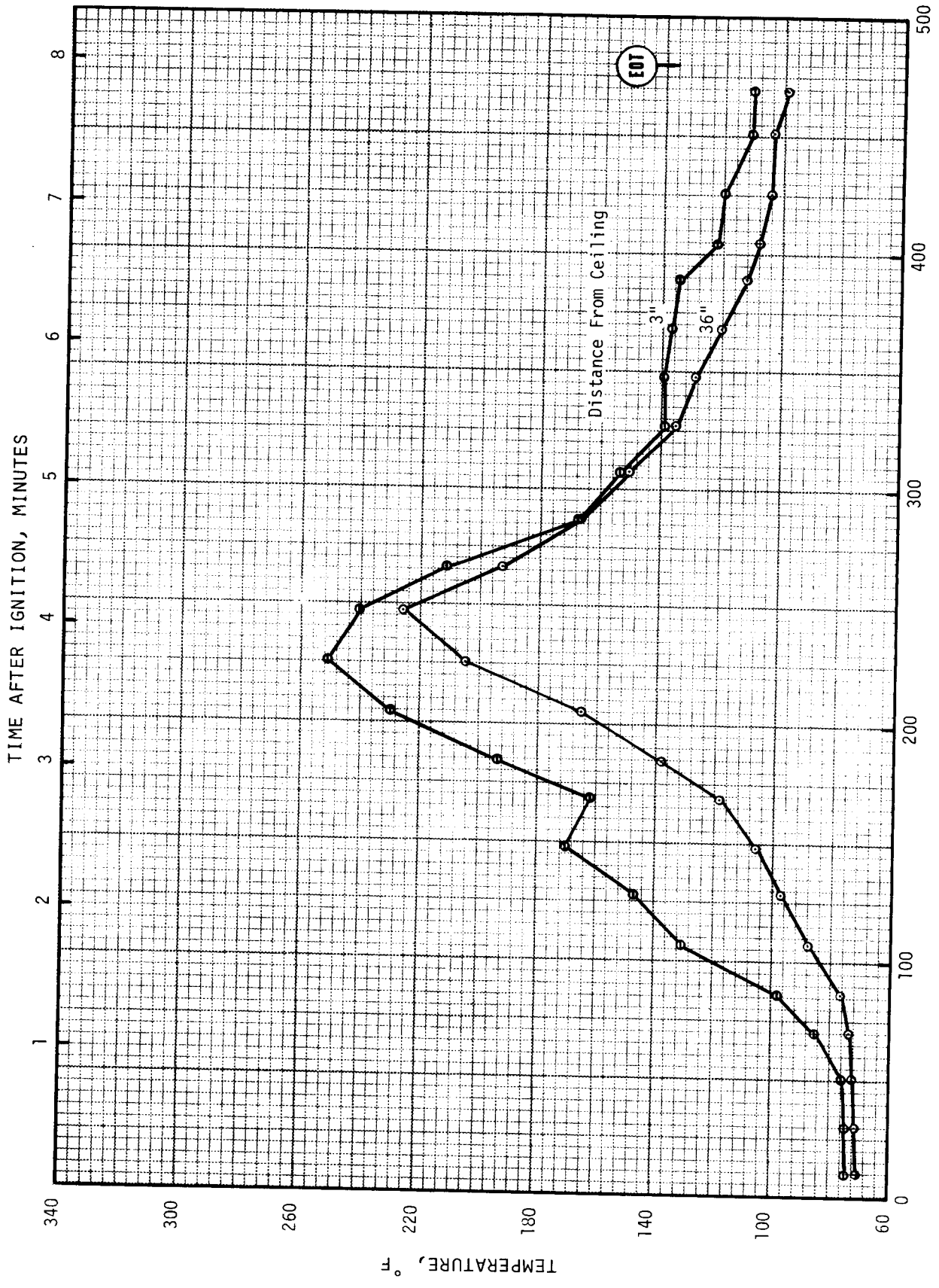


CONDITIONS ON 1ST FLOOR AT 5 FT, W-71

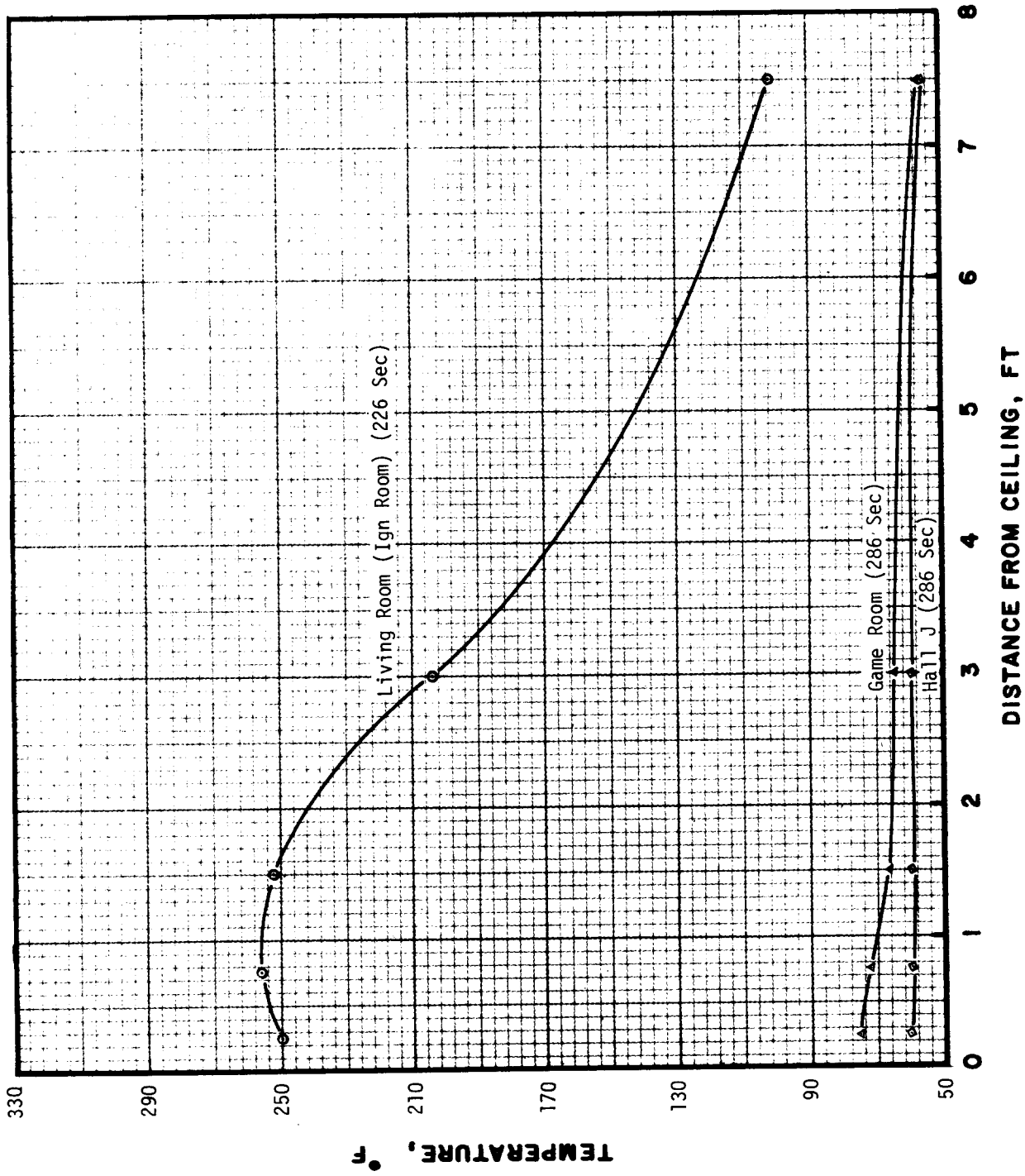


CONDITIONS ON 2ND FLOOR AT 5 FT, W-71

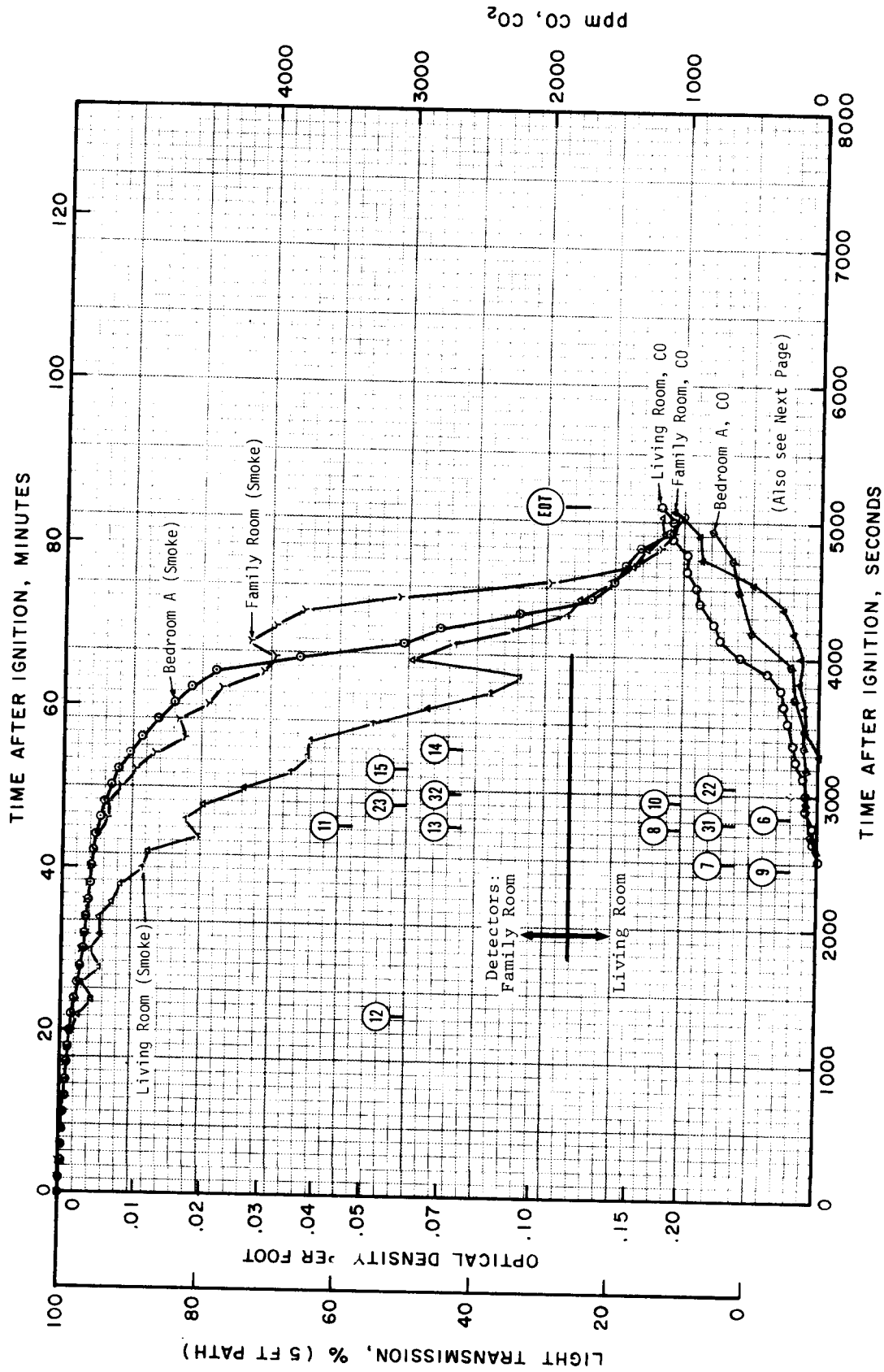




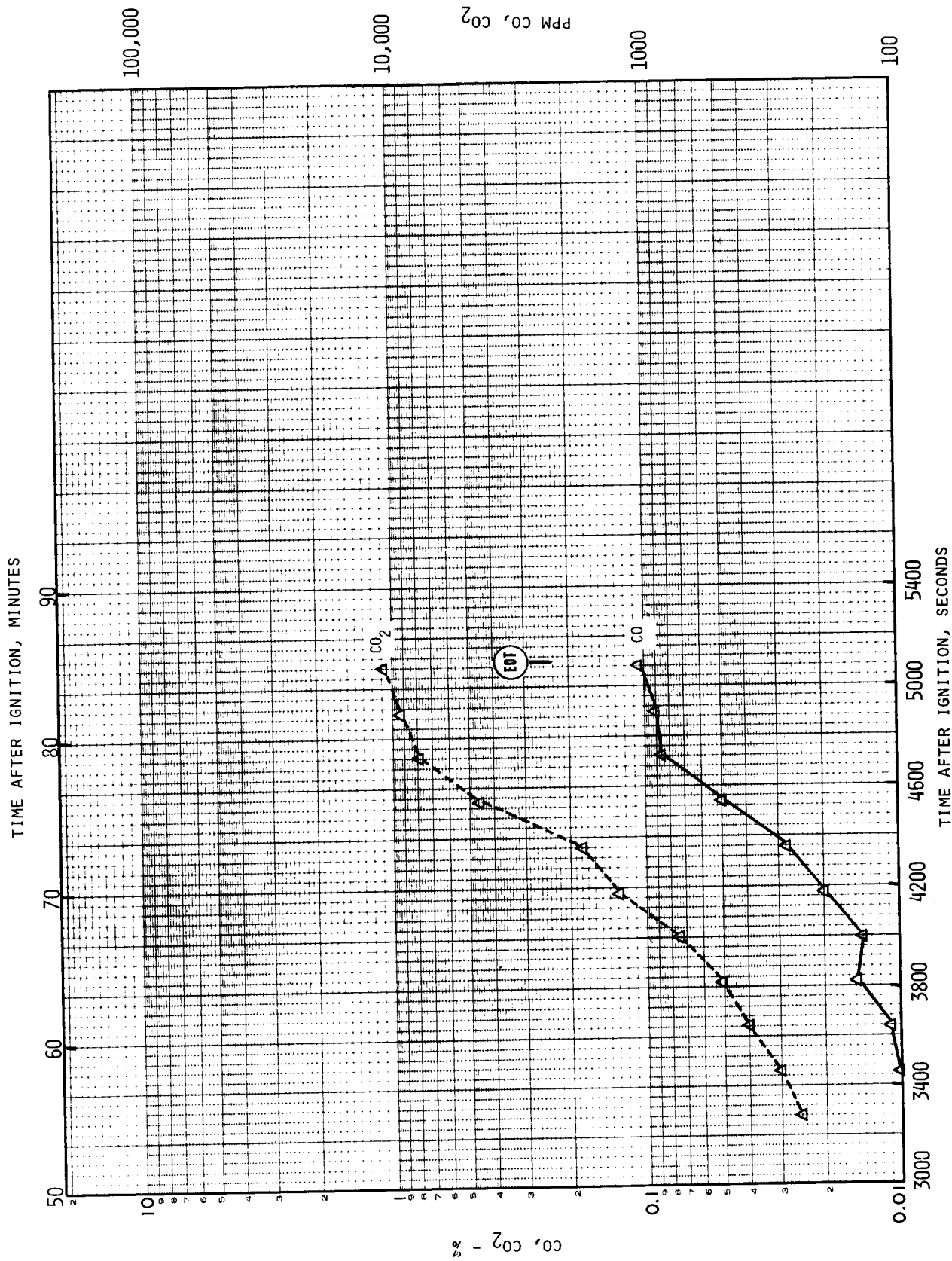
TEMPERATURES IN LIVING ROOM (IGN ROOM), W-71



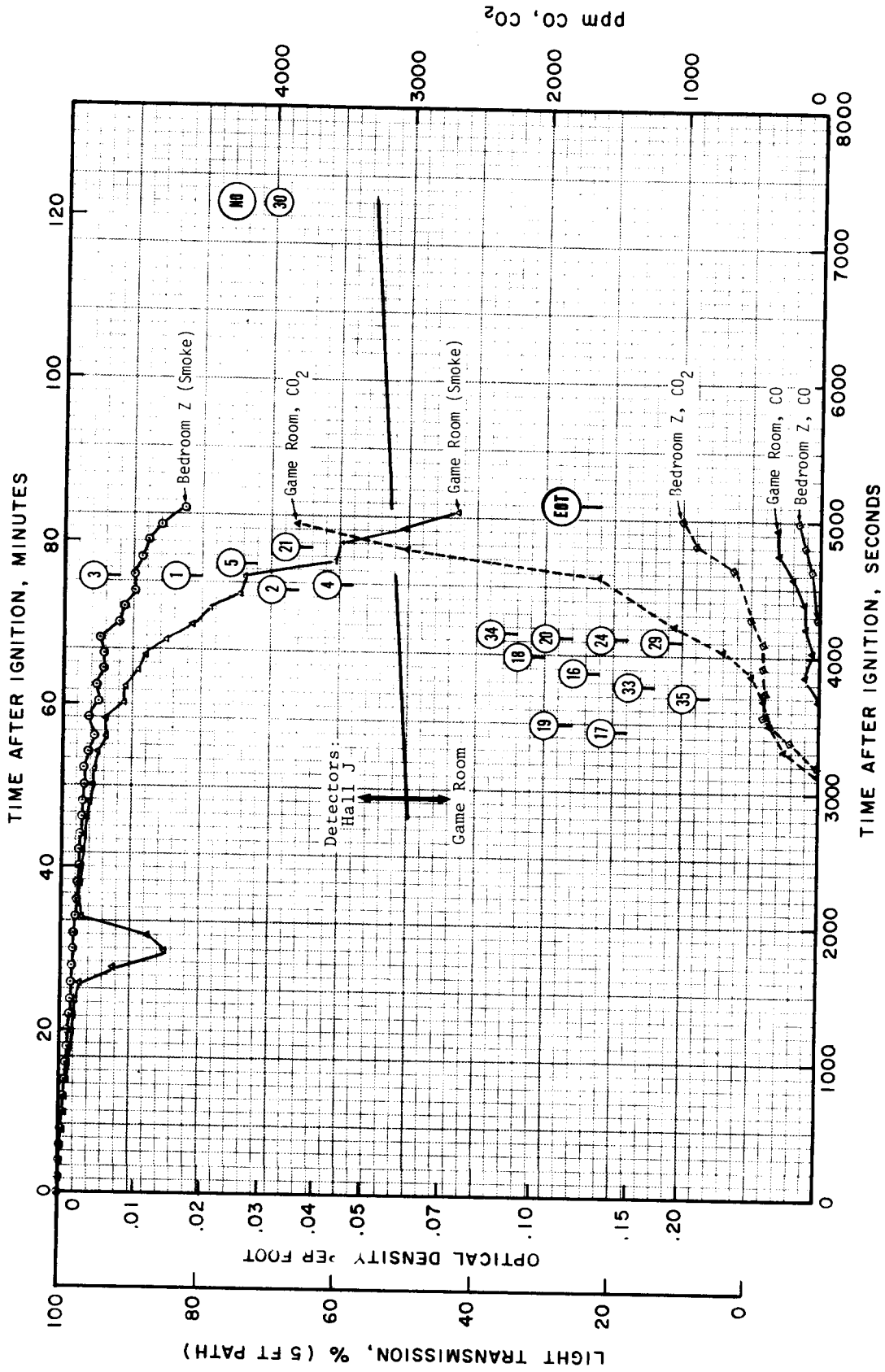
MAXIMUM TEMPERATURE PROFILES, W-71



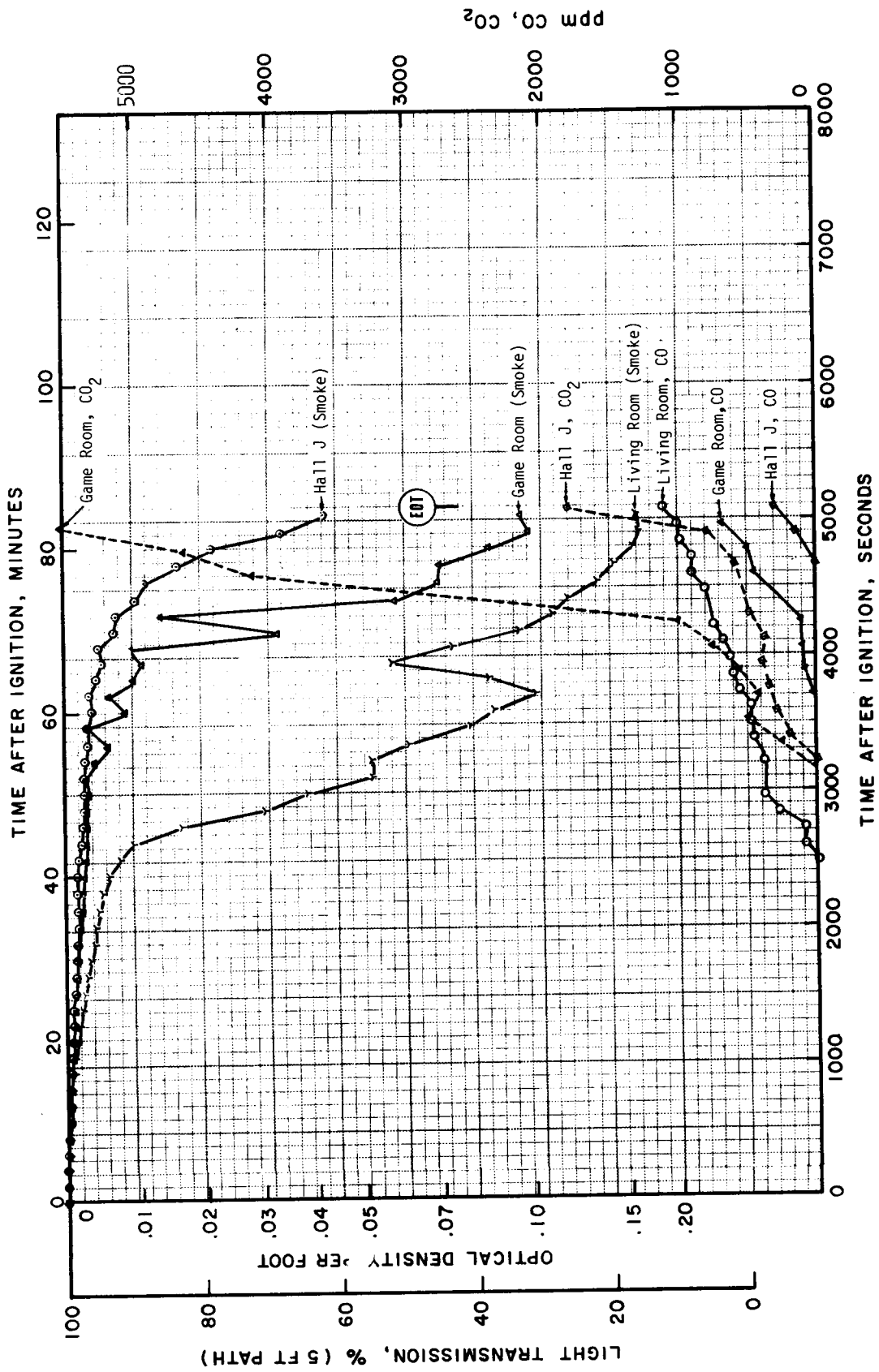
CONDITIONS ON 1ST FLOOR AT 5 FT, W-72



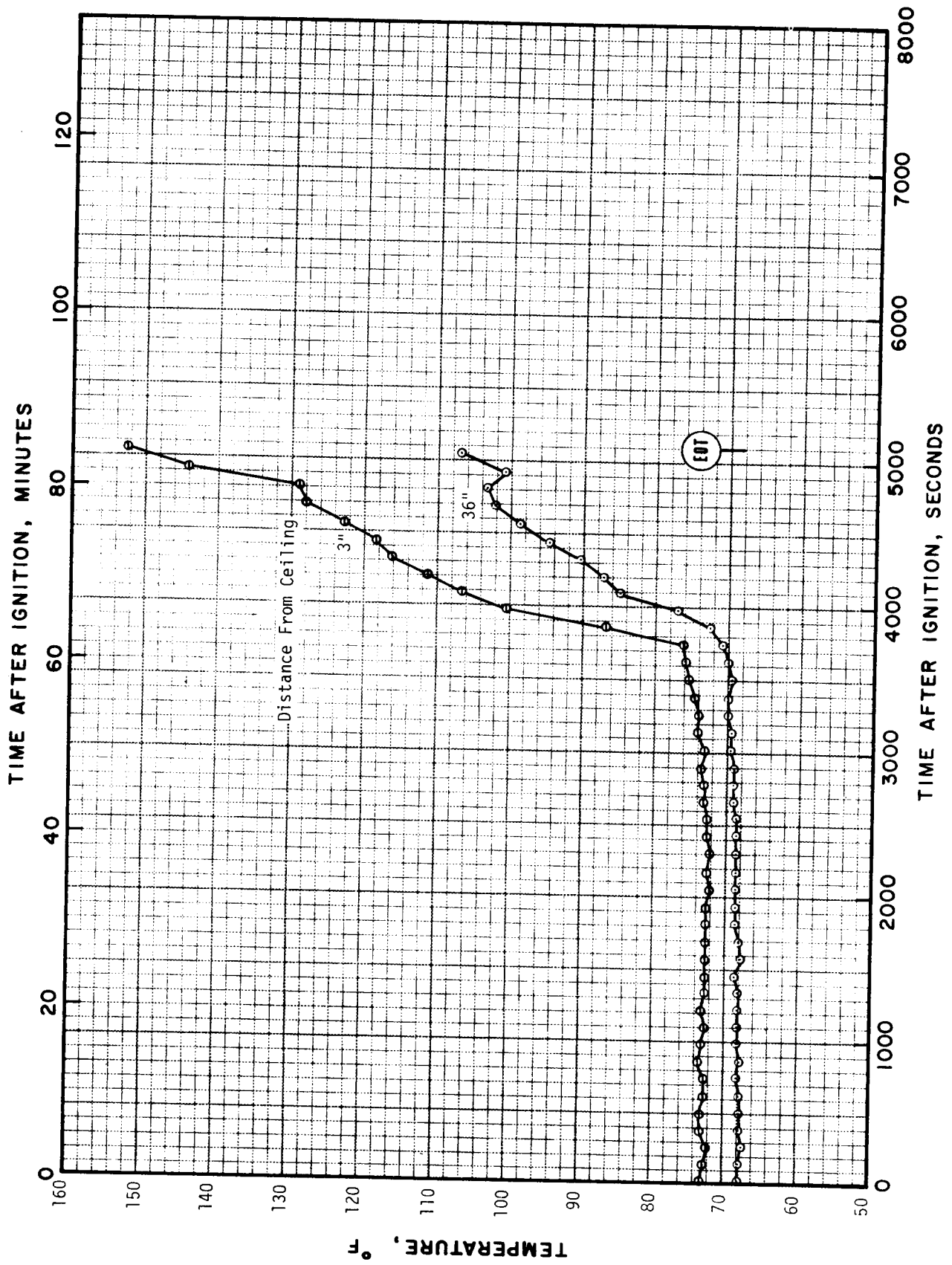
GASES IN FAMILY ROOM AT 5 FT, W-72



