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Inhalation Developmental Toxicology Studies: Teratology Study of Tetrahydrofuran in Mice and Rats

Final Report

T. J. Mast, Study Director
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R. L. Rommereim
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August 1988

Prepared for the
National Institute of Environmental Health Sciences, National Toxicology Program
under a Related Services Agreement
with the U.S. Department of Energy
under Contract DE-AC06-76RLO 1830

Pacific Northwest Laboratory
Operated for the U.S. Department of Energy
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INHALATION DEVELOPMENTAL TOXICOLOGY STUDIES: TERATOLOGY STUDY OF TETRAHYDROFURAN IN MICE AND RATS

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No. NIH-Y01-ES-70153

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SUMMARY

Tetrahydrofuran (THF), a four-carbon cyclic ether, is widely used as an industrial solvent. Although it has been used in large quantities for many years, few long-term toxicology studies, and no reproductive or developmental studies, have been conducted on THF. This study addresses the potential for THF to cause developmental toxicity in rodents by exposing Sprague-Dawley rats and Swiss (CD-1) mice to 0, 600, 1800, or 5000 ppm tetrahydrofuran (THF) vapors, 6 h/day, 7 dy/wk. Each treatment group consisted of 10 virgin females (for comparison), and ≈33 positively mated rats or mice. Positively mated mice were exposed on days 6-17 of gestation (dg), and rats on 6-19 dg. The day of plug or sperm detection was designated as 0 dg. Body weights were obtained throughout the study period, and uterine and fetal body weights were obtained at sacrifice (rats, 20 dg; mice, 18 dg). Implants were enumerated and their status recorded and live fetuses were examined for gross, visceral, skeletal, and soft-tissue craniofacial defects.

The only overt symptom exhibited by pregnant rats was a reduction in body weight gain for the 5000-ppm group and there were no maternal deaths. However, mean body weights of virgin females were not affected, thus indicating that pregnancy was a factor in the toxicological response. The pregnancy rate was 93%. The mean gravid uterine weight and the extra-gestational weight gain (EGWG; sacrifice body weight minus gravid uterine weight minus 0 dg weight) were reduced for the 5000-ppm group relative to the control, but the difference was not significant. There were no treatment-related effects on the number of implantations, the mean percent of live pups/litter and resorptions/litter, or on the fetal sex ratio. Fetal weights were significantly reduced for the 5000-ppm exposure group relative to controls. The mean percent affected fetuses per litter was not significantly different among treatment groups for any individual malformation or variation or for combined totals.

Mice exhibited overt symptoms of toxicity at the 1800- and 5000-ppm THF concentrations. Approximately 30% of the animals in the 1800-ppm group, and all in the 5000-ppm group, were subject to narcosis. Approximately 27% of the

pregnant animals and 30% virgins in the 5000-ppm group died during the first six days of exposure; consequently, this group was removed from exposure to prevent further mortality. There were no maternal deaths in either the 600- or 1800-ppm exposure groups. As in rats, the mean body weights of virgin mice at sacrifice were not significantly affected by exposure to THF. Mean body weights of pregnant mice and uterine weights were significantly less than controls for the 5000- and 1800-ppm groups at sacrifice. The EGWG was also significantly reduced for the 5000-ppm group.

There was no effect on the number of implantations per dam, and the mean pregnancy rate for all mated mice was 86%. There was a significant reduction in the mean percent of live pups/litter for the 1800- and 5000-ppm groups and a corresponding increase in the percent of resorptions/litter. Pregnant females in the 5000-ppm exposure group that survived to the scheduled sacrifice had litters with a 95% incidence of resorption. Neither fetal weight nor the sex ratio was affected in the 600- or 1800-ppm groups. The mean percent affected fetuses per litter was not significantly different among treatment groups for any individual malformation or for combined totals. There was an exposure-correlated increase in the incidence of reduced sternebral ossifications; however differences between groups were not significant.

Swiss (CD-1) mice appeared to be much more susceptible to the toxic effects of THF, manifested as narcosis, mortality, and intrauterine death, than were the rats. The rats appeared unaffected by THF exposure except for a slight, but significant, decrease in maternal and fetal weight at the 5000-ppm level. Interestingly, in mice the reduction in maternal weight gain and the increase in intrauterine death at the 1800-ppm level were not accompanied by a treatment-associated decline in live fetal weight, nor by an increase in the incidence of fetal malformations. These facts suggest that in mice, if the conceptus survives, development as assessed by this experimental design, continues in a normal fashion.

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INTRODUCTION

Tetrahydrofuran (THF; Table 1), a four-carbon cyclic ether, is widely used as an industrial solvent, primarily in the dissolution of plastic resins such as polyvinylchloride and vinylidene chloride copolymers, and as a reaction medium. Approximately 150 million pounds of THF are produced each year by three major U.S. chemical companies. The National Occupational Hazard Survey estimates that more than 90,000 workers in 3,000 plants are exposed to THF; consequently, it is classified in the "high" category of potential human exposure (Little 1987). The combination of its high volatility (b.p. 65°C) and extensive use create a significant possibility for industrial exposure to THF via inhalation. Although THF has been used in industrial settings for many years, few subchronic and no chronic toxicology studies have been conducted. No reports of studies addressing the potential of THF to cause reproductive toxicity were found.

The American Conference of Governmental Industrial Hygienists (ACGIH) has adopted a time-weighted average threshold limit value (TLV) of 200 ppm (590 mg/m^3) with a short-term exposure limit (STEL) of 250 ppm (735 mg/m^3; ACGIH, 1987). Although no permanent effects resulting from short-term exposures to high concentrations of THF have been reported (Rosensteel and Thoburn 1975), subjects have complained of nausea and occipital headaches after exposure (Sittig 1985). The inhalation TC_{lo} for humans has been reported as 25,000 ppm, at which point CNS toxicity appears. At lower concentrations THF is irritating to the skin, eyes and mucous membranes.

Acute toxicity studies in laboratory animals, employing both inhalation and oral routes of exposure, place THF in the moderately toxic range. Lethal concentrations administered to animals result in narcosis, muscular hypotonia, disappearance of corneal reflexes, then coma followed by death (Sax 1986). Oral doses produce inflammation, necrosis and hemorrhage of the gastrointestinal tract, injury to kidney tubules, and inflammation of the liver (Sax 1986). Kimura et al. (1971) compared the acute, oral toxicity of THF in 14-day old, young adult and older adult rats and found that age had no effect on the LD_{50} for the rat.

Subchronic inhalation exposure of rats to four concentrations of THF (100, 200, 1000 and 5000 ppm) for 4 h/day, 5 day/wk, over a period of twelve weeks resulted in irritation of the mucous membranes, the severity of which increased in a dose-related fashion (Katahira et al. 1982a). The 5000-ppm group exhibited marked local irritation and morphological damage to the respiratory epithelium, and had significantly lower white blood cell counts and blood sugar levels than the control group. Single 4-h inhalation exposures of rabbits to five concentration levels of THF (100 to 12,000 ppm) resulted in transient dose-related effects on tracheal ciliary activity (Ikeoka et al. 1983).

The effect of extended exposure to THF (12-18 weeks) on body weight is not clear. Kawata and Ito (1984) reported a decrease in body weight after four weeks of exposure to 3,000 ppm THF for 1 h/day, while Elovaara et al. (1984) stated that body weights of rats exposed to concentrations as high as 2,000 ppm, 6 h/day, did not differ significantly from the controls. Another discrepancy between laboratories exists in reference to serum tests for liver function. Kawata and Ito (1984) reported that SGOT, SGPT, and alkaline phosphatase values were unchanged following a 12-week exposure to 3,000 ppm THF, while Katahira et al. (1982b) reported an increase in SGOT and SGPT values for rats exposed to 1,000 and 5,000 ppm of THF over the same time period.

Although no references relevant to the specifics of THF metabolism were found, Fujita and Suzuki (1973) stated that the metabolism of THF may be analogous to that of other cyclic ethers. In this case, THF would be ring hydroxylated by liver microsomes at the number-five-carbon, and subsequently, cleaved to a straight-chain fatty acid by liver cytosol.

Elovaara et al. (1984) studied the biochemical effects and the body burden in rats exposed to THF vapors (200, 1000 and 2000 ppm) 6 h/day, 5 day/wk, for 2-18 weeks. Brain and body fat concentrations of THF were measured immediately upon cessation of exposure and were found to be correlated to dose. However, the concentrations measured declined progressively during exposure weeks 2 through 18. These declines in tissue concentrations indicate that oxidative metabolic processes may have been induced. Further support for this conjecture was provided when *in vitro* experiments performed by these workers demonstrated an increase in liver and kidney 7-ethoxy-coumarin-O-deethylase activity in the 1000- and 2000-ppm groups relative to that found in the control group. Since the increase in activity in the 2000-ppm group was not significantly greater than for the 1000-ppm group, they surmised that the lack of correlation between increasing exposure concentration and O-deethylase activity may have been due to toxicity present at the higher exposure level. Furthermore, the metabolic processes induced by THF appear to be quite specific since no increase in cytochrome-P_{450} content, N-demethylase activity, or in liver-to-body-weight ratios was noted. Tetrahydrofuran also appeared to inhibit alcohol and aldehyde dehydrogenases. Another *in vitro* biochemical study found THF to inhibit ethanol-induced liver microsomal cytochrome-P_{450} (Ullrich et al. 1975).

Kawata and Ito (1984) measured the rate of decline of THF concentrations in body organs of rats at specific intervals for up to 12 hours post-exposure to 15,000 ppm THF. Although this was not an in depth study, the results indicated that the post-exposure concentrations of THF in the organs of rats exposed daily for seven days (30 min/day) were not greater than for rats exposed for only one day (30 min) to the same concentration. Furthermore, the rate of decline of THF concentrations in the organs during the 12-h period following cessation of exposure was accelerated after repeated periods of daily exposure. These results also implied an induction in oxidative metabolic processes following repeated exposures to THF vapors.

Tetrahydrofuran has been tested for induction of sex-linked recessive lethal mutations (SLRL) in *Drosophila melanogaster* with negative results (Valencia et al. 1985). When THF was tested as a carrier solvent for the *Salmonella*/microsomal assay it was found to be non-mutagenic; however, it was cytotoxic when administered at greater than 50 μl/plate (Maron et al. 1981). Arimoto et al. (1982) later reported that the use of THF as a carrier solvent increased the mutagenicity of two mutagenic tryptophan-pyrolysates. These workers also reported cytotoxicity when more than 50 μl THF/plate was used.

THF, in conjunction with several other solvents, was implicated in an allegedly high prevalence of urinary tract infections among all employees, as well as reproductive and menstrual problems among the ten female employees, in a fiber-glass fabricating plant in Baton Rouge, LA. However, results of a field investigation conducted by NIOSH in 1979 stated that the incidence of urinary tract infections was not high, that none of the female employees had experienced reproductive problems, and that exposures to THF (and other solvents) were well below maximum recommended levels (Markel and Jannerfeldt 1981). Concerns over adverse health effects in Japanese workers exposed to THF were discussed in a review of THF toxicity (Horiguchi et al. 1983). Workers in a high-polymer chemistry laboratory and in a university textile research laboratory reported fatigue, bloating of the stomach, headache, kidney pain, and tiredness in the lower limbs. Blood cells and elevated protein levels were observed in the urine of workers from both sites and the textile researchers also exhibited a decrease in their white blood cell count and an increase in liver function enzymes. Atmospheric levels of THF to which these workers were exposed were not reported.

In summary, results of toxicity studies in laboratory animals indicate that THF vapors at sublethal doses: 1) are irritants, 2) appear to be the cause of decreased tracheal ciliary activity, 3) cause damage to respiratory epithelial cells, and 4) may cause liver and kidney damage. Although the number of studies addressing the issue are limited, these toxic effects appear to be transitory. THF concentrations in the major body organs have been shown to decline within a short period of time after cessation of exposure; however, no detailed pharmacokinetic data are available. There is evidence, both *in vivo* and *in vitro*, to suggest that tetrahydrofuran may induce certain enzymes in the microsomal mixed-function oxidase complex of male rats, and that certain dehydrogenases may be inhibited. Consequently, biochemical changes of this type may affect the organisms' capacity to metabolize other compounds, either endogenous or exogenous in origin. Reports of human health effects have surfaced, but are not clearly defined. No epidemiological studies surveying the possible reproductive or carcinogenic effects of THF were found.

Because of the large volumes produced and the wide variety of industrial processes in which THF is used, there is a potential for a large number of individuals to be exposed to THF. Consequently, this compound has been nominated for testing as a potential carcinogen (Helmes et al. 1983). A detailed search of the literature and computerized databases did not reveal any studies addressing the potential for tetrahydrofuran, or for any closely related compounds, to cause developmental toxicity. This paucity of available toxicity data on tetrahydrofuran, and its classification in the 'high' human exposure category, establish the necessity of testing this material for its potential to cause developmental toxicity.

The following study was conducted in order to assess the developmental toxicity of THF in Swiss (CD-1) mice and in Sprague-Dawley rats following gestational exposure to 0 (filtered air), 600, 1800, or 5000 ppm tetrahydrofuran (THF) vapors 6 h/day, 7 day/week. The highest THF concentration was chosen with the goal of producing mild maternal toxicity, and was based on results obtained from a 90-day Subchronic Study of the effects of THF-exposure on B6C3F1 mice and Fisher 344/N rats (Chou et al. 1987a; Chou et al. 1987b). In these studies narcosis was observed in some mice at the 1800- and 5000-ppm levels, and some rats were ataxic at the 5000-ppm level. However, since no reductions in body weight gains with respect to controls were observed for either species at the 5000-ppm level this concentration was chosen as the highest exposure level. The lowest exposure concentration was chosen to approximate an estimated no observable effect level (NOEL), and the mid-level was chosen to provide a graded toxicological response.

MATERIALS AND METHODS

Four groups each of Sprague-Dawley rats and Swiss (CD-1) mice (Charles River, Raleigh, NC), 14 and 11 weeks old, respectively, were exposed to 0 (filtered air), 600, 1800, or 5000 ppm tetrahydrofuran (THF) vapors 6 h/day, 7 day/week. Each treatment group consisted of 10 virgin females and approximately 33 positively mated females; all groups were randomly selected. The day of plug or sperm detection was designated as 0 dg. Virgin and mated female mice were exposed concurrently for 12 consecutive days (6-17 dg for mated mice), and the rats for 14 consecutive days (6-19 dg for mated rats).

Control animals (0 ppm) were housed in an exposure chamber in the same room, and were handled in the same manner, as the animals that were exposed to the test chemical. Developmental evaluations were conducted on pregnant mice sacrificed on 18 dg, and on pregnant rats sacrificed on 20 dg. Virgin females of both species were sacrificed on the day after the last day of exposure. Although rats and mice were not exposed concurrently, the in-life portions of these studies were conducted within a 7-week period.

EXPOSURE SYSTEM

Inhalation exposures were conducted in Battelle-designed inhalation exposure chambers (Harford Systems; Lab Products, Inc., Aberdeen, MD). The 2.3-m^3 stainless-steel chamber (1.7-m^3 active mixing volume) contained three levels of caging, each of which was split into two offset tiers. The drawer-like stainless-steel cage units accommodated individual animal cages, feed troughs and automatic waterers. Stainless-steel catch pans for the collection of urine and feces were suspended below each cage unit. The catch pans, which remained in the chamber during exposure, were designed to aid in maintaining a uniform concentration of vapor throughout the chamber. Air (HEPA- and charcoal-filtered) containing a uniform mixture of the test article flowed through the chamber at approximately 15 air changes per hour. The uniform mixture was diverted along the inner surfaces of the chamber and a portion of the flow was "peeled off" by each catch pan, thus creating mixing eddies. Exhaust from each tier was cleared through the space between the tiers. (See also Appendix B.)

The THF exposures were conducted using an automated data acquisition and control system in an exposure suite. This system monitored and controlled the basic inhalation chamber environmental parameters at ≈4-h intervals throughout the exposure period (e.g. chamber air flow and vacuum, temperature, and relative humidity). Test chemical concentrations were monitored at ≈30-min intervals during THF vapor generation. Conditions which may have been a threat to the health of the animals, or constituted an explosion hazard, triggered alarms to personnel who were on call 24 h/day. All data acquisition and control originated from an executive computer which contained the exposure protocols and controlled a multiplexing-interface system.

Exposure Chamber Environment

Chamber and room temperatures were measured by resistance temperature devices (RTD) which were located at the measurement site, and were multiplexed to a digital thermometer interfaced to the computer. Prior to the start of the study the RTDs were calibrated to within ±0.5°F of a certified mercury thermometer maintained in a temperature-controlled water bath. Chamber temperature was controlled primarily by adjusting the temperature of the exposure room.

Percent relative humidity (%RH) was calculated with an accuracy of ±6% by pulling an air sample from the measurement location through a Teflon® tube into a dew point hygrometer located in the control center. Measurements were taken from different locations using a valving system which multiplexed the sampling tubes to the hygrometer. Percent RH values were calculated and maintained by the executive computer from temperature and dew point measurements.

Chamber air flow was calculated with an accuracy of ±15 l/min by measuring the pressure drop across calibrated orifices located at the inlet and exhaust of each chamber. Leaks in the chambers could be detected by comparison of the measurement of inlet flow with exhaust flow. Flow was maintained by a computer-controlled gate valve in the exhaust line of each chamber.

Test Material Generation

Tetrahydrofuran was pumped from the bulk reservoir (a modified stainless-steel, flammable liquid container) at a steady rate by a liquid micrometering pump designed to operate in potentially explosive atmospheres (Figure 1). The chemical was pumped into a rotating flask (100 rpm) which was partially immersed in a hot water bath maintained at 175°F. The resulting vapor was forced out of the mouth of the flask into a chilled water condenser where much of the vapor was condensed, and returned to the evaporator flask. Uncondensed vapor was carried from the top of the condenser column by the metered stream of nitrogen. As the vapor laden nitrogen moved through the condenser it became saturated with THF vapor. The temperature of this exiting vapor was monitored by an RTD located at the top of the condenser column. The saturation vapor pressure at the temperature of the column exit was calculated so that the output of the generator was known. For example, at an exit temperature of 15°C, the THF concentration in the exit stream was 150,000 ppm at a nitrogen flow rate of 25 l/min.

Following passage through the condensing column, the vapor entered a short distribution manifold from which individual delivery lines carried metered amounts of vapor to each exposure chamber. Flow to each chamber was maintained by impulse vacuum pumps located at the chamber end of each delivery line. Chamber concentrations were adjusted by the metering valve and/or by adjustment of the compressed air pressure to the vacuum pump. Immediately before entry of the stream into the exposure chamber, the nitrogen:THF vapor mixture was diluted with HEPA and charcoal filtered air in order to achieve the target concentration.

Normal operation called for up to 20% excess vapor to be exhausted from the manifold through a flowmeter located at the end of the manifold. This "excess" flow permitted adjustment of vapor flow rates to each chamber without affecting the flow rate to the other chambers. The excess flow also maintained a slight positive pressure in the manifold preventing air from entering the system and thus creating a potentially explosive mixture. A pressure transducer (Dwyer Instruments Photohelic, Michigan City, IN) monitored the pressure drop across the excess vapor flowmeter. A drop in pressure to less than 2 cm H_2O resulted in an automatic shutdown of the generation system.

Exposure chambers (without animals) and the exposure room were monitored for particles with a particle detector (Gardner Associates, Type CN) during one day of test generation. No particles were found in the control chamber or in any of the exposure chambers.

The time for the concentration to build up to 90% of the final, stable concentration following the start of generation (T_{90}), and the time for the vapor concentration to decay to 10% of the stable concentration following the cessation of generation (T_{10}), were determined before and after animals were placed in the chambers (Figure 2). (These data were obtained during the NTP-sponsored Tetrahydrofuran Subchronic Inhalation Toxicity Study conducted at Battelle-Pacific Northwest Laboratory, February to May 1987.) The experimental value for T_{90}, with or without animals, was found to range from 8 to 10 minutes. At a chamber air flow rate of 15 air changes per hour, the theoretical value for T_{90} is approximately 12.5 minutes. Since there could have been variability in buildup times due to fluctuations in chamber flow rates and sampling accuracy, a T_{90} of 12 minutes was chosen for this study. The value of T_{10} ranged from 7 to 9 minutes without animals present, and increased to 10 to 13 minutes with animals present.

Uniformity of vapor concentration in the exposure chambers was measured prior to the start of, and once during, the study. The vapor concentrations for these determinations were measured using the on-line GC with the automatic sampling valve disabled to allow continuous monitoring from a single input line. Prior to animal loading, 12 chamber positions were measured. The second set of gas concentration measurements was taken from the front and back positions of the chamber only where cage units contained animals.

ANALYTICAL CHEMISTRY

All THF used for animal exposures was taken from BNW Lot No. 51437-15, which was received in four 55-gallon metal drums. This lot was received by Battelle-Pacific Northwest Laboratory on Nov. 12, 1986 under the NTP Subchronic Inhalation Study (Contract N01-ES-65165). After completion of that study, approximately 87 gallons of bulk material were transferred to the NTP Inhalation Reproductive Toxicology (IRT) Program for use in this inhalation teratology study. Of the four drums in this lot, drums 3 and 4 were used on this study. Following completion of the teratology study, the remaining bulk material, approximately 25 gallons, was transferred back to the NTP for disposition. (A letter from the NTP authorizing these transfers of the THF bulk material is included in Appendix A).

The daily requirement for generation of the target concentrations of THF was approximately 4.7 kg. A total of 60.4 gallons of test material was consumed during the study. Prior to generation test material was maintained at room temperature in the LSL-II storage facility. All transfers of THF were performed under nitrogen to prevent the introduction of air into the bulk chemical.

Bulk Chemical Analysis

Bulk chemical analyses were performed using infrared spectroscopy to confirm test material identity. Purity determinations were conducted by gas chromatography (GC). The initial purity analysis was compared to a reference material supplied by the Midwest Research Institute (MRI) and subsequent analyses were compared to a reference material which had been removed from the bulk chemical upon receipt and stored at -20°C. Bulk test material purity was acceptable throughout the study.

A specification for a maximum peroxide content of 300 ppm was applied throughout the study. Tetrahydrofuran was analyzed for peroxide content once per month after opening, and contained less than 100 ppm at each analysis. A peroxide content of less than 300 ppm ensured the safety of the generation process which involved evaporating THF at a temperature of approximately 175°F. The test material was analyzed by GC for stabilizer content and found to contain 0.03% 2,6-di-t-butyl-4-methylphenol (BHT). (See Appendix A for details.)

Exposure Chamber Monitoring

A Hewlett-Packard (HP) 5840 GC system (employing a 1/8" o.d. x 1.0' nickel column packed with 1% SP-1000 on 60/80 mesh Carbopack B operated at 145°C) was used to monitor chambers during animal exposures. This instrument was equipped with an 8-port stream select valve and measured THF in the three exposure chambers, the control chamber, the holding chamber, the exposure room, the on-line standard, and the nitrogen blank. The analysis of bubbler grab samples, collected in order to confirm values obtained from the on-line monitor, was performed using an HP5830 or HP5840 GC with a 2- or 4-mm i.d. x 1.8-m glass column packed with 20% SP-2100/0.1% Carbowax 1500 on 100/120 mesh Supelcoport. An on-line, certified standard, 400 ppm THF in nitrogen (MG

Industries Scientific Gases, Los Angeles, CA), was used to check instrument drift throughout the exposure day.

Precision of the on-line GC was estimated from 17 consecutive measurements of the 400-ppm on-line THF standard. A 0.26% coefficient of variation was observed. Linearity of the on-line GC was assured by calibrating it against a gravimetrically calibrated GC. (See comments in the "Calibration of the On-Line Chamber Monitor" in Appendix A). The minimum detectable limit of the GC was estimated from the decay profile for the highest concentration chamber and estimated to be 0.04 ppm THF.

Degradation and Stability Studies

Stability of the THF in the generator reservoir was determined by aging the test material in the stainless-steel generator reservoir for 36 days at room temperature. Portions of this material were analyzed prior to and following aging. The initial relative purity was 99.3% and the peroxide content was 14 ppm. After aging, the values for purity and peroxide content were 99.6% and 7 ppm, respectively. These results indicated that THF was stable in the generator reservoir.

The stability of THF in the generator flask over the 6-hour exposure period was evaluated during two test runs. During the first test run the initial purity for the THF taken directly from the drum was 99.1% to 99.6%, while the material from the generator flask was 98.8%. During the second run, the initial bulk purity was approximately 100%, as was the purity for the material recovered from the evaporation flask at the end of a typical exposure. These analyses indicated that the THF was stable in the generator flask under the conditions used to generate chamber concentrations.

The extent to which less volatile impurities, the BHT stabilizer and peroxides, concentrated in the generation flask over the 6-hour period was determined. Using the MRI method (See Appendix A), the BHT concentration of bulk test material was found to be 100 ppm and the peroxide content was 14 ppm. Using mass flow calibrations which indicated that 4.7 kg THF was consumed per day, and that an evaporation flask residue of about 200 to 300 ml

(0.18 to 0.27 kg) remained at the end of the 6-hour exposure period, a concentration factor of 17 to 26 was predicted for these compounds. When measured at the end of the exposure day, the BHT concentration in the generator flask was found to be 1640 ppm, and the peroxide content was 11 ppm. The measured BHT concentration was near the predicted range of 1700 to 2600 ppm; however, the peroxide content did not increase as predicted. Since no evidence of peroxide was found in the exposure chambers (see below), these results indicate that the small amount of peroxide present in the bulk material may have reacted within the evaporation flask to form a nonvolatile, polymeric material. Grab samples of chamber atmospheres were also analyzed for BHT concentrations; however, no evidence of BHT in the exposure chambers was observed.

Chamber atmospheres were tested for the presence of organic peroxides by means of a *p*-hydroxyphenylacetic acid coupling reaction (Kok et al., 1986). All chambers containing the THF exhibited a response similar to the control chamber and the areas observed for all samples were near the bottom of the calibration curve. Thus, the organic peroxide level in the exposure chambers was below the calculated limit of detection (≈0.13 ppm) assuming complete reaction of collected peroxides.

Chamber atmospheres were also tested for the presence of other potential THF degradation products: furan, isopropanol, and butyraldehyde. Prior recovery studies indicated that the recoveries of these compounds from spiked charcoal collection tubes, of the type used to sample the chamber atmosphere, were greater than 85% for furan and butyraldehyde, but were low for the relatively non-volatile isopropanol. Analysis of actual chamber grab samples did not reveal the presence of any of the potential THF degradation products at concentrations in excess of 0.1% of the target exposure concentrations.

ANIMAL HUSBANDRY

Upon receipt, all animals were housed in quarantine rooms for at least 20 days prior to the start of exposure. Males and females were housed separately on stainless-steel wire racks equipped with automatic waterers (10-11 mice per cage, 5-6 rats per cage). During the quarantine period at least five males and five females of each species were killed and examined for gross and microscopic lesions. Nasopharyngeal washes from the animals were cultured for bacterial pathogens. Serum from each animal was tested for antibodies to selected pathogens (Appendix D). Another check for antibodies to selected pathogens was performed on serum obtained from five females in the control group and from five females in the 5000-ppm group, for each species, at the final sacrifice. All results were negative for significant pathogens and lesions. Animals were observed daily for mortality, morbidity, and overt signs of toxicity throughout the study.

Food, pelleted NIH-07 diet (Ziegler Bros. Inc., Gardner, PA), was provided *ad libitum* during the entire time the animals were in house. Food was removed during the 6-h exposure period and replaced for the duration of the 18-h recovery period; otherwise food was provided *ad libitum*. Water was provided *ad libitum* with automatic waterers throughout the study. Room lighting was maintained on a 12-h on-off cycle (0600-1800 h for the light phase). During the quarantine period animal room temperature was maintained at 72±3°F and the percent relative humidity was maintained at 50±15%.

Target chamber temperatures during the exposure periods were maintained within the limits of 75±3°F. Actual chamber temperature means for all exposure days (both species) were between 73.5 and 76.2°F, all within the specified limits. Mean percent relative humidity in all exposure chambers was between 50.5 and 58.7%; these fluctuations were within the specified limits of 55±15%. The average air flow in all chambers for the study was between 14.0 and 15.4 CFM (1 CFM = 1 air change per hour). All flows were within the specified limits of 12 to 18 CFM. A complete summary of the daily chamber environmental data can be found in Appendix B.

DEVELOPMENTAL TOXICOLOGY

Female mice and rats were weighed and individually identified by ear tags 1-2 weeks prior to mating. At this time forty virgin females of each species were randomly chosen for assignment to the four exposure groups by using body weight as the blocking variable. The remaining females were bred by caging two to three females overnight with each male. Copulation was established on the following morning by the presence of a vaginal plug in the case of the mice; or for rats, by a sperm-positive vaginal lavage smear. If evidence of mating was detected this day was designated as 0 dg, and positively mated females were weighed and randomly assigned to exposure groups using body weight as the blocking variable. Mating was conducted for five consecutive nights for each species to obtain approximately 130 positively mated females, approximately 33 animals per group. In order to acclimate animals to exposure chambers, mated females were individually caged in exposure chambers with the doors open on 0 dg. The virgins were individually caged in an open exposure chamber eight days prior to exposure.

Mated female mice were weighed on 0, 6, 9, 12, 15, and 18 dg, and rats on 0, 6, 10, 14, 17 and 20 dg. Virgins were weighed twenty days prior to the start of exposure, on exposure days 1, 5, and 10 and at sacrifice. Virgin mice were exposed for 12 consecutive days (rats for 14 consecutive days) concurrently with positively mated animals and sacrificed 1 day after the last day of exposure.

Female mice in the 5000-ppm exposure group exhibited an unexpectedly high level of toxicity, including a significant degree of mortality (>25%), after only 6 days of exposure (5 days for virgins). Consequently, mice in this highest exposure level were removed from exposure at this time and placed in a chamber supplied with fresh, filtered air until the time of scheduled sacrifice.

At the time of sacrifice rats and mice were euthanized with CO_2, weighed and examined grossly for signs of maternal toxicity. Both ovaries from each female were saved for sectioning and quantitative follicle counts (performed by another laboratory designated by the sponsor). Apparently nongravid uteri from positively mated females were stained with 10% ammonium sulfide to detect possible implantation sites. The number, position and status of implants were recorded for each gravid uterus. Placentas were examined and discarded unless abnormal. Live fetuses were weighed, examined for gross defects and their sex was determined by internal examination of the gonads after euthanasia with an injection of Nembutal® (sodium pentobarbital). Fifty percent of the live fetuses and any fetuses with gross external abnormalities were examined for visceral defects by dissection of fresh tissue. The heads of fifty percent of the live fetuses were removed and placed in Bouin's fixative. After fixation the heads were serially sectioned with a razor blade and examined for soft-tissue craniofacial abnormalities. All fetal carcasses, with and without heads, were prepared for skeletal staining. Cartilage as well as ossified bone was visualized by double-staining with alcian blue and alizarin red S. The individual identity of each skeletal and head specimen was maintained throughout the study.

STATISTICAL ANALYSES

All means and standard deviations for animal data were calculated with SAS statistical software on a VAX 11/780 computer. Mean body weights (as a mean of litter means for fetal data) were analyzed using the SAS General Linear Models (GLM) Procedure (SAS, 1985) with an analysis of variance (ANOVA) model for unbalanced data. Response variables, either body weight or the arc-sin transformations of proportional incidence data, were analyzed against the class variable, treatment, in a one-way ANOVA model. A Tukey's t-test (two-tailed) was used to assess statistically significant differences between control and exposed groups. If appropriate, the dose-response relationship was determined by means of an orthogonal trend test (Winer, 1971). In the case of proportional data this test was performed on transformed variables. The litter was used as the basis for analysis of fetal variables.

RESULTS

EXPOSURE AND CHEMISTRY

The chemical stability of tetrahydrofuran was evaluated in both the generator reservoir and in the exposure chambers (with and without animals). Tetrahydrofuran was found to be stable in the generator reservoir, and there was no evidence of degradation products greater than 0.1% of the target concentration in the exposure chambers (with or without animals). Direct measurements of chamber concentrations of BHT and peroxide confirmed that chamber concentrations of these two less volatile species were insignificant.

Temperature-programmed GC failed to show evidence of any other degradation products.

The test material concentration uniformity data was obtained for each chamber during prestart testing and after animals were in place; all chambers were acceptable (Table 2). (Complete data are in Appendix B.) In order to facilitate interpretation of the data in Table 2, the THF concentration reading at each port was also expressed as a percentage of the mean measurement at all ports measured. The possible variations of chemical concentration measured from one sample port to another during the chamber balance procedure was termed the total port variability (TPV). Three factors contribute to the TPV: 1) the between port variability (BPV) which represents the variation of chemical distribution within the chamber; 2) the within port variability (WPV) which represents the fluctuation of the average chemical concentration within the chamber during the time the uniformity measurements are made; and 3) the variability of the measurement instrument itself. All uniformity data were satisfactory with respect to percent relative standard deviations (RSD); ≤7%.

The mean chamber temperature in each exposure level in the mouse study was between 73.5 and 76.2°F, all within the specified limits of 72 to 78°F. Individual temperature extremes ranged from 69.6 to 79.3°F. The mean values of relative humidity in all chambers were between 50.5 and 58.7%, all within the specified limits of 40 to 70%. Relative humidity extremes (considering all chambers) ranged from 35 to 75%; ≥90% of all readings were within operating range. The mean values of chamber air flow were between 14.9 and 15.4 CFM (1 CFM = 1 air change per hour), all within the specified limits of 12 to 18 CFM. Flow extremes (considering all chambers) ranged from 13.3 to 15.8 CFM.

During the rat study the mean temperatures in all chambers were between 74.5 and 76.2°F, all within the specified limits of 72 to 78°F. Temperature extremes ranged from 70.3 to 78.7°F. The percent of temperature readings within the operating range for all chambers were greater than 92%. Mean percent relative humidity in all chambers was between 52.6 and 56.4%, all within the specified limits of 40 to 70%. Individual relative humidity extremes (considering all chambers) ranged from 33 to 79%. All chambers were above the 90% target for the number of readings within operating range. The mean chamber air flows in all chambers were between 14.0 and 15.1 CFM (1 CFM = 1 air change per hour), all within the specified limits of 12 to 18 CFM. Flow extremes (considering all chambers) ranged from 13.9 to 17.7 CFM; all readings were within normal operating limits.

The grand mean of the THF concentration in each chamber for the mouse study was between 101 and 102% of the target, with relative standard deviations in the range of 3 to 4% (Table 3). The daily mean concentrations for all chambers were within ±4% of the target concentrations (the daily protocol required the daily means to be within ±10% of the target concentrations). At least 98% of all individual concentration measurements were within ±10% of the target levels. The maximum concentration observed in the control chamber was 0.7 ppm, and in the holding chamber was 0.5 ppm. The maximum concentration observed in the room was 14.2 ppm; this single, high reading was due to the malfunctioning of a control valve which slightly pressurized the exhaust line and released THF into the exposure room for a short period of time.

The grand means of chamber concentrations for all exposure levels for the rat study were 100% of the target with relative standard deviations in the range of 3 to 4% (Table 4). The daily mean concentrations for all chambers were within ±7% of the target concentrations (the protocol required the daily means to be within ±10% of the target concentrations). At least 98% of all individual concentration measurements were within ±10% of the target levels, the specified operating limits. No measurable concentration of THF was observed in the control or holding chamber at any time during rat exposures and the maximum THF concentration observed in the room during the rat study was 0.1 ppm.

DEVELOPMENTAL TOXICOLOGY: RAT

Each exposure group consisted of 32-33 sperm-positive female rats and 10 virgin female rats. All sperm-positive females were killed on 20 dg, and the virgins were killed one day after the 14th day of exposure. The pregnancy rate of the sperm-positive females was 93%. There were no maternal deaths; however, alopecia was noted on 12 rats exposed to THF (five in the 600 ppm; three in the 1800 ppm; and four in the 5000 ppm). No alopecia was observed in the controls. Aside from a reduction in body weight for the 5000-ppm group, no other overt symptoms of toxicity were evident.

Mean body weights of virgin females were not significantly affected at any time during the 14-day exposure period or at sacrifice although there was a depression in body weight on the 5th exposure day for the 5000-ppm group (Table 5). The animals appeared to have recovered by the 10th exposure day since there was no longer a difference in body weight between the 0- and 5000-ppm groups.

Pregnant females exposed to 5000 ppm THF showed a significant decrease in mean body weight when compared to 0-ppm animals by 10 dg, an effect which continued to be statistically significant throughout the remainder of the exposure period (Table 6). Graphing of the mean cumulative weight gains shows this was due to an initial depression in weight gain, 6-10 dg, followed by a rate of gain equivalent to control groups for the remainder of the exposure period (Figure 3). The mean gravid uterine weight and the extragestational weight gain (EGWG; body weight at the time of sacrifice minus the gravid uterine weight minus 0 dg weight) were reduced at the time of sacrifice for the 5000-ppm group as compared to the 0-ppm group and contemporary control data; however, the difference was not significant (Tables 6 and 7). These reductions were not linearly correlated with increasing exposure concentration, but occurred abruptly at the 5000-ppm level. There was no effect on the mean ratio of uterine weight to EGWG for treated animals as compared to controls (Figure 4).

Exposure of pregnant rats to THF vapors on 6-19 dg had no effect on the number of implantations, the mean percent of live pups per litter, or the mean percent of resorptions per litter with respect to the 0-ppm group or to contemporary control data (Tables 7 and 8). Fetal weights (as means of litter means) were significantly reduced for the 5000-ppm exposure group when compared to controls (Tables 7 and 9). Mean body weights for both male and female fetuses were ≈82% of the mean weights for the control fetuses. The ratio of males to females in the litters was not affected. Although a trend test showed a significant correlation between fetal weight reduction and increasing exposure concentration, the significant trend was due to an abrupt drop in fetal weight between the 1800- and 5000-ppm groups as opposed to a gradual decline with increasing exposure concentrations.

The incidence of fetal malformations was not significantly affected following gestational exposure to THF (Tables 10, 11 and 12). However, several malformations were observed in the 5000-ppm group which were not found in either the 0-ppm group or in the contemporary control data; anal atresia, cleft palate, vestigial tail and vertebral agenesis. The incidence of fetal variations and reduced ossifications was not significantly altered by exposure to THF although there was a slight increase in their incidence with respect to both the 0-ppm group and the contemporary control data (Tables 11, 13 and 14).[1] The mean percent of the litter affected (malformations or variations) was not significantly different among treatment groups (Table 11). The mean percent incidence per litter was calculated based on the number of live fetuses examined for a given malformation or variation per litter, i.e. the incidence of visceral defects was based on the number of fetuses in each litter that received a visceral exam.

DEVELOPMENTAL TOXICOLOGY: MICE

Each exposure group, 0, 600, 1800, or 5000 ppm THF, consisted of 33 plug-positive mice and 10 virgin female mice. All surviving animals were killed following the 12th consecutive day of exposure, 18 dg for plug-positive females. The mean pregnancy rate of plug-positive females for all exposure groups was 86%.

1 In the case of the pelvis, the skull and the phalanges, reduced ossifications are presented here as bone group totals, although each bone is individually evaluated. For example, of fetuses with reduced ossification in the skull, 69% percent had reduced ossification of the interparietal bone, 25% of the supraoccipital, 12.5% of the parietal, 6% of the mandible, 6% of the zygomatic arch, 6% of the nasal, and 6% of the frontal bone.

There were no maternal deaths in either the 600 or 1800 ppm exposure groups; however, some animals in the 1800-ppm group and all animals in the 5000-ppm group were subject to narcosis for up to one hour following the daily shut-down of the THF generation system. Female mice exposed to 5000 ppm THF vapors exhibited an unexpectedly high mortality; 27% of the plug-positive females died between 6 and 11 dg (during exposure days 1-6), and 30% of the virgins died during exposure days 1-5. A 4^{th} virgin died nine days after initiation of exposure. Mated females which survived six exposure days at the 5000-ppm level were placed in another exposure chamber which was supplied with fresh, filtered air on the morning of 12 dg and remained there until the scheduled sacrifice on 18 dg. The surviving 5000-ppm virgins were also placed in the filtered air chamber on the morning of the sixth exposure day and remained there until sacrifice. The surviving females did not show any further signs of overt toxicity.

The mean body weights of virgins were significantly reduced by exposure to THF on exposure day 5, but had recovered by the time of sacrifice (Table 15). Pregnant females exposed to 5000 ppm tetrahydrofuran vapors on 6-11 dg showed a significant decrease in body weight when compared to controls by 9 dg (Table 16). The body weight depression continued through sacrifice, and can be attributed in large part to the high intrauterine mortality in the 5000 ppm group (discussed below). Mean maternal body weights at sacrifice, as well as uterine weights, were also significantly less than the 0-ppm group and the contemporary control data for the 1800-ppm exposure group (Table 16). The extra-gestational weight gain (EGWG; body weight at the time of sacrifice minus the gravid uterine weight minus dg 0 weight) was significantly reduced only for the 5000-ppm group. The cumulative weight gain for the 5000-ppm group was significantly less than control animals for the duration of the exposure (Figure 5). The mean ratio of uterine weight to EGWG showed an exposure-dependant decrease which was statistically significant for the 5000-ppm group when compared to 0-ppm group, undoubtedly due to the high incidence of resorption (Figure 6).

Exposure of mice to THF vapors on 6-17 dg had no effect on the number of implantations per dam. However, there was a significant decrease in the number of live pups per litter and in the mean percent of live pups per litter for both the 1800- and 5000-ppm groups when compared to the 0-ppm group or the contemporary control data (Tables 17 and 18). These decreases corresponded to an increase in the number and percent of resorptions per litter. Pregnant females in the 5000-ppm exposure group that survived to the scheduled sacrifice had litters with a 95% incidence of early resorption. Most of the uteri in this group had to be stained with 10% ammonium sulfide in order to detect the implantation sites. Neither fetal weights nor the fetal sex ratio were affected by gestational exposure of dams to 600 or 1800 ppm THF vapors (Table 19).

There was no significant increase in the incidence of fetal malformations in mice following gestational exposure to THF with respect to the 0-ppm group or to contemporary control data (Tables 20, 21 and 22). However, several malformations appeared in the 1800-ppm group which had not been observed in either the 0-ppm group or in the contemporary control data; cleft palate (5 fetuses), edema (1), ectopic ovaries (1), and undescended testes (1). These malformations were all found in a single litter of low weight fetuses which also had 7 late resorptions. There was a slight increase, not statistically significant, in the incidence of variations and reduced ossifications[2] in the 1800-ppm group with respect to the 0-ppm group and the contemporary control data (Tables 21, 22, and 23). The elevated incidence of variations was due primarily to an increase in the number of reduced sternebral ossification sites and was significantly correlated to increasing exposure concentration. Values for the 5000-ppm group were not included in statistical analyses since only one litter with live fetuses was represented.

[2] Reduced ossifications are presented here as bone group totals, although each bone is individually evaluated. For example, of fetuses with reduced ossifications in the skull, 100% had reduced ossification of the interparietal, parietal and frontal bones, 75% of the supraoccipital, and 25% of the nasal bones.

DISCUSSION

Results of this study indicate that exposure of Sprague-Dawley rats to 0, 600, 1800 or 5000 ppm tetrahydrofuran vapors did not result in selective toxicity to the offspring. The only overt sign of maternal toxicity observed was a significant reduction in body weight for the 5000-ppm group which was due to a depressed rate of gain from 6-11 dg. The added stress of pregnancy appeared to exacerbate THF toxicity since no treatment-correlated reduction in body weight was observed in virgin females. The only observed fetal effect was a significant reduction in fetal body weight for the 5000-ppm group which was accompanied by a corresponding reduction in maternal extragestational weight gain. There were no treatment-related increases in the incidence of intrauterine mortality, or in the frequency of fetal malformations or variations.

Swiss (CD-1) mice appeared to be much more susceptible to the toxic effects of THF than were the rats. The mortality incidence of plug-positive and virgin females in the 5000-ppm exposure group during the first five days of exposure was so high that animals in this group were removed from exposure on the morning of 12 dg (the 6^{th} day of exposure). The mean body weight at sacrifice for dams in both the 5000- and 1800-ppm groups was significantly less than for the control group. In the 1800-ppm group, this weight reduction was not due to a decrease in maternal extra-gestational weight gain, but to a significant reduction in uterine weight, resulting from the increased resorption incidence. The mean maternal body weight, the uterine weight, and the extra-gestational gain for the 600-ppm group were not affected relative to the control group.

This degree of toxicity was surprising in light of the results of a 90-day subchronic study where a different strain of mouse was used, B6C3F1, and where only mild clinical symptoms were observed, even after 90 days of exposure. However, the effects on long-term exposure to THF vapor were evident in histopathological examination of organs of these animals where evidence of toxicity was present in the form of liver cytomegaly, uterine atrophy and degeneration of the cortex and x-zone of the adrenals. Since Swiss (CD-1) dams on this were not examined histopathologically, nor were they exposed for such a long period, a detailed comparison between the two strains cannot be made.

Gestational exposure of mice to THF resulted in a significant increase in the incidence of intrauterine mortality at the 1800-ppm exposure level. The intrauterine mortality was manifested as an increase in the incidence of both early and late resorptions, but not as an increase in the incidence of "dead" fetuses. In the 5000-ppm group, the incidence of intrauterine death was 95% in surviving dams; the majority of early resorptions occurred within one day of implantation (only one litter had live fetuses). Interestingly, the reduction in maternal weight gain and the increase in intrauterine death for the 1800-ppm group were not accompanied by a treatment-associated decline in fetal weight, nor by an increase in the incidence of fetal malformations. The treatment-correlated increase in the mean percent incidence of reduced sternebral ossification is probably indicative of a slight fetal growth retardation, and may be linked to the increasing maternal toxicity evidenced by a treatment-related decline in maternal weight. The lack of an increase in the incidence of malformations, or a reduction in fetal body weight, suggests that in the event the conceptus survives, development as assessed by this experimental design, continues in a normal fashion in the mouse.

Swiss (CD-1) mice were more susceptible to the toxic effects of THF than were the Sprague-Dawley rats as demonstrated by the severe narcosis and death of pregnant and virgin female mice in the 5000-ppm exposure level. The mice exhibited an increased incidence of resorptions at the 1800-ppm level that was not observed in the rat; however, other fetal parameters (body weight and the incidence of abnormalities) were not significantly affected in either species. On the basis of these results it is possible to identify 1800-ppm THF as a no observable effect level (NOEL) in the rat and 600 ppm as a NOEL in the mouse.

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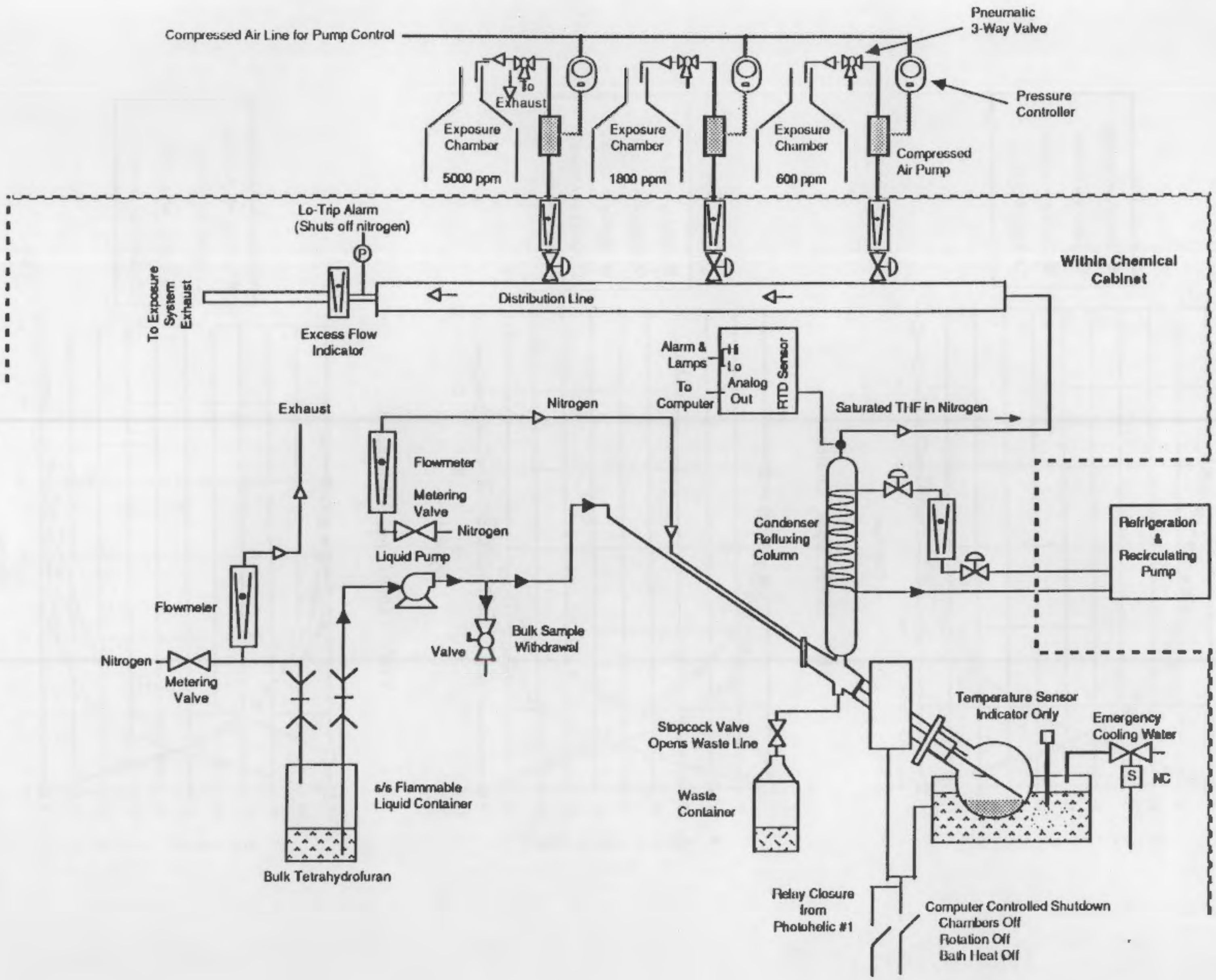
FIGURE 1. Tetrahydrofuran Exposure System



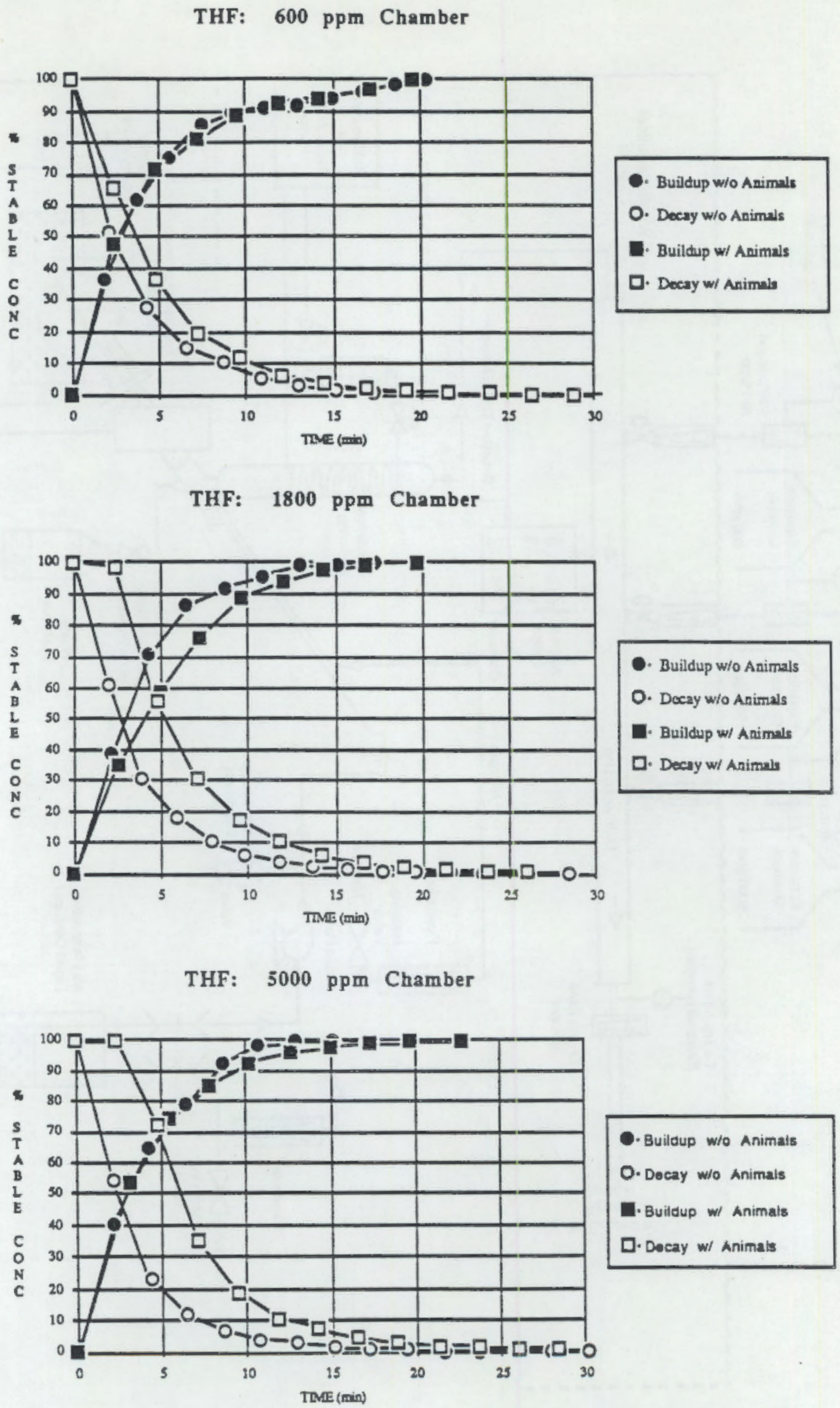
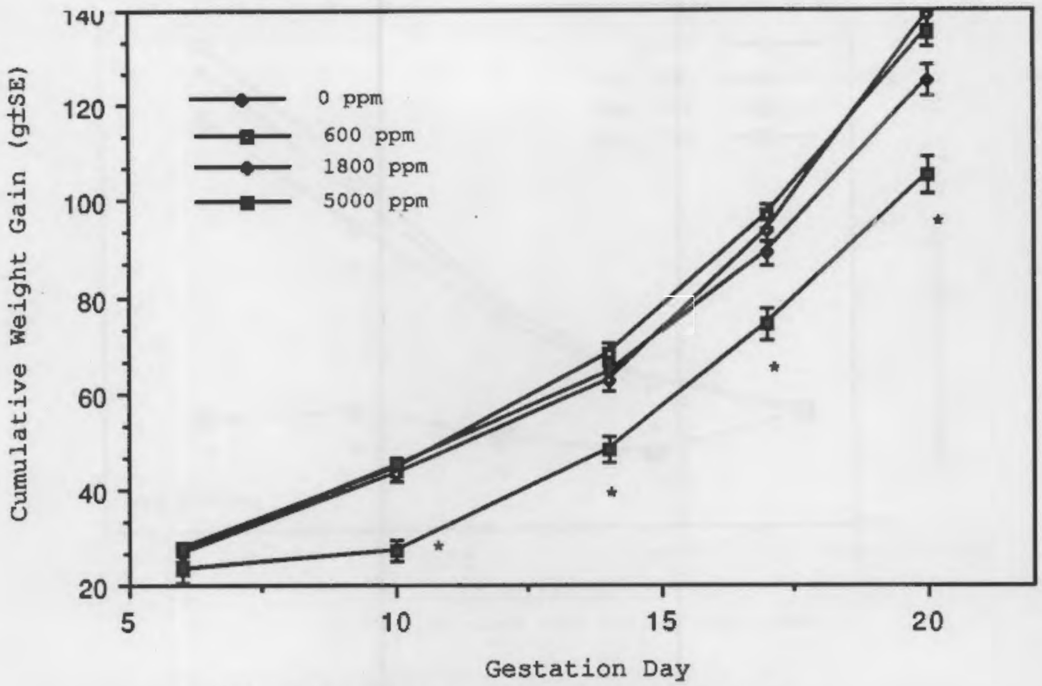


FIGURE 2. Buildup and Decay of Tetrahydrofuran Concentrations in 600, 1800, and 5000 ppm Exposure Chambers (With and Without Animals Present)



* Significantly different from controls at p<0.05.

FIGURE 3. Cumulative Weight Gain for Pregnant Rats (6-20 dg).

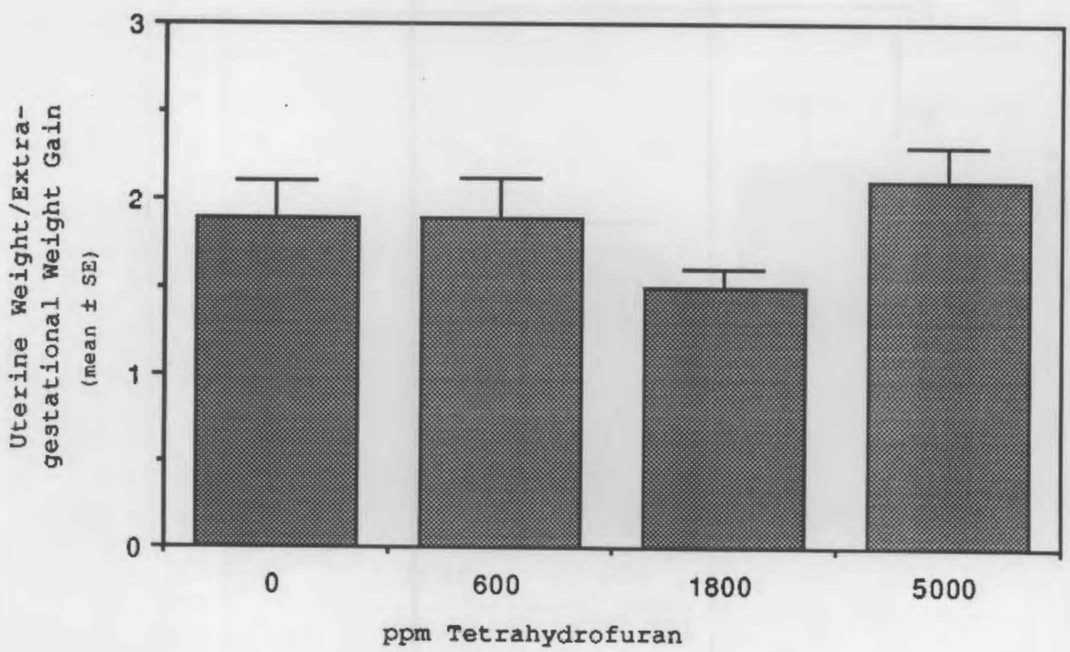


FIGURE 4. The Ratio of Gravid Uterine Weight to Maternal Extra-gestational Weight Gain (Body Weight at Sacrifice minus Body Weight at 0 dg minus Uterine Weight) in Rats at 20 dg.

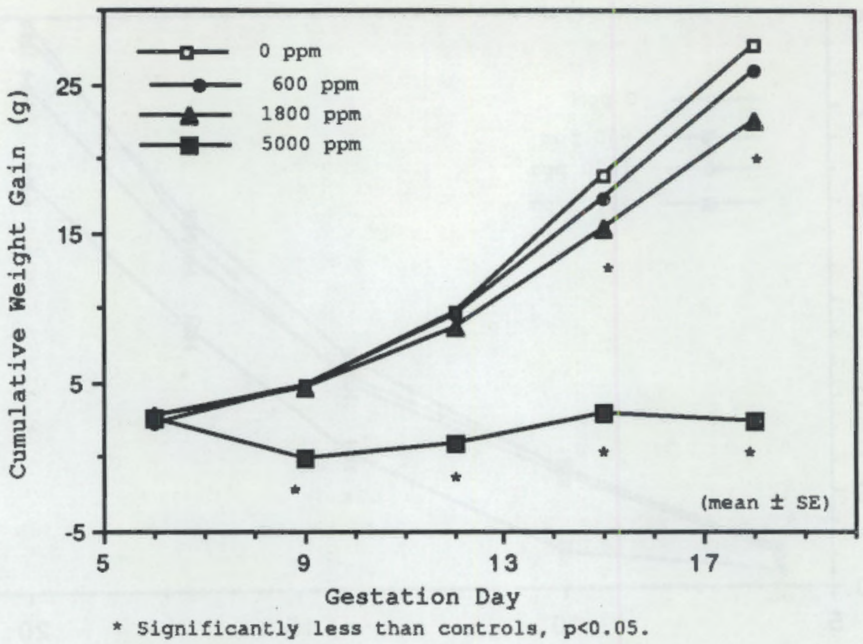


FIGURE 5. Cumulative Weight Gain for Pregnant Mice (6-18 dg).

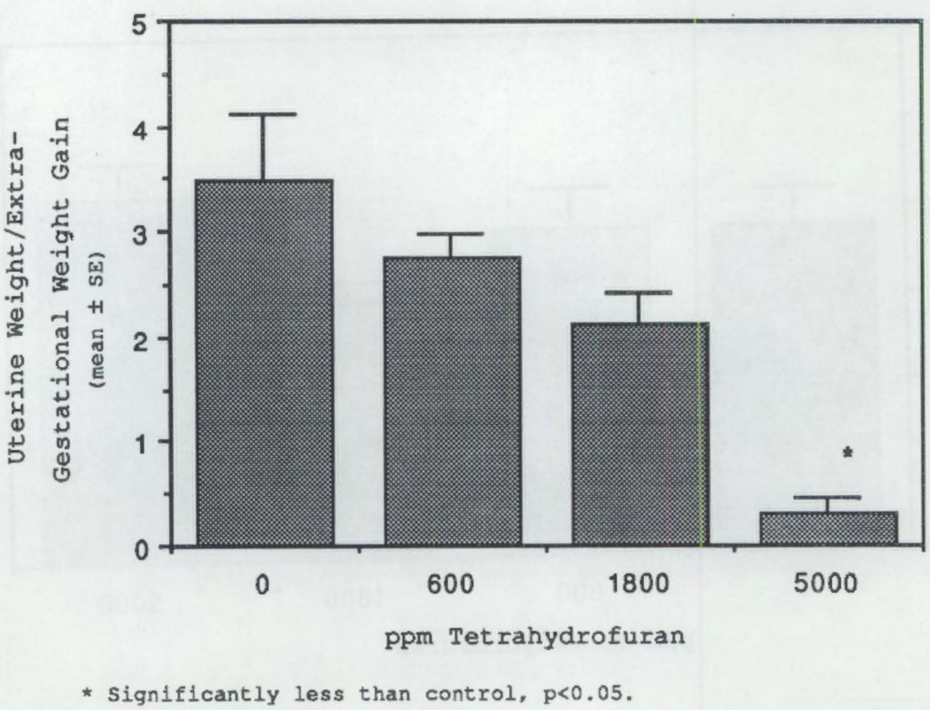


FIGURE 6. The Ratio of Gravid Uterine Weight to Maternal Extra-gestational Weight Gain (Body Weight at Sacrifice minus Body Weight at 0 dg minus Uterine Weight) in Mice at 18 dg.

TABLE 1. Physical and Chemical Properties of Tetrahydrofuran.

Tetrahydrofuran: diethylene oxide, 1,4-epoxybutane; butylene oxide.

CAS# 109-99-9	NTP# 170	RTECS# LU5950000
Mol. Form. C_4H_8O	MW 72.12	BP 65/66°C (760 mm Hg)

Vapor Pressure: 144 mm Hg @ 20°C
114 mm Hg @ 15°C

Flash point: 1°F (17°C)

Flammability limits in air: Lower - 2% by volume
Upper - 11.8% by volume

Colorless liquid with ether-like odor.

Miscible with water, alcohol, ketones, esters and hydrocarbons.

Stabilized with one of the following:

- p-cresol
- Hydroquinone
- 4,4'-thiobis-(6-tert-butyl-m-cresol)

TABLE 2. Teratology Study of THF in Mice and Rats: Summary of Chamber Uniformity Data Obtained Before and During Exposure.

	TPV (%RSD)		WPV (%RSD)		BPV (%RSD)	
Chamber	Prestart	Poststart	Prestart	Poststart	Prestart	Poststart
600 ppm	0.3	0.2	0.3	0.4	≤0	≤0
1800 ppm	0.5	0.7	0.6	1.4	≤0	≤0
5000 ppm	0.4	1.2	0.7	1.7	≤0	≤0

Chamber Uniformity Limits

WPV ≤ 5% RSD
BPV ≤ 5% RSD
TPV ≤ 7% RSD

WPV = Within Port Variability
BPV = Between Port Variability
TPV = Total Port Variability
RSD = Relative Standard Deviation

TABLE 3. Tetrahydrofuran Teratology Study: Average Daily Exposure Chamber Concentrations for Mouse Exposures.

0 ppm Tetrahydrofuran Vapor						
Exposure Day	Mean ±SD (ppm)	Max (ppm)	Min (ppm)	Number Samples	Number in Range (b)	Percent in Range
1	<MDL (a)	<MDL	<MDL	16	16	100
2	<MDL	<MDL	<MDL	17	17	100
3	<MDL	<MDL	<MDL	17	17	100
4	<MDL	<MDL	<MDL	17	17	100
5	<MDL	<MDL	<MDL	17	17	100
6	<MDL	<MDL	<MDL	15	15	100
7	<MDL	<MDL	<MDL	51	51	100
8	<MDL	<MDL	<MDL	23	23	100
9	<MDL	<MDL	<MDL	16	16	100
10	<MDL	<MDL	<MDL	16	16	100
11	<MDL	<MDL	<MDL	17	17	100
12	<MDL	<MDL	<MDL	16	16	100
13	<MDL	<MDL	<MDL	17	17	100
14	<MDL	<MDL	<MDL	16	16	100
15	<MDL	<MDL	<MDL	17	17	100
16	0.14 ± 0.16	0.67	<MDL	17	17	100
Summary	<MDL	0.67	<MDL	305	305	100

(a) Minimum Detectable Limit (MDL)=0.04 ppm Tetrahydrofuran.
(b) Range=0-20 ppm Tetrahydrofuran.

600 ppm Tetrahydrofuran Vapor						
Exposure Day	Mean ±SD (ppm)	Max (ppm)	Min (ppm)	Number Samples	Number in Range (a)	Percent in Range
1	619 ± 21	663	589	16	15	94
2	626 ± 8	638	605	16	16	100
3	614 ± 14	643	573	16	16	100
4	610 ± 12	630	577	16	16	100
5	608 ± 16	640	576	16	16	100
6	611 ± 16	638	576	13	13	100
7	622 ± 13	654	595	16	16	100
8	605 ± 13	627	581	15	15	100
9	595 ± 23	624	541	15	15	100
10	596 ± 18	620	568	14	14	100
11	610 ± 22	676	579	16	15	94
12	607 ± 11	628	582	16	16	100
13	608 ± 11	633	589	16	16	100
14	605 ± 9	620	583	14	14	100
15	605 ± 14	631	587	16	16	100
16	612 ± 19	672	589	16	15	94
Summary	610 ± 17	676	541	247	244	99

(a) Range = ±10% target.

TABLE 3. Tetrahydrofuran Teratology Study: Average Daily Exposure Chamber Concentrations for Mouse Exposures. (cont.)

1800 ppm Tetrahydrofuran Vapor						
Exposure Day	Mean ±SD (ppm)	Max (ppm)	Min (ppm)	Number Samples	Number in Range (a)	Percent in Range
1	1840 ± 66	2000	1740	16	15	94
2	1880 ± 39	1920	1750	17	17	100
3	1850 ± 43	1950	1730	17	17	100
4	1820 ± 34	1880	1730	17	17	100
5	1830 ± 68	1950	1720	17	17	100
6	1810 ± 169	1950	1270	14	13	93
7	1840 ± 42	1910	1730	17	17	100
8	1740 ± 37	1800	1670	16	16	100
9	1780 ± 62	1880	1660	15	15	100
10	1780 ± 63	1850	1610	15	14	93
11	1840 ± 55	1970	1750	17	17	100
12	1840 ± 31	1890	1760	16	16	100
13	1840 ± 40	1940	1770	17	17	100
14	1830 ± 29	1880	1770	15	15	100
15	1830 ± 47	1930	1740	17	17	100
16	1840 ± 64	1990	1730	15	14	93
Summary	1830 ± 68	2000	1270	258	254	98

(a) Range = ±10% target.

5000 ppm Tetrahydrofuran Vapor						
Exposure Day	Mean ±SD (ppm)	Max (ppm)	Min (ppm)	Number Samples	Number in Range (a)	Percent in Range
1	5070 ± 137	5380	4820	16	16	100
2	5180 ± 82	5320	4940	17	17	100
3	5150 ± 74	5240	4920	17	17	100
4	5100 ± 102	5270	4840	17	17	100
5	5110 ± 164	5390	4840	17	17	100
6	5190 ± 217	5430	4490	14	13	93
7	5070 ± 110	5250	4800	17	17	100
8	4970 ± 91	5130	4810	15	15	100
9	4950 ± 133	5170	4760	15	15	100
10	4950 ± 141	5110	4560	15	15	100
11	4980 ± 122	5260	4780	17	17	100
12	5010 ± 70	5130	4840	16	16	100
13	5090 ± 84	5370	4980	17	17	100
14	5050 ± 55	5130	4920	15	15	100
15	4990 ± 83	5120	4840	17	17	100
16	5150 ± 242	5780	4870	15	13	87
Summary	5060 ± 146	5780	4490	257	254	99

(a) Range = ±10% target.

TABLE 4. Tetrahydrofuran Teratology Study: Average Daily Exposure Chamber Concentrations for Rat Exposures.

0 ppm Tetrahydrofuran Vapor						
Exposure Day	Mean ±SD (ppm)	Max (ppm)	Min (ppm)	Number Samples	Number in Range (b)	Percent in Range
1	<MDL (a)	<MDL	<MDL	17	17	100
2	<MDL	<MDL	<MDL	17	17	100
3	<MDL	<MDL	<MDL	48	48	100
4	<MDL	<MDL	<MDL	16	16	100
5	<MDL	<MDL	<MDL	17	17	100
6	<MDL	<MDL	<MDL	17	17	100
7	<MDL	<MDL	<MDL	17	17	100
8	<MDL	<MDL	<MDL	17	17	100
9	<MDL	<MDL	<MDL	17	17	100
10	<MDL	<MDL	<MDL	17	17	100
11	<MDL	<MDL	<MDL	17	17	100
12	<MDL	<MDL	<MDL	15	15	100
13	<MDL	<MDL	<MDL	17	17	100
14	<MDL	<MDL	<MDL	17	17	100
15	<MDL	<MDL	<MDL	17	17	100
16	<MDL	<MDL	<MDL	17	17	100
17	<MDL	<MDL	<MDL	16	16	100
18	<MDL	<MDL	<MDL	16	16	100
Summary	<MDL	<MDL	<MDL	332	332	100

(a) Minimum Detectable Limit (MDL)=0.04 ppm Tetrahydrofuran.
(b) Range=0-20 ppm Tetrahydrofuran.

600 ppm Tetrahydrofuran Vapor						
Exposure Day	Mean ±SD (ppm)	Max (ppm)	Min (ppm)	Number Samples	Number in Range (a)	Percent in Range
1	589 ± 11	605	568	16	16	100
2	582 ± 10	597	563	16	16	100
3	600 ± 10	614	570	15	15	100
4	587 ± 16	615	557	15	15	100
5	594 ± 15	631	571	16	16	100
6	583 ± 36	663	493	16	14	88
7	624 ± 21	670	598	16	14	88
8	595 ± 20	623	535	15	14	93
9	604 ± 25	641	531	16	15	94
10	601 ± 10	633	591	16	16	100
11	605 ± 11	630	593	16	16	100
12	597 ± 12	629	571	14	14	100
13	591 ± 71	626	337	15	14	93
14	599 ± 10	627	567	16	16	100
15	613 ± 12	629	576	16	16	100
16	602 ± 11	615	581	16	16	100
17	604 ± 12	631	587	16	16	100
18	594 ± 21	626	550	16	16	100
Summary	598 ± 25	670	337	282	275	98

(a) Range = ±10% target.

TABLE 4. Tetrahydrofuran Teratology Study: Average Daily Exposure Chamber Concentrations for Rat Exposures. (cont.)

1800 ppm Tetrahydrofuran Vapor						
Exposure Day	Mean ±SD (ppm)	Max (ppm)	Min (ppm)	Number Samples	Number In Range (a)	Percent in Range
1	1830 ± 32	1870	1770	17	17	100
2	1810 ± 43	1880	1720	17	17	100
3	1830 ± 35	1890	1740	16	16	100
4	1780 ± 48	1880	1700	16	16	100
5	1780 ± 45	1860	1710	16	16	100
6	1750 ± 103	1940	1460	16	15	94
7	1870 ± 72	2030	1790	16	14	88
8	1810 ± 48	1900	1680	16	16	100
9	1800 ± 81	1910	1590	16	15	94
10	1780 ± 42	1890	1670	17	17	100
11	1790 ± 29	1860	1720	17	17	100
12	1800 ± 37	1910	1740	14	14	100
13	1790 ± 172	1880	1160	16	15	94
14	1790 ± 36	1900	1730	17	17	100
15	1840 ± 47	1910	1730	17	17	100
16	1810 ± 29	1850	1750	17	17	100
17	1830 ± 27	1890	1800	16	16	100
18	1740 ± 52	1810	1630	15	15	100
Summary	1800 ± 69	2030	1160	292	287	98

(a) Range = ±10% target.

5000 ppm Tetrahydrofuran Vapor						
Exposure Day	Mean ±SD (ppm)	Max (ppm)	Min (ppm)	Number Samples	Number in Range (a)	Percent in Range
1	5060 ± 78	5260	4950	16	16	100
2	4940 ± 90	5060	4690	17	17	100
3	5140 ± 72	5260	4950	16	16	100
4	4980 ± 114	5230	4750	16	16	100
5	4950 ± 139	5160	4710	16	16	100
6	4680 ± 231	5010	3990	16	15	94
7	5040 ± 146	5330	4680	16	16	100
8	5020 ± 115	5230	4850	16	16	100
9	5050 ± 139	5260	4760	16	16	100
10	4950 ± 115	5220	4680	17	17	100
11	5050 ± 74	5220	4960	17	17	100
12	5030 ± 92	5320	4960	14	14	100
13	4990 ± 310	5200	3870	16	15	94
14	4940 ± 94	5240	4830	17	17	100
15	5110 ± 114	5300	4850	17	17	100
16	5030 ± 75	5140	4870	17	17	100
17	5060 ± 64	5180	4990	15	15	100
18	4890 ± 154	5070	4540	15	15	100
Summary	4990 ± 166	5330	3870	290	288	99

(a) Range = ±10% target.

TABLE 5. Tetrahydrofuran Rat Teratology: Mean Body Weights for Virgins (g±SD).

Exposure Concentration	N	Exposure Day 1	Exposure Day 5	Exposure Day 10	Sacrifice
0 ppm	10	288.1 ± 20.0	297.5 ± 20.9	302.2 ± 23.4	300.0 ± 24.8
600 ppm	10	284.8 ± 20.6	295.5 ± 21.7	301.0 ± 22.6	303.0 ± 25.1
1800 ppm	10	291.7 ± 23.7	302.2 ± 29.6	304.8 ± 35.0	303.0 ± 29.4
5000 ppm	10	285.8 ± 21.1	290.4 ± 22.2	297.7 ± 25.1	301.7 ± 32.8

TABLE 6. Tetrahydrofuran Rat Teratology Study: Mean Body, Uterine, and Extra-gestational Weights for Pregnant Dams (g ± SD).

Exposure Concentration	N	DG 6	DG 10 (a)	DG 14 (a)	DG 17 (a)	DG 20 (a)	Uterine	Extra-gestational Weight Gain
0 ppm	31	306.4 ± 18.5	324.7 ± 20.0	344.4 ± 21.7	368.9 ± 23.3	405.3 ± 29.0	76.8 ± 21.1	48.5 ± 14.7
600 ppm	28	303.3 ± 24.8	320.4 ± 25.8	343.9 ± 27.4	372.4 ± 29.2	411.5 ± 30.8	83.3 ± 16.4	52.4 ± 15.2
1800 ppm	29	300.8 ± 18.4	317.3 ± 18.0	336.9 ± 20.0	367.5 ± 23.4	412.9 ± 32.9	79.5 ± 15.9	59.3 ± 20.5
5000 ppm	32	299.1 ± 26.2	302.8 ± 24.0(b)	324.0 ± 27.0(b)	349.8 ± 29.4(b)	380.8 ± 32.8(b)	66.5 ± 15.1	38.7 ± 16.2

(a) Significantly correlated with exposure concentration, $p<0.05$

(b) Significantly different from control groups, $p<0.05$.

TABLE 7. Contemporary Control Data for Sprague Dawley Rats (N=80 Litters; Mean ± SD).

	Number	Percent
Maternal Weight; 18 dg	404.8 ± 29.0	—
Gravid Uterine Weight	79.6 ± 18.7	—
Extra-gestational Weight Gain	48.2 ± 15.0	—
Implants	15.7 ± 2.9	—
Live Fetuses	14.7 ± 3.3	92.5 ± 9.0
Early Resorptions	0.9 ± 1.1	6.4 ± 8.6
Late Resorptions	0.2 ± 0.5	1.1 ± 3.3
Dead Fetuses	0.0 ± 0.0	0.0 ± 0.0
Total Intrauterine Death	1.1 ± 1.1	7.5 ± 9.0
Fetal Weight	3.55 ± 0.33	—
Male	3.64 ± 0.39	—
Female	3.45 ± 0.32	—

TABLE 8. Tetrahydrofuran Rat Teratology Study: Reproductive Measures (mean ± SD).

	Tetrahydrofuran Chamber Concentration (ppm)			
	0	600	1800	5000
Sperm-positive Females	33	32	32	32
Number Pregnant	31	28	29	32
Pregnant (%)	93.9	87.5	90.6	100
Pregnancies Examined	31	28	29	32
Implantations/Dam	15.5 ± 3.7	16.7 ± 3.0	15.4 ± 2.3	15.7 ± 3.2
Live Fetuses/Litter	14.5 ± 4.2	15.4 ± 3.3	14.5 ± 2.5	14.8 ± 3.4
Resorptions/Litter: Total	1.1 ± 1.2	1.3 ± 3.6	0.9 ± 1.4	0.9 ± 1.0
Early	1.0 ± 1.2	1.3 ± 3.6	0.7 ± 1.2	0.8 ± 1.0
Late	0.1 ± 0.4	0.0 ± 0.2	0.2 ± 0.5	0.1 ± 0.3
Dead Fetuses/Litter	0	0	0	0
PERCENTAGE OF:				
Live Fetuses/Litter	91.6 ± 11.1	93.3 ± 15.1	94.2 ± 8.5	93.8 ± 10.4
Resorptions/Litter: Total	8.4 ± 11.1	6.7 ± 15.1	5.8 ± 8.5	6.2 ± 10.4
Early	7.7 ± 10.9	6.4 ± 15.2	4.2 ± 7.4	5.8 ± 10.4
Late	0.7 ± 2.9	0.2 ± 1.2	1.6 ± 3.8	0.4 ± 1.5
Dead Fetuses/Litter	0	0	0	0
Litters with Resorptions	55	43	45	56

TABLE 9. Tetrahydrofuran Rat Teratology Study: Average Fetal Weights (Means of Litter Means; g ± SD), and Fetal Sex Ratio.

	Tetrahydrofuran Chamber Concentration (ppm)			
	0	600	1800	5000
Litter Examined	31	28	29 (a)	32
Live Fetuses Examined	447	430	421 (a)	474
Fetal Weight (b)	3.5 ± 0.3	3.6 ± 0.3	3.6 ± 0.3	2.9 ± 0.2 (c)
Male (b)	3.6 ± 0.4	3.8 ± 0.3	3.6 ± 0.4	3.0 ± 0.3 (c)
Female (b)	3.5 ± 0.2	3.5 ± 0.3	3.5 ± 0.3	2.8 ± 0.2 (c)
Percent Male Fetuses	46.9 ± 13.6	48.4 ± 15.2	48.0 ± 16.6	49.4 ± 16.3

(a) One litter was not weighed, therefore N=28 litters for fetal weight mean.
(b) Significantly correlated to exposure concentration, $p<0.05$.
(c) Significantly different from control group, $p<0.05$.

TABLE 10. Tetrahydrofuran Rat Teratology Study: Malformations Observed in Live Fetuses.

		Fetuses (a)				Litters (a)			
Tetrahydrofuran (ppm)		0	600	1800	5000	0	600	1800	5000
Total Examined (b)		447	430	421	474	31	28	29	32
Heads examined (c)		222	216	206	234	31	28	29	32
Skulls examined (d)		225	214	215	240	31	28	29	32
Viscera examined (e)		226	214	215	241	31	28	29	32
Malformations:									
Anal Atresia	NO.	0	0	0	1	0	0	0	1
	(%)				(0.2)				(3.1)
Cleft Palate	NO.	0	0	1	1	0	0	1	1
	(%)			(0.2)	(0.2)			(3.4)	(3.1)
Vestigial Tail	NO.	0	0	0	2	0	0	0	2
	(%)				(0.4)				(6.2)
Branched or Fused Ribs	NO.	0	2	0	0	0	2	0	0
	(%)		(0.5)				(7.1)		
Fused Sternebrae	NO.	0	1	0	1	0	1	0	1
	(%)		(0.2)		(0.2)		(3.6)		(3.1)
Fused Vertebrae (cervical)	NO.	1	0	0	0	1	0	0	0
	(%)	(0.2)				(3.2)			
Vertebral Agenesis (lumbar, sacral, caudal)	NO.	0	0	0	1	0	0	0	1
	(%)				(0.2)				(3.1)
Ectopic Ovaries	NO.	1	0	0	0	1	0	0	0
	(%)	(0.4)				(3.2)			
Retroesophageal Rt. Subclavian Artery	NO.	0	0	1	0	0	0	1	0
	(%)			(0.5)				(3.4)	
Microphthalmia	NO.	1	0	0	0	1	0	0	0
	(%)	(0.5)				(3.2)			
Total Affected	NO.	2	3	2	4	2	3	2	4
	(%)	(0.4)	(0.7)	(0.5)	(0.8)	(6.5)	(10.7)	(6.9)	(12.5)

(a) A single fetus or litter may be represented more than once in this table.
(b) All fetuses examined for external and skeletal defects.
One-half had heads removed prior to skeletal staining.
(c) Heads fixed in Bouin's solution for soft-tissue cranio-facial malformations.
(d) Heads remaining on the fetuses for skeletal examination; see (b).
(e) Viscerals performed on approx. 50% of live fetuses
and all fetuses with external defects.

Table 11. Tetrahydrofuran Rat Teratology Study: Mean Percent of Live Fetuses Affected per Litter (mean ±SD).

	Tetrahydrofuran Concentration (ppm)			
	0	600	1800	5000
Number Litters	31	28	29	32
Live Fetuses/Litter	14.4 ± 4.2	15.4 ± 3.3	14.5 ± 2.5	14.8 ± 3.4
Malformations:				
Anal Atresia	0	0	0	0.2 ± 1.0
Cleft Palate	0	0	0.2 ±1.2	0.2 ± 1.1
Vestigial Tail	0	0	0	0.4 ± 1.6
Branched or Fused Ribs	0	0.4 ± 1.6	0	0
Fused Sternebrae	0	0.2 ± 1.0	0	0.2 ± 1.3
Fused Cervical Vertebrae	0.2 ± 1.0	0	0	0
Vertebral Agenesis (lumbar,sacral,caudal)	0	0	0	0.2 ± 1.0
Ectopic Ovaries	0.3 ± 1.8	0	0	0
Retroesophageal Rt. Subclavian Artery	0	0	0.4 ± 2.3	0
Microphthalmia	0.5 ± 2.6	0	0	0
Total Malformations	0.4 ± 1.5	0.9 ± 2.7	0.4 ± 1.6	1.2 ± 3.5
Variations:				
Knobby Ribs	0	0.3 ± 1.5	0	0
Dilated Ureter	0.8 ± 3.1	3.6 ±16.7	6.2 ±11.7	1.6 ± 5.3
Misaligned Sternebrae	0.4 ± 1.5	0.5 ± 1.8	0.3 ± 1.4	1.0 ± 2.9
Missing Innominate Artery	0.5 ± 3.0	0	0	0
Supernumerary Ribs	1.8 ± 5.1	1.8 ± 4.2	1.5 ± 4.9	1.8 ± 4.1
Reduced Ossifications:				
Pelvis	1.3 ± 5.5	1.0 ± 3.3	0.4 ± 1.7	2.6 ± 5.4
Phalanges	0.2 ± 1.0	0.5 ± 1.9	0.2 ± 1.2	4.4 ±11.2
Ribs(b)	0.2 ± 1.2	0	0.2 ± 1.2	0.2 ± 1.2
Skull	1.6 ± 6.4	0.4 ± 2.1	0.5 ± 2.7	4.0 ±10.3
Sternebrae 1-4	6.6 ±10.8	9.7 ±19.2	6.1 ± 9.5	14.0 ±15.0
Vertebral Centra	3.7 ± 6.3	3.0 ± 5.4	5.6 ±10.1	4.7 ± 7.4
Total Variations	15.7 ± 17.3	18.9 ± 27.7	17.8 ± 13.7	31.6 ± 31.9

(a) Includes malformations, variations, and reduced ossifications.
(b) Includes thoracic rudimentary ribs.

TABLE 12. Contemporary Control Data on Rat Teratology Studies: Malformations.

		Fetuses (a) Number (Percent)	Litters Number (Percent)	Mean Percent per Litter (± SD)
Total examined (b)		1172	80	—
Heads examined (c)		—	—	
Skulls examined (d)		—	—	
Malformations				
Exencephaly	No.	1	1	0.1 ± 0.9
	(%)	(0.1)	(1.3)	
Microphthalmia	No.	1	1	0.1 ± 0.7
	(%)	(0.1)	(1.3)	
Rudimentary Rib	No.	1	1	0.1 ± 0.7
	(%)	(0.1)	(1.3)	
Anophthalmia	No.	1	1	0.1 ± 0.9
	(%)	(0.1)	(1.3)	
Rachischisis	No.	1	1	0.1 ± 0.9
	(%)	(0.1)	(1.3)	
Ectopic Ovaries	No.	1	1	0.1 ± 0.6
	(%)	(0.1)	(1.3)	
Total Fetuses (Litters) with Malformations	No.	4	6	0.5 ± 2.8
	(%)	(0.3)	(7.5)	

(a) A single fetus or litter may be represented more than once in this table.
(b) All fetuses examined for external and skeletal defects. One-half had heads removed prior to skeletal staining.
(c) Heads fixed in Bouin's solution for soft-tissue craniofacial evaluations.
(d) Heads that remained on the fetuses had a skeletal examination; see (b).

TABLE 13. Tetrahydrofuran Rat Teratology Study: Variations Observed in Live Fetuses.

		Fetuses (a)				Litters (a)			
Tetrahydrofuran (ppm)		0	600	1800	5000	0	600	1800	5000
Total Examined (b)		447	430	421	474	31	28	29	32
Heads examined (c)		222	216	206	234	31	28	29	32
Skulls examined (d)		225	214	215	240	31	28	29	32
Viscera examined (e)		226	214	215	241	31	28	29	32
Variations:									
Knobby Ribs	NO.	0	1	0	0	0	1	0	0
	(%)		(0.2)				(3.6)		
Dilated Ureter	NO.	2	8	12	4	2	2	8	3
	(%)	(0.9)	(3.7)	(5.6)	(1.7)	(6.4)	(7.1)	(27.6)	(9.4)
Misaligned Sternebrae	NO.	2	2	1	5	2	2	1	4
	(%)	(0.4)	(0.5)	(0.2)	(1.0)	(6.4)	(7.1)	(3.4)	(12.5)
Missing Innominate Artery	NO.	1	0	0	0	1	0	0	0
	(%)	(0.2)				(3.2)			
Supernumerary Ribs	NO.	7	8	7	9	5	6	4	6
	(%)	(1.6)	(1.9)	(1.7)	(1.9)	(16.1)	(21.4)	(13.8)	(18.7)
Reduced Ossifications:									
Pelvis	NO.	5	4	2	13	3	3	2	8
	(%)	(1.1)	(0.9)	(0.5)	(2.7)	(9.7)	(10.7)	(6.9)	(25.0)
Phalanges	NO.	1	2	1	23	1	2	1	7
	(%)	(0.2)	(0.5)	(0.2)	(4.8)	(3.2)	(7.1)	(3.4)	(21.9)
Ribs (f)	NO.	0	0	1	1	0	0	1	1
	(%)			(0.2)	(0.2)			(3.4)	(3.1)
Skull	NO.	4	1	1	10	2	1	1	6
	(%)	(1.8)	(0.5)	(0.5)	(4.2)	(6.4)	(3.6)	(3.4)	(18.7)
Sternebrae	NO.	32	39	27	71	12	13	11	23
	(%)	(7.2)	(9.1)	(6.4)	(15.0)	(38.7)	(46.4)	(37.9)	(71.9)
Vertebral Centra	NO.	16	12	22	19	10	9	11	14
	(%)	(3.6)	(2.8)	(5.2)	(4.0)	(32.3)	(32.1)	(37.9)	(43.7)
Total Affected	NO.	59	63	70	111	23	19	25	27
	(%)	(13.2)	(14.7)	(16.6)	(23.5)	(74.2)	(67.9)	(86.2)	(84.4)

(a) A single fetus or litter may be represented more than once in this table.
(b) All fetuses examined for external and skeletal defects. One-half had heads removed prior to skeletal staining.
(c) Heads fixed in Bouin's solution for soft-tissue craniofacial evaluations.
(d) Heads remaining on the fetuses for skeletal examination; see (b).
(e) Viscerals performed on approx. 50% of live fetuses and all fetuses with external defects.
(f) Includes rudimentary thoracic ribs.

TABLE 14. Contemporary Control Data on Rat Teratology Studies: Variations and Reduced Ossifications.

		Fetuses (a) Number (Percent)	Litters Number (Percent)	Mean Percent per Litter (± SD)
Total examined (b)		1172	80	—
Heads examined (c)		—	—	
Skulls examined (d)		—	—	
Variations				
Supernumerary Rib	No.	38	17	3.2 ± 8.4
	(%)	(3.2)	(21.3)	
Missing Innominate Artery	No.	2	2	0.2 ± 1.1
	(%)	(0.2)	(2.5)	
Dilated Ureter	No.	32	15	2.9 ± 8.7
	(%)	(2.7)	(18.8)	
Renal Pelvic Cavitation	No.	8	4	0.7 ± 3.4
	(%)	(0.7)	(5.0)	
Misaligned Sternabrae	No.	4	4	0.3 ± 1.5
	(%)	(0.3)	(5.0)	
Reduced Ossifications				
Sternebrae	No.	95	38	8.5 ± 15.0
	(%)	(8.1)	(47.5)	
Vertebrae	No.	53	29	4.7 ± 10.2
	(%)	(4.5)	(36.3)	
Phalanges	No.	9	6	1.0 ± 4.0
	(%)	(0.8)	(7.5)	
Pelvic	No.	21	10	2.3 ± 9.8
	(%)	(1.8)	(12.5)	
Skull	No.	15	7	1.5 ± 6.1
	(%)	(1.3)	(8.8)	
Total Fetuses (Litters) with Variations or Red. Ossif.	No.	204	69	25.4 ± 37.3
	(%)	(17.4)	(86.3)	

(a) A single fetus or litter may be represented more than once in this table.
(b) All fetuses examined for external and skeletal defects. One-half had heads removed prior to skeletal staining.
(c) Heads fixed in Bouin's solution for soft-tissue craniofacial evaluations.
(d) Heads that remained on the fetuses had a skeletal examination; see (b).

TABLE 15. Tetrahydrofuran Mouse Teratology: Mean Body Weights for Virgins (g ± SD).

Exposure Concen-tration	N	Exposure Day 1	Exposure Day 5 (a)	Exposure Day 10	Sacrifice
0 ppm	10	27.3 ± 1.7	27.9 ± 1.4	27.6 ± 1.3	26.2 ± 1.3
600 ppm	10	27.1 ± 1.5	28.0 ± 1.3	28.6 ± 1.4	26.6 ± 1.7
1800 ppm	10	27.7 ± 1.8	27.6 ± 3.1	26.9 ± 4.1	26.4 ± 3.6
5000 ppm (b)	10	26.7 ± 2.5	20.5 ± 2.2(c,f)	25.8 ± 4.7(d)	25.0 ± 0.9(e)

(a) Significantly correlated with exposure concentration, p<0.05.
(b) 5000 ppm group exposed for only 6 days.
(c) N = 8, see text.
(d) N = 7, see text.
(e) N = 6, see text.
(f) Significantly different from control group, p<0.05.

TABLE 16. Tetrahydrofuran Mouse Teratology Study: Mean Body, Uterine, and Extra-gestational Weights for Pregnant Dams (g ± SD).

Exposure Concen-tration	N	DG 6	DG 9 (a)	DG 12 (a)	DG 15(a)	DG 18 (a)	Uterine (a)	Extra-Gestational Weight Gain (a)
0 ppm	30	29.3 ± 1.7	31.5 ± 2.1	36.4 ± 2.5	45.5 ± 2.7	54.3 ± 3.8	20.5 ± 3.3	7.2 ± 1.9
600 ppm	26	28.6 ± 1.9	31.2 ± 2.3	36.1 ± 3.4	43.8 ± 5.0	52.4 ± 7.5	19.0 ± 5.2	6.9 ± 3.3
1800 ppm	27	29.3 ± 1.8	31.1 ± 2.5	35.3 ± 4.1	41.7 ± 6.7(d)	49.0 ±10.1(d)	15.6 ± 7.1(d)	6.9 ± 4.3
5000 ppm (b)	20(c)	26.8 ± 1.3	26.8 ± 2.6(d)	27.8 ± 2.8(d)	29.8 ± 3.3(d)	29.4 ± 5.0(d)	1.0 ± 3.8(d)	1.4 ± 1.7(d)

(a) Significantly correlated with exposure concentration, p<0.05.
(b) 5000 ppm group exposed from 6-11 dg.
(c) N = 20; 7 dams died during exposure, see text.
(d) Significantly different from control group, p<0.05.

TABLE 17. Contemporary Control Data for Swiss (CD-1) Mice (N=83 Litters; Mean ± SD).

	Number	Percent
Maternal Weight; 18 dg	54.4 ± 5.6	—
Gravid Uterine Weight	20.2 ± 3.6	—
Extra-gestational Weight Gain	6.6 ± 3.0	—
Implants	12.6 ± 2.1	—
Live Fetuses	11.7 ± 2.2	93.5 ± 7.3
Early Resorptions	0.6 ± 0.8	4.6 ± 6.3
Late Resorptions	0.2 ± 0.5	1.9 ± 3.7
Dead Fetuses	0.0 ± 0.0	0.0 ± 0.0
Total Intrauterine Death	0.8 ± 1.0	6.5 ± 7.3
Fetal Weight	1.36 ± 0.11	—
Male	1.39 ± 0.11	—
Female	1.34 ± 0.10	—

TABLE 18. Tetrahydrofuran Mouse Teratology Study: Reproductive Measures (Mean ± SD).

	Tetrahydrofuran Chamber Concentration (ppm)			
	0	600	1800	5000 (a)
Plug-positive Females	33	33	33	33
Number Pregnant	31	28	27	27
Pregnant (%)	93.9	84.8	81.8	81.8
Pregnancies Examined	30 (b)	26 (c)	27	20 (d)
Implantations/Dam	12.8 ± 1.8	12.0 ± 2.2	12.0 ± 1.9	12.6 ± 2.8
Live Fetuses/Litter (e)	11.9 ± 1.9	11.1 ± 3.2	9.3 ± 4.4 (f)	0.6 ± 2.7 (f)
Resorptions/Litter	0.9 ± 1.1	0.9 ± 1.8	2.7 ± 4.1	12.0 ± 3.7
Early	0.6 ± 1.0	0.7 ± 1.8	1.8 ± 3.9	11.9 ± 4.0
Late	0.3 ± 0.5	0.2 ± 0.5	0.9 ± 2.2	0.1 ± 0.5
Dead Fetuses/Litter	0.0 ± 0.0	0.0 ± 0.2	0.0 ± 0.0	0.0 ± 0.0
PERCENTAGE OF:				
Live Fetuses/Litter (e)	93.1 ± 8.2	91.2 ± 19.6	77.4 ± 34.8 (g)	4.3 ± 19.2 (g)
Resorptions/Litter (e)	6.9 ± 8.2	8.4 ± 19.5	22.6 ± 34.8 (g)	95.7 ± 19.2 (g)
Early (e)	4.7 ± 7.6	6.7 ± 19.4	14.6 ± 31.4 (g)	95.0 ± 22.4 (g)
Late	2.1 ± 3.7	1.7 ± 4.5	8.0 ± 21.5	0.7 ± 3.2
Dead Fetuses/Litter	0.0 ± 0.0	0.3 ± 1.6	0.0 ± 0.0	0.0 ± 0.0
Litters with Resorptions	60	50	63	100 (f)

(a) 5000 ppm group exposed only 6-11 dg.
(b) One dam removed from study (see Appendix C).
(c) Two dams removed from study (see Appendix C).
(d) Seven pregnant dams died prior to 18dg.
(e) Significantly correlated with exposure level, $p < 0.05$.
(f) Significantly different from control group, $p<0.05$.
(g) Significantly different from control group after arcsine transformation, $p<0.05$.

TABLE 19. Tetrahydrofuran Mouse Teratology Study: Average Fetal Weights (Means of Litter Means; g ± SD), and Fetal Sex Ratio.

	Tetrahydrofuran Chamber Concentration (ppm)			
	0	600	1800	5000
Litters Examined	30	25	23	20 (a)
Live Fetuses Examined	358	288	252	12
Fetal Weight	1.3 ± 0.1	1.3 ± 0.1	1.2 ± 0.2	1.0 ---
Male	1.4 ± 0.1	1.4 ± 0.1	1.3 ± 0.2	1.0 ---
Female	1.3 ± 0.1	1.3 ± 0.1	1.2 ± 0.2	1.0 ---
Percent Male Fetuses	46.6 ± 15.8	47.0 ± 15.0	50.7 ± 16.2	16.7 ± ---

(a) Only one litter had live fetuses.

TABLE 20. Tetrahydrofuran Mouse Teratology Study: Malformations Observed in Live Fetuses.

		Fetuses (a)				Litters (a)			
Tetrahydrofuran (ppm)		0	600	1800	5000	0	600	1800	5000
Total Examined (b)		358	288	252	12	30	25	23	1
Heads Examined (c)		181	143	128	6	30	25	23	1
Skulls Examined (d)		177	145	124	6	30	25	23	1
Viscera Examined (e)		177	146	127	6	30	25	23	1
Malformations:									
Cleft Palate	NO.	0	0	5	0	0	0	1	0
	(%)			(2.0)				(4.4)	
Edema	NO.	0	0	1	0	0	0	1	0
	(%)			(0.4)				(4.4)	
Exencephaly	NO.	1	1	0	0	1	1	0	0
	(%)	(0.3)	(0.4)			(3.3)	(4.0)		
Forelimb Flexure	NO.	1	0	0	0	1	0	0	0
	(%)	(0.3)				(3.3)			
Open Eye	NO.	0	1	0	0	0	1	0	0
	(%)		(0.4)				(4.0)		
Folded Retina	NO.	1	1	0	0	1	1	0	0
	(%)	(0.6)	(0.7)			(3.3)	(4.0)		
Ectopic Ovaries	NO.	0	0	1	0	0	0	1	0
	(%)			(0.8)				(4.4)	
Undescended Testes	NO.	0	0	2	0	0	0	1	0
	(%)			(1.6)				(4.4)	
Fused Ribs	NO.	0	0	0	1	0	0	0	1
	(%)				(8.3)				(100.0)
Total Affected	NO.	2	1	5	1	2	1	1	1
	(%)	(0.3)	(0.3)	(2.0)	(8.3)	(6.7)	(4.0)	(4.4)	(100.0)

(a) A single fetus or litter may be represented more than once in this table.
(b) All fetuses examined for external and skeletal defects. One-half had heads removed prior to skeletal staining.
(c) Heads fixed in Bouin's solution for soft-tissue craniofacial evaluations.
(d) Heads remaining on the fetuses for skeletal examination; see (b) above.
(e) Visceral evaluations were performed on approximately 50% of live fetuses and on all fetuses with external defects.

