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SMOKE EMISSION FROM BURNING CABIN MATERIALS AND THE EFFECT ON VISIBILITY IN WIDE-BODIED JET TRANSPORTS

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16. Abstract

A study was made of the smoke emission of cabin materials in ten major categories of aircraft interior construction under various burning conditions. Two materials in each category tested represented high to low smoke emission values. A wide-bodied cabin mockup, 2774 cubic feet in volume was used to establish correlation with the 18 cubic foot NBS-type smoke chamber. Additionally, selected materials were tested in the wide-bodied mockup to relate human visual acuity to optical density with and without ventilation flow through the mockup. Results of the study indicate that fair to good correlation exists between the NBS-type smoke chamber and a cabin mockup for various sizes of materials tested in the mockup. Results of visibility studies indicate the relationship of optical density to human visual acuity with and without irritating gases and with and without ventilation flow rate through a wide-bodied cabin mockup.

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PREFACE

This investigation was undertaken by the Lockheed-California Company under DOT contract No. FA72NA-665. The work was administered by the National Aviation Facilities Experimental Center of the Federal Aviation Administration, with Mr. John F. Marcy and Mr. Constantine P. Sarkos serving as Project Monitors. Mr. E. L. Lopez was the Project Leader and Mr. P. K. Shelton provided consultation on materials selection for the program. The method of smoke emission measurement was based on the work done by Mr. D. Gross, et al. (Reference 1) at the National Bureau of Standards.

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INTRODUCTION

Purpose

This study was undertaken to provide direct experimental data on smoke emissions from burning cabin materials within an aircraft fuselage mockup and the effects of such emissions on human visual acuity. The principal areas of study included: (a) the degree of correlation between NBS-type smoke chamber data obtained for various categories of cabin materials and similar data from large-scale tests conducted in a cabin mockup representative of a wide-bodied jet transport, and (b) the effects of smoke on visual acuity and the relationship of human visual acuity to photometric measurements of light transmission.

Background

Although extensive data have been collected on the smoke characteristics of aircraft interior materials, the preponderance of information has been obtained via the test chamber originally developed at the National Bureau of Standards (Reference 1). The NBS technique uses a photometric sensor to measure the decrease in light transmission of a collimated vertical beam caused by smoke generated by exposing a material sample to a controlled ignition source. Data so measured are expressed in terms of the "specific optical density," D_s, defined as:

$$D_s = \frac{V}{AL} \log_{10} \frac{100}{T} = \frac{V}{AL} D$$

where:

V = chamber volume,
A = exposed surface area of test sample,
L = photometer optical path length,
T = percent light transmission, and
D = optical density.

Experimental values of D_s are dimensionless and should vary for a given specimen exposure time only as a function of material thickness (subsurface evolution of combustion products), material chemical and physical properties (amount and nature of smoke aerosols produced), and specimen exposure conditions (flaming or smoldering). Consequently, D_s for a given specimen is dependent only on the ratio of $\frac{V}{AL}$ so that smoke measurements made in the relatively small NBS chamber should ideally be valid for the areas and volumes characteristic of a wide-bodied jet fuselage.

Gross, Loftus, and Robertson (Reference 1) presented limited data which tended to indicate the validity of scaling NBS chamber results to volume ratios as high as 14 and specimen area ratios of 15. They caution, however, that definite limitations exist on data extrapolation and list several underlying assumptions including uniform smoke distribution,

independence from thermal "edge effects", similarity of smoke deposition regardless of chamber size and configuration, and similarity between photometric and human vision. It is to be expected that data extension will be less precise as volume and area ratios increase through several orders of magnitude, and the effects of deviation from the assumed conditions become more pronounced.

The present study is intended to help establish the limits of applicability of experimental results obtained by the NBS method to actual aircraft fire situations. Material samples first tested in the NBS apparatus were again tested in a fuselage mockup and the corresponding specific optical density data compared. Since the primary objective of reducing smoke emission is to achieve improved visibility, further tests were performed with human subjects to measure the quantitative degradation in visual acuity due to smoke alone and that caused by both smoke and eye irritation from gases produced during the combustion process.

EXPERIMENTAL PROCEDURE AND RESULTS

SELECTION OF MATERIALS

Available smoke emission data on a wide variety of fire retardant materials were reviewed during the test materials selection process. The objective was to find a representative material at each end of the smoke emission range for the following ten interior materials usage categories:

1) Ceiling panel
2) Side panel/window reveal
3) Partition panel (class divider, lavatory wall, etc.)
4) Structural flooring
5) Thermoforming (molding, extrusion, etc.)
6) Seat upholstery
7) Seat cushion foam
8) Carpeting
9) Transparency (interior window, divider)
10) Elastomer (molding, extrusion, etc.)

Only materials considered acceptable by current aircraft standards were included. That is, the material had to meet FAA flammability requirements and to have reasonable cost, wear, and aesthetic qualities. In each category two materials were selected, one representative of high smoke emission and one of low smoke emission. The fire retardant materials tested in each category are listed in Table I. The higher smoking material in each category is designated at (A) and the lower smoke-emitting material as (B).

LABORATORY SMOKE EMISSION TESTS

All selected materials were initially tested in a laboratory smoke chamber to establish baseline data. This portion of the work was performed in Lockheed's Fire Research Laboratory (Figure 1).

Laboratory Smoke Chamber Description

The chamber used was of the type which has become known as the NBS Smoke Chamber. This unit was fabricated by Lockheed in accordance with descriptions available from NBS (Reference 1). For these tests the photometric system of the chamber was changed from the fiber optics-Viscor photovoltaic system to the phototube-photomultiplier system used in all commercial NBS smoke chambers. The advantage of the phototube over the photovoltaic system is the capability to measure extremely high smoke densities or very low light transmissions. For this chamber the specific optical density is computed as follows:

$$D_s = \frac{V}{AL} \log_{10} \frac{100}{T}$$

where:

V = Volume of the smoke chamber = 18 $ft.^3$
A = Area of the exposed test specimen = 6.6 $in.^2$ = .046 $ft.^2$
L = Light path length = 3.0 ft.
T = Percent light transmission.

For the calibration of the NBS chamber photometric system, a set of sixteen calibrated gelatin neutral density filters was used ranging from 91.0 percent to 0.24 percent light transmission. Additional checks of the photometric system included testing of NBS-supplied Alpha-Cellulosic paper, $D_s = 170 \pm 8$, and ABS sheet material, $D_s = 455 \pm 26$. The experimental test values of these materials, (average of three runs) were $D_s = 164$ and $D_s = 441$, respectively. For the radiant heat flux determination, a set of certified water-cooled calorimeters was used to calibrate the Gardon-type air cooled radiometer, which is a built-in feature of the NBS-type chamber.

Laboratory Smoke Emission Test Procedures

In the laboratory test program, the controlled test variables included flaming exposures with two levels of radiant heat flux and a nonflaming exposure with normal incident heat flux. In all of the laboratory tests, the specimen was positioned vertically and the normal NBS smoke chamber testing procedure was followed.

All materials were preconditioned for 24 hours in a humidity chamber maintained at 50 ± 4 percent relative humidity and 70 ± 3°F temperature. A typical test in the NBS-type smoke chamber is shown in Figure 2.

Laboratory Test Results

A summary of all the laboratory tests performed in this phase of the program is presented in Table II. The data are presented for the flaming or nonflaming (irradiation only) condition. The maximum specific optical density, $D_{m(corrected)}$ is given, time of D_m occurrence and maximum smoke rate, R_m. The corrected specific optical density is the maximum density less the deposits left on the windows of the photometric system after performing the test. The data as given in Table II represent the average of three runs.

The complete data for all materials tested in the laboratory, for all previously specified conditions, are presented in Appendix I as plots showing the variation of D_s as a function of time. For convenience the flaming, nonflaming and the higher heat flux data (where applicable) are all plotted on one data sheet. For a majority of the materials under study, the flaming condition produced more smoke than did the nonflaming or the smoldering condition. In practically all cases the higher irradiation level (3.81 watts/cm^2), as differentiated from the normal NBS chamber irradiation level (2.54 watts/cm^2), produced more smoking of the materials and in one case produced a ten fold increase, i.e., 4(B). In 4(B), which is an aluminum faced, high temperature nylon core sandwich panel with FR epoxy adhesive, the heat capacity of aluminum prevents the adhesive from decomposing under the standard heat irradiation. However, under the 3.81 watts/cm^2 heat flux the decomposition temperature of the adhesive is reached and a significant amount of smoke emission is evident.

In materials 1(B) and 3(B), although phenolic resin is a lower smoking material than epoxy resin, and theoretically 1(B) and 3(B) should be significantly lower in smoke than 1(A) and 3(A), the bonding adhesive used between the sandwich skins and the honeycomb core produces the opposite result. Present practice is the use of epoxy adhesive for bonding the phenolic-glass skins to the core, with the adhesive partly coating the inner cells of the core. Consequently, with this practice very little is gained, from the smoke emission viewpoint, by use of "prepreged" phenolic resin sandwich skins. Efforts are being directed toward reducing the smoke emission of epoxy adhesives by utilizing certain fire retardant treatments. Substitution of phenolic adhesives for epoxy adhesives causes approximately a ten fold decrease in peel strengths, such that structural strengths of these panels are greatly reduced. Because ceiling panels and partition panels are generally designed to carry a certain amount of load, a great reduction of structural strength of these panels is not tolerable.

CABIN MOCKUP SMOKE TESTS

In this phase of the smoke emission program, a 21-foot long mockup with full-scale cross-section typical of a wide-body jet aircraft was used. The objective was to subject larger specimens of materials selected from the laboratory program to test parameters identical to those of the NBS-type

smoke chamber. In this phase the degree of correlation between full-scale smoke tests and laboratory results was to be explored. These materials included: 1(A) and (B) Ceiling paneling, 2(B) Side panel/window reveal, 3(A) and (B) Partition paneling, 4(A) and (B) Structural flooring, 5(A) and (B) Thermoforming, 6(B) Seat upholstery, 7(A) and (B) Seat cushion foam, 8(A) and (B) Carpeting, 9(A) Transparencies, and 10(A) and (B) Elastomeric materials.

Mockup Test Arrangement

A mockup (Figures 3 and 4), previously used for air distribution tests on a wide-bodied jet transport, was made available for these tests. This wooden mockup was complete with an air circulation system, fire-protection sprinkler heads, and pressure relief doors. Additional modifications in preparation for the present program included careful sealing of all joints, coating the interior with intumescent paint, raising the sprinkler head settings to 180°F, and covering the floor with several layers of fiber-glass cloth. Upon completion of these modifications, a photometric smoke density measurement system, a radiation source, manifold burner, and a specimen holder were installed as shown in Figure 5.

Two vertical light banks were situated on the centerline of the mockup, one in the center of the mockup and the other bank two feet from the aft end (Figures 5, 6, and 7). Each light bank consisted of three smoke meters with a distance of three feet between the light source and receiver optics, corresponding to the separation in the NBS chamber. Since the distance from the floor to the ceiling in the mockup was less than nine feet, the three-foot long smoke meters overlapped. The center ceiling smoke meter is designated as meter No. 1, the center mid-height meter is No. 2 and the center floor meter is No. 3. For the end light bank, the end ceiling meter is No. 4, the end mid-height meter is No. 5 and the end floor meter is No. 6. An overall ceiling to floor meter was installed near the center light bank and is designated as meter No. 7. The purpose for installing the overall ceiling to floor meter was to check the average smoke density reading of the three center light bank smoke meters.

The central 10 foot section of the mockup interior measured 7 feet 6 inches high and the end sections measured 8 feet 2 inches high. The overlapping of the center mid-height smoke meter amounted to 9.0 inches with the ceiling and the floor smoke meters and the end mid-height smoke meter overlapped the ceiling and the floor meter by 5.0 inches. As noted in Figure 5, the difference in the ceiling heights is due to alternating luminaire and non-luminaire areas of a typical wide-bodied interior. For the center light bank the three individual smoke meters were similar in principle to the NBS smoke chamber photometric system as described in References 1, 2, and 4. The collimating lenses used were taken from war surplus gun-sight collimators obtained from Edmund Scientific Company. The light sources were Type 1630, 6.5 volt lamps maintained at 4.0 volts and the light detectors were ND-2 filtered 931V-A photodetectors tubes of the photomultiplier type having an S-4 spectral response. The readout instruments for each of the photodetectors were of the Aminco Model 10-222 Microphotometer type (American Instrument Company). The individual

The significance of radiation level on the test results can be appreciated by an examination of Tables III and IV. Here it can be seen that the smoke emission from materials undergoing the kindling condition (flame front only) are much lower than the flaming condition (flame front and radiation). This indicates the contribution of radiation to the smoke emission of materials in a fire situation is quite significant. This observation is reinforced by examining the 3.3 Btu/ft^2-sec radiation heat flux condition relative to the standard 2.2 Btu/ft^2-sec condition (see Table II). It is apparent, therefore, that higher radiation heat fluxes combined with a flame front induce a higher smoke emission from materials during pyrolysis.

The effect of horizontal versus vertical specimen positioning can be seen in data plot III-3, Appendix III. The slower flame front velocity for horizontal cases causes a slower buildup of smoke. However, the maximum value of D_s for the horizontal cases correlates about as well as the vertical cases (see Figure 10). As might be expected, smoke buildup in the mockup is highly stratified.

As shown by information presented in Table VI, Figure 10, and Appendix III, there appears to be substantial validity for the extrapolation of data obtained from the NBS type smoke chamber to larger area, wide-bodied aircraft volumes, insofar as maximum D_s values are concerned. The time lag for reaching peak D_s values in the larger volume mockup is perhaps the largest departure from NBS chamber data for reasons previously outlined. Data from horizontally applied materials do appear to correlate with maximum NBS vertical test data on similar materials. It is presumed that if the exact test parameters had occurred in the mockup as are present in the NBS chamber (such as exact heater simulation and wall temperatures) a better correlation would have resulted. For this reason no formulas for extrapolation from NBS chamber to wide-bodied conditions, nor use of the regression fit equation appear to be justified. Therefore, the data obtained from the NBS type smoke chamber do appear to provide good comparative smoke emission data on materials for interior wide-body applications.

CABIN MOCKUP VISIBILITY TESTS

In this phase of the program, using human subjects, an attempt was made to obtain a relationship between optical density (D) and visual acuity under the realistic conditions of large scale mockup testing. Also, the effect of irritating gases on the visual acuity of human subjects was investigated.

Test Arrangement

To measure human visual acuity, the standard Snellon eye-test charts, slightly modified were used in the interior of the mockup. The modification of the charts consisted of arranging the larger letter sizes progressing downward (opposite to the usual convention). The larger letter sizes were placed on the bottom, because the smoke stratification tends to progress

downward from the ceiling under zero ventilation conditions. Thus, the initial observation threshold could be detected more easily with the smaller letters. The charts were placed at 5, 10, and 20 foot distances from the aft end of the mockup in pairs, offset equally from the mockup centerline. The charts were mounted with the 20/20 visual acuity line at 20 feet distance measuring 63.0 inches above the floor. This distance was approximated to be the average eye level height between male and female adult population. Scale drawings showing the interior arrangement of the eye charts and the average eye viewing level relative to the smoke meter locations are shown in Figures 11 and 12.

Because of the potential hazard of flash fires, the subjects were not located within the mockup. Instead, four viewing booths (Figure 13) were placed at one end of the mockup. In two of the booths, the subjects viewed the charts through a transparent plastic window. In the other two booths, there was no window. In the open booths the subject inserted his head through a diaphragm seal and was effectively exposed to the mockup gaseous environment from the neck up. A breathing mask for providing fresh air was supplied so that the subjects did not inhale the combustion products. However, their eyes were exposed to the lachrymal effects of these gases. The viewing subjects in the open booths had 20/20 uncorrected vision except for one case where one subject wore corrective contact lenses. This particular case indicated to some degree the protection provided people wearing corrective contact lenses against the effect of irritating gases. Communication channels were set up between the test director and each (or all) subject(s), but without communication between subjects.

Four test subjects viewing forward are shown in Figure 13. Also shown is the instrumentation for recording smoke densities, heat flux, oxygen level; exit lights power equipment; and power supply equipment for the radiation heaters. The interior view of the eye charts is shown in Figure 14. Lamps were situated on the chart supports and illuminated the 5 foot, 10 foot, and 20 foot eye charts with each respective pair of lamps regulated by an individual variable transformer. The transformer power for each pair of lamps was adjusted to enable the test subjects to read the appropriate line at clear mockup conditions, i.e., the 20/20 visual acuity line at 20 feet distance. An interior view looking aft at the observation booths is shown in Figure 15. A manifold capable of handling three colorimetric gas detector tubes was mounted on top of the mockup to monitor hydrogen chloride (HCl), carbon monoxide (CO), and sulfur dioxide (SO_2) gases during the visibility tests.

Materials used for these tests were similar to those used for the laboratory and mockup correlation tests, with the exception of a vinyl-cotton fabric, having a unit weight of 16.2 oz./yd.^{2}. This material has been typically used for seat upholsteries. The vinyl-cotton fabric was initiated into this phase of the program because of the known high level of hydrogen chloride gas emission under pyrolysis conditions. Thus, the lachrymal effect of such gases on visual acuity could be determined.

Test Results

A total of nine mockup visibility tests was performed with four test subjects, two having 20/20 vision viewing through open booths and two having 20/20 vision (corrected) viewing through booths provided with transparent windows.

The results of the visibility tests are shown on individual data sheets in Appendix IV. On each data sheet are plotted the optical density (D) of the material, as measured by the indicated smoke meters, and the visual acuity of the test subjects as a function of test time. In this report, visual acuity of the test subjects is to be understood as the ability of a subject to read clearly the letters of a line of the standard Snellon eye chart as the test progresses. The effect of smoke density and the irritant gases produced on the visual acuity is shown for each test material as a function of time. Because of the rapid buildup of smoke, and the time lag for queries to and responses from the test subjects, the 20 foot distant chart data were deemed most meaningful. Consequently, all visual data plotted pertain to the visibility of the 20 foot distant charts. The development of the Snellon eye test chart (among others) is described in Reference 5. A subject's ability to read the 20/20 line at 20 feet distance is the basis of the chart. A subject capable of reading only the large E, line 1, at 20 feet distance has a vision of 20/200. As can be noted the effect of irritant gases can reduce the visual acuity to a significant degree. In some cases the subjects had to exit the booth because of excessive eye irritation. The exit time of a subject is marked by an X in the data sheets.

The colorimetric detector tubes used to determine the irritating gases have a mean accuracy of ± 15 percent from actual values and are somewhat sensitive to temperature and humidity (Reference 4). The temperature of the gases at the location of sampling was different than at the test subjects' eyes. The scope of this investigation did not warrant an exact analysis of the irritating gases and the accuracy of the reported values in the individual data sheets is probably ± 25 percent. Analysis of the data presented appears to indicate HCl as being the principal irritant. However, SO_2 may also contribute to the tearing and irritation. It is of interest to note the endurance of test subject B in test data sheet IV-9. The test subject was wearing corrective contact lenses and reported no discomfort or eye irritation in comparison to test subject D.

As noted in the data plots, Appendix IV, curves are plotted for various meters indicated in Figures 11 and 12. The average reading of meters one and two are most representative of local smoke obscuration, because of the 20/20 acuity line of sight going through the approximate center of these two meters. However, from the standpoint of correlation with laboratory NBS chamber data, the overall meter (No. 7) is probably the most significant. Curves for meters two and three are also shown in the plots for better comprehension of the stratification effects. Significant degradation of visual acuity does not appear to occur until optical density values of .35 - .40 are reached as indicated in data plot IV-6. This is due to the stratification, so that the really dense smoke is above the level of the

charts for a period of time. Some judgment of the relative obscuration can be made by examining the series of photographs, Figures 16 through 22, the D_S values on the photographs are shown for the center ceiling meter, (No. 1). The photographs were taken 30 seconds apart as the smoke density increased.

From the detector tube data indicated in Appendix IV, taken continuously between three and four minutes, the predominant factor affecting visibility is not the obscuration of vision by particles of smoke, but the irritating effects of combustion gases, predominantly HCl and SO_2. These gases in combination with the moisture in the eyes, tend to cause great discomfort and irritation.

In all of the smoke-visibility tests where a gas analysis was made, the higher principal irritant appears to be HCl, although in one case (IV-5), a higher concentration of SO_2 was measured. Test subjects were queried at varying time intervals, and upon reaching their limit of endurance the subjects without eye protection withdrew from the observation booths and an immediate eye wash was provided. Rapid eye recuperation was evident with no apparent lasting deleterious effects.

As previously mentioned, it appears that any degree of eye protection, such as contact lenses, would afford significant protection against the effects of these irritant gases.

Visibility Tests with Ventilation

A series of six additional visibility tests was run with the normal level of aircraft ventilation. As mentioned earlier, the mockup was equipped with an air distribution system. Both supply and exhaust blowers (Figure 4) were used to create the same level and pattern of air circulation (Figure 23) which is provided in a typical wide-bodied jet transport. The supply outlets are in the ceiling and the exhaust openings are along the kickstrip at the outboard edge of the floor. A normal ventilation flow rate through the cabin mockup of 560 cfm of fresh air was maintained during the subject visibility tests. This ventilation rate is equivalent to 42.0 lb/min. at 75°F and was designed to provide 20 cfm per passenger in the 28 passenger mockup. A total of six visibility/ventilation smoke tests were performed, using four test subjects as in previous tests. Five different materials were tested. The individual data sheets are presented in Appendix IV, data reports IV-10 through IV-15.

The only significant difference noted during these tests with ventilation is the reduction in peak smoke densities observed with similar materials under "no-ventilation" conditions. Also, considerable reduction in smoke stratification was noted because of the increased air circulation. The minimum acuity reported for all tests by any subject with no eye protection was approximately 20/75 at D of 0.40, data report IV-10. This acuity corresponds to distinguishing the letters in line 3 (TOZ), of the Snellon eye test chart at 20 feet distance, Figure 14. In contrast, the minimum acuity reported by any subject, without ventilation was 20/200, data reports IV-3 and IV-6.

SUMMARY OF RESULTS

A total of twenty materials, representing a high and a low smoking material in each of ten categories, was tested in an NBS type laboratory smoke chamber under flaming and nonflaming conditions at radiant heat fluxes of 2.2 and 3.3 Btu/ft^2-sec. A total of eighteen materials in ten categories and of one, two and three foot square sizes was tested in a wide-bodied mockup under flaming and nonflaming conditions, both in the vertical and horizontal attitudes. A total of seven materials in seven categories was utilized for mockup smoke visibility studies using human test subjects to determine the relationship between materials smoke density and human visual acuity.

1. Fair to good correlation of data was obtained for the majority of tests between the NBS type laboratory and the wide-bodied mockup maximum specific optical density values.

2. Although a time lag is noted for materials smoke emission in the mockup horizontal attitude, the maximum specific optical density is comparable to the laboratory vertical attitude.

3. Although maximum specific optical density correlation was obtained between the laboratory and mockup vertical test cases, a time lag was evident for the mockup tests, which is attributed to a difference in specimen heat buildup rates.

4. **With eye protection, reasonably good visual acuity was retained with optical densities of 0.30 (three-foot light path length) or less. Without eye protection, irritation became intolerable well before a serious loss of visual acuity. Contact lenses appeared to provide significant relief from the lachrymal effects of the combustion products.**

5. Normal ventilation, typical of that provided by the environmental control system of a wide-bodied jet transport, reduced the stratification of smoke particles in the mockup. Because of the air circulation, the smoke distribution tended to be more uniform from floor to ceiling than the "no-ventilation" cases.

CONCLUSIONS

1. Fair to good correlation was established between laboratory chamber and mockup smoke test results, based on specific optical density criteria.

2. There is apparent validity for the extrapolation of specific optical density data obtained in a laboratory chamber to larger area/volume enclosures.

3. Both the laboratory and mockup measurements were very sensitive to test radiation heat flux. The heat flux levels used in the tests produced smoke generation rates which are probably considerably lower than those of concern in a hazardous crash fire. The optical densities at 1-1/2 minutes (normal aircraft emergency evacuation time) are only a small fraction of the eventual maximums. Thus, the results might be considered a "slow motion" study of the crash smoke emission case.

4. The dominating factor on human critical visibility is strongly related to the irritating effects of combustion gases generated from flaming materials in a crash fire situation.

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FIGURE 1. FIRE RESEARCH LABORATORY