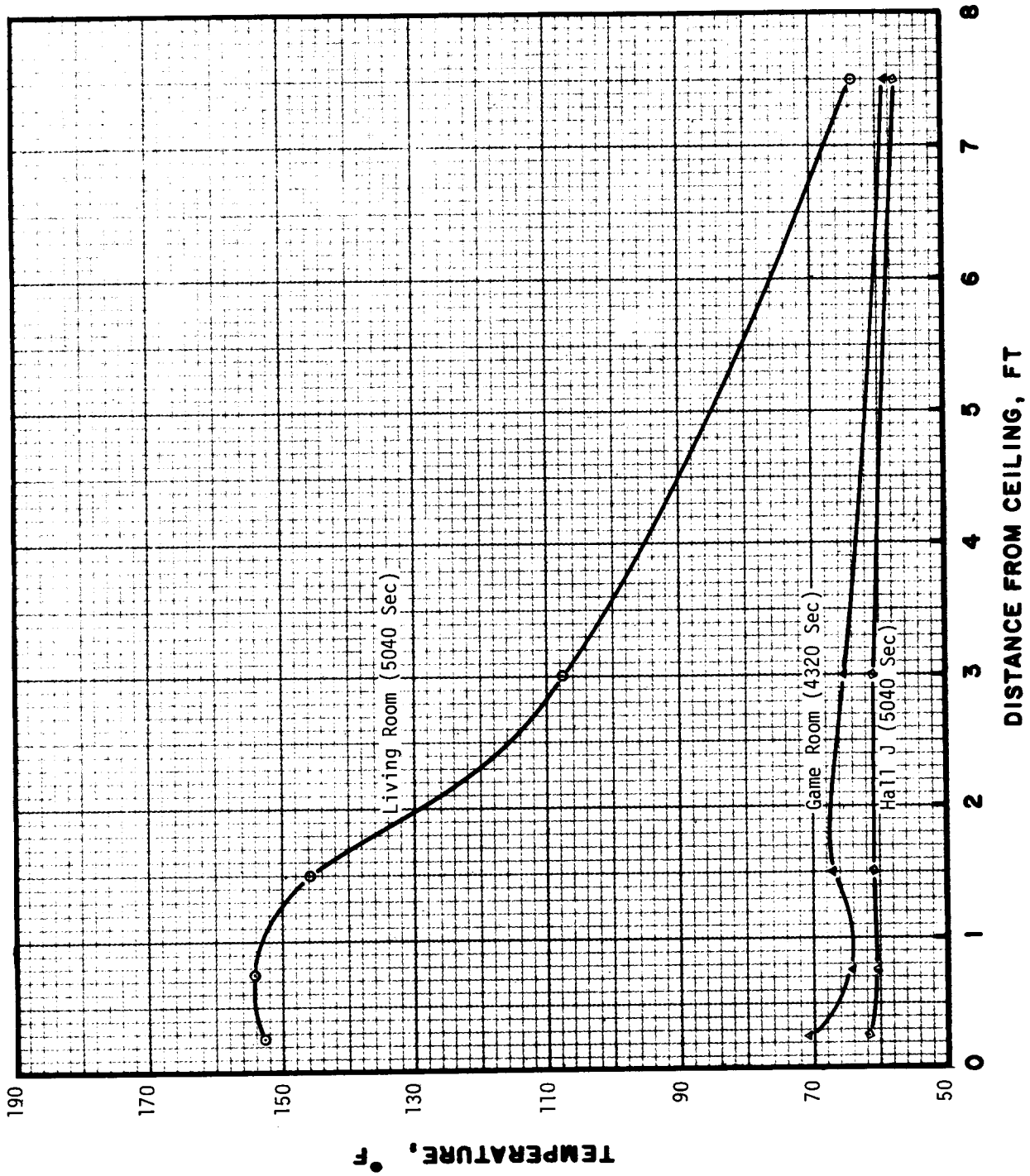
CONDITIONS ON 2ND FLOOR AT 5 FT, W-72



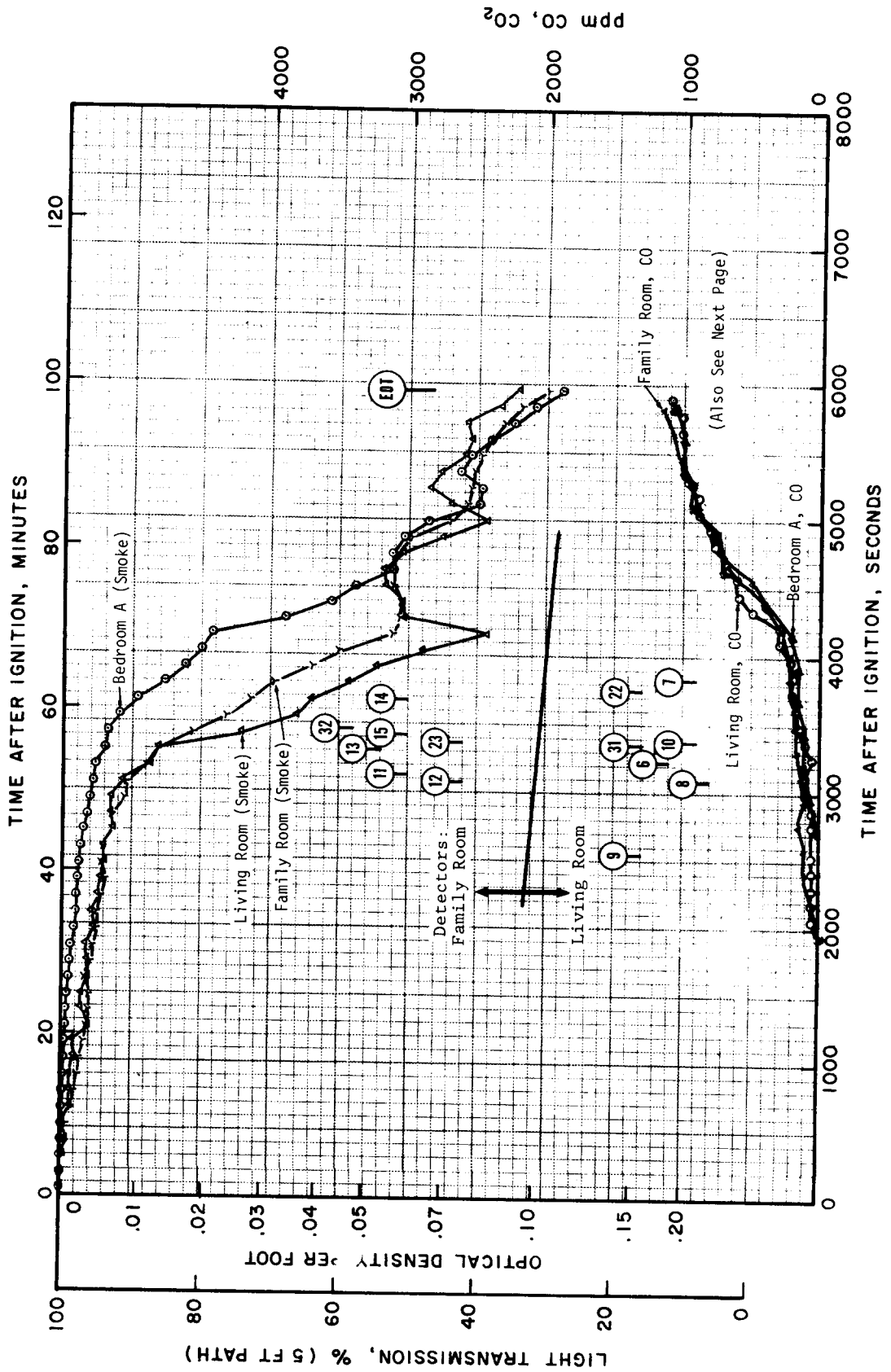
TIME AFTER IGNITION, SECONDS
 VARIOUS CEILING CONDITIONS, W-72



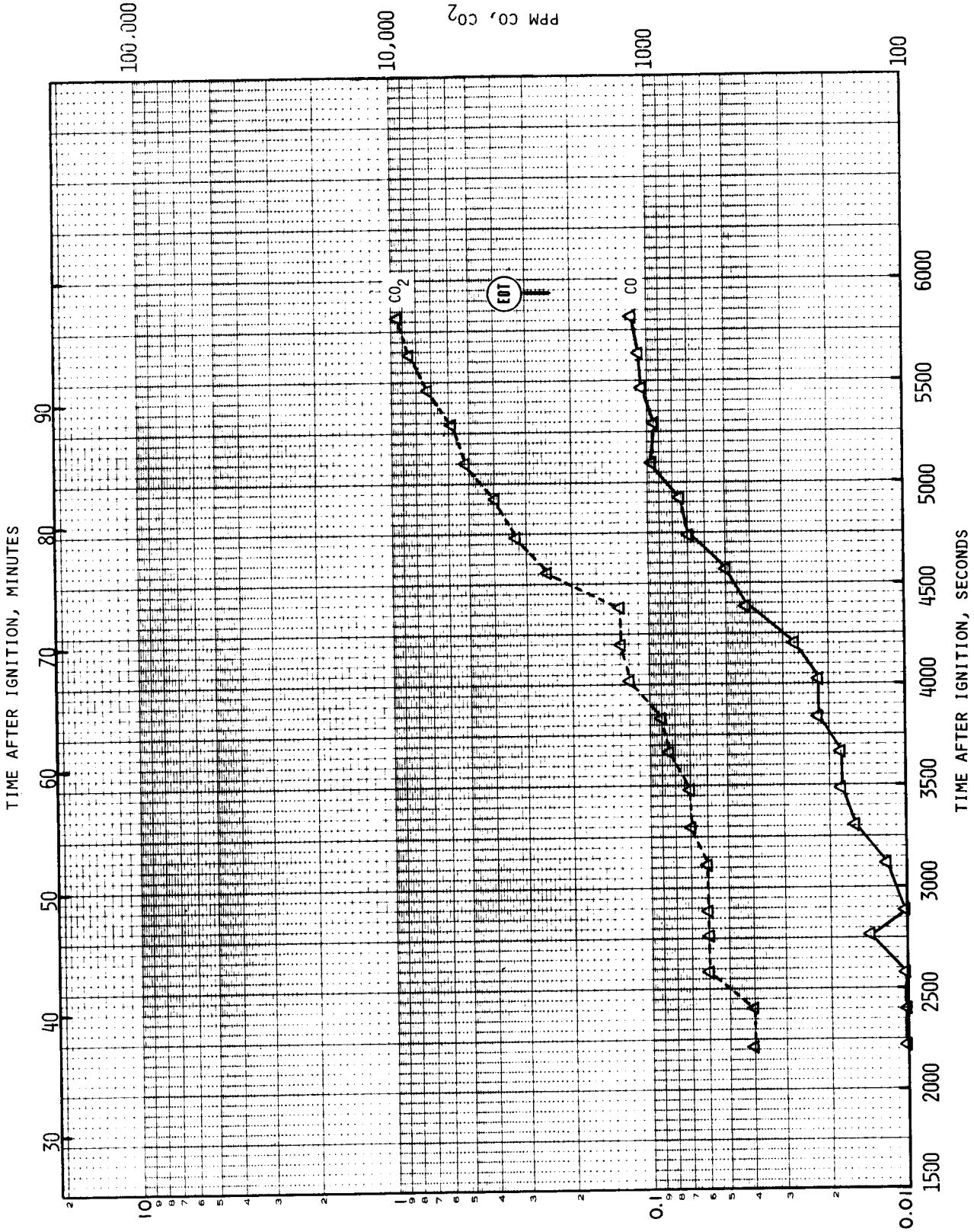
TEMPERATURES IN LIVING ROOM, W-72



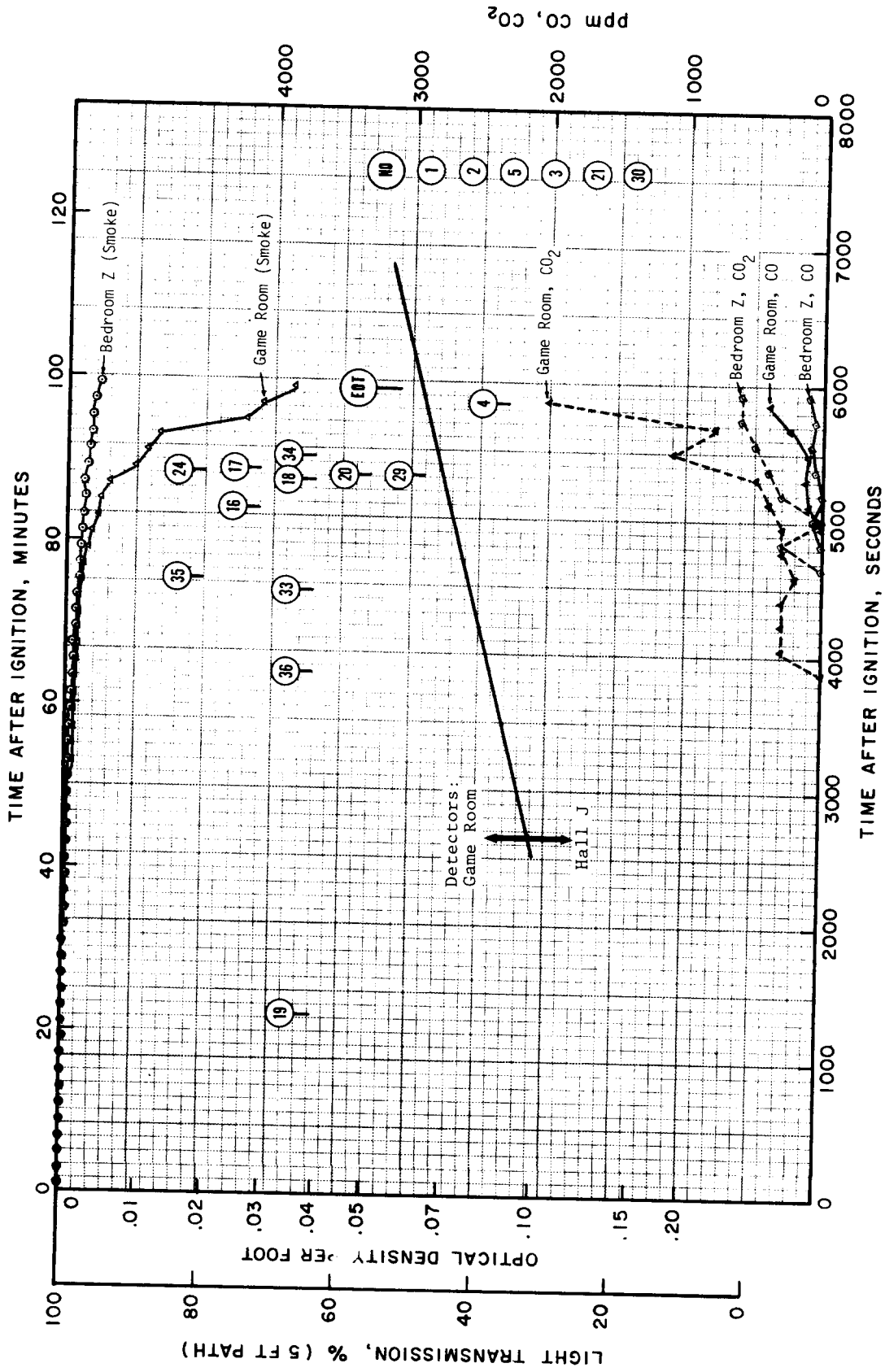
MAXIMUM TEMPERATURE PROFILES, W-72



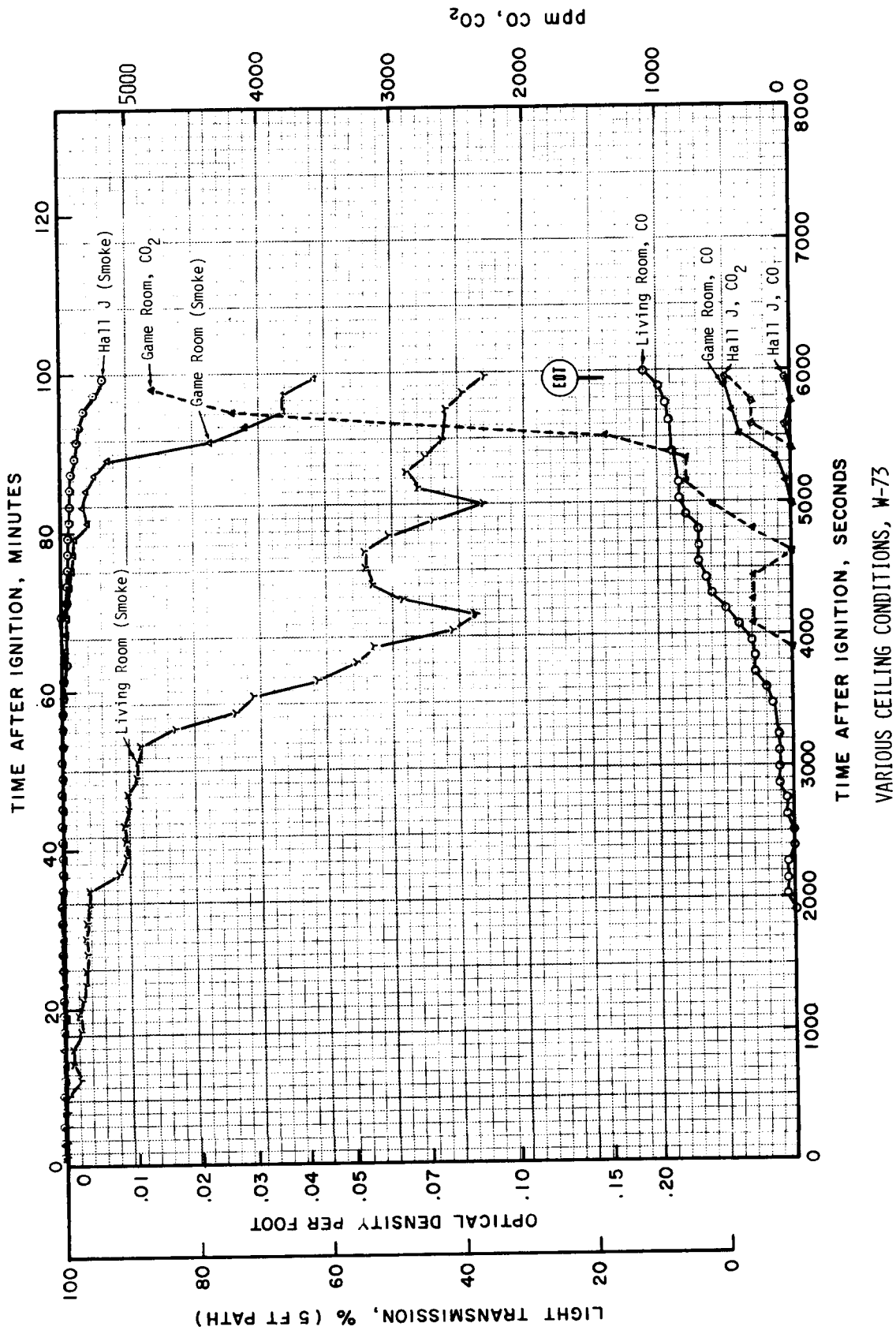
CONDITIONS ON 1ST FLOOR AT 5 FT, W-73

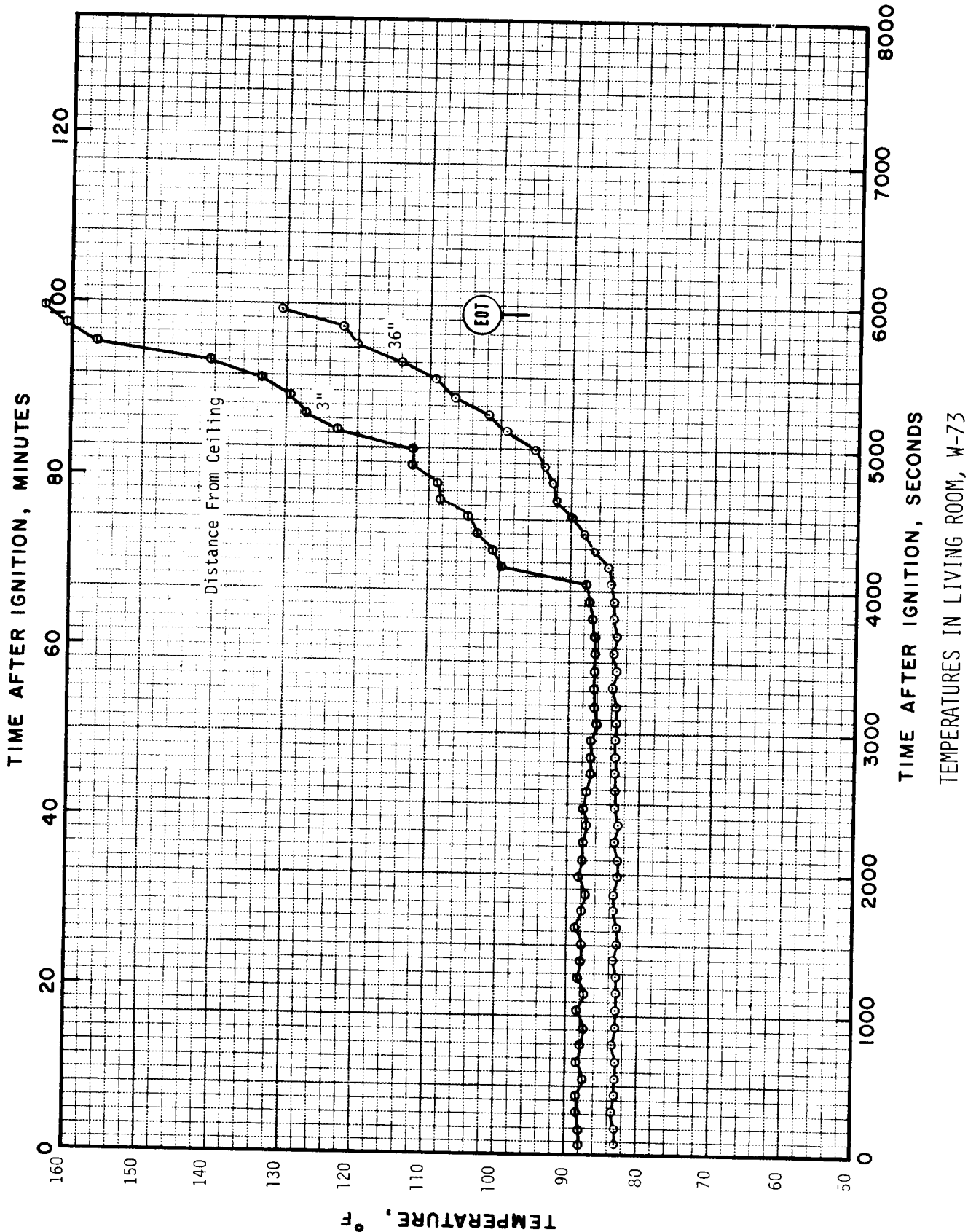


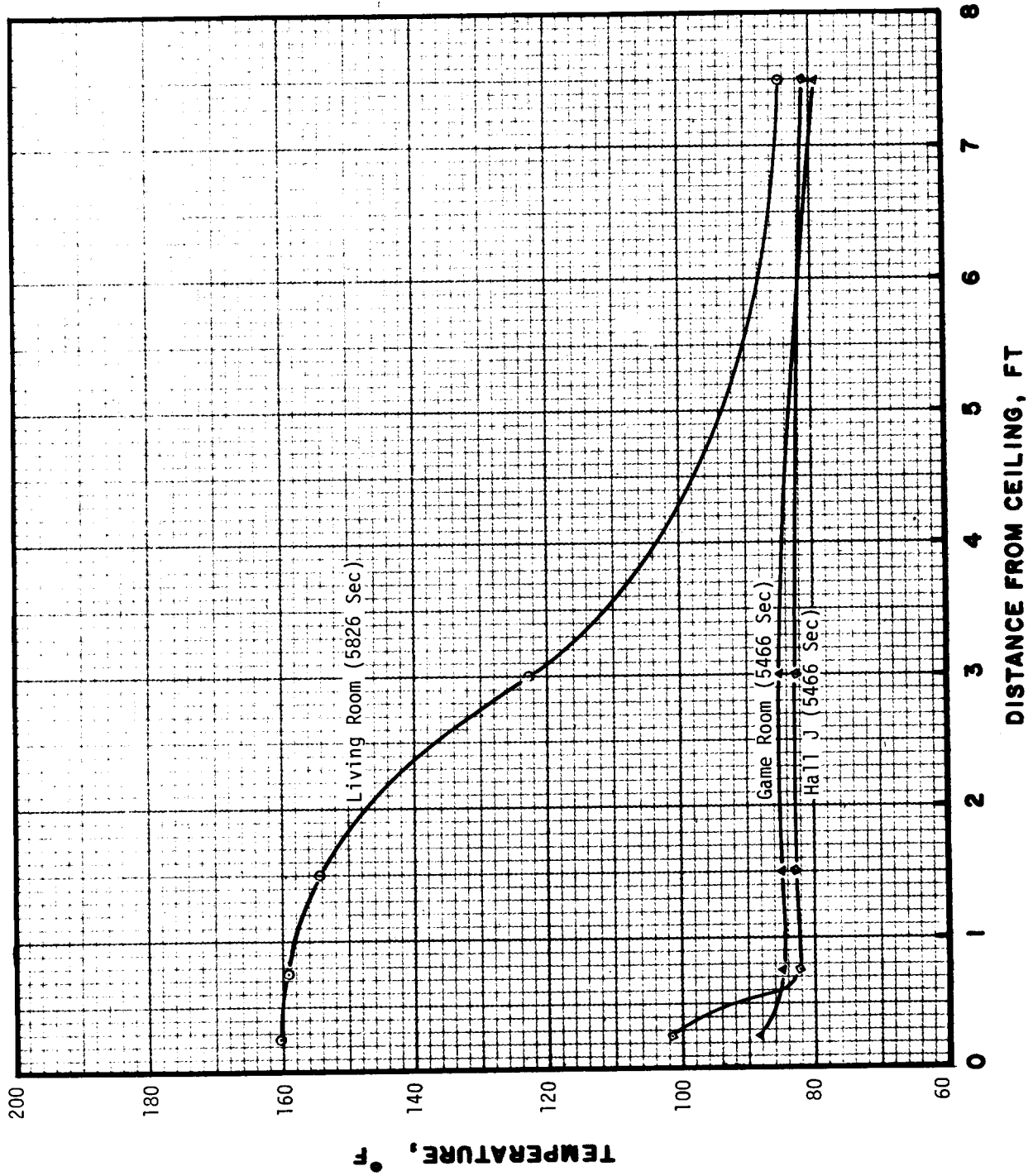
GASES IN FAMILY ROOM AT 5 FT, W-73



