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TOXICITY OF THERMAL DEGRADATION PRODUCTS OF SPACECRAFT MATERIALS

Report to
NASA JOHNSON SPACE CENTER
HOUSTON, TEXAS 77058

Contract Number	NAS 9-15670
Period Covered by Contract	November 10, 1980 to May 9, 1982
Date of Report	May 7, 1982
Report Prepared by	W.H. Lawrence, Ph.D. Associate Director and Head, Animal Toxicology Section
Report Submitted by	John Autian John Autian, Ph.D., Director Materials Science Toxicology Laboratories University of Tennessee Center for the Health Sciences Memphis, Tennessee 38163

Note! The contract specifies separate reports for materials tested under the spacecraft and aircraft procedures. This year, however, all materials submitted for evaluation were for the same (aircraft) testing protocol, as modified.

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May 7, 1982

Investigators: John Autian, Ph.D.
W. H. Lawrence, Ph.D.
J. E. Turner, D.D.S.
Caroline Sanford
Sam Foster
Eula Baldwin
Jacqueline O'Connor

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Abstract

Three polymeric materials were evaluated for relative toxicity of their pyrolysis products to rats by inhalation. These materials were : Y-7683 (LS 200), Y-7684 (Vonar 3 on Fiberglass), and Y-7685 (Vonar 3 on N W Polyester). Criteria employed for assessing relative toxicity were (1) lethality from in-chamber pyrolysis, (2) lethality from an outside-of-chamber pyrolysis procedure [MSTL Procedure], and (3) disruption of trained rats' shock-avoidance performance during sub-lethal exposures to in-chamber pyrolysis of the materials.

The relative toxicity, based upon lethality, from in-chamber pyrolysis of these materials was: Y-7685 > Y-7684 > Y-7683. While the approximate LD_{50} for Y-7684 and Y-7683 was the same at 14 days, deaths occurred sooner after exposure with Y-7684 than with Y-7683.

The relative toxicity, based upon lethality, from the MSTL pyrolysis procedure ranks the materials as: Y-7684 > Y-7685 > Y-7683.

The relative toxicity, based upon detrimental effect to conditioned-avoidance performance of rats exposed to pyrolysates (in-chamber pyrolysis method) of these materials, would rank these samples as: Y-7684 > Y-7685 > Y-7683.

Introduction

This work is a continuation of previous studies to assess the relative toxicity, as expressed by lethality and alterations in trained (conditioned) behavior, to rats of pyrolysis/combustion products of spacecraft materials. While the experimental design still emphasizes the role of carbon monoxide in the overall pyrolysate toxicity (by analysis of exposure chamber atmosphere for carbon monoxide concentration and determination of percent carboxyhemoglobin in rats dying in the chamber), the changes in conditions for pyrolysis/combustion (to an in-chamber thermodegradation) of test samples prevents direct comparison of these toxicity data with much of the data contained in previous reports.

The pyrolysis/combustion process can apparently exert a significant influence upon the absolute toxicity, and probably upon relative toxicity, of the pyrolysis/combustion products produced. Some of the previous toxicity data obtained from spacecraft materials utilized a controlled slow heating rate for thermodegradation outside the exposure chamber, and continuous air-flow through the chamber during pyrolysis and post-pyrolysis exposure (the MSTL procedure). The theoretical rationale usually stated in support of <u>in-chamber</u> pyrolysis/combustion is based upon the concern that some toxicity is lost due to condensation/precipitation of some thermodegradation products from external pyrolysis/combustion prior to entering the exposure chamber. If this were true, then there would be a reduction in the observed toxicity from such externally produced pyrolysis/combustion products when compared to in-chamber pyrolysis.

An earlier report (1) presented toxicity data from a limited number of samples that were evaluated both by in-chamber pyrolysis procedure and by the MSTL procedure (as mentioned above). Although it was apparent that condensates did occur prior to entrance of pyrolysates into the exposure chamber, lethality data did not support the concept that these "high boiling" condensates significantly contributed to the lethality of the pyrolysis/combustion products. The data, in fact, indicated the pyrolysis/combustion products produced by the MSTL (outside of chamber) procedure were more toxic than those produced by the in-chamber method in every instance where there was comparible data. This phenomenon might be due to the formation of different gaseous products by the slower rate of thermodegradation (by the MSTL method) and/or a longer exposure period (used in the MSTL procedure).

The in-chamber thermodegradation procedure used in the current study does not permit the slow rate of degradation, as used in the MSTL procedure, because of (a) the need to prevent excessive temperatures (i.e., no greater than 35°C) within the animal exposure chamber, and (b) the fixed volume of air (i.e., static environment during pyrolysis and subsequent exposure) contained in the animal exposure chamber may produce hypoxia in the experimental animals (independent of pyrolysate toxicity) as a result of longer sojourns of animals in chamber, coupled with depletion of oxygen by pyrolysis/combustion of the test samples.

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[1]W.H. Lawrence and John Autian, "Toxicity of the Pyrolysis Products of Spacecraft Materials", Annual Report to NASA Johnson Space Center, July 25, 1978, p. 45.

The preceeding discussion should be kept in mind in evaluating the subsequent data. These comments may also help to understand why it was sometimes necessary to conduct the experiment or test in a particular manner.

Purpose of Work. The primary objective of this work was to obtain information about the relative toxicity of thermodegradation (pyrolysis/combustion) products of spacecraft materials supplied by the Technical Monitor. The primary procedure used was an in-chamber pyrolysis of the sample to determine its lethal potential, and then to examine the effects of the pyrolysates upon operant conditioned behavior of trained rats from sub-lethal exposures. At the request of the Technical Monitor, lethality of pyrolysates from these samples was also determined by the MSTL procedure. The lethal activities of the pyrolysis/combustion products were evaluated based upon the acute lethality of rats from inhalation of these pyrolysates. Post-exposure observation of the rats, coupled with histological evaluation of selected organs, serve to screen the materials for significant delayed toxic reactions resulting from inhalation of their pyrolysis/combustion products. Also, determination of carbon monoxide concentrations in the chamber atmosphere during exposure, and percent carboxyhemoglobin in animals expiring in the chamber, provide some basis for assessing the importance of carbon monoxide as a toxicant in the pyrolysis/combustion mixture. Oxygen concentrations in the chamber were also measured to ensure hypoxia was not the cause of death.

Materials and Methodology

Materials. The code designations and description of the test samples, as supplies by the Technical Monitor, included in this study are presented in Table 1. Also included in this table is the approximate temperature necessary for thermodegradation of each sample and the percent of the sample which is expected to be pyrolyzed. This information is based upon TGA data.

Method of Sample Pyrolysis/Combustion - In-Chamber Pyrolysis Procedure. All samples were pyrolyzed/combusted directly into the rat exposure chamber [198 liter (0.2 M^3)] using an electric furnace, and all products mixed thoroughly with the chamber atmosphere by an electric fan located inside the exposure chamber. An experimental constraint which influenced pyrolysis/combustion of samples was that of chamber temperature, i.e., the chamber temperature was not to exceed 35°C (95°F). To accomplish this, the sample was pyrolyzed rapidly (~10 minutes) at 700-800°C and the furnace removed from the chamber to reduce added heating of the chamber atmosphere from the furnace as it was cooling (i.e., after thermodegradation).

The furnace contains heating elements embedded in a high temperature ceramic type material which were located in the bottom and four sides of a rectangular chamber 3" x 3" x 5". These heating elements have a maximum temperature rating of 1,200°C, thus exceeding the 1,000°C capability which we desired. A removable stainless steel rectangular cup, with internal dimensions of 2.5" x 2.5" x 4.5", was constructed to fit closely inside the space formed by the heating elements. Since this furnace requires a considerable time to pyrolyze a sample starting at room temperature, pyrolysis was accomplished by pre-heating the furnace (outside of the chamber) to about 700-900°C, then placing the stainless steel cup (containing the test sample)in the furnace opening, and immediately placing the furnace and sample in position to pyrolyze the sample directly into the rat exposure chamber. When pyrolysis was completed the furnace was removed from the exposure chamber to prevent additional heating of the chamber atmosphere by radiation from the furnace. The time required for thermodegradation, and the increase in chamber temperature, varied depending upon sample and quantity of sample. In most cases, however, this could be accomplished and still maintain the chamber temperature less than 35°C (95°F). An advantage to this system is that it permits relatively accurate determination of sample residue.

MSTL Procedure. Four male rats in small individual cages were placed in the rectangular, glass-walled exposure chamber (volume = approximately 64 liters). The chamber was equipped with an external light for illumination, an internal YSI thermister probe for monitoring chamber temperature, and a magnetically-driven fan to prevent air stagnation and layering of pyrolysis products. The test sample was placed in a Vycor tube inside a programmed electric furnace, with a thermocouple adjacent to the sample which controls heating of the furnace. One liter per minute of air was introduced at the end of the Vycor tube, passed over the pyrolyzing sample and into the exposure chamber. Prior to the pyrolysate entering the inhalation chamber, 0.5 liter/minute of fresh air was added to the effluent. The furnace was heated at 10°C/minute until it reached the temperature of maximum decomposition (as determined by TGA data) plus 50°C. At this point, the furnace was turned off and air-flow continued for an additional 60 minutes; then the chamber was opened and the animals removed. A gas sampling port was located immediately upon exit of the fumes from the inhalation chamber prior to their being exhausted.

COHb Determination. Carboxyhemoglobin determinations were conducted spectrophotometrically, using a modification of the method of Commins and Lawther (2). Earlier experiments with this and other methods indicated that excessive dilution of the blood prior to analysis yielded lower calculated percentages of COHb in the blood; presumably this is due to dissociation of COHb in the dilute solution ($COHb \rightleftharpoons CO + Hb$). Thus, the modifications employed were to permit spectrophotometric analysis without undue dilution of the blood sample. The Commins and Lawther method was used with the following modifications: (a) 40 µl of blood (rather than 10 µl) was used per 10 ml of reagent (rather than 25 ml), and (b) a cell path of 0.1 cm (rather than 1.0 cm) was employed. Thus, the solution for analysis was 10 times more concentrated, and the cell path for analysis was one-tenth that recommended by Commins and Lawther. Analyses were performed at a wavelength of 420 nm, with readings at 414 and 426 nm for purposes of correction. Concurrent COHb and O_2Hb controls were tested, in which the rat's blood was saturated with gas from tanks of CO and O_2, respectively.

Thermogravimetric Analyses (TGA). The thermodegradation

[2] B.T. Commins and P.J. Lawther, "A Sensitive Method for the Determination of Carboxyhemoglobin in a Finger Prick Sample of Blood". Brit. J. industr. Med., 22:139-143 (1965).

characteristics of each sample were determined in air and nitrogen. This provided general information about the temperature required to initiate degradation, to complete degradation, expected percent degradation, and some indication of the importance of oxidative processes for degradation.

LD_{50} Determinations. The lethality of each sample was determined by pyrolyzing specific weights of sample and exposing a group of 4 male Sprague-Dawley rats to the pyrolysates for 30 minutes after completion of pyrolysis of each sample weight. LD_{50}s were calculated for the samples based upon chamber deaths, deaths occurring within 48 hours, and those occurring within the 14-day post-exposure observation period. The chamber atmosphere was analyzed for selected gases by use of gas detector tubes or gas chromatography, or both. Carboxyhemoglobin (COHb) levels were determined in rats which died in the chamber. Animals were autopsied when they died, or were sacrificed after 14-days, and tissues from most of these preserved in buffered formalin, and subjected to histopathologic evaluation. The actual LD_{50}, expressed as initial weight of sample, which when pyrolyzed by this method would kill 50% of exposed rats, was calculated by Cornfield and Mantel's modification of Karber's method (3).

Behavioral Studies. The subjects were adult male Sprague-Dawley rats (about 275-325 gm), which were identified by color and cage number and housed individually in stainless steel cages. They had free access

[3] J. Cornfield and N. Mantel, "Some New Aspects of the Application of Maximum Likelihood to the Calculation of the Dosage Response Curve", American Statistical Association Journal, 45: 181-210 (1950).

to fresh tap water and laboratory rat chow. The behavioral apparatus (shock chamber) was approximately 7.5 x 9.5 x 7.75 inches, with a Gerband lever mounted in one end. The floor and two sides of the shock chamber consisted of 1/16" diameter stainless steel rods, mounted about 0.5 inches apart, and connected to a shock source and shock scrambler. This shock chamber was placed inside the inhalation exposure chamber used in the LD_{50} studies, which has a volume of approximately 200 liters (198 liters).

The rats were trained on a Sidman avoidance schedule, with a shock-shock interval of 5 seconds, and a response-shock schedule interval of 20 seconds. The shock duration was 0.5 seconds, with an intensity of 1.3 milliamps. Thus, if the rat did not press the lever at all, he would receive 12 shocks/minute, but appropriate lever presses would permit complete avoidance of shocks. During training, each rat was placed in the apparatus for one hour per day. When the average number of shocks an animal received during the hour was 2.5/minute or less, and the response rate was stable for 2 consecutive days, he was considered for use as a test subject. This usually occurred in about 2 weeks and animals that failed to reach this criterion were rejected from the study.

After training, the first stage of testing consisted of two 70 minute sessions held on two consecutive days (Days 1 and 2), during which cumulative shock avoidance rates were monitored every 10 minutes. If, during the first session, a subject's rate of avoidance decreased so that he received an increased number of shocks over any 20 minute period, he was returned to the training conditions until his performance was stabilized. He was then retested. The purpose of these sessions was to obtain a reasonably stable baseline measure against which the performance on the day of pyrolysis testing could be assessed.

On the day of pyrolysis testing, the rat was placed in the behavioral apparatus and a 30-minute control performance was obtained. If the rat's avoidance performance was adequate and reasonably stable during this time, this was used as a pre-burn control (or response for the pre-burn period) and the experiment was continued. However, if the rat's avoidance behavior was inadequate or very unstable, the sample was not burned, and the rat was returned to training or discarded. If this pre-burn control was satisfactory, the chamber door was secured and the designated sample was pyrolyzed/combusted in the chamber. The animal's shock-avoidance performance during pyrolysis/combustion was recorded, and at 5 minute intervals for the ensuing 30 minutes while the inhalation chamber remains closed.

The pre-burn control period was a minimum of 30 minutes, and frequently a little longer; the duration of pyrolysis/combustion was about 10 minutes (8-15 minutes) depending upon the sample. The maximum temperature in the chamber was kept from exceeding 35°C (95°F). In each instance, the rat's performance was monitored and recorded for at least 30 minutes after completion of pyrolysis/combustion.

As a basis for comparison of "equivalent" non-lethal exposures, one half (½) of the LD_{50} sample weight was chosen as the basis for comparison. Because of the lack of a chamber LD_{50} for two samples and the rough approximation obtained for the 14-day LD_{50}, various quantities of samples were pyrolyzed for the behavioral evaluation; at least one of which approximated one-half of the LD_{50}. Each sample material was tested by exposing four trained rats to its pyrolysate. Assignment of a particular rat to a specific sample and order of testing was semi-random, determined by appropriate information about the sample, the trained rats available, and the needs for obtaining a block of tests for the sample. Each rat was exposed to a pyrolysate of only one sample (experimental run).

Results and Discussion

Thermogravimetric Analyses (TGA). Computer plots of the thermal stability/thermodegradation of these materials are shown in Figures 1-6. A summary analysis of each of these plots is presented in Table 2. Although none of these sample material were completely degraded at temperatures between 900°C and 1,000°C, thermal degradation of the samples appeared to cease at a temperature of 600°C or less.

Lethality Studies. Tests were conducted by both the in-chamber pyrolysis procedure and the MSTL procedure to assess the relative lethality of pyrolysates from these test samples. The initial sample weights, which when pyrolyzed according to their respective procedures, required to kill 50% of the exposed animals (i.e., LD_{50}) and their respective 95% confidence intervals, are presented in Table 3 for both the In-Chamber Pyrolysis and MSTL Procedures. This table shows the LD_{50} values for chamber deaths, deaths within 48 hours of exposure, and deaths within 14 days of exposure.

For the in-chamber pyrolysis it was not possible to obtain an LD_{50} for chamber deaths for samples Y-7683 and Y-7684 using up to 50 and 56.57 gm of sample, respectively. The size of the pyrolysis cup would not permit pyrolysis of significantly larger quantities of the samples. Only one rat died within 48 hours after removal from the inhalation chamber after exposure to pyrolysate from sample Y-7683, with most deaths coming several days after exposure. On the other hand, all of the deaths from Y-7684 occurred within 48 hours after exposure. Sample Y-7685 produced a more ideal pattern of deaths, and all of these occurred in the chamber. Thus, it was possible to obtain a good LD_{50} value for Y-7685, but the values obtained for the other two samples by this procedure must be considered as approximations. Table 4 summarizes the cumulative mortality pattern obtained from in-chamber pyrolysis of the three samples. The test data utilized to calculate the LD_{50} are indicated in this table; constraints imposed by the Karber's method of LD_{50} calculation prohibit use of all of these data.

Table 5 presents a summary of lethality data obtained by the MSTL pyrolysis procedure, and indicates those employed in calculation of the LD_{50} for these three samples. It will be noted in this case, all deaths occurred in the chamber. And, as mentioned earlier for prior comparison of toxicity from in chamber *vs.* outside of chamber pyrolysis, none of these samples were more toxic when pyrolyzed in the chamber, than when pyrolyzed outside the chamber with the pyrolysates flowing into the chamber.

To facilitate comparisons of relative toxicity of the test materials and the two methods of pyrolysis-exposure, Table 6 summarizes and extrapolates data contained in Tables 3, 4 and 5, to remove differences of percentage pyrolyzed by presenting the LD_{50}s in terms of the *quanity of sample pyrolyzed* rather than initial sample weight, and then removes differences in chamber size by calculating it in terms of *per liter* and *per cubic meter*.

The concentrations of selected gases in the exposure chamber during the LD_{50} determinations from the in-chamber pyrolysis procedure are summarized in Table 7, and for the MSTL procedure in Table 8. The results of histological examination of selected tissues of rats dying during exposure to pyrolysates during the 14-day observation period, or which were sacrificed at the end of the 14-day observation are tabulated for the in-chamber pyrolysis procedure in Table 9, and for the MSTL procedure in Table 10. Histopathologic findings from some untreated control rats are presented in Table 11. Brief summary descriptions of observed histological features which, in the opinion of the pathologist were likely related to pyrolysate exposure, along with a summary description of gross autopsy observations, are contained in Table 12 for the in-chamber pyrolysis procedure and in Table 13 for the MSTL procedure.

As indicated previously, it was not possible to calculate an in-chamber LD_{50} for samples Y-7683 and Y-7684 when the material was pyrolyzed in the exposure chamber, although quantities of 50 gm or more were pyrolyzed (see Table 4). All delayed mortalities from exposure to pyrolysates of Y-7684, however, occurred within 48 hours post-exposure. On the other hand, only one of the ten delayed deaths seen with Y-7683 occurred within 48 hours following exposure; most of the deaths occurred between the 7th and 11th post-exposure days, with one on the 5th day and another on the 14th day. Although the estimated 14-day LD_{50} is the same for these two samples (Y-7683 and Y-7684), the mortality pattern is dramatically different.

An interesting response occurred when behavioral tests were initiated with sample Y-7684, and to a lesser extent with Y-7683. Although determination of the LD_{50}s for these samples yielded only a rough approximation, when behavioral tests were initiated with quantities of sample which were well below that required for chamber deaths in the LD_{50} studies, a number of rats died in the chamber or immediately after removal. [Histopathologic examination of tissues from two behaviorally trained rats that died from exposure to pyrolysates of Y-7684 is presented in Table 14.] Initially, we thought this was due to some experimental error in obtaining data for the LD_{50}. We began to repeat the LD_{50} determination for Y-7684, but this gave no new information since the repeated data was comparable to the initial data.

A few pilot tests were performed to examine this unusual response. Since the rats used in the behavioral studies were typically older and heavier than those used for LD_{50} determinations it was decided to see if this might be responsible for the unexpected mortalities. Two experiments were conducted in which three untrained rats of the size used in LD_{50} studies, were put in the shock chamber (with the shock-avoidance lever disconnected) and placed in the pyrolysis-exposure chamber. Table 16 shows the data obtained when 20 grams of Y-7684 were pyrolyzed into the chamber while the rats were receiving the same shock used in the avoidance procedure; all six of these rats died in the chamber. (It might be pointed out that pyrolysis of up to 56.57 gm of this sample had failed to produce any chamber deaths in the LD_{50} studies.) Table 14 shows the histopathology for 5 of these 6 rats exposed to the pyrolysis products while receiving shocks.

As shown in Table 17, five additional experiments were performed in which 15 or 20 gm of Y-7684 was pyrolyzed with 4 rats in the exposure chamber, 2 of which were in the shock box and 2 were not. In the first trial where 15 gm of Y-7684 was pyrolyzed, the two rats receiving the shock died in the chamber, while the two not receiving the shock survived the chamber exposure and the 14-day post-exposure observation period. In the second trial with the same material and quantity, one of the two rats receiving shock died in the chamber and the other died within 48 hours, but neither of the two rats not receiving shock died. Thus, these data suggest a synergistic (potentiating) effect upon lethality between the sub-lethal shock and sub-lethal pyrolysate exposure.

Although this phenomenon was first brought to our attention by death of some of the rats in the behavior studies which were exposed to 20 gm of Y-7684, similar paired (2 rats receiving shock during exposure and 2 rats not receiving shock) tests with pyrolysis of 20 gm samples did not provide such clear-cut evidence (see Table 17). In the first trial none of the animals died within 48 hours; the other three rats surviving the entire 14-day post-exposure period. The second trial resulted in all

4 rats dying in the chamber. The third trial did not produce any chamber deaths, but one rat receiving the shock and one without the shock died within 48 hours; the other two survived the 14-day observation period. Histopathologic evaluation of tissues from most of these rats is presented in Table 14.

With the exception of data discussed in the preceeding paragraph, the accumulated results (including death of some rats during behavior testing which are not tabulated in this report because death occurred so early no behavioral data, from exposure to sub-lethal pyrolysates of the material were included) strongly suggest an increase in toxicity (lethality) of the pyrolysates from Y-7684 when this is combined with a sub-lethal electric shock (or the stress resulting therefrom). If this increased toxicity is real, and most data support the assumption, one can only speculate at this time what the mechanism of action may be. Some of the possibilities include: (1) a component of the pyrolysate may sensitize the heart to endogenous hormones (e.g., adrenaline) released during the trauma/stress of the shock; (2) critical areas of the brain may be sensitized by a component of the pyrolysate which make them more sensitive to CO, HCN, or other toxicant present at (otherwise) non-lethal levels; or (3) an interaction between some pyrolysis product and other shock-induced internal hormonal or metabolic disturbances not noted in the absence of the shock. Initially, the possibility of prolonged stress, from shock-avoidance training, was considered as a likely alternative explanation, but the chamber deaths which occurred with untrained rats would tend to decrease the probability of this being the explanation.

Behavioral Studies. In the ensuing discussion the samples are identified by code numbers; these are presented in Table 1. Because of the lack of good LD_{50} values for two of these samples by in-chamber pyrolysis, as indicated previously, three or four initial sample weights of the samples were utilized in the behavioral studies, one of these was (or approximated) one-half of the sample's LD_{50}.

Definition of terms. In the discussion, Day 1 refers to the first of two pre-test days of behavioral activity, and Day 2 refers to the second of the two pre-test days of behavioral activity. Day 3 is the day on which the pyrolysis-behavioral test is performed. Day 3 may be subdivided into 7 time intervals of 10 minutes each; interval 1, 2 and 3 represent the 30 minute control performance of the rat prior to pyrolyzing the test sample in the chamber. Interval 4 is the period during which the sample is pyrolyzed. Intervals 5, 6 and 7 are the three 10-minute post-burn (post-pyrolysis) periods during which the animal's behavior is scrutinized to see if there are changes in the animal's performance (response). Comparisons of time intervals to Days 1 and 2 represent a similar division of time, but no sample is pyrolyzed nor is furnace heat introduced during these two pre-test days.

Nine groups of 4 rats each were employed in the behavioral evaluations. The group of trained rats exposed to pyrolysates of the materials, the material used, and the initial sample weight of the material are listed below for each group. The sample weight representing, or approximately one half of the

LD_{50} for that test sample as indicated by "*".

Group 1 = 10 gm of Y-7683	Group 6 = 5 gm of Y-7684
* Group 2 = 15 gm of Y-7683	Group 7 = 10 gm of Y-7684
Group 3 = 20 gm of Y-7683	* Group 8 = 15 gm of Y-7684
* Group 4 = 10 gm of Y-7685	Group 9 = 20 gm of Y-7684
Group 5 = 15 gm of Y-7685	

Results. The performance of each rat on the shock-avoidance schedule for at least 30 minutes preceeding pyrolysis of test sample and for 30 minutes following sample pyrolysis (referred to as Day 3) is shown graphically in Figures 7-42. . While the pre-test controls (Days 1 and 2) are not presented here, the data were entered in the computer for statistical analysis and comparisons, and mean pre-test responses for the group are contained in summary graphs by groups (Figures 43-51).

Analyses and Discussion. The data were analyzed by Analysis of Variance for Unweighted Means with factors of Groups (9 levels), Days (3 levels), and Times (7 levels). Groups, Days and Times (time intervals) were defined above.

Significant differences were found for all Main and Interaction effects as shown below:

Analysis of Variance Summary Table

Source	Sum of Squares	DF	Mean Square	F-Ratio	Prob
Group(A)	138.413	8	17.3017	3.478	0.007142
Between Error	134.307	27	4.97433		
Run (B)	1217.55	2	608.776	272.093	0.000000
AB	309.738	16	19.3586	8.652	0.000001
Within Error 1	120.819	54	2.23738		
Time (C)	589.552	6	98.2587	101.748	0.000000
AC	163.106	48	3.39804	3.519	0.000001
Within Error 2	156.445	162	0.965710		
BC	1525.06	12	127.088	115.714	0.00000
ABC	301.006	96	3.13548	2.855	0.00000
Within Error 3	354.751	323	1.09830		

Results of Newman-Keul's post hoc test for significance showed no difference between Day 1 and 2 (baseline testing). These baseline measures, averaged across groups are shown in Table 18. Comparisons among animals exposed to pyrolysates of the three samples tested are summarized in Table 19, which presents means and standard deviations for each group on Day 3 (exposure), broken down into pre-burn, burn (pyrolysis), and post-burn blocks.

For purpose of evaluating the behavioral effects of each sample weight, data for each group during each time interval was factored for a comparison over days. Table 20 summarizes the results of post hoc tests for significance of these data.

Data analysis for each of the 9 groups indicated there were no significant differences between any 10 minute time interval on Days 1 and 2 (i.e., pre-test baseline controls), as shown in Table 18. Performance of the rats during the 30 minute pre-burn period (intervals 1, 2 and 3) of the test day (Day 3) did not differ from similar periods of either Days 1 or 2 (baseline controls) as shown in Table 19. Thus it was indicated that the baseline response was suitably stable to proceed with comparisons of materials' pyrolysates upon behavior of the rats.

Summary figures by rat groups (i.e., sample and sample weight) were prepared in which the mean of all rats in this group for the two day baseline responses (Days 1 and 2) are plotted vs. time and on the same figure is the mean response of these animals preceeding, during and after pyrolysis of the sample (Day 3). These are figures 43-51.

Sample Y-7683 The LD_{50} for this sample was estimated at between 30-40 grams (see Table 4). Since two of the rats exposed to 20 grams for behavioral testing died shortly after testing was completed, tests were repeated with exposures to 15 and 10 grams of the sample.

Group 1 (Sample Y-7683, 10 grams)

Decreased performance was noted for all animals during and after the burn period with only one animal returning to preburn performance level within the last 10 minutes. However, the only statistically significant difference was at the 0.05 level between days two and three during the 6th (10-20 minute postburn) interval. The shock-avoidance behavior for this group, presented as mean values, of Days 1 and 2 (baseline control = triangles) and of pre-burn, burn and post-burn periods (Day 3, experimental = circles) is graphically represented in Figure 43, while the individual rats' performances before, during and after pyrolysis are shown in Figures 7-10.

Observations: Thick yellow smoke prevented observation during the burn period. In the 10 minute postburn period animals remained near the lever and were observed standing on their hind legs with no unusual behavior noted. During the 10-20 minute observation period more activity was noted, with mild loss of coordination in half the animals. Postural slumping was noted in three. During the 20-30 minute observation, coordination worsened for the two noted previously although lever response returned to baseline levels for one of these. During this period all animals spent more time on all four feet than is usual in this situation, with crouching noted for three. Although lever pressing decreased, all animals continued to flinch and orient toward the lever when shocked.

Group 2 (Sample Y-7683, 15 grams) [approximately ½ of 14-day LD_{50}]

There was a worsening of performance during the post-burn period. However during the last interval, half of the animals' performance improved markedly. Statistically significant differences at the 0.01 level were noted between days one and three and between days two and three during the 5th (0-10 minute post-burn) interval and at the 0.05 level between days one and three and days two and three during the 6th (10-20 minute postburn) interval.

Observations: Dense smoke with some flame was noted during the burn period. The initial response overall was increased activity with attempts to escape. Some weakness with convulsive breathing was noted. Two of the animals remained ambulatory. One appeared to be very weak by the end of the burn period, propping himself against the chamber wall to press the lever. These animals responded with movement to all shocks and no loss of coordination was noted. The fourth animal appeared to be stuporous by the 5th interval, responding to shock only occasionally, and ended the session lying on the floor of the chamber motionless. He recovered spontaneously when the chamber was flushed with air.

Responses of individual rats in this group are presented in Figures 11-14. The mean responses for this group are presented in Figure 44.

Group 3 (Sample Y-7683, 20 grams)

Performance deteriorated radically during the postburn period with no lever press response for any animal during the last 10 minutes.

For the 5th, 6th and 7th intervals, there were significant differences at the 0.01 level between days one and three and days two and three.

Observations: Dense smoke (white in 3 observations, black in one) was noted with some flame. After clearing, animal B-1 was observed to lie still with no response for 15 minutes, while the other three engaged in frantic escape attempts. After 15 minutes this animal (B-1) rose, moved around the chamber, and flinched when shocked although he made no attempt to press the lever. He became normally active when the chamber was flushed. B-14 became less active after 10 minutes and by 20 minutes remained prone with labored breathing and no responsiveness to shock. He recovered fully during chamber flushing. B-15 and B-3 made active escape attempts during the first 10 minutes, then became discoordinated and failed to orient toward the lever when shocked. B-15 then lost all responsiveness to shock by 20 minutes and remained lying down with labored breathing while B-3 continued to attempt to rise when shocked but was unable to support his own weight. Both B-3 and B-15 died during flushing of the chamber.

Data from individual rats in this group are shown in Figures 15-18, and group means are shown in Figure 45.

General summary for Sample Y-7683:

For lowest concentrations, loss of coordination with some weakness affected performance, but animals remained responsive to shock and recovery of learned avoidance behavior occurred. At middle concentrations weakness and difficult breathing occurred. Three animals recovered the learned response while one became stuporous until the chamber was flushed. At the highest concentration learned response was lost by all subjects. One was initially rendered stuporous but recovered some activity after 15 minutes, while the other 3 went from frantic activity to helplessness. Two of these died as the chamber was flushed.

Group 4 (Sample Y-7685, 10 grams) [½ of chamber and 14-day LD_{50}]

Differences significant at the 0.05 level were found between days one and three and two and three during the 4th (burn) interval and for the 5th, 6th and 7th intervals, these differences were significant at the 0.01 level.

Observations: Thick white smoke was produced in this burning. All animals were ambulatory and oriented toward the lever during the first 10 minute postburn interval. During the 10-20 minute interval (interval #6) some discoordination was noted for three of the animals with some reduced responsiveness to shock. Three of the animals spent much of the time lying down while the fourth lunged at the lever when shocked. This animal regained some coordination while the others became less active as the session progressed. Overall there was never complete loss of responsiveness.

Data from individual rats in this group are shown in Figures 19-22, while group means are shown in Figure 46.

Group 5 (Sample Y-7685, 15 grams)

A difference, significant at the 0.05 level, was found for interval 4 (burn) between days two and three. For the 5th, 6th and 7th interval differences were found between days one and three and days two and three which were significant at the 0.01 level.

Observations: Dense white smoke occurred during the burn, making observation impossible. At 0-10 minutes postburn all animals spent time walking and rearing toward the lever. General disorientation was apparent. Decreasing coordination and loss of orientation toward the lever was progressive for all. By 15 minutes postburn animals began to spend most of the time lying motionless on their sides and for the last 10 minutes all remained in this position. Recovery occurred rapidly when the chamber was flushed with fresh air.

Behavioral responses of individual rats in this group are shown in Figures 23-26, while group means are presented in Figure 47.

General summary for Y-7685:

The pattern of loss of learned response and general impairment was similar at both levels. However at the lower level one animal never became inactive, and some responsiveness to shock remained for all. At the higher level, incapacitation was more rapid and by 20 minutes after pyrolysis of samples all animals appeared insensitive to shock.

Sample Y-7684: Selection of appropriate level of exposure for comparative behavioral effects was very difficult because of (1) the absence of a good LD_{50} value and (2) deaths of rats occurring during the early behavioral tests. It can be noted in the lethality studies of this material that there were no chamber deaths in any group from pyrolysis from 10 to 56.57 grams. Within 48 hours there were several deaths, but these form a pattern of a very flat dose-mortality curve since pyrolysis of 20,30 and 40 grams killed 50% of exposed animals (although other runs with 20 and 40 grams failed to kill any of the animals), and 50 grams killed 100% of of the animals, but 56.57 grams killed only 50%. The second factor was the unusual finding that a number of rats died during the behavioral test with this sample (20, 15 and 10 gm). Therefore, 4 sample weights (5, 10, 15 and 20 gm) were examined for behavioral effects using this sample.

Group 6 (Sample Y-7684, 5 grams)

No significant differences were found between any intervals on any of the days for Group 6. There was a tendency for mean performance to decrease following the burn period since one animal's performance (B-28)declined rapidly during the last 20 minutes, decreasing from 84% shock-avoidance during the 5 minute postburn interval to 18% by the last 5 minutes. Another animal (B-29) fell from 75% avoidance to 35% during the last 10 minutes.

Behavioral responses of individual rats in this group are shown in Figures 27-30, while group means are presented in Figure 48.

Observations: Some flaming followed by dense white smoke was observed during the burn with visibility in the chamber poor. Throughout the postburn period no unusual behaviors were noted for the two animals (B-27 and B-30) whose avoidance behavior continued at baseline level. B-29 showed little reaction to shock although lever pressing remained steady at about 12% below preburn levels until the last 5 minutes. During this period the animal was observed to spend much of the time walking about the chamber. B-28 appeared unaffected until 10 minutes postburn, when he began to attend more to the chamber walls than the lever. By 20 minutes he showed some loss of coordination, spending more time on all fours away from the lever. However flinching and orientation toward the lever during shock did not decrease.

Group 7 (Sample Y-7684, 10 grams)

Differences significant at the 0.05 level were found for interval 4 (burn period) between days one and three and days two and three. For the 5th, 6th and 7th (postburn) intervals, differences were found between days one and three and days two and three which were significant at the 0.01 level.

Behavioral responses of individual rats in this group are shown in Figures 31-34, and group means are presented in Figure 49.

Observation: Thick white-grey smoke and some flame was noted. All animals except B-36 were ambulatory during the first postburn interval. These three began to lose coordination after 10 minutes, and decrease general activity. While B-24 leaned against the wall and continued to press the lever occasionally with little other response, B-25 and B-34 slowly lost all responsiveness and lay motionless on the floor for the last 10 minutes. B-36 followed the same pattern but was motionless by 15 minutes postburn. B-25 died before being removed from the chamber.

Group 8 (Sample Y-7684, 15 grams) [approximately ½ of 14-day LD_{50}]

A difference significant at the 0.05 level was found between days one and three and days two and three during the 1st interval. This was in the direction of increased efficiency on the 3rd day. The baseline average of 80% shock avoidance followed the pattern of all other groups. Significant differences at the 0.05 level were found between days one and three and days two and three for intervals 5, 6 and 7. These were in the direction of decreased avoidance on the third day (i.e., after pyrolysis of sample).

Observations: Two animals (B-21 and B-26) who appeared to be unconscious by the last 5 minutes of the postburn period were found to be dead when removed from the chamber. These animals were both responsive during the first 10 minutes postburn but soon lost all responsiveness and lay in the chamber having difficulty breathing. Both animals that lived lost some coordination after the first 10 minutes. One gradually lost the avoidance response and was lying on the chamber floor by 25 minutes although he continued to flinch to shock. The other lost coordination and remained in a slumping posture. However, he continued to lunge at the lever and although his manner of response was not normal he maintained effective avoidance.

Behavioral responses of individual rats in this group are shown in Figures 35-38, while group means are presented in Figure 50.

Group 9 (Sample Y-7684, 20 grams)

For interval 4, the burn interval, and interval 5, there was a statistically significant difference between days two and three and days one and three at the 0.05 level. For intervals 6 and 7 the same differences occurred at the 0.05 level.

Observations: Three of these animals died, two in the chamber during the last interval and one upon removal. Serious impairment became obvious after 10 minutes with loss of coordination, slumping and finally loss of all responsiveness. The animal that survived demonstrated almost the same pattern, with short bursts of recovery and lunging at the lever.

Behavioral responses to individual rats in this group are shown in Figures 39-42, while group means are presented in Figure 51.

General summary for Sample Y-7684

Increasing impairment in a dose-related fashion was seen, with 5 grams appearing to be somewhat effective (but not statistically significant), 10 grams highly significant, and 15 and 20 grams producing lethalities with behavioral impairment in the survivors.

Physical parameters.

The physical parameters involved in each of the behavioral tests are tabulated in Table 21. These are presented by rat groups and include identification of the animal and its weight, range of chamber temperatures during pyrolysis and exposure, the temperature to which the furnace was pre-heated prior to introducing the sample, the minimum furnace temperature after introducing the sample, the final furnace temperature at the end of pyrolysis (on removal), and the weight of residue.

RELATIVE TOXICITY OF SAMPLES

The relative toxicity of these samples was quite similar by the *in-chamber pyrolysis* method at the end of the 14-day post-exposure observation period, with overlapping 95% confidence intervals. On the other hand, Vonar 3 on N W Polyester (Y-7685) produced all deaths in the exposure chamber, while Vonar 3 on Fiberglass (Y-7684) produced its lethalities after removal from the chamber but within 48 hours, and LS 200 (Y-7683) exposure resulted in most deaths between 48 hours and 14-days. (The actual LD_{50}s for Y-7683 and Y-7684 must be considered as approximations.)

The relative toxicities of these samples were not greatly different from each other by the *MSTL procedure*, but the 95% confidence intervals were not overlapping. While differences were not great between samples, they can be ranked in order of decreasing toxicity as: Y-7684 (Vonar 3 on Fiberglass), Y-7685 (Vonar 3 on N W Polyester), and Y-7683 (LS 200). The relative ranking is the same whether one considers initial sample weight for the LD_{50} or whether one considers the actual quantity of sample pyrolyzed.

Ranking these samples according to decreasing detrimental effect upon conditioned-avoidance performance when exposed to one-half of the LD_{50} would be as follows: Y-7684 (Vonar 3 on Fiberglass), Y-7685 (Vonar 3 on N W Polyester), and Y-7683 (LS 200). Because of the problems in determining the LD_{50} values for two of these samples, and the large 95% confidence intervals, it is possible the relative toxicities may change with a more precise lethality exposure-response curve. Ranking of Y-7684 as most detrimental to the rats' behavioral performance was based partially upon death of some rats during or immediately after the test.

Table 1

IDENTIFICATION OF TEST SAMPLES

Code Number	Description of Test Sample	Maximum Temp. for Thermodegradation*	Residue*	Amount Pyrolyzed*
Y-7683	LS 200 (a neoprene plastic foam) A pink colored, spongy material such as might be used for seat cushions.	560°C.	44%	56%
Y-7684	Vonar 3 on Fiberglass A light, almost white spongy material (approx. 3/16") on a woven fiberglass backing.	590°C.	47%	53%
Y-7685	Vonar 3 on N W Polyester A light, almost white spongy material (approx. 1/4") on a polyester backing.	595°C.	32%	68%

---

*These are obtained from TGA pyrolysis in air. They are employed as approximations for the purpose of determining the relative completeness of pyrolysis during the LD_{50} and behavioral studies. However, because the LD_{50} and behavioral studies utilize much larger quantities of samples, heat distribution within the sample may be less uniform and the atmosphere immediate to the sample may be less oxidative thereby resulting in a larger residue than this idealistic value.

Table 2

Analysis of TGA Data

Sample No.	Y-7683	Y-7683	Y-7684	Y-7684
Identification	LS 200	LS 200	Vonar 3 on Fiberglass	Vonar 3 on Fiberglass
TGA Run No.	382	389	385	386
Atmosphere	Air	Nitrogen	Air	Nitrogen
Flow Rate	20 ml/min	20 ml/min	20 ml/min	20 ml/min
Heating Rate	20°C/min	20°C/min	20°C/min	20°C/min
Sample Weight	13.60 mg	13.36 mg	8.08 mg	9.06 mg
Initiation of Decomposition *	220°C	200°C	220°C	230°C
Completion of Decomposition *	560°C	530°C	590°C	575°C
Maximum TGA Temp.	870°C	961°C	920°C	955°C
Final Residue Wt.	60.4 mg	5.80 mg	3.76 mg	4.74 mg
Percent Final Residue	44%	43%	47%	52%
Temperature for 50% Degradation	500°C	490°C	525°C	Not attained
Percent Residue at 600°C	44%	45%	48%	56%

* Approximate Values

Table 2

Analysis of TGA Data

Sample No.	Y-7685	Y-7685		
Identification	Vonar 3 on N W Polyester	Vonar 3 on N W Polyester		
TGA Run No.	394	392		
Atmosphere	Air	Nitrogen		
Flow Rate	20 ml/min	20 ml/min		
Heating Rate	20°C/min	20°C/min		
Sample Weight	11.18 mg	10.06 mg		
Initiation of Decomposition *	220°C	250°C		
Completion of Decomposition *	595°C	600°C		
Maximum TGA Temp.	928°C	974°C		
Final Residue Wt.	3.56 mg	3.28 mg		
Percent Final Residue	32%	33%		
Temperature for 50% Degradation	475°C	465°C		
Percent Residue at 600°C	33%	34%		

* Approximate Values

Table 3

LD_{50} (and 95% Confidence Interval) Based Upon Initial Weight of Sample Pyrolyzed

Sample		Chamber Deaths	48 Hours	14 Days
*In-Chamber Pyrolysis Procedure**				
Y-7683	LS 200 (Foam)	> 50 gm (--)	> 50 gm (--)	28 gm ** (20-40)
Y-7684	Vonar 3 on Fiberglass	> 56 gm (--)	28 gm ** (16-50)	28 gm ** (16-50)
Y-7685	Vonar 3 on N W Polyester	19.95 gm (14.56-27.35)	19.95 gm (14.56-27.35)	19.95 gm (14.56-27.35)
*MSTL Procedure****				
Y-7683	LS 200 (Foam)	3.46 gm (3.36-3.56)	3.46 gm (3.36-3.56)	3.46 gm (3.36-3.56)
Y-7684	Vonar 3 on Fiberglass	2.69 gm. (2.58-2.80)	2.69 gm (2.58-2.80)	2.69 gm (2.58-2.80)
Y-7685	Vonar 3 on N W Polyester	3.09 gm (2.89-3.31)	3.09 gm (2.89-3.31)	3.09 gm (2.89-3.31)

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* Chamber volume is approximately 200 liters (198 L).

** These values should be considered as approximations since data on delayed deaths was not sufficient to obtain good estimates of the delayed LD_{50}.

