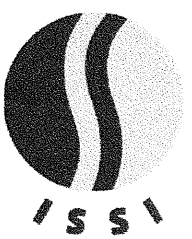
BIOAVAILABILITY OF LEAD IN PAINT

June 1998

PHASE II SWINE BIOAVAILABILITY INVESTIGATIONS



BIOAVAILABILITY OF LEAD IN PAINT

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Ross P. Cowart, DVM, MS, DACVIM, University of Missouri, Columbia, provided expert evaluation of the health of the animals on study

James R. Turk, DVM, PhD, DACVP, University of Missouri, Columbia, performed necropsy and pathological examination of all animals

John T. Payne, DVM, MS, DACVS, University of Missouri, Columbia, performed the surgery to implant intravenous catheters and vascular access ports

Steven L. Stockham, DVM, MS, DACVP, University of Missouri, Columbia, assessed clinical pathology data.

EXECUTIVE SUMMARY

A study using young swine as test animals was performed to measure the gastrointestinal absorption of lead from a sample of powdered leaded paint obtained from the National Institute for Standardization and Testing (NIST). Young swine were selected for use in the study primarily because the gastrointestinal physiology and overall size of young swine are similar to that of young children, who are the population of prime concern for exposure to lead.

The paint material was prepared by NIST by grinding and sieving paint chips obtained from interior leaded paint of houses. This material was mixed with a low-lead soil (< 50 ppm) to simulate a paint-contaminated soil sample from a residential property. The concentration of lead in the soil/paint mixture was 8,350 mg/kg. Groups of 5 swine were given repeated oral doses of the paint/soil test material (75, 225 or 675 ug Pb/kg-day) or lead acetate (25, 75, or 225 ug Pb/kg-day) for 15 days. Another group of animals served as the control. The amount of lead absorbed by each animal was evaluated by measuring the amount of lead in the blood (measured on days -4, 0, 1, 2, 3, 5, 7, 9, 12, and 15), and the amount of lead in liver, kidney and bone (measured on day 15 at study termination). The amount of lead present in blood or tissues of animals exposed to the paint test material was compared to that for animals exposed to lead acetate, and the results were expressed as relative bioavailability (RBA). For example, a relative bioavailability of 50% means that 50% of the lead in test material was absorbed equally as well as lead from lead acetate, and 50% behaved as if it were not available for absorption. Thus, if lead acetate were 40% absorbed, the test material would be 20% absorbed.

The RBA results for the NIST paint sample are summarized below:

Measurement Endpoint	Estimated RBA for NIST Paint
Blood Lead AUC	0.82
Liver Lead	0.85
Kidney Lead	0.70
Bone Lead	0.63

Because the estimates of RBA based on blood, liver, kidney, and bone do not agree in all cases, judgment must be used in interpreting the data. In general, we recommend greatest emphasis be placed on the RBA estimates derived from the blood lead data. This is because blood lead data are more robust and less susceptible to random errors than the tissue lead data, so there is greater confidence in RBA estimates based on blood lead. In addition, absorption into the central compartment is an early indicator of lead exposure, is the most relevant index of central nervous system exposure, and is the standard measurement endpoint in investigations of this sort. However, data from the tissue endpoints (liver, kidney, bone)

also provide valuable information. We consider the plausible range to extend from the RBA based on blood AUC to the mean of the other three tissues (liver, kidney, bone). The preferred range is the interval from the RBA based on blood to the mean of the blood RBA and the tissue mean RBA. Our suggested point estimate is the mid-point of the preferred range. These values are presented below:

RBA Estimate	Value
Plausible Range	0.73 - 0.82
Preferred Range	0.77 - 0.82
Suggested Point Estimate	0.80

If a soil-paint mixture were ingested by a child, the RBA estimates above could be used to estimate the absolute bioavailability (ABA) of lead in the material, as follows:

$$ABA_{paint} = ABA_{soluble} \cdot RBA_{paint}$$

Available data indicate that fully soluble forms of lead are about 50% absorbed by a child. Thus, the estimated absolute bioavailability of lead in the paint/soil mixture is as follows:

Absolute Bioavailability of Lead in NIST Paint	Value
Plausible Range	36%-41%
Preferred Range	39%-41%
Suggested Point Estimate	40%

These absolute bioavailability estimates could be used in EPA's IEUBK model to assess the risks to a child from ingestion of a soil/paint mixture similar to the one tested here. However, it is clear that there is both natural variability and uncertainty associated with these estimates. This variability and uncertainty arises from several sources, including : 1) the inherent variability in the responses of different individual animals to lead exposure, 2) uncertainty in the relative accuracy and applicability of the different measurement endpoints, 3) the extrapolation of measured RBA values in swine to young children, 4) the potential effect of food in the stomach on lead absorption, and 5) uncertainty as to how representative the test sample is for authentic paint-contaminated soil samples. Thus, the values reported above are judged to be reasonable estimates of typical lead absorption by children from finely ground paint chips in soil, but should be interpreted with the understanding that the values are not certain.

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1.0 INTRODUCTION

Absolute and Relative Bioavailability

Bioavailability is a concept that relates to the absorption of chemicals and how absorption depends upon the physical-chemical properties of the chemical and its medium (e.g., dust, soil, rock, food, water, etc.) and the physiology of the exposed receptor. Bioavailability is normally described as the fraction (or percentage) of a chemical which enters into the blood following an exposure of some specified amount, duration and route (usually oral). In some cases, bioavailability may be measured using chemical levels in peripheral tissues such as liver, kidney, and bone, rather than blood. The fraction or percentage absorbed may be expressed either in absolute terms (absolute bioavailability, ABA) or in relative terms (relative bioavailability, RBA). **Absolute bioavailability** is measured by comparing the amount of chemical entering the blood (or other tissue) following oral exposure to test material with the amount entering the blood (or other tissue) following intravenous exposure to an equal amount of some dissolved form of the chemical. Similarly, **relative bioavailability** is measured by comparing oral absorption of test material to oral absorption of some fully soluble form of the chemical (e.g., either the chemical dissolved in water, or a solid form that is expected to fully dissolve in the stomach). For example, if 100 ug of dissolved lead were administered in drinking water and a total of 50 ug entered the blood, the ABA would be 0.50 (50%). Likewise, if 100 ug of lead in soil were administered and 30 ug entered the blood, the ABA for soil would be 0.30 (30%). If the lead dissolved in water were used as the reference substance for describing the relative amount of lead absorbed from soil, the RBA would be 0.30/0.50 = 0.60 (60%). These values (50% absolute bioavailability of dissolved lead and 30% absolute absorption of lead in soil) are the values currently employed as defaults in EPA's IEUBK model.

It is important to recognize that simple solubility of a test material in water or some other fluid (e.g., a weak acid intended to mimic the gastric contents of a child) may not be a reliable estimator of bioavailability due to the non-equilibrium nature of the dissolution and transport processes that occur in the gastrointestinal tract (Mushak 1991). For example, transport of lead across the gut may continuously shift the equilibrium of a poorly soluble lead compound in the direction of dissolution. However, information on the solubility of lead in different materials is useful in interpreting the importance of solubility as a determinant of bioavailability. To avoid confusion, the term "bioaccessability" is used to refer to the relative amount of lead that dissolves under a specified set of test conditions.

For additional discussion about the concept and application of bioavailability see Goodman et al. (1990), Klaassen et al. (1996), and/or Gibaldi and Perrier (1982).

Using Bioavailability Data to Improve Exposure Calculations for Lead

Data on bioavailability are important for evaluating exposure and potential health effects for a variety of different types of chemicals. Overall, the current project has focused mainly on evaluating the bioavailability of lead in various samples of soil or other solid materials from mining, milling or smelting sites. This is because lead may exist, at least in part, as poorly water soluble minerals (e.g., galena), and may also exist inside particles of inert matrix such as rock or slag of variable size, shape and association. In addition, lead may enter soil by chipping or peeling of leaded paint. The chemical and physical properties of lead in different types of mineral forms or in paint may be important determinants of the solubility (bioaccessability) and the absorption (bioavailability) of lead when ingested.

When data are available on the bioavailability of lead in soil, dust, or other soil-like waste material at a site, this information can often be used to improve the accuracy of exposure and risk calculations at that site. The basic equation for estimating the site-specific ABA of a test material is as follows:

$$ABA_{paint} = ABA_{soluble} \cdot RBA_{paint}$$

where:

ABA_{paint} = Absolute bioavailability of lead in paint ingested by a child
$ABA_{soluble}$ = Absolute bioavailability in children of some dissolved or fully soluble form of lead
RBA_{paint} = RBA for paint measured in swine

Based on available information on lead absorption in humans and animals, the EPA estimates that the absolute bioavailability of lead from water and other fully soluble forms of lead is usually about 50% in children. Thus, when a reliable site-specific RBA value for soil is available, it may be used to estimate a site-specific absolute bioavailability as follows:

$$ABA_{paint} = 50\% \cdot RBA_{paint}$$

In the absence of site-specific data, the absolute absorption of lead from soil, dust and other similar media is estimated by EPA to be about 30%. Thus, the default RBA used by EPA for lead in soil and dust compared to lead in water is 30%/50% = 60%. When the measured RBA in soil or dust at a site is found to be less than 60% compared to some fully soluble form of lead, it may be concluded that exposures to and risks from lead in these media at that site are probably lower than typical default assumptions. If the measured RBA is higher than 60%, absorption of and risk from lead in these media may be higher than usually assumed.

This study focused on a sample of test material prepared by mixing paint chips with soil which was otherwise very low in lead (< 50 ppm). The purpose of the investigation was to derive data that would allow calculation of the RBA for paint flakes in soil.

2.0 STUDY DESIGN

A standardized study protocol for measuring absolute and relative bioavailability of lead was developed based upon previous study designs and investigations that characterized the young pig model (Weis et al. 1995). The study was performed as nearly as possible within the spirit and guidelines of Good Laboratory Practices (GLP: 40 CFR 792). Standard Operating Procedures (SOPs) that included detailed methods for all aspects of the study were prepared, approved, and distributed to all study members prior to the study. The generalized study design, quality assurance project plan and all standard operating procedures are documented in a project notebook that is available through the administrative record.

2.1 Test Material

The paint material used in this study was NIST Standard Reference Material 2589. This material is composed of paint collected from the interior surfaces of houses in the US. The nominal lead concentration is 10% (100,000 ppm). The material is powdered with more than 99% of the material being less than 100 um in size. To prepare the test material, approximately 35 grams of the NIST Paint standard were mixed with approximately 565 grams of a low lead soil (< 50 ppm) that was collected in Leadville, Colorado. The resulting final concentration of lead in the soil/paint mixture measured by CLP analysis was 8,350 ppm. Table 2-1 shows the full CLP analysis of the soil/paint mixture.

The soil/paint mixture was also analyzed by electron microprobe in order to characterize the chemical nature of the lead in the paint particles. The results are summarized below:

Lead Form	Particle Frequency	Relative Lead Mass
$PbSO_4$	0.9%	0.6%
$PbCO_3$	67.8%	55.3%
PbO	31.3%	44.1%

As seen, the test material is composed primarily of a mixture of lead oxide and lead carbonate in nearly equal mass ratios.

2.2 Experimental Animals

Young swine were selected for use in these studies because they are considered to be a good physiological model for gastrointestinal absorption in children (Weis and LaVelle 1991). The animals were intact males of the Pig Improvement Corporation (PIC) genetically defined Line 26, and were purchased from Chinn Farms, Clarence, MO. The animals were held under quarantine to observe their health for one week before beginning exposure to the test material. To minimize weight variations between animals and groups, the number of animals purchased

TABLE 2-1 METAL ANALYSIS OF PAINT/SOIL MIXTURE

Chemical	Concentration (ppm)
Aluminum	5,850
Antimony	8.7
Arsenic	4.8
Barium	1,320
Beryllium	0.5
Cadmium	4.0
Calcium	11,800
Chromium	20.8
Cobalt	8.3
Copper	12.2
Iron	8,890
Lead	**8,350**
Magnesium	2,900
Manganese	272
Mercury	0.92
Nickel	5.8
Potassium	1,360
Selenium	0.61
Silver	0.63
Sodium	81.9
Thallium	0.87
Vanadium	11.6
Zinc	1,880

from the supplier was six more than needed for the study, and the six animals most different in body weight on day -4 (either heavier or lighter) were excluded from further study. The remaining animals were assigned to dose groups at random. When exposure began, the animals were about 5-6 weeks old (juveniles, weaned at 3 weeks) and weighed an average of about 10.9 kg. Animals were weighed every three days during the course of the study. The group mean body weights over the course of the study are shown in Figure 2-1. As seen, on average, animals gained about 0.35 kg/day, and the rate of weight gain was comparable in all groups.

All animals were housed in individual lead-free stainless steel cages. Each animal was examined by a certified veterinary clinician (swine specialist) prior to being placed on study, and all animals were examined daily by an attending veterinarian while on study. Any animal that displayed significant signs of illness was given appropriate treatment, and was removed from study if the illness could not be promptly controlled. (This only occurred rarely, and usually only in animals with surgically-implanted venous catheters). Blood samples were collected for hematological analysis on days -4, 7, and 15 to assist in clinical health assessments. In this study, there was one animal (in Group 8, exposed to 75 ug/kg-day of paint/soil test material) that was judged by the principle investigator and the veterinary clinician to be seriously ill, and this animal was removed from the study.

2.3 Diet

Animals provided by the supplier were weaned onto standard pig chow purchased from MFA Inc., Columbia, MO. In order to minimize lead exposure from the diet, the animals were gradually transitioned from the MFA feed to a special low-lead feed (guaranteed less than 0.2 ppm lead, purchased from Zeigler Brothers, Inc., Gardners, PA) over the time interval from day -7 to day -3, and this feed was then maintained for the duration of the study. The feed was nutritionally complete and met all requirements of the National Institutes of Health-National Research Council. The typical nutritional components and chemical analysis of the feed are presented in Table 2-2. Typically, the feed contained approximately 5.7% moisture, 1.7% fiber, and provided about 3.4 kcal of metabolizable energy per gram. Periodic analysis of feed samples during this program indicated the mean lead level (treating non-detects at one-half the quantitation limit of 0.05 ppm) was less than 0.05 ppm.

Each day every animal was given an amount of feed equal to 5% of the mean body weight of all animals on study. Feed was administered in two equal portions of 2.5% of the mean body weight at each feeding. Feed was provided at 11:00 AM and 5:00 PM daily. Drinking water was provided ad libitum via self-activated watering nozzles within each cage. Periodic analysis of samples from randomly selected drinking water nozzles indicated the mean lead concentration (treating non-detects at one-half the quantitation limit) was less than 2 ug/L.

2.4 Dosing

The protocol for exposing animals to lead is shown in Table 2-3. Animals were exposed to lead for 15 days, with the dose for each day being administered in two equal portions given at 9:00

FIGURE 2-1 BODY WEIGHTS OF TEST ANIMALS
PHASE II EXPERIMENT 11

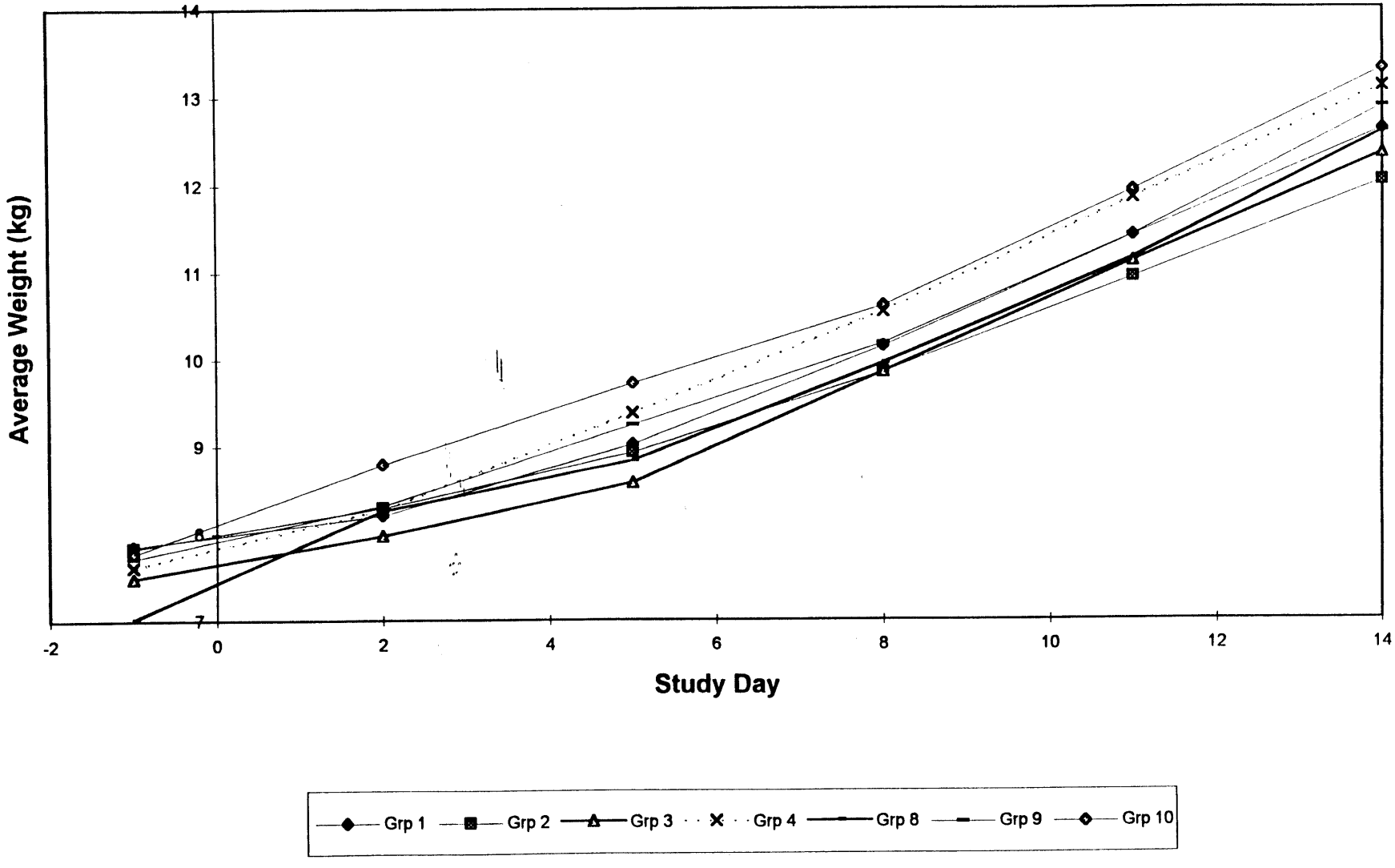


TABLE 2-2 TYPICAL FEED COMPOSITION[a]

Nutrient Name	Amount	Nutrient Name	Amount
Protein	20.1021%	Chlorine	0.1911%
Arginine	1.2070%	Magnesium	0.0533%
Lysine	1.4690%	Sulfur	0.0339%
Methionine	0.8370%	Manganese	20.4719 ppm
Met+Cys	0.5876%	Zinc	118.0608 ppm
Tryptophan	0.2770%	Iron	135.3710 ppm
Histidine	0.5580%	Copper	8.1062 ppm
Leucine	1.8160%	Cobalt	0.0110 ppm
Isoleucine	1.1310%	Iodine	0.2075 ppm
Phenylalanine	1.1050%	Selenium	0.3196 ppm
Phe+Tyr	2.0500%	Nitrogen Free Extract	60.2340%
Threonine	0.8200%	Vitamin A	5.1892 kIU/kg
Valine	1.1910%	Vitamin D3	0.6486 kIU/kg
Fat	4.4440%	Vitamin E	87.2080 IU/kg
Saturated Fat	0.5590%	Vitamin K	0.9089 ppm
Unsaturated Fat	3.7410%	Thiamine	9.1681 ppm
Linoleic 18:2:6	1.9350%	Riboflavin	10.2290 ppm
Linoleic 18:3:3	0.0430%	Niacin	30.1147 ppm
Crude Fiber	3.8035%	Pantothenic Acid	19.1250 ppm
Ash	4.3347%	Choline	1019.8600 ppm
Calcium	0.8675%	Pyridoxine	8.2302 ppm
Phos Total	0.7736%	Folacin	2.0476 ppm
Available Phosphorous	0.7005%	Biotin	0.2038 ppm
Sodium	0.2448%	Vitamin B12	23.4416 ppm
Potassium	0.3733%		

[a] Nutritional values provided by Zeigler Bros., Inc.

TABLE 2-3 DOSING PROTOCOL

Group[a]	Number of Animals	Dose Material Administered	Exposure Route	Lead Dose (ug Pb/kg-d)	
				Target	Actual[b]
1	5	None	Oral	0	0
2	5	Lead acetate	Oral	25	27.8
3	5	Lead acetate	Oral	75	78.0
4	5	Lead Acetate	Oral	225	229
8	5	Paint/Soil	Oral	75	76.5
9	5	Paint/Soil	Oral	225	234
10	8	Paint/Soil	Oral	675	695

Doses were administered in two equal portions given at 9:00 AM and 3:00 PM each day. Doses were based on the mean weight of the animals in each group, and were adjusted every three days to account for weight gain.

[a] Groups 5-7 not shown; data are for a different test material

[b] Calculated as the administered daily dose divided by the measured or extrapolated daily body weight, averaged over days 0-14 for each animal and each group.

AM and 3:00 PM (two hours before feeding). Doses were based on measured group mean body weights, and were adjusted every three days to account for animal growth. For animals exposed by the oral route, dose material was placed in the center of a small portion (about 5 grams) of moistened feed, and this was administered to the animals by hand. Most animals consumed the dose promptly, but occasionally some animals delayed ingestion of the dose for up to two hours (the time the daily feed portion was provided). These delays are noted in the data provided in Appendix A, but are not considered to be a significant source of error. Occasionally, some animals did not consume some or all of the dose (usually because the dose dropped from their mouth while chewing). All missed doses were recorded and the time-weighted average dose calculation for each animal was adjusted downward accordingly.

Actual mean doses, calculated from the administered doses and the measured body weights, are also shown in Table 2-3.

2.5 Collection of Biological Samples

Blood

Samples of blood were collected from each animal four days before exposure began (day -4), on the first day of exposure (day 0), and on days 1, 2, 3, 5, 7, 9, 12, and 15 following the start of exposure. All blood samples were collected by vena-puncture of the anterior vena cava, and samples were immediately placed in purple-top Vacutainer® tubes containing EDTA as anticoagulant. Blood samples were collected each sampling day beginning at 8:00 AM, approximately one hour before the first of the two daily exposures to lead on the sampling day and 17 hours after the last lead exposure the previous day. This blood collection time was selected because the rate of change in blood lead resulting from the preceding exposures is expected to be relatively small after this interval (LaVelle et al. 1991, Weis et al. 1993), so the exact timing of sample collection relative to last dosing is not likely to be critical.

Following collection of the final blood sample at 8:00 AM on day 15, all animals were humanely euthanized and samples of liver, kidney, and bone (the right femur) were removed and stored in lead-free plastic bags for lead analysis. Samples of all biological samples collected were archived in order to allow for later reanalysis and verification, if needed. All animals were also subjected to detailed examination at necropsy by a certified veterinary pathologist in order to assess overall animal health.

2.6 Preparation of Biological Samples for Analysis

Blood

One mL of whole blood was removed from the purple-top Vacutainer and added to 9.0 mL of "matrix modifier", a solution recommended by the Centers for Disease Control and Prevention (CDCP) for analysis of blood samples for lead. The composition of matrix modifier is 0.2% (v/v) ultrapure nitric acid, 0.5% (v/v) Triton X-100, and 0.2% (w/v) dibasic ammonium

phosphate in deionized and ultrafiltered water. Samples of the matrix modifier were routinely analyzed for lead to ensure the absence of lead contamination.

Liver and Kidney

One gram of soft tissue (liver or kidney) was placed in a lead-free screw-cap teflon container with 2 mL of concentrated (70%) nitric acid and heated in an oven to 90°C overnight. After cooling, the digestate was transferred to a clean lead-free 10 mL volumetric flask and diluted to volume with deionized and ultrafiltered water.

Bone

The right femur of each animal was removed and defleshed, and dried at 100°C overnight. The dried bones were then placed in a muffle furnace and dry-ashed at 450°C for 48 hours. Following dry ashing, the bone was ground to a fine powder using a lead-free mortar and pestle, and 200 mg was removed and dissolved in 10.0 mL of 1:1 (v:v) concentrated nitric acid:water. After the powdered bone was dissolved and mixed, 1.0 mL of the acid solution was removed and diluted to 10.0 mL by addition of 0.1% (m/v) lanthanum oxide (La_2O_3) in deionized and ultrafiltered water.

2.7 Lead Analysis

Samples of biological tissue (blood, liver, kidney, bone) and other materials (food, water, reagents and solutions, etc.) were arranged in a random sequence and provided to EPA's analytical laboratory in a blind fashion (identified to the laboratory only by a chain of custody tag number). Each sample was analyzed for lead using a Perkin Elmer Model 5100 graphite furnace atomic absorption spectrophotometer. Internal quality assurance samples were run every tenth sample, and the instrument was recalibrated every 15th sample. A blank, duplicate and spiked sample were run every 20th sample.

All results from the analytical laboratory were reported in units of ug Pb/L of prepared sample. The quantitation limit was defined as three-times the standard deviation of a set of seven replicates of a low-lead sample (typically about 2-5 ug/L). The standard deviation was usually about 0.3 ug/L, so the quantitation limit was usually about 0.9-1.0 ug/L (ppb). For prepared blood samples (diluted 1/10), this corresponds to a quantitation limit of 10 ug/L (1 ug/dL). For soft tissues (liver and kidney, diluted 1/10), this corresponds to a quantitation limit of 10 ug/kg (ppb) wet weight, and for bone (final dilution = 1/500) the corresponding quantitation limit is 0.5 ug/g (ppm) ashed weight.

3.0 DATA ANALYSIS

3.1 Overview

Studies on the absorption of lead are often complicated because some biological responses to lead exposure may be non-linear functions of dose (i.e., tending to flatten out or plateau as dose increases). The cause of this non-linearity is uncertain but might be due either to non-linear **absorption kinetics** and/or to non-linear **biological response** per unit dose absorbed. When the dose-response curve for either the reference material (lead acetate) and/or the test material is non-linear, RBA is equal to the ratio of doses that produce equal responses (not the ratio of responses at equal doses). This is based on the simple but biologically plausible assumption that equal absorbed doses yield equal biological responses. Applying this assumption leads to the following general methods for calculating RBA from a set of non-linear experimental data:

1. Plot the biological responses for individual animals exposed to a series of oral doses of soluble lead (e.g., lead acetate). Find an equation which gives a smooth best fit line through the observed data.