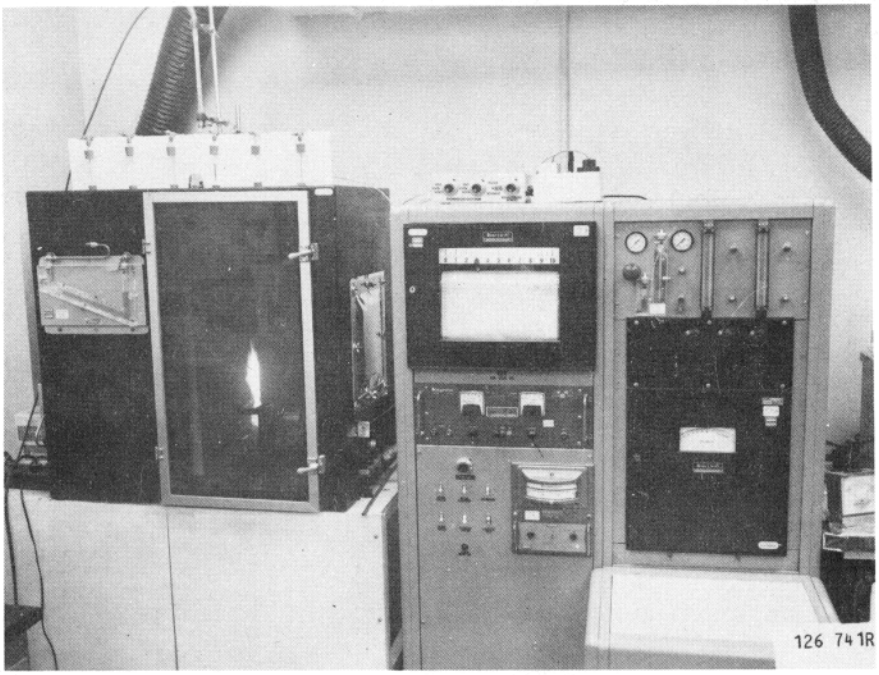


FIGURE 2. LABORATORY SMOKE TEST BEING CONDUCTED IN THE NBS-TYPE SMOKE CHAMBER

FIGURE 3. CABIN MOCKUP INTERIOR CONFIGURATION PRIOR TO MODIFICATION FOR SMOKE TESTS

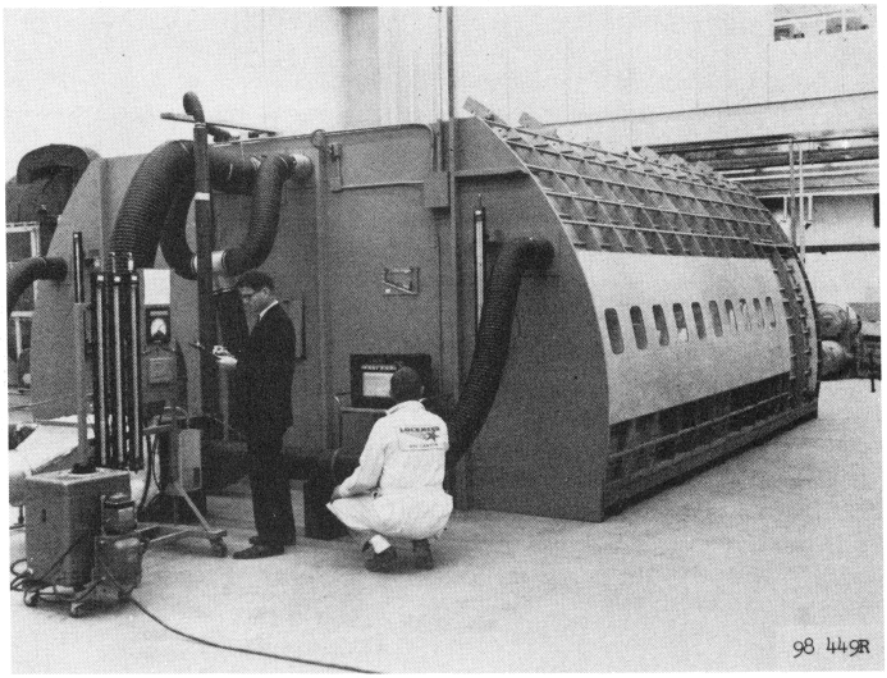


FIGURE 4. EXTERIOR OF CABIN MOCKUP SHOWING AIR SUPPLY AND EXHAUST DUCTING

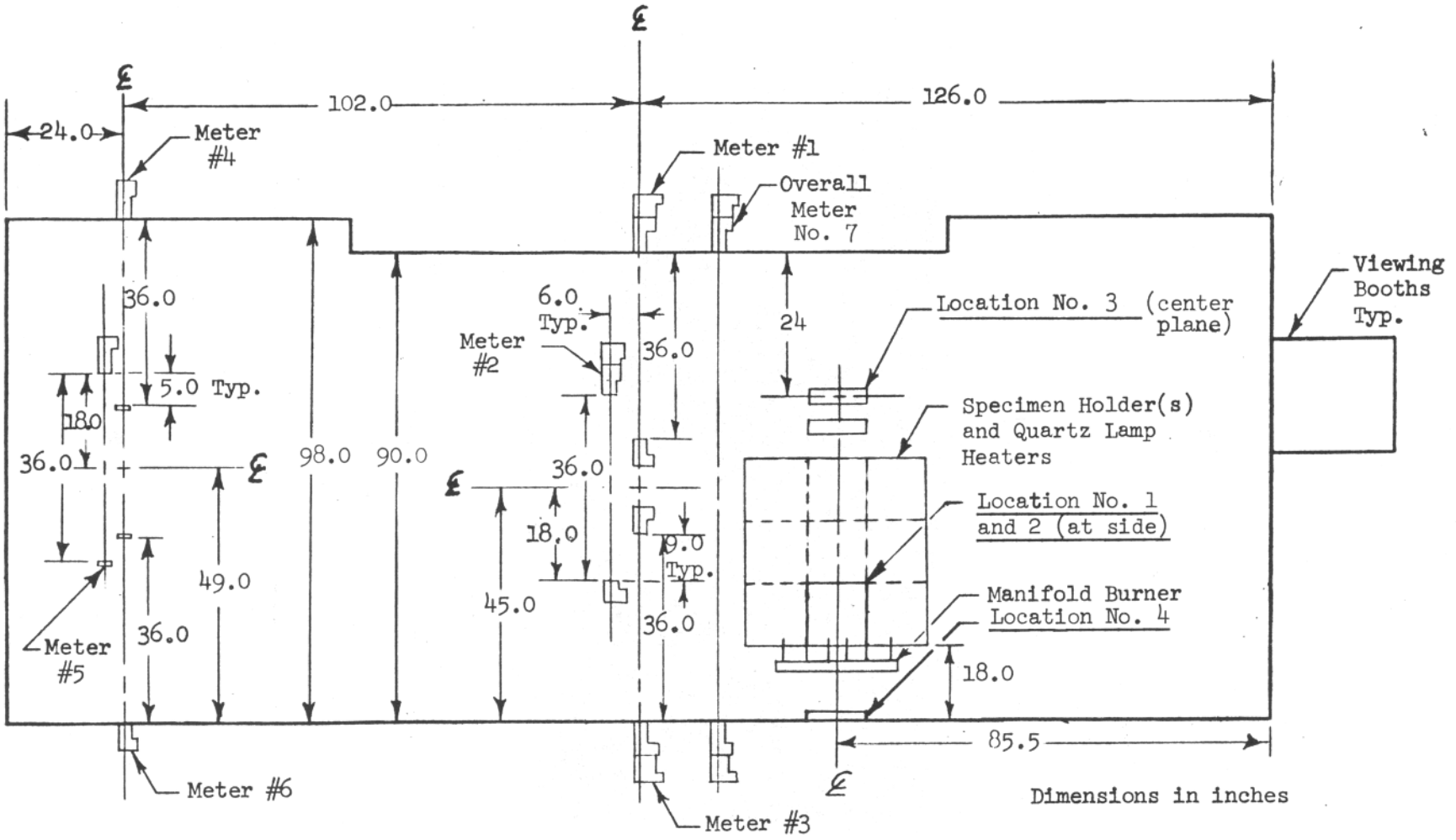


FIGURE 5. TEST EQUIPMENT AND SPECIMEN LOCATION IN CABIN MOCKUP

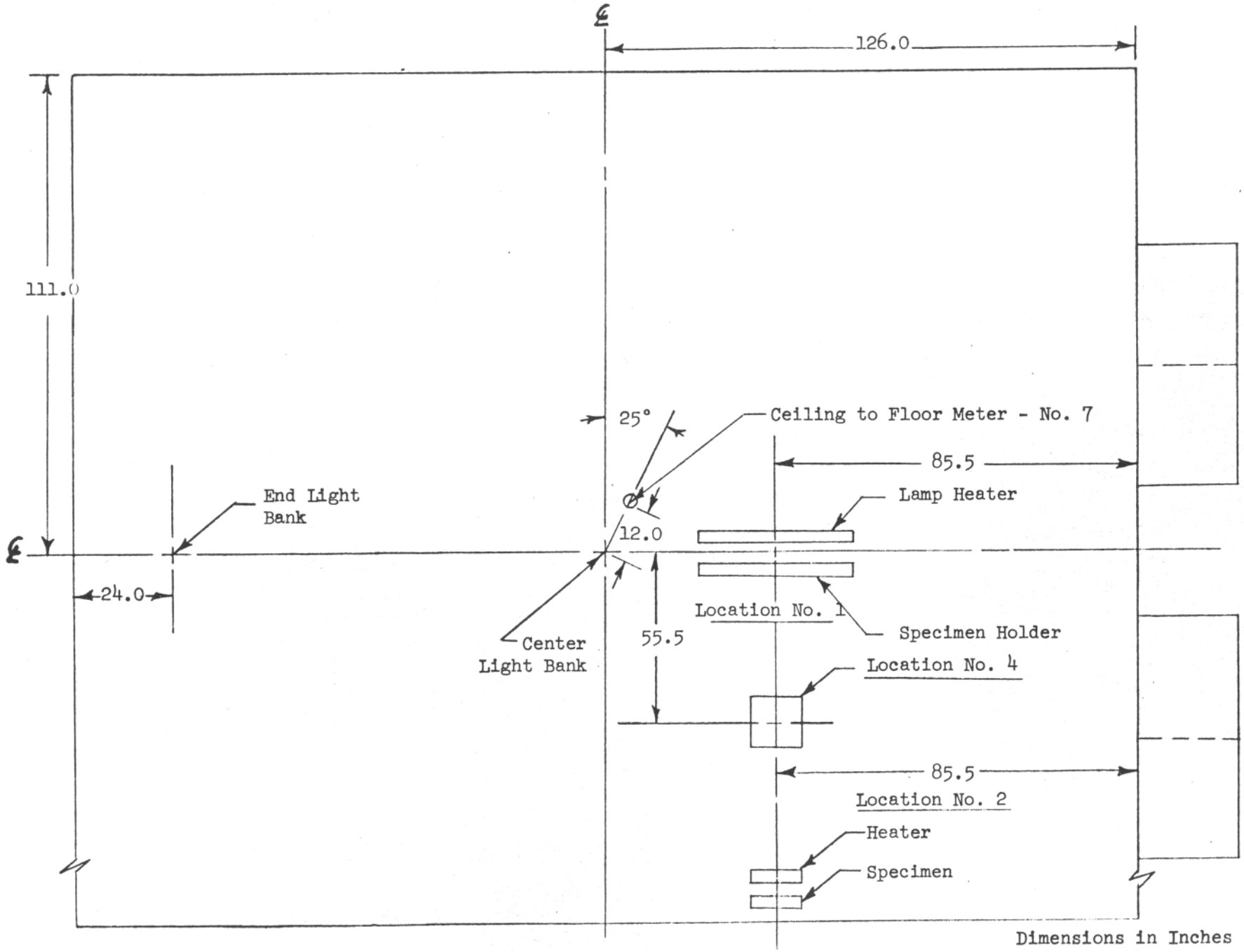


FIGURE 6. PLAN VIEW OF TEST EQUIPMENT AND SPECIMEN LOCATIONS

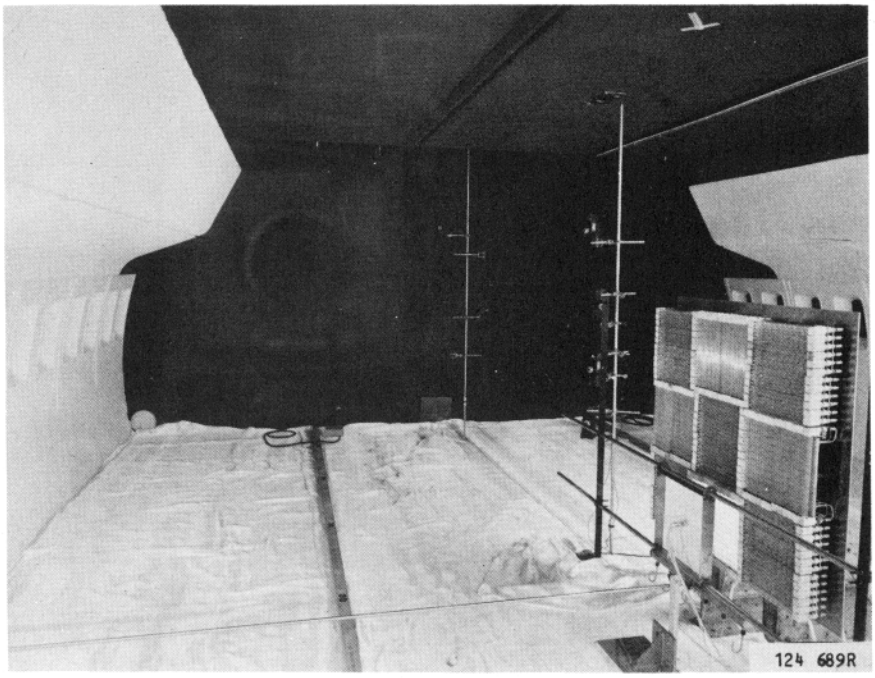


FIGURE 7. INTERIOR OF THE MOCKUP SHOWING THE VERTICAL SMOKE METER LIGHT BANKS

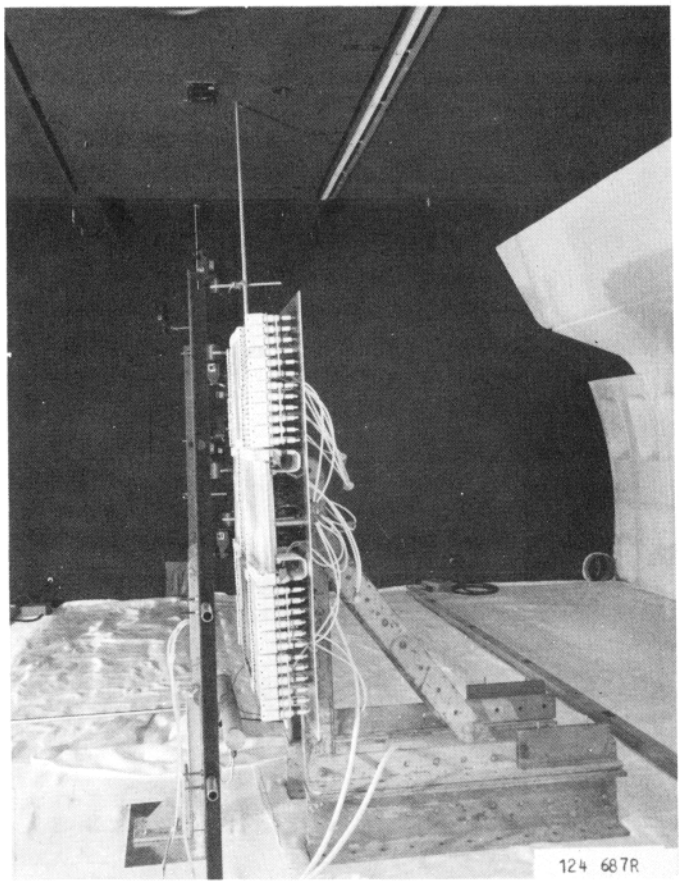


FIGURE 8. VIEW OF ONE SQUARE FOOT SPECIMEN HOLDER WITH RADIANT HEATER

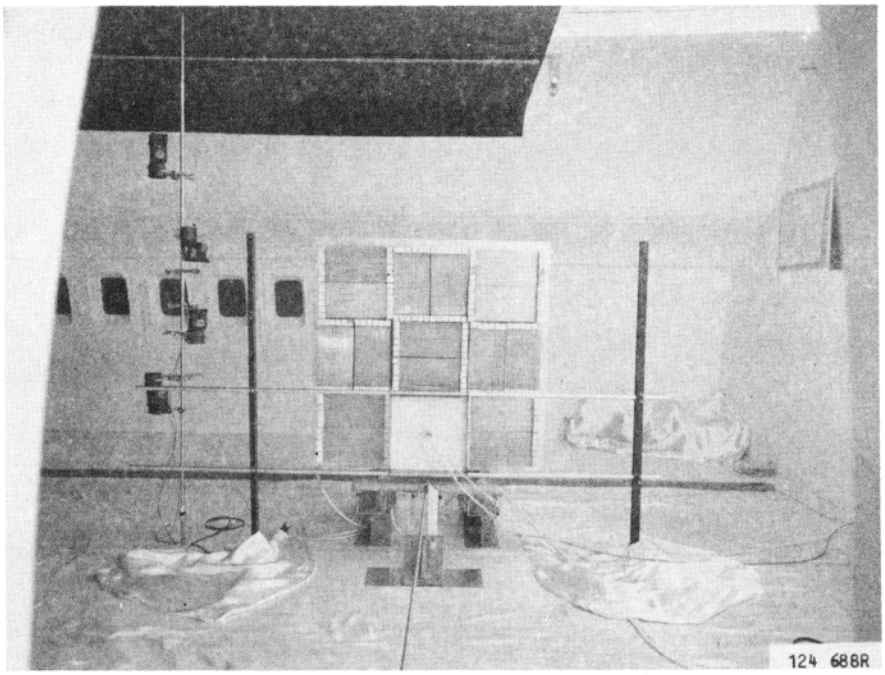


FIGURE 9. BACK SIDE OF SPECIMEN HOLDER WITH CALORIMETER IN PLACE FOR HEAT FLUX CALIBRATION

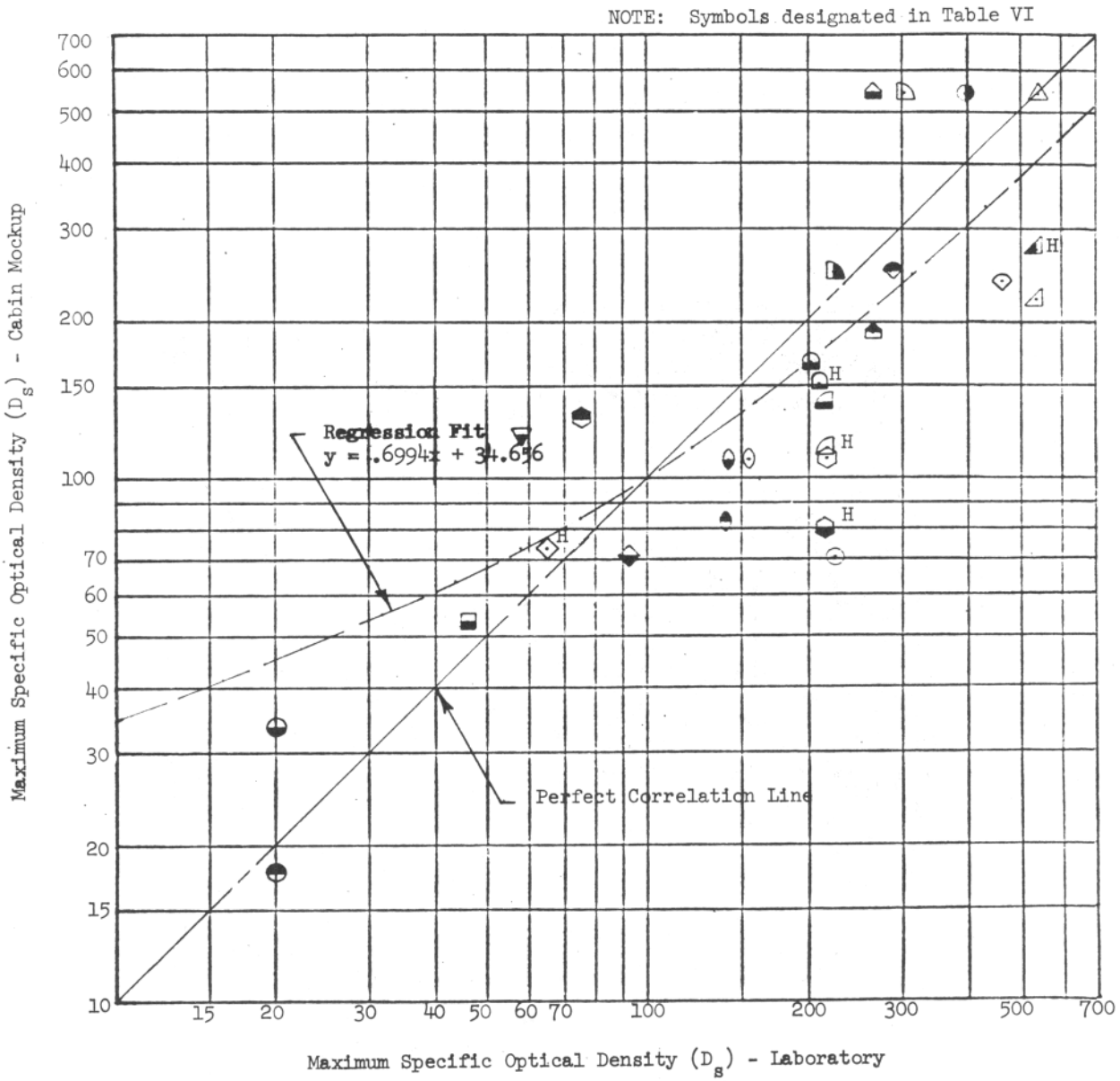


FIGURE 10. CORRELATION OF MAXIMUM D_s BETWEEN LABORATORY AND MOCKUP TEST DATA

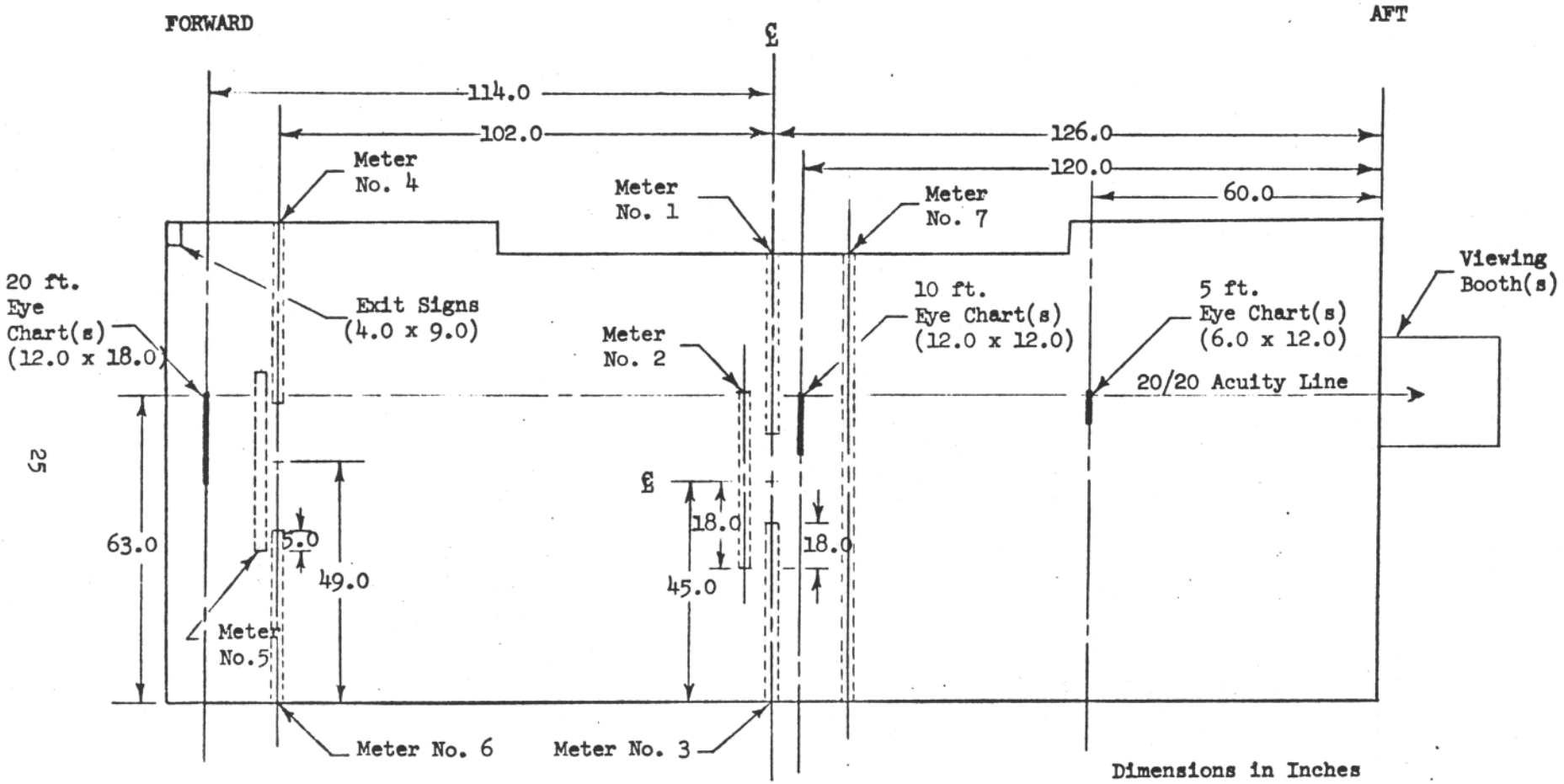


FIGURE 11. INTERIOR ARRANGMENT OF EYE CHARTS AND SMOKE METERS

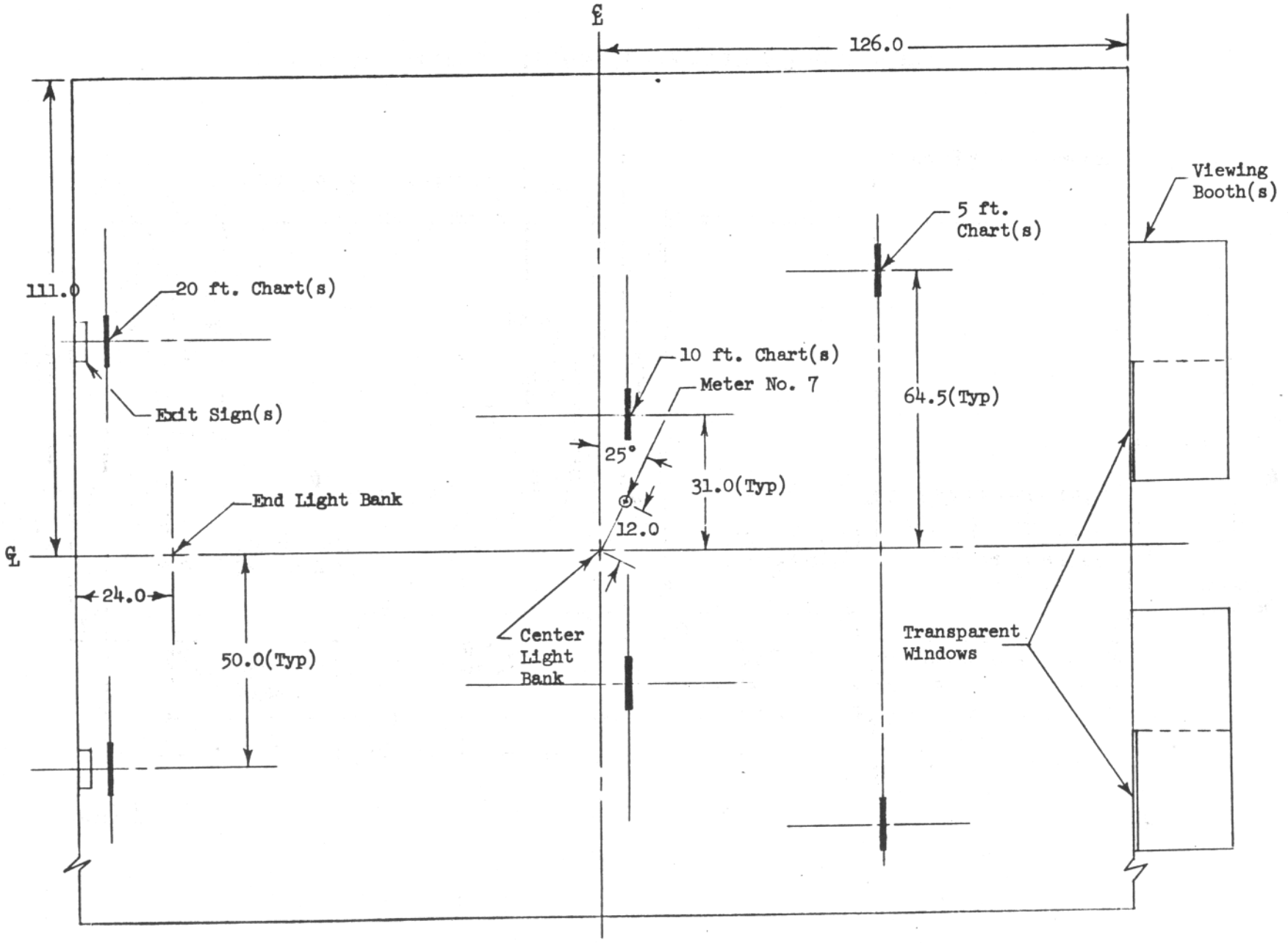


FIGURE 12. PLAN VIEW OF EYE CHART AND SMOKE METER(S) ARRANGEMENT

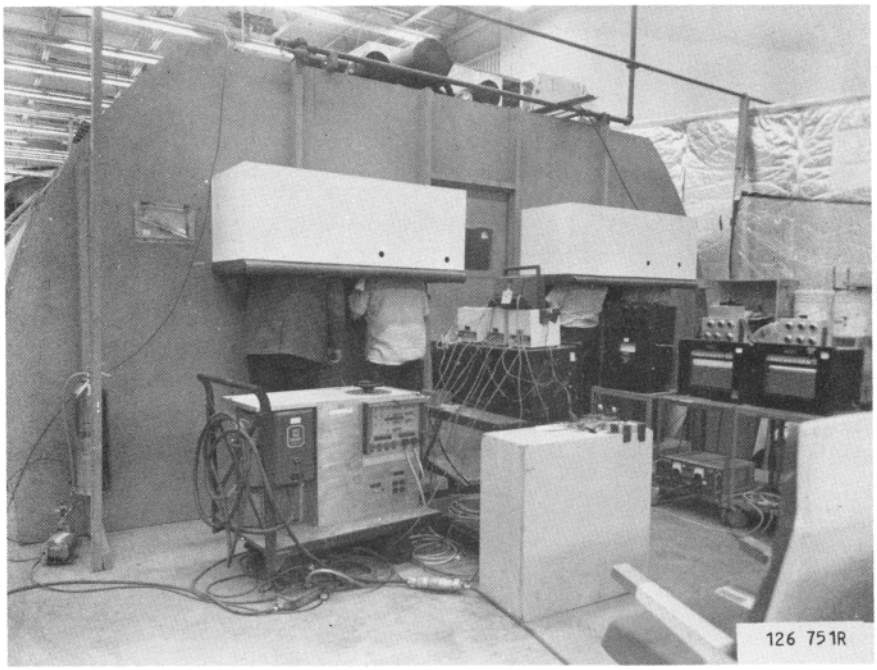


FIGURE 13. SUBJECTS IN THE VIEWING BOOTHS FOR VISIBILITY TESTS

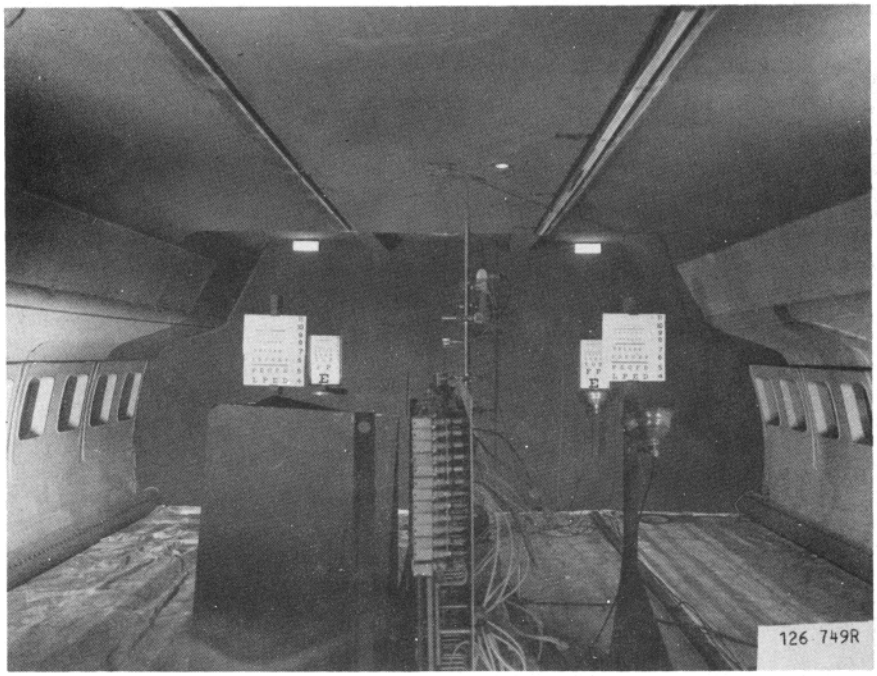


FIGURE 14. ARRANGEMENT OF EYE CHARTS AND EXIT SIGNS

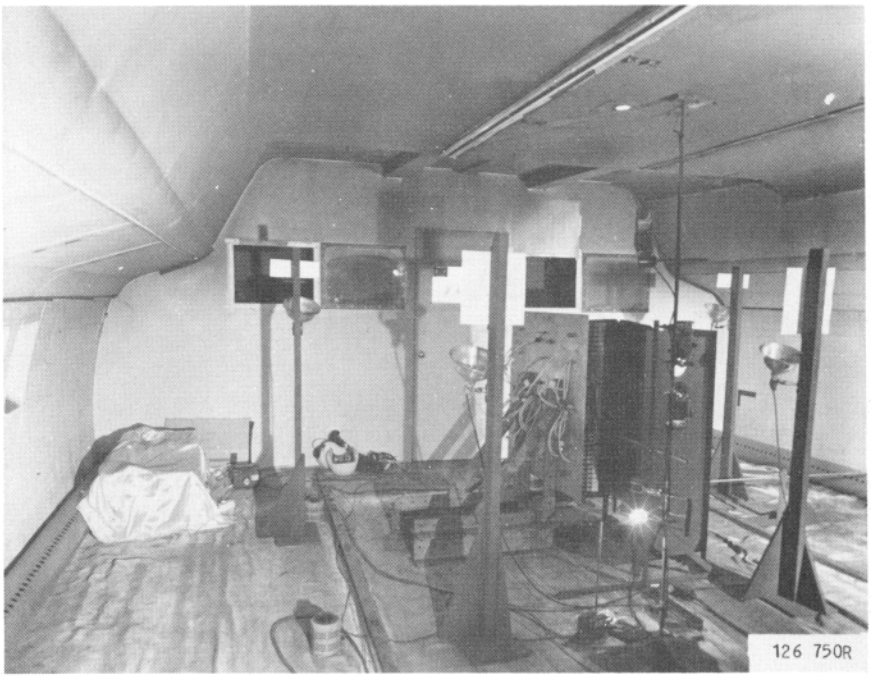


FIGURE 15. INTERIOR OF CABIN MOCKUP SHOWING THE OBSERVATION BOOTHS

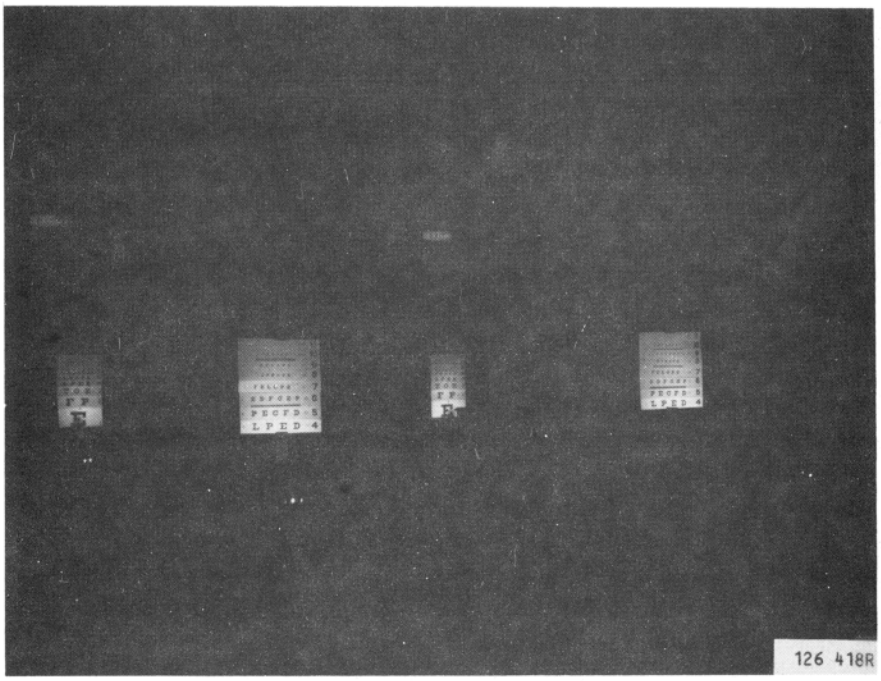


FIGURE 16. INITIAL VISIBILITY OF CHARTS AND EXIT LIGHTS

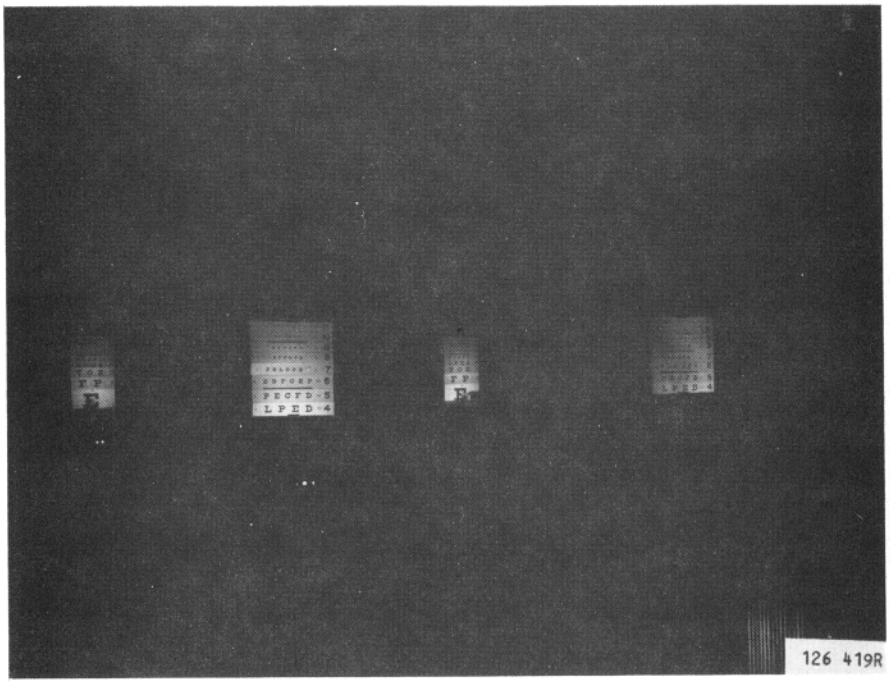


FIGURE 17. VISIBILITY OF D_s=66, ONE EXIT LIGHT BARELY VISIBLE

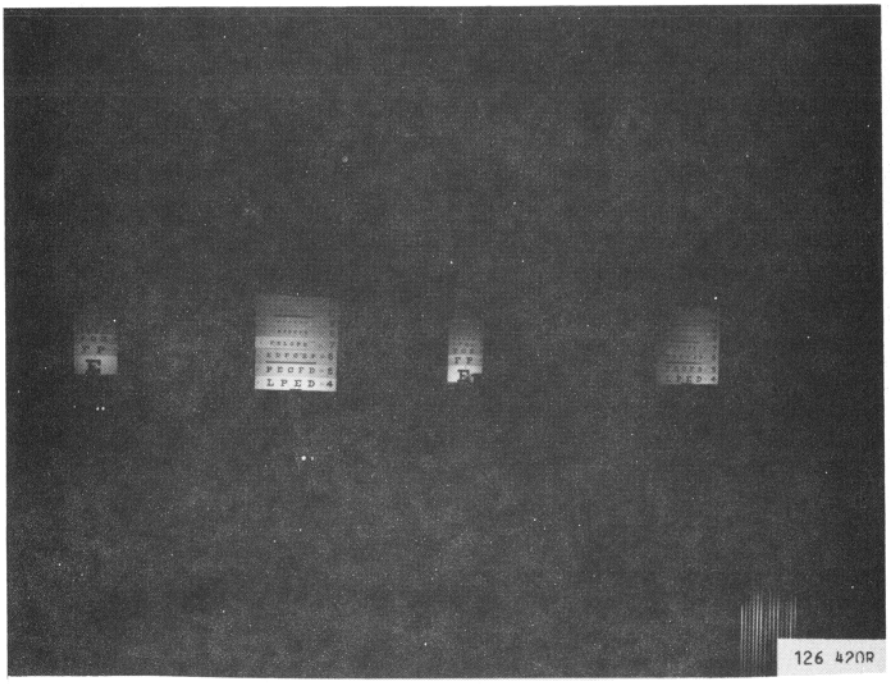


FIGURE 18. VISIBILITY AT D_s=161, EXIT SIGNS OBSCURED

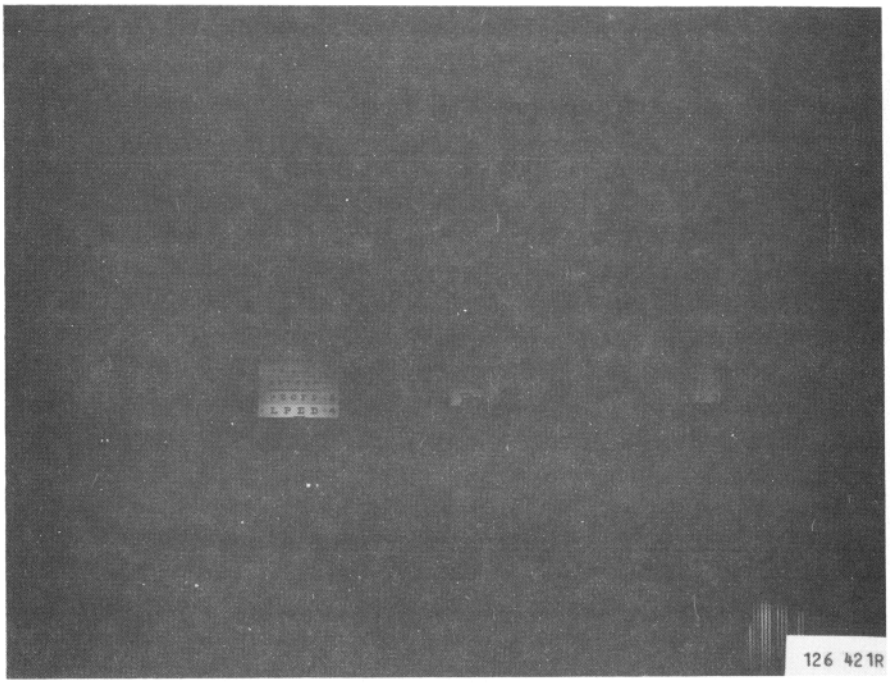


FIGURE 19. VISIBILITY AT D_s=286

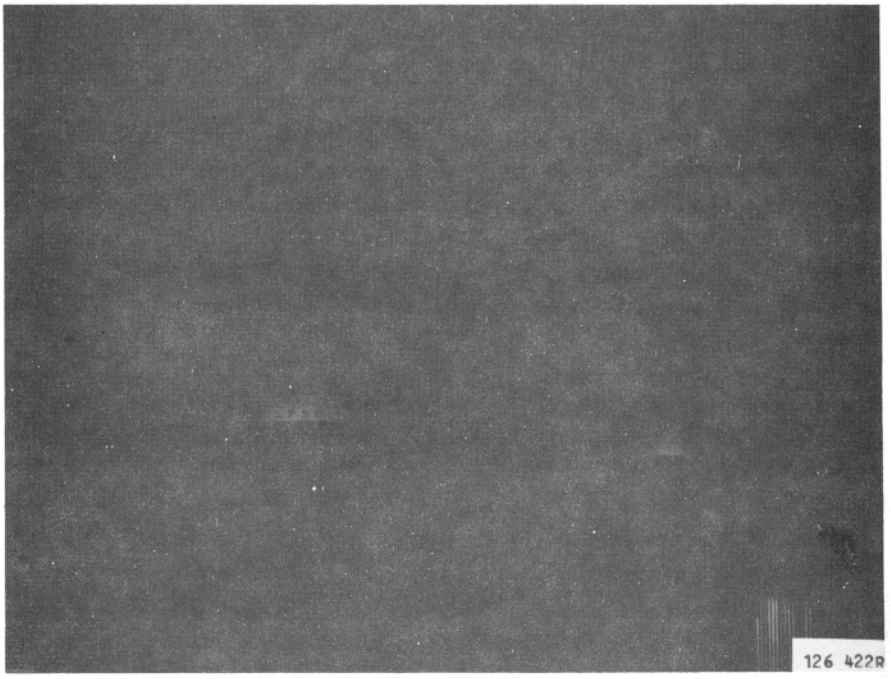


FIGURE 20. VISIBILITY AT D_s=550

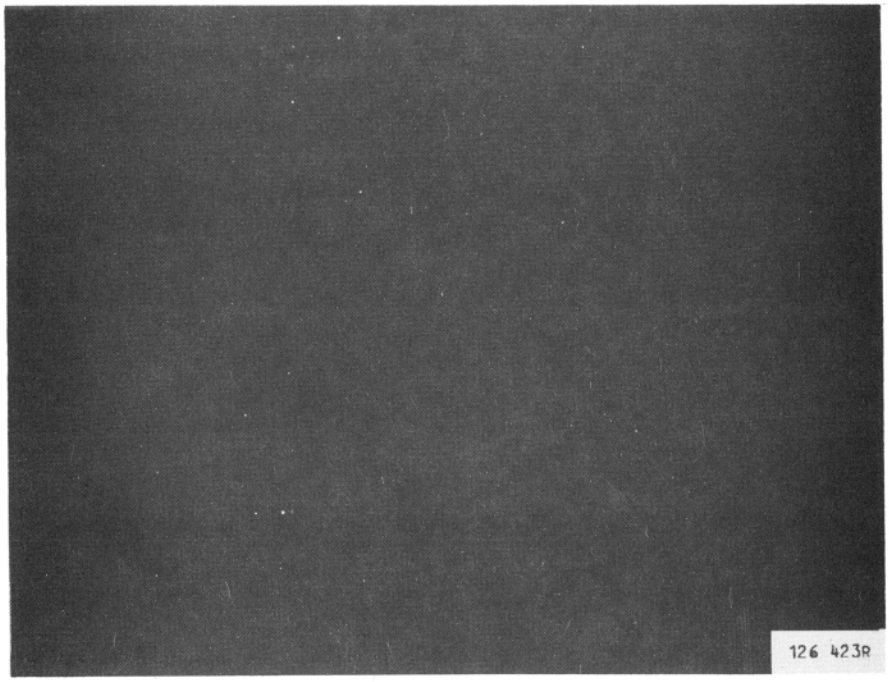


FIGURE 21. VISIBILITY AT MAXIMUM MOCKUP D_s

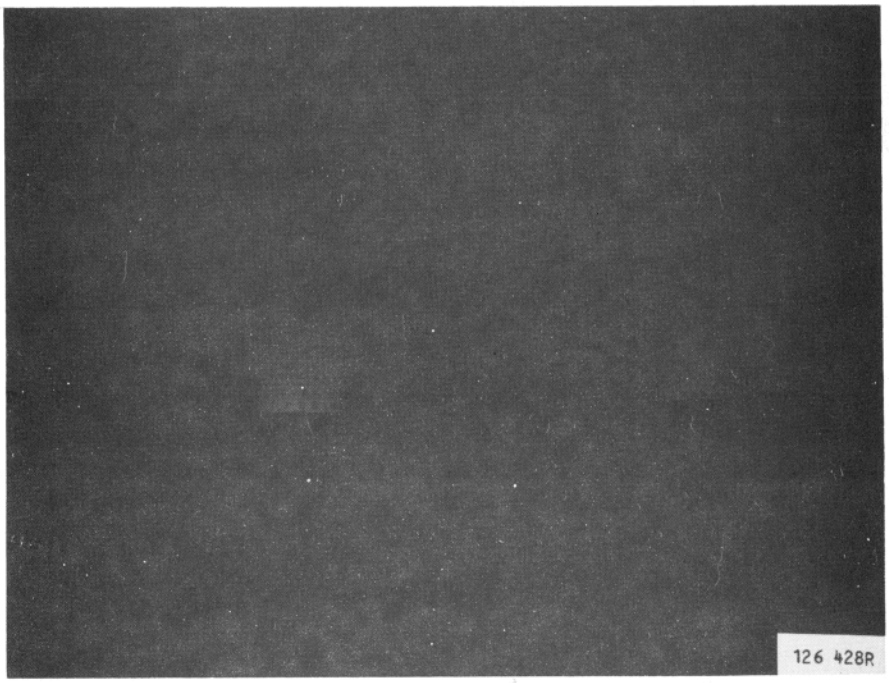


FIGURE 22. VISIBILITY AT D_s=250 AFTER SOME CLEARING WITH AIR FLOW AT CONCLUSION OF TEST

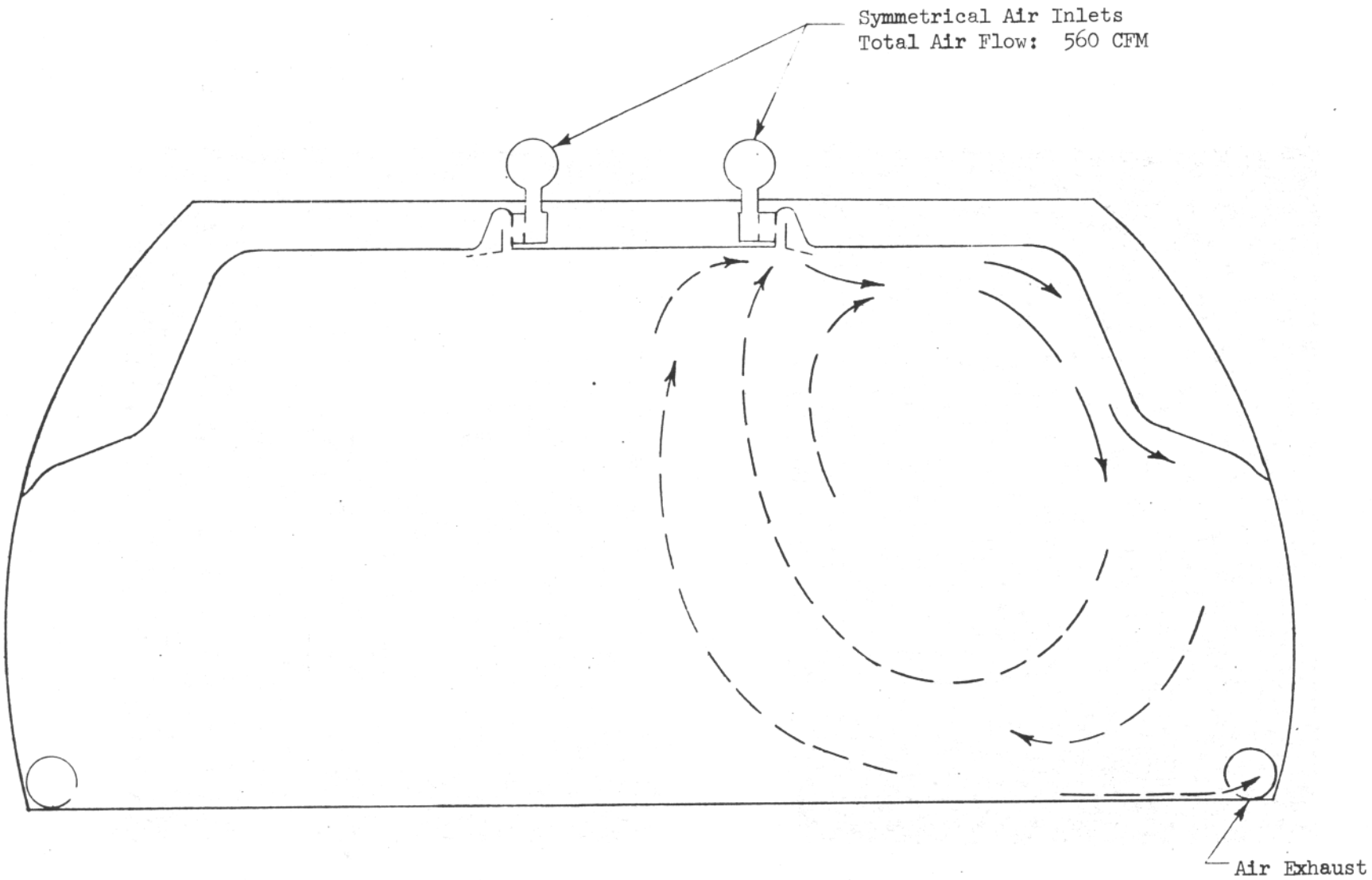


FIGURE 23. CABIN AIR SUPPLY AND EXHAUST FLOW PATTERNS

TABLE I: MATERIALS DESCRIPTION

Category Number	Category	Thickness in.	Unit Weight oz/yd^2	Color and Surface	Approximate Chemical Composition
1	Ceiling Panel	(A) 0.37	47.7	Beige Smooth	Tedlar Coated, Epoxy-Glass Faces, Nomex Core
		(B) 0.40	60.7	Beige Smooth	Tedlar Coated, Phenolic-Glass Faces, Nomex Core
2	Side Panel/ Window Reveal	(A) 0.05	60.7	Gold Smooth	Tedlar Coated, Polyester Glass Laminate
		(B) 0.05	61.0	Blue Smooth	Tedlar Coated, Phenolic Glass Laminate
3	Partition Panel	(A) 0.77	114.0	Gold Smooth	Tedlar Coated, Epoxy-Glass Faces, Nomex Core
		(B) 0.75	97.8	Blue Smooth	Tedlar Coated, Phenolic-Glass Faces, Nomex Core
4	Structural Flooring	(A) 0.37	116.5	Green Smooth	Epoxy-Glass Faces, Nomex Core
		(B) 0.37	86.2	Aluminum Smooth	Aluminum Faces, Nomex Core
5	Thermoforming (Thermoplastic)	(A) 0.06	63.0	Yellow Smooth	Acrylonitrile-Butadiene-Styrene
		(B) 0.06	61.0	Beige Smooth	Polycarbonate
6	Seat Upholstery	(A) 0.035	15.7	Red/Orange Fibrous	100% Wool
		(B) 0.035	18.3	Blue Fibrous	50/50 Cotton-Rayon
7	Seat Cushion Foam	(A) 0.50	12.7	Green	2 PCF Polyurethane
		(B) 0.50	14.2	White	2 PCF Polyethylene
8	Carpeting	(A) 0.37	68.4	Blue-Green	100% Wool, Latex Backing
		(B) 0.37	67.4	Gold-Brown	Modacrylic, Latex Backing
9	Transparency	(A) 0.062	57.8	Clear Smooth	Polycarbonate
		(B) 0.055	47.2	Clear Smooth	Acrylic
10	Elastomer	(A) 0.06	58.4	Black Smooth	Chloroprene
		(B) 0.06	59.8	Light Grey Smooth	Silicone

(A) Designates high smoking material

(B) Designates low smoking material

TABLE II: LABORATORY SMOKE EMISSION DATA

Category Number	Test Exposure F = Flaming N = Nonflaming	Smoke			Remarks
		Maximum Spec. Optical Density D_m (corr.)	Time For D_m (min)	Maximum Rate R_m (min^{-1})	
1(A)	F	220	2.0	187	
	N	76	4.0	58	
(B)	F	270	5.0	180	Epoxy adhesive between the skins and the core contributes mostly to the maximum smoke density.
2(A)	F	340	2.5	275	
	N	120	9.0	50	
(B)	F	143	3.0	95	
	N	47	9.0	18	
	F**	152	3.0	95	
3(A)	F	475	4.0	315	
	N	280	4.0	145	
(B)	F	295	3.0	195	Same as 1(B).
4(A)	F	214	11.0	80	
	N	55	10.0	13	
(B)	F	20	12.0	5	
	N	5	12.0	1.5	
	F**	225	10.0	160	

TABLE II: LABORATORY SMOKE EMISSION DATA
(CONT'D)

Category Number	Test Exposure F = Flaming N = Nonflaming	Smoke			Remarks
		Maximum Spec. Optical Density D_m (corr.)	Time For D_m (min)	Maximum Rate R_m (min^{-1})	
5(A)	F	>550	4.0	200	
	N	240	8.0	60	
(B)	F	165	9.0	70	
	N	1.3	12.0	0.9	
	F**	385	4.0	210	
6(A)	F	180	6.5	70	
	N	64	8.0	20	
(B)	F	65	7.0	37	
	N	92	5.0	72	
	F**	82	5.0	60	
7(A)	F	210	6.0	112	
	N	200	10.0	27	
(B)	F	48	9.0	25	
	N	47	9.0	16	
	F**	115	8.0	30	
8(A)	F	>550	5.0	170	
	N	>550	8.5	119	
(B)	F	400	5.0	280	
	N	>550	4.0	215	
	F**	335	3.0	245	

TABLE II: LABORATORY SMOKE EMISSION DATA
(CONT'D)

Category Number	Test Exposure F = Flaming N = Nonflaming	Smoke			Remarks
		Maximum Spec. Optical Density D_m (corr.)	Time For D_m (min)	Maximum Rate R_m (min^{-1})	
9(A)	F	275	5.0	130	
	N	3	9.0	1	
(B)	F	58	3.0	46	
	N	68	9.0	12	
	F**	147	3.5	105	
10(A)	F	300	3.5	160	
	N	110	6.5	28	
(B)	F	220	9.5	110	
	N	23	6.0	8	
	F**	230	5.0	130	

** 3.81 watts/cm^2 (3.3 Btu/ft^2-sec) radiant heat flux

TABLE III: INDIVIDUAL CABIN MOCKUP SMOKE METER(S) DATA

Category Number	Test Exposure F = Flaming N = Nonflaming K = Kindling	Material Area Sq. Ft.	D_s - Reading at 5.0 minutes - Meter Number 1 Center Ceiling	2 Center Mid-Height (Corr.)	3 Center Floor	Avg.	4 End Ceiling	5 End Mid-Height (Corr.)	6 End Floor	Avg.	Overall Meter 7 Center Ceiling to Floor
1(A)	F	1	180	13	8	67	167	21	4	64	80
	F* (3)	1	95	11	N.D.		106	18	4	43	43
	N	4	231	N.D.	N.D.		283	49	1	111	93
(B)	F	4	>550	66	N.D.		>550	183	5	>550	>550
	F	9	140	11	1	51	174	49	1	75	44
2(B)	F	4	231	46	N.D.		210	113	8	110	115
	F	9	165	20	N.D.		189	60	1	83	68
	F**	1	201	21	N.D.		263	30	8	100	93
3(A)	F	1	370	33	13	137	321	61	4	129	180
	K	1	17	4	4	8	8	0	0	2	0
(B)	F	4	>550	99	143	>550	>550	280	26	>550	214
4(A)	F* (4)	1	30	2	N.D.		47	3	0	16	15
	F	4	267	15	N.D.		352	23	1	125	136
(B)	F**	1	25	4	N.D.		12	3	0	5	10
	F	4	15	4	N.D.		19	1	2	7	9
	F	9	10	1	1	4	12	3	0	5	10
5(A)	F	1	>550	156	N.D.		>550	210	4	>550	>550
(B)	F	1	28	19	21	22	38	N.D.	N.D.		19
6(B)	F*(4)	1	111	2	4	39	173	48	0	74	65
	N	1	90	11	17	39	85	18	N.D.		61

TABLE III: INDIVIDUAL CABIN MOCKUP SMOKE METER(S) DATA
(CONT'D)

Category Number	Test Exposure F = Flaming N = Nonflaming K = Kindling	Material Area Sq. Ft.	D_s - Reading at 5.0 minutes - Meter Number 1 Center Ceiling	2 Center Mid-Height (Corr.)	3 Center Floor	Avg.	4 End Ceiling	5 End Mid-Height (Corr.)	6 End Floor	Avg.	Overall Meter 7 Center Ceiling to Floor
7(A)	F*(4)	1	241	61	N.D.	N.D.	190	68	17	91	101
	N	1	144	15	8	56	141	24	N.D.		167
(B)	F	4	92	18	4	38	85	24	2	37	45
	N(F)+	4	215	40	5	87	N.D.	52	4		98
8(A)	F	1	422	97	13	177	422	230	17	223	159
	F* (4)	1	330	92	N.D.		411	91	4	168	146
	K	1	29	2	8	13	47	3	0	17	12
(B)	F	1	>550	165	21	>550	>550	320	13	>550	>550
	K	1	144	0	25	56	270	18	17	101	75
9(A)	F	1	13	2	N.D.		21	0	4	8	3
(B)	F	1	220	6	N.D.		241	80	3	108	102
10(A)	F	1	>550	139	42	>550	>550	274	34	>550	410
(B)	F	1	321	26	8	118	527	68	4	199	163

All specimens tested in test location No. 1 unless otherwise indicated.

* Horizontal (location no. in Figures 5,6)
** 3.81 watts/cm^2 (3.3 Btu/ft^2-sec)
N.D. No Data
\+ Started with nonflaming condition and spontaneous combustion occurred

TABLE IV: SUMMARY OF CABIN MOCKUP SMOKE EMISSION DATA AT 5.0 MINUTES

Category Number	Test Exposure F = Flaming N = Nonflaming K = Kindling	Material Area Sq. Ft.	D_s - Reading at 5.0 Minutes Center Bank (Corrected)	End Bank (Corrected)	Overall
1(A)	F	1	67	64	80
	F* (3)	1	N.D.	43	43
	N	4	N.D.	111	93
(B)	F	4	N.D.	>550	>550
	F	9	51	75	44
2(B)	F	4	N.D.	115	101
	F	9	N.D.	83	48
	F**	1	N.D.	100	93
3(A)	F	1	131	129	159
	K	1	8	2	0
(B)	F	4	>550	>550	>550
4(A)	F* (4)	1	N.D.	16	15
	F	4	N.D.	125	136
(B)	F**	1	N.D.	5	10
	F	4	N.D.	7	9
	F	9	4	5	10
5(A)	F	1	N.D.	>550	>550
(B)	F	1	22	N.D.	19

TABLE IV: SUMMARY OF CABIN MOCKUP SMOKE EMISSION DATA AT 5.0 MINUTES (CONT'D)

Category Number	Test Exposure F = Flaming N = Nonflaming K = Kindling	Material Area Sq. Ft.	D_S - Reading at 5.0 Minutes Center Bank (Corrected)	End Bank (Corrected)	Overall
6(B)	F*(4)	1	39	74	60
	N	1	39	N.D.	41
7(A)	F*	1	N.D.	69	101
	N (4)	1	57	110	167
(B)	F	4	38	39	45
	N(F)+	4	87	N.D.	98
8(A)	F	1	177	223	159
	F* (4)	1	N.D.	168	146
	K	1	13	17	12
(B)	F	1	>550	>550	>550
	K	1	56	101	75
9(A)	F	1	N.D.	8	3
(B)	F	1	N.D.	108	102
10(A)	F	1	>550	>550	374
(B)	F	1	118	199	163

All specimens tested in location No. 1 unless otherwise indicated.

* Horizontal (location no. in Figures 5, 6)

** 3.81 watts/cm^2 (3.3 Btu/ft^2-sec) radiant heat flux

N.D. No Data

\+ Start Nonflaming condition with subsequent spontaneous combustion

TABLE V: LABORATORY AND CABIN MOCKUP COMPARISON DATA AT 5.0 MINUTES

Category Number	Test Exposure F = Flaming N = Nonflaming K = Kindling	Material Area Sq. Ft.	Laboratory D_s @ 5.0 Minutes	Mockup D_s @ 5.0 Minutes		
				Center Bank (Corr.)	End Bank (Corr.)	Overall
1(A)	F	0.046	212			
	F	1.0		67	64	80
	F* (3)	1.0		N.D.	43	43
	N	0.046	76			
	N	4.0		N.D.	111	93
(B)	F	0.046	270			
	F	4.0		N.D.	>550	> 550
	F	9.0		51	75	44
2(B)	F	0.046	143			
	F	4.0		N.D.	110	115
	F	9.0		N.D.	83	68
	F**	0.046	140			
	F**	1.0		N.D.	100	93
3(A)	F	0.046	460			
	F	1.0		137	129	180
(B)	F	0.046	275			
	F	4.0		>550	>550	214
4(A)	F	0.046	140			
	F* (4)	1.0		N.D.	16	15
	F	4.0		N.D.	125	136
(B)	F	0.046	10			
	F	4.0		N.D.	7	9
	F	9.0		4	5	10
	F**	0.046	10			
	F**	1.0		N.D.	5	10

TABLE V: LABORATORY AND CABIN MOCKUP COMPARISON DATA AT 5.0 MINUTES (CONT'D)

Category Number	Test Exposure (F = Flaming, N = Nonflaming, K = Kindling)	Material Area Sq. Ft.	Laboratory D_s @ 5.0 Minutes	Mockup D_s @ 5.0 Minutes: Center Bank (Corr.)	Mockup D_s @ 5.0 Minutes: End Bank (Corr.)	Mockup D_s @ 5.0 Minutes: Overall
5(A)	F	0.046	>550			
	F	1.0		N.D.	>550	>550
(B)	F	0.046	145			
	F	1.0		22	N.D.	19
6(B)	F	0.046	62			
	F*(4)	1.0		39	74	65
	N	0.046	82			
	N	1.0		39	N.D.	61
7(A)	F	0.046	200			
	F*(4)	1.0		N.D.	91	101
	N	0.046	137			
	N	1.0		57	110	167
(B)	N	0.046	40			
	N	4.0		38	37	45
8(A)	F	0.046	>550			
	F	1.0		177	223	159
	F*(4)	1.0		N.D.	168	146
(B)	F	0.046	400			
	F	1.0		>550	>550	>550
	N	0.046	520			

TABLE V: LABORATORY AND CABIN MOCKUP COMPARISON DATA AT 5.0 MINUTES
(CONT'D)

Category Number	Test Exposure F = Flaming N = Nonflaming K = Kindling	Material Area Sq. Ft.	Laboratory D_s @ 5.0 Minutes	Mockup D_s @ 5.0 Minutes		
				Center Bank (Corr.)	End Bank (Corr.)	Overall
9(A)	F	0.046	275			
	F	1.0		N.D.	8	3
(B)	F	0.046	50			
	F	1.0		N.D.	108	102
10(A)	F	0.046	290			
	F	1.0		>550	>550	410
(B)	F	0.046	160			
	F	1.0		118	199	163

All specimens tested in location No. 1 unless otherwise indicated.

* Horizontal (location no. in Figures 5, 6)

** 3.3 Btu/ft^2-sec. radiant heat flux

N.D. No Data

TABLE VI - MAXIMUM LABORATORY AND CABIN MOCKUP COMPARISON DATA

Category Number	Test Exposure	Symbol	Material Area (sq. ft.)	Laboratory D_s (Max)	Mockup D_s (Max)
1(A)	F		.046	220	
	F		1.0		110
	F *(3)		1.0		80
	N		.046	76	
	N		4.0		135
(B)	F		.046	270	
	F		4.0		>550
	F		9.0		195
2(B)	F		.046	143	
	F		4.0		115
	F		9.0		83
	F**		.046	152	
	F**		1.0		115
3(A)	F		.046	475	
	F		1.0		240
3(B)	F		.046	295	
	F		4.0		258

TABLE VI - MAXIMUM LABORATORY AND CABIN MOCKUP COMPARISON DATA (Continued)

Category Number	Test Exposure	Symbol	Material Area (sq.ft.)	Laboratory D_s (Max)	Mockup D_s (Max)
4(A)	F		.046	214	
	F*(4)		1.0		120
	F		4.0		140
(B)	F		.046	20	
	F		4.0		34
	F		9.0		18
	F**		.046	225	
	F**		1.0		71
5(A)	F		.046	>550	
	F		1.0		>550
(B)	F		.046	165	
	F		1.0		27
6(B)	F		.046	65	
	F*(4)		1.0		74
	N		.046	92	
	N		1.0		72

TABLE VI - MAXIMUM LABORATORY AND CABIN MOCKUP COMPARISON DATA (Continued)

Category Number	Test Exposure	Symbol	Material Area (sq. ft.)	Laboratory D_s (Max)	Mockup D_s (Max)
7(A)	F		.046	210	
	F*(4)	⊙	1.0		151
	N		.046	200	
	N	◓	1.0		167
(B)	N		.046	47	
	N	▬	4.0		54
8(A)	F		.046	>550	
	F	◿	1.0		223
	F*(4)	◿	1.0		280
(B)	F		.046	400	
	F	◑	1.0		>550
9(A)	F		.046	275	
	F	▽	1.0		15
(B)	F		.046	58	
	F	▼	1.0		121
10(A)	F		.046	300	
	F	◺	1.0		>550
(B)	F		.046	220	
	F	◭	1.0		250

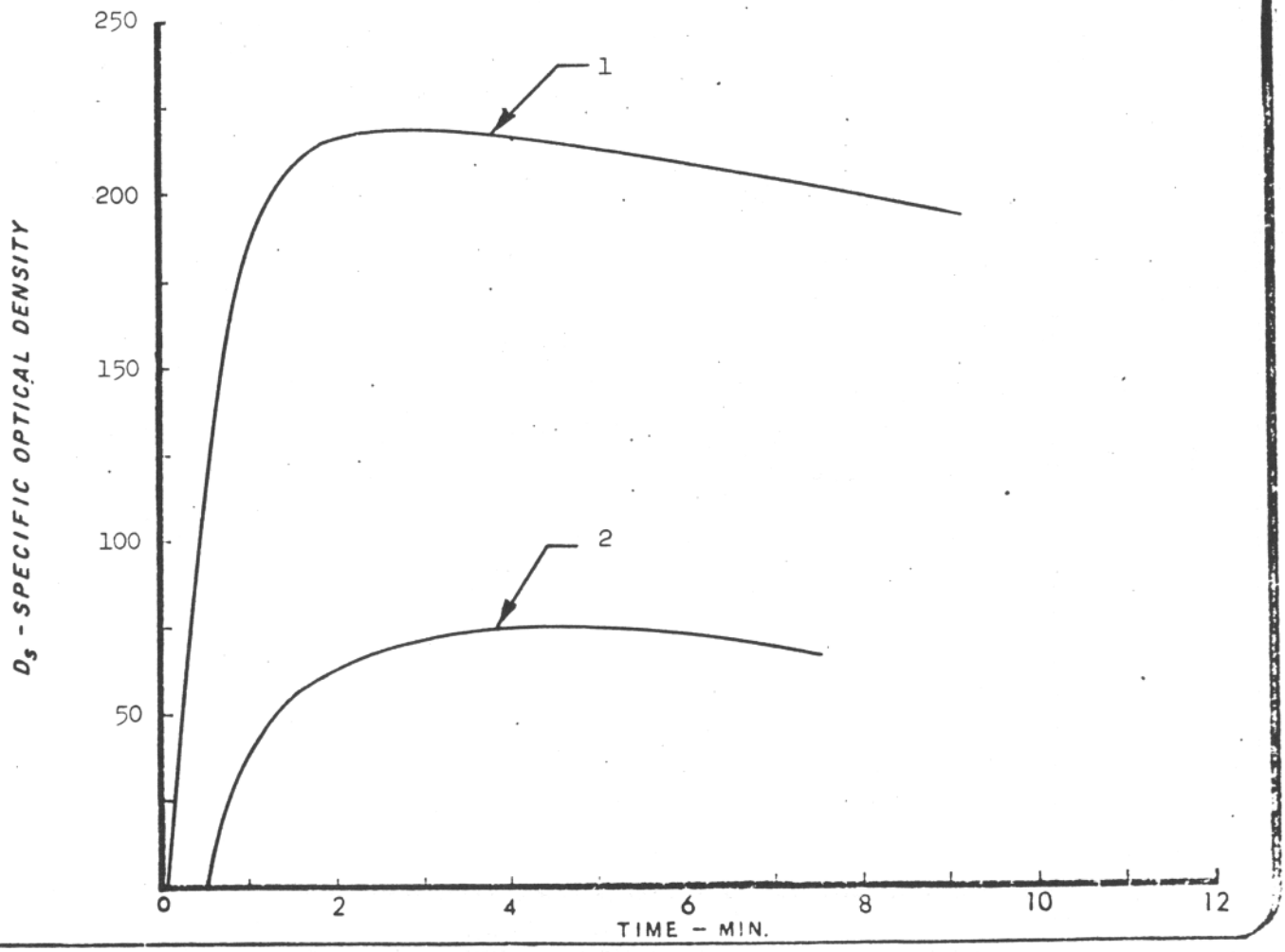
APPENDIX I

LABORATORY MATERIALS SMOKE TEST REPORTS

LABORATORY
MATERIALS SMOKE TEST REPORT

MATERIAL TEST NO: 1(A)
MATERIAL DESCRIPTION: Tedlar Coated Epoxy - Glass Faces Nylon Core
USE/APPLICATION: Ceiling Panel

SET NO.	1	2		COMMENTS
THICKNESS - IN:	0.37	0.37		
WEIGHT - GRAMS:	9.3	9.0		
EXPOSED AREA - SQ. IN:	6.6	6.6		
GAS PRESSURE - PSIG	Pilot	None		
IRRADIANCE - WATTS/CM^2:	2.54	2.54		



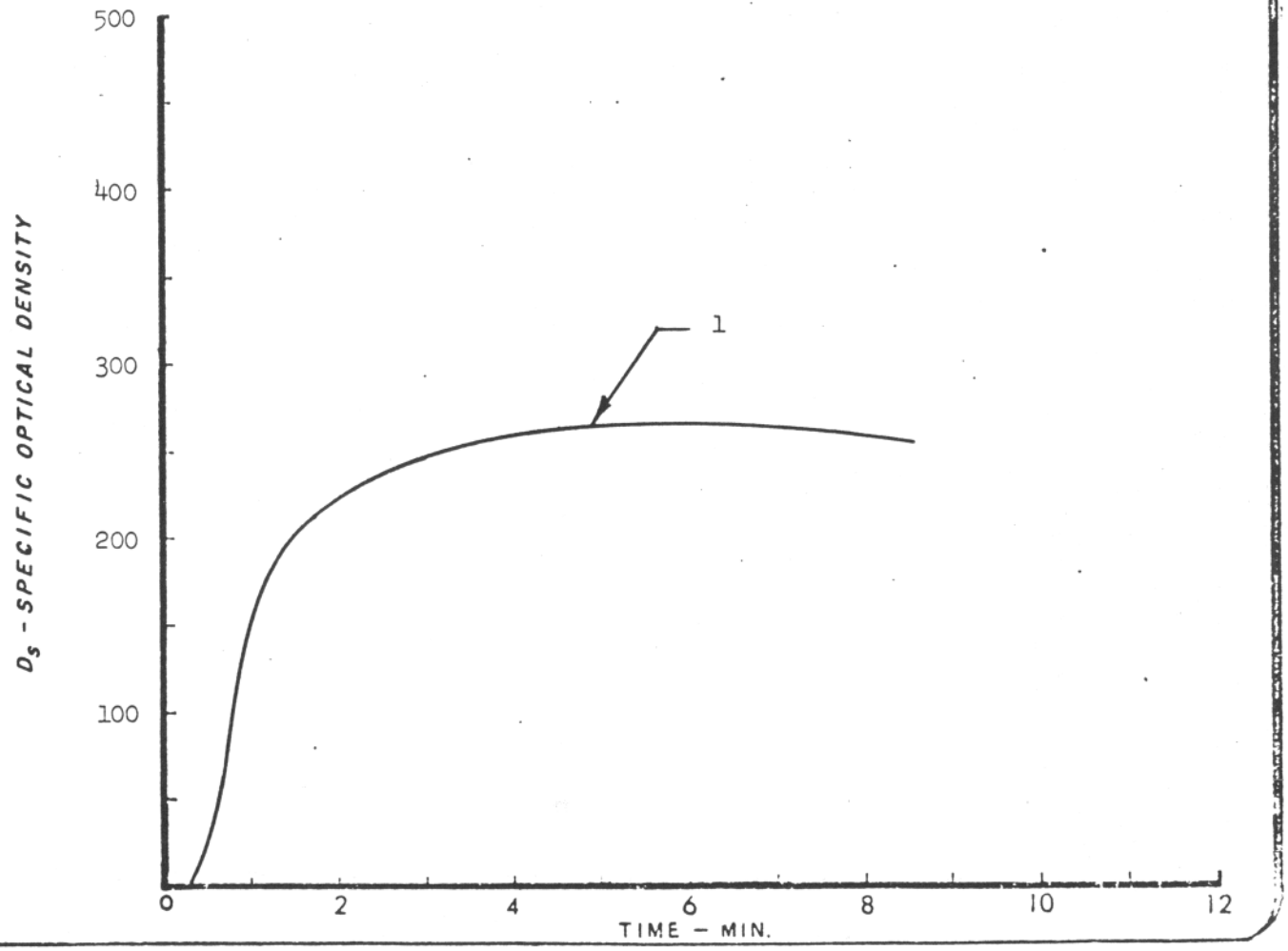
LABORATORY
MATERIALS SMOKE TEST REPORT

MATERIAL TEST NO: 1(B)