*** Chamber volume is approximately 64 liters.

Table 4
SUMMARY
Cumulative Mortality

In-Chamber Pyrolysis

Sample	Sample Wt. (gm)	%Pyrolyzed	Cumulative Mortalities Chamber	48 hr	14 day
Y-7683	5*	60%	0/4	0/4	0/4
	10*	54%	0/4	0/4	0/4
	15	54%	2/4	2/4	2/4
	20*	50%	0/4	0/4	0/4
	25	54%	0/4	0/4	1/4
	30	49%	0/4	0/4	1/4
	40*	47%	0/4	0/4	4/4
	50	47%	0/4	1/4	4/4
		$\bar{X}$ =52%			
		$\bar{X}$*=53%			
Y-7684	10*	52%	0/4	0/4	0/4
	10	53%	0/4	0/4	0/4
	20*	54%	0/4	2/4	2/4
	20	50%	0/4	0/4	0/4
	30	44%	0/4	2/4	2/4
	40*	46%	0/4	2/4	2/4
	40	47%	0/4	0/4	0/4
	50	43%	0/4	4/4	4/4
	56.57	45%	0/4	2/4	2/4
		$\bar{X}$ =48%			
		$\bar{X}$*=51%			
Y-7685	10*	67%	0/4	0/4	0/4
	14.14*	63%	1/4	1/4	1/4
	20*	69%	2/4	2/4	2/4
	28.28*	58%	3/4	3/4	3/4
	40*	62%	4/4	4/4	4/4
	$\bar{X}$&$\bar{X}$*	=64%			

*Indicates data used in LD_{50} Calculations.

Table 5

Summary
MSTL Pyrolysis
Procedure

Sample	Sample Wt. (gm.)	%Pyrolyzed	Cumulative Mortalities Chamber	48 hr	14 day
Y-7683	3.12*	55%	0/4	0/4	0/4
	3.31*	56%	0/4	0/4	0/4
	3.51*	54%	3/4	3/4	3/4
	3.72*	56%	4/4	4/4	4/4
	3.94*	54%	4/4	4/4	4/4
	4.96	58%	4/4	4/4	4/4
	6.25	55%	3/4	3/4	3/4
	12.50	58%	4/4	4/4	4/4
	50.00	52%	4/4	4/4	4/4
		$\overline{X}$ =55%			
		$\overline{X}$* = 55%			
Y-7684	2.45*	53%	0/4	0/4	0/4
	2.60*	57%	1/4	1/4	1/4
	2.76*	58%	3/4	3/4	3/4
	2.93*	60%	4/4	4/4	4/4
	2.93	53%	1/4	1/4	1/4
	3.11*	51%	4/4	4/4	4/4
	3.30	56%	4/4	4/4	4/4
	3.50	53%	4/4	4/4	4/4
		$\overline{X}$ =55%			
		$\overline{X}$* =56%			
Y-7685	2.00	75%	0/4	0/4	0/4
	2.52*	68%	0/4	0/4	0/4
	2.68*	68%	1/4	1/4	1/4
	2.84*	69%	1/4	1/4	1/4
	3.01*	66%	2/4	2/4	2/4
	3.19*	70%	1/4	1/4	1/4
	3.38*	69%	3/4	3/4	3/4
	3.58*	68%	4/4	4/4	4/4
	4.03	66%	4/4	4/4	4/4
		$\overline{X}$ =69%			
		$\overline{X}$* =68%			

*Indicates Data used in LD_{50} Calculations.

Table 6

14 Day LD_{50} Values: Extrapolations and Standardized Comparisons

Sample		LD_{50}	Procedure**	Pyrolysate	LD_{50} of Pyrolysate	LD_{50} of per Liter	Pyrolsate* per M^3
Y-7683	LS 200 (Foam)	28 gm	In-Chamber	53%	14.8 gm	75 mg	74.9 kg
Y-7683	LS 200 (Foam)	3.46 gm	MSTL	55%	1.90 gm	30 mg	29.7 kg
Y-7684	Vonar 3 on Fiberglass	28 gm	In-Chamber	51%	14.3 gm	72 mg	72.1 kg
Y-7684	Vonar 3 on Fiberglass	2.69 gm	MSTL	56%	1.51 gm	24 mg	23.5 kg
Y-7685	Vonar 3 on N W Polyester	20 mg	In-Chamber	64%	12.8 gm	65 mg	64.6 kg
Y-7685	Vonar 3 on N W Polyester	3.09 gm	MSTL	68%	2.10 gm	33 mg	32.8 kg

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*This is not a direct measure of weight of pyrolysate, but rather represents the weight loss of the original sample during pyrolysis.

**Volume of chamber used for "in-chamber" pyrolysis was 198 liters (~6.2 M^3); volume of chamber used for the MSTL procedure was 64 liters (0.064 M^3).

Table 7

SUMMARY: In-Chamber Pyrolysis/Combustion Studies

Y-7683 (LS 200 Foam)

Sample Wt.	5 gm*	10 gm*	15 gm	20 gm*
Group	23	24	25	26
Cumulative Mortality[b]	0/4, 0/4, 0/4	0/4, 0/4, 0/4	2/4, 2/4, 2/4	0/4, 0/4, 0/4
% Pyrolyzed	60	54	54	50
$\overline{x}$ COHb[c]	n/a	n/a	54%	n/a
O_2 (GC)[d]	17.5/15.9/15.8	16.5/16.4/13.8	18.0/18.0/16.9	15.1/13.9/13.8
CO_2 (GC)[d]	0.18/0.34/0.46	0.45/0.45/0.50	0.87/0.95/1.18	0.17/0.22/0.38
CO (GC)[d]	0.18/0.18/0.16	0.18/0.19/0.13	0.32/0.30/0.27	0.19/0.17/0.14
CO_2[e]	0.1%	0.3%	0.8%	0.2%
CO[e]	0.1%	0.2%	0.4%	0.1%
H_2O[e]	10 mg/l	9 mg/l	9 mg/l	6 mg/l
HCN[e]	7 ppm	30 ppm	30 ppm	10 ppm
HF[e]	1 ppm	2 ppm	3 ppm	>20 ppm
HCl[e]	---	---	---	---

a Number in parentheses indicates percent degradation by weight.
b Mortality expressed as number of animals dying in chamber, within 48 hours, and within 14 days per number of animals exposed.
c Carboxyhemoglobin analyses were performed only on animals dying in the chamber.
d GC samples were taken immediately, at 15 and at 30 minutes after combustion/pyrolysis and data indicate percent by weight at these times.
e Measurements made with detector tubes manufactured by Gastec Corp., Tokyo, Japan.
* Used in LD_{50} calculation.

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Table 7 (cont.)

SUMMARY: In-Chamber Pyrolysis/Combustion Studies

Y-7683 (LS 200 Foam)

Sample Wt.	25 gm	30 gm	40 gm*	50 gm
Group	27	28	29	30
Cumulative Mortality[b]	0/4, 0/4, 1/4	0/4, 0/4, 1/4	0/4, 0/4, 4/4	0/4, 1/4, 4/4
% Pyrolyzed	54	49	47	47
$\overline{x}$ COHb[c]	n/a	n/a	n/a	n/a
O_2 (GC)[d]	20.5/19.8/19.8	18.5/17.2/18.0	19.8/19.8/18.9	18.5/18.5/19.5
CO_2 (GC)[d]	0.58/0.70/0.94	0.76/0.81/0.96	0.75/0.90/1.11	0.22/0.40/0.49
CO (GC)[d]	0.14/0.14/0.12	0.21/0.20/0.20	0.15/0.15/0.13	0.07/0.07/0.06
CO_2[e]	0.4%	0.2%	0.4%	0.2%
CO[e]	0.2%	0.1%	0.1%	0.1%
H_2O[e]	9 mg/l	10 mg/l	5 mg/l	11 mg/l
HCN[e]	30 ppm	50 ppm	10 ppm	25 ppm
HF[e]	>20 ppm	>20 ppm	>20 ppm	>20 ppm
HCl[e]	---	---	---	---

a Number in parentheses indicates percent degradation by weight.
b Mortality expressed as number of animals dying in chamber, within 48 hours, and within 14 days per number of animals exposed.
c Carboxyhemoglobin analyses were performed only on animals dying in the chamber.
d GC samples were taken immediately, at 15 and at 30 minutes after combustion/pyrolysis and data indicate percent by weight at these times.
e Measurements made with detector tubes manufactured by Gastec Corp., Tokyo, Japan.
* Used in LD_{50} calculation.

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Table 7
SUMMARY: In-Chamber Pyrolysis/Combustion Studies
Sample Y-7684 (Vonar 3 on Fiberglass)

Sample Wt.	10 gm*	10 gm	20 gm*	20 gm
Group	31	46	44	47
Cumulative Mortality[b]	0/4, 0/4, 0/4	0/4, 0/4, 0/4	0/4, 2/4, 2/4	0/4, 0/4, 0/4
% Pyrolyzed	52	53	54	50
$\overline{x}$ COHb[c]	n/a	n/a	n/a	n/a
O_2 (GC)[d]	20.4/22.7/21.4	22.7/23.4/22.5	21.0/20.9/20.9	19.2/20.0/19.0
CO_2 (GC)[d]	0.78/1.05/0.96	0.52/0.74/0.84	1.05/1.19/1.32	0.54/0.72/0.79
CO (GC)[d]	0.19/0.21/0.14	0.13/0.13/0.12	0.28/0.27/0.27	0.18/0.19/0.18
CO_2[e]	0.6%	0.4%	0.2%	0.4%
CO[e]	0.2%	0.1%	0.1%	0.1%
H_2O[e]	----	10 mg/l	2 mg/l	7 mg/l
HCN[e]	35 ppm	25 ppm	25 ppm	40 ppm
HF[e]	>10 ppm	>20 ppm	15 ppm	>20 ppm
HCl[e]	----	10 ppm	12 ppm	>20 ppm

a Number in parentheses indicates percent degradation by weight.
b Mortality expressed as number of animals dying in chamber. within 48 hours, and within 14 days per number of animals exposed.
c Carboxyhemoglobin analyses were performed only on animals dying in the chamber.
d GC samples were taken immediately, at 15 and at 30 minutes after combustion/pyrolysis and data indicate percent by weight at these times.
e Measurements made with detector tubes manufactured by Gastec Corp., Tokyo, Japan.
* Used in LD_{50} calculation.

Note: Measurements of Cl_2 & Nitrogen Oxides Cl_2 trace at 10 gm, - (0.3 ppm) at 20 and 40 gm.
NO_2 trace at 10 gm, - (2 ppm) at 20 and 40 gm.

Table 7 (Continued)
SUMMARY: In-Chamber Pyrolysis/Combustion Studies
Sample Y-7684 (Vonar 3 on Fiberglass)

Sample Wt.	30 gm	40 gm*	40 gm	50 gm
Group	45	32	48	38
Cumulative Mortality[b]	0/4, 2/4, 2/4	0/4, 2/4, 2/4	0/4, 0/4, 0/4	0/4, 4/4, 4/4
% Pyrolyzed	44	46	47	43
$\overline{x}$ COHb[c]	n/a	n/a	n/a	n/a
O_2 (GC)[d]	21.8/21.8/20.4	20.0/18.3/19.0	20.3/20.1/19.1	20.0/21.2/21.7
CO_2 (GC)[d]	0.79/1.02/0.98	0.34/0.40/0.52	0.42/0.53/0.67	0.41/0.63/0.86
CO (GC)[d]	0.20/0.20/0.17	0.08/0.06/0.05	0.10/0.10/0.10	0.12/0.12/0.14
CO_2[e]	0.4%	0.3%	0.2%	0.2%
CO[e]	0.1%	0.1%	0.1%	0.1%
H_2O[e]	10 mg/l	10 mg/l	8 mg/l	4 mg/l
HCN[e]	25 ppm	60 ppm	45 ppm	20 ppm
HF[e]	>20 ppm	3 ppm	>20 ppm	>20 ppm
HCl[e]	10 ppm	150 ppm	>20 ppm	20 ppm

a Number in parentheses indicates percent degradation by weight.
b Mortality expressed as number of animals dying in chamber, within 48 hours, and within 14 days per number of animals exposed.
c Carboxyhemoglobin analyses were performed only on animals dying in the chamber.
d GC samples were taken immediately, at 15 and at 30 minutes after combustion/pyrolysis and data indicate percent by weight at these times.
e Measurements made with detector tubes manufactured by Gastec Corp., Tokyo, Japan.
* Used in LD_{50} calculation.

Note: Measurements of CL_2 and Nitrogen Oxides Cl_2 trace at 10 gm, - (0.3 ppm) at 20 and 40 gm.
NO trace at 10 gm, - (2 ppm) at 20 and 40 gm

Table 7 (Continued)
SUMMARY: In-Chamber Pyrolysis/Combustion Studies
Sample Y-7684 (Vonar 3 on Fiberglass)

Sample Wt.	56.57 gm			
Group	49			
Cumulative Mortality[b]	0/4, 2/4, 2/4			
% Pyrolyzed	45			
$\overline{x}$ COHb[c]	n/a			
O_2 (GC)[d]	20.9/18.5/18.5			
CO_2 (GC)[d]	0.40/0.54/0.62			
CO (GC)[d]	0.04/0.04/0.04			
CO_2[e]	0.2%			
CO[e]	<0.1%			
H_2O[e]	8 mg/l			
HCN[e]	>60 ppm			
HF[e]	>20 ppm			
HCl[e]	>20 ppm			

a Number in parentheses indicates percent degradation by weight.
b Mortality expressed as number of animals dying in chamber, within 48 hours, and within 14 days per number of animals exposed.
c Carboxyhemoglobin analyses were performed only on animals dying in the chamber.
d GC samples were taken immediately, at 15 and at 30 minutes after combustion/pyrolysis and data indicate percent by weight at these times.
e Measurements made with detector tubes manufactured by Gastec Corp., Tokyo, Japan.
* Used in LD_{50} calculation.

Note: Measurements of Cl_2 and Nitrogen Oxides Cl_2 trace at 10 gm, - (0.3 ppm) at 20 and 40 gm.
NO trace at 10 gm, - (2 ppm) at 20 and 40 gm.

Table 7
SUMMARY: In-Chamber Pyrolysis/Combustion Studies
Sample Y-7685 (Vonar 3 on N W Polyester)

Sample Wt.	10* gm	14.14* gm	20* gm	28.28* gm
Group	36	35	34	37
Cumulative Mortality[b]	0/4, o/4, 0/4	1/4, 1/4, 1/4	2/4, 2/4, 2/4	3/4, 3/4, 3/4
% Pyrolyzed	67	63	69	58
$\overline{x}$ COHb[c]	n/a	76%	71%	64%
O_2 (GC)[d]	17.4/16.0/16.6	16.0/16.8/ ---	18.9/19.4/19.4	18.5/19.8/20.3
CO_2 (GC)[d]	1.34/1.36/1.52	1.62/1.81/ ---	2.01/2.19/2.21	1.04/1.26/1.55
CO (GC)[d]	0.22/0.20/0.20	0.25/0.26/ ---	0.31/0.31/0.30	0.26/0.26/0.28
CO_2[e]	0.6%	0.8%	1.0%	0.4%
CO[e]	0.1%	0.1%	0.1%	0.2%
H_2O[e]	8 mg/1	8 mg/1	11 mg/1	10 mg/1
HCN[e]	30 ppm	50 ppm	50 ppm	40 ppm
HF[e]	1 ppm	2 ppm	4 ppm	>20 ppm
HCl[e]	25 ppm	38 ppm	63 ppm	>20 ppm

a Number in parentheses indicates percent degradation by weight.
b Mortality expressed as number of animals dying in chamber, within 48 hours, and within 14 days per number of animals exposed.
c Carboxyhemoglobin analyses were performed only on animals dying in the chamber.
d GC samples were taken immediately, at 15 and at 30 minutes after combustion/pyrolysis and data indicate percent by weight at these times.
e Measurements made with detector tubes manufactured by Gastec Corp., Tokyo, Japan.
* Used in LD_{50} calculation
Note: Detector tubes for Cl_2 (-@0.33 ppm) and NO_x (-@2ppm) were used on 20 and 40 gm runs.

Table 7 (Continued)
SUMMARY: In-Chamber Pyrolysis/Combustion Studies
Sample Y-7685 (Vonar 3 on N W Polyester)

Sample Wt.	40* gm			
Group	33			
Cumulative Mortality[b]	4/4, 4/4, 4/4			
% Pyrolyzed	62			
$\overline{x}$ COHb[c]	68%			
O_2 (GC)[d]	17.2/16.7/18.1			
CO_2 (GC)[d]	1.47/1.41/1.18			
CO (GC)[d]	0.40/0.35/0.31			
CO_2[e]	1.0%			
CO[e]	0.3%			
H_2O[e]	23 mg/l			
HCN[e]	>60 ppm			
HF[e]	>20 ppm			
HCl[e]	100 ppm			

a Number in parentheses indicates percent degradation by weight.
b Mortality expressed as number of animals dying in chamber, within 48 hours, and within 14 days per number of animals exposed.
c Carboxyhemoglobin analyses were performed only on animals dying in the chamber.
d GC samples were taken immediately, at 15 and at 30 minutes after combustion/pyrolysis and data indicate percent by weight at these times.
e Measurements made with detector tubes manufactured by Gastec Corp., Tokyo, Japan.
* Used in LD_{50} calculation.
Note: Detector tubes for Cl_2 (-@0.33 ppm) and NO_x (-@2 ppm) were used on 40 and 60 gm runs.

Table 8
SUMMARY: MSTL Pyrolysis/Combustion Studies
Sample Y-7683 (LS 200 Foam)

Sample Wt.	3.12 gm*	3.31 gm*	3.51 gm*	3.72 gm*
Group	42	59	58	60
Cumulative Mortality[b]	0/4, 0/4, 0/4	0/4, 0/4, 0/4	3/4, 3/4, 3/4	4/4, 4/4, 4/4
% Pyrolyzed	55	56	54	56
$\overline{x}$ COHb[c]	n/a	n/a	60%	72%
O_2 (GC)[d]	19.1/18.0/20.4/19.7/21.1	16.8/17.3/17.5/17.5/17.5	16.6/15.9/16.4/17.6/17.3	16.1/16.3/15.7/16.1/17.0
CO_2 (GC)[d]	1.63/1.40/1.50/1.36/1.42	2.12/1.89/1.68/1.59/1.49	1.65/1.23/1.05/0.95/0.77	2.37/2.39/1.96/1.66/1.40
CO (GC)[d]	0.27/0.17/0.13/0.09/0.06	0.22/0.17/0.10/0.08/0.05	0.24/0.17/0.14/0.12/0.09	0.26/0.38/0.31/0.26/0.22
CO_2[e]	0.25%	1.2%	2.2%	1.0%
CO[e]	200 ppm	0.2%	0.1%	<0.05%
H_2O[e]	4 mg/l	8 mg/l	12 mg/l	4 mg/l
HCN[e]	2 ppm	5 ppm	2.5 ppm	<1 ppm
HF[e]	0.5 ppm	nt	-@ 0.5 ppm	-@ 0.5 ppm
HCl[e]	nt	nt	nt	nt

a Number in parentheses indicates percent degradation by weight.
b Mortality expressed as number of animals dying in chamber, within 48 hours, and within 14 days per number of animals exposed.
c Carboxyhemoglobin analyses were performed only on animals dying in the chamber.
d GC samples were taken at 0, 15, 30, 45 and 60 minutes after pyrolysis/combustion and data indicate percent by weight at these times.
e Measurements made with detector tubes manufactured by Gastec Corp., Tokyo, Japan.
* Used in LD_{50} calculation.
nt Not tested.

Table 8 (Continued)
SUMMARY: MSTL Pyrolysis/Combustion Studies
Sample Y-7683 (LS 200 Foam)

Sample Wt.	3.94 gm*	4.96 gm	6.25 gm	12.5 gm
Group	57	43	41	40
Cumulative Mortality[b]	4/4, 4/4, 4/4	4/4, 4/4, 4/4	3/4, 3/4, 3/4	4/4, 4/4, 4/4
% Pyrolyzed	54	58	55	58
$\overline{x}$ COHb[c]	80%	72%	78%	80%
O_2 (GC)[d]	17.6/17.3/18.0/18.3/19.0	21.2/23.8/23.6/23.1/24.6	19.0/21.3/22.3/20.4/21.3	14.4/16.3/16.3/19.2/19.9
CO_2 (GC)[d]	2.48/1.82/1.31/1.07/0.76	2.58/2.10/1.49/0.96/0.88	2.34/1.94/1.44/0.94/0.78	3.92/3.51/2.09/1.78/1.20
CO (GC)[d]	0.42/0.31/0.22/0.18/0.12	0.67/0.50/0.37/0.26/0.21	0.44/0.34/0.24/0.20/0.11	1.11/0.99/0.62/0.53/0.37
CO_2[e]	1.5%	0.2%	0.2%	0.5%
CO[e]	0.1%	600 ppm	0.1%	0.1%
H_2O[e]	14 mg/l	4 mg/l	3 mg/l	4 mg/l
HCN[e]	2 ppm	2 ppm	2 ppm	4 ppm
HF[e]	2.5 ppm	0.2 ppm	1 ppm	1 ppm
HCl[e]	-@2 ppm	nt	-@1 ppm	2 ppm

a Number in parentheses indicates percent degradation by weight.
b Mortality expressed as number of animals dying in chamber, within 48 hours, and within 14 days per number of animals exposed.
c Carboxyhemoglobin analyses were performed only on animals dying in the chamber.
d GC samples were taken at 0, 15, 30, 45 and 60 minutes after combustion/pyrolysis and data indicate percent by weight at these times.
e Measurements made with detector tubes manufactured by Gastec Corp., Tokyo, Japan.
* Used in LD_{50} calculation.
nt Not tested.

Table 8 (Continued)
SUMMARY: MSTL Pyrolysis/Combustior S udies
Sample Y-7683 (LS 200 Foa

Sample Wt.	50 gm			
Group	39			
Cumulative Mortality[b]	4/4, 4/4, 4/4			
% Pyrolyzed	52			
$\overline{x}$ COHb[c]	56%			
O_2 (GC)[d]	12.8/12.1/13.2/14.9/17.2			
CO_2 (GC)[d]	5.26/5.68/5.51/5.26/3.47			
CO (GC)[d]	1.19/1.90/1.93/1.81/1.26			
CO_2[e]	0.5%			
CO[e]	0.1%			
H_2O[e]	4 mg/l			
HCN[e]	20 ppm			
HF[e]	7 ppm			
HCl[e]	8 ppm			

a Number in parentheses indicates percent degradation by weight.
b Mortality expressed as number of animals dying in chamber, within 48 hours, and within 14 days per number of animals exposed.
c Carboxyhemoglobin analyses were performed only on animals dying in the chamber.
d GC samples were taken at 0, 15, 30, 45 and 60 minutes after pyrolysis/combustion and data indicate percent by weight at these times.
e Measurements made with detector tubes manufactured by Gastec Corp., Tokyo, Japan.
* Used in LD_{50} calculation.

Table 8 (Continued)
SUMMARY: MSTL Pyrolysis/Combustion Studies
Sample Y-7684 (Vonar 3 on Fiberglass)

Sample Wt.	2.45 gm*	2.60 gm*	2.76 gm*	2.93 gm*
Group	67	66	65	68
Cumulative Mortality[b]	0/4, 0/4, 0/4	1/4, 1/4, 1/4	3/4, 3/4, 3/4	4/4, 4/4, 4/4
% Pyrolyzed	53	57	58	60
$\bar{x}$ COHb[c]	n/a	nt	57%	49%
O_2 (GC)[d]	19.9/16.9/15.7/19.3/21.7	14.4/16.4/15.4/16.4/16.2	15.5/15.2/18.5/20.6/18.2	15.2/18.0/16.6/19.1/17.7
CO_2 (GC)[d]	2.10/1.55/1.38/1.53/1.65	1.48/1.38/1.18/1.16/1.06	1.41/1.13/0.93/0.83/0.56	1.42/1.34/0.74/0.55/0.30
CO (GC)[d]	0.20/0.12/0.07/0.06/0.05	0.14/0.10/0.05/0.04/0.02	0.15/0.10/0.07/0.05/0.02	0.14/0.12/0.04/0.02/0.01
CO_2[e]	0.6%	0.6%	0.5%	0.4%
CO[e]	0.1%	0.1%	0.1%	0.1%
H_2O[e]	9 mg/l	12 mg/l	13 mg/l	16 mg/l
HCN[e]	nt	nt	nt	nt
HF[e]	2 ppm	2 ppm	2 ppm	2 ppm
HCl[e]	nt	nt	nt	nt

a Number in parentheses indicates percent degradation by weight.
b Mortality expressed as number of animals dying in chamber, within 48 hours, and within 14 days per number of animals exposed.
c Carboxyhemoglobin analyses were performed only on animals dying in the chamber.
d GC samples were taken at 0, 15, 30, 45 and 60 minutes after combustion/pyrolysis and data indicate percent by weight at these times.
e Measurements made with detector tubes manufactured by Gastec Corp., Tokyo, Japan.
* Used in LD_{50} calculation.
nt Not tested.

Table 8 (Continued)
SUMMARY: MSTL Pyrolysis/Combustion Studies
Sample Y-7684 (Vonar 3 on Fiberglass)

Sample Wt.	2.93 gm	3.11 gm*	3.30 gm	3.50 gm
Group	63[f]	64	62	61
Cumulative Mortality[b]	1/4, 1/4, 1/4	4/4, 4/4, 4/4	4/4, 4/4, 4/4	4/4, 4/4, 4/4
% Pyrolyzed	53[g]	51	56[g]	53[h]
$\bar{x}$ COHb[c]	50%	70%	64%	59%
O_2 (GC)[d]	15.4/15.4/15.4/17.6/16.3	15.8/15.2/16.8/16.2/19.0	18.4/16.0/16.9/17.7/18.4	19.0/16.6/20.3/17.3/23.0
CO_2 (GC)[d]	1.41/1.22/1.07/0.98/0.78	1.82/1.34/1.04/0.68/0.51	1.76/1.07/0.73/0.52/0.34	2.16/1.52/1.37/0.85/0.85
CO (GC)[d]	0.19/0.13/0.09/0.07/0.04	0.25/0.17/0.12/0.07/0.06	0.23/0.13/0.08/0.05/0.01	0.25/0.[illegible]5/0.15/0.08/0.08
CO_2[e]	0.5%	0.6%	0.6%	0.2%
CO[e]	0.1%	0.1%	0.1%	0.1%
H_2O[e]	6 mg/l	8 mg/l	14 mg/l	7 mg/l
HCN[e]	nt	nt	nt	- @ 2.5 ppm
HF[e]	3 ppm	2.5 ppm	7 ppm	0.2 ppm
HCl[e]	nt	nt	nt	- @ 25 ppm

a Number in parentheses indicates percent degradation by weight.
b Mortality expressed as number of animals dying in chamber, within 48 hours, and within 14 days per number of animals exposed.
c Carboxyhemoglobin analyses were performed only on animals dying in the chamber.
d GC samples were taken at 0, 15, 30, 45 and 60 minutes after pyrolysis/combustion and data indicate percent by weight at these times.
e Measurements made with detector tubes manufactured by Gastec Corp., Tokyo, Japan.
f Group 63 replaced by Group 68
* Used in LD_{50} calculation
g NO tubes - @ 2 ppm
h NO tube = 2 ppm and Cl_2 -@ 0.33 ppm
nt Not tested.

Table 8
SUMMARY: MSTL Pyrolysis/Combustion Studies
Sample Y-7685 (Vonar 3 on N W Polyester)

Sample Wt.	2.00 gm	2.52 gm*	2.68 gm*	2.84 gm*
Group	69	70	77	76
Cumulative Mortality[b]	0/4, 0/4, 0/4	0/4, 0/4, 0/4	1/4, 1/4, 1/4	1/4, 1/4, 1/4
% Pyrolyzed	75	68	68	69
$\bar{x}$ COHb[c]	n/a	n/a	64%	59%
O_2 (GC)[d]	22.1/16.7/17.2/18.0/17.8	20.3/16.0/22.7/16.8/17.3	18.9/19.7/20.8/16.1/16.9	18.0/17.7/21.5/17.5/16.1
CO_2 (GC)[d]	2.08/1.41/1.31/1.31/1.27	2.19/1.82/2.19/1.67/1.62	1.65/1.43/1.32/0.90/0.80	1.76/1.48/1.45/1.06/0.93
CO (GC)[d]	0.24/0.12/0.11/0.06/0.04	0.31/0.26/0.27/0.15/0.12	0.25/0.18/0.11/0.05/0.02	0.29/0.21/0.16/0.09/0.06
CO_2[e]	0.3%	nt	nt	nt
CO[e]	0.1%	nt	500 ppm	100 ppm
H_2O[e]	4 mg/l	nt	nt	nt
HCN[e]	5 ppm	nt	4 ppm	-@2.5 ppm
HF[e]	2 ppm	nt	nt	nt
HCl[e]	-@2.5 ppm	nt	nt	nt

a Number in parentheses indicates percent degradation by weight.
b Mortality expressed as number of animals dying in chamber, within 48 hours, and within 14 days per number of animals exposed.
c Carboxyhemoglobin analyses were performed only on animals dying in the chamber.
d GC samples were taken at 0, 15, 30, 45 and 60 minutes after pyrolysis/combustion and data indicate percent by weight at these times.
e Measurements made with detector tubes manufactured by Gastec Corp., Tokyo, Japan.
* Used in LD_{50} calculation.
nt Not tested

Table 8 (Continued)
SUMMARY: MSTL Pyrolysis/Combustion Studies
Sample Y-7685 (Vonar 3 on N W Polyester)

Sample Wt.	3.01 gm*	3.19 gm*	3.38 gm*	3.58 gm*[f]
Group	75	71	74	73
Cumulative Mortality[b]	2/4, 2/4, 2/4	1/4, 1/4, 1/4	3/4, 3/4, 3/4	4/4, 4/4, 4/4
% Pyrolyzed	66	70	69	68
$\overline{x}$ COHb[c]	60%	62%	66%	63%
O_2 (GC)[d]	15.6/15.6/16.9/19.1/19.1	16.8/17.1/17.9/21.3/18.5	16.7/17.9/18.5/18.2/20.2	16.0/16.0/15.8/20.2/17.0
CO_2 (GC)[d]	1.71/1.52/1.22/1.17/1.06	2.38/2.06/1.99/2.06/1.72	1.87/1.57/1.06/0.90/0.85	2.08/2.20/1.82/1.79/1.19
CO (GC)[d]	0.27/0.19/0.14/0.12/0.08	0.35/0.27/0.22/0.19/0.13	0.32/0.24/0.12/0.10/ g	0.33/0.43/0.35/0.34/0.22
CO_2[e]	nt	nt	nt	nt
CO[e]	800 ppm	0.1%	800 ppm	50 ppm
H_2O[e]	nt	4 mg/l	nt	2 mg/l
HCN[e]	4 ppm	2 ppm	-@2.5 ppm	nt
HF[e]	1 ppm	1 ppm	1 ppm	nt
HCl[e]	nt	-@2.5 ppm Cl_2 -@0.03 ppm	nt	nt

a Number in parentheses indicates percent degradation by weight.
b Mortality expressed as number of animals dying in chamber, within 48 hours, and within 14 days per number of animals exposed.
c Carboxyhemoglobin analyses were performed only on animals dying in the chamber.
d GC samples were taken at 0, 15, 30, 45 and 60 minutes after pyrolysis/combustion and data indicate percent by weight at these times.
e Measurements made with detector tubes manufactured by Gastec Corp., Tokyo, Japan.
* Used in LD_{50} calculation.
nt Not tested. f Detector tube readings suspect due to possible pump malfunction g Sample lost

Table 8 (Continued)
SUMMARY: MSTL Pyrolysis/Combustion Studies
Sample Y-7685 (Vonar 3 on N W Polyester)

Sample Wt.	4.03 gm			
Group	72			
Cumulative Mortality[b]	4/4, 4/4, 4/4			
% Pyrolyzed	66 [f]			
$\bar{x}$ COHb[c]	74%			
O_2 (GC)[d]	13.7/14.4/17.9/15.1/16.8			
CO_2 (GC)[d]	2.26/2.13/1.86/1.28/1.15			
CO (GC)[d]	0.41/0.37/0.34/0.23/0.21			
CO_2[e]	nt			
CO[e]	0.2%			
H_2O[e]	5 mg/l			
HCN[e]	3 ppm			
HF[e]	-@ 0.1 ppm			
HCl[e]	-@ 2.5 ppm			

a Number in parentheses indicates percent degradation by weight.
b Mortality expressed as number of animals dying in chamber, within 48 hours, and within 14 days per number of animals exposed.
c Carboxyhemoglobin analyses were performed only on animals dying in the chamber.
d GC samples were taken at 0, 15, 30, 45 and 60 minutes after pyrolysis/combustion and data indicate percent by weight at these times.
e Measurements made with detector tubes manufactured by Gastec Corp., Tokyo, Japan.
* Used in LD_{50} calculation.
f Cl_2 -@ 0.03 ppm

LIST OF ABBREVIATIONS USED IN HISTOPATHOLOGY SUMMARIES

ClSw . . . . Cloudy Swelling
Comp . . . . Compensatory
Cnlb . . . . Centrolobular
Cong . . . . Congestion
Cort . . . . Cortical
DiSn . . . . Dilated Sinusoids
Ditn . . . . Dilatation
Ed . . . . Edema
Ersn . . . . Erosion
FtCh . . . . Fatty Change
Hem . . . . Hemorrhage
HypF . . . . Hyperplastic Follicles
HyCh . . . . Hydropic Change
Iflt . . . . Infiltrate
Infl . . . . Inflammation
Lum . . . . Lumenar
Med . . . . Medullary
Muc . . . . Mucosal
Myoc . . . . Myocardial
NS . . . . Not submitted
Pfol . . . . Perifollicular
Ptrc . . . . Pertracheitis
Sup . . . . Suppuration
Thyr . . . . Thyroidization
Trch . . . . Tracheitis
Ulcr . . . . Ulceration
WNL . . . . Within normal limits

Table 9

IN CHAMBER

Y-7683 (LS-200 FOAM) HISTOPATHOLOGY SUMMARY (EXCLUDING LUNGS) PYROLYSIS PROCEDURE

MST#	SAMPLE WEIGHT (GRAMS)	DEATH	HEART	TRACHEA	LIVER	SPLEEN	KIDNEY	ADRENAL
12943	5.00	SACRIFICE	WNL	WNL	WNL	CONG/A/D/2	MED CONG/A/D/1	WNL (Clear cells in medulla)
12944	5.00	SACRIFICE	WNL	WNL	FTCH/D/2	CONG/A/D/2	WNL	WNL
12945	10.00	SACRIFICE	WNL	ERSN/F/1	FTCH & CLSN, CNLB/D/2	CONG/A/D/1	WNL	WNL
12946	10.00	SACRIFICE	WNL	WNL	CLSN, CNLB/D/1-2	WNL	WNL	WNL
12921	15.00	CHAMBER	WNL	WNL	FTCH/3	CONG/A/1	WNL	WNL
12922	15.00	CHAMBER	WNL	WNL	FTCH/D/2	CONG/A/1	MED CONG/A/2	WNL
13071	15.00	SACRIFICE	CONG/A/D/1	MUC ERSN/F	WNL	WNL	WNL	WNL
13072	15.00	SACRIFICE	WNL	LUM SUP/A/3 SUB MUC IFLT/C	WNL	WNL	HEM/A/4	WNL
13113	20.00	SACRIFICE	WNL	TRCH/C/D/2-3 MUC ERSN/C	FTCH/D/1	WNL	WNL	WNL
13114	20.00	SACRIFICE	WNL	NS	FTCH/D/1	WNL	WNL	DISH (MED)
13128	25.00	SACRIFICE	WNL	TRCH/C/D/3 MUC ULCR	WNL	WNL	WNL	WNL
13129	25.00	SACRIFICE	WNL	WNL	WNL	WNL	WNL	WNL
13131	30.00	SACRIFICE	WNL	WNL	WNL	WNL	WNL	WNL
13132	30.00	SACRIFICE	WNL	ERSN/D INFL/D/3	WNL	WNL	WNL	WNL
13130	50.00	DELAYED (8 DAYS)	WNL	WNL	WNL	WNL	WNL	WNL
13133	50.00	DELAYED (14 DAYS)	WNL	WNL	WNL	WNL	WNL	WNL

KEY: A = ACUTE, C = CHRONIC, D = DIFFUSE, F = FOCAL, 1 = MILD, 2 = MODERATE, 3 = SEVERE, 4 = MASSIVE

NOTE: REFER TO LIST OF ABREVIATIONS USED IN HISTOPATHOLOGY SUMMARIES.

Table 9 (cont.)

Y-7683 (LS-200 FOAM) HISTOPATHOLOGY SUMMARY (LUNGS ONLY) IN CHAMBER PYROLYSIS PROCEDURE

MST#	SAMPLE WEIGHT (GRAMS)	DEATH	ABSCESS	ATELECTASIS	BRONCHIOLITIS	BRONCHITIS	BRONCHOPNUMONIA	CONGESTION	DILATION OF BRONCHI	EDEMA	EMPHYZEMA	HEMORRHAGE	INFLAMMATION	PERIBRONCHIOLITIS	PERIBRONCHITIS	PLEURITIS	PNEUMONITIS	SUPURATION	VASCULITIS
12943	5.00	SACRIFICE	—	—	—	—	—	A/D/1	—	A/D/1	—	—	—	—	—	—	—	—	—
12944	5.00	SACRIFICE	—	—	—	—	—	—	—	—	—	—	—	—	—	—	C/F/1	—	—
12945	10.00	SACRIFICE	—	—	—	—	—	—	—	—	—	A&C/1	—	—	—	—	—	—	C/F/2
12946	10.00	SACRIFICE	—	—	—	—	—	—	—	—	—	A&C/D/4	—	—	—	—	C/F/1	—	C/F/1
12921	15.00	CHAMBER	—	F/2	—	—	—	A/D/2	—	A/D/2	—	A/F/1	—	—	—	—	C/F/1	—	—
12922	15.00	CHAMBER	—	—	—	—	—	A/D/2	—	A/D/2	—	A/F/2	—	—	—	—	C/F/1	—	—
13071	15.00	SACRIFICE	—	D/2	—	—	—	—	—	—	—	—	—	—	—	—	C/F/1	—	—
13072	15.00	SACRIFICE	—	—	—	C/F/1	—	—	—	—	—	—	—	—	C/F/2-3	—	—	—	—
13113	20.00	SACRIFICE	—	—	—	—	—	—	—	—	—	—	—	D/2	D/2	—	—	—	C/F/1
13114	20.00	SACRIFICE	—	—	—	—	—	—	—	—	D/1-3	—	—	C/D/2	C/D/2	—	—	—	C/D/1
13128	25.00	SACRIFICE	A/3	—	—	—	A/D/3	—	—	—	—	—	—	—	—	—	—	—	—
13129	25.00	SACRIFICE	—	—	—	C/D/1-2	A/F/3	—	—	—	—	A/D/3	—	C/D/1-2	—	—	—	—	—
13131	30.00	SACRIFICE	—	—	—	C/D/1	C/F/2	—	—	—	—	—	—	—	C/D/1	—	—	—	—
13132	30.00	SACRIFICE	—	—	C/D/2	C/D/2	A&C/F/3	—	—	—	—	—	—	—	—	—	C/D/2	—	—
13130	50.00	DELAYED (8 DAYS)	—	—	—	C/F/2	A&C/D/3	—	—	—	—	—	—	—	C/F/2	—	—	—	—
13133	50.00	DELAYED (14 DAYS)	A/3	—	A/3	A/3	—	—	—	—	D/1-3	—	—	C/D/2-3	C/D/2-3	—	—	3	C/D/1-3

KEY: A=ACUTE, C=CHRONIC, D=DIFFUSE, F=FOCAL, 1=MILD, 2=MODERATE, 3=SEVERE, 4=MASSIVE

NOTE: A DASH INDICATES THE LESION WAS NOT OBSERVED IN THAT ANIMAL

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Table 9 (cont.)

Y-7684 (VONAR 3 ON FIBERGLASS) HISTOPATHOLOGY SUMMARY (EXCLUDING LUNGS) IN CHAMBER PYROLYSIS PROCEDURE

	MST#	SAMPLE WEIGHT (GRAMS)	DEATH	HEART	TRACHEA	LIVER	SPLEEN	KIDNEY	ADRENAL
TRIAL 1	13134	10.00	SACRIFICE	WNL	MUC ERSN/F	FTCH/D/1	WNL	WNL	WNL
	13135	10.00	SACRIFICE	WNL	NS	FTCH/D/1	WNL	WNL	WNL
	13455	20.00	SACRIFICE	CONG & ED/A/D/1	TRCH/C/F/1	CONG/A/D/1	WNL	CLSW/D/1	WNL
	13456	20.00	SACRIFICE	CONG & ED/A/D/1	TRCH/C/F/1	FTCH/D/1	WNL	WNL	WNL
	13457	30.00	SACRIFICE	CONG & ED/A/D/2	TRCH/C/F/1	FTCH/D/1	WNL	CLSW/D/2	WNL
	13458	30.00	SACRIFICE	WNL	TRCH/C/D/1	WNL	WNL	WNL	WNL
	13127	40.00	DELAYED 1 DAY	CONG & ED/A/D/1	WNL	CONG/A/D/1	WNL	CLSW/D/1	WNL
	13138	40.00	SACRIFICE	ED & DTN/D/1	MUC ERSN/F TRCH/C/D/1	FTCH/D/1	WNL	WNL	WNL
	13139	40.00	SACRIFICE	WNL	MUC ERSN/F TRCH/C/D	FTCH/D/1	WNL	WNL	WNL
TRIAL 2	13463	10.00	SACRIFICE	WNL	NS	WNL	WNL	WNL	WNL
	13464	10.00	SACRIFICE	CONG/A/F/3	WNL	WNL	WNL	WNL	WNL
	13465	20.00	SACRIFICE	WNL	WNL	CONG & ED/A/D/1	WNL	WNL	WNL
	13466	20.00	SACRIFICE	WNL	MUC ERSH/F TRCH/C	WNL	WNL	WNL	WN
	13467	40.00	SACRIFICE	WNL	TRCH/C/D/1	FTCH/A/D/1	WNL	WNL	WNL
	13468	40.00	SACRIFICE	WNL	TRCH/C/D	FTCH/D/2	WNL	HYCH	MED CONG/A
	13469	56.56	SACRIFICE	WNL	TRCH/C/D/1	WNL	WNL	WNL	WNL
	13470	56.56	SACRIFICE	WNL	WNL	WNL	WNL	WNL	WNL

KEY: A=ACUTE, C=CHRONIC, D=DIFFUSE, F=FOCAL, 1=MILD, 2=MODERATE, 3=SEVERE, 4=MASSIVE

NOTE: REFER TO LIST OF ABREVIATIONS USED IN HISTOPATHOLOGY SUMMARIES

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Table 9 (cont.)