2. Plot the biological response for individual animals exposed to a series of doses of test material. Find an equation which gives a smooth fit line through the observed data.

3. Using the best fit equations for reference material and test material, calculate RBA as the ratios of doses of test material and reference material which yield equal biological responses. Depending on the relative shape of the best-fit lines through the lead acetate and test material dose response curves, RBA may either be constant (dose-independent) or variable (dose-dependent).

The principal advantage of this approach is that it is not necessary to understand the basis for a non-linear dose response curve (non-linear absorption and/or non-linear biological response) in order to derive valid RBA estimates. Also, it is important to realize that this method is very general, as it will yield correct results even if one or both of the dose-response curves are linear. In the case where both curves are linear, RBA is dose-independent and is simply equal to the ratio of the slopes of the best-fit linear equations.

3.2 Fitting the Curves

There are a number of different mathematical equations which can yield reasonable fits with the dose-response data sets obtained in this study. In selecting which equations to employ, the following principles were applied: 1) mathematically simple equations were preferred over mathematically complex equations, 2) the shape of the curves had to be smooth and biologically realistic, without inflection points, maxima or minima, and 3) the general form of the equations had to be able to fit data not only from this one study, but from all the studies that are part of

this project. After testing a wide variety of different equations, it was found that all data sets could be well fitted using one of the following three forms:

Linear (LIN): $\text{Response} = a + b \cdot \text{Dose}$

Exponential (EXP): $\text{Response} = a + c \cdot (1-\exp(-d \cdot \text{Dose}))$

Combination (LIN+EXP): $\text{Response} = a + b \cdot \text{Dose} + c \cdot (1-\exp(-d \cdot \text{Dose}))$

Although underlying mechanism was not considered in selecting these equations, the linear equation allows fitting data that do not show evidence of saturation in either uptake or response, while the exponential and mixed equations allow evaluation of data that appear to reflect some degree of saturation in uptake and/or response.

Each dose-response data set was fit to each of the equations above. If one equation yielded a fit that was clearly superior (as judged by the value of the adjusted correlation coefficient R^2) to the others, that equation was selected. If two or more models fit the data approximately equally well, then the simplest model (that with the fewest parameters) was selected. In the process of finding the best-fits of these equations to the data, the values of the parameters (a, b, c, and d) were subjected to some constraints, and some data points (those that were outside the 95% prediction limits of the fit) were excluded. These constraints and outlier exclusion steps are detailed in Appendix A (Section 3). In general, most blood lead AUC dose-response curves were best fit by the exponential equation, and most dose-response curves for liver, kidney, and bone were best fit by linear equations.

3.3 Responses Below Quantitation Limit

In some cases, most or all of the responses in a group of animals were below the quantitation limit for the endpoint being measured. For example, this was normally the case for blood lead values in unexposed animals (both on day -4 and day 0, and in control animals), and also occurred during the early days in the study for animals given test materials with low bioavailability. In these cases, all animals which yielded responses below the quantitation limit were evaluated as if they had responded at one-half the quantitation limit.

3.4 Quality Assurance

A number of steps were taken throughout this study and the other studies in this project to ensure the quality of the results. These steps are summarized below.

Duplicates

A randomly selected set of about 5% of all samples generated during the study were submitted to the laboratory in a blind fashion for duplicate analysis. The raw data are presented in

Appendix A, and Figure 3-1 plots the results for blood (Panel A, upper) and for bone, liver and kidney (Panel B, lower). As seen, there was good intra-laboratory reproduciblity between duplicate samples for all tissues, with linear regression lines having a slope near 1.0, an intercept near zero, and an R^2 value very near 1.00.

Standards

The Centers for Disease Control and Prevention (CDCP) provide a variety of blood lead "check samples" for use in quality assurance programs for blood lead studies. Each time a group of blood samples was prepared and sent to the laboratory for analysis, several CDCP check samples of different concentrations were included in random order and in a blind fashion.

The results for the samples submitted during this study are presented in Appendix A, and the values are plotted in Figure 3-2 (Panel A, upper). As seen, the analytical results obtained for the check samples were generally good at all three concentrations, with mean results of 2.1 ug/L for the low standards (nominal = 1.7 ug/L), 4.6 ug/L for the middle standard (nominal = 4.8 ug/L), and 14.7 ug/L for the high standards (nominal = 14.9 ug/L).

Interlaboratory Comparison

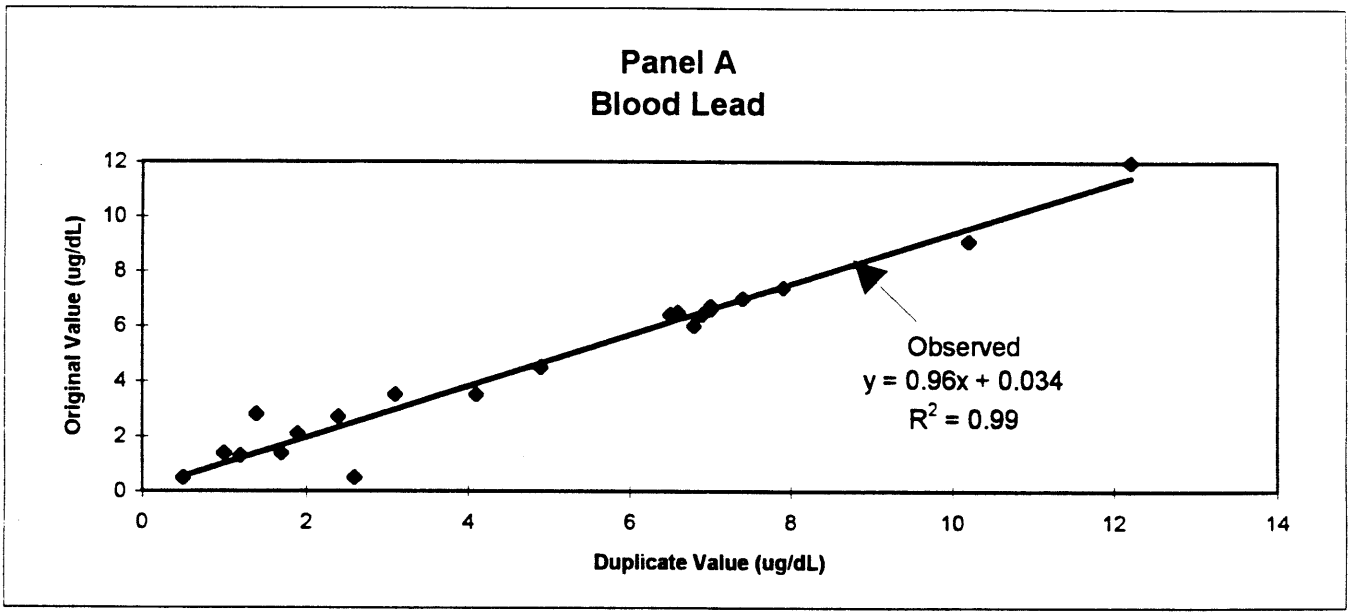
An interlaboratory comparison of blood lead analytical results was performed by sending a set of 21 randomly selected whole blood samples from this study to CDCP for blind independent preparation and analysis. The results are presented in Appendix A, and the values are plotted in Figure 3-2 (Panel B, lower). As seen, the results of analyses by EPA's laboratory are generally similar to those of CDCP, with a mean inter-sample difference of 0.01 ug/L.

Data Audits and Spreadsheet Validation

All analytical data generated by EPA's analytical laboratory were validated prior to being released in the form of a database file. These electronic data files were "decoded" (linking the sample tag to the correct animal and day) using Microsoft's database system ACCESS® (Version 5 for Windows). To ensure that no errors occurred in this process, original downloaded electronic files were printed out and compared to printouts of the tag assignments and the decoded data. All spreadsheets used to manipulate the data and to perform calculations (see Appendix A) were validated by hand-checking random cells for accuracy.

FIGURE 3-1 COMPARISION OF DUPLICATE ANALYSES

Phase II Experiment 11



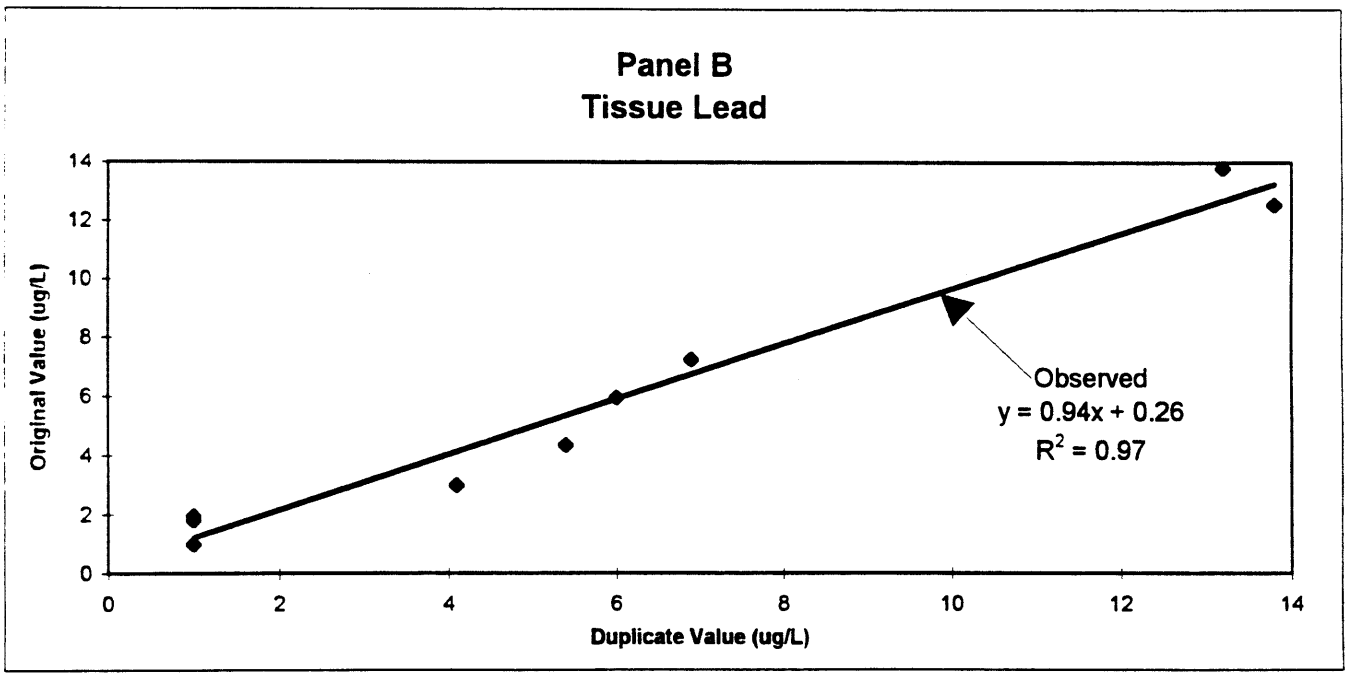
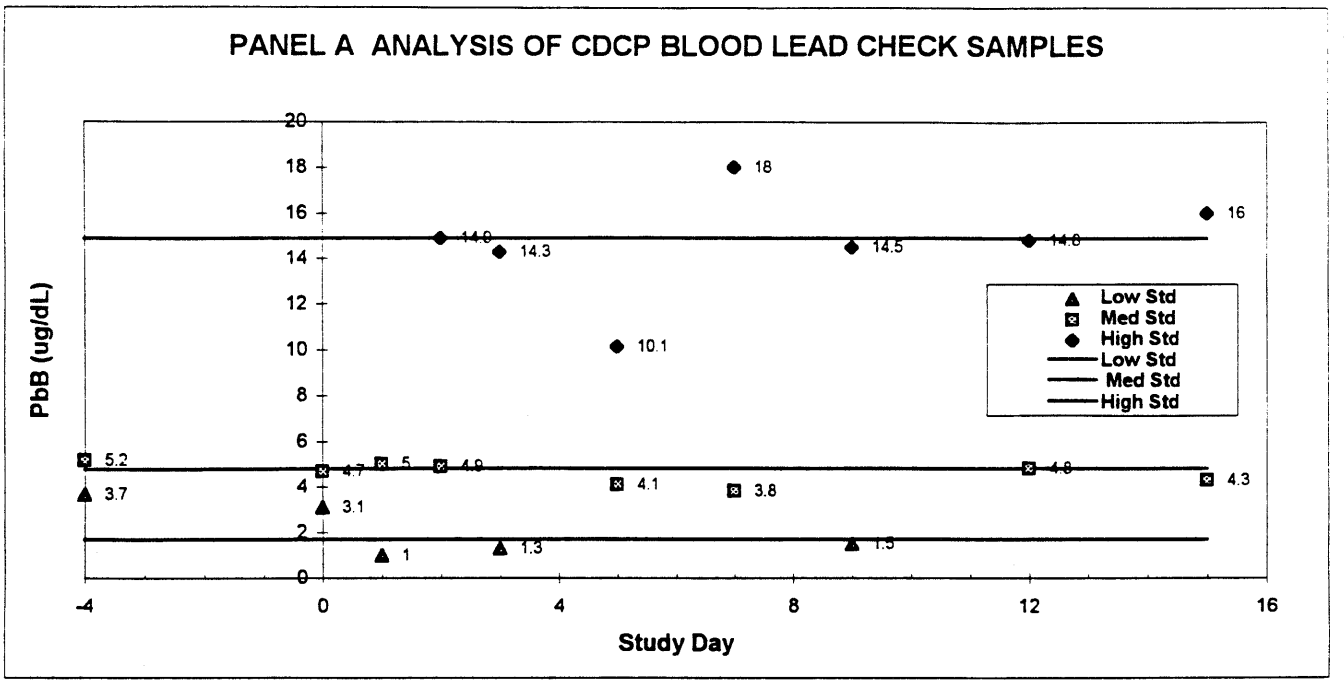
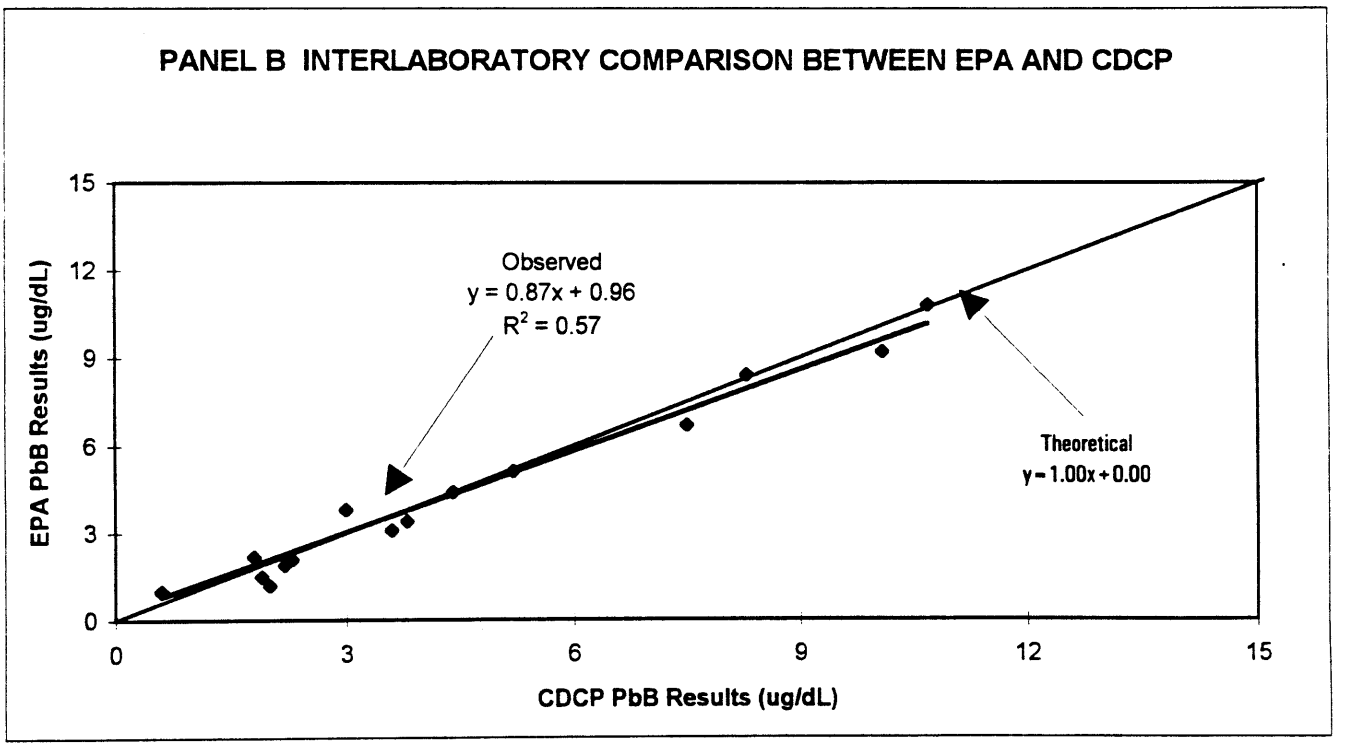


FIGURE 3-2 CDCP CHECK SAMPLES

Phase II Experiment 11





4.0 RESULTS

The following sections provide results based on the group means for each dose group investigated in this study. Appendix A provides detailed data for each individual animal.

4.1 Blood Lead vs Time

Original analyses of blood lead samples from this study suggested that some samples collected early in the study were contaminated with low levels of lead. This conclusion was based mainly on the finding that reported blood levels rose to higher levels than expected on Day 1, with decreased values on Day 2. In other words, a spiked pattern in the data was noted. In order to investigate this finding, all samples from Day 1, and randomly selected samples from Days 0 and 2, were reanalyzed from the archived whole blood samples. As seen in Appendix A, the majority of the reanalyzed values for Day 1 were lower than the original values, with the values for control animals (Group 1) returning to below the detection limit. The reanalyzed samples from Days 0 and 2 remained approximately the same. The source of this apparent lead contamination is not known. For data analysis purposes, the reanalyzed values were used over the original values.

Figure 4-1 shows the group mean blood lead values as a function of time during the study. As seen, blood lead values began below quantitation limits (about 1 ug/dL) in all groups, and remained below quantitation limits in control animals (Group 1). In animals given repeated oral doses of lead acetate (Groups 2, 3 and 4) or the paint/soil test material (Groups 8, 9, and 10), blood levels began to rise within 1-2 days, and tended to plateau by the end of the study (day 15).

4.2 Dose-Response Patterns

Blood Lead

The measurement endpoint used to quantify the blood lead response was the area under the curve (AUC) for blood lead vs time (days 0-15). This AUC was calculated using the trapezoidal rule to estimate the AUC between each time point that a blood lead value was measured (days 0, 1, 2, 3, 5, 7, 9, 12, and 15), and summing the areas across all time intervals in the study. The detailed data and calculations are presented in Appendix A, and the results are shown graphically in Figure 4-2. Each data point reflects the group mean exposure and group mean response, with the variability in dose and response shown by standard error bars. The figure also shows the best-fit equation through each data set.

As seen, the dose response pattern is non-linear for both lead acetate (abbreviated "PbAc") and for the paint/soil test material. The response for the test material is similar to, but slightly lower, than that for lead acetate, indicating that lead is nearly as well absorbed from the paint as from lead acetate.

FIGURE 4-1 GROUP MEAN BLOOD LEAD BY DAY FOR NIST PAINT

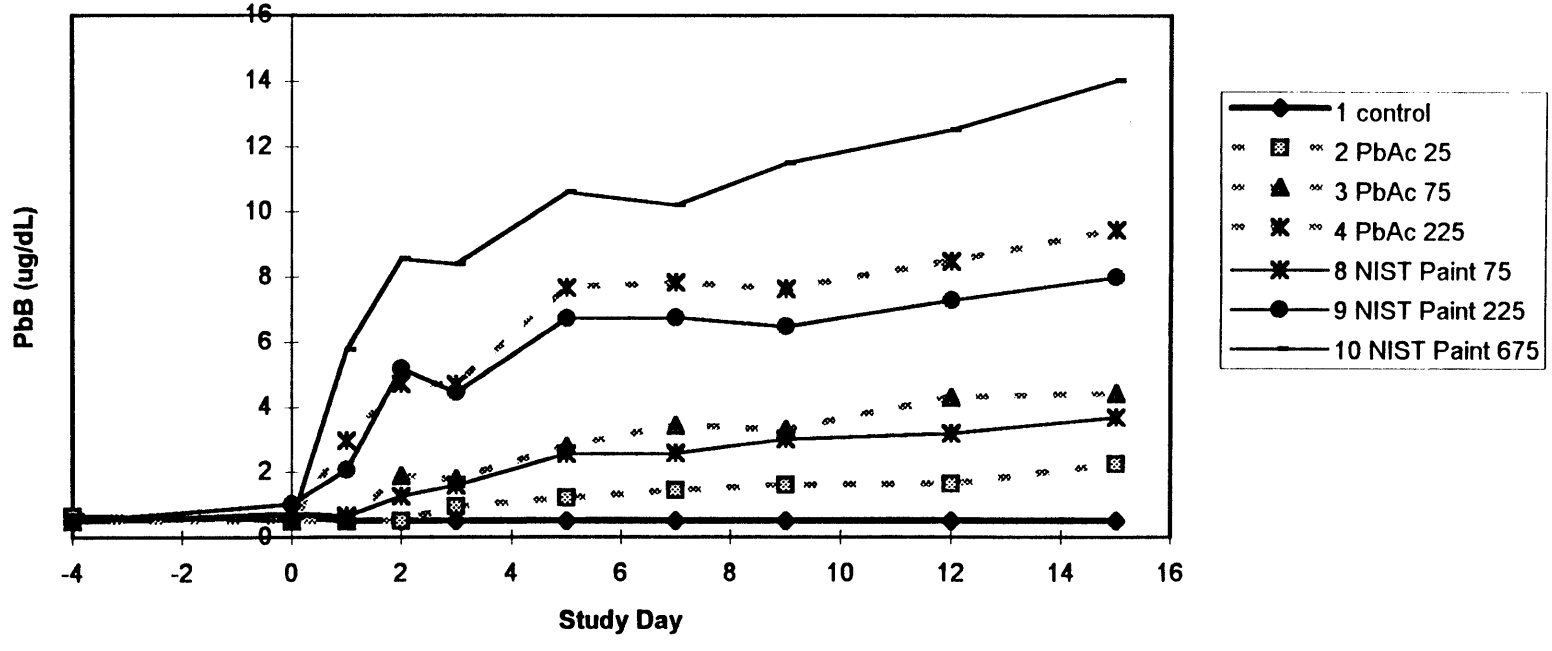
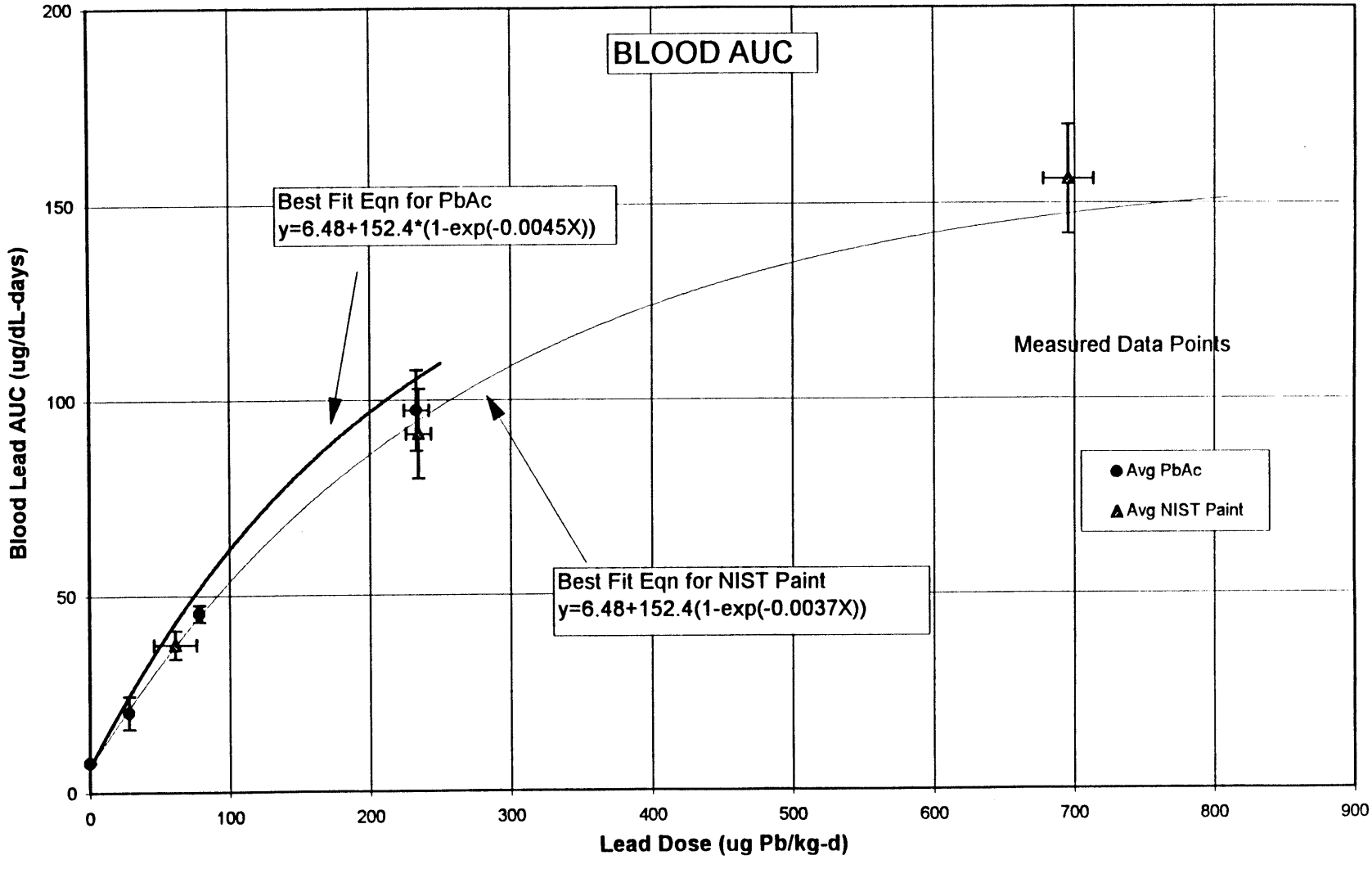


FIGURE 4-2 BLOOD LEAD DOSE-RESPONSE, GROUP MEANS ± SEM FOR NIST PAINT



Tissue Lead

The dose-response data for lead levels in bone, liver and kidney (measured at sacrifice on day 15) are detailed in Appendix A, and are shown graphically in Figures 4-3 through 4-5, respectively. As seen, all of these dose response curves for tissues are fit by linear equations, with the responses (slopes) for the paint/soil test material being somewhat lower than the slope for lead acetate.