MATERIAL DESCRIPTION: Tedlar Coated, Phenolic-Glass Faces Nylon Core

USE/APPLICATION: Ceiling Panel

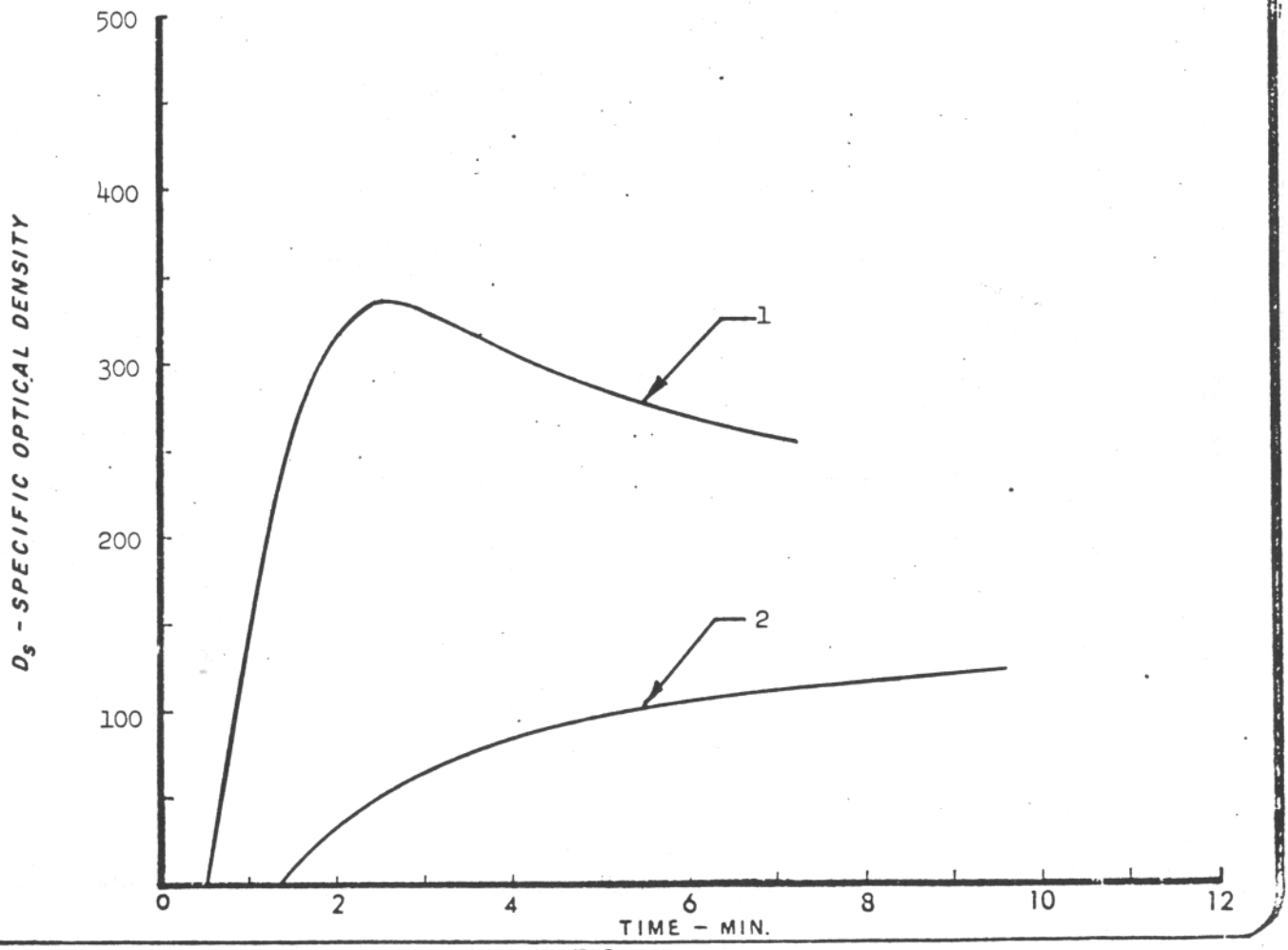
SET NO.	1			COMMENTS
THICKNESS - IN:	0.40			
WEIGHT - GRAMS:	12.4			
EXPOSED AREA - SQ. IN:	6.6			
GAS PRESSURE - PSIG	Pilot			
IRRADIANCE - WATTS/CM^2:	2.54			



LABORATORY
MATERIALS SMOKE TEST REPORT

MATERIAL TEST NO: 2(A)
MATERIAL DESCRIPTION: Tedlar Coated, Polyester Glass Laminate
USE/APPLICATION: Side Panel Window Reveal

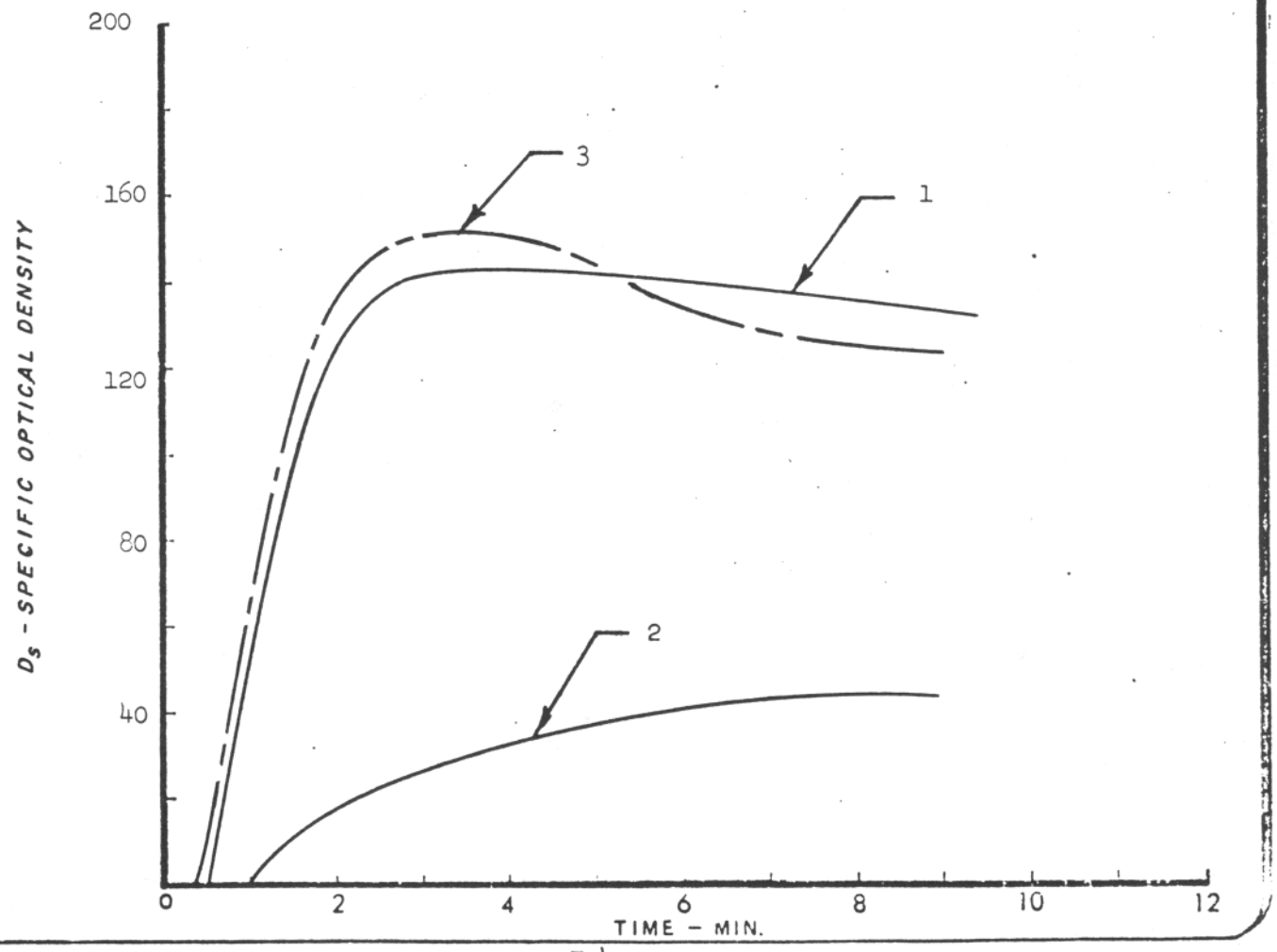
SET NO.	1	2		COMMENTS
THICKNESS - IN:	.05	.05		
WEIGHT - GRAMS:	11.7	12.0		
EXPOSED AREA - SQ. IN:	6.6	6.6		
GAS PRESSURE - PSIG	Pilot	None		
IRRADIANCE - WATTS/CM^2:	2.54	2.54		



LABORATORY
MATERIALS SMOKE TEST REPORT

MATERIAL TEST NO: 2(B)
MATERIAL DESCRIPTION: Tedlar Coated, Phenolic Glass Laminate
USE/APPLICATION: Side Panel/Window Reveal

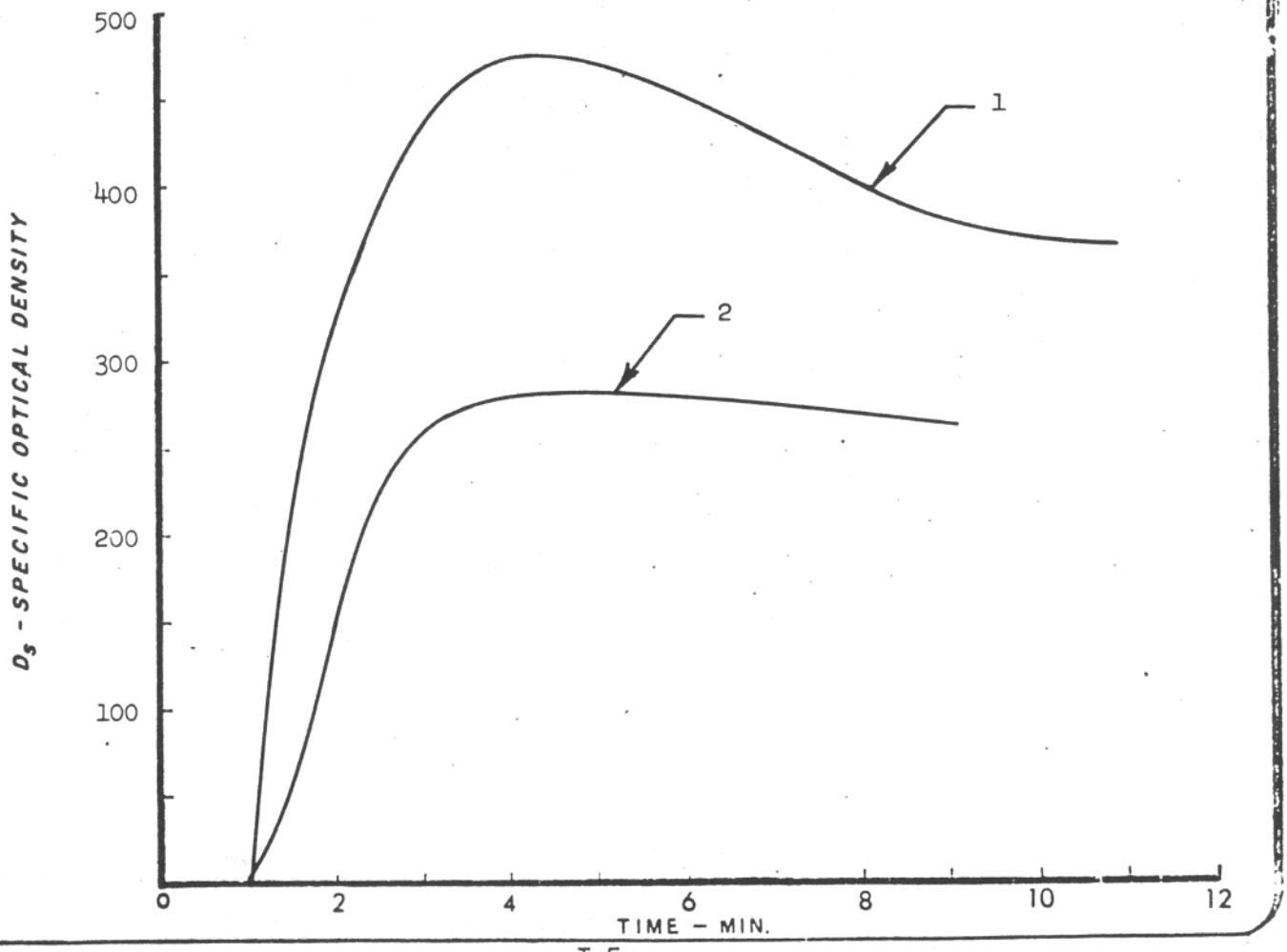
SET NO.	1	2	3	COMMENTS
THICKNESS - IN:	.05	.05	.05	
WEIGHT - GRAMS:	11.8	11.9	12.0	
EXPOSED AREA - SQ. IN:	6.6	6.6	6.6	
GAS PRESSURE - PSIG	Pilot	None	Pilot	
IRRADIANCE - WATTS/CM^2:	2.54	2.54	3.81	



LABORATORY
MATERIALS SMOKE TEST REPORT

MATERIAL TEST NO: 3(A)
MATERIAL DESCRIPTION: Tedlar Coated Epoxy Glass Faces Nylon Core
USE/APPLICATION: Partition Panel

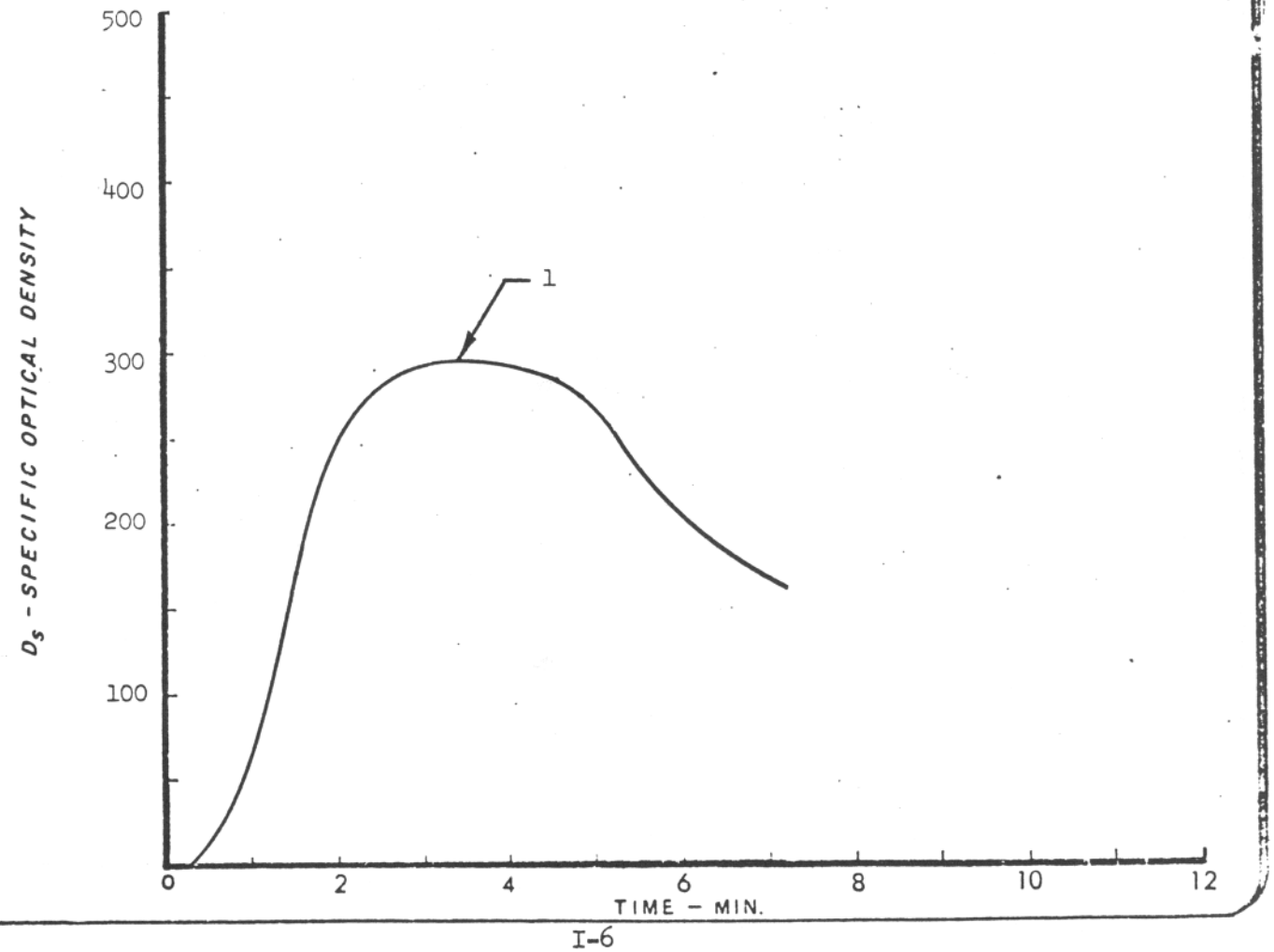
SET NO.	1	2		COMMENTS
THICKNESS - IN:	0.77	0.77		
WEIGHT - GRAMS:	22.4	22.5		
EXPOSED AREA - SQ. IN:	6.6	6.6		
GAS PRESSURE - PSIG	Pilot	None		
IRRADIANCE - WATTS/CM^2:	2.54	2.54		



LABORATORY
MATERIALS SMOKE TEST REPORT

MATERIAL TEST NO: 3(B)
MATERIAL DESCRIPTION: Tedlar Coated, Phenolic Glass Faces Nylon Core
USE/APPLICATION: Partition Panel

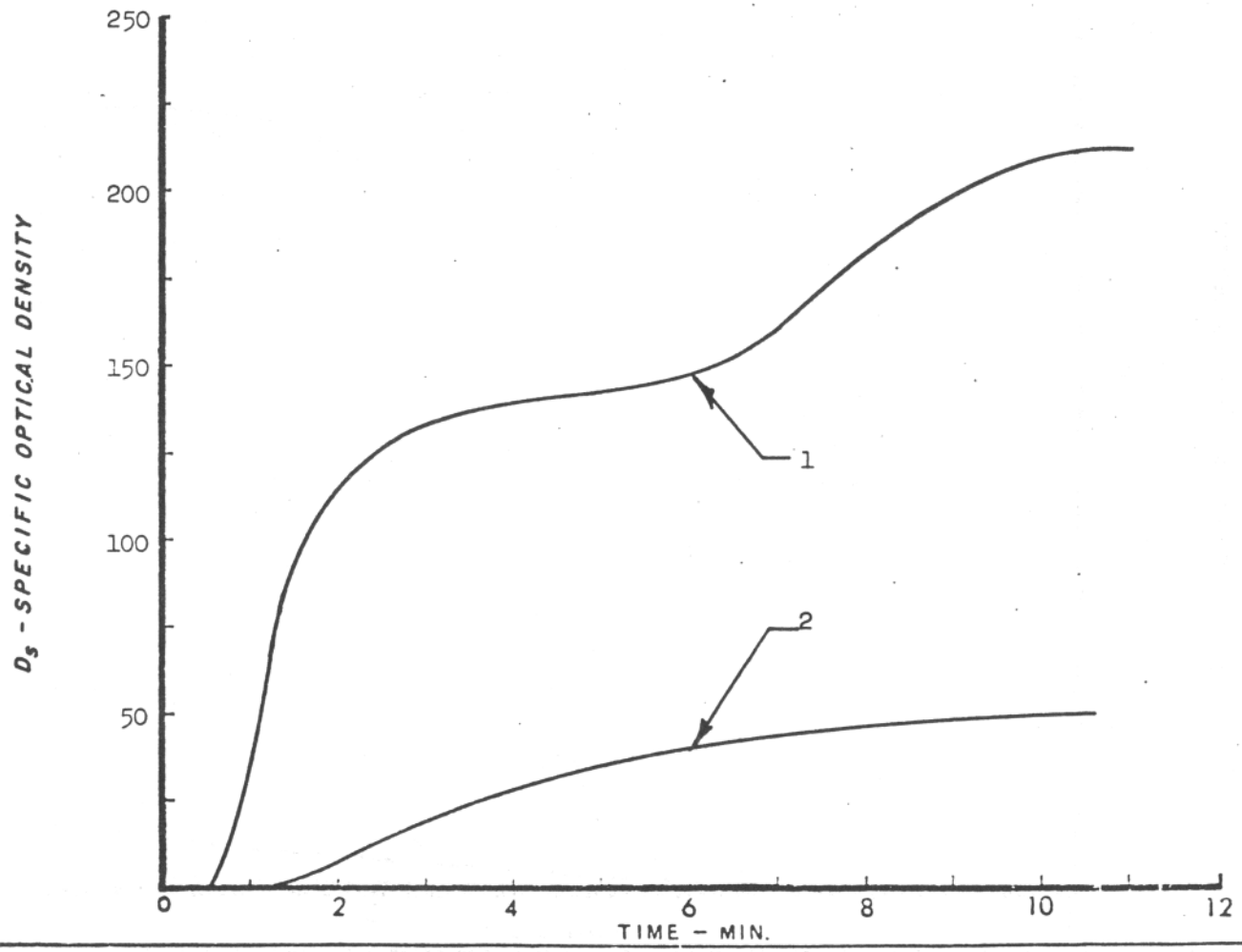
SET NO.	1			COMMENTS
THICKNESS - IN:	0.75			
WEIGHT - GRAMS:	19.2			
EXPOSED AREA - SQ. IN:	6.6			
GAS PRESSURE - PSIG	Pilot			
IRRADIANCE - WATTS/CM^2:	2.54			



LABORATORY
MATERIALS SMOKE TEST REPORT

MATERIAL TEST NO: 4(A)
MATERIAL DESCRIPTION: Epoxy Glass Faces, Nylon Core
USE/APPLICATION: Structural Flooring

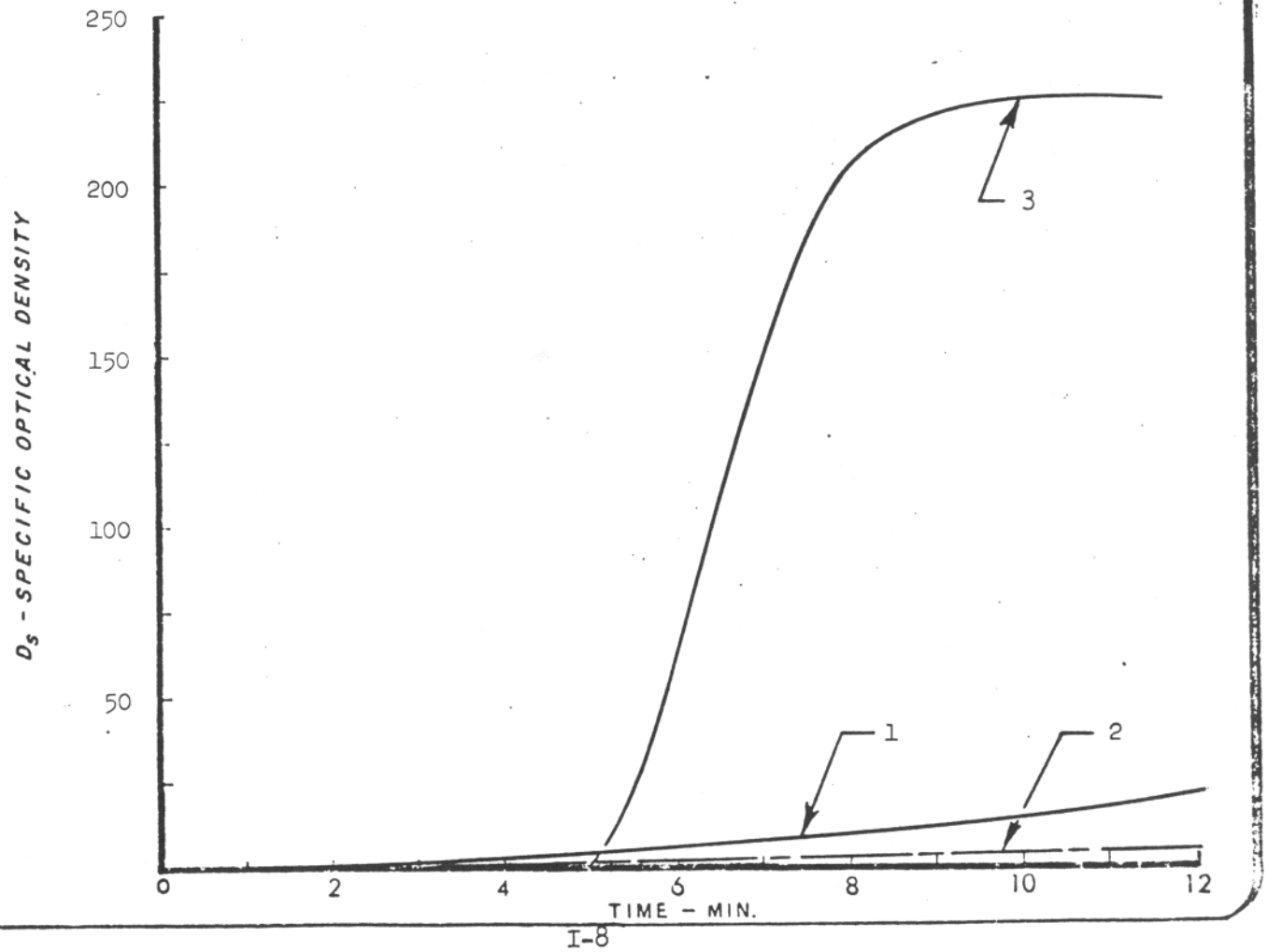
SET NO.	1	2		COMMENTS
THICKNESS - IN:	0.38	0.38		
WEIGHT - GRAMS:	22.9	23.1		
EXPOSED AREA - SQ. IN:	6.6	6.6		
GAS PRESSURE - PSIG	Pilot	None		
IRRADIANCE - WATTS/CM^2:	2.54	2.54		



LABORATORY
MATERIALS SMOKE TEST REPORT

MATERIAL TEST NO: 4(B)
MATERIAL DESCRIPTION: Aluminum Faces, Nylon Core Panel
USE/APPLICATION: Structural Flooring

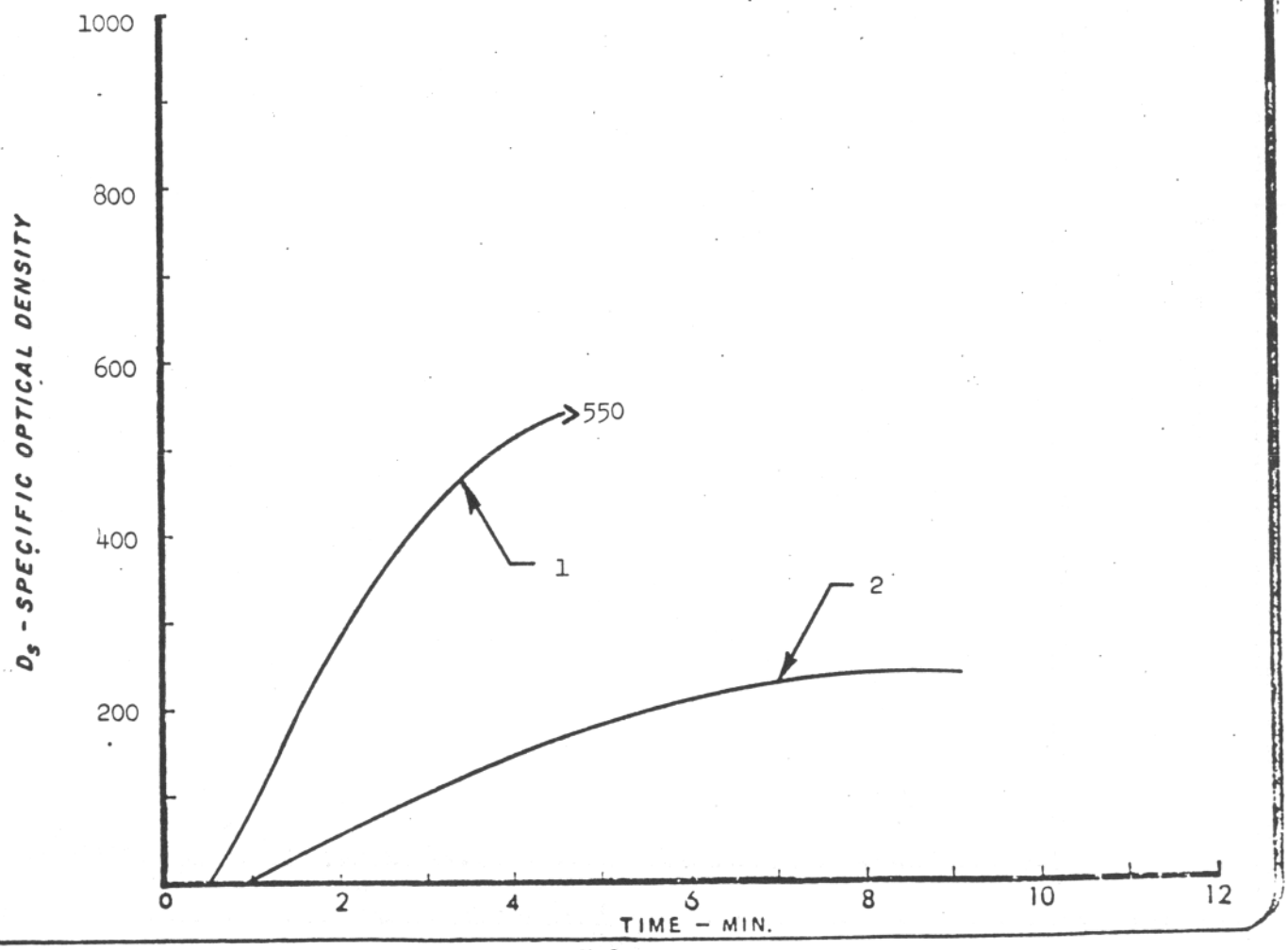
SET NO.	1	2	3	COMMENTS
THICKNESS - IN:	0.37	0.37	0.37	
WEIGHT - GRAMS:	16.9	16.9	17.0	
EXPOSED AREA - SQ. IN:	6.6	6.6	6.6	
GAS PRESSURE - PSIG	Pilot	None	Pilot	
IRRADIANCE - WATTS/CM^2:	2.54	2.54	3.81	



LABORATORY
MATERIALS SMOKE TEST REPORT

MATERIAL TEST NO: 5(A)
MATERIAL DESCRIPTION: FR ABS Sheet 63.0 oz/yd^2
USE/APPLICATION: Thermoforming Parts

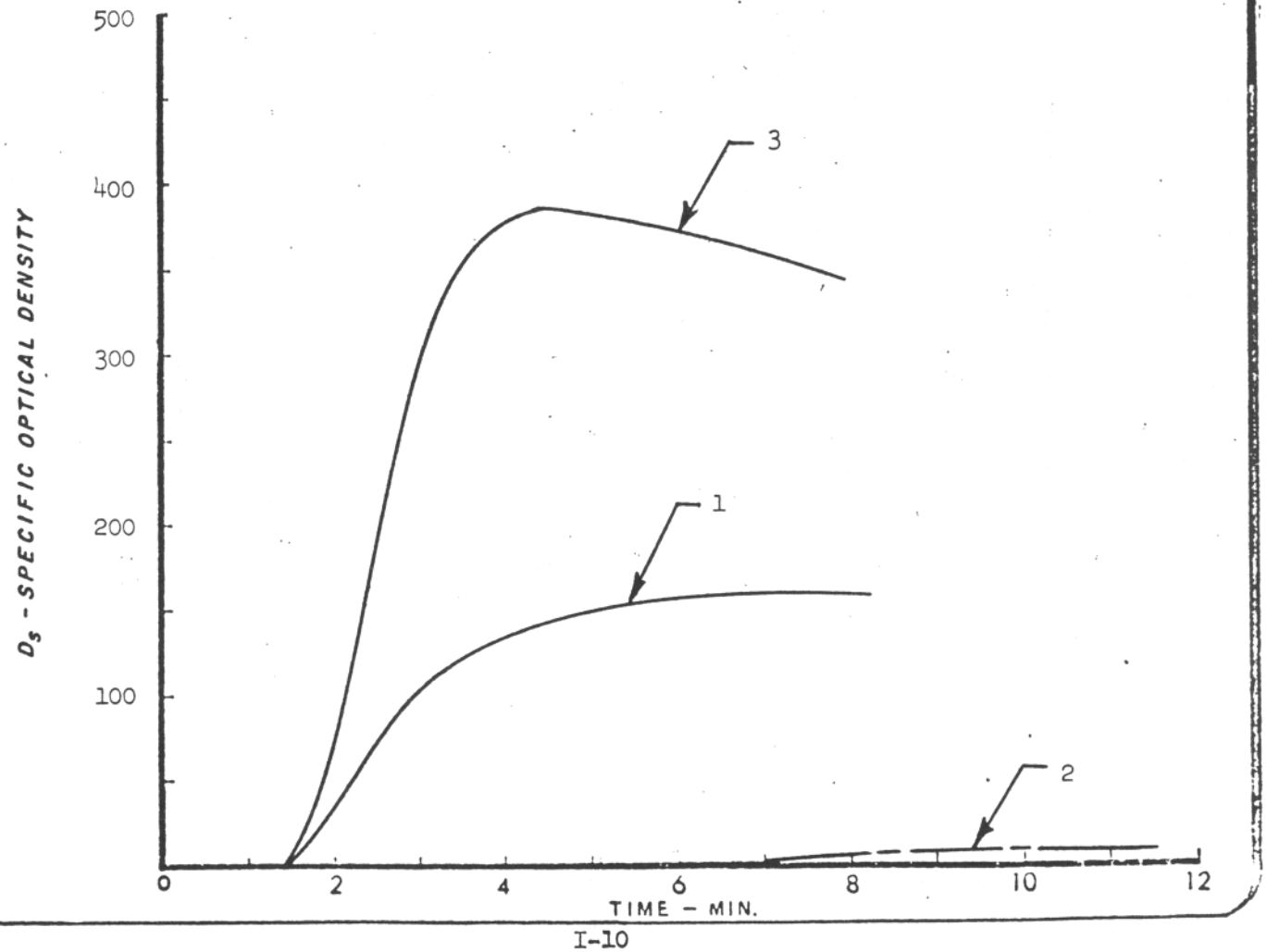
SET NO.	1	2		COMMENTS
THICKNESS - IN:	0.06	0.06		
WEIGHT - GRAMS:	12.4	12.4		
EXPOSED AREA - SQ. IN:	6.6	6.6		
GAS PRESSURE - PSIG	Pilot	None		
IRRADIANCE - WATTS/CM^2:	2.54	2.54		



LABORATORY
MATERIALS SMOKE TEST REPORT

MATERIAL TEST NO: 5(B)
MATERIAL DESCRIPTION: FR Polycarbonate Sheet 61.0 oz/yd^2
USE/APPLICATION: Thermoforming Parts

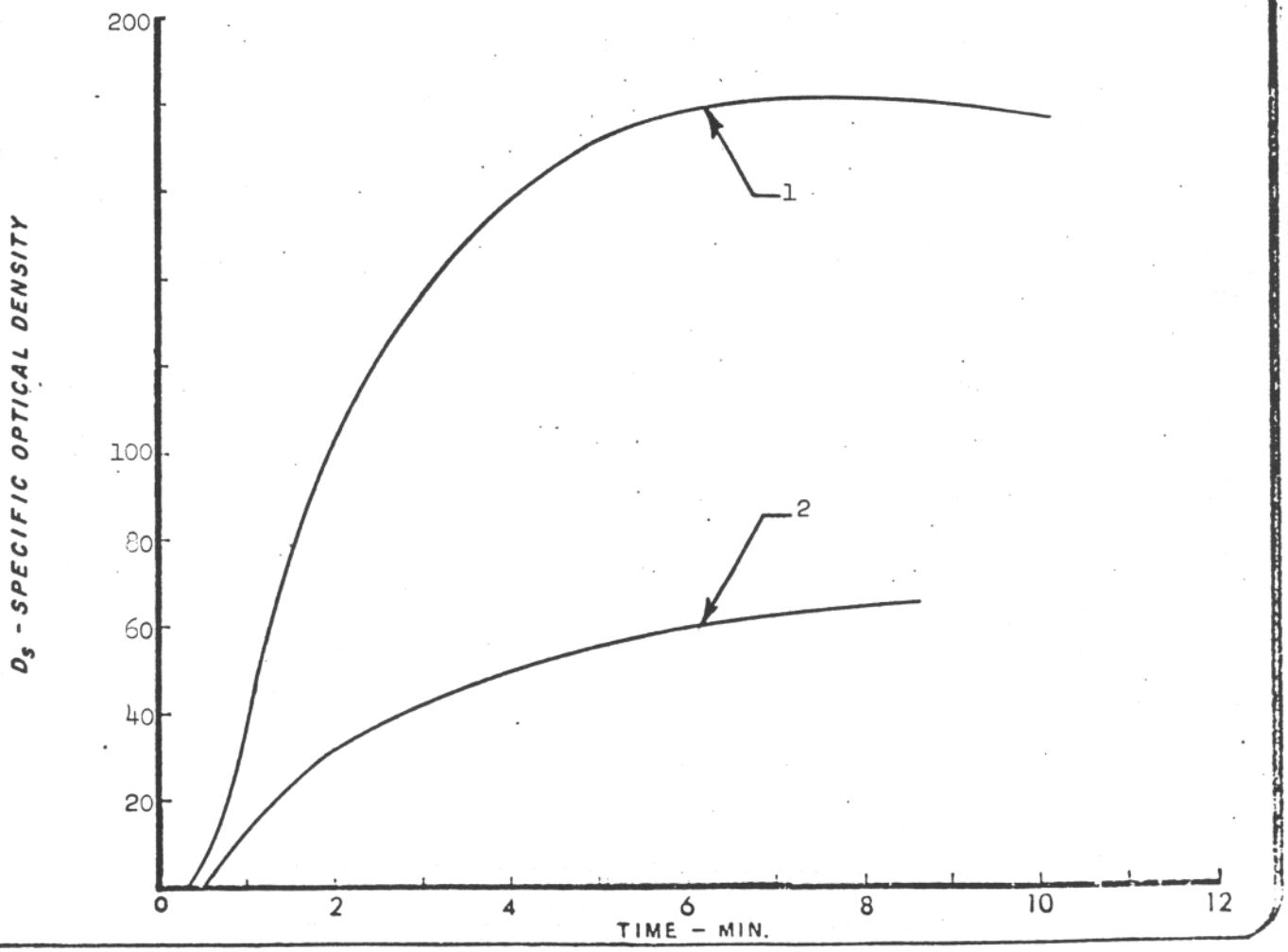
SET NO.	1	2	3	COMMENTS
THICKNESS - IN:	0.06	0.06	0.06	
WEIGHT - GRAMS:	12.8	12.8	12.9	
EXPOSED AREA - SQ. IN:	6.6	6.6	6.6	
GAS PRESSURE - PSIG	Pilot	None	Pilot	
IRRADIANCE - WATTS/CM^2:	2.54	2.54	3.81	



LABORATORY
MATERIALS SMOKE TEST REPORT

MATERIAL TEST NO: 6(A)
MATERIAL DESCRIPTION: FR Wool Fabric, 15.7 oz/yd^2
USE/APPLICATION: Seat Upholstery

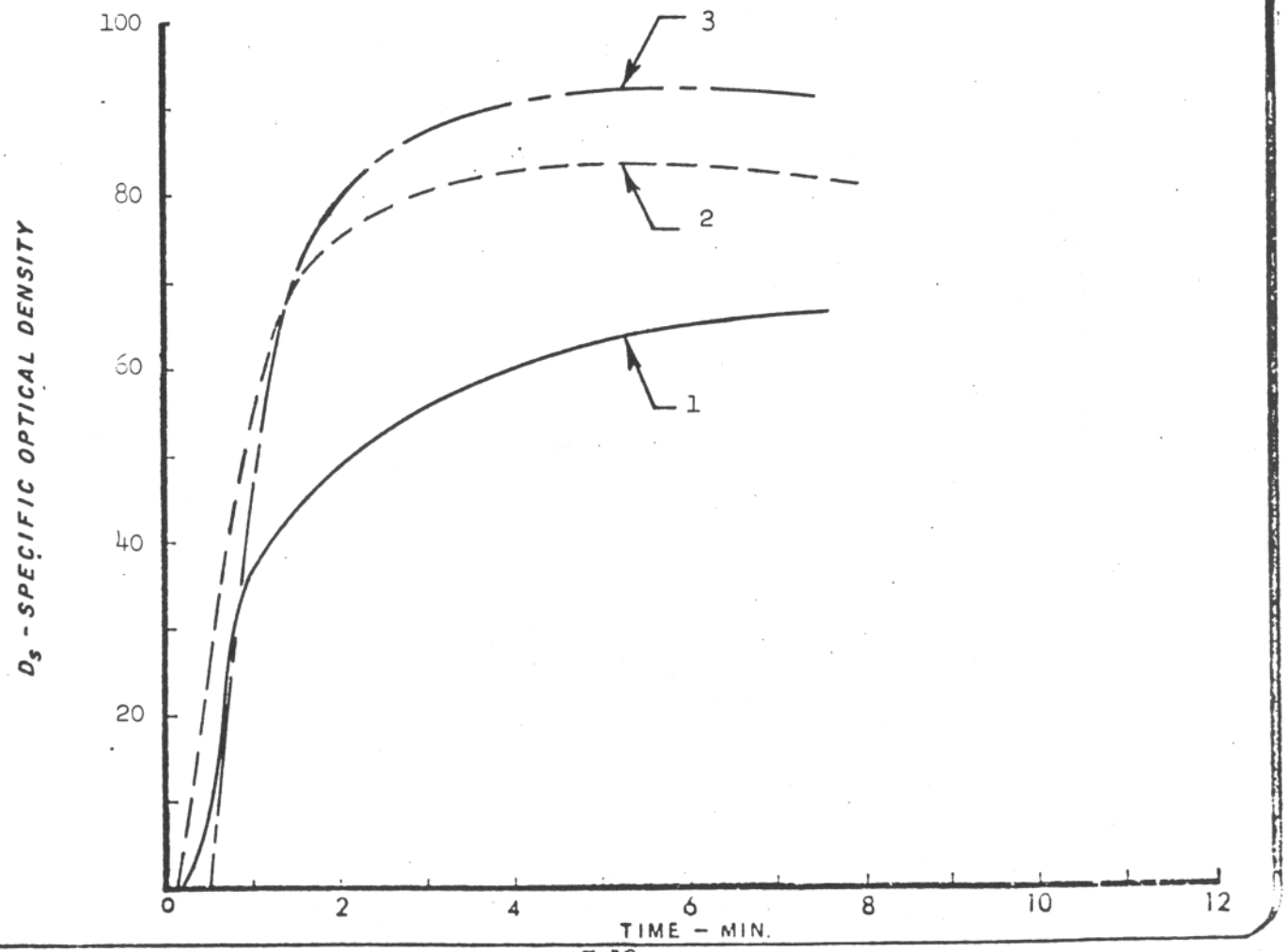
SET NO.	1	2		COMMENTS
THICKNESS - IN:	0.035	0.035		
WEIGHT - GRAMS:	3.1	3.1		
EXPOSED AREA - SQ. IN:	6.6	6.6		
GAS PRESSURE - PSIG	Pilot	None		
IRRADIANCE - WATTS/CM^2:	2.54	2.54		



LABORATORY
MATERIALS SMOKE TEST REPORT

MATERIAL TEST NO: 6(B)
MATERIAL DESCRIPTION: FR Cotton Rayon, 18.3 oz/yd^2
USE/APPLICATION: Seat Upholstery

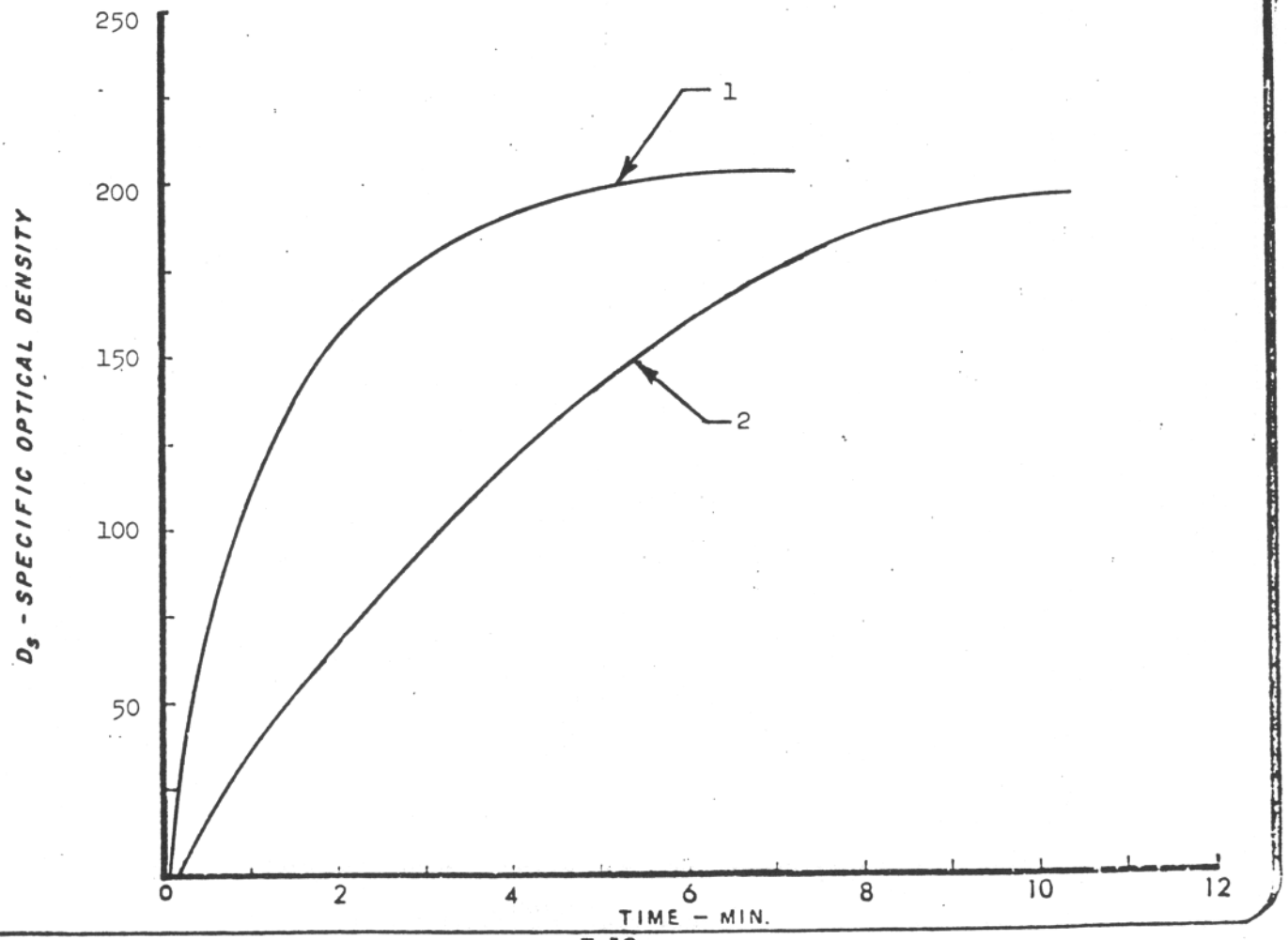
SET NO.	1	2	3	COMMENTS
THICKNESS - IN:	0.03	0.03	0.03	
WEIGHT - GRAMS:	3.6	3.6	3.6	
EXPOSED AREA - SQ. IN:	6.6	6.6	6.6	
GAS PRESSURE - PSIG	Pilot	None	Pilot	
IRRADIANCE - WATTS/CM^2:	2.54	2.54	3.81	



LABORATORY
MATERIALS SMOKE TEST REPORT

MATERIAL TEST NO: 7(A)
MATERIAL DESCRIPTION: FR Polyurethane Foam, 2 PCF
USE/APPLICATION: Seat Cushion