Y-7684 (Vonar 3 on Fiberglass) Histopathology Summary (Lungs Only) In Chamber Pyrolysis Procedure

	MST#	Sample Weight (Grams)	Death	Abscess	Atelectasis	Bronchiolitis	Bronchitis	Bronchopneumonia	Congestion	Dilation of Bronchi	Edema	Emphysema	Hemorrhage	Inflammation	Peribronchiolitis	Peribronchitis	Pleuritis	Pneumonitis	Suppuration	Vasculitis
Trial 1	13134	10.00	Sacrifice	—	—	—	—	—	—	—	—	—	A/D/3	—	C/D/2	C/D/2	—	C/F/1	—	D/1
	13135	10.00	Sacrifice	—	—	—	—	—	—	—	—	F/1	—	—	C/F/1-2	C/F/1-2	—	—	—	C/F/1
	13455	20.00	Sacrifice	—	F/2	—	—	—	A/D/3	—	A/D/3	—	A/D/3	—	—	—	—	—	—	—
	13456	20.00	Sacrifice	—	—	—	—	—	A/D/3	—	A/D/3	—	A/D/3	—	—	—	—	—	—	—
	13457*	30.00	Sacrifice	—	—	—	—	—	A&C/1-2	4	A&C/1-2	F/2	A&C/1-2	—	C/F/1	C/F/1	—	C/F/1-2	—	—
	13458	30.00	Sacrifice	—	—	—	—	—	—	—	—	—	—	—	C/F/1	C/F/1	—	C/F/1	—	—
	13127	40.00	Delayed 1 day	—	D/2	—	—	C/F/1	—	—	—	—	—	—	—	—	—	C/F/1	—	—
	13138	40.00	Sacrifice	—	F/1-2	—	—	—	F/1-2	—	F/1-2	F/1-2	F/1-2	—	—	C/D/2	—	A&C/F/1	—	—
	13139	40.00	Sacrifice	—	—	C/D/2	—	—	—	—	—	D/1	—	—	—	—	—	C/F/1-2	—	C/D/1
Trial 2	13463	10.00	Sacrifice	—	—	—	—	—	A/D/2-3	—	A/D/2-3	—	—	—	—	—	—	—	—	—
	13464	10.00	Sacrifice	—	—	—	—	C/F/1	A/D/2-3	—	A/D/2-3	—	—	—	—	—	—	—	—	—
	13465	20.00	Sacrifice	—	—	—	—	—	A/D/2-3	—	A/D/2-3	—	—	—	—	—	—	—	—	C/F/1
	13466*	20.00	Sacrifice	—	—	—	—	—	D/1	—	D/1	D/1	—	—	—	—	—	C/D/1-2	—	—
	13467	40.00	Sacrifice	—	—	—	—	—	A/D/2-3	—	A/D/2-3	—	—	—	—	C/F/1	—	C/D/1	—	—
	13468	40.00	Sacrifice	—	—	—	—	—	—	—	—	—	—	—	—	—	—	C/D/2	—	—
	13469	56.56	Sacrifice	—	—	—	—	C/F/1	—	—	—	—	—	—	—	C/F/1	C/F/2	—	—	—
	13470	56.56	Sacrifice	—	—	—	—	—	A/D/2	—	A/D/2	—	—	—	D/1	D/1	—	C/D/1-2	—	—

Key: A=acute, C=chronic, D=diffuse, F=focal, 1=mild, 2=moderate, 3=severe, 4=massive

Note: A dash indicates the lesion was not observed in that animal

* Possible foreign body debris

Table 9 (cont.)

Y-7685 (VONAR 3 ON NW POLYESTER) HISTOPATHOLOGY SUMMARY (EXCLUDING LUNGS) IN CHAMBER PYROLYSIS PROCEDURE

MST#	SAMPLE WEIGHT (GRAMS)	DEATH	HEART	TRACHEA	LIVER	SPLEEN	KIDNEY	ADRENAL
13309	10.00	SACRIFICE	WNL	WNL	WNL	WNL	CLSW/D/1	WNL
13310	10.00	SACRIFICE	WNL	WNL	WNL	WNL	CLSW/D/1	CONG/A/D/1
13142	14.14	CHAMBER	CONG & ED/A/D/1	TRCH/C/D/1	CONG/D/1-2 FTCH/D/1	WNL	CLSW/D/1	CONG/A/D/1
13307	14.14	SACRIFICE	CONG & ED/A/D/1	TRCH/C/D/2	WNL	WNL	CLSW/D/1	WNL
13308	14.14	SACRIFICE	ED/A/D/1	WNL	CONG/A/D/1	WNL	WNL	WNL
13140	20.00	CHAMBER	CONG & ED/A/D/1	WNL	CONG/A/D/2	WNL	CLSW/D/1 MED CONG/A/2	CONG/A/D/1
13141	20.00	CHAMBER	CONG & ED/A/D/1	MUC ERSN/F	CONG/A/D/1	WNL	CLSW/D/1	CONG/A/D/1
13305	20.00	SACRIFICE	WNL	MUC ERSN/F	FTCH/D/1	WNL	CLSW/D/1	CONG/A/D/1
13306	20.00	SACRIFICE	CONG & ED/A/D/1	WNL	WNL	WNL	CLSW/D/1	WNL
13143	28.28	CHAMBER	CONG & ED/A/D/2	WNL	CONG/A/D/1 FTCH/D/1	WNL	CLSW/D/1	CONG/A/D/2
13144	28.28	CHAMBER	CONG & ED/A/D/1	TRCH/C/D/1	FTCH/D/1	WNL	MED CONG/A/2	CONG/A/D/1
13311	28.28	SACRIFICE	ED/D/1	TRCH/C/F/1	WNL	WNL	CLSW/D/1	WNL
13136	40.00	CHAMBER	WNL	MUC ERSN/F TRCH/C/F, CONG & HEM/D/2	FTCH/D/1 CONG/A/D	WNL	WNL	WNL
13137	40.00	CHAMBER	WNL	TRCH/C/2	FTCH/D/1	WNL	WNL	WNL

KEY: A=ACUTE, C=CHRONIC, D=DIFFUSE, F=FOCAL, 1=MILD, 2=MODERATE, 3=SEVERE, 4=MASSIVE

NOTE: REFER TO LIST OF ABREVIATIONS USED IN HISTOPATHOLOGY SUMMARIES.

Table 9 (cont.)

Y-7685 (Vonar 3 on NW Polyester) Histopathology Summary (Lungs Only) in Chamber Pyrolysis Procedure

MST #	Sample Weight (Grams)	Death	Abscess	Atelectasis	Bronchiolitis	Bronchitis	Bronchopneumonia	Congestion	Dilation of Bronchi	Edema	Emphyzema	Hemorrhage	Inflammation	Peribronchiolitis	Peribronchitis	Pleuritis	Pneumonitis	Supuration	Vasculitis
13309	10.00	Sacrifice	—	F/1	—	—	—	—	—	—	—	—	—	C/D/1	C/D/1	—	C/F/1-2	—	—
13310	10.00	Sacrifice	—	—	—	—	—	A/D/2	—	A/D/2	—	R/F/1	—	C/F/1	C/F/1	—	C/F/1	—	—
13142	14.14	Chamber	—	D/1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
13307	14.14	Sacrifice	—	—	C/D/1	—	—	—	—	—	—	R/F/2	—	—	C/D/1	—	C/F/1	—	C/F/1
13308	14.14	Sacrifice	—	—	—	—	—	—	—	—	—	R/F/2	—	—	—	—	C/F/1	—	—
13140	20.00	Chamber	—	D/3	—	—	—	—	—	—	—	A/D/2	—	—	—	—	—	—	—
13141	20.00	Chamber	—	D/3	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
13305	20.00	Sacrifice	—	—	—	—	—	A/D/2-3	—	A/D/2-3	—	R/F/1	—	C/F/1	C/F/1	—	—	—	C/F/1
13306	20.00	Sacrifice	—	—	—	—	—	A/D/3	—	A/D/3	—	R/F/3	—	—	—	—	—	—	—
13143	28.28	Chamber	—	D/2	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
13144	28.28	Chamber	—	—	—	—	—	A/D/3	—	A/D/3	—	—	—	—	—	—	—	—	—
13311	28.28	Sacrifice	—	—	—	—	—	A/D/2	—	A/D/2	—	A/C/F/2-3	—	D/F/2	D/F/2	—	C/F/2	—	—
13136	40.00	Chamber	—	D/2-3	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
13137	40.00	Chamber	—	F/2-3	—	—	—	F/2-3	—	F/2-3	F/2-3	F/2-3	—	C/F/1	C/F/1	—	A/C/F	—	C/F/1

Key: A=acute, C=chronic, D=diffuse, F=focal, R=remote, 1=mild, 2=moderate, 3=severe, 4=massive

Note: A dash indicates the lesion was not observed in that animal

Table 10

Y-7683 (LS-200 FOAM) HISTOPATHOLOGY SUMMARY (EXCLUDING LUNGS) MSTL PYROLYSIS PROCEDURE

MST#	SAMPLE WEIGHT (GRAMS)	DEATH	HEART	TRACHEA	LIVER	SPLEEN	KIDNEY	ADRENAL
13421	3.12	SACRIFICE	CONG/A/D/2	ERSN/D	FTCH/D/1	WNL	CLSW/F/2 HYCH/F/2	WNL
13422	3.12	SACRIFICE	ED/D/2	ERSN/F INFL/C/D/1	FTCH/D/1	CONG/A/D/1	WNL	WNL
13506	3.31	SACRIFICE	WNL	TRCH/C/F/1	WNL	WNL	CLSW/D/1 HYCH/D/1	WNL
13507	3.31	SACRIFICE	CONG/A/D/1	TRCH/C/F/1	WNL	WNL	CLSW/D/2-3 HYCH/D/2-3	WNL
13489	3.51	CHAMBER	HEM/A/F/2-3 CONG/A/F/2-3	TRCH/C/D/2	CONG/A/D/1	WNL	MED CONG/A/2	WNL
13490	3.51	CHAMBER	CONG/A/F/2	INFL/C/D/2	CONG/A/D/2	WNL	MED CONG/A/2	MED CONG
13505	3.51	SACRIFICE	WNL	TRCH/C/D/1-2	FTCH/D/1	WNL	CLSW/D/2 HYCH/D/2	WNL
13491	3.72	CHAMBER	WNL	TRCH/C/D/2	CONG/A/D/1	WNL	MED CONG/A/1	MED CONG/A/1
13492	3.72	CHAMBER	WNL	TRCH/C/F/1	CONG/A/D/1	WNL	MED CONG/A/2	WNL
13487	3.94	CHAMBER	WNL	TRCH/C/D/1	CONG/A/D/2	WNL	MED CONG/A/2	WNL
13488	3.94	CHAMBER	WNL	TRCH/C/D/1-2	CONG/A/D/1	WNL	MED CONG/A/2 CLSW & HYCH/D/2	WNL
13418	4.96	CHAMBER	HEM/A/F/2 CONG/ED/A/D/2	WNL	FTCH/D/2 CONG/A/D/2	WNL	CLSW/D/2	CONG/A/D/1
13419	4.96	CHAMBER	CONG/A/D/2	TRCH/C/D/1	CLSW/D/1-2 CONG/A/D/2	PFOL CONG/A/1	MED CONG/A/2	WNL
13416	6.25	CHAMBER	ED/A/D/2 CONG/A/D/2	TRCH/C/D/3	CONG/A/D/2	WNL	CLSW/D/2	CONG/A/D/1
13417	6.25	CHAMBER	CONG/A/D/2	WNL	FTCH/A/D/2 CONG/A/D/2	WNL	CLSW/D/2	CONG/A/D/1
13420	6.25	SACRIFICE	CONG/A/F/1	WNL	WNL	WNL	WNL	WNL
13414	12.50	CHAMBER	ED/A/D/1 CONG/A/D/1	TRCH/C/F/1	CONG/A/D/1	WNL	CLSW/D/2	CONG/A/2
13415	12.50	CHAMBER	ED/A/D/1 CONG/A/D/1	WNL	CONG/A/D/2	WNL	CLSW/D/2	CONG/A/D/1
13412	50.00	CHAMBER	ED/A/D/1 CONG/A/D/1	ERSN/F TRCH/C/F	CONG/A/D/1	WNL	CLSW/D/1	CONG/A/D/1
13413	50.00	CHAMBER	ED/A/D/1 CONG/A/D/1	ERSN/F TRCH/C/F/1	CONG/A/D/1	WNL	CLSW/D/2	CONG/A/D/1

KEY: A=ACUTE, C=CHRONIC, D=DIFFUSE, F=FOCAL, R=REMOTE, 1=MILD, 2=MODERATE, 3=SEVERE, 4=MASSIVE

NOTE: REFER TO LIST OF ABREVIATIONS USED IN HISTOPATHOLOGY SUMMARIES

ORIGINAL PAGE IS OF POOR QUALITY

Table 10 (cont.)

Y-7683 (LS-200 Foam) Histopathology Summary (Lungs Only) MSTL Pyrolysis Procedure

MST#	Sample Weight (Grams)	Death	Abscess	Atelectasis	Bronchiolitis	Bronchitis	Bronchopneumonia	Congestion	Dilation of Bronchi	Edema	Emphysema	Hemorrhage	Inflammation	Peribronchiolitis	Peribronchitis	Pleuritis	Pneumonitis	Suppuration	Vasculitis
13421	3.12	Sacrifice	—	—	—	—	—	F/2-3	—	—	—	F/2-3	—	—	—	—	C/F/1	—	—
13422	3.12	Sacrifice	—	—	—	—	—	—	—	—	—	A/F/1	—	C/F	C/F	—	C/D/1-2	—	—
13506	3.31	Sacrifice	—	—	—	—	—	F/2	—	—	—	F/2	—	D/1	D/1	—	C/F/1	—	—
13507	3.31	Sacrifice	—	—	—	—	—	A/F/1-2	—	—	—	A/F/1-2	—	—	—	—	C/F/1	—	—
13489	3.51	Chamber	—	F/2-3	A/C/D/2-3	A/C/D/2-3	A/C/F/3	A/D/2	—	—	—	—	—	—	C/D/2-3	—	C/F/1	—	—
13490	3.51	Chamber	—	F/2	—	C/F/2-3	—	A/F/2-3	—	—	—	A/F/2-3	—	—	—	—	C/F/1	—	—
13505	3.51	Sacrifice	—	F/1	—	—	—	A/D/2-3	—	—	—	A/F/2-3	—	—	—	—	—	—	—
13491	3.72	Chamber	—	D/1-2	—	C/F/2	—	A/D/1	—	—	—	—	—	—	C/F/2	—	C/F/1	—	—
13492	3.72	Chamber	—	—	—	—	—	A/D/1-2	—	—	—	—	—	—	—	—	C/F/1	—	—
13487	3.94	Chamber	—	D/1	—	—	—	A/D/2	—	—	—	A/D/1	—	—	—	—	C/D/2	—	—
13488	3.94	Chamber	—	—	—	—	—	A/D/1-2	—	A/D/1-2	—	—	—	—	—	—	C/F/1	—	—
13418	4.96	Chamber	—	F/2-3	—	—	—	A/D/3	—	A/D/3	—	—	—	—	—	—	—	—	—
13419	4.96	Chamber	—	F/3	—	—	—	A/D/1	—	—	—	A/D/1	—	C/F/1	—	—	C/F/1	—	—
13416	6.25	Chamber	—	D	—	—	—	A/D/2	—	—	—	—	—	—	—	—	—	—	—
13417	6.25	Chamber	—	—	—	—	—	A/D/2	—	A/D/2	—	—	—	—	—	—	—	—	—
13420	6.25	Sacrifice	—	F/2	—	—	C/F/1	A/D/1	—	—	—	A/D/1	—	C/F/2	—	—	C/F/1	—	—
13414	12.50	Chamber	—	F/2-3	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
13415	12.50	Chamber	—	—	—	—	—	A/D/2-3	—	A/D/2-3	—	—	—	—	—	—	—	—	—
13412	50.00	Chamber	—	D/3	—	—	—	—	—	—	—	—	—	C/D/2	C/D/2	—	—	—	—
13413	50.00	Chamber	—	D/3	—	—	—	A/D/1	—	A/D/1	—	—	—	—	—	—	—	—	—

Key: A=acute, C=chronic, D=diffuse, F=focal, R=remote, 1=mild, 2=moderate, 3=severe, 4=massive

Note: A dash indicates the lesion was not observed in that animal.

Table 10 (cont.)

Y-7684 (VONAR 3 ON FIBERGLASS) HISTOPATHOLOGY SUMMARY (EXCLUDING LUNGS) MSTL PYROLYSIS PROCEDURE

MST#	SAMPLE WEIGHT (GRAMS)	DEATH	HEART	TRACHEA	LIVER	SPLEEN	KIDNEY	ADRENAL
13526	2.45	SACRIFICE	WNL	TRCH/C/D/1	WNL	WNL	CLSW/D/2 HYCH/D/2	WNL
13527	2.45	SACRIFICE	WNL	TRCH/C/D/1	WNL	PFOL CONG/A/1	CLSW/D/1 HYCH/D/1	MED & CORT CONG/D/1
13502	2.60	CHAMBER	WNL	TRCH/C/D/2	CONG/A/D/1	PFOL CONG/A/1	MED CONG/A/1-2	WNL
13520	2.60	SACRIFICE	WNL	TRCH/C/D/1	WNL	PFOL CONG/A/D/1	CLSW/A/D/1 HYCH/A/D/1	WNL
13521	2.60	SACRIFICE	WNL	TRCH/C/D/1	WNL	PFOL CONG/A/D/1	CLSW/A/D/1 HYCH/A/D/1	WNL
13500	2.76	CHAMBER	WNL	ERSN TRCH/C/D/2	CONG/A/D/2	WNL	MED CONG/2-3 CLSW/D/2	MED CONG/D/1
13501	2.76	CHAMBER	WNL	ERSN TRCH/C/D/2	CONG/A/D/2	PFOL CONG/A/D/1	MED CONG/A/2	WNL
13517	2.76	SACRIFICE	WNL	SUBMUC HEM/A/2 TRCH/C/F/1	WNL	WNL	CLSW/D/2	WNL
13503	2.93	CHAMBER	WNL	TRCH/C/D/1	CONG/A/D/1	WNL	MED CONG/A/2	WNL
13504	2.93	CHAMBER	WNL	TRCH/C/F/1	CONG/A/D/2	WNL	MED CONG/A/2 CLSW & HYCH/D/2	CONG/A/D/2
13497	2.93	CHAMBER	CONG/A/F/2	TRCH/C/D/1	WNL	PFOL CONG/A/2	MED CONG/A/D/2	WNL
13511	2.93	SACRIFICE	WNL	TRCH/C/F/1	WNL	WNL	CLSW/D/2	WNL
13512	2.93	SACRIFICE	WNL	TRCH/F/1	WNL	WNL	CLSW/D/2 HYCH/D/2	WNL
13498	3.11	CHAMBER	CONG/A/F/1	TRCH/C/D/2-3	CONG/A/D/2	WNL	MED CONG/A/2	WNL
13499	3.11	CHAMBER	CONG/A/F/1	TRCH/C/D/2	CONG/A/D/2 FTCH/D/2	WNL	MED CONG/A/3	WNL
13495	3.30	CHAMBER	WNL	TRCH/C/D/2-3	WNL	PFOL CONG/A/D/1	MED CONG/A/D/2 CLSW & HYCH/D/1	MED CONG/A/1
13496	3.30	CHAMBER	WNL	ERSN INFL/C/D/2-3	CONG/A/D/1	WNL	MED CONG/A/3 CLSW & HYCH/D/2	WNL
13493	3.50	CHAMBER	WNL	TRCH/C/D/2-3	CONG/A/D/1	PFOL CONG/A/1	MED CONG/A/2	WNL
13494	3.50	CHAMBER	WNL	TRCH/C/D/1	WNL	WNL	MED CONG/A/2 CLSW & HYCH/D/1	MED CONG/A/1

KEY: A=ACUTE, C=CHRONIC, D=DIFFUSE, F=FOCAL, R=REMOTE, 1=MILD, 2=MODERATE, 3=SEVERE, 4=MASSIVE

NOTE: REFER TO LIST OF ABREVIATIONS USED IN HISTOPATHOLOGY SUMMARIES

Table 10 (cont.)

Y-7684 (VONAR 3 ON FIBERGLASS) HISTOPATHOLOGY SUMMARY (LUNGS ONLY) MSTL PYROLYSIS PROCEDURE

MST#	SAMPLE WEIGHT (GRAMS)	DEATH	ABSCESS	ATELECTASIS	BRONCHIOLITIS	BRONCHITIS	BRONCHO-PNEUMONIA	CONGESTION	DILATION OF BRONCHI	EDEMA	EMPHYZEMA	HEMORRHAGE	INFLAMMATION	PERIBRONCHIOLITIS	PERIBRONCHITIS	PLEURITIS	PNEUMONITIS	SUPURATION	VASCULITIS
13526	2.45	SACRIFICE	—	F/3	—	—	—	A/D/2	—	—	—	—	—	—	—	—	—	—	—
13527	2.45	SACRIFICE	—	F/2	—	A/C/F/1	C/F/1	A/D/1	—	—	—	—	—	—	—	—	C/F/2	—	—
13502	2.60	CHAMBER	—	—	—	C/D/2-3	A/C/F/2	A/D/1-2	—	—	—	—	—	—	C/D/2-3	—	—	—	—
13520	2.60	SACRIFICE	—	—	—	—	—	A/F/3	—	—	—	A/F/3	—	—	—	—	C/F/1	—	—
13521	2.60	SACRIFICE	—	—	—	—	—	A/D/3	—	—	—	—	—	—	—	—	C/F/1	—	C/F/1
13500	2.76	CHAMBER	—	F/2	—	—	—	A/D/2	—	—	COMP/F/1	—	—	—	—	—	C/D/1	—	—
13501	2.76	CHAMBER	—	F/2	—	—	—	A/D/2	—	A/F/2-3	—	—	—	—	—	—	C/F/1	—	—
13517	2.76	SACRIFICE	—	D/2	—	—	—	A/D/2	—	—	—	—	—	—	—	—	C/F	—	—
13503	2.93	CHAMBER	—	F/2	—	—	A/F/2	A/D/2	—	—	—	—	—	—	—	—	C/F/1	—	—
13504	2.93	CHAMBER	—	F/1	—	—	—	A/D/1	—	—	—	—	—	—	—	—	C/F/1	—	—
13497	2.93	CHAMBER	—	D/1-2	—	—	—	A/D/1	—	—	—	—	—	—	—	—	---	—	—
13511	2.93	SACRIFICE	—	F/2	—	—	—	A/D/1-2	—	—	—	—	—	—	—	—	C/F/1	—	—
13512	2.93	SACRIFICE	—	F/1-2	—	—	—	A/D/1	—	—	—	A/F/3	—	—	—	—	—	—	—
13498	3.11	CHAMBER	—	—	—	—	—	A/D/2	—	—	—	—	—	—	—	—	C/D/1	—	—
13499	3.11	CHAMBER	—	—	—	—	—	A/D/2-3	—	—	—	—	—	—	—	—	C/D/1	—	—
13495	3.30	CHAMBER	—	D/1-2	—	—	—	A/D/1-2	—	—	—	—	—	—	—	—	—	—	—
13496	3.30	CHAMBER	—	F/2	—	C/F/2-3	C/F/1	A/D/1-2	—	—	—	—	—	—	C/F/2-3	—	A/C/F/2-3	—	—
13493	3.50	CHAMBER	—	F/1	—	—	—	A/D/1	—	—	—	A/F/1	—	—	—	—	—	—	—
13494	3.50	CHAMBER	—	D/1-2	—	—	—	A/D/2	—	—	—	—	—	—	—	—	—	—	—

KEY: A=ACUTE, C=CHRONIC, D=DIFFUSE, F=FOCAL, R=REMOTE, 1=MILD, 2=MODERATE, 3=SEVERE, 4=MASSIVE

NOTE 1: A DASH INDICATES THE LESION WAS NOT OBSERVED IN THAT ANIMAL

NOTE 2: REFER TO LIST OF ABREVIATIONS USED IN HISTOPATHOLOGY SUMMARIES

Table 10 (cont.)

Y-7685 (Vonar 3 on NW Polyester) Histopathology Summary (Excluding Lungs) MSTL Pyrolysis Procedure

MST#	Sample Weight (Grams)	Death	Heart	Trachea	Liver	Spleen	Kidney	Adrenal
13524	2.00	Sacrifice	WNL	Trch/C/D/1	WNL	Pfol Cong/A/D/1	ClSw/D/2	WNL
13525	2.00	Sacrifice	WNL	Trch/C/D/1	FtCh/D/1	Pfol Cong/A/2	ClSw/D/2 HyCh/D/2	WNL
13528	2.52	Sacrifice	WNL	Trch/C/F/1	FtCh/F/2	Pfol Cong/A/2	ClSw/D/2	WNL
13529	2.52	Sacrifice	WNL	Trch/C/F/1	WNL	WNL	ClSw/D/2 HyCh/D/2	WNL
13523	2.68	Chamber	WNL	Trch/C/D/2	Cong/A/D/1 FtCh/D/1	WNL	Med Cong/A/1 ClSw & HyCh/D/1	Med & Cort Cong/A/1
13544	2.68	Sacrifice	WNL	Trch/C/D/1	WNL	WNL	ClSw & HyCh/D/1	WNL
13545	2.68	Sacrifice	WNL	Infl/C/F/1	WNL	WNL	ClSw & HyCh/D/1	WNL
13522	2.84	Chamber	WNL	Trch/A&C/D/2	Cong/A/D/3	WNL	Med Cong/A/3	Med & Cort Cong/A/D/2
13542	2.84	Sacrifice	WNL	Trch/C/F/1	WNL	WNL	NS	WNL
13543	2.84	Sacrifice	WNL	Trch/C/D/1	WNL	WNL	ClSw & HyCh/D/1	WNL
13518	3.01	Chamber	Cong/A/D/2	Trch/C/D/1-2	Cong/A/D/2-3	WNL	Med Cong/A/2	Med & Cort Cong/D/2
13519	3.01	Chamber	Cong/A/D/2	Ersn Trch/A/D/2-3	Cong/A/D/2-3	WNL	Med Cong/A/2	Med & Cort Cong/D/2
13540	3.01	Sacrifice	WNL	NS	WNL	WNL	ClSw & HyCh/D/1	WNL
13541	3.01	Sacrifice	WNL	Trch/C/D/1	FtCh/D/1	Pfol Cong/A/1	ClSw & HyCh/D/1	WNL
13508	3.19	Chamber	WNL	Ersn Trch/C/D/2	Cong/A/D/2-3	WNL	Cong/A/D/2 ClSw & HyCh/D/2	Cong/A/D/1
13530	3.19	Sacrifice	WNL	Trch/C/D/1	WNL	NS	NS	WNL
13531	3.19	Sacrifice	WNL	NS	FtCh/F/1	Pfol Cong/A/2	ClSw & HyCh/D/2	WNL
13515	3.38	Chamber	WNL	Trch/C/D/1	Cong/A/D/2	WNL	Med Cons/A/2	WNL
13516	3.38	Chamber	WNL	Ersn Trch/C/D/1	Cong/A/D/2	WNL	Med Cong/A/2	WNL
13539	3.38	Sacrifice	WNL	NS	FtCh/F/1	WNL	ClSw & HyCh/D/1	WNL
13513	3.58	Chamber	WNL	Trch/A&C/D/2	Cong/A/D/2-3	WNL	Med Cong/A/2	WNL
13514	3.58	Chamber	WNL	Trch/C/F/1	Cong/A/D/2	Pfol Cong/A/1	Med Cong/A/2	WNL
13509	4.03	Chamber	WNL	Trch/C/D/1-2	Cong/A/D/1-2	Pfol Cong/A/D/1-2	Med Cong/A/2 ClSw & HyCh/D/2	WNL
13510	4.03	Chamber	WNL	Trch/C/D/1	Cong/A/D/2	WNL	ClSw & HyCh/D/2	WNL

Key: A=acute, C=chronic, D=diffuse, F=focal, R=remote, 1=mild, 2=moderate, 3=severe, 4=massive

Note: Refer to list of abreviations used in histopathology summaries

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Table 10 (cont.)

Y-7685 (Vonar 3 on NW Polyester) Histopathology Summary (Lungs Only) MSTL Pyrolysis Procedure

MST#	Sample Weight (grams)	Death	Abscess	Atelectasis	Bronchiolitis	Bronchitis	Bronchopneumonia	Congestion	Dilation of Bronchi	Edema	Emphysema	Hemorrhage	Inflammation	Peribronchiolitis	Peribronchitis	Pleuritis	Pneumonitis	Suppuration	Vasculitis
13524	2.00	Sacrifice	—	F/3	—	—	C/F/1	A/D/1	—	—	—	—	—	—	—	—	C/F/1	—	—
13525	2.00	Sacrifice	—	—	—	—	—	F/2-3	—	F/2-3	—	A/F/3	—	—	—	—	C/F/1	—	—
13528	2.52	Sacrifice	—	F/1	—	—	—	A/D/1	—	—	—	A/F/2	—	—	—	—	C/F/1	—	—
13529	2.52	Sacrifice	—	F/1	—	—	—	A/D/1	—	—	—	A/F/2-3	—	—	—	—	C/F/1	—	—
13523	2.68	Chamber	—	—	—	A/C/D/2	—	A/D/2-3	—	A/D/2-3	—	—	—	—	A/C/D/2	—	—	—	—
13544	2.68	Sacrifice	—	—	—	—	—	—	—	—	—	A/4	—	—	—	—	—	—	—
13545	2.68	Sacrifice	—	—	—	—	—	A/F/2	—	—	—	A/F/2	—	C/D/1	C/D/1	—	C/F/1	—	C/F/1
13522	2.84	Chamber	—	F/2-3	—	C/F/1	C/F/1	A/D/1-2	—	—	—	—	—	—	C/D/1	—	C/D/1	—	—
13542	2.84	Sacrifice	—	—	—	—	—	—	—	—	—	A/D/2-3	—	—	C/F/1	—	C/F/1	—	—
13543	2.84	Sacrifice	—	—	—	—	—	—	—	—	—	A/4	—	—	—	—	—	—	—
13518	3.01	Chamber	—	—	—	—	—	A/D/2-3	—	A/D/2-3	—	—	—	—	—	—	—	—	—
13519	3.01	Chamber	—	—	—	—	—	A/D/2-3	—	A/D/2-3	Comp	—	—	—	—	—	—	—	—
13540	3.01	Sacrifice	—	—	—	—	—	—	—	—	—	A/D/4	—	—	—	—	C/F/1	—	—
13541	3.01	Sacrifice	—	—	—	—	—	—	—	—	—	A/D/4	—	—	—	—	C/1	—	C/F/1
13508	3.19	Chamber	—	D/2	—	—	—	A/D/2	—	A/D/2	—	A/D/2	—	—	—	—	—	—	—
13530	3.19	Sacrifice	—	—	—	—	—	—	—	—	—	A/D/3	—	—	—	—	—	—	—
13531	3.19	Sacrifice	—	F/1	—	—	—	—	—	A/F/1	—	A/D/3	—	C/D/1	C/D/1	—	C/F/1	—	—
13515	3.38	Chamber	—	—	—	—	—	A/D/2-3	—	A/D/2-3	—	A/F/2	—	—	—	—	—	—	—
13516	3.38	Chamber	—	—	—	—	—	A/D/2-3	—	A/D/2-3	—	A/F/2	—	—	—	—	—	—	—
13539	3.38	Sacrifice	—	—	C/F/1	—	—	—	—	—	—	A/F/2	—	—	—	—	C/F/1	—	—
13513	3.58	Chamber	—	F/2	—	—	—	A/D/1	—	—	—	—	—	—	—	—	—	—	—
13514	3.58	Chamber	—	—	—	—	—	A/D/2-3	—	A/D/2-3	—	A/F/2	—	—	—	—	—	—	—
13509	4.03	Chamber	—	D/1-2	—	—	—	A/D/1-2	—	A/D/1-2	—	A/D/1-2	—	—	—	—	—	—	—
13510	4.03	Chamber	—	D/2-3	—	—	—	A/D/2	—	—	—	A/F/2	—	—	—	—	—	—	—

Key: A=acute, C=chronic, D=diffuse, F=focal, R=remote, 1=mild, 2=moderate, 3=severe, 4=massive

Note 1: A dash indicates the lesion was not observed in that animal

Note 2: Refer to list of abreviations used in histopathology summaries

Table 11

UNTREATED CONTROL HISTOPATHOLOGY SUMMARY (LUNGS ONLY)

MST#	ABSCESS	ATELEC-TASIS	BRONCHI-OLITIS	BRONCHITIS	BRONCHO-PNEUMONIA	CONGES-TION	DILATION OF BRONCHI	EDEMA	EMPHY-ZEMA	HEMOR-RHAGE	INFLAM-MATION	PERIBRON-CHIOLITIS	PERIBRON-CHITIS	PLEURITIS	PNEUMONITIS	SUPURATION	VASCULITIS
13532	—	—	A&C/F/1	—	C/F/1	A/D/1	—	—	—	—	—	C/D/1	C/D/1	—	A&C/D/1-2	—	—
13533	—	—	—	—	—	F/1-2	—	F/1-2	—	A/F/2-3	—	C/F/1	C/F/1	—	C/F/1	—	—
13534	—	—	—	—	—	A/F/1	—	A/F/1	—	A/D/2-3	—	C/F/1	C/F/1	—	C/F/1	—	—
13535	—	—	—	—	—	A/F/1	—	A/F/1	—	A/D/2-3	—	C/F/1	C/F/1	—	C/F/1	—	—
13536	—	F/1	—	—	—	—	—	—	—	A/D/4	—	—	—	—	—	—	—
13537	—	F/1	—	—	—	—	—	—	—	—	—	C/D/1	C/D/1	—	C/F/1	—	—
13538	—	—	—	—	—	—	—	—	—	A/F/2	—	—	—	—	C/F/1	—	—

UNTREATED CONTROL HISTOPATHOLOGY SUMMARY (EXCLUDING LUNGS)

MST#	HEART	TRACHEA	LIVER	SPLEEN	KIDNEY	ADRENAL
13532	HEM/A/F/2 MYOC INFL/C/F/1	TRCH/C/D/1	WNL	WNL	CLSW & HYCH/D/2	WNL
13533	WNL	ERSN TRCH/C/F/1	WNL	WNL	CLSW & HYCH/D/1	WNL
13534	CONG/A/F/1	ERSN TRCH/C/D/1	FTCH/F/1	WNL	CLSW & HYCH/D/2	WNL
13535	CONG/A/F/1	ERSN TRCH/C/D/1	FTCH/F/1	WNL	CLSW & HYCH/D/2	WNL
13536	WNL	TRCH/C/D/1	WNL	WNL	CLSW/D/1	WNL
13537	WNL	TRCH/A&C/D/2	WNL	PFOL HEM/A/1	CLSW & HYCH/D/1	WNL
13538	HEM/A/F/1	NS	WNL	WNL	CLSW & HYCH/D/1	WNL

KEY: A=ACUTE, C=CHRONIC, D=DIFFUSE, F=FOCAL, R=REMOTE, 1=MILD, 2=MODERATE, 3=SEVERE, 4=MASSIVE

NOTE 1: A DASH INDICATES THE LESION WAS NOT OBSERVED IN THAT ANIMAL

NOTE 2: REFER TO LIST OF ABREVIATIONS USED IN HISTOPATHOLOGY SUMMARIES

Table 12

General Summary of Gross Autopsies and Apparently Exposure-Related Features - In-Chamber Pyrolysis

Sample Tested	Gross Autopsy	Histopathologic Examination
Y-7683 LS 200 Foam	The lungs of sacrificed animals were generally more gray in color having a greater proportion of dark red spots on the surface of each lobe, and the liver of these animals were generally more dark brown in color, when compared with animals that died in the chamber. Animals dying during the 14-day observation period consistently displayed pallor, inactivity with little or no response to manual displacement, and felt abnormally cool to the touch for 24 to 48 hours before death.	The number of inflammatory changes in the lungs seems to increase as sample weight pyrolyzed increases. Sacrificed animals have a greater incidence of inflammatory changes in the trachea than do the animals dying in the chamber.
Y-7684 Vonar 3 on Fiberglass	The lungs of autopsied animals were generally light brown in color with dark brown or red-brown spots on the surface of each lobe.	The animals exposed to higher sample weights show more inflammatory changes in the trachea and higher incidence of erosion than those exposed to lower sample weights. There were no observable trends in lungs histopathology.
Y-7685 Vonar 3 on N W Polyester	The autopsied animals generally had red-brown spots on the surface of each lobe of the lungs and frequently displayed signs of congestion of the liver.	The animals exposed to higher sample weights were generally found to have a greater number of pulmonary lesions than those exposed to lower sample weights. Especially notable is the increases in severity of atelectasis, congestion, and edema with exposure to pyrolysates formed from increasing sample weights.

Table 13

General Summary of Gross Autopsies and Apparently Exposure-Related Histopathologic Features - In-Chamber Pyrolysis

Sample Tested	Gross Autopsy	Histopathologic Examination
Y-7683 LS Foam	Lungs of all animals were generally healthy pink in color, lightly speckled with red spots on the surface of each lobe. These spots were more prominent in sacrificed animals than in those dying in the chamber. Liver and kidneys frequently showed signs of congestion.	Animals exposed to higher sample weights generally showed more congestion of heart and adrenal as well as hydropic change in the kidneys. Sacrificed animals presented more chronic conditions than did those dying in the chamber, especially in the trachea. However, there was no difference noted between these groups in the incidence or severity of pneumonitis. Atelectasis was determined to be more severe in the lungs of animals exposed to higher sample weights and the incidence of pulmonary edema was greater at sample weights of 3.94 grams or more.
Y-7684 Vonar 3 on Fiberglass	Lungs of all animals were generally healthy pink in color, lightly speckled with red spots on the surface of each lobe. The livers of animals dying in the chamber more frequently showed signs of congestion than did those of sacrificed animals.	Animals exposed to higher sample weights generally had a higher incidence of congestion in the heart, congestion and cloudy swelling in the kidneys, greater severity of tracheitis and atelectasis in the respiratory tract than did those animals exposed to lesser sample weights.
Y-7685 Vonar 3 on N W Polyester	All autopsied animals had red-brown spots on the surface of each lobe of the lungs. Animals dying in the chamber more frequently showed signs of congestion of liver and kidneys than did the sacrificed animals.	Sacrificed animals tended to have more chronic pulomonary inflammatory conditions than did those animals dying in the chamber, and the severity of atelectasis appears to have increased as sample weight increased. Animals dying in the chamber generally presented congestion of liver and kidneys while the sacrificed animals generally presented fatty change in the liver and cloudy swelling with hydropic change in the kidneys.

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Table 14

EXPERIMENTS WITH EXPOSURE TO SHOCK AND PYROLYSIS PRODUCTS

Y-7684 (VONAR 3 ON FIBERGLASS) HISTOPATHOLOGY SUMMARY (EXCLUDING LUNGS)

IN CHAMBER PYROLYSIS PROCEDURE

Procedure	MST#	SAMPLE WEIGHT (GRAMS)	DEATH	HEART	TRACHEA	LIVER	SPLEEN	KIDNEY	ADRENAL
BEHAVIOR	13434	15.00	CHAMBER	WNL	WNL	FTCH/D/2	HYPF/D	THYR/D/2	CONG/D/2
BEHAVIOR	13433	20.00	CHAMBER	MYOC ED/F/1	TRCH/C/F/1	CONG/A/D/3	WNL	THYR/F/2, MED CON/A/2, CLSW & HYCH/F/2	NS
N=3 WITH SHOCK	13459	20.00	CHAMBER	CONG & ED/A/1	TRCH/D/2	CONG/A/F/1 FTCH/D/1	WNL	CONG/A/D/1	WNL
N=3 WITH SHOCK	13460	20.00	CHAMBER	WNL	TRCH/C/D/2	CONG/A/D/2 FTCH/D/1	CONG/A/D/1	CONG/A/D/2	CONG/A/D/2
N=3 WITH SHOCK	13461	20.00	CHAMBER	CONG/A/F/1	PTRC/F/1	CONG/A/D/1, FTCH/D/1, INFL/C/F/1	WNL	THYR/F/1	CONG/A/D/2
N=3 WITH SHOCK	13462	20.00	CHAMBER	MYOC CONG & ED/D/2	TRCH/C/D/2-3	CONG/A/D/2, FTCH/F/1	WNL	NS	WNL
WITH SHOCK	13475	15.00	CHAMBER	WNL	TRCH/C/D/1-2	CONG/A/D/1	WNL	MED CONG/A/1	WNL
WITH SHOCK	13476	15.00	CHAMBER	WNL	WNL	CONG/A/D/2	WNL	MED CONG/A/1	WNL
WITH SHOCK	13477	15.00	CHAMBER	WNL	WNL	CONG/A/D/1	WNL	MED CONG/A/2	WNL
WITH SHOCK	13478	20.00	SACRIFICE	WNL	TRCH/C/D/1	WNL	WNL	WNL	WNL
WITH SHOCK	13471	20.00	CHAMBER	WNL	WNL	CONG/A/D/1	WNL	WNL	WNL
WITH SHOCK	13472	20.00	CHAMBER	WNL	WNL	CONG/A/D/2-3	PFOL CONG/A/2	MED CONG/A/2	WNL
WITH SHOCK	13485	20.00	SACRIFICE	WNL	TRCH/C/D/1	WNL	WNL	WNL	WNL
WITHOUT SHOCK	13481	15.00	SACRIFICE	WNL	TRCH/C/D/1	WNL	WNL	WNL	WNL
WITHOUT SHOCK	13482	15.00	SACRIFICE	WNL	WNL	FTCH/D/1-2	WNL	WNL	WNL
WITHOUT SHOCK	13483	15.00	SACRIFICE	WNL	ERSN TRCH/C/D/2	FTCH/D/2	WNL	WNL	WNL
WITHOUT SHOCK	13484	15.00	SACRIFICE	WNL	TRCH/C/D/1	FTCH/D/1	WNL	WNL	WNL
WITHOUT SHOCK	13479	20.00	SACRIFICE	WNL	ERSN/F	WNL	WNL	WNL	WNL
WITHOUT SHOCK	13480	20.00	SACRIFICE	WNL	TRCH/C/F/1-2	WNL	WNL	WNL	WNL
WITHOUT SHOCK	13473	20.00	CHAMBER	WNL	ERSN/F TRCH/C/D/2	WNL	WNL	MED CONG/A/3	WNL
WITHOUT SHOCK	13474	20.00	CHAMBER	WNL	WNL	CONG/A/D/1	WNL	MED CONG/A/2	WNL
WITHOUT SHOCK	13486	20.00	SACRIFICE	WNL	TRCH/C/D/1	FTCH/D/2	WNL	CLSW/1	WNL

KEY: A=ACUTE, C=CHRONIC, D=DIFFUSE, F=FOCAL, R=REMOTE, 1=MILD, 2=MODERATE, 3=SEVERE, 4=MASSIVE.

NOTE: REFER TO LIST OF ABREVIATIONS USED IN HISTOPATHOLOGY SUMMARIES

Table 14 (cont.)