4.3 Calculated RBA Values

Relative bioavailability values were calculated for lead in the paint/soil test material for each measurement endpoint (blood, bone, liver, kidney) using the method described in Section 3.0. The results are shown below:

Measurement Endpoint	RBA Estimate
Blood Lead AUC	0.82
Liver Lead	0.85
Kidney Lead	0.70
Bone Lead	0.63

Recommended RBA Values

As shown above, there are four independent estimates of RBA (based on blood, liver, kidney, and bone), and the values do not agree in all cases. In general, we recommend greatest emphasis be placed on the RBA estimates derived from the blood lead data. There are several reasons for this recommendation, including the following:

1) Blood lead calculations are based on multiple measurements over time, and so are statistically more robust than the single measurements available for tissue concentrations. Further, blood is a homogeneous medium, and is easier to sample than complex tissues such as liver, kidney and bone. Consequently, the AUC endpoint is less susceptible to random measurement errors, and RBA values calculated from AUC data are less uncertain.

2. Blood is the central compartment and one of the first compartments to be affected by absorbed lead. In contrast, uptake of lead into peripheral compartments (liver, kidney, bone) depend on transfer from blood to the tissue, and may be subject to a variety of toxicokinetic factors that could make bioavailability determinations more complicated.

FIGURE 4-3 BONE LEAD DOSE-RESPONSE, GROUP MEANS ± SEM FOR NIST PAINT

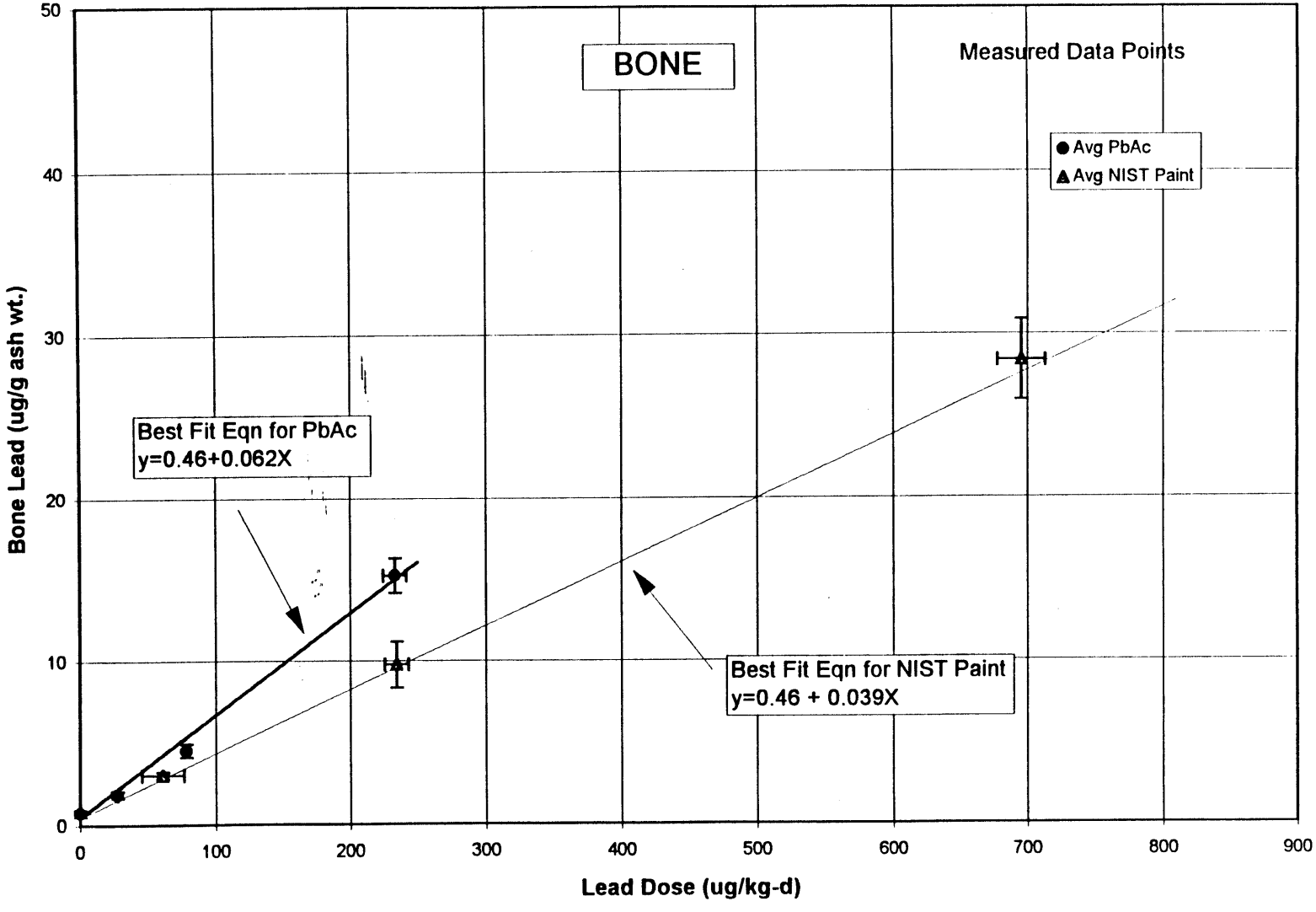


FIGURE 4-4 LIVER LEAD DOSE-RESPONSE, GROUP MEANS ± SEM FOR NIST PAINT

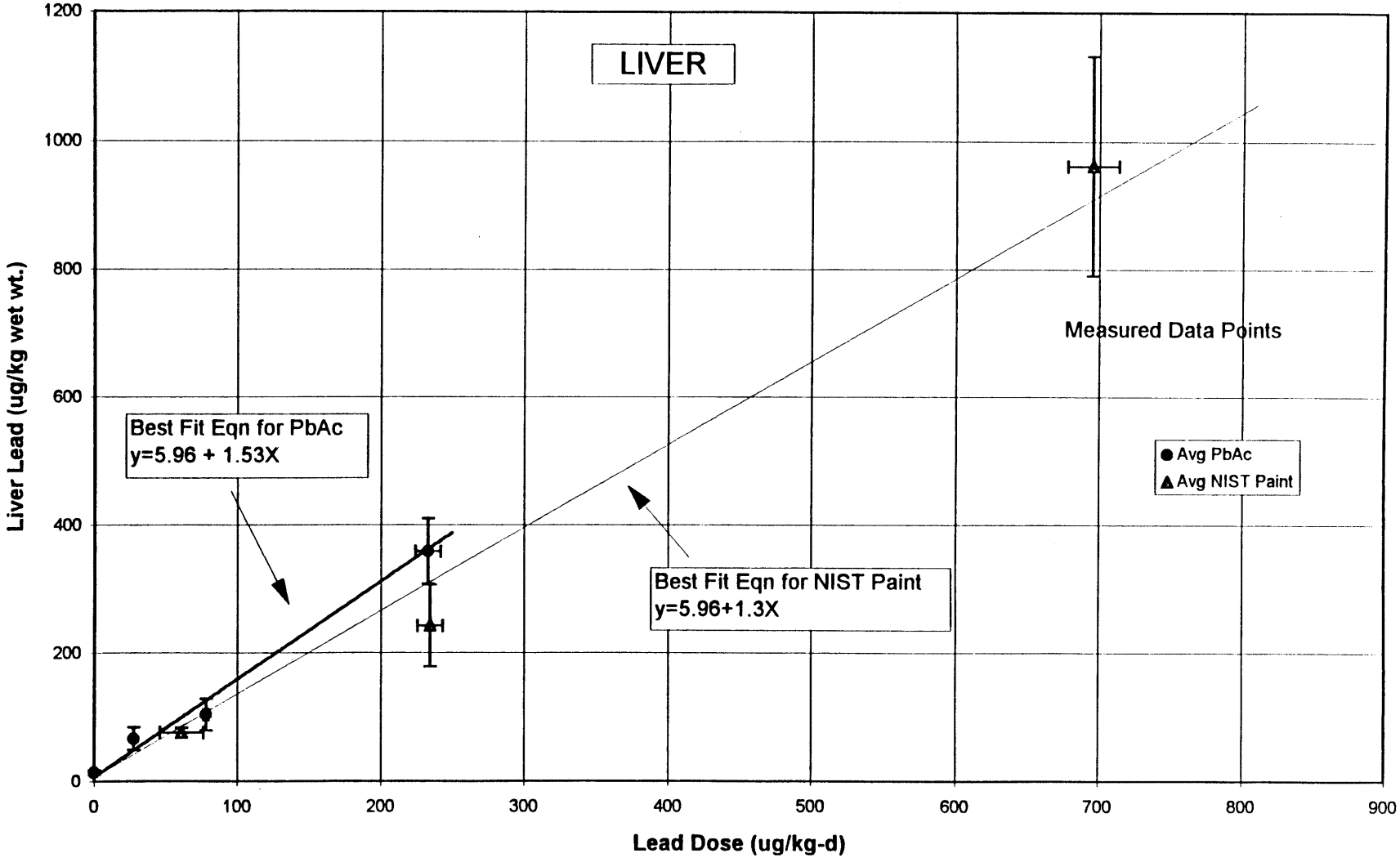
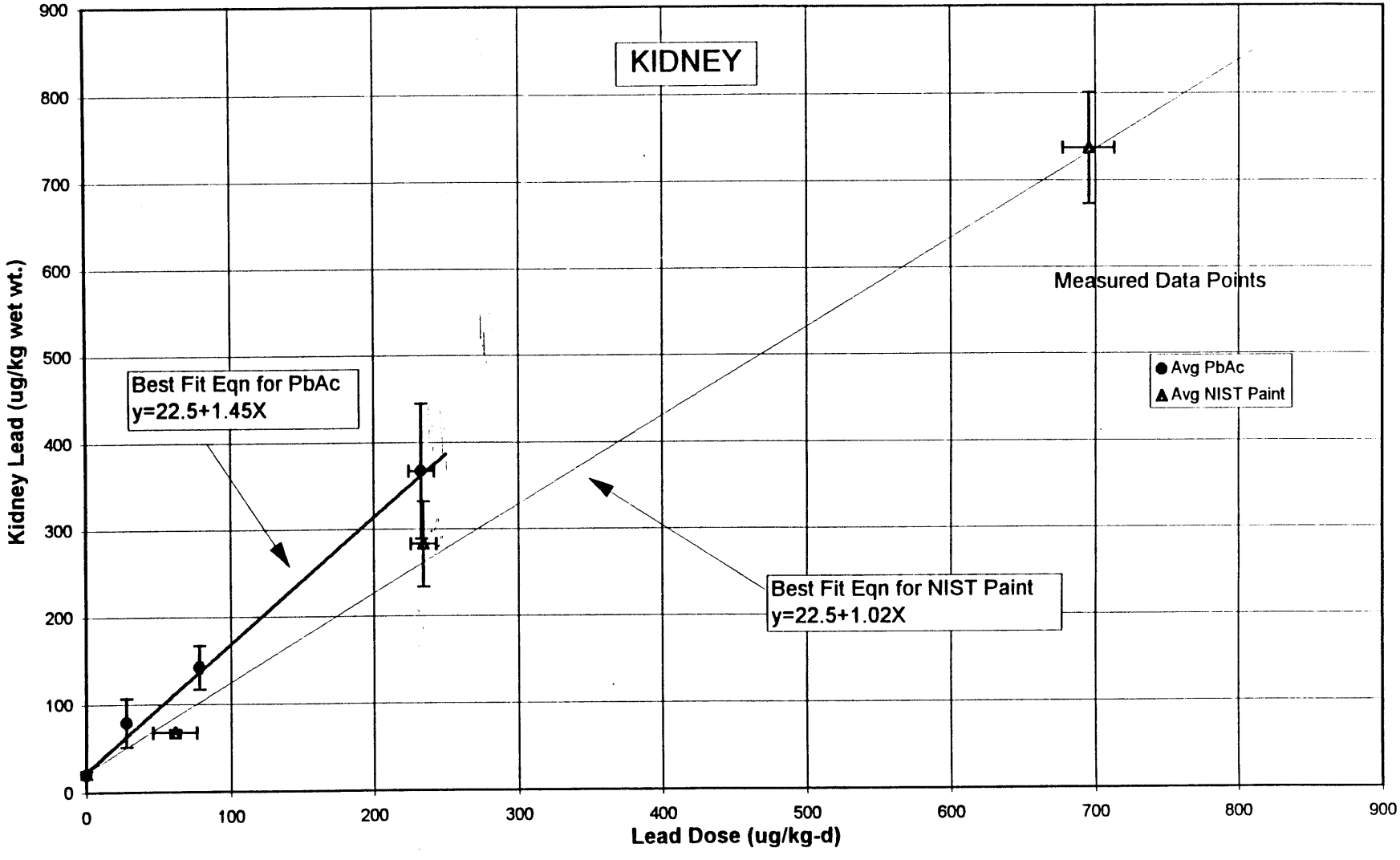


FIGURE 4-5 KIDNEY LEAD DOSE-RESPONSE, GROUP MEANS ± SEM FOR NIST PAINT



3. The dose-response curve for blood lead is non-linear, similar to the non-linear dose-response curve observed in children (e.g., see Sherlock and Quinn 1986). Thus, the response of this endpoint is known to behave similarly in swine as in children, and it is not known if the same is true for the tissue endpoints.

4. Blood lead is the classical measurement endpoint for evaluating exposure and health effects in humans, and the health effects of lead are believed to be proportional to blood lead levels.

However, data from the tissue endpoints (liver, kidney, bone) also provide valuable information. We consider the plausible range to extend from the RBA based on blood AUC to the mean of the other three tissues (liver, kidney, bone). The preferred range is the interval from the RBA based on blood to the mean of the blood RBA and the tissue mean RBA. Our suggested point estimate is the mid-point of the preferred range. These values are presented below:

RBA Estimate	Value
Plausible range	0.73-0.82
Preferred range	0.77-0.82
Suggested Point Estimate	0.80

4.4 Estimated Absolute Bioavailability in Children

These RBA estimates may be used to help assess the potential lead risks which would exist if a child were exposed to a soil/paint mixture similar to the one tested here. The basic approach is to estimate the absolute bioavailability of lead in paint in children as follows:

$$ABA_{paint} = ABA_{soluble} \cdot RBA_{paint}$$

Available data indicate that fully soluble forms of lead are about 50% absorbed by a child (USEPA 1991, 1994). Thus, the estimated absolute bioavailability of lead in the paint sample is calculated as follows:

$$ABA_{paint} = 50\% \cdot RBA_{paint}$$

Based on the RBA values shown above, the estimated absolute bioavailability in children is as follows:

ABA Estimate	Value
Plausible range	36% - 41%
Preferred range	39% - 41%
Suggested Point Estimate	40%

4.5 Uncertainty

These absolute bioavailability estimates presented above would be appropriate for use in EPA's IEUBK model at a site where soil was contaminated with paint similar to that used in this study. However, it is important to emphasize that there are both variability and uncertainty associated with these estimates. This variability and uncertainty arises from several sources. First, differences in physiological and pharmacokinetic parameters between individual animals leads to variability in response even when exposure is the same. Because of this inter-animal variability in the responses of different animals to lead exposure, there is mathematical uncertainty in the best fit dose-response curves for both lead acetate and test material. This in turn leads to uncertainty in the calculated values of RBA, because these are derived from the two best-fit equations. Second, there is uncertainty in how to weight the RBA values based on the different endpoints, and how to select a point estimate for RBA that is applicable to typical site-specific exposure levels. Third, there is uncertainty in the extrapolation of measured RBA values in swine to young children. Even though the immature swine is believed to be a useful and meaningful animal model for gastrointestinal absorption in children, it is possible that differences in stomach pH, stomach emptying time, and other physiological parameters may exist and that RBA values in swine may not be precisely equal to values in children. Fourth, studies in humans reveal that lead absorption is not constant even within an individual, but varies as a function of many factors (mineral intake, health status, etc.). One factor that may be of special importance is time after the last meal, with the presence of food tending to reduce lead absorption. The values of RBA measured in this study are intended to estimate the maximum uptake that occurs when lead is ingested in the absence of food. Thus, these values may be somewhat conservative for children who ingest lead along with food. The magnitude of this bias is not known, although preliminary studies in swine suggest the factor may be relatively minor. Finally, there is uncertainty whether the RBA estimates derived for this particular paint sample are applicable to other paint samples of differing chemical composition and/or particle size.

5.0 REFERENCES

Gibaldi, M. and Perrier, D. 1982. *Pharmacokinetics* (2nd edition) pp 294-297. Marcel Dekker, Inc, NY, NY.

Goodman, A.G., Rall, T.W., Nies, A.S., and Taylor, P. 1990. *The Pharmacological Basis of Therapeutics* (8th ed.) pp. 5-21. Pergamon Press, Inc. Elmsford, NY.

Klaassen, C.D., Amdur, M.O., and Doull, J. (eds). 1996. *Cassarett and Doullś Toxicology: The Basic Science of Poisons*. pp. 190. McGraw-Hill, Inc. NY,NY

LaVelle, J.M., Poppenga, R.H., Thacker, B.J., Giesy, J.P., Weis, C., Othoudt R, and Vandervoot C. 1991. Bioavailability of Lead in Mining Waste: An Oral Intubation Study in Young Swine. In: The Proceedings of the International Symposium on the Bioavailability and Dietary Uptake of Lead. Science and Technology Letters 3:105-111.

Mushak, P. 1991. Gastro-intestinal Absorption of Lead in Children and Adults: Overview of Biological and Biophysico-chemical Aspects. In: The Proceedings of the International Symposium on the Bioavailability and Dietary Uptake of Lead. Science and Technology Letters 3:87-104.

Sherlock, J.C., and Quinn, M.J. 1986. Relationship Between Blood Lead Concentration and Dietary Intake in Infants: the Glasgow Duplicate Diet Study 1979-1980. Food Additives and Contaminants 3:167-176.

USEPA 1991. Technical Support Document on Lead. United States Environmental Protection Agency, Environmental Criteria and Assessment Office. ECAO-CIN-757.

USEPA 1994. Guidance Manual for the Integrated Exposure Uptake Biokinetic Model for Lead in Children. United States Environmental Protection Agency, Office of Emergency and Remedial Response. Publication Number 9285.7-15-1. EPA/540/R-93/081.

Weis, C.P. and LaVelle, J.M. 1991. Characteristics to consider when choosing an animal model for the study of lead bioavailability. In: The Proceedings of the International Symposium on the Bioavailability and Dietary Uptake of Lead. Science and Technology Letters 3:113-119.

Weis, C.P., Henningsen, G.M., Poppenga, R.H., and Thacker, B.J. 1993. Pharmacokinetics of Lead in Blood of Immature Swine Following Acute Oral and Intravenous Exposure. The Toxicologist 13(1):175.

Weis, C.P., Poppenga, R.H., Thacker, B.J., Henningsen, G.M., and Curtis, A. 1995. **"Design of Pharmacokinetic and Bioavailability Studies of Lead in an Immature Swine**

Model." **In:** LEAD IN PAINT, SOIL, AND DUST: HEALTH RISKS, EXPOSURE STUDIES, CONTROL MEASURES, MEASUREMENT METHODS, AND QUALITY ASSURANCE. ASTM STP 1226, Michael E. Beard and S. D. Allen Iske, Eds., American Society for Testing and Materials, Philadelphia, 1995.

APPENDIX A

DETAILED DATA AND CALCULATIONS FOR USEPA SWINE BIOAVAILABILITY STUDY PHASE II, EXPERIMENT 11

NIST PAINT SAMPLE

APPENDIX A

DETAILED DATA SUMMARY

1.0 OVERVIEW

Performance of this study involved collection and reduction of a large number of data items. All of these data items and all of the data reduction steps are contained in a Microsoft Excel spreadsheet named "NIST.XLS" that is available upon request from the administrative record. This file is intended to allow detailed review and evaluation by outside parties of all aspects of the study.

The following sections of this Appendix present printouts of selected tables and graphs from the XLS file. These tables and graphs provide a more detailed documentation of the individual animal data and the data reduction steps performed in this study than was presented in the main text. Any additional details of interest to a reader can be found in the XLS spreadsheet.

2.0 RAW DATA AND DATA REDUCTION STEPS

2.1 Body Weights and Dose Calculations

Animals were weighed on day -1 (one day before exposure) and every three days thereafter during the course of the study. Doses of lead for the three days following each weighing were based on the group mean body weight, adjusted by addition of 1 kg to account for the expected weight gain over the interval. After completion of the experiment, body weights were estimated by interpolation for those days when measurements were not collected, and the actual administered doses (ug Pb/kg) were calculated for each day and then averaged across all days. If an animal missed a dose or was given an incorrect dose, the calculation of average dose corrected for these factors. These data and data reduction steps are shown in Tables A-1 and A-2.

2.2 Blood Lead vs Time

Blood lead values were measured in each animal on days -4, 0, 1, 2, 3, 5, 7, 9, 12, and 15. The raw laboratory data (reported as ug/L of diluted blood) are shown in Table A-3. These data were adjusted as follows: a) non-detects were evaluated by assuming a value equal to one-half the quantitation limit, and b) the concentrations in diluted blood were converted to units of ug/dL in whole blood by dividing by a factor of 1 dL of blood per L of diluted sample. The results are shown in the right-hand column of Table A-3. Figures A-1 and A-2 plot the results for individual animals organized by group and by day. Figure A-3 plots the mean for each dosing group by day.

After adjustment as above, values that were more than a factor of 1.5 above or below the group mean for any given day were "flagged" by computer as potential outliers. These values are shown in Table A-4 by cells that are shaded gray. Each data point identified in this way was reviewed and professional judgement was used to decide if the value should be retained or excluded. In order to avoid inappropriate biases, blood lead outlier designations were restricted to values that were clearly aberrant from a time-course and/or dose-response perspective. Those which were judged to warrant exclusion are shown by a heavy black box around the value. All other flagged values were retained.

Rarely, a value not flagged by the computer was judged to be an outlier that should be excluded. These are shown by unshaded cells surrounded by a heavy black box.

Table A-5 provided a discussion of the rationale used to decide if a blood lead value should be designated as an outlier or not.

2.3 Blood Lead AUC

The area under the blood lead vs time curve for each animal was calculated by finding the area under the curve for each time step using the trapezoidal rule:

$$AUC(d_i \text{ to } d_j) = 0.5*(r_i+r_j)*(d_j-d_i)$$

where:

d = day number
r = response (blood lead value) on day i (r_i) or day j (r_j)

The areas were then summed for each of the time intervals to yield the final AUC for each animal. These calculations are shown in Table A-6. If a blood lead value was missing (either because of problems with sample preparation, or because the measured value was excluded as an outlier), the blood lead value for that day was estimated by linear interpolation.

2.4 Liver, Kidney and Bone Lead Data

At sacrifice (day 15), samples of liver, kidney and bone (femur) were removed and analyzed for lead. The raw data (expressed as ug Pb/L of prepared sample) are summarized in Table A-7. These data were adjusted as follows: a) non-detects were evaluated by assuming a value equal to one-half the quantitation limit, and b) the concentrations in prepared sample were converted to units of concentration in the original biological sample by dividing by the following factors:

Liver:	0.1 kg wet weight/L prepared sample
Kidney:	0.1 kg wet weight/L prepared sample
Bone:	2 gm ashed weight/L prepared sample

The resulting values are shown in the right-hand column of Table A-7.

3.0 CURVE FITTING

Basic Equations

A commercial curve-fitting program (Table Curve-2D™ Version 2.0 for Windows, available from Jandel Scientific) was used to derive best fit equations for each of the individual dose-response data sets derived above. A least squares regression method was used for both linear and non-linear equations. As discussed in the text, three different user-defined equations were fit to each data set:

Linear (LIN): $\text{Response} = a + b \cdot \text{Dose}$

Exponential (EXP): $\text{Response} = a + c \cdot (1-\exp(-d \cdot \text{Dose}))$

Combination (LIN+EXP): $\text{Response} = a + b \cdot \text{Dose} + c \cdot (1-\exp(-d \cdot \text{Dose}))$

Constraints

In the process of finding the best-fits of these equations to the data, the values of the parameters (a, b, c, and d) were constrained as follows:

- Parameter "a" (the intercept, equal to the baseline or control value of the measurement endpoint) was constrained to be non-negative and was forced in all cases to be the same for the reference material (lead acetate) and the test materials. This is because, by definition, all dose-response curves for groups of animals exposed to different materials must arise from the same value at zero dose. In addition, for blood lead data, "a" was constrained to be equal to the mean of the control group ± 20% (typically 7.5 ± 1.5 AUC units).

- Parameter "b" (the slope of the linear dose-response line) was constrained to non-negative values, since all of the measurement endpoints evaluated are observed to increase, not decrease, as a function of lead exposure.

- Parameter "c" (the plateau value of the exponential curve) was constrained to be non-negative, and was forced to be the same for the reference material (lead acetate) and the test material. This is because: 1) it is expected on theoretical grounds that the plateau (saturation level) should be the same regardless of the source of lead, and 2) curve-fitting of individual curves tended to yield values of "c" that were close to each other and were not statistically different.

- Parameter "d" (which determines where the "bend" in the exponential equation occurs) was constrained to be greater than 0.0045 for the lead acetate blood lead (AUC) dose-response curve. This constraint was judged to be necessary because the weight of evidence from all studies clearly showed the lead acetate blood lead dose response curve was non-linear and was best fit by an exponential equation, but in some studies there were only two low doses of lead acetate used to define the dose-response curve, and this narrow range data set could sometimes be fit nearly as well by a linear as an exponential curve. The choice of the constraint on "d" was selected to be slightly lower than the observed best-fit value of "d" (0.006) when data from all lead acetate AUC dose-response curves from all of the different studies in this program were used. This approach may tend to underestimate relative bioavailability slightly in some studies (especially at low doses), but use of the information gained from all studies is judged to be more robust than basing fits solely on the data from one study.

In general, one of these models (the linear, the exponential, or the combination) usually yielded a fit (as judged by the value of the adjusted correlation coefficient R^2 and by visual inspection of the fit of the line through the measured data points) that was clearly superior to the others. If two or more models fit the data approximately equally well, then the simplest model (that with the fewest parameters) was selected.