TABLE 21. Tetrahydrofuran Mouse Teratology Study: Mean Percent of Live Fetuses Affected per Litter (mean ±SD).

	Tetrahydrofuran Concentration (ppm)			
	0	600	1800	5000
Number Litters	30	25	23	1
Live Fetuses/Litter	11.9 ± 2.0	11.1 ± 3.1	11.0 ± 2.0	12.0 ± ---
Percent Affected Fetuses/Litter (a)	25.1 ±24.6	23.3 ±22.3	28.8 ±29.1	66.7 ± ---
Malformations:				
Cleft Palate	0	0	3.6 ± 17.4	0
Edema	0	0	0.7 ± 3.5	0
Exencephaly	0.4 ± 2.0	0.3 ± 1.5	0	0
Limb Flexure	0.3 ± 1.4	0	0	0
Folded Retina	0.7 ± 3.7	0.5 ± 2.5	0	0
Open Eye	0	0.3 ± 1.5	0	0
Ectopic Ovaries	0	0	0.7 ± 3.5	0
Undescended Testes	0	0	1.4 ± 7.0	0
Fused Ribs	0	0	0	8.3 ± ---
Total Malformations	1.0 ± 4.2	0.9 ± 4.6	6.5 ± 31.3	8.3 ± ---
Variations:				
Misaligned Sternebrae	0.2 ± 1.3	0.5 ± 2.8	0	16.7 ± ---
Supernumerary Rib	22.4 ± 25.5	17.3 ± 22.6	20.8 ± 25.6	58.3 ± ---
Reduced Ossifications:				
Pelvic	0	0	2.9 ± 13.9	0
Phalanges	0	0	3.6 ± 17.4	0
Ribs	0.4 ± 2.0	0	0	0
Skull	0	0	2.9 ± 10.8	0
Sternebrae (b)	2.8 ± 5.5	5.6 ± 9.4	10.5 ± 23.1	16.7 ± ---
Vertebral centra	0	0	3.6 ± 17.4	0
Total Variations	25.9 ± 28.1	24.3 ± 23.1	44.0 ± 88.4	91.7 ± ---

(a) Includes malformations, variations, and reduced ossifications.

(b) Significantly correlated with increasing exposure concentration, $p<0.05$ (5000 ppm group excluded).

TABLE 22. Contemporary Control Data on CD-1 Mouse Teratology Studies: Malformations and Variations.

		Fetuses (a) Number (Percent)	Litters Number (Percent)	Mean Percent per Litter (± SD)
Total examined (b)		975	83	—
Heads examined (c)		—	—	
Skulls examined (d)		—	—	
Variations				
Supernumerary Rib	No.	175	52	18.5 ± 24.4
	(%)	(17.9)	(62.7)	
Misaligned Sternabrae	No.	23	14	2.3 ± 6.3
	(%)	(2.4)	(16.9)	
Reduced Ossifications				
Sternebrae	No.	36	25	3.7 ± 6.4
	(%)	(3.7)	(30.1)	
Skull	No.	10	5	1.1 ± 4.8
	(%)	(1.0)	(6.0)	
Total Fetuses (Litters) with Variations or Reduced Ossifications	No.	230	67	24.0 ± 24.5
	(%)	(23.6)	(80.7)	
Malformations				
Exencephaly	No.	1	1	0.1 ± 1.2
	(%)	(0.1)	(1.2)	
Folded Retina	No.	2	2	0.2 ± 1.5
	(%)	(0.2)	(2.4)	
Limb Flexure	No.	12	8	1.1 ± 3.8
	(%)	(1.2)	(9.6)	
Total Fetuses (Litters) with Malformations	No.	14	10	1.3 ± 4.0
	(%)	(1.4)	(12.0)	

(a) A single fetus may be represented more than once in this table.
(b) All fetuses examined for external, visceral and skeletal defects. All fetuses stained with alcian blue and alizarin red S, one-half had heads removed prior to staining.
(c) Heads removed from fetuses and fixed in Bouin's solution then examined for soft-tissue cranio-facial malformations.
(d) Heads remained on the fetuses that were stained for skeletal examination; see a) above.

TABLE 23. **Tetrahydrofuran Mouse Teratology Study: Variations Observed in Live Fetuses.**

		Fetuses (a)				Litters (a)			
Tetrahydrofuran (ppm)		0	600	1800	5000	0	600	1800	5000
Total Examined (b)		358	288	252	12	30	25	23	1
Heads Examined (c)		181	143	128	6	30	25	23	1
Skulls Examined (d)		177	145	124	6	30	25	23	1
Viscera Examined (e)		177	146	127	6	30	25	23	1
Variations:									
Misaligned Sternabrae	NO.	1	2	0	2	1	1	0	1
	(%)	(0.3)	(0.7)		(16.6)	(3.3)	(4.0)		(100.0)
Supernumerary Rib	NO.	78	49	49	7	23	15	14	1
	(%)	(21.8)	(17.0)	(19.4)	(58.3)	(76.7)	(60.0)	(60.9)	(100.0)
Reduced Ossifications:									
Pelvis	NO.	0	0	4	0	0	0	1	0
	(%)			(1.6)				(4.4)	
Phalanges	NO.	0	0	5	0	0	0	1	0
	(%)			(2.0)				(4.4)	
Ribs (f)	NO.	1	0	0	0	1	0	0	0
	(%)	(0.3)				(3.3)			
Skull	NO.	0	0	4	0	0	0	2	0
	(%)			(3.2)				(8.7)	
Sternebrae	NO.	9	19	22	2	7	11	7	1
	(%)	(2.5)	(6.6)	(8.7)	(16.7)	(23.3)	(44.0)	(30.4)	(100.0)
Vertebral Centra	NO.	0	0	5	0	0	0	1	0
	(%)			(2.0)				(4.4)	
Total Affected	NO.	85	68	67	8	25	20	16	1
	(%)	(23.8)	(23.5)	(26.6)	(66.7)	(80.7)	(80.0)	(69.6)	(100.0)

(a) A single fetus or litter may be represented more than once in this table.
(b) All fetuses examined for external and skeletal defects. One-half had heads removed prior to skeletal staining.
(c) Heads fixed in Bouin's solution for soft-tissue craniofacial evaluations.
(d) Heads remaining on the fetuses for skeletal examination; see (b) above.
(e) Visceral evaluations performed on approximately 50% of live fetuses and on all fetuses with external defects.
(f) Includes rudimentary ribs

APPENDIX A

ANALYTICAL CHEMISTRY NARRATIVE AND DATA FOR TETRAHYDROFURAN

ANALYTICAL CHEMISTRY NARRATIVE AND DATA FOR TETRAHYDROFURAN

1. Test Material Receipt and Usage

All test material used for animal exposure was taken from BNW Lot No. 51437-15 (Lot No. WK 8-6-86), consisting of four 55 gallon metal drums. This lot was received at BNW 11/12/86 under the NTP Subchronic Inhalation Study (Contract N01-ES-65165). Following the NTP Subchronic exposure, approximately 87 gallons of bulk material was transferred to the NTP Inhalation Reproductive Toxicology (IRT) Program performed at BNW under a separate related services contract. Of the four drums received in BNW Lot No. 51437-15 (Lot No. WK 8-6-86) only drums 3 and 4 were used on the NTP IRT study. Following termination of the Inhalation Reproductive Toxicology Program, the remaining tetrahydrofuran (THF) bulk material, approximately 25 gallons, was transferred back to NTP for disposition. A letter from NTP authorizing these transfers of THF bulk material is included in this appendix.

Approximately 4.7 kg of THF per exposure day was required to generate the target concentrations in the exposure chambers. Test material consumed during the IRT studies was ≈60.4 gallons. The test material was maintained at room temperature in the LSL-II outside chemical storage facility. All transfers were performed under a nitrogen blanket to avoid the introduction of air to the bulk chemical.

2. Bulk Chemical Analysis

Bulk chemical analysis was performed using infrared spectroscopy to confirm identity and gas chromatography for purity determination. The initial analysis was performed against reference material supplied by Midwest Research Institute (MRI). Subsequent analyses were performed using gas chromatography by major peak comparison to reference material removed from the bulk chemical upon receipt and stored at approximately -20°C.

BNW Lot No. 51437-15 (Lot No. WK 8-6-86 Batch 03) was analyzed 11/14/86 for initial bulk purity and found to be 100.1% pure relative to stored frozen reference material BNW 51437-13, received 11/05/86, (Lot No. WK 8-6-86 Batch 03)]. BNW Lot No. 51437-15 was reanalyzed for bulk purity 02/06/87, 03/19/87, 05/01/87 and 09/09/87 and was found to be 100.3, 99.3, 99.5 and 100.2% relative purity, respectively. Bulk test material purity was acceptable throughout the study.

A specification for maximum peroxide content of 300 ppm was applied throughout the study. BNW Lot No. 51437-15 was analyzed for peroxide content once per month after opening, and contained less than 100 ppm. This measure ensured the safety of the generation process which involves evaporating THF at a temperature of approximately 175°F.

BNW Lot No. 51437-15 was also analyzed for stabilizer content and found to contain 0.03% 2,6-di-tert-butyl-4-methylphenol (BHT) by gas chromatography.

3. Vapor Concentration Monitoring

A Hewlett-Packard 5840 (HP5840) gas chromatographic (GC) system (employing a 1/8" o.d. x 1.0 ft nickel column packed with 1% SP-1000 on

60/80 mesh Carbopack B; oven temperature at 145°C) was used to monitor animal exposures. This instrument was equipped with an 8-port stream select valve and measured THF in the three exposure chambers, the control chamber, the distribution line, the exposure room, and the on-line standard.

a. Calibration of the On-Line Chamber Monitor

The calibration of the on-line chamber monitor was based on analysis of bubbler grab samples. Thus, the calibration of the on-line monitor was tied to gravimetrically prepared standard solutions in dimethyl formalmide (DMF) through a second directly calibrated GC which was off-line. The gravimetrically calibrated GC was used to measure the quantity of THF collected from exposure chambers in dimethylformamide (DMF) filled bubblers. The relationship between the peak area observed with the on-line GC and the concentration of THF in the chamber was defined using chamber concentrations determined by the gravimetrically calibrated GC.

The analysis of bubbler grab samples was performed using an HP5830 or HP5840 GC with a 2 or 4 mm i.d. x 1.8 m glass column packed with 20% SP-2100/0.1% Carbowax 1500 on 100/120 mesh Supelcoport. The initial oven temperature was 60°C followed by temperature programming to elute the DMF solvent peak.

Accurate calibration required quantitatively prepared gravimetric standards and carefully collected grab samples of a measured volume. Several quality control measures were applied to ensure accuracy. A set of four standards was run for each analysis session. The concentration range of the standards bracketed the concentration range of interest. The collection efficiency of a single bubbler was less than 100%, since some THF broke through the primary bubbler. Breakthrough was typically 2%. Breakthrough was measured each time bubblers were collected by acquiring back-up bubblers for the high concentration chamber. The calculation for chamber concentration by the grab sampling method included a breakthrough correction.

b. Detection of Monitor Drift Using an On-Line Standard

An on-line standard was used to check instrument drift throughout the exposure day. The on-line standard was 400 ppm THF in nitrogen from MG Industries Scientific Gases, 11705 South Alameda St., Los Angeles, CA. The standard was checked before the start of any given exposure day, then monitored every 8th sample throughout the exposure period. The measured concentration for the standard had to be within ±10% of the assigned target value before any exposure could begin without consultation with the Exposure Control Task Leader. During the course of the exposure, if the on-line standard was within 5% of the target value, no change in calibration was required. If the on-line standard was between 5% and 10% of its assigned target, the calibration could be updated immediately by an Exposure or Chemistry Specialist. Such a correction was based upon the on-line standard. If the cumulative drift exceeded 15%, then the calibration was checked by quantitative analysis of grab samples.

c. Demonstration of Sensitivity and Specificity

The sensitivity of the GC was estimated from the decay profile for the highest concentration chamber. The minimum detectable limit (MDL) was estimated as 0.04 ppm THF.

d. Precision, Linearity and Absolute Recovery Evaluation

Precision of the on-line GC was estimated from 17 consecutive measurements made on the 400 ppm on-line certified standard. A 0.26% coefficient of variation (CV) was observed. Linearity of the on-line GC was assured by calibrating the on-line GC against a gravimetrically calibrated GC (also see comments in the "Calibration of the On-Line Chamber Monitor" section). This was accomplished by analyzing a series of bubbler grab samples acquired during exposure generation and then implementing the appropriate on-line GC calibration curve in the data acquisition and control system. Achievement of linearity for the on-line monitor was therefore dependent upon defining a linear method for analysis of bubbler samples. The calibration curve for this analysis showed good linearity over an extended range. Routine analysis of bubblers was performed using midrange, high and low level standards in order to assure linearity.

Recovery of the grab method was routinely verified by acquiring back-up bubblers at the highest concentration level. In addition, the value found for the certified on-line standard was within 5% of the prepared value for the entire study. This agreement provides an independent quality control check of on-line monitor accuracy.

4. Stability Studies at MRI

The May 16, 1985 MRI reprocurement report recommended storage in glass bottles at 5°C. A specific investigation of stability under the recommended storage conditions was not performed for this report. An MRI study dated September 10, 1981 included a two-week stability test at 25°C. No loss of purity was noted under these conditions. An MRI report dated February 27, 1987 indicated that storage under nitrogen at 65°F in grounded containers that were protected from light was acceptable.

5. Degradation Studies at BNW

Studies at BNW indicate that significant degradation of the test material does not occur in the exposure chamber. Furthermore, the BHT stabilizer is removed from the test material during the generation process and is not found in the exposure chambers. The following degradation study was performed in support of an earlier NTP sponsored Subchronic Inhalation Study (2/10/87-5/15/87). No changes were made in the generation procedures between the two inhalation studies.

DEGRADATION AND STABILITY STUDIES

The stability of THF during generation was evaluated in the generator reservoir and in exposure chambers with and without animals. Samples were collected from the generator vessel before and after use in concentration chambers. The THF was stable in the generator reservoir, and there was no evidence of decomposition products greater than 0.01% of the target concentration in the exposure chambers before and after the introduction of animals.

1. Test Material Stability in Reservoir and Generator Flask

Tetrahydrofuran, BNW Lot No. 51437-15-1, was placed in the stainless steel generator reservoir and aged for 36 days at room temperature. Aliquots of this material were analyzed prior to and following aging in the generator. The initial relative purity was 99.3% and peroxide content was 14 ppm. The relative purity of the aged resevoir sample was 99.6% and had a peroxide content of 7 ppm. These results indicate that there was no change in the THF aged in the generator reservoir.

The stability of THF in the generator flask was evaluated during test runs performed on January 9, 1987, and February 18, 1987. Drum BNW 51437-15-1 was the source of THF. The initial purity for the THF used on January 9, 1987, was 99.1% to 99.6%, while the material from the generator flask was 98.8%. On February 18, 1987, the initial bulk purity was approximately 100%, as was the material recovered from the evaporation flask at the end of a typical exposure. These analyses indicate that the THF was stable in the generator flask under the conditions used to generate chamber concentrations.

2. Analysis of the Generator Flask Contents for BHT and Peroxides

The bulk THF received for exposures was stabilized with 2,6-di-*tert*-butyl-4-methylphenol (BHT). Using the MRI method, the BHT concentration of bulk test material was determined as 100 ppm and its peroxide content was determined to be 14 ppm. Peroxides, BHT and other compounds less volatile than THF were expected to concentrate in the generator flask at the end of a six hour exposure day. A concentration factor of about 17 to 26 was predicted from mass flow calibrations; about 4.7 kg was consumed per day with an evaporation flask residue of about 200 ml (0.18 kg) to 300 ml (0.27 kg). When measured at the end of the exposure day, the BHT concentration in the generator flask was found to be 1640 ppm and the peroxide content was 11 ppm. The measured BHT concentration was near the predicted range of 1700 to 2600 ppm; however, the peroxide content did not increase as predicted. As discussed below, no evidence of peroxide was found in the exposure chambers. These results indicate that the small amount of peroxide initially present reacted within the evaporation flask during the generation day to form nonvolatile polymeric material.

3. Analysis for BHT in the Exposure Chambers

Grab samples for determination of BHT in the chamber atmosphere were collected from the exposure chambers using the GC method outlined in the MRI analytical report with the standard curve extended to 0.0129 mg/ml BHT in methanol. Sample volumes of chamber atmosphere were approximately 10 and 60 liters. For the 60 liter sample volume a concentration of 0.0129 mg/ml of BHT corresponds to a lower limit of quantitation equivalent to 0.05% of the 5000 ppm target (2.5 ppm). No evidence of BHT in the exposure chamber was observed.

4. Analysis for Organic Peroxides in the Exposure Chamber by the P-Hydroxyphenylacetic Acid Coupling Reaction

In the presence of hydrogen peroxide and many organic peroxides p-hydroxyphenylacetic acid will form a fluorescent dimer. This reaction is catalyzed by horseradish peroxidase and provides a sensitive assay for peroxides. This procedure reported by GL Kok, K Thompson, and A Lazrus (in Derivatization Technique for the Determination of Peroxides in Precipitation. Anal. Chem., 58:1192-1194, 1986.), was adapted to measure the organic peroxide concentration in the exposure chambers. A Perkin Elmer fluorescence detector at 320 nm excitation and 400 nm emission was used for detection. Sample aliquots were introduced using a 1.5 ml/min flow of basified water to sweep a 25 microliter sample loop. The detector was standardized using hydrogen peroxide solutions of 235, 118, 24, 12, and 6 ng/ml.

Several duplicate 9.2 liter chamber samples were collected in 20 ml of reagent solution in bubblers. Backup bubblers were in place to collect breakthrough materials. Findings are summarized as follows:

Sample Number	Description
51437-95-1 & 2	1 hour test generation into unoccupied 5000 ppm chamber
51437-95-3 & 4	3 hours test generation into unoccupied 5000 ppm chamber
51437-95-5 & 6	5 hours test generation into unoccupied 5000 ppm chamber
51437-95-7 & 8	5 hours test generation into unoccupied 66 ppm chamber
51437-95-9 & 10	Unoccupied control chamber

The responses observed for samples from the THF chambers and the control chambers were at background levels. The chambers containing THF exhibited a response similar to the control chamber. The backup bubbler gave a similar response as the front bubbler. The area observed for all samples was near the bottom of the calibration curve. Thus, the organic peroxide level for the exposure chambers was below the limit of detection. The calculated limit of detection was about 0.13 ppm, assuming complete reaction of collected peroxides.

5. Analysis of Charcoal Adsorption Tube Grab Samples of Chamber Atmosphere with and Without Animals Present

Samples were taken from the 5000 ppm and 66 ppm concentration chambers without animals present during the last hour of the 6 hour exposure period on 1/9/87 and with animals present during the last hour of the exposure period on 2/18/87. A measured volume of gas was pulled through standard gas sampling charcoal tubes (Supelco, ORBO-32, large charcoal tubes). Sample size was adjusted to provide adequate sensitivity for impurities without producing excessive breakthrough of THF. Breakthrough of THF was measured by analysis of the secondary charcoal bed within the tubes. Sampling information is summarized in Table A.1.

TABLE A.1. 13-Week Subchronic Inhalation Toxicity Study of Tetrahydrofuran in Rats - Chemical Stability Chamber Samples

Samples Taken Without Animals in the Exposure Chambers

Chamber Concentration (ppm)	Sample Time (min)	Sample Volume (liters)	Amount Absorbed (mg)	Breakthrough
5000	5	4.6	67.6	0.1-2.0%
66	60	55.4	10.7	5-6%

Samples Taken With Animals in the Exposure Chambers

Chamber Concentration (ppm)	Sample Time (min)	Sample Volume (liters)	Amount Absorbed (mg)	Breakthrough
5000	5	4.5	66.1	~0.2%
66	60	53.7	10.4	~2%

The charcoal from the sampling tubes was transferred to GC autosample vials and desorbed using 1 ml carbon disulfide (CS_2) with about 1 minute of ultrasound treatment. Table A.2 summarizes the gas chromatographic system used to analyze the charcoal tubes. A series of three standards over the range of ~ 1 to 0.01 mg/ml of furan, isopropanol and butyraldehyde placed on charcoal were analyzed. When these results were compared to results obtained from a set prepared without charcoal contact, a recovery of ~93% off charcoal was shown for furan down to 0.1 mg; at 0.01 mg the recovery for furan was about 74%.

Table A.2. 13-Week Subchronic Inhalation Toxicity Study of Tetrahydrofuran in Rats - Gas Chromatographic Conditions for Analysis of Charcoal Absorption Tubes

Instrument:	Hewlett Packard 5890
Column:	Fused Silica Capillary, 30 meter DB-5, 1.5 micron film thickness, 0.53 mm id
Initial Temperature:	45°C
Initial Isothermal Time:	5 min
Temperature Program Rat:	10°C/min
Final Temperature:	250°C
Final Time :	5 min
Detector:	FID
Detector Temperature:	300°C
Injector Temperature:	250°
RT Unk Bulk Impurity (81 mg/ml):	~19.97 min (~0.07% of total peak area in bulk test material)
RT THF:	~2.25 min
RT Butyraldehyde:	~1.76 and 1.83 (suspect isomer in standard)
RT Furan:	~1.28 min
RT Propanol:	~1.43 min
RT CS_2 (desorbent):	~1.54 min (main peak) and ~2.64 (trace)

Butyraldehyde exhibited two peaks, recovery was about 87% for the high standard, while no recovery was seen off charcoal at 0.1 mg. The recovery of propanol was very poor at all levels, possibly due to the high polarity of alcohols. However, the low level furan standard was very easily detected; note that 0.01 mg was 0.1% of the amount of THF acquired for the 66 ppm concentration chamber. Chromatograms for a CS_2 blank, 81 mg/ml standard of bulk THF, and a 5000 ppm chamber sample are shown in Figures 1,2, and 3, respectively. No impurity peaks were observed in any of the chamber samples. The standard bulk THF was run to flag any pre-existing impurities initially present in the bulk test material and prevent them from being erroneously called out as generator caused degradation products. As shown in Figure 2 this standard does exhibit a peak (19.9 min) not seen for the chamber samples. Based upon retention time peak was identified as BHT. Recovery of BHT at the concentration encountered in the bulk test material is about 38%.

6. Summary and Discussion of Stability Studies

The vapor generation system uses a rotary evaporator to saturate a nitrogen stream with THF vapor. The rotary evaporator is operated in reflux mode with a fairly substantial reflux ratio. This provides good separation of impurities substantially less volatile than THF. However, the basic design offers little, if any, possibility of removal of compounds of only slightly lesser volatility than THF and absolutely none for compounds more volatile. Thus, it is expected that chamber composition is similar to the bulk material with respect to compounds more volatile than THF and depleted with compounds less volatile than THF. The results of the chemical stability studies are consistent with these fractionation characterisitics of the vapor generation system.

Direct measurements of chamber concentration of BHT and peroxide confirm that chamber concentrations of these two less volatile species are insignificant. Temperature programmed GC with a fused silica capillary column failed to show any evidence of degradation products.

Peroxides were found not to accumulate in the evaporation flask. These results indicate that the peroxide initially present was destroyed and/or partially removed via vaporization during test atmosphere generation. The reactive nature of peroxides probably results in a substantial concentration decrease in the generation flask by chemical reaction.

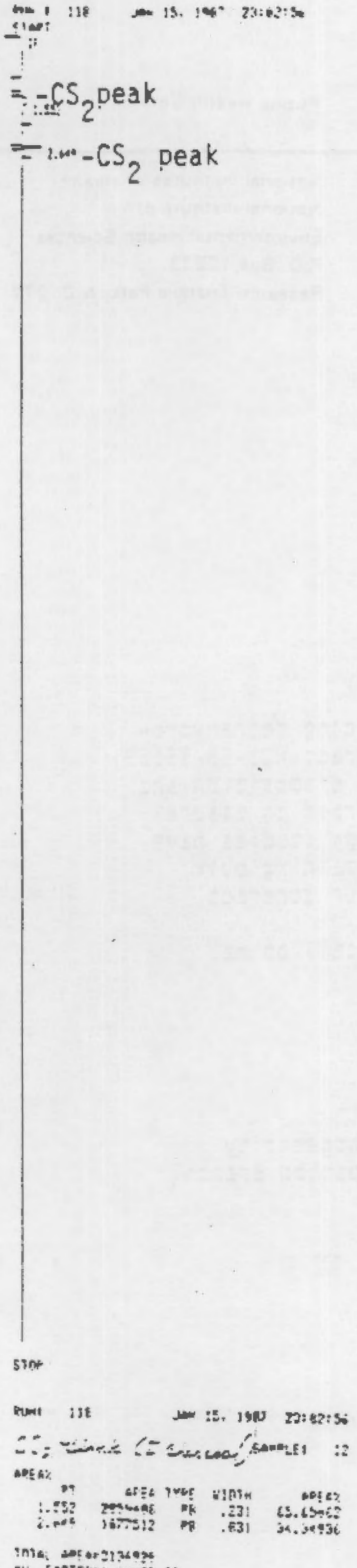


Figure 1.
CS_2 Blank

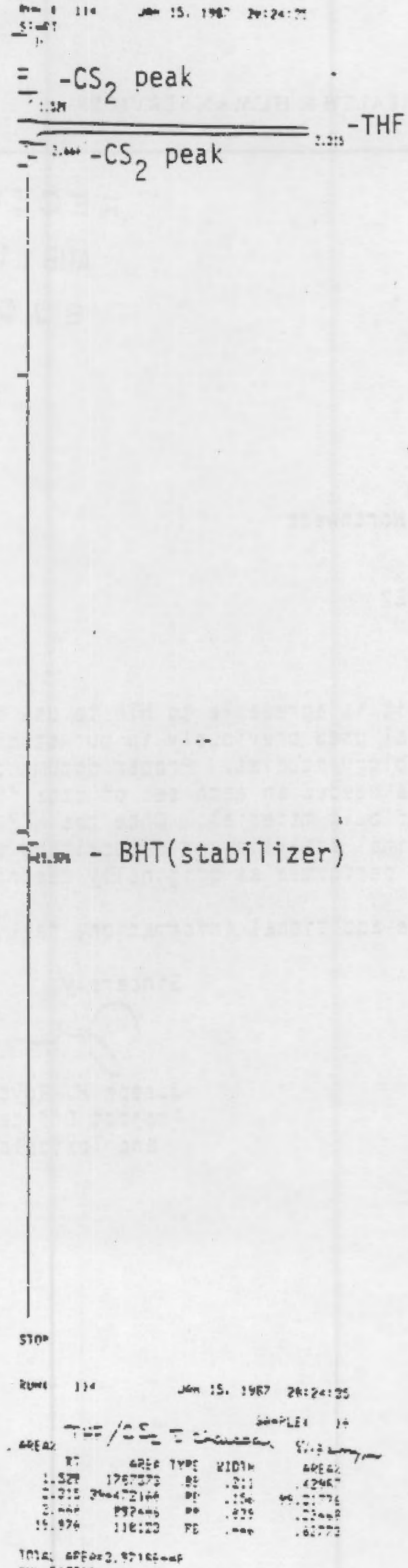


Figure 2.
81 mg/ml Bulk THF

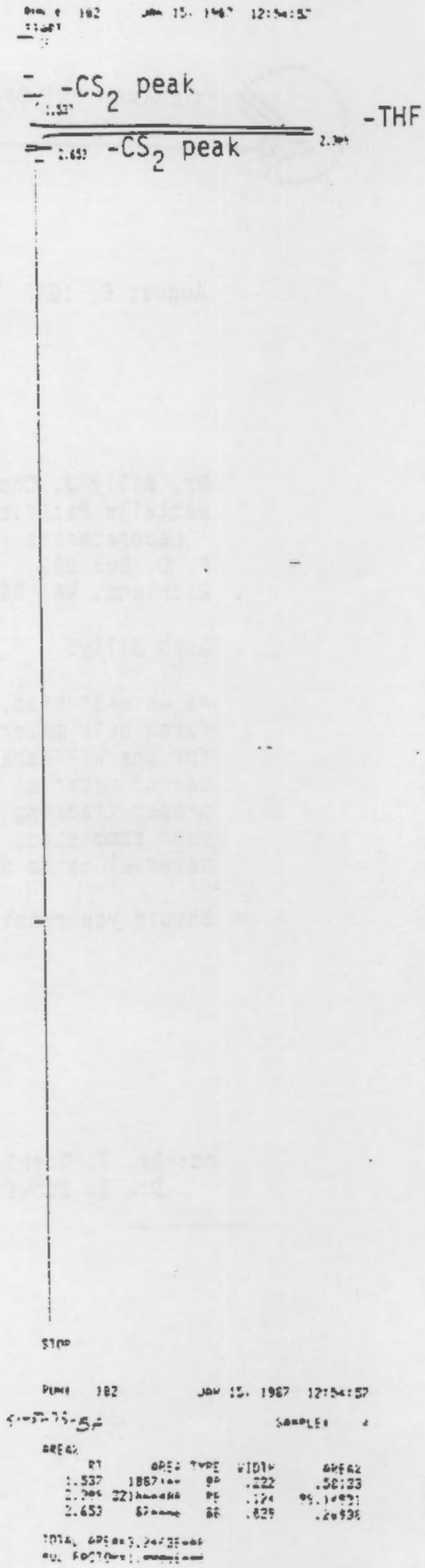


Figure 3.
5000 ppm Chamber (4.6 l sample

DEPARTMENT OF HEALTH & HUMAN SERVICES

Public Health Service

National Institutes of Health
National Institute of
Environmental Health Sciences
P.O. Box 12233
Research Triangle Park, N.C. 277

RECEIVED
AUG 1 1 1987
B. J. CHOU

August 6, 1987

Dr. Billy J. Chou
Battelle Pacific Northwest
  Laboratories
P. O. Box 999
Richland, WA 99352

Dear Billy:

As we discussed, it is agreeable to NTP to use the remaining tetrahydrofuran bulk material used previously in our studies (Contract NO1-ES-55155) for the NTP Teratology studies. Proper documentation of disposition and use of material is needed in each set of data files in order to assure proper tracking of bulk material. Once the NTP Teratology studies have been completed, final analysis and disposition of the remaining bulk material is to be performed as originally described in our contract.

Should you require additional information, feel free to call on me.

Sincerely,

Joseph H. Roycroft, Ph.D
Project Officer, Carcinogenicity
  and Toxicologic Evaluation Branch

cc: Dr. T. Goehl
    Dr. B. Schwetz

BULK CHEMICAL ANALYSIS

COMPOUND	TETRAHYDROFURAN
NTP #	C60560
CAS#	109-99-9
LOT#	WK8-6-86 Batch 03/BNW51437-15-1
APPEARANCE	Clear Colorless Liquid
RECEIPT DATE	11-12-86
ANALYSIS PERIOD	Initial
STORAGE TEMPERATURE	Room Temperature
SAMPLE SUBMITTAL DATE	11-14-86
SAMPLE ANALYSIS DATE	11-14-86 & 11-25-86
ANALYSIS PROCEDURE	Method provided by MRI, May 16, 1985
REFERENCE STANDARD	BNW51437-13-1
NOTEBOOK REFERENCE	BNW51437-28

IDENTITY

Infrared spectroscopy using liquid thin film with AgCl plates scanned from 4000cm^{-1} to 600cm^{-1} to visually compare the bulk chemical spectra to the spectra of the reference standard supplied by MRI.

Date
11/86

Instrument: Nicolet FT-IR 60SX

Results: A visual comparision of the infrared spectra shows that they are similar.

ASSAY

Gas chromatography used a 1.8m x 4mm glass column packed with 20% SP-2100/0.1% carbowax 1500 on 100/120 supelcoport for major peak comparision to the reference standard supplied by MRI.

Date
11/86

Instrument: HP5830

Results

Relative % Purity

100.1

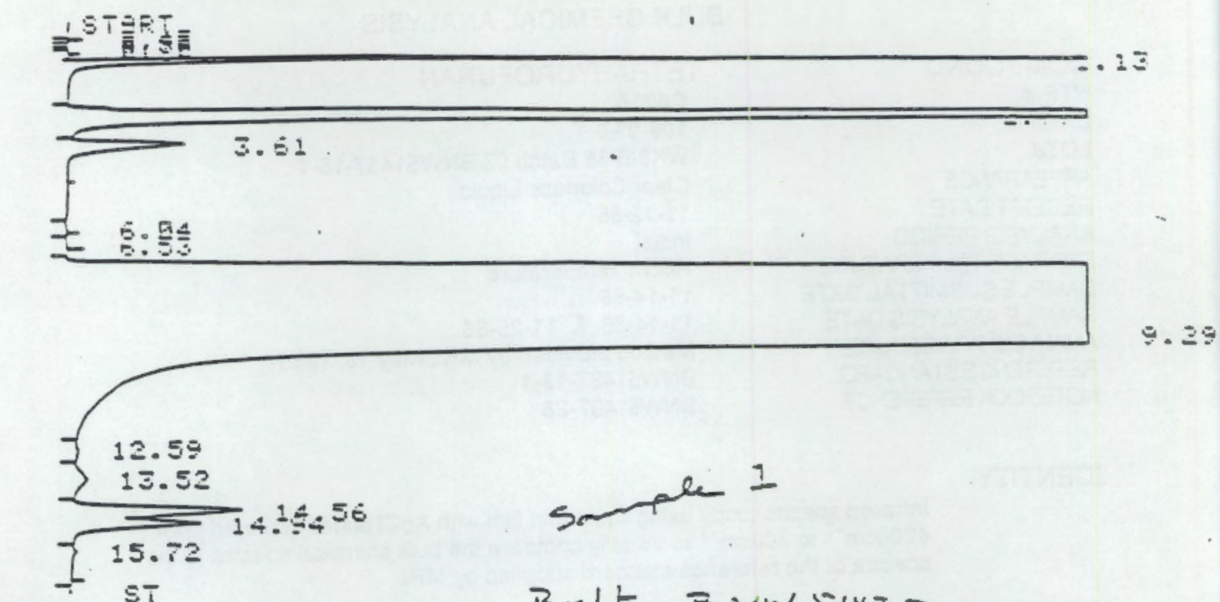
Tetrahydrofuran eluted at 2.72 - 2.77 minutes. No impurities greater than 0.1% noted.

Conclusion: Infrared spectroscopy confirms the identity of lot# WK8-6-86. Gas chromatography shows this lot to be 100.1% pure by major peak comparision.

Signature of Technician: _______________ Date: 3-24-87

Signature of Chemist: _______________ Date: 3-24-87

XF: 1.0000 E+ 0



Sample 1

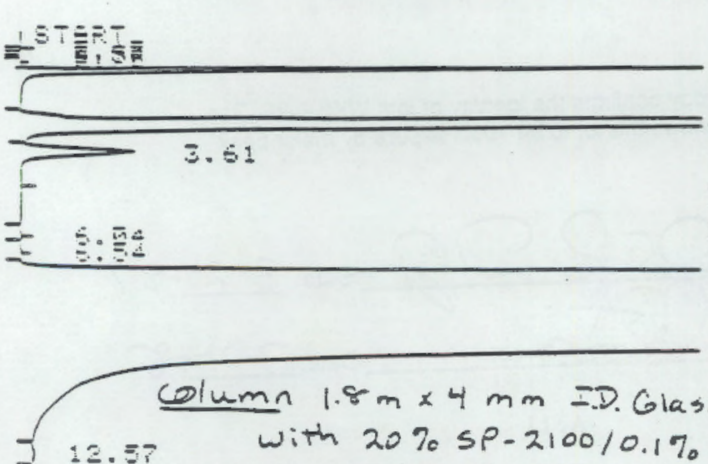
Bulk BNW 51437-15-1

BOTTLE 31
** 5830A
AREA %

RT	AREA	AREA %
0.43	26	0.000
0.57	94	0.000
0.70	64	0.000
0.80	74	0.000
1.13	1648000	0.062
2.77	9152000	0.347
3.61	482400	0.018
6.04	502	0.000
6.53	492	0.000
9.29	2625000000	99.508
12.59	83420	0.003
13.52	178800	0.007
14.56	830000	0.031
14.94	572500	0.022
15.72	30660	0.001

THF Purity Analysis
Representative G.C. Chromatogram
Bulk Chemical
BNW 51437-28
LAP 12-22-86

XF: 1.0000 E+ 0



Column Conditions

TEMP1	70		70
TIME1	13.0		
RATE	20.00		
TEMP2	120		
TIME2	2.0		
INJ TEMP	150		150
FID TEMP	250		250
OVEN MAX	400		
CHT SPD		0.50	
ATTN 2↑	11		
FID SGNL	↑B		
SLP SENS		0.10	
AREA REJ	1		
FLOW A	1		
FLOW B	76		
OPTN	22		
17.0 STOP			

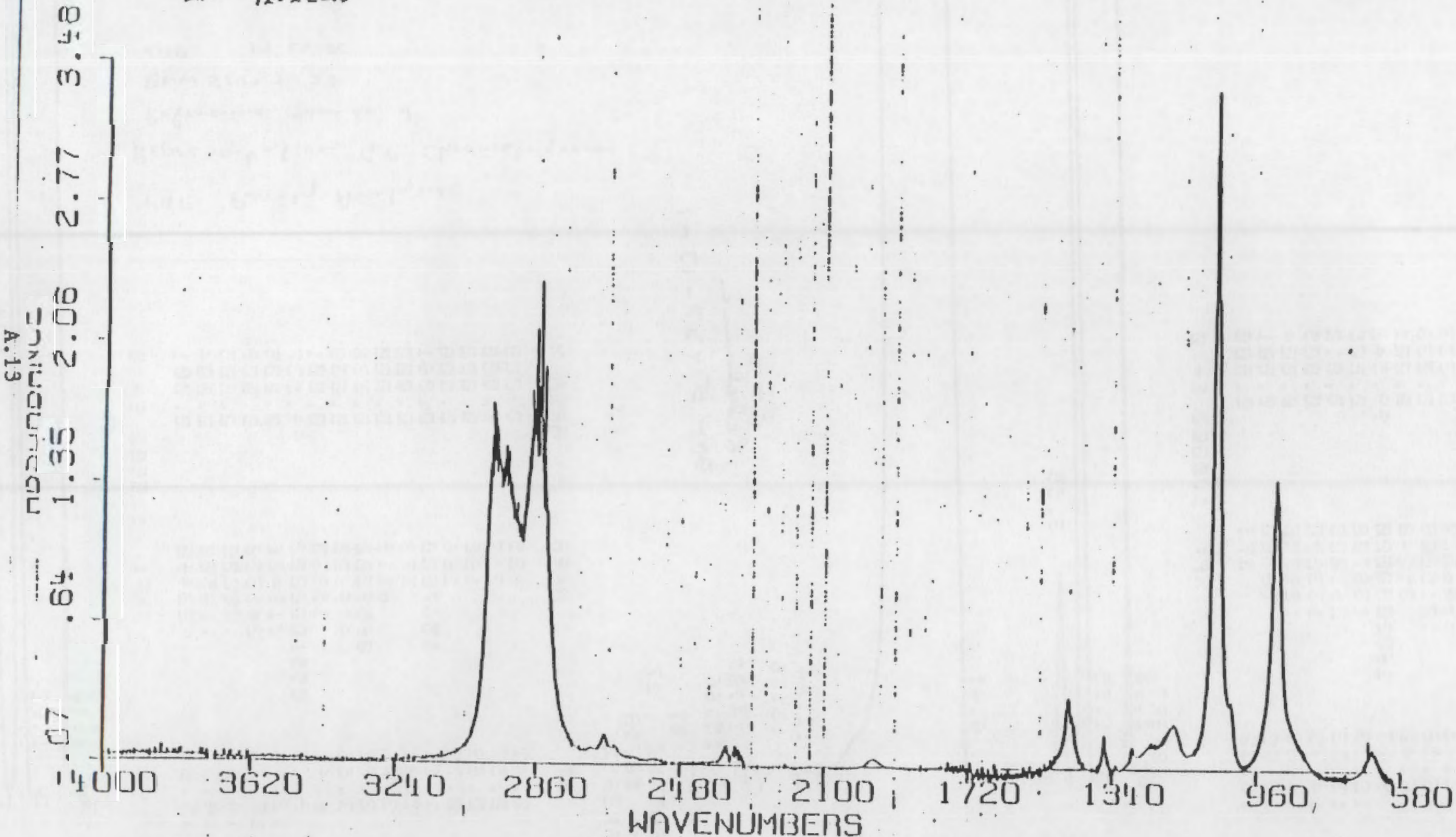
Column 1.8 m x 4 mm I.D. Glass packed with 20% SP-2100/0.1% carbowax 1500 on 100/120 Supelcoport

THF Purity Analysis

Representative I-R. Ch Spectrogram

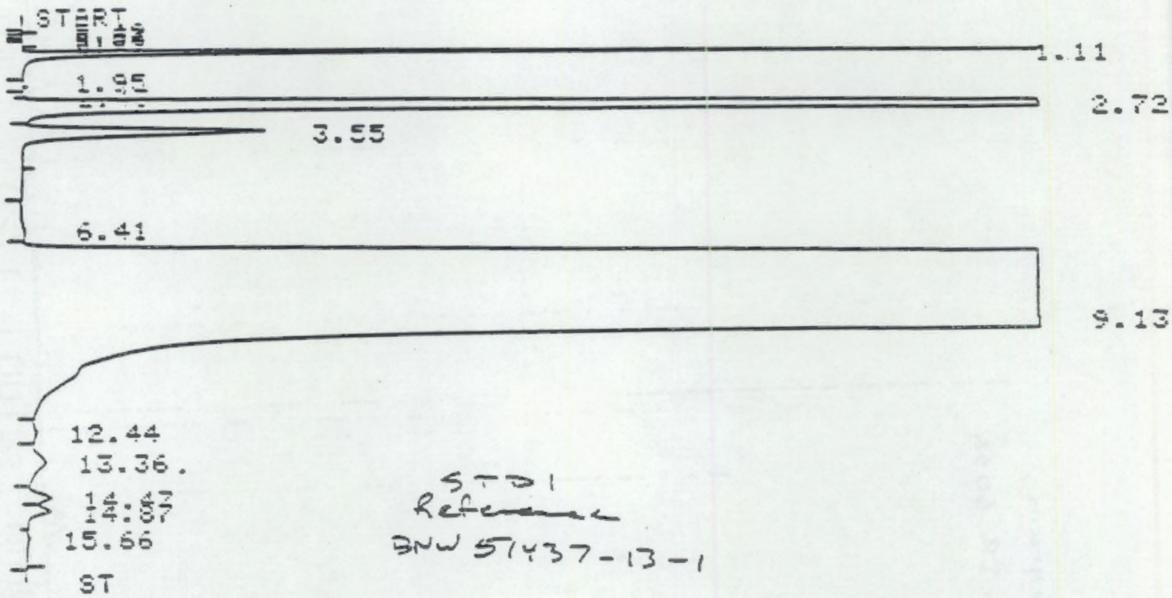
BNW 51437-37 Nicolet FT-IR 605X

LAP 12-22-86



2.44	6382	0.000
2.73	8946000	0.333
3.56	1015000	0.038
6.40	35240	0.001
9.13	2672000000	99.542
12.39	138700	0.005
13.33	261000	0.010
14.43	133200	0.005
14.83	120700	0.004
15.62	16860	0.001
16.22	273	0.000

XF: 1.0000 E+ 0



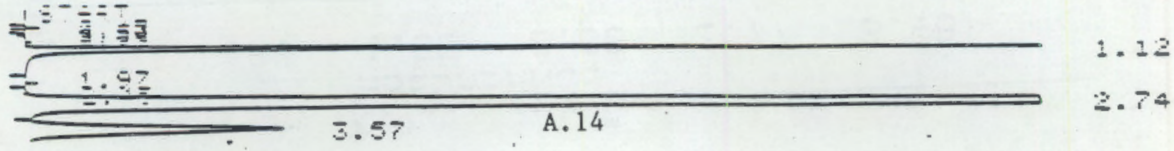
STD 1
Reference
BNW 51437-13-1

BOTTLE 27
5830A
AREA %

RT	AREA	AREA %
0.42	25	0.000
0.57	213	0.000
0.69	160	0.000
0.79	266	0.000
1.11	1567000	0.061
1.95	778	0.000
2.43	6119	0.000
2.72	8658000	0.338
3.55	979600	0.038
6.41	35830	0.001
9.13	2551000000	99.537
12.44	118400	0.005
13.36	241300	0.009
14.47	128200	0.005
14.87	114500	0.004
15.66	22460	0.001

XF: 1.0000 E+ 0

THF Purity Analysis
Representative G.C. Chromatogram
Reference Standard
BNW 51437-28
LAP 12-22-86



BULK CHEMICAL ANALYSIS

COMPOUND	TETRAHYDROFURAN
NTP #	C60560
CAS#	109-99-9
LOT#	WK8-6-86 Batch 03/BNW51437-15-3
APPEARANCE	Clear Colorless Liquid
RECEIPT DATE	11-12-86
ANALYSIS PERIOD	within 30 days of termination of study
STORAGE TEMPERATURE	Room Temperature
SAMPLE SUBMITTAL DATE	5-1-87
SAMPLE ANALYSIS DATE	5-1-87
ANALYSIS PROCEDURE	ØB-AC-3A1A-ØØ
REFERENCE STANDARD	BNW51437-21-3
NOTEBOOK REFERENCE	BNW12317-42

PURITY
date
5/87

Gas chromatography used a 6ft x 4mm glass column packed with 20% SP-2100/0.1% carbowax 1500 on 100/120 supelcoport for major peak comparison to the reference standard.
Instrument: HP5840

Results

Relative % Purity

99.5

Tetrahydrofuran eluted at 1.84 minutes. No impurities greater than 0.1% noted.

STABILIZER
date
5/87

Gas chromatography using a 6ft x 4mm glass column packed with 20% SP-2100/0.1% carbowax 1500 on 100/120 supelcoport for quantitation of 2,6-di-*tert*-butyl-4-methylphenol(BHT) stabilizer against standard. solutions.
Instrument: HP5840

Results

% BHT in Sample

0.03

BHT eluted at ~13.5 minutes. No additional impurities detected.

PEROXIDE
date
5/87

Peroxide content determination using iodometric titration with a standardized sodium thiosulfate to a colorimetric endpoint. Peroxide concentration is calculated as THF hydroperoxide.

Results

Peroxide Concentration(ppm)

< 100

Tetrahydrofuran
BNW 12317-42

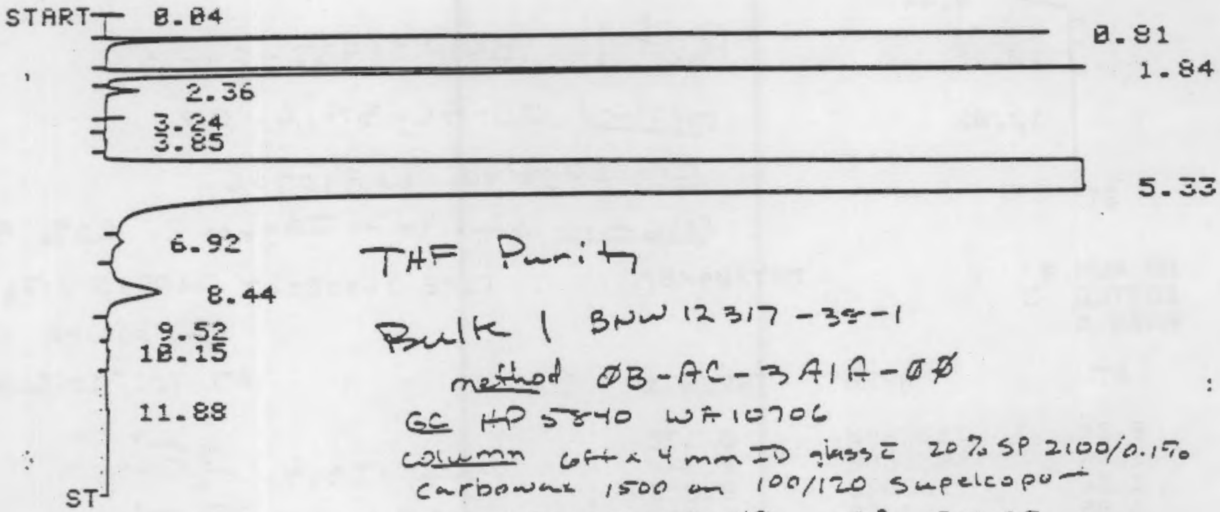
CONCLUSION Lot BNW 51437-15-3 is acceptable as test material for animal exposure. This conclusion is based on the relative percent purity of 99.5%. The percent stabilizer is 0.03% and is comparable to that found by MRI. A peroxide content of less than 100ppm which is within the exceptable values of 0-300ppm.

Signature of Technician: ____________________ Date: 5-27-87

Signature of Chemist: ____________________ Date: 5-27-87

0.81	1658000	0.124
1.84	4532000	0.340
2.36	157400	0.012
3.85	2064	0.000
5.33	1325000000	99.416
6.92	292800	0.022
8.44	966000	0.072
9.53	48500	0.004
10.16	39090	0.003
11.94	84460	0.006

DIL FACTOR: 1.0000 E+ 0



THF Purity

Bulk | BNW 12317-35-1

method ØB-AC-3A1A-ØØ

GC HP 5840 WA10706

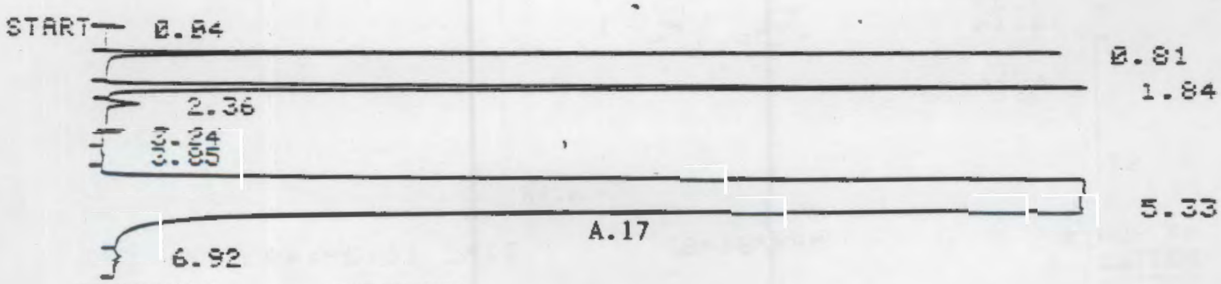
column 6ft x 4 mm ID glass c 20% SP 2100/0.1% carbowax 1500 on 100/120 Supelcoport

BNW 12317-45 LAP 5-4-87

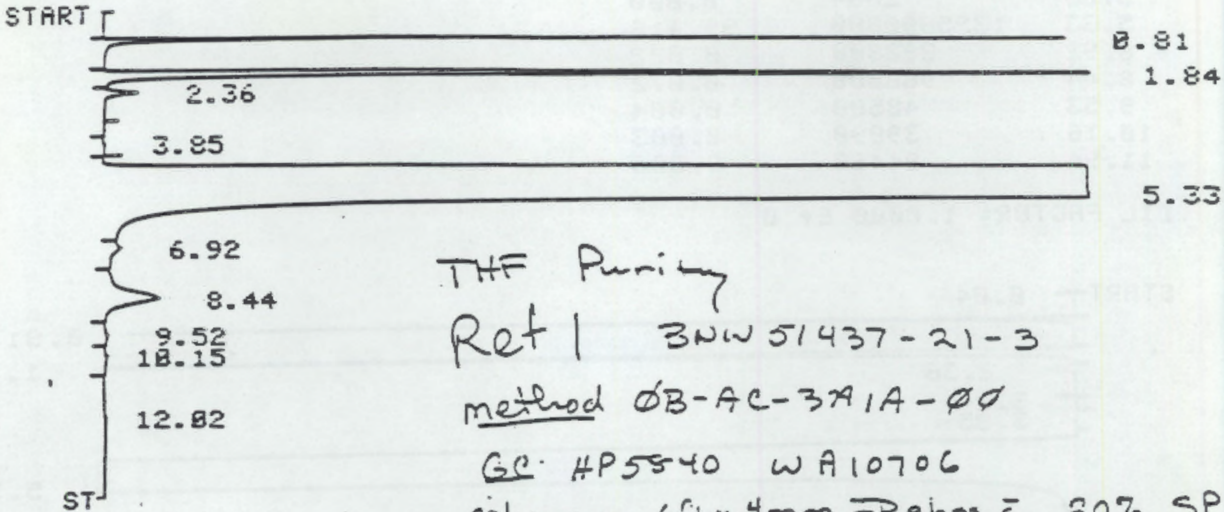
HP RUN # 9 MAY/04/87 TIME 16:46:51
BOTTLE 4
AREA %

RT	AREA	AREA %
0.04	3	0.000
0.81	1664000	0.125
1.84	4547000	0.340
2.36	158000	0.012
3.24	33	0.000
3.85	3876	0.000
5.33	1328000000	99.414
6.92	297700	0.022
8.44	974600	0.073
9.52	51340	0.004
10.15	43650	0.003
11.88	89040	0.007

DIL FACTOR: 1.0000 E+ 0



DIL FACTOR: 1.0000 E+ 0



THF Purity

Ref | BNW 51437-21-3

method ØB-AC-379|A-ØØ

GC HP5840 WA10706

column 6ft x 4mm ID glass c 20% SP 2100/0.1% Carbowax 1500 on 100/120 Supelcoport

HP RUN # 7 MAY/04/87 TIME 16:12:47

BOTTLE 3

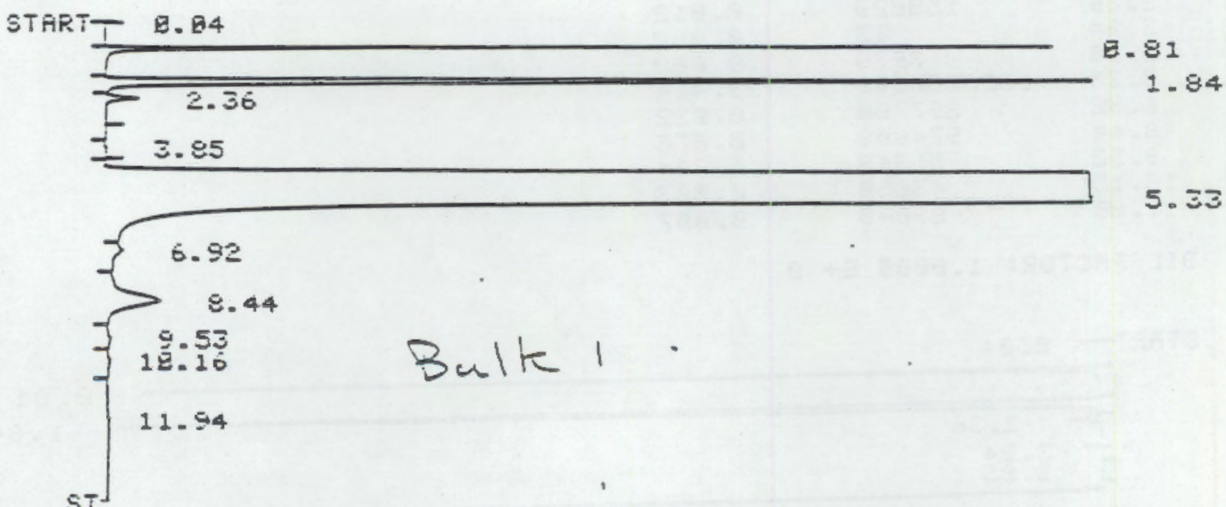
AREA %

RT	AREA	AREA %
0.81	1688000	0.125
1.84	4630000	0.344
2.36	160000	0.012
3.85	2070	0.000
5.33	1338000000	99.412
6.92	295600	0.022
8.44	971200	0.072
9.52	46020	0.003
10.15	36280	0.003
12.02	82640	0.006

BNW 12317-48

LAP 5-4-87

DIL FACTOR: 1.0000 E+ 0

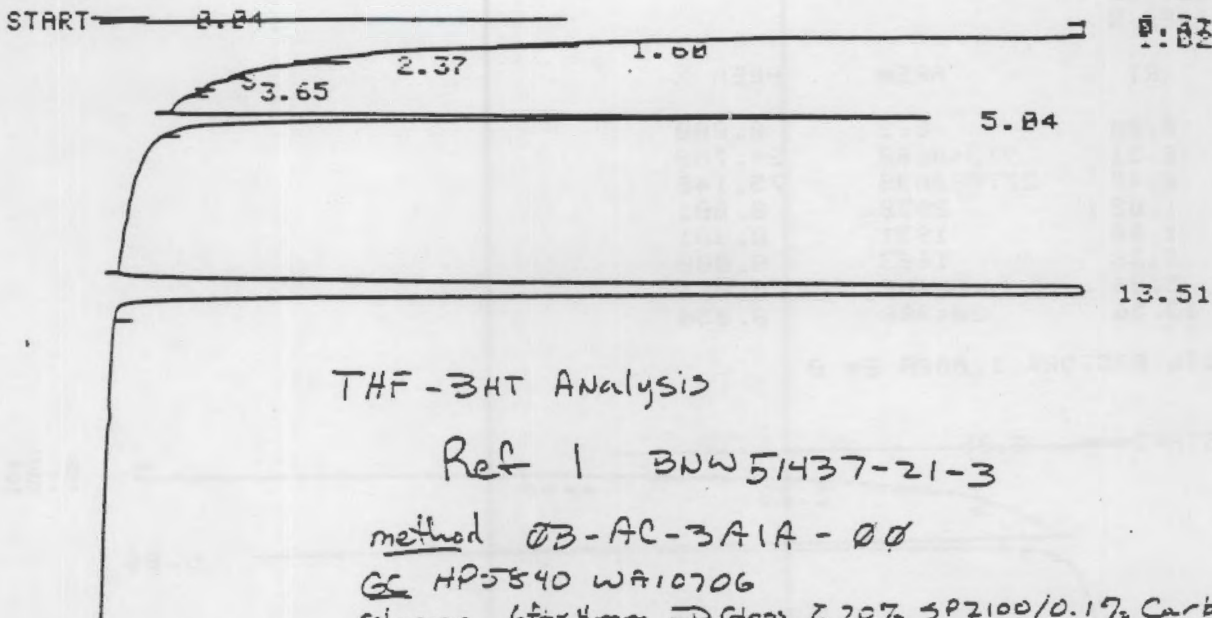


Bulk 1

HP RUN # 8 MAY/04/87 TIME 16:29:49

BOTTLE 4

DIL FACTOR: 1.0000 E+ 0



THF - BHT Analysis

Ref 1 BNW 51437-21-3

method 03-AC-3A1A-00

GC HP5840 WA10706

Column 6ft x 4mm ID Glass c 20% SP2100/0.1% Carbowax 1500 on 100/120 Supelcoport

HP RUN # 42 MAY/02/87 TIME 13:24:03

BOTTLE 22

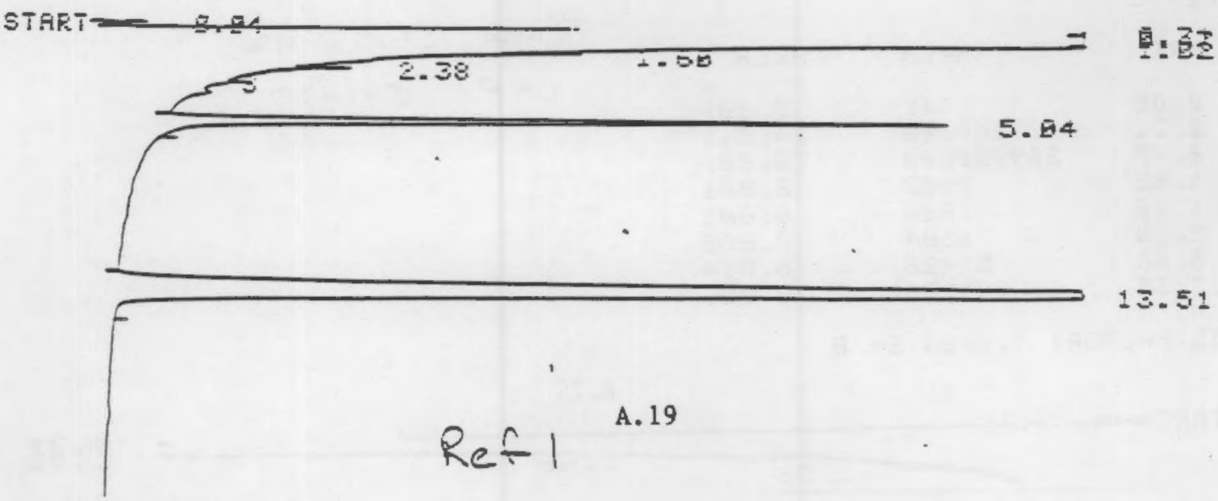
AREA %

BNW 12317-42

LAP 5-1-87

RT	AREA	AREA %
0.04	821	0.000
0.31	87600000	24.693
0.47	266900000	75.233
1.02	8688	0.002
1.68	1996	0.001
2.37	1636	0.000
3.65	352	0.000
5.04	49930	0.014
13.51	199100	0.056

DIL FACTOR: 1.0000 E+ 0



A.19

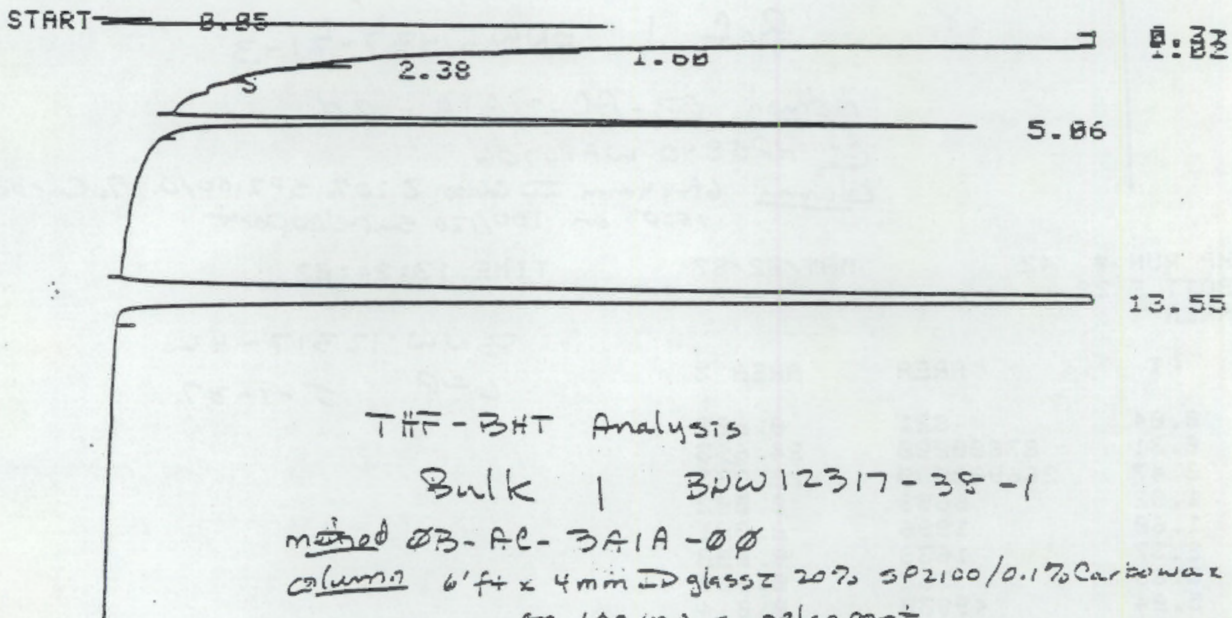
Ref 1

1

HP RUN # 30 MAY/02/87 TIME 06:55:47
BOTTLE 16
AREA %

RT	AREA	AREA %
0.05	862	0.000
0.31	91340000	24.780
0.47	277000000	75.148
1.02	2930	0.001
1.60	1931	0.001
2.38	1603	0.000
5.06	52460	0.014
13.56	204900	0.056

DIL FACTOR: 1.0000 E+ 0



THF-BHT Analysis

Bulk 1 BNW12317-38-1

method ØB-AC-3A1A-ØØ

column 6'ft x 4mm ID glass 20% SP2100/0.1% Carbowax 1500 on 100/120 supelcoport

GC HP5840 WA10706

HP RUN # 31 MAY/02/87 TIME 07:28:10
BOTTLE 16
AREA %

BNW 12317-42

LAP 5-1-87

RT	AREA	AREA %
0.05	841	0.000
0.31	89260000	24.841
0.47	269800000	75.086
1.02	2982	0.001
1.60	1890	0.001
2.38	1604	0.000
5.06	51920	0.014
13.55	201200	0.056

DIL FACTOR: 1.0000 E+ 0

BULK CHEMICAL ANALYSIS

COMPOUND	TETRAHYDROFURAN
NTP #	C60560
CAS#	109-99-9
LOT#	WK8-6-86 Batch 03/BNW51437-15-4
APPEARANCE	Clear Colorless Liquid
RECEIPT DATE	11-12-86
ANALYSIS PERIOD	10 months after receipt
STORAGE TEMPERATURE	Room Temperature
SAMPLE SUBMITTAL DATE	9/8/87
SAMPLE ANALYSIS DATE	9/9-14/87
METHOD	OB-AC-3A1A-00
REFERENCE STANDARD	BNW51437-145-BTL #1
NOTEBOOK REFERENCE	BNW 12317-60 (BNW 51437-21)

PURITY
date
9/87

Gas chromatography used a 1.8m x 2mm glass column packed with 20% SP-2100/0.1% carbowax 1500 on 100/120 supelcoport for major peak comparision to the reference standard.
Instrument: HP5840

Results

Relative % Purity

100.2

Tetrahydrofuran eluted at 1.90-1.91 minutes. No impurities greater than 0.1% noted.

STABILIZER
date
9/87

Gas chromatography using a 1.8m x 4mm glass column packed with 20% SP-2100/0.1% carbowax 1500 on 100/120 supelcoport for quantitation of 2,6-diten-butyl-4-methylphenol(BHT) stabilizer against standard solutions.
Instrument: HP5830

Results

% BHT in Sample

0.03

BHT eluted at 15.73-15.76 minutes. No additional impurities detected.

PEROXIDE
date
9/87

Peroxide content determination using iodometric titration with a standardized sodium thiosulfate to a colormetric endpoint.

Results

Peroxide content <100 ppm.

CONCLUSION

Lot BNW 51437-15-4 is acceptable as test material for animal exposure. This conclusion is based on the relative percent purity of 100.2%, the percent stabilizer of 0.03% and the peroxide content of <100 ppm.

Signature of Technician: S. K. B[illegible] Date: 9-16-87

Signature of Chemist: AW [illegible] Date: 10-29-87

Purity Bulk Analysis of THF by G.C.

Method: Ø3-AC-3A1A-ØØ

G.C. Run Date: 9-9-87

G.C.: HP 5840 WA1C706

Column: 6ft. x 4mm glass, c̄ 20% SP-2100/ 0.1% Carbowax 1500 on 100/120 Supelcoport

BNW 12317-58

THF Test Sample: BNW 51437-15-4

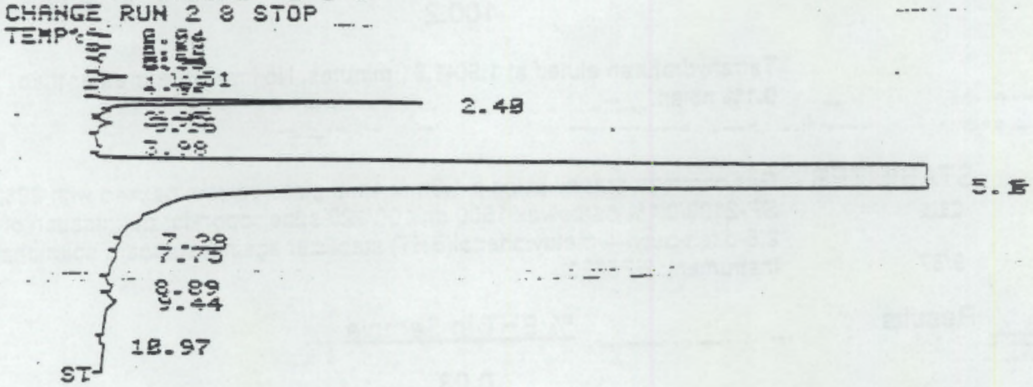
THF Reference Sample: BNW 51437-145-3H. #1

BNW 52017-21 to 25

```
TEMP1      400    80    80
TIME1         0.00
INJ TEMP 400   150   150
FID TEMP 400   250   250
TCD TEMP 400     0    53

CHT SPD       0.50
ZERO         10.0
ATTN 2↑      12
FID SGNL      +B
SLP SENS      0.10
AREA REJ              0
FLOW  A       0.0   71.6:
FLOW  B       0.0    4.3

  12.00 STOP
POWER FAIL 15:21:37
DELETE CHANGE RUN 2
CHANGE RUN 0 2
OPTN # 3 2
  INJ/BTL,STROKE: 2 2 2
CHANGE RUN 2 0 STOP
```



HP RUN # 1   SEP/09/87   TIME 15:23:37

BOTTLE 1 BLANK

AREA %

RT	AREA	AREA %
0.04	21	0.000
0.42	24	0.000
0.59	38	0.000
0.66	164	0.000
0.98	250	0.000
0.99	14740	0.001
1.51	94920	0.006
1.69	12610	0.001
2.05	9176	0.001
2.48	1518000	0.102
2.71	65600	0.004
2.95	9544	0.001
3.16	74980	0.005
3.98	45150	0.003
5.10	1487000000	99.781
7.28	302600	0.020
7.75	415900	0.028
8.89	224400	0.015
9.44	396800	0.027
10.97	81520	0.005

12

Purity Bulk Analysis of THF
Determination of BHT by G.C.
Method: Ø3-AC-3A1A-ØØ
G.C. Run Date: 9-14-87
G.C.: HP 5890 WA10706
Column: 6ft. x 4mm glass, c̄ 20% SP-2100/
0.1% Carbowax 1500 on 100/120
Supelcoport BNW12317-58
Test Material: THF BNW ~~52017~~ wrong * SAB 9
BNW 51437-15-4

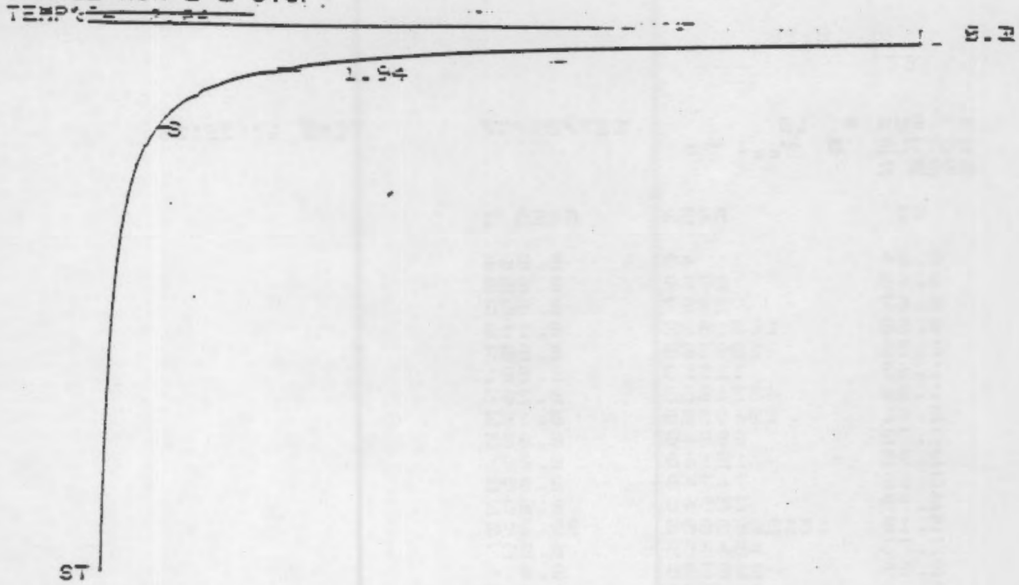
BNW 52017-23
9-15-87 SAB

```
TEMP1:     400   165   165
TIME1          0.00
INJ TEMP   400   150   150
FID TEMP   400   250   250
TCD TEMP   400     0    64

CHT SPD        0.50
ZERO          10.0
ATTN 2↑        6
FID SGNL      →3
SLP SENS       0.10
AREA REJ                0
FLOW  A        0.0    71.2
FLOW  B        0.0     4.3

20.00 STOP

POWER FAIL 11:02:54
DELETE CHANGE RUN 2
CHANGE RUN 0 2
OPTN # 3 2
 INJ/BTL,STROKE: 2 1 2
CHANGE RUN 2 2 STOP
TEMP%
```

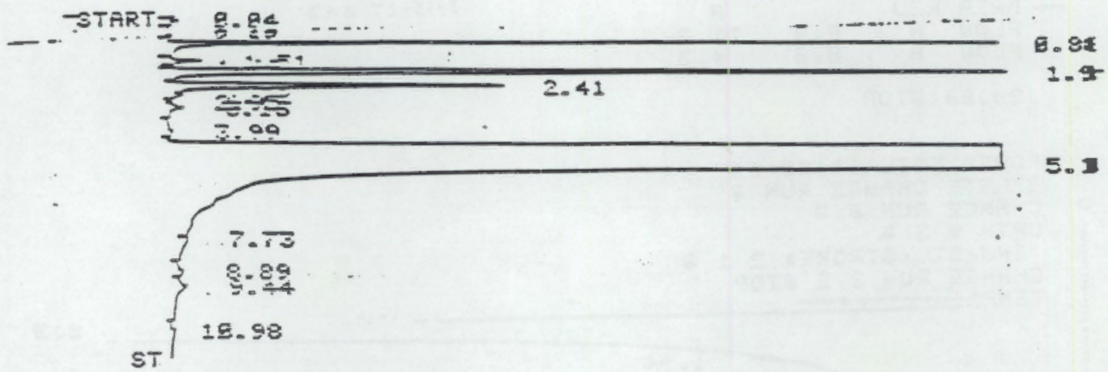


HP RUN # 1 SEP/14/87 TIME 11:04:53
BOTTLE 1 Methanol BLANK
AREA %

RT	AREA	AREA %
0.06	215	0.000
0.39	74880000	99.998
1.94	958	0.001

(G)

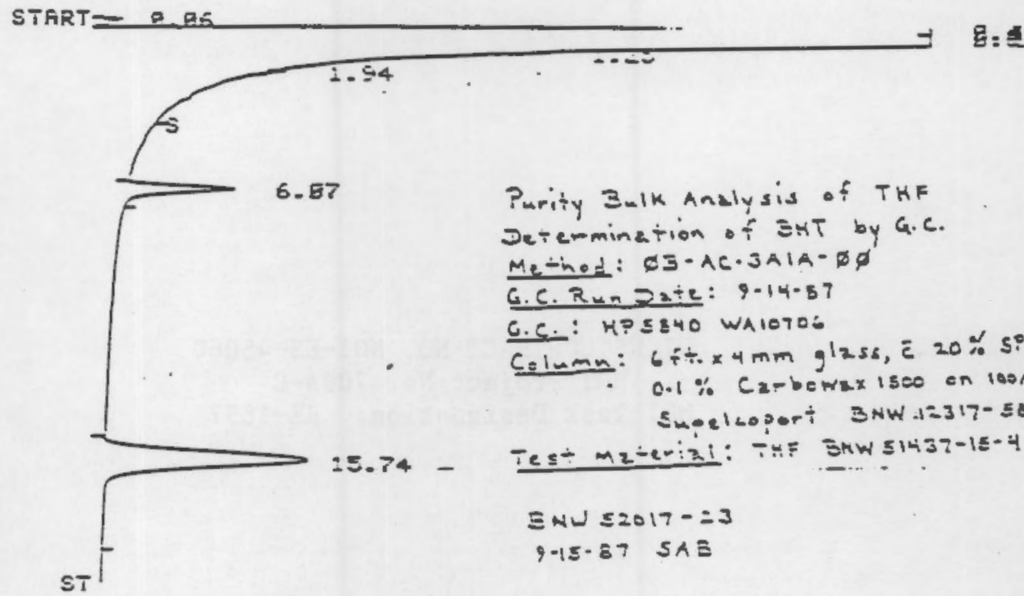
Purity Bulk Analysis of THF by G.C.
Method: 03-AC-3A1A-00
G.C. Run Date: 9-9-87
G.C.: HP5840 WA10706
Column: 6 ft. x 4mm glass, c 20% SP2100/
0.1% Carbowax 1500 on 100/120
Supelcoport BNW 12317-58
THF Test Sample: BNW 51437-15-4
THF Reference Sample: BNW 51437-145-311.*
BNW 52017-21 to 25



HP RUN # 10 SEP/09/87 TIME 17:39:28
BOTTLE 5 Test #3
AREA %

RT	AREA	AREA %
0.04	40	0.000
0.60	2760	0.000
0.67	2097	0.000
0.88	1671000	0.110
1.51	109300	0.007
1.69	11550	0.001
1.90	4521000	0.297
2.41	1569000	0.103
2.72	68840	0.005
2.95	10160	0.001
3.16	74740	0.005
3.99	35540	0.002
5.10	1512000000	99.398
7.73	404400	0.027
8.89	218300	0.014
9.44	386700	0.025
10.98	78560	0.005

DIL FACTOR: 1.0000 E+ 0



Purity Bulk Analysis of THF
Determination of BHT by G.C.
Method: Ø3-AC-3A1A-ØØ
G.C. Run Date: 9-14-87
G.C.: HP5840 WA10706
Column: 6 ft. x 4 mm glass, c 20% SP2100/
0.1% Carbowax 1500 on 100/120
Supelcoport BNW 12317-58
Test Material: THF BNW 51437-15-4

BNW 52017-23
9-15-87 SAB

HP RUN # 22 SEP/14/87 TIME 18:58:19
BOTTLE 11 Test # 3 BNW 52017-23-10
AREA %

RT	AREA	AREA %
0.06	24	0.000
0.48	53530000	25.945
0.61	152700000	74.010
1.25	872	0.000
1.94	713	0.000
6.87	17858	0.008
15.74	73800	0.036

DIL FACTOR: 1.0000 E+ 0

REVISED REPORT*

ANALYSIS OF REPROCURED CHEMICAL - TETRAHYDROFURAN

NIEHS CONTRACT NO. N01-ES-45060
MRI Project No. 7098-C
MRI Task Designation: RE-1857

MIDWEST RESEARCH INSTITUTE
425 Volker Boulevard
Kansas City, Missouri 64110

February 27, 1987

* This is a revision of the reprocurement report, MRI Task Designation RE-1857, dated December 30, 1986.

TETRAHYDROFURAN

Management Information

CAS NO.: 109-99-9
MRI REQUEST NO.: 101N
MRI TASK DESIGNATION: RE-1857
SUBMITTER: National Toxicology Program
TOXICITY STUDY SUPPORTED: Carcinogenesis
MRI RECEIPT DATE: 10/03/86
INTERIM REPORT TO NTP: None
SUPPLIER DATA:
Company: Chem Central
910 N. Prospect
Kansas City, MO 64120

Purchase Order Date: 10/02/86
Company Lot No.: WK8-6-86
MRI Assigned Lot No.: None
MRI Batch No.: 03
Amount Available for Toxicology Laboratory: 4 x 55 gal metal drums
4 x (181 kg)
Purity Grade: Not available
Manufacturer Specifications: Not available
Typical Lot Analysis: Not available
Actual Lot Analysis: Not available

Chemical Information

STRUCTURE:

MOLECULAR FORMULA: C_4H_8O
MOLECULAR WEIGHT: 72.11

EXECUTIVE SUMMARY

This batch of chemical was identified as tetrahydrofuran. Cumulative analytical data indicated a purity of approximately 99%, which was consistent with the purity of Batch No. 01. These conclusions are based on the following information:

The infrared and nuclear magnetic resonance spectra were consistent with the structure of tetrahydrofuran, available literature references, and the spectra obtained for Batch No. 01. The ultraviolet/visible spectrum was consistent with that expected for tetrahydrofuran containing a small amount of BHT (Butylated Hydroxytoluene), literature references for tetrahydrofuran and BHT, and the spectrum obtained for Batch No. 01.

The elemental analysis results for hydrogen agreed with theoretical values; however, the results for carbon were slightly low. Karl Fischer titration indicated 0.06% (w/w) water or less. Peroxide test indicated a peroxide content of less than 1.5 ppm.

Two gas chromatographic systems (20% SP-2100/0.1% Carbowax 1500 and 80/100 Carbopack C/0.1% SP-1000) resolved a major peak and no impurities 0.1% or greater relative to the major peak. Quantitation of BHT by gas chromatography versus a BHT standard indicated a level of 0.28 ± 0.01(s) mg/mL, equivalent to 0.032 ± 0.001(s)% (w/w). A gas chromatographic major peak comparison indicated that this batch of tetrahydrofuran had a purity of 100.3 ± 0.3(s)% relative to a frozen reference sample of Batch No. 01.

The reanalysis protocols in this report were revised at NTP's request. These protocols are based on BHT quantitation by gas chromatography and peroxide titration.

TABLE OF CONTENTS

LIST OF FIGURES

ANALYSIS OF REPROCURED CHEMICAL - TETRAHYDROFURAN

I. INTRODUCTION

The purpose of this work was to provide chemical support for toxicity studies. This support consisted of chemical analyses of reprocured material. The analyses are described in this report. A revision of the bulk chemical analysis protocols for the toxicology laboratory is also included in this report.

II. CHEMICAL HANDLING

This section describes procedures used to homogenize, sample and store the material after receipt at MRI.

A. HOMOGENIZATION

Both 55-gal. metal drums of tetrahydrofuran were independently homogenized by tumbling them for ~ 15 min. One drum was labeled "A," the other "B."

B. SUBBATCH EQUIVALENCY

1. SAMPLING

Samples were removed from both drums. The samples taken from "A" and "B" were used for subbatch equivalency analyses. The sample from "A" was also used for the full complement of analyses for chemical characterization.

2. ANALYSES

a. Gas Chromatographic Impurity Profile

(1) Method: Samples from the two subbatches were concomitantly analyzed by gas chromatographic impurity profiling. (See Section III.F.1.a., p. 5, and Section III.F.1.b., pp. 5-6, for parameters.)

(2) Results: A major peak and no impurities greater than or equal to 0.1% relative to the major peak were observed for both subbatches in each of the two gas chromatographic systems.

System 1:

Peak No.	Retention Time (min)	Retention Time (Relative to Major Peak)	Area (% of Major Peak) A	Area (% of Major Peak) B
1	5.0	1.00	100	100

System 2:

Peak No.	Retention Time (min)	Retention Time (Relative to Major Peak)	Area (% of Major Peak) A	Area (% of Major Peak) B
1	5.0	1.00	100	100

b. Quantitation of 2,6-Di-*tert*-butyl-4-methylphenol (BHT)

(1) Method: Samples from the two subbatches were concomitantly analyzed by gas chromatography for BHT. (See Section III.F.2. p. 6.)

(2) Results: Quantitation of BHT versus a BHT standard indicated a level of 0.28 ± 0.01(s) mg/mL, equivalent to 0.032 ± 0.001(s)% (w/w) for both subbatches.

c. Gas Chromatographic Major Peak Comparison

(1) Method: Samples from the two subbatches were concomitantly analyzed by gas chromatographic major peak comparison. (See Section III.F.3. pp. 6-7.)

(2) Results:

Sample	Tetrahydrofuran Content (%) (Normalized to Batch No. 01)
Batch No. 01 (frozen reference)	100.0 ± 0.5(s)%
Batch No. 03 (A)	100.3 ± 0.3(s)%
Batch No. 03 (B)	100.6 ± 0.6(s)%

3. CONCLUSIONS

Gas chromatographic analyses indicated that the subbatches ("A" and "B") are equivalent within the limits of experimental error.

C. STORAGE

The tetrahydrofuran was stored in its original 55-gal. drums under nitrogen headspace at ~ 65°F. The drums were grounded.

III. CHEMICAL CHARACTERIZATION

This section presents the results of identity confirmation, purity analyses, and impurity profile determinations for the sample of tetrahydrofuran.

A. APPEARANCE

Clear, colorless liquid.

B. SPECTROSCOPY

1. INFRARED

Instrument: Perkin-Elmer 283
Cell: Neat, thin film between silver chloride plates
Results: The spectrum (Figure 1, attached) was consistent with the structure of tetrahydrofuran, a literature reference,[1] and the spectrum obtained for Batch No. 01.[2]

2. ULTRAVIOLET/VISIBLE

Instrument: Varian DMS 100S
Solvent: Methanol
Results: The spectrum was similar to that of a sample of THF containing a small amount of BHT, a literature spectrum,[3] and the spectrum obtained for Batch No. 01.[2] No absorbance was observed in the visible region (800-350 nm) for a concentration of 10% (v/v). Absorbances were observed in the ultraviolet region (350-200 nm) which were consistent with the presence of small amounts of BHT.[4] The results of the analysis and literature data are tabulated below.

			Literature Reference	
λ_{max} (nm)	$\varepsilon \times 10^{-3}$ [a,b]	$\varepsilon \times 10^{-3}$ [c]	λ_{max} (nm)	$\varepsilon \times 10^{-3}$ [d]
278	1.89 ± 0.01(s)	2.02	283 (shoulder)	2.2
233	0.70 ± 0.01(s)	0.74	277	2.2
			227	5.6

Solvent: Isopropanol

[a] Duplicate determinations.
[b] Assuming a BHT concentration of 0.28 mg/mL present in tetrahydrofuran.
[c] Concomitant analysis of uninhibited THF spiked with 0.27 mg/mL BHT and diluted 10% (v/v) in methanol.
[d] ε values calculated from the literature reference for BHT.

[1] Pouchert, J. (ed.), The Aldrich Library of Infrared Spectra, 3rd Edition, Aldrich Chemical Company, Milwaukee, Wisconsin, 139G (1981).
[2] MRI Report: Tetrahydrofuran (Lot No. C052981, Batch No. 01), September 10, 1981.
[3] Przybytek, J. T. (ed.), High Purity Solvent Guide, Burdick and Jackson Laboratories, Inc., Muskegon, Michigan, p. 109 (1980).
[4] Weast, R. C. (ed.), CRC Handbook of Chemistry and Physics, 56th Edition, CRC Press, Cleveland, Ohio, C151 (1975).

3. NUCLEAR MAGNETIC RESONANCE

Instrument: Varian EM-360A
Solvent: Neat
Internal Reference: Tetramethylsilane
Results: The spectrum (see Figure 2, attached) was consistent with the structure of tetrahydrofuran, and a literature reference,[5] and the spectrum obtained for Batch No. 01.[2] The assignments, multiplicity, and integration for the spectrum are tabulated below.

	Assignment	Multiplicity	Observed	Theoretical
(a)	δ 1.60-2.03 ppm	m	3.86	4
(b)	δ 3.38-3.97 ppm	m	4.14	4

C. ELEMENTAL ANALYSIS

Element	C	H
Theoretical % (T)	66.63	11.18
Determined % (D)	65.86 66.08 65.58	11.05 10.99
Difference from Theoretical ($\bar{D}$-T)	-0.80	-0.16
Relative agreement (%) ($\bar{D}$-T)	98.80	98.57

D. WATER ANALYSIS

Method: Karl Fischer titrimetry
Results: Less than or equal to 0.06% (w/w)

E. TEST FOR PEROXIDE CONTENT[6]

Procedure: The sample was analyzed for peroxide content using a commercially available test strip.

Results: Less than 1.5 mg/L (ppm)

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[5] Pouchert, J. (ed.), The Aldrich Library of NMR Spectra, Aldrich Chemical Company, Inc., Milwaukee, Wisconsin, 1, 149C (1974).

[6] Merckoquant® 10 011 Peroxide Test.

F. GAS CHROMATOGRAPHY

1. IMPURITY PROFILE

a. System 1

Instrument: Varian Vista 6000 with Nelson 4400 Data System
Detector: Flame ionization
Inlet Temperature: 150°C
Detector Temperature: 250°C
Carrier Gas: Nitrogen
Carrier Flow Rate: 70 cc/min
Column: 20% SP-2100/0.1% Carbowax 1500 on 100/120 Supelcoport, 1.8 m x 4 mm ID, glass
Oven Temperature:
  Isothermal: 70°C
  Program:
    Initial Temperature, 40°C (5-min hold)
    Program Rate, 10°C/min
    Final Temperature, 170°C
Samples Injected: Neat liquid (program) and a 1% (v/v) solution in o-dichlorobenzene (program) to estimate impurity concentrations; 1% and 0.5% (v/v) solutions in o-dichlorobenzene to confirm detector linearity.
Volume Injected: ~ 2.9 µL
Results: A major peak and no impurity peaks with individual areas greater than or equal to 0.1% of the major peak were observed up to 20 min after the major peak eluted. The results from this analysis are tabulated below and illustrated in Figure 3, attached.

Peak No.	Retention Time (min)	Retention Time (Relative to Major Peak)	Area (% of Major Peak)
1	5.0	1.00	100

b. System 2

Instrument and Parameters

The instrument and parameters described above for System 1 were used with the following exceptions:

Column: 80/100 Carbopack C/0.1% SP-1000, 1.8 m x 4 mm ID, glass
Oven Temperature:
  Isothermal: 80°C
  Program:
    Initial Temperature, 40°C (5-min hold)
    Program Rate, 10°C/min
    Final Temperature, 220°C
Volume injected: ~ 2.5 µL

Results: A major peak and no impurity peaks with individual areas greater than or equal to 0.1% of the major peak were observed. No additional impurities were observed up to 20 min after the major peak eluted. The results from this analysis are tabulated below.

Peak No.	Retention Time (min)	Retention Time (Relative to Major Peak)	Area (% of Major Peak)
1	5.0	1.00	100

2. QUANTITATION OF 2,6-DI-*tert*-BUTYL-4-METHYLPHENOL (BHT)

Method: The quantitation was performed by making injections of BHT standard solutions and the sample. The area of the BHT peak in each chromatogram was compared to an internal standard peak area and the BHT content calculated from the standard curve obtained by comparing the peak area ratio (BHT peak area/internal standard peak area) to the BHT concentration of the standards. The linearity of the standard curve was evaluated over a BHT concentration range of 0.05908 to 0.31104 mg/mL. The linear correlation coefficient was 0.99952. The instrument and parameters described on p. 5 for the impurity profile (System 1) were used with the following exceptions:

Instrument: Varian 3700 with Autosampler and Nelson 4400 Data System
Oven Temperature:
Isothermal: 160°C
Samples Injected: Standard solutions with BHT concentrations of 0.05908, 0.10140, 0.20200, and 0.31104 mg/mL each containing 0.1045 mg/mL *p-tert*-butylphenol as internal standard, in methanol. Triplicate solutions containing 40% (v/v) tetrahydrofuran and 0.1045 mg/mL *p-tert*-butylphenol as internal standard in methanol. A blank solution containing 0.1045 mg/mL internal standard in methanol.
Retention Times:
p-tert-Butylphenol (internal standard) - 5.8 min
BHT - 14.8 min
Results: The content of BHT in tetrahydrofuran was determined to be 0.28 ± 0.01(s) mg/mL, equivalent to 0.032 ± 0.001(s)% (w/w).

3. MAJOR PEAK COMPARISON

The current batch (No. 03) and Batch No. 01 (frozen reference) were concomitantly analyzed for the tetrahydrofuran content. Weighted peak area ratios (major peak:internal standard peak) were calculated for each sample and the amount of tetrahydrofuran in Batch No. 03 was compared to that in Batch No. 01 (frozen reference). The instrumental parameters listed in Section III.F.1.a. (p. 5) of this report were used, with the following exceptions:

Instrument: Varian 3700 with Autosampler and Nelson 4400 Data System
Column Temperature: 70°C, isothermal
Volume Injected: 3.5 μL
Solutions Injected: 0.5% (v/v) tetrahydrofuran in toluene containing 0.25% (v/v) acetone internal standard
Retention Times:
Acetone (Internal Standard) - 0.9 min
Tetrahydrofuran - 1.9 min

Results:

Sample	Tetrahydrofuran Content (%) (Normalized to Batch No. 01)
Batch No. 01 (frozen reference)	100.0 ± 0.5(s)%
Batch No. 03	100.3 ± 0.3(s)%

Pooled standard deviation: 0.5(s)%

G. SUMMARY AND DISCUSSION

The infrared and nuclear magnetic resonance spectra were consistent with the structure of tetrahydrofuran, available literature references, and the spectra obtained for Batch No. 01.[2] The ultraviolet/visible spectrum was consistent with that expected for tetrahydrofuran containing a small amount of BHT, literature references for tetrahydrofuran and BHT, and the spectrum obtained for Batch No. 01.[2]

The elemental analysis results for hydrogen agreed with theoretical values; however, the results for carbon were slightly low. Karl Fischer titration indicated less than or equal to 0.06% water. Peroxide test indicated a peroxide content of less than 1.5 ppm.

Two gas chromatographic systems (20% SP-2100/0.1% Carbowax 1500 and 80/100 Carbopack C/0.1% SP-1000) resolved a major peak and no impurities 0.1% or greater relative to the major peak. Quantitation of BHT by gas chromatography versus a BHT standard indicated a level of 0.28 ± 0.01(s) mg/mL, equivalent to 0.032 ± 0.001(s)% (w/w). A gas chromatographic major peak comparison indicated that this batch of tetrahydrofuran had a purity of 100.3 ± 0.3(s)% relative to a frozen reference sample of Batch No. 01.

The table on p. 8 compares the results for this analysis of Batch No. 03 to those of the previous analyses of Batch Nos. 01 and 02.

Analysis	Batch No. 01[2]	Batch No. 02[7]	Batch No. 03
Water analysis	0.024 ± 0.001(s)%	0.014 ± 0.001(s)%	≦ 0.06 ± 0.037(s)%
Peroxide content	-	< 26 ppm	< 1.5 ppm
Gas chromatography System 1	A major peak and no impurities with areas ≧ 0.1% relative to the major peak area.	A major peak and no impurities with areas ≧ 0.1% relative to the major peak area.	A major peak and no impurities with areas ≧ 0.1% relative to the major peak area.
System 2	A major peak and no impurities with areas ≧ 0.1% relative to the major peak area.	A major peak and no impurities with areas ≧ 0.1% relative to the major peak area.	A major peak and no impurities with areas ≧ 0.1% relative to the major peak area.
Quantitation of BHT	0.26 ± 0.01(s) mg/mL	0.28 ± 0.01(s) mg/mL	0.28 ± 0.01(s) mg/mL
GC major peak comparison (relative to Batch No. 01)	100.0 ± 1.0(s)%	98.6 ± 0.7(s)%	100.3 ± 0.5(s)%

H. CONCLUSION

This batch of chemical was identified as tetrahydrofuran by spectroscopy. The combined analytical data indicated a purity of ~ 99%, which is comparable to that obtained for Batch No. 01.[2]

IV. REVISED PROTOCOLS FOR THE TOXICOLOGY LABORATORY

This section contains chemical handling and bulk chemical protocols for the toxicology laboratory.

A. CHEMICAL HANDLING PROTOCOLS

Chemical handling protocols are described in the <u>NTP Health and Safety Package for Tetrahydrofuran</u> and should be consulted for safety and emergency procedures in handling this chemical, as well as pertinent chemical properties.

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[7] MRI Reprocurement Report: Analysis of Tetrahydrofuran (Lot No. WK 1-14-85, Batch No. 02), MRI Task Designation: RE-1503, May 16, 1985.

DISCLAIMER

The information contained therein is based on data from current published literature and is believed to be accurate. However, no warranty is expressed or implied regarding the accuracy of these data or the results to be obtained from the use thereof.

B. BULK CHEMICAL PROTOCOLS

This section contains protocols to be followed upon receipt of the bulk chemical, for initial confirmation of identity and purity, and for subsequent analyses of the bulk chemical during storage at the toxicology laboratory.

1. RECEIPT OF BULK CHEMICAL

a. Removal and Storage of Reference Material

When the bulk chemical is received, remove 85-mL portions for each subsequent analysis. Place each sample in an appropriately labeled glass vial equipped with a Teflon®-lined screwcap, then tightly close and seal the vial, and store at -20°C. Use this material in subsequent analyses, at intervals specified by the NTP, to replace the reference standard initially supplied by MRI.

b. Bulk Chemical Storage

Store the bulk chemical under nitrogen at 65°F or less, and protected from light. The containers should be grounded.

2. CONFIRMATION OF IDENTITY AND PURITY OF BULK CHEMICAL

Determine whether the bulk chemical received by the toxicology laboratory is identical to that analyzed by MRI. Confirm the identity and purity of the bulk chemical as soon after receipt as practical, using infrared spectroscopy and gas chromatography (pp. 10-11). These analyses require the concomitant analysis of a frozen reference standard supplied by MRI (shipped under separate cover).

Upon receipt, carefully inspect the standard supplied by MRI and store at -20°C prior to analysis. In case of damage to the standard, or if the shipping container does not contain dry ice, notify MRI.* Use this standard only for confirmatory identity and purity analyses upon receipt of the bulk chemical. Subsequent purity analyses (pp. 11-13) require the use of reference material removed by the toxicology laboratory upon receipt of the bulk chemical.

---

* Steven Graves

a. Identity Confirmation by Infrared Spectroscopy

The basis of this analysis is visual comparison of the infrared spectrum obtained for the bulk chemical to the spectrum of the reference standard supplied by MRI.

(1) Prepare separate thin films for both the bulk chemical and the standard supplied by MRI by placing approximately one drop of tetrahydrofuran between silver chloride plates. Be sure no air bubbles are trapped in the cell.

(2) Obtain spectra for the two samples from 600 to 4000 cm^{-1} using a suitable infrared spectrophotometer. Adjust the instrument settings or sample thickness to obtain baselines of about 80% transmission, keeping the largest absorbances at greater than or equal to 10% transmission.

b. Purity Analysis by Gas Chromatography

The basis of this analysis is quantitation of the major component of the bulk chemical by GC major peak comparison to the reference standard supplied by MRI.

(1) Procedure

Note: In the following procedure, use only Class A volumetric pipets ["to deliver" (TD)]. Use ACS reagent grade solvents or equivalent.

Prepare triplicate solutions for both the bulk chemical and the reference standard.

(a) Accurately pipet 5 mL of acetone, the internal standard, into a 100 mL volumetric flask and dilute to volume with toluene. Shake well to mix.

(b) Accurately pipet 1 mL of the appropriate sample into a 200-mL volumetric flask. Pipet 10 mL of the internal standard solution into each flask and dilute to volume with toluene. Shake well to mix.

(c) Prepare a blank solution by pipetting 10 mL of the internal standard solution into a 200-mL volumetric flask and diluting to volume with toluene. Shake well to mix.

(d) Inject each solution at least twice. Use an attenuation to produce peaks with at least half-scale deflection. Use the system parameters described on p. 11, adjusting the oven temperature, if necessary, to obtain retention times close to those reported by MRI.