EXPERIMENTS WITH EXPOSURE TO SHOCK AND PYROLYSIS PRODUCTS

Y-7684 (VONAR3 ON FIBERGLASS) HISTOPATHOLOGY SUMMARY (LUNGS ONLY) IN CHAMBER PYROLYSIS PROCEDURE

	MST#	SAMPLE WEIGHT (GRAMS)	DEATH	ABSCESS	ATELECTASIS	BRONCHIOLITIS	BRONCHITIS	BRONCHOPNEUMONIA	CONGESTION	DILATION OF BRONCHI	EDEMA	EMPHYZEMA	HEMORRHAGE	INFLAMMATION	PERIBRONCHIOLITIS	PERIBRONCHITIS	PLEURITIS	PNEUMONITIS	SUPURATION	VASCULITIS	
BEHAVIOR	13434	15.00	CHAMBER	—	F/2	—	—	—	F/2	—	—	—	—	C	—	—	—	—	—	—	BEHAVIOR
	13433	20.00	CHAMBER	—	—	—	—	—	F/2-3	—	F/2-3	Comp/F	—	—	—	C/F/2	—	—	—	—	
N=3 WITH SHOCK	13459	20.00	CHAMBER	—	D/2-3	C/F/1	C/F/1	—	A/F/2	—	A/F/2	—	—	—	—	—	—	—	—	—	N=3 WITH SHOCK
	13460	20.00	CHAMBER	—	—	—	—	—	A/F/2	—	A/F/2	D/1	—	—	—	C/F/1	—	—	—	—	
	13461	20.00	CHAMBER	—	—	—	—	—	—	—	F/3	—	—	—	—	F/2	—	—	—	—	
	13462	20.00	CHAMBER	—	—	—	—	—	—	—	A/F/2	—	—	—	C/D/2	C/D/2	—	—	—	—	
WITH SHOCK	13475	15.00	CHAMBER	—	—	—	—	C/F/2	A/D/2	—	A/D/2	—	—	—	C/D/1	C/D/1	—	A&C/D/2	—	—	WITH SHOCK
	13476	15.00	CHAMBER	—	—	—	—	—	A/D/3	—	A/D/3	—	—	—	C/F/1	—	—	—	—	—	
	13477	15.00	CHAMBER	—	D/2-3	A&C/F/2	A&C/F/2	—	A/D/2	—	A/D/2	—	—	—	C/F/1	C/F/1	—	—	—	—	
	13478	20.00	SACRIFICE	—	—	—	—	—	A/F/1	—	A/F/1	—	—	—	C/F/1	C/F/1	—	C/F/1	—	—	
	13471	20.00	CHAMBER	—	F/2	—	—	—	A/F/1	—	A/F/1	—	—	—	C/F/1-2	C/F/1-2	—	C/F/1	—	—	
	13472	20.00	CHAMBER	—	D/2-3	—	—	—	A/D/2-3	—	A/D/2-3	—	—	—	C/F/1	C/F/1	—	C/F/2	—	—	
	13485	20.00	SACRIFICE	—	—	—	—	—	A/F/3	—	A/F/3	—	A/F/3	—	C/F/1	C/F/1	—	C/F/1	—	—	
WITHOUT SHOCK	13481	15.00	SACRIFICE	—	F/1	—	—	C/F/1	A/F/1	—	—	—	A/F/1	—	—	—	—	C/F/1	—	—	WITHOUT SHOCK
	13482	15.00	SACRIFICE	—	—	—	A/F/2	—	A/F/2	—	A/F/2	—	—	—	C/F/2	C/F/2	—	C/F/1	—	—	
	13483	15.00	SACRIFICE	—	—	—	—	—	A/F/1	—	A/F/1	—	A/F/2	—	C/F/2	C/F/2	—	C/F/1	—	—	
	13484	15.00	SACRIFICE	—	—	—	—	—	A/D/3	—	A/D/3	—	A/4	—	—	—	—	C/D/2	—	—	
	13479	20.00	SACRIFICE	—	—	—	—	C/F/2-3	A/D/2	—	A/D/2	—	—	—	C/F/2	C/F/2	—	—	—	—	
	13480	20.00	SACRIFICE	—	—	—	—	—	A/D/2	—	A/D/2	—	—	—	C/F/1	C/F/1	—	C/F/1	—	—	
	13473	20.00	CHAMBER	—	F/2	—	A/F/1	—	A/F/2	—	A/F/2	F/1	—	—	C/F/1	C/F/1	—	A&C/D/2-3	—	—	
	13474	20.00	CHAMBER	—	—	—	C/F/2	—	A/D/1	—	A/D/1	—	—	—	C/F/2	C/F/2	—	C/D/2	—	—	
	13486	20.00	SACRIFICE	—	—	—	—	—	A/F/3	—	A/F/3	—	—	—	C/F/1	C/F/1	—	C/F/1	—	—	

KEY: A=ACUTE, C=CHRONIC, D=DIFFUSE, F=FOCAL, R=REMOTE, 1=MILD, 2=MODERATE, 3=SEVERE, 4=MASSIVE

NOTE 1: A DASH INDICATES THE LESION WAS NOT OBSERVED IN THAT ANIMAL.

NOTE 2: REFER TO LIST OF ABREVIATIONS USED IN HISTOPATHOLOGY SUMMARIES

Table 15

General Summary of Gross Autopsies and Apparently Exposure-Related Histopathologic Features...Exploratory Studies with Pyrolysate - Exposure plus Shock [In-Chamber Pyrolysis]

Sample Tested	Gross Autopsy	Histopathologic Examination
Y-7684 Vonar 3 on Fiberglass	There were no grossly observed differences between animals receiving shock and those not receiving shock during exposure. Dark red spots were consistently observed on the surface of each lobe of the lungs in all animals.	Those animals receiving shock during exposure when compared to those not receiving shock tended to have more congestion especially in the liver and kidney but also in the heart, adrenal and spleen. No differences were noted between these groups in pulmonary disorders.
Unexposed Controls	Control sacrifices consistently presented a light red speckling of the surface of each lobe of the lungs. The lungs were generally a healthy pink color.	Control animals show a significant number of pulmonary lesions but generally less severe than those found in experimental group.

Table 16
In-Chamber Pyrolysis and Shock
Three rats in shock chamber exposed to pyrolysates of Y-7684

Sample Wt.	20 gm	20 gm		
Group	50	51		
Cumulative Mortality[b]	3/3, 3/3, 3/3	3/3, 3/3, 3/3		
% Pyrolyzed	52	52		
$\bar{x}$ COHb[c]	83%	73%		
O_2 (GC)[d]	20.1/20.8/20.8	19.6/18.9/17.2		
CO_2 (GC)[d]	1.10/1.26/1.02	1.06/1.16/1.08		
CO (GC)[d]	0.23/0.24/0.18	0.22/0.21/0.19		
CO_2[e]	0.5%	0.6%		
CO[e]	0.1%	0.1%		
H_2O[e]	6 mg/l	nt		
HCN[e]	40 ppm	45 ppm		
HF[e]	>20 ppm	>20 ppm		
HCl[e]	200 ppm	400 ppm		

a Number in parentheses indicates percent degradation by weight.
b Mortality expressed as number of animals dying in chamber, within 48 hours, and within 14 days per number of animals exposed.
c Carboxyhemoglobin analyses were performed only on animals dying in the chamber.
d GC samples were taken immediately, at 15 and at 30 minutes after combustion/pyrolysis and data indicate percent by weight at these times.
e Measurements made with detector tubes manufactured by Gastec Corp., Tokyo, Japan.

These trial runs were conducted because of death of some trained rats to pyrolysates of this sample when similar exposures during the LD_{50} studies were not lethal to the exposed rats.

Table 17

Summary of results from simulataneously exposing 4 rats to in-chamber pyrolysis of Y-7684. During exposure 2 rats received shocks in the behavior apparatus while the other 2 did not receive shocks.

Sample Weight	15 gm	15 gm	20 gm	20 gm	20 gm
Group	54	55	52	53	56
Deaths with Shock	2/2, 2/2, 2/2	1/2, 2/2, 2/2	0/2, 1/2, 1/2	2/2, 2/2, 2/2	0/2, 1/2, 1/2
Deaths without Shock	0/2, 0/2, 0/2	0/2, 0/2, 0/2	0/2, 0/2, 0/2	2/2, 2/2, 2/2	0/2, 1/2, 1/2
GC (0,15,30) O_2 Conc.	19.1%, 20.5%, 20.5%	20.5%, 19.4%, 18.6%	19.9%, 18.9%, 19.1%	18.4%, 18.4%, 18.2%	19.2%, 18.9%, 18.5%
GC (0,15,30) CO_2 Conc.	1.37%, 1.76%, 1.51%	0.74%, 0.80%, 0.88%	0.41%, 0.58%, 0.74%	0.17%, 1.26%, 1.19%	0.63%, 0.85%, 0.94%
GC (0,15,30) CO Conc.	0.23%, 0.23%, 0.23%	0.23%, 0.22%, 0.21%	0.10%, 0.10%, 0.10%	0.33%, 0.32%, 0.31%	0.15%, 0.13%, 0.13%
Det. Tube CO_2	1.0%	0.3%	0.25%	0.75%	0.25%
Det. Tube CO	0.15%	0.1%	0.1%	0.25%	0.1%
Det. Tube H_2O	9 mg/l	13 mg/l	------	10 mg/l	8 mg/l
Det. Tube HCN	47 ppm	42 ppm	37 ppm	60 ppm	---------
Det. Tube HF	>20 ppm	>20 ppm	>20 ppm	>20 ppm	>20 ppm
Det. Tube HCl	75 ppm	110 ppm	100 ppm	100 ppm	100 ppm
Chamber Death $\bar{X}$ COHb	64%	67%	------	67%	---------

Table 18

Means and Standard Deviations Averaged Across Groups for Two Daily Performances Prior to Behavior Test Expressed in Intervals of Ten Minutes

Intervals		Shocks Received Per Minute* Day 1	Day 2
#1	$\overline{X}$	2.380	2.344
	σ	0.485	0.538
#2	$\overline{X}$	2.178	2.061
	σ	0.686	0.717
#3	$\overline{X}$	2.036	1.927
	σ	0.698	0.670
#4	$\overline{X}$	1.925	1.983
	σ	0.727	0.612
#5	$\overline{X}$	1.908	1.794
	σ	0.727	0.689
#6	$\overline{X}$	1.911	1.850
	σ	0.733	0.675
#7	$\overline{X}$	1.918	1.761
	σ	0.673	0.773

* If rat did not press lever, it would receive 12 shocks per minute.

Table 19

Summary of Mean Shocks Per Minute Received During Preburn, Burn, and Postburn Intervals for Each Sample At Each Exposure Level

Sample Y-7683

		Group 1 (10 g.)	Group 2 (15 g.)	Group 3 (20 g.)
Preburn	$\bar{X}$ =	1.933	1.783	1.883
	σ =	.310	.682	.561
Burn	$\bar{X}$ =	2.100	2.712	1.900
	σ =	.626	.712	2.672
Postburn	$\bar{X}$ =	3.877	6.523	8.821
	σ =	1.692	2.977	.836

Sample Y-7685

		Group 4 (10 g.)	Group 5 (15 g.)
Preburn	$\bar{X}$ =	1.698	2.967
	σ =	.905	.478
Burn	$\bar{X}$ =	4.475	3.112
	σ =	1.191	.697
Postburn	$\bar{X}$ =	9.207	10.733
	σ =	1.769	.874

Sample Y-7684

		Group 6 (5 g.)	Group 7 (10 g.)	Group 8 (15 g.)
Preburn	$\bar{X}$ =	2.092	2.392	1.575
	σ =	.624	.421	.510
Burn	$\bar{X}$ =	1.725	3.275	3.450
	σ =	.432	.311	1.765
Postburn	$\bar{X}$ =	3.458	8.765	7.760
	σ =	1.310	1.511	3.763

		Group 9 (20 g.)
Preburn	$\bar{X}$ =	2.217
	σ =	.428
Burn	$\bar{X}$ =	3.942
	σ =	1.397
Postburn	$\bar{X}$ =	9.405
	σ =	1.128

Table 20

Newman Keul's Significance Matrix for Groups with Time Variables as the Variable, Factoring for Days
(Matrices showing no significant difference have been omitted)

Note: * indicates 0.05   ** indicates 0.01

	Interval		Days	
Group 1	6		2	3
		1	0.03 NS	3.96 NS
		2	-	3.93 *
Group 2	5		1	3
		2	0.03 NS	6.69 **
		1	-	6.66 **
	6		2	3
		1	0.55 NS	5.28 *
		2	-	4.73 *
Group 3	5		2	3
		1	0.58 NS	14.11 **
		2	-	13.53 **
	6		2	3
		1	0.30 NS	18.44 **
		2	-	16.14 **

	Interval		Days	
Group 3 (cont.)	7		2	3
		1	0.91 NS	48.30 **
		2	-	47.40 **
Group 4	4		2	3
		1	0.32 NS	5.21 *
		2	0.03 -	4.89 *
	5		2	3
		2	0.03 NS	6.03 *
		1	-	6.00 **
	6		1	3
		2	0.58 NS	15.98 **
		1	-	15.40 **
	7		2	3
		1	1.10 NS	17.04 **
		2	-	15.93 **
Group 5	4		1	3
		2	0.34 NS	4.13 NS
		1	-	3.80 *

Table 20 (contined)

Newman Keul's Significance Matrix for Groups with Time Variables as the Variable, Factoring for Days
(Matrices showing no significant difference have been omitted)

Note: * indicates 0.05 ** indicates 0.01

Group	Interval		Days	
Group 5 (cont)	5		1	3
		2	0.40 NS	11.66 **
		1	-	11.27 **
	6		1	3
		2	0.44 NS	43.36 **
		1	-	42.92 **
	7		2	3
		1	0.00 NS	39.67 **
		2	-	39.67 **
Group 6	No Significant Differences			
Group 7	4		2	3
		1	0.00 NS	4.78 *
		2	-	4.78 *
	5		1	3
		2	0.20 NS	8.45 **
		1	0.00 NS	8.26 **
Group 7 (cont.)	6		2	3
		1	0.00 NS	9.29 **
		2	-	9.29 **
	7		2	3
		1	0.06 NS	20.24 **
		2	-	20.18 **
Group 8	1		2	1
		3	1.13 NS	4.84 *
		2	-	3.71 *
	5		1	3
		2	0.40 NS	4.24 NS
		1	-	3.84 *
	6		1	3
		2	0.03 NS	4.26 NS
		1	-	4.23 *

Table 20(continued)

Newman Keul's Significance Matrix for Groups with
Time Variables as the Variable, Factoring
for Days
(matrices showing no significant difference have been omitted)

Note: * indicates 0.05 ** indicates 0.01

	Interval	Days	1	3
Group 8 (cont.)	7		1	3
		2	0.31 NS	4.53 *
		1	-	4.22 *
Group 9	4		1	3
		2	0.29 NS	4.52 *
		1	-	4.23 *
	5		1	3
		2	0.07 NS	5.29 *
		1	-	5.21 *
	6		1	3
		2	0.35 NS	29.69 **
		1	-	29.34 **
	7		1	3
		2	0.07 NS	26.91 **
		1		26.84 **

Table 21

Tabulation of Physical Parameters in Behavioral Studies

	Animal No.	Body Weight (gm)	Chamber Temp. During Pyrolysis	Oven Temperature: Preheat	Oven Temperature: Initiation of Pyrolysis	Oven Temperature: Final	% Pyrolyzed
Group 1	33	290	26-36°C	775°C	696°C	799°C	51
Y-7683	35	310	28-36°C	753°C	662°C	770°C	52
10 gm.	38	340	25-35°C	770°C	666°C	784°C	52
	39	350	25-35°C	812°C	706°C	842°C	40
Group 2	9	475	25-30°C	820°C	709°C	822°C	55
Y-7683	13	*	25-30°C	805°C	686°C	795°C	56
15 gm.	17	394	25-34°C	*	658°C	777°C	?
	16	370	24-34°C	740°C	*	808°C	57
Group 3	14	456	25-35°C	811°C	692°C	811°C	57
Y-7683	15	437	26-35°C	805°C	692°C	828°C	53
20 gm.	1	392	25-33°C	825°C	714°C	842°C	50
	3	476	24-33°C	*	742°C	860°C	50
Group 4	21	280	23-35°C	800°C	678°C	849°C	66
Y-7685	20	295	23-33°C	800°C	657°C	812°C	65
10 gm.	19	335	23-34°C	806°C	685°C	813°C	65
	18	300	23-34°C	800°C	689°C	801°C	65
Group 5	40	340	26-37°C	825°C	730°C	836°C	67
Y-7685	37	325	24-35°C	800°C	706°C	825°C	67
	31	*	25-35°C	750°C	670°C	800°C	77
	32	310	26-36°C	750°C	686°C	800°C	67

* Data not recorded.

Table 21 (continued)

	Animal No.	Body Weight (gm)	Chamber Temp. During Pyrolysis	Oven Temperature Preheat	Oven Temperature Initiation of Pyrolysis	Oven Temperature Final	% Pyrolyzed
Group 6	27	300	27-36°C	827°C	686°C	819°C	48
Y-7684	30	300	26-37°C	780°C	675°C	812°C	48
5 gm.	28	315	26-36°C	795°C	678°C	815°C	46
	29	327	35-35°C	834°C	729°C	825°C	50
Group 7	25	342	26-37°C	815°C	700°C	800°C	47
Y-7684	24	310	26-37°C	815°C	686°C	810°C	49
10 gm.	34	330	26-35°C	810°C	703°C	829°C	49
	36	325	26-36°C	785°C	683°C	805°C	48
Group 8	2	340	26-36°C	807°C	643°C	805°C	49
Y-7684	26	349	27-37°C	810°C	*	835°C	31
15 gm	41	315	26-36°C	812°C	716°C	818°C	49
	43	335	25-35°C	820°C	712°C	843°C	51
Group 9	23	320	25-35°C	822°C	710°C	800°C	52
Y-7684	22	345	24-35°C	800°C	629°C	797°C	49
20 gm	42	300	25-35°C	822°C	710°C	800°C	50
	45	250	28-38°C	810°C	701°C	832°C	50

* Data not recorded.

Figure 1

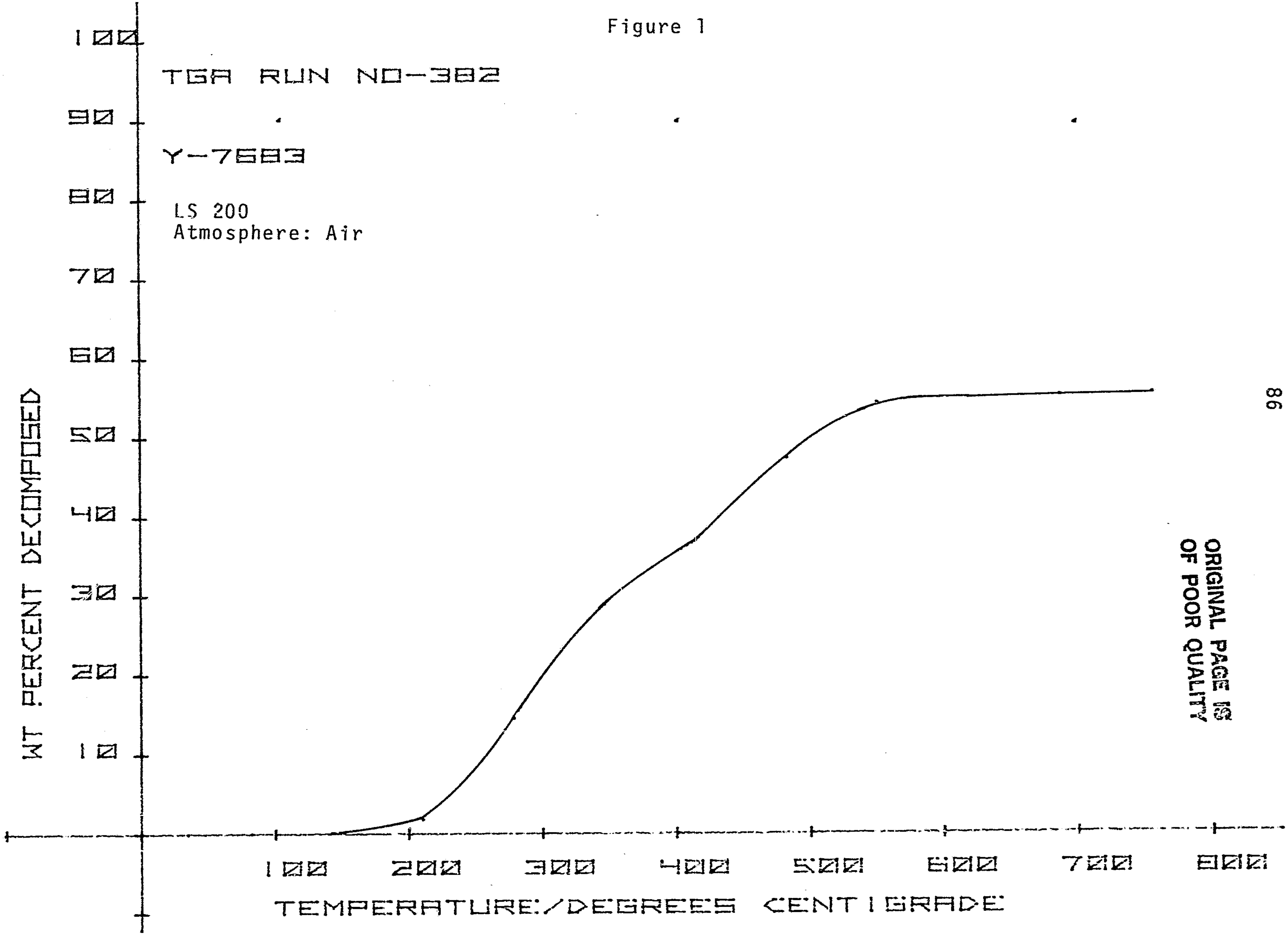
TGA RUN NO-382
Y-7683
LS 200
Atmosphere: Air
WT PERCENT DECOMPOSED
100
90
80
70
60
50
40
30
20
10
100
200
300
400
500
600
700
800
TEMPERATURE/DEGREES CENTIGRADE

Figure 2

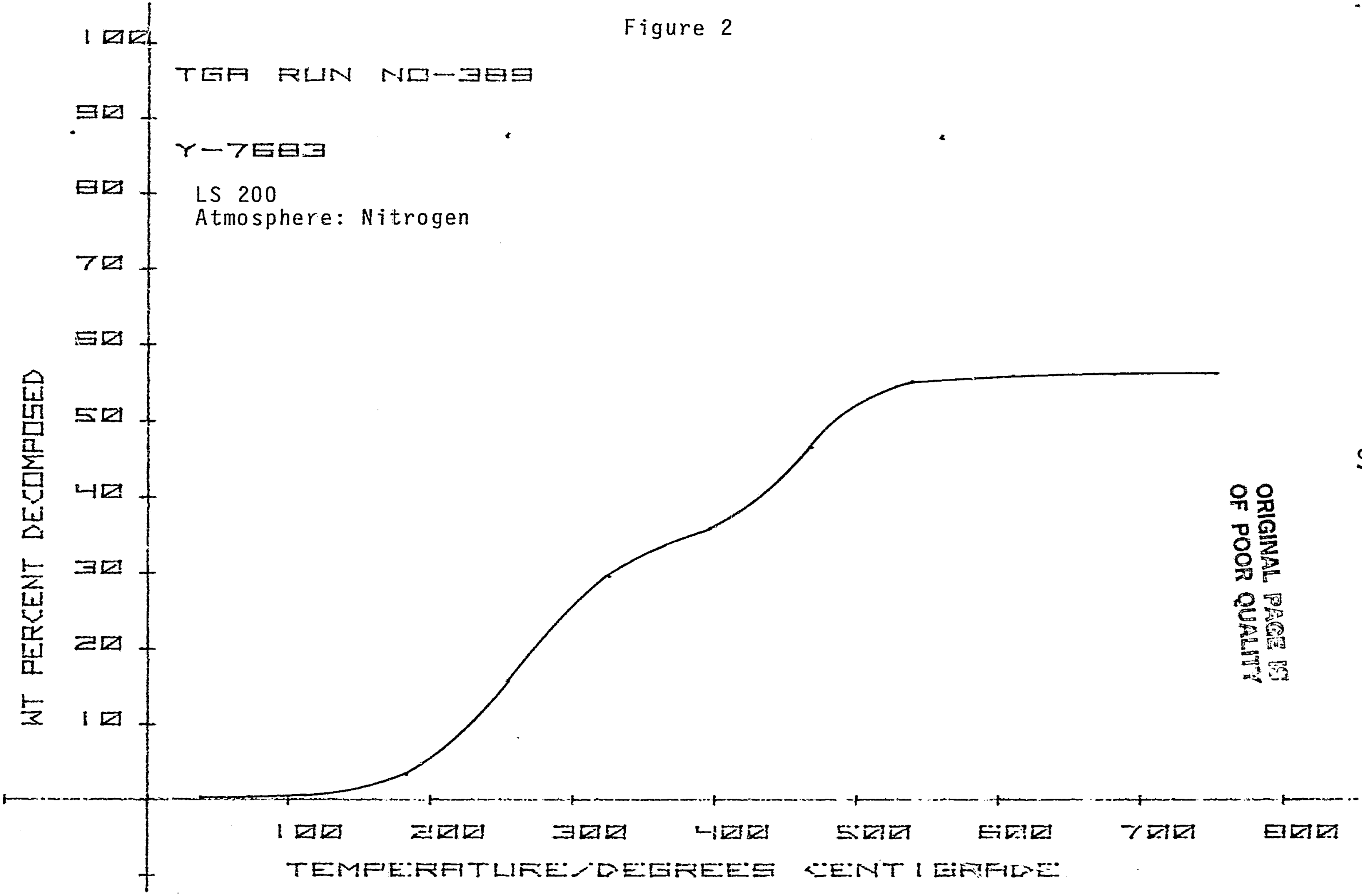
TGA RUN NO-389
Y-7683
LS 200
Atmosphere: Nitrogen
WT PERCENT DECOMPOSED
100
90
80
70
60
50
40
30
20
10
100
200
300
400
500
600
700
800
TEMPERATURE/DEGREES CENTIGRADE

Figure 3

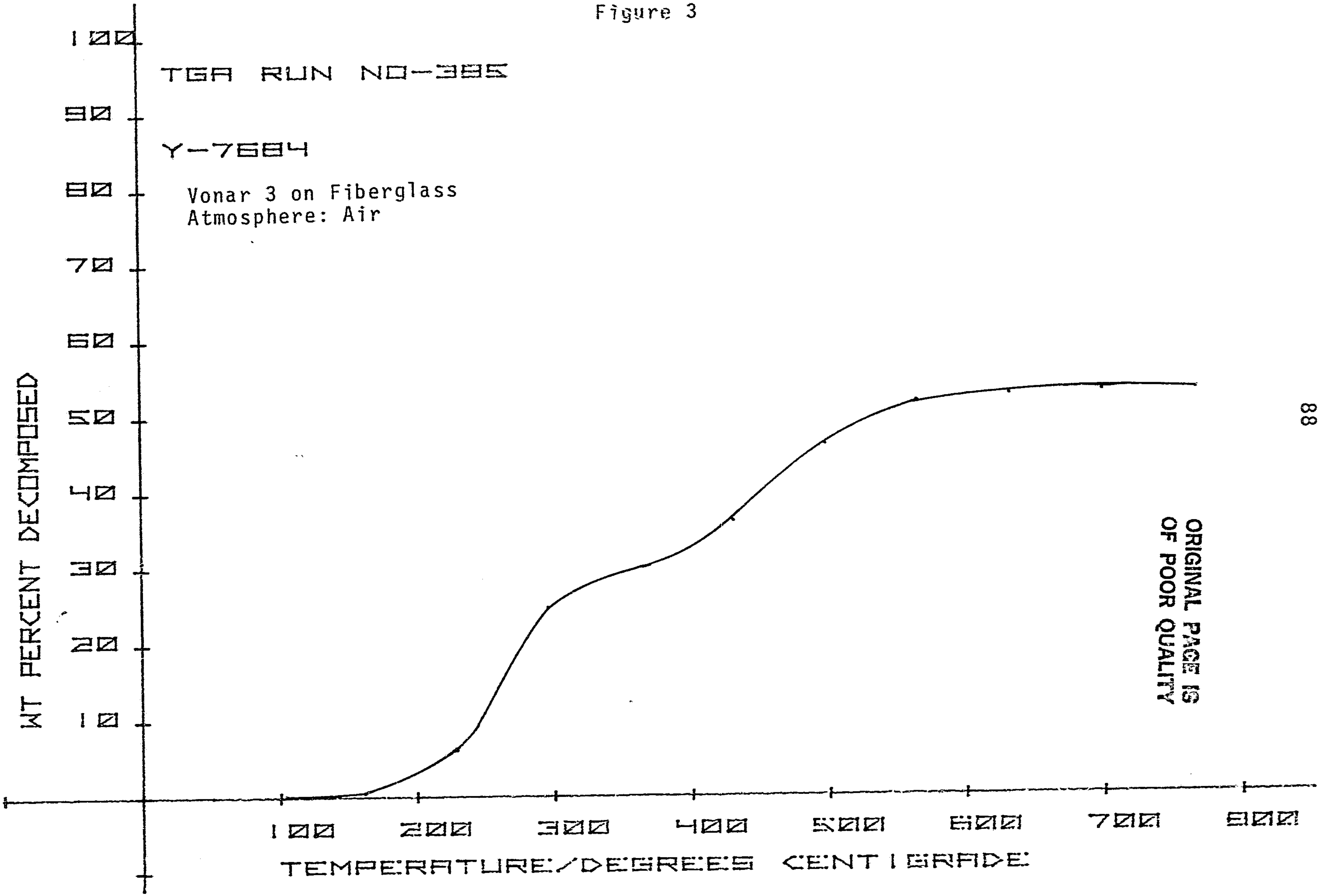

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Figure 4

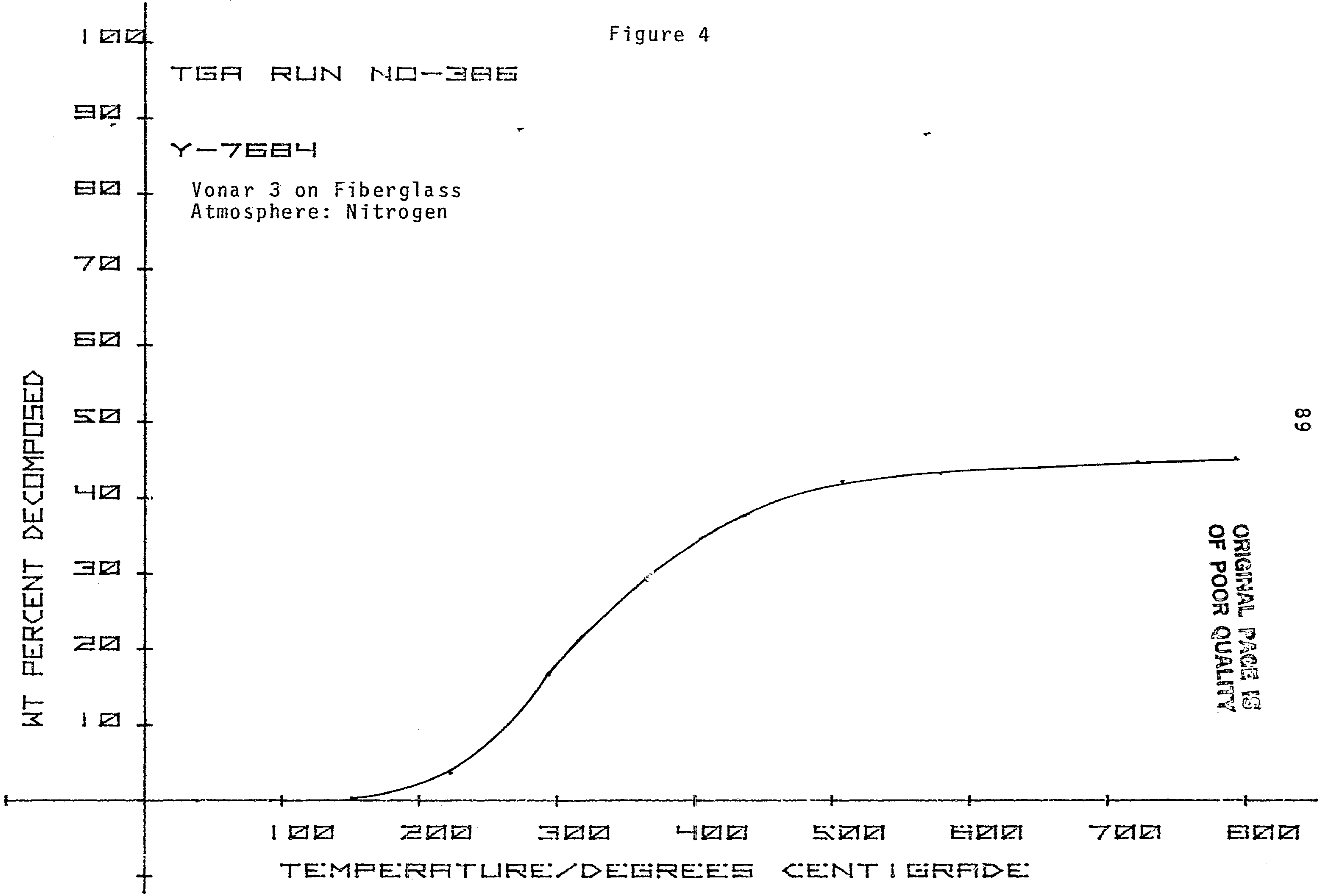
TGA RUN NO-386
Y-7684
Vonar 3 on Fiberglass
Atmosphere: Nitrogen
WT PERCENT DECOMPOSED
100
90
80
70
60
50
40
30
20
10
100
200
300
400
500
600
700
800
TEMPERATURE/DEGREES CENTIGRADE

Figure 5

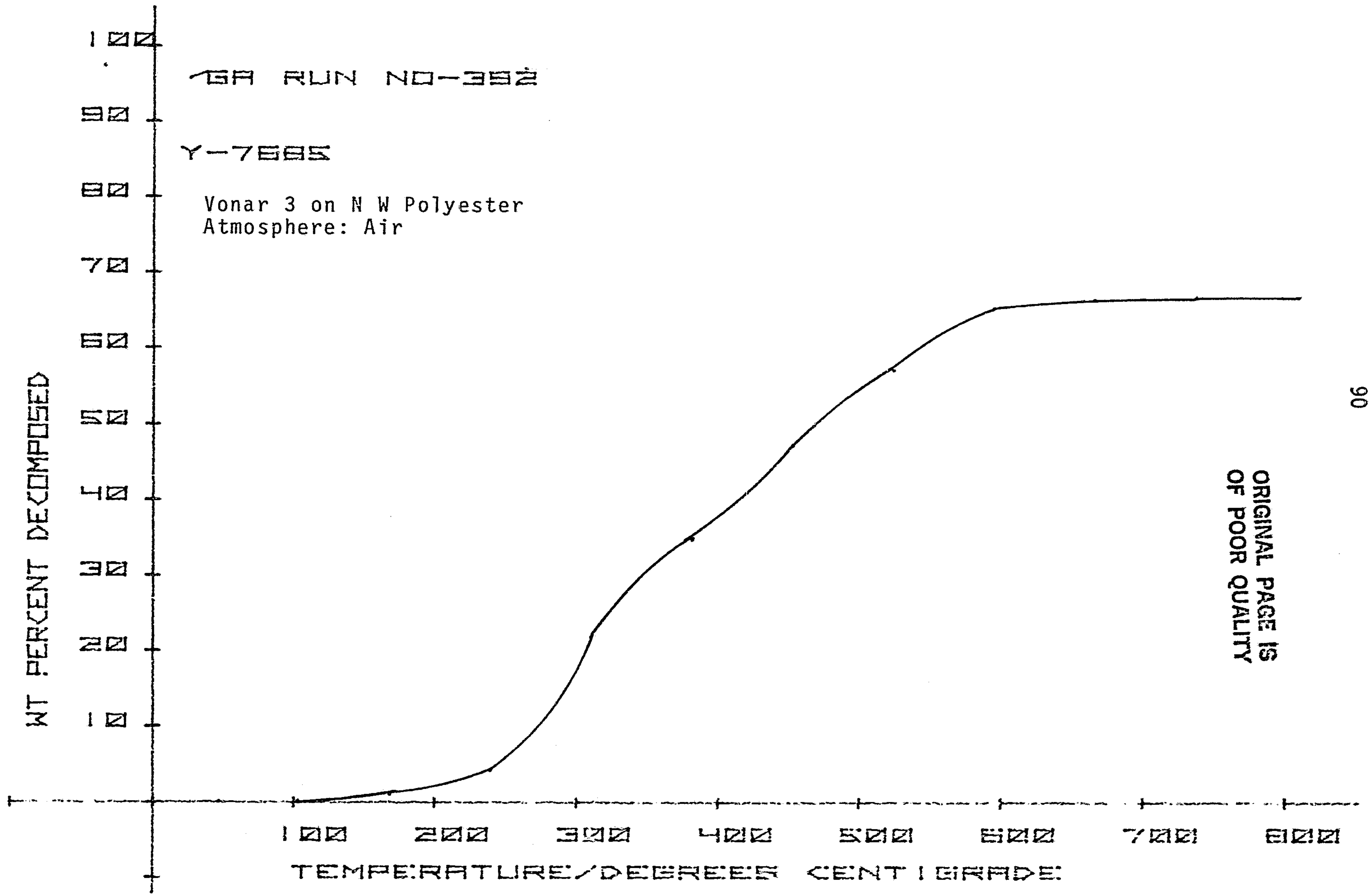
TGA RUN NO-352
Y-7665
Vonar 3 on N W Polyester
Atmosphere: Air
WT PERCENT DECOMPOSED
100
90
80
70
60
50
40
30
20
10
100
200
300
400
500
600
700
800
TEMPERATURE/DEGREES CENTIGRADE

Figure 6

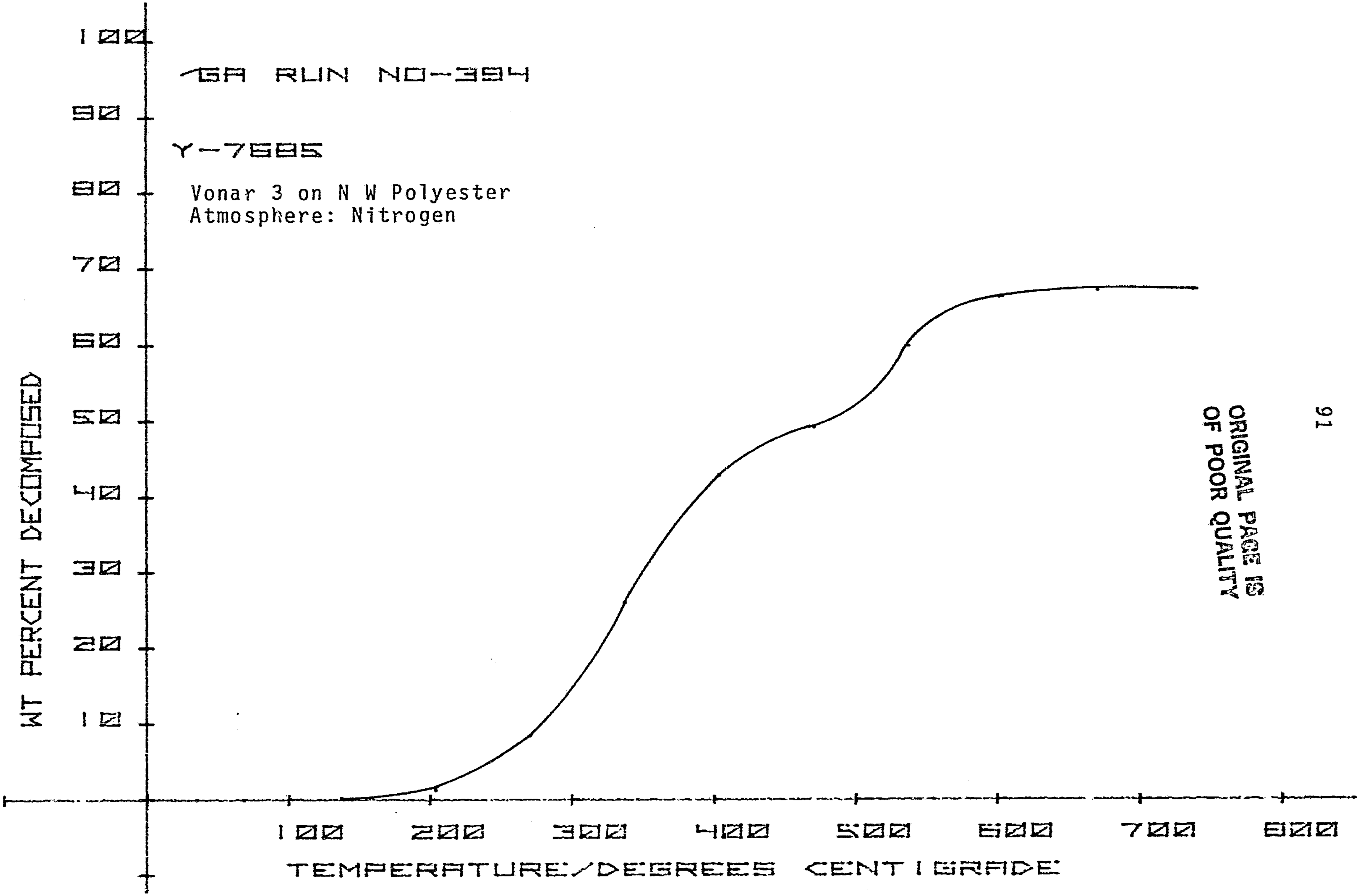
TGA RUN NO-394
Y-7685
Vonar 3 on N W Polyester
Atmosphere: Nitrogen
WT PERCENT DECOMPOSED
100
90
80
70
60
50
40
30
20
10
100
200
300
400
500
600
700
800
TEMPERATURE/DEGREES CENTIGRADE