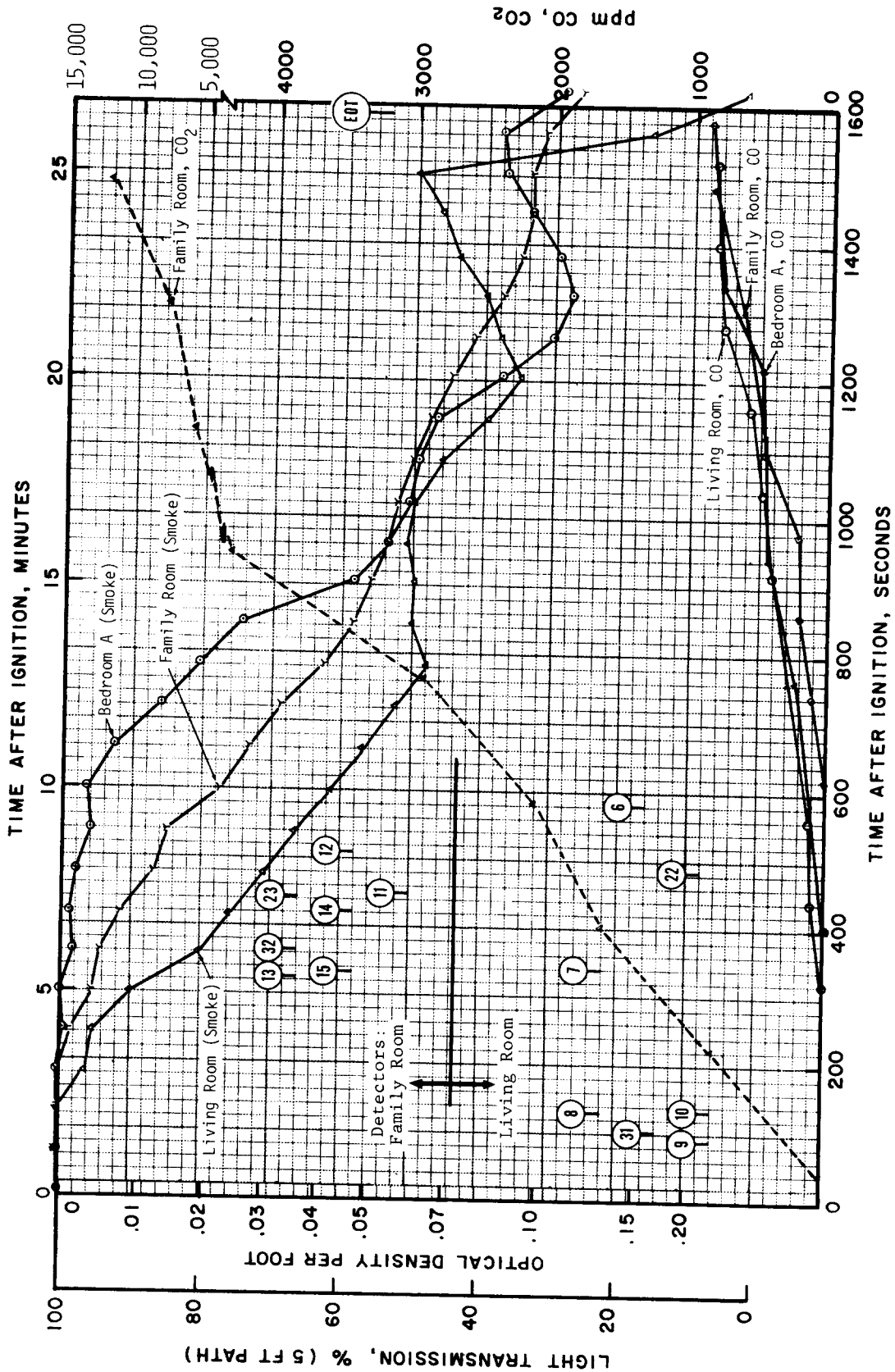
CONDITIONS ON 2ND FLOOR AT 5 FT, W-73



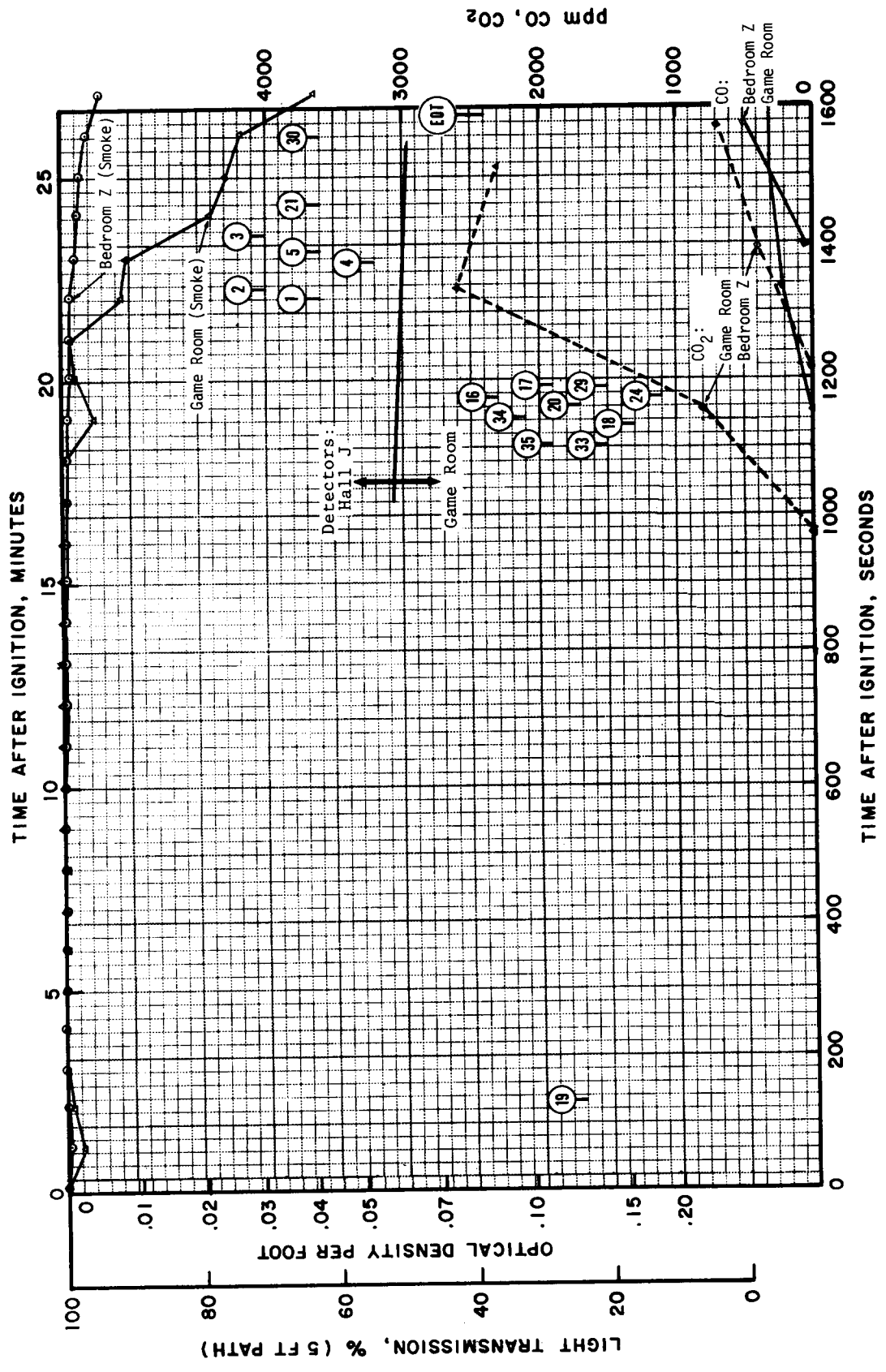




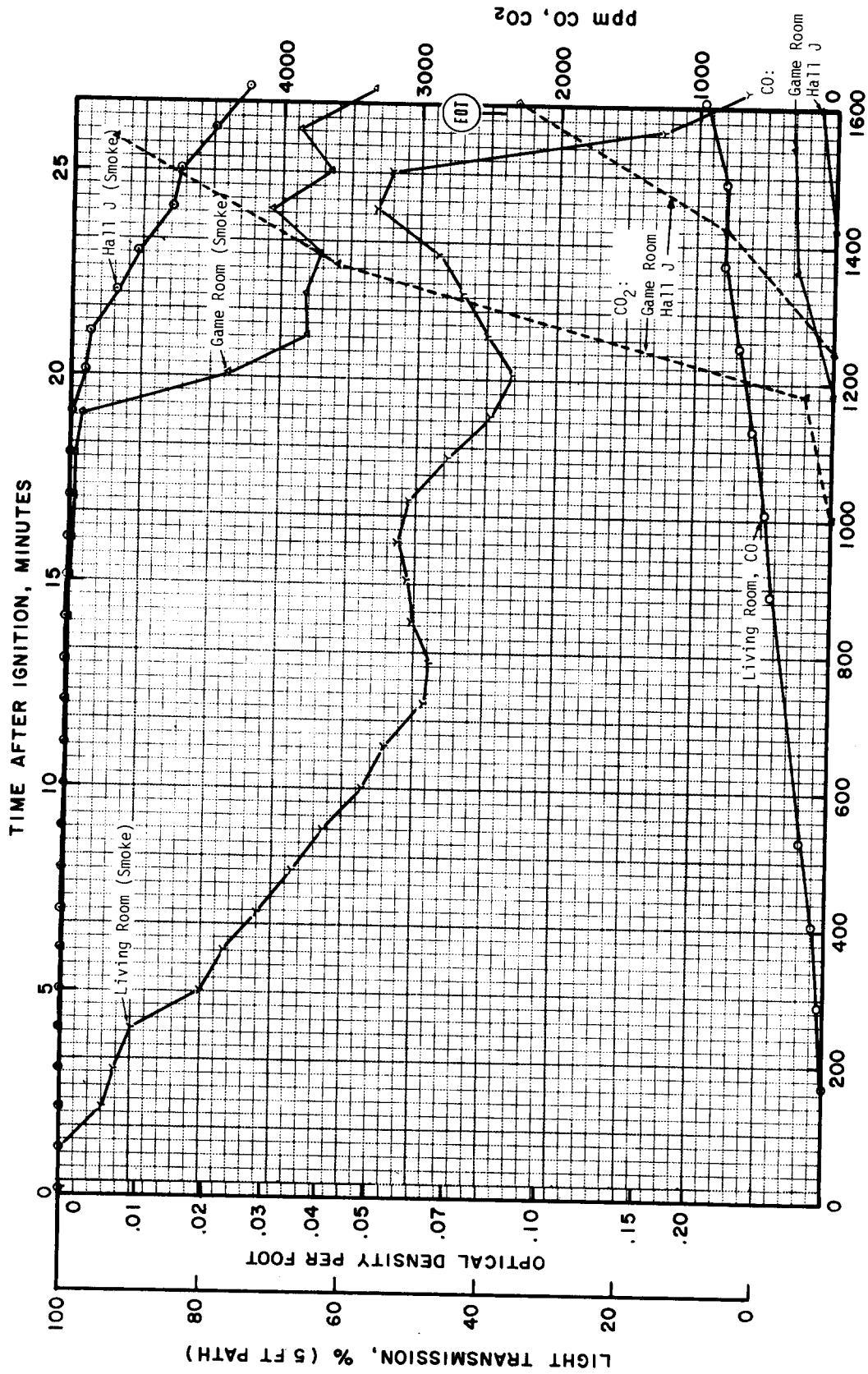
MAXIMUM TEMPERATURE PROFILES, W-73



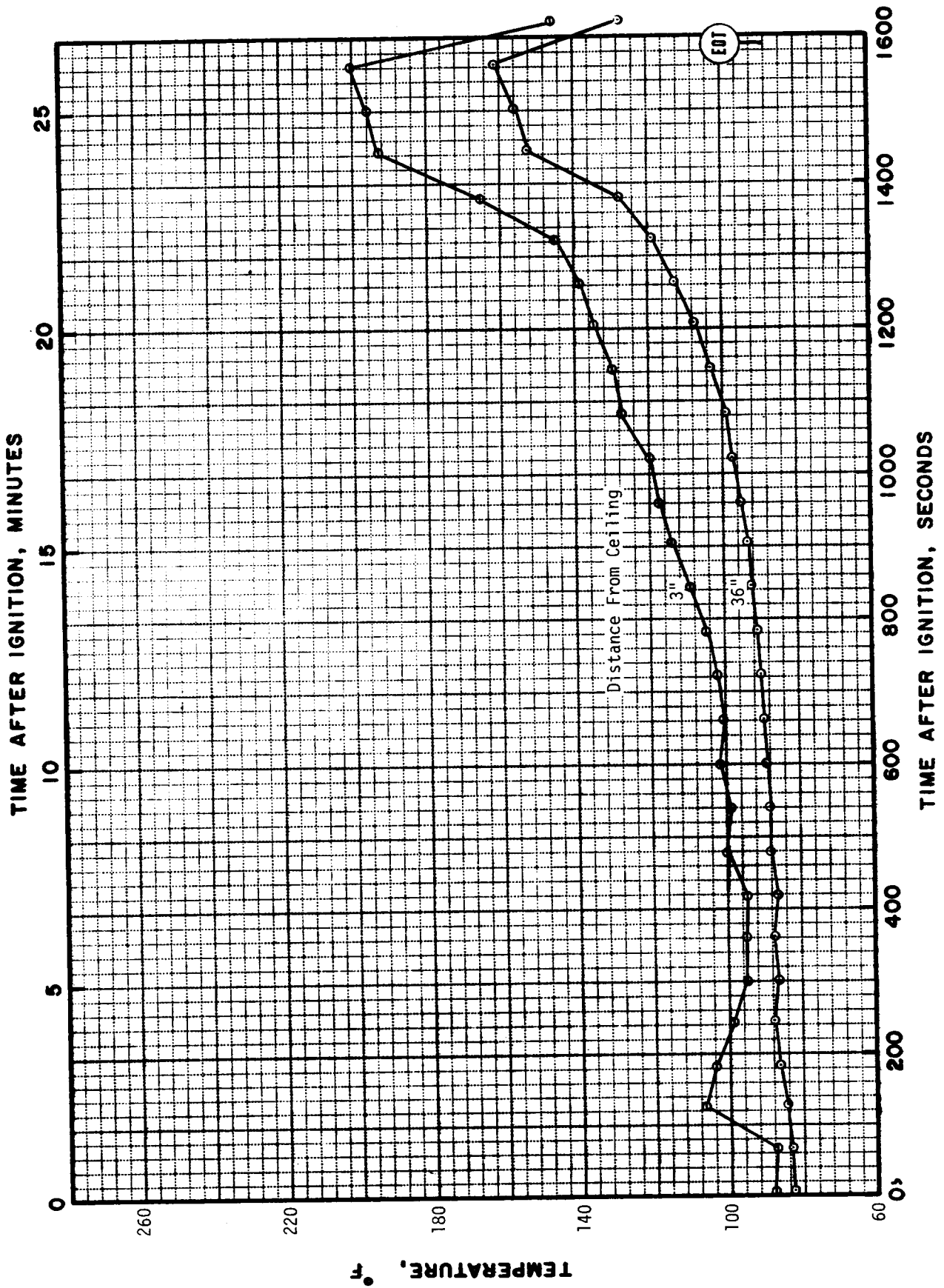
CONDITIONS ON 1ST FLOOR AT 5 FT, W-74



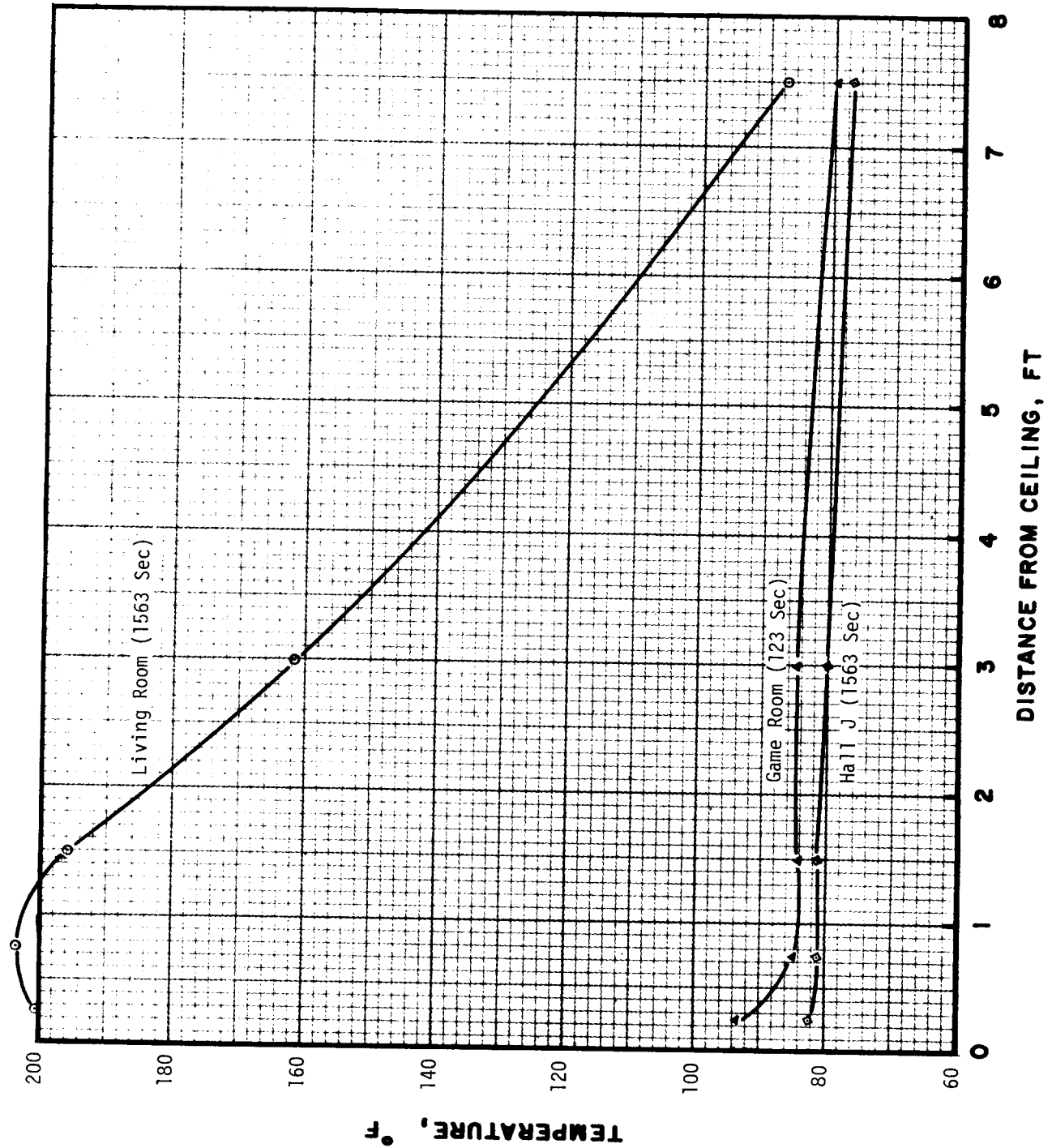
CONDITIONS ON 2ND FLOOR AT 5 FT, W-74



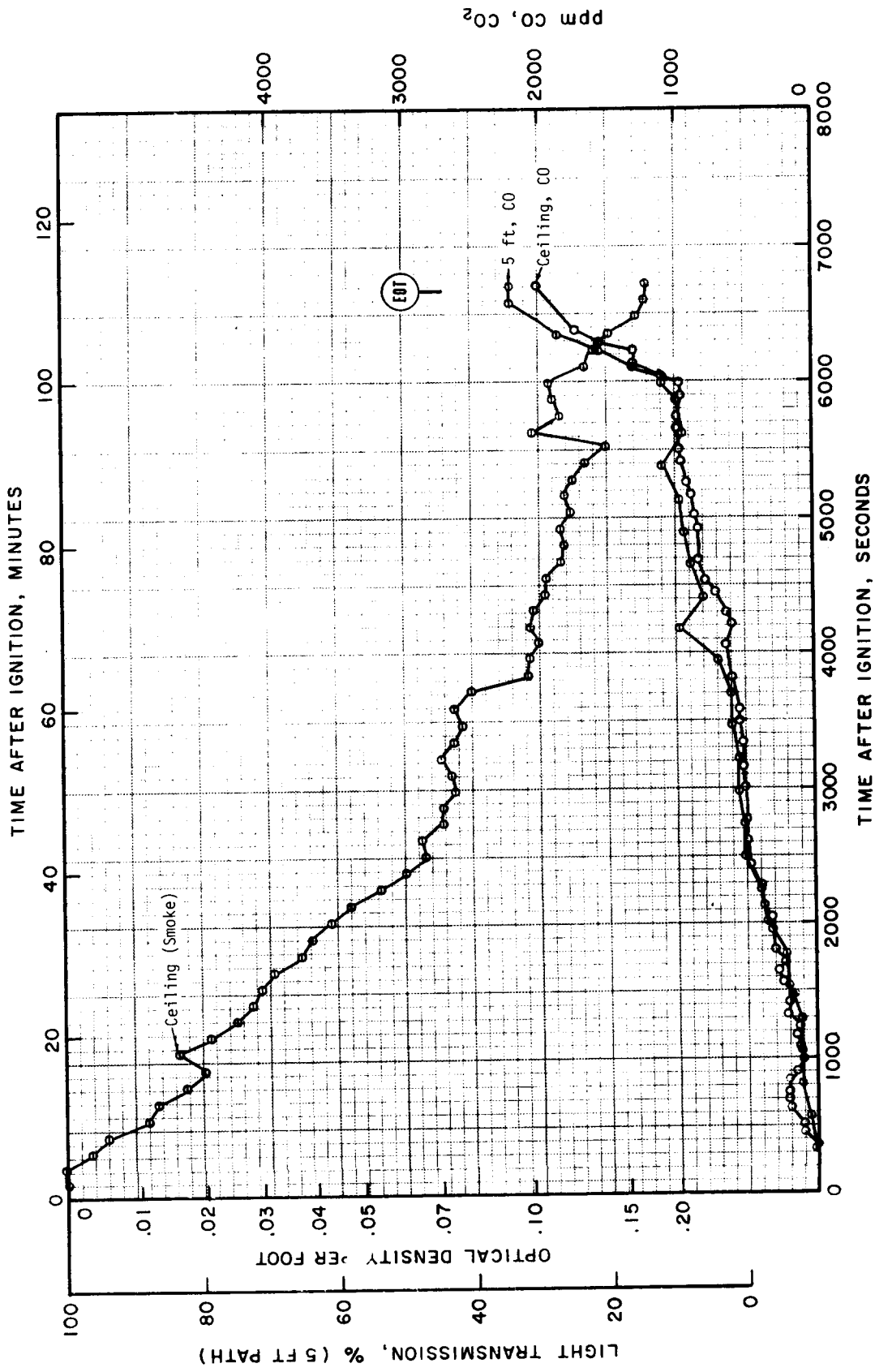
VARIOUS CEILING CONDITIONS, W-74



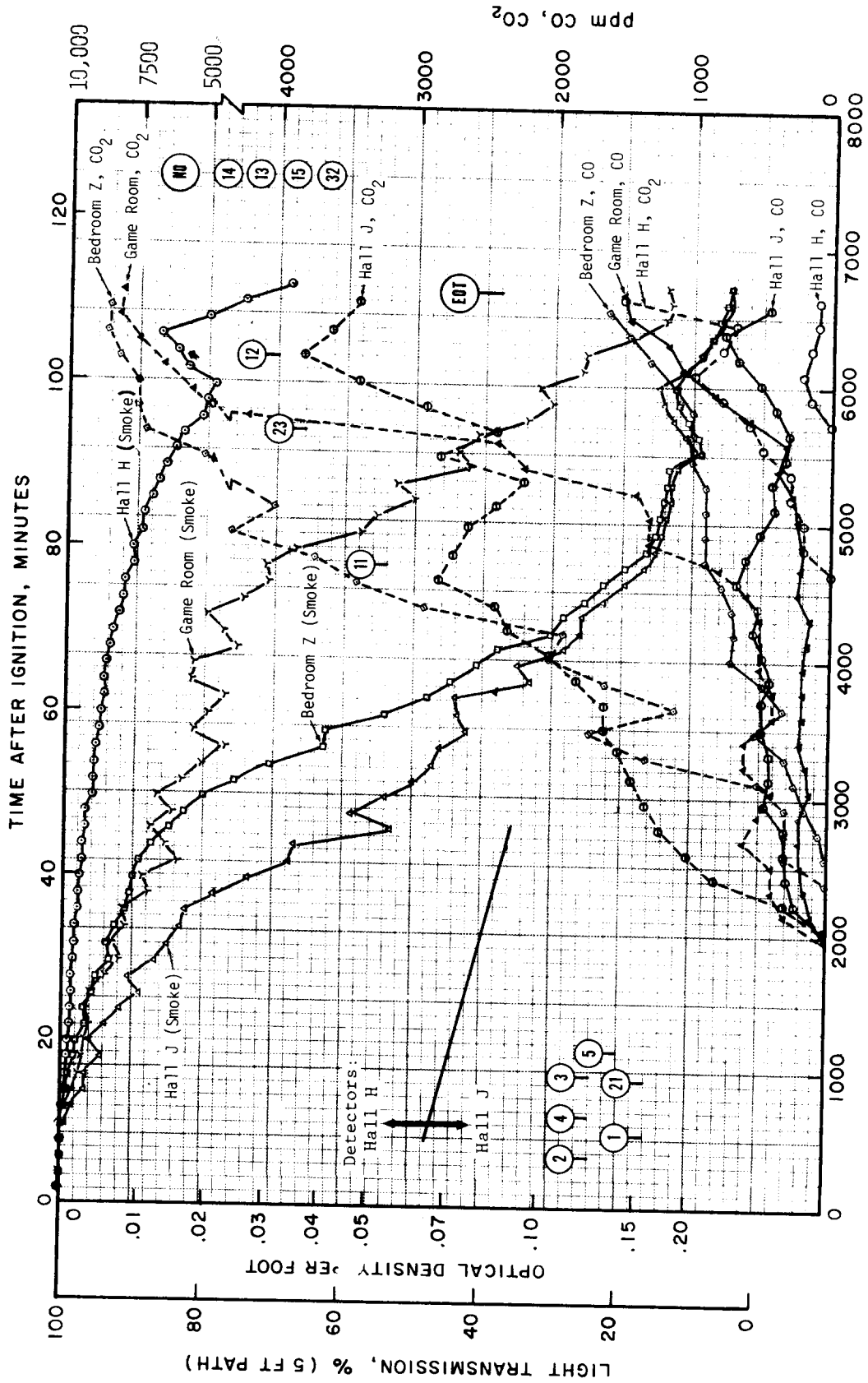
TEMPERATURES IN LIVING ROOM, W-74



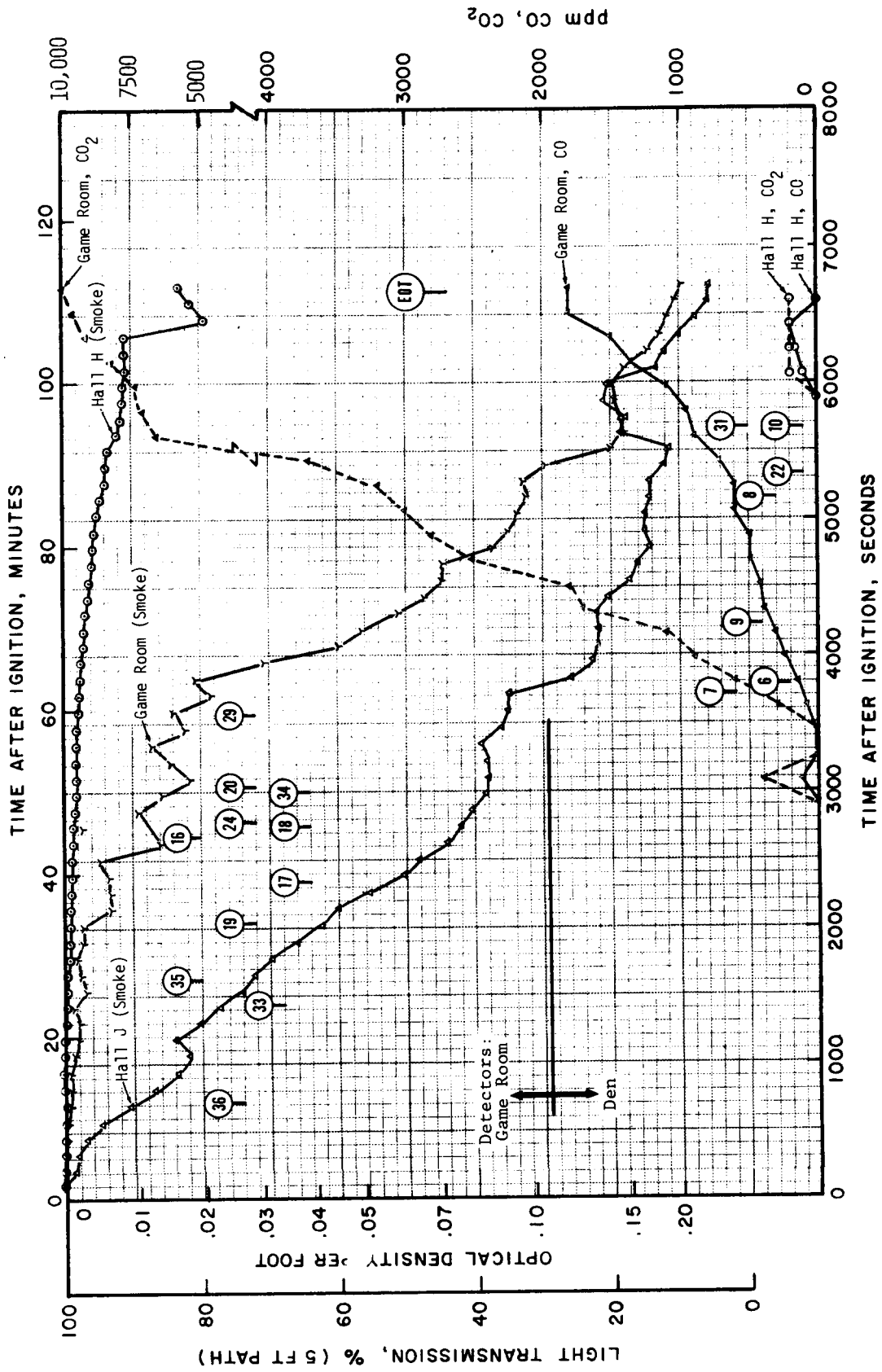