Detection: Flame ionization
Inlet Temperature: 150°C
Detector Temperature: 250°C
Carrier Gas: Nitrogen
Carrier Flow Rate: 70 cc/min
Column: 20% SP-2100/0.1% Carbowax 1500 on 100/120 Supelcoport, 1.8 m x 4 mm ID, glass
Oven Temperature: 70°C
Injection Volume: ~ 3.5 µL
Retention Times: Acetone (Internal Standard - 0.9 min
Tetrahydrofuran - 1.9 min

(2) Calculations

(a) Determine the areas of the tetrahydrofuran and internal standard peaks. Use the injections of the blank solution to determine that there are no interfering peaks under the test sample peak.

(b) Calculate, to at least four significant figures, a RRF (relative response factor) for each bulk chemical and reference standard injection as follows:

$$RRF = \frac{\text{Peak Area Compound}}{\text{Peak Area Internal Standard}}$$

(c) Calculate the average RRF and standard deviation for both the bulk chemical and reference standard.

(d) Calculate, to two significant figures, the relative standard deviation (RSD, %) for both the RRF bulk chemical and RRF reference standard.

(e) Determine, to the tenths place, the relative purity of the bulk chemical by the formula:

$$\text{Relative Purity (\%)} = \frac{\text{RRF Bulk Chemical} \times 100}{\text{RRF Reference Standard}}$$

(f) Note and report any impurities detected in the bulk chemical during the analysis.

3. SUBSEQUENT ANALYSES

Determine whether the purity of the bulk chemical remains unchanged during the toxicity study. Use reference material stored at -20°C for comparison to the stored bulk chemical in these subsequent analyses. (Instructions for the removal and storage of this reference material from the bulk chemical shipment were described on p. 9 of this report.) Use gas chromatography, quantitation of BHT by gas chromatography, and titration for peroxide content (pp. 12-16) to monitor the purity of the bulk chemical at intervals specified by the NTP during the toxicity study.

For all subsequent analyses, remove a single vial of the reference material from the freezer approximately 4 hr prior to analysis. Obtain a sample of the stored bulk chemical. Analyze the two samples concomitantly so that the two sets of tests results can be directly compared.

a. Purity Analysis by Gas Chromatography

Use the procedure and calculations contained in Section IV.B.2.b. (pp. 10-11) to analyze the bulk chemical by gas chromatographic major peak comparison. Replace the standard supplied by MRI with the reference material removed upon receipt of the bulk chemical, as described in Section IV.B.1.a. (p. 9).

b. Quantitation of BHT by Gas Chromatography

The basis of this analysis is quantitation of the 2,6-di-*tert*-butyl-4-methylphenol (BHT) stabilizer by gas chromatographic analysis using standard solutions.

(1) Procedure

Note: In the following procedure, use only Class A volumetric pipets ["to deliver" (TD)]. Use ACS reagent grade solvents or equivalent, and low-actinic (e.g., amber) glassware.

Prepare duplicate solutions for both the bulk chemical and the reference material.

(a) Accurately weigh approximately 40 mg of *p*-*tert*-butylphenol, the internal standard, into a 100-mL volumetric flask and dilute to volume with methanol. Shake well to mix.

(b) Accurately pipet 4 mL of the appropriate sample into a 10-mL volumetric flask. Pipet 2 mL of the internal standard solution into each flask and dilute to volume with methanol. Shake well to mix.

(c) Prepare four BHT standard* stock solutions by accurately weighing ~ 30, 50, 100, and 150 mg of BHT into separate 100-mL volumetric flasks and diluting to volume with methanol. Shake well to mix.

(d) Pipet 2 mL of the BHT stock solution into separate 10-mL volumetric flasks. Pipet 2 mL of the internal standard solution into each flask and dilute to volume with methanol to give standard solutions with concentrations of 0.06, 0.1, 0.2, and 0.3 mg/mL BHT containing 0.08 mg/mL internal standard.

(e) Prepare a blank solution by pipetting 2 mL of the internal standard solution into a 10-mL volumetric flask and diluting to volume with methanol. Shake well to mix.

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* Available from Aldrich Chemical Company.

(f) Inject each solution at least twice. Use an attenuation where the most concentrated standard is approximately 70% of full-scale. Use the system parameters described below, adjusting the oven temperature, if necessary, to obtain retention times close to those reported by MRI.

Detector: Flame ionization
Inlet Temperature: 150°C
Detector Temperature: 250°C
Carrier Gas: Nitrogen
Carrier Flow Rate: 70 cc/min
Column: 20% SP-2100/0.1% Carbowax 1500 on 100/120 Supelcoport, 1.8 m x 4 mm ID, glass
Oven Temperature: 160°C, isothermal
Injection Volume: ~ 3.5 μL
Retention Times:
p-tert-Butylphenol (Internal Standard) - 6.4 min
BHT - 16.9 min

(2) Calculations

(a) Determine the areas of the BHT and internal standard peaks. Use the injections of the blank solution to determine that there are no interfering peaks under the BHT peak.

(b) Calculate, to at least four significant figures, a RRF (relative response factor) for each bulk chemical, reference material, and BHT standard injection as follows:

$$RRF = \frac{\text{Peak Area BHT}}{\text{Peak Area Internal Standard}}$$

(c) Calculate the average RRF for the duplicate injections of each solution of the bulk chemical, reference material, and BHT standards.

(d) Compute the linear regression equation for the BHT standard data, relating the $\overline{RRF}$ of the BHT peak for each standard to the corresponding concentration (mg/mL) of BHT injected.

(e) Calculate the concentration (mg/mL) of BHT present in the sample (40% solution) for both the bulk chemical and reference material using the regression equation and the $\overline{RRF}$ for BHT from the duplicate injections of each sample solution.

(f) Calculate the average concentration of BHT for both the bulk chemical and reference material.

(g) Determine the percent (w/w) of BHT in both the bulk sample of tetrahydrofuran and the reference material by the following formula:

$$\% \text{ (w/w)} = \frac{A \times 2.5 \times 100}{888.5^{*}}$$

where A = concentration of BHT from step (f) above.

(h) Note and report any additional impurities detected in the bulk chemical during the analysis.

c. <u>Titration for Peroxide Content (as Tetrahydrofuran hydroperoxide)</u>

The basis of this analysis is the iodometric titration of any peroxide present in the sample. The sample is dissolved in water and a mixture of concentrated sulfuric acid and water. After addition of ammonium molybdate solution and an excess of potassium iodide, the sample is allowed to react in the dark for 15 min. After the 15-min storage time, starch indicator is added and the sample titrated to a colorimetric endpoint with ~ 0.005 N sodium thiosulfate.

(1) <u>Standardization of Sodium Thiosulfate</u>

Note: In the following procedure use only Class A volumetric pipets ["to deliver" (TD)]. Titrate at least triplicate standard solutions.

(a) Accurately weigh approximately 50 mg of primary standard grade potassium iodate (KIO_3)** and transfer to a 100-mL volumetric flask. Dilute to volume with deionized water.

(b) Accurately pipet 10 mL of the solution prepared in step (a) into a suitable titration vessel. Add 50 mL of deionized water and ~ 1 g of potassium iodide (KI), followed by 5 mL of 1.0 N hydrochloric acid.

(c) Immediately titrate the KIO_3 with 0.005 N sodium thiosulfate† to a light yellow color. Add 3 mL of starch indicator TS†† and continue titrating to the disappearance of the blue color. A 5-mg sample of KIO_3 should require approximately 25 mL of titrant.

(d) Titrate at least duplicate blanks of 50 mL of deionized water, ~ 1 g of potassium iodide, 5 mL of 1.0 N hydrochloric acid,

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* Weight of tetrahydrofuran in 1 mL based on density determined in the analysis of Batch No. 01.[2]

** Dried for 1 hr at 115°C.

† Prepared from commercially available 0.1 N; dilute 50 mL to 1 L with deionized water.

†† Prepare fresh by mixing 250 mg of a suitable starch with sufficient cold deionized water to make a thin paste. Add 50 mL of boiling water, boil for 1 min with continuous stirring, and cool. Use only the clear solution.

and 3 mL of the starch indicator solution. If the addition of 3 mL of starch indicator solution produces no blue color, there is no titratable blank.

(2) Calculations

(a) Calculate the normality of the titrant to four significant figures, using the following formula:

$$\text{Normality} = \frac{LP \times W \times 6}{(A - B) \times 214.0}$$

where LP = label purity (i.e., 99.9% = .999),
W = weight of KIO_3 (in mg),
A = volume of titrant required for KIO_3 (in mL), and
B = volume of titrant required for blank (in mL).

(b) Calculate the average normality and the standard deviation to four significant figures. Calculate the relative standard deviation (RSD, %) to two significant figures.

(3) Titration of Tetrahydrofuran

Note: Titrate at least triplicate samples of both the bulk chemical and the reference material.

(a) Place 200 mL of distilled water, 25 mL of a 1:4 mixture of concentrated sulfuric acid and water (100 mL of acid and 400 mL of water), then 3 drops of 5% ammonium molybdate solution into a 500-mL glass-stoppered Erlenmeyer flask.

(b) Accurately pipet 10 mL of the sample into the flask.

(c) Bubble a gentle stream of nitrogen through the solution for 2 min. Add 25 mL of 40% potassium iodide to the flask while continuing the nitrogen flow. Maintain the nitrogen flow into the solution for an additional 2 min, then stopper the flask immediately and place it in the dark for 15 min.

(d) After the 15-min storage time, resume the nitrogen flow through the solution while magnetically stirring. Add 2 mL of 0.5% starch solution and then titrate with 0.005 N sodium thiosulfate to the starch endpoint, blue to yellow. If no blue color is produced after addition of the starch solution, titrate to the disappearance of the yellow color. Since this gives a high value, report results as a "less than" value.

(e) Titrate at least duplicate blanks, repeating the procedure described above, omitting the sample. If addition of the starch indicator solution produces no blue color, there is no titratable blank.

(4) Calculations

(a) Calculate the peroxide content (ppm) of the bulk chemical and reference material using the following formula:

$$\text{Peroxide Content (ppm)} = \frac{(A - B) \times N \times 52{,}000}{8.88}$$

where A = volume of titrant required for sample (in mL),
B = volume of titrant required for blank (in mL), and
N = average normality of titrant.

(b) Calculate the average peroxide content (ppm) for both the bulk chemical and the reference material to three significant figures. Also, calculate the relative standard deviation (RSD) for each average to two significant figures.

V. CONTRIBUTORS

Janet Naught, Tom Pederson, Stan Tippin, and Dan Timmons contributed to the analysis of tetrahydrofuran.

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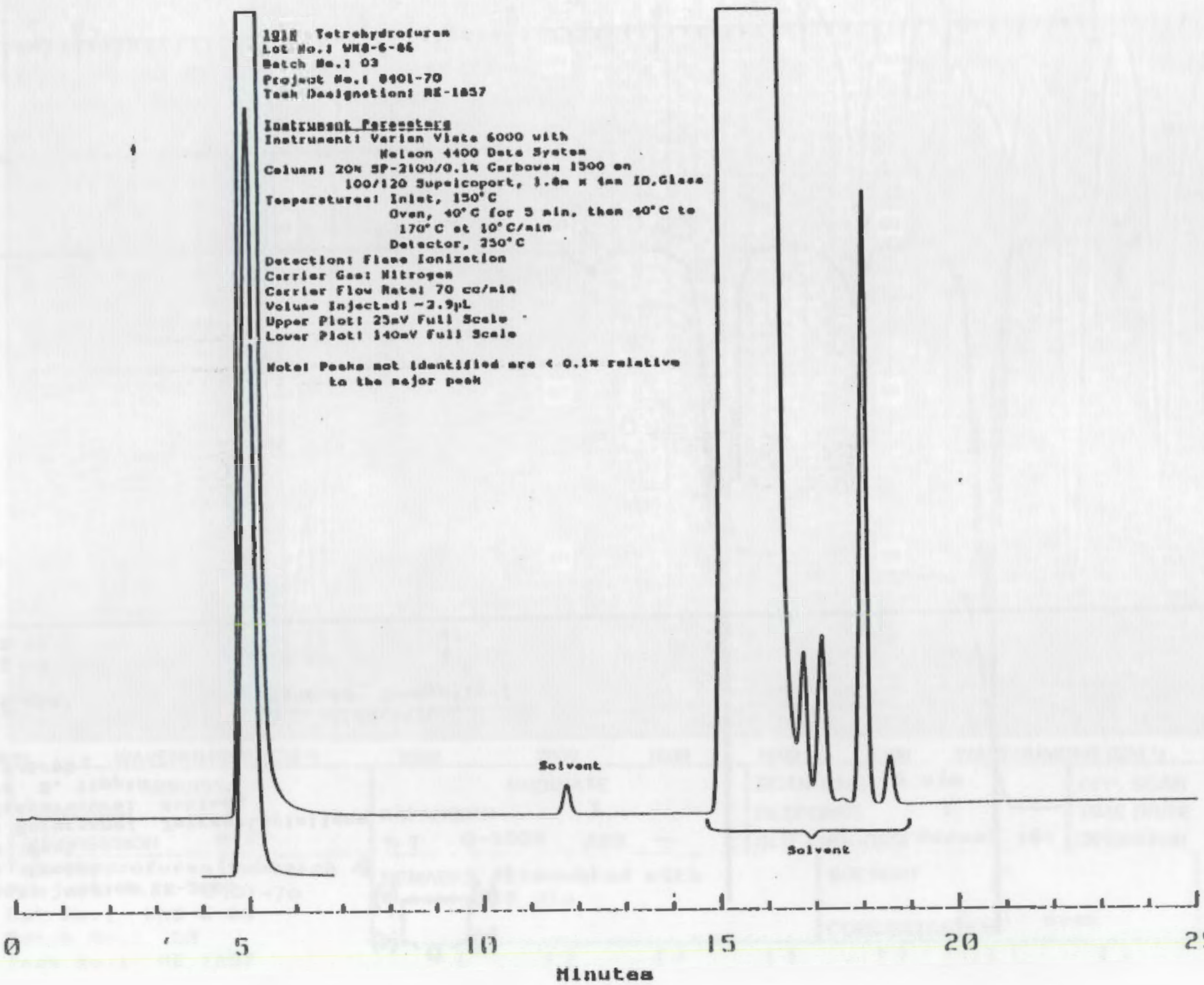


Figure 3 – Gas Chromatographic Profile of Tetrahydrofuran.

APPENDIX B

EXPOSURE NARRATIVE AND DATA

FOR TETRAHYDROFURAN

EXPOSURE DATA AND NARRATIVE FOR TETRAHYDROFURAN

Animal Exposure Chamber

The Battelle-designed inhalation exposure chamber (commercially available from Harford Systems/Lab Products, Inc., Aberdeen, MD) was used for the inhalation exposures. The 2.3 m^3 (1.7 m^3 active mixing volume) stainless steel chamber contained three levels of caging, each level split into two offset tiers (Figure B.1). The drawer-like stainless steel cage units comprise individual animal cages, feed troughs and automatic watering. Stainless steel catch pans for the collection of urine and feces were suspended below each cage unit.

The catch pans, which remained in the chamber during exposure, were designed to aid in maintaining uniform concentrations of aerosol, dust or vapors throughout the chamber. Incoming air was HEPA and charcoal filtered before addition of the test article. Following addition of the test article, the uniform mixture was diverted along the inner surfaces of the chamber. A portion of the flow was "peeled off" by each catch pan thus creating mixing eddies. Exhaust from each tier was cleared through the space between the tiers.

Exposure Suite System Description

The THF exposures were conducted using an automated data acquisition and control system in an exposure suite (Figures B.2 and B.3). This system monitored and controlled the basic inhalation test system functions including chamber air flow, vacuum, temperature, relative humidity, and test chemical concentration. The system computers, printers, magnetic data storage devices, interface equipment, and monitoring instruments were located in a central control room and interfaced with monitoring and control elements in three exposure rooms. All data acquisition and control originated from an executive computer which controlled a multiplexing interface system. All experimental protocols related to data acquisition and control resided in this computer and were entered into software tables accessed by menus.

Data from each exposure was stored in the exposure control center on separate micro-floppy diskettes. Data and comments from each exposure room were printed on separate printers. Data were printed and stored immediately upon completion of the measurement. At the end of the 24 hour period, the daily data were analyzed and summary and data outlier reports were printed.

A dual point alarm system with user-defined set points was available for each parameter measured. Action taken upon alarm depended on the cause and severity of the alarm and ranges from audio/visual alert to automatic shutoff of the exposure generator. Alarm conditions which might be a threat to the health of the animals alerted a building power operator who was on duty 24 hours per day.

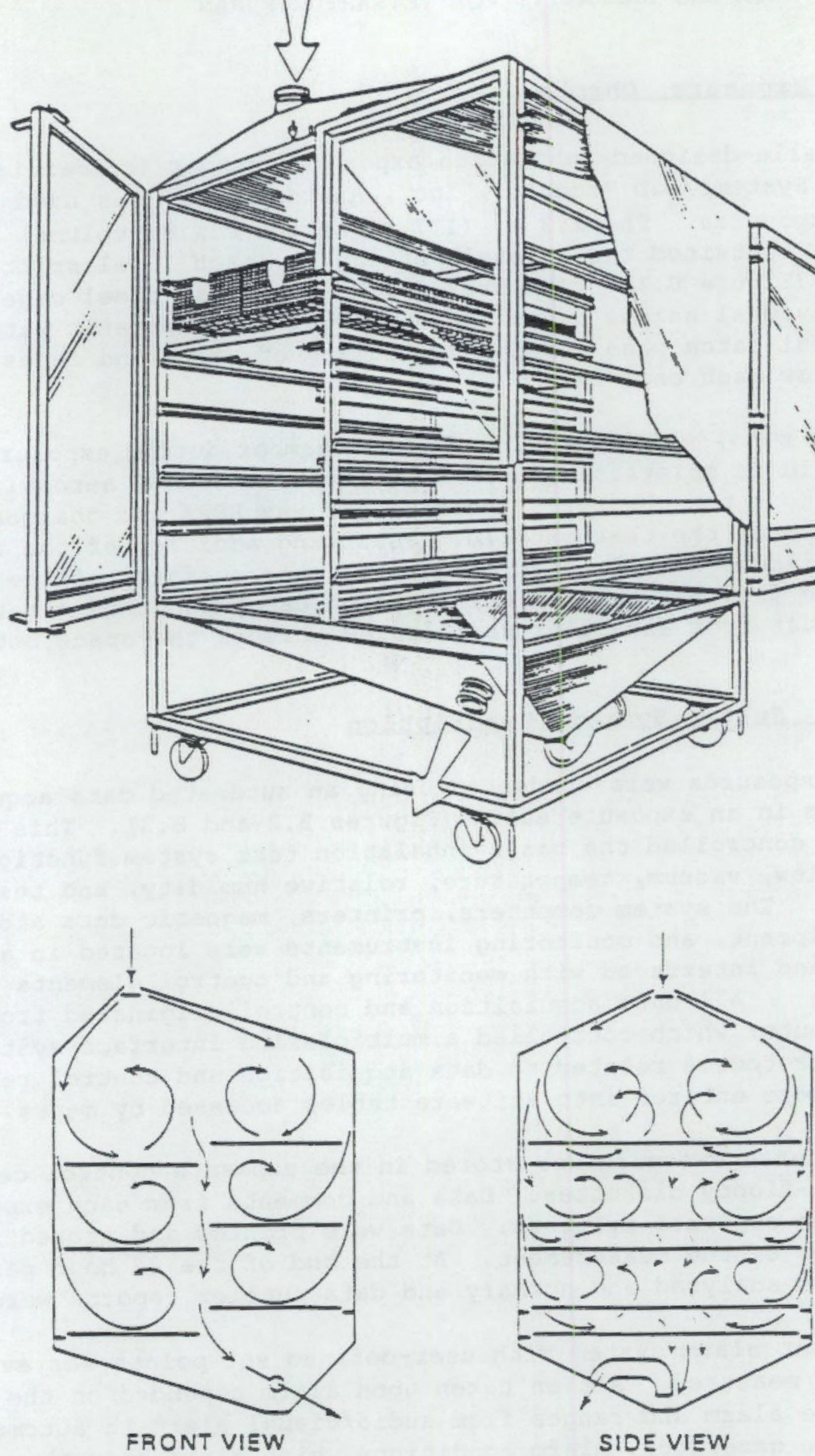


FIGURE B.1. Inhalation Exposure Chamber

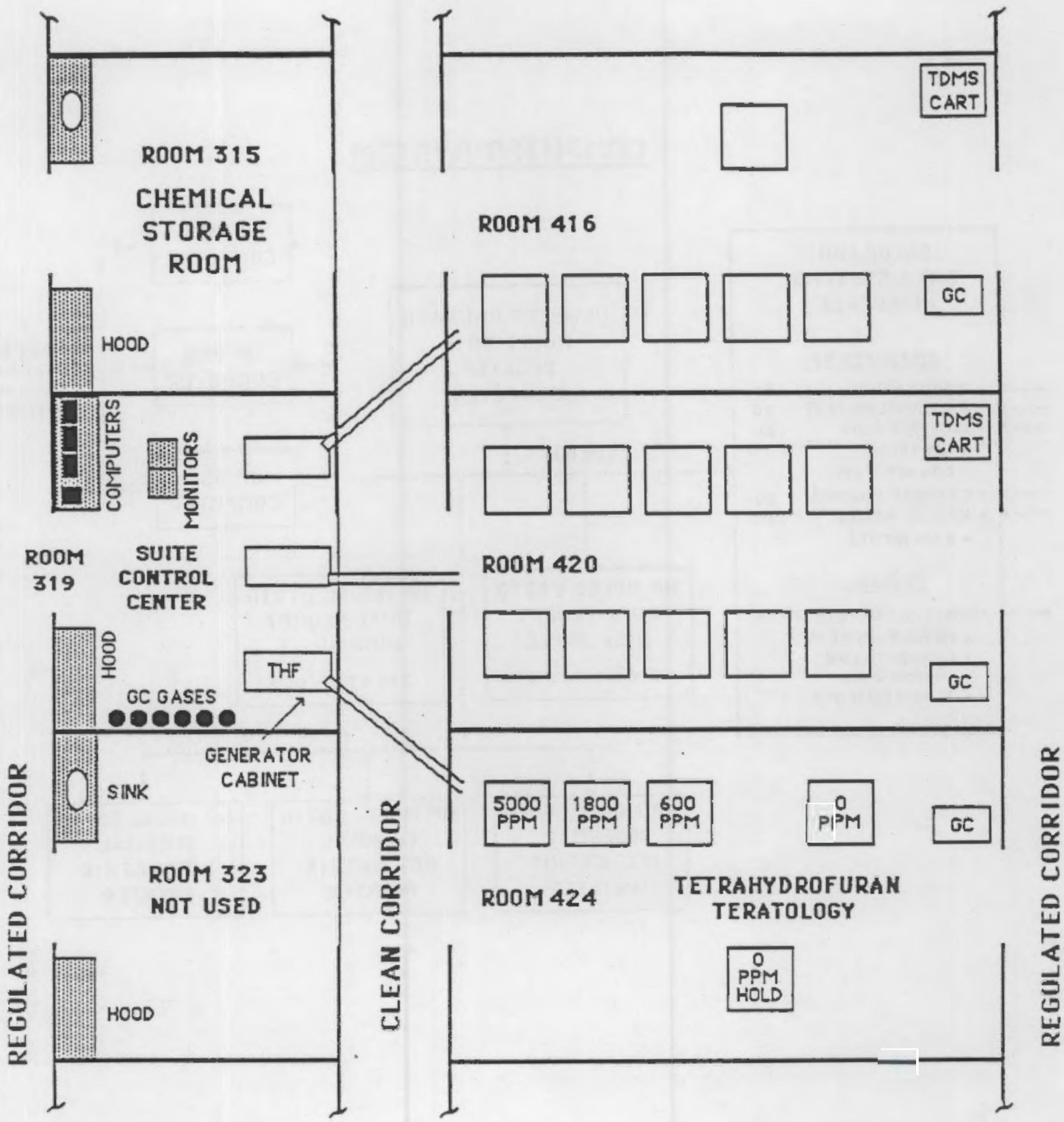


FIGURE B.2. Tetrahydrofuran Exposure Suite

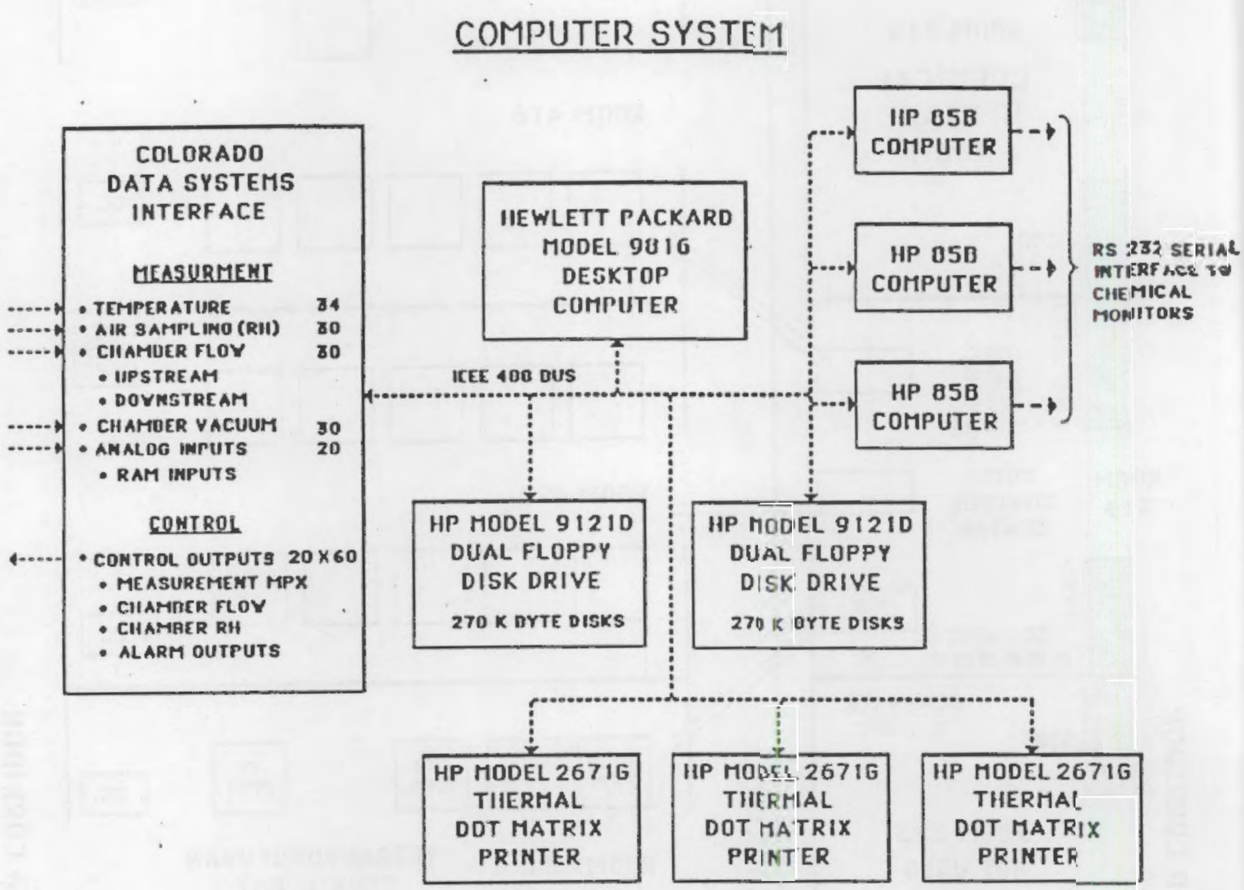


FIGURE B.3. Data Acquisition System for Tetrahydrofuran Exposures

Chamber and room temperatures were measured by Resistance Temperature Devices (RTDs) located at the measurement site. The RTDs were multiplexed to a digital thermometer which was interfaced to the computer. Chamber temperature was controlled primarily by controlling the temperature of the room housing the chambers. Prior to the start of the study RTDs were calibrated to within ±0.5°F of a certified mercury thermometer in a temperature controlled water bath.

Percent relative humidity (%RH) was calculated with an accuracy of approximately ±6% by pulling a sample from the measurement location through a Teflon® tube into a dewpoint hygrometer located in the control center. Measurements were made from different locations by a valving system which multiplexes the tubes to the hygrometer. Percent RH were calculated by the executive computer from temperature and dewpoint measurements. Chamber %RH was maintained by a "wet/dry" air source supplied to each chamber. The ratio of "wet" to "dry" air, determined by a computer-controlled mixing valve, determined the chamber %RH.

Chamber air flow was calculated with an accuracy of approximately ±15 l/min by measurement of the pressure drop across calibrated orifices located at the inlet and exhaust of each chamber. The desired flow orifice was attached by means of a multiplexed valve system to a calibrated pressure transducer located in the control center. Leaks in the chambers could be detected by comparison of the measurement of inlet flow with that of the exhaust. Flow was maintained by a computer-controlled gate valve in the exhaust line of each chamber

Chamber vacuum, relative to the control center, was measured with an accuracy of approximately ±0.2 cm H_2O using the same pressure transducer system which measured chamber air flows. Chamber vacuum was maintained at approximately (-)1" H_2O primarily by inlet resistance provided by the HEPA and charcoal filters.

<u>THF Vapor Generation System</u>

A schematic diagram of the THF generation and delivery system is shown in Figure B.4. The chemical was pumped from the bulk reservoir - a modified stainless steel flammable liquid container - at a steady rate by a liquid micrometering pump designed to operate in potentially explosive atmospheres. The chemical was pumped into a rotating (100 rpm) flask which was partially immersed in a hot water bath maintained at 175 ± 2°F. The resulting vapor was forced out of the mouth of the flask into a chilled water condenser, where much of the vapor was condensed, and returned to the evaporator flask. Uncondensed vapor was carried from the top of the condenser column by a metered stream of nitrogen that was introduced into the bottom of the condenser. As nitrogen moved through the condenser, it became saturated with THF vapor. The temperature of this exiting vapor was monitored by an RTD sensor located at the top of the condenser column. The saturation vapor pressure at the column exit temperature was calculated so that the output (ppm of THF and flow rate of saturated nitrogen) of the generator was known. For example, at an exit temperature of 15°C, the THF concentration was ~150,000 ppm at a typical nitrogen flow of 25 l/min.

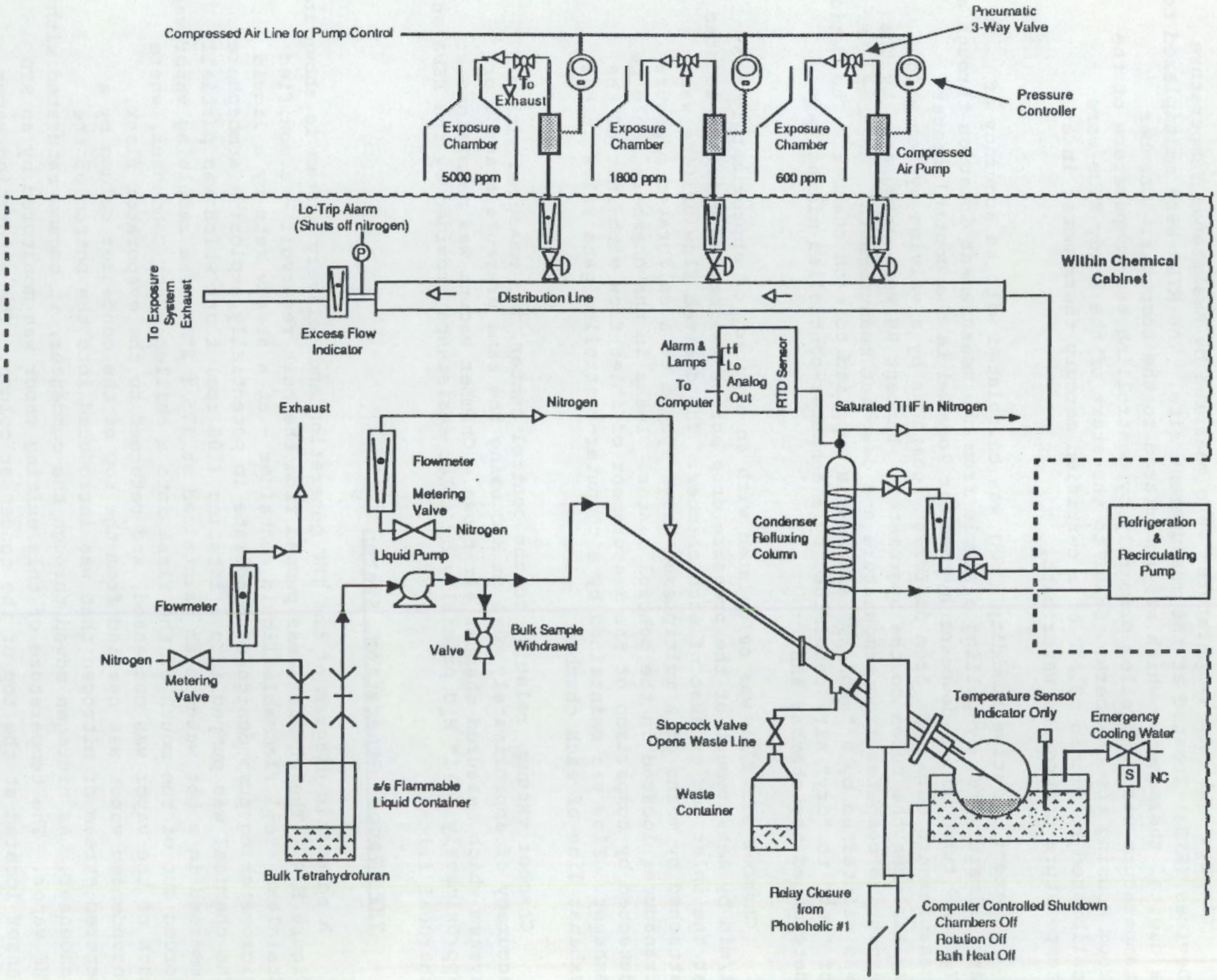


FIGURE B.4. Tetrahydrofuran Generation and Delivery System

From the condensing column, the vapor entered a short distribution manifold from which individual delivery lines carried metered amounts of vapor to each exposure chamber. Flow to each chamber was accomplished by impulse principle vacuum pumps located at the chamber end of each delivery line. Within the chemical cabinet, each delivery line was connected to the distribution manifold through a fine metering valve and flowmeter. Chamber concentration was adjusted by the metering valve and/or by adjustment of the compressed air pressure to the vacuum pump. Dilution of the nitrogen/THF vapor mix with air to meet a target concentration occurred immediately before entry to each chamber.

Normal operation called for up to 20% excess vapor to be exhausted from the manifold through a flowmeter located at the end of the manifold. This "excess" flow allowed for the adjustment of vapor flow rates to each chamber without affecting the flow rate to the other chambers. The excess flow also maintained a slight positive pressure in the manifold preventing air from entering the system and creating a potentially explosive mixture. However, since the vacuum transducer pumps drew vapor from the manifold, the possibility existed of creating a negative pressure in the manifold and generator which could draw air into the nitrogen/THF atmosphere. This would occur if nitrogen delivery was interrupted or if the vacuum pump delivery rates were grossly misadjusted. A safety system was incorporated to prevent the occurrence of a negative pressure in the manifold. A pressure transducer (Dwyer Photohelic) monitored the pressure drop across the excess-vapor flowmeter. A drop in pressure to below 2 cm of water would result in an automatic shutdown of the generation system. Chemical delivery and rotation of the evaporating flask would be stopped.

Generation proceeded in stages: warmup, generation and shutdown. During warmup, filling of the evaporating flask and heating of the water bath proceeded together. During this time, some evaporation occurred but all vapor was exhausted from the distribution manifold through the excess flow exhaust. When the bath temperature and fluid level reached the correct values, computer-controlled startup of the delivery pumps was initiated. Until concentration was equilibrated in the delivery lines, nitrogen/THF was vented to exhaust at each chamber through pneumatic 3-way valves. The addition of this feature allowed for the more rapid diversion of chemical flow from chambers in the event rapid shutdown was necessary. After stabilization of the vapor temperature and possible fine adjustments of the vapor delivery and nitrogen flow rates, the generator was in its normal operating stage. During this stage, the generator operated under computer and exposure operator supervision. The exposure operator monitored the fluid level in the flask as well as other operating parameters. The operator could adjust the overall generator output by changing the flow rate of cooling water to the condenser. This affected the temperature of the vapor leaving the condenser and hence, the concentration of chemical in the nitrogen/THF vapor mix. Overall generator output could also be controlled by adjusting the flow rate of dilution nitrogen. The computer could initiate a shutdown of the generator output under certain conditions by stopping flask rotation and turning off the bath heater. Further reduction in the generator output could then be initiated by the operator by reducing the nitrogen flow and tripping a solenoid-controlled valve which introduced chilled water into the water bath.

Shutdown at the end of the generation stage was similar to a computer-initiated shutdown. Following closure of the valves at the chambers and discontinuation of flask rotation, the operator tripped the solenoid, dumping additional cooling water into the bath. The remaining THF in the evaporating flask was removed to a waste bottle. Nitrogen continuously purged the generation system until preparation for the next day's generation. Any liquid THF waste was slowly evaporated from the bottle by sparging overnight in a chemical vapor hood.

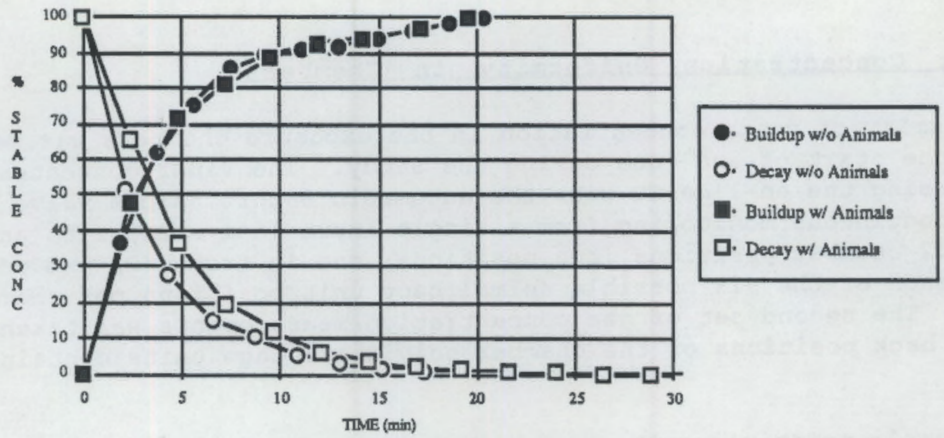
A Gardner type CN small particle detector was used to check the chambers (without animals) and the room for particles during generation on 1/12/87 (during the NTP THF Subchronic Inhalation Toxicity Study). No particles were found in the control chamber or any of the exposure chambers. A particle count of 720 particles/cm^3 in the room was slightly higher than normally found in the HEPA-filtered rooms because the room had not been cleaned following installation of the delivery system for the chemical.

Data for the determination of chemical concentration buildup and decay in the chamber with and without animals were obtained from the NTP Tetrahydrofuran Subchronic Inhalation Toxicity Study conducted at Pacific Northwest Laboratories during the period 2/87 - 5/87. The time (T_{90}), following the start of generation, for the concentration to build up to 90% of the final stable concentration in the chamber and the time (T_{10}), following the stop of generation, for the vapor concentration to decay to 10% of the stable concentration were determined before animals were placed in the chambers prior to the start of the NTP THF Subchronic Inhalation Toxicity Study. The resulting curves for all chambers are shown in Figure B.5. The value of T_{90} was found to range from approximately 8 to 10 minutes. At a chamber air flow rate of 15 air changes per hour, the theoretical value for T_{90} is approximately 12.5 minutes. A T_{90} of 12 minutes was chosen for this study. The value of T_{10} ranged from 7 to 9 minutes.

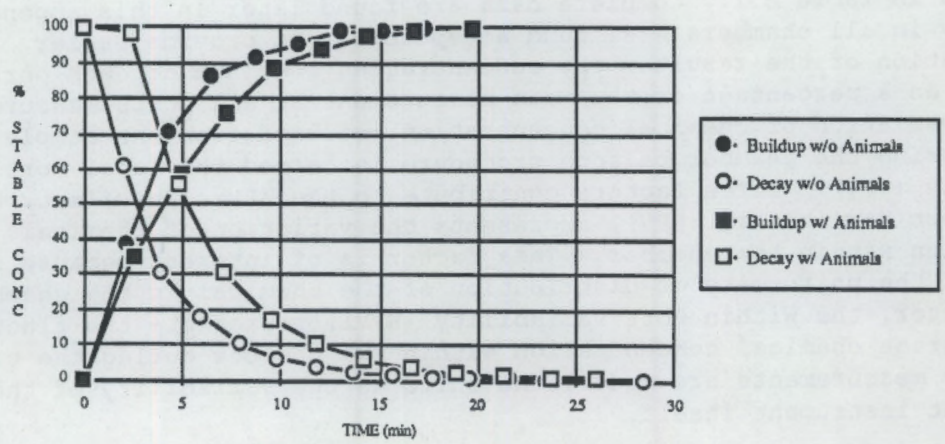
The buildup and decay of concentration with animals in all the chambers were also checked during the NTP THF Subchronic Inhalation Toxicity Study (Figure B.5). The values of T_{90} ranged from 8 to 10 minutes. The decay time, T_{10} with animals present ranged between 10 and 13 minutes.

In order to determine the persistence of the chemical in the chamber following exposure, the concentration of THF in the 5000 ppm chamber was monitored overnight following shutoff of the chemical flow to the chamber. Monitoring was performed during the restart activities without animals. Concentration of THF in the chamber was below 1% of the initial concentration in less than 22 minutes following shutdown of the vapor generation system.

THF: 600 ppm Chamber



THF: 1800 ppm Chamber



THF: 5000 ppm Chamber

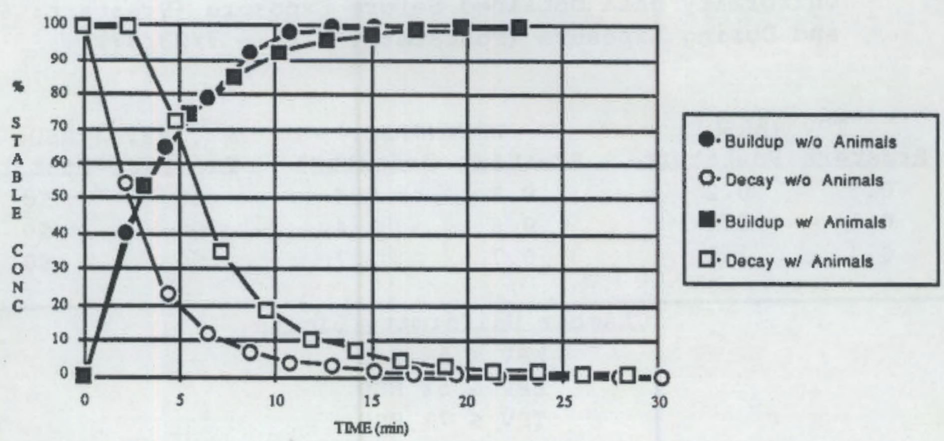


FIGURE B.5. Buildup and Decay of Vapor Concentration With and Without Animals Present. Data taken from NTP THF Subchronic Inhalation Toxicity Study.

Vapor Concentration Uniformity in Chambers

Uniformity of vapor concentration in the exposure chambers was measured prior to the start of and once during the study. The vapor concentration was measured using the on-line GC with the automatic 8-port sample valve disabled to allow continuous monitoring from a single input line. Prior to animal loading, 12 chamber positions [two positions, one in front (F) and one in back (B), for each of the six possible animal cage unit positions per chamber] were measured. The second set of gas concentration measurements was taken from the front and back positions of the chamber only where cage units contained animals.

The sample point was just above and about 10 cm in from the front or back center of each cage unit. The uniformity data for each chamber during prestart testing and after animals were in place in the chambers are summarized in Table B.1. Complete data are found later in this appendix. Uniformity in all chambers was found acceptable. To provide easier interpretation of the results, the concentration readings at each port is also expressed as a percentage of the mean measurement at all ports measured. The possible variation of chemical concentration measured from one sample port to another during the chamber balance procedure is termed the Total Port Variability (TPV). Three factors contribute to the TPV. The first, the Between Port Variablitiy (BPV), represents the variation of chemical distribution within the chamber. This factor is of interest because it is the measure of the uniformity of distribution of the chemical in the chamber. The second factor, the Within Port Variability (WPV), represents the fluctuation of the average chemical concentration within the chamber during the time the uniformity measurements are made. The third is the variability of the measurement instrument itself.

TABLE B.1. Teratology Study of THF in Mice and Rats - Summary of Chamber Uniformity Data Obtained Before Exposure (Prestart: 6/22/87) and During Exposure (Poststart: 7/20 - 7/23/87).

	TPV (%RSD)		WPV (%RSD)		BPV (%RSD)	
Chamber	Prestart	Poststart	Prestart	Poststart	Prestart	Poststart
600 ppm	0.3	0.2	0.3	0.4	≤0	≤0
1800 ppm	0.5	0.7	0.6	1.4	≤0	≤0
5000 ppm	0.4	1.2	0.7	1.7	≤0	≤0

Chamber Uniformity Limits

WPV ≤ 5% RSD

BPV ≤ 5% RSD

TPV ≤ 7% RSD

Environmental Data During Exposure

Summations of chamber air flow, temperature and relative humidity data for the studies in mice and rats are shown in Tables B.2 and B.3. These tables include the mean, standard deviation, mean expressed as a percentage of the target, the percent relative standard deviation (SD/Mean), maximum, minimum readings, number of readings and the percent of readings for which the value was within the specified operating range.

For the mouse study (Table B.2), the mean value of temperature in all chambers for the entire study were between 73.5 and 76.2°F, all within the specified limits of 72 to 78°F. Temperature extremes ranged from 69.6 to 79.3°F. The percent of temperature readings within the operating range for all chambers except 1800 ppm were greater than 90%. Due to one day when the mean temperature in the 1800 ppm chamber was 71.0°F and all temperatures were below the normal operating limits, 89% of readings in the 1800 ppm chamber for the entire study were within operating limits.

The mean values of percent relative humidity in all chambers for the mouse study were between 50.5 and 58.7%, all within the specified limits of 40 to 70%. Percent relative humidity extremes (considering all chambers) ranged from 35 to 75%. All chambers were above the 90% target for readings within operating range.

The mean values of chamber air flow in all chambers for the mouse study were between 14.9 and 15.4 CFM (1 CFM = 1 air change per hour), all within the specified limits of 12 to 18 CFM. Flow extremes (considering all chambers) ranged from 13.3 to 15.8 CFM; all readings were within normal operating limits.

For the rat study (Table B.3), the mean values of temperature in all chambers for the entire study were between 74.5 and 76.2°F, all within the specified limits of 72 to 78°F. Temperature extremes ranged from 70.3 to 78.7°F. The percent of temperature readings within the operating range for all chambers were greater than 93%.

The mean values of relative humidity in all chambers for the rat study were between 52.6 and 56.4%, all within the specified limits of 40 to 70%. Relative humidity extremes (considering all chambers) ranged from 33 to 79%. All chambers were above the 90% target for readings within operating range.

The mean values of chamber air flow in all chambers for the rat study were between 14.0 and 15.1 CFM (1 CFM = 1 air change per hour), all within the specified limits of 12 to 18 CFM. Flow extremes (considering all chambers) ranged from 13.9 to 17.7 CFM; all readings were within normal operating limits.

A complete summary of the daily chamber environmental data and notations on any readings which exceeded critical limits follows.

TABLE B.2. Inhalation Teratology Study of Tetrahydrofuran in Mice—Summation of Environmental Data for the Period when Animals were Housed in the Exposure Chambers. Acceptable ranges are also shown.

Temperature (°F)
Acceptable Range = 72 to 78 °F

Target Chamber Conc. (ppm)	Mean ± SD	Percent of Target ±%RSD	Maximum	Minimum	Number of Samples	% Samples in Range
0	76.2±1.2	102±2%	79.3	71.4	122	98
Hold	75.1±0.9	100±1%	78.3	71.3	132	98
600	74.5±1.1	99±2%	78.5	70.2	122	95
1800	73.6±1.1	98±1%	76.8	69.6	122	89
5000	73.5±1.0	98±1%	77.1	70.1	123	91

Relative Humidity (% RH)
Acceptable Range = 40 to 70 %RH

Target Chamber Conc. (ppm)	Mean ± SD	Percent of Target ±%RSD	Maximum	Minimum	Number of Samples	% Samples in Range
0	55.6±6.3	101±11%	65	40	119	100
Hold	50.5±7.6	92±15%	75	35	126	90
600	58.7±5.7	107±10%	68	39	120	99
1800	58.0±4.1	105± 7%	65	45	120	100
5000	54.0±6.4	98±12%	64	36	120	97

Air Flow (CFM)
Acceptable Range = 12 to 18 CFM

Target Chamber Conc. (ppm)	Mean ± SD	Percent of Target ±%RSD	Maximum	Minimum	Number of Samples	% Samples in Range
0	14.9±0.2	100±2%	15.2	13.3	120	100
Hold	15.1±0.1	101±1%	15.3	15.0	127	100
600	15.0±0.2	100±1%	15.2	13.7	119	100
1800	15.0±0.2	100±1%	15.3	13.7	119	100
5000	15.4±0.3	103±2%	15.8	13.5	119	100

Dates Used for Analysis: 7/15/87 - 7/30/87, except 7/13/87 - 7/30/87 were used for the Hold Chamber. This includes 7/19/87 - 7/20/87 when no animals were in the Hold Chamber.

TABLE B.3. Inhalation Teratology Study of Tetrahydrofuran in Rats—Summation of Environmental Data for the Period when Animals were Housed in the Exposure Chambers. Acceptable ranges are also shown.

Temperature (°F)
Acceptable Range = 72 to 78 °F

Target Chamber Conc. (ppm)	Mean ± SD	Percent of Target ±%RSD	Maximum	Minimum	Number of Samples	% Samples in Range
0	76.0±1.0	101±1%	77.5	71.2	137	99
Hold	76.2±1.3	102±2%	78.7	73.9	55	93
600	76.0±1.1	101±1%	78.0	71.5	136	99
1800	74.7±1.1	100±2%	76.5	70.3	137	99
5000	74.5±1.0	99±1%	76.3	70.4	138	99

Relative Humidity (% RH)
Acceptable Range = 40 to 70 %RH

Target Chamber Conc. (ppm)	Mean ± SD	Percent of Target ±%RSD	Maximum	Minimum	Number of Samples	% Samples in Range
0	53.3±5.8	97±11%	65	33	131	98
Hold	55.8±9.0	102±16%	79	39	53	91
600	56.4±4.5	103± 8%	65	41	136	100
1800	56.1±4.8	102± 9%	65	44	139	100
5000	52.6±6.6	96±13%	67	35	139	98

Air Flow (CFM)
Acceptable Range = 12 to 18 CFM

Target Chamber Conc. (ppm)	Mean ± SD	Percent of Target ±%RSD	Maximum	Minimum	Number of Samples	% Samples in Range
0	14.9±0.1	99±1%	15.2	14.0	133	100
Hold	14.0±0.3	94±2%	15.4	13.9	54	100
600	14.8±0.3	98±2%	17.7	14.6	138	100
1800	15.0±0.1	100±1%	15.4	14.8	138	100
5000	15.1±0.2	101±1%	15.6	14.9	138	100

Dates Used for Analysis: 8/17/87 - 9/3/87 except 8/14/87 - 8/20/87 were used for the Hold Chamber.

Exposure Data

Summaries of the concentration data for both the mouse and rat studies for all chambers and the exposure room are included in Tables B.4 and B.5. Summaries of concentration by exposure day follow in this appendix along with graphic illustrations of the daily mean and standard deviation for each chamber.

For the mouse study (Table B.4), the grand means of the concentrations in each chamber for the entire study were between 101 and 102% of the target, with relative standard deviations in the range of 3 to 4%. The daily mean concentrations for all chambers were within ±4% of the target concentrations (the daily protocol required the daily means to be within ±10% of the target concentrations). At least 98% of all individual concentration measurements were within ±10% of the target levels, the specified operating limits. The maximum concentration observed in the control chamber was 0.7 ppm and 0.5 ppm in the hold chamber. The maximum concentration observed in the room was 14.2 ppm, and was due to malfunctioning of a control valve which slightly pressurized the exhaust line, releasing THF into the room.

For the rat study (Table B.5), the grand means of concentrations in all chambers for the entire study were 100% of the target, with relative standard deviations in the range of 3 to 4%. The daily mean concentrations for all chambers were within ±6% of the target concentrations (the daily protocol required the daily means to be within ±10% of the target concentrations). At least 98% of all individual concentration measurements were within ±10% of the target levels, the specified operating limits. No measurable concentration of THF was observed in the control or hold chamber. The maximum concentration observed in the room was 0.1 ppm.

A complete discussion of all concentration excursions is included in this appendix.

TABLE B.4. Inhalation Teratology Study of Tetrahydrofuran in Mice—Summation of Concentration Data for the Period when Animals were Housed in the Exposure Chambers.

Concentration (PPM)
Acceptable Range = Target ± 10%

Target Conc. (ppm)	Mean ± SD	Percent Target ±RSD	Max	Min	Number Samples	Number In Range	% Samples in Range
Room	0.23 ± 1.3	------	14.2	0	302	*289	*96
0	0.01 ± 0.05	------	0.7	0	305	*305	*100
Hold	0.00 ± 0.03	------	0.5	0	289	289	100
600	610 ± 17.1	102±3%	676	541	247	244	99
1800	1830 ± 67.9	101±4%	2000	1270	258	254	98
5000	5060 ± 146	101±3%	5780	4490	257	254	99
St. Gas	402 ± 1.22	100±0%	404	394	257	257	100

* Samples with concentration less than 1 ppm
Dates Used for Analysis:5/15/87 - 5/30/87, except on 7/19/87 - 7/20/87, no animals were present in the Hold Chamber.

TABLE B.5. Inhalation Teratology Study of Tetrahydrofuran in Rats—Summation of Concentration Data for the Period when Animals were Housed in the Exposure Chambers.

Concentration (PPM)
Acceptable Range = Target ± 10%

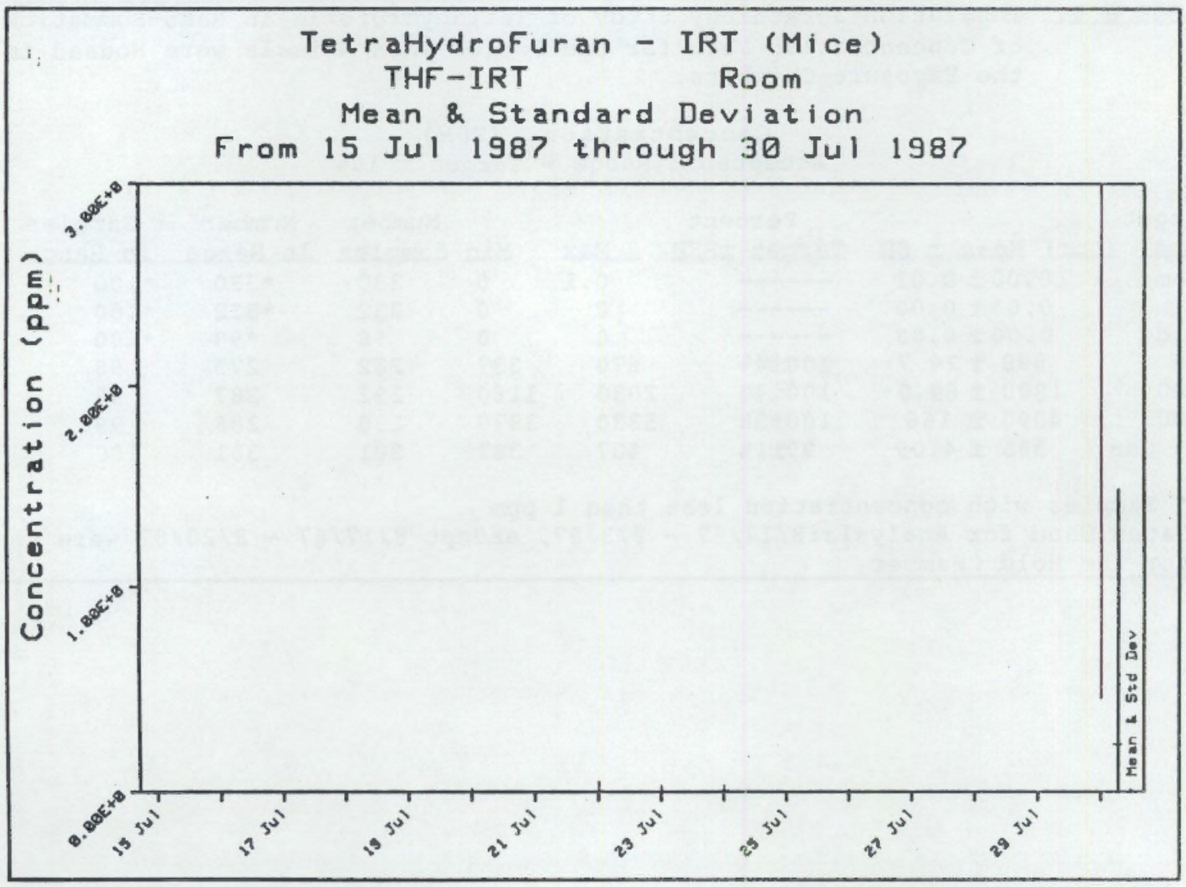
Target Conc. (ppm)	Mean ± SD	Percent Target ±RSD	Max	Min	Number Samples	Number In Range	% Samples in Range
Room	0.00 ± 0.01	------	0.1	0	330	*330	*100
0	0.00 ± 0.00	------	0	0	332	*332	*100
Hold	0.00 ± 0.03	------	0	0	98	*98	*100
600	598 ± 24.7	100±4%	670	337	282	275	98
1800	1800 ± 69.0	100±4%	2030	1160	292	287	98
5000	4990 ± 166	100±3%	5330	3870	290	288	99
St. Gas	395 ± 4.09	99±1%	407	387	301	301	100

* Samples with concentration less than 1 ppm
Dates Used for Analysis:8/17/87 - 9/3/87, except 8/17/87 - 8/20/87 were used for the Hold Chamber

Daily Summation For TetraHydroFuran - IRT (Mice)   From 15 Jul 1987 through 30 Jul 1987

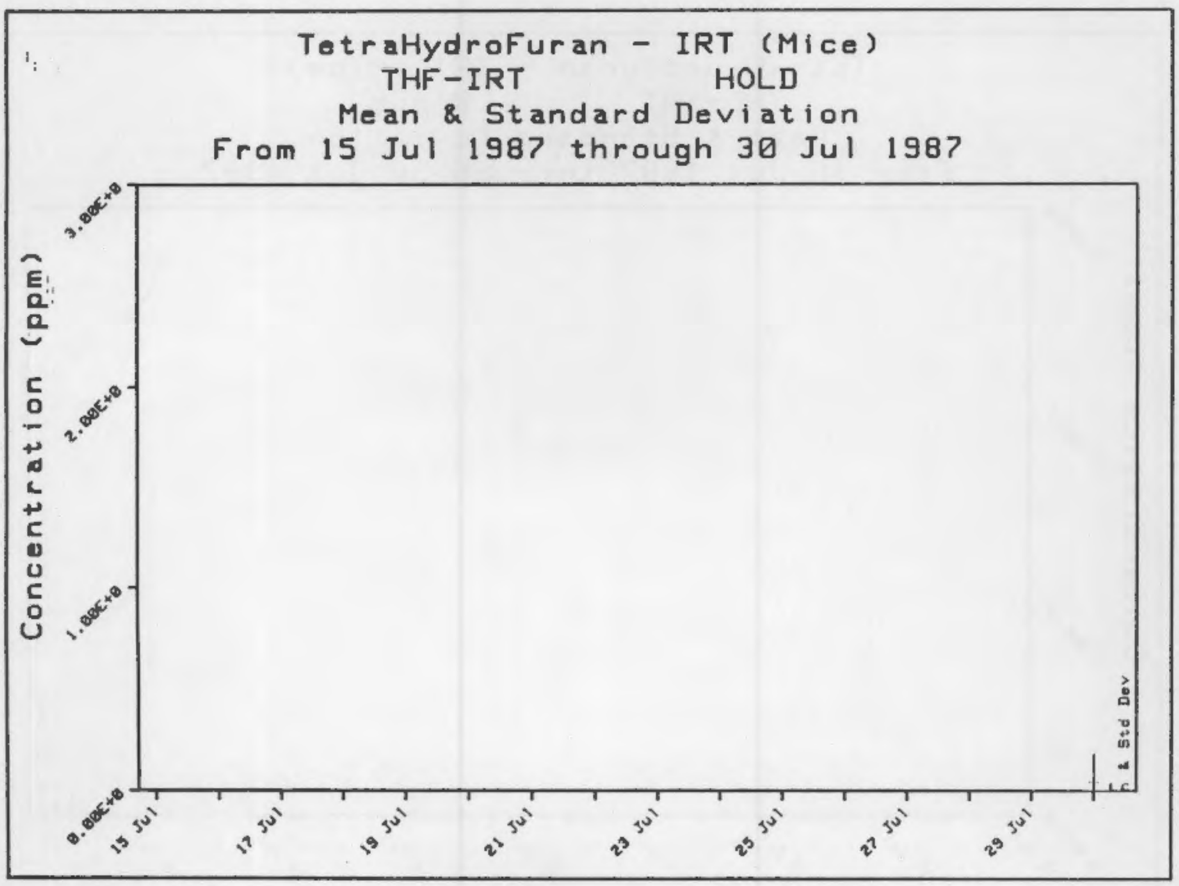
Summary Data for: THF-IRT   Room/Concentration   0.00E+0 to 1.00E+0

Date	Mean	% Target	Std Dev	% RSD	Maximum	Minimum	N	N in	% N in
15 Jul 1987	0.00E+0	0%	0.000E+0	0%	0.00E+0	0.00E+0	14.	14.	100%
16 Jul 1987	1.55E-3	0%	4.033E-3	260%	1.55E-2	0.00E+0	17.	17.	100%
17 Jul 1987	0.00E+0	0%	0.000E+0	0%	0.00E+0	0.00E+0	17.	17.	100%
18 Jul 1987	0.00E+0	0%	0.000E+0	0%	0.00E+0	0.00E+0	17.	17.	100%
19 Jul 1987	0.00E+0	0%	0.000E+0	0%	0.00E+0	0.00E+0	17.	17.	100%
20 Jul 1987	4.42E-3	0%	1.161E-2	263%	3.84E-2	0.00E+0	14.	14.	100%
21 Jul 1987	0.00E+0	0%	0.000E+0	0%	0.00E+0	0.00E+0	51.	51.	100%
22 Jul 1987	9.05E-3	0%	4.339E-2	480%	2.08E-1	0.00E+0	23.	23.	100%
23 Jul 1987	6.56E-3	0%	2.622E-2	400%	1.05E-1	0.00E+0	16.	16.	100%
24 Jul 1987	1.01E-2	0%	2.341E-2	231%	8.54E-2	0.00E+0	16.	16.	100%
25 Jul 1987	7.08E-4	0%	2.920E-3	412%	1.20E-2	0.00E+0	17.	17.	100%
26 Jul 1987	2.69E-3	0%	7.424E-3	276%	2.81E-2	0.00E+0	16.	16.	100%
27 Jul 1987	1.69E-4	0%	6.953E-4	412%	2.87E-3	0.00E+0	17.	17.	100%
28 Jul 1987	0.00E+0	0%	0.000E+0	0%	0.00E+0	0.00E+0	16.	16.	100%
29 Jul 1987	0.00E+0	0%	0.000E+0	0%	0.00E+0	0.00E+0	17.	17.	100%
30 Jul 1987	4.09E+0	0%	3.629E+0	89%	1.42E+1	0.00E+0	17.	4.	24%
Summary	2.32E-1	0%	1.262E+0	543%	1.42E+1	0.00E+0	302.	289.	96%



Daily Summation For TetraHydroFuran - IRT (Mice) From 15 Jul 1987 through 30 Jul 1987

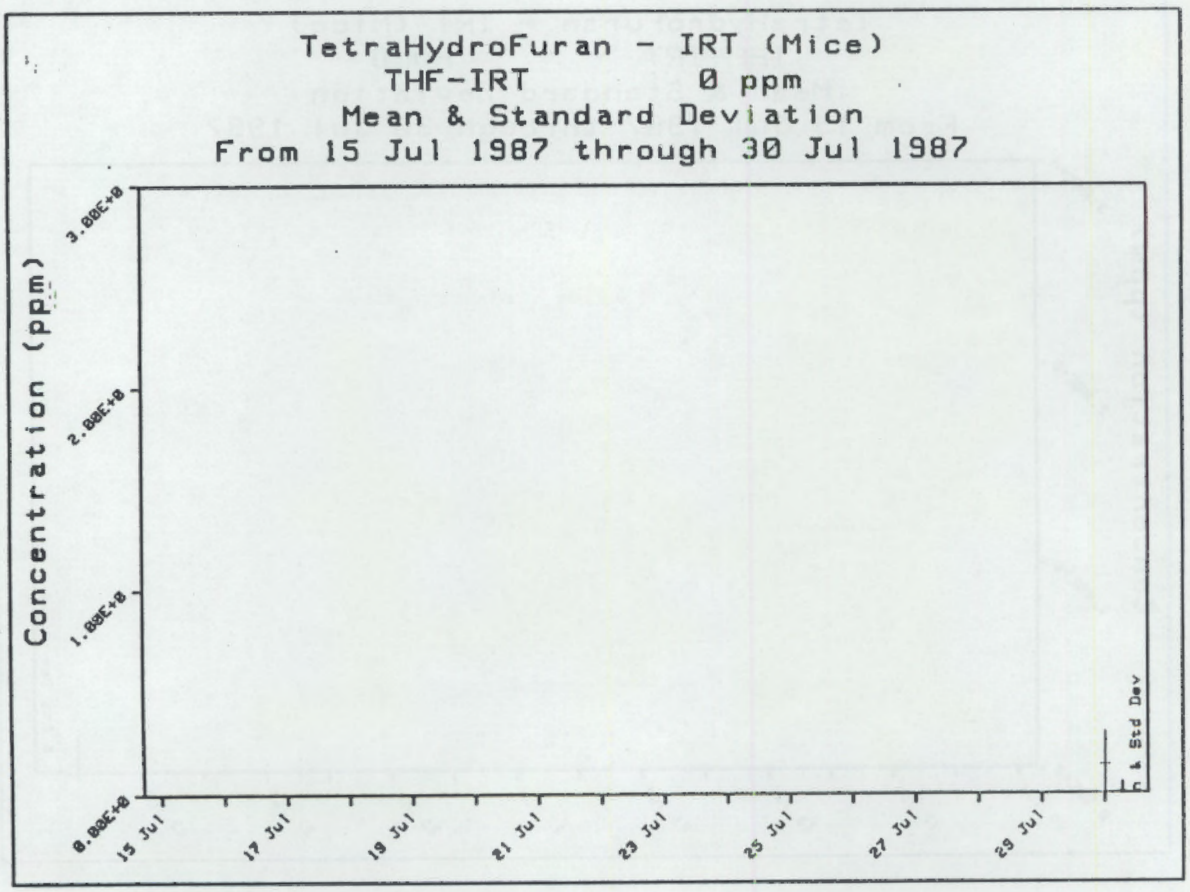
Summary Data for: THF-IRT			HOLD/Concentration					0.00E+0 to 1.00E+0	
Date	Mean	% Target	Std Dev	% RSD	Maximum	Minimum	N	N in	% N in
15 Jul 1987	0.00E+0	0%	0.000E+0	0%	0.00E+0	0.00E+0	15.	15.	100%
16 Jul 1987	0.00E+0	0%	0.000E+0	0%	0.00E+0	0.00E+0	17.	17.	100%
17 Jul 1987	0.00E+0	0%	0.000E+0	0%	0.00E+0	0.00E+0	17.	17.	100%
18 Jul 1987	0.00E+0	0%	0.000E+0	0%	0.00E+0	0.00E+0	17.	17.	100%
19 Jul 1987	0.00E+0	0%	0.000E+0	0%	0.00E+0	0.00E+0	17.	17.	100%
20 Jul 1987									
21 Jul 1987	0.00E+0	0%	0.000E+0	0%	0.00E+0	0.00E+0	51.	51.	100%
22 Jul 1987	0.00E+0	0%	0.000E+0	0%	0.00E+0	0.00E+0	23.	23.	100%
23 Jul 1987	0.00E+0	0%	0.000E+0	0%	0.00E+0	0.00E+0	16.	16.	100%
24 Jul 1987	0.00E+0	0%	0.000E+0	0%	0.00E+0	0.00E+0	16.	16.	100%
25 Jul 1987	0.00E+0	0%	0.000E+0	0%	0.00E+0	0.00E+0	17.	17.	100%
26 Jul 1987	0.00E+0	0%	0.000E+0	0%	0.00E+0	0.00E+0	16.	16.	100%
27 Jul 1987	0.00E+0	0%	0.000E+0	0%	0.00E+0	0.00E+0	17.	17.	100%
28 Jul 1987	0.00E+0	0%	0.000E+0	0%	0.00E+0	0.00E+0	16.	16.	100%
29 Jul 1987	0.00E+0	0%	0.000E+0	0%	0.00E+0	0.00E+0	17.	17.	100%
30 Jul 1987	4.47E-2	0%	1.319E-1	295%	5.14E-1	0.00E+0	17.	17.	100%
Summary	2.63E-3	0%	3.283E-2	1249%	5.14E-1	0.00E+0	289.	289.	100%



Daily Summation For TetraHydroFuran - IRT (Mice)   From 15 Jul 1987 through 30 Jul 1987

Summary Data for: THF-IRT   0 ppm/Concentration   0.00E+0 to 1.00E+0

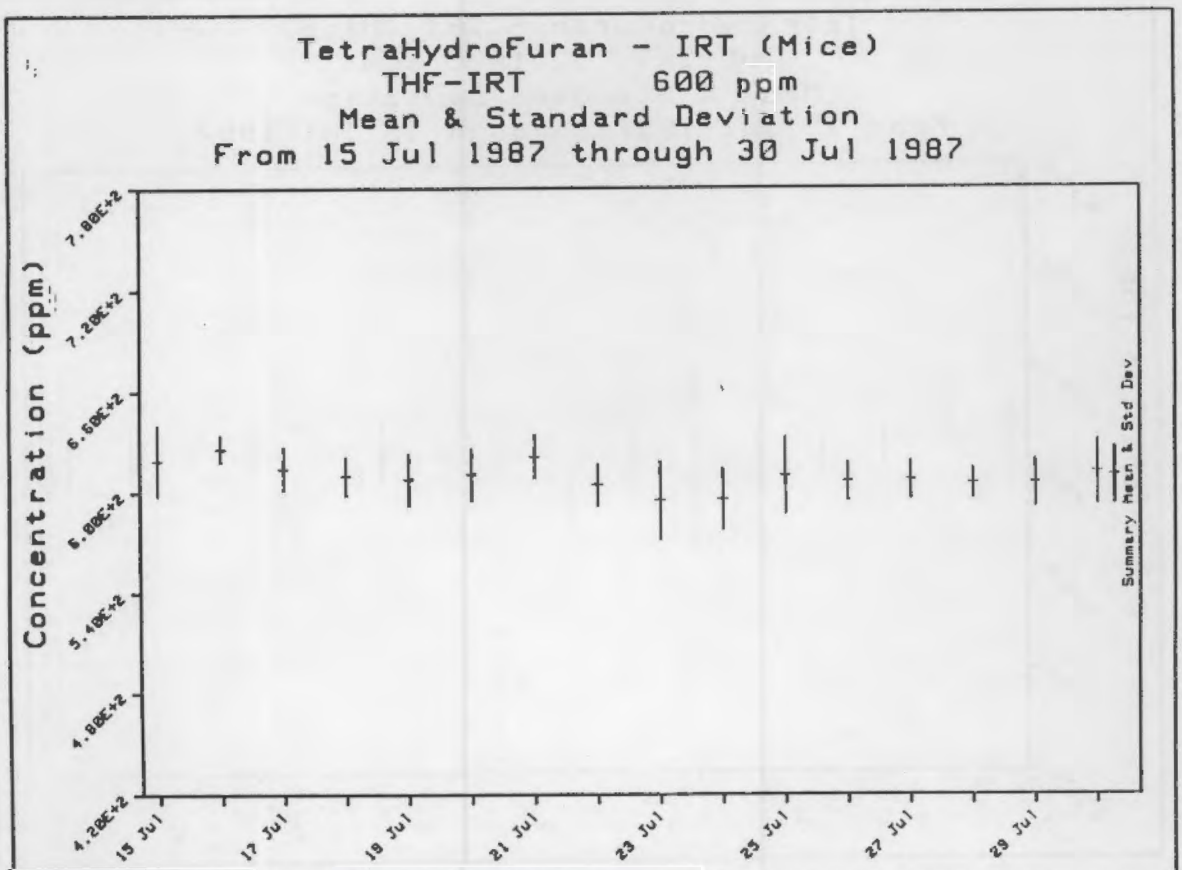
Date	Mean	% Target	Std Dev	% RSD	Maximum	Minimum	N	N in	% N in
15 Jul 1987	0.00E+0	0%	0.000E+0	0%	0.00E+0	0.00E+0	16.	16.	100%
16 Jul 1987	0.00E+0	0%	0.000E+0	0%	0.00E+0	0.00E+0	17.	17.	100%
17 Jul 1987	0.00E+0	0%	0.000E+0	0%	0.00E+0	0.00E+0	17.	17.	100%
18 Jul 1987	0.00E+0	0%	0.000E+0	0%	0.00E+0	0.00E+0	17.	17.	100%
19 Jul 1987	0.00E+0	0%	0.000E+0	0%	0.00E+0	0.00E+0	17.	17.	100%
20 Jul 1987	0.00E+0	0%	0.000E+0	0%	0.00E+0	0.00E+0	15.	15.	100%
21 Jul 1987	0.00E+0	0%	0.000E+0	0%	0.00E+0	0.00E+0	51.	51.	100%
22 Jul 1987	0.00E+0	0%	0.000E+0	0%	0.00E+0	0.00E+0	23.	23.	100%
23 Jul 1987	0.00E+0	0%	0.000E+0	0%	0.00E+0	0.00E+0	16.	16.	100%
24 Jul 1987	0.00E+0	0%	0.000E+0	0%	0.00E+0	0.00E+0	16.	16.	100%
25 Jul 1987	0.00E+0	0%	0.000E+0	0%	0.00E+0	0.00E+0	17.	17.	100%
26 Jul 1987	0.00E+0	0%	0.000E+0	0%	0.00E+0	0.00E+0	16.	16.	100%
27 Jul 1987	0.00E+0	0%	0.000E+0	0%	0.00E+0	0.00E+0	17.	17.	100%
28 Jul 1987	0.00E+0	0%	0.000E+0	0%	0.00E+0	0.00E+0	16.	16.	100%
29 Jul 1987	0.00E+0	0%	0.000E+0	0%	0.00E+0	0.00E+0	17.	17.	100%
30 Jul 1987	1.42E-1	0%	1.585E-1	112%	6.72E-1	0.00E+0	17.	17.	100%
Summary	7.91E-3	0%	4.885E-2	617%	6.72E-1	0.00E+0	305.	305.	100%



Daily Summation For TetraHydroFuran - IRT (Mice) From 15 Jul 1987 through 30 Jul 1987

Summary Data for: THF-IRT 600 ppm/Concentration 5.40E+2 to 6.60E+2

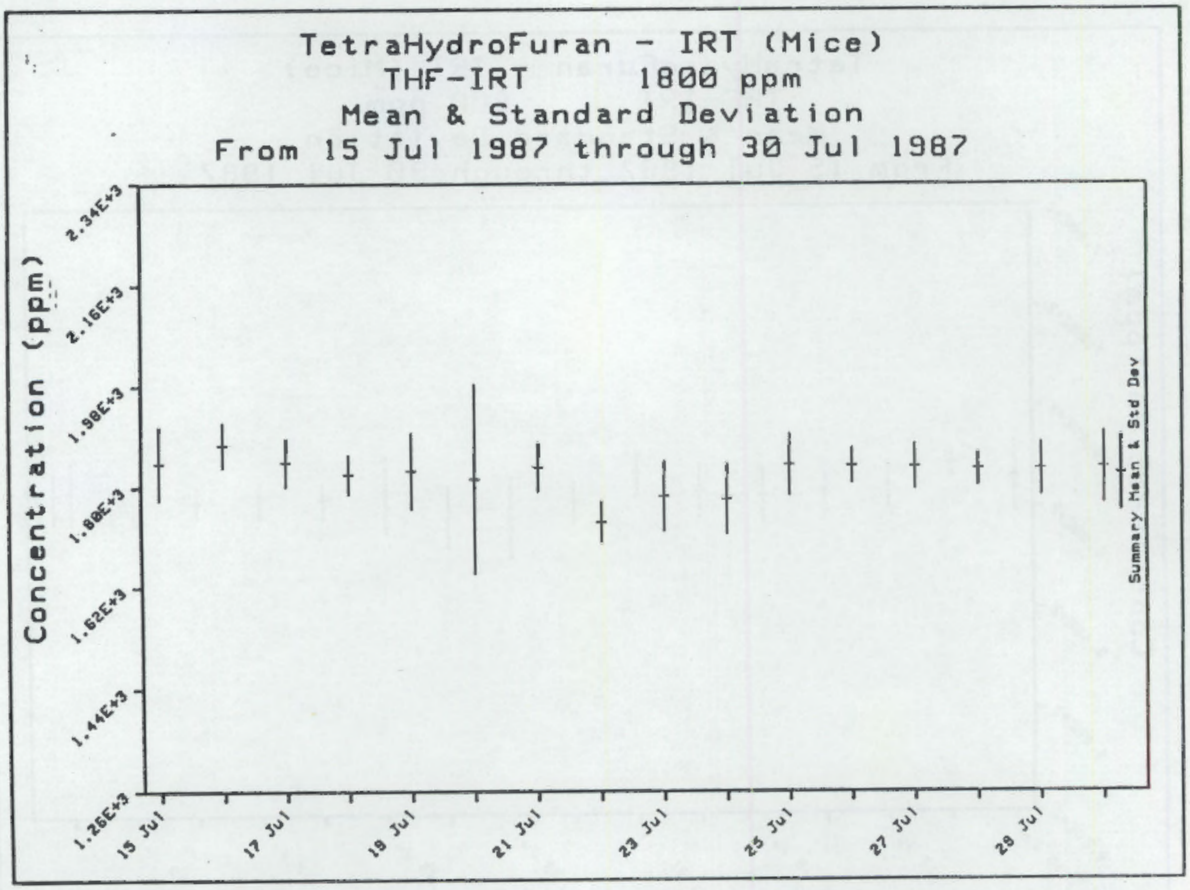
Date	Mean	% Target	Std Dev	% RSD	Maximum	Minimum	N	N in	% N in
15 Jul 1987	6.19E+2	103%	2.090E+1	3%	6.63E+2	5.89E+2	16.	15.	94%
16 Jul 1987	6.26E+2	104%	8.125E+0	1%	6.38E+2	6.05E+2	16.	16.	100%
17 Jul 1987	6.14E+2	102%	1.353E+1	2%	6.43E+2	5.73E+2	16.	16.	100%
18 Jul 1987	6.10E+2	102%	1.169E+1	2%	6.30E+2	5.77E+2	16.	16.	100%
19 Jul 1987	6.08E+2	101%	1.607E+1	3%	6.40E+2	5.76E+2	16.	16.	100%
20 Jul 1987	6.11E+2	102%	1.579E+1	3%	6.38E+2	5.76E+2	13.	13.	100%
21 Jul 1987	6.22E+2	104%	1.322E+1	2%	6.54E+2	5.95E+2	16.	16.	100%
22 Jul 1987	6.05E+2	101%	1.251E+1	2%	6.27E+2	5.81E+2	15.	15.	100%
23 Jul 1987	5.95E+2	99%	2.342E+1	4%	6.24E+2	5.41E+2	15.	15.	100%
24 Jul 1987	5.96E+2	99%	1.798E+1	3%	6.20E+2	5.68E+2	14.	14.	100%
25 Jul 1987	6.10E+2	102%	2.249E+1	4%	6.76E+2	5.79E+2	16.	15.	94%
26 Jul 1987	6.07E+2	101%	1.091E+1	2%	6.28E+2	5.82E+2	16.	16.	100%
27 Jul 1987	6.08E+2	101%	1.111E+1	2%	6.33E+2	5.89E+2	16.	16.	100%
28 Jul 1987	6.05E+2	101%	8.762E+0	1%	6.20E+2	5.83E+2	14.	14.	100%
29 Jul 1987	6.05E+2	101%	1.402E+1	2%	6.31E+2	5.87E+2	16.	16.	100%
30 Jul 1987	6.12E+2	102%	1.925E+1	3%	6.72E+2	5.89E+2	16.	15.	94%
Summary	6.10E+2	102%	1.713E+1	3%	6.76E+2	5.41E+2	247.	244.	99%



Daily Summation For TetraHydroFuran - IRT (Mice)   From 15 Jul 1987 through 30 Jul 1987   --

Summary Data for: THF-IRT   1800 ppm/Concentration   --   1.62E+3 to 1.98E+3

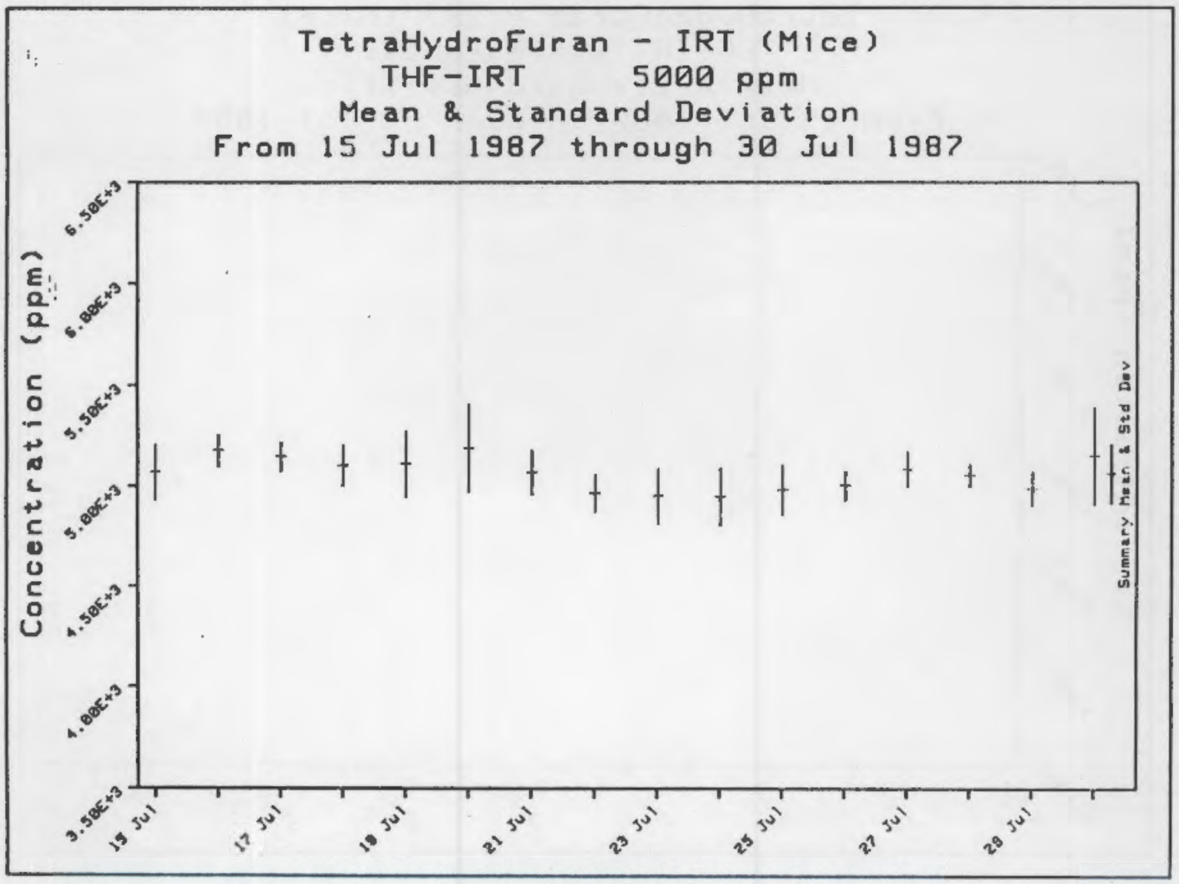
Date	Mean	% Target	Std Dev	% RSD	Maximum	Minimum	N	N in	% N in
15 Jul 1987	1.84E+3	102%	6.583E+1	4%	2.00E+3	1.74E+3	16.	15.	94%
16 Jul 1987	1.88E+3	104%	3.917E+1	2%	1.92E+3	1.75E+3	17.	17.	100%
17 Jul 1987	1.85E+3	103%	4.259E+1	2%	1.95E+3	1.73E+3	17.	17.	100%
18 Jul 1987	1.82E+3	101%	3.442E+1	2%	1.88E+3	1.73E+3	17.	17.	100%
19 Jul 1987	1.83E+3	102%	6.750E+1	4%	1.95E+3	1.72E+3	17.	17.	100%
20 Jul 1987	1.81E+3	101%	1.692E+2	9%	1.95E+3	1.27E+3	14.	13.	93%
21 Jul 1987	1.84E+3	102%	4.239E+1	2%	1.91E+3	1.73E+3	17.	17.	100%
22 Jul 1987	1.74E+3	97%	3.725E+1	2%	1.80E+3	1.67E+3	16.	16.	100%
23 Jul 1987	1.78E+3	99%	6.179E+1	3%	1.88E+3	1.66E+3	15.	15.	100%
24 Jul 1987	1.78E+3	99%	6.252E+1	4%	1.85E+3	1.61E+3	15.	14.	93%
25 Jul 1987	1.84E+3	102%	5.468E+1	3%	1.97E+3	1.75E+3	17.	17.	100%
26 Jul 1987	1.84E+3	102%	3.050E+1	2%	1.89E+3	1.76E+3	16.	16.	100%
27 Jul 1987	1.84E+3	102%	3.968E+1	2%	1.94E+3	1.77E+3	17.	17.	100%
28 Jul 1987	1.83E+3	102%	2.878E+1	2%	1.88E+3	1.77E+3	15.	15.	100%
29 Jul 1987	1.83E+3	102%	4.687E+1	3%	1.93E+3	1.74E+3	17.	17.	100%
30 Jul 1987	1.84E+3	102%	6.359E+1	3%	1.99E+3	1.73E+3	15.	14.	93%
Summary	1.83E+3	101%	6.786E+1	4%	2.00E+3	1.27E+3	258.	254.	98%



Daily Summation For TetraHydroFuran - IRT (Mice)   From 15 Jul 1987 through 30 Jul 1987

Summary Data for: THF-IRT   5000 ppm/Concentration   4.50E+3 to 5.50E+3

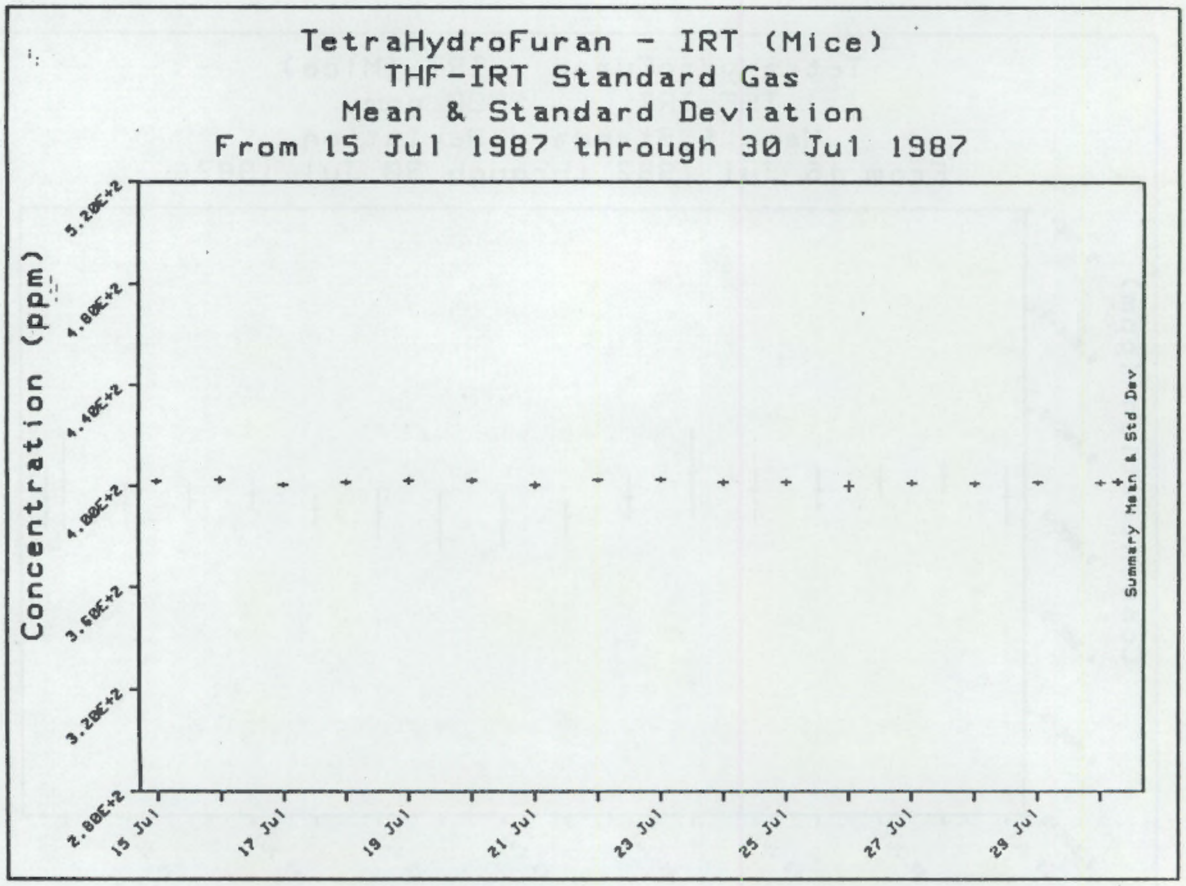
Date	Mean	% Target	Std Dev	% RSD	Maximum	Minimum	N	N in	% N in
15 Jul 1987	5.07E+3	101%	1.373E+2	3%	5.38E+3	4.82E+3	16.	16.	100%
16 Jul 1987	5.18E+3	104%	8.180E+1	2%	5.32E+3	4.94E+3	17.	17.	100%
17 Jul 1987	5.15E+3	103%	7.397E+1	1%	5.24E+3	4.92E+3	17.	17.	100%
18 Jul 1987	5.10E+3	102%	1.024E+2	2%	5.27E+3	4.84E+3	17.	17.	100%
19 Jul 1987	5.11E+3	102%	1.643E+2	3%	5.39E+3	4.84E+3	17.	17.	100%
20 Jul 1987	5.19E+3	104%	2.170E+2	4%	5.43E+3	4.49E+3	14.	13.	93%
21 Jul 1987	5.07E+3	101%	1.095E+2	2%	5.25E+3	4.80E+3	17.	17.	100%
22 Jul 1987	4.97E+3	99%	9.093E+1	2%	5.13E+3	4.81E+3	15.	15.	100%
23 Jul 1987	4.95E+3	99%	1.329E+2	3%	5.17E+3	4.76E+3	15.	15.	100%
24 Jul 1987	4.95E+3	99%	1.414E+2	3%	5.11E+3	4.56E+3	15.	15.	100%
25 Jul 1987	4.98E+3	100%	1.222E+2	2%	5.26E+3	4.78E+3	17.	17.	100%
26 Jul 1987	5.01E+3	100%	6.986E+1	1%	5.13E+3	4.84E+3	16.	16.	100%
27 Jul 1987	5.09E+3	102%	8.411E+1	2%	5.37E+3	4.98E+3	17.	17.	100%
28 Jul 1987	5.05E+3	101%	5.451E+1	1%	5.13E+3	4.92E+3	15.	15.	100%
29 Jul 1987	4.99E+3	100%	8.281E+1	2%	5.12E+3	4.84E+3	17.	17.	100%
30 Jul 1987	5.15E+3	103%	2.417E+2	5%	5.78E+3	4.87E+3	15.	13.	87%
Summary	5.06E+3	101%	1.461E+2	3%	5.78E+3	4.49E+3	257.	254.	99%



Daily Summation For TetraHydroFuran - IRT (Mice)   From 15 Jul 1987 through 30 Jul 1987   --

Summary Data for: THF-IRT Standard Gas/Concentration   --   3.60E+2 to 4.40E+2

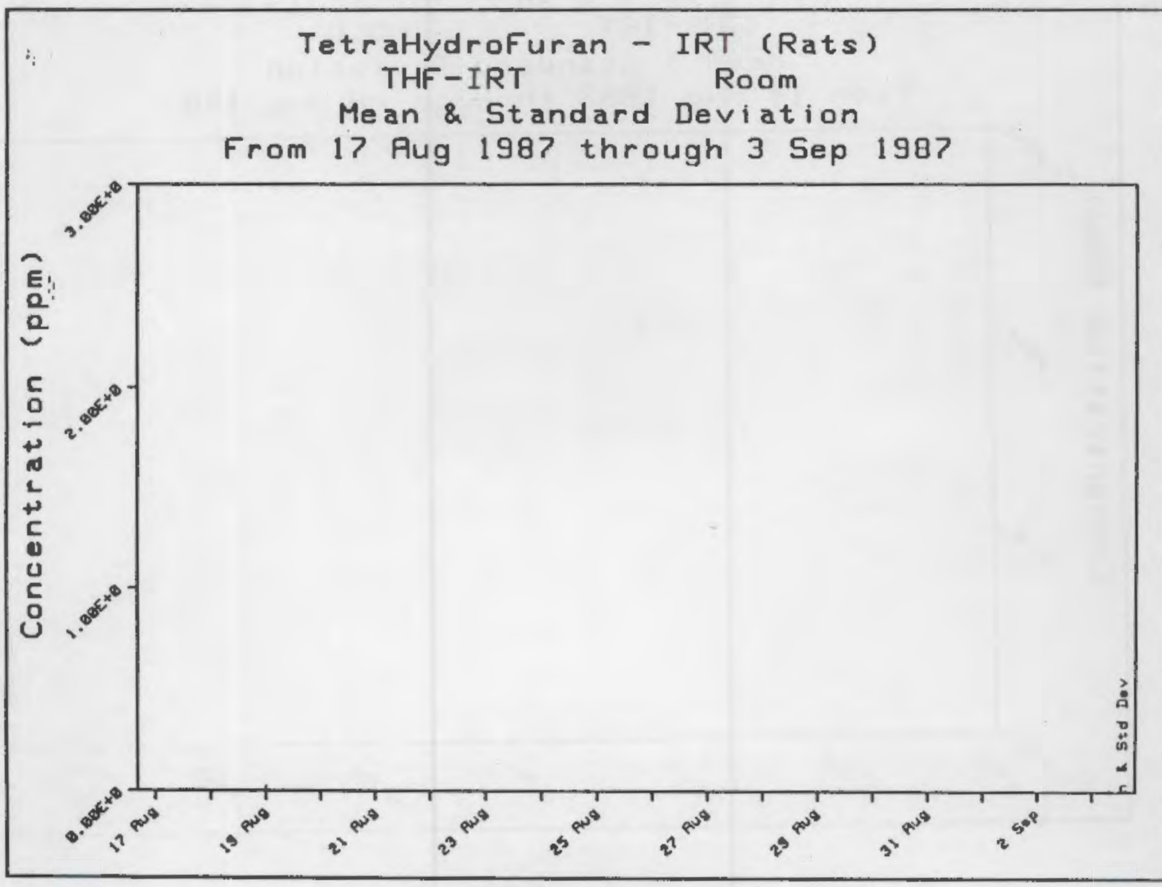
Date	Mean	% Target	Std Dev	% RSD	Maximum	Minimum	N	N in	% N in
15 Jul 1987	4.02E+2	101%	7.302E-1	0%	4.03E+2	4.00E+2	17.	17.	100%
16 Jul 1987	4.03E+2	101%	1.094E+0	0%	4.04E+2	4.00E+2	17.	17.	100%
17 Jul 1987	4.01E+2	100%	6.220E-1	0%	4.02E+2	3.99E+2	11.	11.	100%
18 Jul 1987	4.02E+2	100%	8.280E-1	0%	4.03E+2	4.00E+2	17.	17.	100%
19 Jul 1987	4.02E+2	101%	9.917E-1	0%	4.03E+2	4.01E+2	17.	17.	100%
20 Jul 1987	4.02E+2	101%	8.598E-1	0%	4.03E+2	4.01E+2	14.	14.	100%
21 Jul 1987	4.01E+2	100%	1.055E+0	0%	4.02E+2	3.99E+2	17.	17.	100%
22 Jul 1987	4.03E+2	101%	6.671E-1	0%	4.04E+2	4.01E+2	16.	16.	100%
23 Jul 1987	4.03E+2	101%	8.103E-1	0%	4.04E+2	4.01E+2	16.	16.	100%
24 Jul 1987	4.02E+2	100%	1.064E+0	0%	4.03E+2	4.00E+2	16.	16.	100%
25 Jul 1987	4.02E+2	100%	8.931E-1	0%	4.03E+2	4.00E+2	17.	17.	100%
26 Jul 1987	4.00E+2	100%	1.892E+0	0%	4.02E+2	3.94E+2	16.	16.	100%
27 Jul 1987	4.01E+2	100%	8.682E-1	0%	4.03E+2	4.00E+2	17.	17.	100%
28 Jul 1987	4.01E+2	100%	9.378E-1	0%	4.02E+2	4.00E+2	15.	15.	100%
29 Jul 1987	4.02E+2	100%	7.148E-1	0%	4.02E+2	4.00E+2	17.	17.	100%
30 Jul 1987	4.02E+2	100%	1.021E+0	0%	4.03E+2	4.00E+2	17.	17.	100%
Summary	4.02E+2	100%	1.222E+0	0%	4.04E+2	3.94E+2	257.	257.	100%



Daily Summation For TetraHydroFuran - IRT (Rats)   From 17 Aug 1987 through 3 Sep 1987