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Figure 7

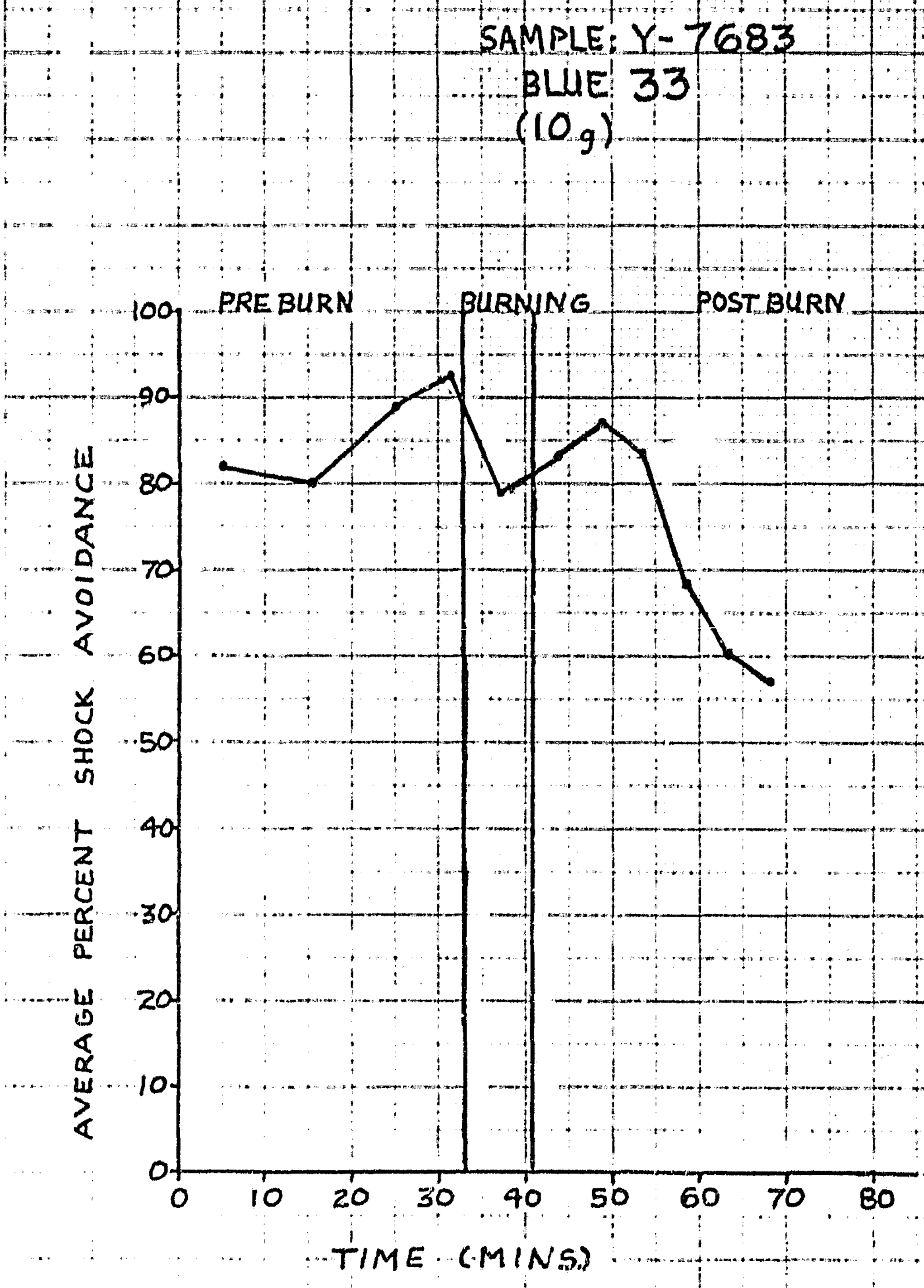

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Figure 8

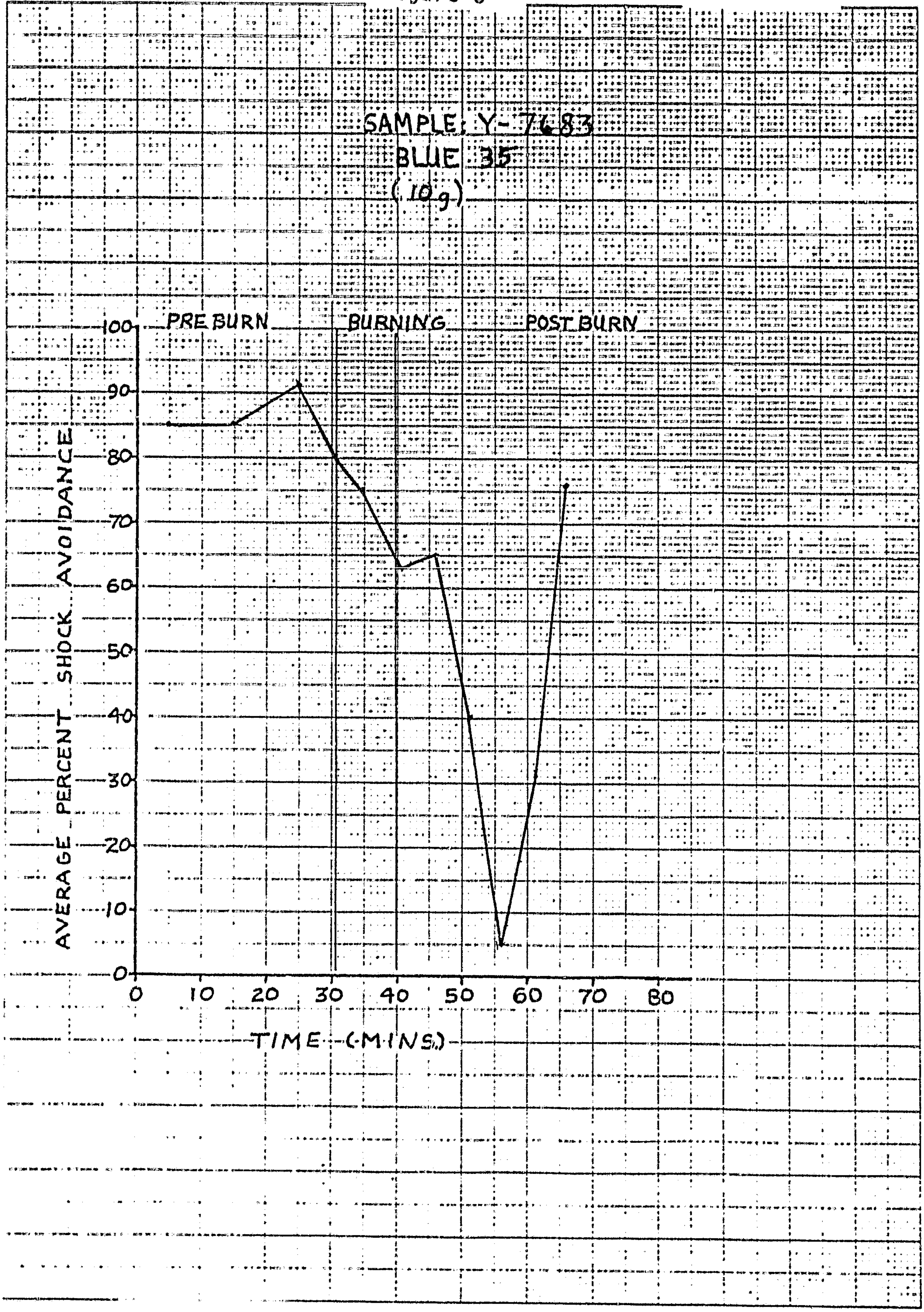

Figure 9

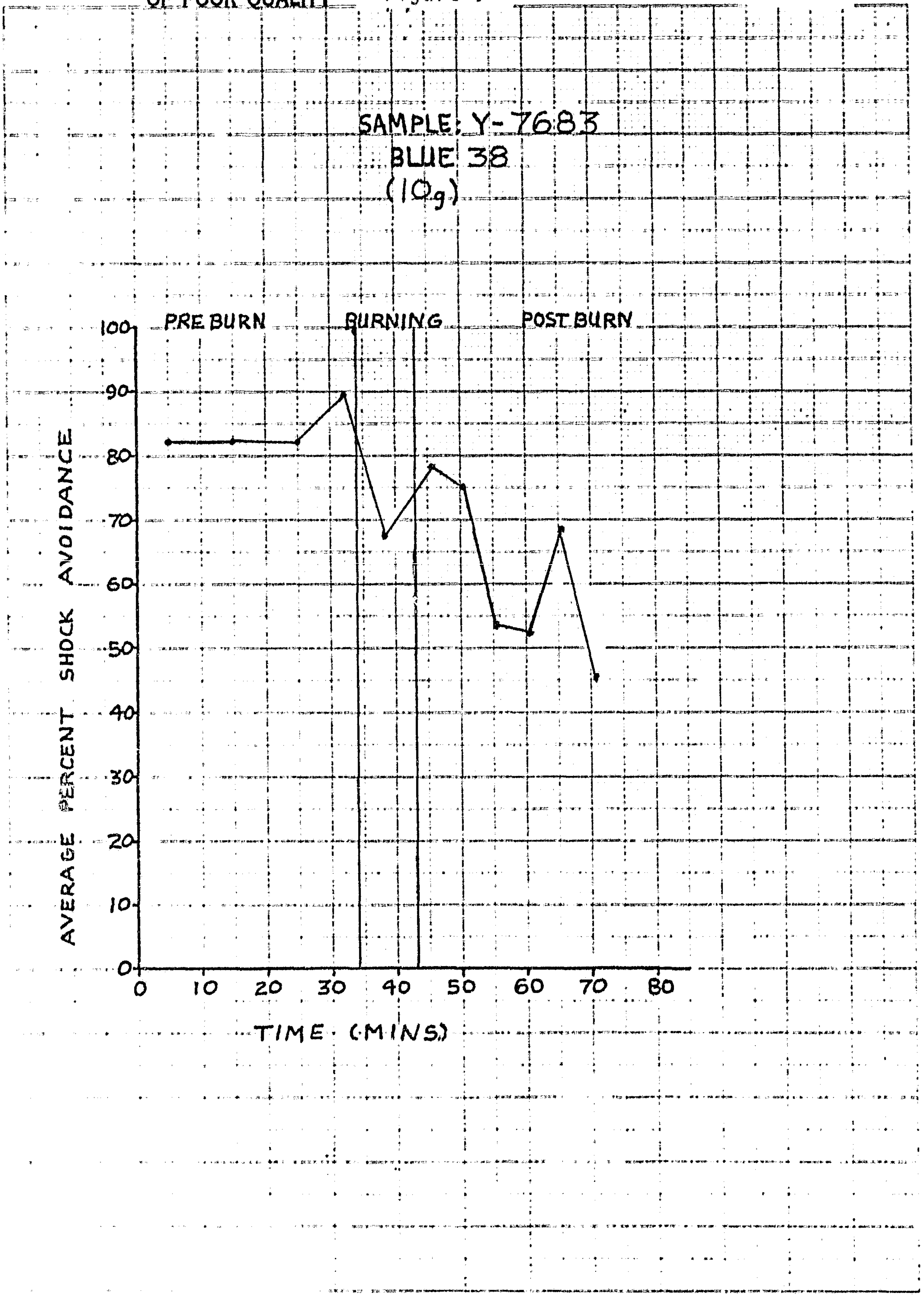
SAMPLE: Y-7683
BLUE 38
(10g)
PRE BURN
BURNING
POST BURN
AVERAGE PERCENT SHOCK AVOIDANCE
100
90
80
70
60
50
40
30
20
10
0
0
10
20
30
40
50
60
70
80
TIME (MINS)

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Figure 10

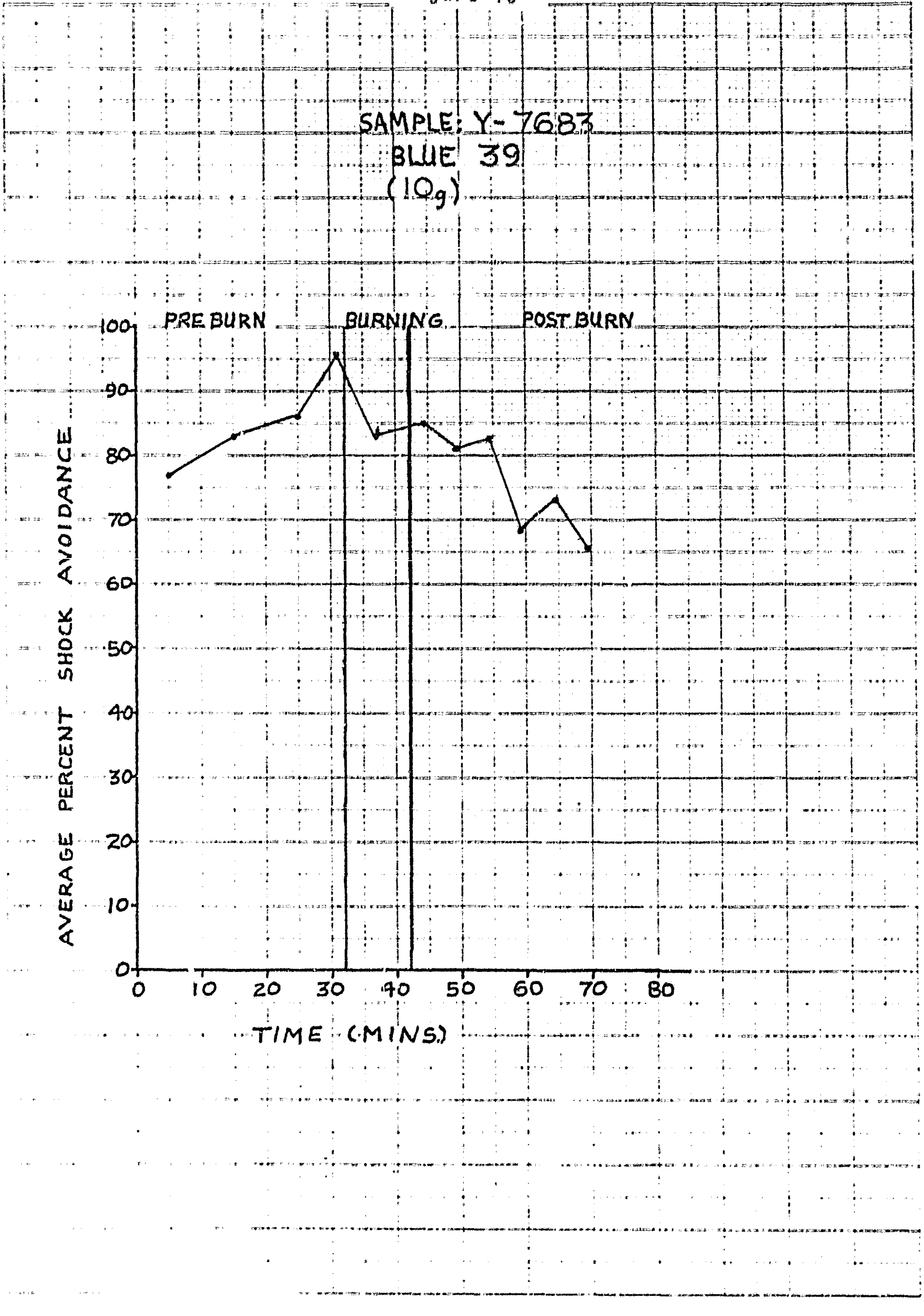

Figure 11

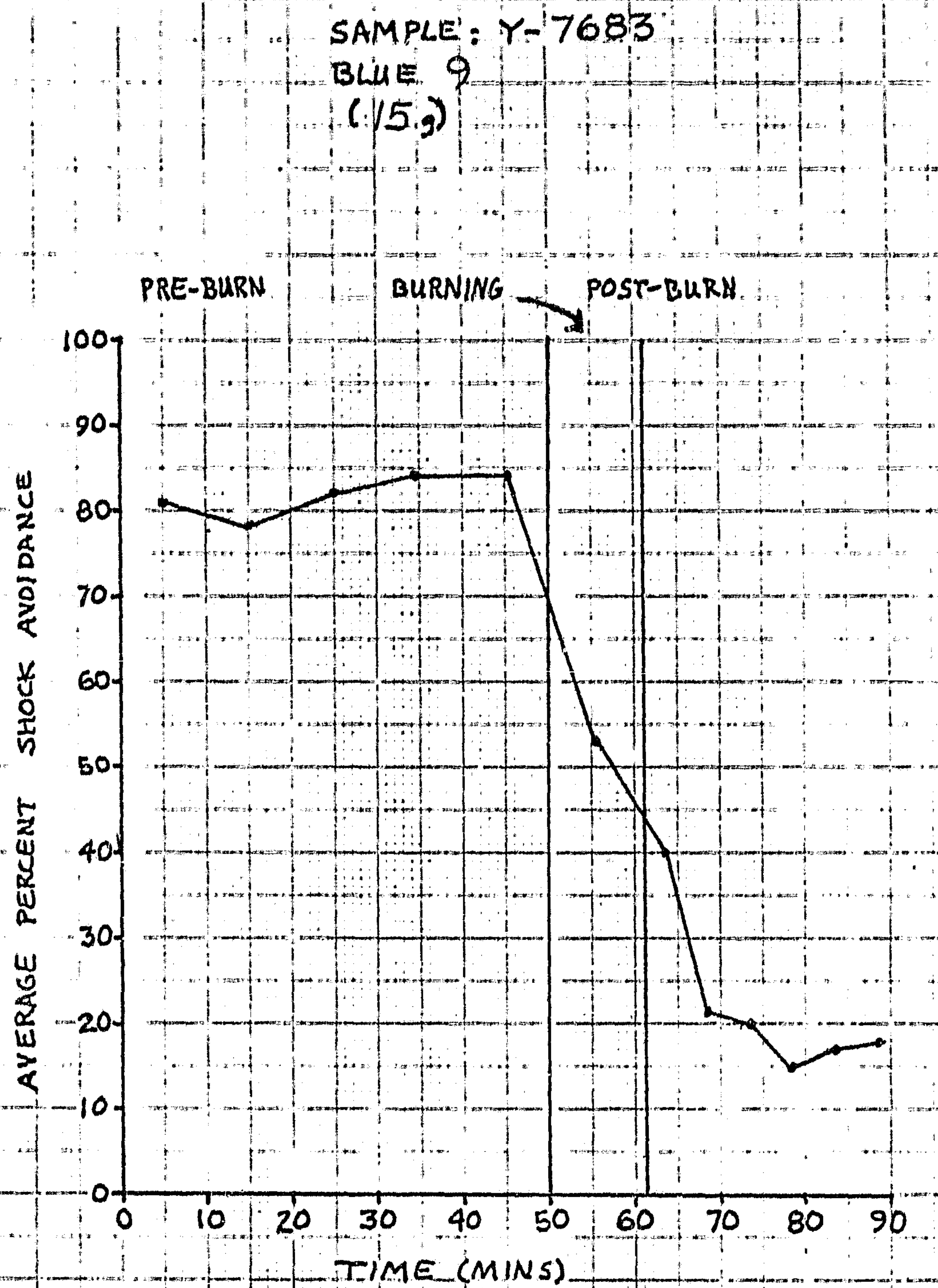
SAMPLE: Y-7683
BLUE 9
(.15 g)
PRE-BURN
BURNING
POST-BURN
AVERAGE PERCENT SHOCK AVOIDANCE
100
90
80
70
60
50
40
30
20
10
0
0
10
20
30
40
50
60
70
80
90
TIME (MINS)

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Figure 12

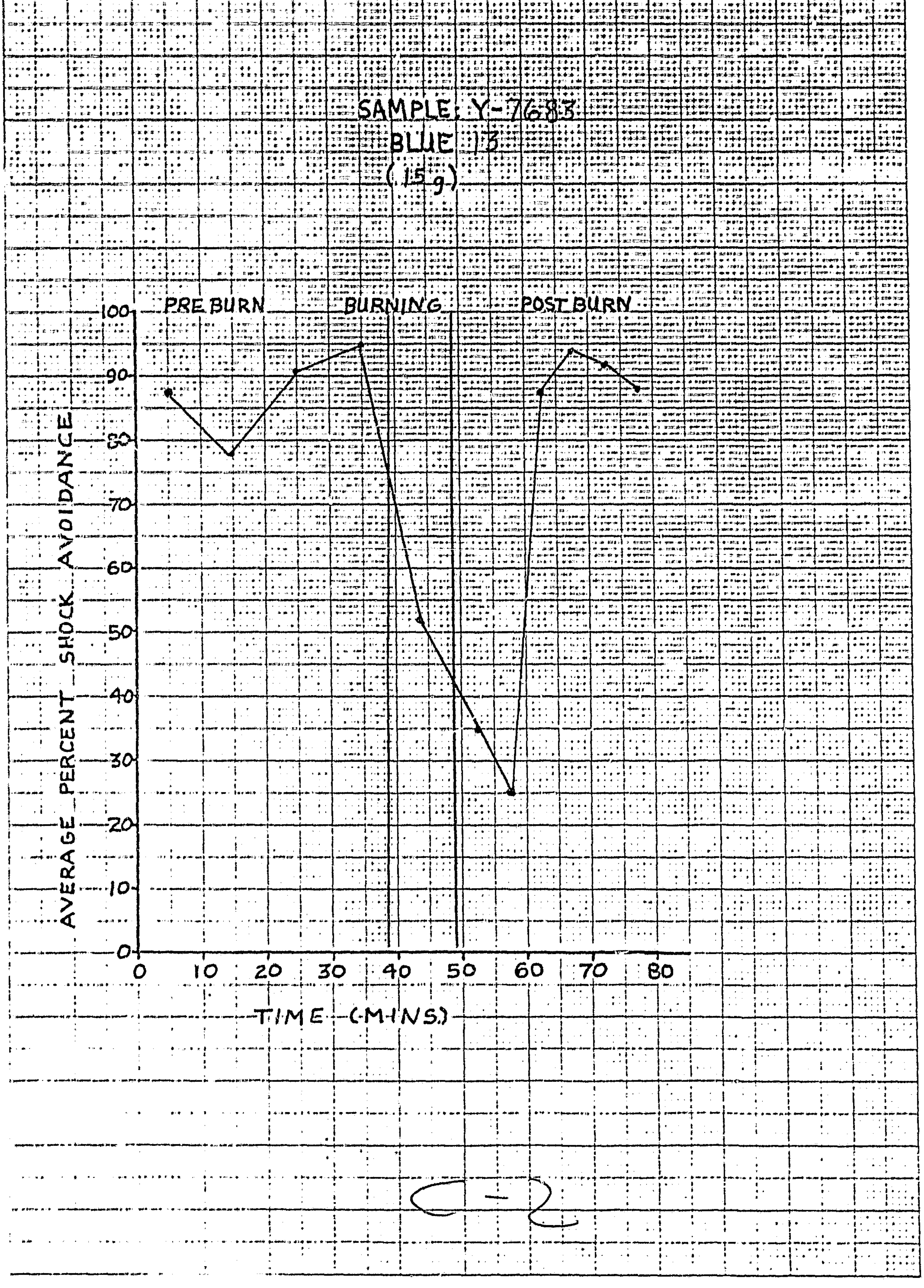

Figure 13

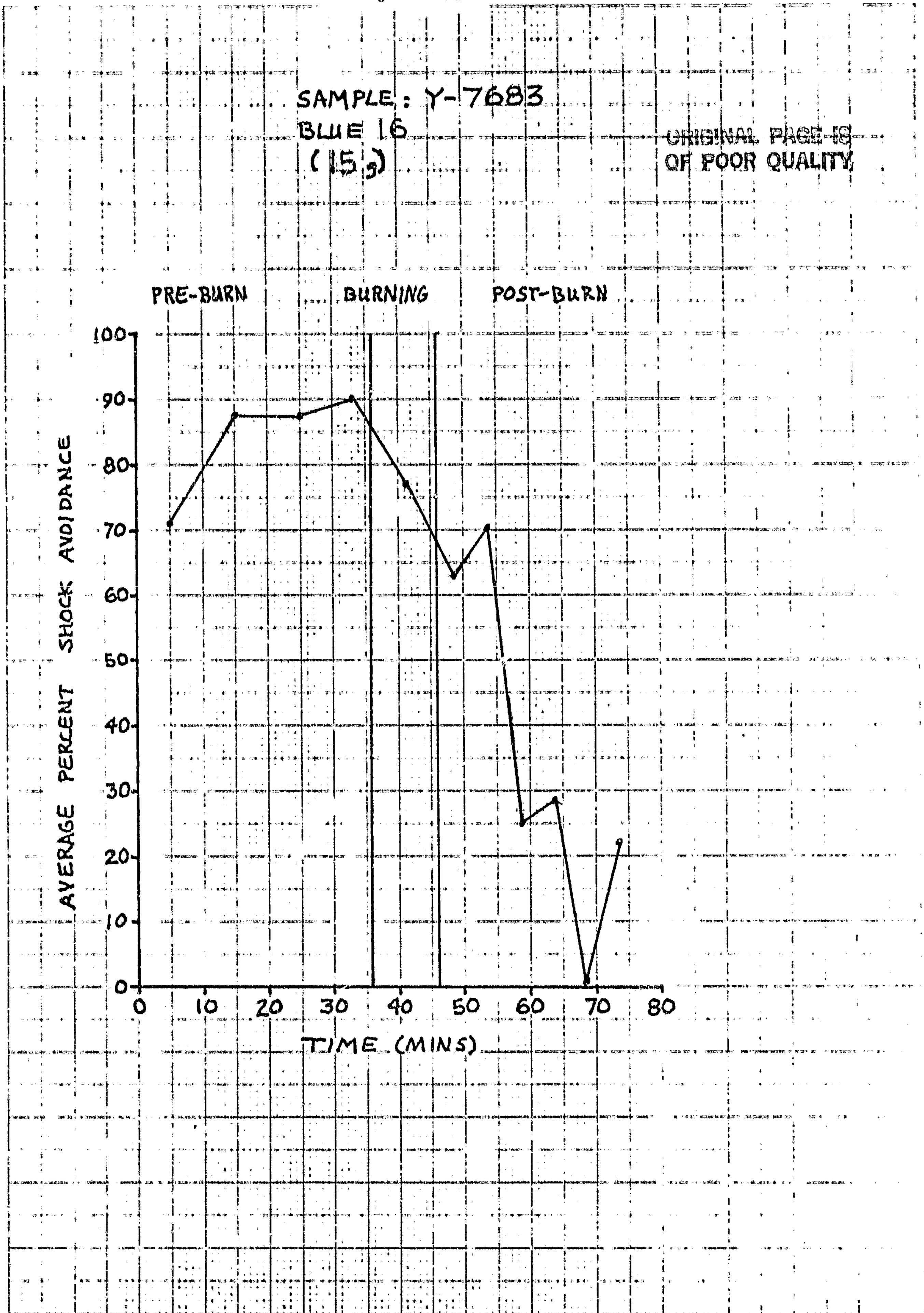
SAMPLE: Y-7683
BLUE 16
(15g)
PRE-BURN
BURNING
POST-BURN
AVERAGE PERCENT SHOCK AVOIDANCE
100
90
80
70
60
50
40
30
20
10
0
0
10
20
30
40
50
60
70
80
TIME (MINS)

Figure 14

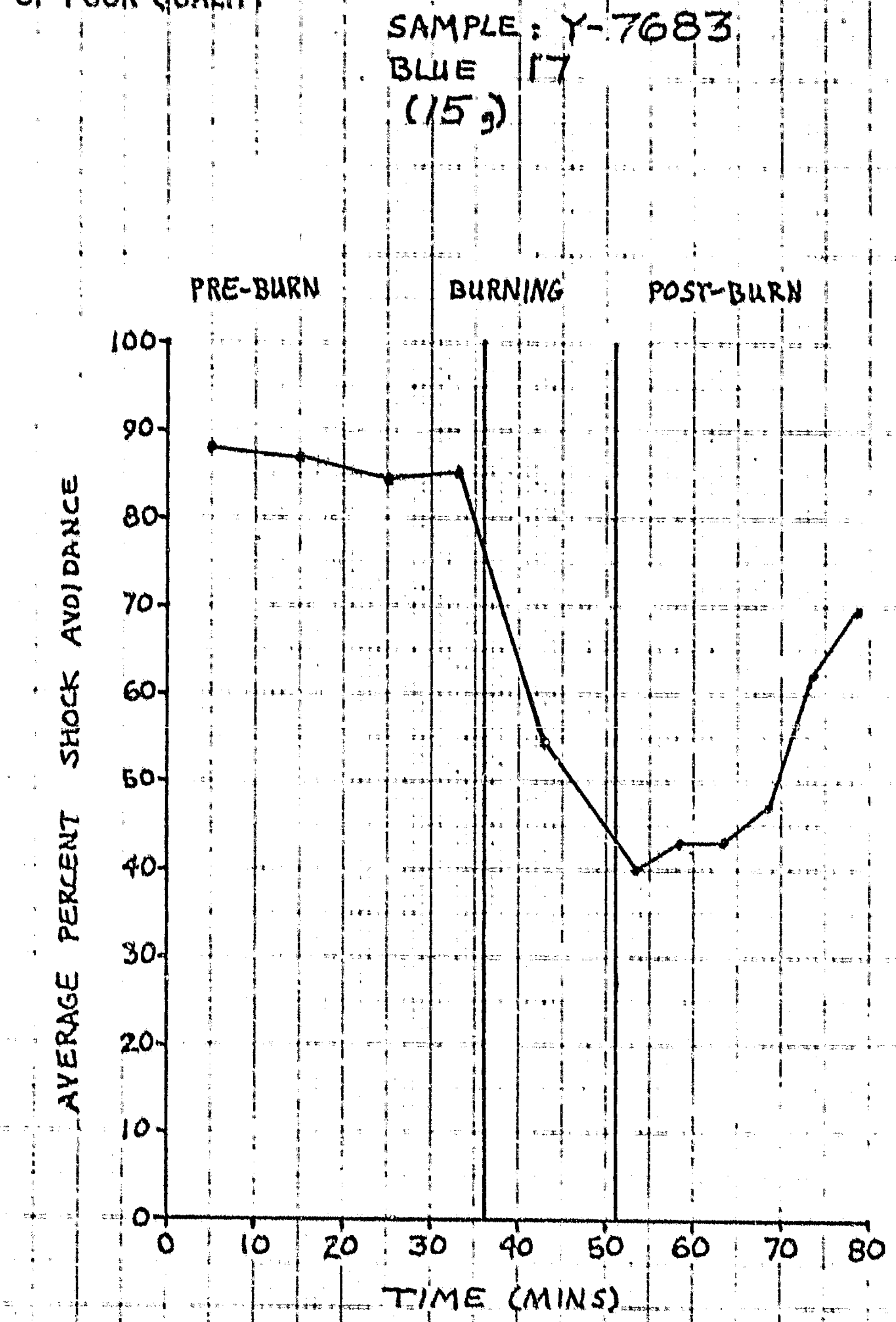
SAMPLE: Y-7683
BLUE 17
(15 g)
PRE-BURN
BURNING
POST-BURN
AVERAGE PERCENT SHOCK AVOIDANCE
100
90
80
70
60
50
40
30
20
10
0
0
10
20
30
40
50
60
70
80
TIME (MINS)

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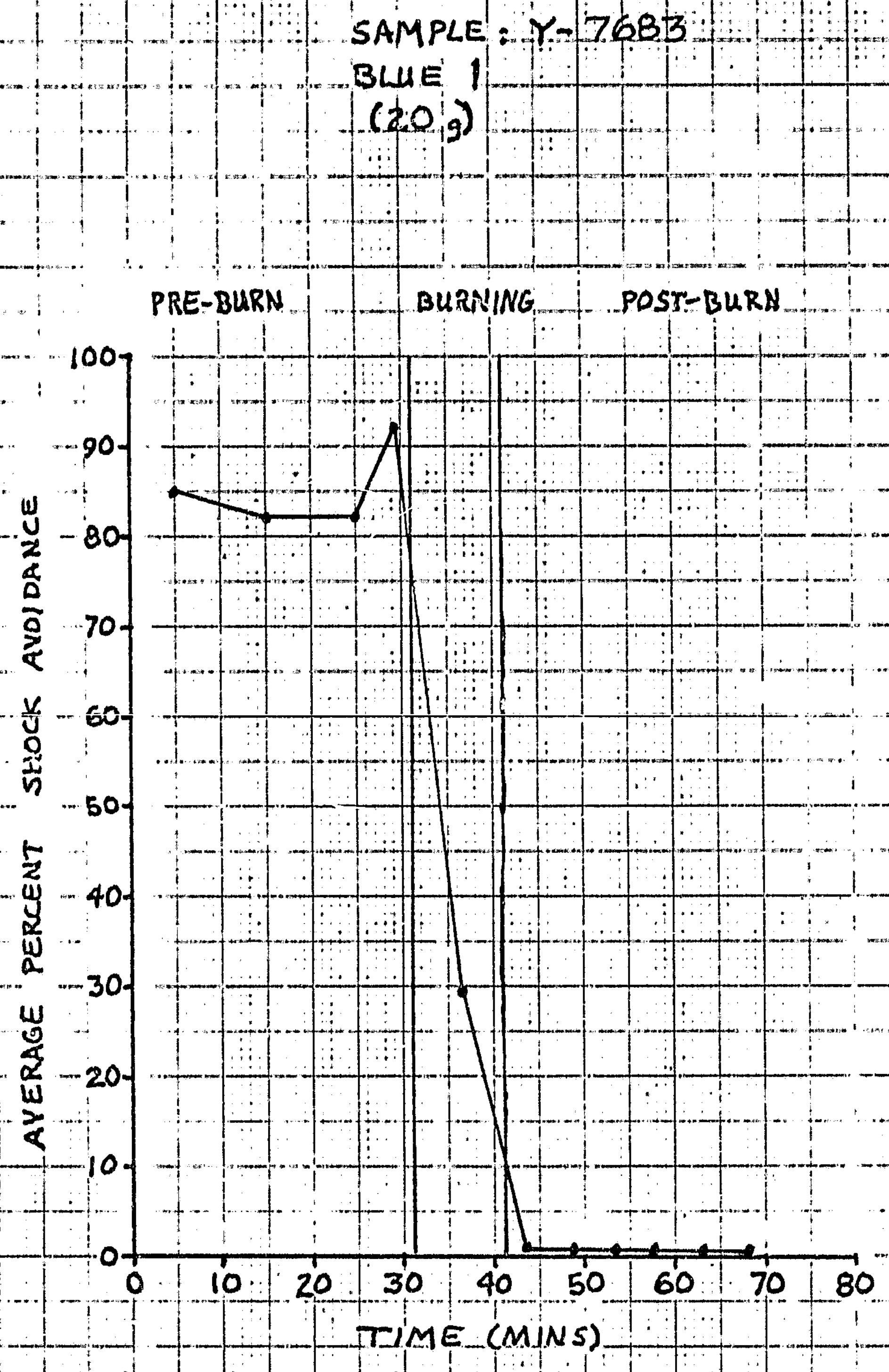
Figure 15



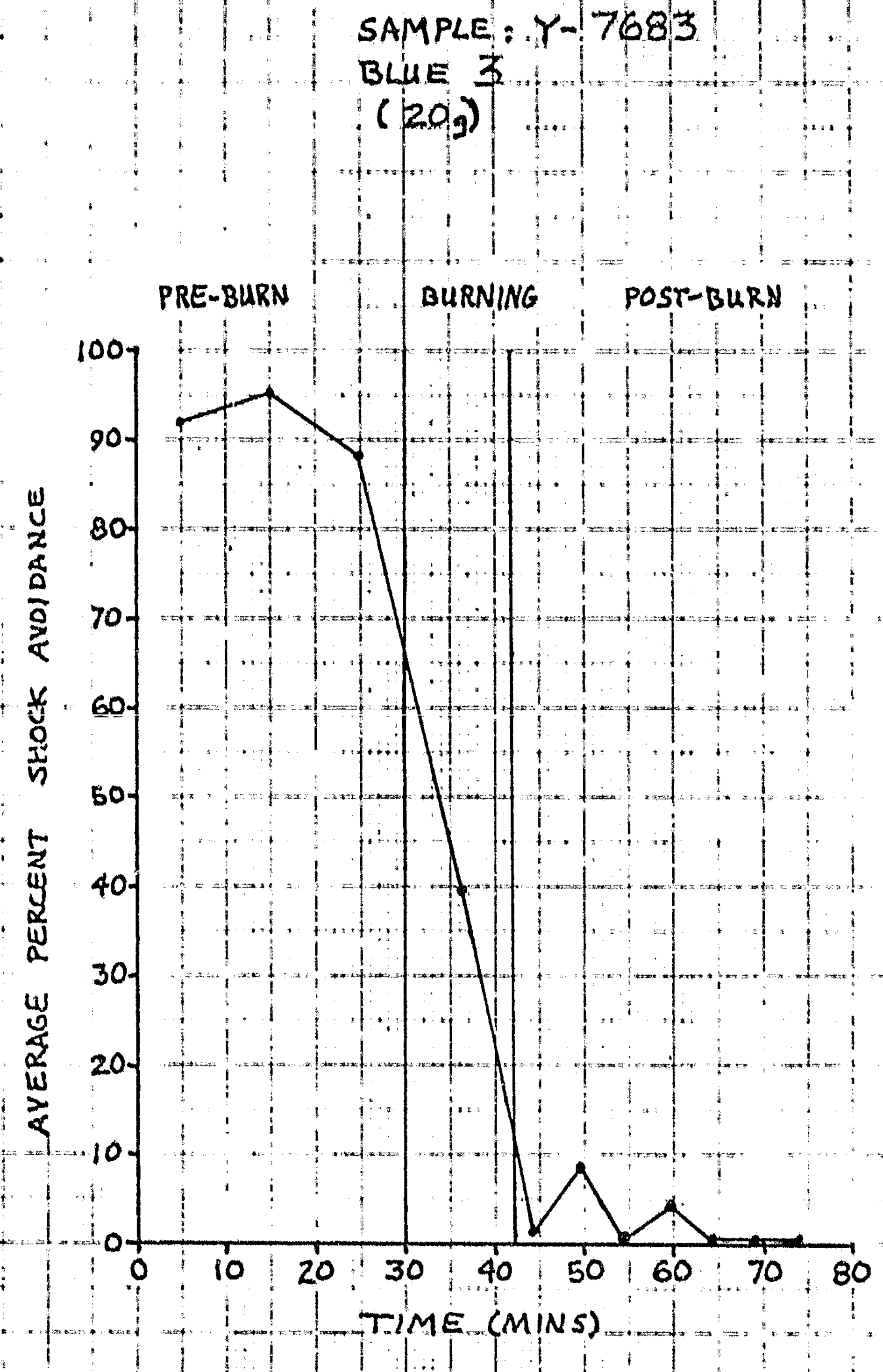
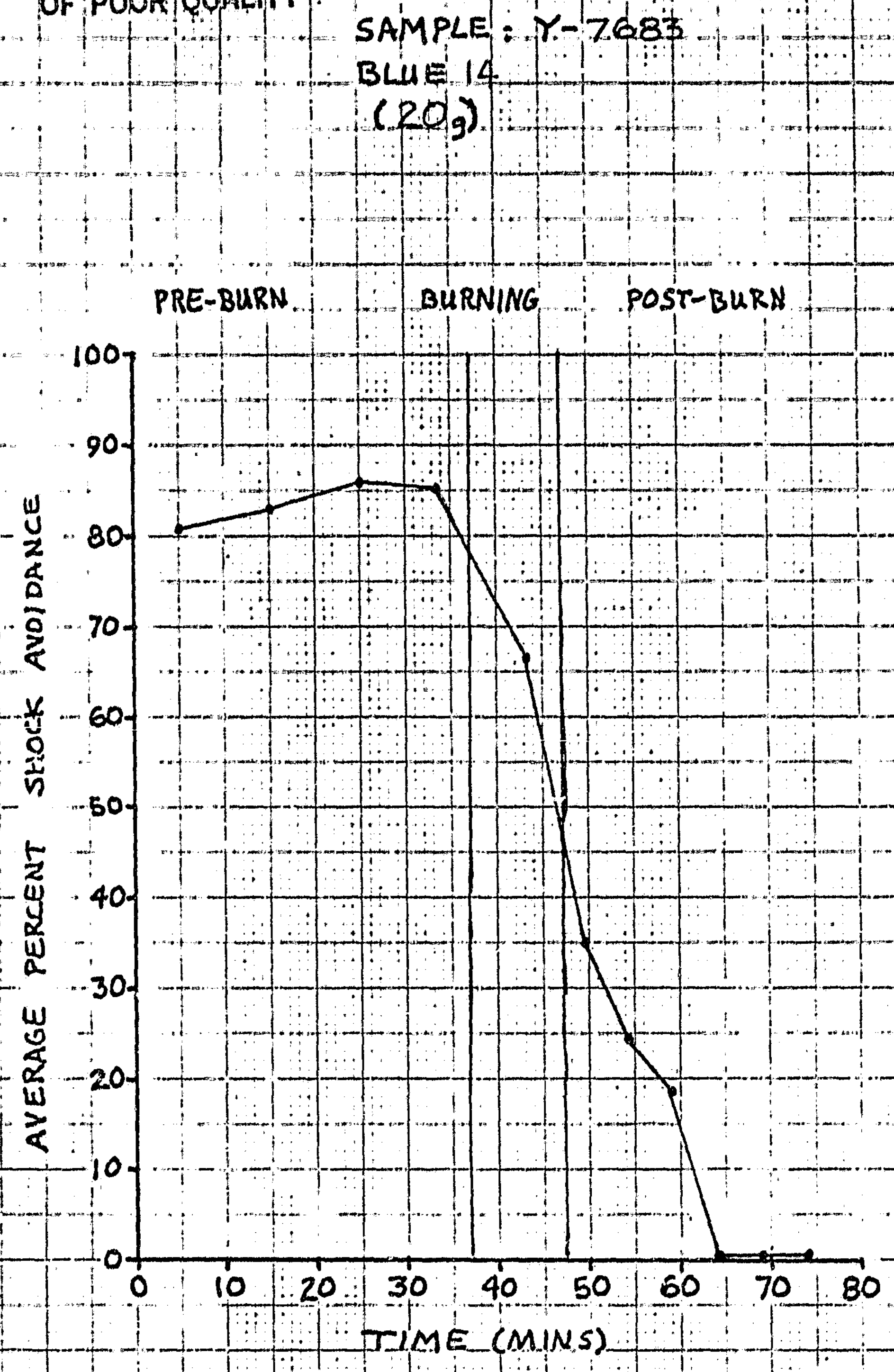

SAMPLE: Y-7683
BLUE 3
(20g)
PRE-BURN
BURNING
POST-BURN
AVERAGE PERCENT SHOCK AVOIDANCE
100
90
80
70
60
50
40
30
20
10
0
0
10
20
30
40
50
60
70
80
TIME (MINS)

Figure 17


SAMPLE: Y-7683
BLUE 14
(20g)
PRE-BURN
BURNING
POST-BURN
AVERAGE PERCENT SHOCK AVOIDANCE
100
90
80
70
60
50
40
30
20
10
0
0
10
20
30
40
50
60
70
80
TIME (MINS)

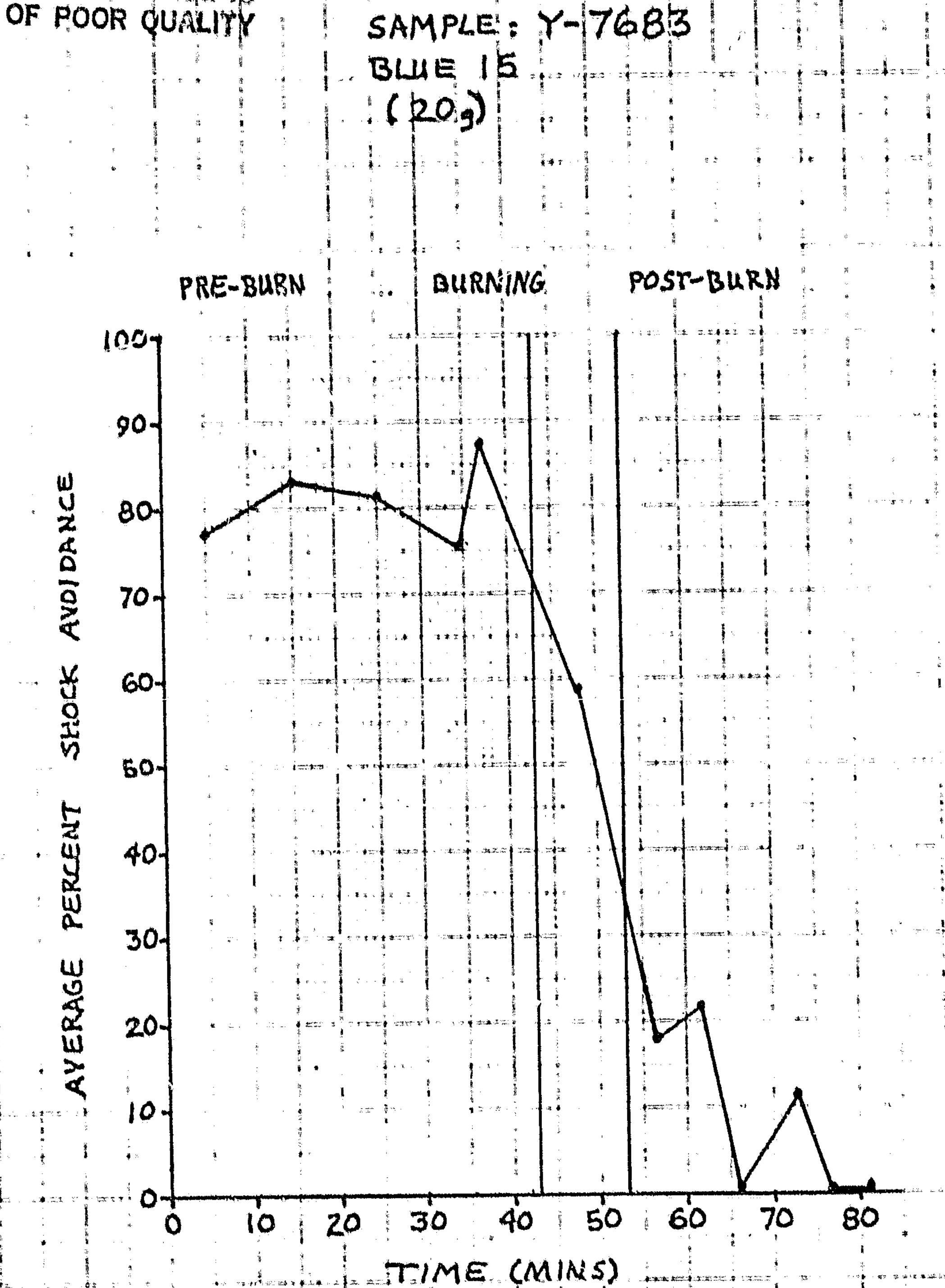

SAMPLE: Y-7683
BLUE 15
(20g)
PRE-BURN
BURNING
POST-BURN
AVERAGE PERCENT SHOCK AVOIDANCE
100
90
80
70
60
50
40
30
20
10
0
0
10
20
30
40
50
60
70
80
TIME (MINS)