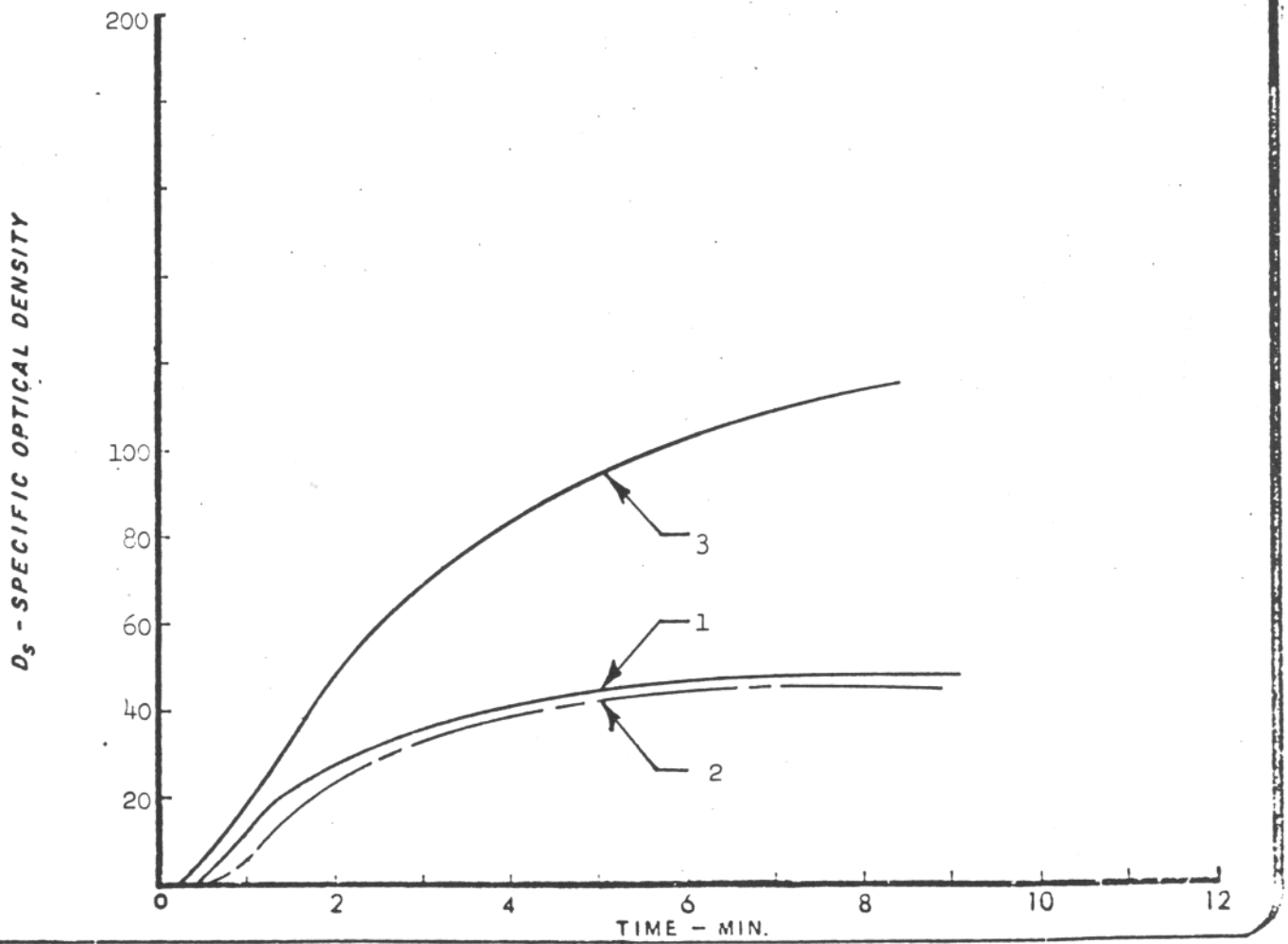
SET NO.	1	2		COMMENTS
THICKNESS - IN:	0.50	0.50		
WEIGHT - GRAMS:	2.51	2.52		
EXPOSED AREA - SQ. IN:	6.6	6.6		
GAS PRESSURE - PSIG	Pilot	None		
IRRADIANCE - WATTS/CM^2:	2.54	2.54		



LABORATORY
MATERIALS SMOKE TEST REPORT

MATERIAL TEST NO: 7(B)
MATERIAL DESCRIPTION: FR Polyethylene Foam, 2 PCF
USE/APPLICATION: Seat Cushion

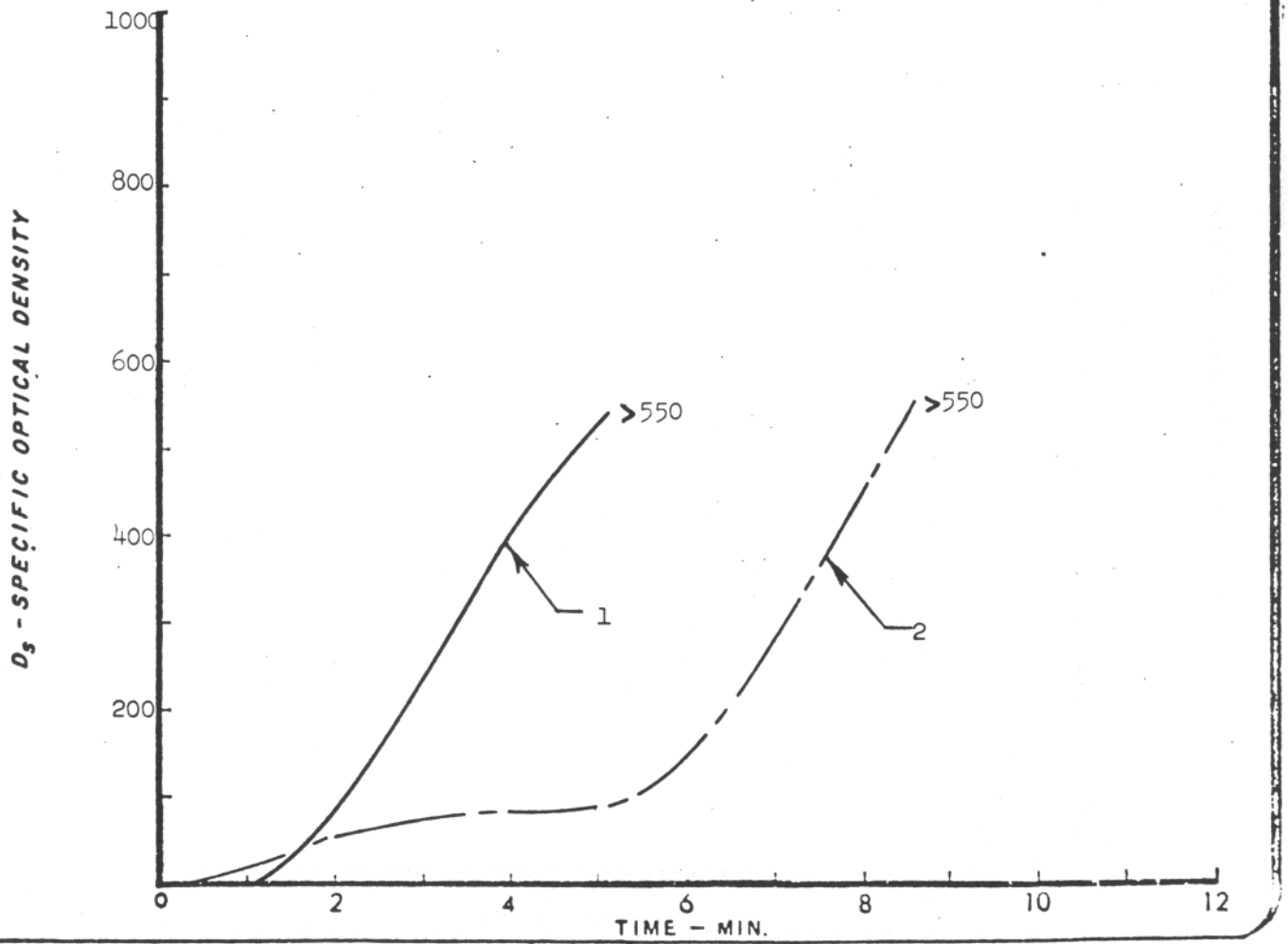
SET NO.	1	2	3	COMMENTS
THICKNESS - IN:	0.5	0.5	0.5	
WEIGHT - GRAMS:	2.9	2.9	2.9	
EXPOSED AREA - SQ. IN:	6.6	6.6	6.6	
GAS PRESSURE - PSIG	Pilot	None	Pilot	
IRRADIANCE - WATTS/CM^2:	2.54	2.54	3.81	



LABORATORY
MATERIALS SMOKE TEST REPORT

MATERIAL TEST NO: 8(A)
MATERIAL DESCRIPTION: FR Wool w/Latex Backing
USE/APPLICATION: Carpeting

SET NO.	1	2		COMMENTS
THICKNESS - IN:	0.26	0.26		
WEIGHT - GRAMS:	13.3	13.3		
EXPOSED AREA - SQ. IN:	6.6	6.6		
GAS PRESSURE - PSIG	Pilot	None		
IRRADIANCE - WATTS/CM²:	2.54	2.54		



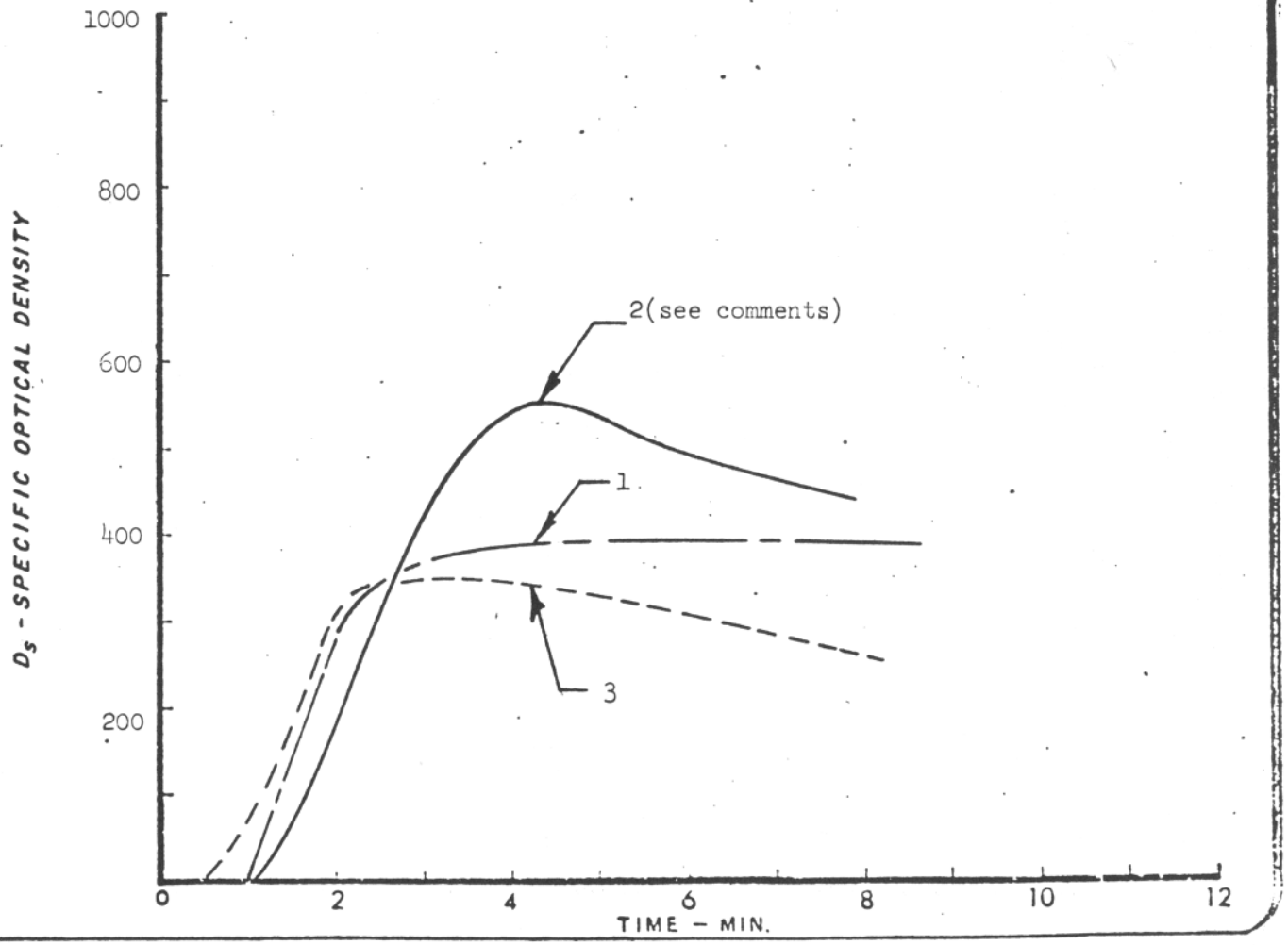
LABORATORY
MATERIALS SMOKE TEST REPORT

MATERIAL TEST NO: 8(B)
MATERIAL DESCRIPTION: FR Modacrylic w/Latex Backing
USE/APPLICATION: Carpeting

SET NO.	1	2	3
THICKNESS - IN:	0.25	0.25	0.25
WEIGHT - GRAMS:	13.5	13.5	13.6
EXPOSED AREA - SQ. IN:	6.6	6.6	6.6
GAS PRESSURE - PSIG	Pilot	None	Pilot
IRRADIANCE - WATTS/CM^2:	2.54	2.54	3.81

COMMENTS

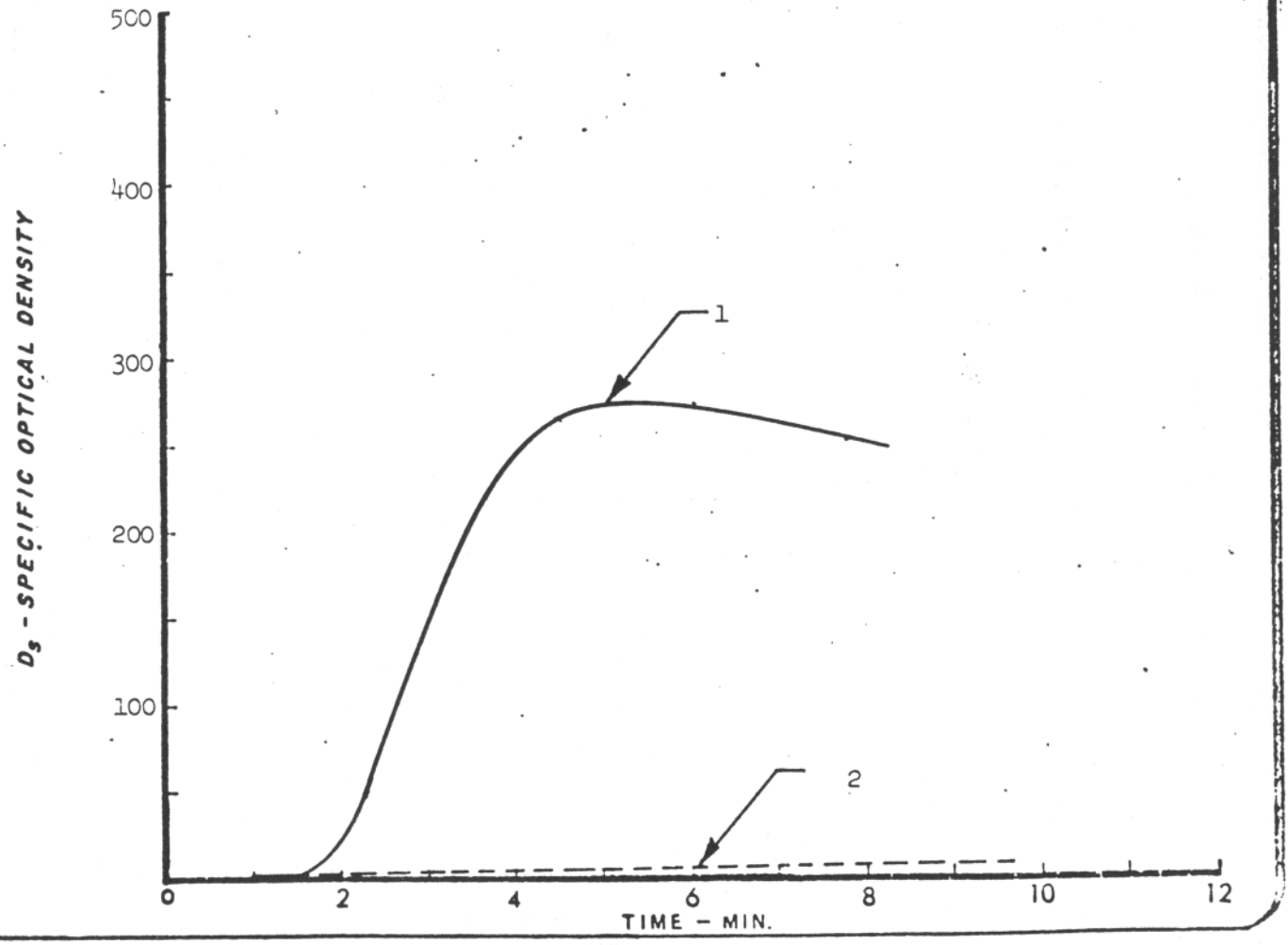
1. Specimen spontaneously burst into fire at D_{max} while exposed to the non-flaming condition.



LABORATORY
MATERIALS SMOKE TEST REPORT

MATERIAL TEST NO: 9(A)
MATERIAL DESCRIPTION: FR Polycarbonate Clear
USE/APPLICATION: Transparency

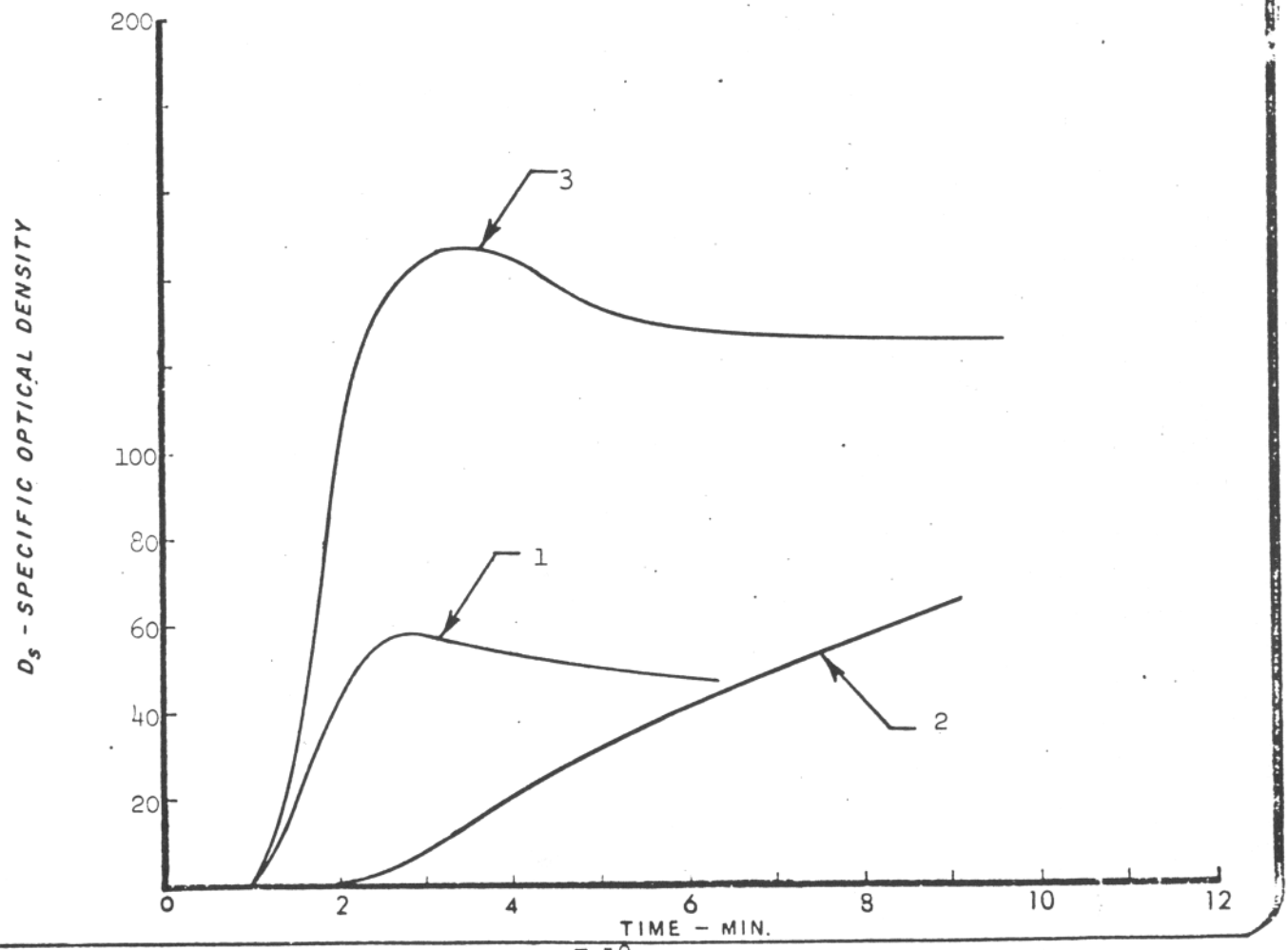
SET NO.	1	2		COMMENTS
THICKNESS - IN:	0.06	0.06		
WEIGHT - GRAMS:	11.4	11.5		
EXPOSED AREA - SQ. IN:	6.6	6.6		
GAS PRESSURE - PSIG	Pilot	None		
IRRADIANCE - WATTS/CM^2:	2.54	2.54		



LABORATORY
MATERIALS SMOKE TEST REPORT

MATERIAL TEST NO: 9(B)
MATERIAL DESCRIPTION: FR Acrylic
USE/APPLICATION: Transparency

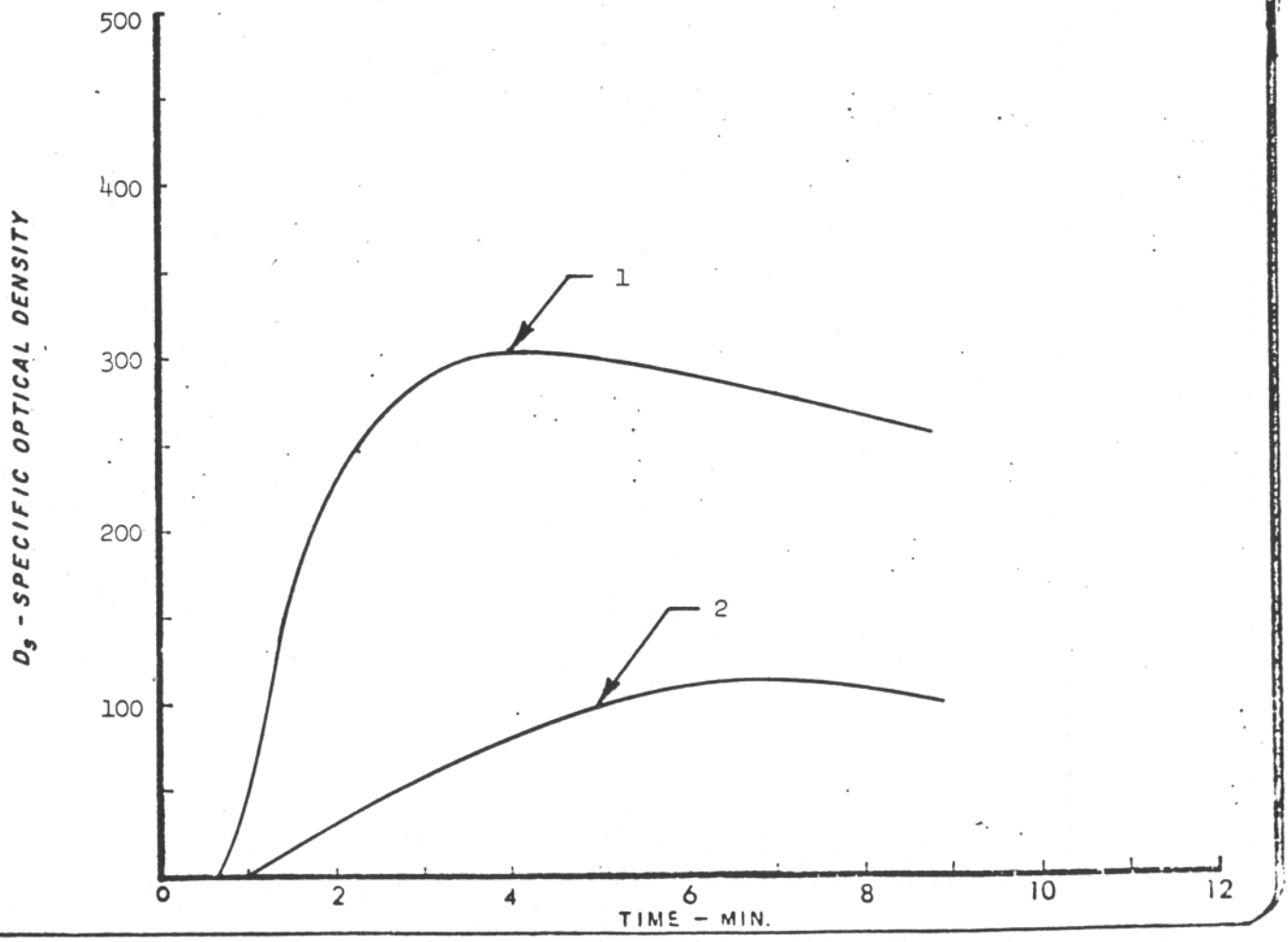
SET NO.	1	2	3	COMMENTS
THICKNESS - IN:	0.06	0.06	.06	
WEIGHT - GRAMS:	9.3	9.3	9.3	
EXPOSED AREA - SQ. IN:	6.6	6.6	6.6	
GAS PRESSURE - PSIG	Pilot	None	Pilot	
IRRADIANCE - WATTS/CM^2:	2.54	2.54	3.81	



LABORATORY
MATERIALS SMOKE TEST REPORT

MATERIAL TEST NO: 10 (A)
MATERIAL DESCRIPTION: FR Chloroprene Rubber
USE/APPLICATION. Elastomer

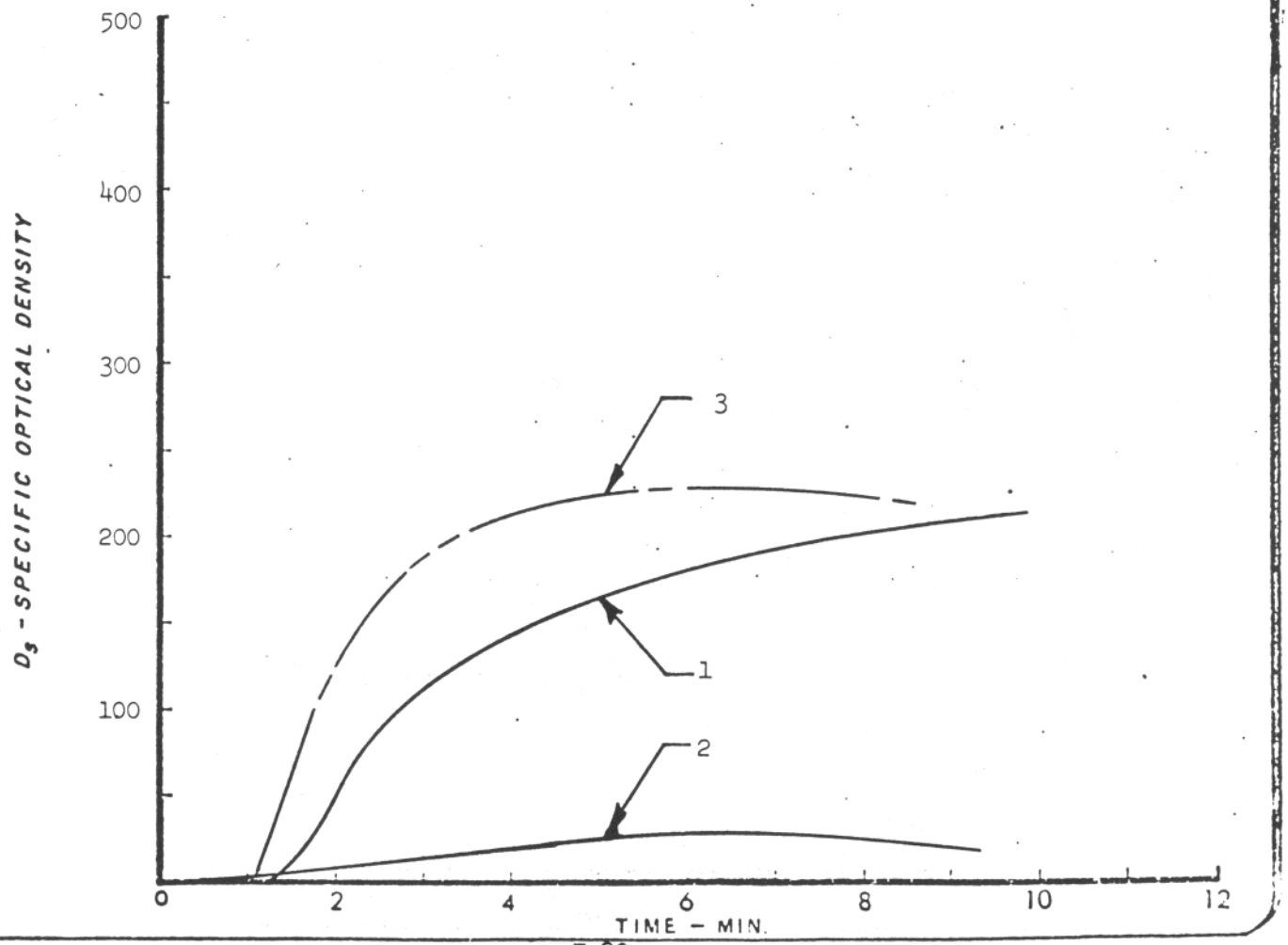
SET NO.	1	2		COMMENTS
THICKNESS - IN:	0.06	0.06		
WEIGHT - GRAMS:	11.5	11.5		
EXPOSED AREA - SQ. IN:	6.6	6.6		
GAS PRESSURE - PSIG	Pilot	None		
IRRADIANCE - WATTS/CM^2:	2.54	2.54		



LABORATORY
MATERIALS SMOKE TEST REPORT

MATERIAL TEST NO: 10 (B)
MATERIAL DESCRIPTION: TR Silicone Rubber
USE/APPLICATION: Elastomer

SET NO.	1	2	3	COMMENTS
THICKNESS - IN:	0.06	0.06	0.06	
WEIGHT - GRAMS:	11.6	11.9	11.9	
EXPOSED AREA - SQ. IN:	6.6	6.6	6.6	
GAS PRESSURE - PSIG	Pilot	None	Pilot	
IRRADIANCE - WATTS/CM^2:	2.54	2.54	3.81	

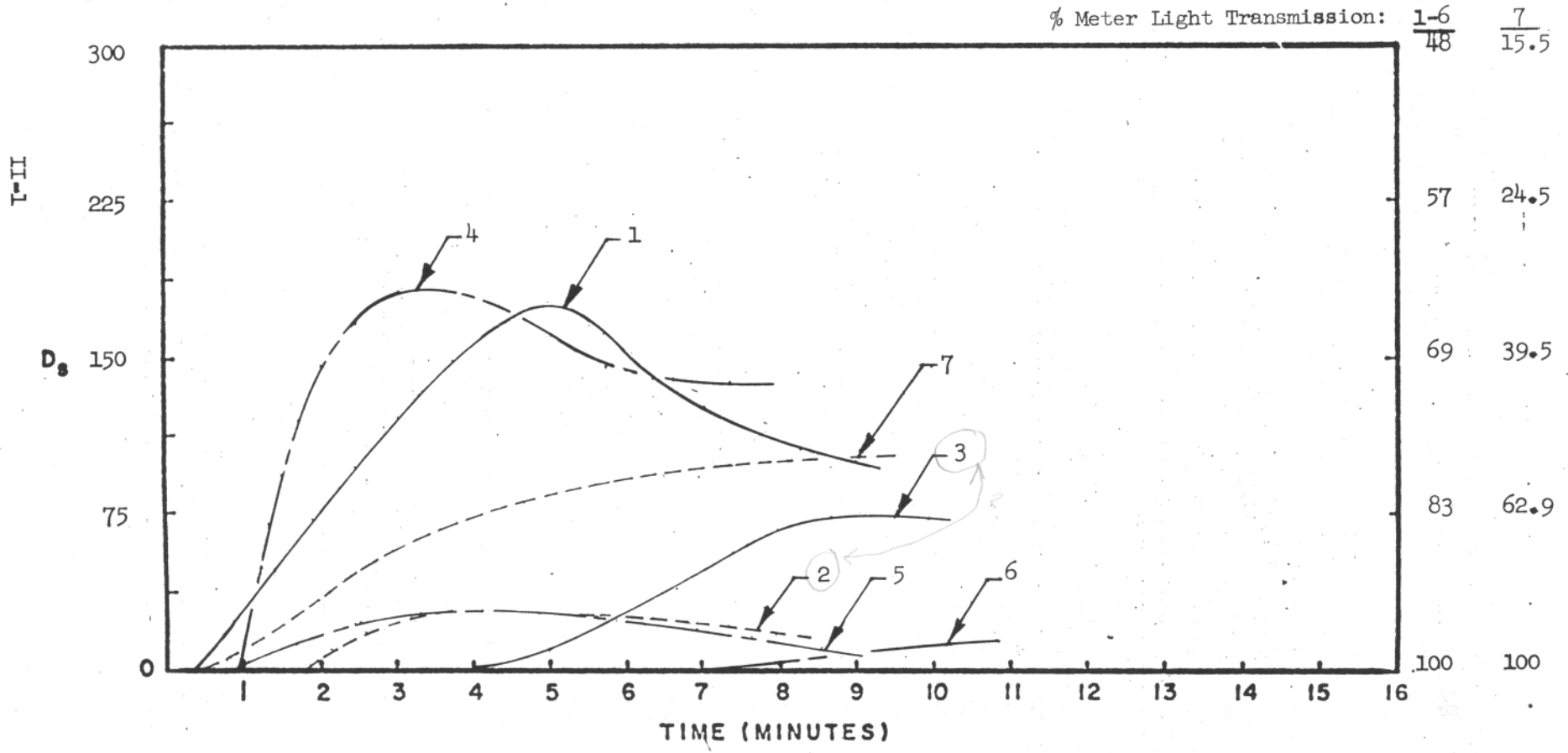


APPENDIX II

MOCKUP MATERIALS SMOKE TEST REPORTS

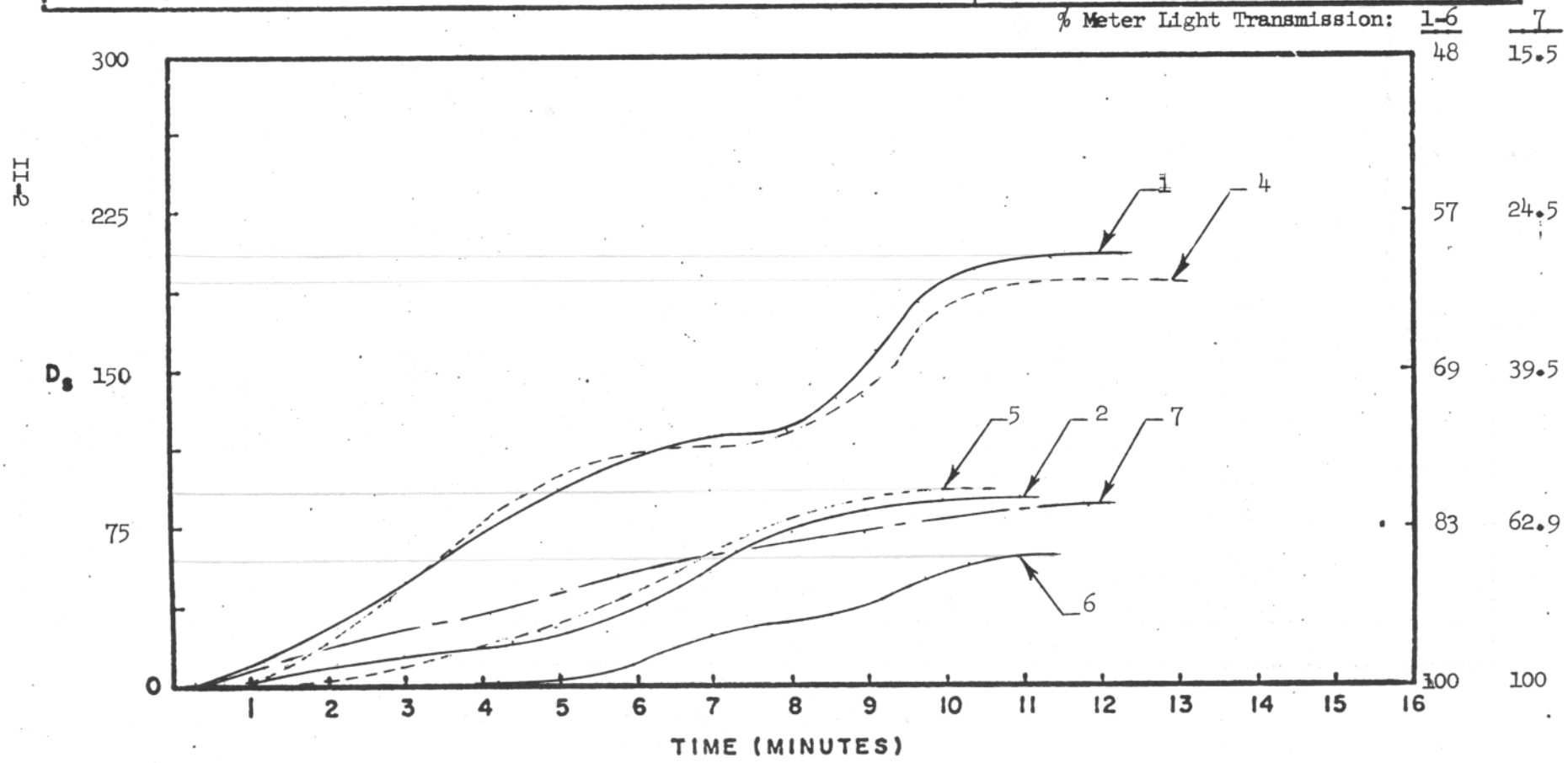
MATERIALS SMOKE DATA REPORT

CATEGORY 1(A)	MATERIAL CATEGORY Ceiling Panel
Tedlar Coated, Epoxy-Glass Faces, Nomex Core Panel, 0.37 inch.	No. 1 Center Ceiling Meter No. 2 Center Mid-Height Meter No. 3 Center Floor Meter No. 4 End Ceiling Meter No. 5 End Mid-Height Meter No. 6 End Floor Meter No. 7 Overall Smoke Meter
☒ FLAMING CONDITION ☒ 2.2 BTU/FT^2 - SEC ☐ NON-FLAMING CONDITION ☐ 3.3 BTU/FT^2 - SEC ☐ KINDLING CONDITION ☐ NONE	REMARKS: (1) Mockup Specimen Size: 1.0 ft^2 (2) Specimen Location No. 1



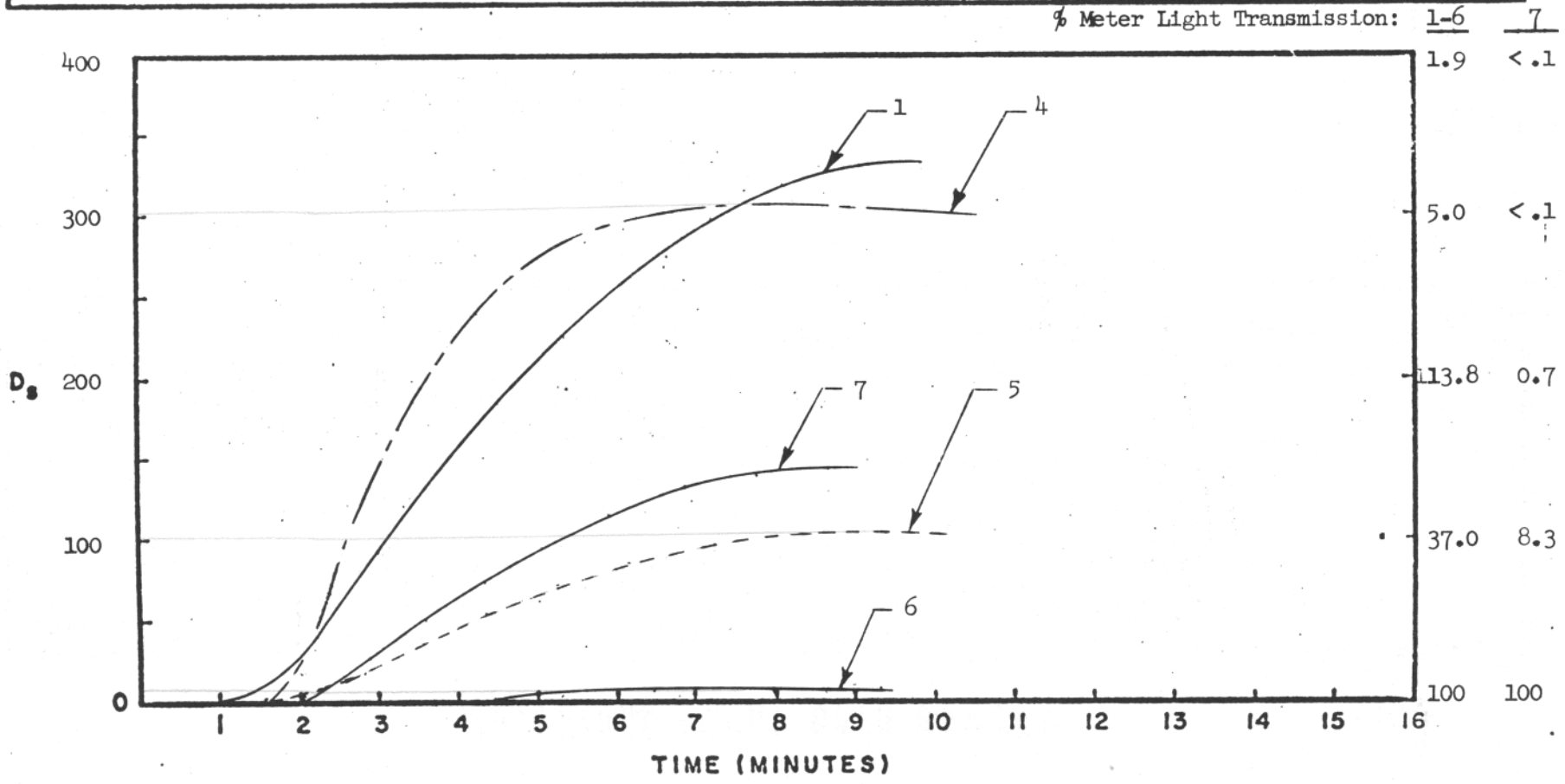
MATERIALS SMOKE DATA REPORT

CATEGORY 1(A)	MATERIAL CATEGORY Ceiling Panel
Tedlar Coated, Epoxy-Glass Faces, Nomex Core Panel, 0.37 inch.	No. 1 Center Ceiling Meter No. 2 Center Mid-Height Meter No. 3 Center Floor Meter No. 4 End Ceiling Meter No. 5 End Mid-Height Meter No. 6 End Floor Meter No. 7 Overall Smoke Meter
☒ FLAMING CONDITION ☒ 2.2 BTU/FT^2 - SEC ☐ NON-FLAMING CONDITION ☐ 3.3 BTU/FT^2 - SEC ☐ KINDLING CONDITION ☐ NONE	REMARKS: (1) Mockup Specimen Size: 1.0 ft^2 (2) Specimen Location No. 3



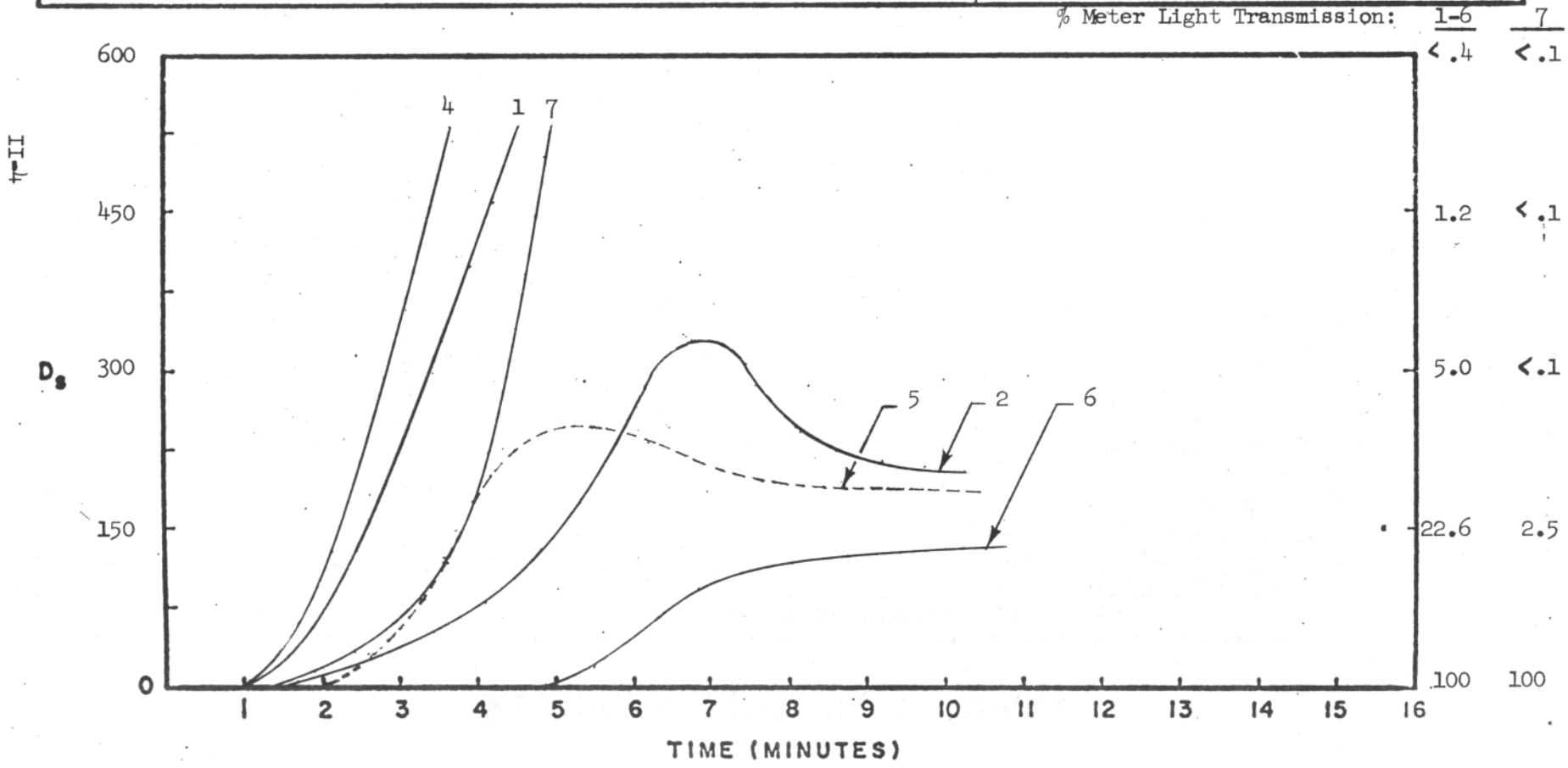
MATERIALS SMOKE DATA REPORT

CATEGORY 1(A)	MATERIAL CATEGORY Ceiling Panel
Tedlar Coated, Epoxy-Glass Faces, Nomex Core Panel, 0.37 inch.	No. 1 Center Ceiling Meter No. 2 Center Mid-Height Meter No. 3 Center Floor Meter No. 4 End Ceiling Meter No. 5 End Mid-Height Meter No. 6 End Floor Meter No. 7 Overall Smoke Meter
☐ FLAMING CONDITION ☒ 2.2 BTU/FT^2 - SEC ☒ NON-FLAMING CONDITION ☐ 3.3 BTU/FT^2 - SEC ☐ KINDLING CONDITION ☐ NONE	REMARKS: (1) Mockup Specimen Size: 4.0 ft^2 (2) Specimen Location No. 1



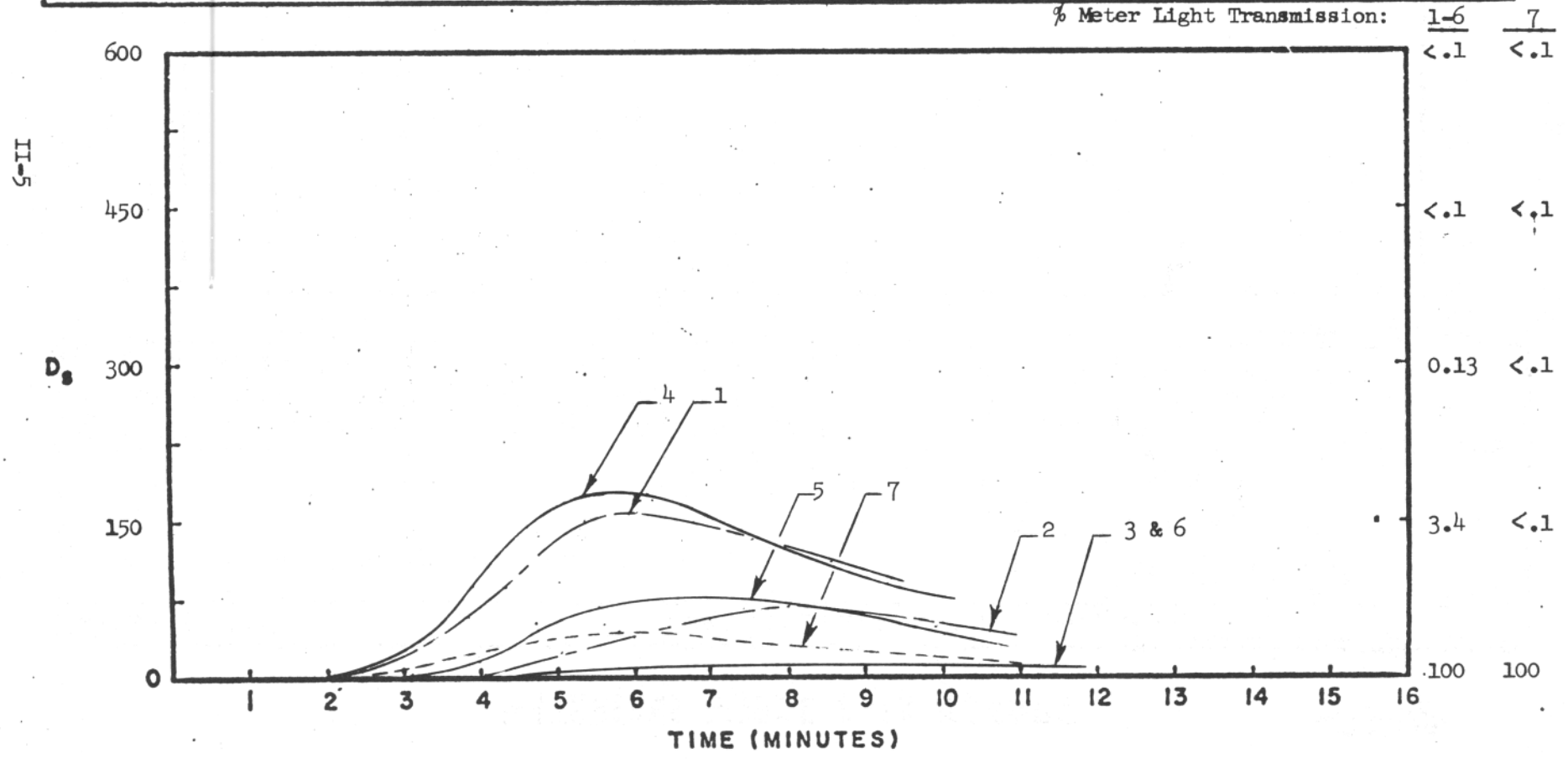
MATERIALS SMOKE DATA REPORT

CATEGORY 1(B)	MATERIAL CATEGORY Ceiling Panel
Tedlar Coated, Phenolic-Glass Faces, Nomex Core Panel, 0.40 inch.	No. 1 Center Ceiling Meter No. 2 Center Mid-Height Meter No. 3 Center Floor Meter No. 4 End Ceiling Meter No. 5 End Mid-Height Meter No. 6 End Floor Meter No. 7 Overall Smoke Meter
☒ FLAMING CONDITION ☒ 2.2 BTU/FT^2 - SEC ☐ NON-FLAMING CONDITION ☐ 3.3 BTU/FT^2 - SEC ☐ KINDLING CONDITION ☐ NONE	REMARKS: (1) Mockup Specimen Size: 4.0 ft^2 (2) Specimen Location No. 1