Outlier Identification

During the dose-response curve fitting process, all data were carefully reviewed to identify any anomalous values. Typically, the process used to identify outliers was as follows:

Step 1 Any data points judged to be outliers based on information derived from analysis of data across multiple studies (as opposed to conclusions drawn from within the study) were excluded.

Step 2 The remaining raw data points were fit to the equation judged to be the most likely to be the best fit (linear, exponential, or mixed). Table Curve 2-D was then used to plot the 95% prediction limits around the best fit line. All data points that fell outside the 95% prediction limits were considered to be outliers and were excluded.

Step 3 After excluding these points (if any), a new best-fit was obtained. In some cases, data points originally inside the 95% prediction limits were now outside the limits. However, further iterative cycles of data point exclusion were not performed, and the fit was considered final.

Curve Fit Results

Table A-8 lists the data used to fit these curves, indicating which endpoints were excluded as outliers and why. Table A-9 shows the type of equation selected to fit each data set, and the best fit parameters. The resulting best-fit equations for the data sets are shown in Figures A-5 to A-16. Values excluded as outliers are represented in the figures by the symbol "+".

4.0 RESULTS -- CALCULATED RBA VALUES

The value of RBA for a test substance was calculated for a series of doses using the following procedure:

1. For each dose, calculate the expected response to test material, using the best fit equation through the dose-response data for that material.

2. For each expected response to test material, calculate the dose of lead acetate that is expected to yield an equivalent response. This is done by "inverting" the dose-response curve for lead acetate, and solving for the dose that corresponds to a specified response.

3. Calculate RBA at that dose as the ratio of the dose of lead acetate to the dose of test material. For the situation where both curves are linear, the value of RBA is the ratio of the slopes (the "b" parameters). In the case where both curves are exponential and where both curves have the same values for parameters "a" and "c", the value of RBA is equal to the ratio of the "d" parameters.

The results are summarized in Table A-10.

5.0 QUALITY ASSURANCE DATA

A number of steps were taken throughout this study and the other studies in this project to ensure the quality of the results, including 5% duplicates, 5% standards, and a program of interlaboratory comparison. These steps are detailed below.

Duplicates

Duplicate samples were prepared and analyzed for about 5% of all samples generated during the study. Table A-11 lists the first and second values for blood, liver, kidney, and bone. The results are shown in Figure 3-1 in the main text.

Standards

The Centers for Disease Control and Prevention (CDCP) provide a variety of blood lead "check samples" for use in quality assurance programs for blood lead studies. Each time a group of

blood samples was prepared and sent to the laboratory for analysis, several CDCP check samples of different concentrations were included. Table A-12 lists the concentrations reported by the laboratory compared to the nominal concentrations indicated by CDCP for the samples submitted during this study, and the results are plotted in Figure 3-2 (Panel A) in the main text.

Interlaboratory Comparison

An interlaboratory comparison of blood lead analytical results was performed by sending a set of 15 randomly selected whole blood samples from this study to CDCP for independent analysis. The data are presented in Table A-13, and the results are plotted in Figure 3-2 (Panel B) in the main text.

DISK INSTRUCTIONS

Enclosed is a disk entitled "NIST.EXE". This disk contains a Microsoft Excel spreadsheet named "NIST.XLS" that contains all of the data items and all of the data reduction steps for animals exposed to the paint/soil test material. This file is intended to allow detailed review and evaluation by outside parties of all aspects of the study. In order to conserve space and help guard against accidental changes in the spreadsheet, all of the formulas and links present in the original spreadsheet used by EPA have been "frozen". Thus, the values shown in the attached file represent the final values employed by EPA. Due to the size of the file (approximately 2 MB), it has been provided as a self-extracting zipped file. To extract the file from the enclosed disk to a location on your hard drive, the following steps should be taken:

1) Go to the DOS Prompt
2) Change directory to desired destination directory (e.g., C:\data)
3) Place the source disk in the appropriate drive (e.g., A:)
4) At the DOS prompt (C:\data>) type "A:\NIST" and press enter. This will cause the NIST.XLS file to extract from your source disk (A:) to your destination directory (C:\data).
5) Open Microsoft Excel to view the unzipped file. Note that even though the formulas have been frozen, the file remains quite large, so it is recommended that the user have a minimum of 8 MB of RAM to facilitate use of this spreadsheet.

TABLE A-1 BODY WEIGHTS AND ADMINISTERED DOSES, BY DAY

Body weights were measured on days -1, 2, 5, 8, 11, 14. Weights for other days are estimated, based on linear interpolation between measured values.

Group	ID #	Day -1		Day 0		Day 1		Day 2		Day 3		Day 4		Day 5		Day 6		Day 7		Day 8		Day 9		Day 10		Day 11		Day 12		Day 13		Day 14		Day 15	
		BW (kg)	ug Pb per day	BW (kg)	ug Pb per day	BW (kg)	ug Pb per day	BW (kg)	ug Pb per day	BW (kg)	ug Pb per day	BW (kg)	ug Pb per day	BW (kg)	ug Pb per day	BW (kg)	ug Pb per day	BW (kg)	ug Pb per day	BW (kg)	ug Pb per day	BW (kg)	ug Pb per day	BW (kg)	ug Pb per day	BW (kg)	ug Pb per day	BW (kg)	ug Pb per day	BW (kg)	ug Pb per day	BW (kg)	ug Pb per day	BW (kg)	ug Pb per day
1	1109	7.1	0	7.3	0	7.4	0	7.58	0	7.8	0	8.0	0	8.28	0	8.8	0	9.3	0	9.74	0	10.1	0	10.4	0	10.79	0	11.3	0	11.8	0	12.34	0	12.9	0
1	1124	7.94	0	8.2	0	8.4	0	8.6	0	9.0	0	9.3	0	9.66	0	10.0	0	10.4	0	10.76	0	11.3	0	11.8	0	12.3	0	12.8	0	12.9	0	13.24	0	13.6	0
1	1135	7.66	0	7.7	0	7.7	0	7.66	0	8.0	0	8.3	0	8.56	0	8.9	0	9.3	0	9.72	0	10.1	0	10.4	0	10.78	0	11.2	0	11.6	0	12	0	12.4	0
1	1139	7.9	0	7.9	0	8.0	0	8.02	0	8.0	0	8.0	0	7.98	0	8.3	0	8.6	0	8.98	0	9.5	0	10.0	0	10.52	0	10.8	0	11.1	0	11.4	0	11.7	0
1	1151	8.66	0	8.8	0	9.0	0	9.18	0	9.7	0	10.1	0	10.62	0	10.9	0	11.2	0	11.5	0	11.9	0	12.3	0	12.68	0	13.2	0	13.7	0	14.14	0	14.6	0
2	1103	7.28	0	7.5	221	7.8	221	8.04	221	8.3	232	8.5	232	8.68	232	9.1	271	9.5	271	9.92	271	10.3	298	10.7	298	11.02	298	11.4	326	11.7	326	12.02	326	12.4	0
2	1104	8.06	0	8.1	221	8.2	221	8.24	221	8.5	232	8.7	232	8.94	232	9.2	271	9.4	271	9.7	271	10.1	298	10.5	298	10.84	298	11.2	326	11.7	326	12.06	326	12.5	0
2	1116	7.58	0	7.9	221	8.2	221	8.48	221	8.7	232	8.9	232	9.06	232	9.4	271	9.7	271	10.08	271	10.5	298	10.9	298	11.38	298	11.9	326	12.4	326	12.86	326	13.4	0
2	1117	7.7	0	7.8	221	7.9	221	7.98	221	8.2	232	8.5	232	8.7	232	8.9	271	9.2	271	9.4	271	9.7	298	10.0	298	10.32	298	10.6	326	10.9	326	11.14	326	11.4	0
2	1118	8.54	0	8.6	221	8.7	221	8.74	221	8.9	232	9.1	232	9.26	232	9.6	271	9.8	271	10.14	271	10.5	298	10.8	298	11.12	298	11.4	326	11.8	326	12.08	326	12.4	0
3	1105	7.56	0	7.7	636	7.8	636	7.92	636	8.1	673	8.3	673	8.52	673	8.7	718	9.0	718	9.18	718	9.6	814	10.1	814	10.58	814	10.9	909	11.3	909	11.66	909	12.0	0
3	1123	7	0	7.1	636	7.1	636	7.18	636	7.6	673	7.9	673	8.32	673	8.9	718	9.5	718	10.04	718	10.3	814	10.6	814	10.94	814	11.4	909	11.9	909	12.36	909	12.8	0
3	1129	7.78	0	7.8	636	7.9	636	7.92	636	8.1	673	8.2	673	8.38	673	8.8	718	9.3	718	9.74	718	10.2	814	10.6	814	10.98	814	11.3	909	11.7	909	12.02	909	12.4	0
3	1130	8.06	0	8.4	636	8.7	636	9.02	636	9.1	673	9.2	673	9.28	673	9.8	718	10.3	718	10.84	718	11.3	814	11.8	814	12.24	814	12.6	909	13.0	909	13.44	909	13.8	0
3	1144	7.02	0	7.3	636	7.5	636	7.8	636	8.0	673	8.2	673	8.38	673	8.7	718	9.1	718	9.44	718	9.9	814	10.4	814	10.86	814	11.3	909	11.8	909	12.24	909	12.7	0
4	1121	7.48	0	7.7	1939	7.9	1939	8.18	1939	8.6	2085	9.0	2085	9.34	2085	9.8	2336	10.2	2336	10.66	2336	11.2	2597	11.6	2597	12.14	2597	12.7	2890	13.2	2890	13.7	2890	14.2	0
4	1136	8.68	0	8.9	1939	7.2	1939	7.42	1939	7.7	2085	8.0	2085	8.34	2085	8.7	2336	9.0	2336	9.4	2336	9.9	2597	10.3	2597	10.76	2597	11.0	2890	11.2	2890	11.46	2890	11.7	0
4	1138	6.96	0	7.3	1939	7.5	1939	7.84	1939	8.2	2085	8.5	2085	8.84	2085	9.2	2336	9.6	2336	9.96	2336	10.4	2597	10.8	2597	11.26	2597	11.6	2890	12.0	2890	12.34	2890	12.7	0
4	1146	8.6	0	8.7	1939	8.8	1939	8.96	1939	9.4	2085	9.8	2085	10.16	2085	10.6	2336	11.1	2336	11.52	2336	11.9	2597	12.2	2597	12.56	2597	13.0	2890	13.5	2890	13.96	2890	14.4	0
4	1150	8.38	0	8.6	1939	8.7	1939	8.94	1939	9.4	2085	9.8	2085	10.22	2085	10.5	2336	10.8	2336	11.16	2336	11.6	2597	12.0	2597	12.48	2597	13.0	2890	13.5	2890	14.08	2890	14.6	0
8	1110	6.18	0	7.0	601.5	7.8	601.5	8.58	601.5	8.4	694.5	8.2	694.5	8.06	694.5	8.5	737.3	8.9	737.3	9.26	737.3	9.7	820.9	10.2	820.9	10.66	820.9	11.1	911.3	11.5	911.3	11.86	911.3	12.3	0.0
8	1115																																		
8	1134	7.06	0	7.4	601.5	7.8	601.5	8.12	601.5	8.3	694.5	8.4	694.5	8.58	694.5	9.0	737.3	9.3	737.3	9.7	737.3	10.1	820.9	10.4	820.9	10.8	820.9	11.3	911.3	11.8	911.3	12.36	911.3	12.9	0.0
8	1148	7.28	0	7.7	601.5	8.0	601.5	8.42	300.8	8.7	694.5	9.0	694.5	9.22	694.5	9.6	737.3	10.1	737.3	10.5	737.3	11.0	820.9	11.4	820.9	11.88	820.9	12.3	911.3	12.8	911.3	13.22	911.3	13.7	0.0
8	1153	8.2	0	8.2	601.5	8.2	601.5	8.24	601.5	8.6	694.5	9.1	694.5	9.46	694.5	9.7	737.3	10.0	737.3	10.32	737.3	10.6	820.9	10.9	820.9	11.26	820.9	11.6	911.3	12.4	911.3	12.94	911.3	13.5	0.0
9	1101	7.04	0	7.3	1960.2	7.5	1960.2	7.68	1960.2	8.1	2097.0	8.5	2097.0	8.86	2097.0	9.3	2304.9	9.7	2304.9	10.1	2304.9	10.5	2515.5	11.0	2515.5	11.38	2515.5	11.8	2793.6	12.2	2793.6	12.64	2793.6	13.1	0.0
9	1108	7.4	0	7.6	1960.2	7.8	1960.2	7.94	1960.2	8.1	2097.0	8.3	2097.0	8.54	2097.0	8.9	2304.9	9.2	2304.9	9.52	2304.9	10.0	2515.5	10.5	2515.5	10.94	2515.5	11.6	2793.6	12.3	2793.6	13.02	2793.6	13.7	0.0
9	1111	6.98	0	7.3	1960.2	7.6	1960.2	7.84	1960.2	8.0	2097.0	8.2	2097.0	8.44	2097.0	8.7	2304.9	9.0	2304.9	9.28	2304.9	9.6	2515.5	9.9	2515.5	10.22	2515.5	10.6	2793.6	10.9	2793.6	11.24	2793.6	11.6	0.0
9	1132	8.76	0	9.0	1960.2	9.3	1960.2	9.5	1960.2	9.9	2097.0	10.3	2097.0	10.7	2097.0	11.0	2304.9	11.2	2304.9	11.48	2304.9	11.9	2515.5	12.3	2515.5	12.72	2515.5	13.2	2793.6	13.7	2793.6	14.12	2793.6	14.6	0.0
9	1152	8.38	0	8.5	1960.2	8.8	1960.2	8.84	1960.2	9.0	2097.0	9.3	2097.0	9.68	2097.0	10.0	2304.9	10.2	2304.9	10.52	2304.9	11.0	2515.5	11.4	2515.5	11.82	2515.5	12.3	2793.6	12.9	2793.6	13.4	2793.6	13.9	0.0
10	1113	8.44	0	8.8	5918.4	9.2	5918.4	9.54	5918.4	9.8	6606.9	10.1	6606.9	10.4	6606.9	10.7	7238.7	11.1	7238.7	11.42	7238.7	11.9	7835.4	12.3	7835.4	12.72	7835.4	13.2	8729.1	13.7	8729.1	14.14	8729.1	14.6	0.0
10	1119	7.4	0	7.8	5918.4	8.2	5918.4	8.54	5918.4	8.8	6606.9	9.1	6606.9	9.4	6606.9	9.6	7238.7	9.8	7238.7	10.04	7238.7	10.5	7835.4	10.9	7835.4	11.3	7835.4	11.8	8729.1	12.3	8729.1	12.86	8729.1	13.4	0.0
10	1120	8.2	0	8.6	5918.4	9.0	5918.4	9.46	5918.4	9.7	6606.9	10.0	6606.9	10.2	6606.9	10.5	7238.7	10.8	7238.7	11.04	7238.7	11.5	7835.4	11.9	7835.4	12.4	7835.4	12.7	8729.1	13.0	8729.1	13.28	8729.1	13.6	0.0
10	1125	7.76	0	7.9	5918.4	8.1	5918.4	8.32	5918.4	8.7	6606.9	9.1	6606.9	9.5	6606.9	9.8	7238.7	10.2	7238.7	10.52	7238.7	11.0	7835.4	11.5	7835.4	11.98	7835.4	12.5	8729.1	13.0	8729.1	13.56	8729.1	14.1	0.0
10	1147	7.04	0	7.4	5918.4	7.7	5918.4	8.08	5918.4	8.4	6606.9	8.8	6606.9	9.12	6606.9	9.4	7238.7	9.7	7238.7	10.02	7238.7	10.4	7835.4	10.8	7835.4	11.26	7835.4	11.7	8729.1	12.2	8729.1	12.7	8729.1	13.2	0.0

Pig removed during course of study
Shaded boxes show days in which adminstered doses were ingested late
Days which required adjustment for missed or partially missed doses

Day 2 Pig # 1148 - Vomitted one of two doses. Daily dose adjusted by 50%

TABLE A-2

Body Weight Adjusted Doses
(Dose for Day/BW for Day)

Group	ID #	Day 0	Day 1	Day 2	Day 3	Day 4	Day 5	Day 6	Day 7	Day 8	Day 9	Day 10	Day 11	Day 12	Day 13	Day 14	Avg Dose	Target Dose	% Target	Avg %
1	1109	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00	0		
1	1124	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00	0		
1	1135	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00	0		
1	1139	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00	0		
1	1151	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00	0		
2	1103	29.31	28.36	27.46	28.16	27.45	26.77	29.82	28.53	27.34	29.01	28.01	27.08	28.70	27.88	27.10	28.07	25	112	
2	1104	27.19	26.99	26.80	27.43	26.69	26.00	29.50	28.71	27.96	29.60	28.53	27.53	28.97	27.96	27.01	27.79	25	111	
2	1116	26.02	26.99	26.04	26.79	26.21	25.65	28.85	27.84	26.90	28.38	27.26	26.22	27.44	26.35	25.33	26.95	25	108	
2	1117	28.33	28.00	27.67	28.27	27.47	26.71	30.36	29.59	28.85	30.74	29.80	28.91	30.76	29.98	29.25	28.98	25	116	
2	1118	25.65	25.46	25.26	26.07	25.58	25.10	28.39	27.54	26.75	28.51	27.65	26.83	28.48	27.70	26.97	26.80	25	107	111
3	1105	82.85	81.58	80.34	82.83	80.84	78.94	82.17	80.16	78.24	84.34	80.45	76.90	83.09	80.44	77.96	80.74	75	108	
3	1123	90.13	89.37	88.62	88.97	84.71	80.84	80.76	75.87	71.53	78.68	76.47	74.37	79.64	76.47	73.54	80.66	75	108	
3	1129	81.30	80.82	80.34	83.31	81.76	80.26	81.31	77.34	73.74	80.13	77.00	74.10	80.25	77.87	75.62	79.01	75	105	
3	1130	75.93	73.14	70.54	73.86	73.16	72.48	73.29	69.59	66.25	71.96	69.11	66.47	71.91	69.71	67.63	71.00	75	95	
3	1144	87.40	84.39	81.58	84.15	82.16	80.26	82.24	79.04	76.08	82.07	78.33	74.92	80.30	77.16	74.26	80.29	75	107	104
4	1121	251.33	243.95	236.99	243.42	232.91	223.27	238.60	228.52	219.09	232.80	222.94	213.88	228.27	219.26	210.94	229.76	225	102	
4	1136	279.87	270.25	261.27	269.88	259.58	250.04	268.65	258.16	248.46	263.51	251.92	241.31	262.88	257.41	252.17	259.69	225	115	
4	1138	267.27	256.88	247.27	255.13	245.14	235.89	253.49	243.62	234.49	249.66	239.53	230.19	248.42	241.09	234.19	245.48	225	109	
4	1148	222.32	219.30	216.36	222.79	213.66	205.25	220.05	211.04	202.73	218.81	212.60	206.73	221.84	214.17	207.01	214.31	225	95	
4	1150	226.65	221.64	216.85	222.63	212.93	204.04	221.72	215.32	209.27	223.84	215.66	208.05	222.07	213.33	205.25	215.95	225	96	104
8	1110	86.17	77.31	70.10	82.61	84.35	86.17	87.15	83.21	79.62	84.39	80.53	77.01	82.39	79.52	78.83	81.16	75	108	
8	1115																	75		
8	1134	81.14	77.45	74.08	83.94	82.42	80.94	82.34	79.05	76.01	81.54	78.68	76.01	80.50	76.96	73.73	78.99	75	105	
8	1148	78.52	74.81	35.72	79.95	77.57	75.33	76.43	73.19	70.21	74.90	71.88	69.10	73.93	71.34	68.93	71.45	75	95	
8	1153	73.23	73.12	73.00	80.32	76.71	73.41	75.64	73.48	71.44	77.20	74.99	72.90	77.09	73.61	70.42	74.44	75	99	102
9	1101	270.25	262.53	255.23	259.74	247.68	236.68	248.55	237.95	228.21	238.96	229.66	221.05	236.75	228.61	221.01	241.52	225	107	
9	1108	258.60	252.60	246.88	257.62	251.44	245.55	259.95	250.71	242.11	251.72	240.33	229.94	240.14	228.63	214.56	244.59	225	109	
9	1111	269.75	259.51	250.03	260.82	254.49	248.46	264.32	256.10	248.37	262.21	253.92	246.14	264.55	256.29	248.54	258.23	225	114	
9	1132	217.64	211.84	206.34	211.82	203.59	195.98	210.30	205.43	200.78	211.51	204.40	197.76	211.85	204.61	197.85	206.11	225	92	
9	1152	231.52	229.17	226.88	233.35	224.68	216.63	231.42	225.09	219.10	229.66	220.92	212.82	226.26	217.01	208.48	223.53	225	99	104
10	1113	672.04	645.17	620.38	672.34	653.29	635.28	673.99	653.31	633.86	661.03	637.72	615.99	661.63	638.71	617.33	646.14	675	96	
10	1119	760.72	725.29	693.02	748.52	724.97	702.86	752.99	736.64	720.99	749.08	720.17	693.40	738.50	707.38	678.78	723.55	675	107	
10	1120	686.59	654.69	625.62	680.66	663.79	647.74	690.72	672.74	655.68	681.73	655.86	631.89	687.69	672.16	657.31	664.32	675	98	
10	1125	744.77	727.67	711.35	758.25	725.50	695.46	735.64	711.07	688.09	711.88	681.73	654.04	697.96	669.75	643.74	703.79	675	104	
10	1147	801.23	765.31	732.48	784.05	753.07	724.44	768.44	744.72	722.43	751.00	722.38	695.86	743.53	714.33	687.33	740.71	675	110	103

Animal removed from study

TABLE A - 3 RAW AND ADJUSTED BLOOD LEAD DATA

Phase II Experiment 11 (Data not shown for groups 5, 6, & 7)