Figure 19

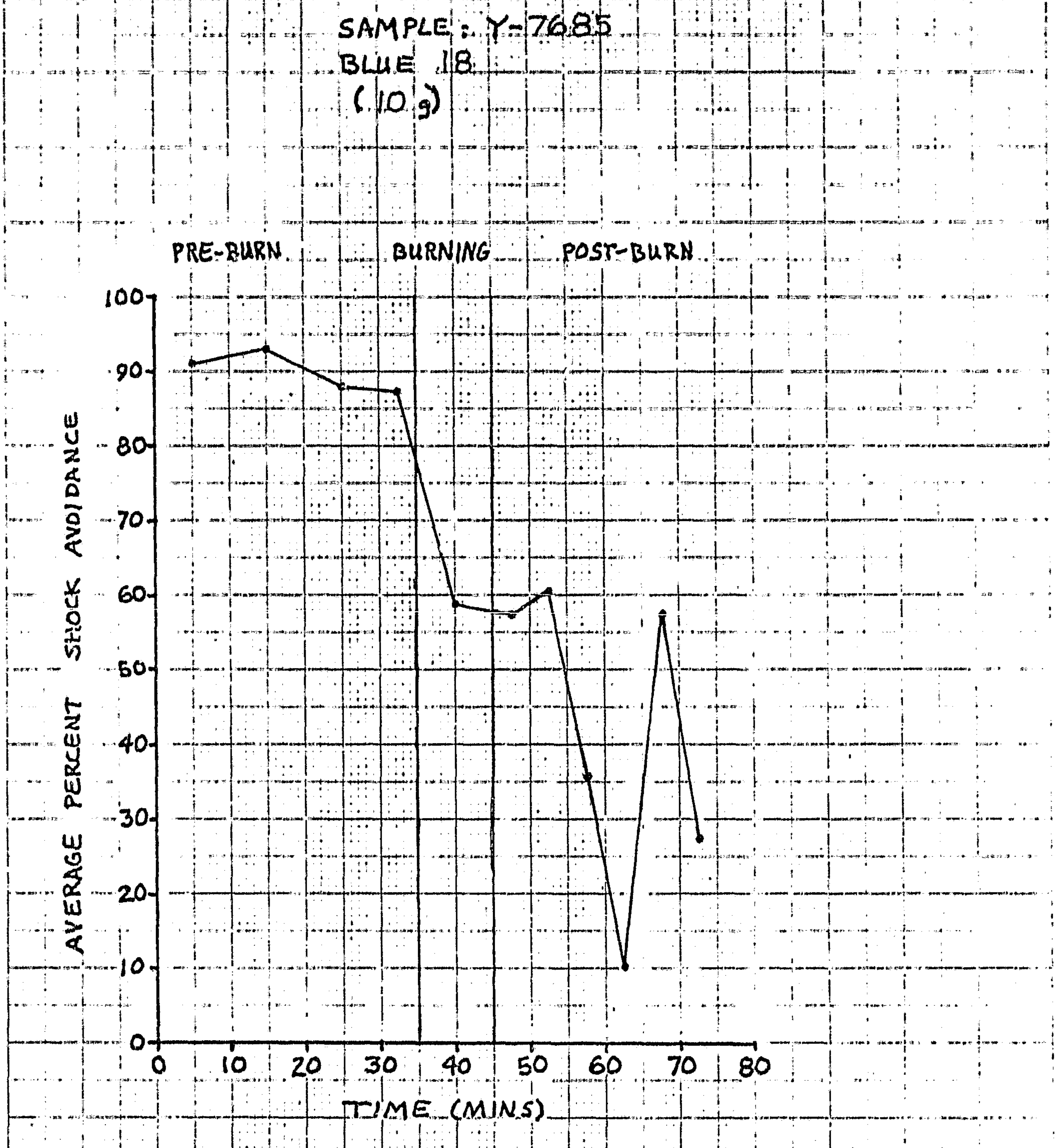

SAMPLE: Y-7685
BLUE 18
(10 g)
PRE-BURN
BURNING
POST-BURN
AVERAGE PERCENT SHOCK AVOIDANCE
0
10
20
30
40
50
60
70
80
90
100
TIME (MINS)

Figure 20

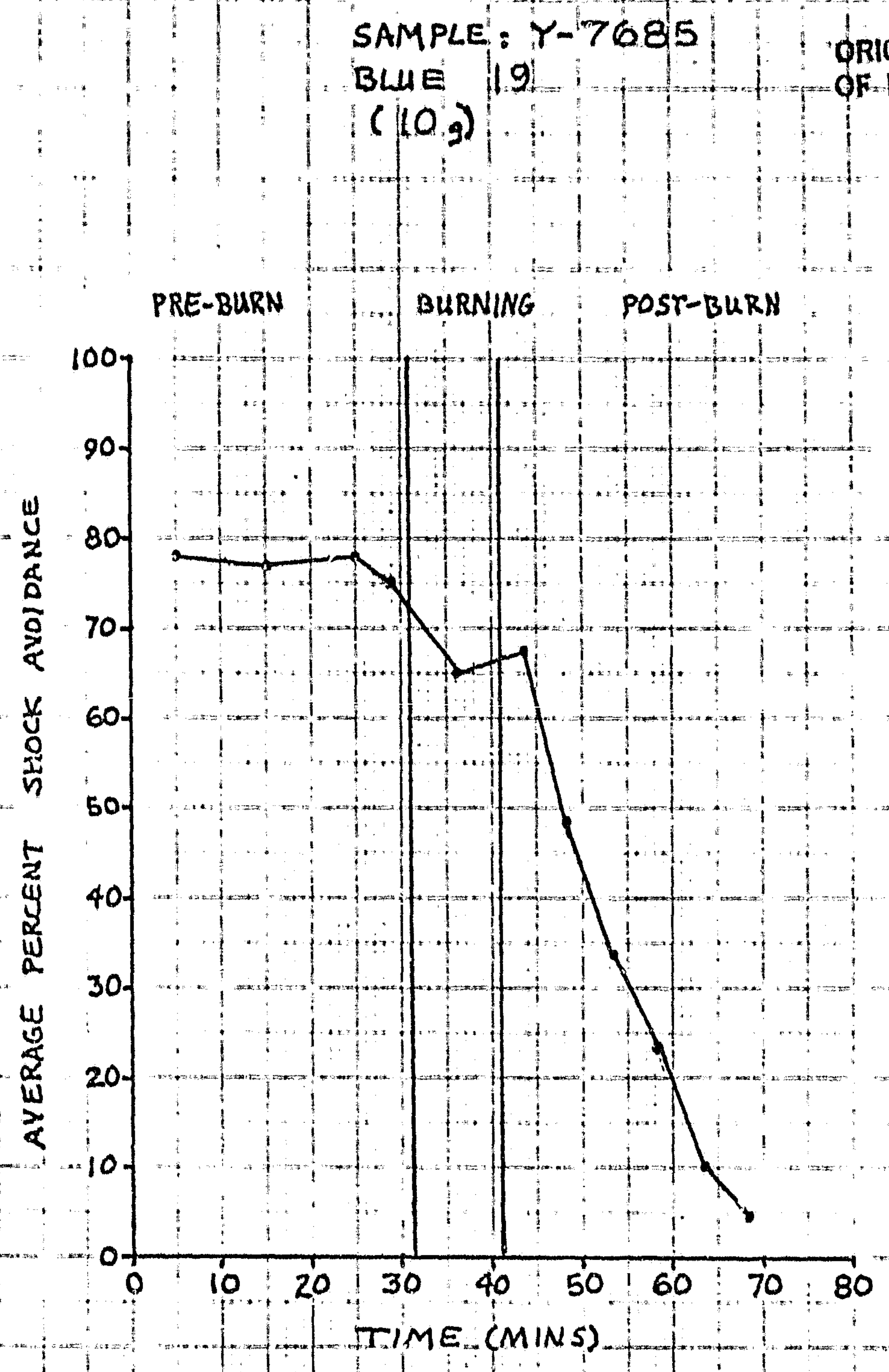

SAMPLE: Y-7685
BLUE 19
(10 g)
PRE-BURN
BURNING
POST-BURN
AVERAGE PERCENT SHOCK AVOIDANCE
100
90
80
70
60
50
40
30
20
10
0
0
10
20
30
40
50
60
70
80
TIME (MINS)

Figure 21

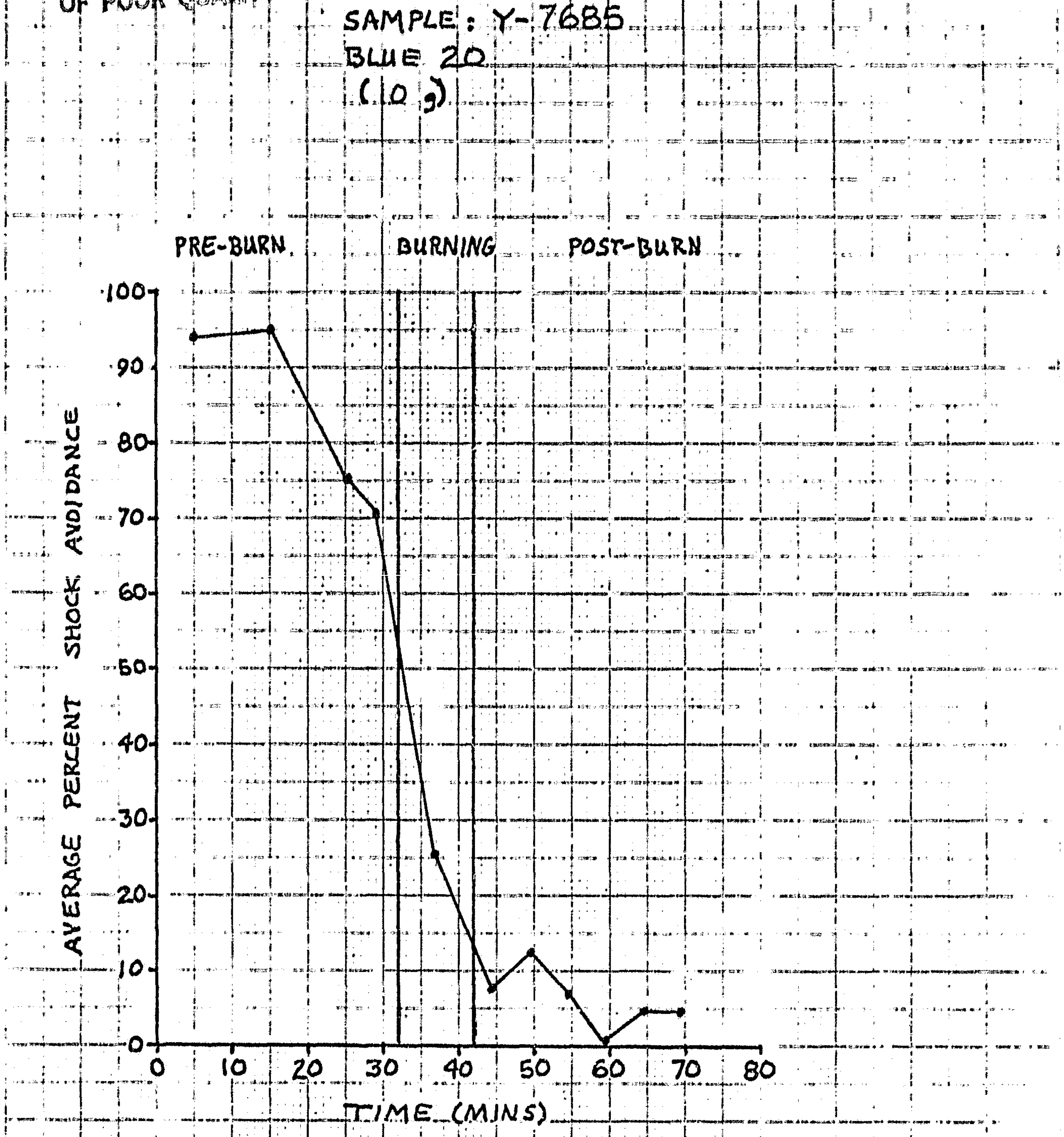

SAMPLE: Y-7685
BLUE 20
(10 g)
PRE-BURN
BURNING
POST-BURN
AVERAGE PERCENT SHOCK AVOIDANCE
100
90
80
70
60
50
40
30
20
10
0
0
10
20
30
40
50
60
70
80
TIME (MINS)

Figure 22

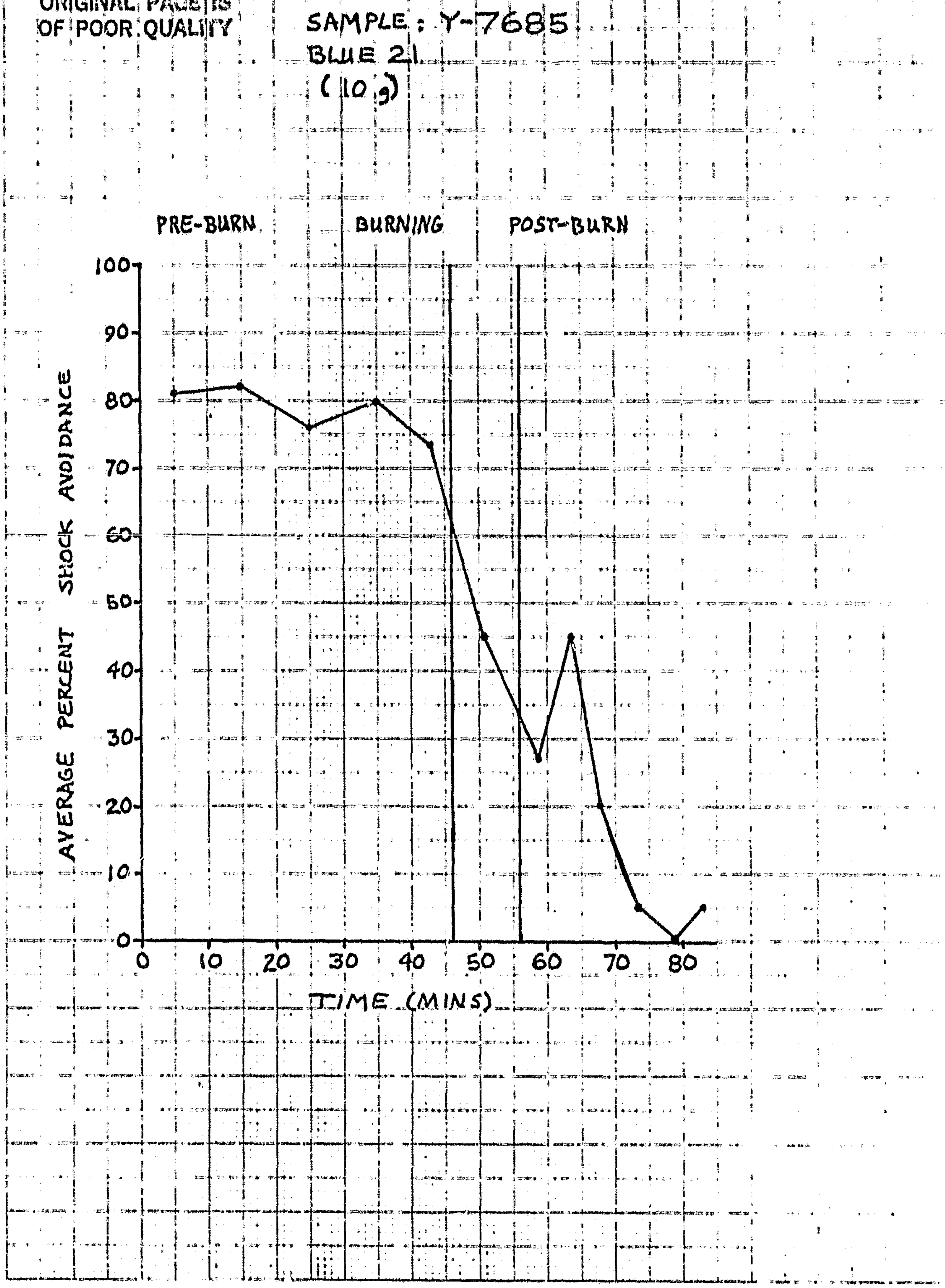

SAMPLE: Y-7685
BLUE 21
(10 g)
PRE-BURN
BURNING
POST-BURN
AVERAGE PERCENT SHOCK AVOIDANCE
100
90
80
70
60
50
40
30
20
10
0
0
10
20
30
40
50
60
70
80
TIME (MINS)

Figure 23

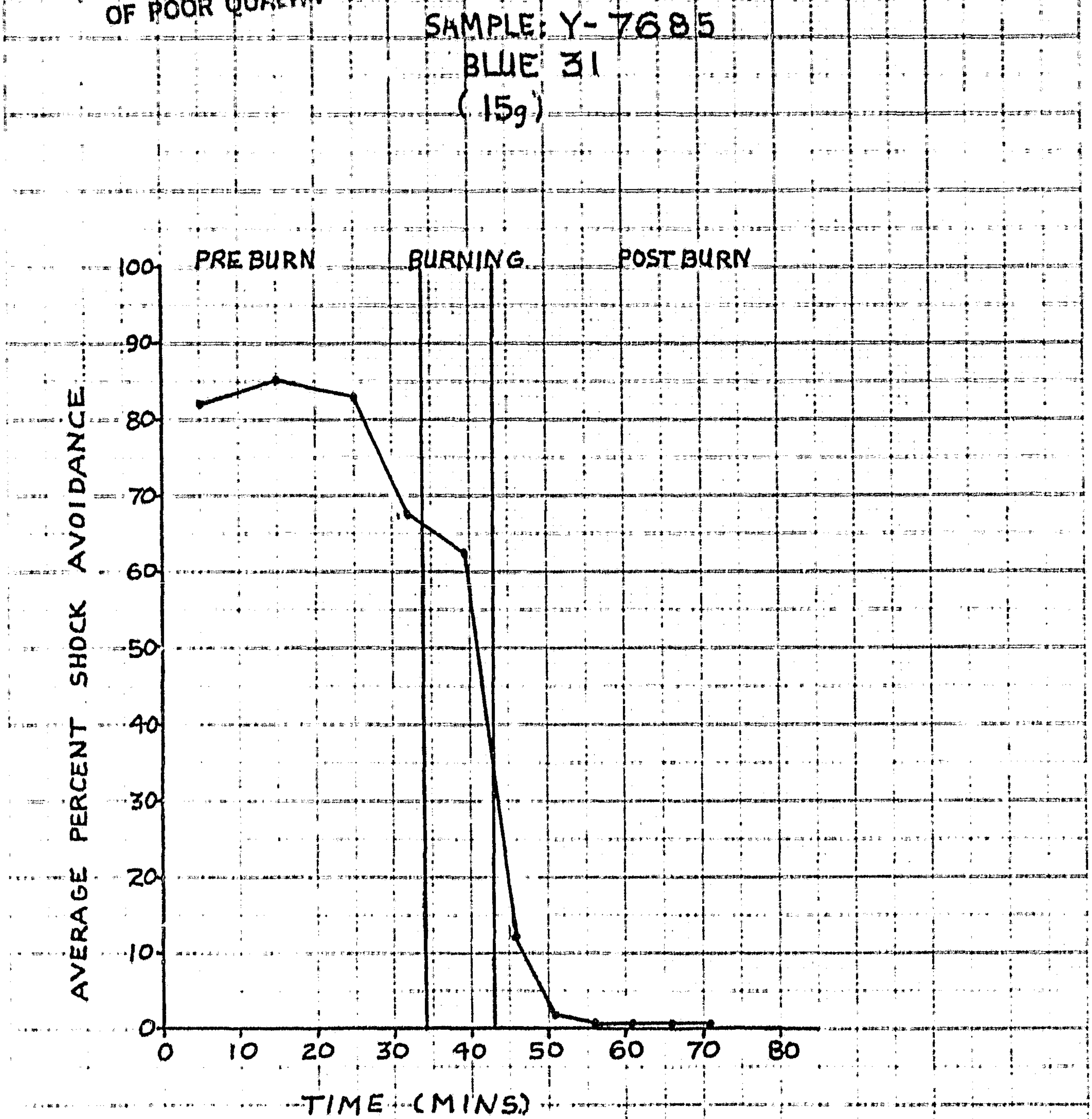

SAMPLE: Y-7685
BLUE 31
(15g)
PRE BURN
BURNING
POST BURN
AVERAGE PERCENT SHOCK AVOIDANCE
100
90
80
70
60
50
40
30
20
10
0
0
10
20
30
40
50
60
70
80
TIME (MINS.)

Figure 24

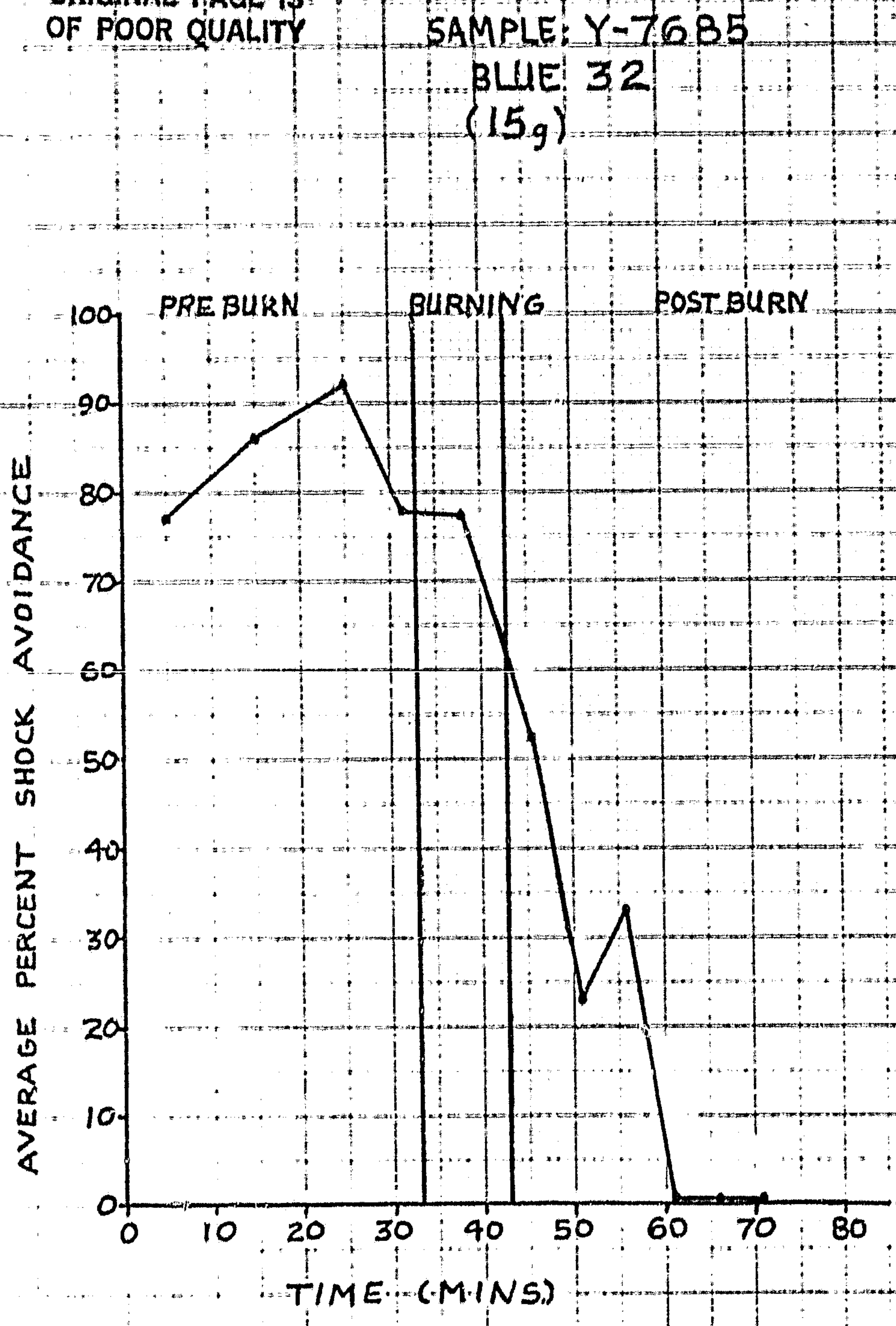

SAMPLE: Y-7685
BLUE 32
(15g)
PRE BURN
BURNING
POST BURN
AVERAGE PERCENT SHOCK AVOIDANCE
100
90
80
70
60
50
40
30
20
10
0
0
10
20
30
40
50
60
70
80
TIME (MINS.)

Figure 25

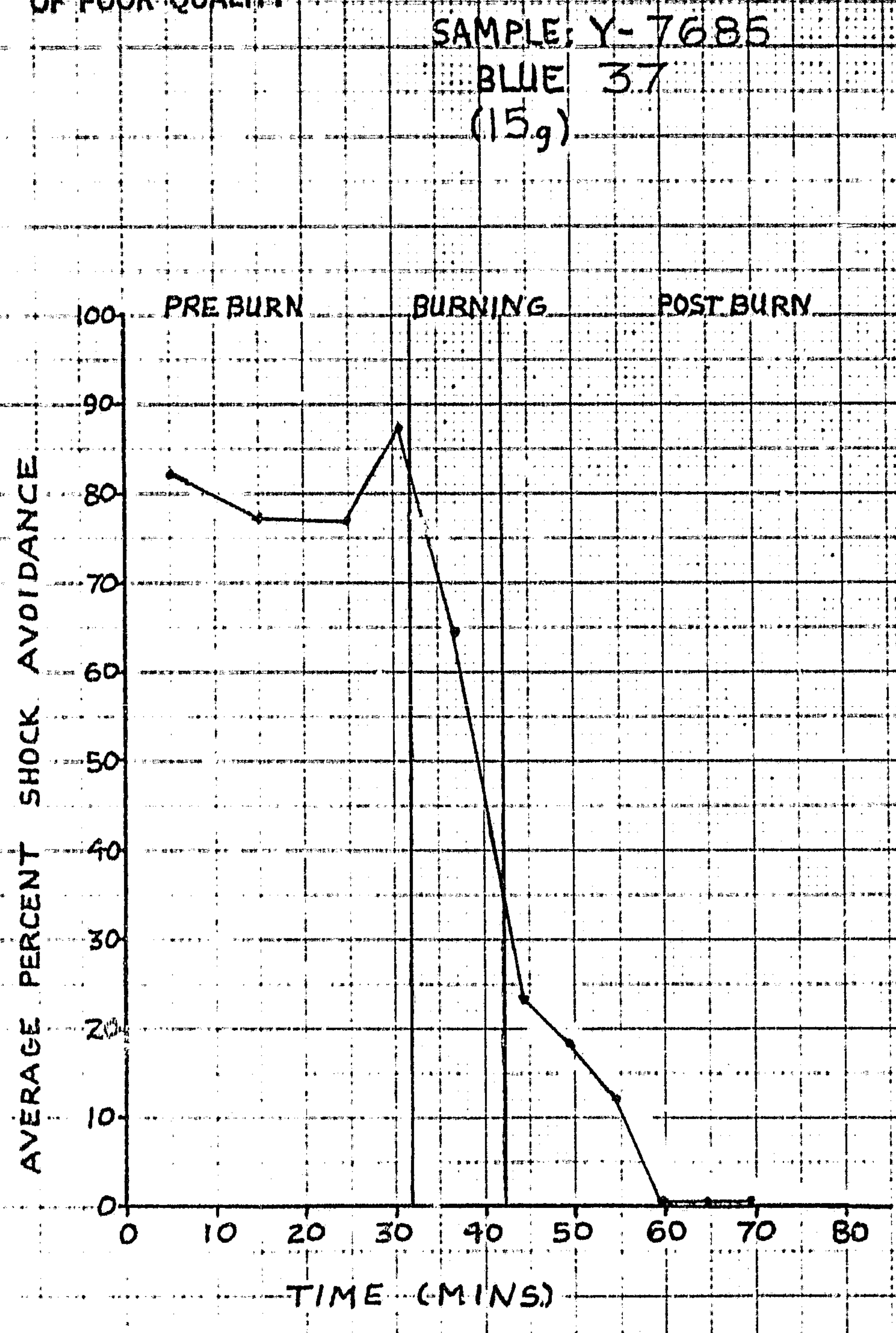

SAMPLE: Y-7685
BLUE 37
(15g)
PRE BURN
BURNING
POST BURN
AVERAGE PERCENT SHOCK AVOIDANCE
0
10
20
30
40
50
60
70
80
90
100
0
10
20
30
40
50
60
70
80
TIME (MINS)

Figure 26

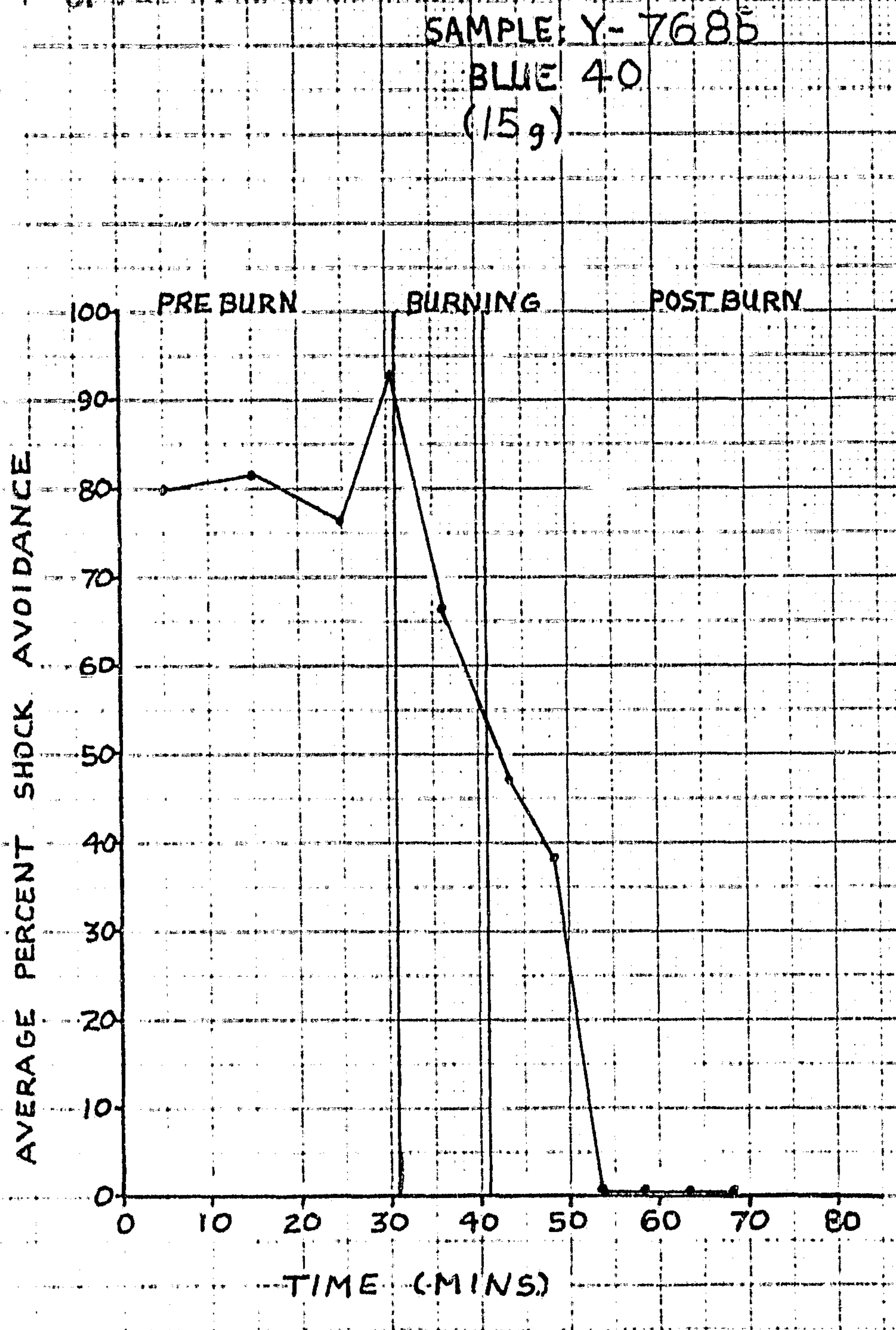

SAMPLE: Y-7685
BLUE 40
(15 g)
PRE BURN
BURNING
POST BURN
AVERAGE PERCENT SHOCK AVOIDANCE
100
90
80
70
60
50
40
30
20
10
0
0
10
20
30
40
50
60
70
80
TIME (MINS)

Figure 27

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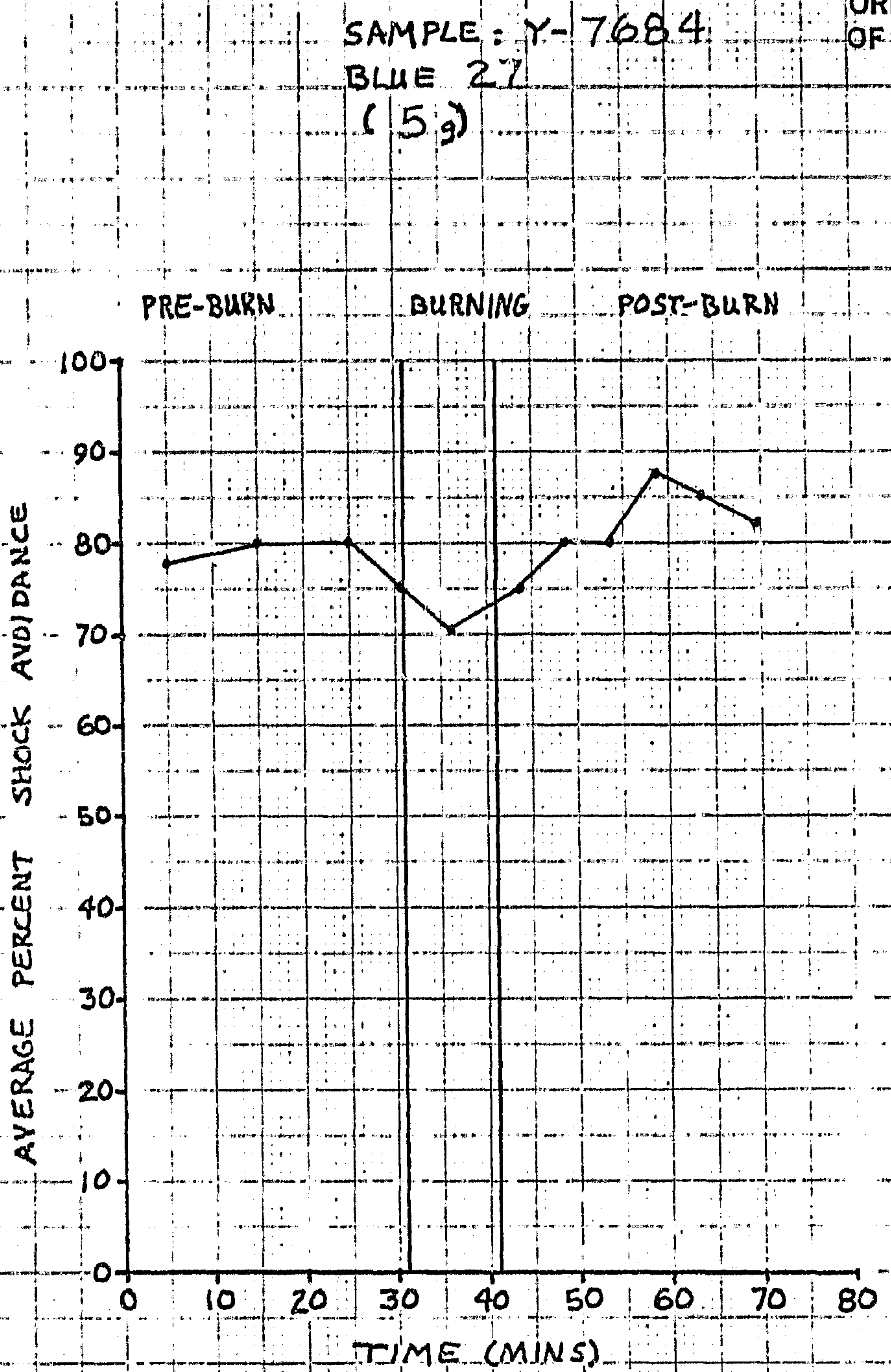


46 1320

Figure 28

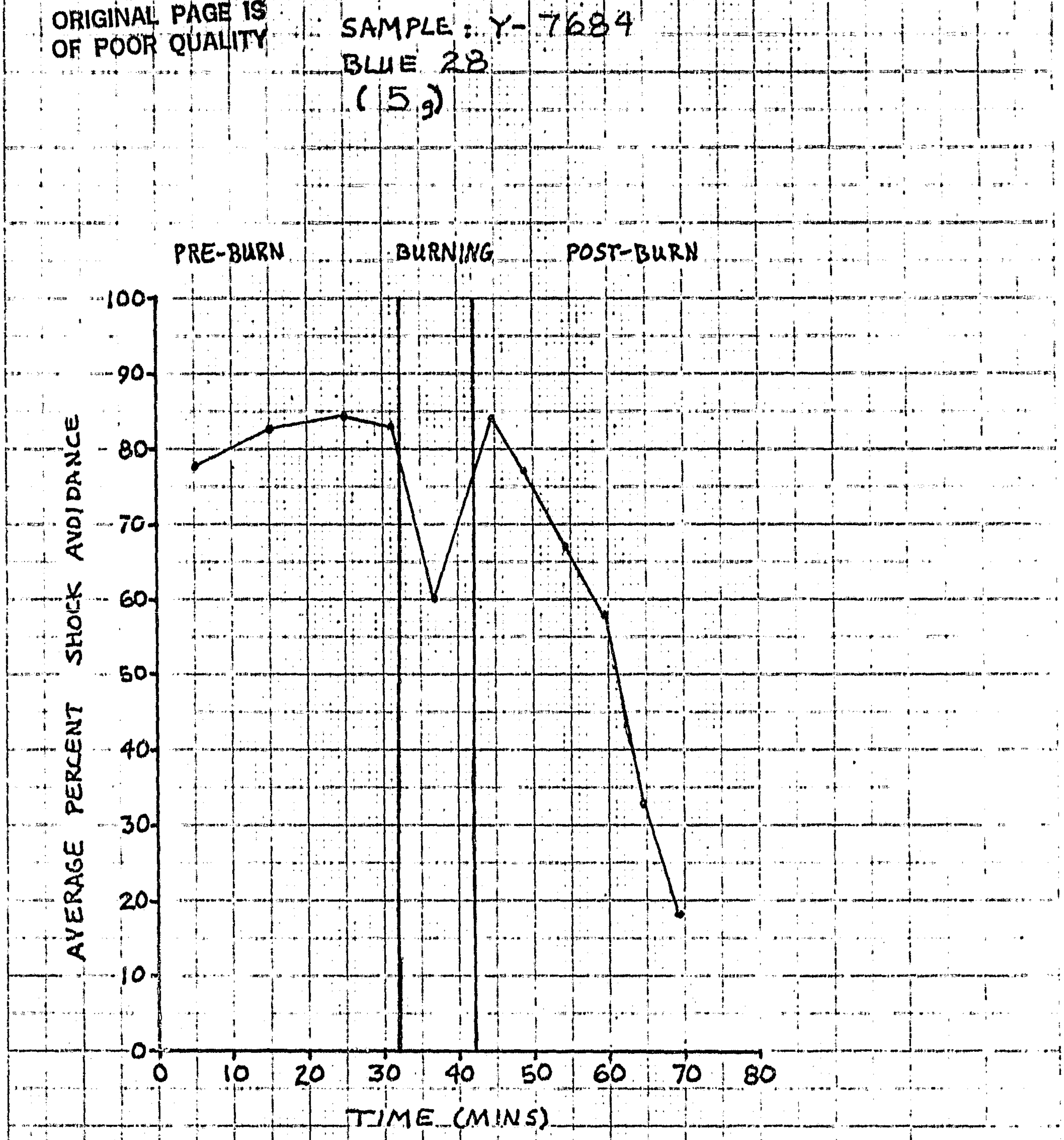

SAMPLE : Y-7684
BLUE 28
(5 g)
PRE-BURN
BURNING
POST-BURN
AVERAGE PERCENT SHOCK AVOIDANCE
100
90
80
70
60
50
40
30
20
10
0
0
10
20
30
40
50
60
70
80
TIME (MINS)

Figure 29

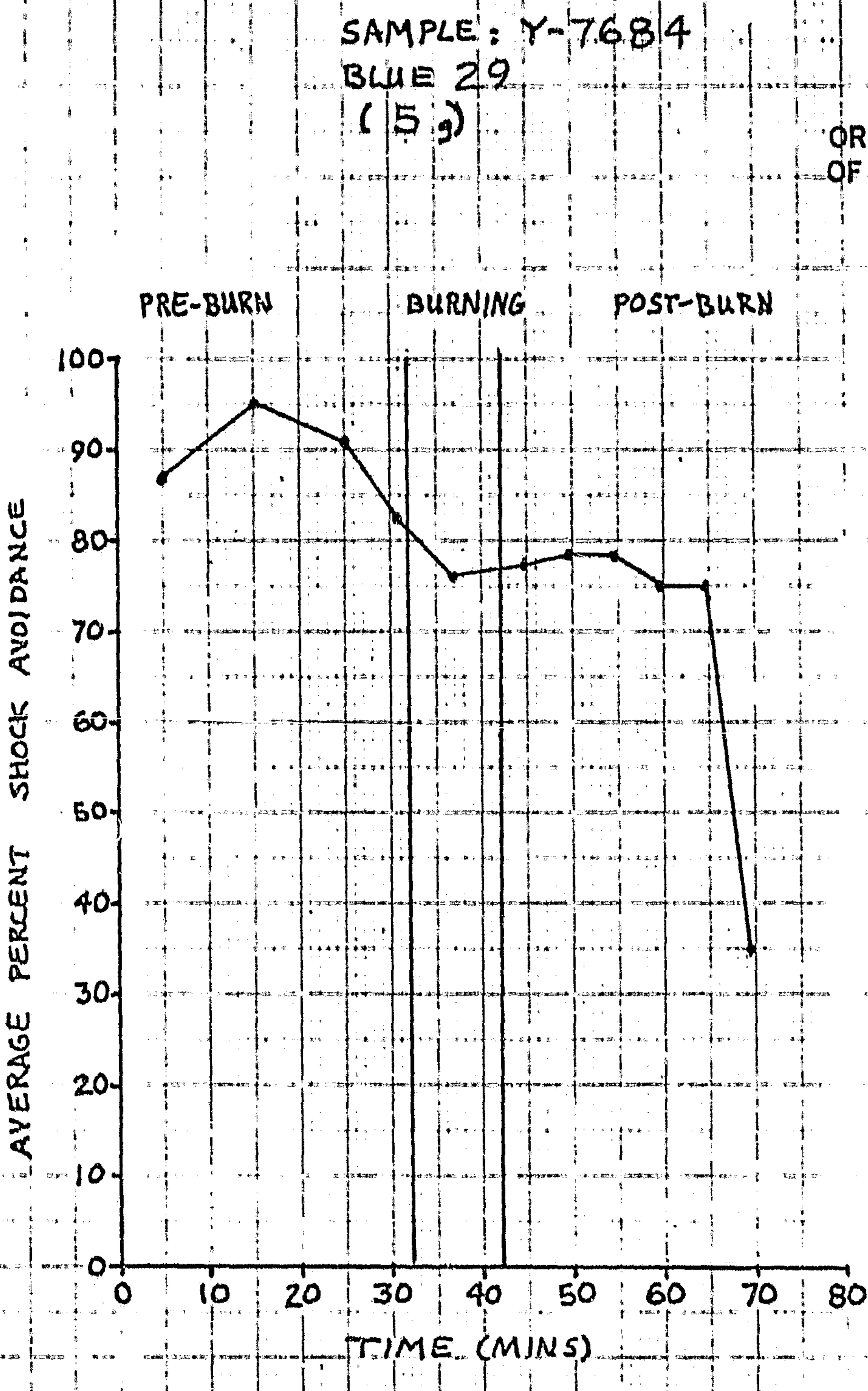

SAMPLE: Y-7684
BLUE 29
(5 g)
PRE-BURN
BURNING
POST-BURN
AVERAGE PERCENT SHOCK AVOIDANCE
100
90
80
70
60
50
40
30
20
10
0
0
10
20
30
40
50
60
70
80
TIME (MINS)