MAXIMUM TEMPERATURE PROFILES, W-74



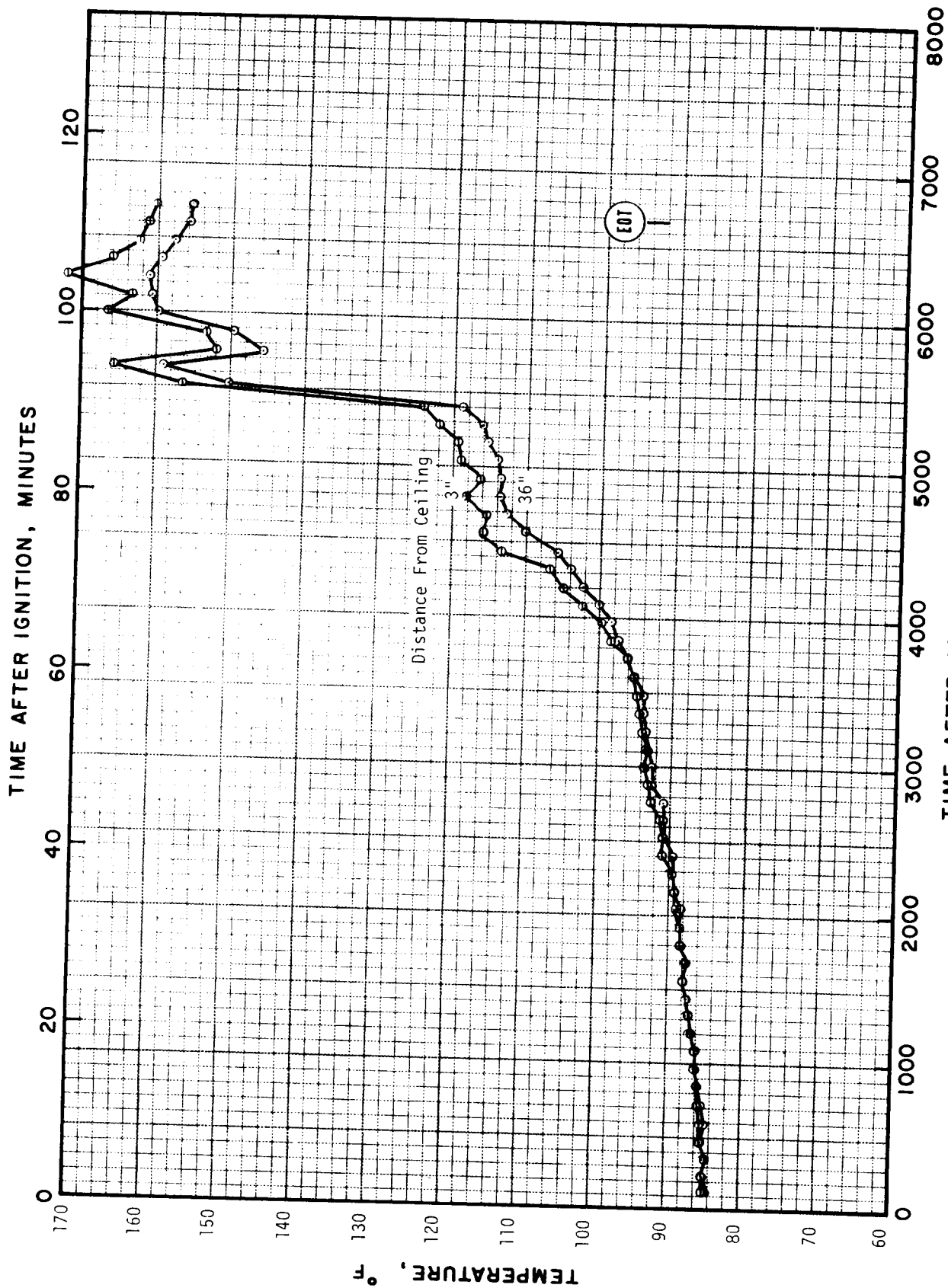
CONDITIONS IN IGNITION ROOM (BEDROOM Y), W-75



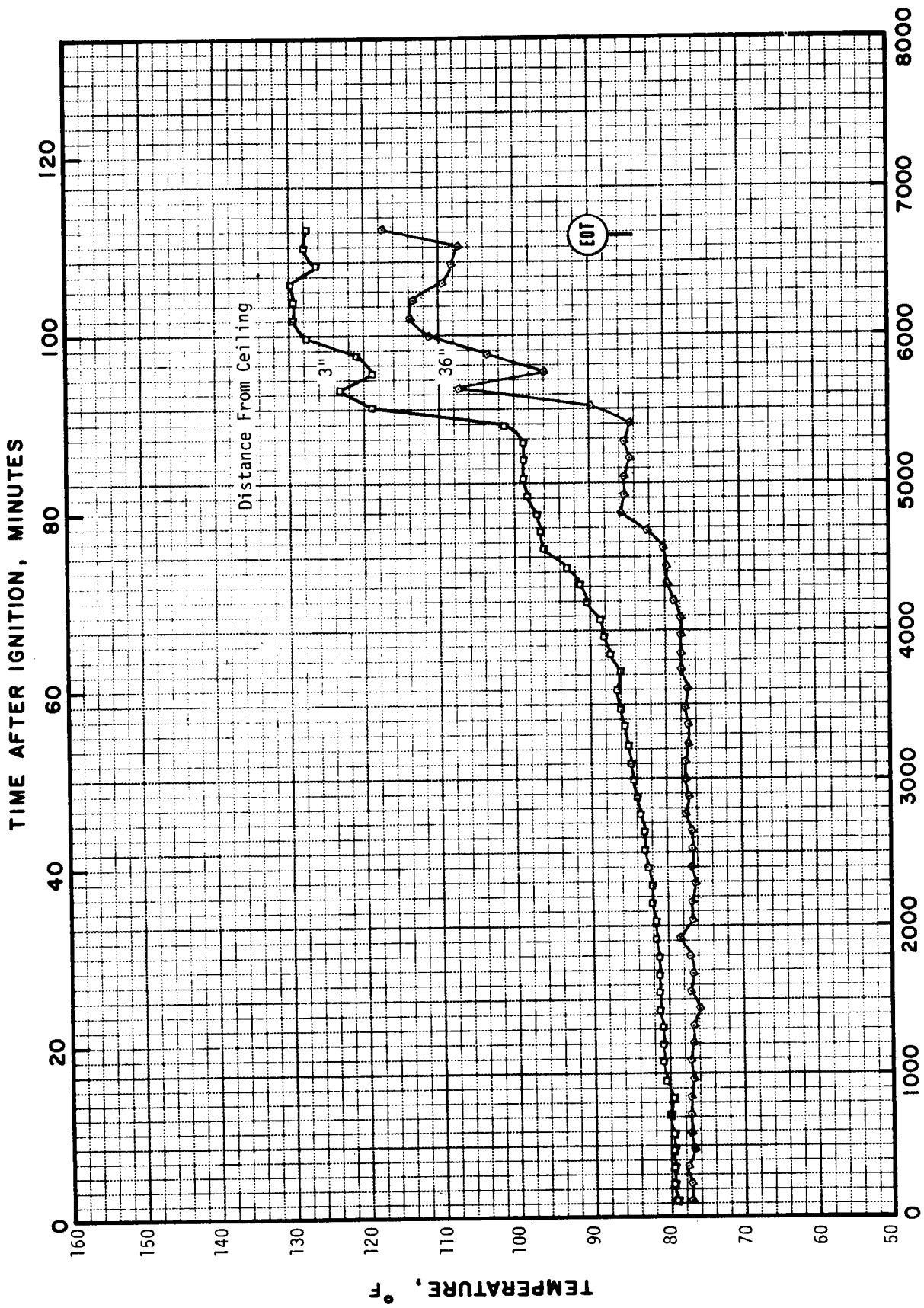
CONDITIONS ON 2ND FLOOR AT 5 FT, W-75



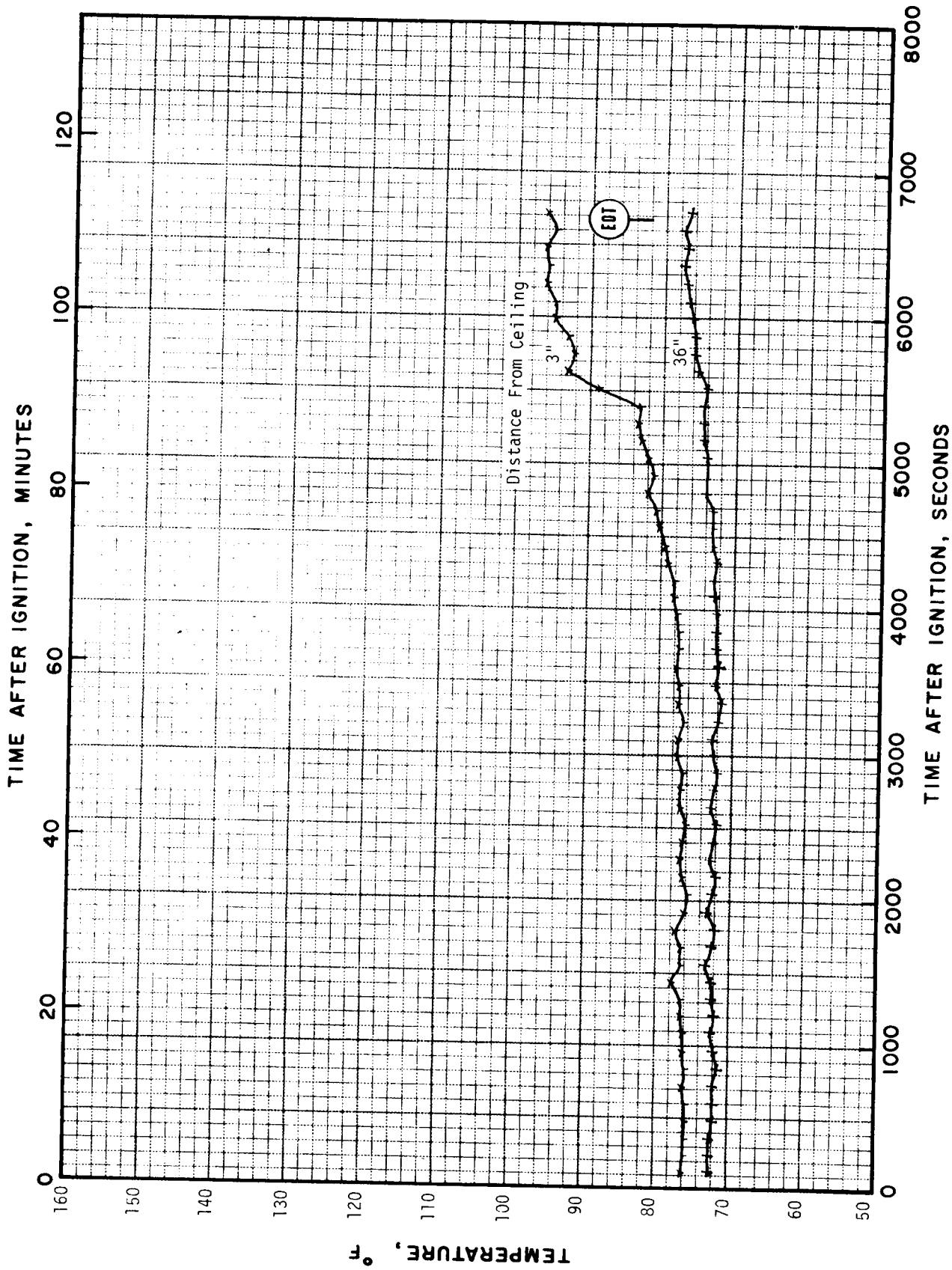
CEILING CONDITIONS ON 2ND FLOOR, W-75



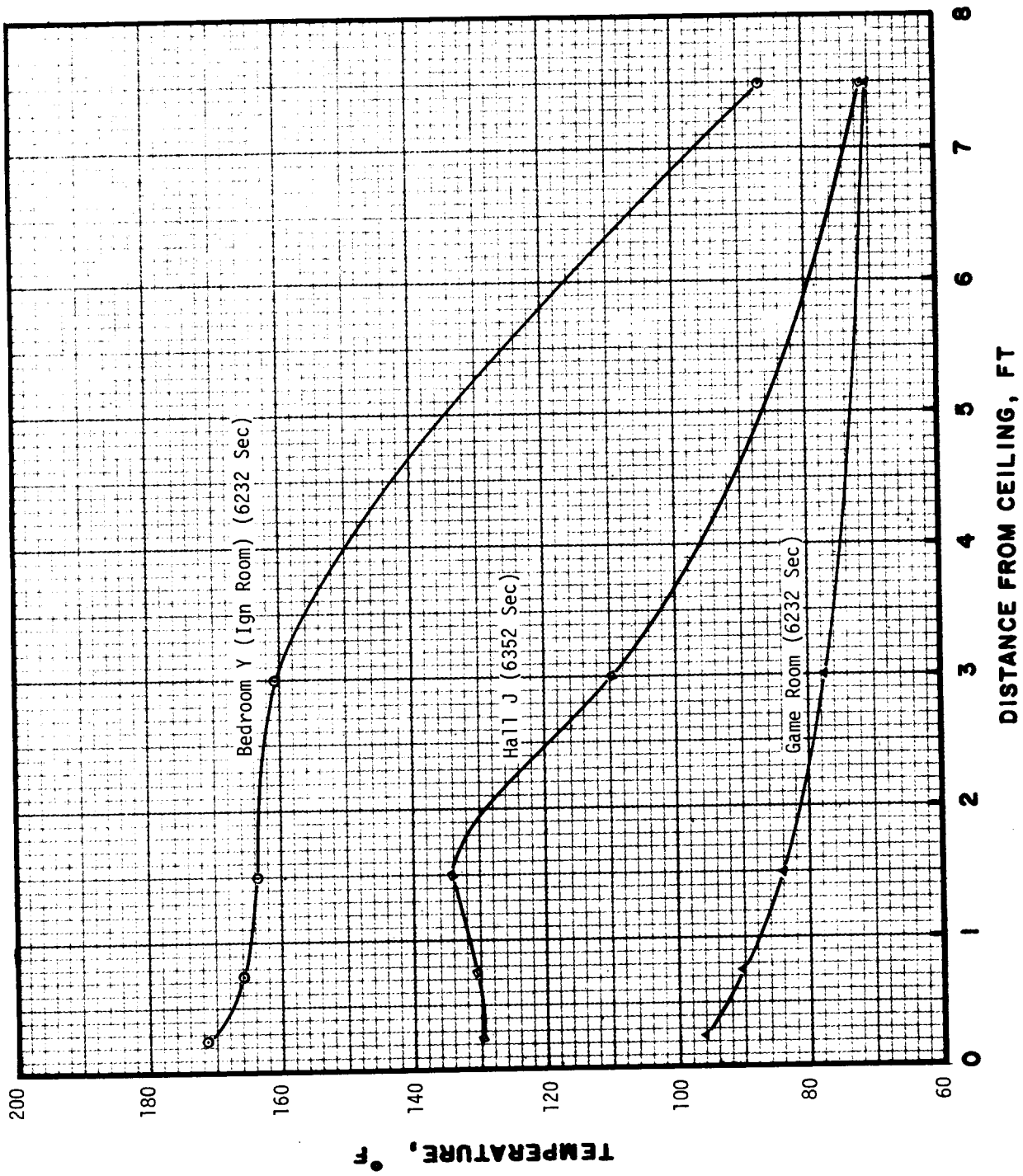
TEMPERATURES IN BEDROOM Y (IGNITION ROOM), W-75



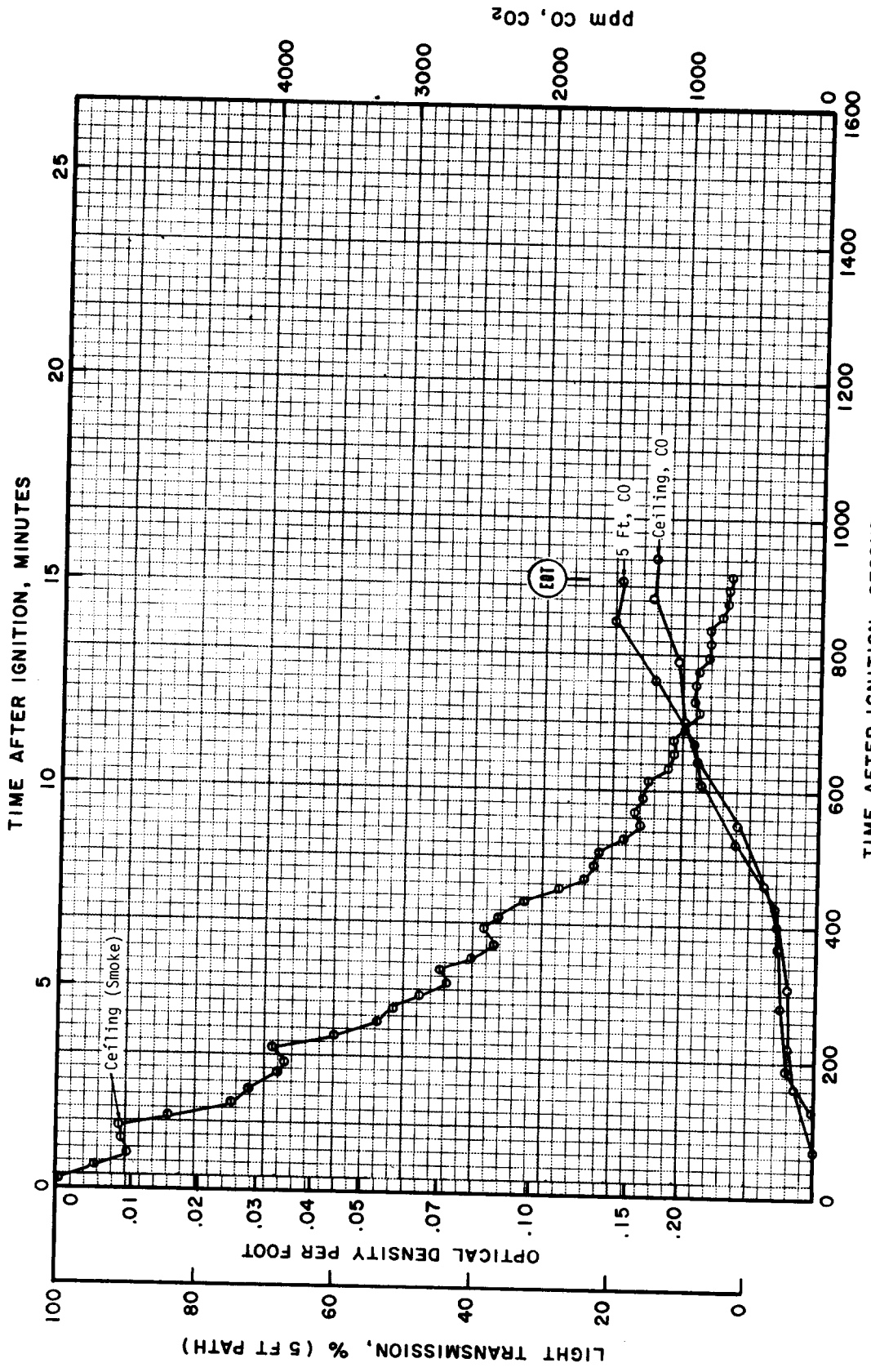
TEMPERATURES IN HALL J, W-75



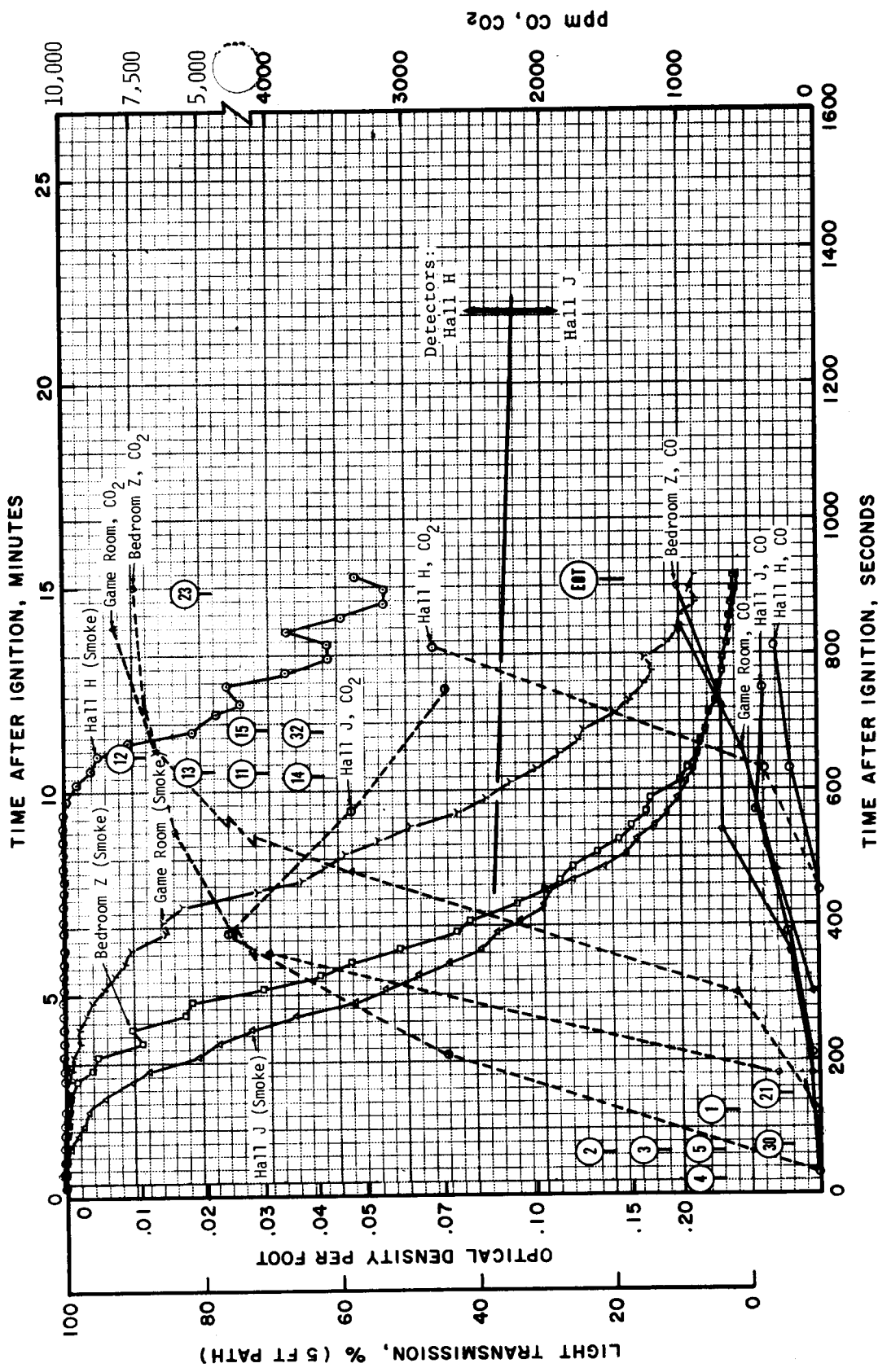
TEMPERATURES IN GAME ROOM, W-75