Summary Data for: THF-IRT   Room/Concentration   0.00E+0 to 1.00E+0

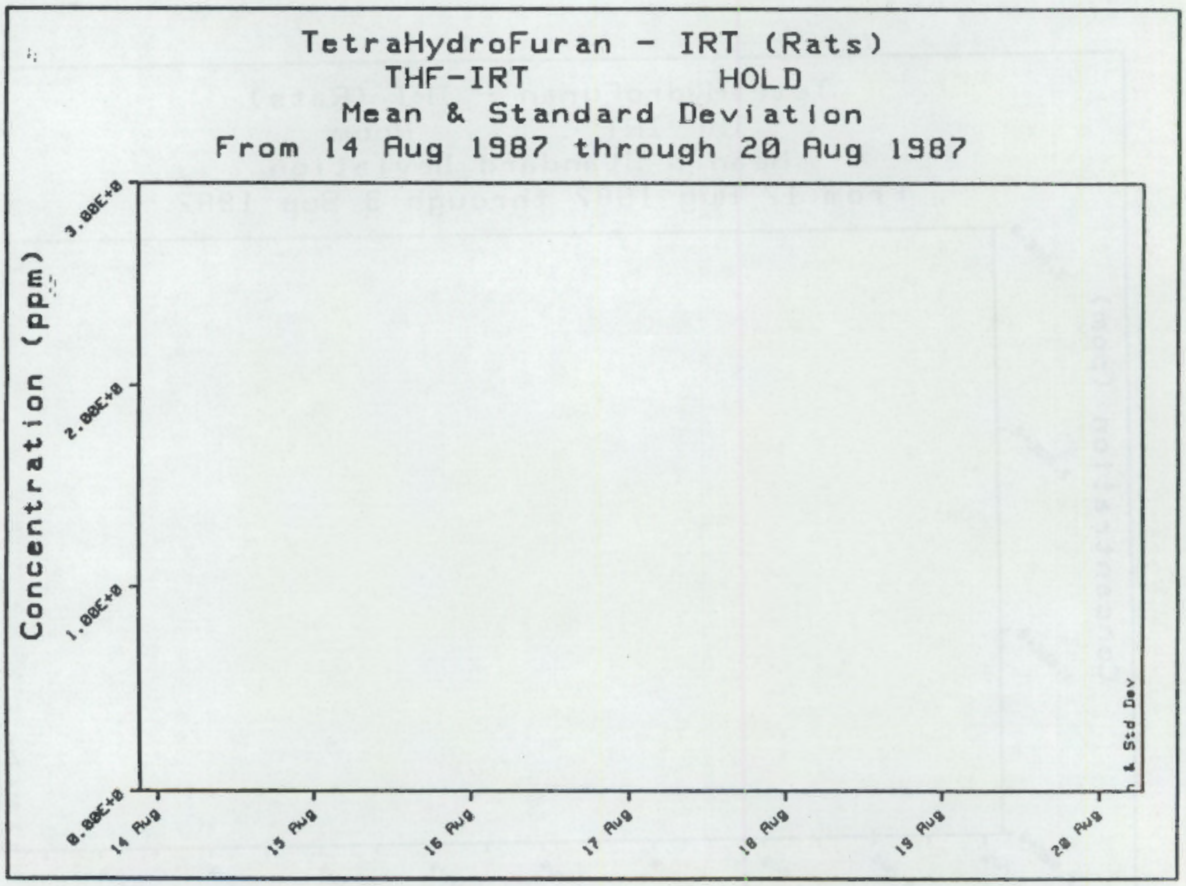
Date	Mean	% Target	Std Dev	% RSD	Maximum	Minimum	N	N in	% N in
17 Aug 1987	0.00E+0	0%	0.000E+0	0%	0.00E+0	0.00E+0	17.	17.	100%
18 Aug 1987	0.00E+0	0%	0.000E+0	0%	0.00E+0	0.00E+0	17.	17.	100%
19 Aug 1987	2.71E-3	0%	1.878E-2	693%	1.30E-1	0.00E+0	48.	48.	100%
20 Aug 1987	0.00E+0	0%	0.000E+0	0%	0.00E+0	0.00E+0	16.	16.	100%
21 Aug 1987	0.00E+0	0%	0.000E+0	0%	0.00E+0	0.00E+0	17.	17.	100%
22 Aug 1987	0.00E+0	0%	0.000E+0	0%	0.00E+0	0.00E+0	17.	17.	100%
23 Aug 1987	0.00E+0	0%	0.000E+0	0%	0.00E+0	0.00E+0	17.	17.	100%
24 Aug 1987	0.00E+0	0%	0.000E+0	0%	0.00E+0	0.00E+0	17.	17.	100%
25 Aug 1987	0.00E+0	0%	0.000E+0	0%	0.00E+0	0.00E+0	17.	17.	100%
26 Aug 1987	0.00E+0	0%	0.000E+0	0%	0.00E+0	0.00E+0	17.	17.	100%
27 Aug 1987	0.00E+0	0%	0.000E+0	0%	0.00E+0	0.00E+0	17.	17.	100%
28 Aug 1987	0.00E+0	0%	0.000E+0	0%	0.00E+0	0.00E+0	15.	15.	100%
29 Aug 1987	0.00E+0	0%	0.000E+0	0%	0.00E+0	0.00E+0	16.	16.	100%
30 Aug 1987	0.00E+0	0%	0.000E+0	0%	0.00E+0	0.00E+0	17.	17.	100%
31 Aug 1987	0.00E+0	0%	0.000E+0	0%	0.00E+0	0.00E+0	17.	17.	100%
1 Sep 1987	0.00E+0	0%	0.000E+0	0%	0.00E+0	0.00E+0	17.	17.	100%
2 Sep 1987	0.00E+0	0%	0.000E+0	0%	0.00E+0	0.00E+0	16.	16.	100%
3 Sep 1987	0.00E+0	0%	0.000E+0	0%	0.00E+0	0.00E+0	15.	15.	100%
Summary	3.94E-4	0%	7.162E-3	1817%	1.30E-1	0.00E+0	330.	330.	100%



Daily Summation For TetraHydroFuran - IRT (Rats)   From 14 Aug 1987 through 20 Aug 1987

Summary Data for: THF-IRT   HOLD/Concentration   --   0.00E+0 to 1.00E+0

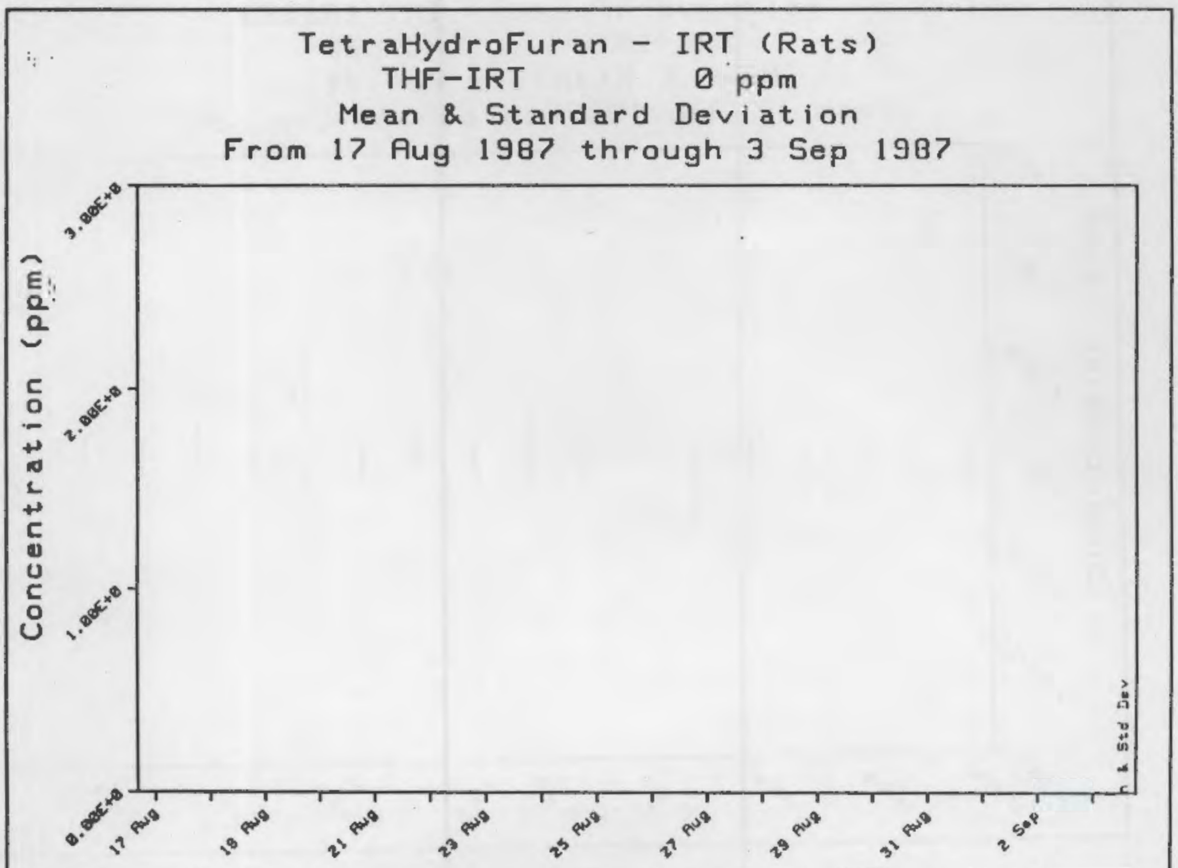
Date	Mean	% Target	Std Dev	% RSD	Maximum	Minimum	N	N in	% N in
14 Aug 1987									
15 Aug 1987									
16 Aug 1987									
17 Aug 1987	0.00E+0	0%	0.000E+0	0%	0.00E+0	0.00E+0	17.	17.	100%
18 Aug 1987	0.00E+0	0%	0.000E+0	0%	0.00E+0	0.00E+0	17.	17.	100%
19 Aug 1987	0.00E+0	0%	0.000E+0	0%	0.00E+0	0.00E+0	48.	48.	100%
20 Aug 1987	0.00E+0	0%	0.000E+0	0%	0.00E+0	0.00E+0	16.	16.	100%
Summary	0.00E+0	0%	0.000E+0	0%	0.00E+0	0.00E+0	98.	98.	100%



Daily Summation For TetraHydroFuran - IRT (Rats) From 17 Aug-1987 through 3 Sep 1987

Summary Data for: THF-IRT 0 ppm/Concentration 0.00E+0 to 1.00E+0

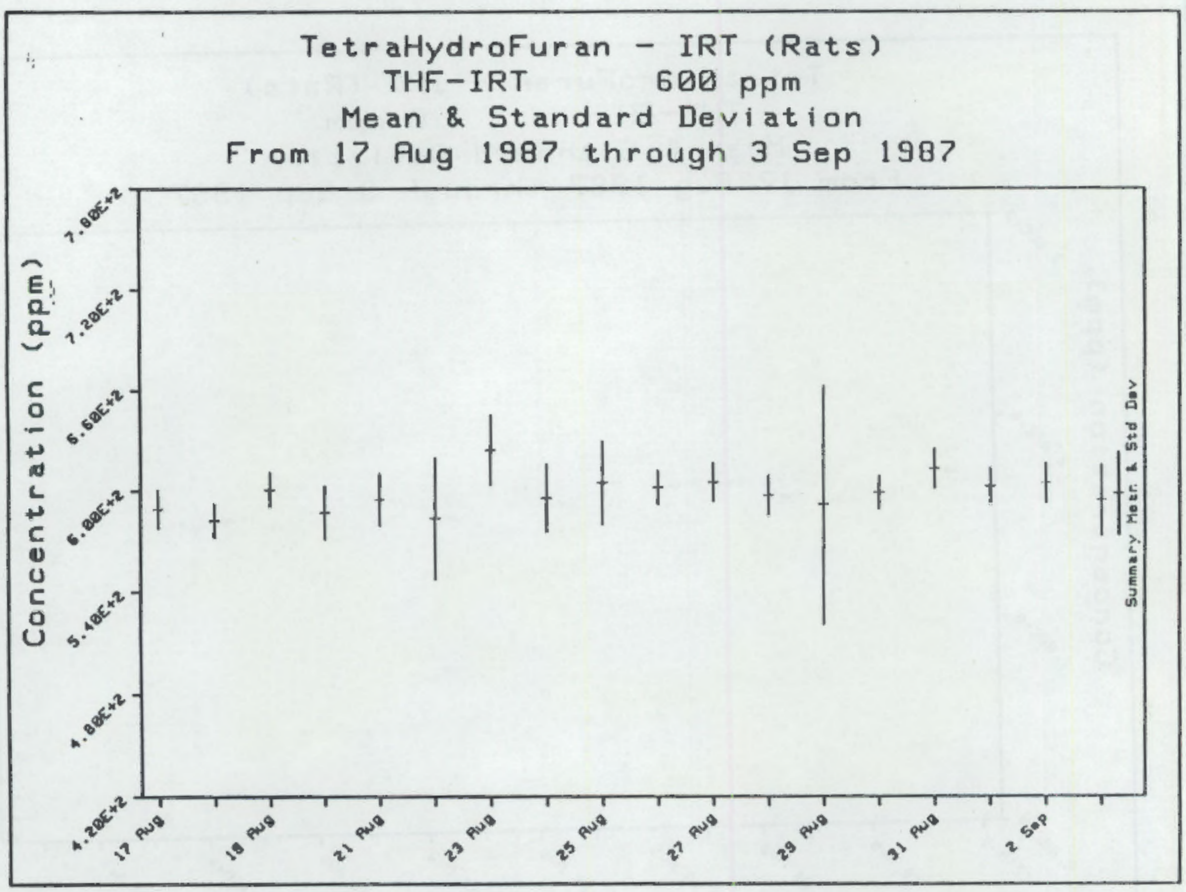
Date	Mean	% Target	Std Dev	% RSD	Maximum	Minimum	N	N in	% N in
17 Aug 1987	0.00E+0	0%	0.000E+0	0%	0.00E+0	0.00E+0	17.	17.	100%
18 Aug 1987	0.00E+0	0%	0.000E+0	0%	0.00E+0	0.00E+0	17.	17.	100%
19 Aug 1987	0.00E+0	0%	0.000E+0	0%	0.00E+0	0.00E+0	48.	48.	100%
20 Aug 1987	0.00E+0	0%	0.000E+0	0%	0.00E+0	0.00E+0	16.	16.	100%
21 Aug 1987	0.00E+0	0%	0.000E+0	0%	0.00E+0	0.00E+0	17.	17.	100%
22 Aug 1987	0.00E+0	0%	0.000E+0	0%	0.00E+0	0.00E+0	17.	17.	100%
23 Aug 1987	0.00E+0	0%	0.000E+0	0%	0.00E+0	0.00E+0	17.	17.	100%
24 Aug 1987	0.00E+0	0%	0.000E+0	0%	0.00E+0	0.00E+0	17.	17.	100%
25 Aug 1987	0.00E+0	0%	0.000E+0	0%	0.00E+0	0.00E+0	17.	17.	100%
26 Aug 1987	0.00E+0	0%	0.000E+0	0%	0.00E+0	0.00E+0	17.	17.	100%
27 Aug 1987	0.00E+0	0%	0.000E+0	0%	0.00E+0	0.00E+0	17.	17.	100%
28 Aug 1987	0.00E+0	0%	0.000E+0	0%	0.00E+0	0.00E+0	15.	15.	100%
29 Aug 1987	0.00E+0	0%	0.000E+0	0%	0.00E+0	0.00E+0	17.	17.	100%
30 Aug 1987	0.00E+0	0%	0.000E+0	0%	0.00E+0	0.00E+0	17.	17.	100%
31 Aug 1987	0.00E+0	0%	0.000E+0	0%	0.00E+0	0.00E+0	17.	17.	100%
1 Sep 1987	0.00E+0	0%	0.000E+0	0%	0.00E+0	0.00E+0	17.	17.	100%
2 Sep 1987	0.00E+0	0%	0.000E+0	0%	0.00E+0	0.00E+0	16.	16.	100%
3 Sep 1987	0.00E+0	0%	0.000E+0	0%	0.00E+0	0.00E+0	16.	16.	100%
Summary	0.00E+0	0%	0.000E+0	0%	0.00E+0	0.00E+0	332.	332.	100%



Daily Summation For TetraHydroFuran - IRT (Rats)   From 17 Aug 198~ through 3 Sep 1987

Summary Data for: THF-IRT   600 ppm/Concentration   5.40E+2 to 6.60E+2

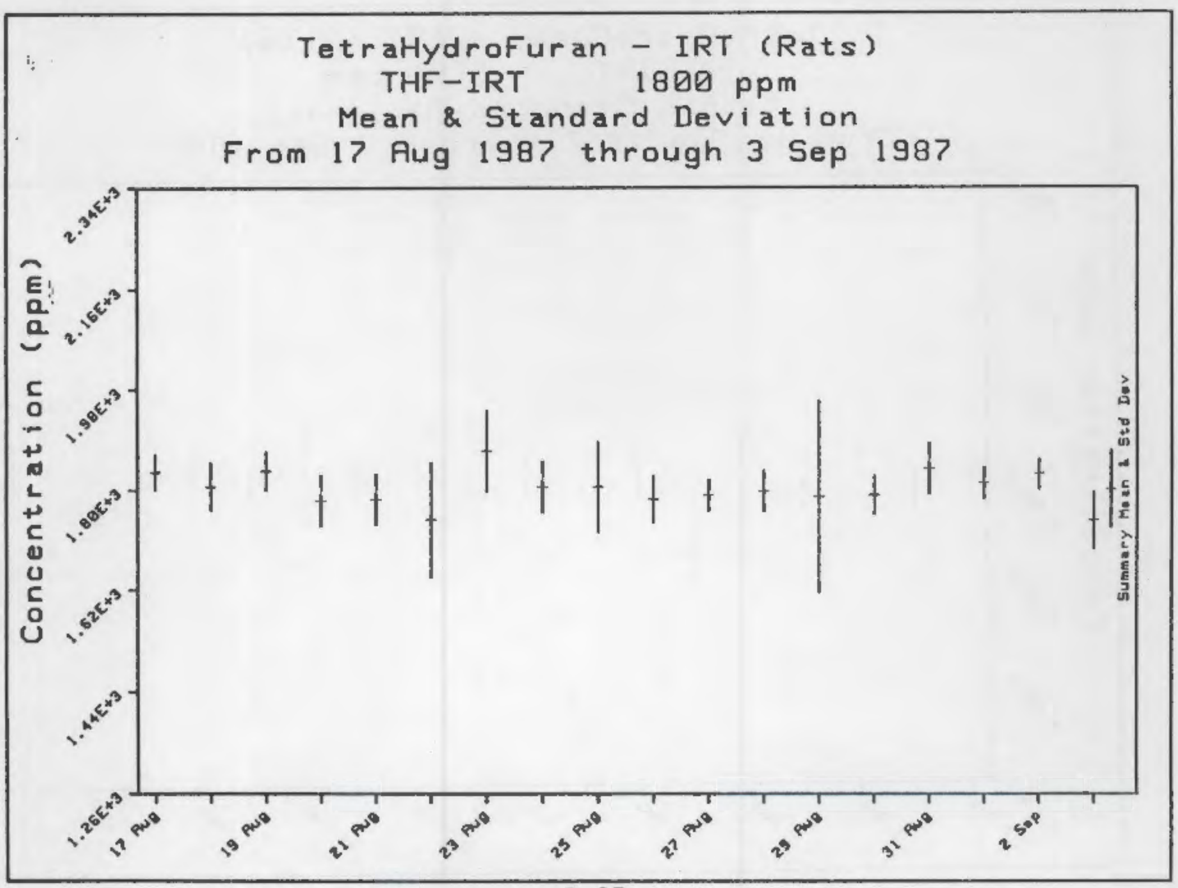
Date	Mean	% Target	Std Dev	% RSD	Maximum	Minimum	N	N in	% N in
17 Aug 1987	5.89E+2	98%	1.123E+1	2%	6.05E+2	5.68E+2	16.	16.	100%
18 Aug 1987	5.82E+2	97%	1.008E+1	2%	5.97E+2	5.63E+2	16.	16.	100%
19 Aug 1987	6.00E+2	100%	1.030E+1	2%	6.14E+2	5.70E+2	15.	15.	100%
20 Aug 1987	5.87E+2	98%	1.570E+1	3%	6.15E+2	5.57E+2	15.	15.	100%
21 Aug 1987	5.94E+2	99%	1.540E+1	3%	6.31E+2	5.71E+2	16.	16.	100%
22 Aug 1987	5.83E+2	97%	3.595E+1	6%	6.63E+2	4.93E+2	16.	14.	88%
23 Aug 1987	6.24E+2	104%	2.064E+1	3%	6.70E+2	5.98E+2	16.	14.	88%
24 Aug 1987	5.95E+2	99%	2.022E+1	3%	6.23E+2	5.35E+2	15.	14.	93%
25 Aug 1987	6.04E+2	101%	2.486E+1	4%	6.41E+2	5.31E+2	16.	15.	94%
26 Aug 1987	6.01E+2	100%	9.880E+0	2%	6.33E+2	5.91E+2	16.	16.	100%
27 Aug 1987	6.05E+2	101%	1.139E+1	2%	6.30E+2	5.93E+2	16.	16.	100%
28 Aug 1987	5.97E+2	99%	1.199E+1	2%	6.29E+2	5.71E+2	14.	14.	100%
29 Aug 1987	5.91E+2	99%	7.069E+1	12%	6.26E+2	3.37E+2	15.	14.	93%
30 Aug 1987	5.99E+2	100%	9.611E+0	2%	6.27E+2	5.87E+2	16.	16.	100%
31 Aug 1987	6.13E+2	102%	1.171E+1	2%	6.29E+2	5.76E+2	16.	16.	100%
1 Sep 1987	6.02E+2	100%	1.114E+1	2%	6.15E+2	5.81E+2	16.	16.	100%
2 Sep 1987	6.04E+2	101%	1.164E+1	2%	6.31E+2	5.87E+2	16.	16.	100%
3 Sep 1987	5.94E+2	99%	2.119E+1	4%	6.26E+2	5.50E+2	16.	16.	100%
Summary	5.98E+2	100%	2.468E+1	4%	6.70E+2	3.37E+2	282.	275.	98%



Daily Summation For TetraHydroFuran - IRT (Rats) From 17 Aug 1987 through 3 Sep 1987

Summary Data for: THF-IRT 1800 ppm/Concentration 1.62E+3 to 1.98E+3

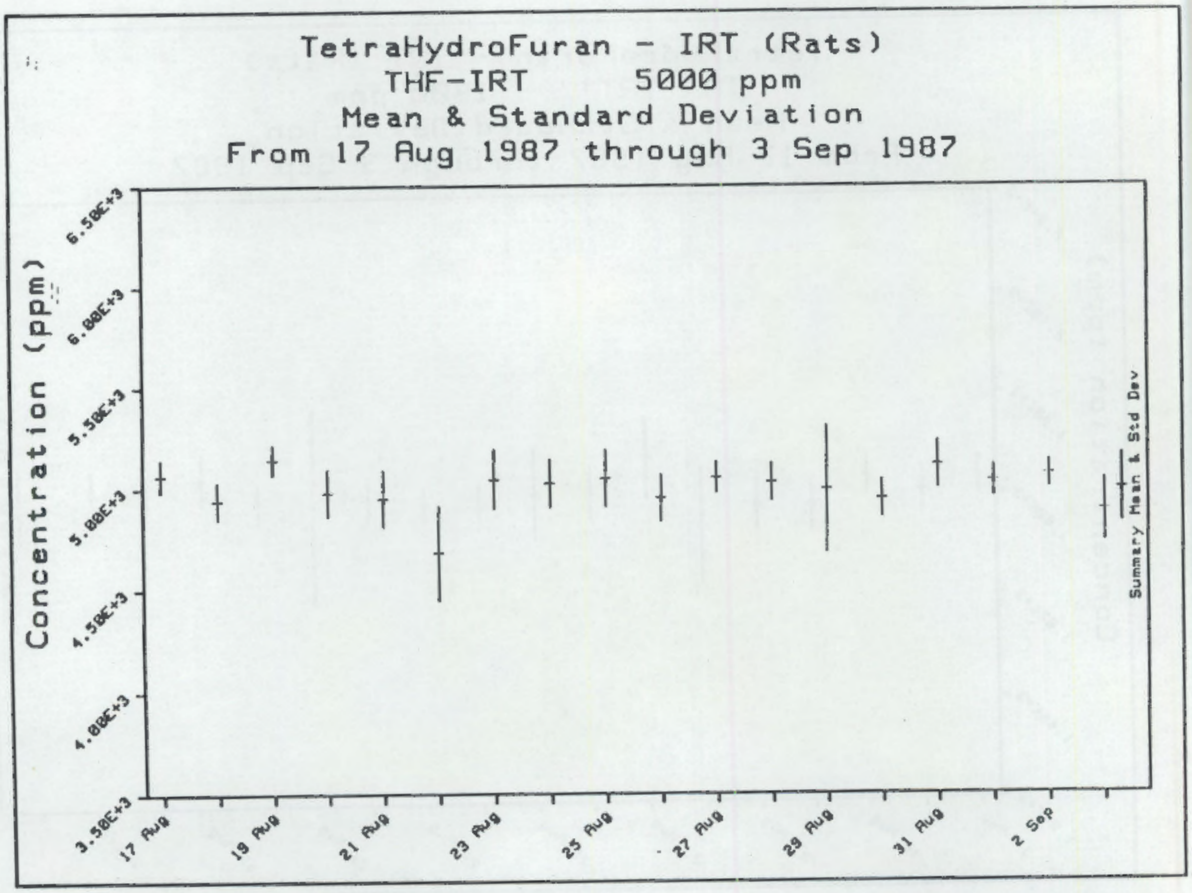
Date	Mean	% Target	Std Dev	% RSD	Maximum	Minimum	N	N in	% N in
17 Aug 1987	1.83E+3	102%	3.175E+1	2%	1.87E+3	1.77E+3	17.	17.	100%
18 Aug 1987	1.81E+3	100%	4.287E+1	2%	1.88E+3	1.72E+3	17.	17.	100%
19 Aug 1987	1.83E+3	102%	3.466E+1	2%	1.89E+3	1.74E+3	16.	16.	100%
20 Aug 1987	1.78E+3	99%	4.832E+1	3%	1.88E+3	1.70E+3	16.	16.	100%
21 Aug 1987	1.78E+3	99%	4.479E+1	3%	1.86E+3	1.71E+3	16.	16.	100%
22 Aug 1987	1.75E+3	97%	1.030E+2	6%	1.94E+3	1.46E+3	16.	15.	94%
23 Aug 1987	1.87E+3	104%	7.231E+1	4%	2.03E+3	1.79E+3	16.	14.	88%
24 Aug 1987	1.81E+3	100%	4.760E+1	3%	1.90E+3	1.68E+3	16.	16.	100%
25 Aug 1987	1.80E+3	100%	8.111E+1	4%	1.91E+3	1.59E+3	16.	15.	94%
26 Aug 1987	1.78E+3	99%	4.187E+1	2%	1.89E+3	1.67E+3	17.	17.	100%
27 Aug 1987	1.79E+3	99%	2.895E+1	2%	1.86E+3	1.72E+3	17.	17.	100%
28 Aug 1987	1.80E+3	100%	3.713E+1	2%	1.91E+3	1.74E+3	14.	14.	100%
29 Aug 1987	1.79E+3	99%	1.718E+2	10%	1.88E+3	1.16E+3	16.	15.	94%
30 Aug 1987	1.79E+3	99%	3.613E+1	2%	1.90E+3	1.73E+3	17.	17.	100%
31 Aug 1987	1.84E+3	102%	4.664E+1	3%	1.91E+3	1.73E+3	17.	17.	100%
1 Sep 1987	1.81E+3	101%	2.876E+1	2%	1.85E+3	1.75E+3	17.	17.	100%
2 Sep 1987	1.83E+3	102%	2.737E+1	1%	1.89E+3	1.80E+3	16.	16.	100%
3 Sep 1987	1.74E+3	97%	5.194E+1	3%	1.81E+3	1.63E+3	15.	15.	100%
Summary	1.80E+3	100%	6.903E+1	4%	2.03E+3	1.16E+3	292.	287.	98%



Daily Summation For TetraHydroFuran - IRT (Rats)   From 17 Aug 1987 through 3 Sep 1987

Summary Data for: THF-IRT   5000 ppm/Concentration   4.50E+3 to 5.50E+3

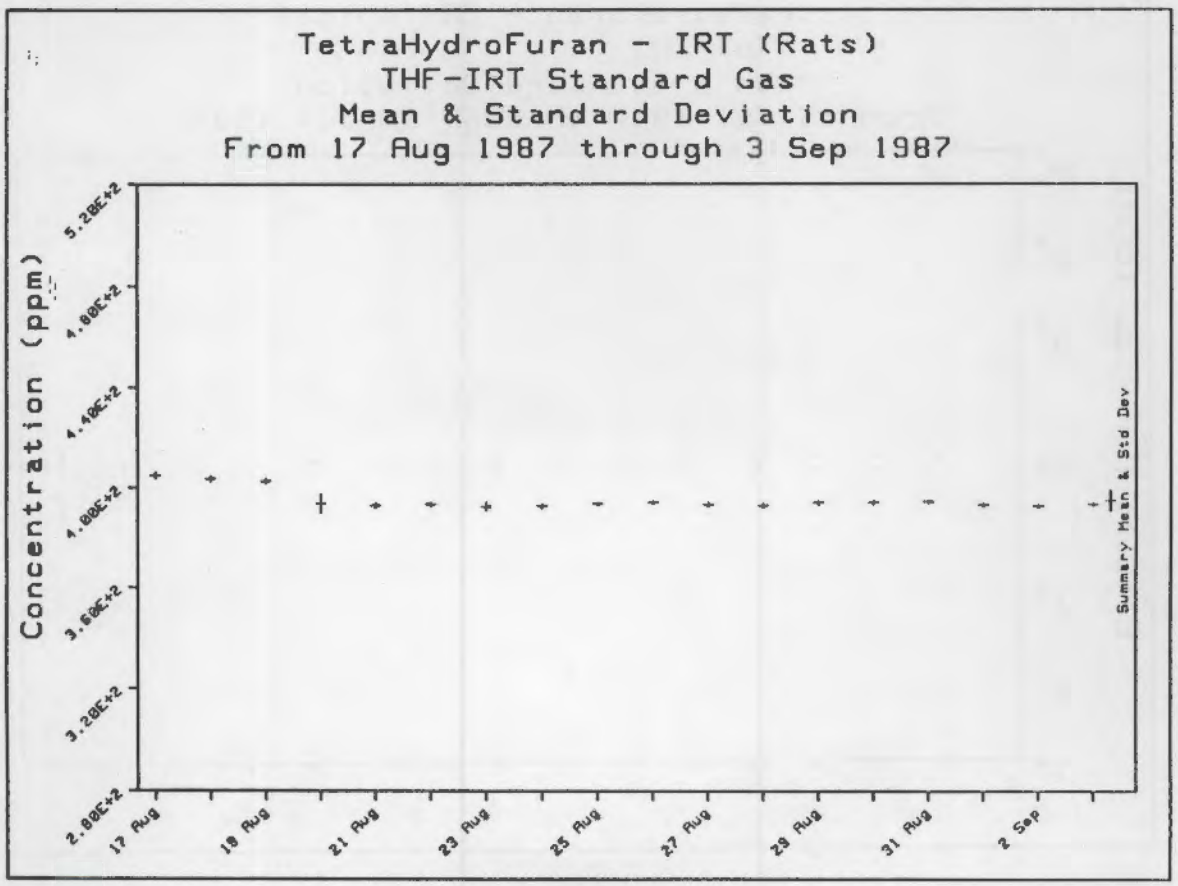
Date	Mean	% Target	Std Dev	% RSD	Maximum	Minimum	N	N in	% N in
17 Aug 1987	5.06E+3	101%	7.777E+1	2%	5.26E+3	4.95E+3	16.	16.	100%
18 Aug 1987	4.94E+3	99%	9.011E+1	2%	5.06E+3	4.69E+3	17.	17.	100%
19 Aug 1987	5.14E+3	103%	7.152E+1	1%	5.26E+3	4.95E+3	16.	16.	100%
20 Aug 1987	4.98E+3	100%	1.140E+2	2%	5.23E+3	4.75E+3	16.	16.	100%
21 Aug 1987	4.95E+3	99%	1.394E+2	3%	5.16E+3	4.71E+3	16.	16.	100%
22 Aug 1987	4.68E+3	94%	2.307E+2	5%	5.01E+3	3.99E+3	16.	15.	94%
23 Aug 1987	5.04E+3	101%	1.459E+2	3%	5.33E+3	4.68E+3	16.	16.	100%
24 Aug 1987	5.02E+3	100%	1.154E+2	2%	5.23E+3	4.85E+3	16.	16.	100%
25 Aug 1987	5.05E+3	101%	1.389E+2	3%	5.26E+3	4.76E+3	16.	16.	100%
26 Aug 1987	4.95E+3	99%	1.147E+2	2%	5.22E+3	4.68E+3	17.	17.	100%
27 Aug 1987	5.05E+3	101%	7.439E+1	1%	5.22E+3	4.96E+3	17.	17.	100%
28 Aug 1987	5.03E+3	101%	9.227E+1	2%	5.32E+3	4.96E+3	14.	14.	100%
29 Aug 1987	4.99E+3	100%	3.100E+2	6%	5.20E+3	3.87E+3	16.	15.	94%
30 Aug 1987	4.94E+3	99%	9.420E+1	2%	5.24E+3	4.83E+3	17.	17.	100%
31 Aug 1987	5.11E+3	102%	1.141E+2	2%	5.30E+3	4.85E+3	17.	17.	100%
1 Sep 1987	5.03E+3	101%	7.507E+1	1%	5.14E+3	4.87E+3	17.	17.	100%
2 Sep 1987	5.06E+3	101%	6.372E+1	1%	5.18E+3	4.99E+3	15.	15.	100%
3 Sep 1987	4.89E+3	98%	1.538E+2	3%	5.07E+3	4.54E+3	15.	15.	100%
Summary	4.99E+3	100%	1.657E+2	3%	5.33E+3	3.87E+3	290.	288.	99%



Daily Summation For TetraHydroFuran - IRT (Rats)   From 17 Aug 1987 through 3 Sep 1987   --

Summary Data for: THF-IRT Standard Gas/Concentration   --   3.60E+2 to 4.40E+2

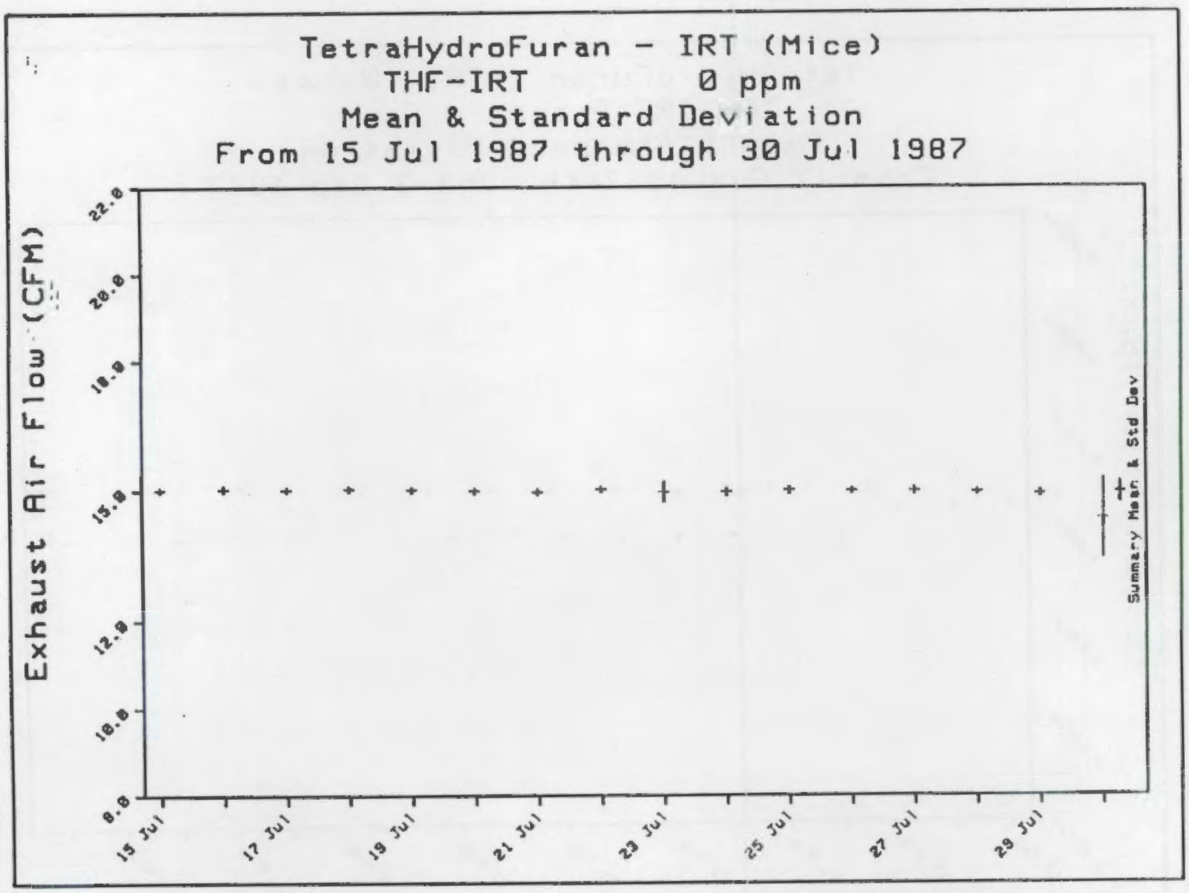
Date	Mean	% Target	Std Dev	% RSD	Maximum	Minimum	N	N in	% N in
17 Aug 1987	4.05E+2	101%	1.283E+0	0%	4.07E+2	4.02E+2	17.	17.	100%
18 Aug 1987	4.03E+2	101%	1.026E+0	0%	4.05E+2	4.01E+2	17.	17.	100%
19 Aug 1987	4.02E+2	101%	1.009E+0	0%	4.04E+2	4.00E+2	16.	16.	100%
20 Aug 1987	3.93E+2	98%	3.626E+0	1%	4.03E+2	3.90E+2	16.	16.	100%
21 Aug 1987	3.93E+2	98%	9.777E-1	0%	3.94E+2	3.91E+2	17.	17.	100%
22 Aug 1987	3.93E+2	98%	8.367E-1	0%	3.94E+2	3.92E+2	17.	17.	100%
23 Aug 1987	3.92E+2	98%	1.589E+0	0%	3.94E+2	3.87E+2	17.	17.	100%
24 Aug 1987	3.92E+2	98%	8.764E-1	0%	3.94E+2	3.90E+2	18.	18.	100%
25 Aug 1987	3.93E+2	98%	5.053E-1	0%	3.94E+2	3.93E+2	17.	17.	100%
26 Aug 1987	3.94E+2	98%	5.347E-1	0%	3.95E+2	3.93E+2	17.	17.	100%
27 Aug 1987	3.93E+2	98%	8.678E-1	0%	3.94E+2	3.91E+2	17.	17.	100%
28 Aug 1987	3.93E+2	98%	8.002E-1	0%	3.94E+2	3.91E+2	15.	15.	100%
29 Aug 1987	3.94E+2	98%	8.099E-1	0%	3.95E+2	3.93E+2	17.	17.	100%
30 Aug 1987	3.94E+2	98%	7.170E-1	0%	3.95E+2	3.93E+2	17.	17.	100%
31 Aug 1987	3.94E+2	99%	4.638E-1	0%	3.95E+2	3.93E+2	17.	17.	100%
1 Sep 1987	3.93E+2	98%	8.405E-1	0%	3.94E+2	3.91E+2	17.	17.	100%
2 Sep 1987	3.92E+2	98%	5.747E-1	0%	3.93E+2	3.91E+2	16.	16.	100%
3 Sep 1987	3.93E+2	98%	6.129E-1	0%	3.94E+2	3.92E+2	16.	16.	100%
Summary	3.95E+2	99%	4.087E+0	1%	4.07E+2	3.87E+2	301.	301.	100%



Daily Summation For TetraHydroFuran - IRT (Mice)   From 15 Jul 1987 through 30 Jul 1987

Summary Data for: THF-IRT   0 ppm/Exhaust Air Flow   --   12.0 to 18.0

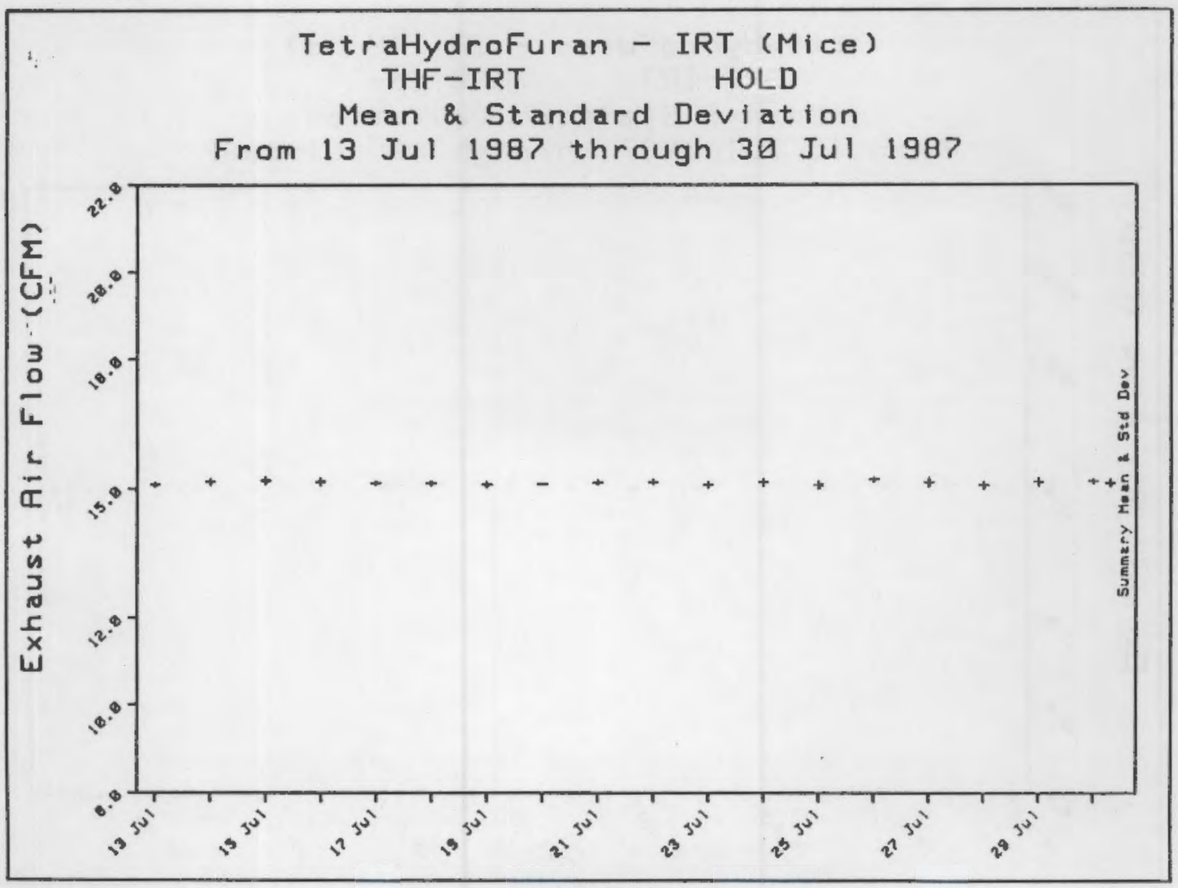
Date	Mean	% Target	Std Dev	% RSD	Maximum	Minimum	N	N in	% N in
15 Jul 1987	15.0	100%	.06	0%	15.1	14.9	7.	7.	100%
16 Jul 1987	15.0	100%	.08	1%	15.2	15.0	7.	7.	100%
17 Jul 1987	15.0	100%	.06	0%	15.1	15.0	8.	8.	100%
18 Jul 1987	15.0	100%	.07	0%	15.1	15.0	8.	8.	100%
19 Jul 1987	15.0	100%	.07	0%	15.1	15.0	8.	8.	100%
20 Jul 1987	15.0	100%	.07	0%	15.1	14.9	8.	8.	100%
21 Jul 1987	15.0	100%	.07	0%	15.1	14.9	8.	8.	100%
22 Jul 1987	15.0	100%	.06	0%	15.1	14.9	7.	7.	100%
23 Jul 1987	14.9	100%	.24	2%	15.1	14.4	7.	7.	100%
24 Jul 1987	15.0	100%	.10	1%	15.1	14.8	8.	8.	100%
25 Jul 1987	15.0	100%	.07	0%	15.1	14.9	8.	8.	100%
26 Jul 1987	15.0	100%	.06	0%	15.1	14.9	8.	8.	100%
27 Jul 1987	15.0	100%	.08	1%	15.1	14.9	7.	7.	100%
28 Jul 1987	14.9	100%	.06	0%	15.1	14.9	8.	8.	100%
29 Jul 1987	14.9	99%	.08	1%	15.0	14.8	8.	8.	100%
30 Jul 1987	14.3	96%	.91	6%	15.1	13.3	5.	5.	100%
Summary	14.9	100%	.23	2%	15.2	13.3	120.	120.	100%



Daily Summation For TetraHydroFuran - IRT (Mice)   From 13 Jul 1987 through 30 Jul 1987   --

Summary Data for: THF-IRT   HOLD/Exhaust Air Flow   --   12.0 to 18.0

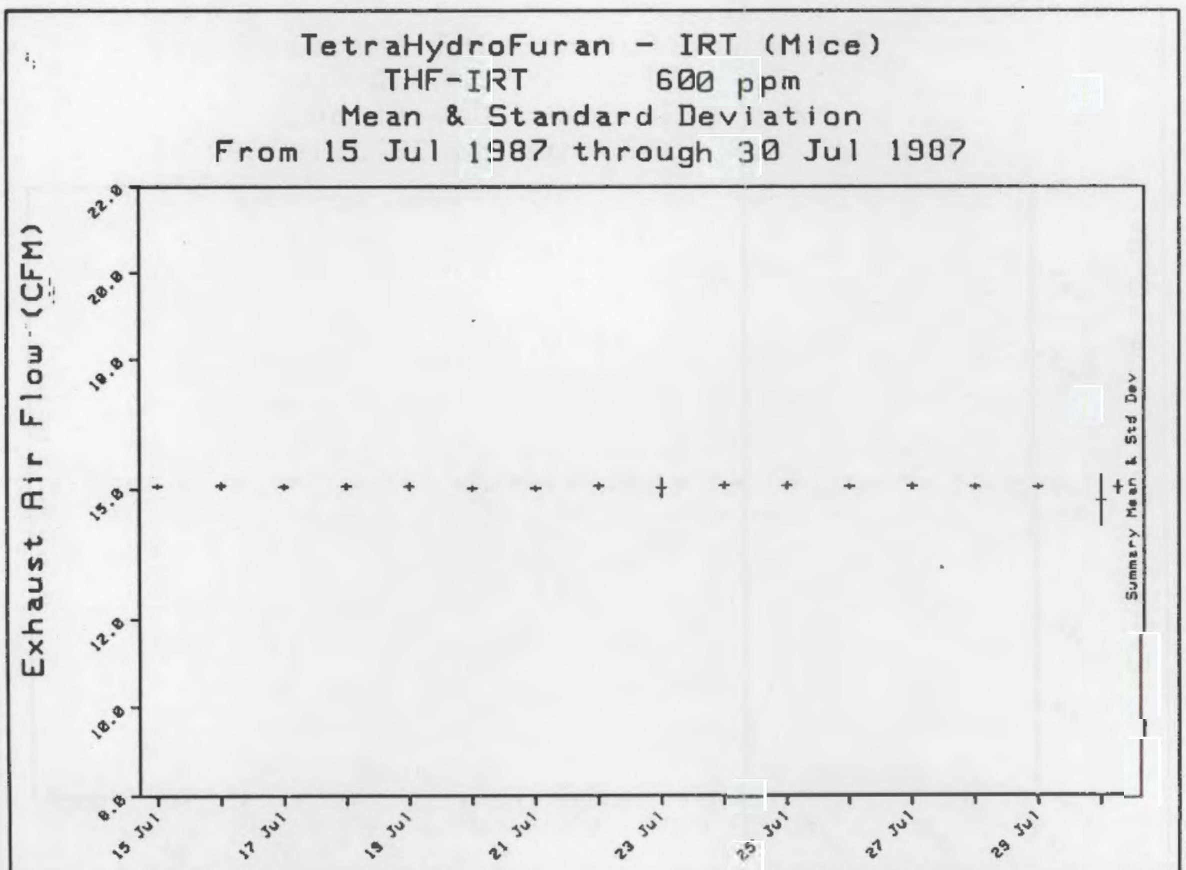
Date	Mean	% Target	Std Dev	% RSD	Maximum	Minimum	N	N in	% N in
13 Jul 1987	15.1	101%	.05	0%	15.2	15.1	8.	8.	100%
14 Jul 1987	15.2	101%	.07	0%	15.2	15.0	8.	8.	100%
15 Jul 1987	15.2	101%	.09	1%	15.3	15.1	7.	7.	100%
16 Jul 1987	15.2	101%	.08	1%	15.2	15.0	7.	7.	100%
17 Jul 1987	15.1	101%	.04	0%	15.2	15.1	8.	8.	100%
18 Jul 1987	15.1	101%	.05	0%	15.2	15.1	8.	8.	100%
19 Jul 1987	15.1	101%	.06	0%	15.2	15.0	8.	8.	100%
20 Jul 1987	15.1	101%	0.00	0%	15.1	15.1	1.	1.	100%
21 Jul 1987	15.1	101%	.05	0%	15.2	15.1	7.	7.	100%
22 Jul 1987	15.2	101%	.06	0%	15.2	15.1	7.	7.	100%
23 Jul 1987	15.1	101%	.07	0%	15.2	15.0	7.	7.	100%
24 Jul 1987	15.1	101%	.09	1%	15.2	15.0	7.	7.	100%
25 Jul 1987	15.1	101%	.09	1%	15.2	15.0	8.	8.	100%
26 Jul 1987	15.2	101%	.05	0%	15.2	15.1	8.	8.	100%
27 Jul 1987	15.1	101%	.10	1%	15.2	15.0	7.	7.	100%
28 Jul 1987	15.1	100%	.08	1%	15.2	15.0	8.	8.	100%
29 Jul 1987	15.2	101%	.09	1%	15.2	15.0	8.	8.	100%
30 Jul 1987	15.2	101%	.05	0%	15.2	15.1	5.	5.	100%
Summary	15.1	101%	.08	1%	15.3	15.0	127.	127.	100%



Daily Summation For TetraHydroFuran - IRT (Mice)   From 15 Jul 1987 through 30 Jul 1987

Summary Data for: THF-IRT   600 ppm/Exhaust Air Flow

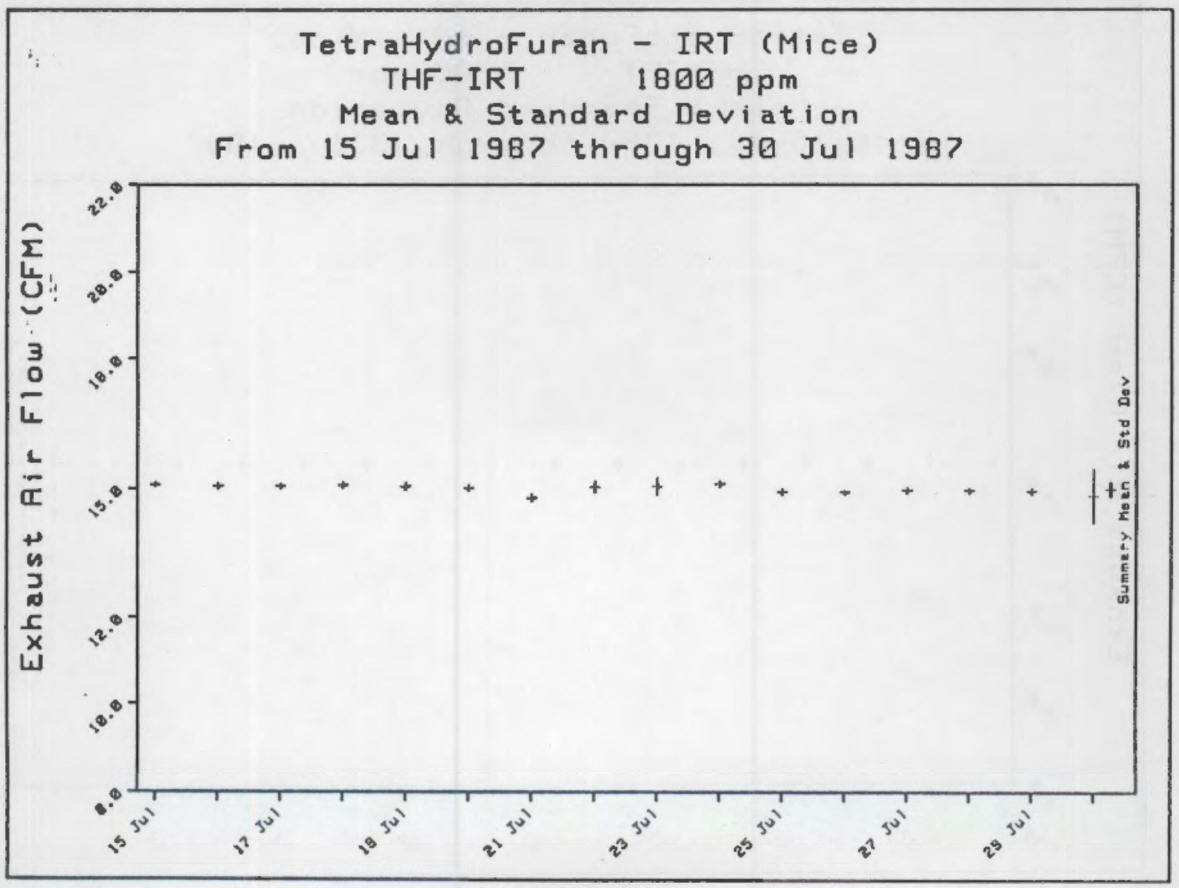
Date	Mean	% Target	Std Dev	% RSD	Maximum	Minimum	N	12.0 to 18.0 N in	% N in
15 Jul 1987	15.1	100%	.04	0%	15.1	15.0	7.	7.	100%
16 Jul 1987	15.1	101%	.08	1%	15.2	15.0	7.	7.	100%
17 Jul 1987	15.1	100%	.05	0%	15.1	15.0	8.	8.	100%
18 Jul 1987	15.1	100%	.07	0%	15.2	15.0	8.	8.	100%
19 Jul 1987	15.1	100%	.07	0%	15.2	15.0	8.	8.	100%
20 Jul 1987	15.0	100%	.05	0%	15.1	15.0	8.	8.	100%
21 Jul 1987	15.0	100%	.05	0%	15.1	15.0	8.	8.	100%
22 Jul 1987	15.1	100%	.06	0%	15.1	15.0	7.	7.	100%
23 Jul 1987	15.0	100%	.22	1%	15.2	14.6	7.	7.	100%
24 Jul 1987	15.1	101%	.07	0%	15.2	15.0	7.	7.	100%
25 Jul 1987	15.1	100%	.07	0%	15.2	15.0	8.	8.	100%
26 Jul 1987	15.0	100%	.05	0%	15.1	15.0	8.	8.	100%
27 Jul 1987	15.1	100%	.07	0%	15.2	15.0	7.	7.	100%
28 Jul 1987	15.0	100%	.05	0%	15.1	15.0	8.	8.	100%
29 Jul 1987	15.0	100%	.05	0%	15.1	15.0	8.	8.	100%
30 Jul 1987	14.7	98%	.58	4%	15.0	13.7	5.	5.	100%
Summary	15.0	100%	.15	1%	15.2	13.7	119.	119.	100%



Daily Summation For TetraHydroFuran - IRT (Mice) From 15 Jul 1987 through 30 Jul 1987 --

Summary Data for: THF-IRT 1800 ppm/Exhaust Air Flow -- 12.0 to 18.0

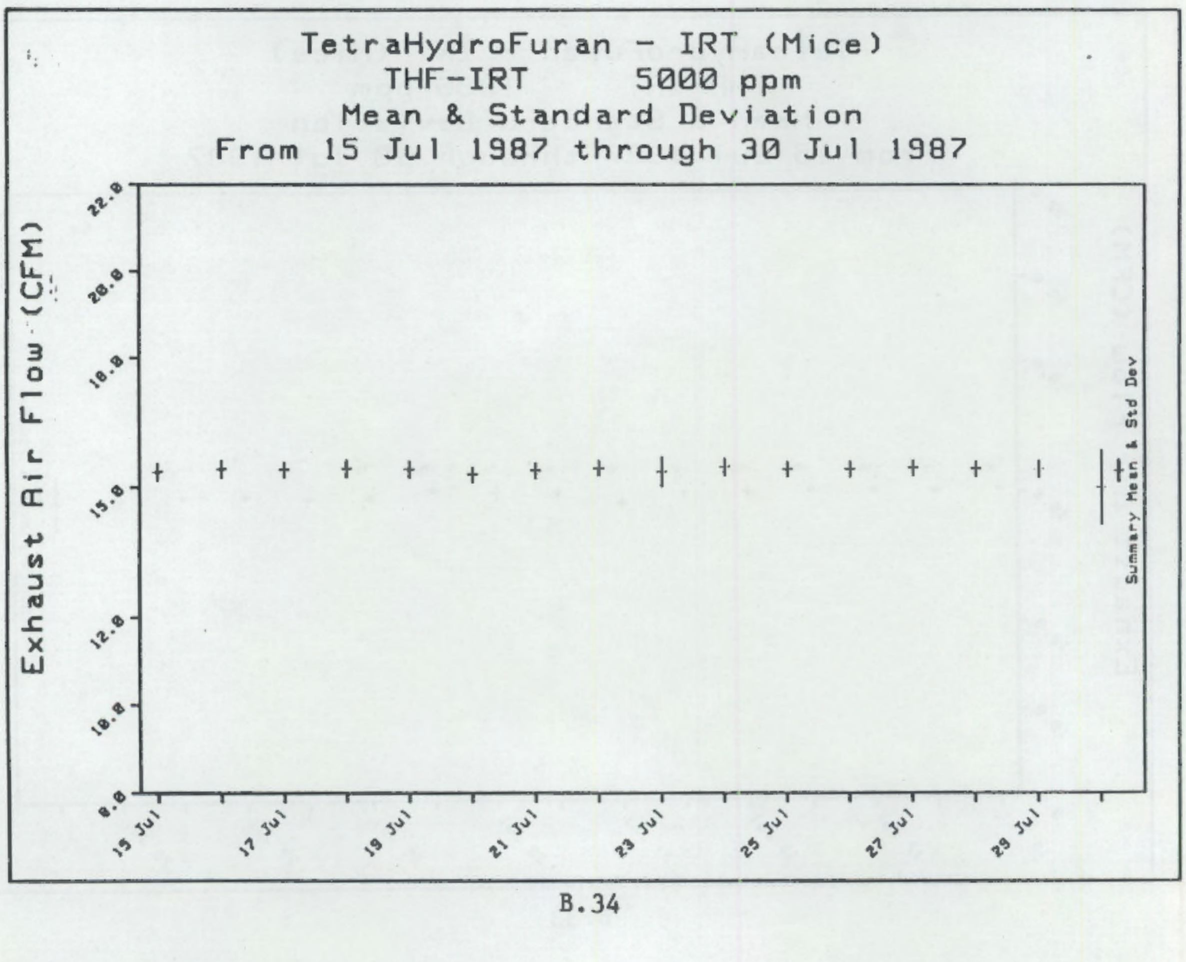
Date	Mean	% Target	Std Dev	% RSD	Maximum	Minimum	N	N in	% N in
15 Jul 1987	15.1	101%	.05	0%	15.1	15.0	7.	7.	100%
16 Jul 1987	15.0	100%	.07	0%	15.1	15.0	7.	7.	100%
17 Jul 1987	15.1	100%	.06	0%	15.2	15.0	8.	8.	100%
18 Jul 1987	15.1	100%	.07	0%	15.2	15.0	8.	8.	100%
19 Jul 1987	15.0	100%	.09	1%	15.2	15.0	8.	8.	100%
20 Jul 1987	15.0	100%	.07	0%	15.1	15.0	8.	8.	100%
21 Jul 1987	14.8	98%	.09	1%	15.0	14.7	8.	8.	100%
22 Jul 1987	15.0	100%	.13	1%	15.2	14.8	7.	7.	100%
23 Jul 1987	15.0	100%	.20	1%	15.2	14.6	7.	7.	100%
24 Jul 1987	15.1	101%	.07	0%	15.2	15.0	7.	7.	100%
25 Jul 1987	14.9	99%	.07	0%	15.1	14.8	8.	8.	100%
26 Jul 1987	14.9	99%	.05	0%	15.0	14.8	8.	8.	100%
27 Jul 1987	15.0	100%	.07	0%	15.1	14.9	7.	7.	100%
28 Jul 1987	14.9	100%	.06	0%	15.1	14.9	8.	8.	100%
29 Jul 1987	14.9	99%	.06	0%	15.0	14.9	8.	8.	100%
30 Jul 1987	14.8	99%	.63	4%	15.3	13.7	5.	5.	100%
Summary	15.0	100%	.17	1%	15.3	13.7	119.	119.	100%



Daily Summation For TetraHydroFuran - IRT (Mice)   From 15 Jul 1987 through 30 Jul 1987

Summary Data for: THF-IRT   5000 ppm/Exhaust Air Flow   12.0 to 18.0

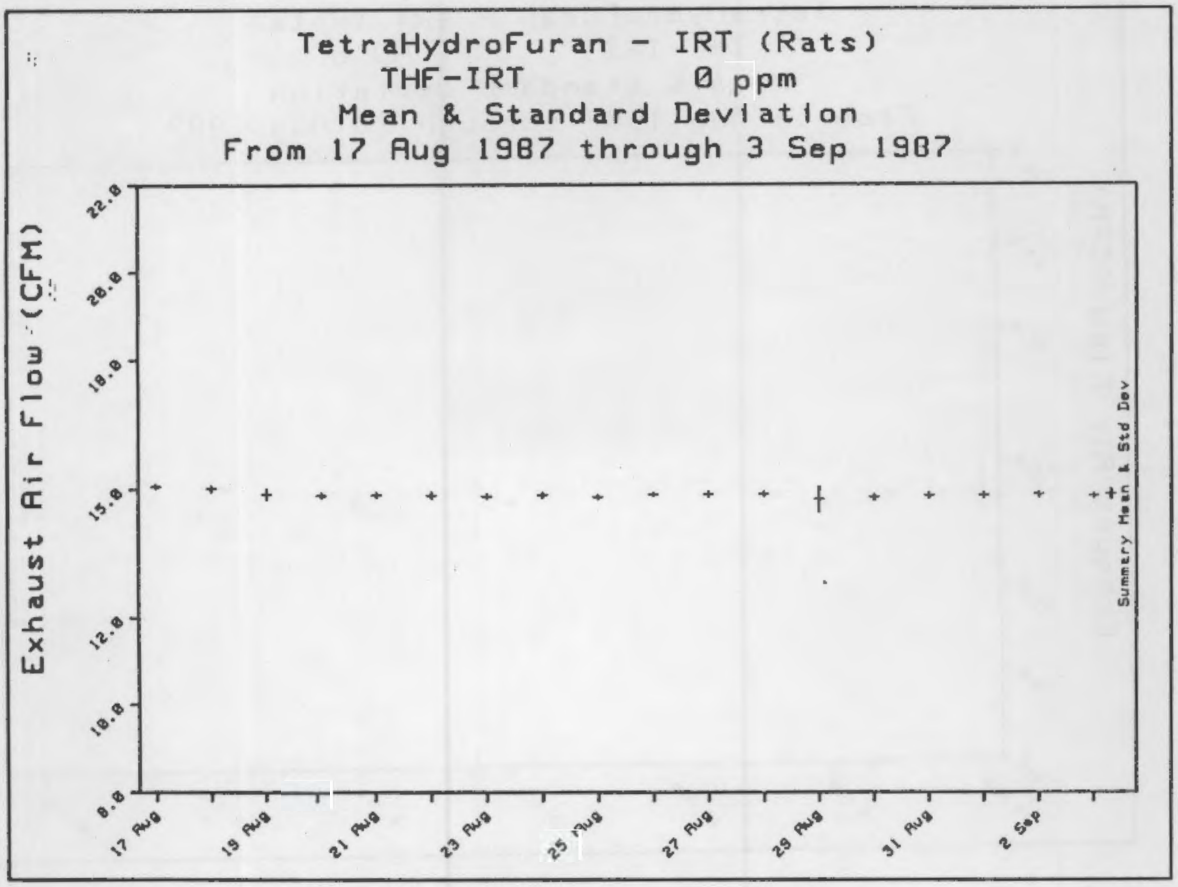
Date	Mean	% Target	Std Dev	% RSD	Maximum	Minimum	N	N in	% N in
15 Jul 1987	15.4	102%	.18	1%	15.7	15.2	7.	7.	100%
16 Jul 1987	15.4	103%	.19	1%	15.7	15.3	7.	7.	100%
17 Jul 1987	15.4	103%	.17	1%	15.7	15.3	8.	8.	100%
18 Jul 1987	15.4	103%	.19	1%	15.7	15.3	8.	8.	100%
19 Jul 1987	15.4	103%	.19	1%	15.7	15.2	8.	8.	100%
20 Jul 1987	15.3	102%	.16	1%	15.5	15.1	8.	8.	100%
21 Jul 1987	15.4	102%	.17	1%	15.7	15.2	8.	8.	100%
22 Jul 1987	15.4	103%	.17	1%	15.7	15.3	7.	7.	100%
23 Jul 1987	15.3	102%	.34	2%	15.7	14.7	7.	7.	100%
24 Jul 1987	15.5	103%	.19	1%	15.8	15.3	7.	7.	100%
25 Jul 1987	15.4	103%	.16	1%	15.7	15.3	8.	8.	100%
26 Jul 1987	15.4	103%	.17	1%	15.7	15.3	8.	8.	100%
27 Jul 1987	15.4	103%	.17	1%	15.7	15.3	7.	7.	100%
28 Jul 1987	15.4	103%	.15	1%	15.7	15.3	8.	8.	100%
29 Jul 1987	15.4	103%	.19	1%	15.7	15.2	8.	8.	100%
30 Jul 1987	15.0	100%	.85	6%	15.6	13.5	5.	5.	100%
Summary	15.4	103%	.25	2%	15.8	13.5	119.	119.	100%



Daily Summation For TetraHydroFuran - IRT (Rats)   From 17 Aug 1987 through 3 Sep 1987   --

Summary Data for: THF-IRT   0 ppm/Exhaust Air Flow   - -   12.0 to 18.0

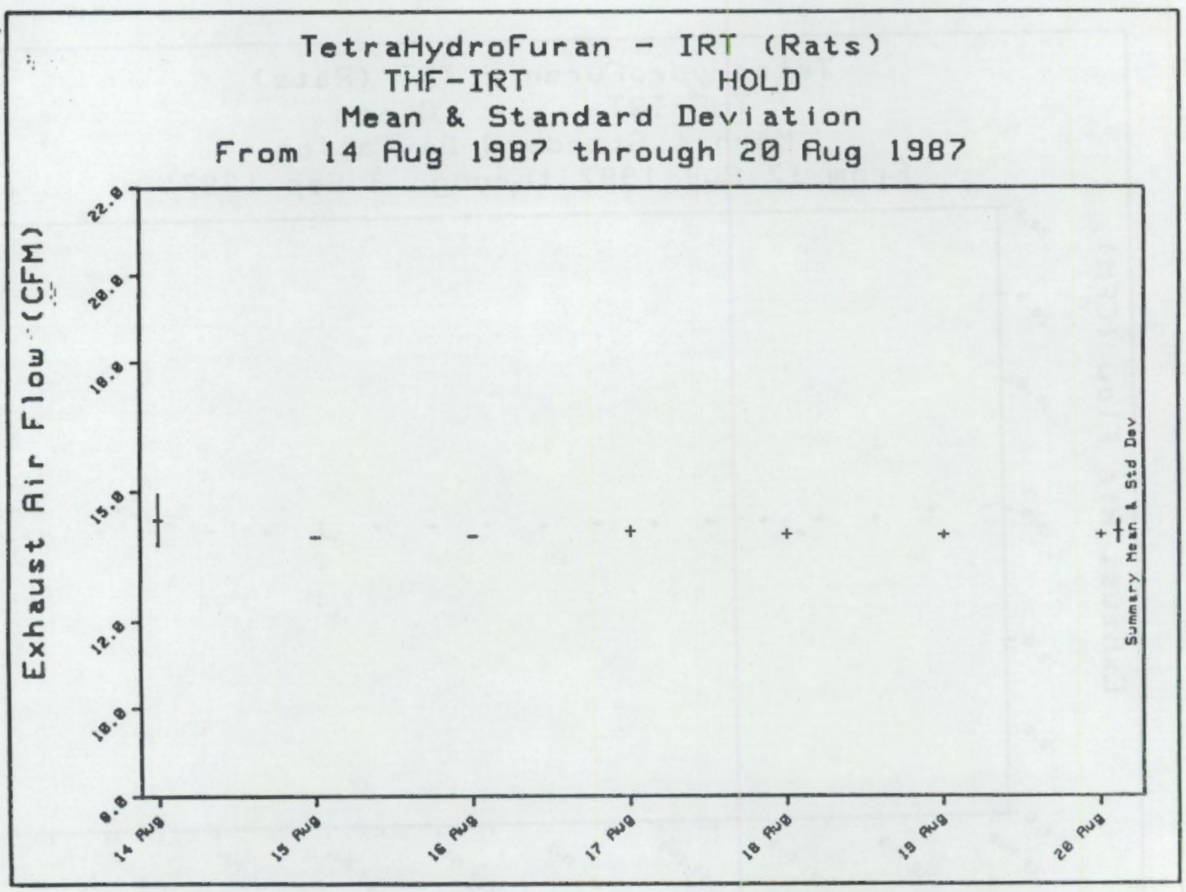
Date	Mean	% Target	Std Dev	% RSD	Maximum	Minimum	N	N in	% N in
17 Aug 1987	15.1	101%	.05	0%	15.2	15.0	7.	7.	100%
18 Aug 1987	15.0	100%	.08	1%	15.1	15.0	8.	8.	100%
19 Aug 1987	14.9	99%	.12	1%	15.1	14.8	7.	7.	100%
20 Aug 1987	14.9	99%	.06	0%	14.9	14.8	7.	7.	100%
21 Aug 1987	14.9	99%	.06	0%	15.0	14.8	8.	8.	100%
22 Aug 1987	14.9	99%	.08	1%	15.0	14.8	8.	8.	100%
23 Aug 1987	14.8	99%	.06	0%	14.9	14.8	8.	8.	100%
24 Aug 1987	14.9	99%	.07	0%	15.0	14.8	7.	7.	100%
25 Aug 1987	14.8	99%	.06	0%	14.9	14.7	8.	8.	100%
26 Aug 1987	14.9	99%	.04	0%	14.9	14.8	4.	4.	100%
27 Aug 1987	14.9	99%	.06	0%	15.0	14.8	7.	7.	100%
28 Aug 1987	14.9	99%	.05	0%	15.0	14.8	8.	8.	100%
29 Aug 1987	14.8	98%	.30	2%	15.0	14.0	8.	8.	100%
30 Aug 1987	14.8	99%	.07	1%	14.9	14.7	8.	8.	100%
31 Aug 1987	14.8	99%	.07	0%	15.0	14.7	8.	8.	100%
1 Sep 1987	14.8	99%	.06	0%	15.0	14.8	8.	8.	100%
2 Sep 1987	14.9	99%	.07	0%	15.0	14.8	7.	7.	100%
3 Sep 1987	14.8	99%	.06	0%	14.9	14.8	7.	7.	100%
Summary	14.9	99%	.12	1%	15.2	14.0	133.	133.	100%



Daily Summation For TetraHydroFuran - IRT (Rats)   From 14 Aug 1987 through 20 Aug 1987

Summary Data for: THF-IRT   HOLD/Exhaust Air Flow

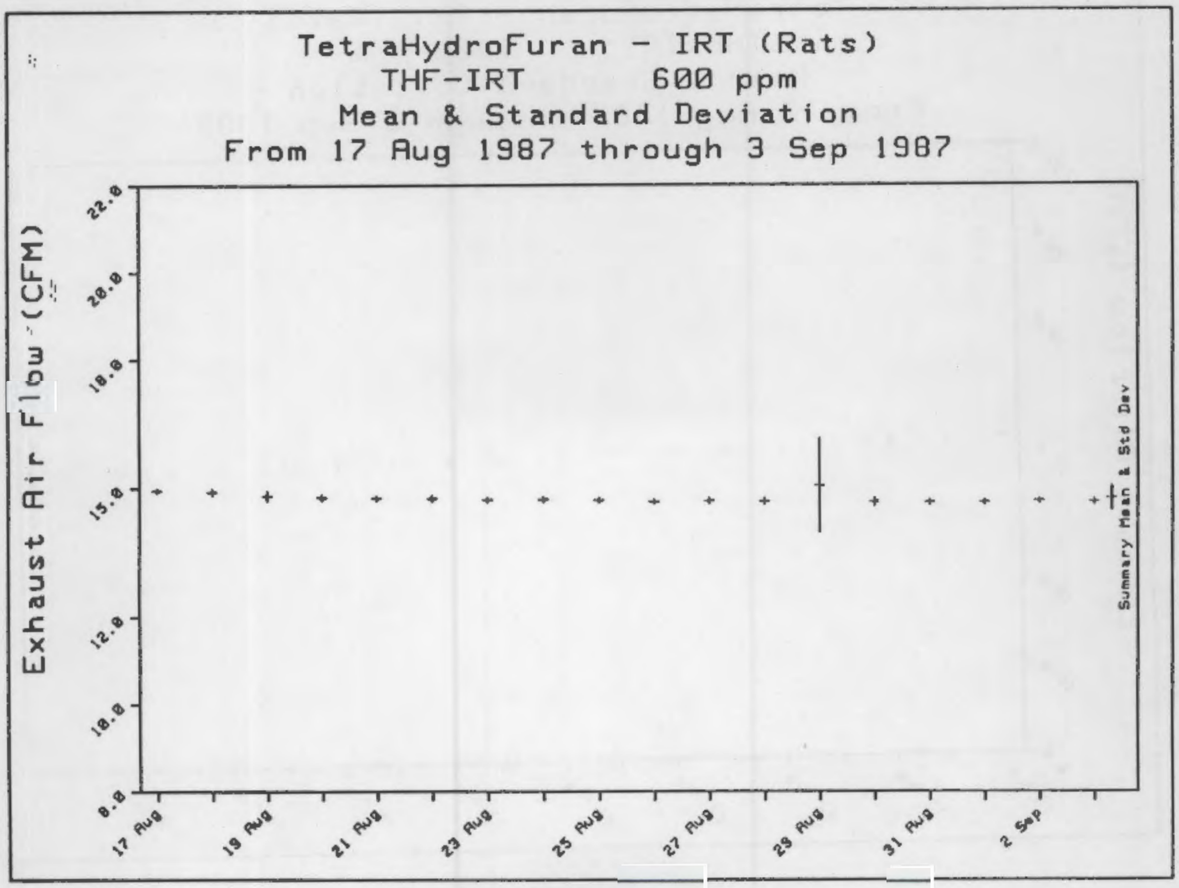
Date	Mean	% Target	Std Dev	% RSD	Maximum	Minimum --	N	12.0 to 18.0 N in	% N in
14 Aug 1987	14.4	96%	.61	4%	15.4	13.9	8.	8.	100%
15 Aug 1987	13.9	93%	.02	0%	14.0	13.9	8.	8.	100%
16 Aug 1987	14.0	93%	.02	0%	14.0	13.9	8.	8.	100%
17 Aug 1987	14.1	94%	.11	1%	14.2	13.9	8.	8.	100%
18 Aug 1987	14.0	93%	.10	1%	14.2	13.9	8.	8.	100%
19 Aug 1987	14.0	93%	.08	1%	14.1	13.9	7.	7.	100%
20 Aug 1987	14.0	93%	.08	1%	14.2	13.9	7.	7.	100%
Summary	14.0	94%	.27	2%	15.4	13.9	54.	54.	100%



Daily Summation For TetraHydroFuran - IRT (Rats) From 17 Aug 1987 through 3 Sep 1987

Summary Data for: THF-IRT 600 ppm/Exhaust Air Flow 12.0 to 18.0

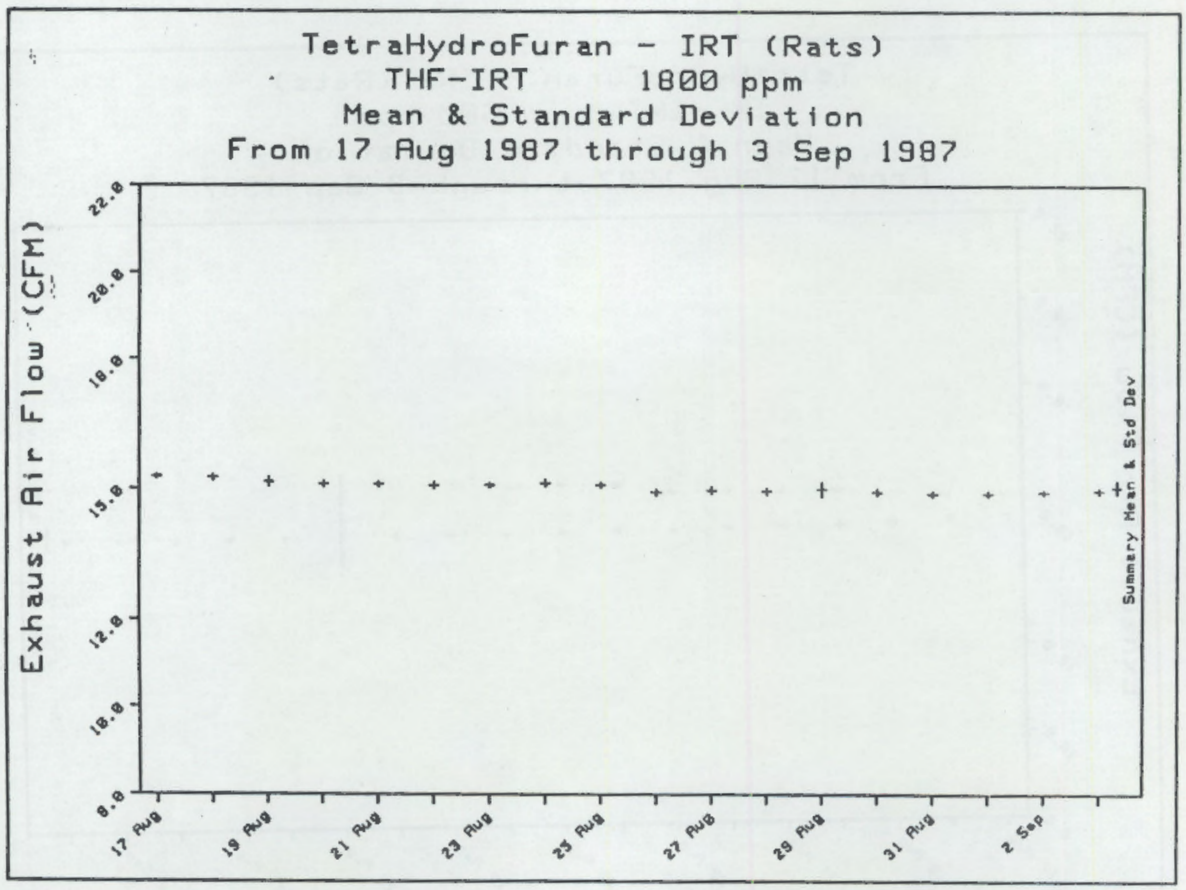
Date	Mean	% Target	Std Dev	% RSD	Maximum	Minimum	N	N in	% N in
17 Aug 1987	14.9	100%	.05	0%	15.0	14.9	7.	7.	100%
18 Aug 1987	14.9	99%	.07	0%	15.0	14.8	8.	8.	100%
19 Aug 1987	14.8	99%	.11	1%	15.0	14.7	7.	7.	100%
20 Aug 1987	14.8	99%	.07	0%	14.9	14.7	7.	7.	100%
21 Aug 1987	14.8	98%	.05	0%	14.9	14.7	8.	8.	100%
22 Aug 1987	14.8	98%	.07	0%	14.8	14.7	8.	8.	100%
23 Aug 1987	14.7	98%	.05	0%	14.8	14.7	8.	8.	100%
24 Aug 1987	14.7	98%	.06	0%	14.8	14.7	7.	7.	100%
25 Aug 1987	14.7	98%	.06	0%	14.8	14.7	8.	8.	100%
26 Aug 1987	14.7	98%	.05	0%	14.8	14.6	8.	8.	100%
27 Aug 1987	14.7	98%	.07	0%	14.8	14.6	8.	8.	100%
28 Aug 1987	14.7	98%	.07	0%	14.8	14.6	8.	8.	100%
29 Aug 1987	15.1	100%	1.08	7%	17.7	14.6	8.	8.	100%
30 Aug 1987	14.7	98%	.08	1%	14.8	14.6	8.	8.	100%
31 Aug 1987	14.7	98%	.06	0%	14.7	14.6	8.	8.	100%
1 Sep 1987	14.7	98%	.06	0%	14.8	14.6	8.	8.	100%
2 Sep 1987	14.7	98%	.06	0%	14.8	14.6	7.	7.	100%
3 Sep 1987	14.7	98%	.07	0%	14.8	14.6	7.	7.	100%
Summary	14.8	98%	.27	2%	17.7	14.6	138.	138.	100%



Daily Summation For TetraHydroFuran - IRT (Rats)   From 17 Aug 1987 through 3 Sep 1987   --

Summary Data for: THF-IRT   1800 ppm/Exhaust Air Flow   --   12.0 to 18.0

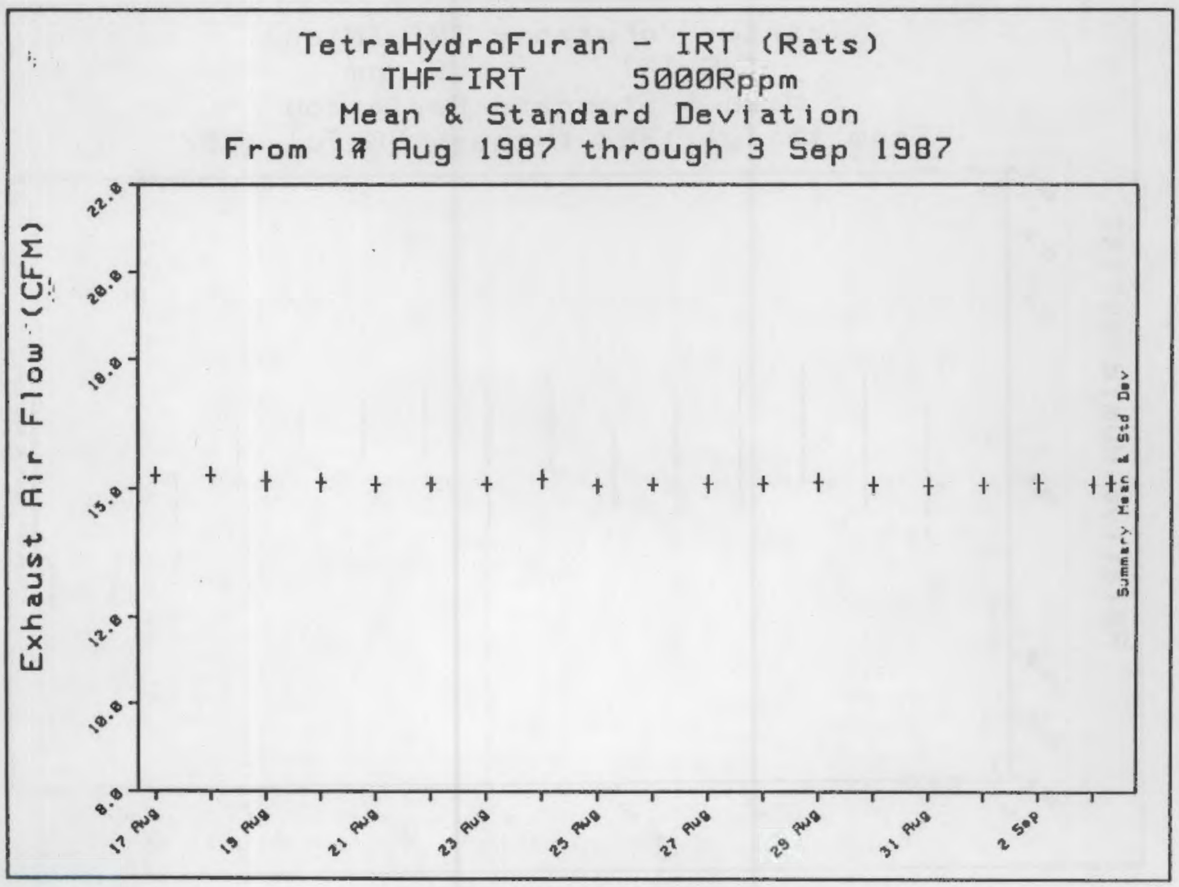
Date	Mean	% Target	Std Dev	% RSD	Maximum	Minimum	N	N in	% N in
17 Aug 1987	15.3	102%	.05	0%	15.4	15.2	7.	7.	100%
18 Aug 1987	15.3	102%	.07	0%	15.4	15.2	8.	8.	100%
19 Aug 1987	15.2	101%	.11	1%	15.3	15.0	7.	7.	100%
20 Aug 1987	15.1	101%	.07	0%	15.2	15.0	7.	7.	100%
21 Aug 1987	15.1	101%	.06	0%	15.2	15.1	8.	8.	100%
22 Aug 1987	15.1	100%	.08	1%	15.2	15.0	8.	8.	100%
23 Aug 1987	15.1	101%	.05	0%	15.2	15.0	8.	8.	100%
24 Aug 1987	15.1	101%	.08	1%	15.3	15.0	7.	7.	100%
25 Aug 1987	15.1	101%	.06	0%	15.2	15.0	8.	8.	100%
26 Aug 1987	14.9	99%	.07	0%	15.1	14.8	8.	8.	100%
27 Aug 1987	15.0	100%	.08	1%	15.1	14.9	8.	8.	100%
28 Aug 1987	14.9	100%	.07	0%	15.1	14.9	8.	8.	100%
29 Aug 1987	15.0	100%	.16	1%	15.4	14.9	8.	8.	100%
30 Aug 1987	14.9	99%	.08	1%	15.0	14.8	8.	8.	100%
31 Aug 1987	14.9	99%	.06	0%	15.0	14.8	8.	8.	100%
1 Sep 1987	14.9	99%	.06	0%	15.0	14.8	8.	8.	100%
2 Sep 1987	14.9	99%	.05	0%	15.0	14.9	7.	7.	100%
3 Sep 1987	15.0	100%	.06	0%	15.1	14.9	7.	7.	100%
Summary	15.0	100%	.14	1%	15.4	14.8	138.	138.	100%



Daily Summation For TetraHydroFuran - IRT (Rats) From 17 Aug 1987 through 3 Sep 1987 --

Summary Data for: THF-IRT 5000 ppm/Exhaust Air Flow -- 12.0 to 18.0

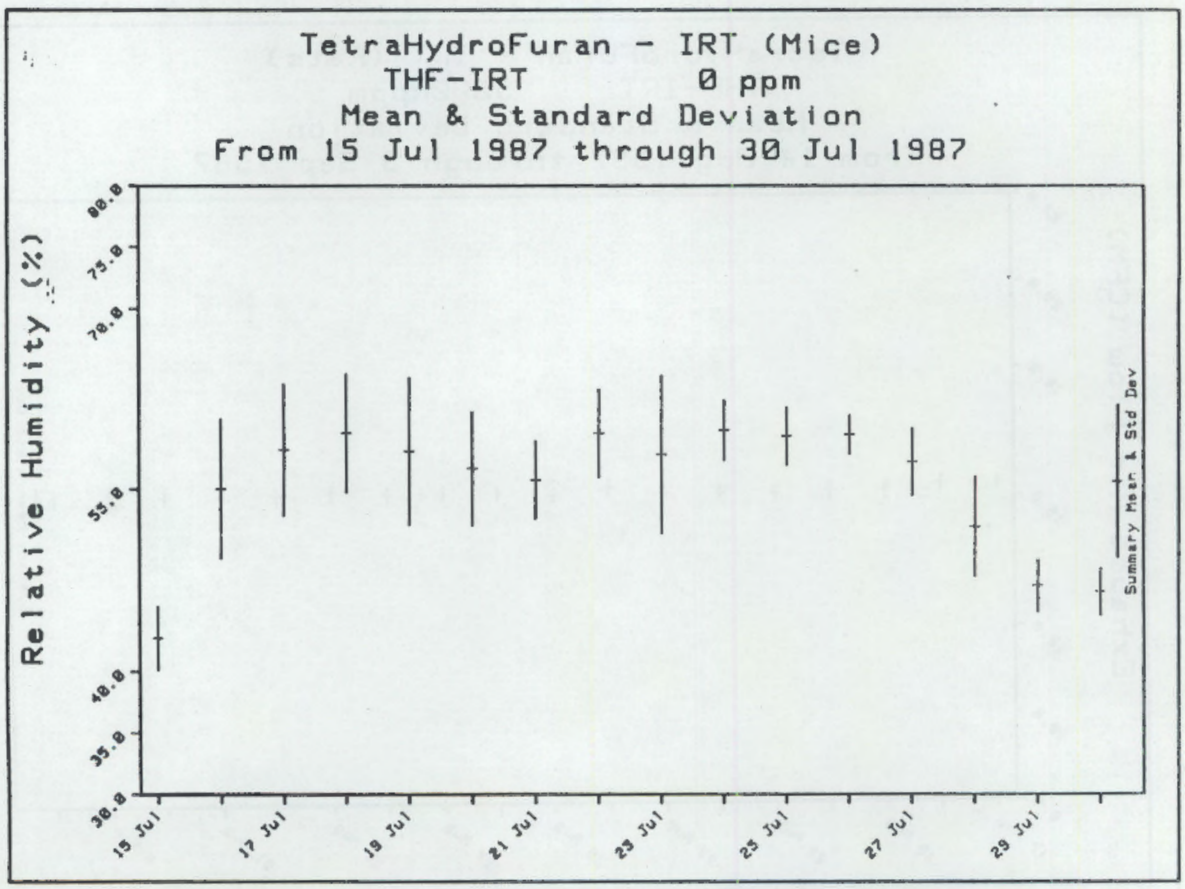
Date	Mean	% Target	Std Dev	% RSD	Maximum	Minimum	N	N in	% N in
17 Aug 1987	15.3	102%	.18	1%	15.6	15.2	7.	7.	100%
18 Aug 1987	15.3	102%	.18	1%	15.6	15.2	8.	8.	100%
19 Aug 1987	15.2	101%	.24	2%	15.6	15.0	7.	7.	100%
20 Aug 1987	15.1	101%	.20	1%	15.4	15.0	7.	7.	100%
21 Aug 1987	15.1	101%	.18	1%	15.4	14.9	8.	8.	100%
22 Aug 1987	15.1	101%	.17	1%	15.4	15.0	8.	8.	100%
23 Aug 1987	15.1	101%	.16	1%	15.4	15.0	8.	8.	100%
24 Aug 1987	15.2	102%	.22	1%	15.5	15.0	7.	7.	100%
25 Aug 1987	15.1	100%	.18	1%	15.3	14.9	8.	8.	100%
26 Aug 1987	15.1	101%	.15	1%	15.4	15.0	8.	8.	100%
27 Aug 1987	15.1	101%	.18	1%	15.5	15.0	8.	8.	100%
28 Aug 1987	15.1	101%	.17	1%	15.4	15.0	8.	8.	100%
29 Aug 1987	15.2	101%	.20	1%	15.6	15.0	8.	8.	100%
30 Aug 1987	15.1	101%	.20	1%	15.4	14.9	8.	8.	100%
31 Aug 1987	15.1	100%	.20	1%	15.4	14.9	8.	8.	100%
1 Sep 1987	15.1	101%	.17	1%	15.4	14.9	8.	8.	100%
2 Sep 1987	15.1	101%	.21	1%	15.5	15.0	7.	7.	100%
3 Sep 1987	15.1	101%	.19	1%	15.4	15.0	7.	7.	100%
Summary	15.1	101%	.19	1%	15.6	14.9	138.	138.	100%



Daily Summation For TetraHydroFuran - IRT (Mice) From 15 Jul 1987 through 30 Jul 1987

Summary Data for: THF-IRT 0 ppm/Relative Humidity -- 40.0 to 70.0

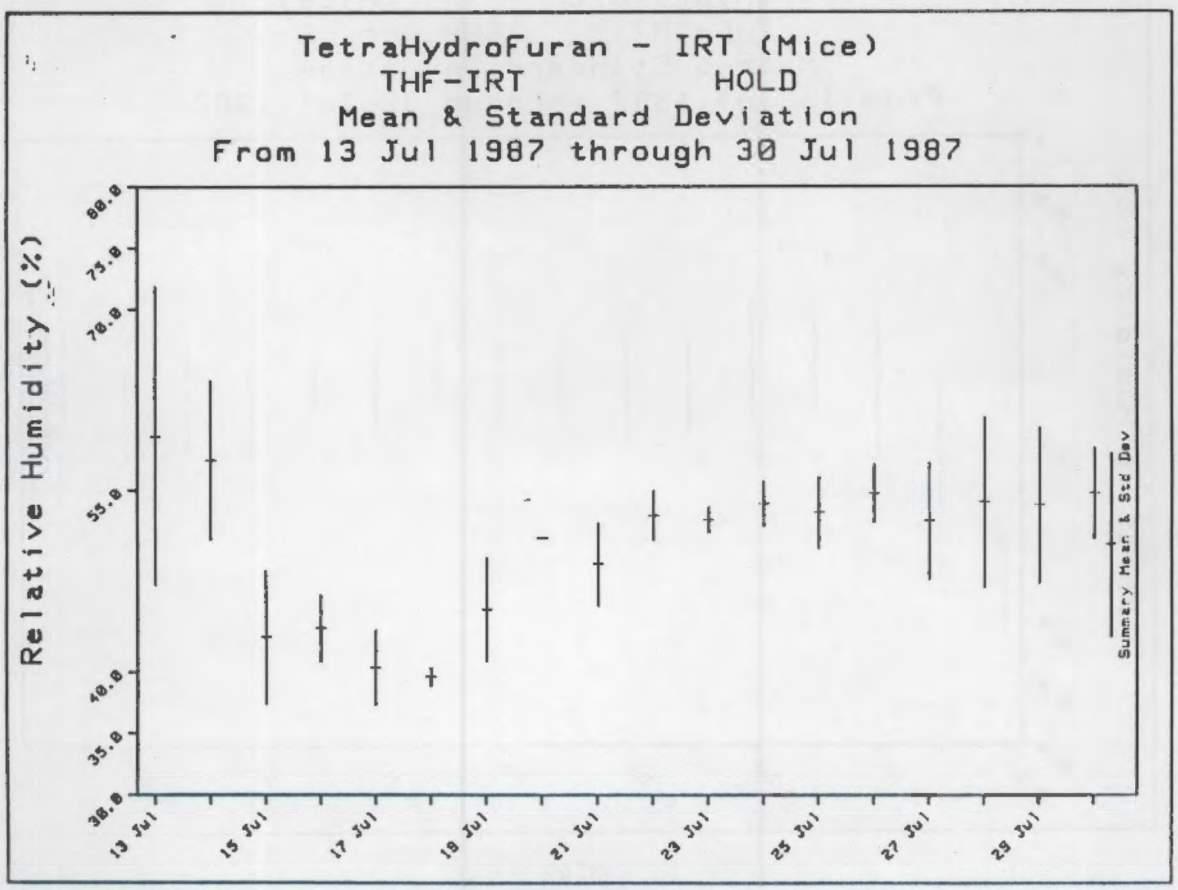
Date	Mean	% Target	Std Dev	% RSD	Maximum	Minimum	N	N in	% N in
15 Jul 1987	42.7	78%	2.56	6%	47.0	40.0	7.	7.	100%
16 Jul 1987	55.0	100%	5.77	10%	60.0	43.0	7.	7.	100%
17 Jul 1987	58.3	106%	5.44	9%	65.0	48.0	8.	8.	100%
18 Jul 1987	59.6	108%	4.90	8%	65.0	53.0	8.	8.	100%
19 Jul 1987	58.1	106%	6.08	10%	65.0	48.0	8.	8.	100%
20 Jul 1987	56.7	103%	4.68	8%	63.0	51.0	7.	7.	100%
21 Jul 1987	55.7	101%	3.20	6%	60.0	51.0	8.	8.	100%
22 Jul 1987	59.6	108%	3.62	6%	65.0	53.0	8.	8.	100%
23 Jul 1987	57.9	105%	6.52	11%	63.0	45.0	7.	7.	100%
24 Jul 1987	59.9	109%	2.48	4%	62.0	56.0	7.	7.	100%
25 Jul 1987	59.4	108%	2.39	4%	62.0	56.0	8.	8.	100%
26 Jul 1987	59.5	108%	1.60	3%	61.0	57.0	8.	8.	100%
27 Jul 1987	57.3	104%	2.76	5%	60.0	52.0	8.	8.	100%
28 Jul 1987	51.9	94%	4.12	8%	59.0	48.0	8.	8.	100%
29 Jul 1987	47.0	85%	2.14	5%	49.0	43.0	8.	8.	100%
30 Jul 1987	46.5	85%	1.91	4%	48.0	44.0	4.	4.	100%
Summary	55.6	101%	6.33	11%	65.0	40.0	119.	119.	100%



Daily Summation For TetraHydroFuran - IRT (Mice)   From 13 Jul 1987 through 30 Jul 1987   --

Summary Data for: THF-IRT   HOLD/Relative Humidity   --   40.0 to 70.0

Date	Mean	% Target	Std Dev	% RSD	Maximum	Minimum	N	N in	% N in
13 Jul 1987	59.5	108%	12.35	21%	75.0	41.0	8.	5.	63%
14 Jul 1987	57.5	105%	6.61	11%	69.0	49.0	8.	8.	100%
15 Jul 1987	42.9	78%	5.46	13%	49.0	35.0	7.	5.	71%
16 Jul 1987	43.6	79%	2.76	6%	46.0	38.0	7.	6.	86%
17 Jul 1987	40.4	73%	3.02	7%	47.0	37.0	8.	5.	63%
18 Jul 1987	39.6	72%	.74	2%	40.0	38.0	8.	6.	75%
19 Jul 1987	45.1	82%	4.22	9%	50.0	39.0	7.	6.	86%
20 Jul 1987	51.0	93%	0.00	0%	51.0	51.0	1.	1.	100%
21 Jul 1987	48.9	89%	3.39	7%	52.0	42.0	7.	7.	100%
22 Jul 1987	52.9	96%	2.03	4%	56.0	50.0	8.	8.	100%
23 Jul 1987	52.5	95%	1.07	2%	53.0	50.0	8.	8.	100%
24 Jul 1987	53.9	98%	1.86	3%	55.0	50.0	7.	7.	100%
25 Jul 1987	53.1	97%	3.00	6%	57.0	47.0	8.	8.	100%
26 Jul 1987	54.7	99%	2.43	4%	58.0	51.0	7.	7.	100%
27 Jul 1987	52.4	95%	4.79	9%	59.0	46.0	7.	7.	100%
28 Jul 1987	54.0	98%	7.05	13%	61.0	40.0	8.	8.	100%
29 Jul 1987	53.7	98%	6.45	12%	61.0	40.0	8.	8.	100%
30 Jul 1987	54.7	100%	3.77	7%	60.0	51.0	4.	4.	100%
Summary	50.5	92%	7.59	15%	75.0	35.0	126.	114.	90%