pig number	sample	group	material administered	dosage	qualifier	reanqualifier	reanresult	result (ug/L)	day	source file	MATRIX	Adjusted Value (ug/dL)[a]	Notes
1109	8-911-0168	1	Control	0	<			1.0	-4	T960313B	BLOOD	0.5	
1124	8-911-0157	1	Control	0	<			1.0	-4	T960313B	BLOOD	0.5	
1135	8-911-0174	1	Control	0	<			1.0	-4	T960313B	BLOOD	0.5	
1139	8-911-0165	1	Control	0	<			1.0	-4	T960313B	BLOOD	0.5	
1151	8-911-0121	1	Control	0	<			1.0	-4	T960313B	BLOOD	0.5	
1103	8-911-0125	2	PbAc	25		<	1.0	567.0	-4	T960313B	BLOOD	0.5	
1104	8-911-0147	2	PbAc	25	<			1.0	-4	T960313B	BLOOD	0.5	
1116	8-911-0158	2	PbAc	25	<			1.0	-4	T960313B	BLOOD	0.5	
1117	8-911-0133	2	PbAc	25				1.2	-4	T960313B	BLOOD	1.2	
1118	8-911-0145	2	PbAc	25	<			1.0	-4	T960313B	BLOOD	0.5	
1105	8-911-0161	3	PbAc	75	<			1.0	-4	T960313B	BLOOD	0.5	
1123	8-911-0146	3	PbAc	75	<			1.0	-4	T960313B	BLOOD	0.5	
1129	8-911-0149	3	PbAc	75	<			1.0	-4	T960313B	BLOOD	0.5	
1130	8-911-0172	3	PbAc	75	<			1.0	-4	T960313B	BLOOD	0.5	
1144	8-911-0142	3	PbAc	75	<			1.0	-4	T960313B	BLOOD	0.5	
1121	8-911-0171	4	PbAc	225	<			1.0	-4	T960313B	BLOOD	0.5	
1136	8-911-0151	4	PbAc	225	<			1.0	-4	T960313B	BLOOD	0.5	
1138	8-911-0153	4	PbAc	225	<			1.0	-4	T960313B	BLOOD	0.5	
1146	8-911-0148	4	PbAc	225	<			1.0	-4	T960313B	BLOOD	0.5	
1150	8-911-0135	4	PbAc	225	<			1.0	-4	T960313B	BLOOD	0.5	
1110	8-911-0141	8	NIST Paint	75	<			1.0	-4	T960313B	BLOOD	0.5	
1115	8-911-0138	8	NIST Paint	75					-4		BLOOD		Removed
1134	8-911-0167	8	NIST Paint	75	<			1.0	-4	T960313B	BLOOD	0.5	
1148	8-911-0124	8	NIST Paint	75	<			1.0	-4	T960313B	BLOOD	0.5	
1153	8-911-0166	8	NIST Paint	75	<			1.0	-4	T960313B	BLOOD	0.5	
1101	8-911-0170	9	NIST Paint	225	<			1.0	-4	T960313B	BLOOD	0.5	
1108	8-911-0137	9	NIST Paint	225	<			1.0	-4	T960313B	BLOOD	0.5	
1111	8-911-0169	9	NIST Paint	225	<			1.0	-4	T960313B	BLOOD	0.5	
1132	8-911-0164	9	NIST Paint	225	<			1.0	-4	T960313B	BLOOD	0.5	
1152	8-911-0152	9	NIST Paint	225	<			1.0	-4	T960313B	BLOOD	0.5	
1113	8-911-0140	10	NIST Paint	675	<			1.0	-4	T960313B	BLOOD	0.5	
1119	8-911-0128	10	NIST Paint	675				1.3	-4	T960313B	BLOOD	1.3	
1120	8-911-0173	10	NIST Paint	675	<			1.0	-4	T960313B	BLOOD	0.5	
1125	8-911-0143	10	NIST Paint	675	<			1.0	-4	T960313B	BLOOD	0.5	
1147	8-911-0150	10	NIST Paint	675	<			1.0	-4	T960313B	BLOOD	0.5	
1109	8-911-0205	1	Control	0	<			1.0	0	T960313B	BLOOD	0.5	
1124	8-911-0209	1	Control	0	<			1.0	0	T960313B	BLOOD	0.5	
1135	8-911-0223	1	Control	0	<			1.0	0	T960313B	BLOOD	0.5	
1139	8-911-0213	1	Control	0	<	<	1.0	1.0	0	T960313B	BLOOD	0.5	
1151	8-911-0211	1	Control	0				1.1	0	T960313B	BLOOD	1.1	
1103	8-911-0229	2	PbAc	25	<			1.0	0	T960313B	BLOOD	0.5	
1104	8-911-0216	2	PbAc	25	<			1.0	0	T960313B	BLOOD	0.5	
1116	8-911-0200	2	PbAc	25	<			1.0	0	T960313B	BLOOD	0.5	
1117	8-911-0225	2	PbAc	25	<			1.0	0	T960313B	BLOOD	0.5	
1118	8-911-0189	2	PbAc	25	<	<	1.0	1.0	0	T960313B	BLOOD	0.5	
1105	8-911-0187	3	PbAc	75	<			1.0	0	T960313B	BLOOD	0.5	
1123	8-911-0226	3	PbAc	75	<			1.0	0	T960313B	BLOOD	0.5	
1129	8-911-0183	3	PbAc	75	<			1.0	0	T960313B	BLOOD	0.5	
1130	8-911-0186	3	PbAc	75	<			1.0	0	T960313B	BLOOD	0.5	
1144	8-911-0177	3	PbAc	75	<	<	1.0	1.0	0	T960313B	BLOOD	0.5	
1121	8-911-0176	4	PbAc	225	<			1.0	0	T960313B	BLOOD	0.5	
1136	8-911-0193	4	PbAc	225	<			1.0	0	T960313B	BLOOD	0.5	
1138	8-911-0190	4	PbAc	225	<			1.0	0	T960313B	BLOOD	0.5	
1146	8-911-0181	4	PbAc	225	<			1.0	0	T960313B	BLOOD	0.5	
1150	8-911-0227	4	PbAc	225	<	<	1.0	1.0	0	T960313B	BLOOD	0.5	
1110	8-911-0178	8	NIST Paint	75	<			1.0	0	T960313B	BLOOD	0.5	
1115	8-911-0224	8	NIST Paint	75					0		BLOOD		Removed
1134	8-911-0175	8	NIST Paint	75	<			1.0	0	T960313B	BLOOD	0.5	
1148	8-911-0191	8	NIST Paint	75				1.5	0	T960313B	BLOOD	1.5	
1153	8-911-0184	8	NIST Paint	75	<	<	1.0	1.0	0	T960313B	BLOOD	0.5	
1101	8-911-0202	9	NIST Paint	225	<			1.0	0	T960313B	BLOOD	0.5	
1108	8-911-0220	9	NIST Paint	225	<			1.0	0	T960313B	BLOOD	0.5	
1111	8-911-0192	9	NIST Paint	225	<			1.0	0	T960313B	BLOOD	0.5	
1132	8-911-0221	9	NIST Paint	225				2.3	0	T960313B	BLOOD	2.3	
1152	8-911-0219	9	NIST Paint	225				1.3	0	T960313B	BLOOD	1.3	
1113	8-911-0194	10	NIST Paint	675	<			1.0	0	T960313B	BLOOD	0.5	
1119	8-911-0207	10	NIST Paint	675	<			1.0	0	T960313B	BLOOD	0.5	
1120	8-911-0195	10	NIST Paint	675		<	1.0	3.8	0	T960313B	BLOOD	0.5	
1125	8-911-0208	10	NIST Paint	675		<	1.0	2.3	0	T960313B	BLOOD	0.5	
1147	8-911-0215	10	NIST Paint	675		<	1.0	4.5	0	T960313B	BLOOD	0.5	
1109	8-911-0250	1	Control	0		<	1.0	2.0	1	T960313B	BLOOD	0.5	
1124	8-911-0280	1	Control	0		<	1.0	1.4	1	T960313B	BLOOD	0.5	
1135	8-911-0272	1	Control	0		<	1.0	1.8	1	T960313B	BLOOD	0.5	
1139	8-911-0236	1	Control	0		<	1.0	4.4	1	T960313B	BLOOD	0.5	
1151	8-911-0251	1	Control	0		<	1.0	3.6	1	T960313B	BLOOD	0.5	
1103	8-911-0243	2	PbAc	25		<	1.0	2.3	1	T960313B	BLOOD	0.5	
1104	8-911-0266	2	PbAc	25		<	1.0	5.8	1	T960313B	BLOOD	0.5	
1116	8-911-0257	2	PbAc	25		<	1.0	4.8	1	T960313B	BLOOD	0.5	
1117	8-911-0241	2	PbAc	25		<	1.0	4.0	1	T960313B	BLOOD	0.5	
1118	8-911-0258	2	PbAc	25			5.8	1.9	1	T960313B	BLOOD	5.8	
1105	8-911-0237	3	PbAc	75		<	1.0	4.6	1	T960313B	BLOOD	0.5	
1123	8-911-0246	3	PbAc	75		<	1.0	3.7	1	T960313B	BLOOD	0.5	
1129	8-911-0247	3	PbAc	75		<	1.0	1.1	1	T960313B	BLOOD	0.5	
1130	8-911-0277	3	PbAc	75		<	1.0	5.9	1	T960313B	BLOOD	0.5	
1144	8-911-0240	3	PbAc	75		<	1.0	2.8	1	T960313B	BLOOD	0.5	
1121	8-911-0233	4	PbAc	225			3.3	6.2	1	T960313B	BLOOD	3.3	
1136	8-911-0276	4	PbAc	225			1.4	4.8	1	T960313B	BLOOD	1.4	
1138	8-911-0248	4	PbAc	225			2.0	5.6	1	T960313B	BLOOD	2.0	
1146	8-911-0282	4	PbAc	225			3.6	3.0	1	T960313B	BLOOD	3.6	
1150	8-911-0284	4	PbAc	225			4.5	4.2	1	T960313B	BLOOD	4.5	
1110	8-911-0260	8	NIST Paint	75	<	<	1.0	1.0	1	T960313B	BLOOD	0.5	
1115	8-911-0270	8	NIST Paint	75					1		BLOOD		Removed
1134	8-911-0265	8	NIST Paint	75			1.1	13.0	1	T960313B	BLOOD	1.1	
1148	8-911-0259	8	NIST Paint	75		<	1.0	12.4	1	T960313B	BLOOD	0.5	
1153	8-911-0239	8	NIST Paint	75		<	1.0	1.1	1	T960313B	BLOOD	0.5	
1101	8-911-0249	9	NIST Paint	225			1.1	2.0	1	T960313B	BLOOD	1.1	
1108	8-911-0281	9	NIST Paint	225			2.1	13.4	1	T960313B	BLOOD	2.1	

pig number	sample	group	material administered	dosage	qualifier	reanqualifier	reanresult	result (ug/L)	day	source file	MATRIX	Adjusted Value (ug/dL)*	Notes
1111	8-911-0255	9	NIST Paint	225			3.3	1.9	1	T960313B	BLOOD	3.3	
1132	8-911-0283	9	NIST Paint	225			1.3	1.1	1	T960313B	BLOOD	1.3	
1152	8-911-0242	9	NIST Paint	225			2.5	2.7	1	T960313B	BLOOD	2.5	
1113	8-911-0256	10	NIST Paint	675			7.5	18.6	1	T960313B	BLOOD	7.5	
1119	8-911-0244	10	NIST Paint	675			3.8	14.3	1	T960313B	BLOOD	3.8	
1120	8-911-0261	10	NIST Paint	675			7.0	18.4	1	T960313B	BLOOD	7.0	
1125	8-911-0268	10	NIST Paint	675			4.5	16.5	1	T960313B	BLOOD	4.5	
1147	8-911-0238	10	NIST Paint	675			6.0	7.7	1	T960313B	BLOOD	6.0	
1109	8-911-0301	1	Control	0	<			1.0	2	T960330B	BLOOD	0.5	
1124	8-911-0320	1	Control	0	<	<	1.0	1.0	2	T960330B	BLOOD	0.5	
1135	8-911-0338	1	Control	0	<			1.0	2	T960330B	BLOOD	0.5	
1139	8-911-0334	1	Control	0		<	1.0	1.3	2	T960330B	BLOOD	0.5	
1151	8-911-0324	1	Control	0	<			1.0	2	T960330B	BLOOD	0.5	
1103	8-911-0304	2	PbAc	25	<	<	1.0	1.0	2	T960330B	BLOOD	0.5	
1104	8-911-0303	2	PbAc	25	<			1.0	2	T960330B	BLOOD	0.5	
1116	8-911-0302	2	PbAc	25	<			1.0	2	T960330B	BLOOD	0.5	
1117	8-911-0307	2	PbAc	25	<			1.0	2	T960330B	BLOOD	0.5	
1118	8-911-0309	2	PbAc	25	<			1.0	2	T960330B	BLOOD	0.5	
1105	8-911-0289	3	PbAc	75				1.3	2	T960330B	BLOOD	1.3	
1123	8-911-0318	3	PbAc	75				2.7	2	T960330B	BLOOD	2.7	
1129	8-911-0298	3	PbAc	75	<		1.2	1.0	2	T960330B	BLOOD	1.2	
1130	8-911-0326	3	PbAc	75				2.8	2	T960330B	BLOOD	2.8	
1144	8-911-0285	3	PbAc	75			1.4	1.6	2	T960330B	BLOOD	1.4	
1121	8-911-0311	4	PbAc	225				5.9	2	T960330B	BLOOD	5.9	
1136	8-911-0305	4	PbAc	225				2.9	2	T960330B	BLOOD	2.9	
1138	8-911-0288	4	PbAc	225				3.4	2	T960330B	BLOOD	3.4	
1146	8-911-0337	4	PbAc	225				5.2	2	T960330B	BLOOD	5.2	
1150	8-911-0310	4	PbAc	225				6.2	2	T960330B	BLOOD	6.2	
1110	8-911-0286	8	NIST Paint	75				1.0	2	T960330B	BLOOD	1.0	
1115	8-911-0294	8	NIST Paint	75					2		BLOOD		Removed
1134	8-911-0297	8	NIST Paint	75	<		1.8	1.0	2	T960330B	BLOOD	1.8	
1148	8-911-0330	8	NIST Paint	75			1.7	2.2	2	T960330B	BLOOD	1.7	
1153	8-911-0308	8	NIST Paint	75	<			1.0	2	T960330B	BLOOD	0.5	
1101	8-911-0316	9	NIST Paint	225				6.0	2	T960330B	BLOOD	6.0	
1108	8-911-0290	9	NIST Paint	225				3.6	2	T960330B	BLOOD	3.6	
1111	8-911-0291	9	NIST Paint	225				7.3	2	T960330B	BLOOD	7.3	
1132	8-911-0339	9	NIST Paint	225				3.1	2	T960330B	BLOOD	3.1	
1152	8-911-0295	9	NIST Paint	225				5.9	2	T960330B	BLOOD	5.9	
1113	8-911-0327	10	NIST Paint	675				11.0	2	T960330B	BLOOD	11.0	
1119	8-911-0287	10	NIST Paint	675				6.7	2	T960330B	BLOOD	6.7	
1120	8-911-0315	10	NIST Paint	675			10.6	9.8	2	T960330B	BLOOD	10.6	
1125	8-911-0314	10	NIST Paint	675				7.2	2	T960330B	BLOOD	7.2	
1147	8-911-0313	10	NIST Paint	675				7.3	2	T960330B	BLOOD	7.3	
1109	8-911-0367	1	Control	0	<			1.0	3	T960330B	BLOOD	0.5	
1124	8-911-0375	1	Control	0	<			1.0	3	T960330B	BLOOD	0.5	
1135	8-911-0357	1	Control	0	<			1.0	3	T960330B	BLOOD	0.5	
1139	8-911-0340	1	Control	0	<			1.0	3	T960330B	BLOOD	0.5	
1151	8-911-0345	1	Control	0	<			1.0	3	T960330B	BLOOD	0.5	
1103	8-911-0384	2	PbAc	25				1.1	3	T960330B	BLOOD	1.1	
1104	8-911-0370	2	PbAc	25				1.0	3	T960330B	BLOOD	1.0	
1116	8-911-0353	2	PbAc	25				1.6	3	T960330B	BLOOD	1.6	
1117	8-911-0379	2	PbAc	25	<			1.0	3	T960330B	BLOOD	0.5	
1118	8-911-0374	2	PbAc	25	<			1.0	3	T960330B	BLOOD	0.5	
1105	8-911-0342	3	PbAc	75				2.4	3	T960330B	BLOOD	2.4	
1123	8-911-0351	3	PbAc	75				2.8	3	T960330B	BLOOD	2.8	
1129	8-911-0372	3	PbAc	75	<			1.0	3	T960330B	BLOOD	0.5	
1130	8-911-0391	3	PbAc	75				1.9	3	T960330B	BLOOD	1.9	
1144	8-911-0360	3	PbAc	75				1.3	3	T960330B	BLOOD	1.3	
1121	8-911-0377	4	PbAc	225				5.9	3	T960330B	BLOOD	5.9	
1136	8-911-0390	4	PbAc	225				2.7	3	T960330B	BLOOD	2.7	
1138	8-911-0355	4	PbAc	225				4.3	3	T960330B	BLOOD	4.3	
1146	8-911-0356	4	PbAc	225				5.2	3	T960330B	BLOOD	5.2	
1150	8-911-0386	4	PbAc	225				5.4	3	T960330B	BLOOD	5.4	
1110	8-911-0361	8	NIST Paint	75				1.9	3	T960330B	BLOOD	1.9	
1115	8-911-0347	8	NIST Paint	75					3		BLOOD		Removed
1134	8-911-0371	8	NIST Paint	75				1.4	3	T960330B	BLOOD	1.4	
1148	8-911-0393	8	NIST Paint	75				1.2	3	T960330B	BLOOD	1.2	
1153	8-911-0383	8	NIST Paint	75				1.9	3	T960330B	BLOOD	1.9	
1101	8-911-0378	9	NIST Paint	225				3.4	3	T960330B	BLOOD	3.4	
1108	8-911-0365	9	NIST Paint	225				3.9	3	T960330B	BLOOD	3.9	
1111	8-911-0385	9	NIST Paint	225				5.9	3	T960330B	BLOOD	5.9	
1132	8-911-0376	9	NIST Paint	225				3.1	3	T960330B	BLOOD	3.1	
1152	8-911-0366	9	NIST Paint	225				5.9	3	T960330B	BLOOD	5.9	
1113	8-911-0349	10	NIST Paint	675				9.4	3	T960330B	BLOOD	9.4	
1119	8-911-0354	10	NIST Paint	675				6.5	3	T960330B	BLOOD	6.5	
1120	8-911-0388	10	NIST Paint	675				8.9	3	T960330B	BLOOD	8.9	
1125	8-911-0363	10	NIST Paint	675				7.0	3	T960330B	BLOOD	7.0	
1147	8-911-0350	10	NIST Paint	675				10.2	3	T960330B	BLOOD	10.2	
1109	8-911-0418	1	Control	0				12.6	5	T960330B	BLOOD	12.6	
1124	8-911-0425	1	Control	0	<			1.0	5	T960330B	BLOOD	0.5	
1135	8-911-0438	1	Control	0	<			1.0	5	T960330B	BLOOD	0.5	
1139	8-911-0434	1	Control	0	<			1.0	5	T960330B	BLOOD	0.5	
1151	8-911-0417	1	Control	0	<			1.0	5	T960330B	BLOOD	0.5	
1103	8-911-0415	2	PbAc	25				1.0	5	T960330B	BLOOD	1.0	
1104	8-911-0405	2	PbAc	25				1.3	5	T960330B	BLOOD	1.3	
1116	8-911-0399	2	PbAc	25	<			1.0	5	T960330B	BLOOD	0.5	
1117	8-911-0437	2	PbAc	25				1.8	5	T960330B	BLOOD	1.8	
1118	8-911-0413	2	PbAc	25				1.4	5	T960330B	BLOOD	1.4	
1105	8-911-0442	3	PbAc	75				3.4	5	T960330B	BLOOD	3.4	
1123	8-911-0443	3	PbAc	75				3.9	5	T960330B	BLOOD	3.9	
1129	8-911-0409	3	PbAc	75				2.7	5	T960330B	BLOOD	2.7	
1130	8-911-0398	3	PbAc	75				2.1	5	T960330B	BLOOD	2.1	
1144	8-911-0432	3	PbAc	75				1.9	5	T960330B	BLOOD	1.9	
1121	8-911-0430	4	PbAc	225				9.6	5	T960330B	BLOOD	9.6	
1136	8-911-0397	4	PbAc	225				5.4	5	T960330B	BLOOD	5.4	
1138	8-911-0424	4	PbAc	225				6.5	5	T960330B	BLOOD	6.5	
1146	8-911-0427	4	PbAc	225				8.4	5	T960330B	BLOOD	8.4	
1150	8-911-0407	4	PbAc	225				8.4	5	T960330B	BLOOD	8.4	
1110	8-911-0435	8	NIST Paint	75				1.9	5	T960330B	BLOOD	1.9	
1115	8-911-0403	8	NIST Paint	75					5		BLOOD		Removed
1134	8-911-0448	8	NIST Paint	75				3.1	5	T960330B	BLOOD	3.1	
1148	8-911-0428	8	NIST Paint	75				3.1	5	T960330B	BLOOD	3.1	

pig number	sample	group	material administered	dosage	qualifier	reanqualifier	reanresult	result (ug/L)	day	source file	MATRIX	Adjusted Value (ug/dL)[a]	Notes
1153	8-911-0408	8	NIST Paint	75				2.1	5	T960330B	BLOOD	2.1	
1101	8-911-0444	9	NIST Paint	225				8.0	5	T960330B	BLOOD	8.0	
1108	8-911-0433	9	NIST Paint	225				6.2	5	T960330B	BLOOD	6.2	
1111	8-911-0414	9	NIST Paint	225				10.3	5	T960330B	BLOOD	10.3	
1132	8-911-0416	9	NIST Paint	225				3.5	5	T960330B	BLOOD	3.5	
1152	8-911-0412	9	NIST Paint	225				5.6	5	T960330B	BLOOD	5.6	
1113	8-911-0420	10	NIST Paint	675				12.0	5	T960330B	BLOOD	12.0	
1119	8-911-0411	10	NIST Paint	675				8.2	5	T960330B	BLOOD	8.2	
1120	8-911-0445	10	NIST Paint	675				12.9	5	T960330B	BLOOD	12.9	
1125	8-911-0396	10	NIST Paint	675				8.7	5	T960330B	BLOOD	8.7	
1147	8-911-0395	10	NIST Paint	675				11.2	5	T960330B	BLOOD	11.2	
1109	8-911-0453	1	Control	0	<			1.0	7	T960330B	BLOOD	0.5	
1124	8-911-0485	1	Control	0	<			1.0	7	T960330B	BLOOD	0.5	
1135	8-911-0479	1	Control	0	<			1.0	7	T960330B	BLOOD	0.5	
1139	8-911-0466	1	Control	0	<			1.0	7	T960330B	BLOOD	0.5	
1151	8-911-0492	1	Control	0	<			1.0	7	T960330B	BLOOD	0.5	
1103	8-911-0471	2	PbAc	25				1.5	7	T960330B	BLOOD	1.5	
1104	8-911-0451	2	PbAc	25				1.5	7	T960330B	BLOOD	1.5	
1116	8-911-0491	2	PbAc	25	<			1.0	7	T960330B	BLOOD	0.5	
1117	8-911-0464	2	PbAc	25				2.5	7	T960330B	BLOOD	2.5	
1118	8-911-0472	2	PbAc	25				1.2	7	T960330B	BLOOD	1.2	
1105	8-911-0489	3	PbAc	75				3.8	7	T960330B	BLOOD	3.8	
1123	8-911-0501	3	PbAc	75				4.3	7	T960330B	BLOOD	4.3	
1129	8-911-0461	3	PbAc	75				3.0	7	T960330B	BLOOD	3.0	
1130	8-911-0454	3	PbAc	75				2.9	7	T960330B	BLOOD	2.9	
1144	8-911-0480	3	PbAc	75				3.1	7	T960330B	BLOOD	3.1	
1121	8-911-0474	4	PbAc	225				7.6	7	T960330B	BLOOD	7.6	
1136	8-911-0496	4	PbAc	225				5.9	7	T960330B	BLOOD	5.9	
1138	8-911-0469	4	PbAc	225				5.9	7	T960330B	BLOOD	5.9	
1146	8-911-0484	4	PbAc	225				8.0	7	T960330B	BLOOD	8.0	
1150	8-911-0450	4	PbAc	225				11.7	7	T960330B	BLOOD	11.7	
1110	8-911-0488	8	NIST Paint	75				1.9	7	T960330B	BLOOD	1.9	
1115	8-911-0465	8	NIST Paint	75					7		BLOOD		Removed
1134	8-911-0504	8	NIST Paint	75				2.7	7	T960330B	BLOOD	2.7	
1148	8-911-0456	8	NIST Paint	75				3.7	7	T960330B	BLOOD	3.7	
1153	8-911-0486	8	NIST Paint	75				2.0	7	T960330B	BLOOD	2.0	
1101	8-911-0494	9	NIST Paint	225				7.2	7	T960330B	BLOOD	7.2	
1108	8-911-0470	9	NIST Paint	225				5.8	7	T960330B	BLOOD	5.8	
1111	8-911-0487	9	NIST Paint	225				9.1	7	T960330B	BLOOD	9.1	
1132	8-911-0457	9	NIST Paint	225				4.1	7	T960330B	BLOOD	4.1	
1152	8-911-0467	9	NIST Paint	225				7.5	7	T960330B	BLOOD	7.5	
1113	8-911-0502	10	NIST Paint	675				11.3	7	T960330B	BLOOD	11.3	
1119	8-911-0477	10	NIST Paint	675				7.7	7	T960330B	BLOOD	7.7	
1120	8-911-0490	10	NIST Paint	675				12.0	7	T960330B	BLOOD	12.0	
1125	8-911-0493	10	NIST Paint	675				8.5	7	T960330B	BLOOD	8.5	
1147	8-911-0500	10	NIST Paint	675				11.5	7	T960330B	BLOOD	11.5	
1109	8-911-0533	1	Control	0	<			1.0	9	T960330B	BLOOD	0.5	
1124	8-911-0546	1	Control	0	<			1.0	9	T960330B	BLOOD	0.5	
1135	8-911-0510	1	Control	0	<			1.0	9	T960330B	BLOOD	0.5	
1139	8-911-0556	1	Control	0	<			1.0	9	T960410B	BLOOD	0.5	
1151	8-911-0527	1	Control	0	<			1.0	9	T960330B	BLOOD	0.5	
1103	8-911-0543	2	PbAc	25				1.6	9	T960330B	BLOOD	1.6	
1104	8-911-0524	2	PbAc	25	<			1.0	9	T960330B	BLOOD	0.5	
1116	8-911-0551	2	PbAc	25	<			1.0	9	T960410B	BLOOD	0.5	
1117	8-911-0507	2	PbAc	25				3.3	9	T960330B	BLOOD	3.3	
1118	8-911-0536	2	PbAc	25				2.1	9	T960330B	BLOOD	2.1	
1105	8-911-0559	3	PbAc	75				3.4	9	T960410B	BLOOD	3.4	
1123	8-911-0544	3	PbAc	75				3.3	9	T960330B	BLOOD	3.3	
1129	8-911-0534	3	PbAc	75				3.9	9	T960330B	BLOOD	3.9	
1130	8-911-0520	3	PbAc	75				3.1	9	T960330B	BLOOD	3.1	
1144	8-911-0553	3	PbAc	75				2.8	9	T960410B	BLOOD	2.8	
1121	8-911-0542	4	PbAc	225				8.8	9	T960330B	BLOOD	8.8	
1136	8-911-0511	4	PbAc	225				5.8	9	T960330B	BLOOD	5.8	
1138	8-911-0547	4	PbAc	225				4.9	9	T960330B	BLOOD	4.9	
1146	8-911-0529	4	PbAc	225				8.3	9	T960330B	BLOOD	8.3	
1150	8-911-0521	4	PbAc	225				10.3	9	T960330B	BLOOD	10.3	
1110	8-911-0558	8	NIST Paint	75				2.0	9	T960410B	BLOOD	2.0	
1115	8-911-0517	8	NIST Paint	75					9		BLOOD		Removed
1134	8-911-0531	8	NIST Paint	75				2.8	9	T960330B	BLOOD	2.8	
1148	8-911-0541	8	NIST Paint	75				3.7	9	T960330B	BLOOD	3.7	
1153	8-911-0537	8	NIST Paint	75				3.5	9	T960330B	BLOOD	3.5	
1101	8-911-0505	9	NIST Paint	225				5.4	9	T960330B	BLOOD	5.4	
1108	8-911-0540	9	NIST Paint	225				5.8	9	T960330B	BLOOD	5.8	
1111	8-911-0525	9	NIST Paint	225				8.9	9	T960330B	BLOOD	8.9	
1132	8-911-0548	9	NIST Paint	225				4.9	9	T960330B	BLOOD	4.9	
1152	8-911-0528	9	NIST Paint	225				7.3	9	T960330B	BLOOD	7.3	
1113	8-911-0506	10	NIST Paint	675				12.4	9	T960330B	BLOOD	12.4	
1119	8-911-0550	10	NIST Paint	675				7.7	9	T960410B	BLOOD	7.7	
1120	8-911-0519	10	NIST Paint	675				14.8	9	T960330B	BLOOD	14.8	
1125	8-911-0522	10	NIST Paint	675				8.9	9	T960330B	BLOOD	8.9	
1147	8-911-0538	10	NIST Paint	675				13.6	9	T960330B	BLOOD	13.6	
1109	8-911-0585	1	Control	0	<			1.0	12	T960410B	BLOOD	0.5	
1124	8-911-0595	1	Control	0	<			1.0	12	T960410B	BLOOD	0.5	
1135	8-911-0566	1	Control	0	<			1.0	12	T960410B	BLOOD	0.5	
1139	8-911-0573	1	Control	0	<			1.0	12	T960410B	BLOOD	0.5	
1151	8-911-0600	1	Control	0	<			1.0	12	T960410B	BLOOD	0.5	
1103	8-911-0580	2	PbAc	25	<			1.0	12	T960410B	BLOOD	0.5	
1104	8-911-0584	2	PbAc	25				1.2	12	T960410B	BLOOD	1.2	
1116	8-911-0574	2	PbAc	25	<			1.0	12	T960410B	BLOOD	0.5	
1117	8-911-0578	2	PbAc	25				3.5	12	T960410B	BLOOD	3.5	
1118	8-911-0588	2	PbAc	25				2.5	12	T960410B	BLOOD	2.5	
1105	8-911-0593	3	PbAc	75				5.0	12	T960410B	BLOOD	5.0	
1123	8-911-0599	3	PbAc	75				3.7	12	T960410B	BLOOD	3.7	
1129	8-911-0612	3	PbAc	75				5.1	12	T960410B	BLOOD	5.1	
1130	8-911-0571	3	PbAc	75				3.8	12	T960410B	BLOOD	3.8	
1144	8-911-0610	3	PbAc	75				3.8	12	T960410B	BLOOD	3.8	
1121	8-911-0570	4	PbAc	225				9.5	12	T960410B	BLOOD	9.5	
1136	8-911-0611	4	PbAc	225				6.4	12	T960410B	BLOOD	6.4	
1138	8-911-0581	4	PbAc	225				7.3	12	T960410B	BLOOD	7.3	
1146	8-911-0607	4	PbAc	225				8.3	12	T960410B	BLOOD	8.3	
1150	8-911-0609	4	PbAc	225				10.9	12	T960410B	BLOOD	10.9	
1110	8-911-0587	8	NIST Paint	75				2.4	12	T960410B	BLOOD	2.4	