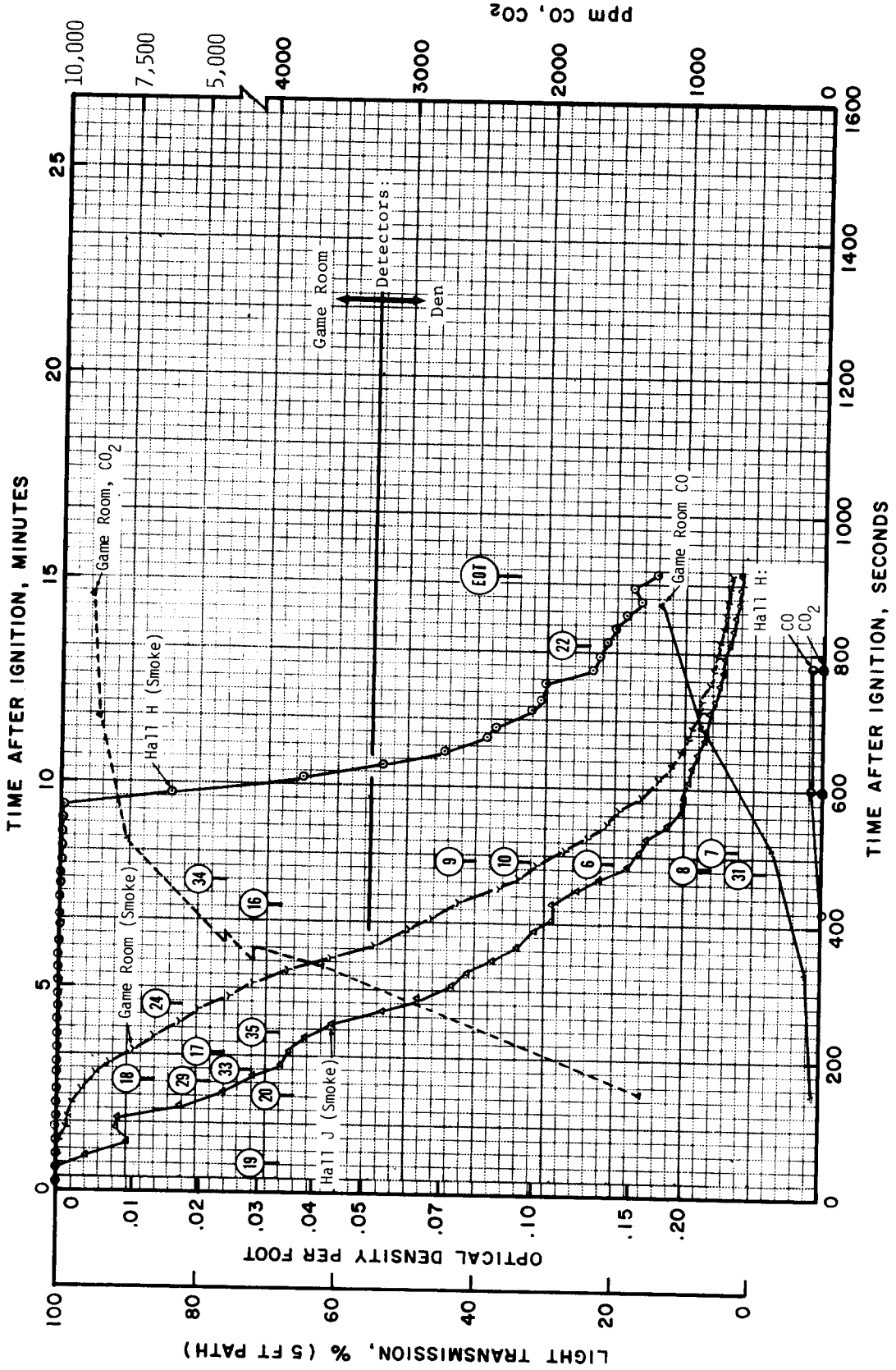
MAXIMUM TEMPERATURE PROFILES, W-75



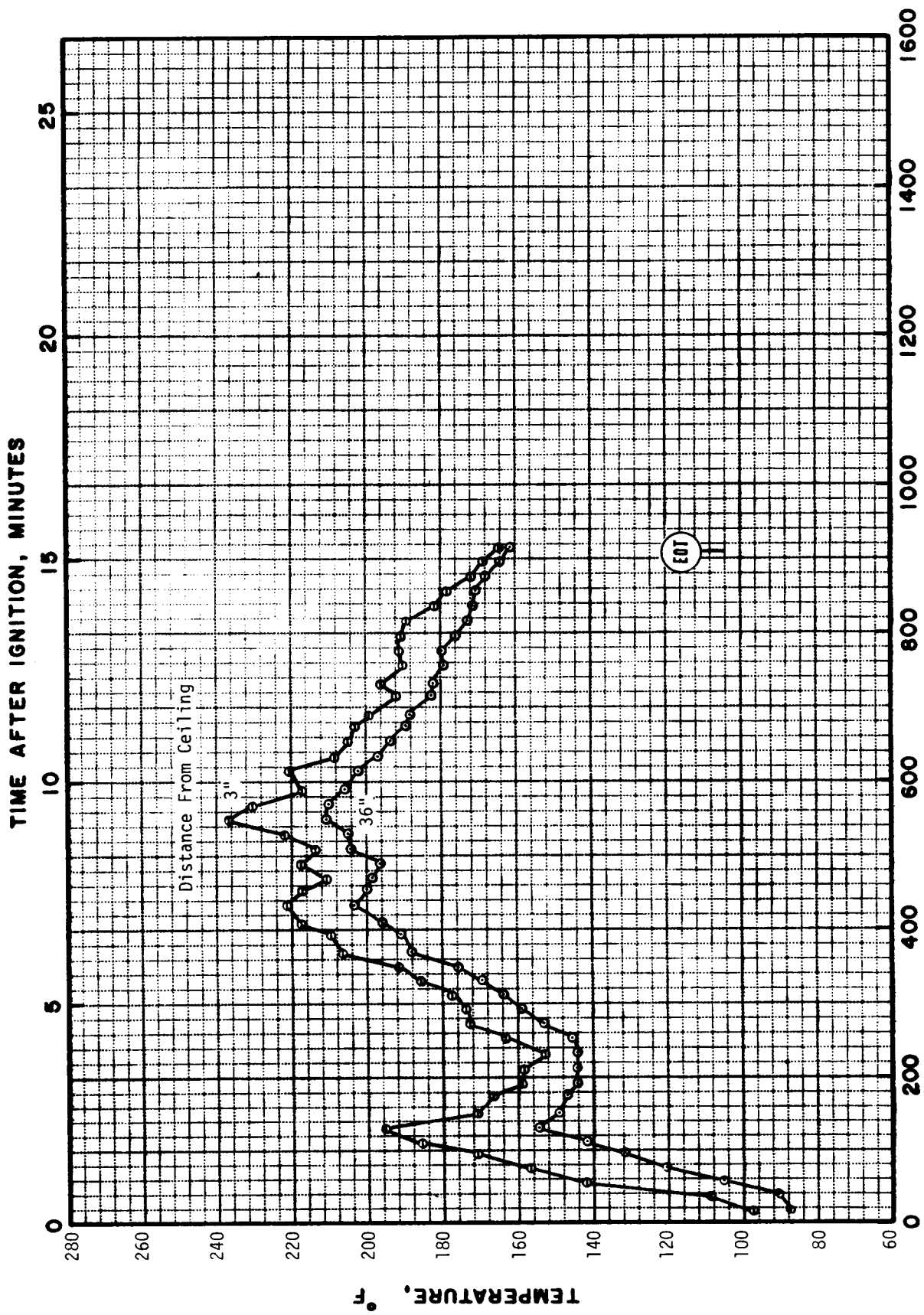
CONDITIONS IN IGNITION ROOM (BEDROOM Y), W-76



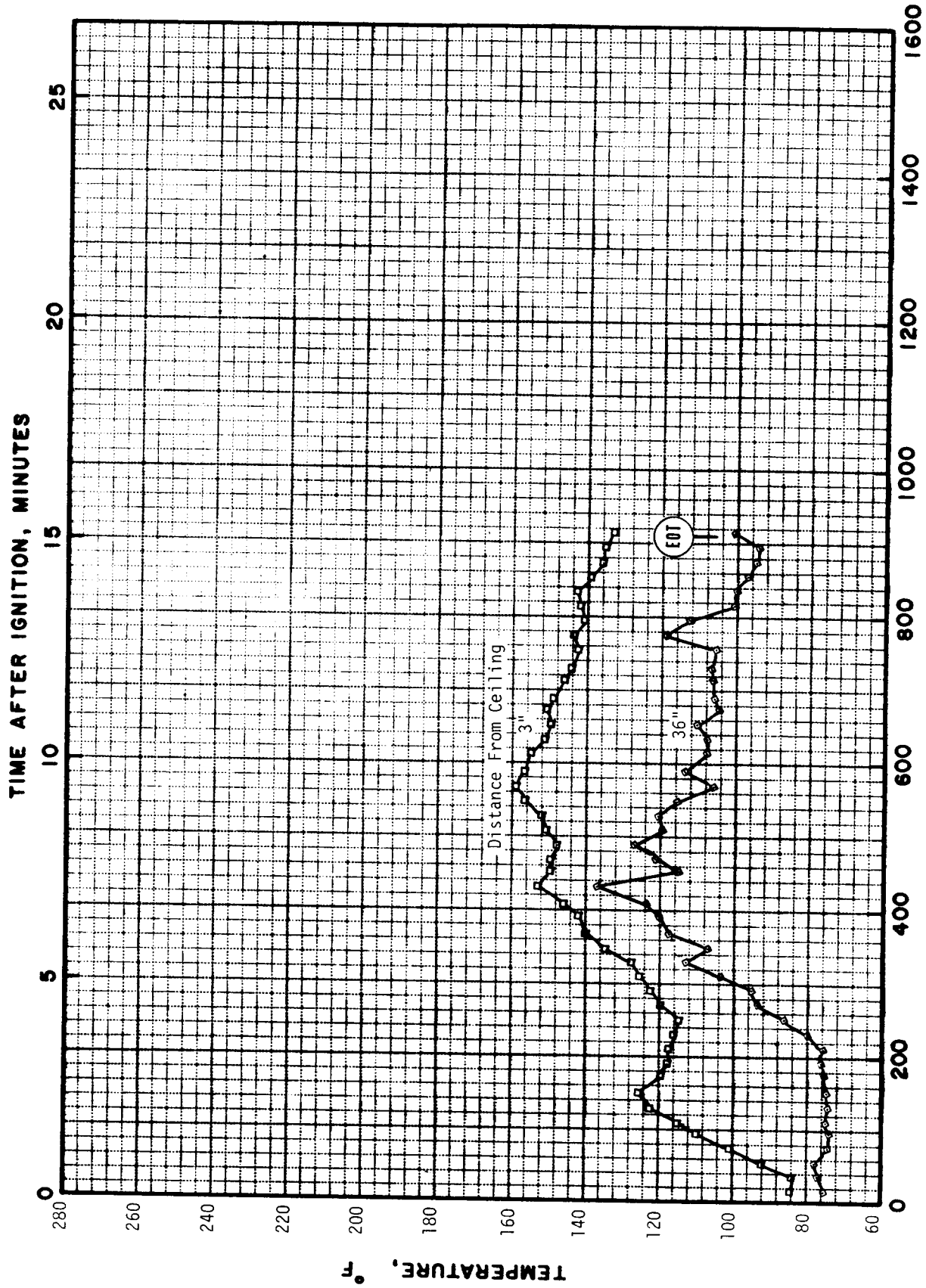
CONDITIONS ON 2ND FLOOR AT 5 FT, W-76



CEILING CONDITIONS ON 2ND FLOOR, W-76



TEMPERATURES IN BEDROOM Y (IGNITION ROOM), W-76

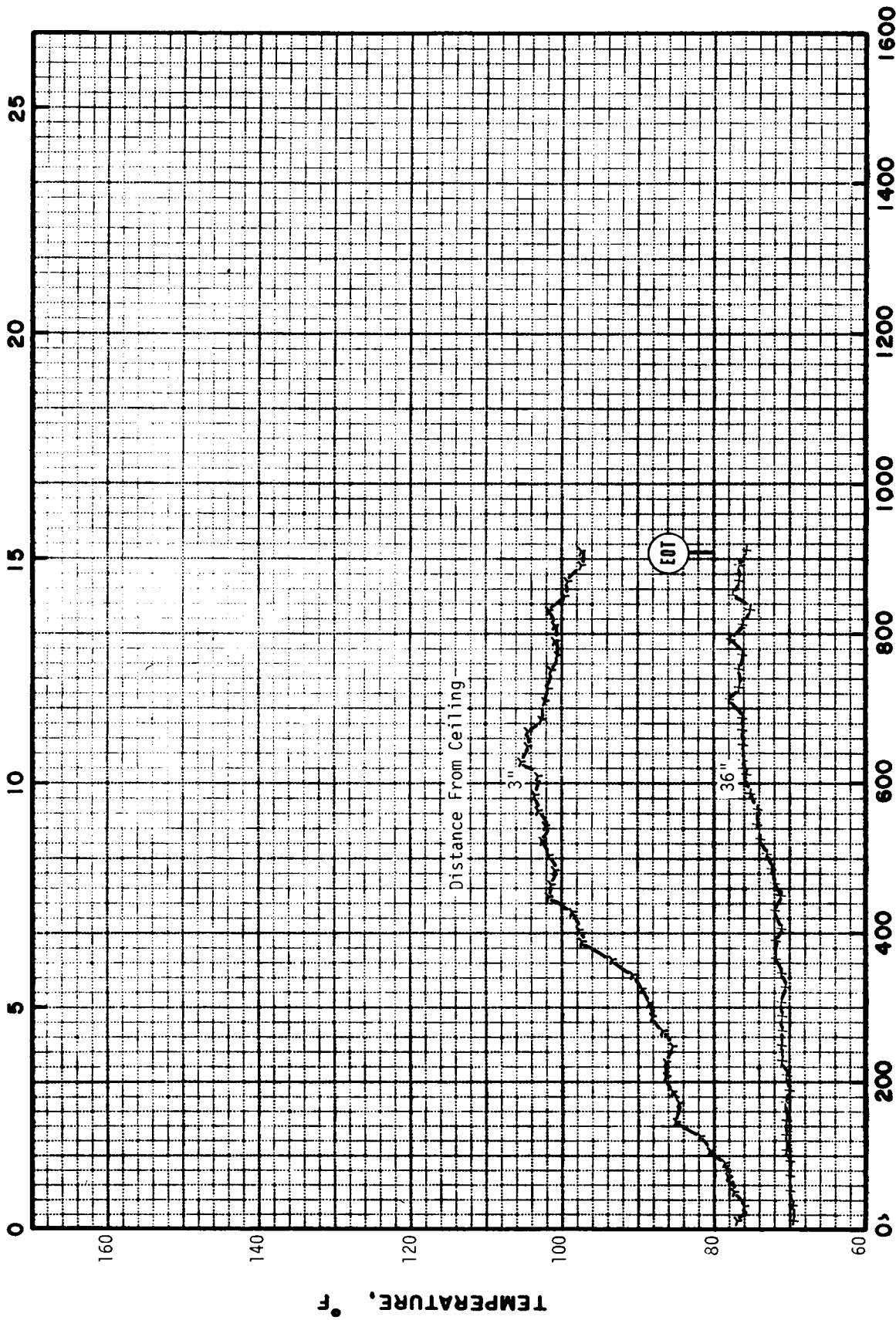


TEMPERATURES IN HALL J, W-76

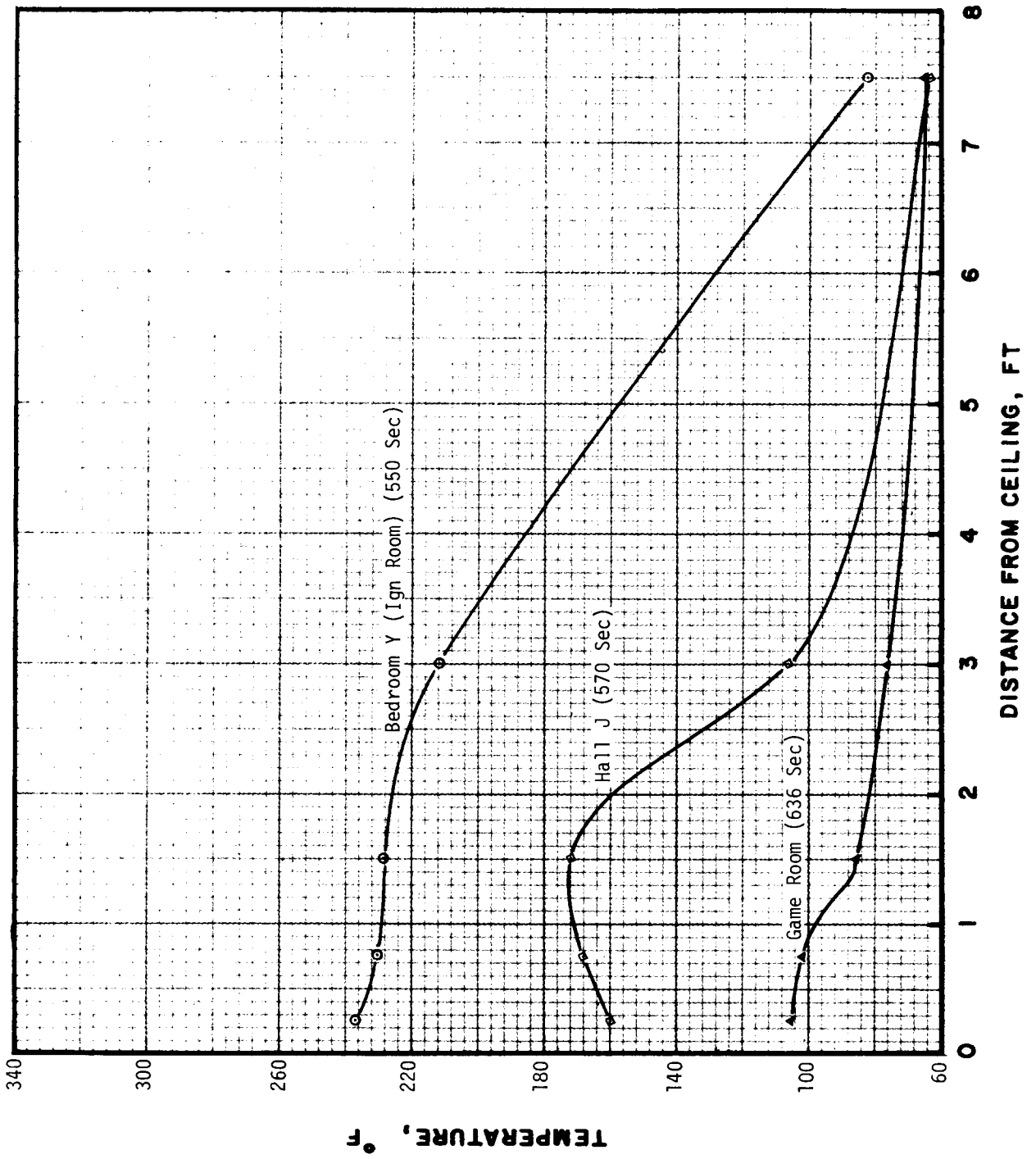
TIME AFTER IGNITION, MINUTES

TIME AFTER IGNITION, SECONDS

TEMPERATURES IN GAME ROOM, W-76



TEMPERATURE, °F



MAXIMUM TEMPERATURE PROFILES, W-76

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<p>16. ABSTRACT (A 200-word or less factual summary of most significant information. If document includes a significant bibliography or literature survey, mention it here.)</p> <p>The contract for a field investigation of the effectiveness of residential smoke detectors was extended to cover 36 additional tests investigating details not completely covered in the first report. The objective of the second phase of the program was to gather information on fires under summer/fall conditions without air conditioning and to expand available information on high volume, two story structures. The effects of open windows, new technical developments in photoelectric detector design, and the response of semiconductor type residential gas detectors and mechanically powered heat detectors were also included.</p> <p>The tests reinforced the conclusions of the first phase of testing. They showed that open windows have little appreciable affect of life safety and detection times, and that semiconductor gas sensing fire detectors exhibit fuel specific response characteristics which seriously degraded the effectiveness in certain types of fires.</p>			
<p>17. KEY WORDS (six to twelve entries; alphabetical order; capitalize only the first letter of the first key word unless a proper name; separated by semicolons)</p> <p>Detector sensitivity; detector siting; escape time; fire tests; gas detectors; heat detectors; residential fires; smoke detectors.</p>			
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