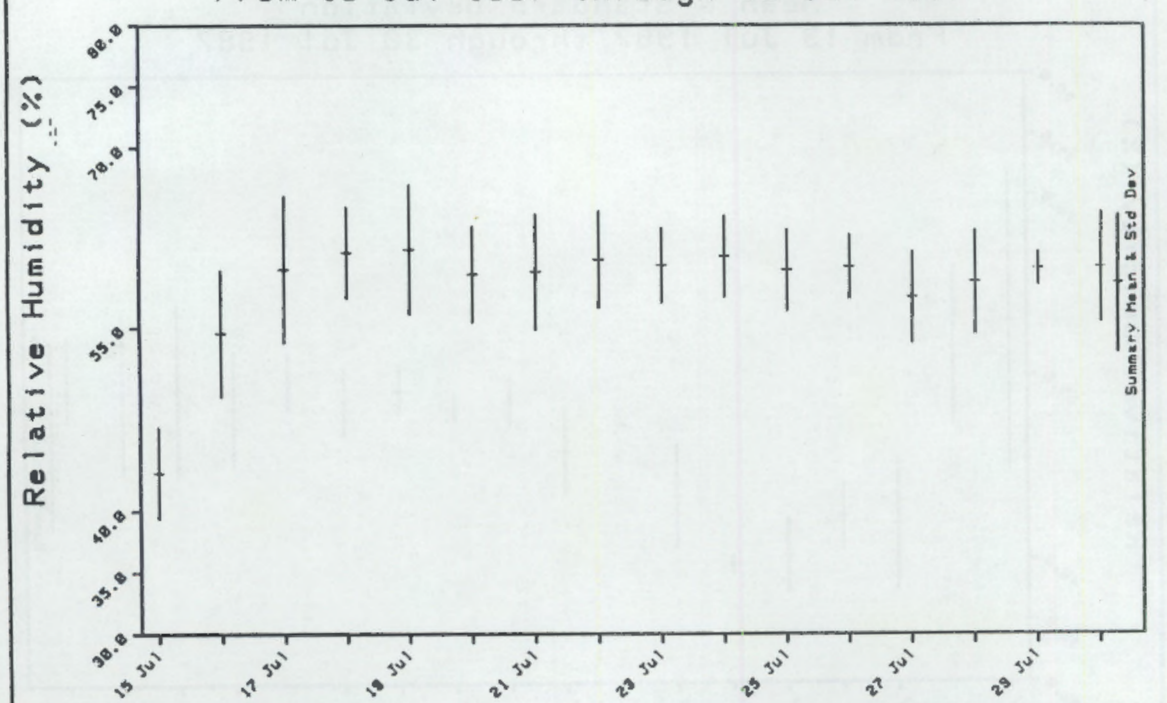


Daily Summation For TetraHydroFuran - IRT (Mice) From 15 Jul 1987 through 30 Jul 1987 --

Summary Data for: THF-IRT 600 ppm/Relative Humidity -- 40.0 to 70.0

Date	Mean	% Target	Std Dev	% RSD	Maximum	Minimum	N	N in	% N in
15 Jul 1987	43.1	78%	3.72	9%	50.0	39.0	7.	6.	86%
16 Jul 1987	54.6	99%	5.22	10%	58.0	43.0	7.	7.	100%
17 Jul 1987	59.9	109%	6.08	10%	67.0	51.0	8.	8.	100%
18 Jul 1987	61.3	111%	3.77	6%	65.0	55.0	8.	8.	100%
19 Jul 1987	61.5	112%	5.35	9%	68.0	52.0	8.	8.	100%
20 Jul 1987	59.4	108%	3.95	7%	65.0	54.0	7.	7.	100%
21 Jul 1987	59.6	108%	4.75	8%	67.0	54.0	8.	8.	100%
22 Jul 1987	60.6	110%	4.00	7%	64.0	54.0	8.	8.	100%
23 Jul 1987	60.1	109%	3.08	5%	64.0	56.0	7.	7.	100%
24 Jul 1987	60.9	111%	3.36	6%	64.0	55.0	8.	8.	100%
25 Jul 1987	59.8	109%	3.41	6%	64.0	55.0	8.	8.	100%
26 Jul 1987	60.0	109%	2.67	4%	63.0	56.0	8.	8.	100%
27 Jul 1987	57.5	105%	3.74	7%	61.0	50.0	8.	8.	100%
28 Jul 1987	58.8	107%	4.27	7%	63.0	51.0	8.	8.	100%
29 Jul 1987	59.9	109%	1.36	2%	62.0	58.0	8.	8.	100%
30 Jul 1987	60.0	109%	4.55	8%	65.0	54.0	4.	4.	100%
Summary	58.7	107%	5.67	10%	68.0	39.0	120.	119.	99%

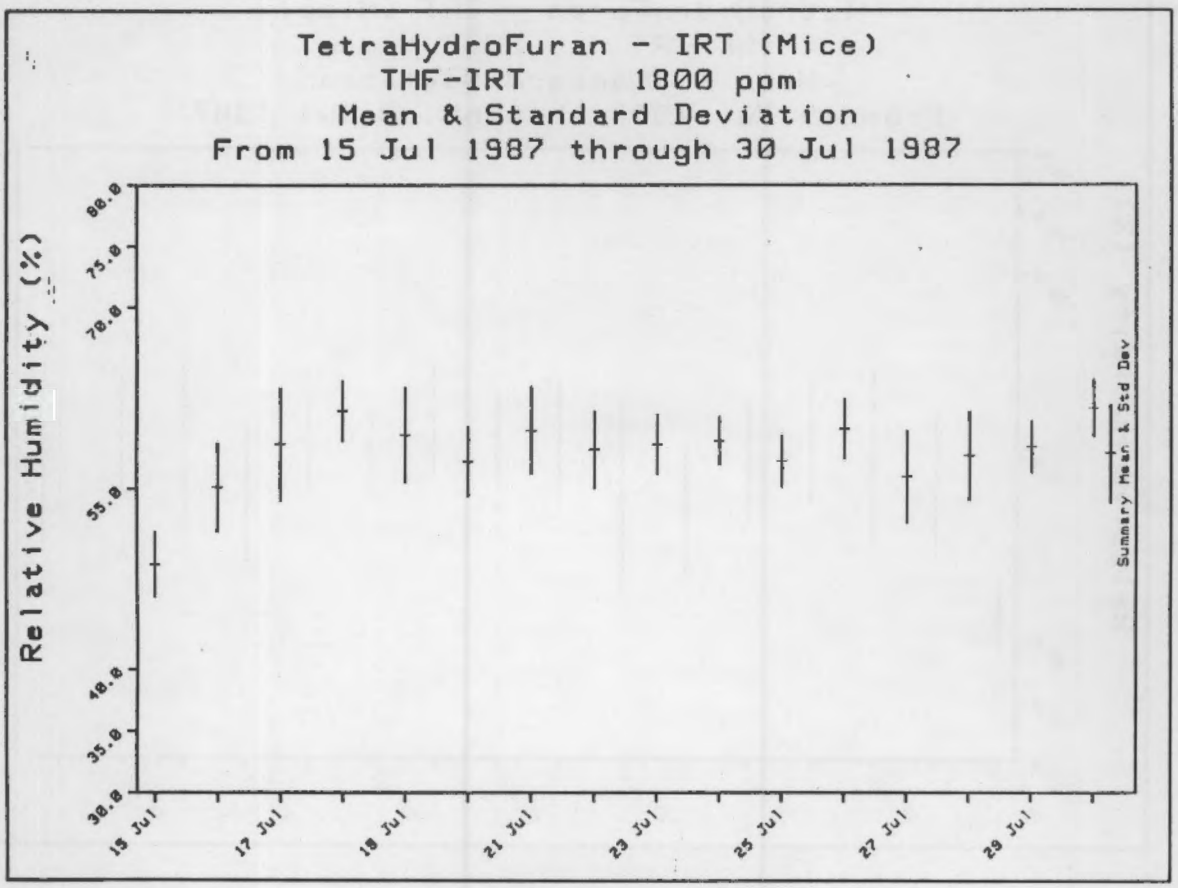
TetraHydroFuran - IRT (Mice)
THF-IRT 600 ppm
Mean & Standard Deviation
From 15 Jul 1987 through 30 Jul 1987



Daily Summation For TetraHydroFuran - IRT (Mice)   From 15 Jul-1987 through 30 Jul 1987   --

Summary Data for: THF-IRT   1800 ppm/Relative Humidity   --   40.0 to 70.0

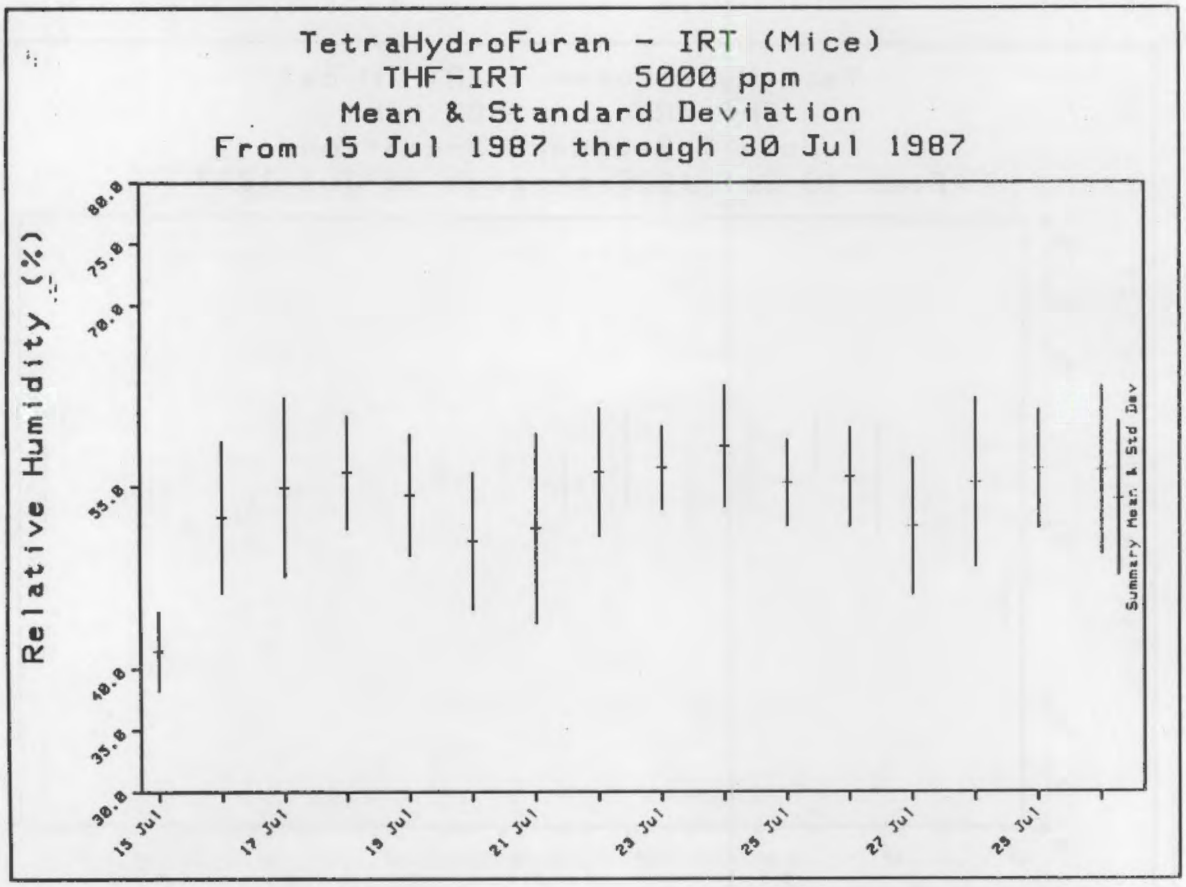
Date	Mean	% Target	Std Dev	% RSD	Maximum	Minimum	N	N in	% N in
15 Jul 1987	48.7	89%	2.69	6%	53.0	45.0	7.	7.	100%
16 Jul 1987	55.1	100%	3.76	7%	59.0	48.0	7.	7.	100%
17 Jul 1987	58.8	107%	4.71	8%	63.0	51.0	8.	8.	100%
18 Jul 1987	61.5	112%	2.51	4%	64.0	58.0	8.	8.	100%
19 Jul 1987	59.5	108%	3.96	7%	65.0	53.0	8.	8.	100%
20 Jul 1987	57.3	104%	2.87	5%	62.0	54.0	7.	7.	100%
21 Jul 1987	59.9	109%	3.64	6%	65.0	56.0	8.	8.	100%
22 Jul 1987	58.3	106%	3.20	5%	62.0	52.0	8.	8.	100%
23 Jul 1987	58.7	107%	2.43	4%	62.0	55.0	7.	7.	100%
24 Jul 1987	59.0	107%	2.00	3%	61.0	56.0	8.	8.	100%
25 Jul 1987	57.4	104%	2.20	4%	61.0	55.0	8.	8.	100%
26 Jul 1987	60.0	109%	2.56	4%	63.0	56.0	8.	8.	100%
27 Jul 1987	56.0	102%	3.82	7%	61.0	49.0	8.	8.	100%
28 Jul 1987	57.8	105%	3.69	6%	62.0	52.0	8.	8.	100%
29 Jul 1987	58.5	106%	2.14	4%	61.0	56.0	8.	8.	100%
30 Jul 1987	61.8	112%	2.36	4%	65.0	60.0	4.	4.	100%
Summary	58.0	105%	4.09	7%	65.0	45.0	120.	120.	100%



Daily Summation For TetraHydroFuran - IRT (Mice) From 15 Jul 1987 through 30 Jul 1987

Summary Data for: THF-IRT 5000 ppm/Relative Humidity 40.0 to 70.0

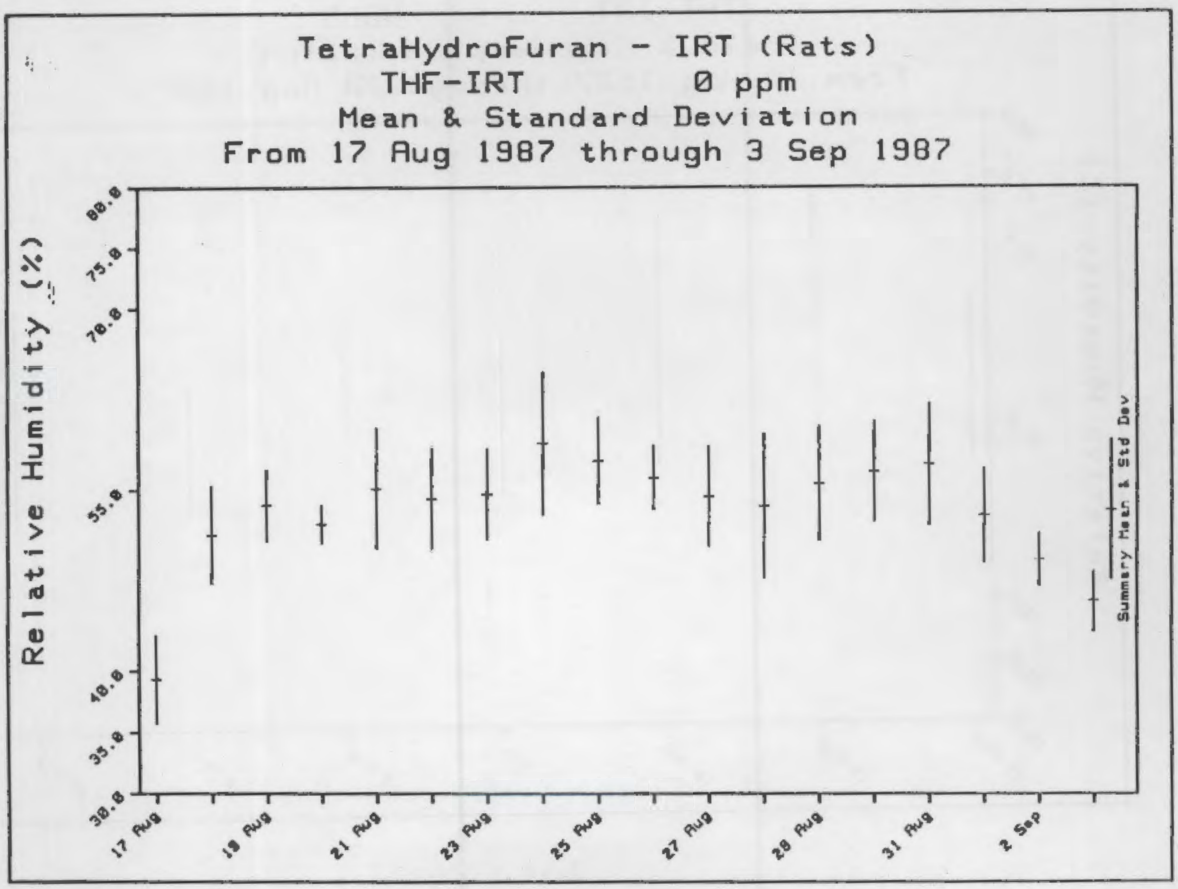
Date	Mean	% Target	Std Dev	% RSD	Maximum	Minimum	N	N in	% N in
15 Jul 1987	41.4	75%	3.21	8%	46.0	36.0	7.	5.	71%
16 Jul 1987	52.4	95%	6.24	12%	59.0	42.0	7.	7.	100%
17 Jul 1987	54.9	100%	7.41	14%	61.0	43.0	8.	8.	100%
18 Jul 1987	56.1	102%	4.67	8%	61.0	50.0	8.	8.	100%
19 Jul 1987	54.2	99%	5.04	9%	60.0	46.0	8.	8.	100%
20 Jul 1987	50.4	92%	5.65	11%	59.0	41.0	7.	7.	100%
21 Jul 1987	51.5	94%	7.84	15%	62.0	37.0	8.	7.	88%
22 Jul 1987	56.1	102%	5.28	9%	61.0	48.0	8.	8.	100%
23 Jul 1987	56.5	103%	3.42	6%	60.0	50.0	8.	8.	100%
24 Jul 1987	58.3	106%	5.01	9%	64.0	51.0	8.	8.	100%
25 Jul 1987	55.2	100%	3.54	6%	60.0	50.0	8.	8.	100%
26 Jul 1987	55.7	101%	4.07	7%	61.0	49.0	7.	7.	100%
27 Jul 1987	51.6	94%	5.63	11%	56.0	43.0	8.	8.	100%
28 Jul 1987	55.2	100%	6.94	13%	63.0	43.0	8.	8.	100%
29 Jul 1987	56.4	102%	4.90	9%	61.0	49.0	8.	8.	100%
30 Jul 1987	56.3	102%	6.95	12%	64.0	49.0	4.	4.	100%
Summary	54.0	98%	6.37	12%	64.0	36.0	120.	117.	97%



Daily Summation For TetraHydroFuran - IRT (Rats)   From 17 Aug 1987 through 3 Sep 1987   --

Summary Data for: THF-IRT   0 ppm/Relative Humidity   --   40.0 to 70.0

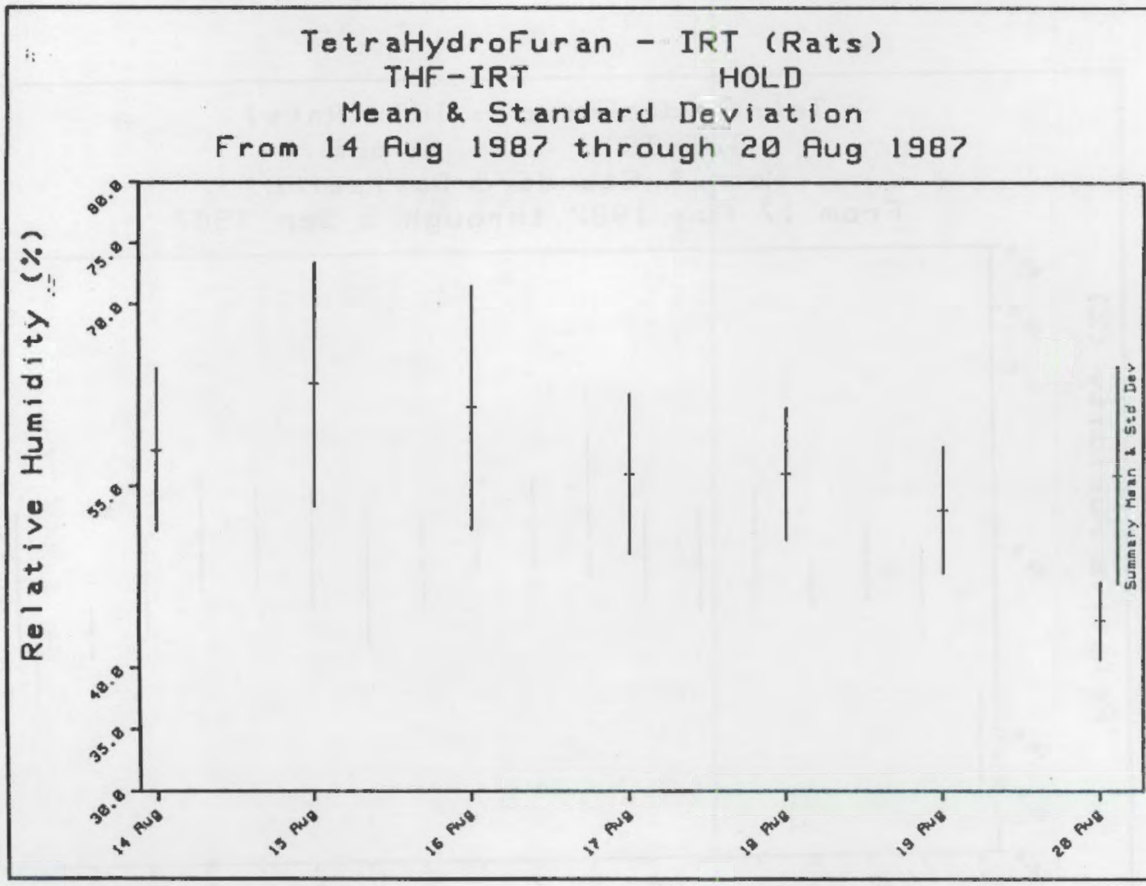
Date	Mean	% Target	Std Dev	% RSD	Maximum	Minimum	N	N in	% N in
17 Aug 1987	39.3	72%	3.56	9%	43.0	33.0	6.	4.	67%
18 Aug 1987	51.2	93%	4.10	8%	56.0	43.0	8.	8.	100%
19 Aug 1987	53.7	98%	2.98	6%	58.0	49.0	7.	7.	100%
20 Aug 1987	52.1	95%	1.57	3%	55.0	50.0	7.	7.	100%
21 Aug 1987	55.1	100%	5.00	9%	61.0	49.0	8.	8.	100%
22 Aug 1987	54.2	99%	4.30	8%	59.0	48.0	8.	8.	100%
23 Aug 1987	54.6	99%	3.74	7%	61.0	51.0	8.	8.	100%
24 Aug 1987	58.9	107%	5.93	10%	65.0	51.0	7.	7.	100%
25 Aug 1987	57.4	104%	3.58	6%	62.0	53.0	8.	8.	100%
26 Aug 1987	56.0	102%	2.65	5%	59.0	54.0	3.	3.	100%
27 Aug 1987	54.4	99%	4.12	8%	60.0	49.0	7.	7.	100%
28 Aug 1987	53.6	97%	5.95	11%	60.0	41.0	8.	8.	100%
29 Aug 1987	55.5	101%	4.75	9%	61.0	50.0	8.	8.	100%
30 Aug 1987	56.5	103%	4.11	7%	61.0	50.0	8.	8.	100%
31 Aug 1987	57.1	104%	5.03	9%	63.0	51.0	8.	8.	100%
1 Sep 1987	52.9	96%	3.91	7%	61.0	49.0	8.	8.	100%
2 Sep 1987	49.1	89%	2.19	4%	52.0	45.0	7.	7.	100%
3 Sep 1987	45.7	83%	2.50	5%	50.0	43.0	7.	7.	100%
Summary	53.3	97%	5.78	11%	65.0	33.0	131.	129.	98%



Daily Summation For TetraHydroFuran - IRT (Rats) From 14 Aug 1987 through 20 Aug 1987

Summary Data for: THF-IRT HOLD/Relative Humidity -- 40.0 to 70.0

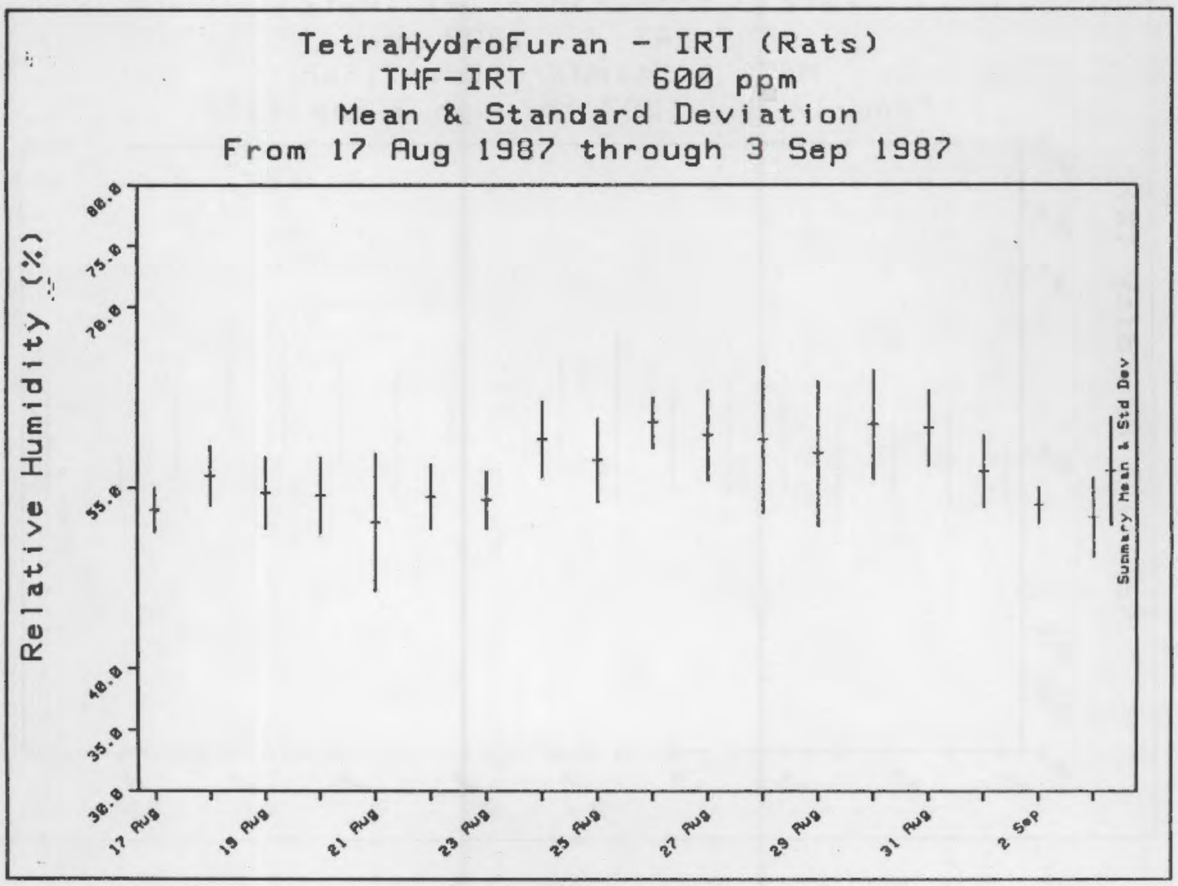
Date	Mean	% Target	Std Dev	% RSD	Maximum	Minimum	N	N in	% N in
14 Aug 1987	58.0	105%	6.68	12%	71.0	49.0	7.	6.	86%
15 Aug 1987	63.4	115%	10.03	16%	72.0	44.0	7.	5.	71%
16 Aug 1987	61.5	112%	10.06	16%	79.0	43.0	8.	7.	88%
17 Aug 1987	56.0	102%	6.59	12%	68.0	49.0	8.	8.	100%
18 Aug 1987	56.0	102%	5.45	10%	62.0	48.0	8.	8.	100%
19 Aug 1987	53.0	96%	5.26	10%	59.0	47.0	7.	7.	100%
20 Aug 1987	43.9	80%	3.14	7%	49.0	39.0	8.	7.	88%
Summary	55.8	102%	9.01	16%	79.0	39.0	53.	48.	91%



Daily Summation For TetraHydroFuran - IRT (Rats)   From 17 Aug 1987 through 3 Sep 1987

Summary Data for: THF-IRT   600 ppm/Relative Humidity   -- 40.0 to 70.0

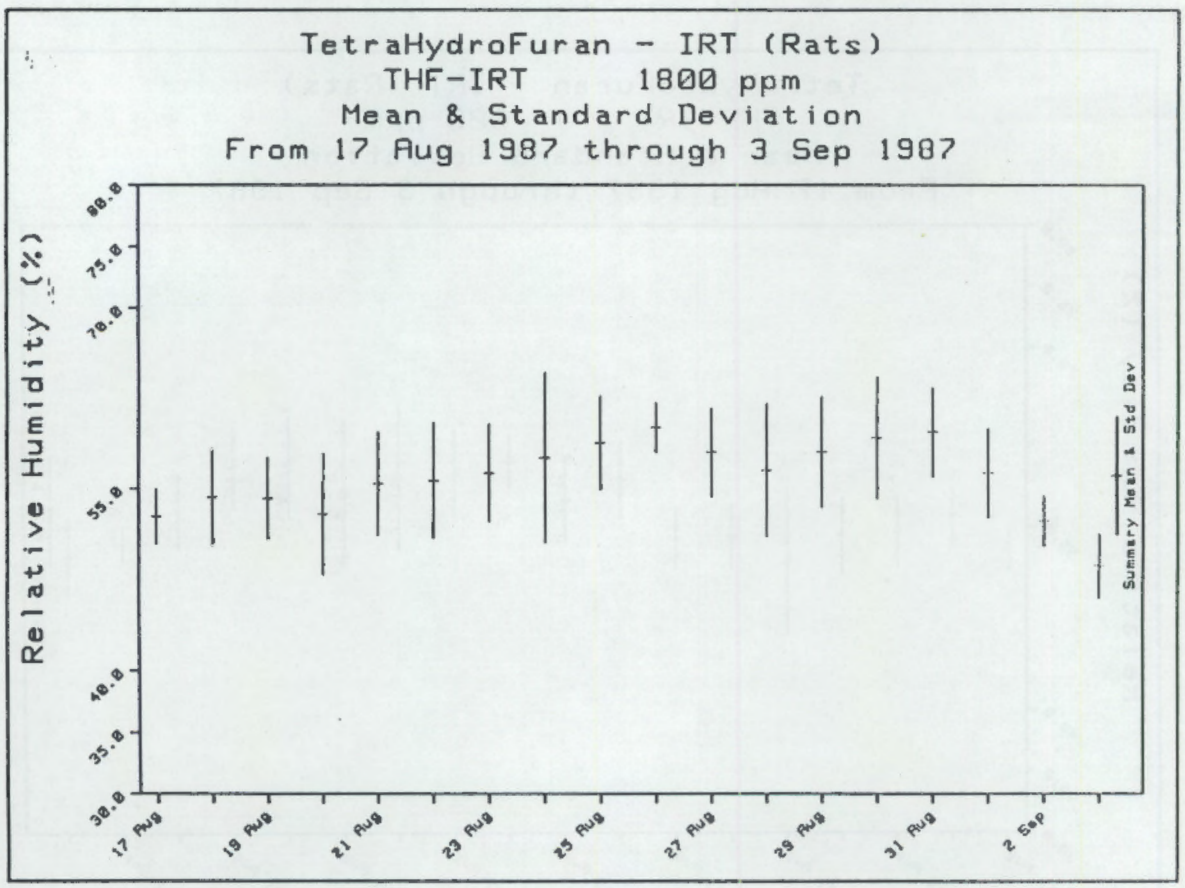
Date	Mean	% Target	Std Dev	% RSD	Maximum	Minimum	N	N in	% N in
17 Aug 1987	53.2	97%	1.83	3%	55.0	50.0	6.	6.	100%
18 Aug 1987	56.0	102%	2.45	4%	58.0	51.0	8.	8.	100%
19 Aug 1987	54.6	99%	2.94	5%	59.0	50.0	7.	7.	100%
20 Aug 1987	54.3	99%	3.20	6%	57.0	49.0	7.	7.	100%
21 Aug 1987	52.1	95%	5.69	11%	59.0	41.0	8.	8.	100%
22 Aug 1987	54.2	99%	2.66	5%	58.0	50.0	8.	8.	100%
23 Aug 1987	54.0	98%	2.39	4%	59.0	52.0	8.	8.	100%
24 Aug 1987	59.0	107%	3.27	6%	63.0	54.0	7.	7.	100%
25 Aug 1987	57.3	104%	3.45	6%	61.0	51.0	7.	7.	100%
26 Aug 1987	60.4	110%	2.15	4%	63.0	57.0	7.	7.	100%
27 Aug 1987	59.4	108%	3.81	6%	64.0	54.0	8.	8.	100%
28 Aug 1987	59.0	107%	6.07	10%	65.0	46.0	8.	8.	100%
29 Aug 1987	57.9	105%	6.03	10%	65.0	45.0	9.	9.	100%
30 Aug 1987	60.3	110%	4.53	8%	65.0	53.0	8.	8.	100%
31 Aug 1987	60.0	109%	3.16	5%	65.0	57.0	8.	8.	100%
1 Sep 1987	56.4	102%	2.97	5%	63.0	54.0	8.	8.	100%
2 Sep 1987	53.6	97%	1.51	3%	55.0	51.0	7.	7.	100%
3 Sep 1987	52.6	96%	3.31	6%	57.0	49.0	7.	7.	100%
Summary	56.4	103%	4.47	8%	65.0	41.0	136.	136.	100%



Daily Summation For TetraHydroFuran - IRT (Rats)   From 17 Aug 1987 through 3 Sep 1987

Summary Data for: THF-IRT   1800 ppm/Relative Humidity   40.0 to 70.0

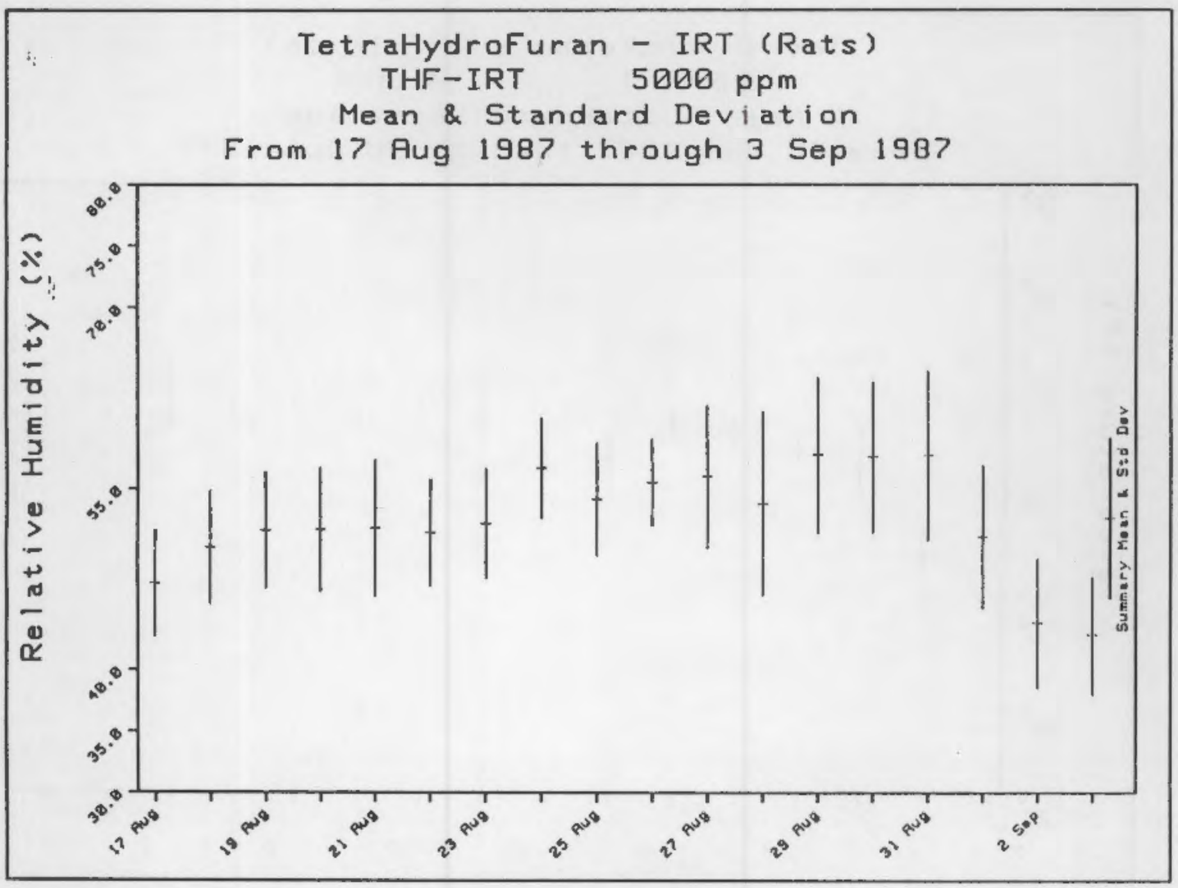
Date	Mean	% Target	Std Dev	% RSD	Maximum	Minimum	N	N in	% N in
17 Aug 1987	52.7	96%	2.25	4%	56.0	51.0	6.	6.	100%
18 Aug 1987	54.2	99%	3.99	7%	61.0	49.0	8.	8.	100%
19 Aug 1987	54.1	98%	3.39	6%	58.0	50.0	7.	7.	100%
20 Aug 1987	52.9	96%	4.95	9%	59.0	44.0	7.	7.	100%
21 Aug 1987	55.4	101%	4.24	8%	62.0	49.0	8.	8.	100%
22 Aug 1987	55.6	101%	4.75	9%	62.0	50.0	8.	8.	100%
23 Aug 1987	56.3	102%	3.99	7%	62.0	51.0	8.	8.	100%
24 Aug 1987	57.5	105%	6.99	12%	65.0	46.0	8.	8.	100%
25 Aug 1987	58.8	107%	3.81	6%	64.0	52.0	8.	8.	100%
26 Aug 1987	60.0	109%	2.00	3%	62.0	56.0	8.	8.	100%
27 Aug 1987	58.0	105%	3.55	6%	62.0	52.0	8.	8.	100%
28 Aug 1987	56.5	103%	5.42	10%	63.0	45.0	8.	8.	100%
29 Aug 1987	58.0	105%	4.53	8%	64.0	52.0	9.	9.	100%
30 Aug 1987	59.1	107%	4.97	8%	65.0	51.0	8.	8.	100%
31 Aug 1987	59.6	108%	3.62	6%	64.0	55.0	8.	8.	100%
1 Sep 1987	56.3	102%	3.62	6%	64.0	53.0	8.	8.	100%
2 Sep 1987	52.3	95%	2.06	4%	56.0	50.0	7.	7.	100%
3 Sep 1987	48.6	88%	2.64	5%	54.0	46.0	7.	7.	100%
Summary	56.1	102%	4.84	9%	65.0	44.0	139.	139.	100%



Daily Summation For TetraHydroFuran - IRT (Rats)   From 17 Aug 1987 through 3 Sep 1987

Summary Data for: THF-IRT   5000 ppm/Relative Humidity   40.0 to 70.0

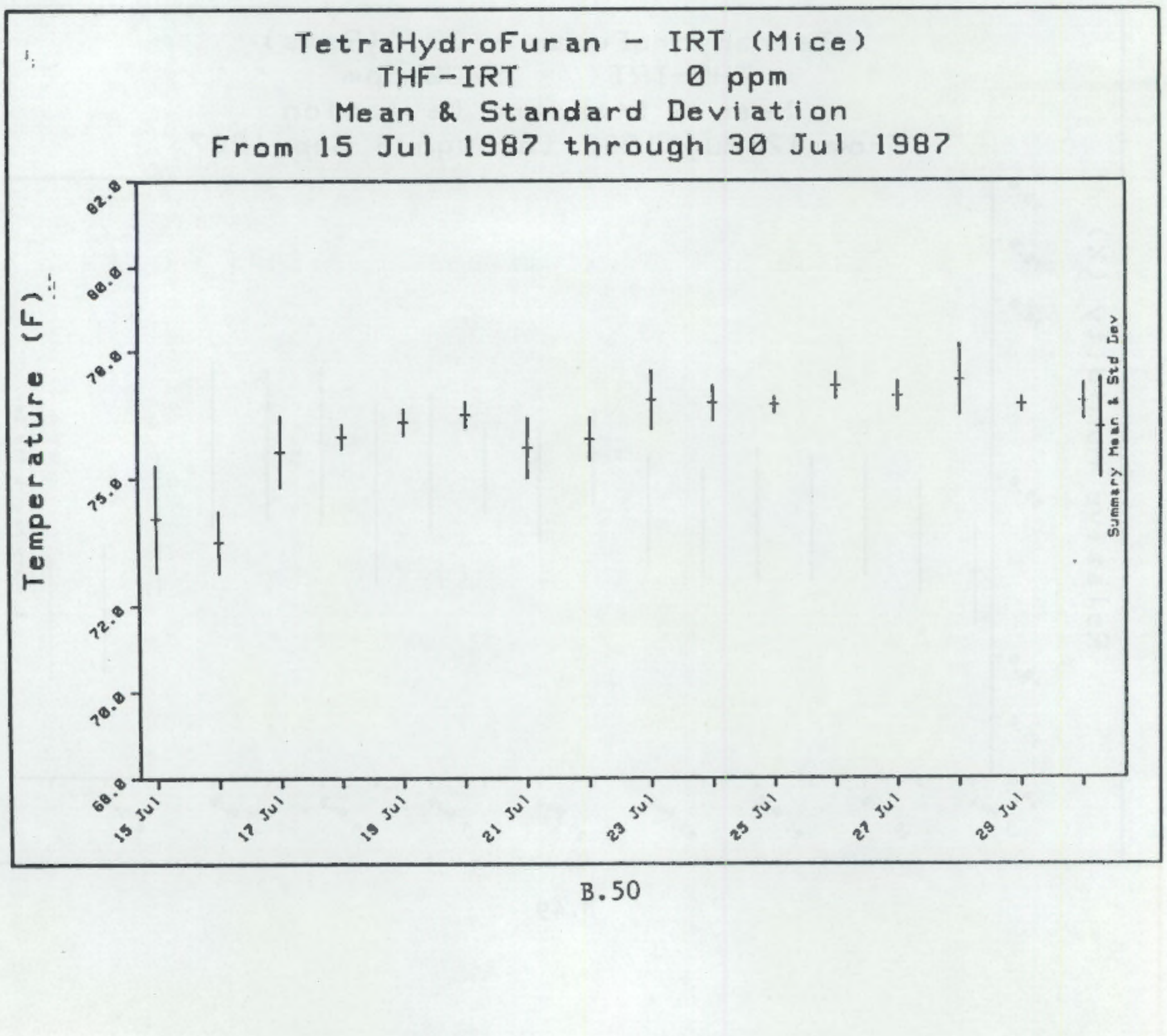
Date	Mean	% Target	Std Dev	% RSD	Maximum	Minimum	N	N in	% N in
17 Aug 1987	47.2	86%	4.36	9%	52.0	42.0	6.	6.	100%
18 Aug 1987	50.1	91%	4.70	9%	56.0	44.0	8.	8.	100%
19 Aug 1987	51.6	94%	4.79	9%	58.0	45.0	7.	7.	100%
20 Aug 1987	51.6	94%	5.13	10%	60.0	45.0	8.	8.	100%
21 Aug 1987	51.7	94%	5.63	11%	58.0	42.0	8.	8.	100%
22 Aug 1987	51.4	93%	4.41	9%	56.0	46.0	8.	8.	100%
23 Aug 1987	52.1	95%	4.52	9%	59.0	46.0	8.	8.	100%
24 Aug 1987	56.7	103%	4.15	7%	62.0	50.0	7.	7.	100%
25 Aug 1987	54.1	98%	4.61	9%	59.0	47.0	8.	8.	100%
26 Aug 1987	55.5	101%	3.55	6%	59.0	49.0	8.	8.	100%
27 Aug 1987	56.0	102%	5.90	11%	66.0	47.0	8.	8.	100%
28 Aug 1987	53.7	98%	7.59	14%	64.0	44.0	8.	8.	100%
29 Aug 1987	57.8	105%	6.46	11%	64.0	48.0	9.	9.	100%
30 Aug 1987	57.6	105%	6.23	11%	65.0	48.0	8.	8.	100%
31 Aug 1987	57.8	105%	7.01	12%	67.0	47.0	8.	8.	100%
1 Sep 1987	51.0	93%	5.90	12%	64.0	45.0	8.	8.	100%
2 Sep 1987	43.9	80%	5.30	12%	51.0	35.0	7.	6.	86%
3 Sep 1987	42.9	78%	4.85	11%	49.0	35.0	7.	5.	71%
Summary	52.6	96%	6.60	13%	67.0	35.0	139.	136.	98%



Daily Summation For TetraHydroFuran - IRT (Mice)   From 15 Jul 1987 through 30 Jul 1987

Summary Data for: THF-IRT   0 ppm/Temperature   72.0 to 78.0

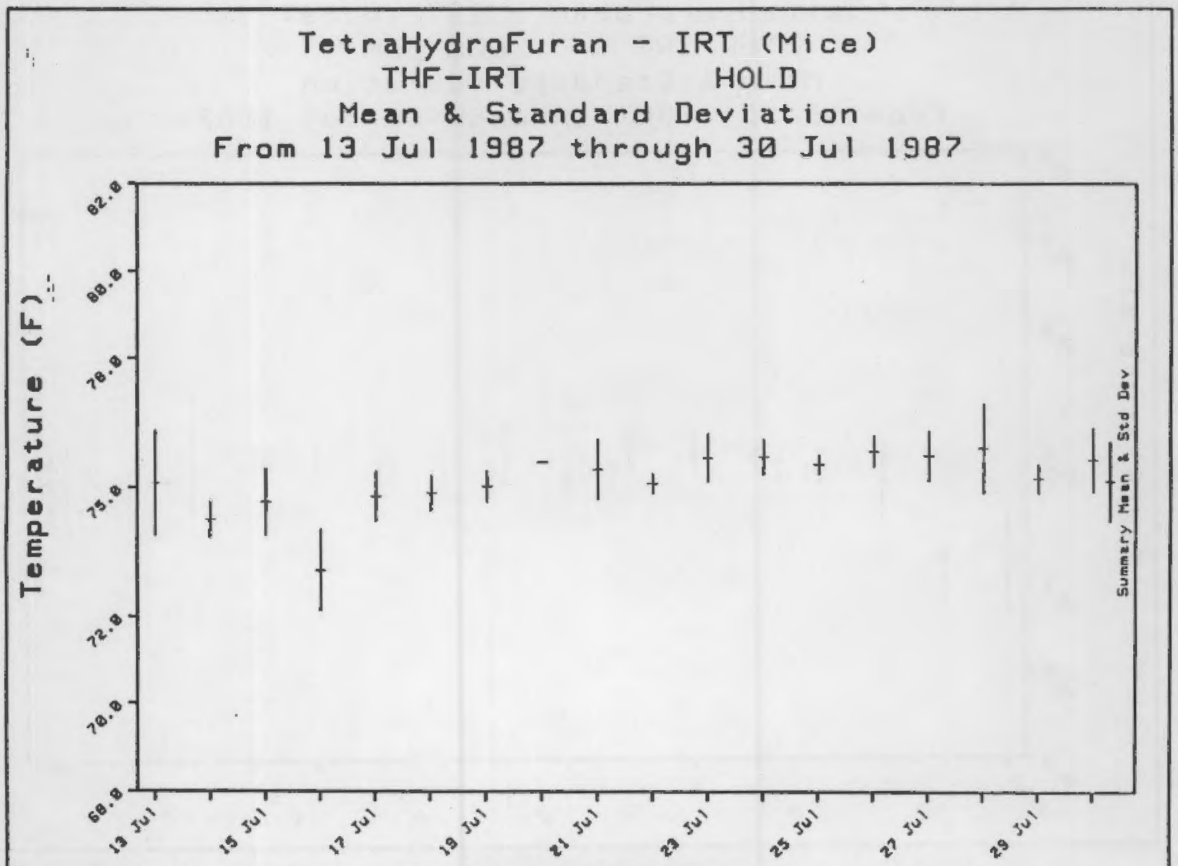
Date	Mean	% Target	Std Dev	% RSD	Maximum	Minimum	N	N in	% N in
15 Jul 1987	74.1	99%	1.25	2%	75.0	71.4	7.	6.	86%
16 Jul 1987	73.5	98%	.73	1%	74.6	72.2	8.	8.	100%
17 Jul 1987	75.6	101%	.84	1%	76.8	73.9	8.	8.	100%
18 Jul 1987	76.0	101%	.29	0%	76.4	75.7	8.	8.	100%
19 Jul 1987	76.3	102%	.31	0%	76.6	75.7	7.	7.	100%
20 Jul 1987	76.5	102%	.32	0%	76.9	75.9	7.	7.	100%
21 Jul 1987	75.7	101%	.71	1%	77.0	74.9	8.	8.	100%
22 Jul 1987	75.9	101%	.51	1%	76.7	74.9	8.	8.	100%
23 Jul 1987	76.8	102%	.69	1%	78.3	76.2	8.	7.	88%
24 Jul 1987	76.8	102%	.42	1%	77.2	76.1	8.	8.	100%
25 Jul 1987	76.7	102%	.20	0%	77.0	76.5	8.	8.	100%
26 Jul 1987	77.2	103%	.31	0%	77.6	76.8	8.	8.	100%
27 Jul 1987	76.9	103%	.35	0%	77.5	76.5	7.	7.	100%
28 Jul 1987	77.3	103%	.84	1%	79.3	76.4	9.	8.	89%
29 Jul 1987	76.7	102%	.17	0%	76.9	76.4	8.	8.	100%
30 Jul 1987	76.8	102%	.43	1%	77.4	76.5	5.	5.	100%
Summary	76.2	102%	1.18	2%	79.3	71.4	122.	119.	98%



Daily Summation For TetraHydroFuran - IRT (Mice) From 13 Jul 1987 through 30 Jul 1987

Summary Data for: THF-IRT HOLD/Temperature 72.0 to 78.0

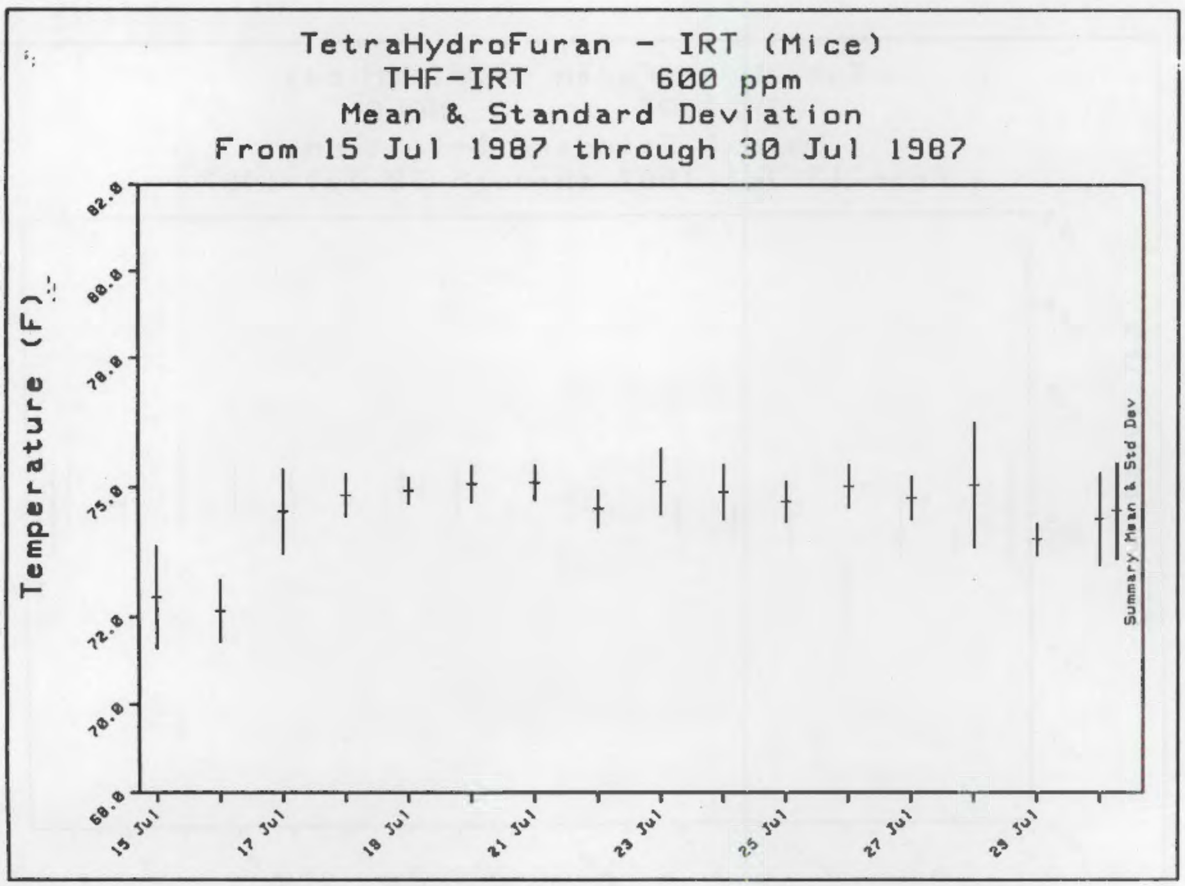
Date	Mean	% Target	Std Dev	% RSD	Maximum	Minimum	N	N in	% N in
13 Jul 1987	75.1	100%	1.22	2%	77.8	74.0	8.	8.	100%
14 Jul 1987	74.3	99%	.43	1%	74.8	73.6	9.	9.	100%
15 Jul 1987	74.7	100%	.77	1%	75.7	73.3	7.	7.	100%
16 Jul 1987	73.1	97%	.94	1%	74.4	71.3	8.	7.	88%
17 Jul 1987	74.8	100%	.57	1%	75.4	73.6	8.	8.	100%
18 Jul 1987	74.9	100%	.42	1%	75.7	74.4	8.	8.	100%
19 Jul 1987	75.0	100%	.35	0%	75.6	74.5	8.	8.	100%
20 Jul 1987	75.6	101%	0.00	0%	75.6	75.6	1.	1.	100%
21 Jul 1987	75.4	101%	.69	1%	76.8	74.6	7.	7.	100%
22 Jul 1987	75.1	100%	.22	0%	75.3	74.7	7.	7.	100%
23 Jul 1987	75.7	101%	.55	1%	76.8	75.0	8.	8.	100%
24 Jul 1987	75.7	101%	.40	1%	76.3	75.1	8.	8.	100%
25 Jul 1987	75.5	101%	.21	0%	76.0	75.3	8.	8.	100%
26 Jul 1987	75.8	101%	.35	0%	76.4	75.6	8.	8.	100%
27 Jul 1987	75.7	101%	.57	1%	76.8	75.2	7.	7.	100%
28 Jul 1987	75.9	101%	1.04	1%	78.3	75.1	9.	8.	89%
29 Jul 1987	75.2	100%	.33	0%	75.8	74.7	8.	8.	100%
30 Jul 1987	75.6	101%	.74	1%	76.6	74.8	5.	5.	100%
Summary	75.1	100%	.92	1%	78.3	71.3	132.	130.	98%



Daily Summation For TetraHydroFuran - IRT (Mice)   From 15 Jul 1987 through 30 Jul 1987

Summary Data for: THF-IRT   600 ppm/Temperature   72.0 to 78.0

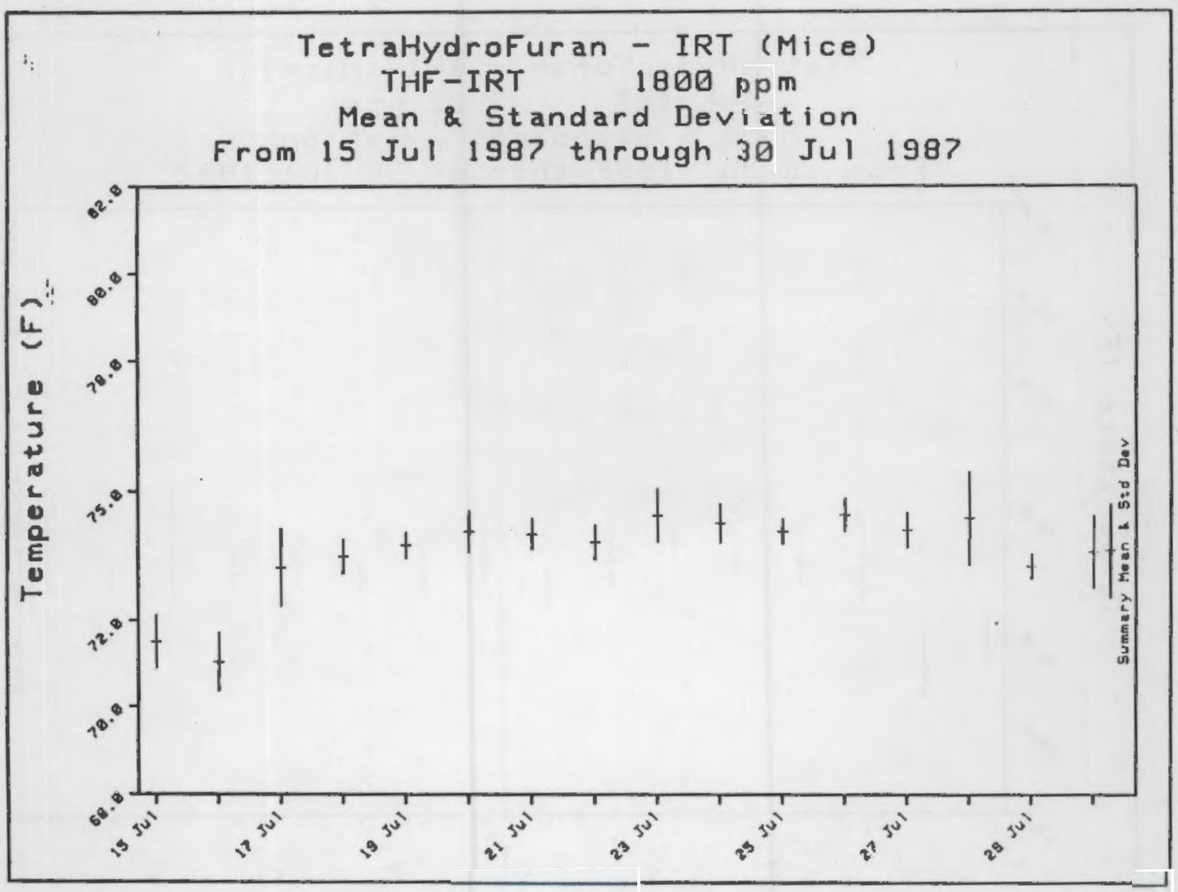
Date	Mean	% Target	Std Dev	% RSD	Maximum	Minimum	N	N in	% N in
15 Jul 1987	72.5	97%	1.17	2%	73.5	70.2	7.	5.	71%
16 Jul 1987	72.1	96%	.70	1%	72.9	70.8	8.	5.	63%
17 Jul 1987	74.4	99%	.98	1%	75.8	72.5	8.	8.	100%
18 Jul 1987	74.8	100%	.48	1%	75.7	74.3	8.	8.	100%
19 Jul 1987	74.9	100%	.29	0%	75.2	74.4	7.	7.	100%
20 Jul 1987	75.1	100%	.42	1%	75.6	74.5	7.	7.	100%
21 Jul 1987	75.1	100%	.40	1%	75.7	74.6	8.	8.	100%
22 Jul 1987	74.5	99%	.42	1%	75.0	73.9	8.	8.	100%
23 Jul 1987	75.1	100%	.76	1%	76.6	74.2	8.	8.	100%
24 Jul 1987	74.9	100%	.64	1%	75.9	74.2	8.	8.	100%
25 Jul 1987	74.7	100%	.46	1%	75.6	74.2	8.	8.	100%
26 Jul 1987	75.0	100%	.50	1%	75.9	74.4	8.	8.	100%
27 Jul 1987	74.8	100%	.50	1%	75.5	74.2	7.	7.	100%
28 Jul 1987	75.1	100%	1.44	2%	78.5	73.9	9.	8.	89%
29 Jul 1987	73.8	98%	.37	1%	74.3	73.4	8.	8.	100%
30 Jul 1987	74.3	99%	1.06	1%	75.9	73.3	5.	5.	100%
Summary	74.5	99%	1.12	2%	78.5	70.2	122.	116.	95%



Daily Summation For TetraHydroFuran - IRT (Mice)   From 15 Jul 1987 through 30 Jul 1987

Summary Data for: THF-IRT   1800 ppm/Temperature   72.0 to 78.0

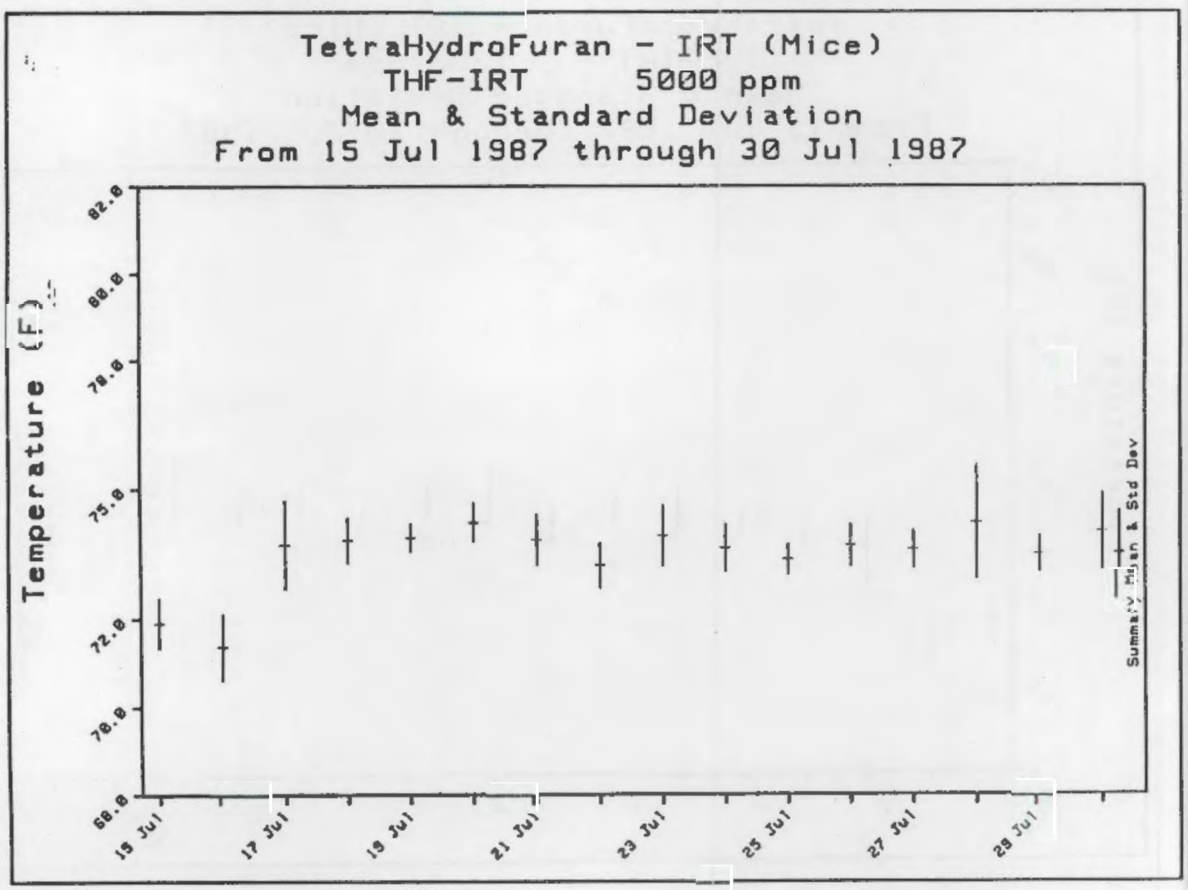
Date	Mean	% Target	Std Dev	% RSD	Maximum	Minimum	N	N in	% N in
15 Jul 1987	71.5	95%	.64	1%	72.2	70.3	6.	1.	17%
16 Jul 1987	71.0	95%	.67	1%	71.6	69.6	8.	0.	0%
17 Jul 1987	73.2	98%	.89	1%	74.5	71.5	8.	7.	88%
18 Jul 1987	73.5	98%	.41	1%	74.3	73.1	8.	8.	100%
19 Jul 1987	73.7	98%	.29	0%	73.9	73.1	7.	7.	100%
20 Jul 1987	74.1	99%	.48	1%	74.7	73.3	8.	8.	100%
21 Jul 1987	74.0	99%	.36	0%	74.7	73.5	8.	8.	100%
22 Jul 1987	73.8	98%	.40	1%	74.5	73.4	8.	8.	100%
23 Jul 1987	74.4	99%	.61	1%	75.6	73.6	8.	8.	100%
24 Jul 1987	74.2	99%	.45	1%	74.9	73.6	8.	8.	100%
25 Jul 1987	74.1	99%	.29	0%	74.7	73.8	8.	8.	100%
26 Jul 1987	74.5	99%	.38	1%	75.1	74.1	8.	8.	100%
27 Jul 1987	74.1	99%	.39	1%	74.8	73.7	7.	7.	100%
28 Jul 1987	74.4	99%	1.07	1%	76.8	73.5	9.	9.	100%
29 Jul 1987	73.2	98%	.28	0%	73.7	72.9	8.	8.	100%
30 Jul 1987	73.6	98%	.84	1%	74.7	72.7	5.	5.	100%
Summary	73.6	98%	1.09	1%	76.8	69.6	122.	108.	89%



Daily Summation For TetraHydroFuran - IRT (Mice) From 15 Jul 1987 through 30 Jul 1987 --

Summary Data for: THF-IRT 5000 ppm/Temperature - - 72.0 to 78.0

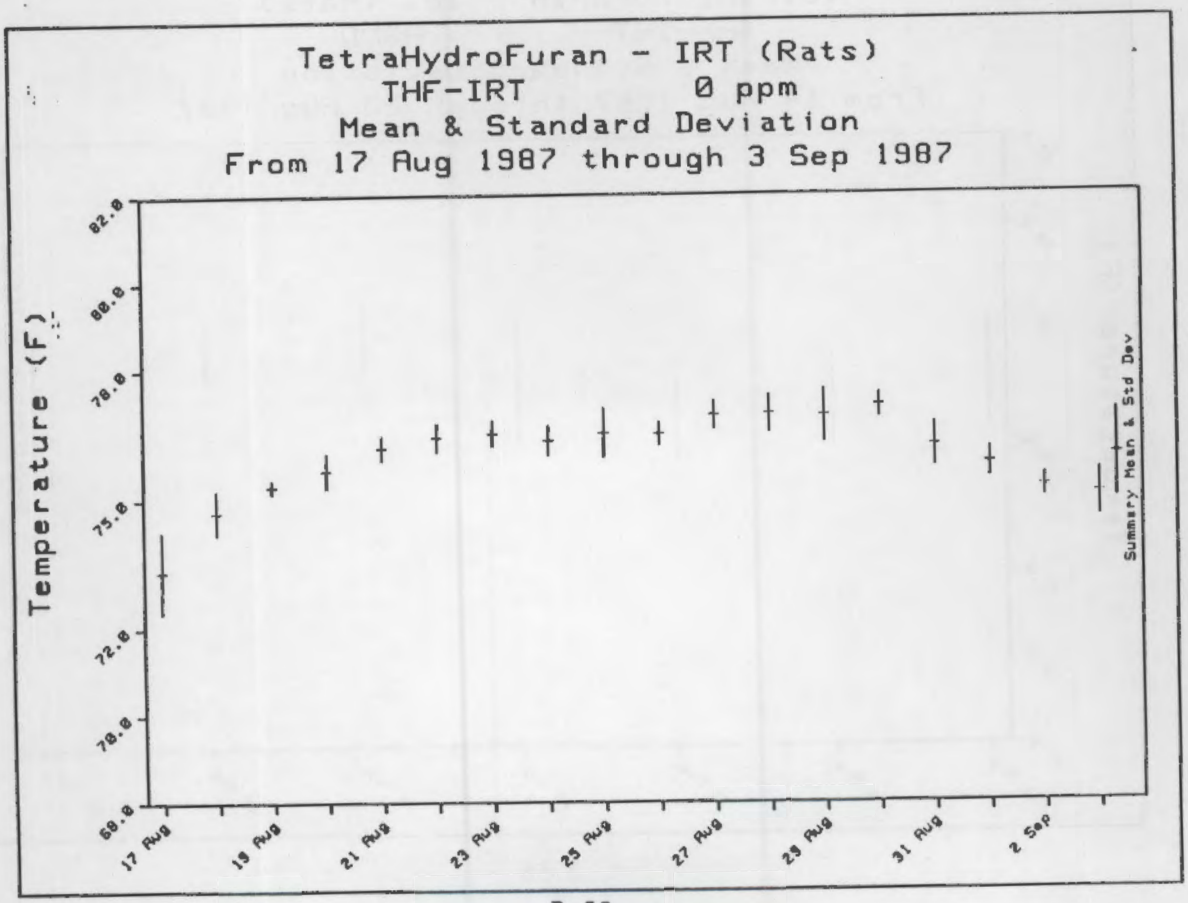
Date	Mean	% Target	Std Dev	% RSD	Maximum	Minimum	N	N in	% N in
15 Jul 1987	71.9	96%	.58	1%	72.6	70.8	7.	3.	43%
16 Jul 1987	71.4	95%	.74	1%	72.3	70.1	8.	2.	25%
17 Jul 1987	73.7	98%	1.03	1%	75.2	71.7	8.	7.	88%
18 Jul 1987	73.8	98%	.53	1%	74.7	73.2	8.	8.	100%
19 Jul 1987	73.9	98%	.32	0%	74.3	73.2	8.	8.	100%
20 Jul 1987	74.2	99%	.44	1%	74.8	73.6	8.	8.	100%
21 Jul 1987	73.8	98%	.60	1%	74.8	73.0	8.	8.	100%
22 Jul 1987	73.2	98%	.51	1%	73.8	72.5	7.	7.	100%
23 Jul 1987	73.9	99%	.71	1%	75.3	73.0	8.	8.	100%
24 Jul 1987	73.6	98%	.55	1%	74.6	73.1	8.	8.	100%
25 Jul 1987	73.4	98%	.35	0%	74.0	73.0	8.	8.	100%
26 Jul 1987	73.7	98%	.49	1%	74.6	73.2	8.	8.	100%
27 Jul 1987	73.6	98%	.43	1%	74.3	73.0	7.	7.	100%
28 Jul 1987	74.2	99%	1.32	2%	77.1	73.2	9.	9.	100%
29 Jul 1987	73.5	98%	.41	1%	74.2	73.1	8.	8.	100%
30 Jul 1987	74.0	99%	.88	1%	75.0	72.9	5.	5.	100%
Summary	73.5	98%	.98	1%	77.1	70.1	123.	112.	91%



Daily Summation For TetraHydroFuran - IRT (Rats) From 17 Aug 1987 through 3 Sep 1987 --

Summary Data for: THF-IRT 0 ppm/Temperature -- 72.0 to 78.0

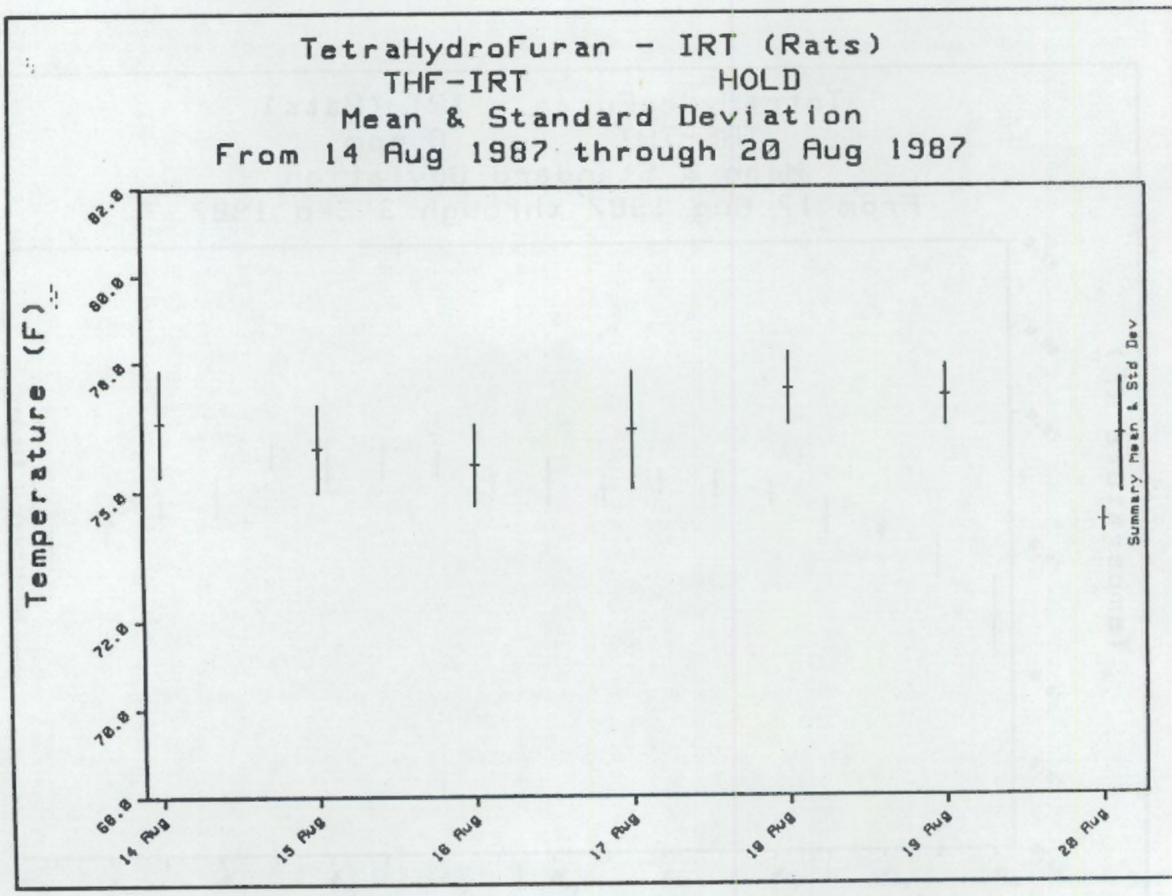
Date	Mean	% Target	Std Dev	% RSD	Maximum	Minimum	N	N in	% N in
17 Aug 1987	73.3	98%	.94	1%	73.8	71.2	7.	6.	86%
18 Aug 1987	74.7	100%	.50	1%	75.2	73.5	8.	8.	100%
19 Aug 1987	75.3	100%	.15	0%	75.5	75.1	7.	7.	100%
20 Aug 1987	75.7	101%	.40	1%	76.3	75.2	7.	7.	100%
21 Aug 1987	76.2	102%	.29	0%	76.5	75.7	8.	8.	100%
22 Aug 1987	76.4	102%	.33	0%	76.8	75.7	8.	8.	100%
23 Aug 1987	76.5	102%	.30	0%	76.9	75.9	8.	8.	100%
24 Aug 1987	76.3	102%	.32	0%	76.6	75.7	7.	7.	100%
25 Aug 1987	76.5	102%	.55	1%	77.3	75.7	8.	8.	100%
26 Aug 1987	76.5	102%	.26	0%	76.8	76.1	7.	7.	100%
27 Aug 1987	76.9	103%	.31	0%	77.3	76.5	7.	7.	100%
28 Aug 1987	76.9	103%	.41	1%	77.4	76.2	8.	8.	100%
29 Aug 1987	76.9	103%	.61	1%	77.5	75.7	8.	8.	100%
30 Aug 1987	77.1	103%	.28	0%	77.5	76.7	8.	8.	100%
31 Aug 1987	76.2	102%	.49	1%	77.3	75.6	8.	8.	100%
1 Sep 1987	75.8	101%	.34	0%	76.3	75.3	8.	8.	100%
2 Sep 1987	75.2	100%	.26	0%	75.5	74.8	7.	7.	100%
3 Sep 1987	75.1	100%	.54	1%	75.5	73.9	8.	8.	100%
Summary	76.0	101%	1.02	1%	77.5	71.2	137.	136.	99%



Daily Summation For TetraHydroFuran - IRT (Rats) From 14 Aug 1987 through 20 Aug 1987

Summary Data for: THF-IRT HOLD/Temperature -- 72.0 to 78.0

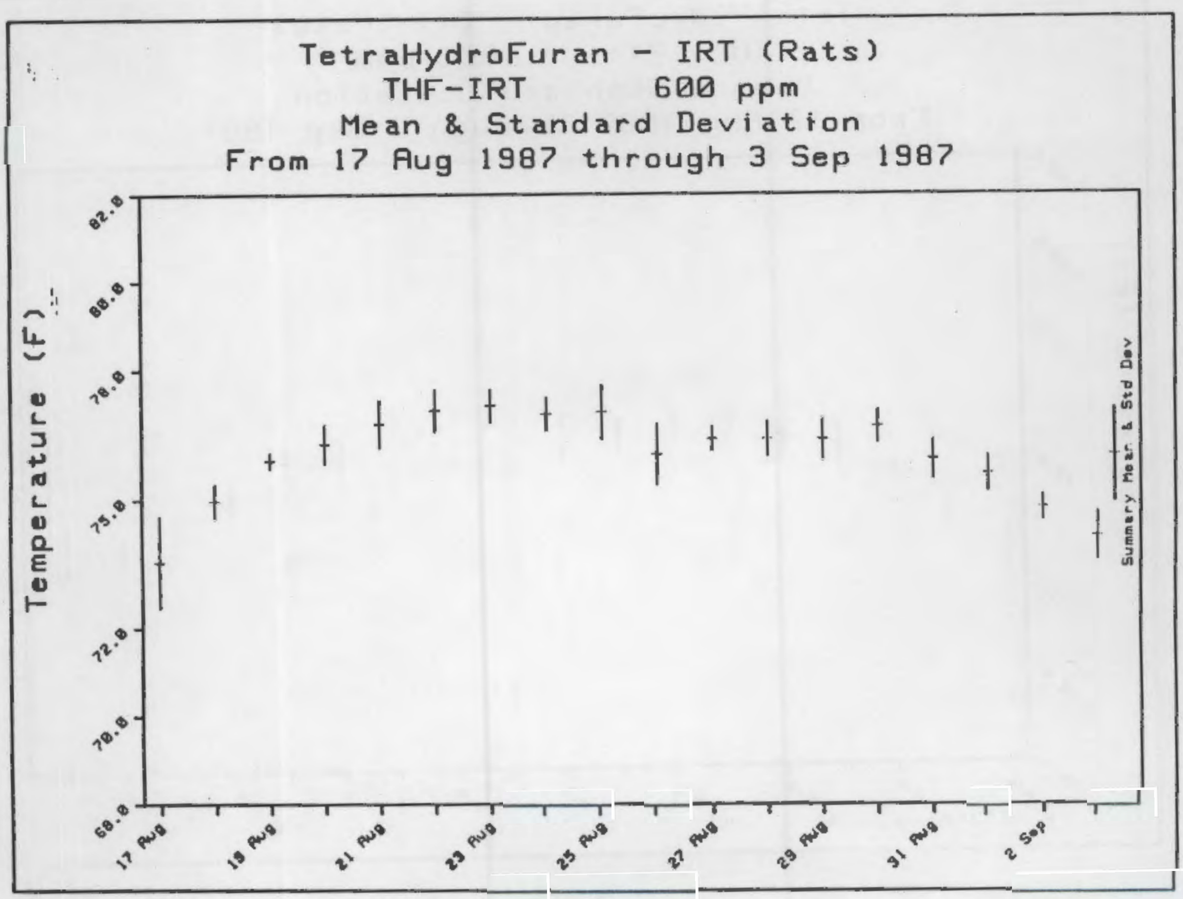
Date	Mean	% Target	Std Dev	% RSD	Maximum	Minimum	N	N in	% N in
14 Aug 1987	76.6	102%	1.24	2%	78.0	74.8	8.	7.	88%
15 Aug 1987	76.0	101%	1.01	1%	77.7	74.4	8.	8.	100%
16 Aug 1987	75.6	101%	.93	1%	76.8	74.6	8.	8.	100%
17 Aug 1987	76.4	102%	1.36	2%	77.8	73.9	8.	8.	100%
18 Aug 1987	77.4	103%	.84	1%	78.7	76.0	9.	7.	78%
19 Aug 1987	77.2	103%	.72	1%	78.2	76.3	7.	6.	86%
20 Aug 1987	74.3	99%	.27	0%	74.8	74.0	7.	7.	100%
Summary	76.2	102%	1.33	2%	78.7	73.9	55.	51.	93%



Daily Summation For TetraHydroFuran - IRT (Rats) From 17 Aug 1987 through 3 Sep 1987

Summary Data for: THF-IRT 600 ppm/Temperature -- 72.0 to 78.0

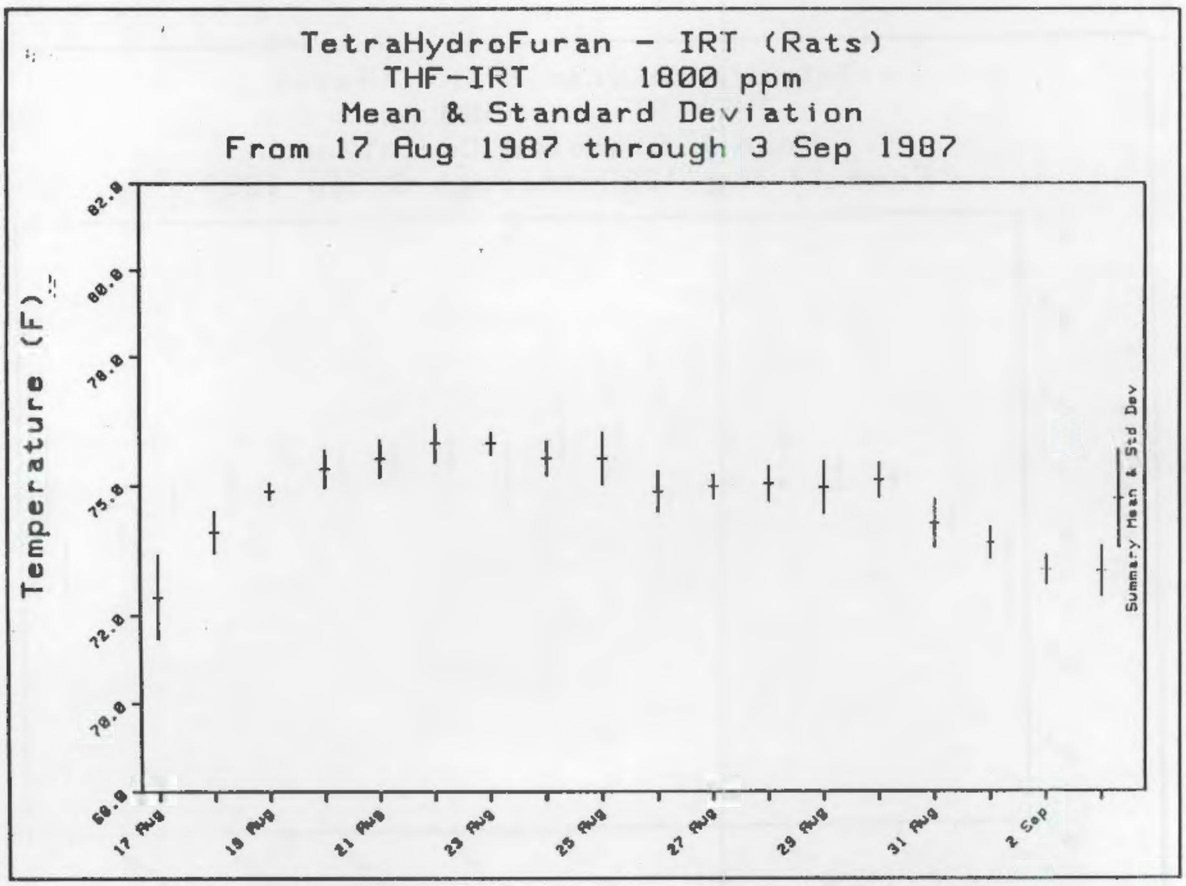
Date	Mean	% Target	Std Dev	% RSD	Maximum	Minimum	N	N in	% N in
17 Aug 1987	73.6	98%	1.06	1%	74.4	71.5	6.	5.	83%
18 Aug 1987	75.0	100%	.40	1%	75.4	74.1	8.	8.	100%
19 Aug 1987	75.9	101%	.18	0%	76.2	75.6	7.	7.	100%
20 Aug 1987	76.3	102%	.45	1%	76.9	75.6	7.	7.	100%
21 Aug 1987	76.8	102%	.55	1%	77.4	75.7	8.	8.	100%
22 Aug 1987	77.1	103%	.49	1%	77.7	76.3	8.	8.	100%
23 Aug 1987	77.2	103%	.38	0%	77.5	76.5	7.	7.	100%
24 Aug 1987	77.0	103%	.38	0%	77.5	76.2	7.	7.	100%
25 Aug 1987	77.0	103%	.63	1%	78.0	76.2	8.	8.	100%
26 Aug 1987	76.0	101%	.69	1%	77.0	74.9	8.	8.	100%
27 Aug 1987	76.4	102%	.28	0%	76.7	76.0	7.	7.	100%
28 Aug 1987	76.4	102%	.39	1%	77.0	75.8	8.	8.	100%
29 Aug 1987	76.4	102%	.49	1%	77.0	75.5	8.	8.	100%
30 Aug 1987	76.7	102%	.37	0%	77.0	75.9	8.	8.	100%
31 Aug 1987	75.9	101%	.47	1%	76.8	75.2	8.	8.	100%
1 Sep 1987	75.6	101%	.41	1%	76.1	74.8	8.	8.	100%
2 Sep 1987	74.8	100%	.29	0%	75.2	74.4	7.	7.	100%
3 Sep 1987	74.1	99%	.55	1%	74.6	73.0	8.	8.	100%
Summary	76.0	101%	1.08	1%	78.0	71.5	136.	135.	99%



Daily Summation For TetraHydroFuran - IRT (Rats)   From 17 Aug 1987 through 3 Sep 1987

Summary Data for: THF-IRT   1800 ppm/Temperature   72.0 to 78.0

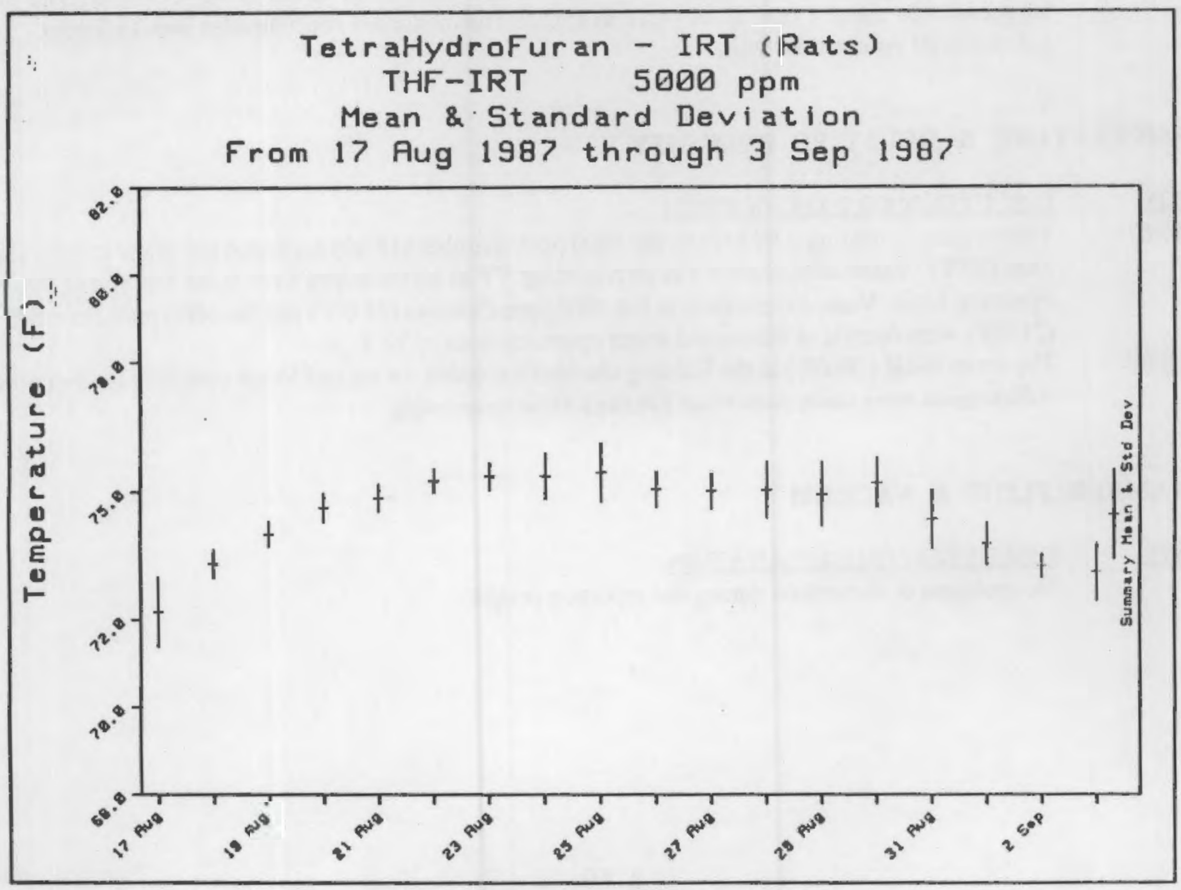
Date	Mean	% Target	Std Dev	% RSD	Maximum	Minimum	N	N in	% N in
17 Aug 1987	72.4	97%	.97	1%	73.2	70.3	7.	6.	86%
18 Aug 1987	73.9	99%	.47	1%	74.3	72.8	8.	8.	100%
19 Aug 1987	74.9	100%	.19	0%	75.1	74.6	7.	7.	100%
20 Aug 1987	75.4	101%	.44	1%	76.1	74.8	7.	7.	100%
21 Aug 1987	75.6	101%	.43	1%	76.0	74.8	8.	8.	100%
22 Aug 1987	76.0	101%	.44	1%	76.4	75.2	8.	8.	100%
23 Aug 1987	76.0	101%	.25	0%	76.2	75.5	8.	8.	100%
24 Aug 1987	75.6	101%	.41	1%	76.1	75.0	7.	7.	100%
25 Aug 1987	75.6	101%	.60	1%	76.5	74.8	8.	8.	100%
26 Aug 1987	74.8	100%	.48	1%	75.7	74.0	8.	8.	100%
27 Aug 1987	75.0	100%	.28	0%	75.3	74.6	7.	7.	100%
28 Aug 1987	75.0	100%	.42	1%	75.6	74.4	8.	8.	100%
29 Aug 1987	74.9	100%	.61	1%	75.7	73.8	8.	8.	100%
30 Aug 1987	75.1	100%	.40	1%	75.6	74.3	8.	8.	100%
31 Aug 1987	74.1	99%	.55	1%	75.3	73.5	8.	8.	100%
1 Sep 1987	73.7	98%	.36	0%	74.3	73.3	7.	7.	100%
2 Sep 1987	73.0	97%	.33	0%	73.4	72.4	7.	7.	100%
3 Sep 1987	73.0	97%	.58	1%	73.6	71.7	8.	7.	88%
Summary	74.7	100%	1.13	2%	76.5	70.3	137.	135.	99%



Daily Summation For TetraHydroFuran - IRT (Rats) From 17 Aug 1987 through 3 Sep 1987

Summary Data for: THF-IRT 5000 ppm/Temperature 72.0 to 78.0

Date	Mean	% Target	Std Dev	% RSD	Maximum	Minimum	N	N in	% N in
17 Aug 1987	72.2	96%	.82	1%	72.8	70.4	7.	6.	86%
18 Aug 1987	73.3	98%	.33	0%	73.8	72.6	8.	8.	100%
19 Aug 1987	74.0	99%	.29	0%	74.3	73.6	8.	8.	100%
20 Aug 1987	74.6	100%	.33	0%	75.0	74.2	7.	7.	100%
21 Aug 1987	74.8	100%	.31	0%	75.3	74.3	8.	8.	100%
22 Aug 1987	75.2	100%	.27	0%	75.6	74.7	8.	8.	100%
23 Aug 1987	75.3	100%	.31	0%	75.7	74.8	8.	8.	100%
24 Aug 1987	75.3	100%	.52	1%	75.9	74.3	7.	7.	100%
25 Aug 1987	75.4	101%	.67	1%	76.3	74.4	8.	8.	100%
26 Aug 1987	75.0	100%	.41	1%	75.5	74.2	8.	8.	100%
27 Aug 1987	75.0	100%	.43	1%	75.5	74.5	7.	7.	100%
28 Aug 1987	75.0	100%	.63	1%	75.9	74.0	8.	8.	100%
29 Aug 1987	74.9	100%	.73	1%	75.9	74.0	8.	8.	100%
30 Aug 1987	75.2	100%	.57	1%	75.8	74.3	8.	8.	100%
31 Aug 1987	74.3	99%	.69	1%	75.7	73.5	8.	8.	100%
1 Sep 1987	73.8	98%	.48	1%	74.7	73.2	7.	7.	100%
2 Sep 1987	73.3	98%	.27	0%	73.6	72.8	7.	7.	100%
3 Sep 1987	73.1	97%	.68	1%	73.9	71.7	8.	7.	88%
Summary	74.5	99%	1.04	1%	76.3	70.4	138.	136.	99%



EXPOSURE OPERATION DISCUSSION SHEET

INCLUDES DISCUSSIONS AND/OR EXPLANATIONS OF PROBLEMS AFFECTING ANIMAL ENVIRONMENT AND EXPOSURES. EXPLANATIONS ARE INCLUDED FOR DATA IN WHICH THERE WERE EXCURSIONS OF DAILY MEAN OR STANDARD DEVIATION BEYOND ALLOWABLE OPERATING LIMITS OR EXCURSIONS OF INDIVIDUAL DATUM BEYOND CRITICAL LIMITS.

STUDY: IRT Tetrahydrofuran Mouse Teratology

REPORTING PERIOD: July 13 - July 30, 1987

NOTE: 24 Hour Data Collection Period extends from ~5:00 a.m. to ~5:00 a.m.

COMPILED BY: R. J. Weigel **DATE:** 8 / 5 / 87

CHAMBER CONCENTRATION

DATE	DISCUSSION OR EXPLANATION
7/20/87	Concentration in the 1800 ppm chamber (1 reading = 1270 ppm) exceeded the critical low operating limit (1440 ppm) at 13:04. A short (<1 min) computer controlled shutdown of the system resulted in the problem. Daily mean and standard deviations are within the operating limits.
7/30/87	Power outages in the morning delayed startup approximately 1 hour. T_{90} expired at 10:58. Due to the power outage, a valve controlling exhaust flow did not cycle to the correct opening. A slight positive pressure occurred in the exhaust line, releasing THF to the room. Concentrations in the room were above 1 ppm from 11:11 to 15:29. The maximum concentration was 14.2 ppm, below the 20 ppm action limit.

TEMPERATURE & RELATIVE HUMIDITY

DATE	DISCUSSION OR EXPLANATION
7/16/87	Temperature (1 reading = 69.6°F) in the 1800 ppm chamber (13:10) exceeded the lower critical alarm limit (70°F). Room temperature was increased by 3°F as all chambers were at the low end of the operating limit. Mean temperature in the 1800 ppm chamber (71.0°F) and the 5000 ppm chamber (71.4°F) were outside of the normal lower operating limit of 72°F.
7/18/87	The mean %RH (39.6%) in the Holding chamber exceeded the normal lower operating limit of 40%. Adjustments were made to increase RH the following morning.

CHAMBER FLOW & VACUUM

DATE	DISCUSSION OR EXPLANATION
	No problems or excursions during this reporting period.

EXPOSURE OPERATION DISCUSSION SHEET

INCLUDES DISCUSSIONS AND/OR EXPLANATIONS OF PROBLEMS AFFECTING ANIMAL ENVIRONMENT AND EXPOSURES. EXPLANATIONS ARE INCLUDED FOR DATA IN WHICH THERE WERE EXCURSIONS OF DAILY MEAN OR STANDARD DEVIATION BEYOND ALLOWABLE OPERATING LIMITS OR EXCURSIONS OF INDIVIDUAL DATUM BEYOND CRITICAL LIMITS.

STUDY: IRT Tetrahydrofuran Rat Teratology

REPORTING PERIOD: Aug 14 - Sept 3, 1987
NOTE: 24 Hour Data Collection Period extends from ~5:00 a.m. to ~5:00 a.m.

COMPILED BY: R. J. Weigel **DATE:** 9 / 10 / 87

CHAMBER CONCENTRATION

DATE	DISCUSSION OR EXPLANATION
8/22/87	Concentration in the 5000 ppm chamber (1 reading = 3990 ppm) exceeded the critical low operating limit (4000 ppm) at 12:44. In reducing chemical levels in the flask, generator operating temperature fell, reducing the generator output. Daily mean and standard deviations are within the operating limits.
8/24/87	Power outage at 11:00 (1:05 into exposure) interrupted exposure. Exposure was continued beginning at 13:44. Total exposure time for the day was 6:00.
8/29/87	Due to a drop in the distribution line exhaust flow (12:50), a potential safety hazard, the computer shut down the generator for 10 min until the flow was increased by the operator. As a result concentrations in all chambers exceeded the critical low operating limits.

Chamber	Time	Reading	Critical Low Limit
600 ppm	12:56	387 ppm	400 ppm
1800 ppm	12:59	1160	1440 ppm
5000 ppm	13:01	3870	4000 ppm

The % relative standard deviation for the 600 ppm chamber (12%) exceeded the protocol defined limt of 10%.

TEMPERATURE & RELATIVE HUMIDITY

DATE	DISCUSSION OR EXPLANATION
8/17/87	% RH exceeded the critical lower operating limit (35%) in the 0 ppm chamber (1 reading: 33%) at 12:11. Operator made adjustments at that time to bring it within operating limits. As a result, the daily mean for RH in the 0 ppm chamber was 39.3%, exceeding the protocol defined limit of 40%.
8/26/87	Due to a loose stopper in the 0 ppm chamber, environmental data except temperature was not collected after 16:39. Animal care personnel were reminded to verify chamber integrity before leaving for the night.

CHAMBER FLOW & VACUUM

DATE	DISCUSSION OR EXPLANATION
	No problems or excursions during this reporting period.