pig number	sample	group	material administered	dosage	qualifier	reanqualifier	reanresult	result (ug/L)	day	source file	MATRIX	Adjusted Value (ug/dL)[a]	Notes
1115	8-911-0576	8	NIST Paint	75					12		BLOOD		Removed
1134	8-911-0613	8	NIST Paint	75				3.8	12	T960410B	BLOOD	3.8	
1148	8-911-0592	8	NIST Paint	75				3.7	12	T960410B	BLOOD	3.7	
1153	8-911-0577	8	NIST Paint	75				2.8	12	T960410B	BLOOD	2.8	
1101	8-911-0582	9	NIST Paint	225				6.6	12	T960410B	BLOOD	6.6	
1108	8-911-0604	9	NIST Paint	225				5.9	12	T960410B	BLOOD	5.9	
1111	8-911-0596	9	NIST Paint	225				11.4	12	T960410B	BLOOD	11.4	
1132	8-911-0605	9	NIST Paint	225				6.3	12	T960410B	BLOOD	6.3	
1152	8-911-0560	9	NIST Paint	225				6.2	12	T960410B	BLOOD	6.2	
1113	8-911-0589	10	NIST Paint	675				13.5	12	T960410B	BLOOD	13.5	
1119	8-911-0583	10	NIST Paint	675				10.9	12	T960410B	BLOOD	10.9	
1120	8-911-0597	10	NIST Paint	675				13.0	12	T960410B	BLOOD	13.0	
1125	8-911-0563	10	NIST Paint	675				9.3	12	T960410B	BLOOD	9.3	
1147	8-911-0591	10	NIST Paint	675				15.8	12	T960410B	BLOOD	15.8	
1109	8-911-0633	1	Control	0	<			1.0	15	T960410B	BLOOD	0.5	
1124	8-911-0659	1	Control	0	<			1.0	15	T960410B	BLOOD	0.5	
1135	8-911-0638	1	Control	0	<			1.0	15	T960410B	BLOOD	0.5	
1139	8-911-0622	1	Control	0	<			1.0	15	T960410B	BLOOD	0.5	
1151	8-911-0627	1	Control	0	<			1.0	15	T960410B	BLOOD	0.5	
1103	8-911-0666	2	PbAc	25				2.1	15	T960410B	BLOOD	2.1	
1104	8-911-0637	2	PbAc	25				1.6	15	T960410B	BLOOD	1.6	
1116	8-911-0665	2	PbAc	25				1.4	15	T960410B	BLOOD	1.4	
1117	8-911-0653	2	PbAc	25				3.2	15	T960410B	BLOOD	3.2	
1118	8-911-0652	2	PbAc	25				2.9	15	T960410B	BLOOD	2.9	
1105	8-911-0660	3	PbAc	75				4.4	15	T960410B	BLOOD	4.4	
1123	8-911-0628	3	PbAc	75				3.8	15	T960410B	BLOOD	3.8	
1129	8-911-0631	3	PbAc	75				4.9	15	T960410B	BLOOD	4.9	
1130	8-911-0643	3	PbAc	75				4.9	15	T960410B	BLOOD	4.9	
1144	8-911-0632	3	PbAc	75				4.0	15	T960410B	BLOOD	4.0	
1121	8-911-0636	4	PbAc	225				10.8	15	T960410B	BLOOD	10.8	
1136	8-911-0650	4	PbAc	225				7.4	15	T960410B	BLOOD	7.4	
1138	8-911-0619	4	PbAc	225				8.4	15	T960410B	BLOOD	8.4	
1146	8-911-0657	4	PbAc	225				9.8	15	T960410B	BLOOD	9.8	
1150	8-911-0664	4	PbAc	225				10.8	15	T960410B	BLOOD	10.8	
1110	8-911-0625	8	NIST Paint	75				2.3	15	T960410B	BLOOD	2.3	
1115	8-911-0649	8	NIST Paint	75					15		BLOOD		Removed
1134	8-911-0667	8	NIST Paint	75				3.4	15	T960410B	BLOOD	3.4	
1148	8-911-0647	8	NIST Paint	75				4.3	15	T960410B	BLOOD	4.3	
1153	8-911-0640	8	NIST Paint	75				4.7	15	T960410B	BLOOD	4.7	
1101	8-911-0635	9	NIST Paint	225				6.0	15	T960410B	BLOOD	6.0	
1108	8-911-0623	9	NIST Paint	225				6.3	15	T960410B	BLOOD	6.3	
1111	8-911-0655	9	NIST Paint	225				12.6	15	T960410B	BLOOD	12.6	
1132	8-911-0648	9	NIST Paint	225				6.6	15	T960410B	BLOOD	6.6	
1152	8-911-0645	9	NIST Paint	225				8.4	15	T960410B	BLOOD	8.4	
1113	8-911-0639	10	NIST Paint	675				15.9	15	T960410B	BLOOD	15.9	
1119	8-911-0654	10	NIST Paint	675				10.7	15	T960410B	BLOOD	10.7	
1120	8-911-0642	10	NIST Paint	675				13.4	15	T960410B	BLOOD	13.4	
1125	8-911-0618	10	NIST Paint	675				11.3	15	T960410B	BLOOD	11.3	
1147	8-911-0644	10	NIST Paint	675				18.8	15	T960410B	BLOOD	18.8	

a Non-detects evaluated using 1/2 the quantitation limit; laboratory results (ug/L) converted to concentration in blood (ug/dL) by dividing by dilution factor of 1 dL/L

TABLE A-4 BLOOD LEAD OUTLIERS

Flagged Data Points
Outliers

test material	target dosage	Actual Dose*	group	pig#	BLOOD LEAD (ug/dL) BY DAY									
					-4	0	1	2	3	5	7	9	12	15
Control	0	0.00	1	1109	0.5	0.5	0.5	0.5	0.5	12.6	0.5	0.5	0.5	0.5
Control	0	0.00	1	1124	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5
Control	0	0.00	1	1135	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5
Control	0	0.00	1	1139	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5
Control	0	0.00	1	1151	0.5	1.1	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5
PbAc	25	28.07	2	1103	0.5	0.5	0.5	0.5	1.1	1.0	1.5	1.6	0.5	2.1
PbAc	25	27.79	2	1104	0.5	0.5	0.5	0.5	1.0	1.3	1.5	0.5	1.2	1.6
PbAc	25	26.95	2	1116	0.5	0.5	0.5	0.5	1.6	0.5	0.5	0.5	0.5	1.4
PbAc	25	28.98	2	1117	1.2	0.5	0.5	0.5	0.5	1.8	2.5	3.3	3.5	3.2
PbAc	25	26.80	2	1118	0.5	0.5	5.5	0.5	0.5	1.4	1.2	2.1	2.5	2.9
PbAc	75	80.74	3	1105	0.5	0.5	0.5	1.3	2.4	3.4	3.8	3.4	5.0	4.4
PbAc	75	80.66	3	1123	0.5	0.5	0.5	2.7	2.8	3.9	4.3	3.3	3.7	3.8
PbAc	75	79.01	3	1129	0.5	0.5	0.5	1.2	0.5	2.7	3.0	3.9	5.1	4.9
PbAc	75	71.00	3	1130	0.5	0.5	0.5	2.8	1.9	2.1	2.9	3.1	3.8	4.9
PbAc	75	80.29	3	1144	0.5	0.5	0.5	1.4	1.3	1.9	3.1	2.8	3.8	4.0
PbAc	225	229.76	4	1121	0.5	0.5	3.3	5.9	5.9	9.6	7.6	8.8	9.5	10.8
PbAc	225	259.69	4	1136	0.5	0.5	1.4	2.9	2.7	5.4	5.9	5.8	6.4	7.4
PbAc	225	245.48	4	1138	0.5	0.5	2.0	3.4	4.3	6.5	5.9	4.9	7.3	8.4
PbAc	225	214.31	4	1146	0.5	0.5	3.6	5.2	5.2	8.4	8.0	8.3	8.3	9.8
PbAc	225	215.95	4	1150	0.5	0.5	4.5	6.2	5.4	8.4	11.7	10.3	10.9	10.8
NIST Paint	75	81.16	8	1110	0.5	0.5	0.5	1.0	1.9	1.9	1.9	2.0	2.4	2.3
NIST Paint	75	0.00	8	1115										
NIST Paint	75	78.99	8	1134	0.5	0.5	1.1	1.8	1.4	3.1	2.7	2.8	3.8	3.4
NIST Paint	75	71.45	8	1148	0.5	1.5	0.5	1.7	1.2	3.1	3.7	3.7	3.7	4.3
NIST Paint	75	74.44	8	1153	0.5	0.5	0.5	0.5	1.9	2.1	2.0	3.5	2.8	4.7
NIST Paint	225	241.52	9	1101	0.5	0.5	1.1	6.0	3.4	8.0	7.2	5.4	6.6	6.0
NIST Paint	225	244.59	9	1108	0.5	0.5	2.1	3.6	3.9	6.2	5.8	5.8	5.9	6.3
NIST Paint	225	256.23	9	1111	0.5	0.5	3.3	7.3	5.9	10.3	9.1	8.9	11.4	12.6
NIST Paint	225	206.11	9	1132	0.5	2.3	1.3	3.1	3.1	3.5	4.1	4.9	6.3	6.6
NIST Paint	225	223.53	9	1152	0.5	1.3	2.5	5.9	5.9	5.6	7.5	7.3	6.2	8.4
NIST Paint	675	646.14	10	1113	0.5	0.5	7.5	11.0	9.4	12.0	11.3	12.4	13.5	15.9
NIST Paint	675	723.55	10	1119	1.3	0.5	3.8	6.7	6.5	8.2	7.7	7.7	10.9	10.7
NIST Paint	675	664.32	10	1120	0.5	0.5	7.0	10.6	8.9	12.9	12.0	14.8	13.0	13.4
NIST Paint	675	703.79	10	1125	0.5	0.5	4.5	7.2	7.0	8.7	8.5	8.9	9.3	11.3
NIST Paint	675	740.71	10	1147	0.5	0.5	6.0	7.3	10.2	11.2	11.5	13.6	15.8	18.8

*** Average Time and Weight-Adjusted Dose for Each Pig**

Animal removed during course of study

TABLE A-5 RATIONALE FOR PbB OUTLIER DECISIONS

Pig # 1109 Group 1 Day 5	The measured value for this data point (12.6) was substantially higher than measured in this same animal on the preceding or following sampling days, and was also higher than measured in other animals in the same group on the same day. This value was replaced with an interpolated estimate of 0.5 ug/dL.
Pig # 1118 Group 2 Day 1	The measured value for this data point (5.8) was substantially higher than measured in this same animal on the preceding or following sampling days, and was also higher than measured in other animals in the same group on the same day. This value was replaced with an interpolated estimate of 0.5 ug/dL

TABLE A-6 Area Under Curve Determinations

Calculated using interpolated values for excluded data as noted in Table A-5

		AUC (ug/dL-days) For Time Span Shown								AUC Total
group	pig#	0-1	1-2	2-3	3-5	5-7	7-9	9-12	12-15	(ug/dL-days)
1	1109	0.50	0.50	0.50	1.00	1.00	1.00	1.50	1.50	7.50
1	1124	0.50	0.50	0.50	1.00	1.00	1.00	1.50	1.50	7.50
1	1135	0.50	0.50	0.50	1.00	1.00	1.00	1.50	1.50	7.50
1	1139	0.50	0.50	0.50	1.00	1.00	1.00	1.50	1.50	7.50
1	1151	0.80	0.50	0.50	1.00	1.00	1.00	1.50	1.50	7.80
2	1103	0.50	0.50	0.80	2.10	2.50	3.10	3.15	3.90	16.55
2	1104	0.50	0.50	0.75	2.30	2.80	2.00	2.55	4.20	15.60
2	1116	0.50	0.50	1.05	2.10	1.00	1.00	1.50	2.85	10.50
2	1117	0.50	0.50	0.50	2.30	4.30	5.80	10.20	10.05	34.15
2	1118	0.50	0.50	0.50	1.90	2.60	3.30	6.90	8.10	24.30
3	1105	0.50	0.90	1.85	5.80	7.20	7.20	12.60	14.10	50.15
3	1123	0.50	1.60	2.75	6.70	8.20	7.60	10.50	11.25	49.10
3	1129	0.50	0.85	0.85	3.20	5.70	6.90	13.50	15.00	46.50
3	1130	0.50	1.65	2.35	4.00	5.00	6.00	10.35	13.05	42.90
3	1144	0.50	0.95	1.35	3.20	5.00	5.90	9.90	11.70	38.50
4	1121	1.90	4.60	5.90	15.50	17.20	16.40	27.45	30.45	119.40
4	1136	0.95	2.15	2.80	8.10	11.30	11.70	18.30	20.70	76.00
4	1138	1.25	2.70	3.85	10.80	12.40	10.80	18.30	23.55	83.65
4	1146	2.05	4.40	5.20	13.60	16.40	16.30	24.90	27.15	110.00
4	1150	2.50	5.35	5.80	13.80	20.10	22.00	31.80	32.55	133.90
8	1110	0.50	0.75	1.45	3.80	3.80	3.90	6.60	7.05	27.85
8	1115									
8	1134	0.80	1.45	1.60	4.50	5.80	5.50	9.90	10.80	40.35
8	1148	1.00	1.10	1.45	4.30	6.80	7.40	11.10	12.00	45.15
8	1153	0.50	0.50	1.20	4.00	4.10	5.50	9.45	11.25	36.50
9	1101	0.80	3.55	4.70	11.40	15.20	12.60	18.00	18.90	85.15
9	1108	1.30	2.85	3.75	10.10	12.00	11.60	17.55	18.30	77.45
9	1111	1.90	5.30	6.60	16.20	19.40	18.00	30.45	36.00	133.85
9	1132	1.80	2.20	3.10	6.60	7.60	9.00	16.80	19.35	66.45
9	1152	1.90	4.20	5.90	11.50	13.10	14.80	20.25	21.90	93.55
10	1113	4.00	9.25	10.20	21.40	23.30	23.70	38.85	44.10	174.80
10	1119	2.15	5.25	6.60	14.70	15.90	15.40	27.90	32.40	120.30
10	1120	3.75	8.80	9.75	21.80	24.90	26.80	41.70	39.60	177.10
10	1125	2.50	5.85	7.10	15.70	17.20	17.40	27.30	30.90	123.95
10	1147	3.25	6.65	8.75	21.40	22.70	25.10	44.10	51.90	183.85

Animal removed during course of study

TABLE A - 7 TISSUE LEAD DATA

Phase II Experiment 11 (Data not shown for groups 5, 6, & 7)

pig number	sample	group	material administered	dosage	qualifier	result (ug/L)	day	source file	MATRIX	Adjusted Value *	Notes
1109	8-911-0843	1	Control	0		3.2	15	T960501F	FEMUR	1.6	
1124	8-911-0836	1	Control	0	<	2.0	15	T960501F	FEMUR	0.5	
1135	8-911-0832	1	Control	0	<	2.0	15	T960501F	FEMUR	0.5	
1139	8-911-0851	1	Control	0	<	2.0	15	T960501F	FEMUR	0.5	
1151	8-911-0812	1	Control	0	<	2.0	15	T960501F	FEMUR	0.5	
1103	8-911-0831	2	PbAc	25		2.4	15	T960501F	FEMUR	1.2	
1104	8-911-0856	2	PbAc	25		3.8	15	T960501F	FEMUR	1.9	
1116	8-911-0828	2	PbAc	25		3.2	15	T960501F	FEMUR	1.6	
1117	8-911-0842	2	PbAc	25		4.8	15	T960501F	FEMUR	2.4	
1118	8-911-0855	2	PbAc	25		4.2	15	T960501F	FEMUR	2.1	
1105	8-911-0859	3	PbAc	75		9.3	15	T960501F	FEMUR	4.7	
1123	8-911-0825	3	PbAc	75		7.2	15	T960501F	FEMUR	3.6	
1129	8-911-0833	3	PbAc	75		12.0	15	T960501F	FEMUR	6.0	
1130	8-911-0844	3	PbAc	75		8.5	15	T960501F	FEMUR	4.3	
1144	8-911-0848	3	PbAc	75		8.1	15	T960501F	FEMUR	4.1	
1121	8-911-0822	4	PbAc	225		38.8	15	T960501F	FEMUR	19.4	
1136	8-911-0829	4	PbAc	225		23.5	15	T960501F	FEMUR	11.8	
1138	8-911-0837	4	PbAc	225		26.3	15	T960501F	FEMUR	13.2	
1146	8-911-0864	4	PbAc	225		31.5	15	T960501F	FEMUR	15.8	
1150	8-911-0816	4	PbAc	225		33.4	15	T960501F	FEMUR	16.7	
1110	8-911-0854	8	NIST Paint	75		4.9	15	T960501F	FEMUR	2.5	
1115	8-911-0847	8	NIST Paint	75			15		FEMUR		Removed
1134	8-911-0846	8	NIST Paint	75		6.6	15	T960501F	FEMUR	3.3	
1148	8-911-0838	8	NIST Paint	75		6.4	15	T960501F	FEMUR	3.2	
1153	8-911-0819	8	NIST Paint	75		6.3	15	T960501F	FEMUR	3.2	
1101	8-911-0863	9	NIST Paint	225		14.7	15	T960501F	FEMUR	7.4	
1108	8-911-0857	9	NIST Paint	225		22.8	15	T960501F	FEMUR	11.4	
1111	8-911-0861	9	NIST Paint	225		28.9	15	T960501F	FEMUR	14.5	
1132	8-911-0820	9	NIST Paint	225		13.9	15	T960501F	FEMUR	7.0	
1152	8-911-0826	9	NIST Paint	225		17.2	15	T960501F	FEMUR	8.6	
1113	8-911-0853	10	NIST Paint	675		70.0	15	T960501F	FEMUR	35.0	
1119	8-911-0813	10	NIST Paint	675		51.6	15	T960501F	FEMUR	25.8	
1120	8-911-0849	10	NIST Paint	675		80.7	15	T960501F	FEMUR	40.4	
1125	8-911-0824	10	NIST Paint	675		47.2	15	T960501F	FEMUR	23.6	
1147	8-911-0839	10	NIST Paint	675		58.4	15	T960501F	FEMUR	29.2	
1109	8-911-0800	1	Control	0		1.3	15	T960420K	KIDNEY	13.0	
1124	8-911-0772	1	Control	0		2.9	15	T960420K	KIDNEY	29.0	
1135	8-911-0760	1	Control	0		3.0	15	T960420K	KIDNEY	30.0	
1139	8-911-0765	1	Control	0	<	2.0	15	T960420K	KIDNEY	10.0	
1151	8-911-0805	1	Control	0		1.5	15	T960420K	KIDNEY	15.0	
1103	8-911-0778	2	PbAc	25		3.6	15	T960420K	KIDNEY	36.0	
1104	8-911-0796	2	PbAc	25		14.4	15	T960420K	KIDNEY	144.0	
1116	8-911-0783	2	PbAc	25		3.1	15	T960420K	KIDNEY	31.0	
1117	8-911-0759	2	PbAc	25		3.5	15	T960420K	KIDNEY	35.0	
1118	8-911-0787	2	PbAc	25		14.8	15	T960420K	KIDNEY	148.0	
1105	8-911-0785	3	PbAc	75		9.4	15	T960420K	KIDNEY	94.0	
1123	8-911-0761	3	PbAc	75		12.3	15	T960420K	KIDNEY	123.0	
1129	8-911-0802	3	PbAc	75		22.8	15	T960420K	KIDNEY	228.0	
1130	8-911-0781	3	PbAc	75		10.0	15	T960420K	KIDNEY	100.0	
1144	8-911-0762	3	PbAc	75		16.3	15	T960420K	KIDNEY	163.0	
1121	8-911-0797	4	PbAc	225		59.9	15	T960420K	KIDNEY	599.0	
1136	8-911-0770	4	PbAc	225		29.5	15	T960420K	KIDNEY	295.0	
1138	8-911-0801	4	PbAc	225		30.2	15	T960420K	KIDNEY	302.0	
1146	8-911-0771	4	PbAc	225		27.0	15	T960420K	KIDNEY	270.0	
1150	8-911-0792	4	PbAc	225		59.9	15	T960420K	KIDNEY	599.0	
1110	8-911-0798	8	NIST Paint	75		7.1	15	T960420K	KIDNEY	71.0	
1115	8-911-0808	8	NIST Paint	75			15		KIDNEY		Removed
1134	8-911-0780	8	NIST Paint	75		5.9	15	T960420K	KIDNEY	59.0	
1148	8-911-0791	8	NIST Paint	75		6.6	15	T960420K	KIDNEY	66.0	
1153	8-911-0779	8	NIST Paint	75		7.2	15	T960420K	KIDNEY	72.0	
1101	8-911-0767	9	NIST Paint	225		20.7	15	T960420K	KIDNEY	207.0	
1108	8-911-0810	9	NIST Paint	225		24.1	15	T960420K	KIDNEY	241.0	
1111	8-911-0784	9	NIST Paint	225		47.3	15	T960420K	KIDNEY	473.0	
1132	8-911-0764	9	NIST Paint	225		21.6	15	T960420K	KIDNEY	216.0	
1152	8-911-0782	9	NIST Paint	225		27.5	15	T960420K	KIDNEY	275.0	
1113	8-911-0786	10	NIST Paint	675		84.1	15	T960420K	KIDNEY	841.0	
1119	8-911-0768	10	NIST Paint	675		62.8	15	T960420K	KIDNEY	628.0	
1120	8-911-0775	10	NIST Paint	675		134.0	15	T960420K	KIDNEY	1340.0	
1125	8-911-0766	10	NIST Paint	675		62.4	15	T960420K	KIDNEY	624.0	
1147	8-911-0763	10	NIST Paint	675		85.4	15	T960420K	KIDNEY	854.0	
1109	8-911-0750	1	Control	0	<	2.0	15	T960420L	LIVER	10.0	
1124	8-911-0730	1	Control	0		2.6	15	T960420L	LIVER	26.0	
1135	8-911-0744	1	Control	0	<	2.0	15	T960420L	LIVER	10.0	
1139	8-911-0716	1	Control	0	<	2.0	15	T960420L	LIVER	10.0	
1151	8-911-0706	1	Control	0	<	2.0	15	T960420L	LIVER	10.0	
1103	8-911-0708	2	PbAc	25		6.0	15	T960420L	LIVER	60.0	
1104	8-911-0735	2	PbAc	25		11.3	15	T960420L	LIVER	113.0	
1116	8-911-0738	2	PbAc	25		2.4	15	T960420L	LIVER	24.0	
1117	8-911-0722	2	PbAc	25		3.2	15	T960420L	LIVER	32.0	
1118	8-911-0752	2	PbAc	25		10.0	15	T960420L	LIVER	100.0	

pig number	sample	group	material administered	dosage	qualifier	result (ug/L)	day	source file	MATRIX	Adjusted Value [a]	Notes
1105	8-911-0732	3	PbAc	75		6.7	15	T960420L	LIVER	67.0	
1123	8-911-0740	3	PbAc	75		5.2	15	T960420L	LIVER	52.0	
1129	8-911-0756	3	PbAc	75		14.5	15	T960420L	LIVER	145.0	
1130	8-911-0748	3	PbAc	75		7.4	15	T960420L	LIVER	74.0	
1144	8-911-0754	3	PbAc	75		17.7	15	T960420L	LIVER	177.0	
1121	8-911-0741	4	PbAc	225		46.0	15	T960420L	LIVER	460.0	
1136	8-911-0727	4	PbAc	225		17.8	15	T960420L	LIVER	178.0	
1138	8-911-0720	4	PbAc	225		34.0	15	T960420L	LIVER	340.0	
1146	8-911-0747	4	PbAc	225		22.3	15	T960420L	LIVER	223.0	
1150	8-911-0717	4	PbAc	225		41.0	15	T960420L	LIVER	410.0	
1110	8-911-0734	8	NIST Paint	75		6.0	15	T960420L	LIVER	60.0	
1115	8-911-0755	8	NIST Paint	75			15		LIVER		Removed
1134	8-911-0711	8	NIST Paint	75		7.6	15	T960420L	LIVER	76.0	
1148	8-911-0712	8	NIST Paint	75		7.0	15	T960420L	LIVER	70.0	
1153	8-911-0715	8	NIST Paint	75		9.6	15	T960420L	LIVER	96.0	
1101	8-911-0742	9	NIST Paint	225		15.9	15	T960420L	LIVER	159.0	
1108	8-911-0743	9	NIST Paint	225		14.1	15	T960420L	LIVER	141.0	
1111	8-911-0739	9	NIST Paint	225		47.8	15	T960420L	LIVER	478.0	
1132	8-911-0728	9	NIST Paint	225		15.4	15	T960420L	LIVER	154.0	
1152	8-911-0729	9	NIST Paint	225		27.5	15	T960420L	LIVER	275.0	
1113	8-911-0726	10	NIST Paint	675		145.0	15	T960420L	LIVER	1450.0	
1119	8-911-0757	10	NIST Paint	675		67.5	15	T960420L	LIVER	675.0	
1120	8-911-0721	10	NIST Paint	675		112.0	15	T960420L	LIVER	1120.0	
1125	8-911-0707	10	NIST Paint	675		68.1	15	T960420L	LIVER	681.0	
1147	8-911-0746	10	NIST Paint	675		137.0	15	T960420L	LIVER	1370.0	

a Non-detects evaluated using 1/2 the quantitation limit. Laboratory results (ug/L) converted to tissue concentrations by dividing by sample dilution factors of 0.1 kg/L (liver, kidney) or 2 g/L (ashed bone). Final units are ug Pb/kg wet weight (liver, kidney) or ug Pb/g ashed bone (femur)