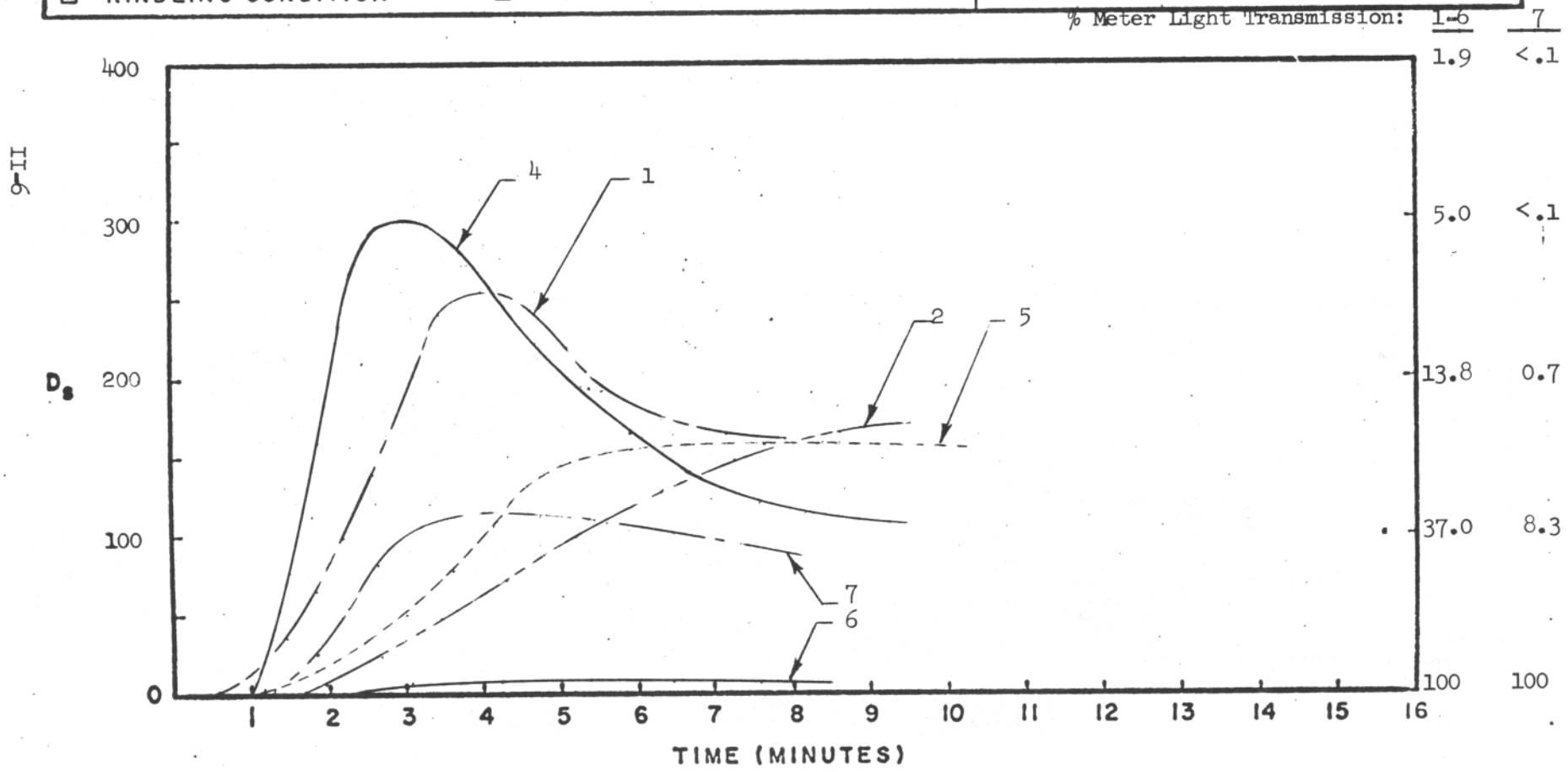
MATERIALS SMOKE DATA REPORT

CATEGORY 1(B)	MATERIAL CATEGORY Ceiling Panel
Tedlar Coated, Phenolic-Glass Faces, Nomex Core, 0.40 inch.	No. 1 Center Ceiling Meter No. 2 Center Mid-Height Meter No. 3 Center Floor Meter No. 4 End Ceiling Meter No. 5 End Mid-Height Meter No. 6 End Floor Meter No. 7 Overall Smoke Meter
☒ FLAMING CONDITION ☒ 2.2 BTU/FT^2 - SEC ☐ NON-FLAMING CONDITION ☐ 3.3 BTU/FT^2 - SEC ☐ KINDLING CONDITION ☐ NONE	REMARKS: (1) Mockup Specimen Size: 9.0 ft^2 (2) Specimen Location No. 1



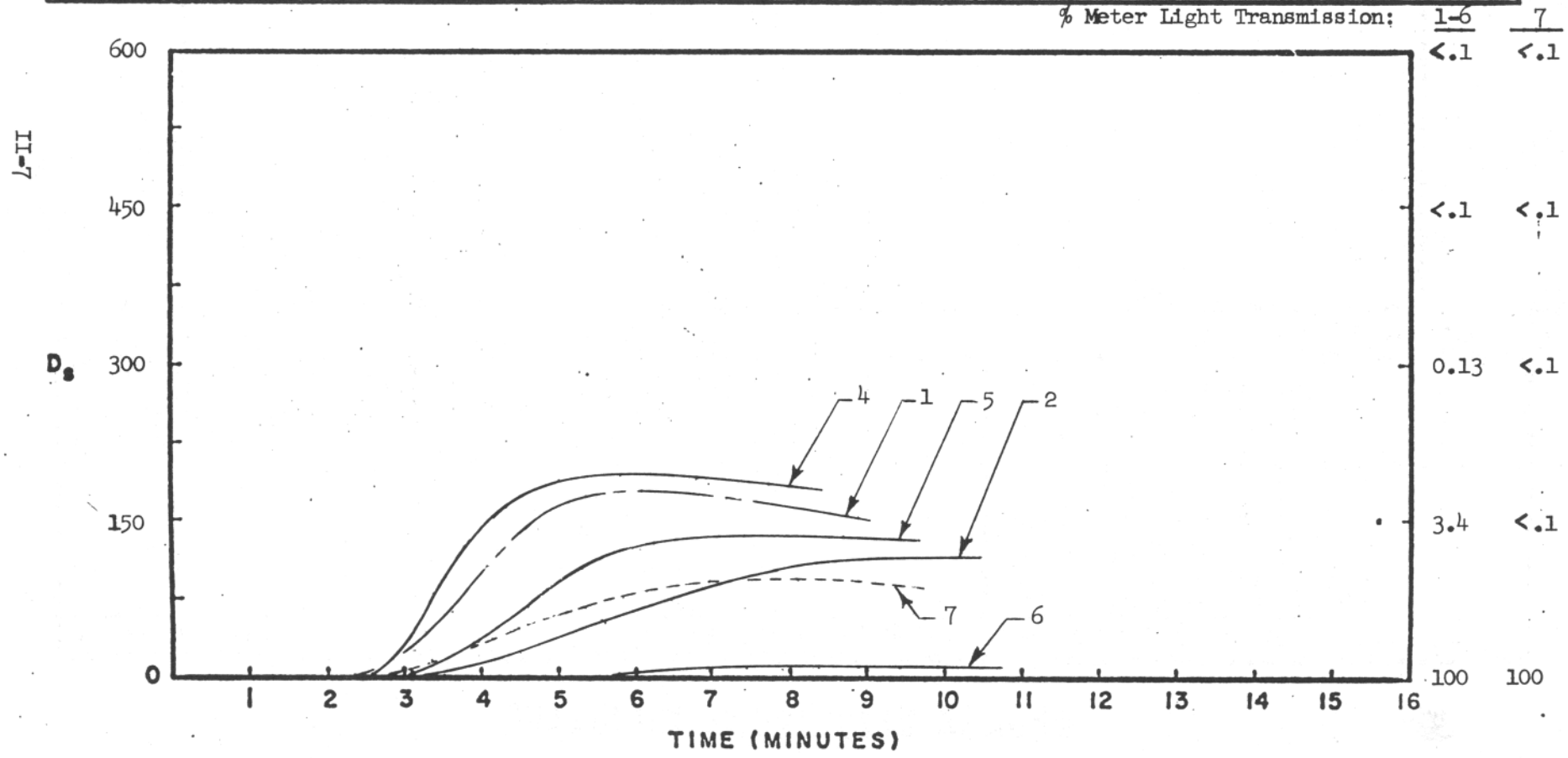
MATERIALS SMOKE DATA REPORT

CATEGORY 2(B)	MATERIAL CATEGORY Side Panel/Window Reveal
Tedlar Coated, Phenolic-Glass Laminate, .05 inch.	No. 1 Center Ceiling Meter No. 2 Center Mid-Height Meter No. 3 Center Floor Meter No. 4 End Ceiling Meter No. 5 End Mid-Height Meter No. 6 End Floor Meter No. 7 Overall Smoke Meter
☒ FLAMING CONDITION ☒ 2.2 BTU/FT^2 - SEC ☐ NON-FLAMING CONDITION ☐ 3.3 BTU/FT^2 - SEC ☐ KINDLING CONDITION ☐ NONE	REMARKS: (1) Mockup Specimen Size: 4.0 ft^2 (2) Specimen Location No. 1



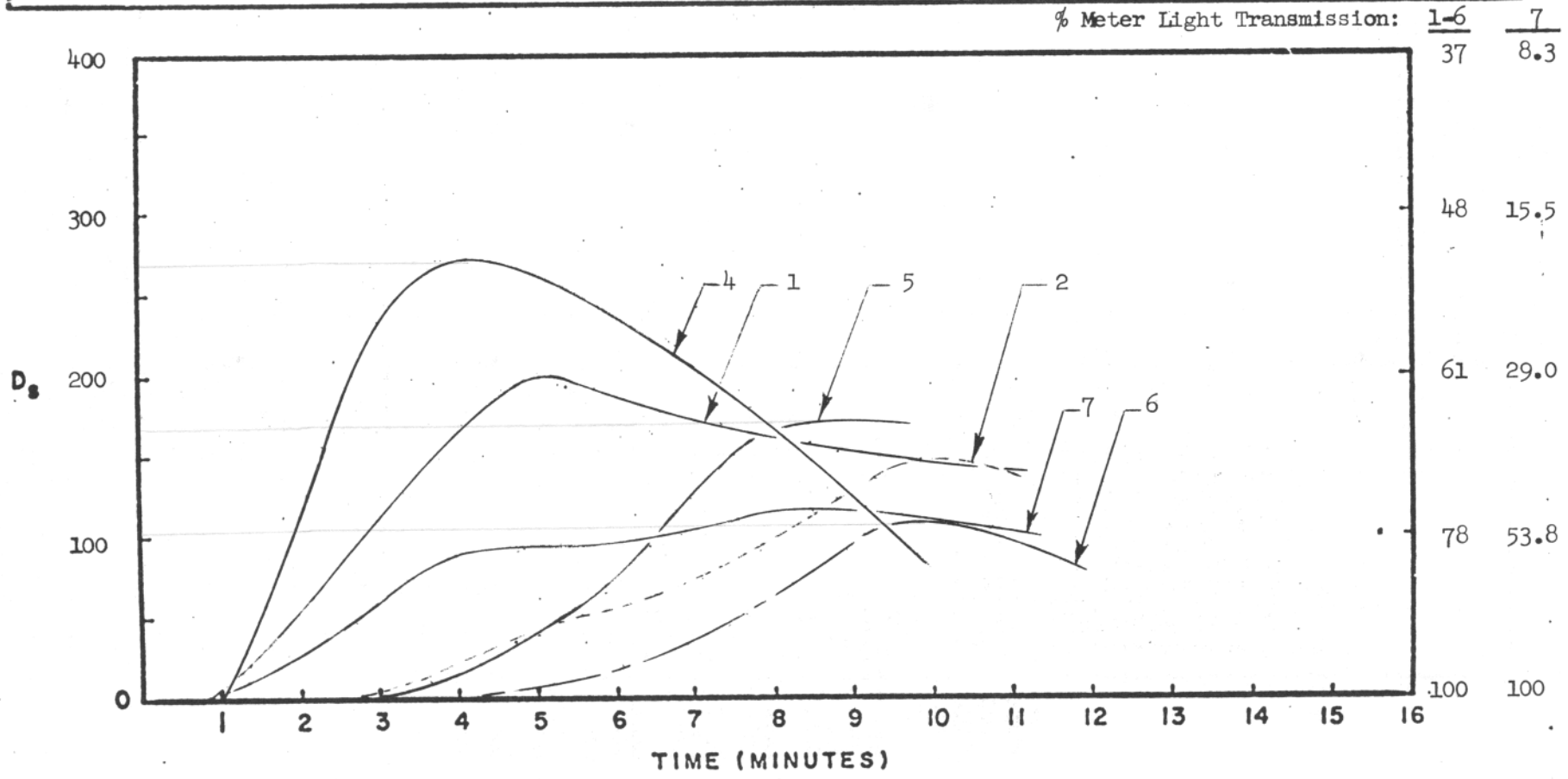
MATERIALS SMOKE DATA REPORT

CATEGORY 2(B)	MATERIAL CATEGORY	Side Panel/Window Reveal
Tedlar Covered, Phenolic-Glass Laminate, .05 inch.		No. 1 Center Ceiling Meter No. 2 Center Mid-Height Meter No. 3 Center Floor Meter No. 4 End Ceiling Meter No. 5 End Mid-Height Meter No. 6 End Floor Meter No. 7 Overall Smoke Meter
☒ FLAMING CONDITION ☐ NON-FLAMING CONDITION ☐ KINDLING CONDITION	☒ 2.2 BTU/FT^2 - SEC ☐ 3.3 BTU/FT^2 - SEC ☐ NONE	REMARKS: (1) Mockup Specimen Size: 9.0 ft^2 (2) Specimen Location No. 1



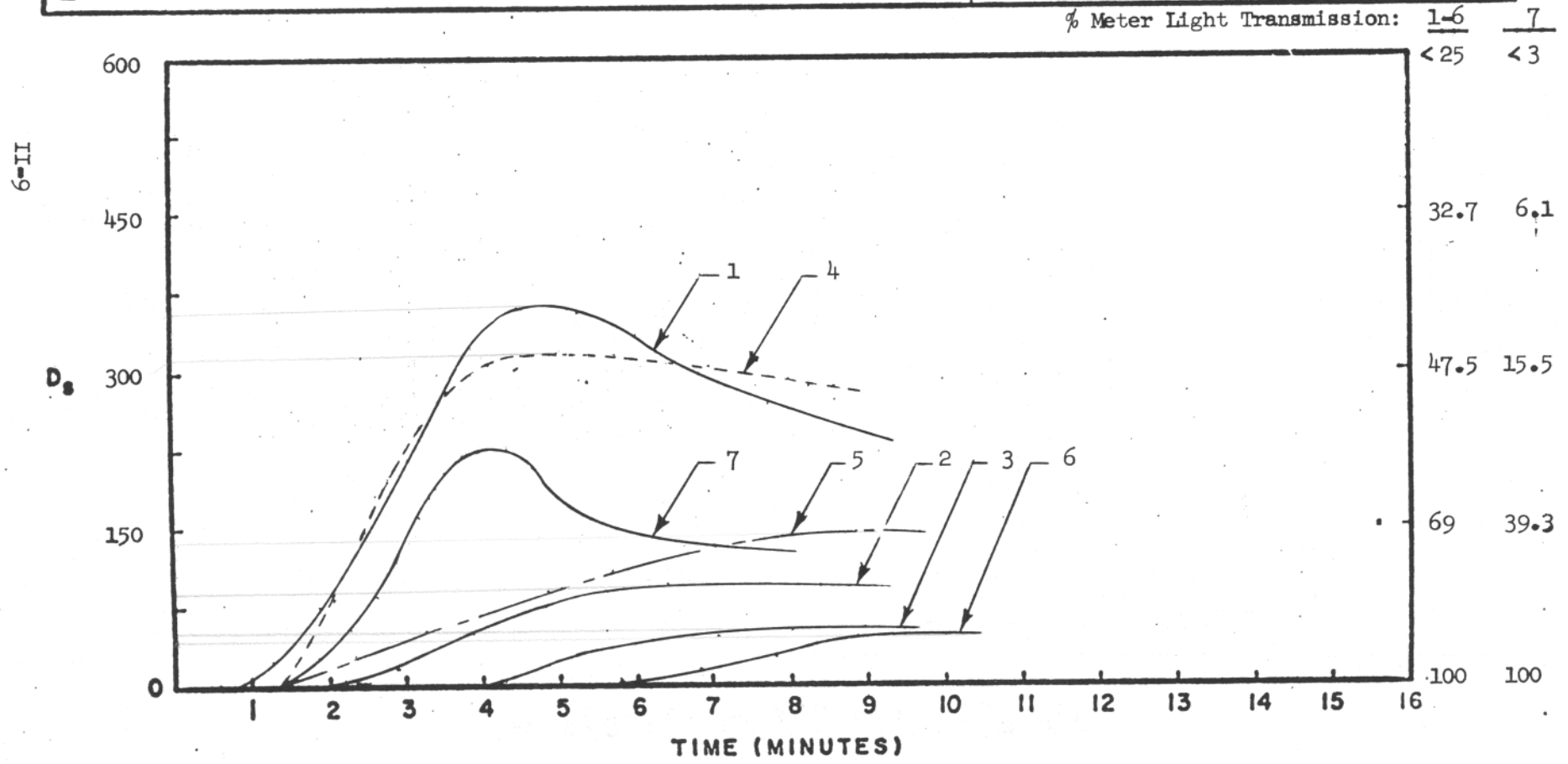
MATERIALS SMOKE DATA REPORT

CATEGORY 2(B)	MATERIAL CATEGORY Side Panel/Window Reveal
Tedlar Coated, Phenolic-Glass Laminate, .05 inch.	No. 1 Center Ceiling Meter No. 2 Center Mid-Height Meter No. 3 Center Floor Meter No. 4 End Ceiling Meter No. 5 End Mid-Height Meter No. 6 End Floor Meter No. 7 Overall Smoke Meter
☒ FLAMING CONDITION ☐ 2.2 BTU/FT^2 - SEC ☐ NON-FLAMING CONDITION ☒ 3.3 BTU/FT^2 - SEC ☐ KINDLING CONDITION ☐ NONE	REMARKS: (1) Mockup Specimen Size: 1.0 ft^2 (2) Specimen Location No. 1



MATERIALS SMOKE DATA REPORT

CATEGORY 3(A)	MATERIAL CATEGORY Partition Panel
Tedlar Coared, Epoxy-Glass Faces, Nomex Core Panel, 0.75 inch.	No. 1 Center Ceiling Meter No. 2 Center Mid-Height Meter No. 3 Center Floor Meter No. 4 End Ceiling Meter No. 5 End Mid-Height Meter No. 6 End Floor Meter No. 7 Overall Smoke Meter
☒ FLAMING CONDITION ☒ 2.2 BTU/FT^2 - SEC ☐ NON-FLAMING CONDITION ☐ 3.3 BTU/FT^2 - SEC ☐ KINDLING CONDITION ☐ NONE	REMARKS: (1) Mockup Specimen Size: 1.0 ft^2 (2) Specimen Location No. 1



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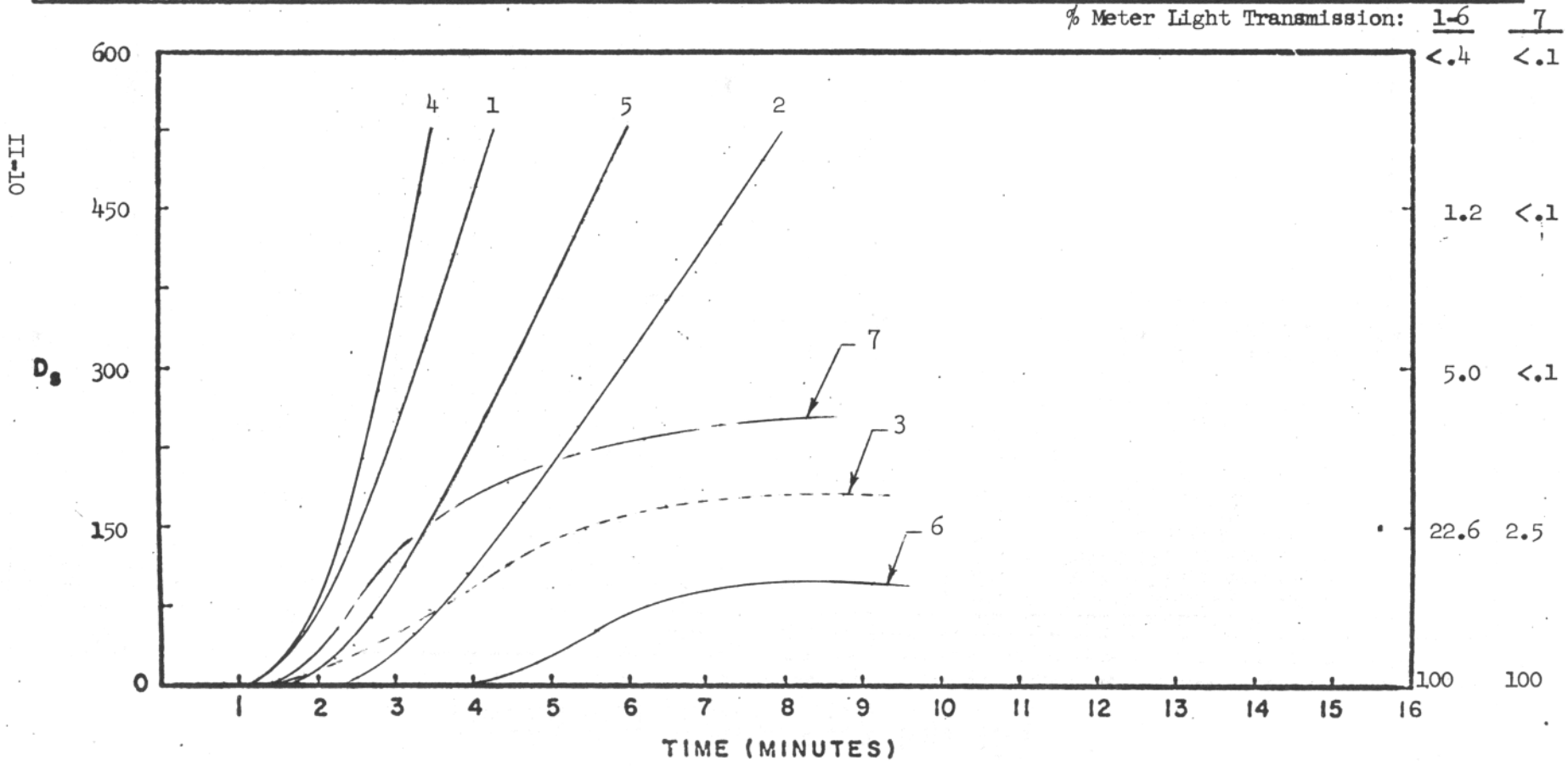
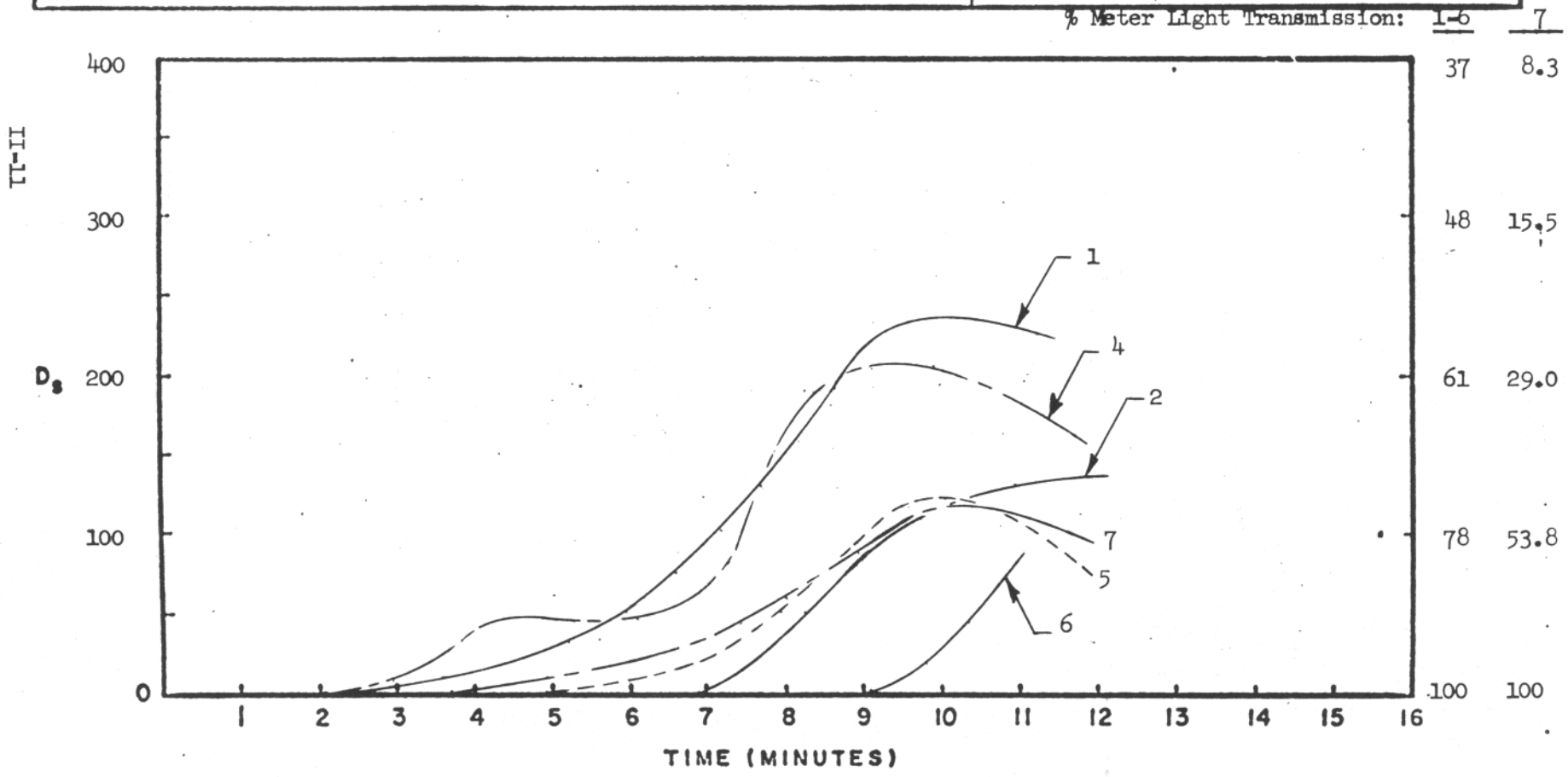
MATERIALS SMOKE DATA REPORT

CATEGORY 3(B)	MATERIAL CATEGORY Partition Paneling
Tedlar Coated, Phenolic-Glass Faces, Epoxy Adhesive, Nomex Core Panel, 0.75 inch.	No. 1 Center Ceiling Meter No. 2 Center Mid-Height Meter No. 3 Center Floor Meter No. 4 End Ceiling Meter No. 5 End Mid-Height Meter No. 6 End Floor Meter No. 7 Overall Smoke Meter
■ FLAMING CONDITION ☒ 2.2 BTU/FT^2 - SEC □ NON-FLAMING CONDITION □ 3.3 BTU/FT^2 - SEC □ KINDLING CONDITION □ NONE	REMARKS: (1) Mockup Specimen Size: 4.0 ft^2 (2) Specimen Location No. 1



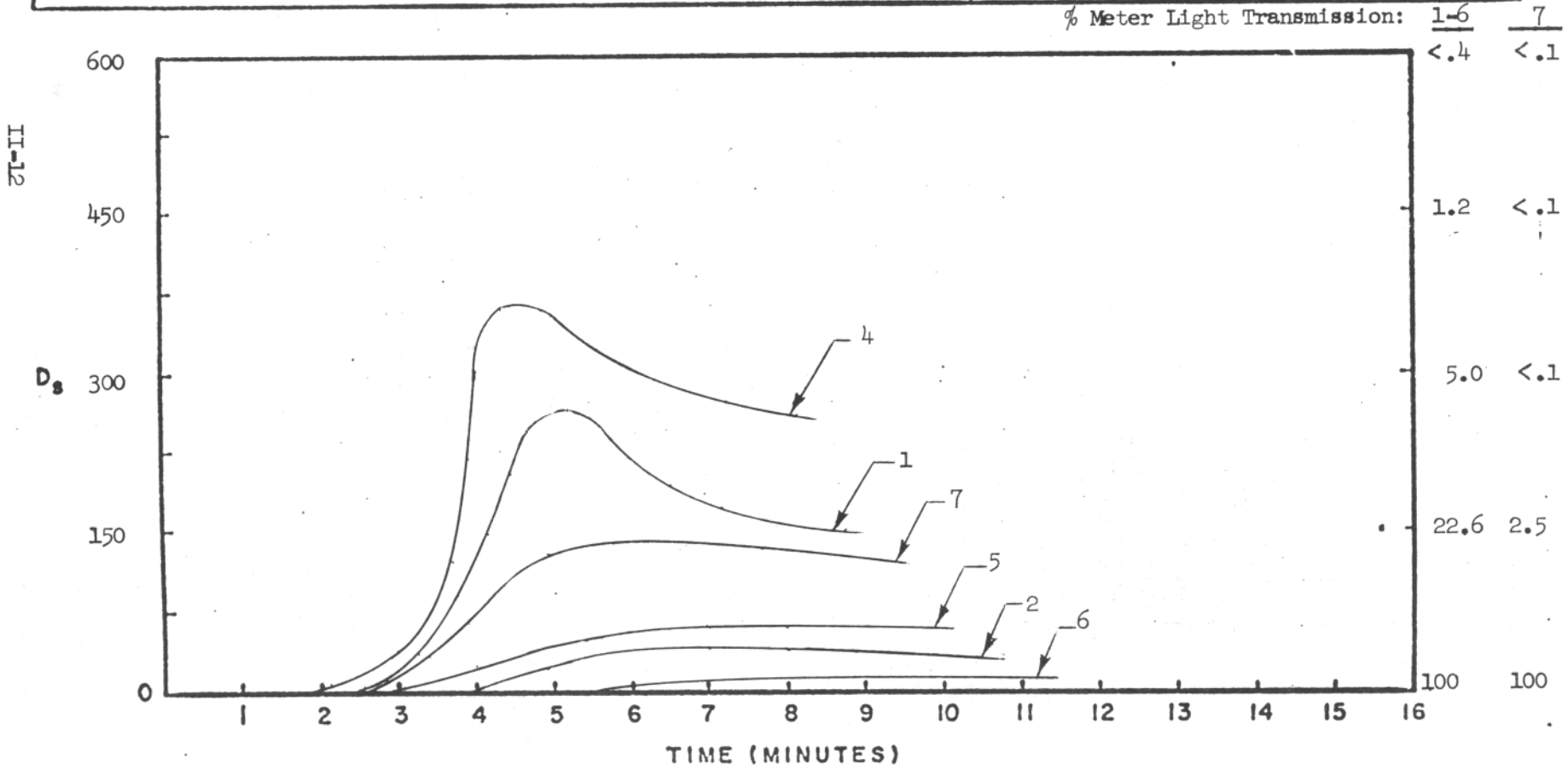
MATERIALS SMOKE DATA REPORT

CATEGORY 4(A)	MATERIAL CATEGORY Structural Flooring
Epoxy-Glass Faces, Nomex Core Panel, 0.37 inch.	No. 1 Center Ceiling Meter No. 2 Center Mid-Height Meter No. 3 Center Floor Meter No. 4 End Ceiling Meter No. 5 End Mid-Height Meter No. 6 End Floor Meter No. 7 Overall Smoke Meter
☒ FLAMING CONDITION ☒ 2.2 BTU/FT^2 - SEC ☐ NON-FLAMING CONDITION ☐ 3.3 BTU/FT^2 - SEC ☐ KINDLING CONDITION ☐ NONE	REMARKS: (1) Mockup Specimen Size: 1.0 ft^2 (2) Specimen Location No. 4



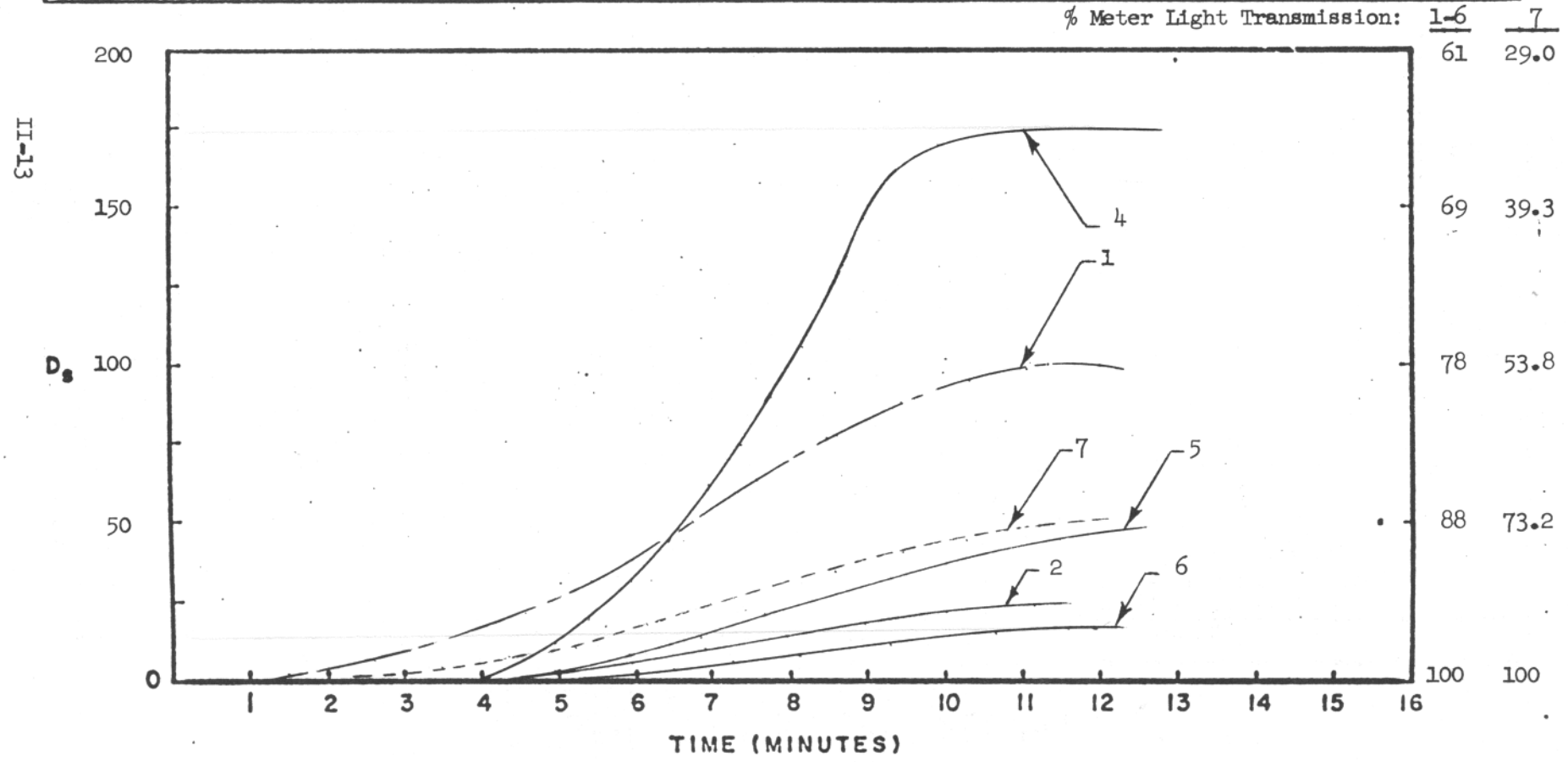
MATERIALS SMOKE DATA REPORT

CATEGORY 4(A)	MATERIAL CATEGORY Structural Flooring
Epoxy-Glass Faces, Nomex Core Panel, 0.37 inch.	No. 1 Center Ceiling Meter No. 2 Center Mid-Height Meter No. 3 Center Floor Meter No. 4 End Ceiling Meter No. 5 End Mid-Height Meter No. 6 End Floor Meter No. 7 Overall Smoke Meter
☒ FLAMING CONDITION ☒ 2.2 BTU/FT^2 - SEC ☐ NON-FLAMING CONDITION ☐ 3.3 BTU/FT^2 - SEC ☐ KINDLING CONDITION ☐ NONE	REMARKS: (1) Mockup Specimen Size: 4.0 ft^2 (2) Specimen Location No. 1



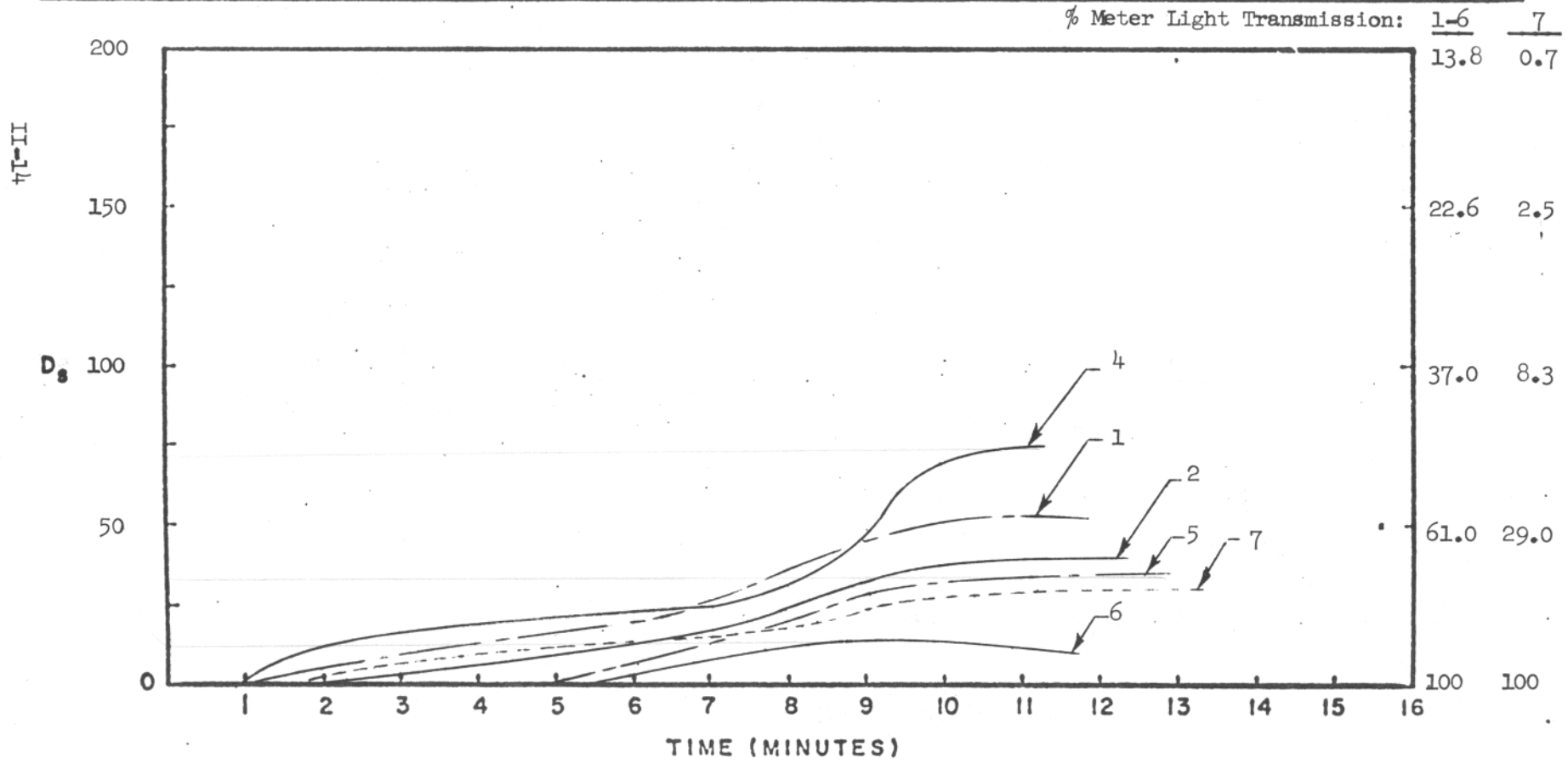
MATERIALS SMOKE DATA REPORT

CATEGORY 4(B)	MATERIAL CATEGORY Structural Flooring
Aluminum Faces, Nomex Core Panel, 0.37 inch.	No. 1 Center Ceiling Meter No. 2 Center Mid-Height Meter No. 3 Center Floor Meter No. 4 End Ceiling Meter No. 5 End Mid-Height Meter No. 6 End Floor Meter No. 7 Overall Smoke Meter
☒ FLAMING CONDITION ☐ 2.2 BTU/FT^2 - SEC ☐ NON-FLAMING CONDITION ☒ 3.3 BTU/FT^2 - SEC ☐ KINDLING CONDITION ☐ NONE	REMARKS: (1) Mockup Specimen Size: 1.0 ft^2 (2) Specimen Location No. 1



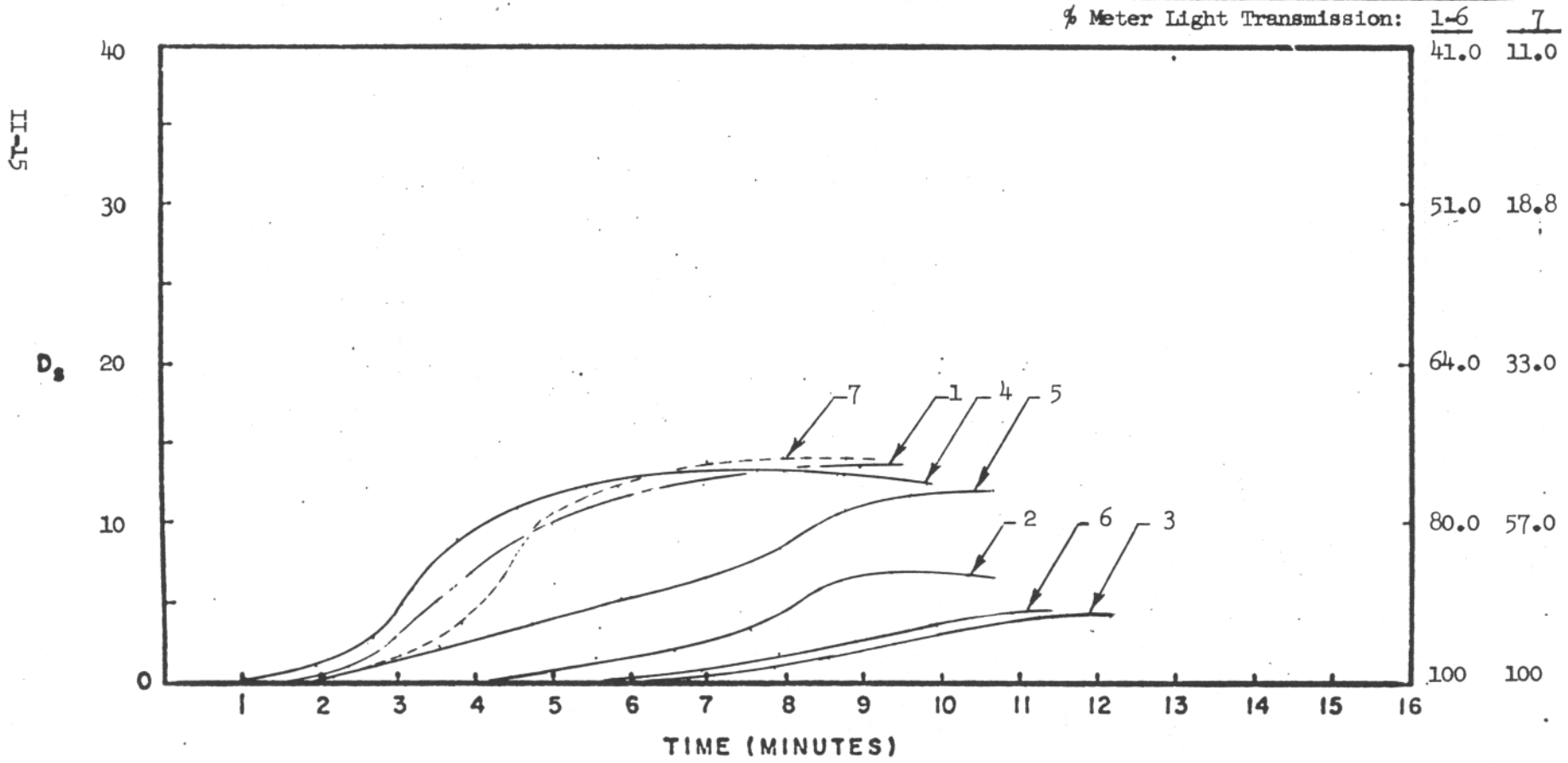
MATERIALS SMOKE DATA REPORT

CATEGORY 4(B)	MATERIAL CATEGORY Structural Flooring
Aluminum Faces, Nomex Core Panel, 0.37 inch.	No. 1 Center Ceiling Meter No. 2 Center Mid-Height Meter No. 3 Center Floor Meter No. 4 End Ceiling Meter No. 5 End Mid-Height Meter No. 6 End Floor Meter No. 7 Overall Smoke Meter
☒ FLAMING CONDITION ☒ 2.2 BTU/FT^2 - SEC ☐ NON-FLAMING CONDITION ☐ 3.3 BTU/FT^2 - SEC ☐ KINDLING CONDITION ☐ NONE	REMARKS: (1) Mockup Specimen Size: 4.0 ft^2 (2) Specimen Location No. 1



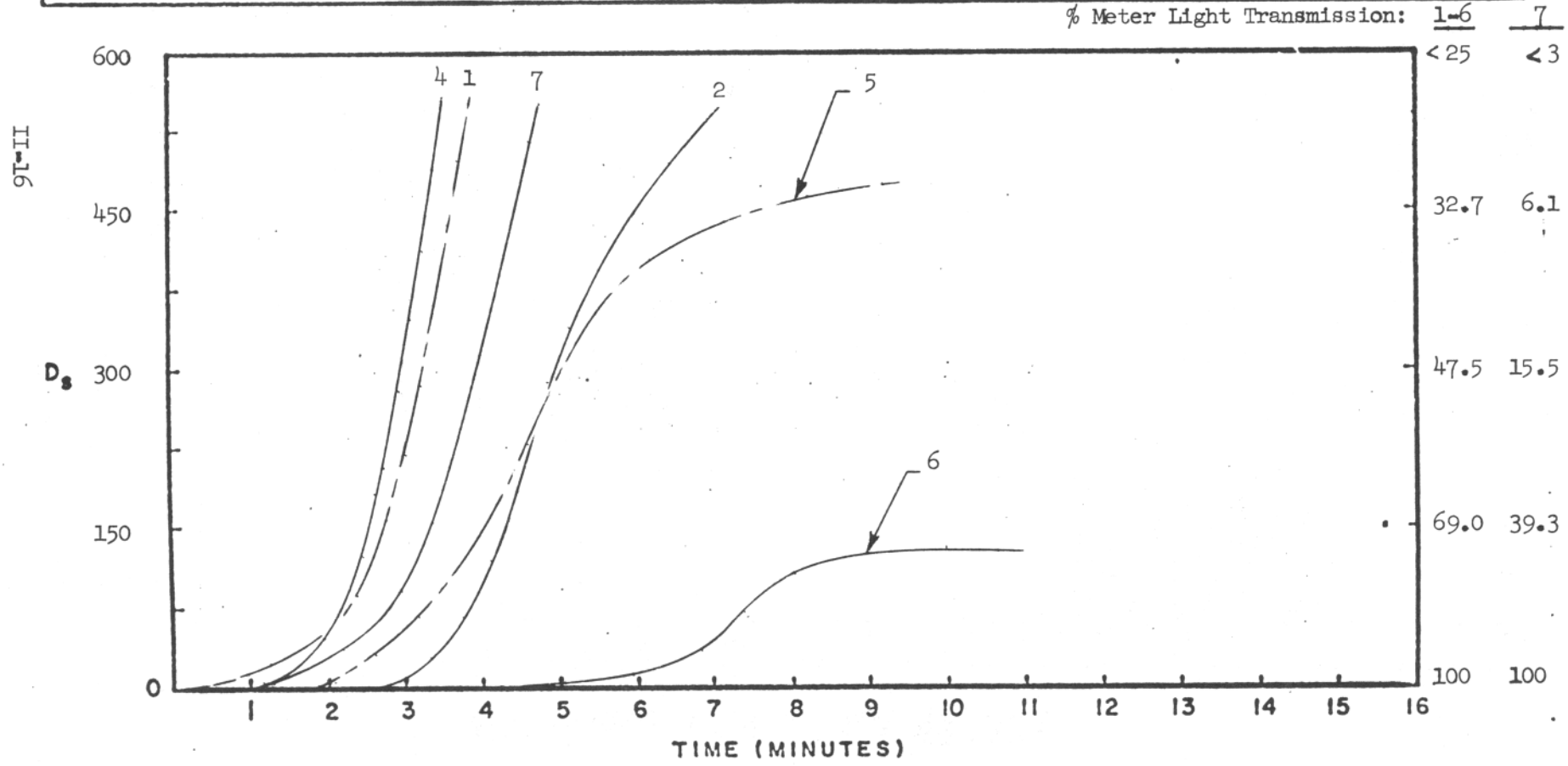
MATERIALS SMOKE DATA REPORT

CATEGORY 4(B)	MATERIAL CATEGORY Structural Flooring
Aluminum Faces, Nomex Core Panel, 0.37 inch.	No. 1 Center Ceiling Meter No. 2 Center Mid-Height Meter No. 3 Center Floor Meter No. 4 End Ceiling Meter No. 5 End Mid-Height Meter No. 6 End Floor Meter No. 7 Overall Smoke Meter
☒ FLAMING CONDITION ☒ 2.2 BTU/FT^2 - SEC ☐ NON-FLAMING CONDITION ☐ 3.3 BTU/FT^2 - SEC ☐ KINDLING CONDITION ☐ NONE	REMARKS: (1) Mockup Specimen Size: 9.0 ft^2 (2) Specimen Location No. 1