APPENDIX C

DEVELOPMENTAL TOXICOLOGY DATA

THF Mouse Teratology Study: Body Weights (g) for Virgin Females

0 ppm THF

MATNO	Pre-study Wt	Exposure Day1	Exposure Day5	Exposure Day10	Sacrifice Wt
17	27.1	30.0	29.7	30.1	28.5
19	23.3	27.0	26.9	26.2	25.8
32	22.5	27.3	28.3	27.6	26.8
91	24.6	29.8	30.2	28.3	27.0
174	23.9	25.2	27.0	27.4	25.3
245	25.9	26.1	26.9	26.5	25.6
246	24.3	28.3	28.9	29.1	27.5
278	25.5	28.0	28.6	27.6	26.6
283	24.1	25.0	26.0	26.2	24.1
328	26.6	26.3	26.6	27.0	24.6

600 ppm THF

MATNO	Pre-study Wt	Exposure Day1	Exposure Day5	Exposure Day10	Sacrifice Wt
43	27.0	30.8	31.2	31.4	30.3
50	26.0	27.6	28.2	28.5	27.5
68	23.9	25.6	27.6	27.7	26.9
115	23.9	25.9	27.1	27.0	25.2
167	26.5	27.2	27.1	27.0	24.3
204	25.1	27.3	27.1	27.7	25.6
221	23.1	27.2	28.5	30.2	27.9
242	25.3	27.3	26.5	29.1	27.1
247	23.1	26.5	27.8	29.2	26.9
257	24.1	25.8	26.4	27.7	26.1

THF Mouse Teratology Study: Body Weights (g) for Virgin Females

1800 ppm THF

MATNO	Pre-study Wt	Exposure Day1	Exposure Day5	Exposure Day10	Sacrifice Wt
8	26.8	31.2	30.3	29.8	28.6
12	26.8	27.3	28.9	23.2	22.8
77	23.3	26.2	25.8	20.5	18.3
131	27.1	29.8	30.6	30.9	29.4
141	25.3	28.1	20.4	30.7	29.0
164	24.0	25.1	26.0	25.8	24.2
211	24.1	26.9	27.7	27.8	26.2
267	25.0	28.8	30.6	31.0	29.0
301	23.6	26.7	27.6	20.7	27.2
309	22.9	26.5	27.6	28.9	27.1

----------5000 ppm THF ----------

MATNO	Pre-study Wt	Exposure Day1	Exposure Day5	Exposure Day10	Sacrifice Wt
4	25.5	27.4	DEAD	.	.
52	23.2	24.2	23.2	26.0	23.6
87	24.4	26.5	19.1	29.4	25.8
124	24.0	24.7	17.6	27.5	25.9
142	23.3	24.8	18.9	26.5	24.9
148	25.2	26.0	DEAD	.	.
201	24.2	26.1	19.5	28.0	25.4
264	28.1	31.6	21.5	15.3	DEAD
282	26.4	30.3	20.2	DEAD	.
310	22.7	25.1	24.0	27.7	24.1

Tetrahydrofuran Rat Teratology Study: Body Weights (g) for Virgin Females

---0 ppm THF ---

MATNO	Pre-study Wt	Exposure Day1	Exposure Day5	Exposure Day10	Sacrifice Wt
428	251.4	276.9	293.4	296.3	291.09
449	261.0	284.4	296.9	298.3	301.91
460	261.8	277.3	291.2	293.8	296.74
470	236.8	268.8	261.2	267.5	260.86
486	243.1	271.3	276.8	278.4	268.97
490	250.1	281.4	288.8	292.0	292.34
546	275.5	312.3	326.4	345.2	482.71
592	268.2	295.9	298.9	304.6	303.08
600	272.1	301.3	315.6	318.5	312.47
624	289.7	323.1	327.5	329.9	330.35

-----800 ppm THF -----

MATNO	Pre-study Wt	Exposure Day1	Exposure Day5	Exposure Day10	Sacrifice Wt
415	269.1	285.8	295.9	292.6	318.89
437	274.2	301.0	309.2	310.4	313.44
451	244.3	273.4	289.7	296.5	295.76
467	256.2	280.6	300.8	306.8	306.32
475	266.8	290.7	304.8	317.5	320.83
539	296.7	332.0	343.2	349.5	347.98
581	261.2	283.6	291.7	301.8	308.34
589	256.9	277.1	282.7	286.8	282.84
590	249.0	266.1	269.1	280.6	278.22
632	235.0	257.7	267.9	267.5	259.75

--1800 ppm THF --

MATNO	Pre-study Wt	Exposure Day1	Exposure Day5	Exposure Day10	Sacrifice Wt
422	284.4	304.8	319.7	322.0	323.78
427	260.7	295.5	295.2	300.9	299.47
434	260.4	280.3	286.3	287.2	289.11
556	313.1	342.7	373.8	388.2	373.49
565	257.8	292.8	296.5	299.7	290.17
572	269.9	301.9	308.7	310.8	308.12
586	261.5	297.4	308.5	310.7	308.07
588	247.4	271.8	276.4	284.7	283.57
599	240.1	255.5	265.2	252.3	267.11
610	253.6	274.4	292.5	291.5	286.77

5000 ppm THF

MATNO	Pre-study Wt	Exposure Day1	Exposure Day5	Exposure Day10	Sacrifice Wt
404	268.7	285.4	302.2	327.8	368.83
462	282.6	304.3	304.7	309.0	306.75
474	267.8	283.0	298.9	301.0	294.75
483	255.8	280.3	277.9	279.9	280.72
485	290.5	331.1	337.4	337.7	330.65
508	259.0	294.2	285.8	295.8	305.49
510	243.5	269.7	280.5	300.0	309.37
530	248.2	265.0	263.7	262.9	271.44
570	260.1	287.6	291.3	303.6	300.97
605	240.8	257.6	261.6	259.3	248.44

THF Mouse Teratology Study: Body Weights (g) for Plug-positive Females

0 ppm THF

MATNO	Pre-study Wt (g)	0 dg Wt (g)	6 dg Wt (g)	9 dg Wt (g)	12 dg Wt (g)	15 dg Wt (g)	18 dg Wt (g)	Uter Wt (g)	Pregnant	LIVE	EARLY	LATE	DEAD	IMPLANT
9	20.8	22.3	25.1	27.0	31.7	37.7	45.1	15.9	1	9	0	1	0	10
34	25.5	26.5	30.2	31.8	37.6	47.4	56.7	20.7	1	13	1	0	0	14
54	26.0	26.7	29.4	31.5	38.9	46.5	55.6	19.8	1	12	0	0	0	12
64	24.4	26.6	28.7	30.4	35.9	42.9	50.2	18.0	1	13	1	0	0	14
71	23.5	25.5	27.0	30.5	35.0	42.0	48.1	15.2	1	9	4	1	0	14
80	26.3	27.6	30.8	33.5	32.5	46.0	52.5	16.5	1	10	0	0	0	10
100	26.4	27.0	29.3	32.6	36.8	44.9	51.5	19.5	1	12	2	0	0	14
118	26.7	27.3	30.2	33.7	36.9	45.2	53.2	18.1	1	10	3	0	0	13
120	24.6	28.2	28.4	31.3	35.6	45.1	55.6	21.5	1	14	0	1	0	15
122	25.2	26.8	29.6	33.0	38.0	46.2	54.5	21.5	1	12	0	0	0	12
130	25.5	27.4	30.9	33.0	39.7	49.8	58.1	29.3	1	13	1	1	0	15
137	22.4	24.5	27.0	26.7	35.9	43.3	53.3	19.8	1	12	0	0	0	12
139	25.9	26.3	28.4	31.5	36.8	44.3	52.3	17.1	1	9	0	1	0	10
154	26.9	26.7	28.6	30.1	33.5	40.2	47.0	16.5	1	11	1	0	0	12
159	27.5	27.4	29.1	31.4	37.3	45.4	56.4	22.3	1	12	0	1	0	13
165	24.0	25.7	28.2	31.0	36.6	45.1	57.8	24.7	1	13	0	0	0	13
190	23.6	25.8	29.3	32.6	36.3	47.9	58.0	25.5	1	14	0	0	0	14
192	29.1	28.0	29.4	32.8	39.1	47.7	57.5	22.6	1	14	1	0	0	15
212	27.2	27.9	31.4	29.5	37.9	45.9	56.3	20.7	1	13	0	0	0	13
223	25.2	27.0	29.5	31.7	34.5	42.3	48.1	14.2	1	8	2	0	0	10
228	25.6	26.0	29.5	27.4	37.6	46.4	56.6	21.4	1	12	0	1	0	13
236	24.0	26.0	28.8	32.1	39.1	47.3	59.2	23.6	1	13	0	0	0	13
256	27.4	28.1	30.4	33.2	39.0	48.1	57.3	21.9	1	13	0	0	0	13
269	24.6	24.5	25.5	26.1	26.3	26.5	25.0	.	0	.	.	.	.	.
271	23.6	24.2	27.0	30.8	37.3	45.8	55.5	22.3	1	11	0	1	0	12
276	26.4	26.5	26.9	29.4	34.1	44.3	52.6	20.5	1	12	1	0	0	13
296	23.0	25.1	27.9	30.9	29.6	44.9	52.2	17.4	1	9	0	0	0	9
302	25.8	29.6	32.1	34.5	34.2	49.7	60.1	24.0	1	16	1	0	0	17
305	24.4	26.3	27.0	26.7	26.3	28.0	26.7	0.2	0	.	.	.	.	.
308	23.9	25.7	29.6	31.0	37.1	44.9	54.2	20.0	1	11	0	0	0	11
325	26.1	30.5	33.6	35.9	40.4	48.8	58.0	20.8	1	13	1	0	0	14
326	27.3	27.5	31.2	32.4	36.8	47.7	56.9	23.6	1	15	0	0	0	15

THF Mouse Teratology Study: Body Weights (g) for Plug-positive Females

600 ppm THF

MATNO	Pre-study Wt (g)	0 dg Wt (g)	6 dg Wt (g)	9 dg Wt (g)	12 dg Wt (g)	15 dg Wt (g)	18 dg Wt (g)	Uter Wt (g)	Pregnant	LIVE	EARLY	LATE	DEAD	IMPLANT
37	24.9	26.3	26.9	29.0	32.9	38.0	45.9	13.7	1	8	1	1	0	10
38	25.6	24.9	28.4	30.1	34.7	41.8	48.9	15.7	1	10	1	0	0	11
39	26.4	26.6	26.6	31.8	35.0	43.0	50.8	18.2	1	10	0	1	0	11
51	25.6	26.2	29.8	31.4	36.9	46.0	56.6	20.8	1	14	0	0	0	14
56	25.2	26.5	26.3	31.9	37.5	46.3	58.0	22.7	1	13	0	0	0	13
70	25.7	28.3	31.4	33.3	39.9	50.0	61.0	22.3	1	13	0	0	0	13
76	24.2	24.4	26.6	30.4	35.3	41.6	48.2	16.0	1	9	0	2	0	11
83	24.4	25.2	27.2	29.2	35.3	43.9	53.1	21.2	1	16	0	0	0	16
104	24.1	25.8	28.0	29.0	28.4	28.4	28.1	0.2	0	.	.	.	.	.
113	26.1	26.7	26.4	27.7	32.2	39.1	47.6	16.3	1	10	0	0	0	10
114	27.0	27.4	31.3	34.2	39.1	47.6	57.5	21.5	1	13	1	0	0	14
132	25.1	27.5	30.2	33.3	39.6	49.2	59.2	24.8	1	14	1	0	0	15
140	27.4	27.3	30.9	33.8	39.8	49.2	59.6	23.0	1	14	0	0	0	14
165	23.5	27.2	29.7	28.3	29.6	30.0	28.4	0.1	0	.	.	.	.	.
168	24.6	26.5	27.8	27.0	25.8	26.1	25.9	0.7	1	0	9	0	0	9
177	25.3	26.9	29.7	29.5	30.8	30.1	29.8	.	0	.	.	.	.	.
183	26.2	27.8	30.2	34.9	41.5	48.2	58.4	22.3	1	12	0	0	0	12
184	25.2	27.0	26.5	29.1	34.3	45.5	60.3	25.7	1	14	1	0	0	15
187	24.8	26.8	29.4	30.2	28.0	29.3	27.3	0.1	0	.	.	.	.	.
205	24.1	27.3	30.2	32.1	37.7	46.1	59.9	23.6	1	15	0	0	0	15
210	25.3	27.5	30.6	32.3	38.5	48.4	57.2	25.9	1	13	1	0	0	14
220	26.7	26.4	29.9	34.4	37.6	45.5	55.7	20.0	1	12	0	0	0	12
240	24.7	25.5	27.8	31.3	36.6	43.8	52.4	20.7	1	11	1	0	0	12
249	24.1	26.2	27.5	30.9	35.7	44.7	52.8	19.2	1	11	0	0	0	11
275	23.3	23.3	24.2	25.7	29.9	35.9	41.7	14.7	1	9	1	0	0	10
288	26.0	27.2	30.9	33.3	37.9	45.3	54.2	19.3	1	10	0	1	1	12
294	24.7	26.3	36.0	30.4	34.0	41.2	45.6	12.6	1	7	0	0	0	7
303	24.8	25.6	27.1	27.4	28.2	28.5	26.1	0.1	0	.	.	.	.	.
313	22.7	26.2	28.0	30.2	34.9	42.8	49.2	17.4	1	10	1	0	0	11
330	24.7	25.9	28.0	31.3	36.8	44.2	51.9	18.9	1	11	0	0	0	11
331	24.7	28.1	31.0	32.5	38.7	44.4	52.6	17.7	1	9	0	0	0	9

-- 1000 ppm THF --

MATNO	Pre-study Wt (g)	0 dg Wt (g)	6 dg Wt (g)	9 dg Wt (g)	12 dg Wt (g)	15 dg Wt (g)	18 dg Wt (g)	Uter Wt (g)	Pregnant	LIVE	EARLY	LATE	DEAD	IMPLANT
13	23.7	26.4	27.4	30.5	31.4	31.4	32.5	0.2	0	.	.	.	.	.
20	23.9	24.6	26.0	24.2	27.6	27.2	26.6	0.2	1	0	14	0	0	14
27	23.9	26.1	30.0	31.2	37.6	45.4	53.7	19.7	1	13	2	0	0	15
44	26.9	27.0	28.2	30.4	35.3	43.0	52.0	17.6	1	11	1	0	0	12
45	24.2	25.6	28.6	30.4	34.3	42.2	50.5	17.1	1	11	0	1	0	12
47	25.1	27.9	32.6	29.7	29.8	28.7	30.6	0.2	0	.	.	.	.	.
53	25.3	26.6	28.0	32.0	37.9	46.2	55.7	19.7	1	13	0	0	0	13
58	25.6	27.7	30.5	34.2	37.6	46.5	53.8	15.7	1	9	0	0	0	9
61	24.7	26.7	28.8	30.6	33.1	42.2	52.0	16.4	1	11	1	0	0	12
66	25.7	27.1	30.8	30.7	36.3	42.8	53.4	18.5	1	13	1	0	0	14
75	25.8	26.0	30.7	32.2	37.2	44.2	52.0	18.6	1	11	0	0	0	11
85	25.2	26.7	30.8	32.5	33.5	32.6	31.9	0.3	1	0	11	0	0	11
88	23.6	23.4	24.4	23.1	22.5	27.2	30.7	3.4	1	0	0	9	0	9
92	21.6	26.4	29.9	32.4	39.0	47.1	56.4	18.2	1	10	0	0	0	10
108	24.8	26.4	31.1	33.0	38.4	41.3	56.4	20.5	1	11	0	2	0	13
136	26.8	27.8	28.3	27.9	30.0	28.7	29.0	.	0	.	.	.	.	.
149	26.2	28.6	32.0	33.5	42.2	51.3	61.3	21.8	1	15	0	0	0	15
157	22.9	23.3	26.5	28.5	28.4	29.8	28.8	0.2	1	0	12	0	0	12
176	25.1	27.5	30.0	33.2	37.1	44.8	51.9	21.4	1	11	0	0	0	11
200	26.7	28.9	31.5	33.3	38.6	48.3	57.7	25.4	1	13	0	0	0	13
206	27.1	28.3	28.6	30.0	32.1	27.0	23.3	.	0	.	.	.	.	.
226	23.7	25.8	27.4	30.7	35.2	43.4	51.9	19.0	1	12	0	0	0	12
239	24.7	26.0	26.5	26.8	27.3	28.0	27.0	0.1	0	.	.	.	.	.
260	24.9	27.0	28.7	30.6	36.7	45.6	52.7	21.4	1	11	1	2	0	14
263	30.1	31.1	32.0	31.6	29.7	27.3	27.4	6.4	1	6	0	7	0	13
270	23.4	25.3	29.2	31.5	35.9	43.6	51.9	18.3	1	11	3	0	0	14
274	26.1	25.6	30.2	31.9	37.5	46.4	54.6	16.7	1	11	0	1	0	12
287	25.0	27.3	28.6	31.4	35.1	41.8	49.5	15.7	1	9	2	0	0	11
293	25.9	27.1	28.4	30.2	35.7	46.5	55.3	21.6	1	13	0	0	0	13
298	25.0	24.6	28.0	31.5	35.0	42.3	47.1	11.0	1	7	0	0	0	7
311	26.3	28.0	28.9	26.7	28.1	29.6	28.0	0.1	0	.	.	.	.	.
321	26.0	26.7	30.3	32.9	36.5	43.4	50.4	15.7	1	10	1	0	0	11
329	26.2	28.0	30.0	32.6	38.0	45.7	56.9	17.8	1	10	0	2	0	12

5ØØØ ppm THF

MATNO	Pre-study Wt (g)	Ø dg Wt (g)	6 dg Wt (g)	9 dg Wt (g)	12 dg Wt (g)	15 dg Wt (g)	18 dg Wt (g)	Uter Wt (g)	Pregnant	LIVE	EARLY	LATE	DEAD	IMPLANT
26	25.4	26.7	31.5	26.Ø	25.9	29.1	29.8	Ø.2	1	Ø	13	Ø	Ø	13
28	24.3	26.5	3Ø.7	26.9	29.Ø	29.4	29.1	Ø.1	1	Ø	12	Ø	Ø	12
31	27.Ø	3Ø.6	32.5	3Ø.7	32.1	3Ø.9	29.5	Ø.2	1	Ø	15	Ø	Ø	15
33	26.2	26.7	29.3	27.1	28.4	3Ø.7	3Ø.2	Ø.1	1	Ø	12	Ø	Ø	12
36	25.7	26.4	29.9	.	.	.	.	.	1	.	.	.	.	.
46	27.5	27.1	29.4	23.2	26.7	26.5	26.9	Ø.1	1	Ø	12	Ø	Ø	12
59	25.5	26.2	29.7	.	.	.	.	.	1	.	.	.	.	.
61	26.7	27.Ø	28.5	23.7	26.6	3Ø.Ø	27.3	Ø.1	1	Ø	15	Ø	Ø	15
62	25.1	26.9	28.8	25.5	21.4	26.8	26.3	Ø.1	1	Ø	13	Ø	Ø	13
64	24.1	23.4	25.6	24.3	27.3	25.9	25.8	.	Ø	.	.	.	.	.
9Ø	24.7	25.7	27.2	.	.	.	.	.	1	.	.	.	.	.
97	23.6	25.2	26.9	25.8	26.5	26.7	26.1	Ø.2	1	Ø	12	Ø	Ø	12
1Ø5	23.9	24.6	27.1	22.5	22.3	26.1	27.7	Ø.1	1	Ø	9	Ø	Ø	9
1Ø6	26.1	26.1	28.6	21.3	.	.	.	.	Ø	.	.	.	.	.
125	26.2	25.9	29.1	27.7	27.2	29.Ø	27.1	Ø.1	1	Ø	13	Ø	Ø	13
151	26.6	3Ø.Ø	3Ø.6	27.8	3Ø.Ø	3Ø.3	29.2	Ø.4	1	Ø	5	Ø	Ø	5
155	24.Ø	27.6	3Ø.4	27.8	3Ø.6	3Ø.2	29.6	Ø.2	1	Ø	18	Ø	Ø	18
162	23.2	25.7	29.Ø	26.2	26.1	27.1	26.8	Ø.3	1	Ø	16	Ø	Ø	16
179	25.8	25.1	27.2	24.Ø	27.4	27.4	26.2	Ø.3	1	Ø	1Ø	Ø	Ø	1Ø
195	25.Ø	26.8	29.7	25.4	.	.	.	.	Ø	.	.	.	.	.
2Ø6	24.Ø	26.5	26.4	24.6	27.6	27.9	27.5	Ø.4	1	Ø	11	Ø	Ø	11
213	25.2	27.4	29.9	3Ø.9	29.8	31.6	3Ø.8	Ø.2	1	Ø	14	Ø	Ø	14
218	26.5	28.3	32.Ø	31.7	3Ø.9	31.4	29.7	Ø.3	1	Ø	15	Ø	Ø	15
219	24.8	26.5	29.4	25.7	24.7	28.4	26.8	Ø.1	1	Ø	12	Ø	Ø	12
222	26.8	27.7	29.3	27.1	28.3	28.4	31.4	Ø.2	Ø	.	.	.	.	.
225	26.3	27.7	29.3	24.7	25.6	27.Ø	26.Ø	Ø.1	Ø	.	.	.	.	.
231	25.3	27.6	3Ø.4	3Ø.Ø	3Ø.4	42.2	49.9	17.Ø	1	12	Ø	2	Ø	14
238	26.Ø	27.2	28.2	.	.	.	.	.	1	.	.	.	.	.
265	24.Ø	26.7	28.2	.	.	.	.	.	1	.	.	.	.	.
268	25.4	26.7	28.7	.	.	.	.	.	1	.	.	.	.	.
273	24.7	27.2	3Ø.5	.	.	.	.	.	1	.	.	.	.	.
28Ø	26.6	26.5	29.6	27.3	3Ø.6	3Ø.1	27.3	Ø.1	1	Ø	1Ø	Ø	Ø	1Ø
327	24.Ø	23.8	26.3	23.9	26.9	26.8	25.6	Ø.2	Ø	.	.	.	.	.

Tetrahydrofuran Rat Teratology Study: Body Weights (g) for Sperm-positive Females

0 ppm THF

MATNO	Pre-study Wt (g)	0 dg Wt (g)	6 dg Wt (g)	10 dg Wt (g)	14 dg Wt (g)	17 dg Wt (g)	20 dg Wt (g)	Uter Wt (g)	Pregnant	LIVE	EARLY	LATE	DEAD	IMPLANT
403	257.4	275.7	303.2	295.0	299.8	306.0	286.99	0.96	0	.	.	.	.	.
405	276.1	291.7	314.7	334.1	352.0	375.4	413.88	49.80	1	10	3	0	0	13
416	263.3	273.5	304.6	329.1	349.2	376.1	418.03	88.25	1	17	0	0	0	17
425	237.6	244.1	269.2	282.8	304.6	312.0	325.30	25.17	1	4	4	0	0	8
433	287.4	302.9	337.5	353.7	350.5	341.4	338.36	0.90	0	.	.	.	.	.
452	237.0	265.5	284.8	304.7	319.9	344.4	379.84	75.53	1	15	3	0	0	18
464	277.5	294.5	317.8	337.5	357.3	381.1	430.17	93.89	1	19	1	0	0	20
466	272.8	279.3	306.7	321.9	355.5	373.4	399.64	60.36	1	11	2	0	0	13
471	262.3	283.7	319.0	338.6	356.8	383.6	425.80	70.95	1	13	1	0	0	14
477	250.8	262.4	292.9	315.0	327.0	354.6	384.65	76.82	1	15	1	0	0	16
491	266.4	280.0	303.3	322.3	339.1	364.5	393.57	73.14	1	14	1	0	0	15
495	273.5	286.8	313.9	340.4	360.8	382.5	415.64	75.97	1	14	3	0	0	17
499	256.3	285.5	307.1	339.3	355.9	394.3	429.05	97.69	1	16	1	0	0	19
502	276.5	302.0	324.3	337.7	360.9	374.4	423.38	100.30	1	19	0	0	0	19
515	273.2	282.3	314.4	327.6	349.4	367.0	377.95	21.83	1	3	1	0	0	4
521	261.9	283.3	306.9	327.9	344.8	366.8	408.66	79.71	1	16	1	0	0	17
525	257.0	273.6	287.0	306.2	316.9	341.2	386.63	90.60	1	18	0	0	0	18
529	271.7	278.4	300.9	312.6	337.7	364.7	394.28	63.94	1	12	2	0	0	14
537	258.2	275.5	298.1	320.9	349.3	377.6	427.84	92.79	1	16	1	0	0	17
541	252.2	262.0	297.2	313.3	334.4	360.9	386.71	72.43	1	14	2	0	0	16
557	279.8	293.2	329.4	353.4	373.4	398.3	449.50	90.63	1	17	0	0	0	17
560	284.0	315.3	334.4	351.0	370.2	392.5	440.75	99.24	1	19	0	0	0	19
564	245.8	275.5	293.9	300.5	309.2	336.9	372.92	78.64	1	15	0	1	0	16
573	256.0	271.7	301.2	314.2	339.6	367.9	412.47	89.85	1	18	0	0	0	18
574	290.4	303.4	320.5	349.2	375.1	410.6	453.11	99.66	1	18	0	0	0	18
578	251.2	266.8	291.5	306.2	314.0	340.3	380.34	87.75	1	15	0	0	0	15
596	261.6	281.2	324.1	337.6	355.5	383.6	425.12	109.87	1	20	0	0	0	20
597	266.8	310.6	342.3	354.5	374.7	387.4	414.18	48.41	1	8	0	0	0	8
608	273.1	283.4	316.5	331.8	361.9	379.2	417.66	83.53	1	16	0	0	0	16
612	280.8	300.6	329.7	352.4	371.4	406.2	445.24	82.88	1	16	3	0	0	19
616	231.2	244.6	267.8	292.3	312.7	344.0	385.43	86.89	1	16	0	0	0	16
617	260.1	281.5	312.5	329.9	345.2	372.0	398.15	64.82	1	12	0	0	0	12
618	233.7	248.5	271.3	281.3	303.3	321.4	347.42	46.09	1	10	1	2	0	13

--800 ppm THF --

MATNO	Pre-study Wt (g)	Ø dg Wt (g)	6 dg Wt (g)	10 dg Wt (g)	14 dg Wt (g)	17 dg Wt (g)	20 dg Wt (g)	Uter Wt (g)	Pregnant	LIVE	EARLY	LATE	DEAD	IMPLANT
4Ø1	29Ø.6	298.5	333.2	337.8	365.9	397.7	448.68	94.18	1	18	Ø	Ø	Ø	18
412	259.9	274.7	309.8	322.8	351.9	383.4	422.19	86.77	1	16	2	Ø	Ø	18
419	268.9	285.2	307.Ø	324.1	341.8	373.1	415.67	77.Ø3	1	14	1	Ø	Ø	15
42Ø	282.1	295.Ø	323.9	342.Ø	362.3	389.Ø	42Ø.96	78.59	1	16	Ø	Ø	Ø	16
421	237.2	265.7	288.4	304.8	318.2	343.5	387.5Ø	69.45	1	13	2	Ø	Ø	15
436	247.6	254.7	276.7	298.6	305.2	338.4	376.9Ø	84.75	1	15	2	Ø	Ø	17
444	257.7	283.Ø	311.9	327.5	353.1	385.2	433.17	88.16	1	17	1	Ø	Ø	18
446	261.9	28Ø.8	265.8	277.1	301.3	329.7	368.56	86.41	1	15	Ø	1	Ø	16
469	249.1	266.7	292.6	313.8	333.6	369.5	417.29	1ØØ.4Ø	1	2Ø	Ø	Ø	Ø	2Ø
482	233.6	242.2	26Ø.1	273.6	292.2	316.Ø	357.53	66.67	1	17	Ø	Ø	Ø	17
484	263.4	29Ø.5	324.8	347.1	373.9	396.4	444.52	92.48	1	16	2	Ø	Ø	18
494	254.2	262.6	292.2	31Ø.Ø	342.2	37Ø.7	4Ø7.Ø1	82.38	1	16	Ø	Ø	Ø	16
6Ø5	249.8	281.6	322.Ø	298.1	35Ø.1	388.5	444.79	92.63	1	17	Ø	Ø	Ø	17
6Ø9	28Ø.7	295.9	234.6	294.7	294.4	3ØØ.2	3Ø4.44	Ø.53	Ø	.	.	.	.	.
613	3Ø3.7	336.8	37Ø.1	392.1	418.Ø	458.2	488.8Ø	94.91	1	18	Ø	Ø	Ø	18
619	23Ø.6	24Ø.2	267.3	291.8	312.8	338.7	376.67	9Ø.28	1	17	Ø	Ø	Ø	17
627	241.2	249.6	274.Ø	288.4	3Ø7.4	336.6	374.69	84.18	1	15	Ø	Ø	Ø	15
64Ø	248.8	258.4	282.2	294.8	318.8	334.9	37Ø.85	73.27	1	14	2	Ø	Ø	16
642	227.4	249.9	265.2	3Ø5.1	326.2	349.5	394.Ø1	84.76	1	16	2	Ø	Ø	18
66Ø	25Ø.5	268.1	294.3	3Ø9.Ø	34Ø.6	376.Ø	432.91	1Ø9.46	1	2Ø	Ø	Ø	Ø	2Ø
669	28Ø.9	298.Ø	311.2	317.6	322.7	328.3	324.61	Ø.5Ø	Ø	.	.	.	.	.
687	252.4	259.3	295.6	319.8	346.9	378.1	4Ø6.65	63.14	1	11	Ø	Ø	Ø	11
671	272.6	284.Ø	324.9	349.9	372.3	391.7	428.1Ø	77.16	1	14	2	Ø	Ø	16
687	257.9	279.5	293.2	321.4	349.6	377.8	415.2Ø	94.32	1	16	Ø	Ø	Ø	16
694	256.4	283.3	3Ø6.9	333.3	349.2	367.8	374.79	33.31	1	5	19	Ø	Ø	24
698	258.4	281.8	312.6	326.9	345.4	365.4	4Ø5.Ø8	76.Ø8	1	14	Ø	Ø	Ø	14
8Ø3	256.4	287.8	282.9	298.8	291.Ø	296.9	289.37	Ø.83	Ø	.	.	.	.	.
8Ø8	261.Ø	28Ø.9	3Ø3.6	327.4	352.Ø	383.4	43Ø.86	9Ø.53	1	17	1	Ø	Ø	18
815	274.8	3Ø1.6	327.Ø	341.Ø	359.7	398.3	415.98	99.17	1	19	Ø	Ø	Ø	19
826	28Ø.9	3ØØ.4	333.1	354.1	375.9	39Ø.1	413.97	41.97	1	7	Ø	Ø	Ø	7
829	274.4	29Ø.2	315.1	339.2	366.8	4Ø1.1	45Ø.8Ø	99.52	1	17	Ø	Ø	Ø	17
833	246.9	26Ø.Ø	275.7	288.2	277.6	276.4	271.1Ø	. (a)	Ø	.	.	.	.	.

a) Uterus inadvertantly not weighed.

C.14

-----1800 ppm THF -----

MATNO	Pre-study Wt (g)	0 dg Wt (g)	6 dg Wt (g)	10 dg Wt (g)	14 dg Wt (g)	17 dg Wt (g)	20 dg Wt (g)	Uter Wt (g)	Pregnant	LIVE	EARLY	LATE	DEAD	IMPLANT
408	254.3	288.0	311.5	328.0	348.5	375.4	413.70	74.36	1	15	0	0	0	15
411	237.9	251.4	277.2	295.2	315.9	330.4	373.21	70.30	1	13	2	0	0	15
413	244.5	256.6	283.6	291.1	312.8	338.7	373.95	80.02	1	16	0	0	0	16
426	275.8	297.5	322.4	330.4	316.1	383.2	425.60	74.13	1	14	0	1	0	15
432	250.6	270.7	298.6	319.5	333.2	361.1	408.32	80.69	1	15	1	0	0	16
445	270.2	281.3	311.3	333.2	349.9	382.8	431.86	85.88	1	15	0	0	0	15
454	245.1	270.5	306.8	320.4	338.5	371.1	422.99	84.03	1	16	0	0	0	16
455	262.8	270.1	315.8	331.0	363.0	386.8	421.49	70.34	1	13	1	0	0	14
478	309.9	337.9	347.0	361.6	388.4	427.8	466.08	82.14	1	15	2	0	0	17
479	263.7	275.1	313.8	321.1	338.3	368.7	398.44	71.08	1	13	3	0	0	16
481	274.1	293.4	320.0	339.3	363.9	394.3	439.21	79.07	1	16	0	0	0	16
496	243.6	268.1	291.4	316.1	329.7	358.5	403.64	87.19	1	17	2	0	0	19
500	277.5	298.0	331.6	346.8	373.6	403.8	430.29	36.96	1	6	0	1	0	7
504	258.6	265.7	294.7	315.5	337.8	367.0	391.53	65.87	1	13	1	1	0	15
522	248.1	262.9	292.7	307.4	322.9	344.2	525.18	122.05	1	14	0	0	0	14
528	258.5	276.1	301.3	310.9	315.2	308.4	308.17	0.73	0	.	.	.	.	.
531	260.7	289.2	289.1	304.1	323.1	356.0	393.89	72.73	1	13	0	0	0	13
532	259.7	273.6	295.8	310.2	331.9	357.9	398.36	78.27	1	15	0	2	0	17
534	242.4	259.6	281.6	291.4	317.7	340.2	384.55	77.84	1	15	0	0	0	15
538	257.7	279.1	310.1	329.1	350.1	385.5	429.00	81.07	1	16	0	0	0	16
544	244.0	273.0	291.1	320.6	343.5	378.3	416.43	81.63	1	16	0	0	0	16
545	263.0	291.3	321.0	318.8	345.6	378.2	430.33	82.87	1	15	1	0	0	16
562	252.9	268.6	298.5	320.1	334.5	368.1	420.98	88.64	1	17	0	0	0	17
577	229.6	243.0	270.2	295.6	307.4	333.3	361.95	59.99	1	10	5	1	0	16
583	238.2	254.0	278.3	298.3	309.7	334.9	370.02	80.44	1	15	0	0	0	15
595	252.3	268.6	290.4	294.3	321.0	357.4	415.54	94.62	1	18	0	0	0	18
601	253.3	273.8	285.5	318.1	325.0	353.3	395.26	81.15	1	15	0	0	0	15
604	246.2	280.5	315.5	317.0	330.3	319.0	314.68	0.71	0	.	.	.	.	.
607	257.3	263.3	303.7	316.2	340.1	383.4	420.65	119.94	1	18	0	0	0	18
613	284.6	313.5	333.3	345.6	343.5	344.5	338.33	0.67	0	.	.	.	.	.
623	289.3	302.5	316.1	343.3	363.6	396.4	441.01	84.08	1	16	2	0	0	18
630	238.9	263.1	279.3	293.3	324.2	341.5	372.46	59.40	1	11	0	0	0	11

--------------------6000 ppm THF --------------------

MATNO	Pre-study Wt (g)	0 dg Wt (g)	6 dg Wt (g)	10 dg Wt (g)	14 dg Wt (g)	17 dg Wt (g)	20 dg Wt (g)	Uter Wt (g)	Pregnant	LIVE	EARLY	LATE	DEAD	IMPLANT
406	254.2	261.8	293.4	290.7	303.3	320.6	352.99	66.65	1	16	0	0	0	16
414	258.2	274.7	305.0	302.4	325.7	362.3	395.48	89.29	1	18	0	0	0	16
418	251.5	283.8	294.7	302.2	331.5	358.1	390.45	73.69	1	18	0	0	0	18
429	248.0	265.6	288.3	289.8	311.4	334.8	367.19	84.71	1	15	1	0	0	16
431	263.5	271.0	295.3	299.4	326.0	339.4	374.90	81.84	1	18	1	0	0	19
447	290.4	298.4	340.7	336.3	363.8	392.8	428.00	70.12	1	16	1	0	0	17
456	260.4	268.3	209.2	275.5	305.9	341.2	373.19	63.29	1	15	1	0	0	16
468	254.1	264.6	283.6	293.3	312.1	339.4	366.84	58.74	1	13	1	0	0	14
473	258.2	271.8	315.2	321.3	341.0	361.5	399.45	75.50	1	15	1	0	0	16
480	266.4	269.4	293.8	289.0	309.3	325.9	357.47	61.66	1	14	1	0	0	15
488	262.4	279.6	309.4	304.3	319.5	353.9	366.61	76.29	1	17	1	0	0	18
497	231.4	243.5	280.1	255.0	271.9	293.2	332.36	68.01	1	15	0	0	0	15
503	294.8	327.0	354.4	369.0	401.1	428.4	461.41	74.04	1	16	2	0	0	18
506	273.3	291.3	317.4	313.5	342.1	369.1	408.62	63.74	1	14	0	0	0	14
507	270.6	293.1	329.0	334.8	359.0	383.5	416.02	57.49	1	13	1	0	0	14
518	246.9	257.2	286.4	281.9	296.3	321.5	354.00	67.14	1	15	2	0	0	17
524	282.1	273.2	300.6	307.0	325.3	354.4	379.91	73.00	1	16	0	0	0	16
528	271.1	294.4	302.0	305.6	316.0	350.2	384.97	60.20	1	15	0	0	0	15
549	248.2	254.2	275.5	278.6	304.0	332.1	361.60	77.52	1	17	0	0	0	17
563	244.1	258.2	276.7	281.8	304.0	325.6	374.70	87.56	1	18	0	0	0	18
583	272.7	291.2	319.1	317.1	344.3	374.9	404.01	81.27	1	18	0	0	0	18
566	269.2	291.4	324.8	340.5	369.4	407.8	442.15	77.17	1	16	0	0	0	16
575	266.8	290.9	316.5	308.6	323.5	352.7	375.26	68.87	1	16	0	0	0	16
580	264.7	278.6	294.6	298.3	319.8	344.6	374.36	72.30	1	16	2	0	0	18
584	277.9	292.4	303.7	313.7	327.1	348.3	393.89	65.22	1	15	2	0	0	17
593	251.9	268.2	318.3	328.7	338.7	365.2	395.15	68.04	1	14	0	0	0	14
611	265.5	289.3	321.3	320.9	355.9	383.0	417.95	78.85	1	18	1	0	0	19
614	254.0	276.5	304.1	308.1	328.7	353.8	386.07	72.91	1	15	2	0	0	17
620	243.8	258.7	266.8	270.4	291.7	312.2	329.34	57.56	1	14	0	1	0	15
631	234.9	255.6	284.5	288.1	291.0	302.1	304.04	14.40	1	3	0	0	0	3
638	258.2	271.6	299.4	302.4	324.5	342.8	348.88	18.61	1	3	4	0	0	7
639	239.5	273.7	288.6	262.8	284.4	321.2	349.85	62.92	1	16	2	1	0	19

Tetrahydrofuran Mouse Teratology Study: Raw Fetal Data

Ø ppm THF

Matno	Site	Status	Sex	Fetal Wt(g)	Head or Visceral	ABN1	ABN2	ABN3	ABN4	ABN5	ABN6	ABN7
9	1	1	2	1.343	V							
9	2	1	2	1.25Ø	H							
9	3	1	1	1.396	V							
9	4	1	2	1.343	H							
9	5	1	1	1.3ØØ	V							
9	6	1	2	1.172	H	ROST						
9	7	1	2	1.Ø58	V							
9	8	1	1	1.315	H							
9	9	1	1	1.265	V							
9	1Ø	4	.	.								
34	1	1	1	1.318	V	SURB						
34	2	1	1	1.37Ø	H	SURB						
34	3	1	1	1.178	V	SURB						
34	4	1	1	1.215	H	SURB						
34	6	1	1	1.131	V	SURB						
34	8	1	1	1.247	H	SURB						
34	7	2	.	.								
34	8	1	2	1.182	V	SURB						
34	9	1	1	1.254	H	SURB						
34	1Ø	1	2	1.279	V							
34	11	1	2	1.283	H	SURB						
34	12	1	1	1.4Ø9	V	SURB						
34	13	1	2	1.245	H	SURB						
34	14	1	1	1.379	V	SURB						
54	1	1	2	1.288	H							
54	2	1	2	1.217	V							
54	3	1	2	Ø.991	H							
64	4	1	2	1.275	V	SURB						
54	5	1	1	1.386	H							
54	6	1	2	1.284	V							
54	7	1	1	1.339	H	SURB						
54	8	1	1	1.3Ø1	V							
54	9	1	1	1.358	H							
54	1Ø	1	1	1.4ØØ	V							
54	11	1	1	1.4Ø5	H							
54	12	1	2	1.327	V							
64	1	1	1	1.Ø12	V							
64	2	1	1	1.Ø96	H	SURB						
64	3	1	2	1.Ø13	V							
64	4	1	1	1.135	H							
64	5	1	1	1.198	V	SURB						
64	6	1	2	1.Ø7Ø	H	SURB						
64	7	2	.	.								
64	8	1	1	1.Ø1Ø	V							
64	9	1	2	1.Ø97	H							
64	1Ø	1	2	Ø.997	V							
64	11	1	2	1.Ø84	H							
64	12	1	2	1.Ø8Ø	V	SURB						

Status: 1 = Live; 2 = Early Resorption; 4 = Late Resorption
Sex: Male = 1; Female = 2; See Code Sheet 3Ø for identification of abnormalities [ABNn]

C.17

Tetrahydrofuran Mouse Teratology Study: Raw Fetal Data

---------- 0 ppm THF ----------

Matno	Site	Status	Sex	Fetal Wt(g)	Head or Visceral	ABN1	ABN2	ABN3	ABN4	ABN5	ABN6	ABN7
64	13	1	2	1.065	H	SURB						
64	14	1	1	1.061	V							
71	1	2	.	.								
71	2	1	2	1.399	H							
71	3	2	.	.								
71	4	1	2	1.445	V							
71	5	1	1	1.390	H							
71	6	1	1	1.199	V	SURB						
71	7	1	2	1.260	H							
71	8	1	2	1.365	V							
71	9	1	2	1.429	H							
71	10	1	2	0.696	HV	EXCE	FRET					
71	11	4	.	.								
71	12	2	.	.								
71	13	1	2	1.265	V	ROST						
71	14	2	.	.								
80	1	1	2	1.325	V							
80	2	1	2	1.294	H							
80	3	1	2	1.322	V							
80	4	1	2	1.311	H							
80	5	1	1	1.308	V							
80	6	1	2	1.330	H							
80	7	1	2	1.235	V							
80	8	1	2	1.341	H							
80	9	1	1	1.351	V							
80	10	1	2	1.323	H							
100	1	1	1	1.364	V							
100	2	1	1	1.251	H							
100	3	1	1	1.188	V							
100	4	1	1	1.222	H							
100	5	2	.	.								
100	6	1	2	1.321	V							
100	7	1	2	1.259	H							
100	8	1	2	1.233	V							
100	9	1	2	1.238	H							
100	10	2	.	.								
100	11	1	1	1.336	V							
100	12	1	2	1.185	H							
100	13	1	2	1.249	V							
100	14	1	1	1.327	H							
118	1	1	2	1.420	H							
118	2	1	1	1.547	V	ROST	SURB					
118	3	2	.	.								
118	4	2	.	.								
118	5	1	1	1.515	V	SURB						
118	6	1	1	1.498	H							
118	7	1	1	1.498	V							

Status: 1 = Live; 2 = Early Resorption; 4 = Late Resorption
Sex: Male = 1; Female = 2; See Code Sheet 30 for identification of abnormalities [ABNn]

Tetrahydrofuran Mouse Teratology Study: Raw Fetal Data

-- 0 ppm THF --

Matno	Site	Status	Sex	Fetal Wt(g)	Head or Visceral	ABN1	ABN2	ABN3	ABN4	ABN5	ABN6	ABN7
118	8	1	2	1.493	H	SURB						
118	9	2	.	.								
118	10	1	2	1.418	V	SURB						
118	11	1	2	1.361	H	SURB	ROST					
118	12	1	2	1.390	V							
118	13	1	1	1.511	H							
120	1	1	2	1.319	H							
120	2	1	2	1.251	V							
120	3	4	.	.								
120	4	1	2	1.352	H	SURB						
120	5	1	2	1.230	V							
120	6	1	1	1.328	H							
120	7	1	2	1.126	V							
120	8	1	2	1.159	H							
120	9	1	2	0.966	V							
120	10	1	2	1.106	H	SURB						
120	11	1	1	1.200	V	SURB						
120	12	1	1	1.336	H							
120	13	1	2	1.202	V	SURB						
120	14	1	2	1.278	H							
120	15	1	1	1.326	V							
122	1	1	2	1.501	V							
122	2	1	2	1.441	H	ROST						
122	3	1	2	1.448	V							
122	4	1	1	1.460	H							
122	5	1	2	1.522	V							
122	6	1	2	1.414	H	SURB						
122	7	1	2	1.413	V							
122	8	1	2	1.481	H	SURB						
122	9	1	2	1.394	V	SURB						
122	10	1	1	1.523	H							
122	11	1	1	1.567	V							
122	12	1	2	1.467	H							
130	1	1	2	1.285	V							
130	2	1	2	1.131	H	SURB						
130	3	1	2	1.154	V							
130	4	1	2	1.209	H							
130	5	1	1	1.196	V							
130	6	1	1	1.164	H							
130	7	1	1	1.314	V							
130	8	1	2	1.178	H							
130	9	1	1	1.280	V	SURB						
130	10	2	.	.								
130	11	1	1	1.233	H							
130	12	1	1	1.391	V							
130	13	1	2	1.338	H	ROST						
130	14	4	.	.								

Status: 1 = Live; 2 = Early Resorption; 4 = Late Resorption
Sex: Male = 1; Female = 2; See Code Sheet 30 for identification of abnormalities [ABNn]

Tetrahydrofuran Mouse Teratology Study: Raw Fetal Data

-- 0 ppm THF --

Matno	Site	Status	Sex	Fetal Wt(g)	Head or Visceral	ABN1	ABN2	ABN3	ABN4	ABN5	ABN6	ABN7
130	15	1	1	1.338	V							
137	1	1	2	1.318	V							
137	2	1	1	1.410	H							
137	3	1	2	1.298	V							
137	4	1	1	1.305	H							
137	5	1	2	1.337	V	SURB						
137	6	1	1	1.851	H	SURB						
137	7	1	1	1.319	V	SURB						
137	8	1	1	1.440	H	SURB						
137	9	1	2	1.320	V							
137	10	1	2	1.280	H	SURB						
137	11	1	2	1.369	V	SURB						
137	12	1	1	1.349	H	SURB						
139	1	1	2	1.301	H	SURB						
139	2	4	.	.								
139	3	1	2	1.480	V	SURB						
139	4	1	1	1.359	H	ROST	SURB					
139	5	1	2	1.274	V	RURB	SURB					
139	6	1	1	1.385	H	SURB						
139	7	1	1	1.187	V	SURB						
139	8	1	1	1.870	H	SURB						
139	9	1	2	1.330	V	SURB						
139	10	1	1	1.396	H	SURB						
154	1	1	2	1.208	V							
154	2	1	1	1.163	H							
154	3	1	2	1.148	V	SURB						
154	4	1	2	1.269	H							
154	5	2	.	.								
154	6	1	1	1.335	V	SURB						
154	7	1	1	1.027	H							
154	8	1	1	1.127	V	SURB						
154	9	1	2	1.205	H							
154	10	1	2	1.245	V							
154	11	1	1	1.258	H	SURB						
154	12	1	2	1.252	V							
159	1	1	2	1.273	V							
159	2	1	2	1.337	H	SURB						
159	3	1	2	1.465	V	SURB						
159	4	1	1	1.427	H							
159	5	1	1	1.383	V							
159	6	1	2	1.430	H							
159	7	1	2	1.388	V							
159	8	1	1	1.391	H							
159	9	1	1	1.420	V	SURB						
159	10	1	1	1.449	H							
159	11	4	.	.								
159	12	1	2	1.335	V							

Status: 1 = Live; 2 = Early Resorption; 4 = Late Resorption
Sex: Male = 1; Female = 2; See Code Sheet 30 for identification of abnormalities [ABNn]

Tetrahydrofuran Mouse Teratology Study: Raw Fetal Data

---------- Ø ppm THF ----------

Matno	Site	Status	Sex	Fetal Wt(g)	Head or Visceral	ABN1	ABN2	ABN3	ABN4	ABN5	ABN6	ABN7
169	13	1	1	1.415	H							
185	1	1	2	1.388	H							
185	2	1	2	1.233	V							
185	3	1	2	1.339	H							
185	4	1	2	1.339	V							
185	5	1	2	1.423	H	SURB						
185	6	1	2	1.337	V							
185	7	1	2	1.341	H							
185	8	1	1	1.490	V	SURB						
185	9	1	1	1.418	H							
185	10	1	2	1.230	V							
185	11	1	2	1.372	H							
185	12	1	2	1.332	V							
185	13	1	1	1.446	H	SURB						
190	1	1	1	1.229	H							
190	2	1	2	1.199	V							
190	3	1	2	1.288	H							
190	4	1	1	1.356	V							
190	5	1	2	1.188	H							
190	6	1	1	1.247	V							
190	7	1	1	1.323	H							
190	8	1	2	1.352	V							
190	9	1	1	1.281	H							
190	10	1	2	1.253	V							
190	11	1	1	1.359	H							
190	12	1	1	1.307	V							
190	13	1	1	1.291	H							
190	14	1	2	1.342	V							
192	1	1	1	1.364	H							
192	2	1	1	1.272	V							
192	3	1	1	1.219	H							
192	4	1	1	1.256	V							
192	5	1	2	1.224	H							
192	6	1	1	1.207	V	MAST						
192	7	1	1	1.301	H							
192	8	1	2	1.218	V							
192	9	2	.	.								
192	10	1	1	1.182	H							
192	11	1	1	1.458	V							
192	12	1	1	1.403	H							
192	13	1	1	1.377	V	SURB						
192	14	1	1	1.218	H							
192	15	1	1	1.416	V							
212	1	1	2	1.285	H							
212	2	1	2	1.225	V							
212	3	1	2	1.104	H	SURB						
212	4	1	2	1.204	V							

Status: 1 = Live; 2 = Early Resorption; 4 = Late Resorption
Sex: Male = 1; Female = 2; See Code Sheet 30 for identification of abnormalities [ABNn]

Tetrahydrofuran Mouse Teratology Study: Raw Fetal Data

-- 0 ppm THF --

Matno	Site	Status	Sex	Fetal Wt(g)	Head or Visceral	ABN1	ABN2	ABN3	ABN4	ABN5	ABN6	ABN7
212	5	1	2	1.169	H	SURB						
212	6	1	2	1.197	V	SURB						
212	7	1	2	1.249	H	SURB						
212	8	1	1	1.364	V	SURB						
212	9	1	2	1.308	H							
212	10	1	2	1.291	V							
212	11	1	2	1.244	H							
212	12	1	1	1.326	V							
212	13	1	1	1.244	H							
223	1	1	2	1.329	H							
223	2	1	1	1.297	V							
223	3	1	1	1.433	H							
223	4	2	.	.								
223	5	1	2	1.306	V	SURB						
223	6	2	.	.								
223	7	1	1	1.397	H	SURB						
223	8	1	1	1.290	V							
223	9	1	2	1.305	H							
223	10	1	2	1.335	V							
228	1	1	2	1.352	HV							
228	2	4	.	.								
228	3	1	2	1.216	H	SURB						
228	4	1	1	1.387	V							
228	5	1	2	1.376	H							
228	6	1	1	1.449	V							
228	7	1	2	1.339	H							
228	8	1	1	1.437	V							
228	9	1	2	1.289	H							
228	10	1	1	1.392	V							
228	11	1	1	1.453	H							
228	12	1	1	1.286	V							
228	13	1	1	1.349	H							
236	1	1	2	1.467	V							
236	2	1	2	1.365	H	SURB						
236	3	1	2	1.337	V							
236	4	1	2	1.536	H							
236	5	1	2	1.550	V							
236	6	1	1	1.588	H							
236	7	1	2	1.533	V							
236	8	1	2	1.458	H							
236	9	1	2	1.500	V							
236	10	1	1	1.466	H							
236	11	1	1	1.488	V							
236	12	1	2	1.392	H							
236	13	1	2	1.473	V	LMFL						
256	1	1	1	1.387	H							
256	2	1	2	1.293	V							

Status: 1 = Live; 2 = Early Resorption; 4 = Late Resorption
Sex: Male = 1; Female = 2; See Code Sheet 30 for identification of abnormalities [ABNn]

Tetrahydrofuran Mouse Teratology Study: Raw Fetal Data

0 ppm THF

Matno	Site	Status	Sex	Fetal Wt(g)	Head or Visceral	ABN1	ABN2	ABN3	ABN4	ABN5	ABN6	ABN7
256	3	1	1	1.432	H							
256	4	1	2	1.345	V							
256	5	1	1	1.435	H							
256	6	1	1	1.382	V							
256	7	1	1	1.409	H							
256	8	1	2	1.289	V							
256	9	1	2	1.386	H							
256	10	1	2	1.333	V							
256	11	1	2	1.302	H							
256	12	1	2	1.069	V							
256	13	1	2	1.481	H							
271	1	1	1	1.604	H							
271	2	1	2	1.439	V	SURB						
271	3	1	1	1.502	H							
271	4	1	1	1.566	V							
271	5	4	.	.								
271	6	1	1	1.522	H							
271	7	1	2	1.551	V							
271	8	1	1	1.510	H	SURB						
271	9	1	1	1.589	V							
271	10	1	2	1.477	H							
271	11	1	1	1.584	V							
271	12	1	2	1.553	H	SURB						
276	1	1	2	1.434	V							
276	2	1	2	1.395	H							
276	3	1	1	1.363	V							
276	4	1	1	1.321	H							
276	5	1	1	1.491	V							
276	6	1	2	1.434	H							
276	7	1	2	1.376	V							
276	8	1	1	1.371	H							
276	9	1	2	1.333	V							
276	10	1	1	1.374	H							
276	11	2	.	.								
276	12	1	1	1.328	V	SURB						
276	13	1	1	1.439	H							
296	1	1	1	1.582	H							
296	2	1	1	1.499	V							
296	3	1	2	1.516	H							
296	4	1	2	1.542	V							
296	5	1	1	1.574	H							
296	6	1	1	1.489	V							
296	7	1	1	1.602	H							
296	8	1	1	1.588	V							
296	9	1	2	1.501	H							
302	1	2	.	.								
302	2	1	1	1.386	H							

Status: 1 = Live; 2 = Early Resorption; 4 = Late Resorption
Sex: Male = 1; Female = 2; See Code Sheet 30 for identification of abnormalities [ABNn]

Tetrahydrofuran Mouse Teratology Study: Raw Fetal Data

-- Ø ppm THF --

Matno	Site	Status	Sex	Fetal Wt(g)	Head or Visceral	ABN1	ABN2	ABN3	ABN4	ABN5	ABN6	ABN7
3Ø2	3	1	2	1.188	V							
3Ø2	4	1	1	1.158	H							
3Ø2	5	1	1	1.251	V							
3Ø2	6	1	1	1.255	H							
3Ø2	7	1	2	1.Ø81	V							
3Ø2	8	1	1	1.177	H							
3Ø2	9	1	2	1.174	V							
3Ø2	1Ø	1	1	1.225	H							
3Ø2	11	1	2	1.21Ø	V	SURB						
3Ø2	12	1	2	1.27Ø	H							
3Ø2	13	1	2	1.22Ø	V							
3Ø2	14	1	2	1.224	H							
3Ø2	15	1	1	1.3Ø5	V							
3Ø2	16	1	2	1.17Ø	H							
3Ø2	17	1	2	1.1Ø1	V							
3Ø8	1	1	1	1.54Ø	H							
3Ø8	2	1	2	1.481	V							
3Ø8	3	1	1	1.451	H							
3Ø8	4	1	2	1.388	V							
3Ø8	5	1	1	1.5Ø6	H	SURB						
3Ø8	6	1	1	1.441	V							
3Ø8	7	1	2	1.468	H							
3Ø8	8	1	2	.								
3Ø8	9	1	1	1.511	H							
3Ø8	1Ø	1	2	1.467	V							
3Ø8	11	1	1	1.513	H							
325	1	1	1	1.428	H	SURB						
325	2	1	2	1.314	V							
325	3	1	2	1.399	H							
325	4	1	2	1.174	V							
325	5	2	.	.								
325	6	1	2	1.358	H							
326	7	1	1	1.276	V	SURB						
326	8	1	2	1.142	H							
325	9	1	2	1.383	V							
326	1Ø	1	1	1.312	H							
325	11	1	1	1.274	V							
326	12	1	1	1.273	H							
325	13	1	2	1.334	V							
325	14	1	1	1.34Ø	H							
326	1	1	2	1.358	H							
328	2	1	2	1.157	V							
328	3	1	2	1.262	H							
328	4	1	2	1.26Ø	V							
328	5	1	1	1.343	H							
328	6	1	1	1.339	V							
328	7	1	2	1.364	H							

Status: 1 = Live; 2 = Early Resorption; 4 = Late Resorption
Sex: Male = 1; Female = 2; See Code Sheet 3Ø for identification of abnormalities [ABNn]

C.24

Tetrahydrofuran Mouse Teratology Study: Raw Fetal Data

---------- Ø ppm THF ----------

Matno	Site	Status	Sex	Fetal Wt(g)	Head or Visceral	ABN1	ABN2	ABN3	ABN4	ABN5	ABN6	ABN7
326	8	1	2	1.264	V							
326	9	1	2	1.358	H							
326	1Ø	1	1	1.2ØØ	V	ROST						
326	11	1	2	Ø.986	H	ROST						
326	12	1	1	1.216	V							
326	13	1	1	1.271	H							
326	14	1	1	1.278	V							
326	15	1	1	1.224	H							

C.25

Status: 1 = Live; 2 = Early Resorption; 4 = Late Resorption
Sex: Male = 1; Female = 2; See Code Sheet 3Ø for identification of abnormalities [ABNn]

Tetrahydrofuran Mouse Teratology Study: Raw Fetal Data

-- 600 ppm THF --

Matno	Site	Status	Sex	Fetal Wt(g)	Head or Visceral	ABN1	ABN2	ABN3	ABN4	ABN5	ABN6	ABN7
37	1	2	.	.								
37	2	1	2	1.236	H							
37	3	1	2	1.311	V							
37	4	1	1	1.252	H	SURB						
37	5	1	1	1.318	V							
37	6	4	.	.								
37	7	1	2	1.356	H							
37	8	1	1	1.347	V							
37	9	1	2	1.308	H							
37	10	1	2	1.292	V							
38	1	1	2	1.195	V							
38	2	1	1	1.254	H							
38	3	1	2	1.188	V							
38	4	2	.	.								
38	5	1	2	1.220	H							
38	6	1	1	1.382	V							
38	7	1	1	1.174	H							
38	8	1	1	1.282	V							
38	9	1	2	1.197	H							
38	10	1	2	1.147	V							
38	11	1	1	1.227	H							
39	1	1	2	1.319	H	SURB						
39	2	1	2	1.393	V	SURB						
39	3	1	2	1.281	V							
39	4	1	1	1.397	V							
39	5	1	1	1.431	H							
39	6	1	1	1.245	V	ROST	SURB					
39	7	1	2	1.310	H							
39	8	4	.	.								
39	9	1	1	1.264	V							
39	10	1	2	1.264	H							
39	11	1	2	1.370	V							
51	1	1	2	1.318	V							
51	2	1	2	1.241	H							
51	3	1	2	1.126	V							
51	4	1	1	0.933	H	ROST						
51	5	1	1	1.107	V							
51	6	1	1	1.033	H							
51	7	1	2	1.025	V							
51	8	1	1	1.147	H	ROST						
51	9	1	1	1.310	V							
51	10	1	2	1.168	H							
51	11	1	2	1.127	V							
51	12	1	1	1.197	H							
51	13	1	2	1.071	V							
51	14	1	2	1.072	H							
55	1	1	2	1.290	H	SURB						

Status: 1 = Live; 2 = Early Resorption; 4 = Late Resorption
Sex: Male = 1; Female = 2; See Code Sheet 30 for identification of abnormalities [ABNn]

Tetrahydrofuran Mouse Teratology Study: Raw Fetal Data

600 ppm THF

Matno	Site	Status	Sex	Fetal Wt(g)	Head or Visceral	ABN1	ABN2	ABN3	ABN4	ABN5	ABN6	ABN7
55	2	1	2	1.283	V							
55	3	1	2	1.330	H	ROST	SURB					
55	4	1	1	1.405	V	SURB						
55	5	1	2	1.338	H	SURB						
55	6	1	1	1.438	V	SURB						
55	7	1	1	1.428	H							
55	8	1	2	1.250	HV	EXCE	OPEY	FRET	SURB			
55	9	1	1	1.417	H	SURB						
55	10	1	2	1.363	V							
55	11	1	2	1.437	H	SURB						
55	12	1	1	1.482	V							
55	13	1	1	1.445	H	SURB						
70	1	1	1	1.458	H							
70	2	1	2	1.092	V							
70	3	1	1	1.385	H							
70	4	1	1	1.386	V							
70	5	1	2	1.333	H							
70	6	1	2	1.398	V							
70	7	1	2	1.310	H	ROST						
70	8	1	1	1.395	V							
70	9	1	1	1.460	H							
70	10	1	2	1.353	V							
70	11	1	2	1.336	H							
70	12	1	1	1.493	V							
70	13	1	1	1.390	H							
76	1	1	1	1.546	V							
76	2	1	1	1.462	H							
76	3	1	2	1.395	V							
76	4	1	2	1.117	H	SURB						
76	5	1	2	1.207	V							
76	6	1	1	1.360	H							
76	7	4	.	.								
76	8	1	1	1.348	V							
76	9	1	1	1.341	H							
76	10	1	1	1.363	V	SURB						
76	11	4	.	.								
83	1	1	2	1.048	H	ROST						
83	2	1	1	0.988	V							
83	3	1	2	1.068	H							
83	4	1	1	1.052	V							
83	5	1	2	1.025	H	ROST						
83	6	1	1	1.040	V							
83	7	1	2	1.064	H							
83	8	1	2	1.010	V							
83	9	1	1	1.181	H							
83	10	1	1	1.169	V	ROST						
83	11	1	2	1.078	H							

Status: 1 = Live; 2 = Early Resorption; 4 = Late Resorption
Sex: Male = 1; Female = 2; See Code Sheet 30 for identification of abnormalities [ABNn]

Tetrahydrofuran Mouse Teratology Study: Raw Fetal Data

-- 600 ppm THF --

Matno	Site	Status	Sex	Fetal Wt(g)	Head or Visceral	ABN1	ABN2	ABN3	ABN4	ABN5	ABN6	ABN7
83	12	1	1	1.129	V	ROST						
83	13	1	2	0.954	H	ROST						
83	14	1	1	0.876	V	ROST						
83	15	1	2	0.989	H							
83	16	1	2	1.059	V	ROST						
113	1	1	2	1.278	H	SURB						
113	2	1	2	1.248	V							
113	3	1	1	1.330	H	SURB						
113	4	1	1	1.267	V	ROST						
113	5	1	2	1.227	H							
113	6	1	2	1.351	V							
113	7	1	1	1.271	H	SURB						
113	8	1	2	1.206	V							
113	9	1	2	1.259	H							
113	10	1	2	1.325	V	SURB						
114	1	1	1	1.481	H							
114	2	1	2	1.311	V							
114	3	1	2	1.326	H	ROST						
114	4	1	2	1.241	V							
114	5	1	2	1.234	H	ROST						
114	6	1	1	1.291	V							
114	7	1	2	1.288	H							
114	8	1	1	1.370	V							
114	9	2	.	.								
114	10	1	2	1.409	H	SURB						
114	11	1	1	1.388	V							
114	12	1	2	1.328	H	SURB						
114	13	1	1	1.380	V	SURB						
114	14	1	1	1.371	H							
132	1	1	1	1.520	V							
132	2	1	2	1.444	H							
132	3	1	1	1.499	V							
132	4	1	1	1.473	H							
132	5	1	1	1.460	V							
132	6	2	.	.								
132	7	1	1	1.473	H							
132	8	1	1	1.423	V							
132	9	1	1	1.408	H							
132	10	1	2	1.426	V							
132	11	1	2	1.405	H							
132	12	1	2	1.276	V							
132	13	1	1	1.457	H							
132	14	1	2	1.351	V							
132	15	1	2	1.485	H							
140	1	1	2	1.339	V							
140	2	1	1	1.397	H							
140	3	1	2	1.327	V							

Status: 1 = Live; 2 = Early Resorption; 4 = Late Resorption
Sex: Male = 1; Female = 2; See Code Sheet 30 for identification of abnormalities [ABNn]

Tetrahydrofuran Mouse Teratology Study: Raw Fetal Data

--- 600 ppm THF ---

Matno	Site	Status	Sex	Fetal Wt(g)	Head or Visceral	ABN1	ABN2	ABN3	ABN4	ABN5	ABN6	ABN7
140	4	1	2	1.363	H							
140	5	1	2	1.311	V							
140	6	1	2	1.252	H							
140	7	1	2	1.348	V							
140	8	1	1	1.355	H							
140	9	1	2	1.223	V							
140	10	1	2	1.327	H							
140	11	1	2	1.390	V							
140	12	1	1	1.367	H							
140	13	1	2	1.392	V							
140	14	1	1	1.323	H							
168	1	2	.	.								
168	2	2	.	.								
168	3	2	.	.								
168	4	2	.	.								
168	5	2	.	.								
168	6	2	.	.								
168	7	2	.	.								
168	8	2	.	.								
168	9	2	.	.								
183	1	1	2	1.450	H							
183	2	1	2	1.517	V							
183	3	1	2	1.518	H							
183	4	1	1	1.510	V							
183	5	1	1	1.535	H							
183	6	1	1	1.562	V							
183	7	1	1	1.527	H	ROST						
183	8	1	2	1.517	V	SURB						
183	9	1	1	1.435	H							
183	10	1	2	1.378	V							
183	11	1	2	1.408	H							
183	12	1	1	1.555	V							
184	1	1	2	1.357	V							
184	2	1	2	1.330	H							
184	3	1	2	1.324	V							
184	4	1	1	1.311	H							
184	5	1	2	1.168	V							
184	6	2	.	.								
184	7	1	2	1.228	H	MAST	ROST					
184	8	1	2	1.273	V							
184	9	1	1	1.300	H							
184	10	1	2	1.318	V							
184	11	1	1	1.437	H							
184	12	1	2	1.308	V							
184	13	1	2	1.258	H							
184	14	1	2	1.241	V	MAST						
184	15	1	2	1.308	H							

Status: 1 = Live; 2 = Early Resorption; 4 = Late Resorption
Sex: Male = 1; Female = 2; See Code Sheet 30 for identification of abnormalities [ABNn]

Tetrahydrofuran Mouse Teratology Study: Raw Fetal Data

-- 600 ppm THF --

Matno	Site	Status	Sex	Fetal Wt(g)	Head or Visceral	ABN1	ABN2	ABN3	ABN4	ABN5	ABN6	ABN7
205	1	1	2	1.281	H							
205	2	1	1	1.388	V							
205	3	1	1	1.242	H	SURB						
205	4	1	2	1.221	V							
205	5	1	2	1.317	H							
205	6	1	2	1.105	V	SURB						
205	7	1	2	1.288	H	SURB						
205	8	1	2	1.210	V	SURB						
205	9	1	2	1.321	H							
205	10	1	1	1.316	V	SURB						
205	11	1	1	1.273	H	SURB						
205	12	1	1	1.291	V							
205	13	1	2	1.364	H	SURB						
205	14	1	1	1.378	V	SURB						
205	15	1	2	1.275	H	SURB						
210	1	1	2	1.468	V							
210	2	1	1	1.554	H	SURB						
210	3	2	.	.								
210	4	1	1	1.419	V							
210	5	1	2	1.355	H							
210	6	1	1	1.424	V							
210	7	1	1	1.427	H							
210	8	1	1	1.403	V							
210	9	1	1	1.409	H							
210	10	1	2	1.297	V							
210	11	1	2	1.228	H							
210	12	1	2	1.352	V							
210	13	1	1	1.439	H							
210	14	1	1	1.363	V							
220	1	1	2	1.339	H							
220	2	1	2	1.454	V							
220	3	1	1	1.469	H							
220	4	1	2	1.304	V							
220	5	1	2	1.228	H							
220	6	1	2	1.272	V							
220	7	1	2	1.272	H							
220	8	1	2	1.308	V							
220	9	1	2	1.281	H	SURB						
220	10	1	1	1.382	V							
220	11	1	1	1.310	H							
220	12	1	1	1.506	V							
240	1	1	2	1.515	V							
240	2	1	1	1.505	H							
240	3	1	1	1.568	V							
240	4	1	2	1.538	H	SURB						
240	5	1	2	1.544	V							
240	6	1	1	1.442	H	SURB						

Status: 1 = Live; 2 = Early Resorption; 4 = Late Resorption
Sex: Male = 1; Female = 2; See Code Sheet 30 for identification of abnormalities [ABNn]

Tetrahydrofuran Mouse Teratology Study: Raw Fetal Data

600 ppm THF

Matno	Site	Status	Sex	Fetal Wt(g)	Head or Visceral	ABN1	ABN2	ABN3	ABN4	ABN5	ABN6	ABN7
240	7	1	2	1.558	V							
240	8	1	1	1.460	H	SURB						
240	9	2	.	.								
240	10	1	2	1.498	V							
240	11	1	2	1.451	H							
240	12	1	1	1.384	V							
249	1	1	1	1.426	V							
249	2	1	1	1.439	H							
249	3	1	2	1.353	V							
249	4	1	2	1.413	H							
249	5	1	1	1.396	V							
249	6	1	2	1.391	H							
249	7	1	1	1.418	V							
249	8	1	2	1.273	H							
249	9	1	1	1.458	V							
249	10	1	2	1.397	H							
249	11	1	2	1.457	V							
255	1	1	2	1.834	V							
275	1	1	2	1.399	V	SURB						
275	2	1	1	1.380	H							
275	3	1	1	1.228	V	SURB						
275	4	1	2	1.294	H	SURB						
275	5	1	1	1.377	V	SURB						
275	6	1	1	1.266	H	SURB						
275	7	2	.	.								
275	8	1	2	1.374	V	SURB						
275	9	1	2	1.371	H	SURB						
275	10	1	2	1.318	V							
288	1	1	1	1.389	V							
288	2	1	2	1.447	H							
288	3	1	2	1.387	V							
288	4	4	.	.								
288	5	1	2	1.251	H							
288	6	1	1	1.335	V							
288	7	5	.	.								
288	8	1	1	1.262	H							
288	9	1	2	1.099	V							
288	10	1	1	1.317	H							
288	11	1	2	1.360	V							
288	12	1	2	1.224	H							
294	1	1	2	1.488	V							
294	2	1	1	1.460	H							
294	3	1	2	1.343	V							
294	4	1	2	1.369	H							
294	5	1	2	1.334	V							
294	6	1	2	1.353	H	SURB						
294	7	1	1	1.422	V							

Status: 1 = Live; 2 = Early Resorption; 4 = Late Resorption
Sex: Male = 1; Female = 2; See Code Sheet 30 for identification of abnormalities [ABNn]

Tetrahydrofuran Mouse Teratology Study: Raw Fetal Data

---------- 600 ppm THF ----------

Matno	Site	Status	Sex	Fetal Wt(g)	Head or Visceral	ABN1	ABN2	ABN3	ABN4	ABN5	ABN6	ABN7
313	1	1	1	1.386	H							
313	2	1	2	1.413	V							
313	3	1	1	1.320	H	SURB						
313	4	1	1	1.384	V							
313	5	1	2	1.309	H							
313	6	1	1	1.340	V							
313	7	1	1	1.340	H	SURB						
313	8	1	2	1.403	V							
313	9	1	1	1.462	H							
313	10	1	1	1.456	V	SURB						
313	11	2	.	.								
330	1	1	2	1.421	H							
330	2	1	1	1.460	V	SURB						
330	3	1	1	1.387	H	ROST						
330	4	1	2	1.240	V							
330	5	1	1	1.363	H							
330	6	1	1	1.411	V	SURB						
330	7	1	1	1.466	H							
330	8	1	1	1.349	V							
330	9	1	2	1.426	H							
330	10	1	1	1.470	V							
330	11	1	2	1.361	H							
331	1	1	1	.	V							
331	2	1	1	.	H	ROST						
331	3	1	1	.	V							
331	4	1	1	.	H							
331	5	1	1	.	V							
331	6	1	1	.	H							
331	7	1	1	.	V							
331	8	1	2	.	H							
331	9	1	1	.	V							

Status: 1 = Live; 2 = Early Resorption; 4 = Late Resorption
Sex: Male = 1; Female = 2; See Code Sheet 30 for identification of abnormalities [ABNn]

Tetrahydrofuran Mouse Teratology Study: Raw Fetal Data

1800 ppm THF

C.33

Matno	Site	Status	Sex	Fetal Wt(g)	Head or Visceral	ABN1	ABN2	ABN3	ABN4	ABN5	ABN6	ABN7
20	1	2	.	.								
20	2	2	.	.								
20	3	2	.	.								
20	4	2	.	.								
20	5	2	.	.								
20	6	2	.	.								
20	7	2	.	.								
20	8	2	.	.								
20	9	2	.	.								
20	10	2	.	.								
20	11	2	.	.								
20	12	2	.	.								
20	13	2	.	.								
20	14	2	.	.								
27	1	1	1	1.303	H							
27	2	1	1	1.277	V							
27	3	1	1	1.309	H							
27	4	2	.	.								
27	5	1	2	1.140	V							
27	6	1	1	1.208	H							
27	7	1	2	1.254	V							
27	8	1	1	1.219	H							
27	9	1	2	1.179	V	ROST						
27	10	1	2	1.026	H							
27	11	1	1	1.139	V							
27	12	1	2	1.239	H							
27	13	2	.	.								
27	14	1	1	1.273	V	ROST	SURB					
27	15	1	1	1.134	H							
44	1	2	.	.								
44	2	1	1	1.262	H							
44	3	1	2	1.306	V	SURB						
44	4	1	2	1.283	H	SURB						
44	5	1	2	1.279	V							
44	6	1	1	1.278	H	SURB						
44	7	1	2	1.257	V	SURB						
44	8	1	2	1.244	H							
44	9	1	2	1.238	V							
44	10	1	2	1.249	H	SURB						
44	11	1	2	1.025	V							
44	12	1	2	1.204	H							
45	1	1	1	1.278	V							
45	2	1	2	1.181	H							
45	3	1	1	1.289	V							
45	4	1	2	1.109	H							
45	5	1	1	1.274	V							
45	6	1	1	1.365	H							

Status: 1 = Live; 2 = Early Resorption; 4 = Late Resorption
Sex: Male = 1; Female = 2; See Code Sheet 30 for identification of abnormalities [ABNn]

Tetrahydrofuran Mouse Teratology Study: Raw Fetal Data

------------------------------ 1800 ppm THF ------------------------------

C.34

Matno	Site	Status	Sex	Fetal Wt(g)	Head or Visceral	ABN1	ABN2	ABN3	ABN4	ABN5	ABN6	ABN7
45	7	1	2	1.203	V							
45	8	4	.	.								
45	9	1	2	1.214	H							
45	10	1	1	1.283	V							
45	11	1	2	1.224	H							
45	12	1	1	1.235	V							
53	1	1	2	1.224	H							
53	2	1	1	1.165	V							
53	3	1	2	1.211	H							
53	4	1	2	1.160	V							
53	5	1	1	1.225	H							
53	6	1	2	1.265	V							
53	7	1	2	1.212	H							
53	8	1	1	1.186	V							
53	9	1	2	1.130	H	SURB						
53	10	1	2	1.182	V	SURB						
53	11	1	1	1.272	H							
53	12	1	2	1.188	V							
53	13	1	1	1.256	H							
58	1	1	1	1.397	V	SURB						
58	2	1	1	1.420	H	SURB						
58	3	1	2	1.293	V	SURB						
58	4	1	1	1.356	H							
58	5	1	1	1.171	V	SURB						
58	6	1	1	1.406	H							
58	7	1	1	1.399	V							
58	8	1	1	1.309	H							
58	9	1	1	1.276	V	SURB						
61	1	1	1	1.091	H							
61	2	1	1	1.164	V							
61	3	1	1	1.272	H							
61	4	1	2	1.119	V							
61	5	1	2	1.115	H							
61	6	1	2	1.069	V							
61	7	2	.	.								
61	8	1	1	1.126	H							
61	9	1	2	1.060	V							
61	10	1	1	1.222	H							
61	11	1	2	1.013	V							
61	12	1	1	1.105	H							
66	1	1	2	1.106	H							
66	2	1	2	1.124	V	ROST						
66	3	1	1	1.218	H							
66	4	1	2	1.153	V							
66	5	1	1	1.140	H							
66	6	1	2	1.219	V							
66	7	2	.	.								

Status: 1 = Live; 2 = Early Resorption; 4 = Late Resorption
Sex: Male = 1; Female = 2; See Code Sheet 30 for identification of abnormalities [ABNn]

Tetrahydrofuran Mouse Teratology Study: Raw Fetal Data

1800 ppm THF

Matno	Site	Status	Sex	Fetal Wt(g)	Head or Visceral	ABN1	ABN2	ABN3	ABN4	ABN5	ABN6	ABN7
66	8	1	1	1.120	H							
66	9	1	2	1.172	V							
66	10	1	2	1.160	H							
66	11	1	1	1.233	V							
66	12	1	1	1.190	H							
66	13	1	2	1.140	V							
66	14	1	2	1.139	H	ROST						
75	1	1	2	1.401	V							
75	2	1	1	1.414	H							
75	3	1	1	1.347	V							
75	4	1	2	1.370	H	SURB						
75	5	1	2	1.327	V	SURB						
75	6	1	2	1.342	H							
75	7	1	1	1.200	V	ROSK	SURB					
75	8	1	2	1.348	H							
75	9	1	2	1.369	V	SURB						
75	10	1	2	1.414	H							
75	11	1	1	1.366	V	SURB						
85	1	2	.	.								
85	2	2	.	.								
85	3	2	.	.								
85	4	2	.	.								
85	5	2	.	.								
85	6	2	.	.								
85	7	2	.	.								
85	8	2	.	.								
85	9	2	.	.								
85	10	2	.	.								
85	11	2	.	.								
88	1	4	.	.								
88	2	4	.	.								
88	3	4	.	.								
88	4	4	.	.								
88	5	4	.	.								
88	6	4	.	.								
88	7	4	.	.								
88	8	4	.	.								
88	9	4	.	.								
92	1	1	2	1.415	H							
92	2	1	1	1.460	V							
92	3	1	2	1.354	H	ROST						
92	4	1	1	1.454	V							
92	5	1	2	1.347	H							
92	6	1	1	1.386	V							
92	7	1	2	1.315	H	ROST						
92	8	1	1	1.339	V	SURB						
92	9	1	1	1.461	H							

Status: 1 = Live; 2 = Early Resorption; 4 = Late Resorption
Sex: Male = 1; Female = 2; See Code Sheet 30 for identification of abnormalities [ABNn]

Tetrahydrofuran Mouse Teratology Study: Raw Fetal Data

1800 ppm THF

Matno	Site	Status	Sex	Fetal Wt(g)	Head or Visceral	ABN1	ABN2	ABN3	ABN4	ABN5	ABN6	ABN7
92	10	1	1	1.417	V							
108	1	1	1	1.357	V							
108	2	1	2	1.346	H							
108	3	1	2	1.389	V							
108	4	1	1	1.315	H	SURB						
108	5	1	2	1.329	V							
108	6	4	.	.								
108	7	4	.	.								
108	8	1	2	1.344	H							
108	9	1	2	1.287	V							
108	10	1	1	1.455	H							
108	11	1	1	1.340	V							
108	12	1	2	1.280	H							
108	13	1	2	1.286	V							
149	1	1	1	1.166	H							
149	2	1	2	1.190	V							
149	3	1	2	1.120	H							
149	4	1	2	1.196	V							
149	5	1	2	1.009	H							
149	6	1	1	1.076	V							
149	7	1	1	1.095	H							
149	8	1	2	1.023	V							
149	9	1	2	1.031	H							
149	10	1	2	1.193	V							
149	11	1	2	1.174	H							
149	12	1	2	1.097	V							
149	13	1	1	1.212	H							
149	14	1	1	1.192	V							
149	15	1	2	1.067	H							
157	1	2	.	.								
157	2	2	.	.								
157	3	2	.	.								
157	4	2	.	.								
157	5	2	.	.								
157	6	2	.	.								
157	7	2	.	.								
157	8	2	.	.								
157	9	2	.	.								
157	10	2	.	.								
157	11	2	.	.								
157	12	2	.	.								
176	1	1	1	1.390	H							
176	2	1	1	1.353	V							
176	3	1	2	1.321	H							
176	4	1	2	1.329	V							
176	5	1	2	1.099	H	SURB						
176	6	1	1	1.306	V							

Status: 1 = Live; 2 = Early Resorption; 4 = Late Resorption
Sex: Male = 1; Female = 2; See Code Sheet 30 for identification of abnormalities [ABNn]

Tetrahydrofuran Mouse Teratology Study: Raw Fetal Data

-- 1800 ppm THF --

Matno	Site	Status	Sex	Fetal Wt(g)	Head or Visceral	ABN1	ABN2	ABN3	ABN4	ABN5	ABN6	ABN7
176	7	1	1	1.335	H							
176	8	1	2	1.349	V							
176	9	1	2	1.312	H							
176	10	1	2	1.281	V	SURB						
176	11	1	2	1.297	H							
200	1	1	2	1.376	V							
200	2	1	1	1.477	H							
200	3	1	1	1.492	V							
200	4	1	2	1.366	H							
200	5	1	2	1.402	V							
200	6	1	1	1.397	H							
200	7	1	2	1.240	V							
200	8	1	1	1.383	H							
200	9	1	2	1.292	V							
200	10	1	1	1.391	H							
200	11	1	2	1.364	V							
200	12	1	2	1.484	H							
200	13	1	1	1.459	V							
226	1	1	1	1.326	H	ROST						
226	2	1	2	1.257	V	ROST						
226	3	1	1	1.268	H							
226	4	1	1	1.247	V							
226	5	1	2	1.217	H	ROST						
226	6	1	1	1.248	V							
226	7	1	2	1.111	H							
226	8	1	2	1.135	V	ROST						
226	9	1	1	1.322	H							
226	10	1	2	1.260	V	ROST						
226	11	1	2	1.329	H							
226	12	1	2	1.282	V							
260	1	1	1	1.418	H	SURB						
260	2	1	1	1.354	V	SURB						
260	3	1	1	1.392	H	SURB						
260	4	4	.	.								
260	5	2	.	.								
260	6	1	1	1.267	V	SURB						
260	7	1	2	1.350	H							
260	8	1	2	1.252	V	SURB						
260	9	4	.	.								
260	10	1	1	1.344	H	SURB						
260	11	1	1	1.276	V	SURB						
260	12	1	1	1.286	H							
260	13	1	2	1.199	V	SURB						
260	14	1	1	1.359	H							
283	1	1	2	0.620	V	ROSK	ROST					
283	2	4	.	.								
283	3	1	1	0.602	VH	CLPA	UNTE	ROST	SURB	ROPB	ROVE	ROPH

Status: 1 = Live; 2 = Early Resorption; 4 = Late Resorption
Sex: Male = 1; Female = 2; See Code Sheet 30 for identification of abnormalities [ABNn]

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Tetrahydrofuran Mouse Teratology Study: Raw Fetal Data

1800 ppm THF

Matno	Site	Status	Sex	Fetal Wt(g)	Head or Visceral	ABN1	ABN2	ABN3	ABN4	ABN5	ABN6	ABN7
263	4	4	.	.								
263	5	4	.	.								
263	6	1	1	0.603	V	EDEM	CLPA	ROSK	ROST	SURB	ROVE	ROPH
263	7	4	.	.								
263	8	1	1	0.315	VH	CLPA	UNTE	ROST	ROVE	ROPB	ROPH	
263	9	1	2	0.420	V	CLPA	ROSK	ROST	ROVE	ROPB	ROPH	
263	10	1	2	0.423	VH	CLPA	ECOV	SURB	ROST	ROVE	ROPB	ROPH
263	11	4	.	.								
263	12	4	.	.								
263	13	4	.	.								
270	1	1	2	1.329	H							
270	2	1	1	1.428	V							
270	3	1	2	1.354	H							
270	4	1	1	1.326	V							
270	5	1	1	1.318	H							
270	6	1	1	1.340	V	SURB						
270	7	1	1	1.326	H	SURB						
270	8	1	1	1.340	V	SURB						
270	9	1	2	1.205	H	SURB						
270	10	2	.	.								
270	11	1	2	1.357	V							
270	12	2	.	.								
270	13	1	2	1.299	H							
270	14	2	.	.								
274	1	1	1	1.276	V	SURB						
274	2	1	1	1.260	H	SURB						
274	3	1	1	1.306	V	SURB						
274	4	1	1	1.229	H	SURB						
274	5	4	.	.								
274	6	1	2	1.195	V							
274	7	1	2	1.242	H	SURB						
274	8	1	2	1.220	V	SURB						
274	9	1	2	1.175	H	SURB						
274	10	1	2	1.277	V							
274	11	1	2	1.241	H	SURB						
274	12	1	2	1.320	V	SURB						
287	1	1	1	1.511	V							
287	2	1	1	1.420	H							
287	3	1	1	1.440	V							
287	4	2	.	.								
287	5	1	1	1.432	H							
287	6	1	1	1.272	V							
287	7	1	2	1.359	H							
287	8	2	.	.								
287	9	1	2	1.455	V							
287	10	1	2	1.397	H							
287	11	1	1	1.410	V							

Status: 1 = Live; 2 = Early Resorption; 4 = Late Resorption
Sex: Male = 1; Female = 2; See Code Sheet 30 for identification of abnormalities [ABNn]

Tetrahydrofuran Mouse Teratology Study: Raw Fetal Data

-- 1800 ppm THF --

Matno	Site	Status	Sex	Fetal Wt(g)	Head or Visceral	ABN1	ABN2	ABN3	ABN4	ABN5	ABN6	ABN7
293	1	1	1	1.386	H							
293	2	1	1	1.372	V							
293	3	1	2	1.323	H							
293	4	1	2	1.220	V							
293	5	1	2	1.240	H							
293	6	1	1	1.367	V							
293	7	1	1	1.417	H							
293	8	1	1	1.437	V							
293	9	1	1	1.473	H							
293	10	1	1	1.439	V							
293	11	1	1	1.369	H							
293	12	1	1	1.393	V							
293	13	1	2	1.355	H							
298	1	1	2	1.147	H							
298	2	1	1	1.155	V							
298	3	1	1	1.262	H							
298	4	1	1	1.268	V							
298	5	1	2	1.085	H							
298	6	1	1	1.031	V							
298	7	1	1	1.119	H							
321	1	1	1	1.265	V							
321	2	1	2	1.288	H							
321	3	1	2	1.179	V							
321	4	1	2	1.285	H							
321	5	2	.	.								
321	6	1	1	1.289	V	ROST						
321	7	1	2	1.128	H	ROST						
321	8	1	1	1.130	V	ROST						
321	9	1	1	1.093	H							
321	10	1	2	1.162	V	SURB						
321	11	1	1	1.284	H	ROST						
329	1	1	1	1.036	V							
329	2	1	2	1.117	H	ROST						
329	3	1	2	1.113	V							
329	4	1	1	1.325	H							
329	5	1	1	1.289	V	SURB						
329	6	1	2	1.266	H							
329	7	1	2	1.252	V	SURB						
329	8	4	.	.								
329	9	4	.	.								
329	10	1	1	1.364	H							
329	11	1	2	1.247	V							
329	12	1	1	1.409	H							

Status: 1 = Live; 2 = Early Resorption; 4 = Late Resorption
Sex: Male = 1; Female = 2; See Code Sheet 30 for identification of abnormalities [ABNn]

Tetrahydrofuran Mouse Teratology Study: Raw Fetal Data

-- 5000 ppm THF --

Matno	Site	Status	Sex	Fetal Wt(g)	Head or Visceral	ABN1	ABN2	ABN3	ABN4	ABN5	ABN6	ABN7
26	1	2	.	.								
26	2	2	.	.								
26	3	2	.	.								
26	4	2	.	.								
26	5	2	.	.								
26	6	2	.	.								
26	7	2	.	.								
26	8	2	.	.								
26	9	2	.	.								
26	10	2	.	.								
26	11	2	.	.								
26	12	2	.	.								
26	13	2	.	.								
28	1	2	.	.								
28	2	2	.	.								
28	3	2	.	.								
28	4	2	.	.								
28	5	2	.	.								
28	6	2	.	.								
28	7	2	.	.								
28	8	2	.	.								
28	9	2	.	.								
28	10	2	.	.								
28	11	2	.	.								
28	12	2	.	.								
31	1	2	.	.								
31	2	2	.	.								
31	3	2	.	.								
31	4	2	.	.								
31	5	2	.	.								
31	6	2	.	.								
31	7	2	.	.								
31	8	2	.	.								
31	9	2	.	.								
31	10	2	.	.								
31	11	2	.	.								
31	12	2	.	.								
31	13	2	.	.								
31	14	2	.	.								
31	15	2	.	.								
33	1	2	.	.								
33	2	2	.	.								
33	3	2	.	.								
33	4	2	.	.								
33	5	2	.	.								
33	6	2	.	.								
33	7	2	.	.								

Status: 1 = Live; 2 = Early Resorption; 4 = Late Resorption
Sex: Male = 1; Female = 2; See Code Sheet 30 for identification of abnormalities [ABNn]

Tetrahydrofuran Mouse Teratology Study: Raw Fetal Data

5000 ppm THF

Matno	Site	Status	Sex	Fetal Wt(g)	Head or Visceral	ABN1	ABN2	ABN3	ABN4	ABN5	ABN6	ABN7
33	8	2	.	.								
33	9	2	.	.								
33	10	2	.	.								
33	11	2	.	.								
33	12	2	.	.								
48	1	2	.	.								
48	2	2	.	.								
48	3	2	.	.								
48	4	2	.	.								
48	5	2	.	.								
48	6	2	.	.								
48	7	2	.	.								
48	8	2	.	.								
48	9	2	.	.								
48	10	2	.	.								
48	11	2	.	.								
48	12	2	.	.								
81	1	2	.	.								
81	2	2	.	.								
81	3	2	.	.								
81	4	2	.	.								
81	5	2	.	.								
81	6	2	.	.								
81	7	2	.	.								
81	8	2	.	.								
81	9	2	.	.								
81	10	2	.	.								
81	11	2	.	.								
81	12	2	.	.								
81	13	2	.	.								
81	14	2	.	.								
81	15	2	.	.								
82	1	2	.	.								
82	2	2	.	.								
82	3	2	.	.								
82	4	2	.	.								
82	5	2	.	.								
82	6	2	.	.								
82	7	2	.	.								
82	8	2	.	.								
82	9	2	.	.								
82	10	2	.	.								
82	11	2	.	.								
82	12	2	.	.								
82	13	2	.	.								
97	1	2	.	.								
97	2	2	.	.								

Status: 1 = Live; 2 = Early Resorption; 4 = Late Resorption
Sex: Male = 1; Female = 2; See Code Sheet 30 for identification of abnormalities [ABNn]

Tetrahydrofuran Mouse Teratology Study: Raw Fetal Data

5000 ppm THF

Matno	Site	Status	Sex	Fetal Wt(g)	Head or Visceral	ABN1	ABN2	ABN3	ABN4	ABN5	ABN6	ABN7
97	3	2	.	.								
97	4	2	.	.								
97	5	2	.	.								
97	6	2	.	.								
97	7	2	.	.								
97	8	2	.	.								
97	9	2	.	.								
97	10	2	.	.								
97	11	2	.	.								
97	12	2	.	.								
105	1	2	.	.								
105	2	2	.	.								
105	3	2	.	.								
105	4	2	.	.								
105	5	2	.	.								
105	6	2	.	.								
105	7	2	.	.								
105	8	2	.	.								
105	9	2	.	.								
125	1	2	.	.								
125	2	2	.	.								
125	3	2	.	.								
125	4	2	.	.								
125	5	2	.	.								
125	6	2	.	.								
125	7	2	.	.								
125	8	2	.	.								
125	9	2	.	.								
125	10	2	.	.								
125	11	2	.	.								
125	12	2	.	.								
125	13	2	.	.								
151	1	2	.	.								
151	2	2	.	.								
151	3	2	.	.								
151	4	2	.	.								
151	5	2	.	.								
155	1	2	.	.								
155	2	2	.	.								
155	3	2	.	.								
155	4	2	.	.								
155	5	2	.	.								
155	6	2	.	.								
155	7	2	.	.								
155	8	2	.	.								
155	9	2	.	.								
155	10	2	.	.								

Status: 1 = Live; 2 = Early Resorption; 4 = Late Resorption
Sex: Male = 1; Female = 2; See Code Sheet 30 for identification of abnormalities [ABNn]

Tetrahydrofuran Mouse Teratology Study: Raw Fetal Data

------ 5000 ppm THF ------

Matno	Site	Status	Sex	Fetal Wt(g)	Head or Visceral	ABN1	ABN2	ABN3	ABN4	ABN5	ABN6	ABN7
155	11	2	.	.								
155	12	2	.	.								
155	13	2	.	.								
155	14	2	.	.								
155	15	2	.	.								
155	16	2	.	.								
155	17	2	.	.								
155	18	2	.	.								
162	1	2	.	.								
162	2	2	.	.								
162	3	2	.	.								
162	4	2	.	.								
162	5	2	.	.								
162	6	2	.	.								
162	7	2	.	.								
162	8	2	.	.								
162	9	2	.	.								
162	10	2	.	.								
162	11	2	.	.								
162	12	2	.	.								
162	13	2	.	.								
162	14	2	.	.								
162	15	2	.	.								
162	16	2	.	.								
179	1	2	.	.								
179	2	2	.	.								
179	3	2	.	.								
179	4	2	.	.								
179	5	2	.	.								
179	6	2	.	.								
179	7	2	.	.								
179	8	2	.	.								
179	9	2	.	.								
179	10	2	.	.								
206	1	2	.	.								
206	2	2	.	.								
206	3	2	.	.								
206	4	2	.	.								
206	5	2	.	.								
206	6	2	.	.								
206	7	2	.	.								
206	8	2	.	.								
206	9	2	.	.								
206	10	2	.	.								
206	11	2	.	.								
213	1	2	.	.								
213	2	2	.	.								

Status: 1 = Live; 2 = Early Resorption; 4 = Late Resorption
Sex: Male = 1; Female = 2; See Code Sheet 30 for identification of abnormalities [ABNn]

Tetrahydrofuran Mouse Teratology Study: Raw Fetal Data

6000 ppm THF

Matno	Site	Status	Sex	Fetal Wt(g)	Head or Visceral	ABN1	ABN2	ABN3	ABN4	ABN5	ABN6	ABN7
213	3	2	.	.								
213	4	2	.	.								
213	5	2	.	.								
213	6	2	.	.								
213	7	2	.	.								
213	8	2	.	.								
213	9	2	.	.								
213	10	2	.	.								
213	11	2	.	.								
213	12	2	.	.								
213	13	2	.	.								
213	14	2	.	.								
218	1	2	.	.								
218	2	2	.	.								
218	3	2	.	.								
218	4	2	.	.								
218	5	2	.	.								
218	6	2	.	.								
218	7	2	.	.								
218	8	2	.	.								
218	9	2	.	.								
218	10	2	.	.								
218	11	2	.	.								
218	12	2	.	.								
218	13	2	.	.								
218	14	2	.	.								
218	15	2	.	.								
219	1	2	.	.								
219	2	2	.	.								
219	3	2	.	.								
219	4	2	.	.								
219	5	2	.	.								
219	6	2	.	.								
219	7	2	.	.								
219	8	2	.	.								
219	9	2	.	.								
219	10	2	.	.								
219	11	2	.	.								
219	12	2	.	.								
231	1	1	1	1.067	V	SURB						
231	2	1	2	1.098	H	SURB						
231	3	1	2	1.084	V							
231	4	1	2	1.053	H	SURB						
231	5	1	2	1.018	V	SURB						
231	6	1	2	0.959	H							
231	7	1	2	0.922	V	MAST	ROST	SURB				
231	8	1	2	0.950	H	FURB	SURB					

Status: 1 = Live; 2 = Early Resorption; 4 = Late Resorption
Sex: Male = 1; Female = 2; See Code Sheet 30 for identification of abnormalities [ABNn]

Tetrahydrofuran Mouse Teratology Study: Raw Fetal Data

------------------------------ 5000 ppm THF ------------------------------

Matno	Site	Status	Sex	Fetal Wt(g)	Head or Visceral	ABN1	ABN2	ABN3	ABN4	ABN5	ABN6	ABN7
231	9	1	2	0.908	V							
231	10	4	.	.								
231	11	1	2	0.958	H							
231	12	1	1	0.914	V	MAST	ROST					
231	13	4	.	.								
231	14	1	2	0.955	H	SURB						
280	1	2	.	.								
280	2	2	.	.								
280	3	2	.	.								
280	4	2	.	.								
280	5	2	.	.								
280	6	2	.	.								
280	7	2	.	.								
280	8	2	.	.								
280	9	2	.	.								
280	10	2	.	.								