Figure 30

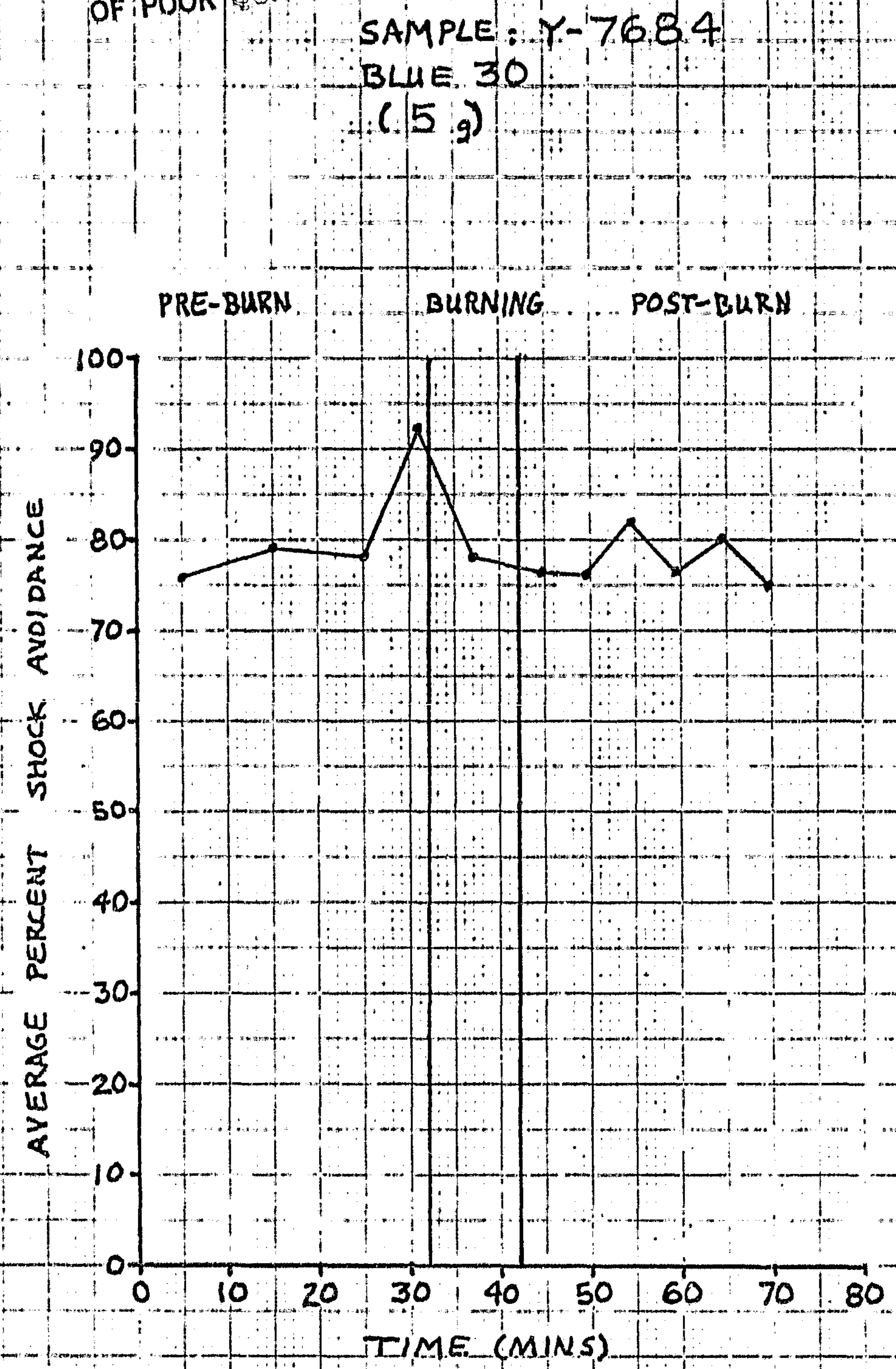

SAMPLE: Y-7684
BLUE 30
(5 g)
PRE-BURN
BURNING
POST-BURN
AVERAGE PERCENT SHOCK AVOIDANCE
100
90
80
70
60
50
40
30
20
10
0
0
10
20
30
40
50
60
70
80
TIME (MINS)

Figure 31

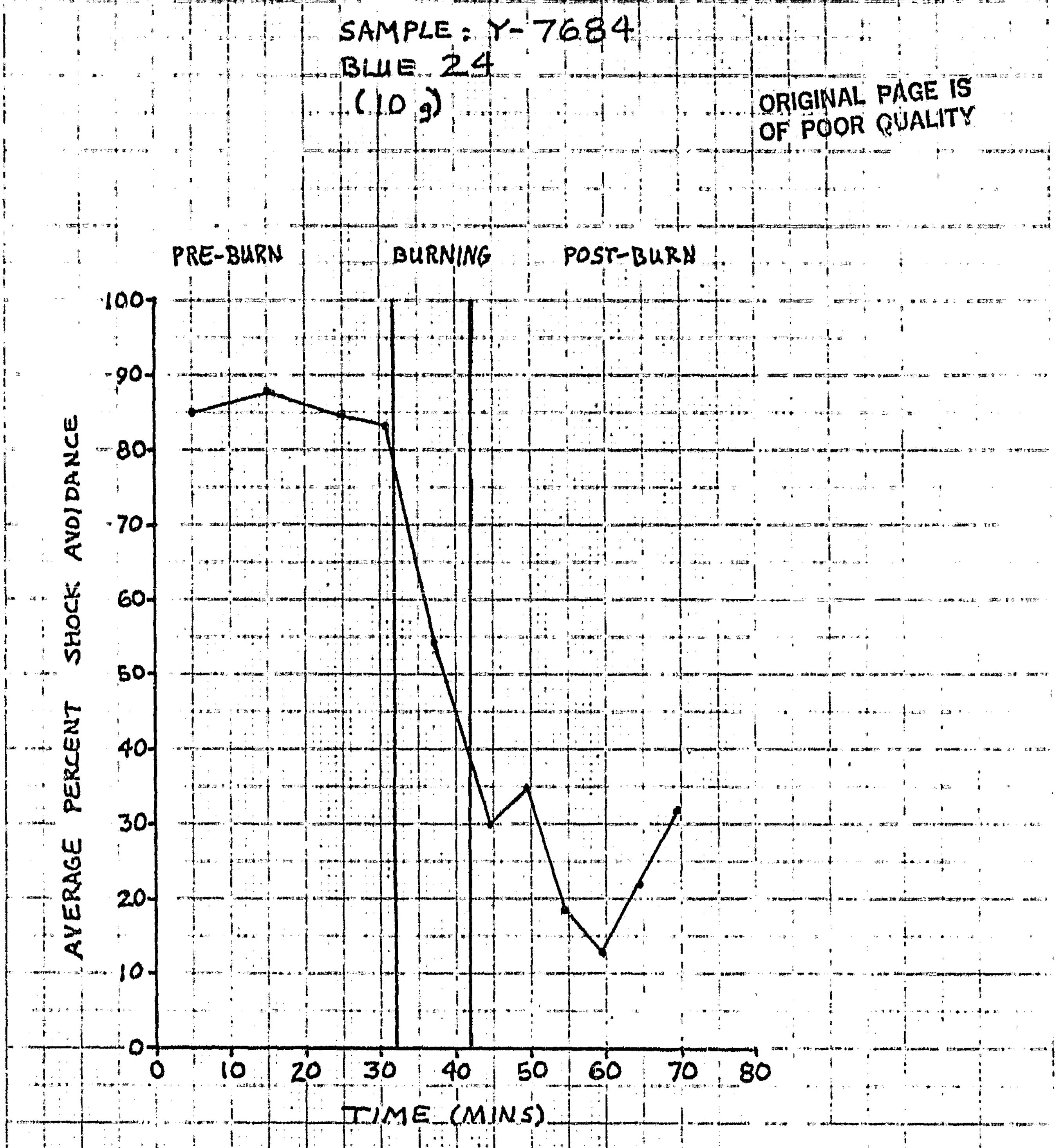
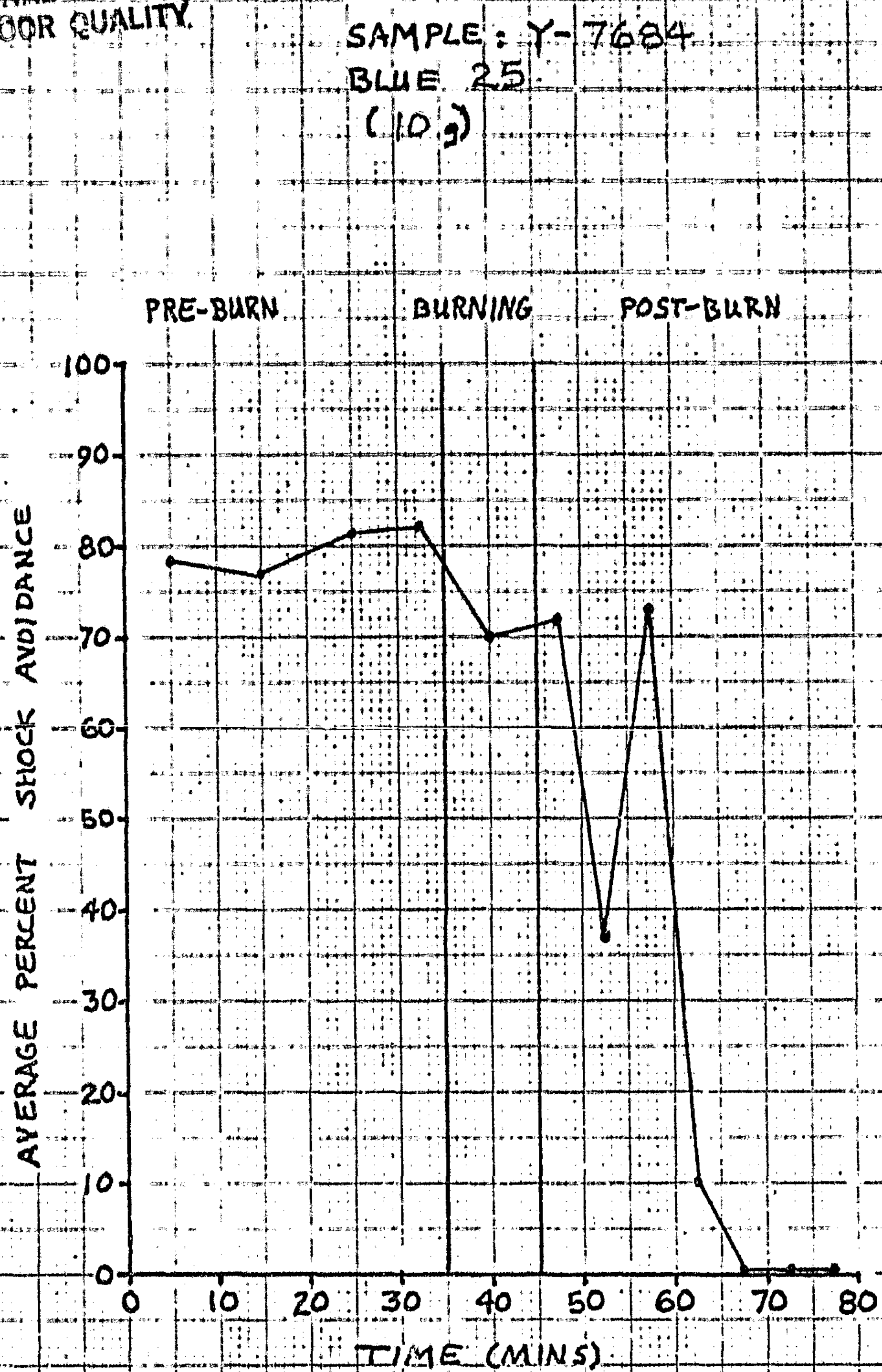

SAMPLE: Y-7684
BLUE 24
(10 g)
PRE-BURN
BURNING
POST-BURN
AVERAGE PERCENT SHOCK AVOIDANCE
100
90
80
70
60
50
40
30
20
10
0
0
10
20
30
40
50
60
70
80
TIME (MINS)

Figure 32


SAMPLE: Y-7684
BLUE 25
(10 g)
PRE-BURN
BURNING
POST-BURN
AVERAGE PERCENT SHOCK AVOIDANCE
100
90
80
70
60
50
40
30
20
10
0
0
10
20
30
40
50
60
70
80
TIME (MINS)

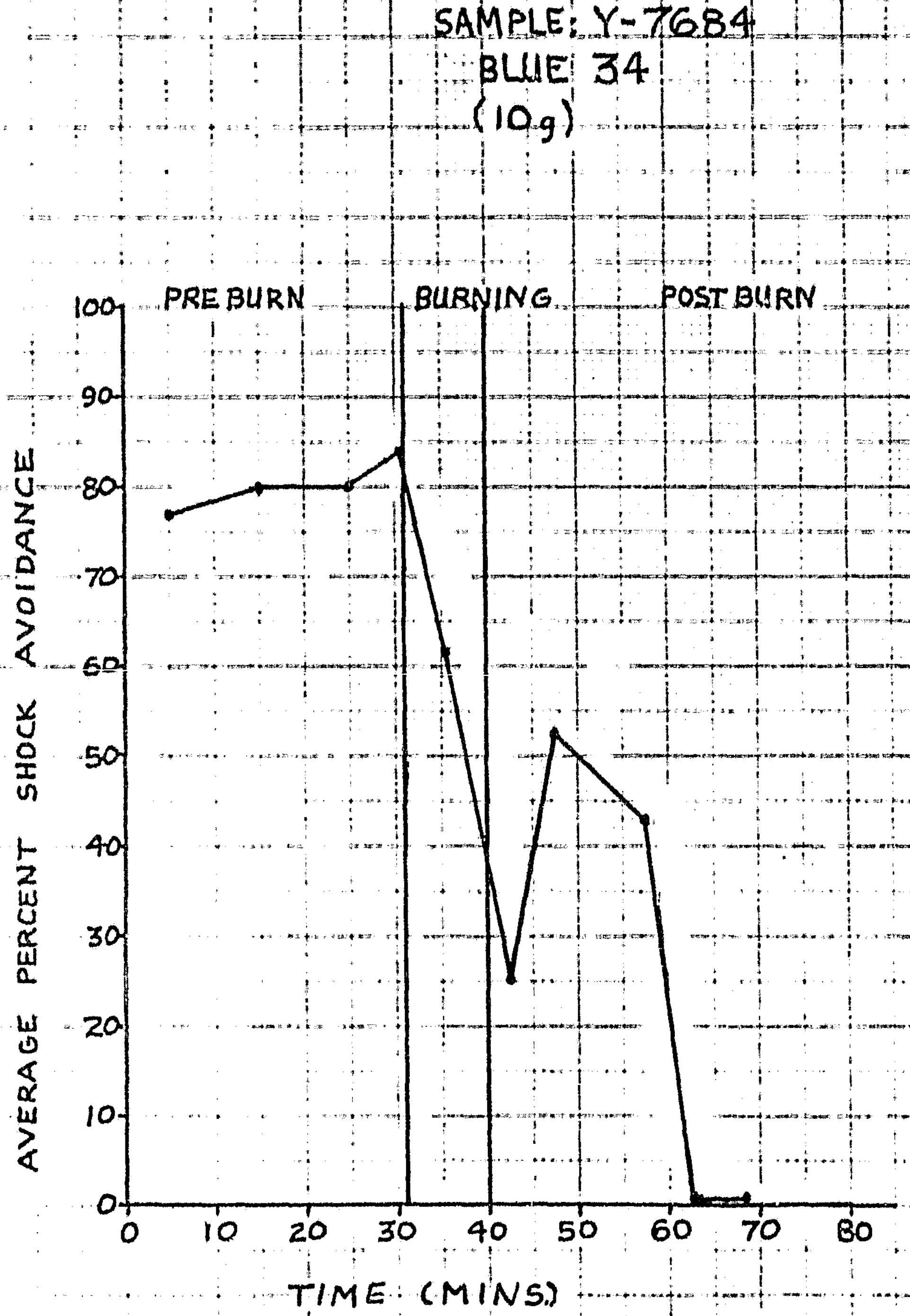

SAMPLE: Y-7684
BLUE 34
(10g)
PRE BURN
BURNING
POST BURN
AVERAGE PERCENT SHOCK AVOIDANCE
100
90
80
70
60
50
40
30
20
10
0
0
10
20
30
40
50
60
70
80
TIME (MINS)

Figure 34

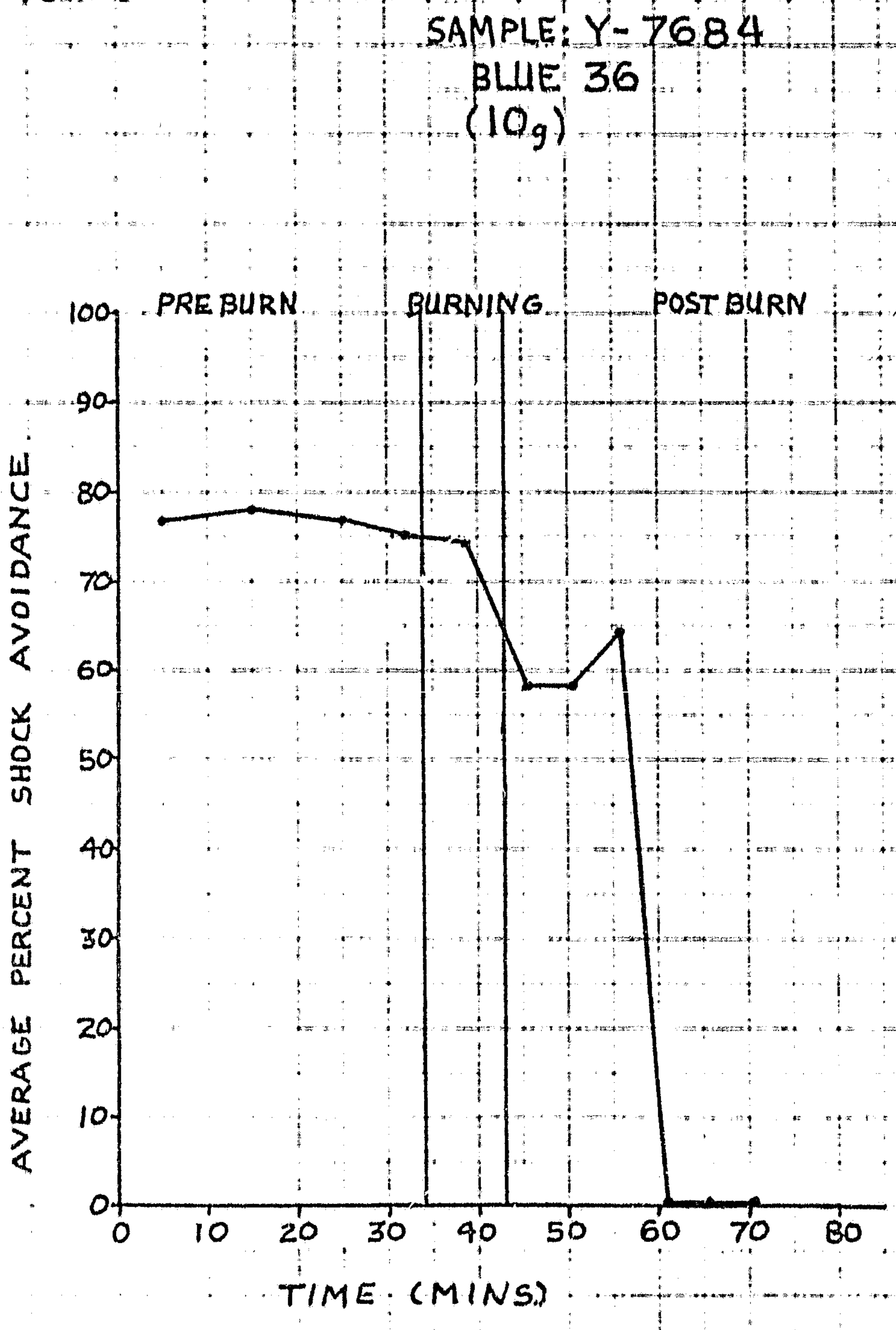
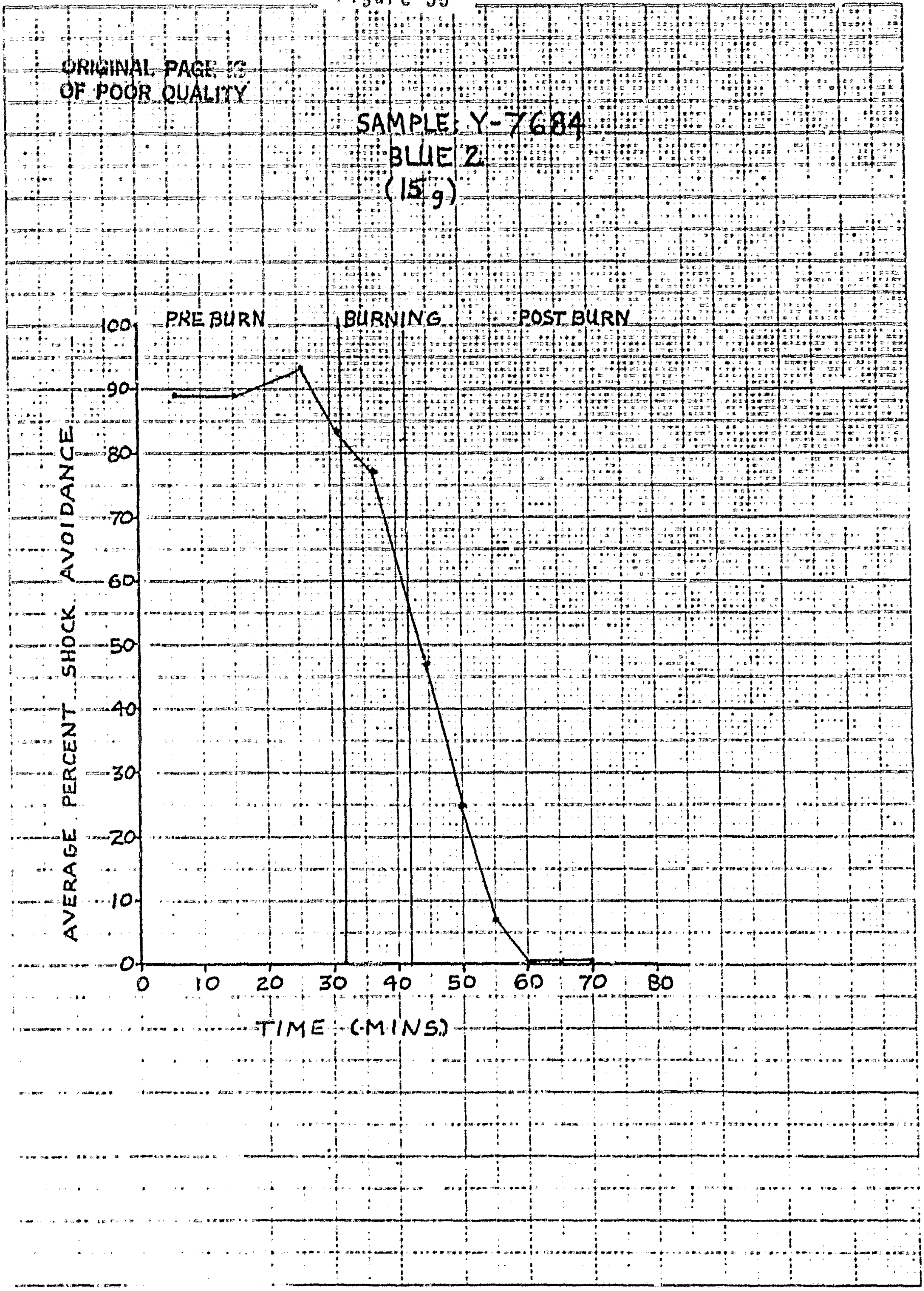

SAMPLE: Y-7684
BLUE 36
(10g)
PRE BURN
BURNING
POST BURN
AVERAGE PERCENT SHOCK AVOIDANCE
100
90
80
70
60
50
40
30
20
10
0
0
10
20
30
40
50
60
70
80
TIME (MINS)

Figure 35


ORIGINAL PAGE IS
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SAMPLE: Y-7684
BLUE 2
(15 g)
PREBURN
BURNING
POST BURN
AVERAGE PERCENT SHOCK AVOIDANCE
100
90
80
70
60
50
40
30
20
10
0
0
10
20
30
40
50
60
70
80
TIME (MINS)

Figure 36

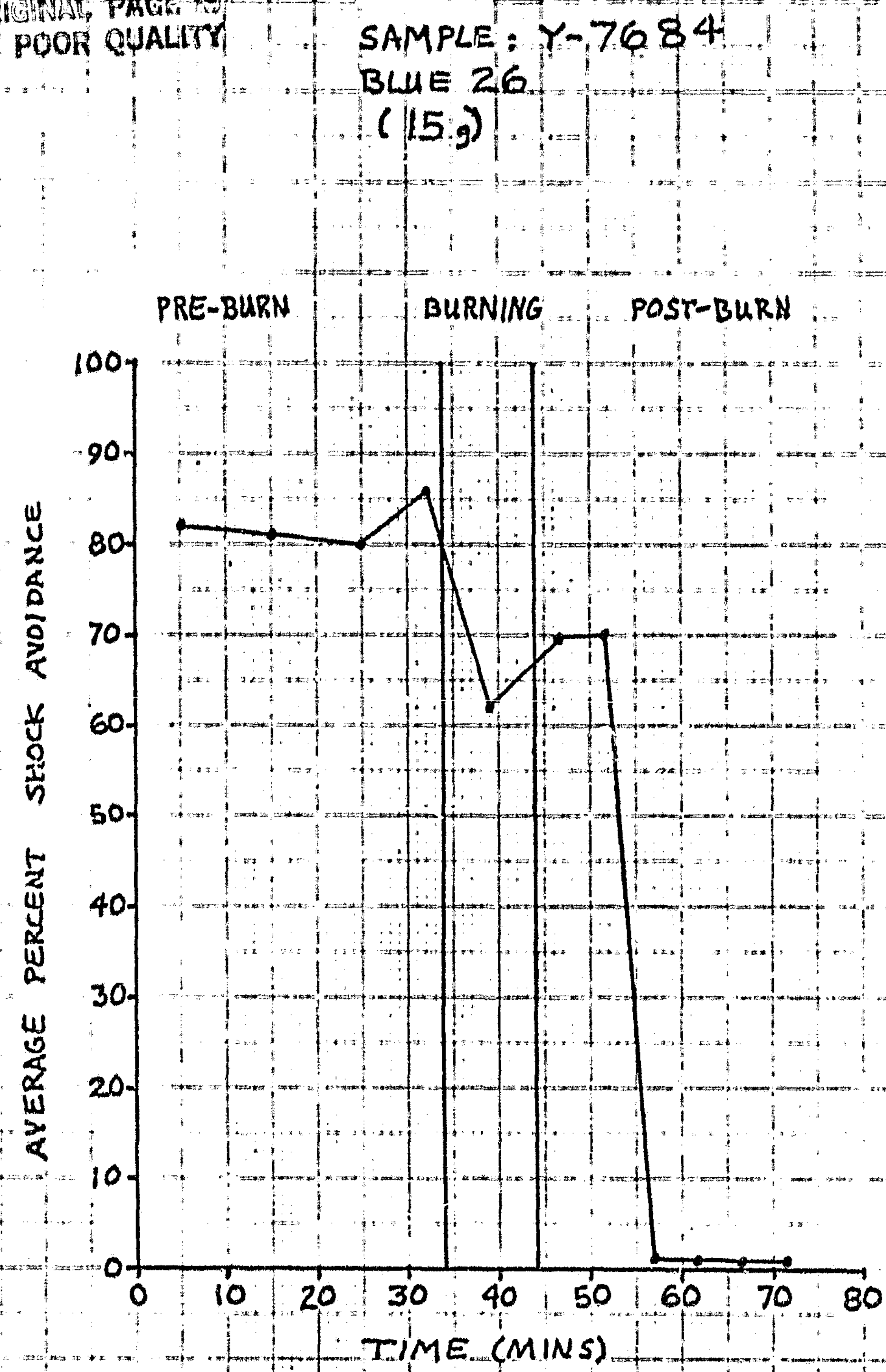
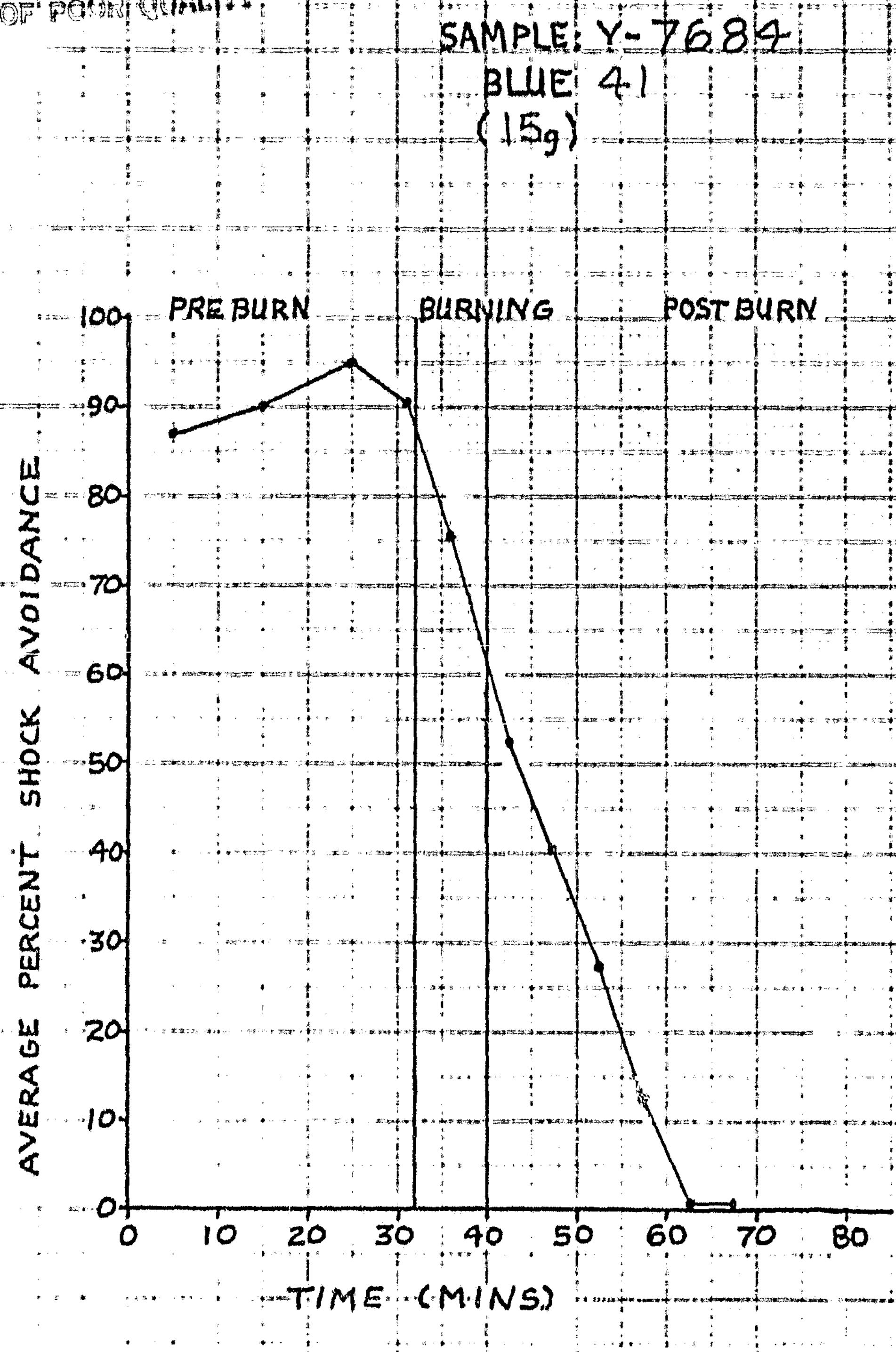

SAMPLE: Y-7684
BLUE 26
(15 g)
PRE-BURN
BURNING
POST-BURN
AVERAGE PERCENT SHOCK AVOIDANCE
0
10
20
30
40
50
60
70
80
90
100
TIME (MINS)

Figure 37


SAMPLE: Y-7684
BLUE 41
(15g)
PRE BURN
BURNING
POST BURN
AVERAGE PERCENT SHOCK AVOIDANCE
100
90
80
70
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50
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30
20
10
0
0
10
20
30
40
50
60
70
80
TIME (MINS.)

Figure 38

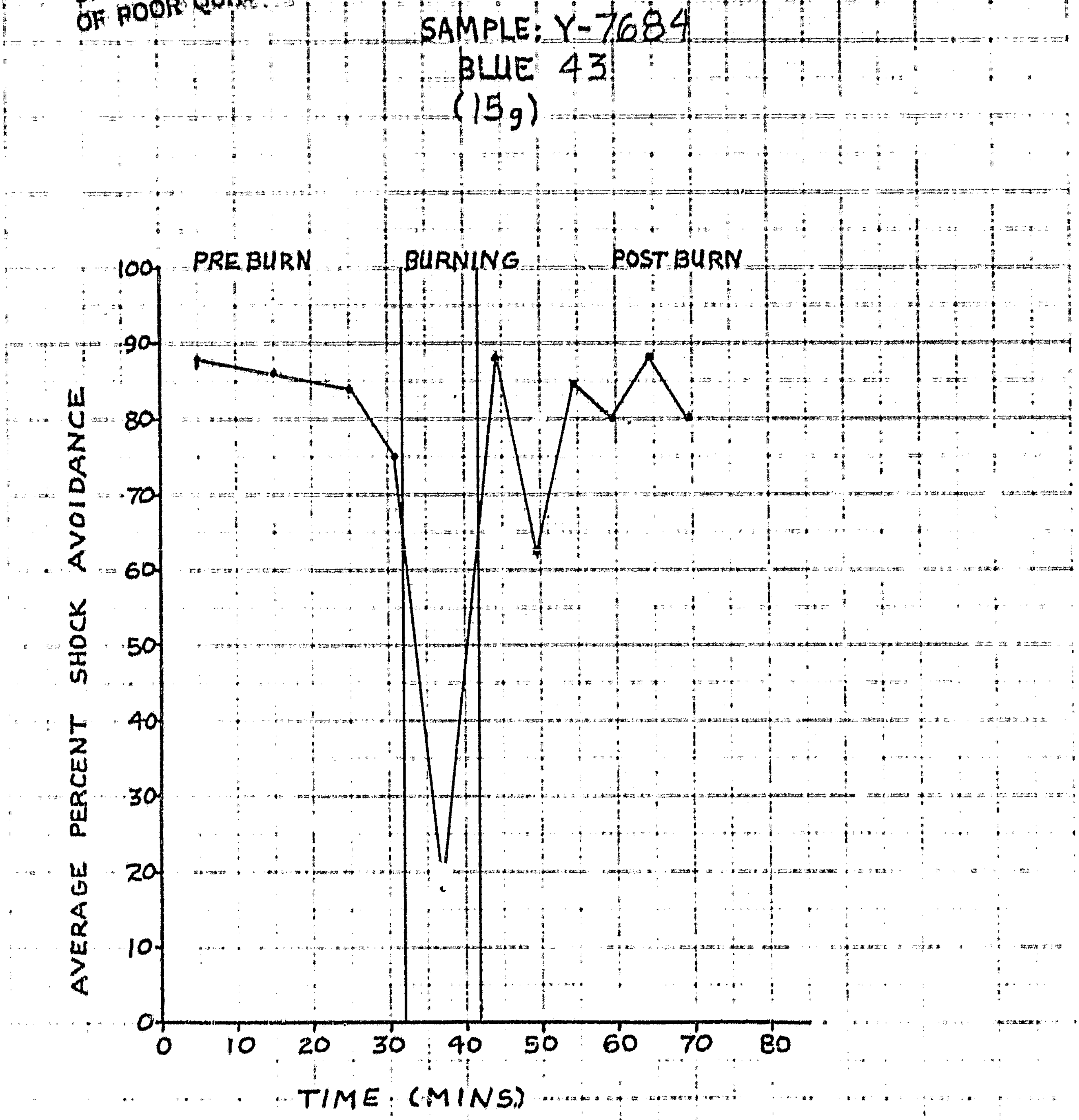
SAMPLE: Y-7684
BLUE 43
(15g)
PRE BURN
BURNING
POST BURN
AVERAGE PERCENT SHOCK AVOIDANCE
100
90
80
70
60
50
40
30
20
10
0
0
10
20
30
40
50
60
70
80
TIME (MINS.)