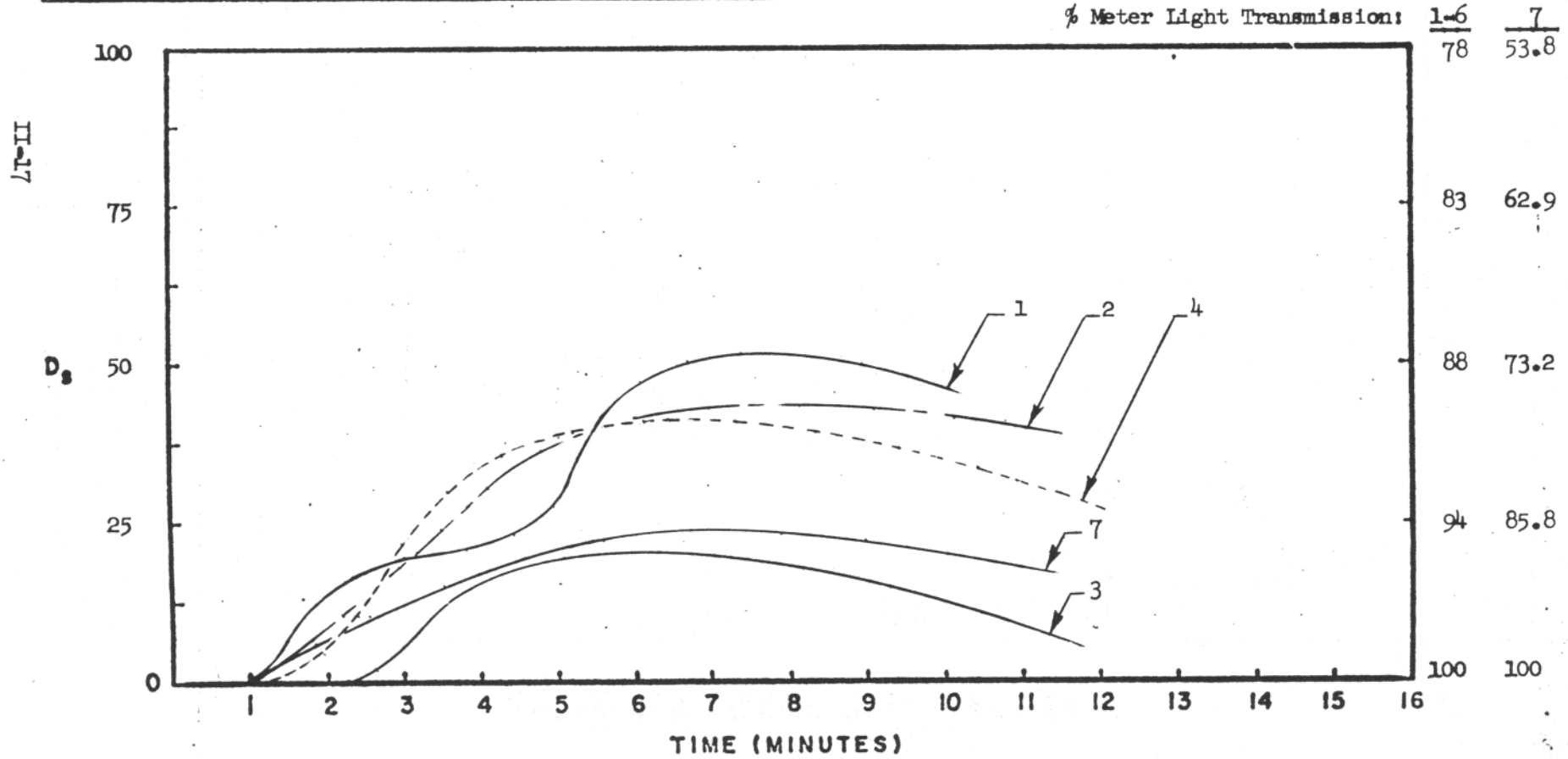
MATERIALS SMOKE DATA REPORT

CATEGORY 5(A)	MATERIAL CATEGORY Thermoforming
Acrylonitrile - Butadiene-Styrene Sheet Stock, 0.06 inch.	No. 1 Center Ceiling Meter No. 2 Center Mid-Height Meter No. 3 Center Floor Meter No. 4 End Ceiling Meter No. 5 End Mid-Height Meter No. 6 End Floor Meter No. 7 Overall Smoke Meter
☒ FLAMING CONDITION ☒ 2.2 BTU/FT^2 - SEC ☐ NON-FLAMING CONDITION ☐ 3.3 BTU/FT^2 - SEC ☐ KINDLING CONDITION ☐ NONE	REMARKS: (1) Mockup Specimen Size: 1.0 ft^2 (2) Specimen Location No. 1



MATERIALS SMOKE DATA REPORT

CATEGORY 5(B)	MATERIAL CATEGORY Thermoforming
Polycarbonate Sheet Stock, .06 inch.	No. 1 Center Ceiling Meter No. 2 Center Mid-Height Meter No. 3 Center Floor Meter No. 4 End Ceiling Meter No. 5 End Mid-Height Meter No. 6 End Floor Meter No. 7 Overall Smoke Meter
☒ FLAMING CONDITION ☒ 2.2 BTU/FT^2 - SEC ☐ NON-FLAMING CONDITION ☐ 3.3 BTU/FT^2 - SEC ☐ KINDLING CONDITION ☐ NONE	REMARKS: (1) Mockup Specimen Size: 1.0 ft^2 (2) Specimen Location No. 1



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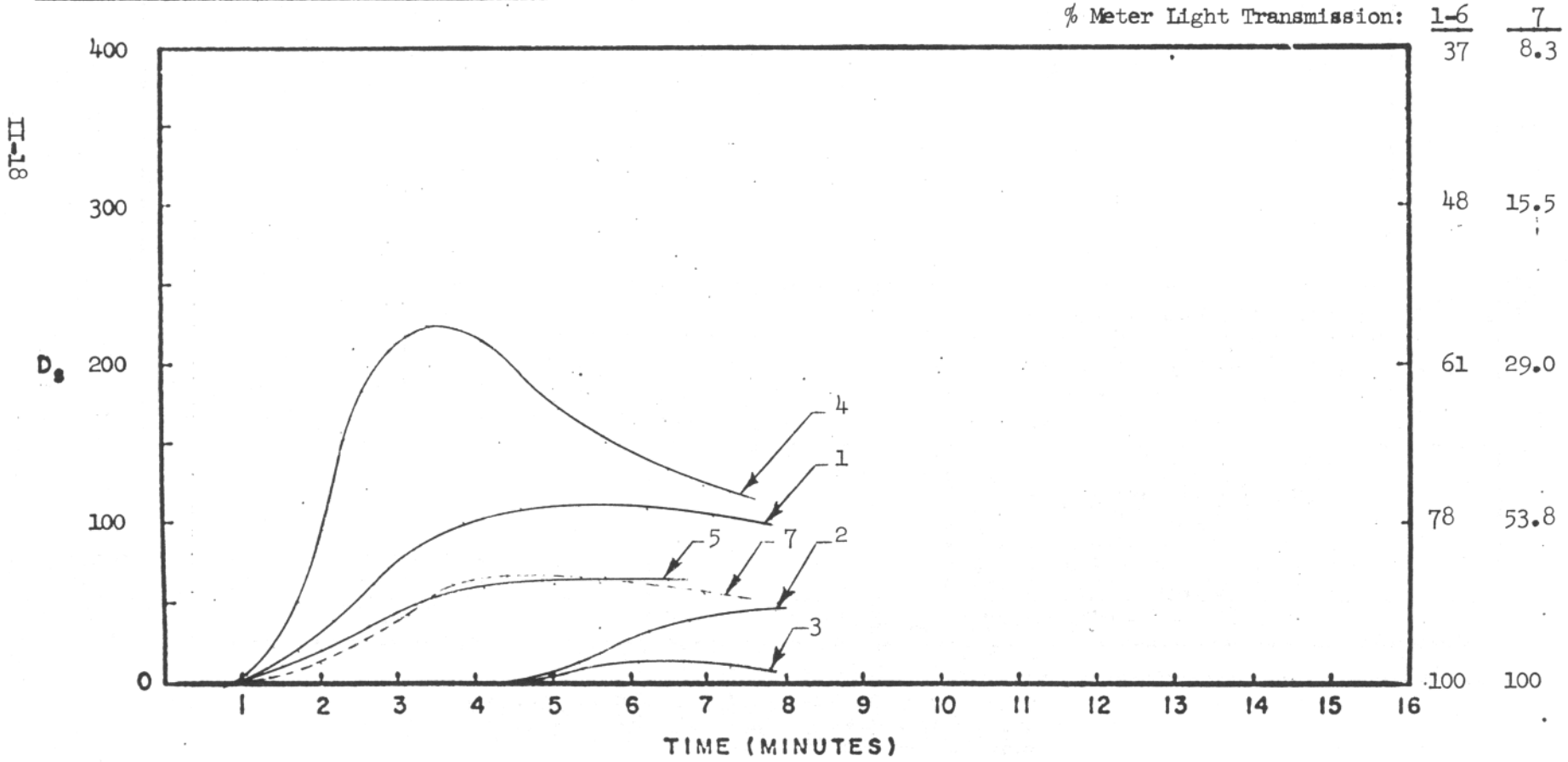
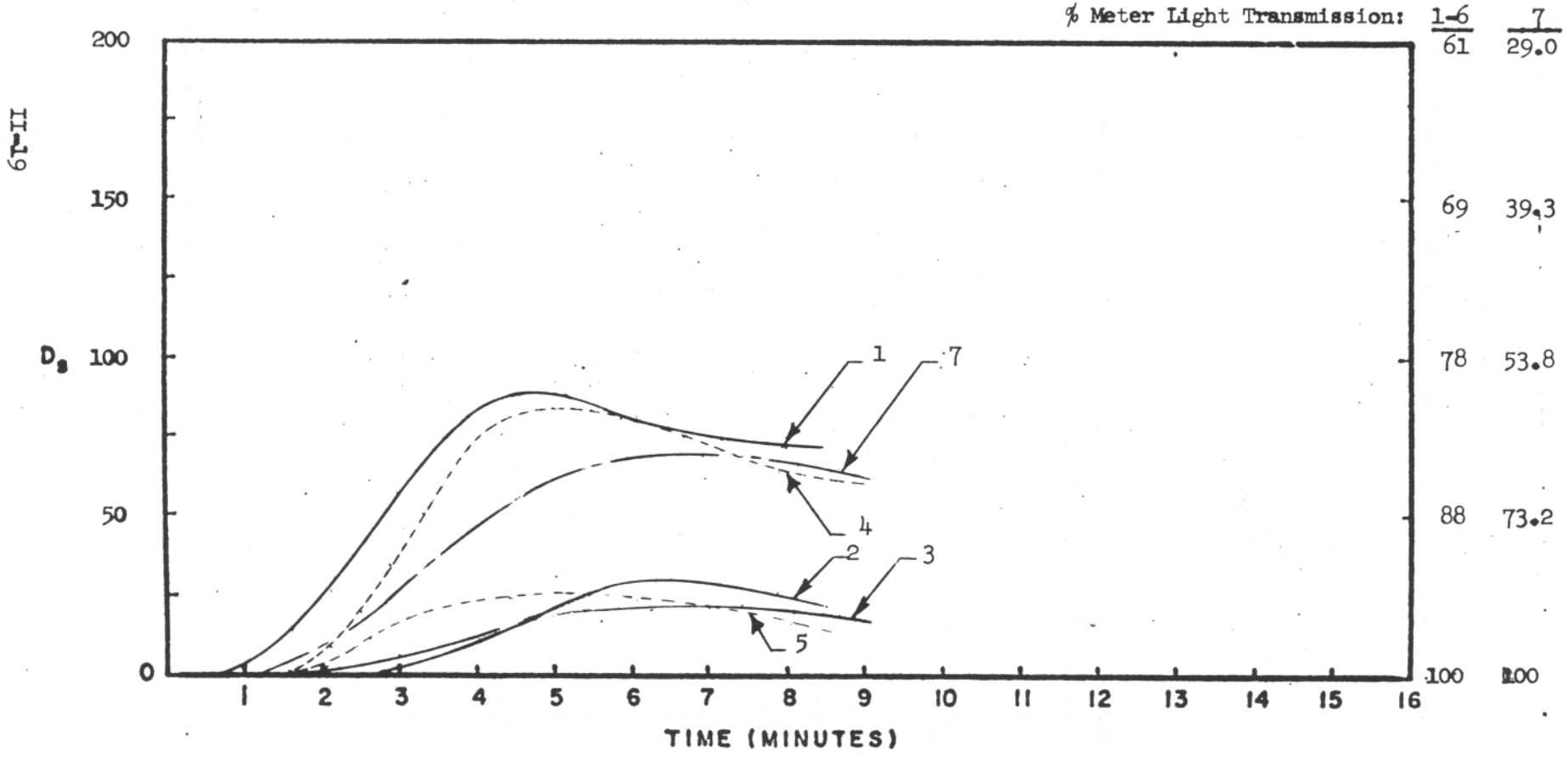
MATERIALS SMOKE DATA REPORT

CATEGORY 6(B)	MATERIAL CATEGORY Seat Upholstery
50/50 Cotton-Rayon, .035 inch.	No. 1 Center Ceiling Meter No. 2 Center Mid-Height Meter No. 3 Center Floor Meter No. 4 End Ceiling Meter No. 5 End Mid-Height Meter No. 6 End Floor Meter No. 7 Overall Smoke Meter
☒ FLAMING CONDITION ☒ 2.2 BTU/FT^2 - SEC ☐ NON-FLAMING CONDITION ☐ 3.3 BTU/FT^2 - SEC ☐ KINDLING CONDITION ☐ NONE	REMARKS: (1) Mockup Specimen Size: 1.0 ft^2 (2) Specimen Location No. 4



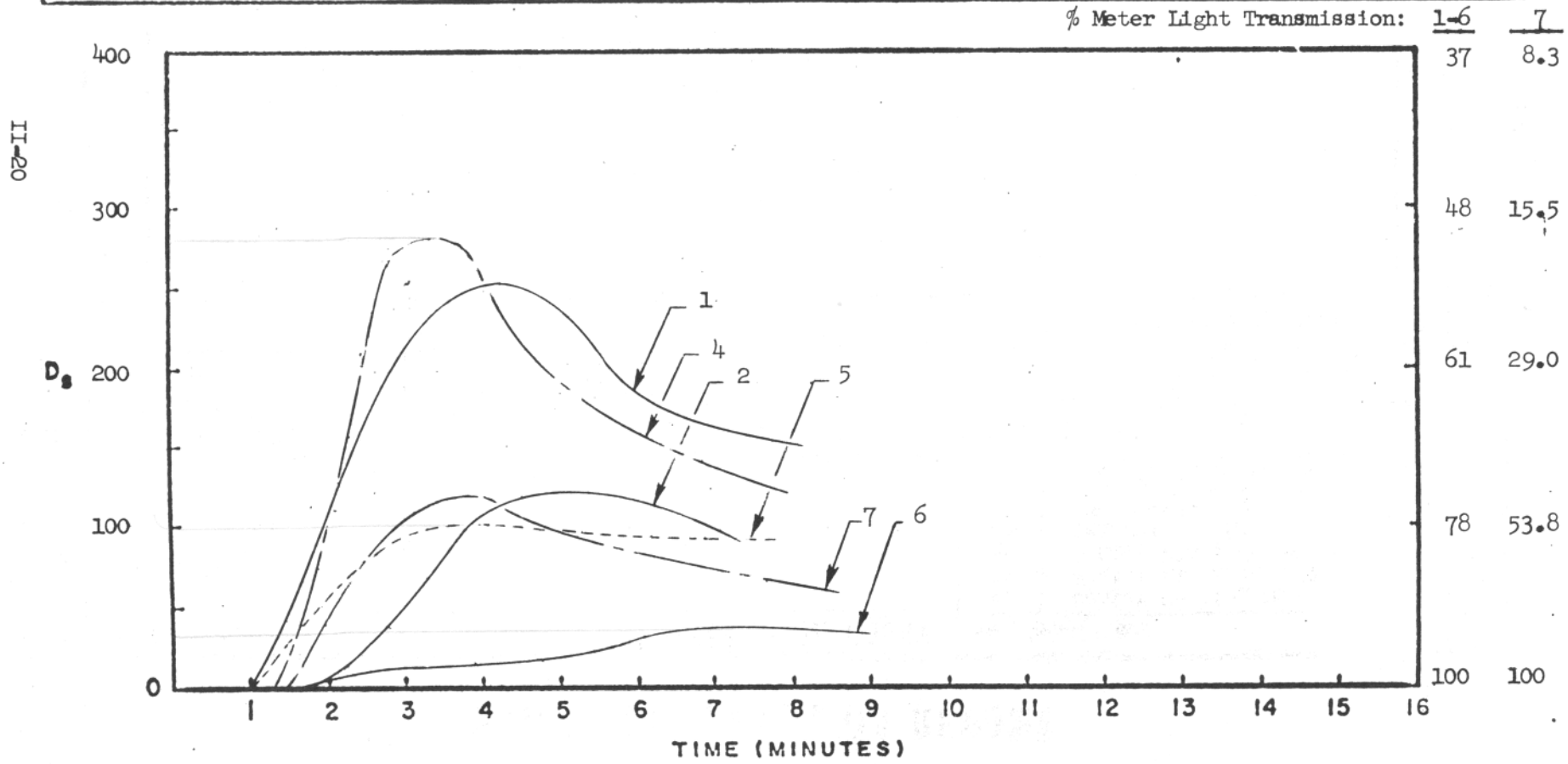
MATERIALS SMOKE DATA REPORT

CATEGORY 6(B)	MATERIAL CATEGORY Seat Upholstery
50/50 Cotton-Rayon, .035 inch.	No. 1 Center Ceiling Meter No. 2 Center Mid-Height Meter No. 3 Center Floor Meter No. 4 End Ceiling Meter No. 5 End Mid-Height Meter No. 6 End Floor Meter No. 7 Overall Smoke Meter
☐ FLAMING CONDITION ☒ 2.2 BTU/FT^2 - SEC ☒ NON-FLAMING CONDITION ☐ 3.3 BTU/FT^2 - SEC ☐ KINDLING CONDITION ☐ NONE	REMARKS: (1) Mockup Specimen Size: 1.0 ft^2 (2) Specimen Location No. 1



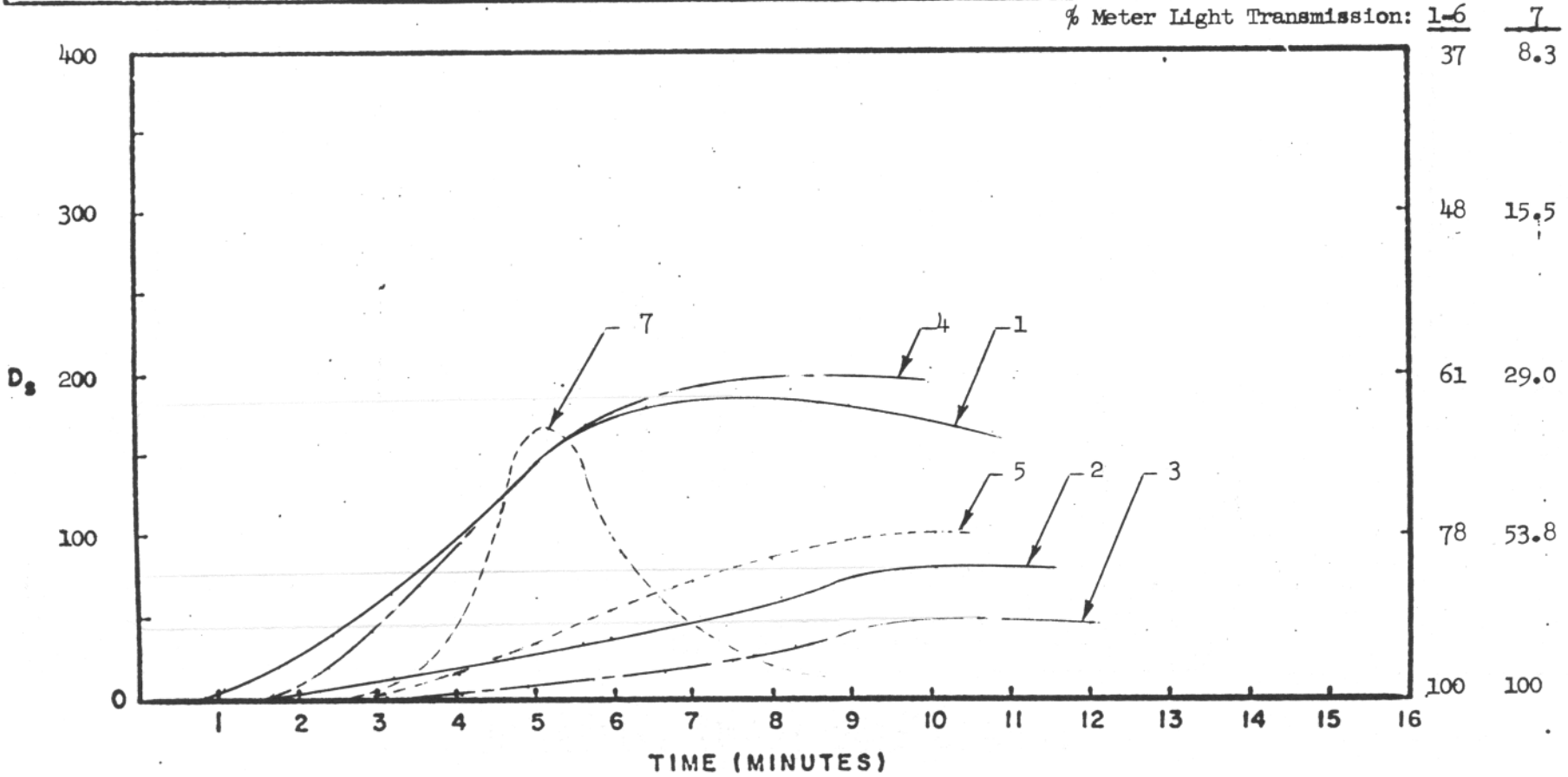
MATERIALS SMOKE DATA REPORT

CATEGORY 7(A)	MATERIAL CATEGORY Seat Cushion Foam
Polyurethane Foam, 2 PCF, 0.50 inch.	No. 1 Center Ceiling Meter No. 2 Center Mid-Height Meter No. 3 Center Floor Meter No. 4 End Ceiling Meter No. 5 End Mid-Height Meter No. 6 End Floor Meter No. 7 Overall Smoke Meter
☒ FLAMING CONDITION ☒ 2.2 BTU/FT^2 - SEC ☐ NON-FLAMING CONDITION ☐ 3.3 BTU/FT^2 - SEC ☐ KINDLING CONDITION ☐ NONE	REMARKS: (1) Mockup Specimen Size: 1.0 ft^2 (2) Specimen Location No. 4



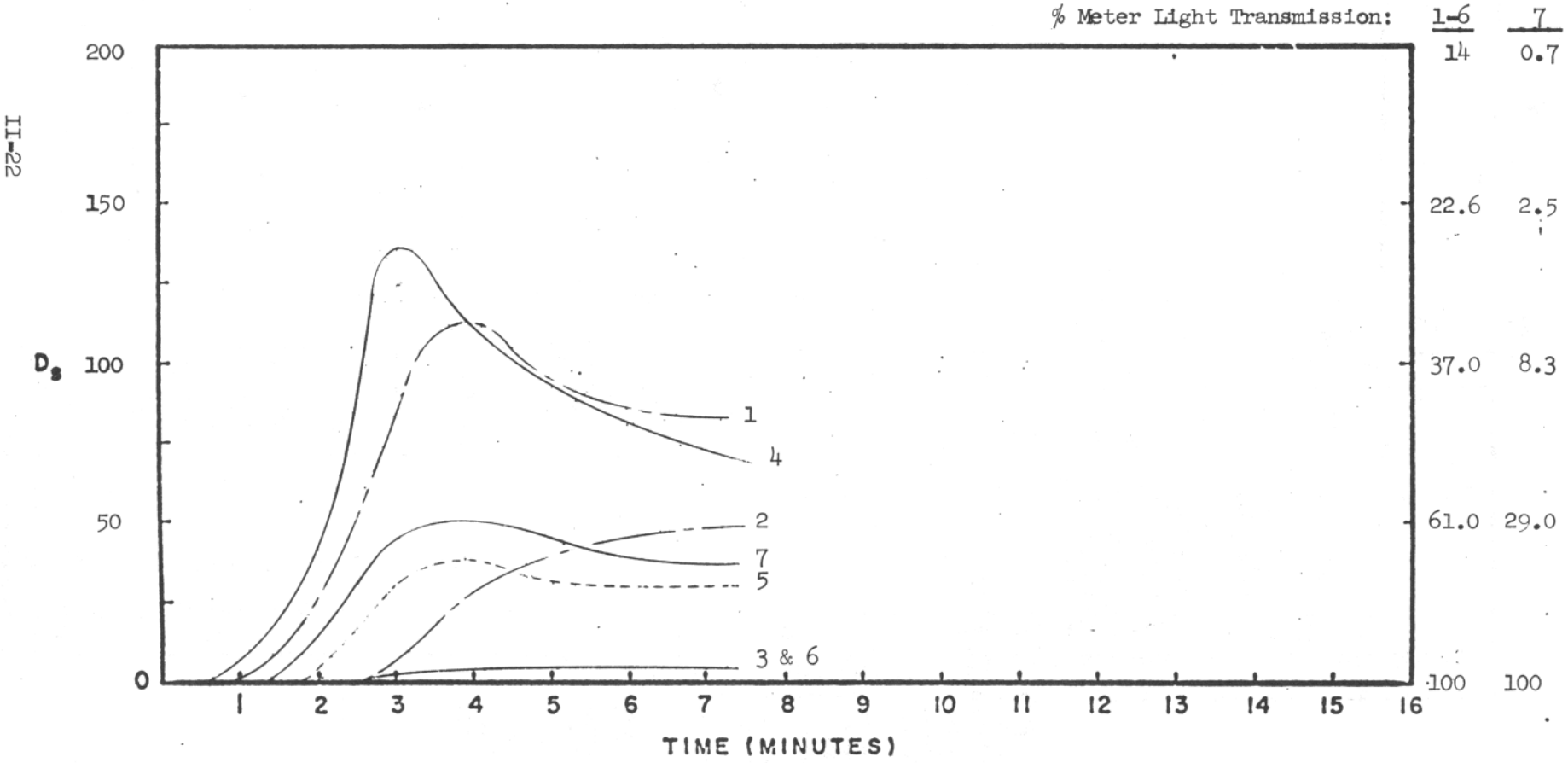
MATERIALS SMOKE DATA REPORT

CATEGORY 7(A)	MATERIAL CATEGORY Seat Cushion Foam
Polyurethane Foam, 2 PCF, 0.50 inch.	No. 1 Center Ceiling Meter No. 2 Center Mid-Height Meter No. 3 Center Floor Meter No. 4 End Ceiling Meter No. 5 End Mid-Height Meter No. 6 End Floor Meter No. 7 Overall Smoke Meter
☐ FLAMING CONDITION ☒ 2.2 BTU/FT^2 - SEC ☒ NON-FLAMING CONDITION ☐ 3.3 BTU/FT^2 - SEC ☐ KINDLING CONDITION ☐ NONE	REMARKS: (1) Mockup Specimen Size: 1.0 ft^2 (2) Specimen Location No. 1



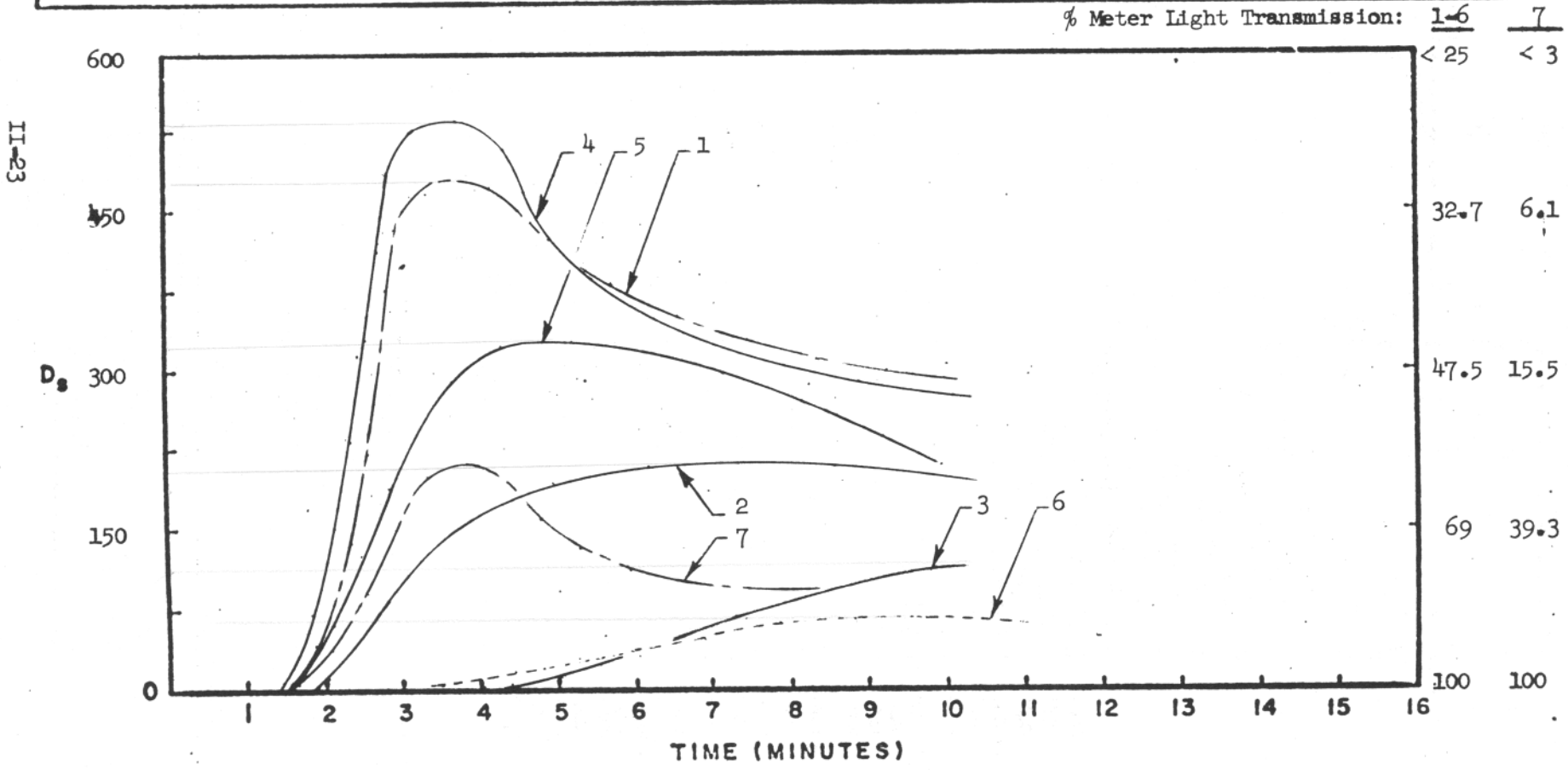
MATERIALS SMOKE DATA REPORT

CATEGORY 7(B)	MATERIAL CATEGORY Seat Cushion
FR Polyethylene Foam, 2 PCF, 0.5 inch thick.	No. 1 Center Ceiling Meter No. 2 Center Mid-Height Meter No. 3 Center Floor Meter No. 4 End Ceiling Meter No. 5 End Mid-Height Meter No. 6 End Floor Meter No. 7 Overall Smoke Meter
☒ FLAMING CONDITION ☒ 2.2 BTU/FT^2 - SEC ☐ NON-FLAMING CONDITION ☐ 3.3 BTU/FT^2 - SEC ☐ KINDLING CONDITION ☐ NONE	REMARKS: (1) Mockup Specimen Size: 4 ft^2 (2) Specimen Location No. 1



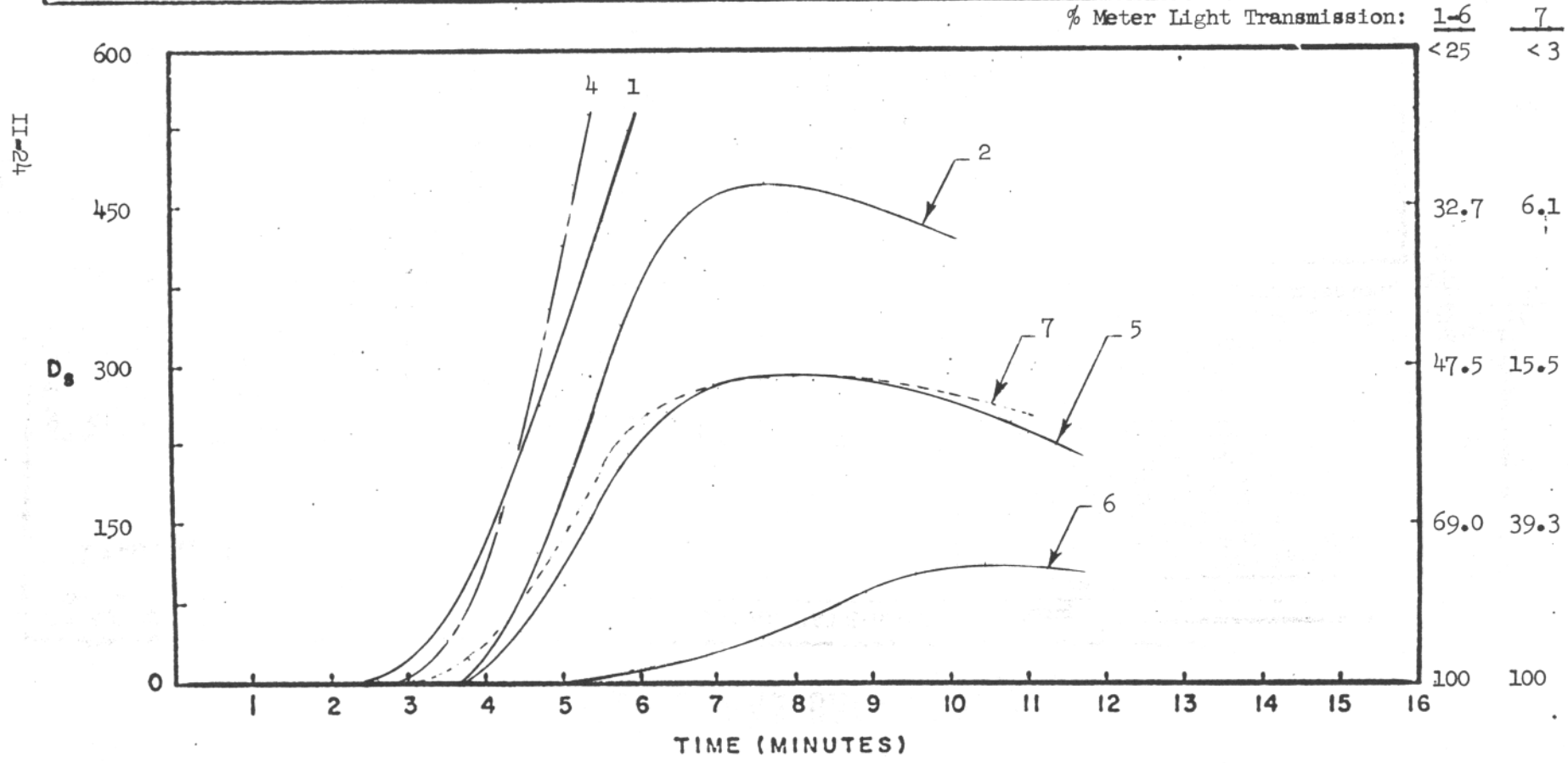
MATERIALS SMOKE DATA REPORT

CATEGORY 8(A)	MATERIAL CATEGORY Carpeting
100% Wool, Latex Backing, 0.37 inch.	No. 1 Center Ceiling Meter No. 2 Center Mid-Height Meter No. 3 Center Floor Meter No. 4 End Ceiling Meter No. 5 End Mid-Height Meter No. 6 End Floor Meter No. 7 Overall Smoke Meter
☒ FLAMING CONDITION ☒ 2.2 BTU/FT^2 - SEC ☐ NON-FLAMING CONDITION ☐ 3.3 BTU/FT^2 - SEC ☐ KINDLING CONDITION ☐ NONE	REMARKS: (1) Mockup Specimen Size: 1.0 ft^2 (2) Specimen Location No. 1



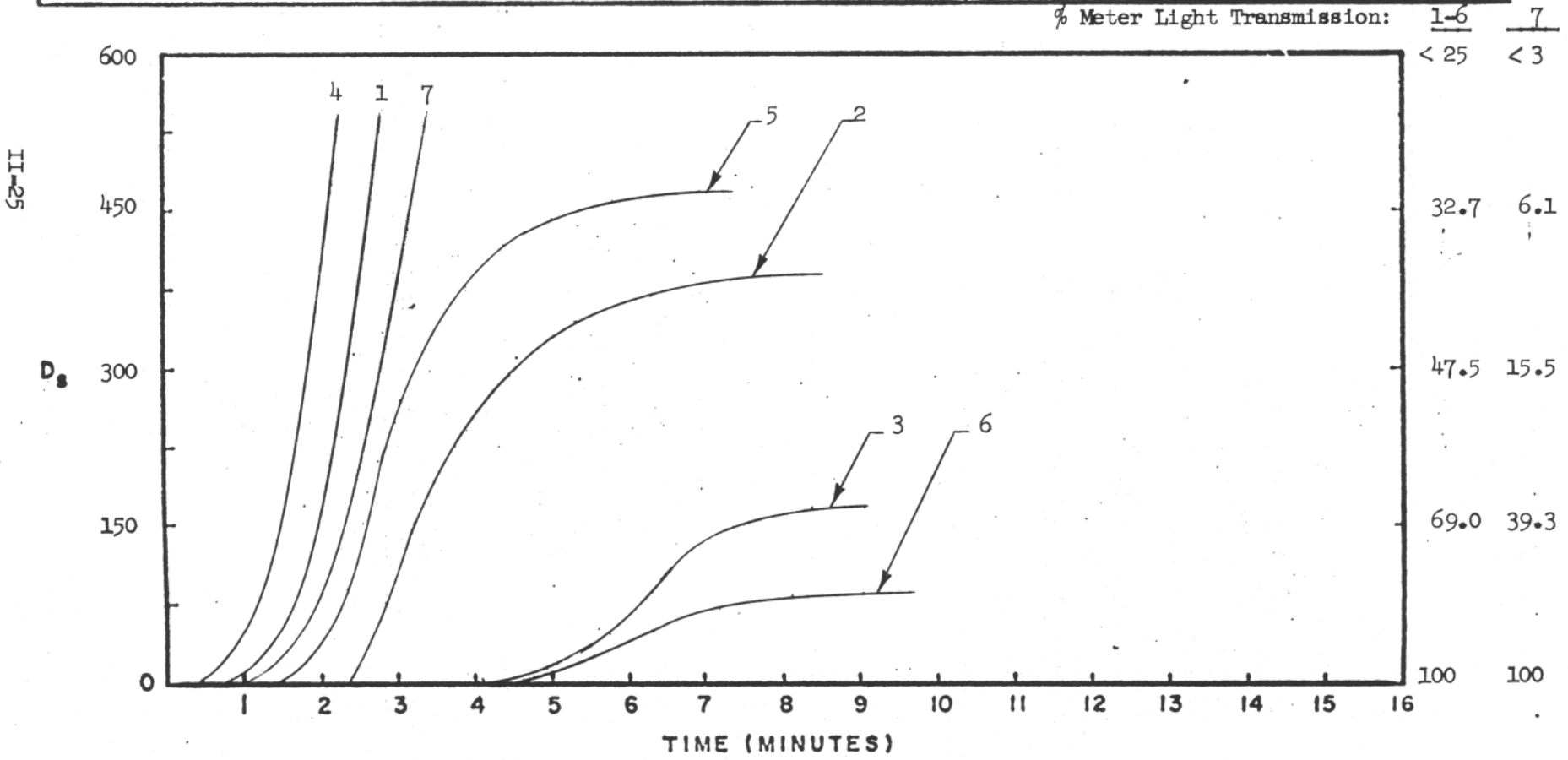
MATERIALS SMOKE DATA REPORT

CATEGORY 8(A)	MATERIAL CATEGORY Carpeting
100% Wool, Latex Backing, 0.37 inch thick.	No. 1 Center Ceiling Meter No. 2 Center Mid-Height Meter No. 3 Center Floor Meter No. 4 End Ceiling Meter No. 5 End Mid-Height Meter No. 6 End Floor Meter No. 7 Overall Smoke Meter
☒ FLAMING CONDITION ☒ 2.2 BTU/FT^2 - SEC ☐ NON-FLAMING CONDITION ☐ 3.3 BTU/FT^2 - SEC ☐ KINDLING CONDITION ☐ NONE	REMARKS: (1) Mockup Specimen Size: 1.0 ft^2 (2) Specimen Location No. 4



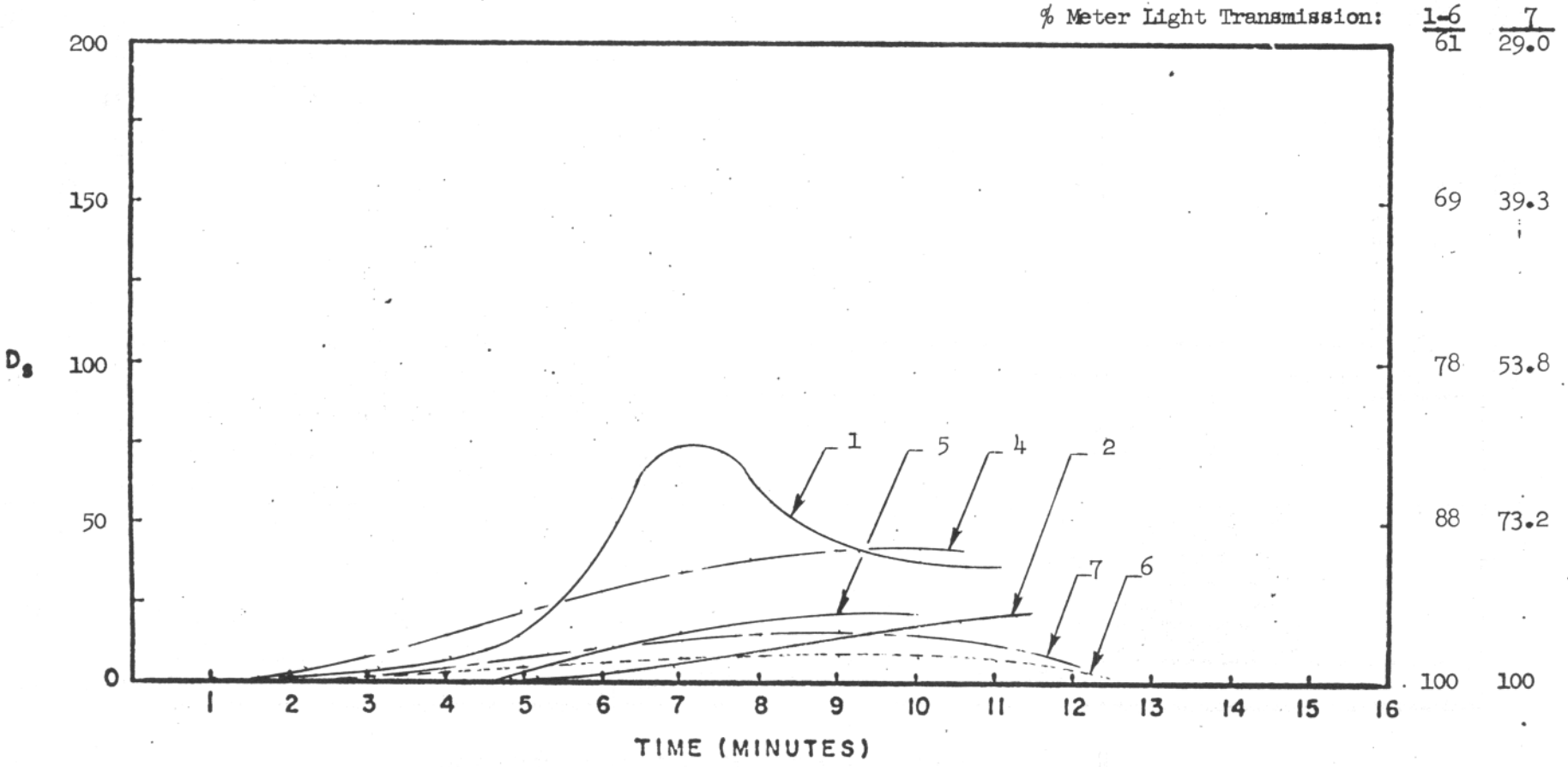
MATERIALS SMOKE DATA REPORT

CATEGORY 8(B)	MATERIAL CATEGORY Carpeting
Modacrylic, Latex Backing, 0.37 inch.	No. 1 Center Ceiling Meter No. 2 Center Mid-Height Meter No. 3 Center Floor Meter No. 4 End Ceiling Meter No. 5 End Mid-Height Meter No. 6 End Floor Meter No. 7 Overall Smoke Meter
☒ FLAMING CONDITION ☒ 2.2 BTU/FT^2 - SEC ☐ NON-FLAMING CONDITION ☐ 3.3 BTU/FT^2 - SEC ☐ KINDLING CONDITION ☐ NONE	REMARKS: (1) Mockup Specimen Size: 1.0 ft^2 (2) Specimen Location No. 1



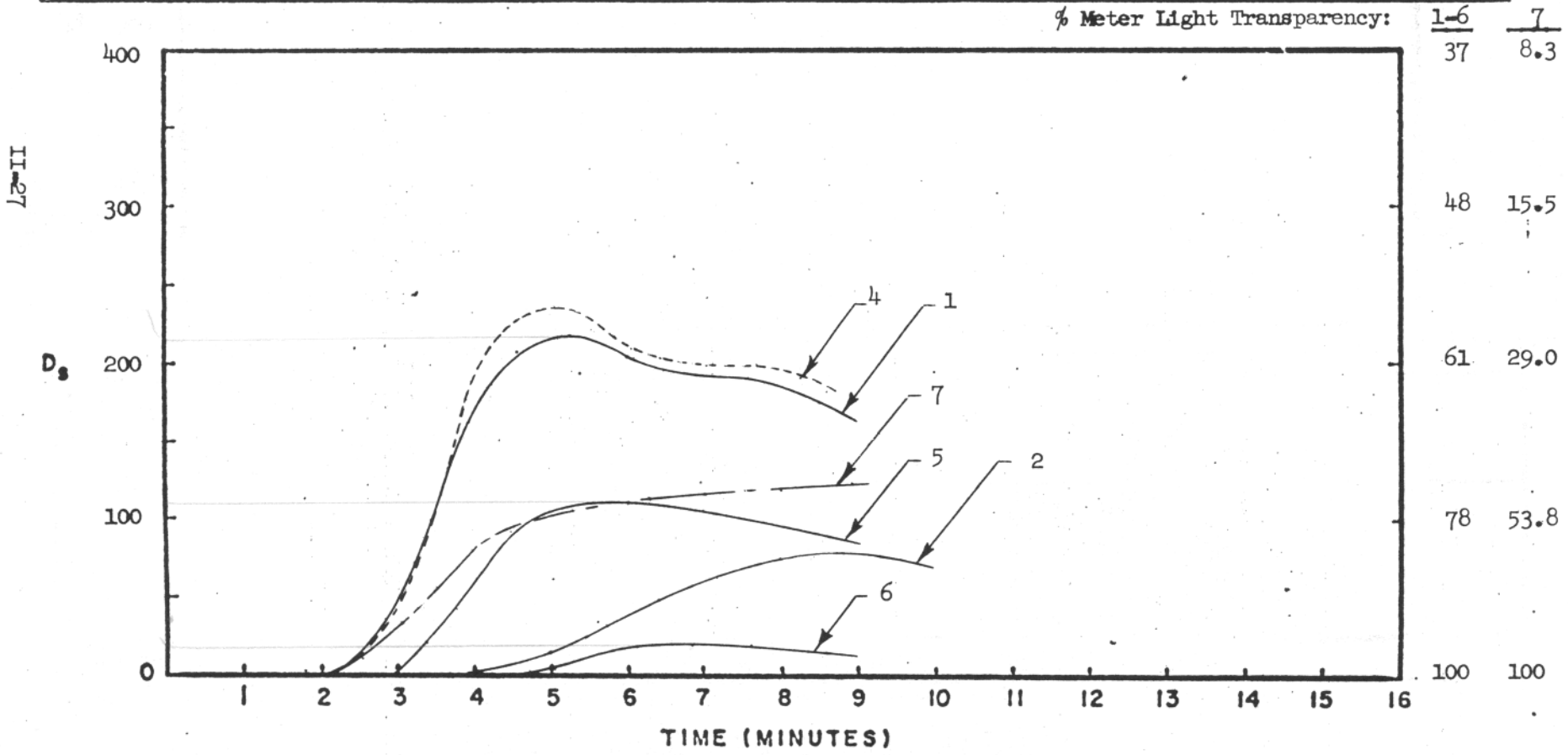
MATERIALS SMOKE DATA REPORT

CATEGORY 9(A)	MATERIAL CATEGORY Transparency
Polycarbonate Sheet Stock, Clear, .062 inch.	No. 1 Center Ceiling Meter No. 2 Center Mid-Height Meter No. 3 Center Floor Meter No. 4 End Ceiling Meter No. 5 End Mid-Height Meter No. 6 End Floor Meter No. 7 Overall Smoke Meter
☒ FLAMING CONDITION ☒ 2.2 BTU/FT^2 - SEC ☐ NON-FLAMING CONDITION ☐ 3.3 BTU/FT^2 - SEC ☐ KINDLING CONDITION ☐ NONE	REMARKS: (1) Mockup Specimen Size: 1.0 ft^2 (2) Specimen Location No. 1