Status: 1 = Live; 2 = Early Resorption; 4 = Late Resorption
Sex: Male = 1; Female = 2; See Code Sheet 30 for identification of abnormalities [ABNn]

Tetrahydrofuran Mouse Teratology Study: Raw Fetal Data

Code Sheet for Identification of Fetal Abnormalities

CLPA	Cleft Palate
ECOV	Ectopic Ovaries
EDEM	Edema
EXCE	Excencephaly
FRET	Folded Retina
FURB	Fused Ribs
LMFL	Limb Flexure
MAST	Misaligned Sternebra
OPEY	Open Eye
ROPB	Reduced Ossification Pelvic
ROPH	Reduced Ossification Phalanges
ROSK	Reduced Ossification Skull
ROVE	Reduced Ossification Vertebra
RURB	Rudimentary Ribs
SURB	Supernumary Rib
UNTE	Undescended Testes

Tetrahydrofuran Rat Teratology Study: Raw Fetal Data

---------- 0 ppm THF ----------

Matno	Site	Status	Fetal Wt(g)	Sex	Head or Visceral	ABN1	ABN2	ABN3	ABN4	ABN5	ABN6
405	1	1	3.020	2	H						
405	2	1	3.197	1	V	ROVE					
405	3	1	3.739	1	H						
405	4	1	4.064	1	V	COST					
405	5	2	-1.000	-1							
405	6	1	3.126	2	H						
405	7	1	3.745	1	V						
405	8	1	3.604	2	H						
405	9	2	-1.000	-1							
405	10	1	3.474	2	V	ROVE					
405	11	1	3.536	2	H						
405	12	2	-1.000	-1							
416	1	1	3.473	1	V						
416	2	1	2.884	1	H	ROST					
416	3	1	3.181	2	V						
416	4	1	3.555	2	H						
416	5	1	3.411	1	V						
416	6	1	3.721	1	H						
416	7	1	3.859	1	V						
416	8	1	3.821	1	H						
416	9	1	3.845	1	V						
416	10	1	3.316	2	H						
416	11	1	3.756	1	V						
416	12	1	3.651	1	H						
416	13	1	3.941	2	V						
416	14	1	3.564	2	H						
416	15	1	3.713	1	V						
416	16	1	3.624	2	H						
416	17	1	3.270	1	V						
425	1	2	-1.000	-1							
425	2	1	2.990	1	V						
425	3	2	-1.000	-1							
425	4	2	-1.000	-1							
425	5	1	3.801	2	H						
425	6	1	3.760	2	V						
425	7	2	-1.000	-1							
425	8	1	3.505	2	H						
452	1	1	3.356	1	V						
452	2	1	3.137	1	H	ROST					
452	3	1	3.379	1	V						
452	4	1	3.364	1	H	ROST	SURB				
452	5	1	3.294	2	V	ROST					
452	6	1	3.546	2	H						
452	7	1	3.361	2	V						
452	8	1	3.262	1	H						
452	9	1	3.302	1	V						
452	10	2	-1.000	-1							

Status: 1 = Live; 2 = Early Resorption; 4 = Late Resorption
Sex: Male = 1; Female = 2; See Code Sheet 43 for identification of abnormalities [ABNn]

Tetrahydrofuran Rat Teratology Study: Raw Fetal Data

-- 0 ppm THF --

Matno	Site	Status	Fetal Wt(g)	Sex	Head or Visceral	ABN1	ABN2	ABN3	ABN4	ABN5	ABN6
462	11	1	3.348	1	H						
462	12	2	-1.000	-1							
462	13	1	3.389	1	V	ROST					
462	14	1	3.262	1	H						
462	15	1	3.594	1	V						
462	16	1	3.329	2	H						
462	17	2	-1.000	-1							
462	18	1	3.529	1	V	ROST	MAST				
464	1	1	3.495	1	V						
464	2	1	3.318	1	H						
464	3	1	3.288	1	V						
464	4	1	3.437	1	H						
464	5	1	3.179	1	V	ROVE					
464	6	1	3.441	1	H	ROVE					
464	7	1	3.317	1	V						
464	8	2	-1.000	-1							
464	9	1	3.520	2	H						
464	10	1	3.217	2	V						
464	11	1	3.552	1	H						
464	12	1	3.693	1	V						
464	13	1	3.449	1	H						
464	14	1	3.251	2	V						
464	15	1	3.644	1	H						
464	16	1	3.300	2	V						
464	17	1	3.424	2	H						
464	18	1	3.378	2	V						
464	19	1	3.384	1	H						
464	20	1	3.647	1	V						
466	1	1	3.433	2	H						
466	2	1	3.534	2	V	COST					
466	3	1	3.626	2	H	COST					
466	4	1	3.708	1	V	COST	ROVE				
466	5	1	3.829	1	H	COST					
466	6	2	-1.000	-1							
466	7	2	-1.000	-1							
466	8	1	3.333	1	V						
466	9	1	4.018	1	H	COST					
466	10	1	3.478	2	V						
466	11	1	3.808	2	H	ROVE					
466	12	1	3.712	2	V	COST					
466	13	1	3.969	2	H	COST					
471	1	1	3.616	2	H						
471	2	1	3.620	2	V						
471	3	1	3.386	1	H						
471	4	1	3.678	1	V						
471	5	1	3.493	2	H						
471	6	1	3.472	2	V						

Status: 1 = Live; 2 = Early Resorption; 4 = late Resorption
Sex: Male = 1; Female = 2; See Code Sheet 43 for identification of abnormalities [ABNn]

Tetrahydrofuran Rat Teratology Study: Raw Fetal Data

0 ppm THF

Matno	Site	Status	Fetal Wt(g)	Sex	Head or Visceral	ABN1	ABN2	ABN3	ABN4	ABN5	ABN6
471	7	1	3.719	1	H						
471	8	1	3.428	2	V						
471	9	1	3.497	2	H						
471	10	1	2.121	2	V	MIIN	ROVE				
471	11	2	-1.000	-1							
471	12	1	3.691	1	H						
471	13	1	4.146	1	V						
471	14	1	3.469	1	H						
477	1	1	3.235	2	H						
477	2	1	3.098	1	V						
477	3	2	-1.000	-1							
477	4	1	3.342	1	H						
477	5	1	3.560	2	V						
477	6	1	3.541	2	H						
477	7	1	3.188	2	V						
477	8	1	3.620	1	H						
477	9	1	3.160	2	V						
477	10	1	3.414	2	H						
477	11	1	3.486	1	V						
477	12	1	3.863	1	H	COST					
477	13	1	3.000	2	V						
477	14	1	3.112	1	H						
477	15	1	3.863	2	V						
477	16	1	2.934	2	H						
491	1	1	3.442	1	H						
491	2	1	3.380	2	V						
491	3	1	3.565	2	H						
491	4	1	3.997	2	V						
491	5	1	3.648	2	H						
491	6	1	3.704	2	V						
491	7	1	3.494	2	H						
491	8	1	3.060	2	V						
491	9	1	3.681	1	H						
491	10	1	3.460	2	V						
491	11	1	3.390	1	H	ROST					
491	12	1	3.517	2	V	ROVE					
491	13	2	-1.000	-1							
491	14	1	3.641	2	H						
491	15	1	3.901	1	V	ROVE					
495	1	1	3.267	1	H	ROST					
495	2	1	3.371	1	V						
495	3	2	-1.000	-1							
495	4	1	3.599	1	H						
495	5	1	3.505	2	V						
495	6	1	3.511	2	H						
495	7	1	3.476	2	V						
495	8	2	-1.000	-1							

Status: 1 = Live; 2 = Early Resorption; 4 = Late Resorption
Sex: Male = 1; Female = 2; See Code Sheet 43 for identification of abnormalities [ABNn]

Tetrahydrofuran Rat Teratology Study: Raw Fetal Data

---------- Ø ppm THF ----------

Matno	Site	Status	Fetal Wt(g)	Sex	Head or Visceral	ABN1	ABN2	ABN3	ABN4	ABN5	ABN6
495	9	1	3.289	2	H						
495	10	1	3.485	2	V						
495	11	1	3.701	1	H						
495	12	1	3.837	1	V						
495	13	1	3.794	1	H						
495	14	2	-1.000	-1							
495	15	1	3.430	2	V						
495	16	1	3.882	2	H						
495	17	1	3.696	2	V						
499	1	1	3.158	2	H						
499	2	1	2.695	2	V						
499	3	1	3.552	2	H						
499	4	1	3.339	2	V						
499	5	1	3.332	2	H						
499	6	1	3.261	2	V						
499	7	1	3.107	1	H						
499	8	1	3.876	1	V						
499	9	1	3.298	2	H	ROST					
499	10	1	3.505	1	V						
499	11	1	3.238	1	H						
499	12	1	3.468	1	V						
499	13	1	3.548	1	H						
499	14	1	3.725	1	V						
499	15	1	3.252	2	H						
499	16	2	-1.000	-1							
499	17	1	3.852	2	V						
499	18	1	3.298	2	H						
499	19	1	3.413	2	V	ROST					
502	1	1	3.575	1	V						
502	2	1	3.325	2	H	ROST					
502	3	1	3.220	1	V						
502	4	1	3.447	1	H						
502	5	1	2.583	2	V	ROST					
502	6	1	3.566	1	H						
502	7	1	3.282	1	V						
502	8	1	3.841	1	H						
502	9	1	3.043	1	V						
502	10	1	3.247	2	H						
502	11	1	3.589	1	V						
502	12	1	3.447	2	H						
502	13	1	3.342	2	V						
502	14	1	2.900	2	H						
502	15	1	3.319	1	V						
502	16	1	3.317	2	H						
502	17	1	3.980	1	V	ROST					
502	18	1	3.469	2	H						
502	19	1	3.670	1	V	ROST					

Status: 1 = Live; 2 = Early Resorption; 4 = Late Resorption
Sex: Male = 1; Female = 2; See Code Sheet 43 for identification of abnormalities [ABNn]

Tetrahydrofuran Rat Teratology Study: Raw Fetal Data

-- Ø ppm THF --

Matno	Site	Status	Fetal Wt(g)	Sex	Head or Visceral	ABN1	ABN2	ABN3	ABN4	ABN5	ABN6
515	1	1	5.165	1	V						
515	2	1	3.909	2	H						
515	3	2	-1.000	-1							
515	4	1	4.264	2	V						
521	1	1	3.181	2	H						
521	2	1	3.568	2	V						
521	3	1	3.080	2	H						
521	4	1	3.620	1	V						
521	5	2	-1.000	-1							
521	6	1	3.488	1	H						
521	7	1	3.224	2	V						
521	8	1	3.242	2	H						
521	9	1	3.341	1	V						
521	10	1	3.524	1	H						
521	11	1	3.471	2	V						
521	12	1	3.449	2	H						
521	13	1	3.470	1	V						
521	14	1	3.257	2	H						
521	15	1	3.471	2	V						
521	16	1	3.211	2	H						
521	17	1	3.299	2	V						
525	1	1	3.248	2	V						
525	2	1	3.222	1	H						
525	3	1	3.020	2	V						
525	4	1	3.240	1	H						
525	5	1	3.360	2	V						
525	6	1	3.359	1	H						
525	7	1	3.357	1	V						
525	8	1	3.472	2	H						
525	9	1	3.436	1	V	ROST					
525	10	1	3.426	1	H						
525	11	1	3.181	2	V	ROST					
525	12	1	3.088	1	H						
525	13	1	3.229	2	V						
525	14	1	3.273	2	H						
525	15	1	3.114	2	V						
525	16	1	3.403	1	H						
525	17	1	3.073	2	V						
525	18	1	3.489	1	H						
529	1	1	3.772	1	H	COST					
529	2	1	3.729	2	V						
529	3	2	-1.000	-1							
529	4	1	3.547	2	H						
529	5	1	3.331	1	V						
529	6	1	3.848	2	H						
529	7	1	3.670	2	V						
529	8	1	3.299	2	H						

Status: 1 = Live; 2 = Early Resorption; 4 = Late Resorption
Sex: Male = 1; Female = 2; See Code Sheet 43 for identification of abnormalities [ABNn]

Tetrahydrofuran Rat Teratology Study: Raw Fetal Data

-- 0 ppm THF --

Matno	Site	Status	Fetal Wt(g)	Sex	Head or Visceral	ABN1	ABN2	ABN3	ABN4	ABN5	ABN6
529	9	1	3.852	2	V						
529	10	1	3.647	2	H						
529	11	1	4.031	1	V						
529	12	1	3.464	2	H						
529	13	2	-1.000	-1							
529	14	1	3.691	2	V						
537	1	1	4.007	1	V						
537	2	1	3.702	1	H						
537	3	1	4.022	2	V						
537	4	1	3.590	2	H						
537	5	1	4.256	1	V						
537	6	1	3.648	2	H						
537	7	1	4.220	1	V						
537	8	1	4.031	1	H						
537	9	1	3.857	2	V						
537	10	2	-1.000	-1							
537	11	1	3.873	2	H						
537	12	1	4.042	1	V						
537	13	1	4.017	1	H						
537	14	1	3.818	1	V						
537	15	1	3.772	1	H						
537	16	1	3.593	2	V						
537	17	1	4.063	1	H						
541	1	1	3.295	1	H						
541	2	1	3.641	1	V						
541	3	1	3.717	1	H						
541	4	1	3.751	1	V						
541	5	2	-1.000	-1							
541	6	1	3.684	2	H						
541	7	1	3.612	2	V						
541	8	1	3.763	2	H						
541	9	1	3.439	1	V						
541	10	2	-1.000	-1							
541	11	1	3.289	2	H						
541	12	1	3.721	1	V						
541	13	1	3.867	1	H						
541	14	1	3.739	1	V	ROVE					
541	15	1	3.587	2	H						
541	16	1	3.924	1	V						
557	1	1	3.529	1	H						
557	2	1	3.843	1	V						
557	3	1	3.908	2	H						
557	4	1	3.705	1	V						
557	5	1	3.400	2	H						
557	6	1	3.637	2	V						
557	7	1	3.742	1	H						
557	8	1	3.892	2	V						

Status: 1 = Live; 2 = Early Resorption; 4 = Late Resorption
Sex: Male = 1; Female = 2; See Code Sheet 43 for identification of abnormalities [ABNn]

Tetrahydrofuran Rat Teratology Study: Raw Fetal Data

Ø ppm THF

Matno	Site	Status	Fetal Wt(g)	Sex	Head or Visceral	ABN1	ABN2	ABN3	ABN4	ABN5	ABN6
557	9	1	3.911	2	H						
557	1Ø	1	3.454	2	V						
557	11	1	3.665	1	H						
557	12	1	3.593	1	V						
557	13	1	3.519	2	H	COST					
557	14	1	3.463	2	V						
557	15	1	3.832	1	H						
557	16	1	4.Ø4Ø	1	V						
557	17	1	3.9Ø2	1	H	COST					
56Ø	1	1	3.311	2	V	ROSK					
56Ø	2	1	3.369	1	H						
56Ø	3	1	3.473	1	V						
56Ø	4	1	3.546	2	H						
56Ø	5	1	3.239	2	V	ROVE					
56Ø	6	1	3.399	1	H						
56Ø	7	1	3.Ø82	2	V						
56Ø	8	1	3.585	1	H						
56Ø	9	1	3.379	2	V						
56Ø	1Ø	1	3.59Ø	1	H						
56Ø	11	1	3.173	2	V	ROSK	ROPB				
56Ø	12	1	3.448	2	H						
56Ø	13	1	3.465	2	V						
56Ø	14	1	3.358	1	H						
56Ø	15	1	3.623	1	V						
56Ø	16	1	3.539	1	H						
56Ø	17	1	3.58Ø	1	V	ROSK					
56Ø	18	1	3.584	1	H						
56Ø	19	1	3.613	2	V						
564	1	1	3.213	2	V						
564	2	1	3.243	2	H						
564	3	1	3.612	1	V						
564	4	1	3.769	1	H	ROST					
564	5	1	3.717	1	V						
564	6	1	3.864	1	H	ROST					
564	7	1	3.675	2	V						
564	8	4	-1.ØØØ	-1							
564	9	1	3.36Ø	1	H						
564	1Ø	1	3.399	2	V	ROST					
564	11	1	3.441	1	H	MOPT					
564	12	1	3.447	1	V						
564	13	1	3.243	2	H						
564	14	1	3.199	2	V						
564	15	1	3.327	2	H						
564	16	1	3.6Ø7	1	V						
573	1	1	3.172	1	H	ROST					
573	2	1	3.Ø44	2	V						
573	3	1	3.Ø94	1	H						

Status: 1 = Live; 2 = Early Resorption; 4 = Late Resorption
Sex: Male = 1; Female = 2; See Code Sheet 43 for identification of abnormalities [ABNn]

Tetrahydrofuran Rat Teratology Study: Raw Fetal Data

------ Ø ppm THF ------

Matno	Site	Status	Fetal Wt(g)	Sex	Head or Visceral	ABN1	ABN2	ABN3	ABN4	ABN5	ABN6
573	4	1	3.367	1	V	ROVE					
573	5	1	3.524	1	H						
573	6	1	3.380	2	V	SURB					
573	7	1	3.360	2	H						
573	8	1	3.391	2	V						
573	9	1	3.424	2	H						
573	10	1	3.348	2	V						
573	11	1	3.318	2	H						
573	12	1	3.580	1	V						
573	13	1	1.309	2	HV	ECOV	ROST	ROVE	ROPB	ROPH	FUVA
573	14	1	3.585	1	V						
573	15	1	3.303	2	H						
573	16	1	2.982	2	V						
573	17	1	3.549	1	H						
573	18	1	3.474	2	V	ROVE					
574	1	1	4.083	1	H						
574	2	1	3.932	1	V						
574	3	1	3.984	1	H	COST					
574	4	1	3.853	2	V						
574	5	1	3.733	2	H						
574	6	1	4.031	1	V						
574	7	1	4.222	1	H						
574	8	1	3.168	1	V						
574	9	1	3.489	1	H						
574	10	1	3.552	2	V						
574	11	1	3.604	2	H						
574	12	1	3.802	2	V						
574	13	1	3.750	2	H	ROVE					
574	14	1	4.086	1	V						
574	15	1	3.908	1	H						
574	16	1	3.809	1	V						
574	17	1	4.020	1	H						
574	18	1	3.778	1	V						
578	1	1	3.936	2	V	RURB					
578	2	1	4.064	1	H	COST					
578	3	1	3.958	1	V	COST					
578	4	1	4.039	2	H	COST	ROVE				
578	5	1	4.180	1	V	DIUR	COST				
578	6	1	3.810	1	H						
578	7	1	3.978	1	V	COST					
578	8	1	3.993	1	H	COST					
578	9	1	4.102	2	V						
578	10	1	3.475	2	H						
578	11	1	3.747	2	V						
578	12	1	3.945	2	H	COST					
578	13	1	3.702	2	V						
578	14	1	3.744	2	H						

Status: 1 = Live; 2 = Early Resorption; 4 = Late Resorption
Sex: Male = 1, Female = 2; See Code Sheet 43 for identification of abnormalities [ABNn]

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Tetrahydrofuran Rat Teratology Study: Raw Fetal Data

-- 0 ppm THF --

Matno	Site	Status	Fetal Wt(g)	Sex	Head or Visceral	ABN1	ABN2	ABN3	ABN4	ABN5	ABN6
578	15	1	3.675	2	V						
596	1	1	3.684	2	H						
596	2	1	3.609	2	V	ROST	MAST				
596	3	1	3.760	1	H						
596	4	1	3.779	2	V						
596	5	1	3.369	2	H						
596	6	1	3.622	2	V	ROST					
596	7	1	4.003	1	H						
596	8	1	2.749	1	V	ROST					
596	9	1	3.746	2	H						
596	10	1	3.859	1	V						
596	11	1	3.729	2	H						
596	12	1	3.587	1	V						
596	13	1	3.594	2	H	ROST					
596	14	1	3.992	1	V						
596	15	1	3.743	1	H						
596	16	1	3.968	1	V						
596	17	1	3.767	2	H						
596	18	1	3.471	2	V						
596	19	1	3.559	2	H	ROST					
596	20	1	3.838	2	V						
597	1	1	4.243	1	V						
597	2	1	3.818	2	H						
597	3	1	3.958	2	V						
597	4	1	3.713	2	H	SURB					
597	5	1	4.140	1	V						
597	6	1	3.900	1	H	SURB					
597	7	1	3.903	2	V						
597	8	1	1.868	2	H						
608	1	1	3.577	1	H						
608	2	1	3.349	2	V						
608	3	1	3.457	2	H						
608	4	1	3.376	2	V	DIUR					
608	5	1	3.611	2	H						
608	6	1	3.633	1	V						
608	7	1	3.347	1	H						
608	8	1	3.328	2	V						
608	9	1	3.569	2	H	COST					
608	10	1	1.629	1	V						
608	11	1	3.203	2	H						
608	12	1	3.641	1	V						
608	13	1	3.499	2	H						
608	14	1	3.734	1	V						
608	15	1	3.606	1	H						
608	16	1	3.963	1	V						
612	1	1	3.300	2	V						
612	2	1	3.140	1	H	ROST					

Status: 1 = Live; 2 = Early Resorption; 4 = Late Resorption
Sex: Male = 1; Female = 2; See Code Sheet 43 for identification of abnormalities [ABNn]

Tetrahydrofuran Rat Teratology Study: Raw Fetal Data

0 ppm THF

Matno	Site	Status	Fetal Wt(g)	Sex	Head or Visceral	ABN1	ABN2	ABN3	ABN4	ABN5	ABN6
612	3	1	3.326	2	V						
612	4	1	3.500	1	H						
612	5	1	2.861	2	V	ROST					
612	6	1	3.790	1	H						
612	7	1	3.629	1	V	SURB					
612	8	1	3.591	1	H						
612	9	1	3.413	1	V						
612	10	1	3.042	2	H						
612	11	2	-1.000	-1							
612	12	1	3.294	2	V						
612	13	1	3.331	2	H						
612	14	1	3.633	1	V						
612	15	1	3.656	2	H						
612	16	2	-1.000	-1							
612	17	1	3.572	2	V						
612	18	2	-1.000	-1							
612	19	1	3.276	2	H						
616	1	1	3.881	1	H	SURB					
616	2	1	3.511	2	V						
616	3	1	4.031	1	H						
616	4	1	3.693	2	V						
616	5	1	4.003	1	H	SURB					
616	6	1	3.739	1	V						
616	7	1	3.769	1	H						
616	8	1	3.561	2	V						
616	9	1	3.536	2	H						
616	10	1	3.441	2	V						
616	11	1	3.999	2	H						
616	12	1	3.899	1	V						
616	13	1	3.723	2	H						
616	14	1	3.905	1	V						
616	15	1	4.129	1	H						
616	16	1	3.295	2	V						
617	1	1	3.374	1	H						
617	2	1	3.295	1	V						
617	3	1	4.037	1	H						
617	4	1	3.549	1	V						
617	5	1	3.109	2	H						
617	6	1	3.515	1	V						
617	7	1	3.255	2	H						
617	8	1	3.136	1	V						
617	9	1	3.195	2	H						
617	10	1	3.724	2	V						
617	11	1	3.203	1	H						
617	12	1	3.529	1	V						
618	1	1	3.017	2	V						
618	2	4	-1.000	-1							

Status: 1 = Live; 2 = Early Resorption; 4 = Late Resorption
Sex. Male = 1, Female = 2; See Code Sheet 43 for identification of abnormalities [ABNn]

Tetrahydrofuran Rat Teratology Study: Raw Fetal Data

Ø ppm THF

Matno	Site	Status	Fetal Wt(g)	Sex	Head or Visceral	ABN1	ABN2	ABN3	ABN4	ABN5	ABN6
618	3	1	3.320	2	H						
618	4	1	3.049	2	V						
618	5	1	2.850	1	H	ROST	ROPB				
618	6	1	3.088	2	V						
618	7	2	-1.000	-1							
618	8	1	2.353	2	H	ROST	ROPB				
618	9	1	2.777	1	V						
618	10	1	3.077	1	H	ROST	ROPB				
618	11	1	3.150	2	V	ROSK	ROST				
618	12	1	2.824	2	H						
618	13	4	-1.000	-1							

Status: 1 = Live; 2 = Early Resorption; 4 = Late Resorption
Sex: Male = 1; Female = 2; See Code Sheet 43 for identification of abnormalities [ABNn]

Tetrahydrofuran Rat Teratology Study: Raw Fetal Data

---------- 600 ppm THF ----------

Matno	Site	Status	Fetal Wt(g)	Sex	Head or Visceral	ABN1	ABN2	ABN3	ABN4	ABN5	ABN6
401	1	1	3.467	2	H						
401	2	1	3.690	1	V						
401	3	1	3.817	1	H						
401	4	1	3.744	1	V						
401	5	1	3.668	1	H						
401	6	1	3.422	1	V						
401	7	1	3.614	2	H						
401	8	1	3.373	2	V						
401	9	1	3.368	1	H						
401	10	1	2.623	1	V						
401	11	1	3.670	1	H	COST					
401	12	1	3.668	1	V						
401	13	1	3.836	1	H	ROST					
401	14	1	3.609	1	V						
401	15	1	3.218	2	H						
401	16	1	3.446	2	V						
401	17	1	3.685	2	H						
401	18	1	3.368	2	V	FUST					
412	1	1	3.744	2	H						
412	2	1	3.638	2	V						
412	3	1	3.660	2	H						
412	4	1	3.922	1	V						
412	5	1	3.631	2	H						
412	6	1	3.959	1	V						
412	7	1	3.655	2	H						
412	8	1	3.806	2	V						
412	9	1	3.631	2	H						
412	10	1	3.888	1	V						
412	11	1	3.771	1	H						
412	12	2	-1.000	-1							
412	13	2	-1.000	-1							
412	14	1	3.545	2	V						
412	15	1	3.932	1	H						
412	16	1	4.003	1	V						
412	17	1	3.952	1	H						
412	18	1	3.845	2	V						
419	1	1	3.899	2	V	ROVE	DIUR				
419	2	1	3.478	2	H						
419	3	1	3.878	1	V	COST					
419	4	1	3.718	1	H	COST					
419	5	1	3.860	2	V	COST					
419	6	1	3.862	1	H						
419	7	1	3.793	1	V	ROVE					
419	8	1	3.701	1	H	COST					
419	9	1	3.561	2	V	COST					
419	10	1	3.772	1	H						
419	11	1	3.618	1	V						

Status: 1 = Live; 2 = Early Resorption; 4 = Late Resorption
Sex: Male = 1; Female = 2; See Code Sheet 43 for identification of abnormalities [ABNn]

Tetrahydrofuran Rat Teratology Study: Raw Fetal Data

600 ppm THF

Matno	Site	Status	Fetal Wt(g)	Sex	Head or Visceral	ABN1	ABN2	ABN3	ABN4	ABN5	ABN6
419	12	1	3.548	1	H						
419	13	2	-1.000	-1							
419	14	1	3.684	2	V	ROVE					
419	15	1	3.948	2	H						
420	1	1	3.838	1	V						
420	2	1	3.092	2	H						
420	3	1	3.451	2	V						
420	4	1	3.369	2	H						
420	5	1	3.414	2	V						
420	6	1	3.289	2	H						
420	7	1	3.405	1	V						
420	8	1	3.361	1	H						
420	9	1	3.011	2	H						
420	10	1	3.344	1	V						
420	11	1	2.970	2	H						
420	12	1	3.437	2	V						
420	13	1	3.490	2	H						
420	14	1	3.468	1	H						
420	15	1	3.431	2	V						
420	16	1	3.481	2	H						
421	1	1	2.499	2	V	ROST	ROPH				
421	2	1	3.034	1	H	ROST	ROVE				
421	3	2	-1.000	-1							
421	4	1	3.073	2	V	ROST					
421	5	1	2.987	1	H						
421	6	1	2.393	2	V	ROST	ROPB				
421	7	1	3.017	2	H	ROST	SURB				
421	8	1	3.102	2	V	ROST					
421	9	1	2.668	1	H	ROST					
421	10	1	2.788	2	V	ROST					
421	11	1	3.495	1	H	ANOR					
421	12	1	2.970	1	V	ROST	ROPB				
421	13	2	-1.000	-1							
421	14	1	3.200	2	H						
421	15	1	3.523	1	V	ROST					
436	1	1	4.018	1	H						
436	2	1	4.020	1	V						
436	3	1	3.573	2	H						
436	4	1	4.008	2	V						
436	5	2	-1.000	-1							
436	6	1	3.958	2	H						
436	7	1	3.461	2	V						
436	8	1	3.420	2	H						
436	9	1	3.686	1	V						
436	10	1	2.835	2	H						
436	11	2	-1.000	-1							
436	12	1	3.663	1	V						

Status: 1 = Live; 2 = Early Resorption; 4 = Late Resorption
Sex: Male = 1; Female = 2; See Code Sheet 43 for identification of abnormalities [ABNn]

Tetrahydrofuran Rat Teratology Study: Raw Fetal Data

600 ppm THF

Matno	Site	Status	Fetal Wt(g)	Sex	Head or Visceral	ABN1	ABN2	ABN3	ABN4	ABN5	ABN6
436	13	1	3.833	1	H						
436	14	1	4.001	1	V						
436	15	1	3.583	2	H						
436	16	1	3.751	2	V						
436	17	1	3.984	1	H						
444	1	1	3.188	2	V						
444	2	1	3.382	1	H						
444	3	1	3.100	2	V						
444	4	2	-1.000	-1							
444	5	1	3.184	2	H						
444	6	1	3.435	1	V						
444	7	1	2.838	2	H	ROST					
444	8	1	3.058	2	V						
444	9	1	3.141	2	H						
444	10	1	3.633	1	V						
444	11	1	3.270	2	H						
444	12	1	1.864	2	V	ROSK	ROST	BRRB	FURB	SURB	ROPB
444	13	1	3.406	2	H						
444	14	1	3.197	2	V						
444	15	1	3.459	1	H						
444	16	1	3.283	2	V						
444	17	1	3.348	1	H						
444	18	1	2.999	2	V						
446	1	1	3.570	2	V	DIUR					
446	2	1	3.807	1	H						
446	3	1	3.844	1	V	DIUR					
446	4	1	3.755	1	H						
446	5	1	3.908	1	V	DIUR					
446	6	1	2.775	2	H						
446	7	1	3.598	2	V	DIUR					
446	8	1	3.275	2	H						
446	9	1	3.453	2	V	DIUR					
446	10	1	3.472	2	H						
446	11	1	3.897	1	V	DIUR					
446	12	4	-1.000	-1							
446	13	1	3.576	2	H						
446	14	1	3.583	2	V	DIUR					
446	15	1	3.667	2	H						
446	16	1	3.456	2	V						
469	1	1	3.588	1	V						
469	2	1	3.209	2	H						
469	3	1	3.214	2	V						
469	4	1	3.096	1	H						
469	5	1	3.527	1	V						
469	6	1	3.504	1	H						
469	7	1	3.367	1	V						
469	8	1	3.454	2	H						

Status: 1 = Live; 2 = Early Resorption; 4 = Late Resorption
Sex: Male = 1; Female = 2; See Code Sheet 43 for identification of abnormalities [ABNn]

Tetrahydrofuran Rat Teratology Study: Raw Fetal Data

600 ppm THF

Matno	Site	Status	Fetal Wt(g)	Sex	Head or Visceral	ABN1	ABN2	ABN3	ABN4	ABN5	ABN6
469	9	1	3.603	1	V						
469	10	1	3.347	2	H						
469	11	1	3.497	1	V						
469	12	1	4.201	1	H						
469	13	1	3.844	1	V						
469	14	1	3.294	2	H						
469	15	1	3.572	1	V						
469	16	1	2.898	2	H	ROVE					
469	17	1	3.471	2	V						
469	18	1	3.414	2	H						
469	19	1	3.480	1	V						
469	20	1	3.660	1	H						
482	1	1	3.261	1	H						
482	2	1	3.607	1	V						
482	3	1	3.489	1	H						
482	4	1	3.384	1	V						
482	5	1	3.398	2	H						
482	6	1	3.525	1	V						
482	7	1	3.495	2	H	COST					
482	8	1	3.061	2	V						
482	9	1	3.091	2	H						
482	10	1	2.440	1	V						
482	11	1	3.233	1	H						
482	12	1	3.466	1	V	COST					
482	13	1	3.815	1	H	COST					
482	14	1	3.273	1	V						
482	15	1	3.581	2	H						
482	16	1	3.498	2	V						
482	17	1	3.659	1	H						
484	1	1	3.932	2	V						
484	2	1	3.491	1	H						
484	3	1	3.821	2	V						
484	4	2	-1.000	-1							
484	5	1	3.484	1	H						
484	6	1	3.988	1	V						
484	7	1	3.895	2	H	SURB					
484	8	1	3.775	2	V						
484	9	1	3.853	1	H	COST					
484	10	1	3.821	1	V	COST					
484	11	1	3.903	2	H						
484	12	1	4.075	1	V						
484	13	2	-1.000	-1							
484	14	1	3.669	2	H						
484	15	1	3.948	1	V	MAST	COST				
484	16	1	3.854	2	H						
484	17	1	3.836	2	V						
484	18	1	3.906	1	H						

Status: 1 = Live; 2 = Early Resorption; 4 = Late Resorption
Sex: Male = 1; Female = 2; See Code Sheet 43 for identification of abnormalities [ABNn]

Tetrahydrofuran Rat Teratology Study: Raw Fetal Data

600 ppm THF

Matno	Site	Status	Fetal Wt(g)	Sex	Head or Visceral	ABN1	ABN2	ABN3	ABN4	ABN5	ABN6
494	1	1	3.403	1	V	SURB					
494	2	1	3.821	1	H						
494	3	1	3.684	1	V	COST					
494	4	1	3.364	2	H						
494	5	1	3.301	1	V						
494	6	1	3.466	2	H						
494	7	1	3.402	1	V	COST	SURB				
494	8	1	3.655	1	H	SURB					
494	9	1	3.519	2	V						
494	10	1	3.292	2	H						
494	11	1	3.730	1	V	COST					
494	12	1	3.940	1	H						
494	13	1	3.508	1	V	COST					
494	14	1	3.872	1	H						
494	15	1	3.637	2	V						
494	16	1	3.381	2	H						
505	1	1	3.180	2	H						
505	2	1	3.498	1	V						
505	3	1	3.627	1	H						
505	4	1	3.480	1	V						
505	5	1	3.596	1	H						
505	6	1	3.715	1	V						
505	7	1	3.672	1	H						
505	8	1	3.606	1	V						
505	9	1	3.459	2	H						
505	10	1	3.643	2	V						
505	11	1	3.683	1	H						
505	12	1	3.434	1	V						
505	13	1	3.335	2	H						
505	14	1	3.535	1	V						
505	15	1	3.618	2	H						
505	16	1	3.575	2	V						
505	17	1	4.085	1	H	ROVE					
513	1	1	4.110	1	V	COST					
513	2	1	3.829	1	H						
513	3	1	2.786	2	V						
513	4	1	3.629	1	H	COST					
513	5	1	3.572	2	V						
513	6	1	3.490	2	H	COST					
513	7	1	3.887	1	V						
513	8	1	2.766	1	H						
513	9	1	3.666	1	V	COST					
513	10	1	3.748	1	H						
513	11	1	3.565	2	V						
513	12	1	3.175	1	H						
513	13	1	4.066	1	V	COST					
513	14	1	3.925	1	H	COST					

Status: 1 = Live; 2 = Early Resorption; 4 = Late Resorption
Sex: Male = 1; Female = 2; See Code Sheet 43 for identification of abnormalities [ABNn]

Tetrahydrofuran Rat Teratology Study: Raw Fetal Data

600 ppm THF

Matno	Site	Status	Fetal Wt(g)	Sex	Head or Visceral	ABN1	ABN2	ABN3	ABN4	ABN5	ABN6
513	15	1	3.819	1	V						
513	16	1	3.930	1	H	COST					
513	17	1	3.803	1	V						
513	18	1	3.601	2	H	COST					
519	1	1	3.696	2	V						
519	2	1	4.050	1	H						
519	3	1	3.984	1	V						
519	4	1	3.610	2	H	ROVE					
519	5	1	4.044	1	V						
519	6	1	3.913	1	H						
519	7	1	3.766	1	V						
519	8	1	3.743	2	H						
519	9	1	3.782	2	V						
519	10	1	3.847	1	H						
519	11	1	3.604	1	V						
519	12	1	3.813	1	H						
519	13	1	3.798	1	V	ROST					
519	14	1	3.141	2	H						
519	15	1	3.877	1	V						
519	16	1	3.464	2	H						
519	17	1	4.239	1	V						
527	1	1	3.544	1	H	ROST					
527	2	1	3.492	2	V						
527	3	1	3.690	2	H	ROST	SURB				
527	4	1	4.284	1	V	ROST					
527	5	1	3.394	2	H	ROST					
527	6	1	3.694	2	V	ROST					
527	7	1	3.922	2	H	ROST					
527	8	1	4.148	1	V	FURB					
527	9	1	3.718	2	H	ROST	ROVE				
527	10	1	3.739	2	V	ROST					
527	11	1	4.154	1	H						
527	12	1	4.249	1	V						
527	13	1	4.105	1	H	ROST					
527	14	1	3.840	1	V	ROST					
527	15	1	4.133	2	H	COST					
540	1	1	3.284	1	V						
540	2	1	3.415	1	H						
540	3	1	3.531	2	V						
540	4	1	3.547	1	H						
540	5	1	3.487	2	V						
540	6	1	3.434	2	H						
540	7	1	3.692	1	V	COST					
540	8	1	3.778	2	H						
540	9	1	3.561	1	V						
540	10	1	3.484	2	H						
540	11	1	3.702	1	V						

Status: 1 = Live; 2 = Early Resorption; 4 = Late Resorption
Sex: Male = 1; Female = 2; See Code Sheet 43 for identification of abnormalities [ABNn]

Tetrahydrofuran Rat Teratology Study: Raw Fetal Data

C.64

600 ppm THF

Matno	Site	Status	Fetal Wt(g)	Sex	Head or Visceral	ABN1	ABN2	ABN3	ABN4	ABN5	ABN6
540	12	1	3.350	2	H						
540	13	1	1.997	2	V	ROST	ROPB	ROPH			
540	14	1	3.707	1	H	MAST					
540	15	2	-1.000	-1							
540	16	2	-1.000	-1							
542	1	1	3.504	1	H						
542	2	1	3.296	1	V						
542	3	1	3.210	2	H						
542	4	1	3.593	1	V						
542	5	1	3.309	1	H	ROVE					
542	6	1	3.541	1	V						
542	7	1	3.090	2	H	ROST					
542	8	1	3.441	2	V						
542	9	1	3.116	1	H						
542	10	1	4.012	1	V						
542	11	1	3.592	1	H						
542	12	1	3.477	1	V						
542	13	1	3.633	1	H						
542	14	1	3.799	1	V						
542	15	1	3.324	2	H						
542	16	1	3.730	1	V						
542	17	2	-1.000	-1							
542	18	2	-1.000	-1							
560	1	1	3.692	1	H	ROST					
560	2	1	3.392	1	V						
560	3	1	3.480	1	H						
560	4	1	3.896	1	V						
560	5	1	3.501	2	H						
560	6	1	3.589	2	V						
560	7	1	3.708	2	H	ROST					
560	8	1	4.053	1	V						
560	9	1	3.617	1	H						
560	10	1	3.826	2	V						
560	11	1	3.405	2	H						
560	12	1	3.923	1	V						
560	13	1	3.686	1	H						
560	14	1	3.123	2	V	ROST					
560	15	1	3.760	1	H						
560	16	1	3.914	2	V						
560	17	1	3.671	1	H						
560	18	1	3.523	1	V						
560	19	1	2.829	2	H	ROST					
560	20	1	3.719	2	V						
567	1	1	4.172	1	V						
567	2	1	3.651	2	H						
567	3	1	4.270	1	V						
567	4	1	3.963	2	H						

Status: 1 = Live; 2 = Early Resorption; 4 = Late Resorption
Sex: Male = 1; Female = 2; See Code Sheet 43 for identification of abnormalities [ABNn]

Tetrahydrofuran Rat Teratology Study: Raw Fetal Data

-- 800 ppm THF --

Matno	Site	Status	Fetal Wt(g)	Sex	Head or Visceral	ABN1	ABN2	ABN3	ABN4	ABN5	ABN6
567	5	1	4.153	2	V						
567	6	1	4.119	1	H						
567	7	1	3.861	2	V						
567	8	1	3.895	2	H						
567	9	1	3.914	1	V						
567	10	1	4.050	2	H						
567	11	1	3.616	2	V						
571	1	2	-1.000	-1							
571	2	1	3.796	1	H						
571	3	1	3.408	2	V						
571	4	1	3.614	2	H						
571	5	1	3.861	1	V						
571	6	1	3.452	2	H						
571	7	1	3.248	2	V						
571	8	1	3.507	1	H						
571	9	1	3.998	1	V						
571	10	1	3.493	2	H						
571	11	1	3.162	2	V	ROST					
571	12	1	2.788	2	H						
571	13	1	3.626	1	V						
571	14	1	3.701	1	H						
571	15	2	-1.000	-1							
571	16	1	3.548	2	V						
587	1	1	4.184	1	H						
587	2	1	3.883	1	V						
587	3	1	4.295	1	H						
587	4	1	4.170	2	V						
587	5	1	4.145	2	H						
587	6	1	4.010	2	V						
587	7	1	4.136	1	H						
587	8	1	3.977	2	V						
587	9	1	4.198	2	H						
587	10	1	4.290	1	V						
587	11	1	3.946	2	H						
587	12	1	4.730	1	V						
587	13	1	4.269	2	H						
587	14	1	4.588	1	V						
587	15	1	4.196	2	H						
587	16	1	4.000	1	V						
594	1	2	-1.000	-1							
594	2	2	-1.000	-1							
594	3	2	-1.000	-1							
594	4	2	-1.000	-1							
594	5	2	-1.000	-1							
594	6	2	-1.000	-1							
594	7	2	-1.000	-1							
594	8	2	-1.000	-1							

Status: 1 = Live; 2 = Early Resorption; 4 = Late Resorption
Sex: Male = 1; Female = 2; See Code Sheet 43 for identification of abnormalities [ABNn]

Tetrahydrofuran Rat Teratology Study: Raw Fetal Data

----- 600 ppm THF -----

Matno	Site	Status	Fetal Wt(g)	Sex	Head or Visceral	ABN1	ABN2	ABN3	ABN4	ABN5	ABN6
594	9	2	-1.000	-1							
594	10	2	-1.000	-1							
594	11	1	4.090	2	H						
594	12	2	-1.000	-1							
594	13	2	-1.000	-1							
594	14	2	-1.000	-1							
594	15	2	-1.000	-1							
594	16	2	-1.000	-1							
594	17	2	-1.000	-1							
594	18	1	3.898	2	V						
594	19	2	-1.000	-1							
594	20	2	-1.000	-1							
594	21	2	-1.000	-1							
594	22	1	3.957	1	H						
594	23	1	4.063	2	V						
594	24	1	4.232	2	H						
598	1	1	3.679	1	H						
598	2	1	4.238	1	V						
598	3	1	3.705	2	H						
598	4	1	3.673	1	V						
598	5	1	3.551	2	H						
598	6	1	3.790	1	V						
598	7	1	3.849	2	H						
598	8	1	3.881	2	V						
598	9	1	3.799	2	H						
598	10	1	3.412	2	V						
598	11	1	3.588	2	H						
598	12	1	4.067	1	V						
598	13	1	3.948	2	H						
598	14	1	3.698	2	V						
606	1	1	3.714	1	V						
606	2	1	3.646	2	H						
606	3	1	3.816	1	V						
606	4	2	-1.000	-1							
606	5	1	3.779	1	H						
606	6	1	3.176	2	V						
606	7	1	3.307	2	H						
606	8	1	3.898	1	V						
606	9	1	3.759	1	H	ROST					
606	10	1	3.663	2	V						
606	11	1	3.414	2	H						
606	12	1	3.573	1	V						
606	13	1	3.477	2	H	SURB					
606	14	1	3.758	2	V						
606	15	1	3.752	1	H	COST					
606	16	1	3.272	2	V						
606	17	1	3.838	2	H						

Status: 1 = Live; 2 = Early Resorption; 4 = Late Resorption
Sex. Male = 1; Female = 2; See Code Sheet 43 for identification of abnormalities [ABNn]

Tetrahydrofuran Rat Teratology Study: Raw Fetal Data

600 ppm THF

Matno	Site	Status	Fetal Wt(g)	Sex	Head or Visceral	ABN1	ABN2	ABN3	ABN4	ABN5	ABN6
606	18	1	3.642	2	V						
615	1	1	3.268	2	H						
615	2	1	3.654	2	V						
615	3	1	3.431	2	H						
615	4	1	3.689	2	V						
615	5	1	3.493	2	H						
615	6	1	3.344	2	V						
615	7	1	3.874	1	H						
615	8	1	3.712	2	V						
615	9	1	3.475	1	H						
615	10	1	3.682	2	V						
615	11	1	3.683	2	H						
615	12	1	3.525	2	V						
615	13	1	3.572	1	H	ROST					
615	14	1	3.462	2	V						
615	15	1	3.603	2	H						
615	16	1	3.344	2	V						
615	17	1	3.360	2	H						
615	18	1	3.606	2	V						
615	19	1	3.654	1	H	COST					
626	1	1	4.319	1	H	ROST					
626	2	1	4.358	1	V						
626	3	1	4.003	2	H						
626	4	1	3.924	2	V						
626	5	1	4.016	2	H						
626	6	1	3.239	2	V	ROST	ROVE				
626	7	1	3.693	2	H						
629	1	1	3.573	1	V						
629	2	1	3.997	1	H						
629	3	1	4.240	1	V	ROST					
629	4	1	3.927	1	H						
629	5	1	4.111	1	V	ROVE					
629	6	1	3.757	2	H						
629	7	1	3.814	2	V	ROST					
629	8	1	3.982	1	H	ROST					
629	9	1	3.928	2	V						
629	10	1	3.997	1	H						
629	11	1	4.044	1	V	ROVE					
629	12	1	4.076	1	H						
629	13	1	3.858	2	V	ROST					
629	14	1	4.266	1	H						
629	15	1	3.995	2	V						
629	16	1	3.449	2	H						
629	17	1	4.127	1	V						

Status: 1 = Live; 2 = Early Resorption; 4 = Late Resorption
Sex: Male = 1; Female = 2; See Code Sheet 43 for identification of abnormalities [ABNn]

Tetrahydrofuran Rat Teratology Study: Raw Fetal Data

1800 ppm THF

Matno	Site	Status	Fetal Wt(g)	Sex	Head or Visceral	ABN1	ABN2	ABN3	ABN4	ABN5	ABN6
408	1	1	-1.000	2	V						
408	2	1	-1.000	1	H						
408	3	1	-1.000	2	V						
408	4	1	-1.000	2	H						
408	5	1	-1.000	2	V						
408	6	1	-1.000	2	H						
408	7	1	-1.000	1	V	ROST					
408	8	1	-1.000	2	H						
408	9	1	-1.000	2	V	ROST					
408	10	1	-1.000	1	H	ROST					
408	11	1	-1.000	1	V						
408	12	1	-1.000	2	H						
408	13	1	-1.000	1	V						
408	14	1	-1.000	2	H	ROST	SURB				
408	16	1	-1.000	1	V						
411	1	1	3.232	1	V						
411	2	1	3.934	1	H						
411	3	2	-1.000	-1							
411	4	2	-1.000	-1							
411	5	1	3.687	1	V						
411	6	1	3.460	2	H						
411	7	1	3.908	1	V						
411	8	1	3.836	1	H						
411	9	1	3.386	1	V						
411	10	1	3.455	1	H	MAST					
411	11	1	3.563	1	V						
411	12	1	3.772	2	H						
411	13	1	3.393	2	V						
411	14	1	3.686	1	H						
411	15	1	3.477	2	V						
413	1	1	3.270	2	V	COST					
413	2	1	3.249	2	H						
413	3	1	3.020	2	V						
413	4	1	3.452	1	H						
413	5	1	3.382	2	V						
413	6	1	3.626	1	H						
413	7	1	3.407	2	V						
413	8	1	3.674	1	H						
413	9	1	3.657	1	V						
413	10	1	3.036	1	H						
413	11	1	3.282	2	V	COST					
413	12	1	3.236	2	H						
413	13	1	3.206	2	V						
413	14	1	3.314	1	H						
413	15	1	3.601	1	V						
413	16	1	3.290	2	H	ROST					
426	1	1	3.143	1	H						

Status: 1 = Live; 2 = Early Resorption; 4 = Late Resorption
Sex: Male = 1; Female = 2; See Code Sheet 43 for identification of abnormalities [ABNn]

Tetrahydrofuran Rat Teratology Study: Raw Fetal Data

-- 1800 ppm THF --

Matno	Site	Status	Fetal Wt(g)	Sex	Head or Visceral	ABN1	ABN2	ABN3	ABN4	ABN5	ABN6
426	2	1	3.625	1	V						
426	3	1	3.404	2	H						
426	4	1	3.514	1	V						
426	5	1	3.518	1	H						
426	6	1	3.484	2	V						
426	7	1	3.542	1	H						
426	8	1	3.592	1	V						
426	9	1	3.502	2	H	ROVE					
426	10	1	3.516	2	V						
426	11	1	3.407	2	H						
426	12	1	3.675	2	V						
426	13	4	-1.000	1							
426	14	1	3.480	2	H						
426	15	1	3.399	2	V						
432	1	1	3.215	2	V						
432	2	1	3.336	1	H						
432	3	1	3.479	1	V						
432	4	1	3.935	2	H	ROVE					
432	5	1	3.419	2	V						
432	6	1	3.441	1	H	ROVE					
432	7	1	3.670	1	V						
432	8	1	3.288	2	H						
432	9	1	3.385	2	V						
432	10	1	3.740	1	H	ROST					
432	11	1	3.396	1	V						
432	12	1	3.092	1	H						
432	13	1	2.420	2	V	ROST					
432	14	1	3.482	1	H						
432	15	2	-1.000	-1							
432	16	1	3.766	2	V						
445	1	1	3.695	2	V						
445	2	1	3.767	2	H						
445	3	1	3.900	2	V						
445	4	1	3.776	1	H						
445	5	1	3.681	1	V						
445	6	1	3.283	2	H	ROST					
445	7	1	4.175	1	V						
445	8	1	3.905	1	H						
445	9	1	3.977	1	V						
445	10	1	3.507	2	H	ROST					
445	11	1	3.829	2	V						
445	12	1	4.169	1	H						
445	13	1	3.630	1	V	ROST					
445	14	1	3.707	1	H						
445	15	1	3.766	2	V						
454	1	1	3.679	1	V	ROVE					
454	2	1	3.605	1	H						

Status: 1 = Live; 2 = Early Resorption; 4 = Late Resorption
Sex: Male = 1; Female = 2; See Code Sheet 43 for identification of abnormalities [ABNn]

Tetrahydrofuran Rat Teratology Study: Raw Fetal Data

------------------------------ 1800 ppm THF ------------------------------

Matno	Site	Status	Fetal Wt(g)	Sex	Head or Visceral	ABN1	ABN2	ABN3	ABN4	ABN5	ABN6
454	3	1	3.222	1	V						
454	4	1	3.288	2	H	ROST					
454	5	1	3.216	2	V						
454	6	1	3.619	1	H	SURB					
454	7	1	3.114	2	V						
454	8	1	3.481	2	H						
454	9	1	3.677	1	V						
454	10	1	3.508	1	H	SURB					
454	11	1	3.674	1	V						
454	12	1	3.284	2	H	SURB					
454	13	1	3.224	2	V	ROVE					
454	14	1	3.643	1	H						
454	15	1	3.088	2	V	SURB					
454	16	1	3.189	1	H						
455	1	1	3.093	1	V	ROST					
455	2	2	-1.000	-1							
455	3	1	-1.000	2	H						
455	4	1	3.668	2	V						
455	5	1	-1.000	2	H						
455	6	1	3.481	1	V	COST					
455	7	1	-1.000	2	H						
455	8	1	3.483	1	V						
455	9	1	-1.000	2	H						
455	10	1	3.397	2	V						
455	11	1	-1.000	2	H						
455	12	1	3.808	2	V	ROVE					
455	13	1	-1.000	2	H						
455	14	1	3.379	2	V						
478	1	1	3.514	1	V						
478	2	1	3.893	1	H						
478	3	2	-1.000	-1							
478	4	1	3.423	2	V						
478	5	1	3.598	2	H						
478	6	1	3.723	1	V						
478	7	1	3.614	2	H						
478	8	1	3.651	1	V	DIUR					
478	9	1	3.343	2	H						
478	10	1	3.862	1	V						
478	11	1	3.397	2	H						
478	12	1	3.890	1	V						
478	13	1	3.297	2	H						
478	14	1	3.368	2	V						
478	15	2	-1.000	-1							
478	16	1	3.866	1	H						
478	17	1	3.807	1	V						
479	1	1	3.662	2	V						
479	2	1	3.656	2	H						

Status: 1 = Live; 2 = Early Resorption; 4 = Late Resorption
Sex: Male = 1; Female = 2; See Code Sheet 43 for identification of abnormalities [ABNn]

Tetrahydrofuran Rat Teratology Study: Raw Fetal Data

1800 ppm THF

Matno	Site	Status	Fetal Wt(g)	Sex	Head or Visceral	ABN1	ABN2	ABN3	ABN4	ABN5	ABN6
479	3	1	3.954	1	V	DIUR					
479	4	1	3.597	1	H						
479	5	1	3.516	2	V						
479	6	1	3.624	2	H						
479	7	1	3.662	2	V						
479	8	1	3.632	2	H						
479	9	1	3.951	1	V						
479	10	1	3.723	2	H						
479	11	2	-1.000	-1							
479	12	1	3.527	2	V						
479	13	2	-1.000	-1							
479	14	1	3.901	1	H						
479	15	1	3.731	2	V						
479	16	2	-1.000	-1							
481	1	1	3.096	2	H						
481	2	1	3.604	2	V						
481	3	1	3.532	2	H						
481	4	1	3.701	1	V						
481	5	1	3.329	2	H						
481	6	1	3.108	2	V						
481	7	1	3.276	2	H						
481	8	1	3.240	2	V						
481	9	1	2.933	2	H						
481	10	1	2.479	2	V						
481	11	1	3.339	2	H						
481	12	1	3.124	2	V						
481	13	1	3.246	2	H						
481	14	1	3.436	2	V						
481	15	1	3.385	2	H						
481	16	1	3.223	1	V						
496	1	1	3.081	1	V						
496	2	1	3.550	1	H						
496	3	1	3.253	2	V	COST					
496	4	1	3.400	2	H						
496	5	1	3.347	2	V						
496	6	1	3.502	1	H						
496	7	1	3.322	2	V						
496	8	1	3.198	2	H						
496	9	1	3.099	2	V						
496	10	1	4.681	2	H						
496	11	1	3.537	1	V						
496	12	2	-1.000	-1							
496	13	2	-1.000	-1							
496	14	1	3.680	1	H	COST					
496	15	1	3.615	1	V						
496	16	1	3.412	2	H						
496	17	1	3.565	1	V						

Status: 1 = Live; 2 = Early Resorption; 4 = Late Resorption
Sex: Male = 1; Female = 2; See Code Sheet 43 for identification of abnormalities [ABNn]

Tetrahydrofuran Rat Teratology Study: Raw Fetal Data

-- 1800 ppm THF --

Matno	Site	Status	Fetal Wt(g)	Sex	Head or Visceral	ABN1	ABN2	ABN3	ABN4	ABN5	ABN6
496	18	1	2.943	1	H						
496	19	1	3.574	1	V						
500	1	1	3.459	2	H						
500	2	4	-1.000	-1							
500	3	1	3.701	1	V	ROVE					
500	4	1	4.139	1	H						
500	5	1	3.885	1	V	DIUR					
500	6	1	4.323	1	H						
500	7	1	3.851	1	V						
504	1	1	3.143	1	V						
504	2	1	3.120	2	H						
504	3	1	3.360	2	V						
504	4	1	3.222	1	H						
504	5	1	3.184	2	V						
504	6	2	-1.000	-1							
504	7	1	3.573	1	H	COST					
504	8	4	-1.000	-1							
504	9	1	3.153	2	V	ROSK					
504	10	1	3.149	2	H						
504	11	1	3.268	1	V						
504	12	1	3.360	1	H						
504	13	1	3.151	2	V						
504	14	1	3.275	2	H						
504	15	1	3.334	1	V						
522	1	1	3.870	1	H						
522	2	1	3.609	2	V	DIUR					
522	3	1	3.737	1	H						
522	4	1	4.000	1	V						
522	5	1	3.829	1	H	COST					
522	6	1	3.635	2	V						
522	7	1	3.715	2	H						
522	8	1	3.710	2	V	DIUR					
522	9	1	3.952	1	H	COST					
522	10	1	3.930	1	V						
522	11	1	4.004	1	H						
522	12	1	4.093	2	V						
522	13	1	4.156	1	H	COST					
522	14	1	3.923	1	V						
531	1	1	3.651	2	V						
531	2	1	3.791	1	H						
531	3	1	3.350	2	V	ROVE					
531	4	1	3.645	2	H						
531	5	1	3.992	1	V						
531	6	1	3.362	2	H						
531	7	1	4.031	1	V						
531	8	1	4.219	1	H	COST					
531	9	1	3.614	2	V						

Status: 1 = Live; 2 = Early Resorption; 4 = Late Resorption
Sex: Male = 1; Female = 2; See Code Sheet 43 for identification of abnormalities [ABNn]

Tetrahydrofuran Rat Teratology Study: Raw Fetal Data

1800 ppm THF

Matno	Site	Status	Fetal Wt(g)	Sex	Head or Visceral	ABN1	ABN2	ABN3	ABN4	ABN5	ABN6
531	10	1	3.894	1	H						
531	11	1	3.727	2	V						
531	12	1	3.872	1	H						
531	13	1	3.226	1	V						
532	1	1	2.653	1	H	ROST	ROPB				
532	2	1	2.937	1	V						
532	3	1	3.382	2	H						
532	4	1	3.288	2	V	ROVE					
532	5	1	3.103	2	H						
532	6	1	3.346	1	V	ROST					
532	7	1	3.254	1	H						
532	8	1	3.218	1	V	ROST					
532	9	4	-1.000	-1							
532	10	1	3.424	2	H						
532	11	1	3.434	1	V						
532	12	1	3.290	2	H						
532	13	4	-1.000	-1							
532	14	1	3.492	2	V						
532	15	1	3.264	1	H	ROST					
532	16	1	3.378	2	V	ROST					
532	17	1	3.516	2	H						
534	1	1	2.991	2	H						
534	2	1	3.367	1	V	DIUR					
534	3	1	3.503	1	H						
534	4	1	3.246	2	V						
534	5	1	3.431	2	H						
534	6	1	3.115	1	V						
534	7	1	3.376	1	H						
534	8	1	3.556	1	V						
534	9	1	3.423	2	H						
534	10	1	3.218	2	V	DIUR					
534	11	1	3.214	2	H						
534	12	1	3.372	1	V						
534	13	1	3.362	1	H						
534	14	1	3.129	2	V	DIUR					
534	15	1	2.979	2	H						
538	1	1	2.817	2	V						
538	2	1	3.394	1	H						
538	3	1	3.343	2	V						
538	4	1	3.632	1	H						
538	5	1	3.412	2	V						
538	6	1	3.721	1	H						
538	7	1	3.621	1	V						
538	8	1	2.316	2	H						
538	9	1	2.921	1	V						
538	10	1	3.419	2	H						
538	11	1	3.551	1	V						

Status: 1 = Live; 2 = Early Resorption; 4 = Late Resorption
Sex: Male = 1; Female = 2; See Code Sheet 43 for identification of abnormalities [ABNn]

Tetrahydrofuran Rat Teratology Study: Raw Fetal Data

------ 1800 ppm THF ------

Matno	Site	Status	Fetal Wt(g)	Sex	Head or Visceral	ABN1	ABN2	ABN3	ABN4	ABN5	ABN6
538	12	1	3.753	1	H	COST					
538	13	1	3.575	1	V						
538	14	1	3.540	2	H						
538	15	1	3.591	2	V						
538	16	1	3.412	2	H						
544	1	1	3.368	1	H						
544	2	1	3.294	1	V						
544	3	1	3.333	2	H						
544	4	1	3.584	1	V						
544	5	1	3.336	2	H						
544	6	1	3.569	1	V						
544	7	1	3.207	2	H						
544	8	1	3.609	1	V						
544	9	1	1.935	1	H	ROST					
544	10	1	3.267	2	V						
544	11	1	3.606	2	H						
544	12	1	3.787	1	V	DIUR					
544	13	1	3.286	1	H						
544	14	1	3.423	1	V						
544	15	1	2.392	1	H	CLPA	ROVE	ROST	ROPH		
544	16	1	3.563	2	V						
545	1	1	3.218	2	V						
545	2	1	3.272	2	H						
545	3	1	3.673	2	V						
545	4	1	3.764	1	H						
545	5	1	3.822	1	V						
545	6	2	-1.000	-1							
545	7	1	3.208	1	H						
545	8	1	3.523	2	V						
545	9	1	3.722	2	H						
545	10	1	3.761	1	V						
545	11	1	3.294	2	H	RORB					
545	12	1	3.654	2	V	DIUR					
545	13	1	3.868	1	H						
545	14	1	2.821	2	V						
545	15	1	3.380	2	H						
545	16	1	3.645	2	V						
562	1	1	3.204	2	H						
562	2	1	3.598	1	V						
562	3	1	3.669	2	H	ROVE					
562	4	1	3.508	2	V						
562	5	1	3.436	2	H						
562	6	1	3.615	2	V						
562	7	1	3.381	2	H	COST					
562	8	1	3.384	2	V						
562	9	1	3.625	1	H						
562	10	1	3.542	2	V						

Status: 1 = Live; 2 = Early Resorption; 4 = Late Resorption
Sex: Male = 1; Female = 2; See Code Sheet 43 for identification of abnormalities [ABNn]

Tetrahydrofuran Rat Teratology Study: Raw Fetal Data

1800 ppm THF

Matno	Site	Status	Fetal Wt(g)	Sex	Head or Visceral	ABN1	ABN2	ABN3	ABN4	ABN5	ABN6
562	11	1	3.390	2	H	ROVE					
562	12	1	3.564	2	V	MAVM					
562	13	1	3.440	2	H						
562	14	1	3.682	2	V	COST					
562	15	1	3.523	2	H						
562	16	1	3.546	2	V	ROVE					
562	17	1	3.518	2	H	ROVE					
577	1	1	4.053	2	H						
577	2	1	3.234	2	V						
577	3	1	3.608	1	H						
577	4	1	3.965	1	V						
577	5	1	3.752	1	H						
577	6	1	3.863	2	V						
577	7	2	-1.000	-1							
577	8	2	-1.000	-1							
577	9	4	-1.000	-1							
577	10	2	-1.000	-1							
577	11	1	3.597	2	H						
577	12	2	-1.000	-1							
577	13	2	-1.000	-1							
577	14	1	3.319	2	V						
577	15	1	3.601	1	H						
577	16	1	3.536	2	V						
583	1	1	3.298	2	V						
583	2	1	3.685	1	H						
583	3	1	3.237	2	V	ROST					
583	4	1	3.347	2	H						
583	5	1	3.405	2	V						
583	6	1	3.615	1	H						
583	7	1	3.495	2	V						
583	8	1	3.768	1	H						
583	9	1	3.529	1	V						
583	10	1	3.441	1	H						
583	11	1	3.661	1	V	ROST					
583	12	1	3.638	1	H						
583	13	1	3.448	2	V						
583	14	1	3.526	1	H						
583	15	1	3.458	2	V						
595	1	1	3.530	1	H						
595	2	1	3.530	2	V						
595	3	1	3.148	2	H	ROVE					
595	4	1	3.768	1	V						
595	5	1	3.888	1	H	COST					
595	6	1	3.621	2	V	COST					
595	7	1	3.378	2	H						
595	8	1	3.632	2	V						
595	9	1	3.661	1	H						

Status: 1 = Live; 2 = Early Resorption; 4 = Late Resorption
Sex: Male = 1; Female = 2; See Code Sheet 43 for identification of abnormalities [ABNn]

Tetrahydrofuran Rat Teratology Study: Raw Fetal Data

-- 1000 ppm THF --

Matno	Site	Status	Fetal Wt(g)	Sex	Head or Visceral	ABN1	ABN2	ABN3	ABN4	ABN5	ABN6
595	10	1	3.109	2	V	ROVE					
595	11	1	3.305	2	H						
595	12	1	3.689	1	V	ROVE					
595	13	1	3.382	2	H						
595	14	1	3.399	2	V						
595	15	1	3.567	2	H						
595	16	1	3.680	1	V						
595	17	1	3.372	2	H						
595	18	1	3.805	1	V						
601	1	1	2.917	2	H						
601	2	1	3.511	1	V	ROST					
601	3	1	3.855	2	H						
601	4	1	3.532	2	V	SURB					
601	5	1	3.742	1	H						
601	6	1	4.000	2	V						
601	7	1	4.024	1	H	ROST					
601	8	1	3.891	2	V	COST					
601	9	1	3.428	1	H						
601	10	1	3.651	2	V	ROST					
601	11	1	3.612	2	H						
601	12	1	3.471	2	V						
601	13	1	4.119	1	H						
601	14	1	3.494	2	V						
601	15	1	3.665	2	H						
607	1	1	4.879	2	V						
607	2	1	5.103	1	H	COST					
607	3	1	5.003	1	V	DIUR					
607	4	1	4.667	2	H						
607	5	1	5.331	1	V						
607	6	1	5.289	1	H						
607	7	1	4.851	1	V						
607	8	1	5.190	2	H						
607	9	1	5.245	1	V						
607	10	1	5.355	1	H						
607	11	1	5.151	2	V	COST	SURB				
607	12	1	4.570	2	H						
607	13	1	5.299	1	V	DIUR	COST				
607	14	1	4.904	1	H	COST					
607	15	1	5.046	1	V	COST					
607	16	1	5.214	2	H						
607	17	1	4.999	2	V						
607	18	1	5.149	2	H						
623	1	1	3.231	1	H						
623	2	2	-1.000	-1							
623	3	2	-1.000	-1							
623	4	1	3.198	2	V						
623	5	1	3.019	2	H						

Status: 1 = Live; 2 = Early Resorption; 4 = Late Resorption
Sex: Male = 1; Female = 2; See Code Sheet 43 for identification of abnormalities [ABNn]

Tetrahydrofuran Rat Teratology Study: Raw Fetal Data

1800 ppm THF

Matno	Site	Status	Fetal Wt(g)	Sex	Head or Visceral	ABN1	ABN2	ABN3	ABN4	ABN5	ABN6
623	6	1	3.760	1	V						
623	7	1	3.436	2	H	ROPB					
623	8	1	3.554	2	V						
623	9	1	3.246	1	H						
623	10	1	3.648	1	V						
623	11	1	3.031	1	H	ROST					
623	12	1	2.981	1	V	ROST					
623	13	1	3.291	1	H						
623	14	1	3.392	1	V						
623	15	1	3.378	1	H						
623	16	1	3.393	2	V						
623	17	1	3.162	1	H						
623	18	1	3.444	1	V	ROST					
630	1	1	3.756	1	V	COST					
630	2	1	3.880	1	H						
630	3	1	3.606	2	V	ROVE					
630	4	1	3.863	1	H	ROVE					
630	5	1	3.793	1	V	ROVE					
630	6	1	3.745	1	H						
630	7	1	3.507	2	V						
630	8	1	3.902	1	H						
630	9	1	3.890	1	V						
630	10	1	3.803	2	H	ROVE					
630	11	1	3.928	1	V	ROVE					

Status: 1 = Live; 2 = Early Resorption; 4 = Late Resorption
Sex: Male = 1; Female = 2; See Code Sheet 43 for identification of abnormalities [ABNn]

Tetrahydrofuran Rat Teratology Study: Raw Fetal Data

5000 ppm THF

Matno	Site	Status	Fetal Wt(g)	Sex	Head or Visceral	ABN1	ABN2	ABN3	ABN4	ABN5	ABN6
406	1	1	2.612	2	V	ROVE	ROPH				
406	2	1	2.687	2	H	ROPH					
406	3	1	2.767	2	V						
406	4	1	2.537	2	H	ROPH					
406	5	1	2.546	2	V	ROPH					
406	6	1	2.611	1	H	ROST					
406	7	1	2.495	2	V	ROPH					
406	8	1	2.662	1	H						
406	9	1	2.740	1	V						
406	10	1	2.478	2	H	ROST					
406	11	1	2.691	1	V	ROPH					
406	12	1	2.868	1	H						
406	13	1	2.240	2	V	CLPA	DIUR	ROST	MAST		
406	14	1	2.799	2	H						
406	15	1	2.501	2	V	ROST					
406	16	1	2.322	2	H	ROST	ROPB	ROPH			
414	1	1	2.678	1	H						
414	2	1	2.869	1	V	ROST	MAST	ROPH			
414	3	1	2.607	2	H	ROST					
414	4	1	2.723	2	V	ROST					
414	5	1	2.834	1	H						
414	6	1	2.857	1	V						
414	7	1	2.751	2	H						
414	8	1	2.672	1	V						
414	9	1	2.276	2	H	ROST	ROPH				
414	10	1	2.781	1	V	ROPH					
414	11	1	2.496	2	H	ROST	ROPH				
414	12	1	2.746	1	V	ROST	MAST				
414	13	1	2.882	1	H						
414	14	1	2.742	1	V	ROST	ROPH				
414	15	1	2.925	2	H						
414	16	1	2.717	1	V	ROST					
418	1	1	2.884	2	H						
418	2	1	2.958	2	V	ROVE					
418	3	1	3.010	2	H						
418	4	1	2.961	2	V						
418	5	1	4.370	1	H						
418	6	1	2.935	2	V						
418	7	1	3.125	1	H						
418	8	1	2.823	2	V						
418	9	1	3.115	1	H						
418	10	1	2.986	2	V						
418	11	1	2.881	2	H						
418	12	1	3.320	1	V						
418	13	1	2.901	2	H						
418	14	1	2.887	2	V						
418	15	1	3.070	2	H	ROST					

Status: 1 = Live; 2 = Early Resorption; 4 = Late Resorption
Sex: Male = 1; Female = 2; See Code Sheet 43 for identification of abnormalities [ABNn]

Tetrahydrofuran Rat Teratology Study: Raw Fetal Data

-- 5000 ppm THF --

Matno	Site	Status	Fetal Wt(g)	Sex	Head or Visceral	ABN1	ABN2	ABN3	ABN4	ABN5	ABN6
418	16	1	2.975	1	V						
429	1	1	2.338	2	H	ROST					
429	2	1	2.508	2	V	ROST					
429	3	1	2.721	1	H	SURB					
429	4	1	2.666	1	V						
429	5	1	2.905	1	H	ROST	SURB				
429	6	2	-1.000	-1							
429	7	1	2.598	1	V						
429	8	1	2.835	1	H	ROST					
429	9	1	2.434	2	V						
429	10	1	2.376	2	H						
429	11	1	2.514	2	V	ROST					
429	12	1	2.465	2	H	ROST	ROVE				
429	13	1	2.400	2	V						
429	14	1	2.405	2	H						
429	15	1	2.653	1	V						
429	16	1	2.198	2	H	ROST					
431	1	1	3.636	2	V						
431	2	1	3.011	1	H						
431	3	1	4.590	2	V						
431	4	1	3.061	1	H						
431	5	1	3.555	2	V						
431	6	1	3.015	2	H						
431	7	1	2.774	2	V						
431	8	1	3.069	1	H						
431	9	1	2.873	2	V						
431	10	1	3.320	1	H						
431	11	1	3.288	1	V						
431	12	1	2.795	2	H						
431	13	1	2.995	1	V						
431	14	2	-1.000	-1							
431	15	1	2.826	1	H						
431	16	1	3.314	1	V						
431	17	1	3.096	2	H						
431	18	1	3.021	2	V						
431	19	1	2.797	1	H						
447	1	1	2.762	1	H						
447	2	1	2.582	1	V						
447	3	1	2.306	2	H						
447	4	1	2.896	1	V						
447	5	1	2.742	1	H						
447	6	1	2.380	1	V						
447	7	1	2.846	1	H						
447	8	1	2.211	2	V	ROSK	ROST				
447	9	1	2.639	1	H						
447	10	1	2.347	2	V	ROSK					
447	11	1	2.573	2	H						

Status: 1 = Live; 2 = Early Resorption; 4 = Late Resorption
Sex: Male = 1; Female = 2; See Code Sheet 43 for identification of abnormalities [ABNn]

Tetrahydrofuran Rat Teratology Study: Raw Fetal Data

5000 ppm THF

Matno	Site	Status	Fetal Wt(g)	Sex	Head or Visceral	ABN1	ABN2	ABN3	ABN4	ABN5	ABN6
447	12	1	2.482	1	V						
447	13	2	-1.000	-1							
447	14	1	2.558	1	H						
447	15	1	2.645	2	V						
447	16	1	2.368	2	H						
447	17	1	2.952	1	V						
456	1	1	2.871	1	H						
456	2	1	2.774	2	V						
456	3	1	3.023	1	H						
456	4	1	3.298	1	V						
456	5	1	2.964	2	H						
456	6	1	2.952	1	V						
456	7	1	2.394	2	H	ROST	ROPB				
456	8	1	2.686	1	V						
456	9	1	2.751	2	H						
456	10	1	2.633	2	V	ROPB					
456	11	1	2.791	2	H	ROST					
456	12	1	2.764	2	V	ROST					
456	13	1	2.639	2	H	ROST					
456	14	1	2.578	1	V	ROPB					
456	15	1	2.319	2	H	ROST					
456	16	2	-1.000	-1							
458	1	1	2.802	2	V						
458	2	1	2.763	1	H						
458	3	1	2.633	2	V						
458	4	1	2.799	1	H						
458	5	2	-1.000	-1							
458	6	1	2.815	2	V						
458	7	1	2.974	1	H						
458	8	1	2.703	1	V						
458	9	1	2.415	1	H						
458	10	1	2.498	1	V						
458	11	1	2.915	2	H						
458	12	1	2.889	1	V						
458	13	1	3.138	2	H						
458	14	1	3.108	1	V						
473	1	1	2.980	2	V	RORB					
473	2	1	2.940	2	H						
473	3	1	3.468	1	V						
473	4	1	3.411	1	H	ROST					
473	5	1	3.287	1	V						
473	6	1	3.602	1	H						
473	7	1	3.485	1	V	DIUR					
473	8	1	3.230	2	H	ROVE					
473	9	1	3.325	2	V						
473	10	1	3.044	2	H	ROVE					
473	11	1	3.216	1	V	COST					

Status: 1 = Live; 2 = Early Resorption; 4 = Late Resorption
Sex: Male = 1; Female = 2; See Code Sheet 43 for identification of abnormalities [ABNn]

Tetrahydrofuran Rat Teratology Study: Raw Fetal Data

----- 5000 ppm THF -----

Matno	Site	Status	Fetal Wt(g)	Sex	Head or Visceral	ABN1	ABN2	ABN3	ABN4	ABN5	ABN6
473	12	1	3.189	2	H						
473	13	1	2.918	1	V						
473	14	1	3.689	1	H						
473	15	1	3.349	2	V						
473	16	2	-1.000	-1							
480	1	1	2.994	2	V						
480	2	1	3.110	2	HV	VETA					
480	3	1	2.822	2	V						
480	4	1	2.798	2	H						
480	5	1	3.062	1	V						
480	6	1	3.069	1	H						
480	7	1	2.897	2	V						
480	8	1	3.301	2	H						
480	9	2	-1.000	-1							
480	10	1	2.182	2	V	ROST	MAST	SURB			
480	11	1	2.827	1	H						
480	12	1	2.689	2	V						
480	13	1	2.860	1	H						
480	14	1	2.270	2	V						
480	15	1	2.922	2	H	SURB					
488	1	1	2.878	1	V						
488	2	1	3.061	1	H						
488	3	2	-1.000	-1							
488	4	1	3.018	2	V						
488	5	1	2.888	2	H						
488	6	1	2.839	1	V						
488	7	1	2.859	2	H						
488	8	1	3.012	1	V						
488	9	1	2.960	1	H						
488	10	1	2.850	1	V						
488	11	1	3.324	1	H						
488	12	1	2.812	2	V						
488	13	1	3.031	1	H						
488	14	1	3.131	1	V						
488	15	1	2.887	1	H	ROST					
488	16	1	2.718	2	V						
488	17	1	2.871	2	H						
488	18	1	2.747	2	V	ROST					
497	1	1	2.818	1	V						
497	2	1	2.903	1	H						
497	3	1	3.001	1	V						
497	4	1	2.953	1	H						
497	5	1	2.812	1	V						
497	6	1	2.515	2	H						
497	7	1	2.811	2	V						
497	8	1	2.734	2	H						
497	9	1	2.878	2	V						

Status: 1 = Live; 2 = Early Resorption; 4 = Late Resorption
Sex: Male = 1; Female = 2; See Code Sheet 43 for identification of abnormalities [ABNn]

Tetrahydrofuran Rat Teratology Study: Raw Fetal Data

5000 ppm THF

Matno	Site	Status	Fetal Wt(g)	Sex	Head or Visceral	ABN1	ABN2	ABN3	ABN4	ABN5	ABN6
497	10	1	2.977	1	H						
497	11	1	2.934	1	V	COST					
497	12	1	3.004	2	H						
497	13	1	3.025	2	V	COST					
497	14	1	3.060	1	H						
497	16	1	3.230	1	V						
503	1	1	1.812	2	H	ROST	ROPB	SURB	ROPH		
503	2	1	3.008	1	V						
503	3	1	2.813	2	H	ROST					
503	4	2	-1.000	-1							
503	5	1	3.301	1	V	DIUR					
503	6	1	3.341	2	H						
503	7	1	2.959	1	V						
503	8	1	2.709	2	H	ROST					
503	9	1	3.137	1	V						
503	10	1	3.027	2	H						
503	11	2	-1.000	-1							
503	12	1	2.852	1	V	ROST					
503	13	1	3.433	1	H						
503	14	1	2.485	2	V						
503	15	1	2.908	2	H						
503	16	1	2.864	2	V	DIUR	ROST				
503	17	1	2.698	2	H	ROVE					
503	18	1	3.087	2	V						
506	1	1	2.941	1	H						
506	2	1	2.883	2	V	ROPB					
506	3	1	3.118	1	H						
506	4	1	3.153	1	V						
506	5	1	3.158	1	H						
506	6	1	3.090	2	V	ROST					
506	7	1	3.222	2	H						
506	8	1	2.722	2	V	ROVE					
506	9	1	3.188	2	H						
506	10	1	2.857	2	V						
506	11	1	2.970	2	H						
506	12	1	2.492	2	V	ROST					
506	13	1	2.876	2	H						
506	14	1	2.957	2	V						
507	1	1	2.322	2	V						
507	2	1	2.732	2	H						
507	3	2	-1.000	-1							
507	4	1	2.822	2	V						
507	5	1	3.125	1	H						
507	6	1	2.800	2	V						
507	7	1	2.753	1	H						
507	8	1	2.574	2	V						
507	9	1	2.727	2	H						

Status: 1 = Live; 2 = Early Resorption; 4 = Late Resorption
Sex: Male = 1; Female = 2; See Code Sheet 43 for identification of abnormalities [ABNn]

Tetrahydrofuran Rat Teratology Study: Raw Fetal Data

5000 ppm THF

Matno	Site	Status	Fetal Wt(g)	Sex	Head or Visceral	ABN1	ABN2	ABN3	ABN4	ABN5	ABN6
507	10	1	3.134	1	V						
507	11	1	2.620	2	H						
507	12	1	2.996	1	V						
507	13	1	3.133	1	H						
507	14	1	2.921	1	V						
518	1	1	2.854	1	H	ROST					
518	2	1	2.976	1	V						
518	3	1	2.507	2	H						
518	4	1	2.635	2	V						
518	5	2	-1.000	-1							
518	6	1	3.036	2	H						
518	7	1	2.899	2	V						
518	8	1	3.294	1	H	COST					
518	9	1	2.701	2	V						
518	10	1	3.287	1	H						
518	11	2	-1.000	-1							
518	12	1	3.474	1	V						
518	13	1	2.900	2	H						
518	14	1	3.016	2	V						
518	15	1	3.121	1	H						
518	16	1	2.949	2	V	ROST					
518	17	1	3.331	1	H						
524	1	1	2.466	2	H						
524	2	1	3.030	2	V						
524	3	1	3.256	1	H						
524	4	1	3.231	2	V						
524	5	1	3.332	1	H	SURB					
524	6	1	3.047	1	V						
524	7	1	2.788	2	H						
524	8	1	3.093	1	V	ROVE					
524	9	1	3.081	2	H						
524	10	1	3.116	1	V						
524	11	1	2.863	2	H						
524	12	1	3.068	1	V	ROST					
524	13	1	3.212	2	H						
524	14	1	2.961	2	V						
524	15	1	2.878	2	H						
524	16	1	3.334	1	V						
528	1	1	2.183	2	H						
528	2	1	2.633	1	V						
528	3	1	2.635	2	H						
528	4	1	2.786	1	V						
528	5	1	2.612	2	H						
528	6	1	2.515	2	V						
528	7	1	2.707	1	H	ROST					
528	8	1	2.187	2	V	ROST					
528	9	1	2.566	2	H						

Status: 1 = Live; 2 = Early Resorption; 4 = Late Resorption
Sex: Male = 1; Female = 2; See Code Sheet 43 for identification of abnormalities [ABNn]

Tetrahydrofuran Rat Teratology Study: Raw Fetal Data

5000 ppm THF

Matno	Site	Status	Fetal Wt(g)	Sex	Head or Visceral	ABN1	ABN2	ABN3	ABN4	ABN5	ABN6
528	10	1	2.459	2	V						
528	11	1	2.621	1	H						
528	12	1	2.629	1	V						
528	13	1	2.718	1	H						
528	14	1	2.686	2	V						
528	15	1	2.798	1	H						
549	1	1	2.791	2	V						
549	2	1	3.169	2	H						
549	3	1	2.816	2	V						
549	4	1	2.972	2	H						
549	5	1	2.994	2	V						
549	6	1	3.297	1	H	COST					
549	7	1	2.963	2	V						
549	8	1	2.804	1	H						
549	9	1	3.016	2	V	ROST	SURB				
549	10	1	2.785	2	H						
549	11	1	3.098	1	V						
549	12	1	3.229	1	H	SURB					
549	13	1	2.976	1	V						
549	14	1	2.867	2	H						
549	15	1	3.076	2	V						
549	16	1	2.875	2	H	ROST					
549	17	1	3.228	1	V						
553	1	1	2.384	2	H	ROST					
553	2	1	2.656	2	V						
553	3	1	2.561	2	H	ROST					
553	4	1	2.864	1	V						
553	5	1	2.546	2	H						
553	6	1	2.789	1	V						
553	7	1	2.777	1	H						
553	8	1	2.819	1	V						
553	9	1	2.298	2	H						
553	10	1	2.522	1	V						
553	11	1	2.546	1	H						
553	12	1	2.883	1	V						
553	13	1	2.669	1	H	ROST					
553	14	1	2.471	2	V						
553	15	1	2.759	1	H						
553	16	1	2.149	2	V						
553	17	1	2.968	1	H						
553	18	1	2.716	1	V						
563	1	1	3.053	2	H	ROPH					
563	2	1	2.884	1	V						
563	3	1	2.954	2	H						
563	4	1	3.064	1	V						
563	5	1	2.852	2	H						
563	6	1	3.146	1	V						

Status: 1 = Live; 2 = Early Resorption; 4 = Late Resorption
Sex: Male = 1; Female = 2; See Code Sheet 43 for identification of abnormalities [ABNn]

Tetrahydrofuran Rat Teratology Study: Raw Fetal Data

5000 ppm THF

Matno	Site	Status	Fetal Wt(g)	Sex	Head or Visceral	ABN1	ABN2	ABN3	ABN4	ABN5	ABN6
563	7	1	3.069	1	H						
563	8	1	2.831	2	V						
563	9	1	2.445	2	H	ROPH					
563	10	1	2.736	1	V						
563	11	1	3.086	1	H						
563	12	1	2.954	1	V	VETA	IMAN	MIVE	ROVE		
563	13	1	2.686	2	H						
563	14	1	3.425	1	V						
563	15	1	3.545	1	H						
563	16	1	2.716	2	V						
563	17	1	3.467	1	H						
563	18	1	2.811	2	V						
566	1	1	2.791	1	H	ROST					
566	2	1	3.138	1	V						
566	3	1	3.028	2	H						
566	4	1	3.429	1	V						
566	5	1	3.367	1	H						
566	6	1	3.052	2	V						
566	7	1	3.015	2	H						
566	8	1	3.412	1	V						
566	9	1	2.996	2	H						
566	10	1	2.908	2	V	ROSK					
566	11	1	3.113	1	H						
566	12	1	3.399	1	V						
566	13	1	3.219	1	H						
566	14	1	3.226	1	V						
566	15	1	3.448	1	H						
566	16	1	3.309	1	V						
575	1	1	2.154	1	H	ROST	ROPB	ROPH			
575	2	1	2.779	1	V	ROST					
575	3	1	2.766	1	H						
575	4	1	2.787	2	V	ROVE					
575	5	1	2.778	1	H						
575	6	1	3.031	1	V						
575	7	1	2.558	2	H						
575	8	1	2.980	1	V						
575	9	1	2.414	2	H						
575	10	1	2.805	1	V	ROVE					
575	11	1	2.212	2	H	ROVE					
575	12	1	2.773	1	V						
575	13	1	2.768	1	H						
575	14	1	2.731	1	V						
575	15	1	2.729	2	H						
575	16	1	2.753	1	V						
580	1	2	-1.000	-1							
580	2	1	2.701	2	H	ROST					
580	3	1	3.163	1	V						

Status: 1 = Live; 2 = Early Resorption; 4 = Late Resorption
Sex: Male = 1; Female = 2; See Code Sheet 43 for identification of abnormalities [ABNn]

Tetrahydrofuran Rat Teratology Study: Raw Fetal Data

5000 ppm THF

Matno	Site	Status	Fetal Wt(g)	Sex	Head or Visceral	ABN1	ABN2	ABN3	ABN4	ABN6	ABN8
580	4	1	2.987	1	H						
580	5	1	3.093	1	V						
580	6	1	2.795	2	H						
580	7	1	2.018	2	V	ROST	ROPH				
580	8	1	2.714	1	H	ROST	ROPH				
580	9	1	2.680	2	V	ROSK					
580	10	1	3.003	2	H						
580	11	1	2.777	2	V	ROSK	ROST	ROPH			
580	12	1	3.138	1	H	ROPH					
580	13	1	2.846	1	V	ROSK	ROST	ROPB	ROPH		
580	14	1	3.148	1	H	ROVE	SURB				
580	15	1	2.997	2	V						
580	16	1	3.299	1	H						
580	17	1	1.948	2	V	ROSK	ROST	ROPB	ROPH		
580	18	2	-1.000	-1							
584	1	1	2.314	1	V	ROST	MAST				
584	2	1	2.614	2	H	ROST					
584	3	2	-1.000	-1							
584	4	1	2.469	1	V						
584	5	1	2.711	1	H						
584	6	1	2.398	2	V						
584	7	1	2.369	2	H						
584	8	1	2.702	1	V						
584	9	2	-1.000	-1							
584	10	1	2.749	1	H						
584	11	1	2.578	1	V						
584	12	1	2.411	2	H						
584	13	1	2.823	2	V						
584	14	1	2.271	1	H						
584	15	1	2.459	2	V						
584	16	1	2.803	2	H						
584	17	1	2.787	1	V						
593	1	1	3.455	1	H						
593	2	1	3.264	1	V	COST					
593	3	1	3.349	1	H						
593	4	1	2.730	2	V	ROVE					
593	5	1	3.500	1	H	COST					
593	6	1	3.402	1	V						
593	7	1	3.048	2	H						
593	8	1	3.175	1	V						
593	9	1	3.464	1	H	FUST	ROST				
593	10	1	3.397	2	V						
593	11	1	3.337	1	H	ROVE					
593	12	1	3.209	2	V						
593	13	1	3.476	1	H						
593	14	1	3.208	1	V	COST					
611	1	1	2.725	2	V						

Status: 1 = Live; 2 = Early Resorption; 4 = Late Resorption
Sex: Male = 1; Female = 2; See Code Sheet 43 for identification of abnormalities [ABNn]

Tetrahydrofuran Rat Teratology Study: Raw Fetal Data

5000 ppm THF

Matno	Site	Status	Fetal Wt(g)	Sex	Head or Visceral	ABN1	ABN2	ABN3	ABN4	ABN5	ABN6
611	2	1	2.738	2	H						
611	3	1	2.837	2	V	ROST					
611	4	1	3.042	2	H						
611	5	2	-1.000	-1							
611	6	1	3.064	1	V						
611	7	1	2.853	2	H						
611	8	1	2.922	2	V						
611	9	1	2.719	2	H						
611	10	1	2.085	1	V	ROST	ROPB				
611	11	1	2.962	1	H	ROST					
611	12	1	2.972	1	V						
611	13	1	2.764	2	H						
611	14	1	2.601	2	V						
611	15	1	2.615	2	H						
611	16	1	2.862	2	V						
611	17	1	3.041	1	H						
611	18	1	2.882	2	V						
611	19	1	2.824	2	H	ROST					
614	1	1	3.280	1	V	ROVE					
614	2	1	3.216	1	H						
614	3	1	3.314	2	V						
614	4	2	-1.000	-1							
614	5	1	3.479	2	H						
614	6	1	3.241	2	V						
614	7	1	3.091	2	H						
614	8	1	3.338	1	V						
614	9	1	3.238	2	H						
614	10	2	-1.000	-1							
614	11	1	3.363	1	V						
614	12	1	3.026	1	H						
614	13	1	3.430	1	V	ROVE					
614	14	1	3.547	1	H	COST					
614	15	1	3.163	1	V	ROSK					
614	16	1	2.781	1	H						
614	17	1	3.217	2	V						
620	1	1	2.528	2	V						
620	2	1	2.550	1	H						
620	3	1	2.752	1	V	COST					
620	4	1	2.661	2	H						
620	5	1	2.775	1	V						
620	6	1	2.727	1	H						
620	7	1	2.742	1	V						
620	8	1	2.716	1	H						
620	9	1	2.699	1	V						
620	10	1	2.539	1	H						
620	11	4	-1.000	-1							
620	12	1	2.529	1	V						

Status: 1 = Live; 2 = Early Resorption; 4 = Late Resorption
Sex: Male = 1; Female = 2; See Code Sheet 43 for identification of abnormalities [ABNn]

Tetrahydrofuran Rat Teratology Study: Raw Fetal Data

------ 5000 ppm THF ------

Matno	Site	Status	Fetal Wt(g)	Sex	Head or Visceral	ABN1	ABN2	ABN3	ABN4	ABN5	ABN6
620	13	1	2.711	2	H						
620	14	1	2.597	1	V	ROSK					
620	15	1	2.692	2	H						
631	1	1	2.529	2	V						
631	2	1	2.833	2	H						
631	3	1	2.674	2	V	ROVE					
638	1	2	-1.000	-1							
638	2	1	3.175	1	V						
638	3	2	-1.000	-1							
638	4	2	-1.000	-1							
638	5	1	3.279	2	H						
638	6	2	-1.000	-1							
638	7	1	3.539	1	V						
639	1	1	3.004	1	H						
639	2	1	2.813	2	V						
639	3	1	3.101	1	H						
639	4	2	-1.000	-1							
639	5	1	2.796	1	V						
639	6	1	1.876	2	H	ROST	ROPB	ROPH			
639	7	1	2.834	2	V						
639	8	1	2.298	2	H	ROST					
639	9	2	-1.000	-1							
639	10	1	2.125	1	V	ROSK	ROST	ROVE	ROPB		
639	11	1	2.564	2	H	ROST					
639	12	1	2.022	1	V	ROST					
639	13	1	2.531	1	H						
639	14	1	2.292	1	V						
639	15	1	2.488	2	H						
639	16	1	2.436	1	V						
639	17	4	-1.000	-1							
639	18	1	2.118	1	H	ROST	ROPB				
639	19	1	2.096	1	V	ROST					

Status: 1 = Live; 2 = Early Resorption; 4 = Late Resorption
Sex: Male = 1; Female = 2; See Code Sheet 43 for identification of abnormalities [ABNn]

Tetrahydrofuran Rat Teratology Study: Raw Fetal Data

Code Sheet for Identification of Fetal Abnormalities

ANOR	Anomalous Rib (knobby, wavy, bent)
BRRB	Branched Rib
CLPA	Cleft Palate
COST	Completely Ossified Sternebra 1-6
DIUR	Dilated Ureter
ECOV	Ectopic Ovaries
FURB	Fused Ribs
FUST	Fused Sternebra
FUVA	Fused Vertebral Arch
IMAN	Imperforate Anus
MAST	Misaligned Sternebra
MAVM	Major Vessel Malformation
MIIN	Missing Innominate
MIVE	Missing Vertebra
MOPT	Micropthalmia
ROPB	Reduced Ossification Pelvic
ROPH	Reduced Ossification Phalanges
RORB	Reduced Ossification Rib
ROSK	Reduced Ossification Skull
ROST	Reduced Ossification Sternebra
ROVE	Reduced Ossification Vertebra
RURB	Rudimentary Rib
SURB	Supernumary Rib
VETA	Vestigial Tail

C.89

Tetrahydrofuran Mouse Teratology Study: Calendar of Events

Exposure levels; Treatments 1-4	0, 600, 1800, 5000 ppm THF
Ordered mice	5-15-87
Received mice (ARC# 870049)	6-16-87
Eartagged & weighed females	6-25-87
Virgins selected and randomized	6-25-87
Health screen; 5 males, 5 females	7-7-87
Virgins individually caged	7-8-87
Detection of copulation (0dg), weighed, randomized, individually caged	(A) 7-9-87 (29) (B) 7-10-87 (18) (C) 7-11-87 (84; 45 on study) (D) 7-12-87 (27) (E) 7-13-87 (13)
Released from quarantine & moved to exposure room	7-13-87
Exposure; tmt 1-3 (6hours/day; 6-17 dg)	(A) 7-15-87 to 7-26-87 (B) 7-16-87 to 7-27-87 (C) 7-17-87 to 7-28-87 (D) 7-18-87 to 7-29-87 (E) 7-19-87 to 7-30-87
Exposure; tmt 4 (6hours/day; 6-11 dg @ 5000 ppm)	(A) 7-15-87 to 7-20-87 (B) 7-16-87 to 7-21-87 (C) 7-17-87 to 7-22-87 (D) 7-18-87 to 7-23-87 (E) 7-19-87 to 7-24-87
Exposure; tmt 4 (6hours/day; 12-17 dg @ 0 ppm)	(A) 7-21-87 to 7-26-87 (B) 7-22-87 to 7-27-87 (C) 7-23-87 to 7-28-87 (D) 7-24-87 to 7-29-87 (E) 7-25-87 to 7-30-87
Weighed (6dg) start exposure	(A-E) 7-15-87 to 7-19-87
Weighed (9dg)	(A-E) 7-18-87 to 7-22-87
Weighed (12dg)	(A-E) 7-21-87 to 7-25-87
Weighed (15dg)	(A-E) 7-24-87 to 7-28-87
Sacrifice (18dg):	(A) 7-27-87 (B) 7-28-87 (C) 7-29-87 terminal serology (D) 7-30-87 (E) 7-31-87
Virgins exposed 12 days concurrent with Grp B	
Weighed exposure day 1	7-16-87
Weighed exposure day 5	7-20-87
Tmt 4 into holding chamber on exposure day 6	7-21-87
Weighed exposure day 10	7-25-87
Sacrifice one day post-exposure	7-28-87
Fetal exams completed	8-24-87

Tetrahydrofuran Rat Teratology Study: Calendar of Events

Exposure levels; Treatments 1-4	0, 600, 1800, 5000 ppm THF
Ordered rats	5-15-87
Received rats (ARC# 870057)	7-14-87
Preliminary health screen; 3 males	7-20-87
Health screen; 5 males, 5 females (5 test exposure males used for health screen)	8-3-87
Eartagged & weighed females	8-4-87
Virgins selected and randomized	8-4-87
Released from quarantine	8-7-87
Virgins individually caged	8-10-87
Detection of copulation (0dg), weighed, randomized, individually caged	(A) 8-11-87 (33) (B) 8-12-87 (12) (C) 8-13-87 (15) (D) 8-14-87 (44) (E) 8-15-87 (25)
Moved to exposure room; grp A, B, C & virgins	8-14-87
grp D & E	8-18-87
Exposure (6 hours/day; 6-19 dg)	(A) 8-17 to 8-30-87 (B) 8-18 to 8-31-87 (C) 8-19 to 9-1-87 (D) 8-20 to 9-2-87 (E) 8-21 to 9-3-87
Weighed (6dg) start exposure	(A-E) 8-17 to 8-21-87
Weighed (10dg)	(A-E) 8-21 to 8-25-87
Weighed (14dg)	(A-E) 8-25 to 8-29-87
Weighed (17dg)	(A-E) 8-28 to 9-1-87
Sacrifice (20dg)	(A) 8-31-87 terminal serology (B) 9-1-87 (C) 9-2-87 (D) 9-3-87 (E) 9-4-87
Virgins exposed 14 days concurrent with grp B.	8-18 to 8-31-87
Weighed exposure day 1	8-18-87
Weighed exposure day 5	8-22-87
Weighed exposure day 10	8-27-87
Sacrifice one day post-exposure	9-1-87
Fetal exams completed	10-28-87

TETRAHYDROFURAN MOUSE TERATOLOGY STUDY DISPOSITION

Exposure Group	Treatment	Virgins	Plug-Positive Teratology Mice: On Study(a)	Removed From Study	Sacrifice	Litters Examined
Control (0 ppm)	1	10	33	1(b)	32	30
600 ppm	2	10	33	2(c)	31	26
1800 ppm	3	10	33	0	33	27
5000 ppm	4	10(e)	33	0	24(d)	20

(a) The study protocol required a minimum of 33 plug-positive females (to obtain 20 pregnant females).
(b) 1 dam - premature delivery of litter
(c) 1 dam - premature delivery of litter
1 dam - litter ≤ 2 implants
(d) Nine mice died during exposure due to toxicity.
(e) Four of the original 10 virgin mice died during exposure due to toxicity.

TETRAHYDROFURAN RAT TERATOLOGY STUDY DISPOSITION

Exposure Group	Treatment	Virgins	Sperm-Positive Teratology Rats: On Study(a)	Removed From Study	Sacrifice	Litters Examined(b)
Control (0 ppm)	1	10	33	0	33	31
600 ppm	2	10	32	0	32	28
1800 ppm	3	10	32	0	32	29
5000 ppm	4	10	32	0	32	32

(a) The study protocol required a minimum of 30 sperm-positive females (to obtain 20 pregnant females).
(b) Includes resorbed litters

APPENDIX D

ANIMAL HEALTH SCREEN

ARC RODENT HEALTH SCREEN REPORT

Investigator: Mast
Study: THF Teratology
Building: LSL II
Room: 433
Date initiated: 7/7/87

Lab no: P-103
Animal/Shipment no: 870049
Date rc'd: 6/16/87
Source: CR Raleigh R03
Species/Strain: Mice/CD1
Sex: M/F Age: BD 4/23/87

Status: Ten mice (5 male #1-5, 5 female #6-10) submitted for pre-exposure health screen including nasopharyngeal wash cultures, gross necropsy, serology and histopathology

Gross Necropsy

Eye(#1)	The cornea of right eye is dry and ulcerated and the globe is protruding from the orbit. A 1.2x1x0.5 cm mass is located behind and lateral to globe. The mass extends ventrally to the mandible. Upon incision, the mass in the area of the mandible exudes white purulent material. Lateral to the eye mass has a more solid appearance, is light brown in color and has only a slight exudate from the cut surface. A culture was initiated from the mass.
Abdominal(#1) viscera	The spleen is enlarged (2.8x.6x.3 cm).
Ventral neck (#1)	The right submandibular lymph node is moderately enlarged.
Thoracic viscera (#1)	A 1mm diameter, roughly spherical light brown mass is evident on medial surface of the right cardiac lobe of lung.

Nasopharyngeal culture

0/10 *	Beta hemolytic Streptococcus
0/10	_Bordetella bronchiseptica_
1/10	_Citrobacter_ sp.
0/10	Coagulase positive Staphylococcus
0/10	_Klebsiella oxytoca_
1/10	_Klebsiella pneumoniae_
0/10	_Pasturella multocida_
0/10	_Pseudomonas aeruginosa_
0/10	_Streptococcus pneumoniae_

*Number of positive cultures/number cultured

Culture results:

- Abcess (mouse #1) culture
  Direct smear: Rare WBC
  Rare gram positive cocci

  Culture: 3+ coagulase positive Staphylococcus sp.

Serology: Mouse

0/10 *	*Mycoplasma pulmonis*
0/10	Sendai virus
0/10	Pneumonia virus of mice
0/10	Mouse hepatitis virus
0/10	GD VII virus

*Number of positive tests/number tested

Histopathology

1/10	Colon	Focal inflammation is present in adipose tissue adjacent to the colon(#5)
2/10	Liver	Occasional tiny focus of inflammation(#6,7)
1/10	Colon	Focus of slight inflammation in submucosa(#8)
1/10	Lung	Rare focus of slight perivascular inflammation(#1)
1/10	Liver	Occasional tiny focus of PMN's in hepatic parenchyma(#1)
1/10	Kidney	Rare tiny focus of tubular degenerative change(#2)
1/10	Kidney	Rare focus of periarterial inflammation in kidney and focal slight inflammation in pelvis of kidney(#2)
1/10	Mass (head)	Granulomatous inflammation involving Harderian gland and other tissues of the head; origin may be in Harderian gland but this could not be determined with any certainty(#1)

*Number affected/number examined

Correlation/Summary

There were a number of incidental lesions in these animals; but taken individually or as a whole, they are not considered indicative of any contagious disease. The lesion in the head of male #1 may have originated as a wound with secondary Staphylococcus infection. The microscopic lesions in liver and the spleen of that animal were probably caused by bacteremia or toxemia secondary to the infection in the head.The cause of the lesions in the other animal was not determined but these are considered only incidental findings. Serologic tests for antibodies to viral pathogens were negative.

Released for Study on 7/13/87.

Released from Quarantine on 7/13/87.