Figure 39

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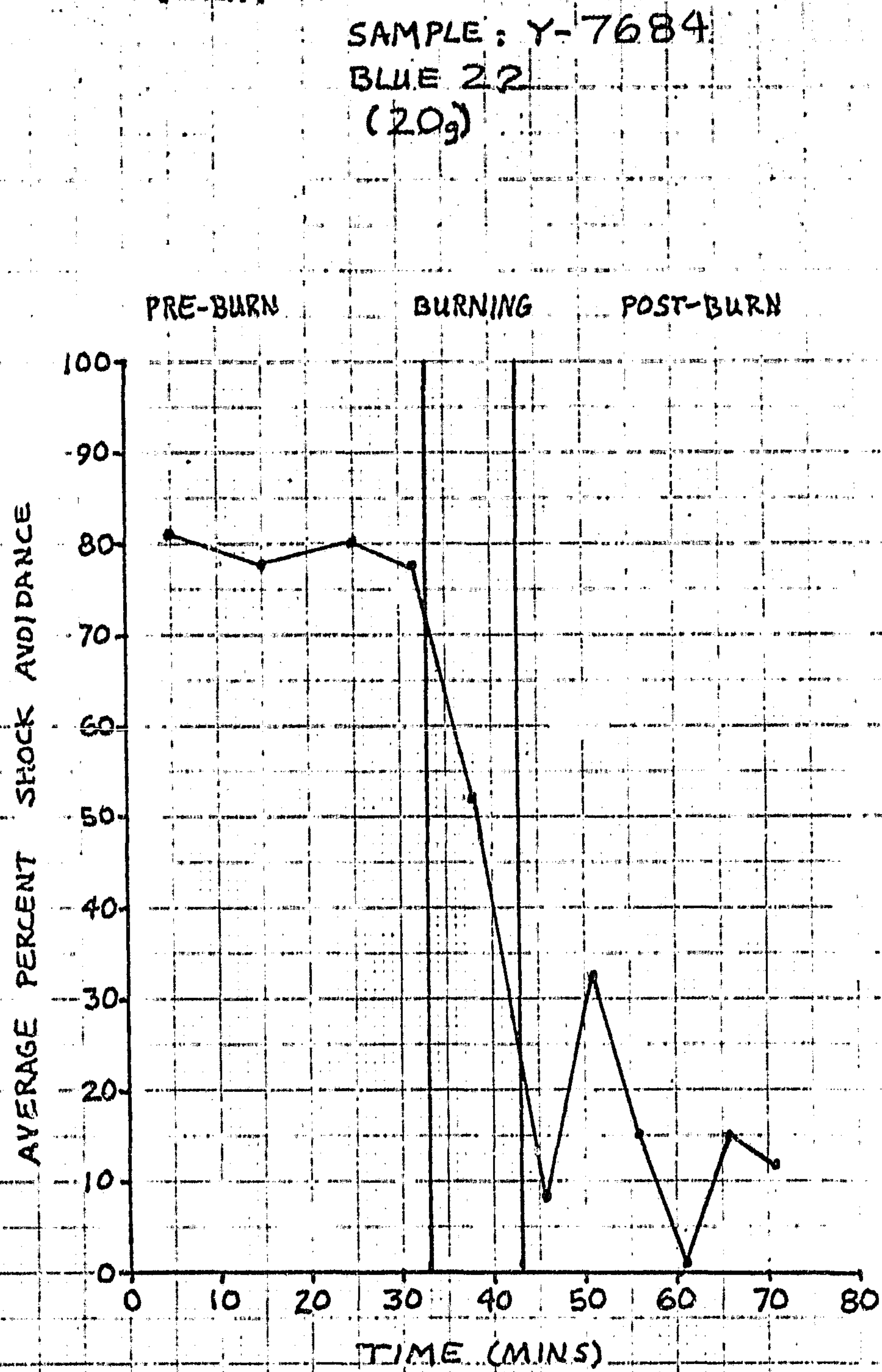


Figure 40

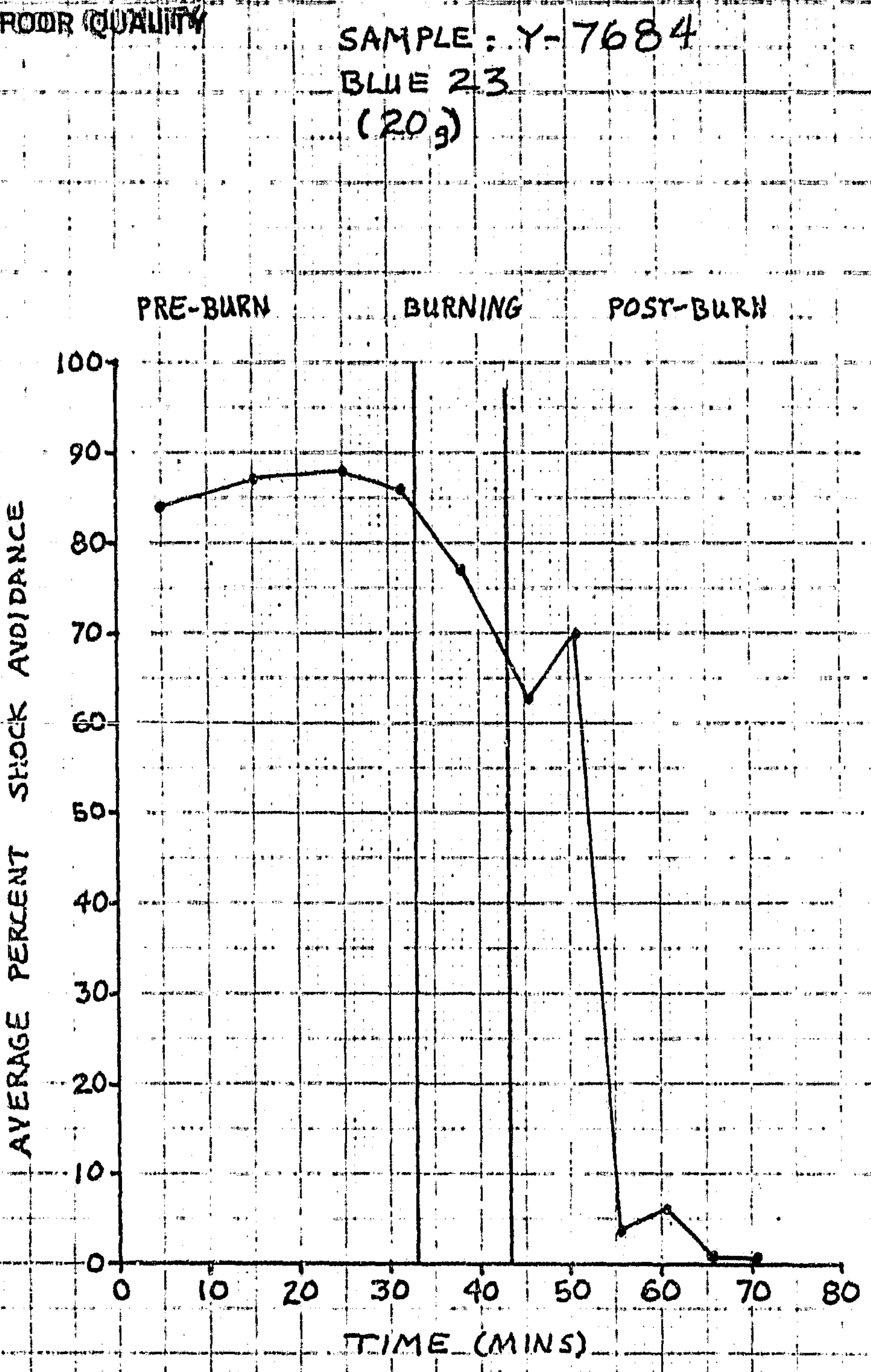

SAMPLE: Y-7684
BLUE 23
(20g)
PRE-BURN
BURNING
POST-BURN
AVERAGE PERCENT SHOCK AVOIDANCE
100
90
80
70
60
50
40
30
20
10
0
10
20
30
40
50
60
70
80
TIME (MINS)

Figure 41

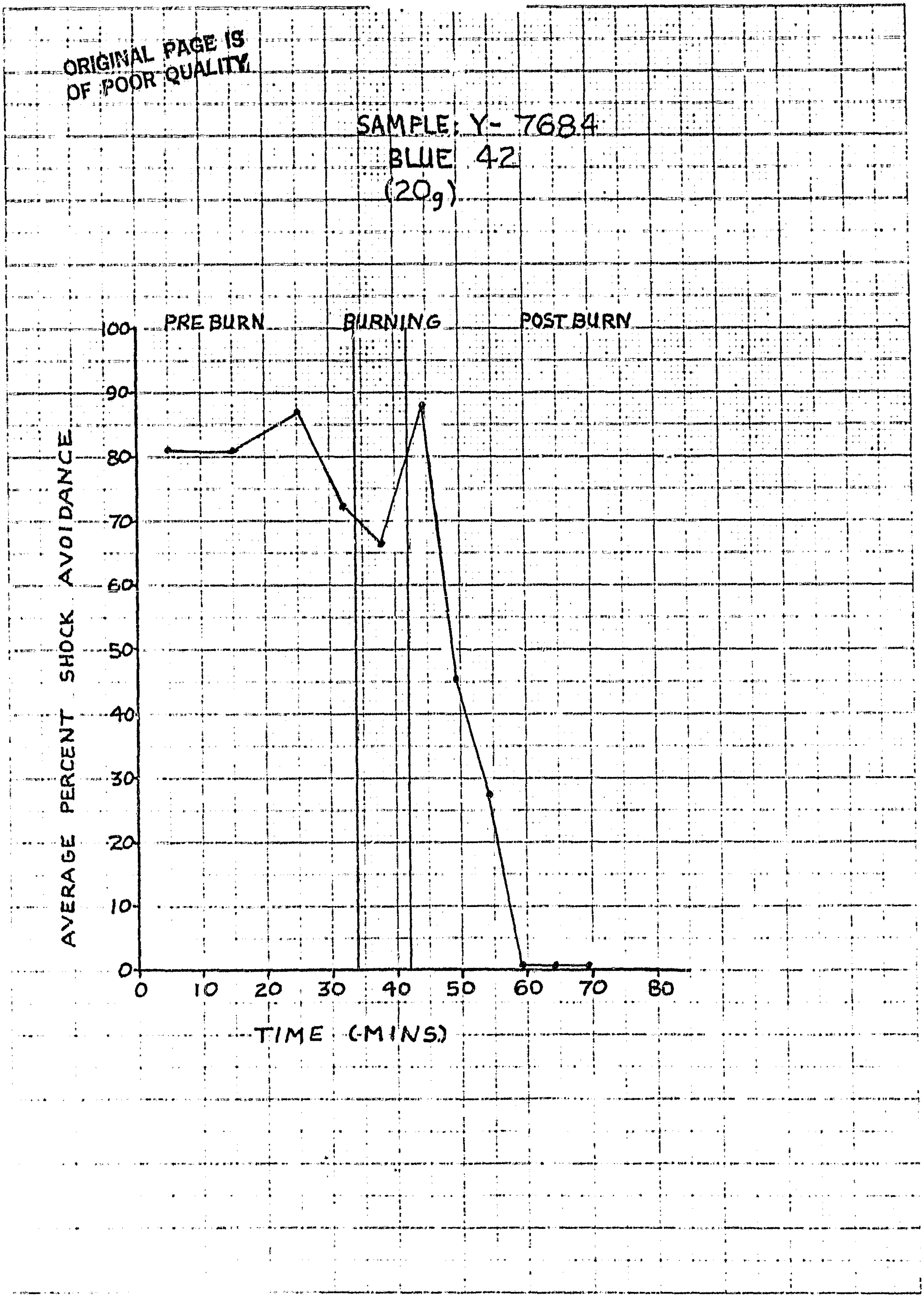
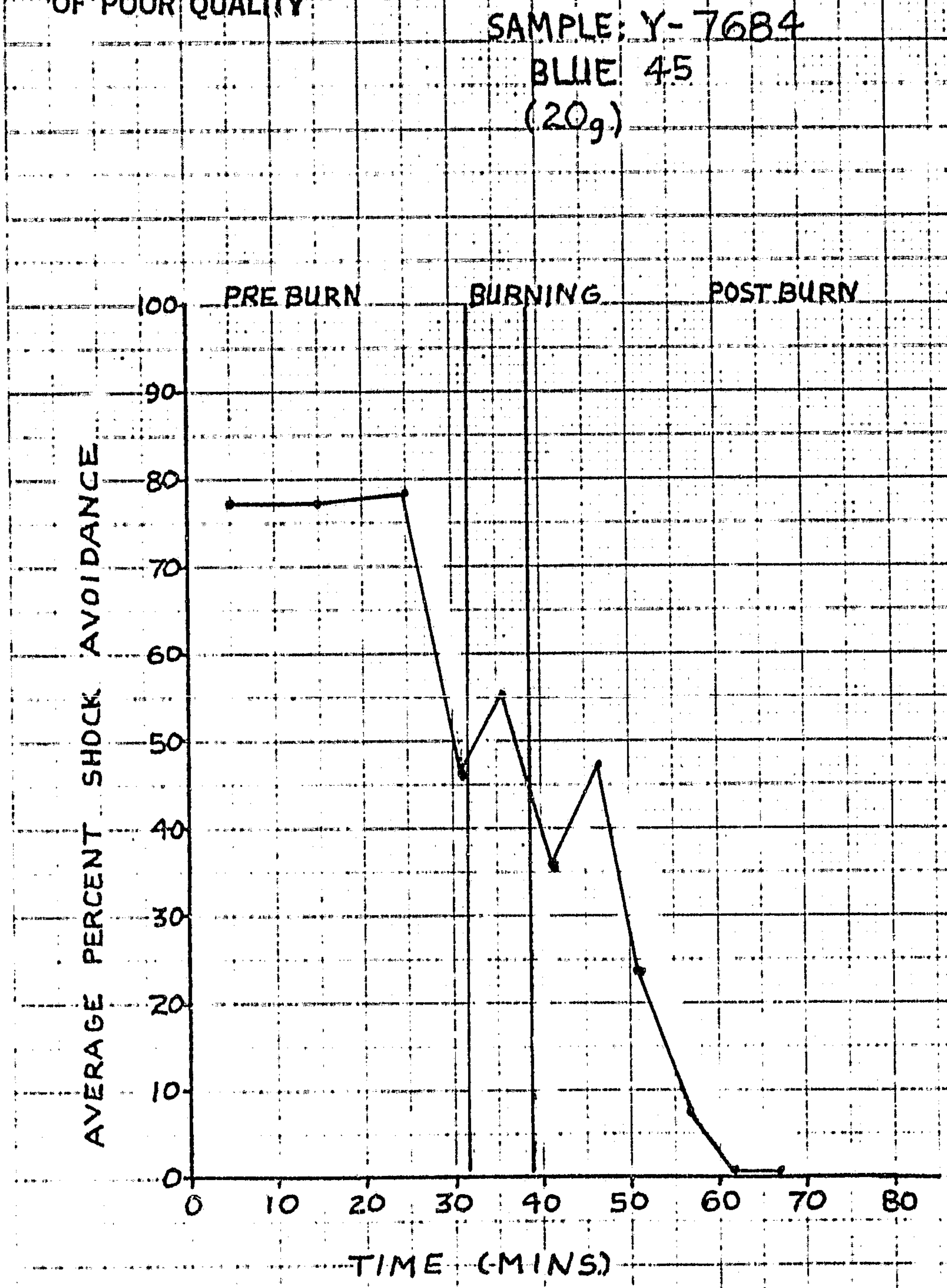

SAMPLE: Y- 7684
BLUE 42
(20g)
PRE BURN
BURNING
POST BURN
AVERAGE PERCENT SHOCK AVOIDANCE
0
10
20
30
40
50
60
70
80
90
100
0
10
20
30
40
50
60
70
80
TIME (MINS)

Figure 42


SAMPLE: Y-7684
BLUE 45
(20g)
PRE BURN
BURNING
POST BURN
AVERAGE PERCENT SHOCK AVOIDANCE
100
90
80
70
60
50
40
30
20
10
0
0
10
20
30
40
50
60
70
80
TIME (MINS)

Explanation of
Pyrolysis-Behavior Responses: Group Summaries

Figures 43 through 51 summarize shock-avoidance behavioral activity of each group of rats exposed to pyrolysates of sample materials. The data are plotted as *mean responses* for the group of rats at each of the 7 time intervals. In these figures, the triangles show the baseline controls (*i.e.*, the average of responses for the two tests, Days 1 and 2, preceeding actual exposure of rats to the pyrolysates). The other symbols, as defined on the figure, show the mean response of all animals in the group or sub-groups of the animals on the day of the pyrolysis-behavior test (Day 3). As before, the first 3 points represent responses preceeding the burn or pyrolysis phase, the 4th is the burn or pyrolysis phase, and the 5th, 6th, and 7th points represent responses for the 10 minute periods following pyrolysis (burn) of the sample.

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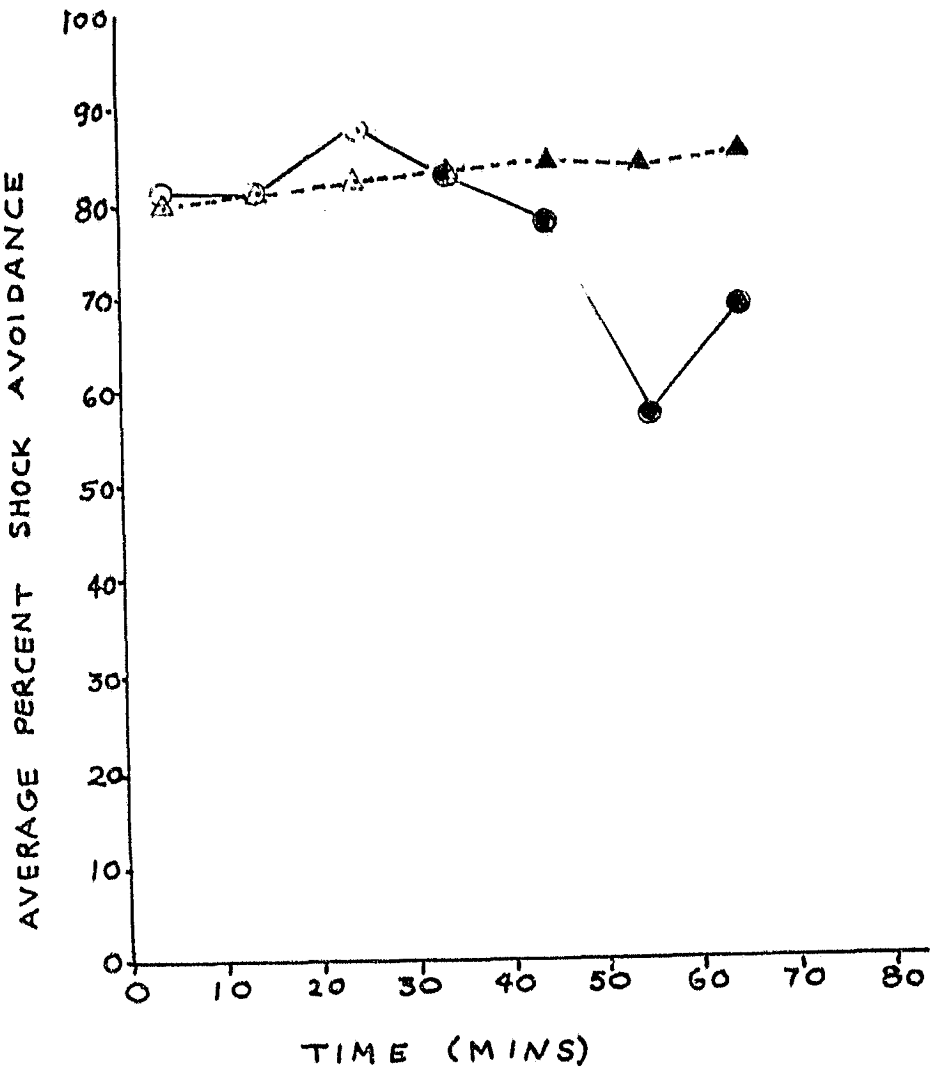
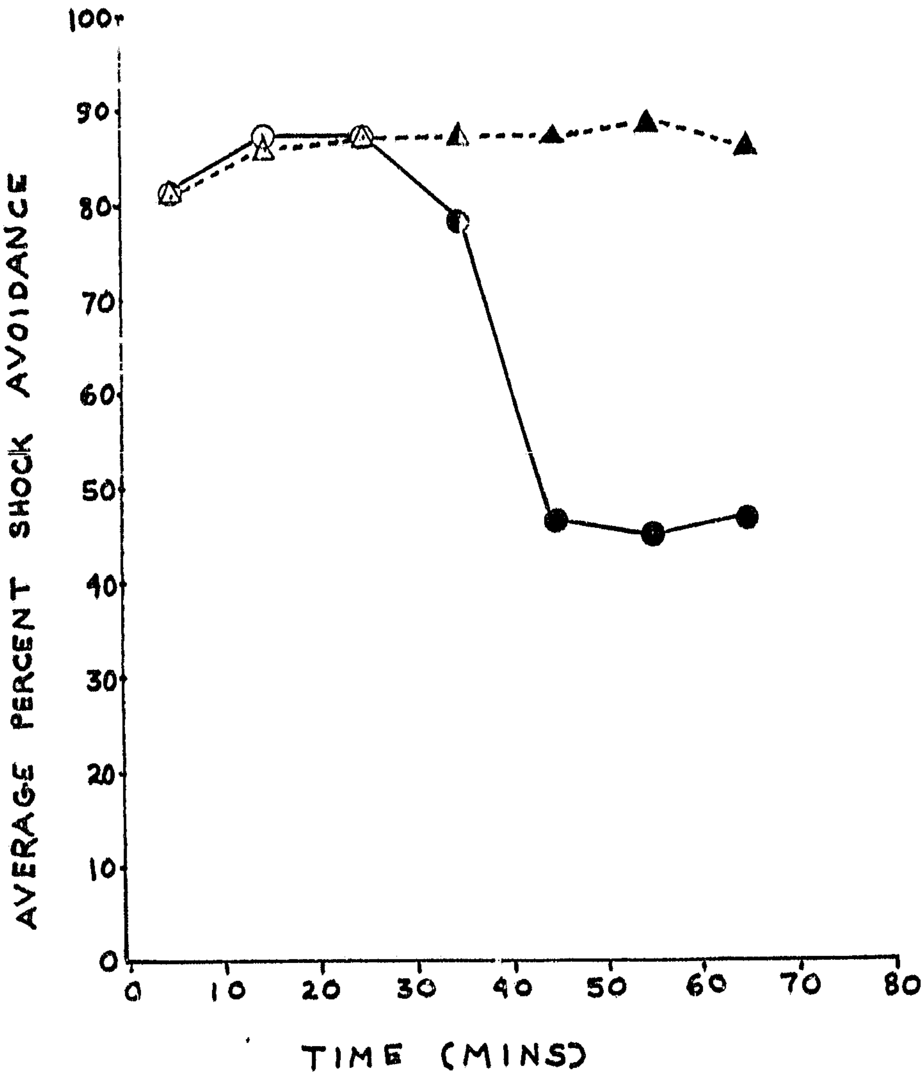
Figure 43
Sample Y-7683
(10 grams)
Group 1



Averaged 2 day baseline, period corresponding to preburn.
Averaged 2 day baseline, period corresponding to burn.
Averaged 2 day baseline, period corresponding to postburn.
Test day, preburn period.
Test day, burn period.
Test day, postburn period.

Figure 44
Sample Y-7683
(15 grams)
Group 2



△--△ Averaged 2 day baseline, period corresponding to preburn.
◭--◭ Averaged 2 day baseline, period corresponding to burn.
▲--▲ Averaged 2 day baseline, period corresponding to postburn.
○—○ Test day, preburn period.
◐—◐ Test day, burn period.
●—● Test day, postburn period.

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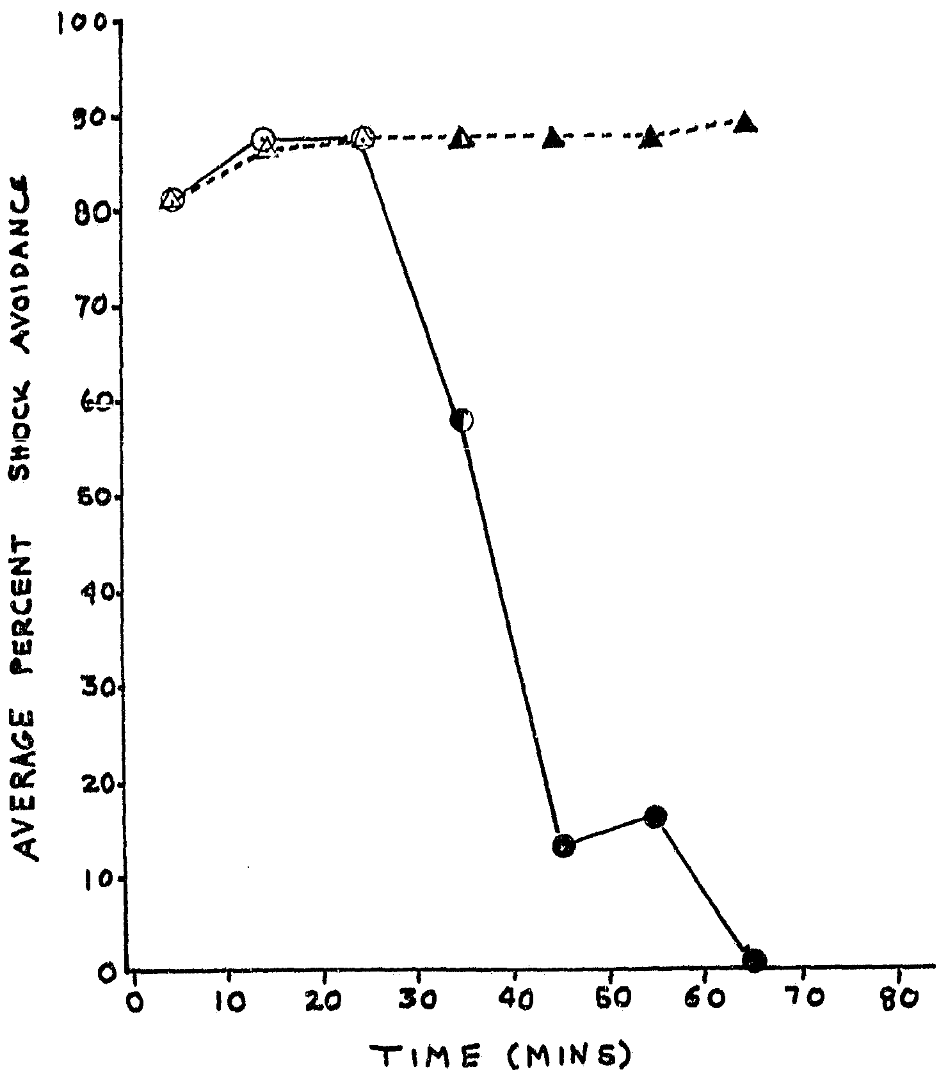
Figure 45
Sample Y-7683
(20 grams)
Group 3



△--△ Averaged 2 day baseline, period corresponding to preburn.
◭--◭ Averaged 2 day baseline, period corresponding to burn.
▲--▲ Averaged 2 day baseline, period corresponding to postburn.
○—○ Test day, preburn period.
◐—◐ Test day, burn period.
●—● Test day, postburn period.

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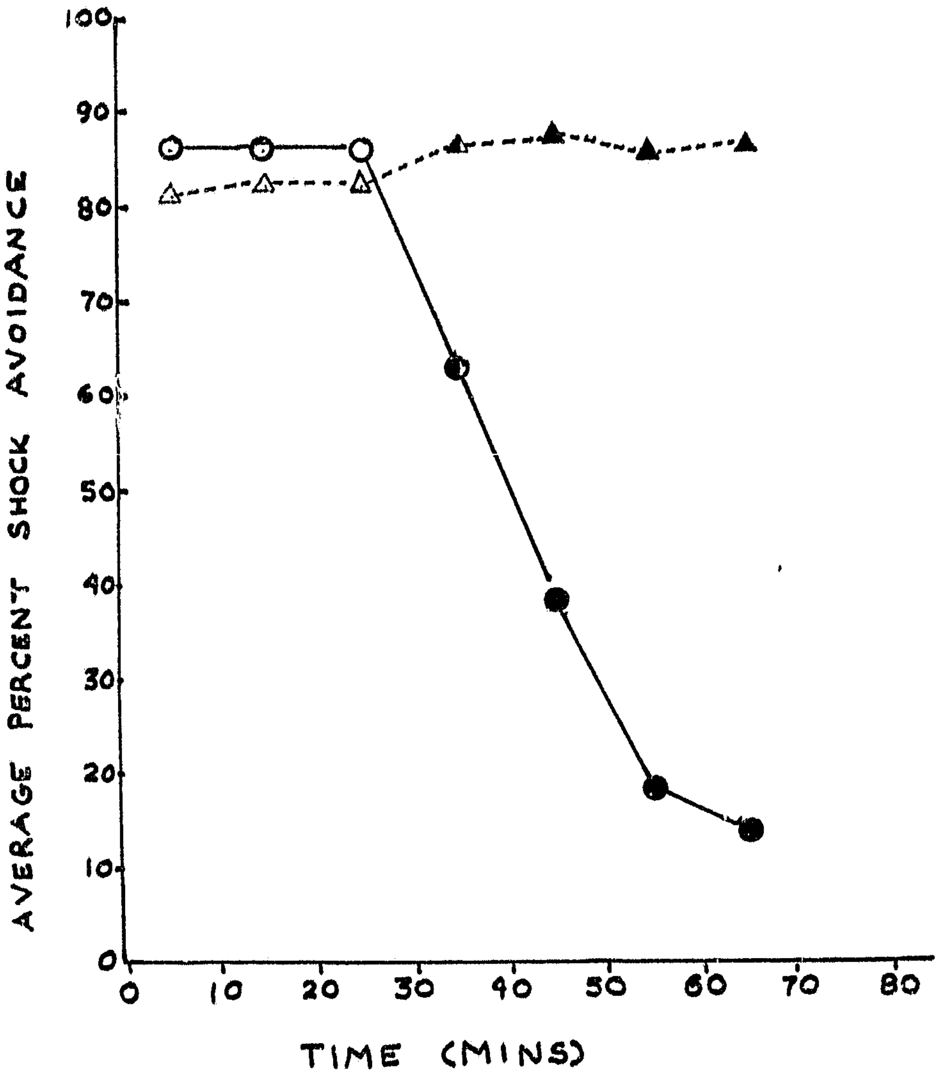
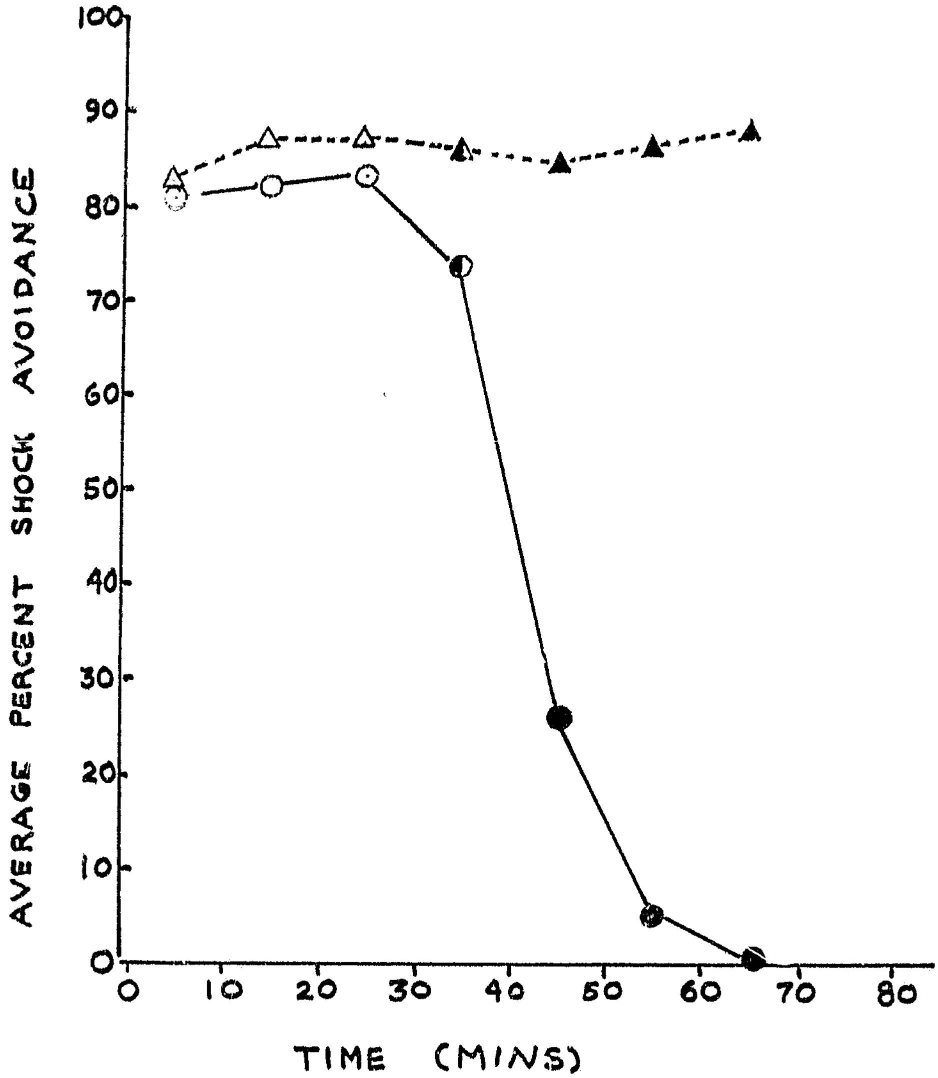
Figure 46
Sample Y-7685
(10 grams)
Group 4



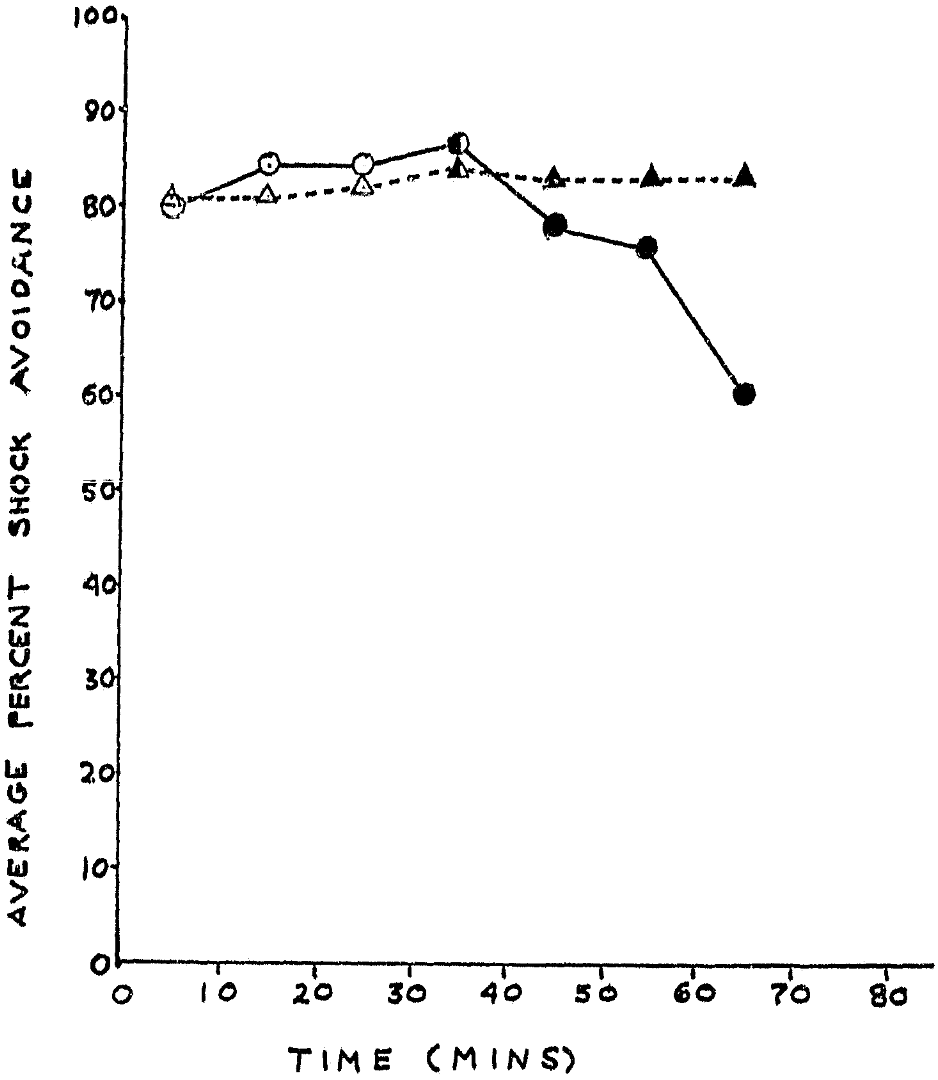
△--△ Averaged 2 day baseline, period corresponding to preburn.
▲--▲ Averaged 2 day baseline, period corresponding to burn.
▲--▲ Averaged 2 day baseline, period corresponding to postburn.
○—○ Test day, preburn period.
◐—◐ Test day, burn period.
●—● Test day, postburn period.

Figure 47
Sample Y-7685
(15 grams)
Group 5



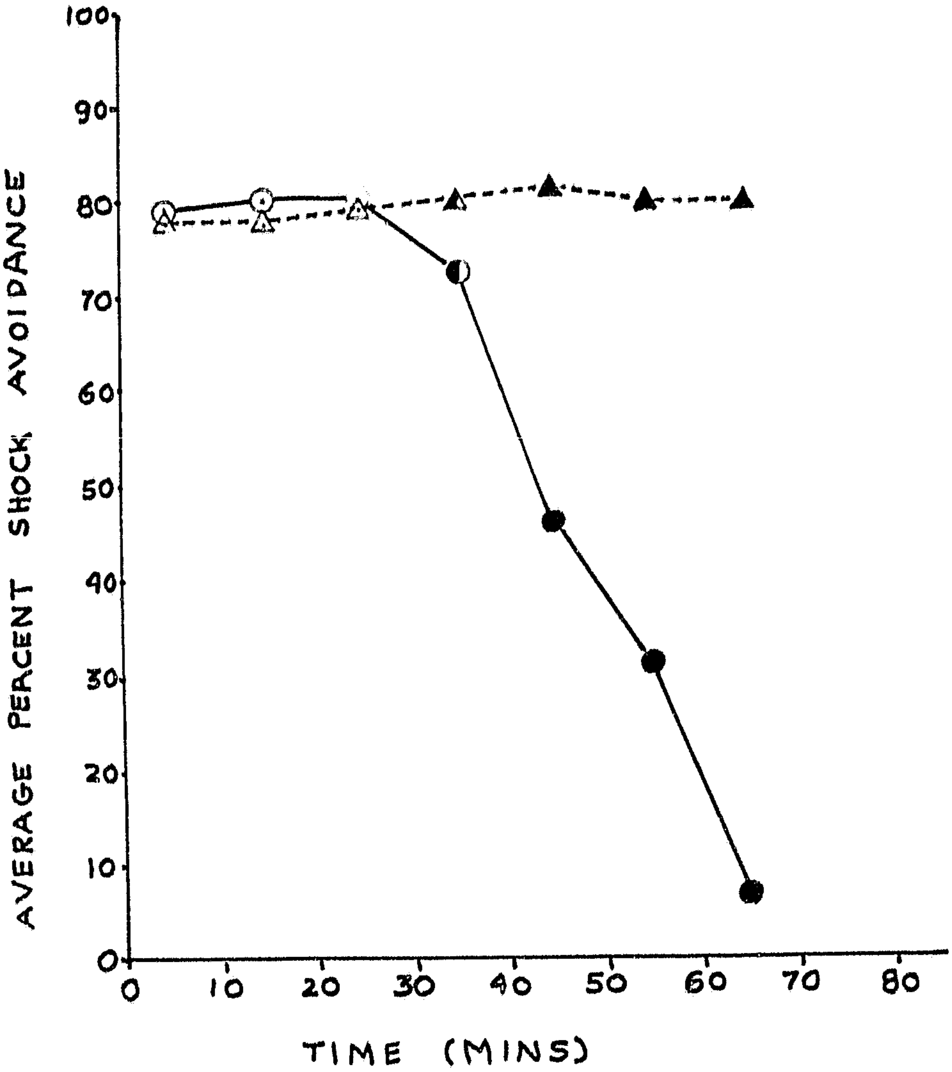
△--△ Averaged 2 day baseline, period corresponding to preburn.
▲--▲ Averaged 2 day baseline, period corresponding to burn.
▲--▲ Averaged 2 day baseline, period corresponding to postburn.
○—○ Test day, preburn period.
◐—◐ Test day, burn period.
●—● Test day, postburn period.

Figure 48
Sample Y-7684
(5 grams)
Group 6



Averaged 2 day baseline, period corresponding to preburn.
Averaged 2 day baseline, period corresponding to burn.
Averaged 2 day baseline, period corresponding to postburn.
Test day, preburn period.
Test day, burn period.
Test day, postburn period.

Figure 49
Sample Y-7684
(10 grams)
Group 7



△--△ Averaged 2 day baseline, period corresponding to preburn.
◭--◭ Averaged 2 day baseline, period corresponding to burn.
▲--▲ Averaged 2 day baseline, period corresponding to postburn.
○—○ Test day, preburn period.
◐—◐ Test day, burn period.
●—● Test day, postburn period.

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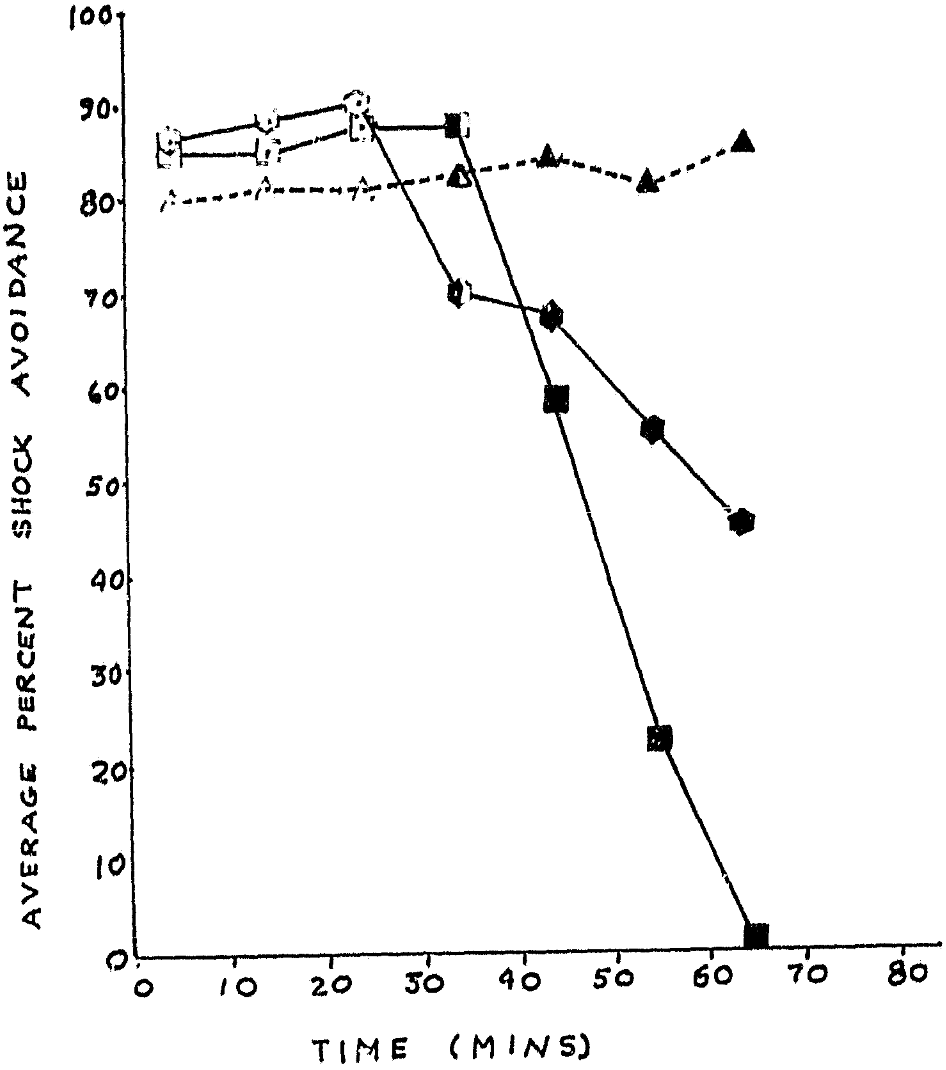
Figure 50
Sample Y-7684
(15 gm)
Group 8



Average 2 day baseline, period corresponding to preburn
Average 2 day baseline, period corresponding to burn
Average 2 day baseline, period corresponding to postburn
Test day, preburn period for animals surviving postburn
Test day, burn period for animals surviving postburn
Test day, postburn period for animals surviving postburn
Test day, preburn period for animals not surviving postburn
Test day, burn period for animals not surviving postburn
Test day, postburn period for animals not surviving postburn

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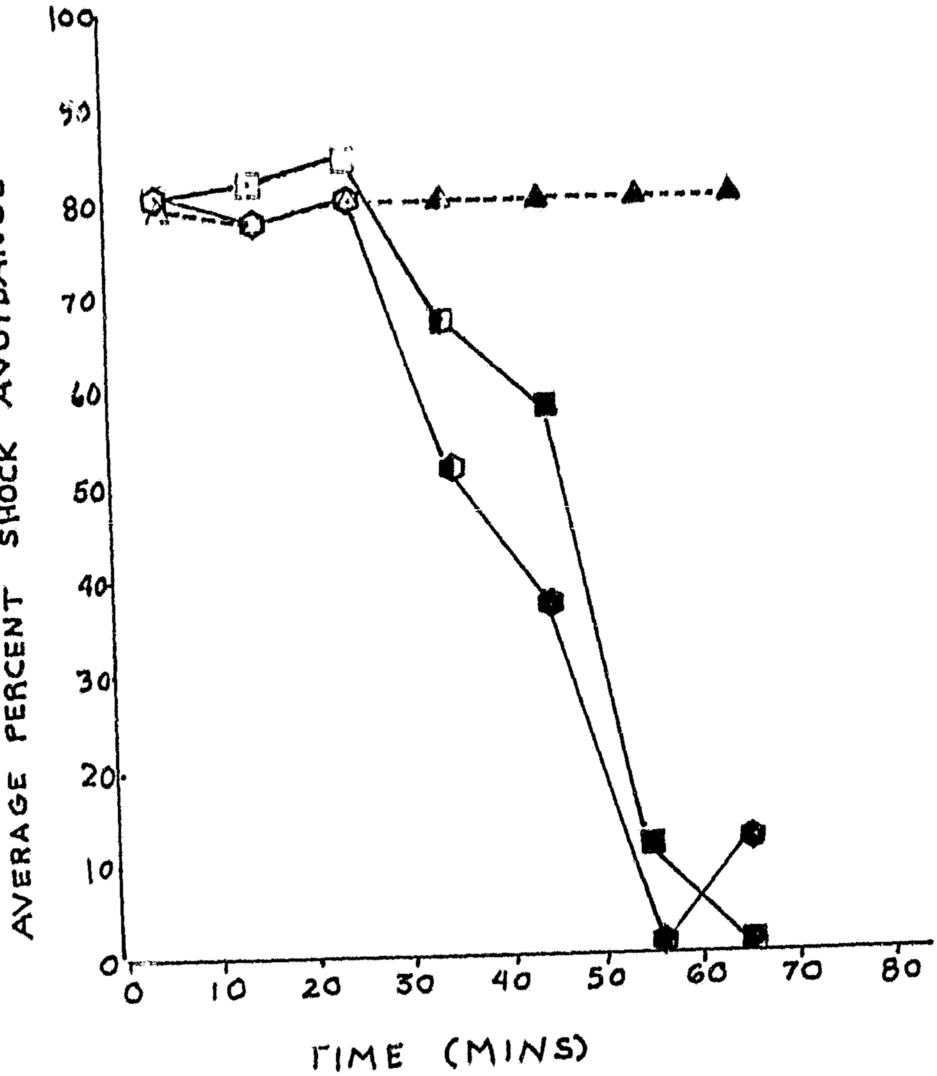
Figure 51
Sample Y-7684
(20 gm)
Group 9



△--△ Average 2 day baseline, period corresponding to preburn
◭--◭ Average 2 day baseline, period corresponding to burn
▲--▲ Average 2 day baseline, period corresponding to postburn
⬡—⬡ Test day, preburn period for animals surviving postburn
◐—◐ Test day, burn period for animals surviving postburn
⬢—⬢ Test day, postburn period for animals surviving postburn
□—□ Test day, preburn period for animals not surviving postburn
◧—◧ Test day, burn period for animals not surviving postburn
■—■ Test day, postburn period for animals not surviving postburn