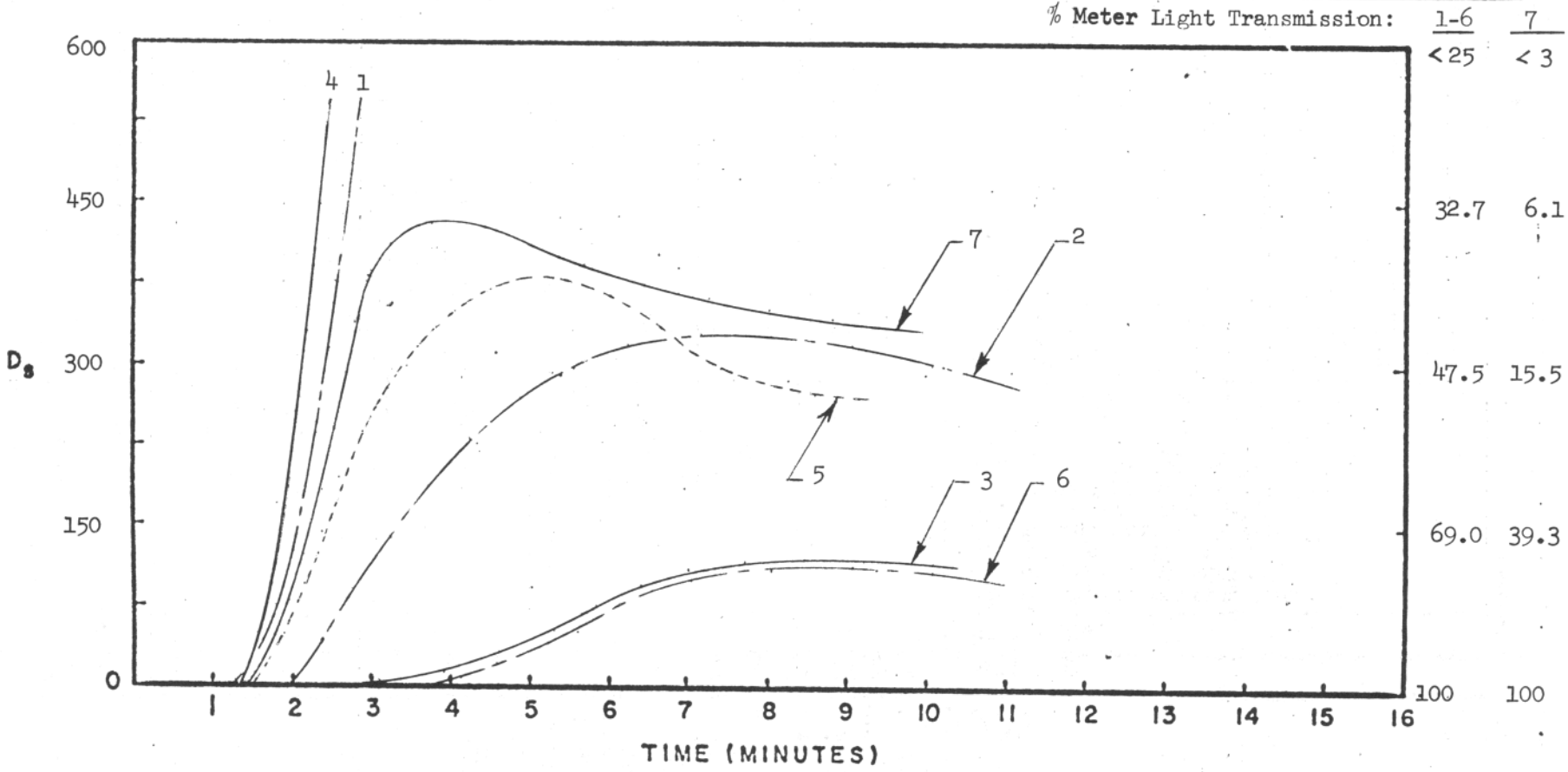
MATERIALS SMOKE DATA REPORT

CATEGORY 9(B)	MATERIAL CATEGORY Transparency
Acrylic Sheet Stock, Clear, .055 inch.	No. 1 Center Ceiling Meter No. 2 Center Mid-Height Meter No. 3 Center Floor Meter No. 4 End Ceiling Meter No. 5 End Mid-Height Meter No. 6 End Floor Meter No. 7 Overall Smoke Meter
☒ FLAMING CONDITION ☒ 2.2 BTU/FT^2 - SEC ☐ NON-FLAMING CONDITION ☐ 3.3 BTU/FT^2 - SEC ☐ KINDLING CONDITION ☐ NONE	REMARKS: (1) Mockup Specimen Size: 1.0 ft^2 (2) Specimen Location No. 1



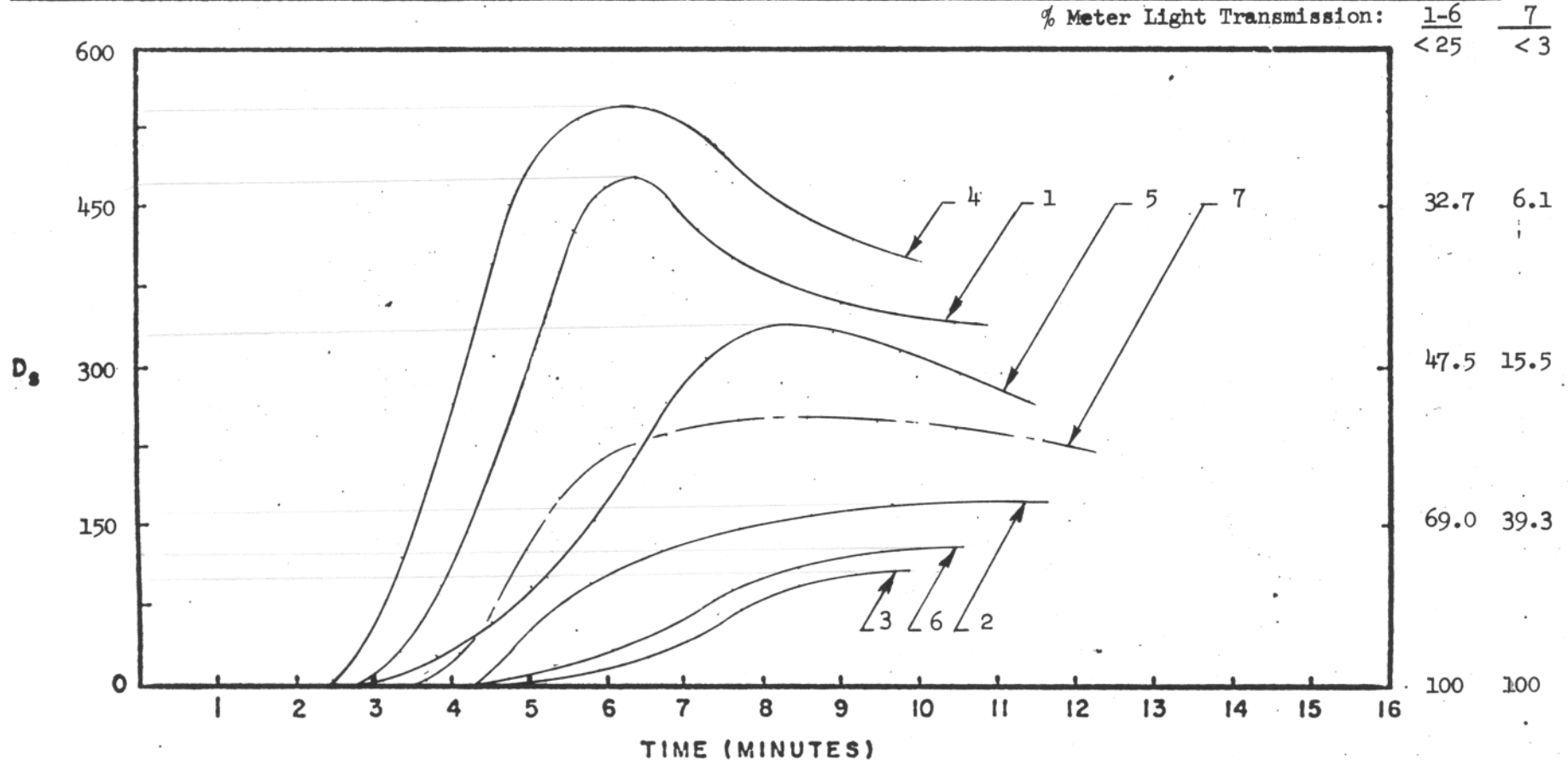
MATERIALS SMOKE DATA REPORT

CATEGORY 10(A)	MATERIAL CATEGORY Elastomeric
Chloroprene Sheet Stock, .06 inch.	No. 1 Center Ceiling Meter No. 2 Center Mid-Height Meter No. 3 Center Floor Meter No. 4 End Ceiling Meter No. 5 End Mid-Height Meter No. 6 End Floor Meter No. 7 Overall Smoke Meter
☒ FLAMING CONDITION ☒ 2.2 BTU/FT^2 - SEC ☐ NON-FLAMING CONDITION ☐ 3.3 BTU/FT^2 - SEC ☐ KINDLING CONDITION ☐ NONE	REMARKS: (1) Mockup Specimen Size: 1.0 ft^2 (2) Specimen Location No. 1



MATERIALS SMOKE DATA REPORT

CATEGORY 10(B)	MATERIAL CATEGORY Elastomer
Silicone Sheet Stock, 0.06 inch thick.	No. 1 Center Ceiling Meter No. 2 Center Mid-Height Meter No. 3 Center Floor Meter No. 4 End Ceiling Meter No. 5 End Mid-Height Meter No. 6 End Floor Meter No. 7 Overall Smoke Meter
■ FLAMING CONDITION ☒ 2.2 BTU/FT^2 - SEC ☐ NON-FLAMING CONDITION ☐ 3.3 BTU/FT^2 - SEC ☐ KINDLING CONDITION ☐ NONE	REMARKS: (1) Mockup Specimen Size: 1.0 ft^2 (2) Specimen Location No. 1

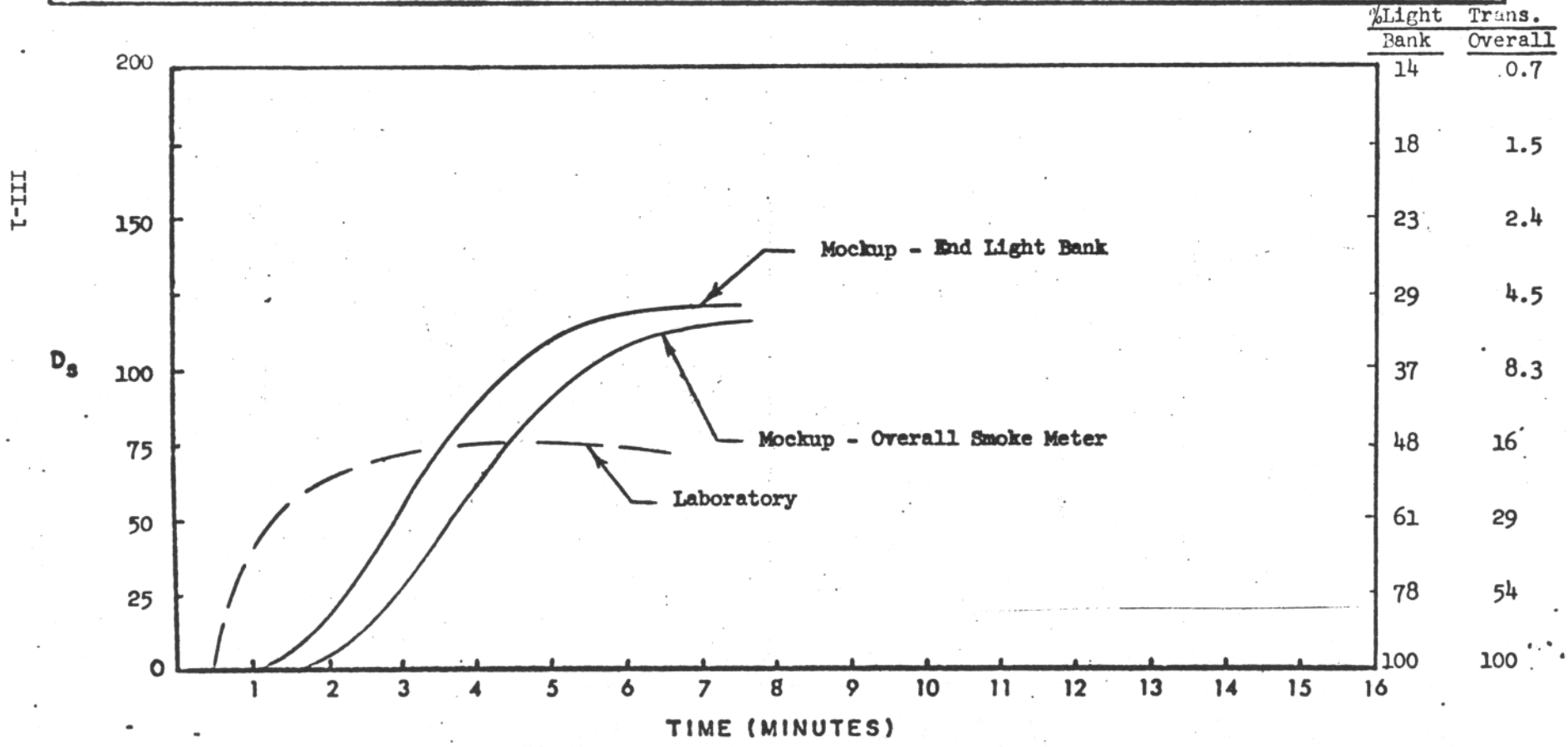


APPENDIX III

MOCKUP CORRELATION SMOKE TEST REPORTS

MATERIALS SMOKE DATA REPORT

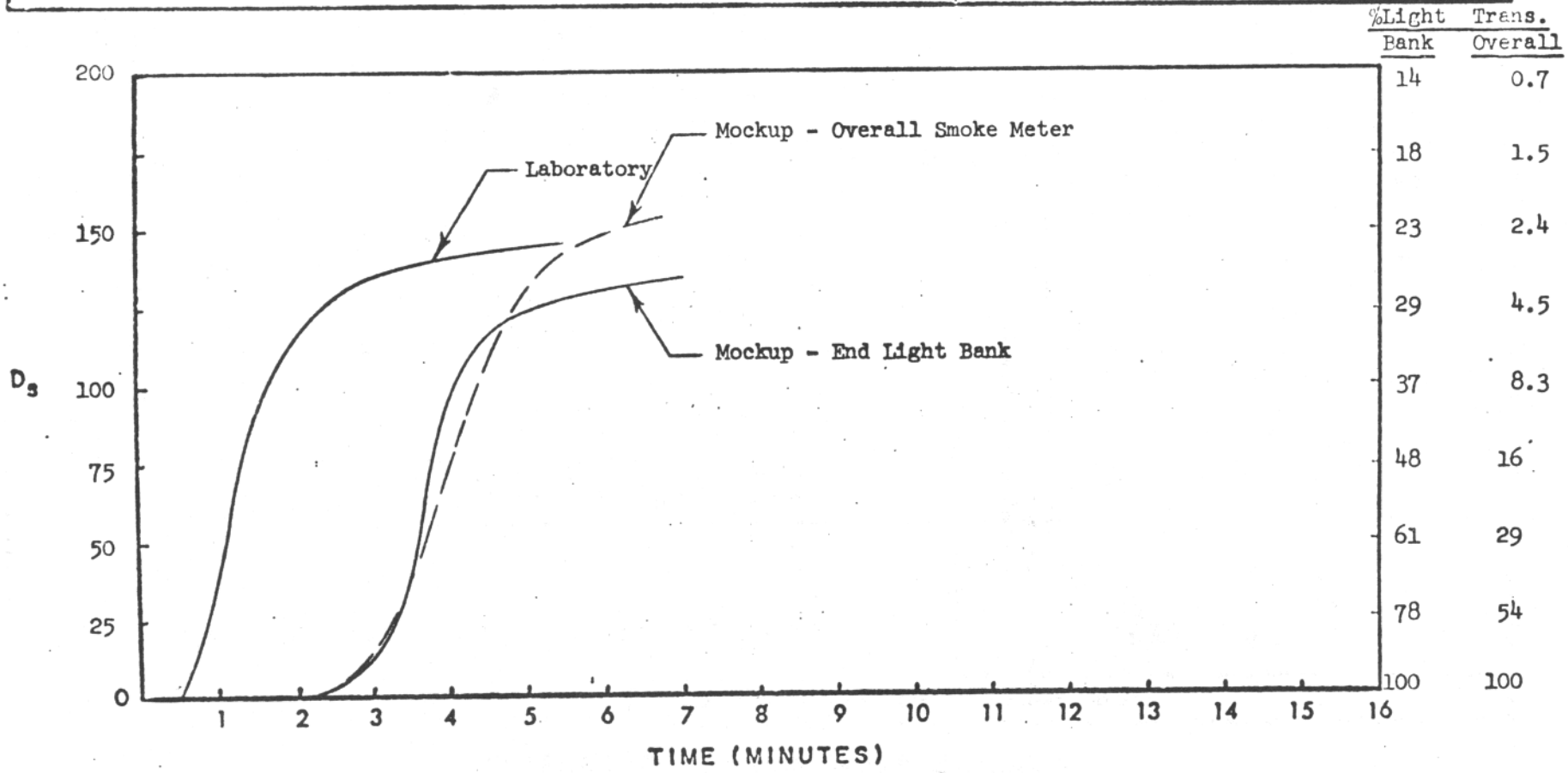
CATEGORY 1A	MATERIAL CATEGORY CEILING PANEL
Epoxy-Glass Faces, Nomex Core, H/C Sandwich, 0.37 in. thick	**Specimen Size** Laboratory: 0.046 $ft.^2$ Mockup: 4.0 $ft.^2$
☐ FLAMING CONDITION ☒ 2.2 BTU/FT^2 - SEC ☒ NON-FLAMING CONDITION ☐ 3.3 BTU/FT^2 - SEC ☐ KINDLING CONDITION ☐ NONE	**REMARKS:** (1) Corrected for meter overlap (2) Specimen location No. 1



III-1

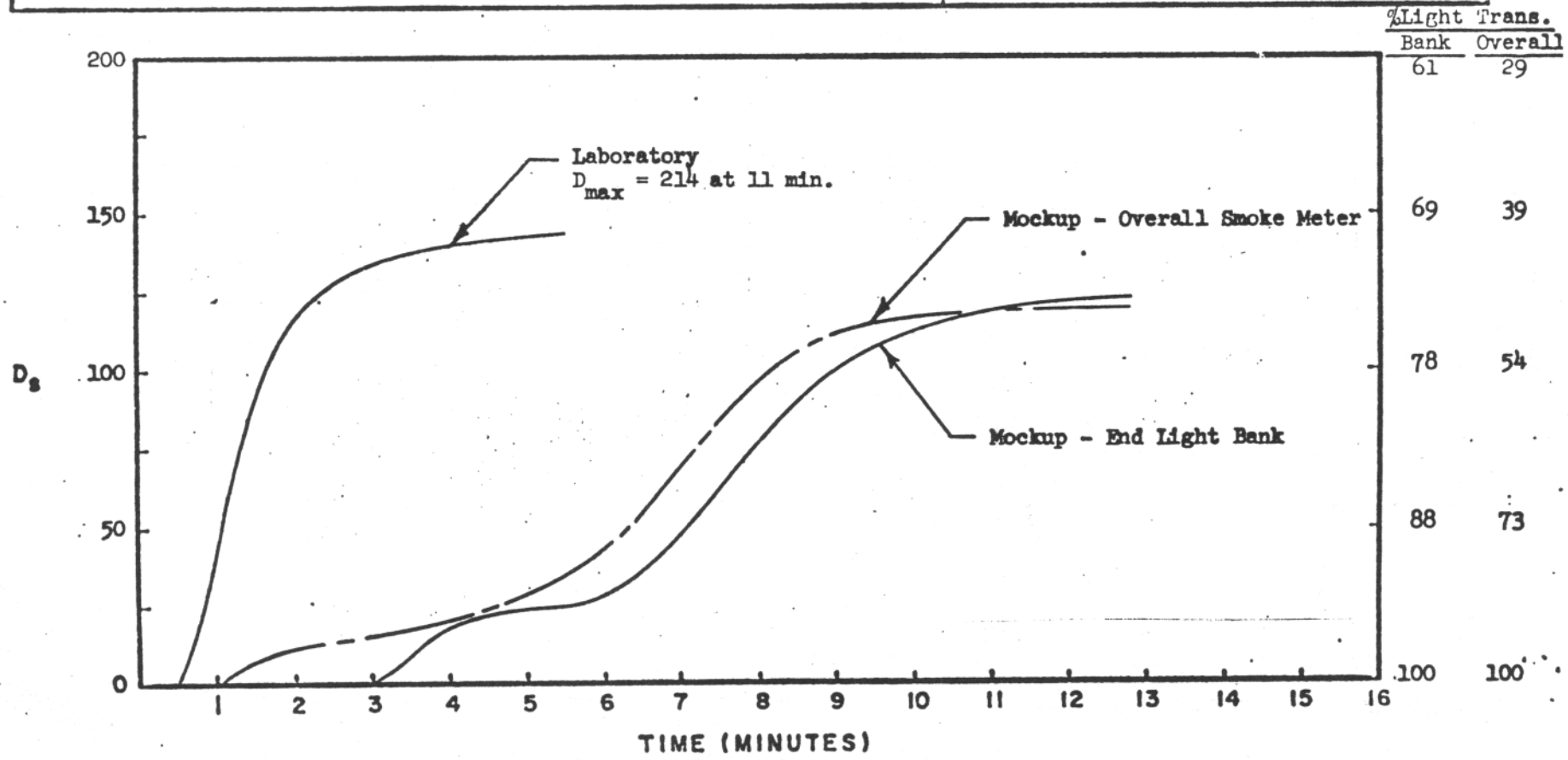
MATERIALS SMOKE DATA REPORT

CATEGORY 4A	MATERIAL CATEGORY STRUCTURAL FLOORING
Epoxy-Glass Faces, Nomex Core, H/C Sandwich, 0.38 in. thick	Specimen Size Laboratory: 0.046 ft.^{2} Mockup: 4.0 ft.^{2}
☒ FLAMING CONDITION ☒ 2.2 BTU/FT^2 - SEC ☐ NON-FLAMING CONDITION ☐ 3.3 BTU/FT^2 - SEC ☐ KINDLING CONDITION ☐ NONE	REMARKS: (1) Corrected for meter overlap (2) Specimen location No. 1



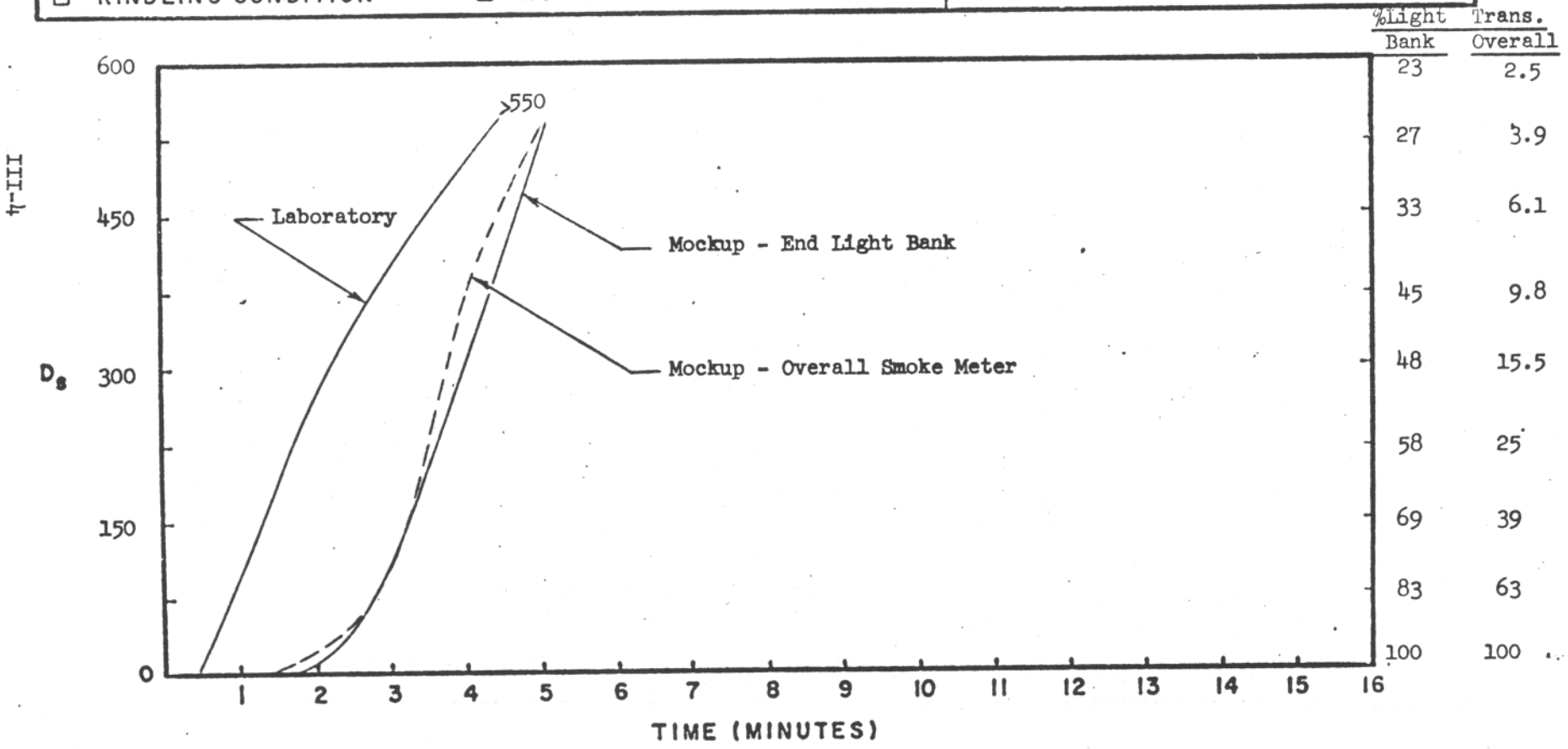
MATERIALS SMOKE DATA REPORT

CATEGORY 4A	MATERIAL CATEGORY STRUCTURAL FLOORING
Epoxy-Glass Faces, Nomex Core, H/C Sandwich, 0.38 in. thick	Specimen Size Laboratory: 0.046 ft^2 Mockup: 1.0 ft^2
☑ FLAMING CONDITION ☑ 2.2 BTU/FT^2 - SEC ☐ NON-FLAMING CONDITION ☐ 3.3 BTU/FT^2 - SEC ☐ KINDLING CONDITION ☐ NONE	REMARKS: (1) Corrected for meter overlap (2) Specimen location No. 4 (horizontal)



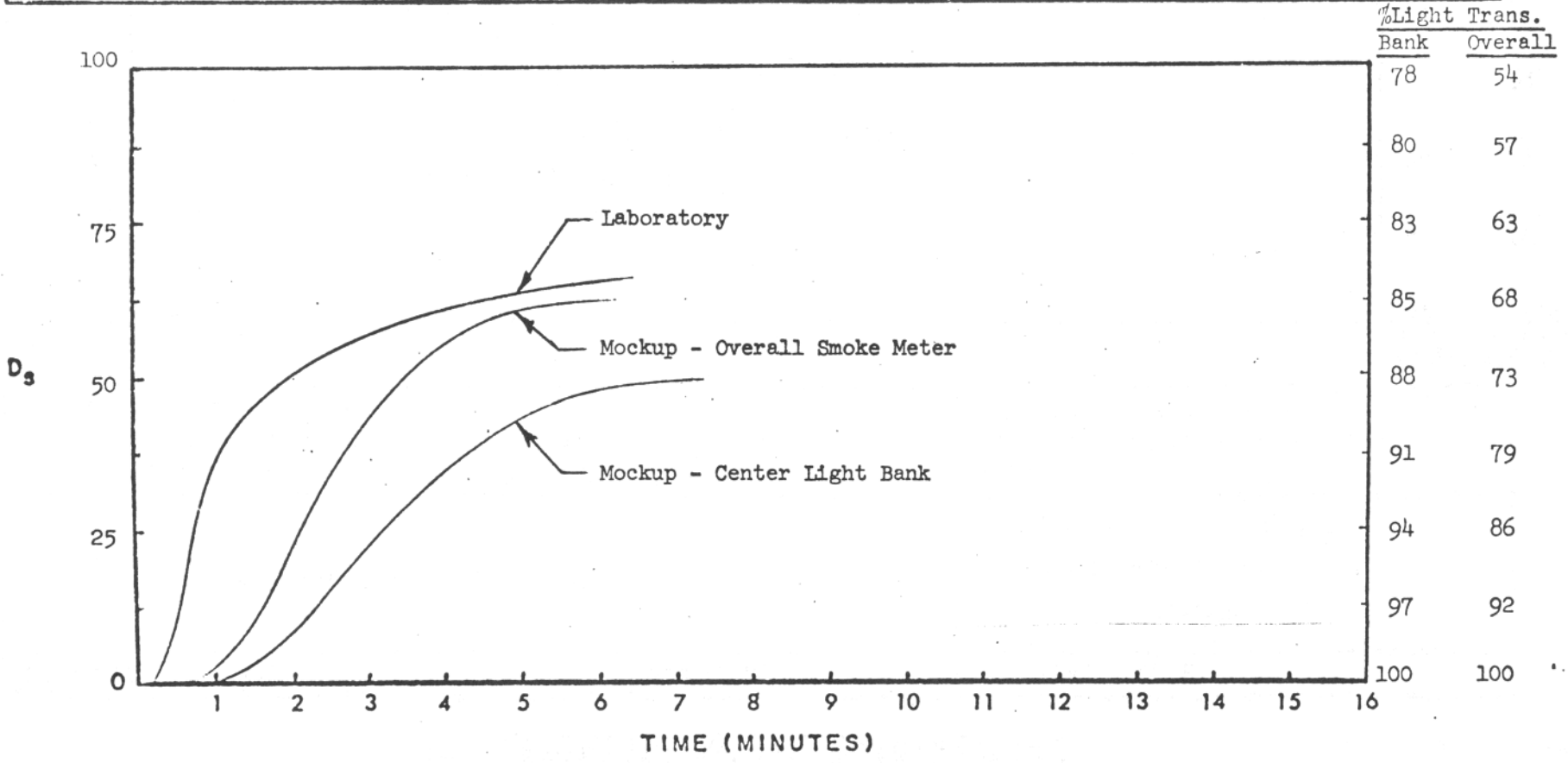
MATERIALS SMOKE DATA REPORT

CATEGORY 5A	MATERIAL CATEGORY THERMOFORMING
FR ABS Sheet, 63.0 oz./yd.^{2}	Specimen Size Laboratory: 0.046 ft.^{2} Mockup: 1.0 ft.^{2}
☒ FLAMING CONDITION ☒ 2.2 BTU/FT^2 - SEC ☐ NON-FLAMING CONDITION ☐ 3.3 BTU/FT^2 - SEC ☐ KINDLING CONDITION ☐ NONE	REMARKS: (1) Corrected for meter overlap (2) Specimen Location No. 1



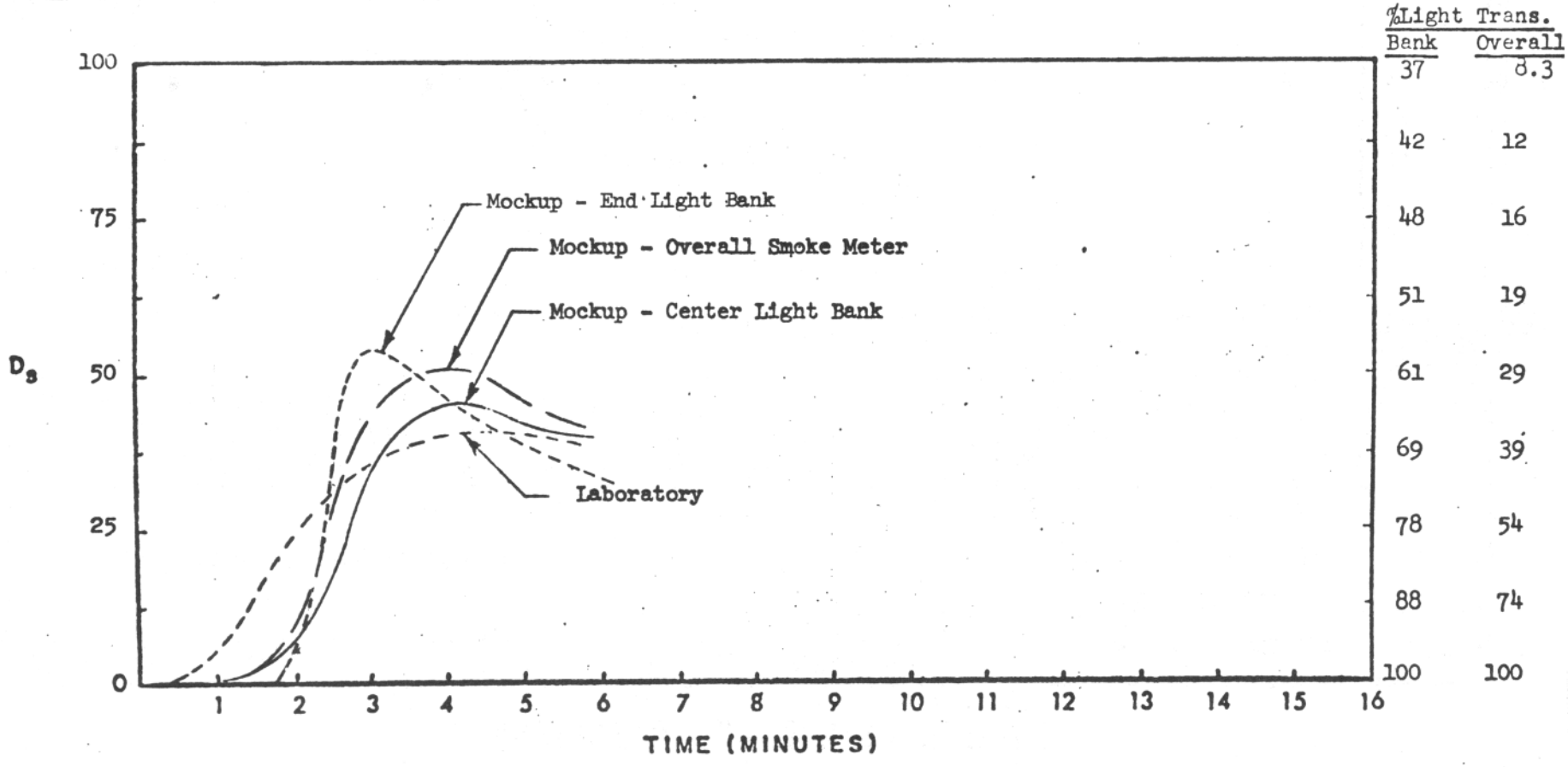
MATERIALS SMOKE DATA REPORT

CATEGORY 6(B)	MATERIAL CATEGORY UPHOLSTERY
FR 50% Cotton - 50% Rayon, 18.3 oz./yd.^{2}	Specimen Size Laboratory: 0.046 ft.^{2} Mockup: 1.0 ft.^{2}
☒ FLAMING CONDITION ☒ 2.2 BTU/FT^2 - SEC ☐ NON-FLAMING CONDITION ☐ 3.3 BTU/FT^2 - SEC ☐ KINDLING CONDITION ☐ NONE	REMARKS: (1) Corrected for meter overlap (2) Specimen location No. 4 (horizontal)



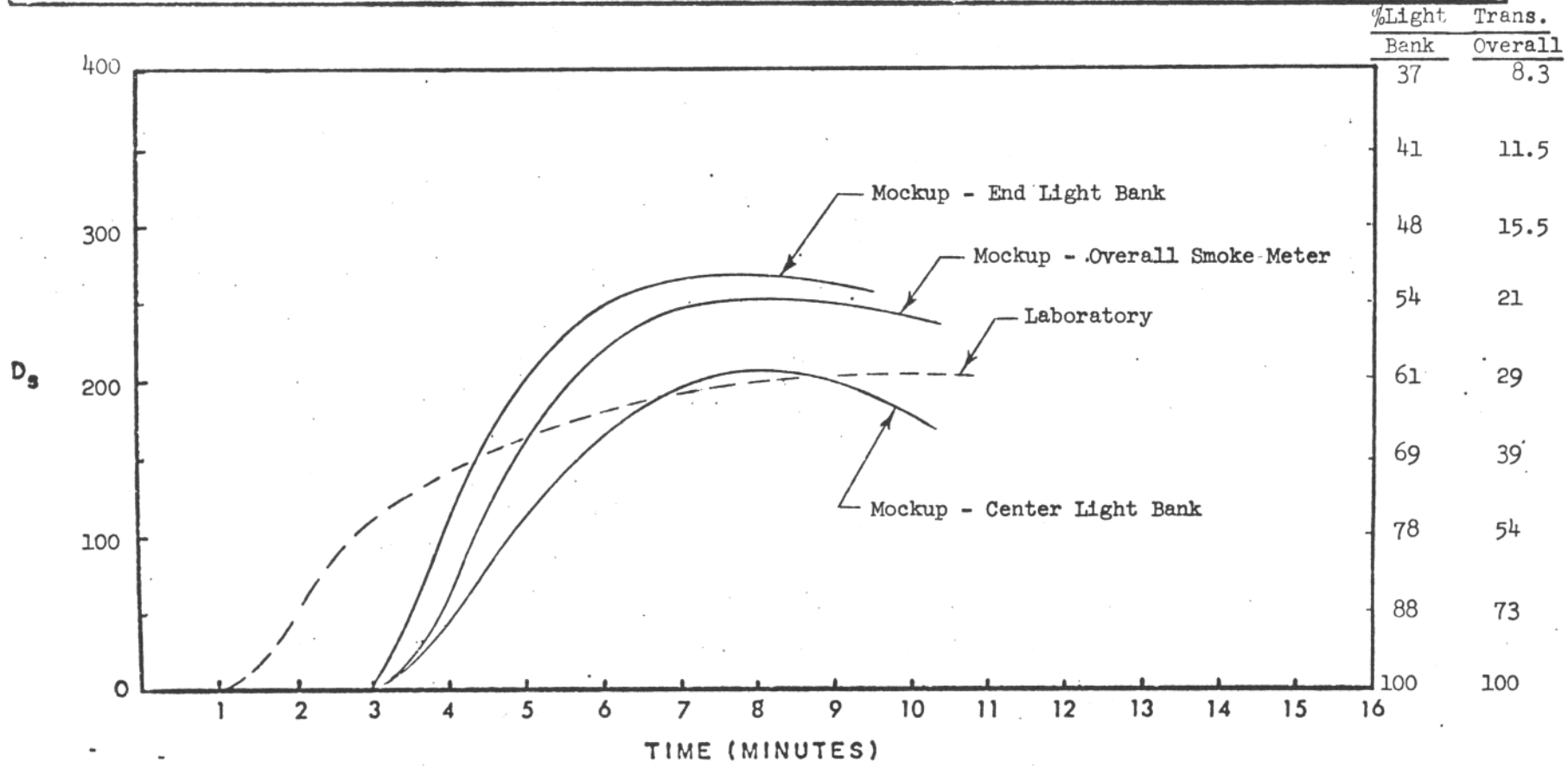
MATERIALS SMOKE DATA REPORT

CATEGORY 7(B)	MATERIAL CATEGORY SEAT CUSHION
FR Polyethylene Foam, 2 pcf, 0.5 in. thick	Specimen Size Laboratory: 0.046 ft.^{2} Mockup: 4.0 ft.^{2}
☒ FLAMING CONDITION ☒ 2.2 BTU/FT^2 - SEC ☐ NON-FLAMING CONDITION ☐ 3.3 BTU/FT^2 - SEC ☐ KINDLING CONDITION ☐ NONE	REMARKS: (1) Corrected for meter overlap (2) Specimen location No. 1



MATERIALS SMOKE DATA REPORT

CATEGORY 10 (B)	MATERIAL CATEGORY ELASTOMER
FR Silicone Rubber, 0.06 in. thick	Specimen Size Laboratory: 0.046 ft.^{2} Mockup: 1.0 ft.^{2}
☒ FLAMING CONDITION ☒ 2.2 BTU/FT^2 - SEC ☐ NON-FLAMING CONDITION ☐ 3.3 BTU/FT^2 - SEC ☐ KINDLING CONDITION ☐ NONE	REMARKS: (1) Corrected for meter overlap (2) Specimen location No. 1

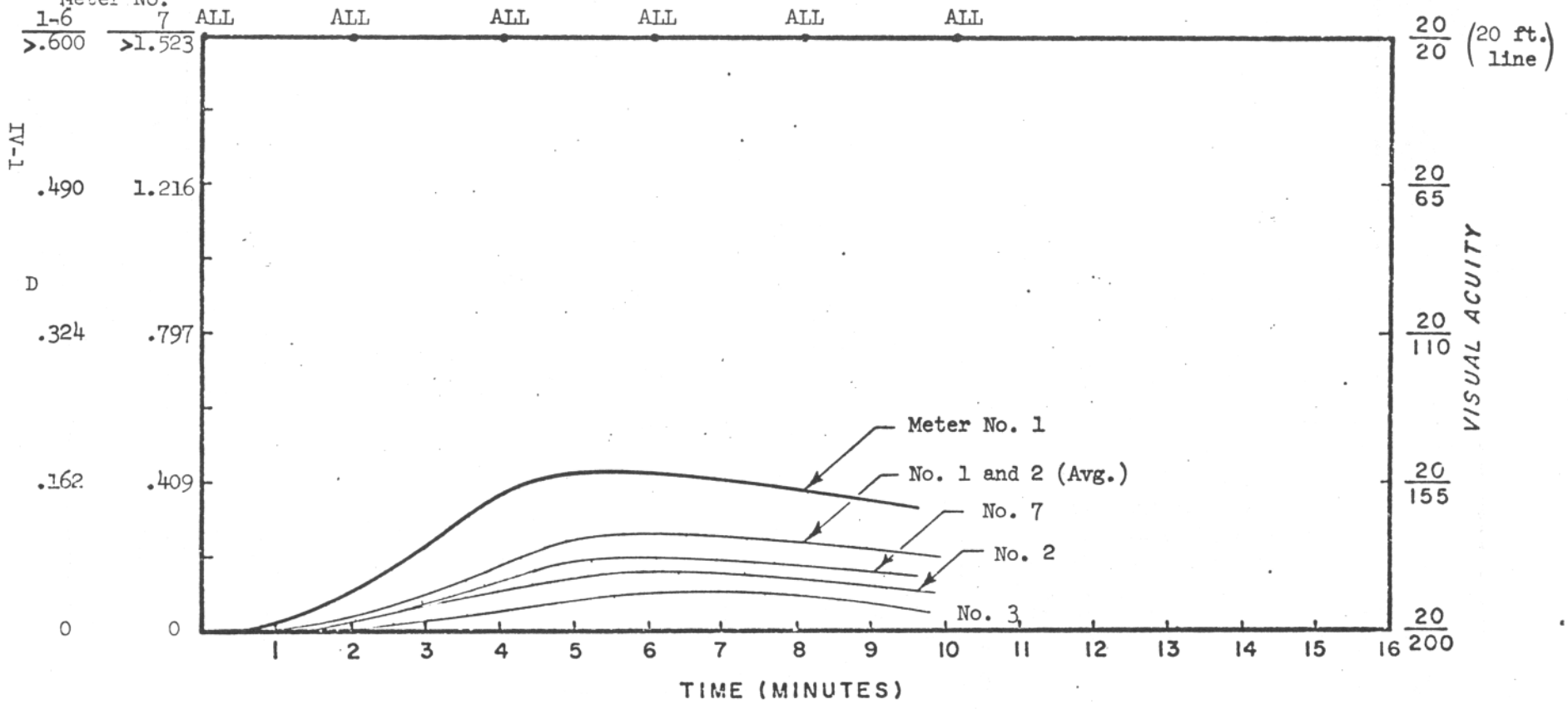


APPENDIX IV

MOCKUP VISIBILITY TEST REPORTS

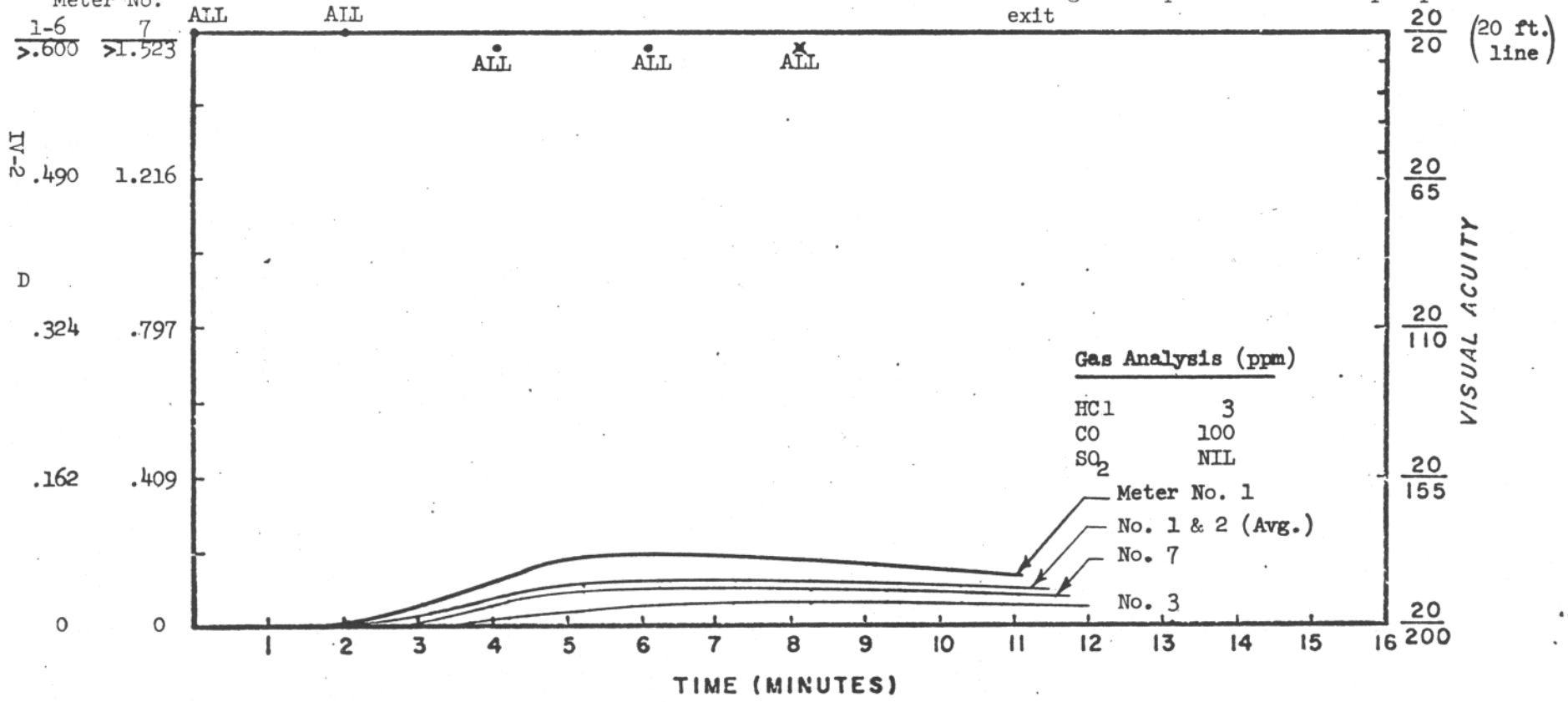
MOCKUP VISIBILITY TEST

CATEGORY 1A	MATERIAL CATEGORY CEILING PANEL
Tedlar coated, Epoxy-glass face skins, Nomex core sandwich panel, 0.38 in. thick, 1 ft^2	A - EYES PROTECTED B - EYES UNPROTECTED C - EYES PROTECTED D - EYES UNPROTECTED
☒ FLAMING CONDITION ☒ 2.2 BTU/FT^2 - SEC ☐ NON-FLAMING CONDITION ☐ 3.3 BTU/FT^2 - SEC ☐ KINDLING CONDITION	REMARKS: 1. Meter No.(s) refer to figures 11 & 12 2. Specimen Location No. 1