TABLE A-8 SUMMARY OF ENDPOINT OUTLIERS

[ ] Selected Outliers

test material	target dosage	Actual Dose*	group	pig#	MEASUREMENT ENDPOINT Blood	Femur	Liver	Kidney
Control	0	0.00	1	1109	7.5	1.6	10	13
Control	0	0.00	1	1124	7.5	0.5	26	29
Control	0	0.00	1	1135	7.5	0.5	10	30
Control	0	0.00	1	1139	7.5	0.5	10	10
Control	0	0.00	1	1151	7.8	0.5	10	15
PbAc	25	28.07	2	1103	16.6	1.2	60	36
PbAc	25	27.79	2	1104	15.6	1.9	113	144
PbAc	25	26.95	2	1116	10.5	1.6	24	31
PbAc	25	28.98	2	1117	34.2	2.4	32	35
PbAc	25	26.80	2	1118	24.3	2.1	100	148
PbAc	75	80.74	3	1105	50.2	4.65	67	94
PbAc	75	80.66	3	1123	49.1	3.6	52	123
PbAc	75	79.01	3	1129	46.5	6	145	228
PbAc	75	71.00	3	1130	42.9	4.25	74	100
PbAc	75	80.29	3	1144	38.5	4.05	177	163
PbAc	225	229.76	4	1121	119.4	[19.4 b]	460	599
PbAc	225	259.69	4	1136	76.0	[11.75 b]	[178 b]	295
PbAc	225	245.48	4	1138	83.7	13.15	340	302
PbAc	225	214.31	4	1146	110.0	15.75	223	270
PbAc	225	215.95	4	1150	[133.9 b]	16.7	410	[599 b]
NIST Paint	75	81.16	8	1110	27.9	2.45	60	71
NIST Paint	75	0.00	8	1115				
NIST Paint	75	78.99	8	1134	40.4	3.3	76	59
NIST Paint	75	71.45	8	1148	45.2	3.2	70	66
NIST Paint	75	74.44	8	1153	36.5	3.15	96	72
NIST Paint	225	241.52	9	1101	85.2	7.35	159	207
NIST Paint	225	244.59	9	1108	77.5	11.4	141	241
NIST Paint	225	256.23	9	1111	133.9	14.45	478	473
NIST Paint	225	206.11	9	1132	66.5	6.95	154	216
NIST Paint	225	223.53	9	1152	93.6	8.6	275	275
NIST Paint	675	646.14	10	1113	174.8	35	[1450 b]	841
NIST Paint	675	723.55	10	1119	120.3	25.8	675	628
NIST Paint	675	664.32	10	1120	177.1	[40.35 b]	1120	[1340 b]
NIST Paint	675	703.79	10	1125	124.0	23.6	681	624
NIST Paint	675	740.71	10	1147	183.9	29.2	1370	854

▨ Animal removed during course of study

a *a priori* outlier determinations (none selected in this study)

b Outside 95% Prediction Intervals

TABLE A-9 Best Curve Fit Parameters

BLOOD

PbAc Curve -	Exp
a	6.48
b	
c	152.4
d	0.0045
R2	0.863

NIST Paint Curve -	Exp
a	6.48
b	
c	152.4
d	0.0037
R2	0.893

BONE

PbAc Curve -	Linear
a	0.46
b	0.0623
c	
d	
R2	0.935

NIST Paint Curve -	Linear
a	0.46
b	0.039
c	
d	
R2	0.927

LIVER

PbAc Curve -	Linear
a	5.96
b	1.526
c	
d	
R2	0.841

NIST Paint Curve -	Linear
a	5.96
b	1.3
c	
d	
R2	0.829

KIDNEY

PbAc Curve -	Linear
a	22.53
b	1.454
c	
d	
R2	0.71

NIST Paint Curve -	Linear
a	22.53
b	1.02
c	
d	
R2	0.92

Equations Used	
EXP	Y=a+c*(1-exp(-d*dose))
LIN	Y=a+b*dose

TABLE A-10 Relative Bioavailability of Lead in Test Materials

Endpoint	Test Material NIST Paint
Blood	0.82
Liver	0.85
Kidney	0.70
Bone	0.63

Definitions

Plausible Range:	RBA(Blood) to mean RBA for Tissues
Preferred Range:	RBA(Blood) to (RBA(Blood) + RBA(Tissues))/2
Suggested Point Est:	1/2(RBA(Blood) + (RBA(Blood)+RBA(Tissues))/2)

Relative Bioavailability

	NIST Paint	
Plausible Range	0.82	0.73
Preferred Range	0.82	0.77
Point Estimate	0.80	

Absolute Bioavailability

	NIST Paint	
Plausible Range	41%	36%
Preferred Range	41%	39%
Point Estimate	40%	

TABLE A-11 INTRALABORATORY DUPLICATES

RPD = Relative Percent Difference
RPD = 100*[Orig-Dup]/((Orig+Dup)/2

* Non detects evaluated at 1/2 DL

Pig number	group	material administered	dosage	day	matrix	Duplicate Value*	Original Value*	Average	RPD	Avg RPD	
1109	1	Control	0	-4	BLOOD	0.5	0.5	0.5	0%		
1136	4	PbAc	225	-4	BLOOD	0.5	0.5	0.5	0%		
1141	7	Murray Res. Soil	675	-4	BLOOD	0.5	0.5	0.5	0%		
1116	2	PbAc	25	0	BLOOD	0.5	0.5	0.5	0%		
1110	8	NIST Paint	75	0	BLOOD	0.5	0.5	0.5	0%		
1125	10	NIST Paint	675	0	BLOOD	0.5	0.5	0.5	0%		
1104	2	PbAc	25	1	BLOOD	0.5	0.5	0.5	0%		
1132	9	NIST Paint	225	1	BLOOD	1.2	1.3	1.3	8%		
1147	10	NIST Paint	675	1	BLOOD	6.8	6.0	6.4	-13%		
1139	1	Control	0	2	BLOOD	0.5	0.5	0.5	0%		
1144	3	PbAc	75	2	BLOOD	1.7	1.4	1.6	-19%		
1153	8	NIST Paint	75	2	BLOOD	2.6	0.5	1.6	-135%		
1123	3	PbAc	75	3	BLOOD	1.4	2.8	2.1	67%		
1122	6	Murray Res. Soil	225	3	BLOOD	4.9	4.5	4.7	-9%		
1134	8	NIST Paint	75	3	BLOOD	1.0	1.4	1.2	33%		
1129	3	PbAc	75	5	BLOOD	2.4	2.7	2.6	12%		
1138	4	PbAc	225	5	BLOOD	6.6	6.5	6.6	-2%		
1154	6	Murray Res. Soil	225	5	BLOOD	6.5	6.4	6.5	-2%		
1137	7	Murray Res. Soil	675	7	BLOOD	7.0	6.7	6.9	-4%		
1111	9	NIST Paint	225	7	BLOOD	10.2	9.1	9.7	-11%		
1120	10	NIST Paint	675	7	BLOOD	12.2	12.0	12.1	-2%		
1124	1	Control	0	9	BLOOD	0.5	0.5	0.5	0%		
1118	2	PbAc	25	9	BLOOD	1.9	2.1	2.0	10%		
1133	5	Murray Res. Soil	75	9	BLOOD	3.1	3.5	3.3	12%		
1117	2	PbAc	25	12	BLOOD	4.1	3.5	3.8	-16%		
1102	6	Murray Res. Soil	225	12	BLOOD	7.4	7.0	7.2	-6%		
1143	6	Murray Res. Soil	225	12	BLOOD	6.9	6.4	6.7	-8%		
1151	1	Control	0	15	BLOOD	0.5	0.5	0.5	0%		
1136	4	PbAc	225	15	BLOOD	7.9	7.4	7.7	-7%		
1132	9	NIST Paint	225	15	BLOOD	7.0	6.6	6.8	-6%	-3%	BLOOD
1124	1	Control	0	15	FEMUR	1.0	1.0	1.0	0%		
1104	2	PbAc	25	15	FEMUR	4.1	1.9	3.0	-73%		
1134	8	NIST Paint	75	15	FEMUR	5.4	3.3	4.4	-48%	-41%	FEMUR
1124	1	Control	0	15	KIDNEY	1.0	2.9	2.0	97%		
1104	2	PbAc	25	15	KIDNEY	13.2	14.4	13.8	9%		
1134	8	NIST Paint	75	15	KIDNEY	6.0	5.9	6.0	-2%	35%	KIDNEY
1124	1	Control	0	15	LIVER	1.0	2.6	1.8	89%		
1104	2	PbAc	25	15	LIVER	13.8	11.3	12.6	-20%		
1134	8	NIST Paint	75	15	LIVER	6.9	7.6	7.3	10%	26%	LIVER

TABLE A-12 CDC STANDARDS

Sample ID	Day	Q	Measured* Low Std	Measured* Med Std	Measured* High Std	Nominal Low Std	Nominal Med Std	Nominal High Std
11.1	-4		3.7			1.7	4.8	14.9
11.1	0		3.1			1.7	4.8	14.9
11.1	1	<	1.0			1.7	4.8	14.9
11.1	3		1.3			1.7	4.8	14.9
11.1	9		1.5			1.7	4.8	14.9
11.2	-4			5.2		1.7	4.8	14.9
11.2	0			4.7		1.7	4.8	14.9
11.2	1			5.0		1.7	4.8	14.9
11.2	2			4.9		1.7	4.8	14.9
11.2	5			4.1		1.7	4.8	14.9
11.2	7			3.8		1.7	4.8	14.9
11.2	12			4.8		1.7	4.8	14.9
11.2	15			4.3		1.7	4.8	14.9
11.3	2				14.9	1.7	4.8	14.9
11.3	3				14.3	1.7	4.8	14.9
11.3	5				10.1	1.7	4.8	14.9
11.3	7				18.0	1.7	4.8	14.9
11.3	9				14.5	1.7	4.8	14.9
11.3	12				14.8	1.7	4.8	14.9
11.3	15				16.0	1.7	4.8	14.9
		Avg	2.1	4.6	14.7			

* Non-detects evaluated at the detection limit

TABLE A-13 INTERLABORATORY COMPARISON

Tag Number	Pig Number	Group	Material Administered	Dosage	Qualifier			Result			
					CDC	EPA		CDC	EPA	Average	RPD
8-911-0120	1143	6	Murray Res. Soil	225	<	<		0.6	1.0	0.8	50%
8-911-0125	1103	2	PbAc	25	<	<		0.6	1.0	0.8	50%
8-911-0171	1121	4	PbAc	225	<	<		0.6	1.0	0.8	50%
8-911-0194	1113	10	NIST Paint	675	<	<		0.6	1.0	0.8	50%
8-911-0217	1106	5	Murray Res. Soil	75		<		0.6	1.0	0.8	50%
8-911-0274	1140	7	Murray Res. Soil	675				4.4	4.4	4.4	0%
8-911-0281	1108	9	NIST Paint	225				2.3	2.1	2.2	-9%
8-911-0288	1138	4	PbAc	225				3.8	3.4	3.6	-11%
8-911-0330	1148	8	NIST Paint	75				1.8	2.2	2.0	20%
8-911-0389	1133	5	Murray Res. Soil	75				1.9	1.5	1.7	-24%
8-911-0391	1130	3	PbAc	75				2.2	1.9	2.1	-15%
8-911-0425	1124	1	Control	0	<	<		0.6	1.0	0.8	50%
8-911-0427	1146	4	PbAc	225				8.3	8.4	8.4	1%
8-911-0472	1118	2	PbAc	25				2.0	1.2	1.6	-50%
8-911-0481	1137	7	Murray Res. Soil	675				7.5	6.7	7.1	-11%
8-911-0518	1141	7	Murray Res. Soil	675				10.1	9.2	9.7	-9%
8-911-0520	1130	3	PbAc	75				3.6	3.1	3.4	-15%
8-911-0573	1139	1	Control	0	<	<		0.6	1.0	0.8	50%
8-911-0612	1129	3	PbAc	75				5.2	5.1	5.2	-2%
8-911-0628	1123	3	PbAc	75				3.0	3.8	3.4	24%
8-911-0664	1150	4	PbAc	225				10.7	10.8	10.8	0.9%

FIGURE A-1 PbAc Groups by Day
Raw Data

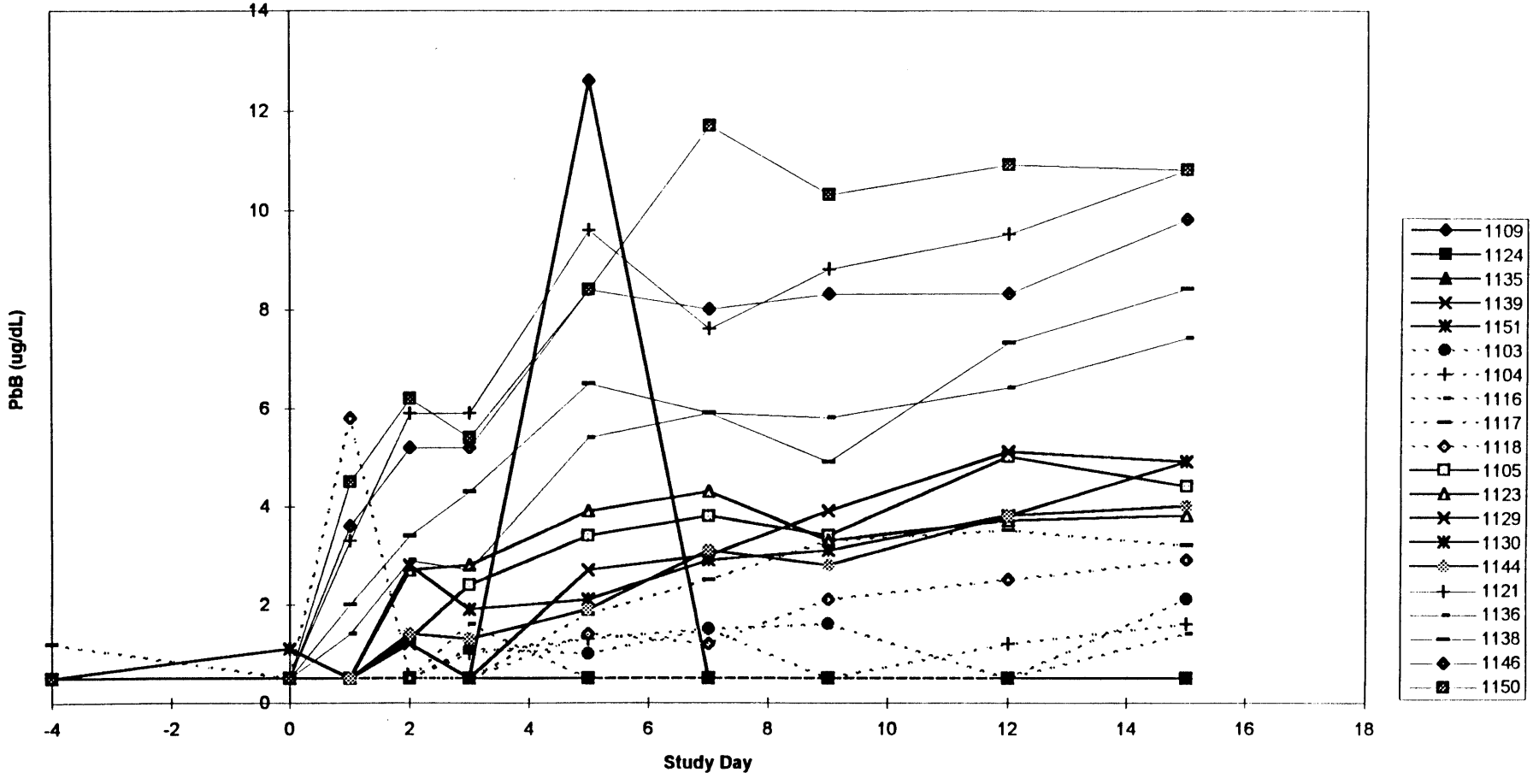


FIGURE A-2 NIST Paint Groups
Raw Data

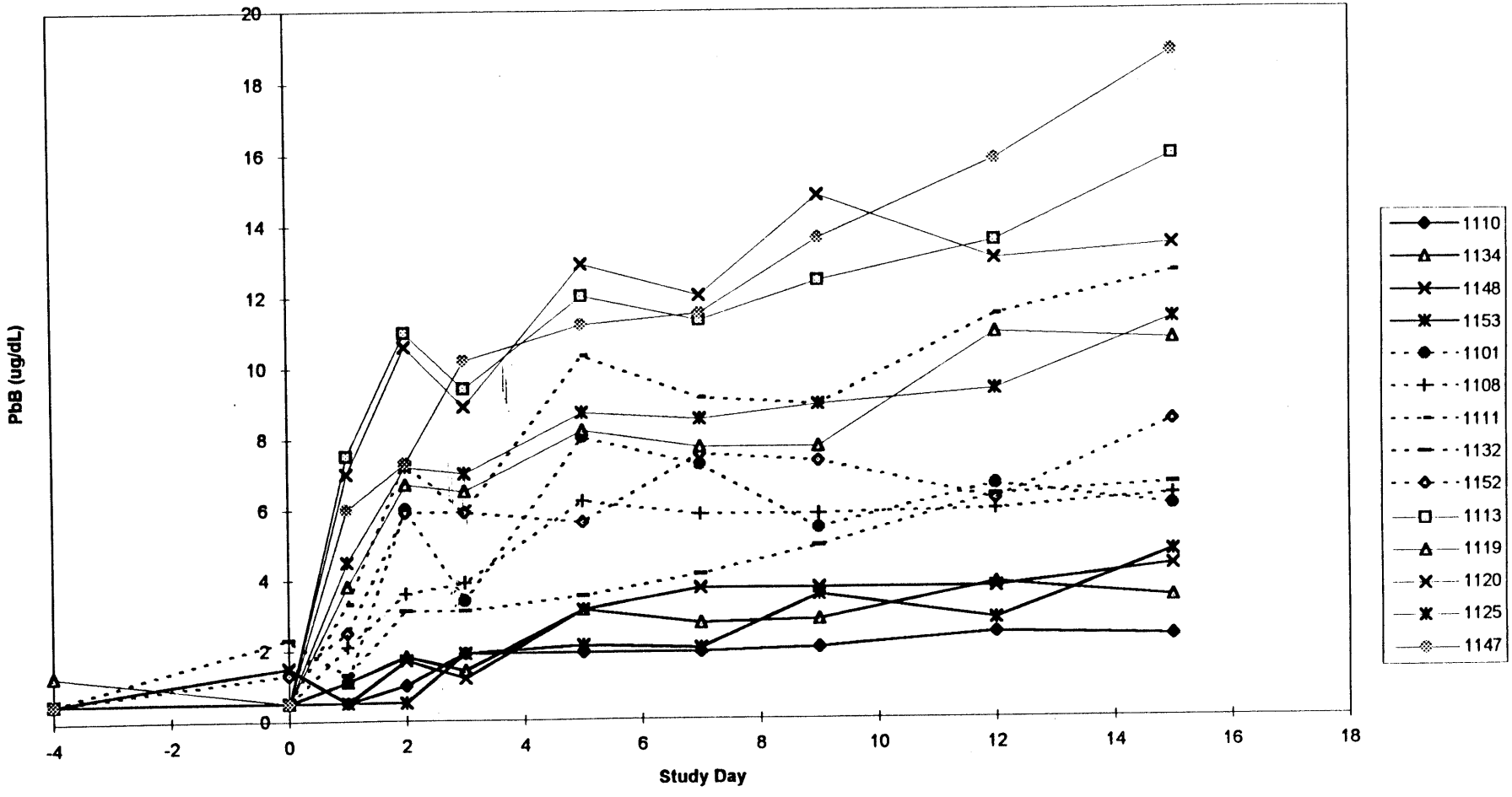


FIGURE A-3 Group Mean PbB By Day
Raw Data

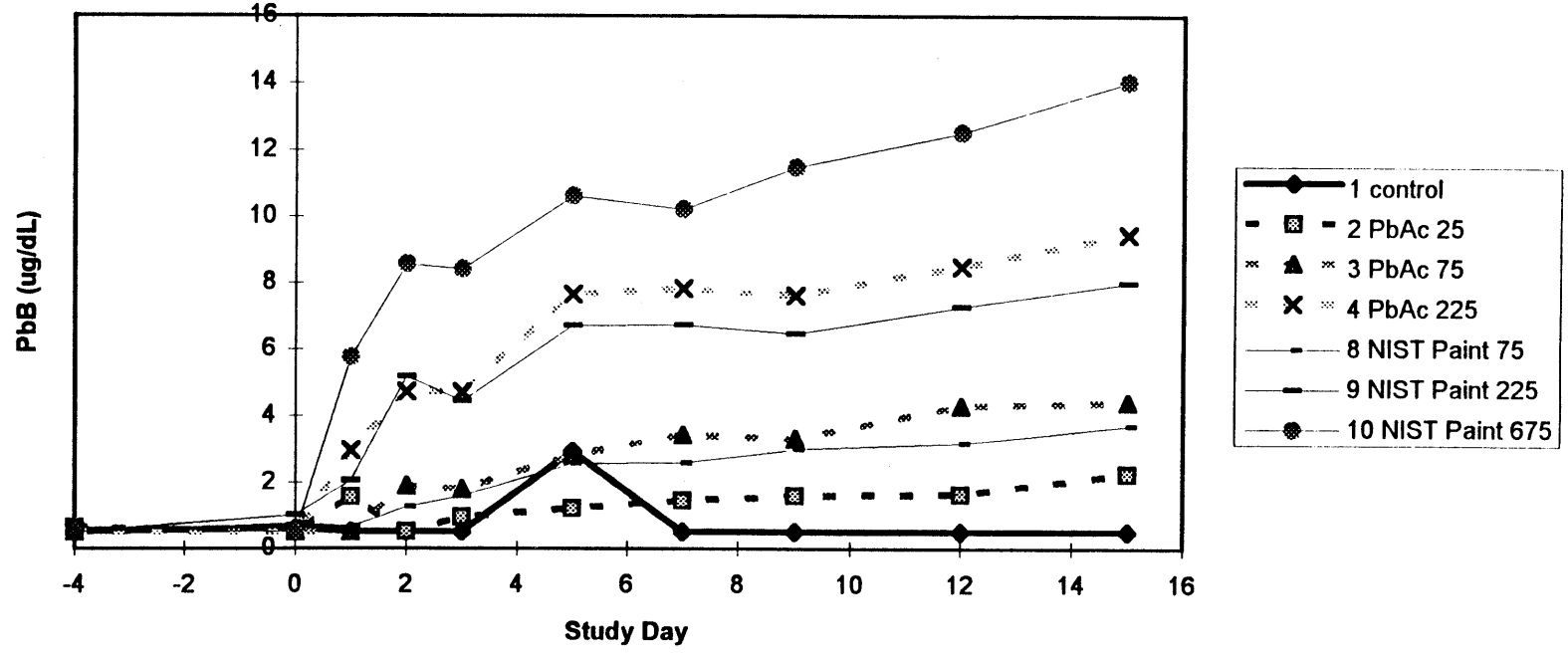


FIGURE A-4

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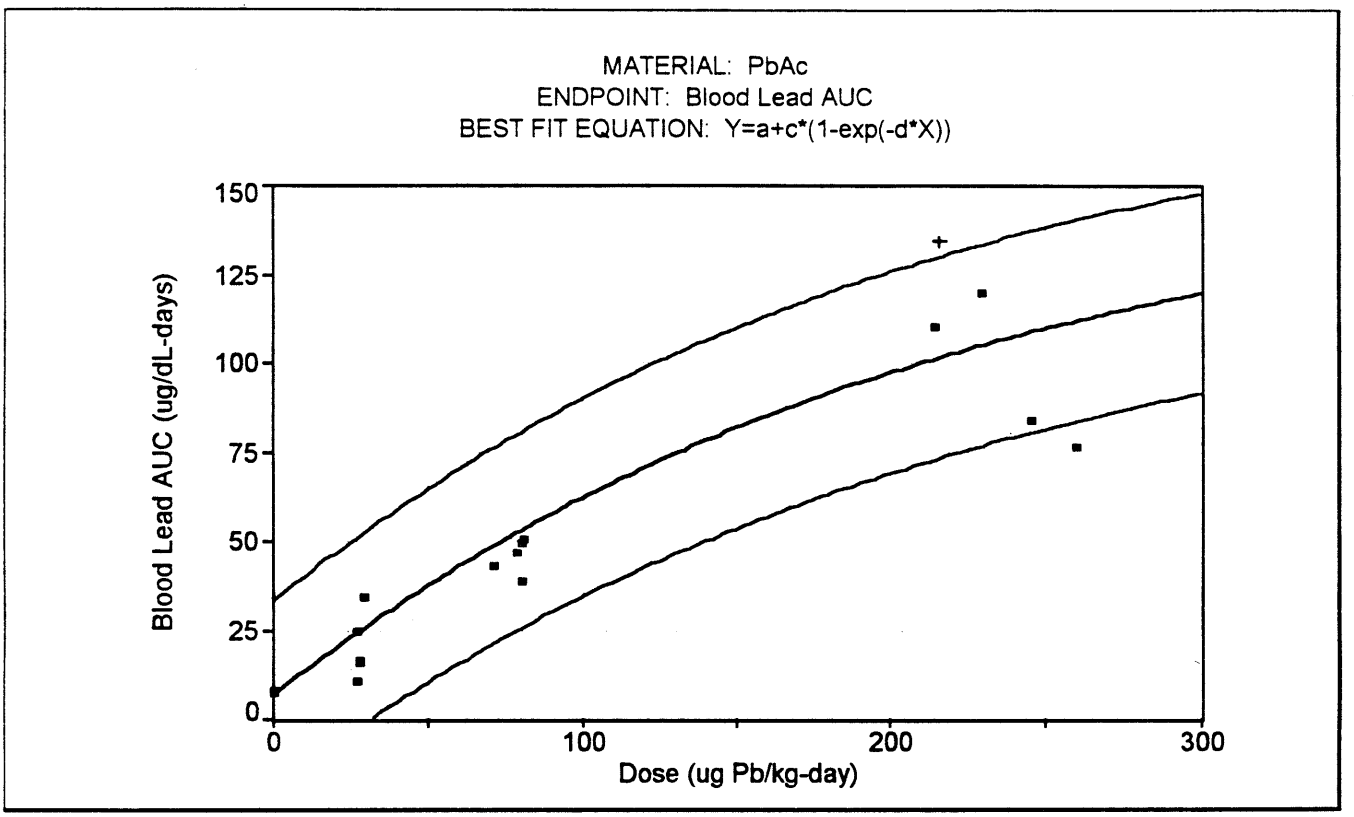
FIGURE A-5 BEST FIT CURVE WITH 95% PREDICTION INTERVALS

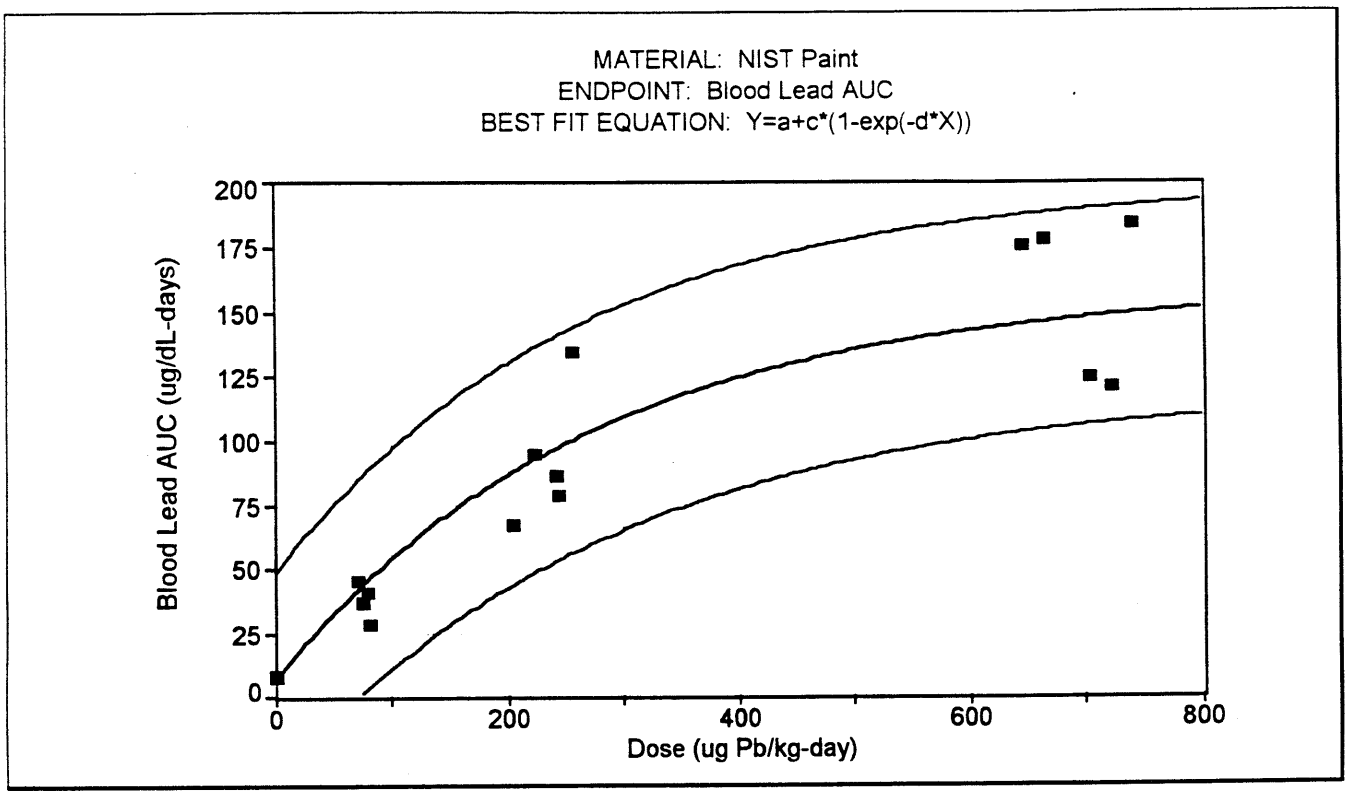


Parameters	Value	Std. Error	95% Confidence Limits	
a	6.48	fixed value	–	–
c	152.4	fixed value	–	–
d	0.0045	0.0004	0.0037	0.0053

Adj R^2	0.863

Generated using Table Curve 2D v. 3.0. Outliers represented by "+".