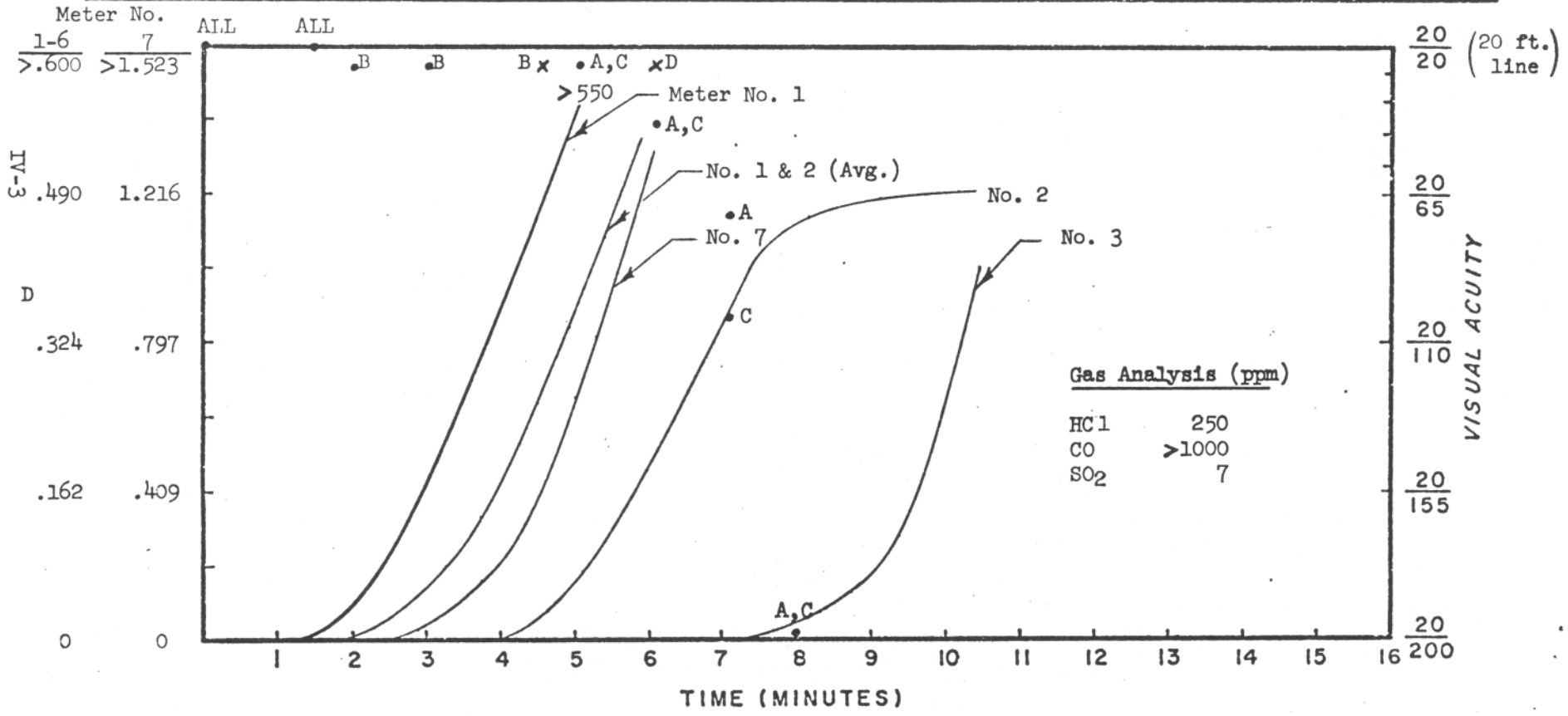
MOCKUP VISIBILITY TEST

CATEGORY 4A	MATERIAL CATEGORY FLOORING
Epoxy-glass faces, Nomex core H/C sandwich 0.38 in. thick, 1 ft^2	A - EYES PROTECTED B - EYES UNPROTECTED C - EYES PROTECTED D - EYES UNPROTECTED
☒ FLAMING CONDITION ☒ 2.2 BTU/FT^2 - SEC ☐ NON-FLAMING CONDITION ☐ 3.3 BTU/FT^2 - SEC ☐ KINDLING CONDITION	REMARKS: 1. Meter No.(s) refer to figures 11 & 12 2. x - subject(s) out of booth 3. Specimen Location No. 1 4. Leakage into protected booths prompted exit



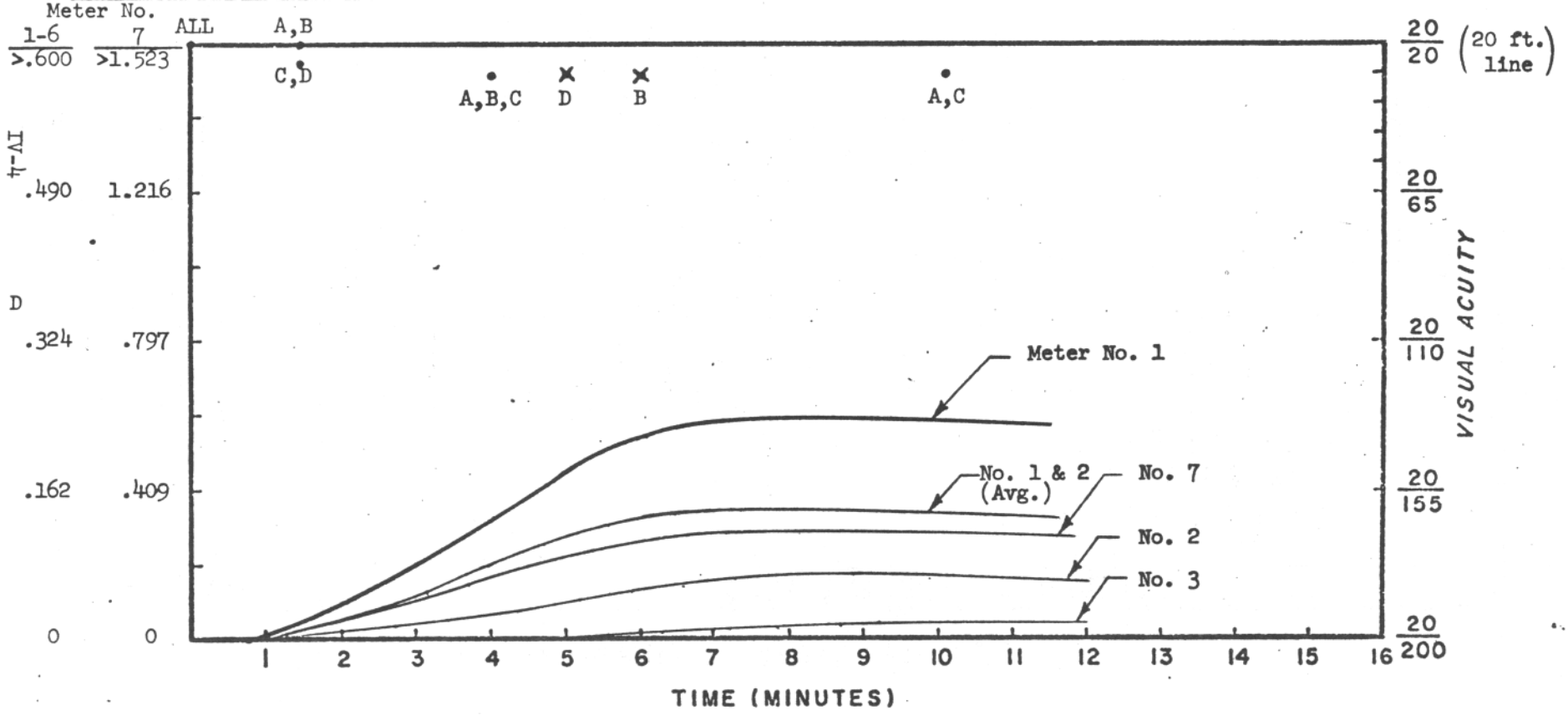
MOCKUP VISIBILITY TEST

CATEGORY 5A	MATERIAL CATEGORY THERMOFORMING
ABS sheet, .06 in. thick, 1 ft^2	A - EYES PROTECTED B - EYES UNPROTECTED C - EYES PROTECTED D - EYES UNPROTECTED
☒ FLAMING CONDITION ☒ 2.2 BTU/FT^2 - SEC ☐ NON-FLAMING CONDITION ☐ 3.3 BTU/FT^2 - SEC ☐ KINDLING CONDITION	REMARKS: 1. Specimen Location No. 1 2. x - subject(s) out of booth 3. Meter No.(s) refer to figures 11 & 12



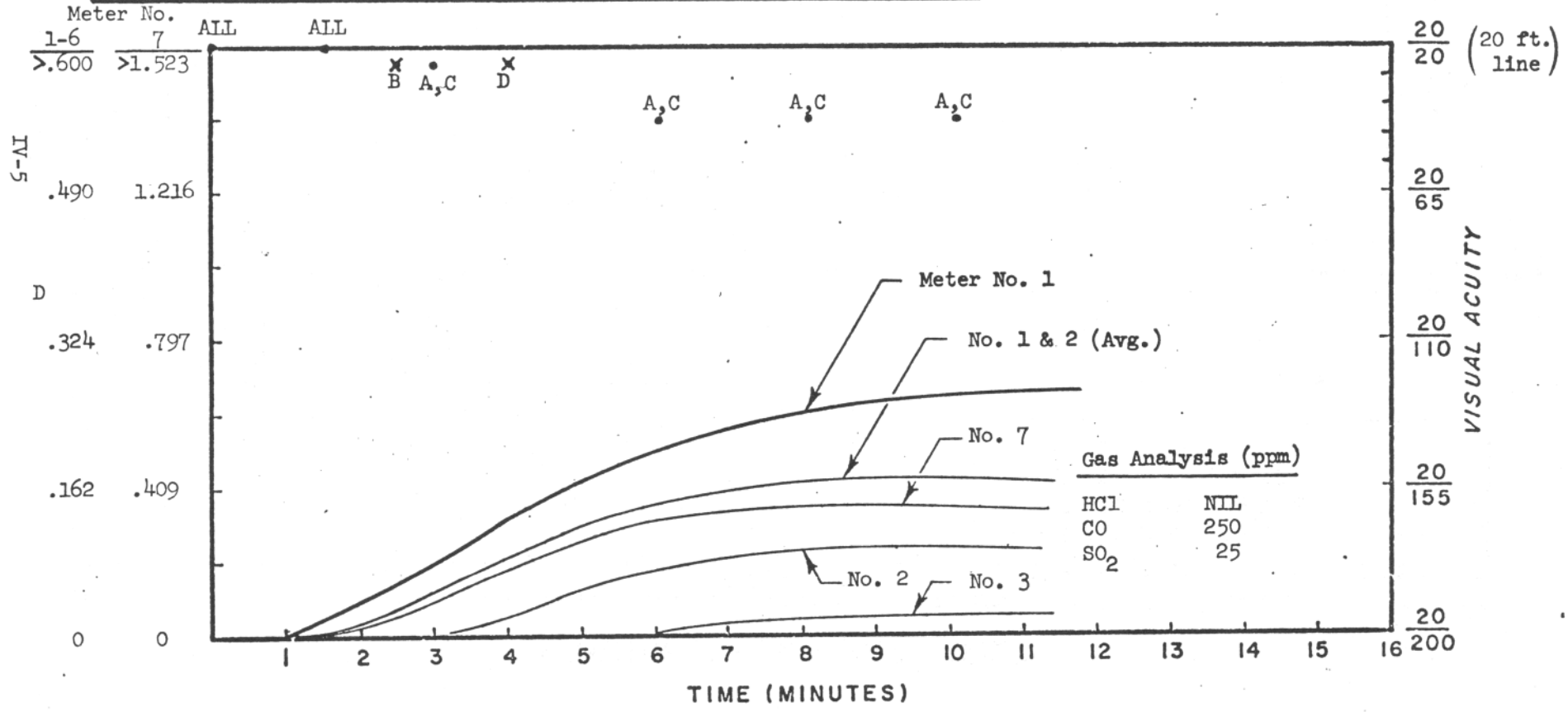
MOCKUP VISIBILITY TEST

CATEGORY 7A	MATERIAL CATEGORY SEAT CUSHION
FR Polyurethane foam, 2 PCF, 0.5 in. thick, 1 ft^2	A - EYES PROTECTED B - EYES UNPROTECTED C - EYES PROTECTED D - EYES UNPROTECTED
☐ FLAMING CONDITION ☒ 2.2 BTU/FT^2 - SEC ☒ NON-FLAMING CONDITION ☐ 3.3 BTU/FT^2 - SEC ☐ KINDLING CONDITION	REMARKS: 1. Meter No.(s) refer to figures 11 and 12 2. x - subject(s) out of booth 3. Specimen Location No. 1



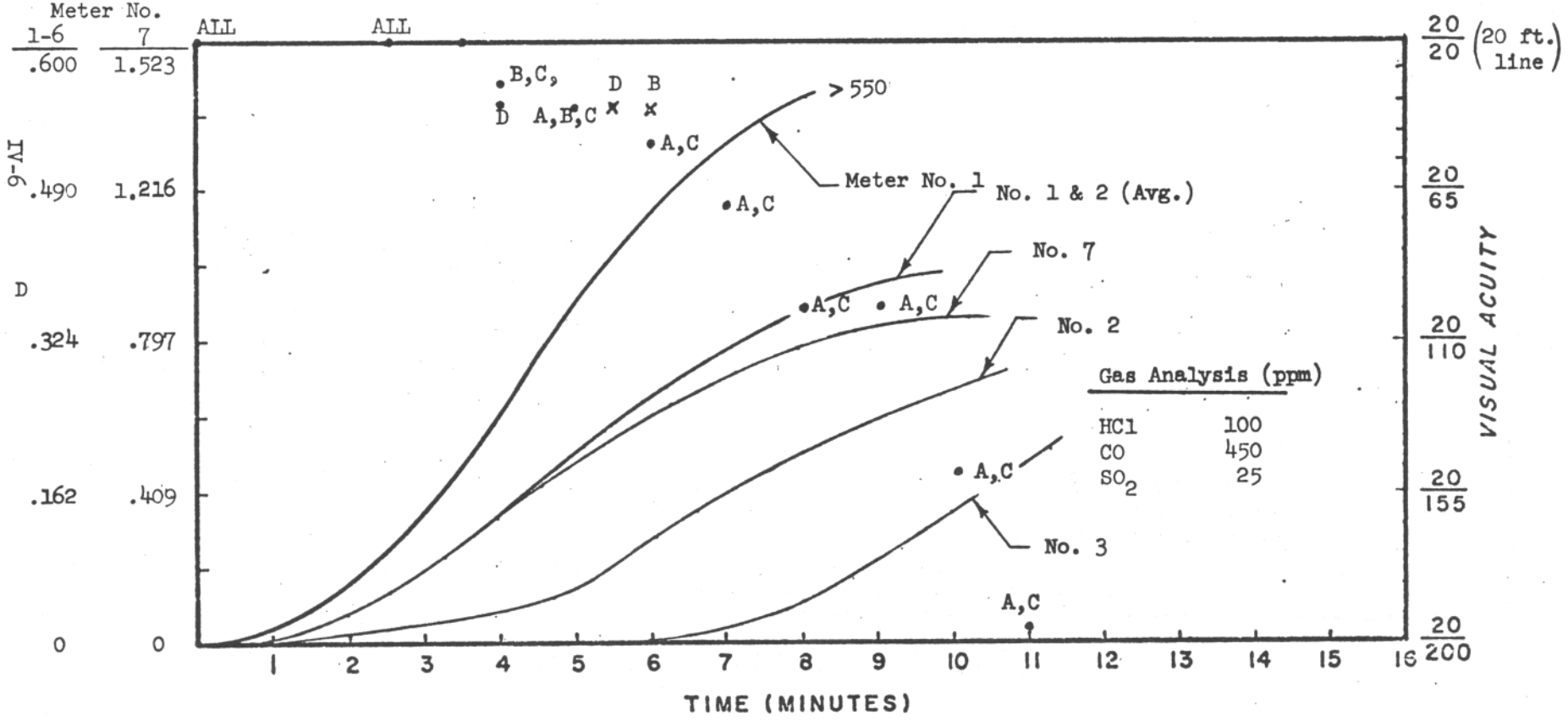
MOCKUP VISIBILITY TEST

CATEGORY 7A	MATERIAL CATEGORY SEAT CUSHION
FR Polyurethane foam, 2 PCF, 1.0 in. thick, 1 ft^2	A - EYES PROTECTED B - EYES UNPROTECTED C - EYES PROTECTED D - EYES UNPROTECTED
☒ FLAMING CONDITION ☒ 2.2 BTU/FT^2 - SEC ☐ NON-FLAMING CONDITION ☐ 3.3 BTU/FT^2 - SEC ☐ KINDLING CONDITION	REMARKS: 1. Meter No.(s) refer to figures 11 & 12 2. x - subject(s) out of booth 3. Specimen Location No. 1



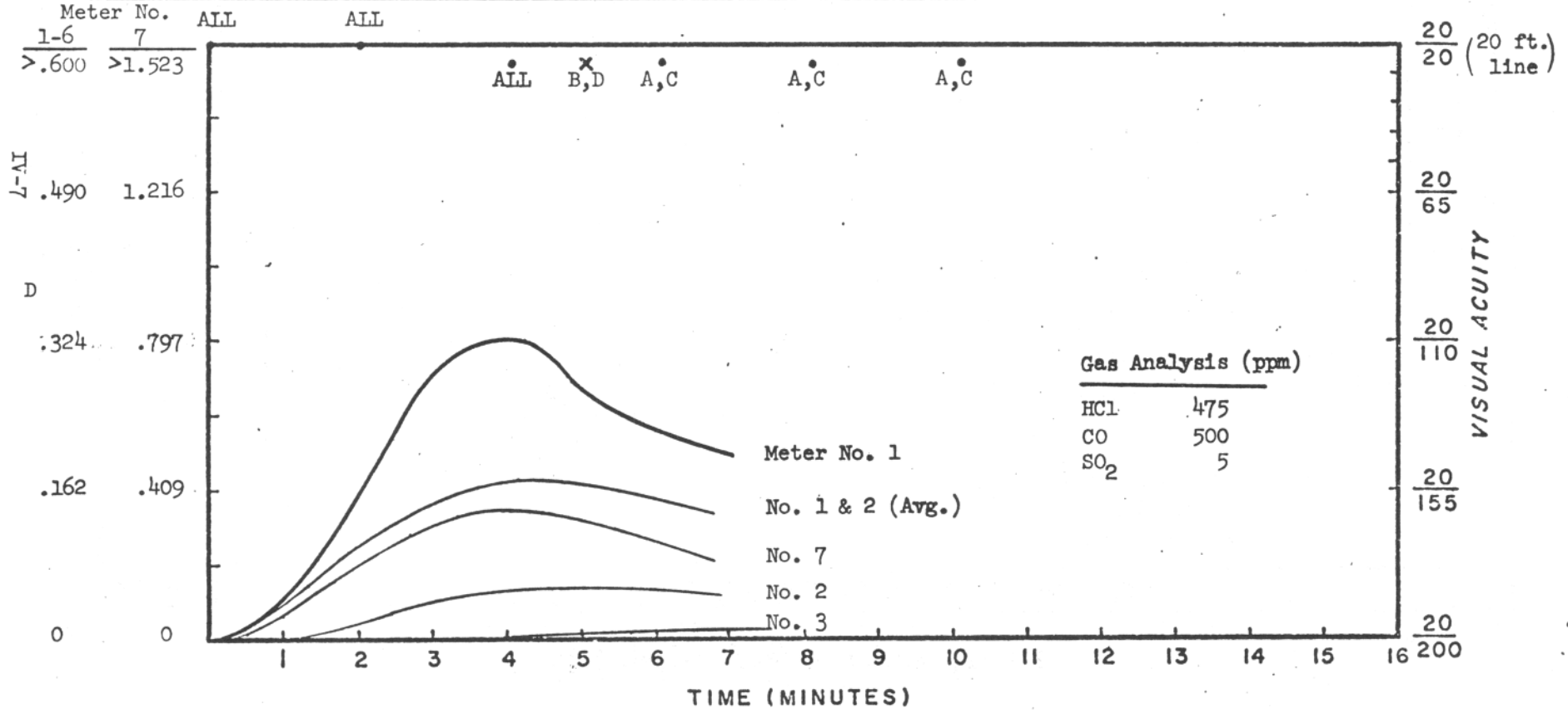
MOCKUP VISIBILITY TEST

CATEGORY 7A	MATERIAL CATEGORY SEAT CUSHION
FR Polyurethane foam, 2 PCF, 1.5 in. thick, 1 ft^2	A - EYES PROTECTED B - EYES UNPROTECTED C - EYES PROTECTED D - EYES UNPROTECTED
☐ FLAMING CONDITION ☒ 2.2 BTU/FT^2 - SEC ☒ NON-FLAMING CONDITION ☐ 3.3 BTU/FT^2 - SEC ☐ KINDLING CONDITION	REMARKS: 1. Meter No.(s) refer to figure 11 & 12 2. x - subject(s) out of booth 3. Specimen Location No. 1



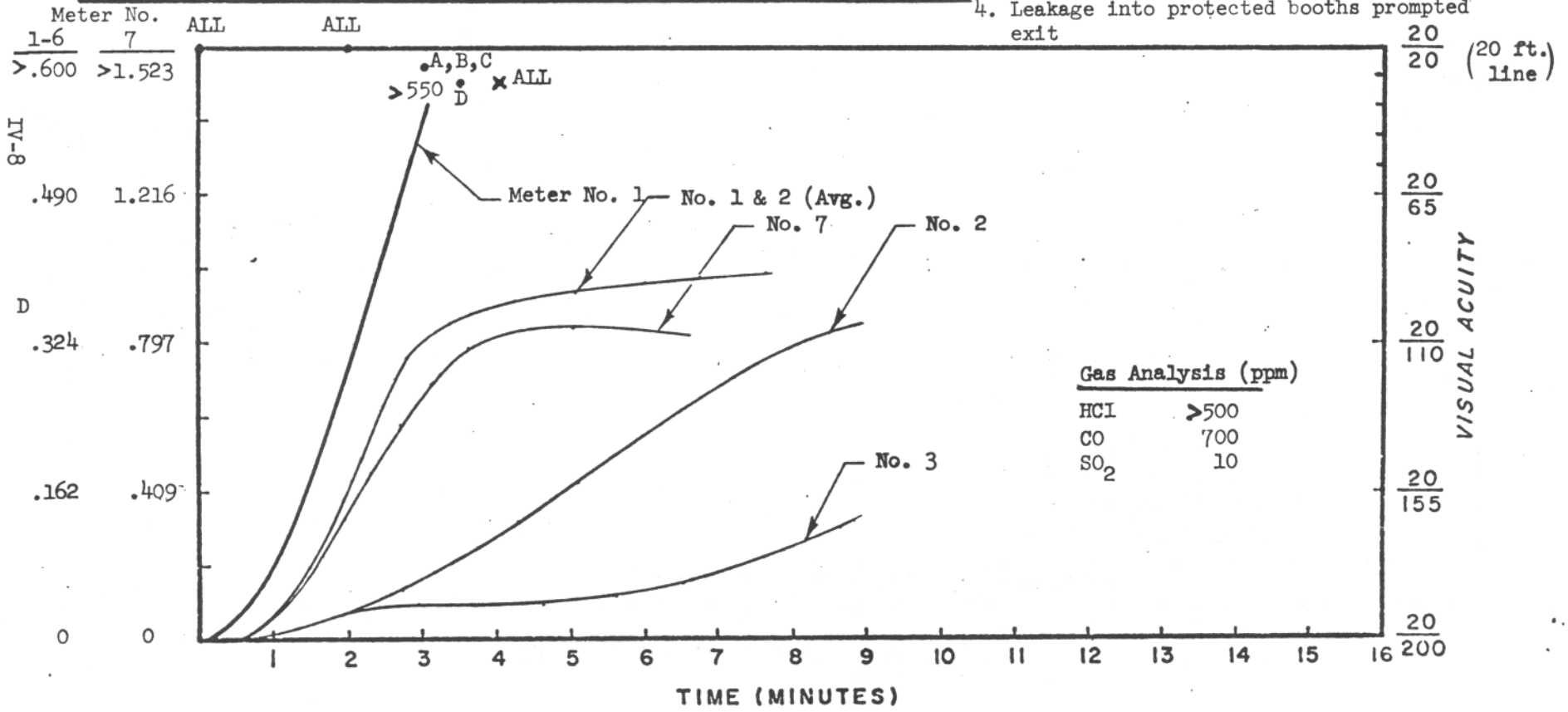
MOCKUP VISIBILITY TEST

CATEGORY	MATERIAL CATEGORY UPHOLSTERY
Vinyl-Cotton fabric, .008 in. thick, 1 ft^2	A - EYES PROTECTED B - EYES UNPROTECTED C - EYES PROTECTED D - EYES UNPROTECTED
☒ FLAMING CONDITION ☒ 2.2 BTU/FT^2 - SEC ☐ NON-FLAMING CONDITION ☐ 3.3 BTU/FT^2 - SEC ☐ KINDLING CONDITION	REMARKS: 1. Meter No.(s) refer to figures 11 & 12 2. x - subject(s) out of booth 3. Specimen Location No. 1



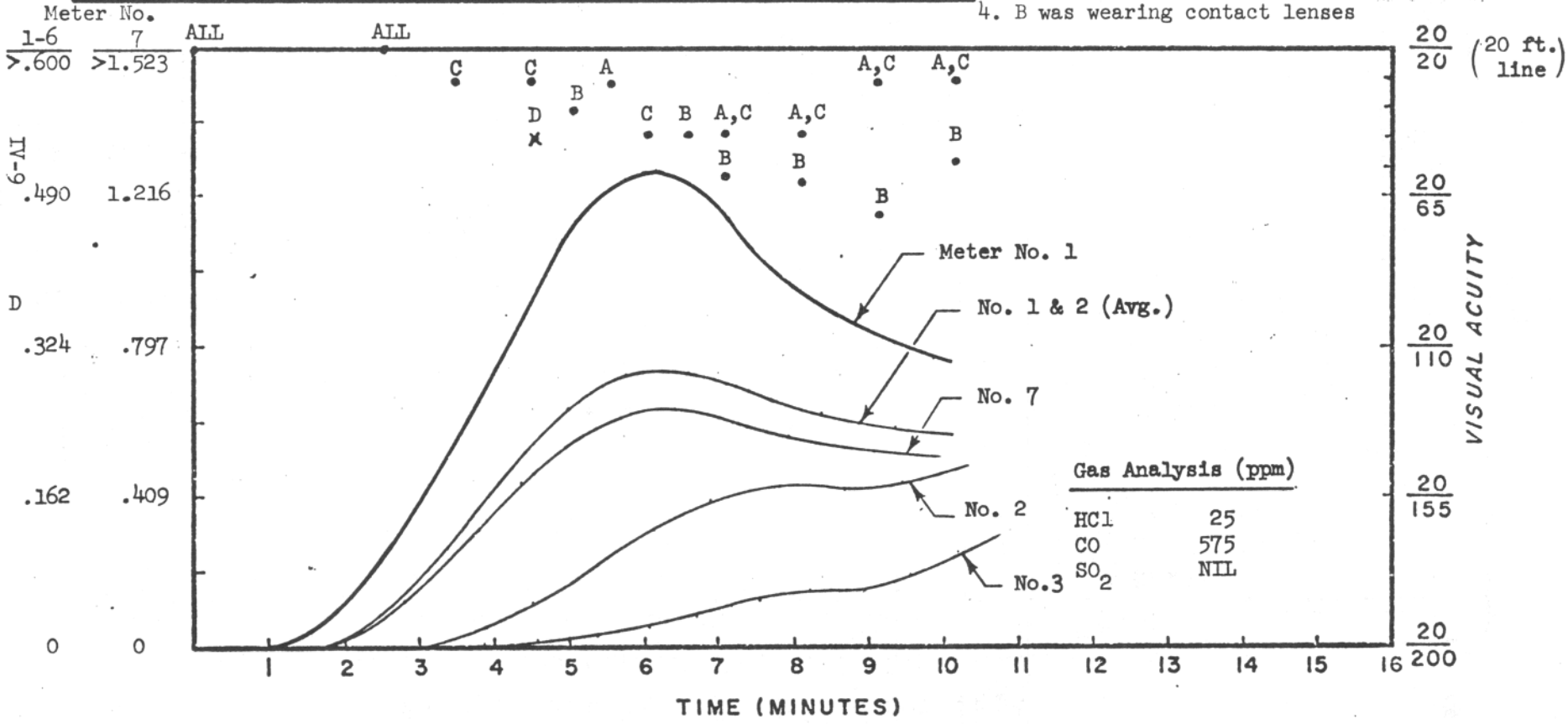
MOCKUP VISIBILITY TEST

CATEGORY	MATERIAL CATEGORY	UPHOLSTERY
Vinyl-Cotton fabric, .024 in. thick, 1 ft^2	A - EYES PROTECTED B - EYES UNPROTECTED C - EYES PROTECTED D - EYES UNPROTECTED	
☑ FLAMING CONDITION ☒ 2.2 BTU/FT^2 - SEC ☐ NON-FLAMING CONDITION ☐ 3.3 BTU/FT^2 - SEC ☐ KINDLING CONDITION	REMARKS; 1. Meter No.(s) refer to figure 11 & 12 2. x - subject(s) out of booth 3. Specimen Location No. 1 4. Leakage into protected booths prompted exit	



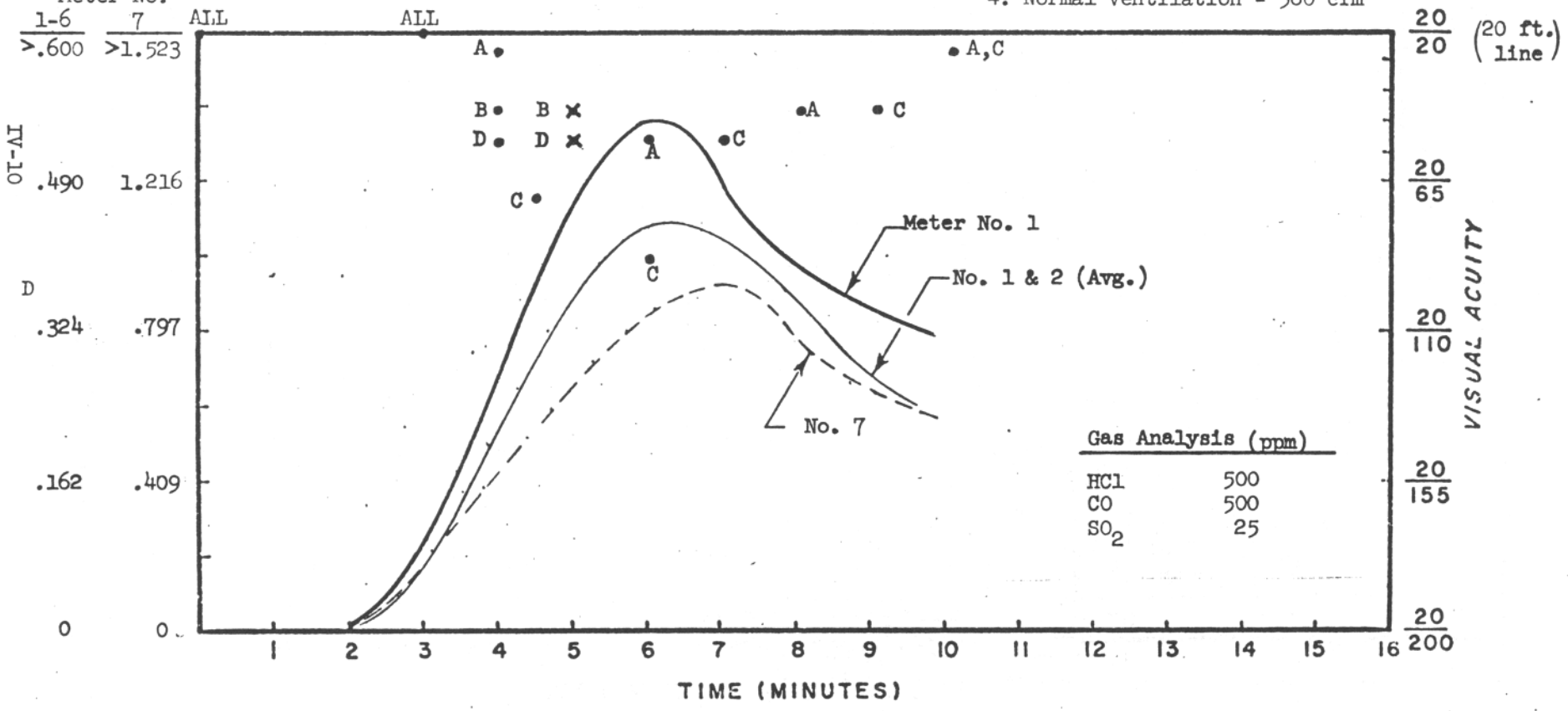
MOCKUP VISIBILITY TEST

CATEGORY 8A	MATERIAL CATEGORY CARPETING
100% Wool, latex backing, 0.37 in. thick, 1 ft^2	A - EYES PROTECTED B - EYES UNPROTECTED C - EYES PROTECTED D - EYES UNPROTECTED
☒ FLAMING CONDITION ☒ 2.2 BTU/FT^2 - SEC ☐ NON-FLAMING CONDITION ☐ 3.3 BTU/FT^2 - SEC ☐ KINDLING CONDITION	REMARKS: 1. Meter No.(s) refer to figures 11 & 12 2. x - subject(s) out of booth 3. Specimen Location No. 1 4. B was wearing contact lenses



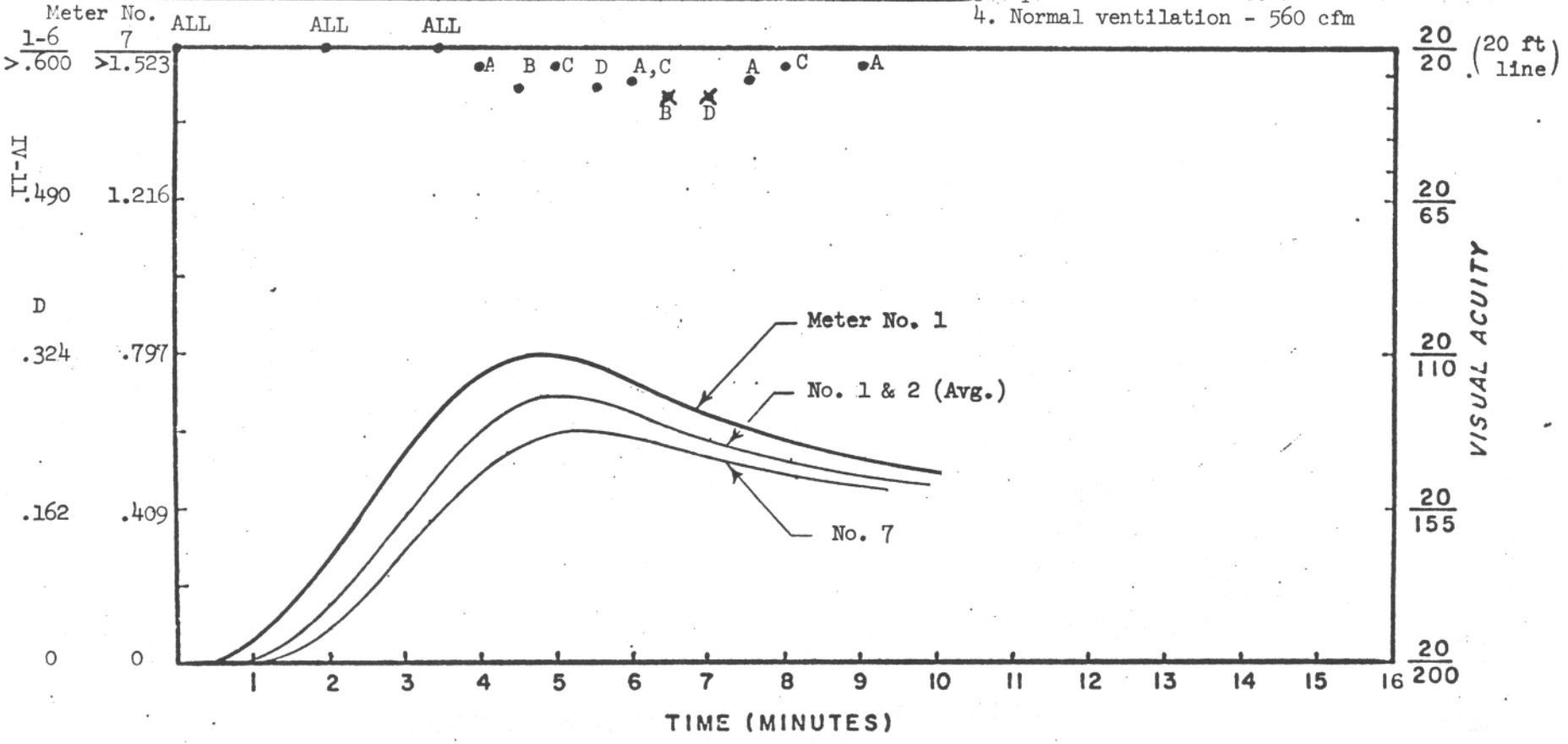
MOCKUP VENTILATION/VISIBILITY TEST

CATEGORY 5A	MATERIAL CATEGORY THERMOFORMING
ABS sheet, 0.06 in. thick, 1 ft^2	A - EYES PROTECTED B - EYES UNPROTECTED C - EYES PROTECTED D - EYES UNPROTECTED
☒ FLAMING CONDITION ☒ 2.2 BTU/FT^2 - SEC ☐ NON-FLAMING CONDITION ☐ 3.3 BTU/FT^2 - SEC ☐ KINDLING CONDITION ☐ NONE	REMARKS: 1. Meter No.(s) refer to figures 11 & 12 2. x - subject(s) out of booth 3. Specimen Location No. 1 4. Normal ventilation - 560 cfm



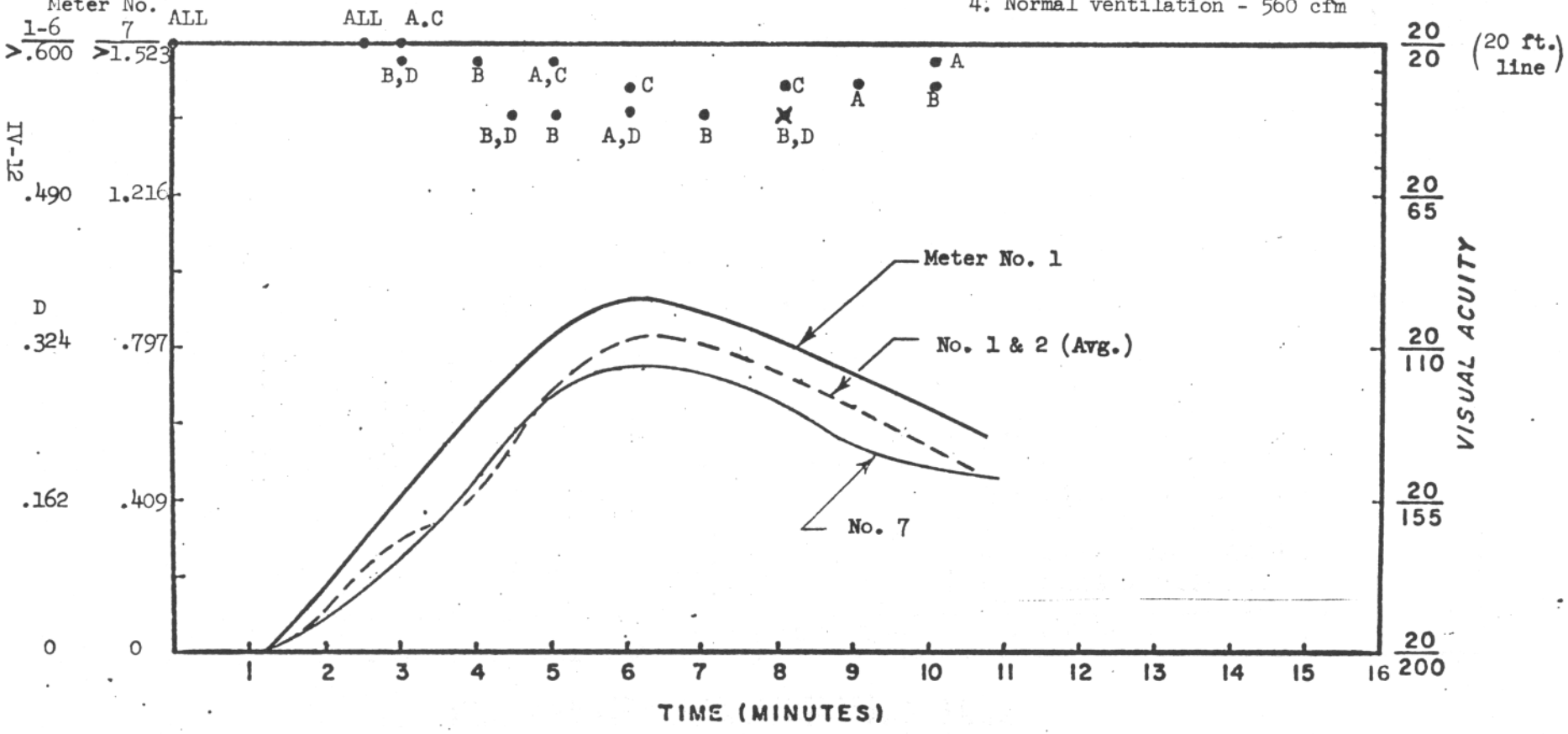
MOCKUP VENTILATION/VISIBILITY TEST

CATEGORY 7A	MATERIAL CATEGORY SEAT CUSHION
FR polyurethane foam, 2 pcf, 1.5 in. thick, 1 ft^2	A - EYES PROTECTED B - EYES UNPROTECTED C - EYES PROTECTED D - EYES UNPROTECTED
☒ FLAMING CONDITION ☒ 2.2 BTU/FT^2 - SEC ☐ NON-FLAMING CONDITION ☐ 3.3 BTU/FT^2 - SEC ☐ KINDLING CONDITION ☐ NONE	REMARKS: 1. Meter No.(s) refer to figures 11 & 12 2. x - subject(s) out of booth 3. Specimen Location No. 1 4. Normal ventilation - 560 cfm



MOCKUP VENTILATION/VISIBILITY TEST

CATEGORY 7A	MATERIAL CATEGORY SEAT CUSHION
FR polyurethane foam, 1.5 in. thick, 1 ft^2, 2 pcf	A - EYES PROTECTED B - EYES UNPROTECTED C - EYES PROTECTED D - EYES UNPROTECTED
☐ FLAMING CONDITION ☒ 2.2 BTU/FT^2 - SEC ☒ NON-FLAMING CONDITION ☐ 3.3 BTU/FT^2 - SEC ☐ KINDLING CONDITION ☐ NONE	REMARKS: 1. Meter No.(s) refer to figures 11 & 12 2. x - subject(s) out of booth 3. Specimen Location No. 1 4. Normal ventilation - 560 cfm

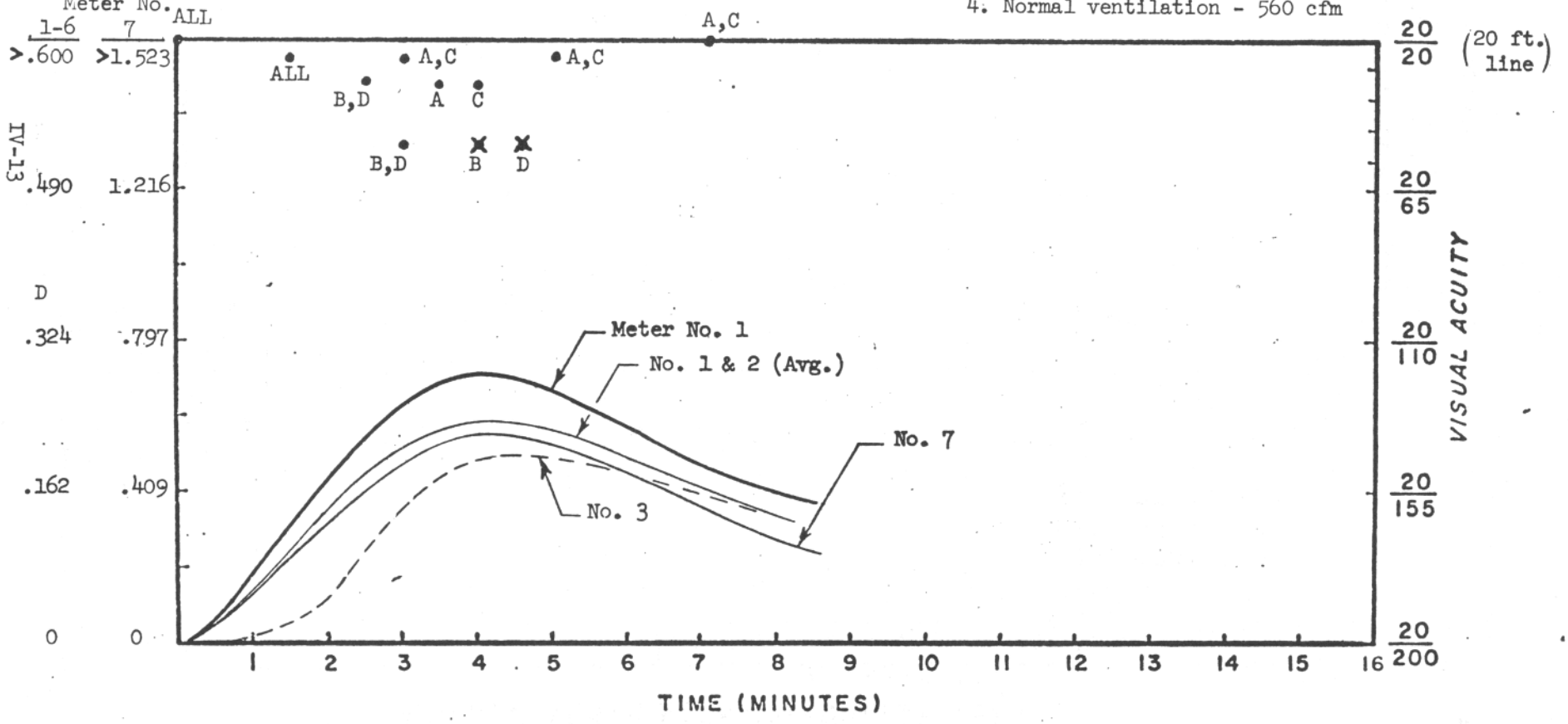


MOCKUP VENTILATION/VISIBILITY TEST

CATEGORY	MATERIAL CATEGORY	UPHOLSTERY
Vinyl cotton fabric, 0.024 in. thick, 1 ft^2	A - EYES PROTECTED B - EYES UNPROTECTED C - EYES PROTECTED D - EYES UNPROTECTED	

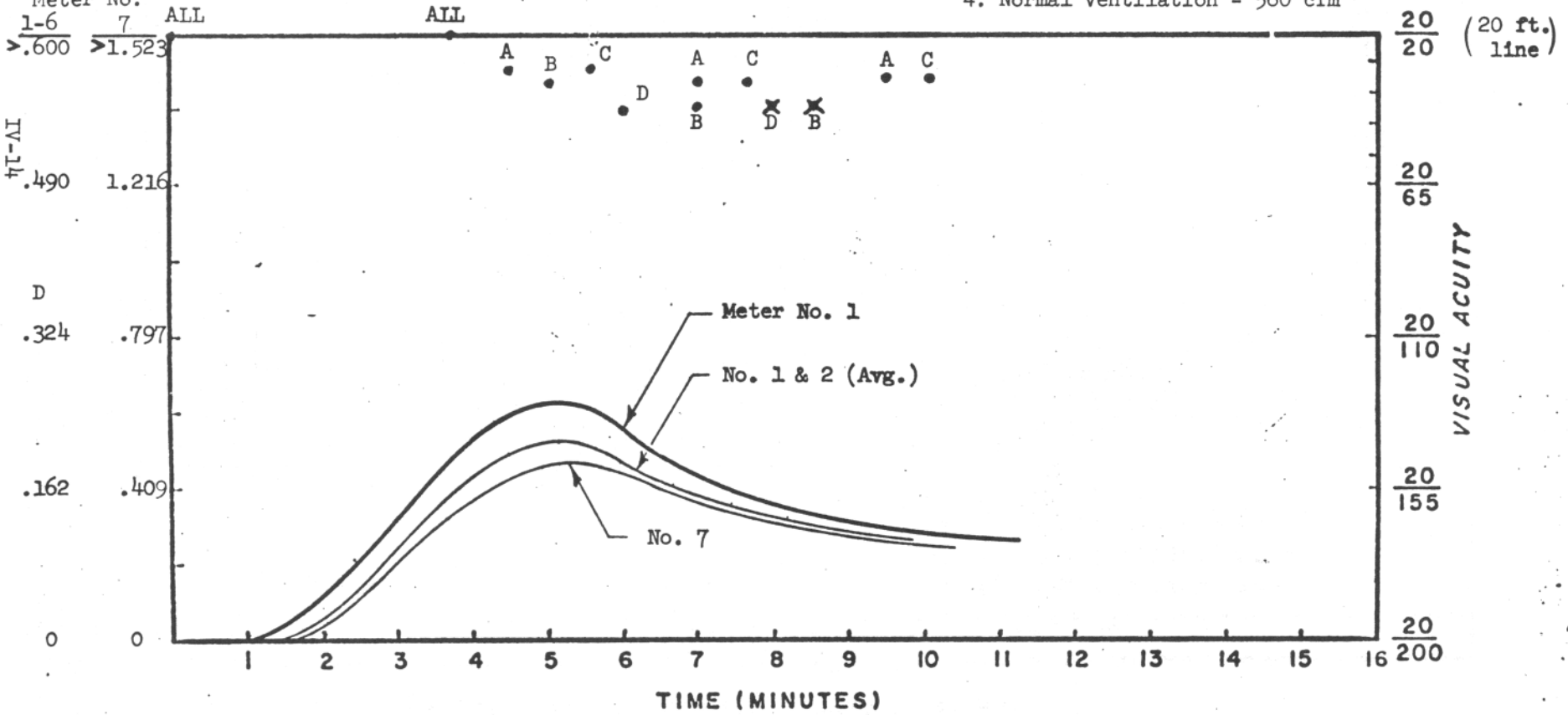
☒ FLAMING CONDITION	☒ 2.2 BTU/FT^2 - SEC
☐ NON-FLAMING CONDITION	☐ 3.3 BTU/FT^2 - SEC
☐ KINDLING CONDITION	☐ NONE

REMARKS:
1. Meter No.(s) refer to figures 11 & 12
2. x - subject(s) out of booth
3. Specimen Location No. 1
4. Normal ventilation - 560 cfm



MOCKUP VENTILATION/VISIBILITY TEST

CATEGORY 8A	MATERIAL CATEGORY CARPETING
100% FR wool, latex backing, 0.37 in. thick, 1 ft^2	A - EYES PROTECTED B - EYES UNPROTECTED C - EYES PROTECTED D - EYES UNPROTECTED
☒ FLAMING CONDITION ☒ 2.2 BTU/FT^2 - SEC ☐ NON-FLAMING CONDITION ☐ 3.3 BTU/FT^2 - SEC ☐ KINDLING CONDITION ☐ NONE	REMARKS: 1. Meter No.(s) refer to figures 11 & 12 2. x - subject(s) out of booth 3. Specimen Location No. 1 4. Normal ventilation - 560 cfm



MOCKUP VENTILATION/VISIBILITY TEST

CATEGORY 10(B)	MATERIAL CATEGORY ELASTOMER
FR silicone rubber, 0.06 in. thick, 59.8 oz/yd^2, 1.0 ft^2	A - EYES PROTECTED B - EYES UNPROTECTED C - EYES PROTECTED D - EYES UNPROTECTED
☒ FLAMING CONDITION ☒ 2.2 BTU/FT^2 - SEC ☐ NON-FLAMING CONDITION ☐ 3.3 BTU/FT^2 - SEC ☐ KINDLING CONDITION ☐ NONE	REMARKS: 1. Meter No.(s) refer to figures 11 & 12 2. x - subject(s) out of booth 3. Specimen Location No. 1 4. Normal ventilation - 560 cfm