FIGURE A-6 BEST FIT CURVE WITH 95% PREDICTION INTERVALS

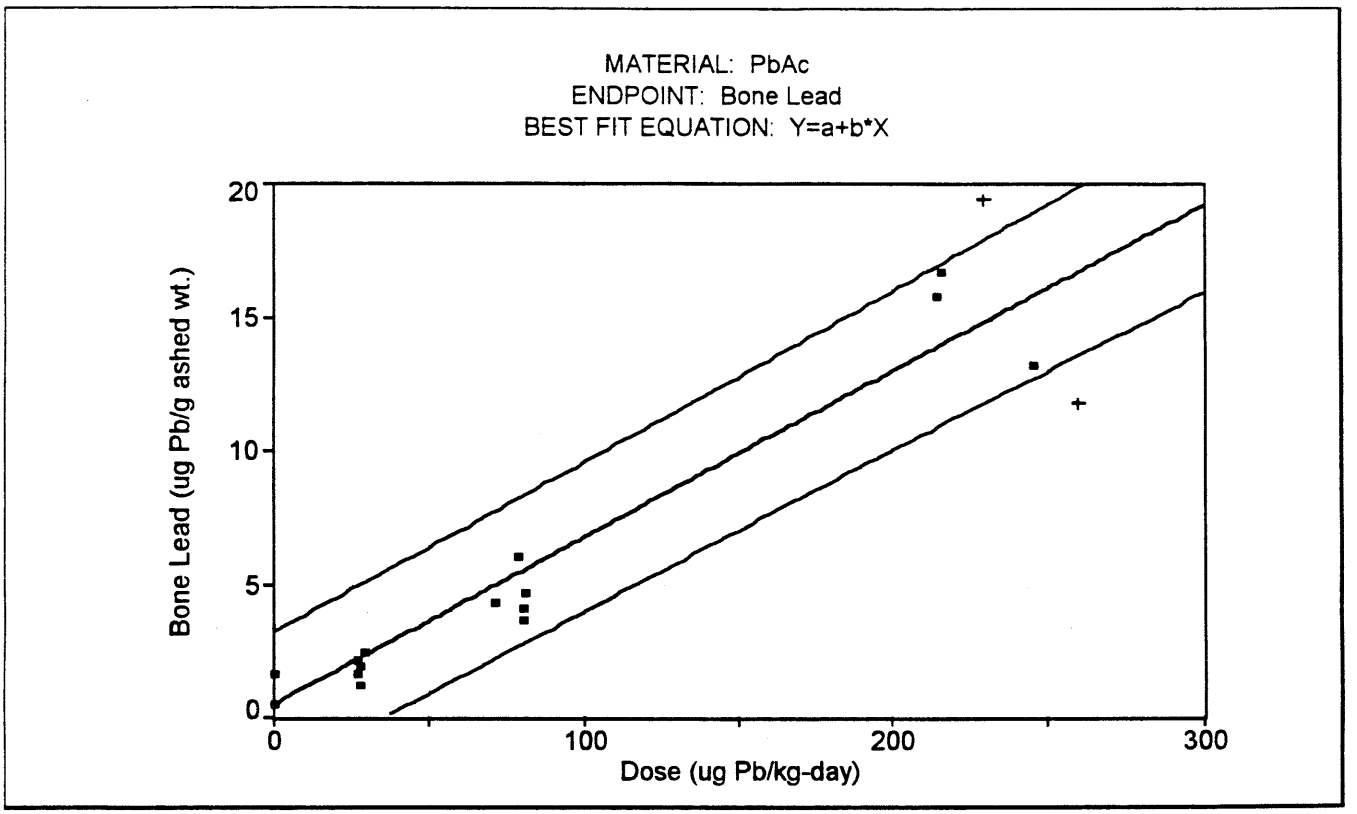


Parameters	Value	Std. Error	95% Confidence Limits	
a	6.48	fixed value	–	–
c	152.4	fixed value	–	–
d	0.0037	0.00046	0.0027	0.0046

Adj R^2	0.893

Generated using Table Curve 2D v. 3.0. Outliers represented by "+".

FIGURE A-7 BEST FIT CURVE WITH 95% PREDICTION INTERVALS

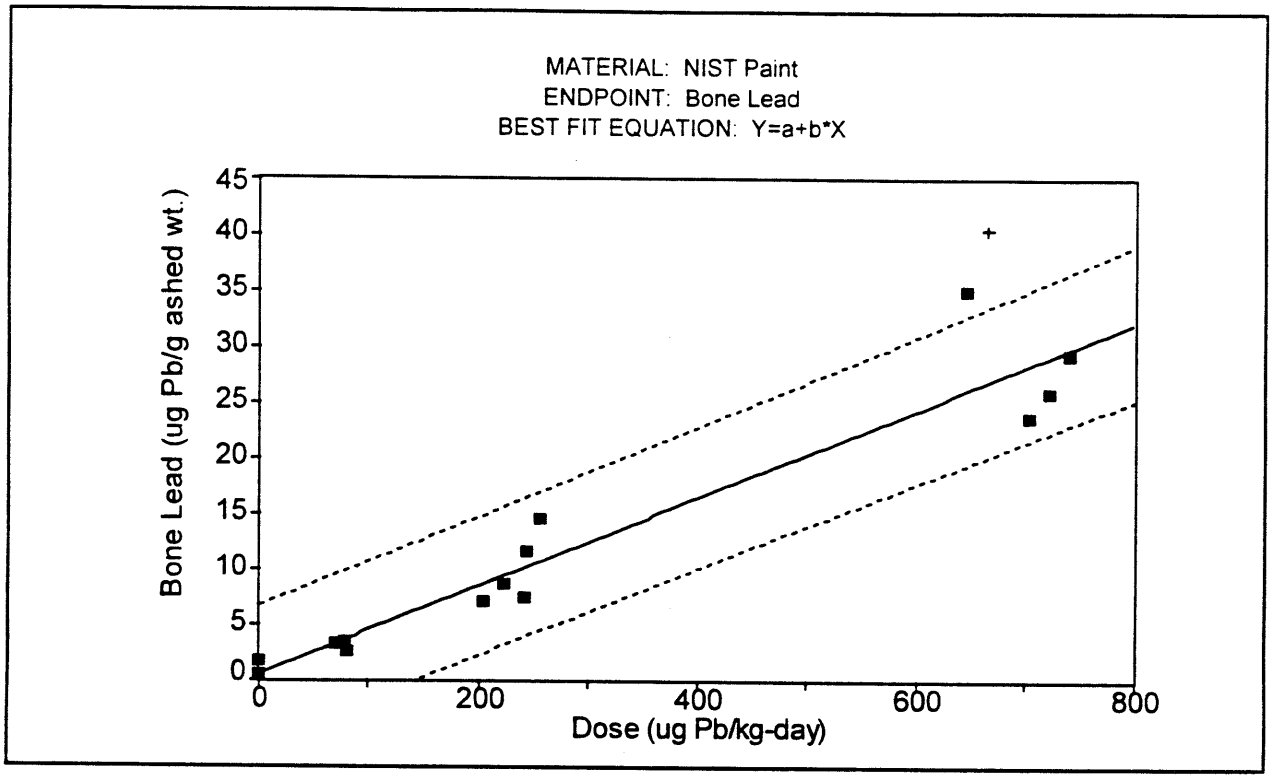


Parameters	Value	Std. Error	95% Confidence Limits	
a	0.46	fixed value	–	–
b	0.062	0.003	0.056	0.069

Adj R^2	0.935

Generated using Table Curve 2D v. 3.0. Outliers represented by "+".

FIGURE A-8 BEST FIT CURVE WITH 95% PREDICTION INTERVALS*

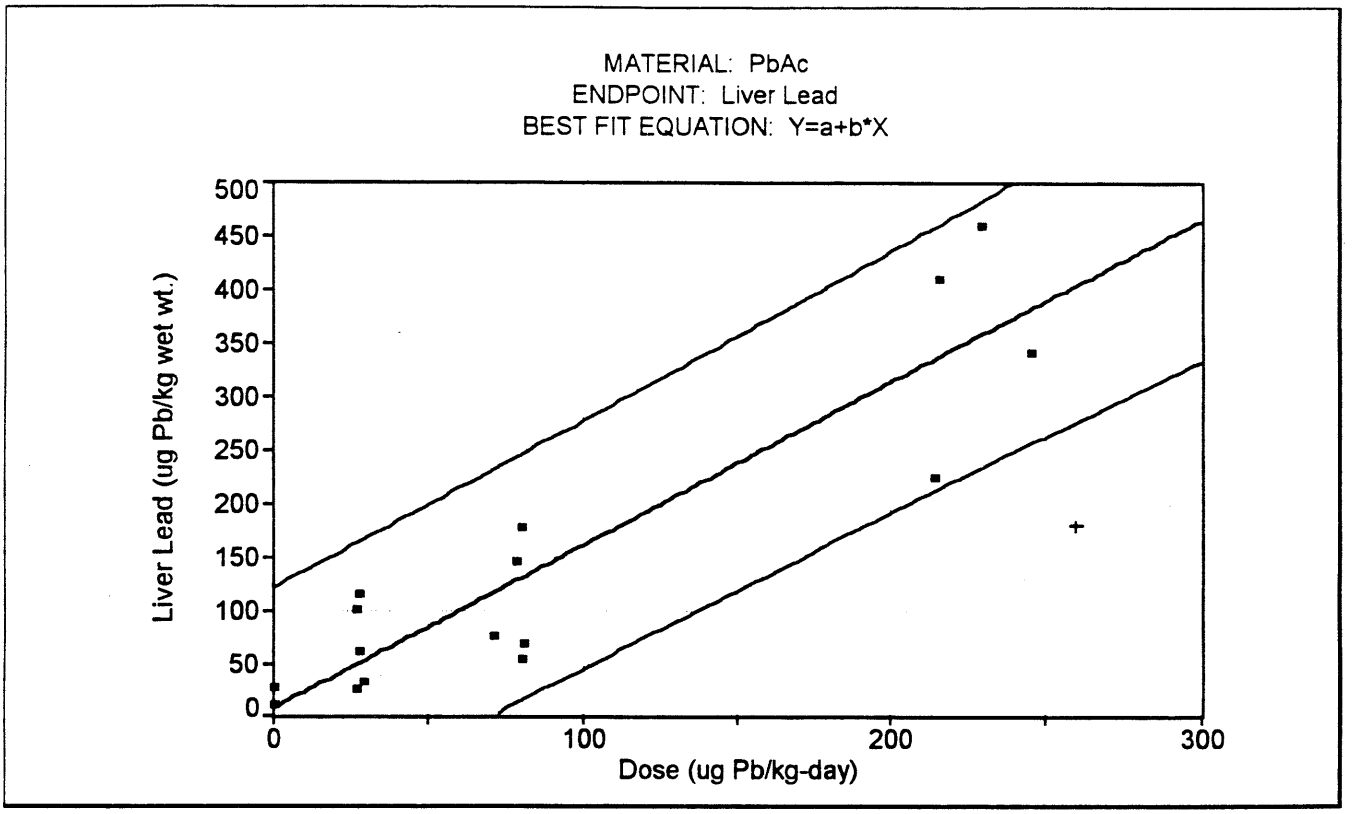


Parameters	Value	Std. Error	95% Confidence Limits	
a	0.46	fixed value	--	--
b	0.039	0.0019	0.035	0.043

Adj R^2	0.927

Generated using Table Curve 2D v. 3.0. Outliers represented by "+".

FIGURE A-9 BEST FIT CURVE WITH 95% PREDICTION INTERVALS

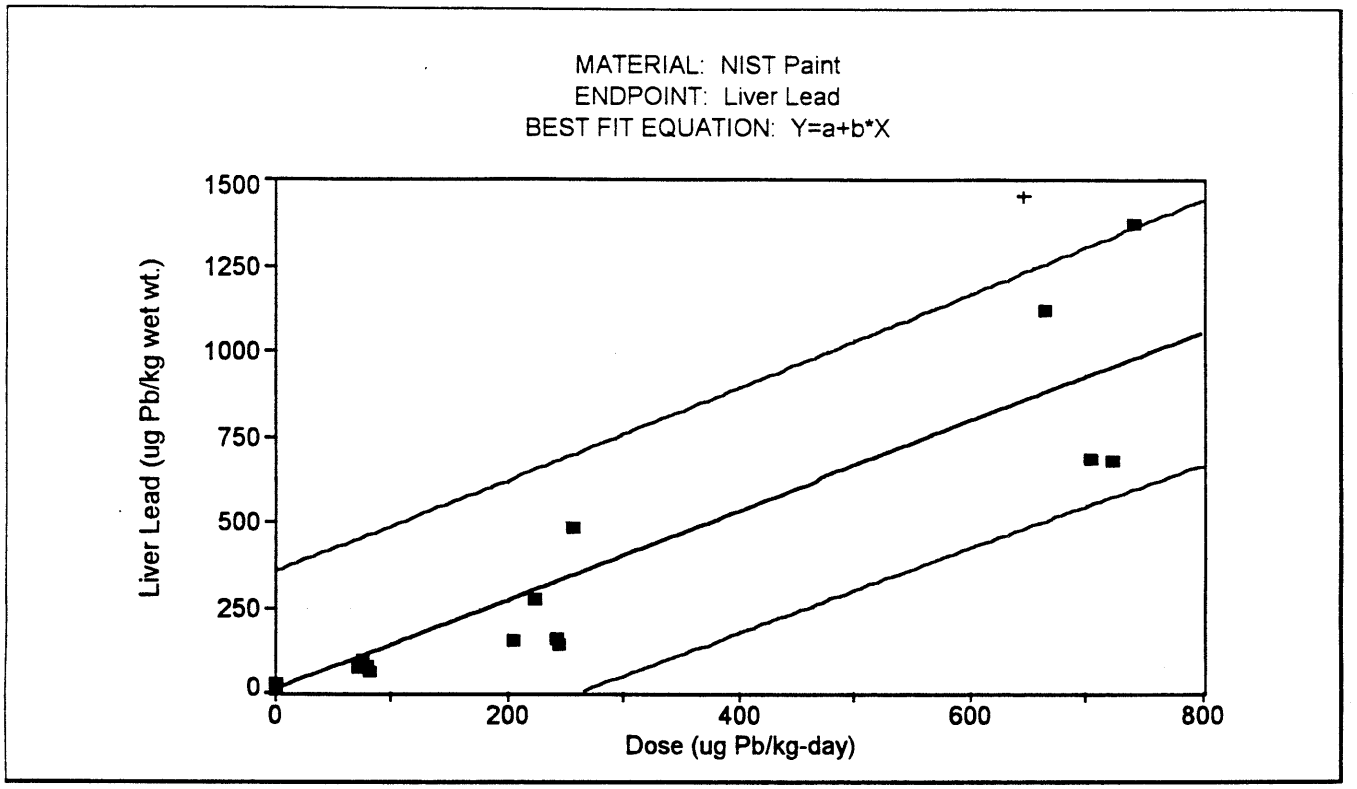


Parameters	Value	Std. Error	95% Confidence Limits	
a	5.96	fixed value	–	–
b	1.53	0.11	1.29	1.76

Adj R^2	0.841

Generated using Table Curve 2D v. 3.0. Outliers represented by "+".

FIGURE A-10 BEST FIT CURVE WITH 95% PREDICTION INTERVALS

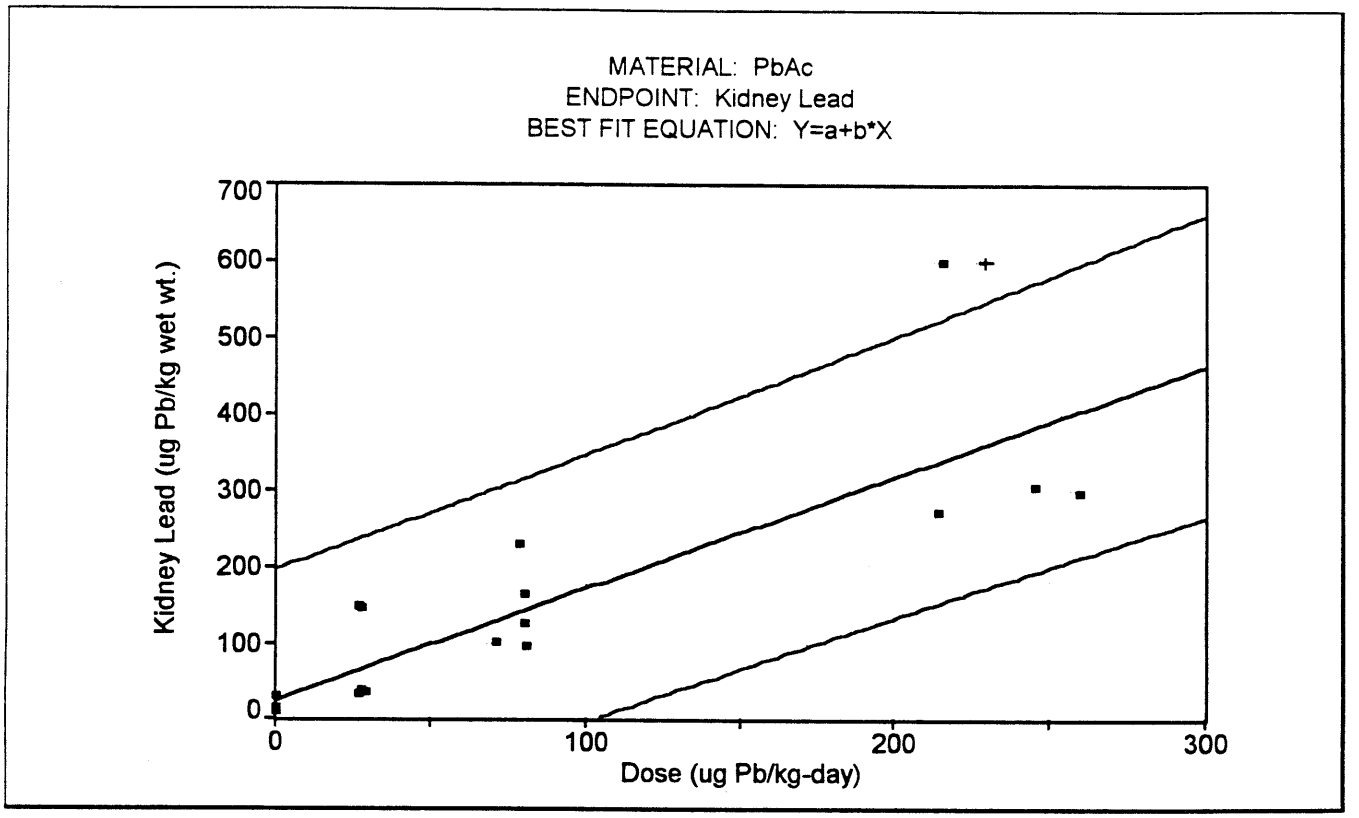


Parameters	Value	Std. Error	95% Confidence Limits	
a	5.96	fixed value	–	–
b	1.305	0.107	1.078	1.532

Adj R^2	0.829

Generated using Table Curve 2D v. 3.0. Outliers represented by "+".

FIGURE A-11 BEST FIT CURVE WITH 95% PREDICTION INTERVALS

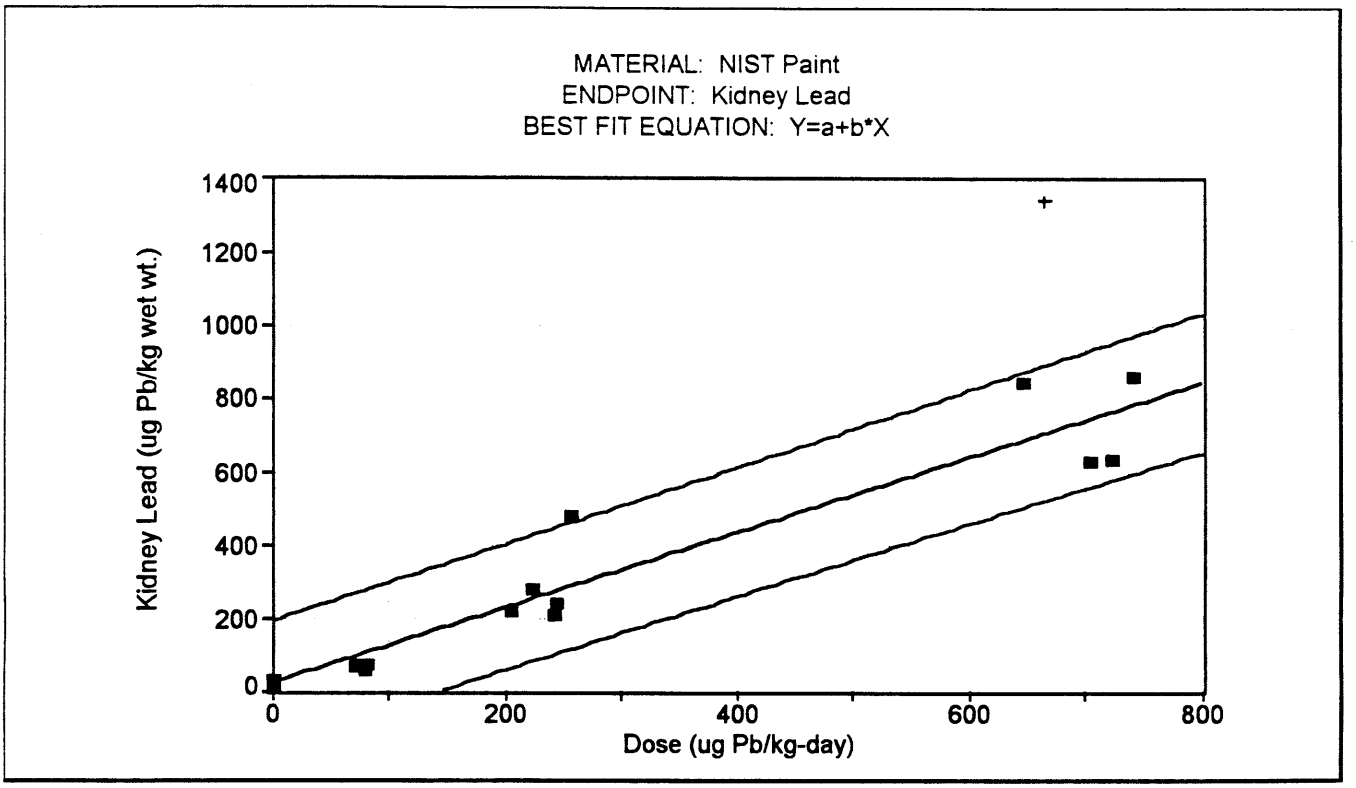


Parameters	Value	Std. Error	95% Confidence Limits	
a	22.53	fixed value	–	–
b	1.45	0.152	1.13	1.77

Adj R^2	0.71

Generated using Table Curve 2D v. 3.0. Outliers represented by "+".

FIGURE A-12 BEST FIT CURVE WITH 95% PREDICTION INTERVALS



Parameters	Value	Std. Error	95% Confidence Limits	
a	22.53	fixed value	–	–
b	1.019	0.053	0.908	1.131

Adj R^2	0.92

Generated using Table Curve 2D v. 3.0. Outliers represented by "+".