A E Jassell 7/16/87
Technologist

7/16/87
Veterinarian

RODENT HEALTH SCREEN
HISTOPATHOLOGY

STUDY/Species THF-IRT / MICE

Lab Number P103
Histo Number 287-1031

ANIMAL NUMBER	1	2	3	4	5	6	7	8	9	10
Lung	5	1	1	1	1	1	1	1	1	1
Trachea	X	X	X	X	X	X	X	X	X	X
Ileum	1	1	1	1	1	1	X	1	1	1
Colon	1	1	1	1	2	1	1	4	1	1
Harderian Gland (rat)										
Salivary Gland (rat)										
Submand. Lymph Node (rat)										
Heart	1	1	1	1	1	1	1	1	1	1
Liver	6	1	1	1	1	3	3	1	1	1
Kidney	1	7,8	1	1	1	1	1	1	1	1
MASS - Head	9									

OBSERVATIONS:

X Not examined (tissue not submitted or lost in processing)

1 No significant lesions

2 Focal inflammation is present in adipose tissue adjacent to the colon.

3 Occasional tiny focus of inflammation in hepatic parenchyma

4 Focus of slight inflammation in submucosa

5 Rare focus of slight perivascular inflammation

6 Occasional tiny focus of PMN's in hepatic parenchyma

7 Rare tiny focus of tubular degenerative change in kidney

8 Rare focus of periarterial inflammation in kidney and focal slight inflammation in pelvis of kidney.

Ref: OB-AR-3F02
10/2/86

9. Granulomatous inflammation involving Harderian gland and other tissues of the head; origin may be in Harderian gland but this could not be determined with any certainty. SER 7/13/87

RODENT HEALTH SCREEN
GROSS NECROPSY

Lab Number P103

STUDY/Species THF/mice

Date Performed 7/7/87

ANIMAL NUMBER	1 M	2m	3M	4M	5M	6F	7F	8F	9F	10F
Haircoat/Skin	1	1	1	1	1	1	1	1	1	1
Ventral Neck Area	4	1	1	1	1	1	1	1	1	1
Abdominal Viscera	3	1	1	1	1	1	1	1	1	1
Thoracic Viscera	5	1	1	1	1	1	1	1	1	1
Middle Ear	1	1	1	1	1	1	1	1	1	1
Eyes/Conjunctiva	2	1	1	1	1	1	1	1	1	1
Harderian Gland (rat)	no data →									
Brain	1	1	1	1	1	1	1	1	1	1
Tissues saved in 10% NBF**	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
								end of data		7/7/8[7] aEg

OBSERVATIONS:

X Not examined

1 No significant lesions

cornea rt. eye partly ulcerated; globe is protruding from orbit; 1.2x1x.5 cm mass behind

2 and lateral to globe; ventrally mass situated beneath mandible; on incision mass contains wht. purulent material; lateral to eye mass has more solid appearance, lt. brown, lacking purulent material; culture done; abscess + mass saved in formalin

3 - 2.8x.6x.3 cm spleen enlarged

4 - rt. submandibular lymph node moderately enlarged; ~~rt. eye~~ wrote in wrong place 7/7/87 aEg

5 - Lung - 1 mm diameter roughly spherical lt. brown mass evident on medial surface of rt. cardiac lobe

end of data 7/7/aEg

** Tissues saved: lungs with trachea, heart, salivary gland, right kidney, brain, ileum, colon, liver, spleen, testis/ovary turbinates, eyes with harderian gland (rats), other

Ref: ØB-AR-3FØ2
9/8/86

ARC RODENT HEALTH SCREEN REPORT

Investigator: Mast
Study: THF-IRT Teratology
Building: LSL II
Room: 433
Date initiated: 7/29/87

Lab no: P-121
Animal/Shipment no: 870049
Date rc'd: 6/16/87
Source: CR Raleigh R03
Species/Strain: Mice/CD1
Sex: M/F Age: BD 4/23/87

Status: Received ten mouse blood samples for serology testing at terminal sacrifice

Serology: Mouse

0/10 *	*Mycoplasma pulmonis*
0/10	Sendai virus
0/10	Pneumonia virus of mice
0/10	Mouse hepatitis virus
0/10	GD VII virus

*Number of positive tests/number tested

Correlation/Summary

All serologic tests were negative indicating these mice did not have antibodies to any of the above pathogens.

A E Carrell 8/10/87
Technologist

8/7/87
Veterinarian

ARC RODENT HEALTH SCREEN REPORT

Investigator: Mast
Study: THF-Teratology
Building: LSL II
Room: 433
Date initiated: 7/20/87

Lab no: P-~~166~~ 116 typo AEJ 7/22/87
Animal/Shipment no: 870057
Date rc'd: 7/14/87
Source: CR/Raleigh R04
Species/Strain: Rat/CD
Sex: M Age: BD5/14/87

Status: Received 3 rats for pre-exposure health screen

Gross Necropsy
No significant lesions

Serology: Rat

0/3 *	*Mycoplasma pulmonis*
0/3	Sendai virus
0/3	Pneumonia virus of mice
0/3	RCV/SDAV
0/3	KRV/H1

*Number of positive tests/number tested

Histopathology

1/3*	Liver	Rare tiny focus of inflammation in hepatic parenchyma

*Number affected/number examined

Correlation/Summary

This is a preliminary health screen done because the investigator wants to move rats from this group into the ongoing THF-IRT mouse study. No evidence of infection or disease was found in the 3 rats examined. However, because of the small number examined and early examination relative to the arrival date, this provides only marginal assurance that the group has not been exposed to and infected with some significant pathogen. Therefore the mouse exposure room should be placed on quarantine until additional rats from the group are tested beginning August 3.

AE Jarrell 7/22/87
Technologist

7/22/87
Veterinarian

Brown
Mast

RODENT HEALTH SCREEN
GROSS NECROPSY

Lab Number *P116*

STUDY/Species *THF-Teratology/RAT*

Date Performed *7/20/87*

ANIMAL NUMBER	1M	2M	3M	4	5	6	7	8	9	10
Haircoat/Skin	1	1	1							
Ventral Neck Area	1	1	1							
Abdominal Viscera	1	1	1							
Thoracic Viscera	1	1	1							
Middle Ear	1	1	1							
Eyes/Conjunctiva	1	1	1							
Harderian Gland (rat)	1	1	1							
Brain	1	1	1							
Tissues saved in 10% NBF**	✓	✓	✓							
			end of data collection FEJ 7/20/87							

OBSERVATIONS:

X Not examined

1 No significant lesions

2

** Tissues saved: lungs with trachea, heart, salivary gland, right kidney, brain, ileum, colon, liver, spleen, testis/ovary turbinates, eyes with harderian gland (rats), other: ______

Ref: Ø5-AR-3FØ2
9/8/86

RODENT HEALTH SCREEN
HISTOPATHOLOGY

STUDY/Species THF-IRT/Rat

Lab Number P116
Histo Number 287-1033

ANIMAL NUMBER	1	2	3	4	5	6	7	8	9	10
Lung	1	1	1							
Trachea	1	1	1							
Ileum	1	1	1							
Colon	1	1	1							
Harderian Gland (rat)	1	1	1							
Salivary Gland (rat)	1	1	1							
Submand. Lymph Node (rat)	1	X	X	End of data						
Heart	1	1	1							
Liver	1	1	2							
Kidney	1	1	1							

OBSERVATIONS:

X Not examined (tissue not submitted or lost in processing)

1 No significant lesions

2 Rare tiny focus of inflammation in hepatic parenchyma.
The liver lesion seen in #3 are not considered to be significant. SER 7/22/87

Ref: ØB-AR-3FØ2
10/2/86

ARC RODENT HEALTH SCREEN REPORT

Investigator: Mast
Study: THF-Teratology
Building: LSL II
Room: 433 & 424
Date initiated: 8/3/87

Lab no: P-123
Animal/Shipment no: 870057
Date rc'd: 7/14/87
Source: CR Raleigh R04
Species/Strain: Rat/CD
Sex: M/F Age: BD 5/14/87

Status: Received 10 rats (5M, #1-5; 5F, #6-10) for pre-exposure health screen. The male rats were taken from room 424 on 7/31/87 and housed in lab 1428 with food and water until 8/3/87.

Gross Necropsy
No significant lesions

Nasopharyngeal culture

1/10 *	Beta hemolytic Streptococcus, Group G (*S. anginosus*)
0/10	*Bordetella bronchiseptica*
0/10	*Citrobacter freundii*
5/10	Coagulase positive Staphylococcus
0/10	*Klebsiella oxytoca*
0/10	*Klebsiella pneumoniae*
0/10	*Pasturella multocida*
0/10	*Pseudomonas aeruginosa*
0/10	*Streptococcus pneumoniae*

*Number of positive cultures/number cultured

Serology: Rat

0/10 *	*Mycoplasma pulmonis*
0/10	Sendai virus
0/10	Pneumonia virus of mice
0/10	RCV/SDAV
0/10	KRV/H1

*Number of positive tests/number tested

Histopathology

3/10 *	Liver	Rare small focus of inflammation in hepatic parenchyma (#2,7,9)
1/10	Sub.man. Lym.node	Slight hyperplasia; erythrophagocytosis (#6)
1/10	Liver	Occasional slight pericholangial inflammation (#6)

1/10	Lung	Occasional perivascular cuffing with mixed WBC (#7)
1/10	Kidney	Slight chronic pyelitis (#9)

*Number affected/number examined

Correlation/Summary

The Group G Streptococcus seen in one rat from this group was also recovered from another shipment of CD rats received from Raleigh in October 86. The 1986 shipment came from R01 while this one is from R04. Group G Strep are not known to be a significant pathogen for rats. The coagulase positive Staph is a common isolate from barrier reared rats and is not of concern. The histopathologic findings are considered incidental and are not an indication of a significant group health problem.

Released for Study on 8/7/87.

Released from Quarantine on 8/7/87.

8/11/87
Technologist

8/11/87
Veterinarian

RODENT HEALTH SCREEN
GROSS NECROPSY

Lab Number P-123

STUDY/Species IRT-THF/Rat teratology/Mast

Date Performed 8-3-87

ANIMAL NUMBER	1M	2M	3M	4M	5M	6F	7F	8F	9F	10F
Haircoat/Skin	1	1	1	1	1	1	1	1	1	1
Ventral Neck Area	1	1	1	1	1	1	1	1	1	1
Abdominal Viscera	1	1	1	1	1	1	1	1	1	1
Thoracic Viscera	1	1	1	1	1	1	1	1	1	1
Middle Ear	1	1	1	1	1	1	1	1	1	1
Eyes/Conjunctiva	1	1	1	1	1	1	1	1	1	1
Harderian Gland (rat)	1	1	1	1	1	1	1	1	1	1
Brain	1	1	1	1	1	1	1	1	1	1
Tissues saved in 10% NBF**	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Eartag	3364	3366	3365	3367	3363				end	of data
									AEB	8/4/87

OBSERVATIONS:

X Not examined

1 No significant lesions

2

** Tissues saved: lungs with trachea, heart, salivary gland, right kidney, brain, ileum, colon, liver, spleen, testis/ovary turbinates, eyes with harderian gland (rats), other

Ref: ØB-AR-3FØ2
9/8/86

RODENT HEALTH SCREEN
HISTOPATHOLOGY

Lab Number P-123
STUDY/Species IRT-THF/Rat teratology Histo Number 287-1037

ANIMAL NUMBER	1	2	3	4	5	6	7	8	9	10
Lung	1	1	1	1	1	1	5	1	1	1
Trachea	1	X	1	1	X	1	1	1	1	X
Ileum	1	1	1	1	1	1	1	1	1	1
Colon	1	1	1	1	1	1	X	1	1	1
Harderian Gland (rat)	1	1	1	1	1	1	1	1	1	1
Salivary Gland (rat)	1	1	1	1	1	1	1	1	X	1
Submand. Lymph Node (rat)	X	X	1	X	1	3	1	1	X	X
Heart	1	1	1	1	1	1	1	1	1	1
Liver	1	2	1	1	1	4	2	1	2	1
Kidney	1	1	1	1	1	1	1	1	6	1

OBSERVATIONS:

X Not examined (tissue not submitted or lost in processing)

1 No significant lesions

2 Rare small focus of inflammation in hepatic parenchyma

3. Slight hyperplasia & erythrophagocytosis

4 Occasional slight peribronchiolar inflammation

5. Occasional peribronchiolar cuffing with mixed WBC

6. Slight chronic pyelitis SEP - 8/7/87

Ref: ØB-AR-3FØ2
10/2/86

ARC RODENT HEALTH SCREEN REPORT

Investigator: Mast
Study: THF IRT Teratology
Building: LSL II
Room: 433
Date initiated: 8/31/87

Lab no: P-135
Animal/Shipment no: 870057
Date rc'd: 7/14/87
Source: CR Raleigh R04
Species/Strain: Rat/CD
Sex F Age: 5/14/87

Status: Received the following specimens from terminal sacrifice rats for viral serology:

NO.	Animal #	Lipemia(serum)
1.	425	-
2.	431	+
3.	416	+
4.	418	+
5.	408	+
6.	466	-
7.	403	-
8.	477	+
9.	473	+
10.	401	+

Serology: Rat

0/10 *	*Mycoplasma pulmonis*
0/10	Sendai virus
0/10	Pneumonia virus of mice
0/10	RCV/SDAV
0/10	KRV/H1

*Number of positive tests/number tested

Correlation/Summary

There was no serologic evidence (presence of antibodies) of current or previous infection by any of the above mentioned pathogens. The cause of the lipemia was not determined.

AE Jarrell 9/24/87
Technologist

[signature] 9/24/87
Veterinarian

APPENDIX E

QUALITY ASSURANCE STATEMENT

TERATOLOGY STUDY OF TETRAHYDROFURAN IN MICE AND RATS
(Final Report)

Quality Assurance Statement

Listed below are the phases and/or procedures included in the study described in this report which were reviewed by the Quality Assurance Unit during the period, 6/01/88 - 11/30/87, specifically for this study and the dates the reviews were performed and findings reported to management. (All findings were reported to the study director or his designee at the time of the review.)

Phase/Procedure Reviewed	Review Date	Date Findings Submitted in Writing to Study Director/Management
Animal Receipt	6/16/87	6/17/88
Animal Identification	6/25/87	6/30/87
Health Screen	7/07/87	7/07/87
Dosing	7/18/87	7/21/87
Body Weights	7/19/87	7/22/87
Mating	8/14/87	8/14/87
Developmental Evaluations	9/04/87	9/21/87
Necropsy	9/04/87	9/21/87
Body Weights	10/19,22/87	10/24/87
Mating	10/19,22/87	10/24/87
Data	10/14,27-28/87	11/10/87
Data	10/21-23,26-28/87	11/10/87
Draft Report	4/4,13-15&18/88	4/19/88
Final Report	9/2,5/88	9/05/88

R. A. Gelman
Quality Assurance Specialist

9/6/88
Date

Patricia S. Ruemmler
Quality Assurance Specialist

9/5/88
Date

APPENDIX F

PROTOCOL AND CAGE MAPS

STUDY PROTOCOL

Inhalation Teratology Study of Tetrahydrofuran

in Mice and Rats

Submitted to:

Dr. Bernard Schwetz
Dr. Richard Morrissey
National Toxicology Program
National Institute Environmental Health Sciences
Research Triangle Park, NC

Submitted by:

Dr. Terryl J. Mast
Battelle - Pacific Northwest Laboratory
Richland, WA 99352

TABLE OF CONTENTS

INHALATION REPRODUCTIVE TOXICOLOGY STUDY PROTOCOL

TETRAHYDROFURAN

I. TITLE: Teratology Study of Tetrahydrofuran in Mice and Rats

II. PURPOSE OF STUDY

Tetrahydrofuran (THF), a four-carbon cyclic ether, is widely used as an industrial solvent, primarily in the dissolution of plastic resins such as polyvinylchloride and vinylidene chloride copolymers, and as a reaction medium. Approximately 150 million pounds of THF are produced each year by three major U.S. chemical companies. The National Occupational Hazard Survey estimates that more than 90,000 workers in 3,000 plants are exposed to THF; consequently, it is classified in the "high" category of potential human exposure (Little, 1984). The combination of its high volatility (bp 65 °C) and extensive use create a significant possibility for industrial exposure to THF via inhalation. Although THF has been used in industrial settings for a considerable number of years, few subchronic, and no chronic, toxicology studies have been conducted, nor has its potential for reproductive toxicity been assessed.

The National Institute of Occupational Health and Safety has established a time-weighted average threshold limit value (TLV) of 200 ppm (590 mg/m^3) with a short-term exposure limit (STEL) of 250 ppm (735 mg/m^3). Although no permanent effects have been observed from short-term exposures to high concentrations of THF (Rosensteel, 1976), subjects have complained of occipital headaches after exposure (International Labor Office). The inhalation lowest toxic concentration (TC_{low}) for humans has been reported as 25,000 ppm, at which point CNS toxicity appears. At lower concentrations THF is irritating to the skin, eyes and mucous membranes.

Acute toxicity studies in laboratory animals, with both inhalation and oral routes of exposure, place THF in the moderately toxic range. Lethal concentrations administered to animals result in narcosis, muscular hypotonia, disappearance of corneal reflexes, then coma followed by death (International Labor Office). Oral doses produce inflammation, necrosis and hemorrhage of the gastrointestinal tract, injury to kidney tubules, and inflammation of the liver (International Labor Office). Kimura et al. (1971) compared the acute, oral toxicity of THF in 14-day old, young adult and older adult rats and found that age had no effect on the LD50 for the rat.

Subchronic inhalation exposure of rats to four concentrations of THF (100, 200, 1000 and 5000 ppm) for 4 hr/day, 5 day/wk, over a period of twelve weeks resulted in irritation of the mucous membranes; severity increased in a dose-related fashion (Katahira, et al. 1982). The 5000 ppm group exhibited marked local irritation and morphological damage to the respiratory epithelium, and had significantly lower white blood cell counts and blood sugar levels than the control group. Single 4-hr inhalation exposures of rabbits to five concentration levels of THF (100 to 12,000 ppm) also resulted in transient dose-related effects on tracheal ciliary activity (Ikeoka, et al., 1983).

The effect of extended (12 - 18 weeks) exposure to THF on body weight is not clear. Kawata and Ito (1984) report a decrease in body weight after 4 weeks of exposure to 3,000 ppm THF for 1 hr/day while Elovaara, et al.(1984) state that body weights of exposed animals (up to 2,000 ppm, 6 hr/day) did not differ significantly from the controls. Another discrepancy between laboratories exists in reference to serum tests for liver function. Kawata and Ito (1984) report that SGOT, SGPT, and alkaline phosphatase values were unchanged after 12 weeks exposure to 3,000 ppm while Katahira, et al. (1982) report an increase in SGOT and SGPT values for rats exposed to 1,000 and 5,000 ppm concentrations of THF for 12 weeks.

Although no references relevant to the specifics of THF metabolism were found, Fujita and Suzuki (1973) state that the metabolism of THF is analogous to that of other cyclic ethers. THF is ring hydroxylated by liver microsomes at the number five carbon and subsequently cleaved to a straight-chain fatty acid by liver cytosol.

Elovaara et al. (1984) studied the biochemical effects and the body burden in rats exposed to THF vapors (200, 1000 and 2000 ppm) for 6 hr/day, 5 day/wk, for 2-18 weeks. Brain and body fat concentrations of THF were measured immediately upon cessation of exposure; the concentrations were correlated to dose, but declined progressively during exposure weeks 2 through 18. These declines in concentration indicate that oxidative metabolic processes may have been induced. Further support for this conjecture was provided when in vitro experiments performed by these workers demonstrated an increase in liver and kidney 7-ethoxy-coumarin-O-deethylase activity in the 1000 and 2000 ppm groups relative to that found in the controls. The increase in activity in the high dose group was not significantly greater than the mid-dose group. They surmise the lack of correlation between increasing dose and O-deethylase activity to be a result of toxicity at the high dose level. Furthermore, the metabolic processes induced by THF appear to be quite specific as no increase in cytochrome-P450 content, N-demethylase activity, or liver to body weight ratios was noted. Additionally, alcohol and aldehyde dehydrogenase appeared to be inhibited. Another in vitro biochemical study found THF to inhibit ethanol-induced liver microsomal cytochrome-P450 (Ullrich, et al. 1975).

Kawata and Ito (1984) measured the rate of decline of THF concentrations in body organs of rats at specific intervals for up to 12 hr post-exposure. Although this was not an in depth study, the results indicated that the post-exposure concentrations of THF in the organs of rats exposed daily for seven days were not greater than for rats exposed for only one day. Furthermore, the rate of decline of THF concentrations in the organs during the 12-hr period following cessation of exposure increased after extended periods of daily exposure. These results also imply an induction in oxidative metabolic processes following repeated exposure to THF vapors.

THF has been tested for induction of sex-linked recessive lethal mutations (SLRLs) in Drosphila melanogaster with negative results (Valencia, et al. 1985). When THF was tested as a carrier solvent for the Salmonella/microsomal assay it was found to be non-mutagenic; however, it was cytotoxic when administered at greater than 50 ul/plate (Maron, et al. 1981). Arimoto et al. (1982) later reported that the use of THF as a carrier solvent increased the mutagenicity of two mutagenic tryptophan-pyrolysates. These workers also reported cytotoxicity when more than 50 ul THF/plate was used.

THF, in conjunction with several other solvents, was suspect in an allegedly high prevalence of urinary tract infections among all employees as well as reproductive and menstrual problems among the ten female employees in a fiber-glass fabricating plant in Baton Rouge, LA. However, results of a field investigation conducted by NIOSH in 1979 stated that the incidence of urinary tract infections was not high, that none of the female employees had experienced reproductive problems, and that exposures to THF (and other solvents) were well below recommended levels. Concerns over adverse health effects in Japanese workers exposed to THF were discussed in a review of THF toxicity (Horiguchi, et al. 1983). Workers in a high-polymer chemistry laboratory and in a university textile research laboratory reported fatigue, bloating of the stomach, headache, kidney pain, and tiredness in the lower limbs. Blood cells and elevated protein levels were observed in the urine of workers from both sites and the textile researchers also exhibited a decrease in white blood cell count and an increase in liver function enzymes. Atmospheric levels of THF to which these workers were exposed were not reported.

In summary, results of toxicity studies in laboratory animals indicate that THF vapors at sublethal doses: 1) are irritants, 2) appear to be the cause of decreased tracheal ciliary activity, 3) cause damage to respiratory epithelial cells, and 4) may cause liver and kidney damage. Although the number of studies addressing the issue are limited these toxic effects appear to be transitory. THF concentrations in the major body organs decline within a short period of time after cessation of exposure; however, no detailed pharmacokinetic information is available. There is evidence, both in vivo and in vitro, to suggest that tetrahydrofuran may induce certain enzymes in the microsomal mixed-function oxidase complex and inhibit specific dehydrogenases. Biochemical changes of this type may consequently affect the organisms' capacity to metabolize other compounds, either endogenous or exogenous in origin. Reports of human health effects have surfaced, but are not clearly defined. No epidemiological studies surveying possible reproductive or carcinogenic effects of THF were found.

As a result of the high-volume production of THF and its wide variety of industrial uses there is potential for a large number of individuals to be exposed to THF; consequently, it has been nominated for potential carcinogen testing (Helmes, et al. 1983). A detailed search of the literature and computerized databases did not reveal any studies addressing the potential for reproductive toxicity of tetrahydrofuran or for any closely related compounds. Accordingly, the paucity of available toxicity data and its classification in the 'high' human exposure category point out the necessity of testing of this nature.

III. SPONSOR AND SPONSOR'S REPRESENTATIVE

A. Sponsor:
National Institute of Environmental Health Sciences
National Toxicology Program (NTP)
P.O. Box 12233;
Research Triangle Park, N.C. 27709

B. Sponsor's Representatives:
Dr. Bernard Schwetz
Dr. Richard Morrissey

IV. TESTING LABORATORY

A. Facility
Battelle - Pacific Northwest Laboratory (PNL)
P.O.Box 999; Richland, Washington 99352

B. Study Director:
Dr. Terryl J. Mast

V. PROPOSED SCHEDULE OF EVENTS

(This proposed schedule may be altered. All changes will be appended to the protocol.)

	Mice	Rats
A. Prestart audit for GLP compliance:	6/15/87	6/15/87
B. Animals arrive week of:	6/15/87	7/14/87
C. Identification of females:	~~6/30/87~~ [6/25/87][&A]	~~7/24/87~~ [8/4/87][&A]
D. Health screen :	7/07/87	8/03/87
E. Initiate breeding procedures:	7/08/87	~~8/03/87~~ [8/10/87][&A]
F. Initiate exposure :	7/15/87	~~8/10/87~~ [8/17/87][&A]
G. Initiate necropsy:	7/27/87	~~8/24/87~~ [8/31/87][&A]
H. Evaluate fetal specimens:	8/3/87 - 9/21/87	

[&A] Changed by Amendment A 4/4/88. F.6

Combined

I. Submit draft report: ~~10/12/87~~ [4/30/88][&A]

J. Submit final report: ~~11/23/87~~ [5/30/88][&A]

VI. TEST SYSTEM

A. Species: mouse and rats

[&A] Changed by Amendment A 4/4/88. F.7

B. Strain: Mice: CrI:CD-1(ICR)BR; rats: Sprague-Dawley [CrI:CD(SD)BR]

C. Number of Animals and Supplier: Charles River Breeding Laboratories, Raleigh, NC.
Mice: 85 males
310 females
Rats: 55 males
245 females

D. Age of Animals Upon Arrival:
Mice: 7-8 weeks
Rats: 8-9 weeks

E. Experimental Animals (Females): 40 virgin female mice or rats will be randomly selected and assigned to four dose groups (10/group) from the total female pool (ØB-DT-3BØB). The remaining females will be mated by placing at least two females with one male overnight in a breeding cage (ØB-DT-3BØD). Nine AM of the day that copulation is established will be designated as 0 dg (ØB-DT-3BØD).

F. Number of Animals in Study: A minimum of 33 plug-positive female mice or 30 sperm-positive rats (to obtain 20 pregnant females) will comprise each of the four treatment groups; the minimum number of mated females to be exposed will be 132 mice or 120 rats. There will also be 10 virgins (females) of each species per exposure level.

There will also be 15 pairs on one level of the control (0 ppm) chamber to be used for a small pilot study. These animals are from the same shipment as study animals and will individually identified with eartags.

VII. EXPERIMENTAL DESIGN AND DOSE LEVELS

A. Experimental Design: Four groups of mated female mice will be exposed to the test chemical on 12 consecutive days (6 dg - 17 dg). The animals will be necropsied on 18 dg for maternal and fetal evaluations.

Four groups of mated female rats will be exposed to the test chemical on 14 consecutive days (6-19 dg). The rats will be necropsied on 20 dg for maternal and fetal evaluations.

In addition, 10 virgin females of each species will be added to each exposure group for the purpose of obtaining ovaries to be used for quantitative ovarian follicle counts. These animals will be exposed concurrently with the mated females and sacrificed immediately after the last exposure period.

B. Exposure Regimen: Chamber atmospheric concentrations of tetrahydrofuran will be 0 (filtered air), 600, 1800 and 5000 ppm. Plug-positive and virgin mice will be exposed for 6 hrs/day for 12 consecutive days (6 dg - 17 dg [for mated females][+A])[See note on page 18a.][+A] ; sperm-positive and virgin rats for 14 consecutive days (6 dg - 19 dg [for mated females][+A]), 6 hr/day. The exposure chamber doors will be closed throughout the exposure and non-exposure periods, except during animal care procedures. Exposure chamber temperatures will be maintained at 75 ±

[+A] Added by Amendment A 4/4/88.

3°F and relative humidities at 55 ± 15%. Air flow will be maintained at 15±3 cfm and the chamber pressure at approximately 1" water negative with respect to room pressure.

C. Selection of Atmospheric Concentrations: Exposure chamber concentrations are based on results from a subchronic toxicology study of tetrahydrofuran in mice and rats sponsored by NTP and conducted at Battelle - Pacific Northwest Laboratory and were approved by sponsor. The highest exposure concentration, 5000 ppm, was also used in the subchronic study and produced significant narcosis in the test animals.

VIII. TEST SYSTEM HOUSING, HANDLING AND ENVIRONMENTAL CONDITIONS

A. Quarantine and Acclimatization (ØB-AR-3FØ3)

1. Animal shipping crates will be examined upon arrival for evidence of conditions likely to permit exposure to pathogens (soiled, wet or otherwise damaged).

2. The uncrating will be conducted at the door of the quarantine room. While being removed from the crates the animals will be examined for evidence of shipping stress.

3. The animals will be quarantined and acclimatized in the LSL-II Building for 3-4 weeks prior to the start of the study.

4. During part of the quarantine/acclimatization period the animals will be housed by sex, approximately 10 mice or 5 rats per cage in wire cages on flush racks. The cage space will meet the requirements stated in the NIH "Guide for Care and Use of Laboratory Animals".

5. During the breeding period the animals will be housed in the quarantine room.

6. Plug-positive mice or sperm-positive rats will be acclimated from 0 dg in individual compartments of wire-mesh cages within exposure chambers (with chamber doors open). Virgin females will be acclimated for approximately 1 week prior to exposure under the same conditions.

7. Room temperature during the acclimatization and exposure periods will be maintained at 72±3° F and relative humidity at 50±15%. These measurements will be recorded at least twice daily.

8. Twelve hours light and twelve hours dark will be maintained with light starting at 0600.

9. Five male and five female animals will be randomly selected for pre-exposure health screening (ØB-AR-3FØ2). They will be examined by gross necropsy, histopathology and nasopharyngeal culture for evidence of disease and the presence of potentially pathogenic organisms.

10. The clinical veterinarian will make a visual inspection of the animals to be used in the study just prior to their release for the study (documented on the last quarantine/ acclimatization record).

11. As an added screen for viral infection, 5 animals from the control group and 5 animals from the highest dose group will be tested promptly after sacrifice at BNW for viral pathogens (ØB-AR-3B1R).

12. Females not selected for the study or health screen will be discarded during the first exposure week. The disposition of these females will be recorded on the Animal Disposition Record and retained in the study files (ØB-AR-3FØ3). Males, (they are not individually identified) will also be discarded.

B. Feed (ØB-AR-3FØ5)

1. NTP pre-approved NIH-07 Open Formula Diet (pellets) from Ziegler Bros., Inc., Gardner, PA will be used during the quarantine/acclimatization periods and throughout the duration of the experiment.

2. Feed will be provided ad libitum in slot feeders during the experiment, except during exposure hours.

C. Water

1. Fresh softened water (ion exchange softener, Illinois Water Treatment Company, Model 2R-2240, Rockford, IL) will be supplied ad libitum at all times. The hardness of the water will be checked approximately once every week. Records will be retained in the LSL-II Building Engineer's office.

2. The automatic watering system (Edstrom Industries, Waterford, WI) will be used for the quarantine/acclimatization period and throughout the duration of the study.

3. A representative sample of animal drinking water from one of the NTP study rooms will be analyzed for contaminants at least once each calendar year.

D. Randomization: Virgin females will be randomly chosen by eartag number and then assigned to dose groups based on the first body weights. Their weights will be ranked from lightest to heaviest and each animal randomly assigned to a treatment group by means of a computer-assisted randomization program which is based on a single blocking factor, body weight (ØB-DT-3BØB). On the day of plug or sperm detection (0 dg), the mated animals will be weighed and assigned to dose groups as above.

E. Identification:

1. All female animals will be individually identified by metal ear tags during the first weighing session (ØB-DT-3FØC)

2. Cage maps (ØB-DT-3BØ3) showing placement of individual animals in each cage unit of the exposure chamber will be prepared and updated as needed. Each exposure chamber will be identified by chamber number and exposure level. The proposed arrangement of the exposure chambers is included in Figure 1.

IX. TEST ARTICLE

A. Chemical name: tetrahydrofuran

B. Formula: C_4H_8O

C. Manufacturer: Chemcentral
7050 W. 71st St.
Chicago, IL 60638

D. CAS No.: 109-99-9

E. LOT No.:BNW LOT No.:51437-15
MRI No.:101N Lot No.:WK 8-6-86 Batch No:03

F. The vehicle control will be filtered air.

G. Storage conditions: A ready reserve is maintained in a flammable storage cabinet at room temperature in the LSLII Building. The remaining inventory is stored at or below 65°F in a chemical storage facility adjacent to the Research Technology Laboratory (RTL). The bulk test material is maintained in 55-gallon metal drums with a nitrogen headspace.

H. Analytical Chemistry

1. Upon receipt, identity and gross purity analyses of the bulk chemical were performed by infrared spectroscopy. Bulk purity is periodically determined using gas chromatography with a 20% SP2100/0.1% Carbowax 1500 on 100/200 Supelcoport column. The concentration of the BHT stabilizer is determined using gas chromatography with the same column packing. A peroxide content of 300 ppm has been established as an upper limit for material to be used in animal exposures.

2. Tetrahydrofuran concentrations within the exposure chambers will be monitored using an HP-5840 gas chromatographic system. Details of the calibration method are given in Attachment 2.

I. Analysis Schedule

1. Purity analysis was performed on the bulk chemical upon receipt, and will be performed once during the study.

X. DESCRIPTION OF INHALATION EXPOSURE SYSTEM

The inhalation chambers will be located in room 424 of the LSL-II building. A detailed description of the inhalation exposure system to be used in this study is included in Attachment 2 of this protocol. The location of the exposure room and chamber layout are shown in Figure 1.

A. Environmental Monitoring

1. Air filtration: HEPA and charcoal filters will be used for intake air, and a HEPA filter will be used for exhaust air.

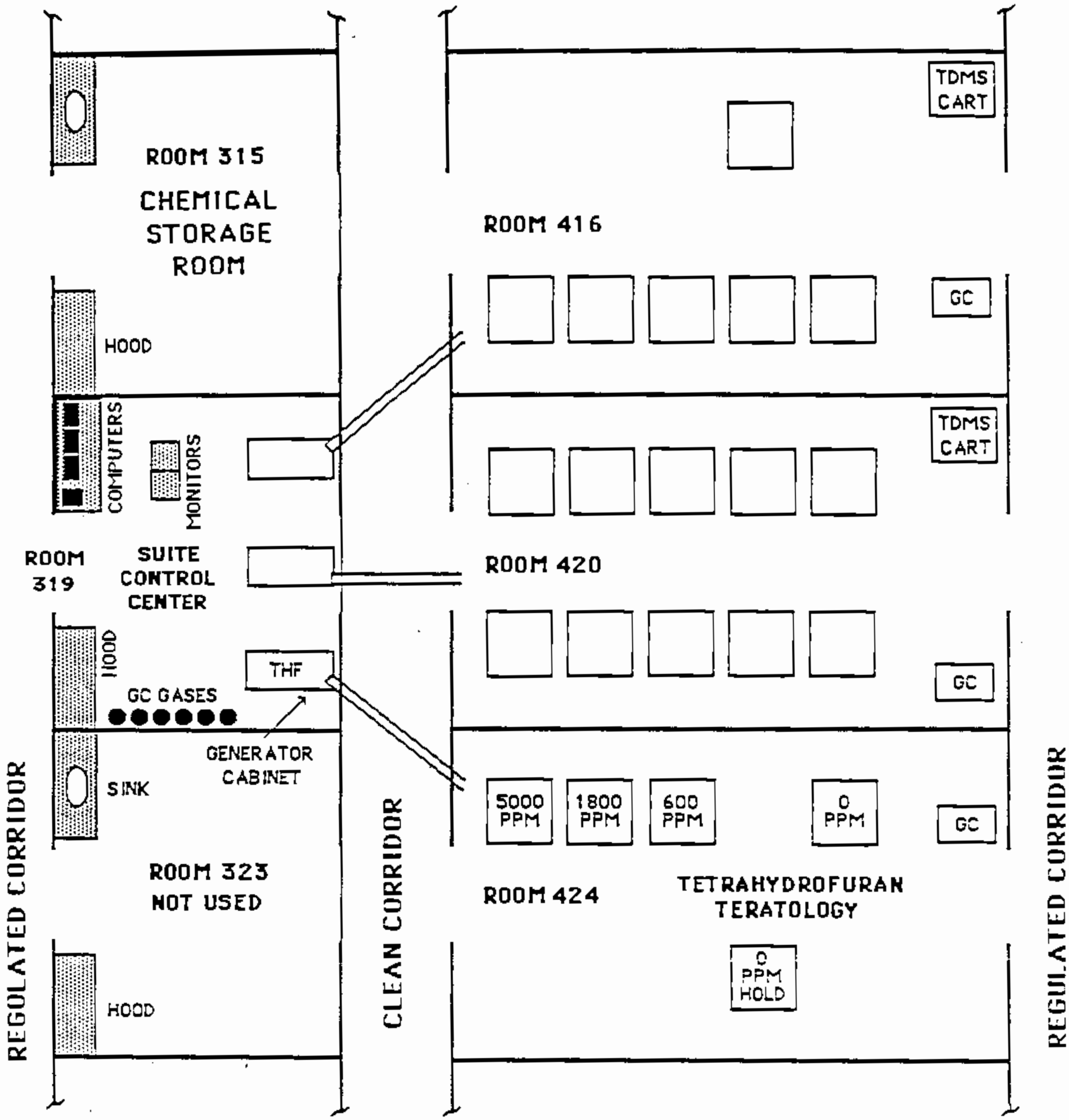

Figure 1. Exposure Room Location and Chamber Layout for Tetrahydrofuran

2. Temperatures will be monitored by RTDs multiplexed to a digital thermometer with computer data acquisition at approximately 4-hour cycles for 24 hours per day. The control range is 75±3° F with critical limits, <70 or >80° F. Any chamber temperature excursion beyond the critical limits will be recorded and alarmed automatically.

3. Relative humidity will be monitored by a single dew point hygrometer in conjunction with a multiplexed sampling system with computer data acquisition at approximately 4-hour cycles, 24 hours per day. The control range is 55±15% with critical limits of <35% or >75%. Any relative humidity excursion beyond the critical limits will be recorded and alarmed automatically.

4. Chamber air flow will be monitored at an exhaust orifice using a multiplexed Validyne pressure transducer system with computer data acquisition at approximately 4-hour cycles, 24 hours per day. The control range is 15±3 air changes/hour (≈15±3 CFM) with critical limits of <10 CFM or >20 CFM. Any chamber flow excursion beyond critical limits will be recorded and alarmed automatically. Tetrahydrofuran concentrations in the chambers will be controlled primarily by the automatic adjustment of chamber air flow.

5. Chamber vacuum will be monitored using a multiplexed Validyne pressure transducer system with computer data acquisition at approximately 4-hour cycles, 24 hours per day. The control range is -0.2 to -2.0 inches of water pressure with critical limits set at the same values. Any chamber vacuum excursion beyond the critical limits will be recorded and alarmed automatically. If chamber vacuum exceeds the limits of -0.2 inch of water, the chamber valve will be automatically turned off.

6. Uniformity of the concentration of the test chemical in each of the chambers (i.e., chamber balance) was determined during the development of exposure generation without animals; at the beginning of the 13-week NTP-sponsored study with the animals in the chamber; and at least once during that study. Chamber balances will be verified within the first week of the mouse teratology and again within the first week of the rat teratology study.

7. The exposure chambers test chemical buildup and decay time was determined prior to start of the 13-week study to determine T90 curves.

8. Prior to the start of the 13-week study, samples were taken from the chamber using a Gardner condensation nuclei counter to assure that the vapor generation did not produce an aerosol of tetrahydrofuran.

9. A study of test material stability in the exposure chambers and in the generator reservoir was conducted during the developmental work for the 13-week study without animals in the chambers and once during the first week of the animal exposures. The chamber samples were taken from the high and low dose chambers during the last hour of exposure. A generator reservoir sample was taken at the end of an exposure day.

C. Effluent Treatment (ØB-AC-3AØF)

Chamber exhaust will be diluted to comply with applicable State and Federal Regulations prior to release from the building exhaust stack.

XI. EXPERIMENTAL OBSERVATIONS

A. Clinical Observations: The animals will be observed daily for mortality, morbidity, and signs of toxicity (ØB-DT-3BØ3). The date and time of death or euthanasia of moribund animals will be recorded and the animals will be necropsied according to (ØB-DT-3BØF).

B. Body Weights: All females will be weighed prior to mating. Plug-positive mice will be weighed on 0, 6, 9, 12, 15, and 18 dg (ØB-DT-3BØC). Sperm-positive rats will be weighed on 0, 6, 10, 14, 17, and 20 dg. Virgin females will be weighed on the 1^{st}, 5^{th}, 10^{th} day of exposure and at sacrifice.

C. Scheduled Necropsy: The mice are scheduled to be euthanized with CO_2 on 18 dg and the rats on 20 dg. At necropsy (ØB-DT-3BØG) maternal animals will be weighed and examined for gross tissue abnormalities. To document the presence of lesions which may be due to chemical exposure, any organs or tissues with lesions will be preserved in neutral buffered formalin (NBF); in this case, comparable organs or tissues from approximately 20% of the control animals will be preserved in NBF; all other tissues will be discarded. The gravid uterus will be removed and weighed, and the number, position and status of implants will be recorded. The placentas will be examined. The identity of live fetuses (by study, dam number and uterine position) will be retained throughout all examinations and archiving. Live fetuses will be examined for gross defects and weighed. A complete visceral examination will be performed on 50% of all fetuses and on any fetuses with gross abnormalities. (ØB-DT-3BØG) Sex will be determined on all fetuses by internal examination. All skeletons will be double-stained and examined for cartilage formation and centers of ossification. (ØB-DT-3BØG). Approximately 50% of the fetal heads will be examined by razor-blade sectioning of fixed preparations (Wilson, 1965; [ØB-DT-3BØI]). Records of morphologic lesions observed in gross and visceral examinations will include photographs (ØB-DT-3BØJ) of representative lesions.

Both ovaries from the virgin females and one ovary from each of the pregnant females will be collected at the time of sacrifice. (ØB-DT-3BØG). Collected ovaries will be fixed for 24 hr in Bouin's fluid then transferred to 70% ethanol and sent to Dr. Donald Mattison at the National Center for Toxicological Research for sectioning and quantitative follicle counts.

D. Indices of Effects: The following parameters, expressed as mean ± SE, when appropriate, will be computed from data for inseminated animals and their litters and will be presented in the Final Report for each treatment group:

- Number of dead maternal animals, animals removed from the study and reason for removal
- Summary of maternal toxicity, including incidence of changes detected during clinical observations
- Number and percent pregnant
- Maternal body weights:

  Mice on 0, 6, 9, 12, 15 and 18 dg
  Rats on 0, 6, 10, 14, 17, and 20 dg

- Weight of gravid uterus
- Extragestational weight and weight gain
- Number of implantation sites/litter
- Number of litters with live fetuses
- Number and percent of live fetuses/litter
- Body weight of live fetuses/litter
- Body weight of male and female fetuses/litter
- Sex ratio of fetuses/litter
- Number and percent of early and late resorptions/litter
- Number and percent of non-live/litter (early and late resorptions and dead fetuses)
- Listing of malformations and variations observed in fetuses/litters
- Number and percent of malformed fetuses
- Number and percent of litters with malformed fetuses

XII. PROPOSED STATISTICAL METHODS

The methods proposed for the statistical analyses of representative maternal, reproductive and fetal indices of effects are: summary statistics, N, mean, standard deviation, with accompanying ANOVA based on multiple comparisons where appropriate. Arc sin transformations will be performed on data presented as percent incidence. Further statistical analyses may be performed at discretion of sponsor.

XIII. RECORDS RETENTION (ØB-9A-3EØ6)

Records that accumulate during the study will be retained at BNW until requested and shipped to NTP archives. Some of these records may be presented as part of the protocol or reports. These will include but not be limited to the following records:

A. Personnel Records

1. List of BNW personnel participating in the study.

2. Name, address, and function of any outside consultant(s)

3. Record of removal of any individual from direct contact of the test system due to illness.

B. Health and Safety Records (original records and five copies of microfiche will be submitted to NTP within approximately two months after the end of each fiscal year). Chemical specific records will be submitted with the study. Facility specific records will be submitted annually.

1. Medical records of all personnel participating in the study. These records will be retained by Hanford Environmental Health Foundation (HEHF), P.O. Box 100, Richland, WA 99352 for a minimum of 40 years. A letter verifying this arrangement will be retained for each test material file.

2. Records and results of any biological monitoring on laboratory personnel (if applicable).

3. NTP Health and Safety package for tetrahydrofuran.

4. BNW biohazard protocols and BNW Health and Safety Plan.

5. Chemical specific health and safety training records.

6. Waste disposal records.

7. Respiratory protection program with documentation of user training (specific fit testing if needed) for each type of respirator.

8. Building ventilation system, hoods and exhausting system monitoring records (pertinent to NTP studies).

9. Hanford Environmental Health Foundation (HEHF) formaldehyde sampling results.

10. Health and Safety Section of the Monthly Progress Reports.

11. Accident/injury reports for personnel involved in this study.

12. NTP site visit reports, attention items and related correspondence on health and safety.

C. Protocols

1. Approved and dated BNW study protocol.

2. Protocol amendments including NTP technical contract modifications which affect the study.

3. Documentation of any deviation from the protocol.

4. Documenting any unforeseen circumstances that may affect the integrity of the study and corrective actions taken.

D. Test Material Records

1. Test material identity records including manufacturer, quantity, lot number(s), purity grade and date(s), etc.

2. NTP analytical contractor characterization reports.

3. NTP analytical contractor bulk stability reports.

4. NTP analytical contractor shipment records (if available).

5. BNW test chemical receipt records.

6. BNW storage records including storage conditions.

7. BNW bulk analysis and degradation records.

8. BNW method development records.

9. Chemical exposure generation system description and procedures.

10. Chamber concentration monitoring records, including GC tracings.

11. Uniformity (chamber balance) records.

12. Gas chromatograph calibration records.

13. Generation and chamber degradation study records.

14. BNW test material inventory and usage records.

15. Records of shipment to NTP repository of any unused test material.

E. Animal Records - Pretest

1. Animal receiving records including supplier, species, strain, birth week, sex, number of animals for each sex, receiving date and receiving conditions (photocopy of a representative animal shipping crate label).

2. Quarantine and acclimatization records.

3. Pretest health screening records and animal health notebook.

4. Randomization records.

5. Animal identification records.

6. Written release records from clinical veterinarian.

7. Disposal of excess animals.

8. Bedding type.

F. Animal Records - On Test

1. Exposure room location and chamber layout records.

2. Chamber cage map.

3. Cage type, rack type and the rotation scheme during study.

4. Cageboard type.

5. Type of watering system.

6. Body weight records.

7. Daily observation records

8. Clinical signs of toxicity records.

9. Serology data and reports.

10. Pathological specimen inventory records.

G. Feed

1. Feed tags with manufacturer, lot numbers and milling dates.

2. Feed analysis records as provided by NTP analytical contract laboratory.

H. Water

1. Annual water analysis.

2. Weekly water hardness check (records will be maintained in building engineer and/or building manager's office).

I. Quarantine Room, Exposure Room, and Inhalation Exposure Chamber Records

1. Exposure chamber description.

2. Exposure suite control center description.

3. Temperature raw data and daily and monthly summation reports.

4. Relative humidity raw data and daily and monthly summation reports.

5. Air flow raw data and daily and monthly summation reports.

6. Chamber vacuum raw data and daily and monthly summation reports.

7. Exposure system monitors calibration and maintenance records.

8. Description of the lighting system and light/dark regimen.

9. Sanitation procedures and pest control program.

J. All Relevant Correspondence

K. Reports

1. Monthly Progress Report.

2. Special study reports if any:

3. Incident reports (if applicable).

4. Final Teratology Report.

M. Internal Computer Generated Forms and Tables

1. Teratology results and statistical analyses.

2. Analytical chemistry results.

3. Exposure suite control center computer printouts.

4. XYBION printouts (if any).

XIV. OTHER SPECIFICATIONS

A. This study will be performed in compliance with the FDA Good Laboratory Practice Regulations for Non-Clinical Laboratory Studies (21 CFR 58) except where deviations are required by the NTP January, 1984 General Statement of Work and subsequent modifications.

B. This Protocol will be the controlling document in case of discrepancies between the Protocol and SOPs. If this occurs the Study Director is to be notified immediately for clarification.

C. A list of all relevant Standard Operating Procedures (SOPs) for this study are present in Attachment 1.

XVI. HEALTH AND SAFETY (ØB-HS-3S1Z)

BNW's Health and Safety Plan (ØB-HS-3S1C) has been approved by NTP. In addition, a respiratory program is instituted. This is supplemented by using supplied-air respirators (ØB-HS-3S19) which will be worn by personnel during periods of animal care while the chambers are open and by having available self-contained breathing apparatus for use when entering a room under emergency conditions following a leak.

XVII. APPROVAL BY PNL

Terry J Mast
Study Director

Date: July 1, 1987

R A Gelman
Quality Assurance Auditor

Date: 7/1/87

XVIII. APPROVAL BY NTP

B A Schwetz
Co-Study Officer

Date: 6 July 87

Richard E. Morrissey
Co-Study Officer

Date: 2 July 87

XVII. CHANGES AND/OR REVISIONS TO THE PROTOCOL

4/4/88 **AMENDMENT A**

Page 4, Section V. A-J. Amendment corrects Schedule of Events to reflect actual dates.

Page 5, Section VII. B. Amendment clarifies exposure regimen for virgin rats and mice.

Page 5, Section VII. B. Exposures of the 5000-ppm group for mice, plug-positive and virgins, were terminated prematurely due to an unexpected mortality. Plug-postive mice were placed in fresh air chambers on the morning of 12 dg, and virgins were placed in fresh air chamber on the morning of the 5th day of exposure. Approval of Project Officer, Dr. Bern Schwetz, was obtained by telephone on July 21, 1987.

Terry J. Mast 4/4/88

Study Director

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ATTACHMENT 1

STANDARD OPERATING PROCEDURES FOR INHALATION REPRODUCTIVE TOXICOLOGY STUDIES

REPRODUCTIVE AND DEVELOPMENTAL TOXICOLOGY

ØB-DT-3BØ3	Cage Location Maps and Daily Observations
ØB-DT-3BØB	Randomization of Animals
ØB-DT-3BØC	Animal Body Weights
ØB-DT-3BØD	Rodent Mating Procedures
ØB-DT-3BØF	Necropsies for Health Evaluation and of Dead and Moribund Animals
ØB-DT-3BØG	Developmental Evaluations for Teratology Studies
ØB-DT-3BØI	Examination of Fetal Heads Fixed in Bouin's Solution
ØB-DT-3BØJ	Photography
ØB-DT-3BØL	Data Handling and Storage
ØB-DT-3BØM	Sample Storage/Shipment
ØB-DT-3BØY	Examination of Fetal Skeletons Stained with Alcian Blue and Alizarin Red.
ØB-DT-3B1J	Preparation of the Reproductive System for Histologic Evaluation
ØS-SI-3EØ1	Macintosh Data Collection System using Arbor Balance for Teratology and Dominant Lethal Sacrifice.
ØS-SI-3EØ3	Data Transfer from Macintosh to VAX using MacTerminal

ANIMAL FACILITIES

ØB-AR-3BØG	Barrier Procedures for LSL-II Animal Facility
ØB-AR-3GØ1	Pre-Cleaning Equipment and Operation of Cage - Bottle and Rack Washers
ØB-AR-3GØB	Animal Weighing Using Xybion PATH/TOX System
ØB-AR-3BØ3	Handling and Changing Out Exposure Chambers and Cage Units
ØB-AR-3BØ8	Handling Escaped Small Animals
ØB-AR-3FØ2	Pre-Exposure Health Screening of Rodents
ØB-AR-3FØ3	Quarantine of Animals

ØB-AR-3FØC	Rodent Identification with Ear Tags
ØB-AR-3FØ5	Management of Animal Feed
ØB-AR-3FØB	Selection and Notification Procedures, Moribund Sacrifice Animals and Animals Found Dead
ØB-AR-3B1R	Pathogen Monitoring
ØB-AR-3FØA	Daily Care of Bioassay Animals and Cleaning of Exposure Rooms

INHALATION EXPOSURE AND BIOENGINEERING

ØB-QA-3EØA	Filling Out Data Sheets
ØB-BE-3B24	Inhalation Exposure Chamber Balance
ØB-BE-3CØL	RTD Thermometer Calibration
ØB-BE-3DØE	Exposure Suite QC, Maintenance, and Calibration
ØB-BE-3EØ9	Study Protocol Entry Into Exposure Suite Computers
ØB-BE-3GØ4	Exposure Suite Routine Computer Operation
ØB-BE-3EØB	Exposure Suite Data Analysis Program Operation
ØB-BE-3CØJ	EG&G Hygrometer: Operation, Maintenance, and Calibration
ØB-BE-3CØV	Calibration and Check of Chamber Airflow Using Digital Anemometer
ØB-BE-3B1X	Relative Humidity Determination via Use of Dewpoint Hygrometer
ØB-BE-3GØ3	Operating Procedures for the Gardner Type CN Small-Particle Detector
ØB-BE-3C13	General FGD Calibration-Exposure Chamber and Generator Cabinets
ØB-BE-3DØ6	Model 1 Chamber Leak Tester
ØB-BE-3B3A	Tetrahydrofuran Exposure System Daily Operating Procedure
ØB-BE-3DØN	Tetrahydrofuran Exposure System QC,Maintenance, and Calibration

ANALYTICAL CHEMISTRY

ØB-AC-3A1A	Bulk Analysis of Tetrahydrofuran
ØB-AC-3AØF	Analysis of Building Exhaust by Gas Chromatography
ØB-AC-3B1V	Operation of HP5840 GC for Monitoring Tetrahydrofuran

ØB-AC-3DØ2	Routine Maintenance of the HP 5840 GC
ØB-AC-3CØX	Calibration of the Tetrahydrofuran Chamber Monitor

SAFETY

ØB-HS-3S19	The 3M Brand W-2860 Hardcap, Continuous-Flow Air Line Respirator
ØB-HS-3S1C	Bioassay Studies: Health and Safety Plan
ØB-HS-3S1B	Bioassay Studies: Respiratory Protection Program
ØB-HS-3S1Z	Biohazard Protocol - Tetrahydrofuran

NTP PROJECT OFFICE

ØB-9A-3EØ6	Data Handling and Storage of NTP Study Documents and Materials

INTRODUCTION

The exposure levels for the teratology study are 5000, 1800, 600, and Ø ppm. The details of the generator design and operation are discussed below. Much of the information in this section is based on the pre-start chemistry package for the recently completed 13-week study on tetrahydrofuran for the National Toxicology Program performed at Battelle - Pacific Northwest Laboratory.

Animal Exposure Chamber

The animals will be exposed and maintained in inhalation exposure chambers developed at BNW by O.R. Moss and M.G. Brown (U.S. Patent No. 4,261,741, August 12, 1980) and now commercially produced by Hartford Systems/Lab Products, Inc., Aberdeen, MD. The chamber (Figure 1A) facilitates multiple-tier exposures of various laboratory rodent species to aerosol- and vapor-laden atmospheres. The design permits the use of excreta-collecting pans under each tier of animal cages during exposures, yet keeps variability of exposure concentrations at the different tier levels as low as, or lower than, that usually experienced in conventional single-tier exposure chambers. The total volume of the chamber is 2.3 m^3 with an active mixing volume of 1.7 m^3, the remainder being the non-mixing inlet and exhaust volumes. There are three levels of caging, each level split into two tiers which are offset from each other and from the chamber walls (Figure 1B). Drawer-like stainless steel catch pans for the collection of urine and feces are suspended below each cage unit and are left in position during each exposure period. Cageboard is added to these catch pans during non-exposure periods to reduce ammonia levels.

The chamber was designed so that uniform aerosol or vapor concentrations can be maintained throughout the chamber when the catch pans are left in position. Incoming air containing a uniform mixture of test material is diverted so that it flows vertically along the inner surfaces of the chamber. Waves are formed (Figure 1B) at each tier as the aerosol or vapor flows past the catch pans. Stagnant zones that would normally exist above each pair of catch pans are cleared by exhaust flow through the space between the tiers. Aerosol or vapor reaching the lowest level is deflected across the bottom tiers by metal strips in the space between the catch pan and the wall. Tests have shown that aerosol or vapor concentration homogeneous to within 8% throughout the chamber can be obtained repeatedly provided the aerosol or vapor is uniformly mixed before passing through the chamber inlet (Griffis, LC, et al, 1981, Fund. Appl. Toxicol. 1: 8-12).

The dimensions of the individual cages are as follows:

Animal Species	Cages/ Unit	Floor Dimensions (cm)	Floor Area (cm^2)	Height (cm)
Mouse	60	14 x 7.6	106	15.2
Rat	24	27.9 x 9.7	270	20.3

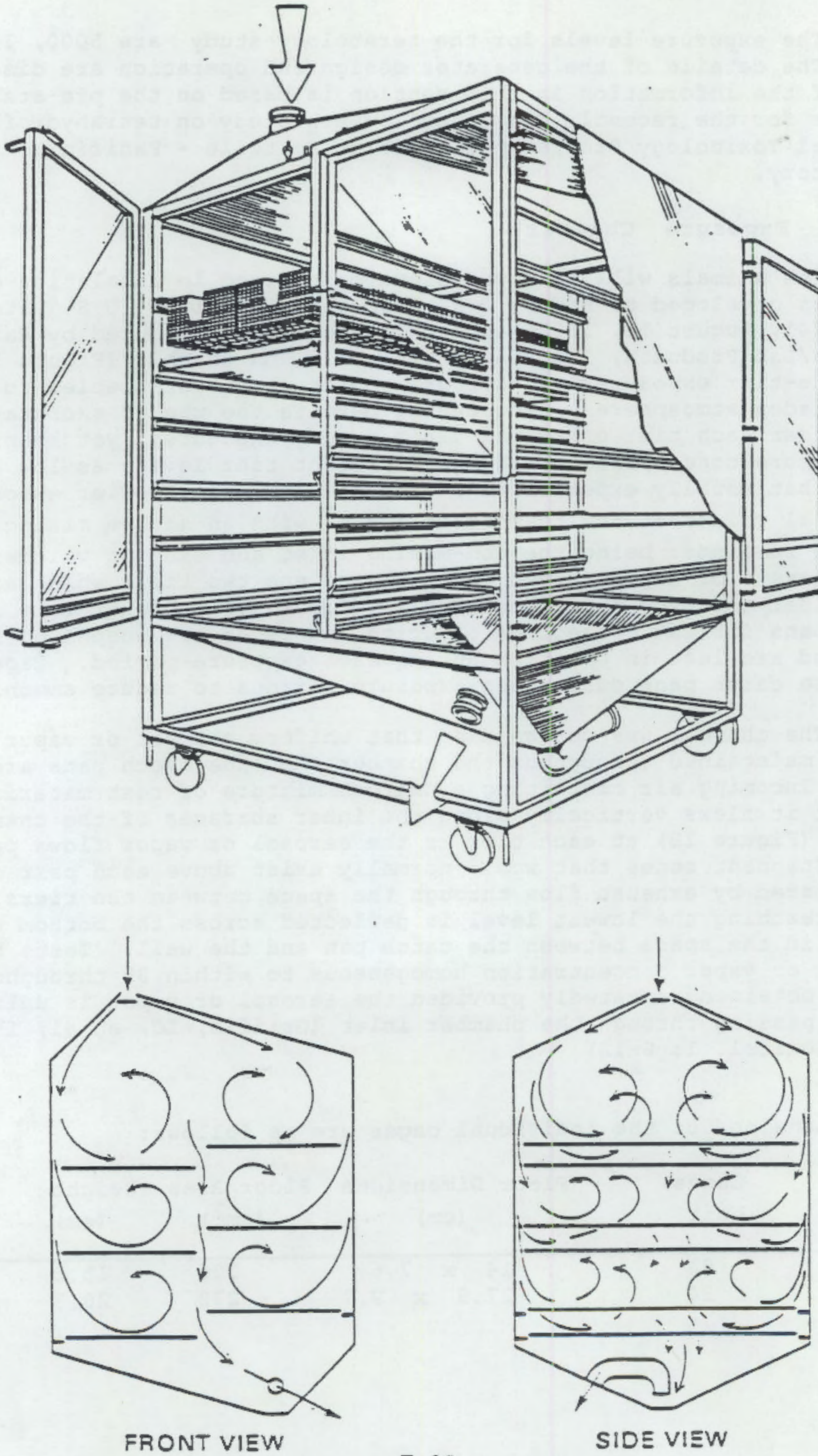

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Figure 1. Inhalation exposure chamber designed at BNW. A. Oblique cutaway view of the chamber. B. Airflow patterns.

Tetrahydrofuran Generation System

A schematic diagram of the tetrahydrofuran generation system is shown in Figure 2. The generator is housed in a vented cabinet located in the Suite Control Center. The cabinet is vented to the building exhaust. The generator employs a rotary evaporation system to produce a nearly pure tetrahydrofuran vapor. The chemical is pumped from the bulk reservoir - a modified stainless steel flammable liquid container - at a steady rate by a liquid micrometering pump designed to operate in potentially explosive atmospheres. Chemical is pumped into a rotating (100 rpm) flask which is partially immersed in a hot water bath maintained at 178 ± 2°F. The resulting vapor is forced out of the mouth of the flask into a chilled water condenser where much of the vapor is condensed, returning to the evaporator flask. Uncondensed vapor is carried from the top of the condenser column by nitrogen which is metered into the bottom of the condenser. As nitrogen moves through the condenser, it becomes saturated with tetrahydrofuran vapor. The temperature of this exiting vapor is monitored by an RTD sensor located at the top of the condenser column. The saturation vapor pressure at the column exit temperature is predicted so that the output (ppm of tetrahydrofuran and flow rate of saturated nitrogen) of the generator is known. For example, at an exit temperature of 59°F, the tetrahydrofuran concentration is ~150,000 ppm at a typical nitrogen flow of 25 l/min.

From the condensing column, the vapor enters a short distribution manifold from which individual delivery lines carry a metered amount of vapor to each exposure chamber. Flow to each chamber is accomplished by impulse principle vacuum pumps located at the chamber end of each delivery line. Within the chemical cabinet, each delivery line is connected to the distribution manifold through a fine metering valve and flowmeter. Individual chamber concentration is adjusted by the metering valves and/or by adjustment of the compressed air pressure to the vacuum pumps. Dilution of the nitrogen/ tetrahydrofuran vapor mix with air to the target chamber concentrations occurs immediately before entry to the chambers.

Normal operation calls for up to 20% excess vapor to be exhausted from the manifold through a flowmeter located at the end of the manifold. This "excess" flow allows for the adjustment of vapor flow rates to each chamber without affecting the flow rate to the other chambers. The excess flow also maintains a slight positive pressure in the manifold preventing air from entering the system and creating a potentially explosive mixture. However, since the vacuum transducer pumps draw vapor from the manifold, the possibility exists of creating a negative pressure in the manifold and generator which could draw air into the nitrogen/THF atmosphere. This would occur if nitrogen delivery was interrupted or if the vacuum pump delivery rates were grossly misadjusted. A safety system has been incorporated to prevent the occurrence of a negative pressure in the manifold. A pressure transducer (Dwyer Photohelic) monitors the pressure drop across the excess-vapor flowmeter. A drop in pressure to below 2 cm of water results in an automatic shutdown of the generation system. Chemical delivery and rotation of the evaporating flask are stopped.

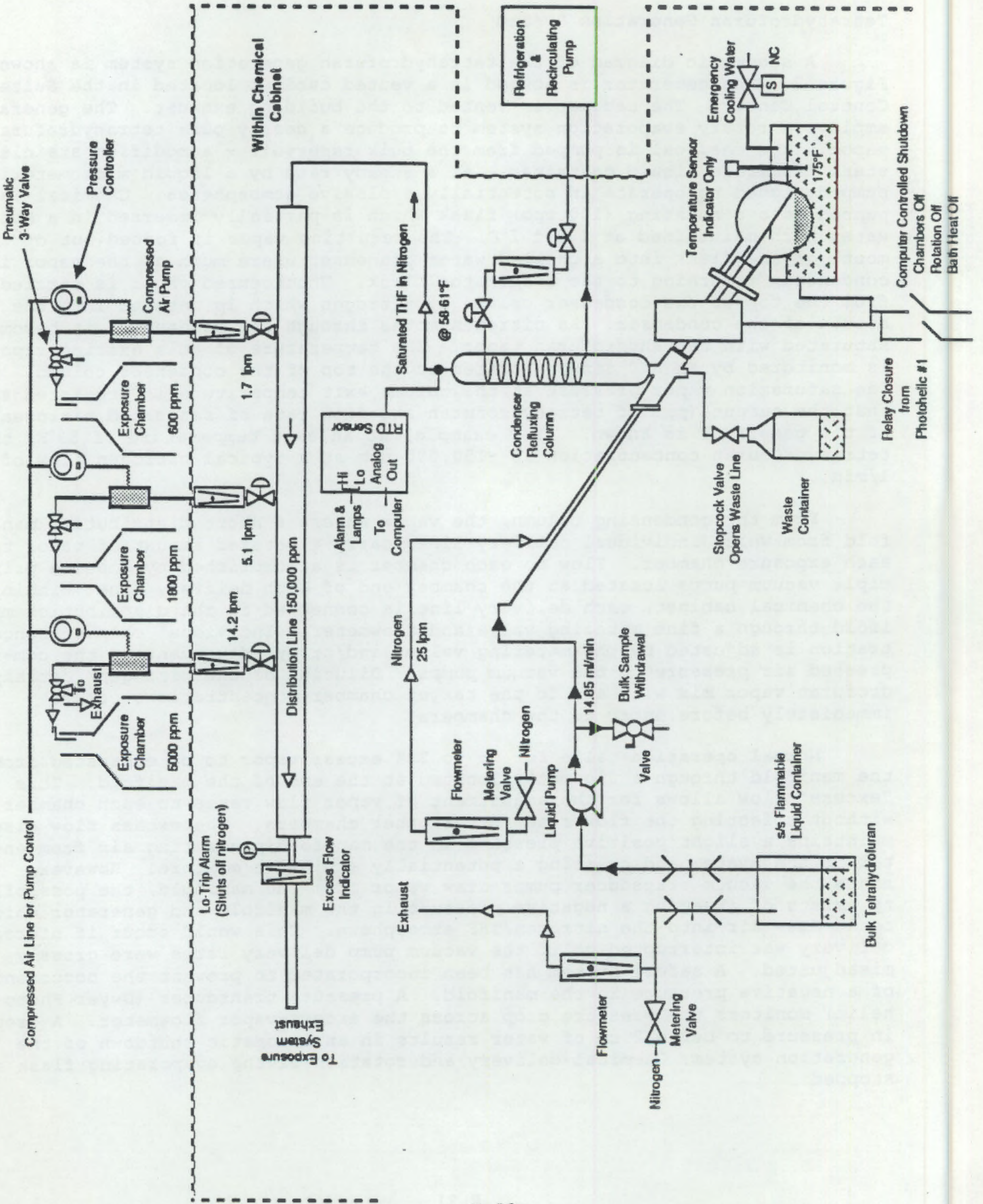

Figure 2 TETRAHYDROFURAN VAPOR GENERATION SYSTEM

Generation proceeds in stages: warmup, generation and shutdown. During warmup, filling of the evaporating flask and heating of the water bath proceed together. During this time, some evaporation occurs but all vapor is exhausted from the distribution manifold through the excess flow exhaust. When the bath temperature and fluid level reach the correct values, computer-controlled startup of the delivery pumps is initiated. Until concentration is equilibrated in the delivery lines, nitrogen/THF is vented to exhaust at each chamber through pneumatic 3-way valves. The addition of this feature allows for the more rapid diversion of chemical flow from chambers in the event rapid shutdown is necessitated. After stabilization of the vapor temperature and possible fine adjustments of the vapor delivery and nitrogen flow rates, the generator is in its normal operating stage. During this stage, the generator operates under computer and exposure operator supervision. The exposure operator monitors the fluid level in the flask as well as other operating parameters. The operator can adjust the overall generator output by changing the flow rate of cooling water to the condenser. This affects the temperature of the vapor leaving the condenser and hence, the concentration of chemical in the vapor. Overall generator output can also be controlled by adjusting the flow rate of dilution nitrogen. The computer can initiate a shutdown of the generator output under certain conditions by stopping flask rotation and turning off the bath heater. Further reduction in the generator output can then be initiated by the operator by reducing the nitrogen flow and tripping a solenoid-controlled valve which introduces chilled water into the water bath.

Shutdown at the end of the generation stage is similar to a computer-initiated shutdown. Following closure of the valves at the chambers and discontinuation of flask rotation, the operator trips the solenoid dumping additional cooling water into the bath. The remaining THF in the evaporating flask is removed to a waste bottle. Nitrogen continuously purges the generation system until preparation for the next day's generation. Any liquid THF waste is slowly evaporated from the bottle by sparging overnight in a chemical vapor hood.

TEST MATERIAL INVENTORY

Two shipments of test material have been received. The first was a shipment of ten one-gallon bottles that arrived on 10/7/86 (BNW lot No 51437-8). One bottle has been consumed in the process of test generation. No chemical from this shipment will be used for the animal exposure study. The second shipment, received at LSL-2 on 11/12/86, consisted of four 55 gallon metal drums (BNW lot No 51437-15). Each exposure day consumes about 4.7 kg. Since a full drum contains about 184 kg, each drum should last 39 exposure days. Following completion of test generation, approximately 368 kg will be available for the teratology study; there will not be a shortage of test material. A ready reserve of test material is maintained at room temperature in the LSL-II basement. The remaining test material is stored at room temperature in a facility adjacent to the Research Technology Laboratory (RTL).

TEST MATERIAL PURITY

Analysis of the test material is accomplished following the procedures set forth in the May 16, 1986 MRI special report "Reprocurement Report Analysis of Tetrahydrofuran". Identity of the test material is confirmed on receipt by IR analysis. Bulk purity is periodically determined using gas chromatography with a 20% SP2100/0.1% Carbowax 1500 on 100/200 Supelcoport column. The concentration of the BHT stabilizer is determined using gas chromatography with the same column packing. BNW Lot No 51437-15 is to be used for the exposure and has demonstrated the proper IR spectrum and gave a bulk purity of 99.3%. The BHT content of the BNW Lot No 51437-15 was found to be 100 ppm (0.01%). The initial peroxide content of BNW Lot No 51437-15 drum #1 was 14 ppm. A peroxide content of 300 ppm was established in the original proposal as an upper limit for use of the test material for exposures. The contents of each drum will be sampled and analyzed for peroxide content monthly upon opening and monthly thereafter.

ON-LINE MONITORING

An HP 5840 gas chromatographic system is used to support the animal exposure. This instrument is equipped with a 8 position stream select valve and measures tetrahydrofuran concentration in the three exposure chambers, control chamber, exposure room, a nitrogen blank (preceding the room and control chamber positions), and an on-line standard. The nitrogen blank should allow more rigorous definition of the minimum detectable and quantifiable limit.

On-Line Gas Chromatographic (Hewlett-Packard) Chamber Monitor (ØB-AC-3B1V, ØB-AC-3CØX) (ØB-BE-3B3A Bioengineering Daily Operating Procedure)

Detector: Flame Ionization
Column: 1 m x 1/8" OD nickel
Packing: 1% SP-1000 on 60/80 Carbopack B
Column Temperature: 145°C
Carrier: Nitrogen
Carrier Flow: 20-30 ml/min
Sample Valve: Hastalloy C mounted in GC oven (Valco)
Sample Loop: One ml nickel
Stream Select Valve: 12-port, Hastalloy C mounted in GC oven (Valco)
Chromatographic Run Time: Approximately 1.3 min. exclusive of report generation
On-Line Standard: 400 ppm THF in N_2 (MG Industries)
Calibration Frequency: Daily check against on-line standard. The on-line monitor will be calibrated biweekly by collecting grab samples from the chambers and analyzing them against gravimetrically prepared tetrahydrofuran standards in DMF on a second off-line GC (ØB-AC-3CØX).
Control Range: Target concentration +20%, alarmed (shut off gas flow to the chamber)
Target concentration -20%, alarmed

Calibration of On-Line Chamber Monitor

The calibration of the on-line chamber monitor is based on analysis of bubbler grab samples. Thus, the calibration of the on-line monitor is indirectly tied to gravimetrically prepared standard solutions in dimethylformamide (DMF) through a second directly calibrated GC which is off-line. The analysis depends upon careful quantitative preparation of gravimetric standards and careful grab sampling. The gravimetrically calibrated GC is used to measure the quantity of tetrahydrofuran collected from exposure chambers in

DMF filled bubblers. The relationship between the peak area observed with the on-line GC and the concentration of tetrahydrofuran in the chamber is then defined using chamber concentrations determined by the gravimetrically calibrated GC. The analysis of bubbler grab samples is performed using a HP5840 GC with a 1.8m by 2mm (or 4 mm) ID glass column packed with 20% SP 2100/0.1% Carbowax 1500 on 100/120 mesh Supelcoport with an oven temperature of 60°C (with follow-up temperature programing to elute the DMF solvent peak). A set of five standards is run for each analysis session. The concentration range of the standards brackets the concentration range of interest. Two independently weighed stock solutions are prepared each time the standard series is made up. The preparation of dual stock solutions helps "flag" any weighing errors. A typical calibration curve is shown below, Fig. 3, the calibration is linear through the range of interest, however a non-zero intercept is observed. The linear regression curve is used in the assay of the bubbler. One technician prepared three independent sets of calibration solution on the same day and calculated the gravimetric relative response factors (RRF). Mean RRF values of 0.8077, 0.8103 and 0.8032 were observed for these standard sets (BNW 51437 p39).

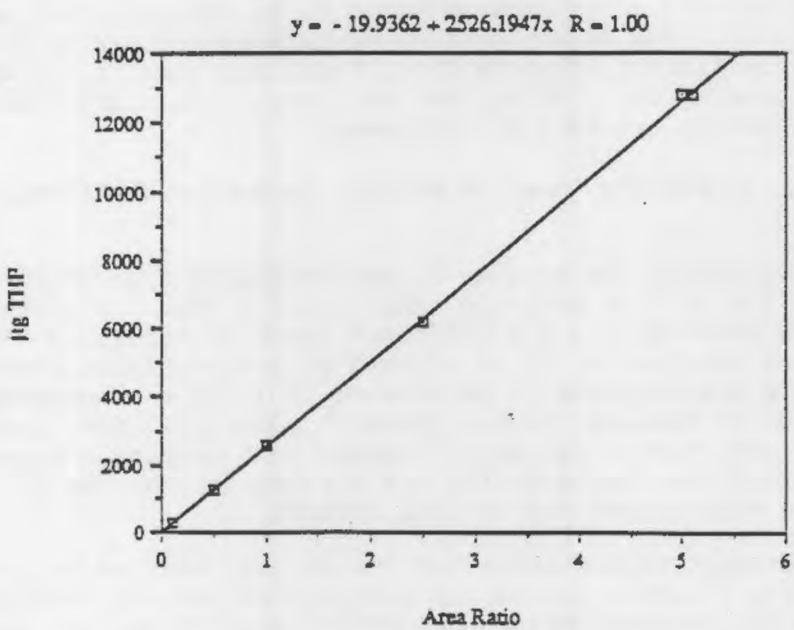

Figure 3. Linear Response of Off-Line GC Detector to Gravimetrically Prepared Standards Containing Tetrahydrofuran and Internal Standard of Acetone

Detection of Drift using an On-line Standard

An on-line standard will be used to check instrument drift throughout the exposure day. The on-line standard is 400 ppm of tetrahydrofuran in nitrogen (MG Industries Scientific Gases, 11705 South Alameda Street, Los Angeles, CA). The standard concentration is close to the middle exposure level. The standard will be monitored once for every of cycle of the 12-port stream selection valve. The standard will also be checked before the start each exposure day. The measured concentration for the standard must be within ±10% of the assigned target value before any exposure may begin without consultation with the Exposure Control Task Leader. During the course of the exposure, if the on-line standard is within 5% of the target value, no change in calibration will be required. If the on-line standard is between 5% and 10% of its assigned target, the calibration may be updated immediately by an Exposure or Chemistry Specialist. Such a correction will be based upon the on-line standard. If the cumulative drift exceeds 15%, then the calibration will be double checked by quantitative analysis of grab samples. Very little carry over is seen from the regulator and standard on/off valve when the standard is removed. The standard reaches 97% of target within two minutes. We have assigned the standard a target of 400 ppm for use with the data acquisition and control system.

Demonstration of Sensitivity and Specificity (SOW II.D.7.c.)

The sensitivity of the GC was estimated from the decay profile for the highest concentration chamber. The minimum detectable limit (MDL) is estimated as ~0.10 ppm (BNW 12272 p 42). Some measure of chromatographic specificity is typically defined by determination of the analytes' partition coefficient. The retention time of methane, assumed to be non-retained, was found to be about 0.27 min. The retention time of tetrahydrofuran is 0.84 min, for a partition coefficient of about 2.1. Total run time is 1.5 minutes exclusive of report generation. During the test generation phase, the nitrogen blank port has shown no evidence of carryover.

Precision, Linearity and Absolute Recovery Evaluation (SOW II.D.7.c.)

Precision for the on-line GC was estimated from 12 repeated measurements made using the on-line standard (mean = 408.1 ppm). A standard deviation of 0.6 ppm was observed for a 0.15% coefficient of variation (BNW 12272 p 51). Linearity of the on-line GC is assured by indirectly calibrating the on-line GC against a gravimetrically calibrated GC (also see comments in the "Calibration of On-line Chamber Monitor" section). This is basically accomplished by analyzing a series of bubbler grab samples acquired during exposure generation and then implementing the appropriate on-line GC calibration curve in the data acquisition and control system.

Achievement of linearity for the on-line monitor is therefore dependent upon defining a linear method for analysis of bubbler samples. The calibration curve for this analysis shows good linearity over an extended range. Routine analysis of bubblers is performed using five levels of standards which cover the concentration range of interest in order to assure adequate linearity.

Good accuracy depends upon good characterization of the absolute recovery demonstrated by both sampling methods used to measure chamber concentration (on-line and bubbler grab). A study of potential losses in the on-line sample lines was performed by comparing the concentration observed for a test chamber with and without the addition of an additional 50 ft of sample line. No difference in the measured chamber concentration was observed (BNW 12272 p 29 & 35).

Recovery of the bubbler grab sample method is measured by determining breakthrough. Breakthrough is measured every time samples are collected by collection of backup bubblers from the high concentration chamber. With the 1-liter sample sizes selected for the study, breakthrough of about 1-2 % is encountered. Backup bubblers are acquired for the high exposure chamber and used to correct the measured chamber concentration at all exposure levels for breakthrough encountered during grab sampling.

DEGRADATION STUDIES/STABILITY STUDIES (SOW II.D.7.j):

Stability of Test Material in the Generator Reservoir

A study of the test material stability in the stainless steel reservoir was performed. The test material was allowed to remain in the reservoir for 36 days at room temperature. Initial purity of reservoir test material #BNW 51437-15-1 was 99.3% and peroxide content was 14 ppm. Aged reservoir sample purity was analyzed as 99.6% (BNW 51437 p 60) and peroxide content was 7 ppm (BNW 51437 p 60). No evidence of degradation was observed.

Analysis of Evaporation Flask Residue for BHT and Peroxide Content

Studies of the degradation of tetrahydrofuran in the exposure chambers and stability in the generator flask were conducted for the test run performed on January 9, 1987. Drum # BNW 51437-15-1 was the source of test material (BNW 51437, p 73). The bulk purity as measured by the MRI specified gas chromatographic internal standard method, was approximately 99.1% to 99.6% (BNW 51437 pp 29, 56, 70) while material recovered from the evaporation flask at the end of a typical 6-hour exposure period exhibits a bulk purity of 98.8% (BNW 51437 pp 91-3).

THF is stabilized with butylated hydroxytoluene (BHT). Using the MRI method, the BHT concentration was determined (BNW 51437 pp 65, 85) as 100 ppm, the peroxide content was determined to be 14 ppm (BNW 51437 pg 24). Peroxide, BHT, and other materials less volatile than THF are expected to concentrate in the generator flask during the course of an exposure day. The lower volatility of BHT with some refluxing of test material from the condenser produces enough separation to reduce the vapor concentration of BHT to very low levels.

As expected, concentration of BHT occurs within the generation evaporation flask. A BHT concentration of 1640 ppm was found in the evaporation flask at the end of a typical six-hour exposure day (BNW 51437 pg 90). The retention of BHT in the evaporation flask indicates that very little of the stabilizer finds its way into the chambers. Direct measurements of chamber concentration of BHT and peroxide, discussed later in this section, confirm that chamber concentrations of these two species are insignificant.

The peroxide content of the evaporation flask was 11 ppm (BNW 51437 pg 99). A concentration factor of about 17 to 26 is predicted from mass flow considerations; about 4.7 kg is consumed per day with an evaporation flask residue of about 200 ml (0.18 kg) to 300 ml (0.27 kg). Based on this estimated concentration factor, the BHT concentration in the evaporation flask was quite near the predicted range of 1700 to 2600 ppm, exhibiting no increase during the exposure day. These results indicate that the peroxide initially present is destroyed and/or partially removed via vaporization during test atmosphere generation. The reactive nature of peroxides probably results in a substantial loss in the generation flask by chemical reaction.

Analysis of Charcoal Adsorption Tube Grab Samples

Samples were taken from the high and low chambers without animals present during the last hour of the exposure period on 1/9/87 by pulling a measured volume of gas through standard gas sampling charcoal tubes (Supelco, ORBO-32, large charcoal tubes). Sample size was adjusted to provide adequate sensitivity for impurities without producing excessive breakthrough of tetrahydrofuran. Breakthrough of THF was measured by analysis of the secondary charcoal bed within the tubes. Sampling information is summarized in Table 1.

Table 1. Samples Taken with Large Charcoal Tubes

Chamber Conc ppm	Sample Time min	Sample Volume liter	Amount Absorbed mg	Breakthrough
5000.	5	4.6	67.6	0.1-2.0%
66.6	60	55.4	10.7	5-6%

The charcoal was transferred to GC autosampler vials and desorbed using 1 ml carbon disulfide (CS_2) with about 1 minute of ultrasound treatment. Table 2 summarizes the gas chromatographic system used to analyze the charcoal tubes. A series of three standards over the range of ~1 to 0.01mg/ml of furan, isopropanol and butyraldehyde placed on charcoal were analyzed. When this standard series was compared to a set prepared without charcoal contact, a recovery of about 93% off charcoal is shown for furan down to 0.1 mg, at 0.01 mg the recovery for furan is about 74%.

Butyraldehyde displays two peaks, recovery is about 87% for the high standard, while no recovery is seen off charcoal at 0.1 mg. Propanol shows very poor recovery at all levels, probably owing to its polarity. However, the the low level furan standard was very easily detected; note that 0.01 mg is 0.1% of the amount of THF acquired for the lowest concentration chamber. Chromatograms for a CS_2 blank, 81 mg/ml standard of bulk THF, and a 5000 ppm chamber sample are shown in Figures 4, 5 and 6 respectively. No impurity peaks were observed in any of the chamber samples. The standard of bulk THF is run to flag any pre-existing impurities initially present in the bulk test material and prevent them from being erroneously called out as generator caused degradation products. As shown in the figure this standard does exhibit a peak (19.9 min) not seen for the chamber samples. Based upon retention time, this peak is BHT. Recovery at the concentrations encountered in the bulk test material is about 38% off charcoal.

Table 2. Gas Chromatographic Conditions for Analysis of Charcoal Absorption Tubes

Instrument:	Hewlett Packard 5890
Column:	Fused Silica Capillary, 30 meter DB-5, 1.5 micron film thickness, 0.53 mm id
Initial Temperature:	45°C
Initial Isothermal Time:	5 min
Temperature Program rate:	10 °C/min
Final Temperature:	250 °C
Final Time:	5 min
Detector:	FID
Detector Temperature:	300°C
Injector Temperature:	250°C
RT Unk Bulk Impurity(81mg/ml): bulk	~19.97min (~ 0.07% of total peak area in test material)
RT THF:	~2.25 min
RT Buteraldehyde :	~1.76 and 1.85 (suspect isomer in standard)
RT Furan:	~1.28 min
RT Propanol	~1.43 min
RT CS-2 (desorbent):	~1.54 min(main peak) and ~2.64 (trace)

Analysis for BHT using Sample Collection with Methanol Filled Bubblers

The presence of BHT in the 5000 ppm chamber atmosphere was sought using the GC method outlined in the MRI·analytical report, with the exception that the standard curve was extended to 0.0129 mg/ml BHT in methanol (BNW 51437 p 81-6). Sample volume was approximately 10 and 60 liters. For the 60 liter sample volume a concentration of 0.0129 mg/ml of BHT corresponds to a concentration relative to THF in the 5000 ppm chamber of 0.05%. No evidence of BHT was observed.

Analysis for Organic Peroxides by the p-Hydroxyphenylacetic Acid Coupling Reaction

In the presence of hydrogen peroxide and many organic peroxides, p-hydroxyphenylacetic acid may form a fluorescent dimer. The reaction is catalyzed by horseradish peroxidase. We adapted the procedure reported by GL Kok et al [Anal. Chem. 1986, 58, 1192-1194]. A Perkin Elmer fluorescence detector at 320 nm excitation and 400 nm emission was used for detection. Sample aliquots were introduced using a 1.5 ml/mim flow of basicified water to sweep a 25 microliter sample loop.

Standardization was accomplished using hydrogen peroxide solutions at 235, 118, 24, 12 and 6 ng/ml. A calibration curve is shown in the Figure 7. Several duplicate 9.2 liter bubbler samples (with backup bubblers), each charged with 20 ml of reagent solution, were collected. The samples are summarized below:

Sample No.	Description
51437-103-1&2	1 hour test generation into empty 5000 ppm chamber
51437-103-7&8	3 hours test generation into empty 5000 ppm chamber
51437-104-9&10	5 hours test generation into empty 5000 ppm chamber
51437-103-5&6	5 hours test generation into empty 66 ppm chamber
51437-103-3&4	Control Chamber

Figure 8 shows the response observed for the suite of samples. The chambers containing THF exhibit a response similar to the control chamber. The area observed is near the bottom of the calibration curve. We calculate an amount of peroxide equivalent to 0.2% of the 66 ppm chamber (0.13 ppm) can be determined assuming complete reaction of the organic peroxide.

Conclusion

The study of chemical stability in the vapor generator and the chambers fails to show any evidence for significant degradation of the test material.

The vapor generation system uses a rotary evaporator to saturate a nitrogen steam with THF vapor. The rotary evaporator is operated in reflux mode with a fairly substantial reflux ratio. This provides good separation power for reduction of impurities substantially less volatile than THF. However, the basic design offers little, if any, possibility of removal of compounds of only slightly lesser volatility than THF and absolutely none for compounds more volatile. Thus, it is entirely expected that the composition of test material in the chambers will be similar to that of the bulk material with respect to compounds with volatilities greater than that of THF and purified relative to compounds with lesser volatility.

This study shows good sensitivity for furan to levels well below 1% of the lower exposure level using sample collection by charcoal adsorption. Recoveries are not as good for the more polar propanol and butyraldehyde. The BHT stabilizer is detected in the native test material using the charcoal procedure. Temperature programmed GC with a fused silica capillary column fails to show any evidence of the production of degradation products.

Analysis of the evaporation flask fails to show any evidence of significant degradation. Retention and concentration of BHT is demonstrated. Peroxides do not accumulate in the flask. Grab sampling with methanol filled bubblers specifically for BHT fails to show significant levels in the exposure chambers. Analysis for organic peroxides using a sensitive fluorescence technique shows no difference between chambers containing THF and the control chamber.

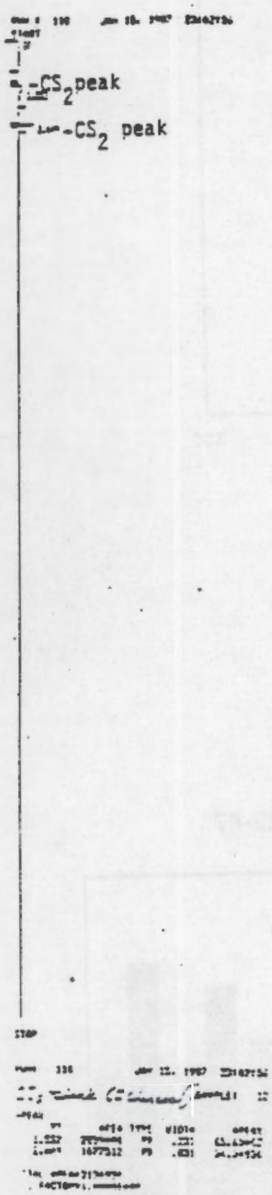

Figure 4
CS_2 Blank

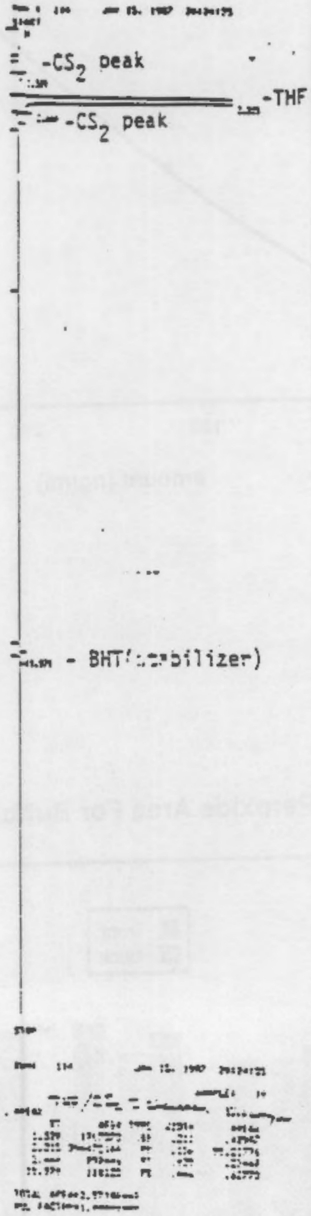

Figure 5
81 mg/ml Bulk THF

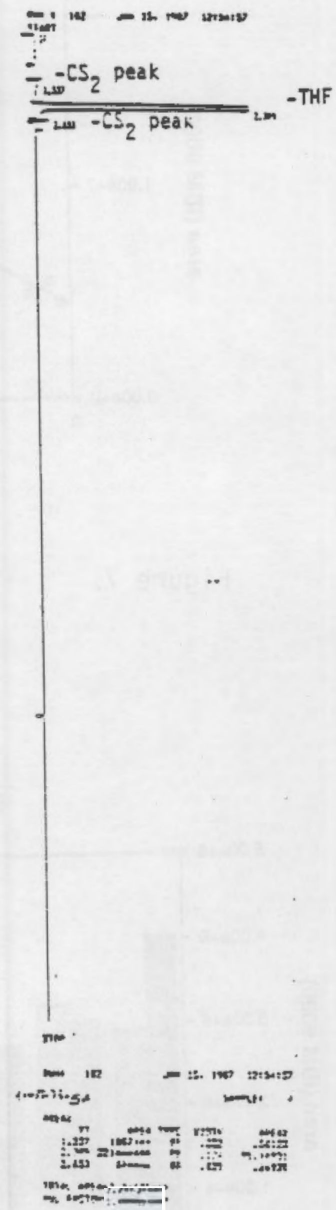

Figure 6
5000 ppm chamber (4.6 l sample)

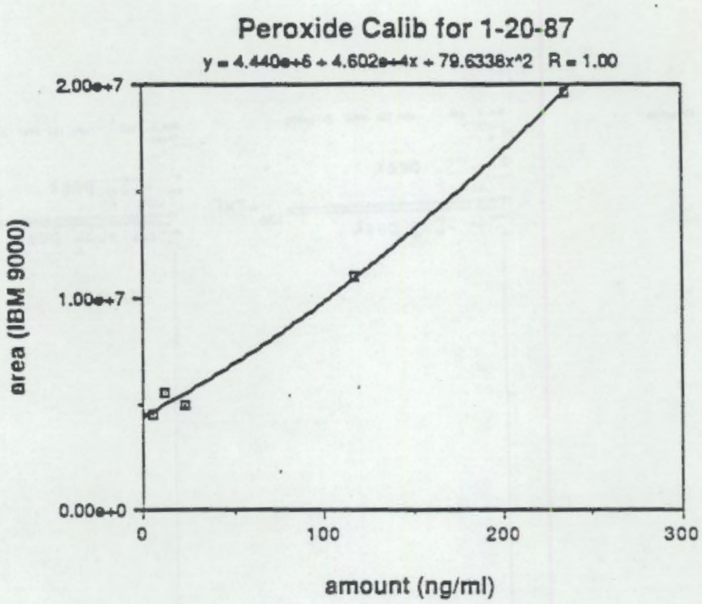

Figure 7.

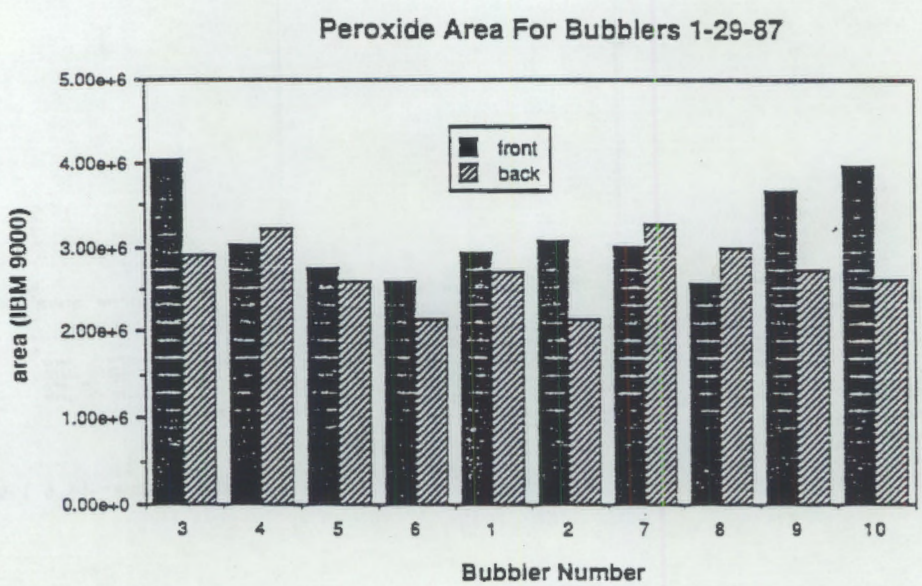

Figure 8

UNIFORMITY OF CHAMBER EXPOSURE ATMOSPHERE (SOW II.D.7.f.)

Data regarding uniformity of the vapor in the exposure chamber has been collected for all sample ports for all chambers. The data sheet, attached as Figure 7, demonstrates good mixing of the exposure atmosphere at all levels of the chamber. The uniformity data are summarized in Table 3, which includes Total Port Variability (TPV), Within Port Variability (WPV) and Between Port Variability (BPV), all expressed as % Relative Standard Deviation (%RSD). The uniformity criteria, as set forth in SOP #ØB-BE-3B24 and listed below, were easily met for all chambers.

Chamber Uniformity Limits
WPV ≤ 5% RSD
BPV ≤ 5% RSD
TPV ≤ 7% RSD

Table 3 . Summary of Pre-Start Chamber Uniformity Data

Chamber	TPV (%RSD)	WPV (%RSD)	BPV (%RSD)
5000 ppm	1.0	1.5	0
1800 ppm	1.2	1.9	0
600 ppm	2.2	2.8	0
200 ppm	1.8	2.2	0
66 ppm	1.2	2.0	0

CHAMBER CONCENTRATION VERSUS TIME (SOW II.D.7.g. & h.)

Plots showing the buildup and decay of vapor concentration in all chambers are attached as Figure 9. The T90 values (time for the concentration to reach 90% of the target value following start of exposure) and the T10 values (the time for the concentration to reach 10% of the target value following termination of the exposure) for all chambers are summarized in Table 4. Buildup times range from 6 to 8.5 minutes while decay times range from 5.5 to 9.5 minutes. Variation is due to a combination of slightly different flow rates in each chamber and to the variation of the discrete gas chromatograph samples times relative to the times of exposure start or stop. The theoretical T90 at a flow rate of 15 air changes per hour is 11 minutes. To conform with other inhalation studies currently underway and as a hedge against the possible effects of animal loading, a value of 12 minutes will be used for T90 for this study.

Table 4. Summary of T90 and T10 for all Exposure Chambers

Chamber	T90 (min)	T10 (min)
5000 ppm	8.5	7.5
1800 ppm	8	8
600 ppm	10	8
200 ppm	8.5	9.5
66 ppm	7.5	8

CONCENTRATION STABILITY (SOW II.D.7.e.)

Table 5 lists the concentration summary for all exposure chambers for three 6-hour test exposure runs on January 9, 12, and 13, 1987. The protocol requires that the daily average concentration be within ± 10% of target and that the percent relative standard deviation (%RSD) be ≤ 10% of the daily average concentration. The summary data show that the system is capable of maintaining concentrations to these specifications. Minor adjustments were made to individual chambers to fine tune the concentration levels during these test exposures.

Table 5.

Concentration Summary for all Exposure Chambers for a 6-hour Exposure Period (1/09/87)

Chamber:	5000 ppm	1800 ppm	600 ppm	200 ppm	66 ppm
Mean Concentration:	4984	1745	623	206	62.8
% of Target:	99.7%	96.9%	104%	103%	95.2%
Standard Deviation:	229	87	25	8	2.6
% RSD:	5%	5%	4%	4%	4%

Concentration Summary for all Exposure Chambers for a 6-hour Exposure Period (1/12/87)

Chamber:	5000 ppm	1800 ppm	600 ppm	200 ppm	66 ppm
Mean Concentration:	5142	1888	631	211	66.7
% of Target:	103%	105%	105%	106%	101%
Standard Deviation:	215	70	30	19	4.7
% RSD:	4%	4%	5%	9%	7%

Concentration Summary for all Exposure Chambers for a 6-hour Exposure Period (1/13/87)

Chamber:	5000 ppm	1800 ppm	600 ppm	200 ppm	66 ppm
Mean Concentration:	4900	1780	596	194	65.0
% of Target:	98%	99%	99%	97%	98%
Standard Deviation:	128	59	19	9	2.2
% RSD:	3%	3%	3%	5%	3%

TEST FOR AEROSOL IN EXPOSURE ATMOSPHERE (SOW II.D.7.j.)

A Gardner type CN small particle detector was used to check the chambers (without animals) and the room for particles during generation on 1/12/87. Table 6 shows the results of these tests. No particles were found in the control chamber or any of the exposure chambers. The particle count in the room was slightly higher than normally found in the HEPA-filtered rooms because the room had not been cleaned following installation of the delivery system for the chemical.

Table 6.
Analysis of Particle Count in Chambers During Exposure

Sample Area	Particle Concentration (Particles / cm^3)
Room	720
Control Chamber	0
66 ppm Chamber	0
200 ppm Chamber	0
600 ppm Chamber	0
1800 ppm Chamber	0
5000 ppm Chamber	0

EXPOSURE ROOM MONITORING AND EXHAUST

In conjunction with concentration stability tests (SOW II.D.7.e.) performed on exposure chambers during three 6-hour runs as detailed above, exposure room air monitoring was also conducted. The sample location was approximately breathing zone height near the room exhaust vent. No trace of tetrahydrofuran vapor was detected at any time in the room during test generation. The predicted building exhaust concentration of tetrahydrofuran vapor is <2.1 ppm (the TLV for tetrahydrofuran is 200 ppm). Building exhaust concentration will be measured during the teratology study to confirm the predicted value.

CHAMBER UNIFORMITY DATA SHEET

COMPOUND: Tetrahydrofuran

EXPOSURE ROOM NUMBER: 424

TPV MEASUREMENTS

CHAMBER:	66 ppm		200 ppm		600 ppm		1800 ppm		5000 ppm	
DATE:	1/8/87		1/8/87		1/8/87		1/8/87		1/8/87	
SAMPLE PORT	MONITOR READING	% of Mean	MONITOR READING	% of Mean	MONITOR READING	% of Mean	MONITOR READING	% of Mean	MONITOR READING	% of Mean
BACK: 1B	88.0	100.7%	395.0	98.8%	460.0	103.1%	1630.0	99.8%	5011.0	102.3%
2B	87.0	99.5%	392.0	98.1%	438.0	98.2%	1622.0	99.3%	4912.0	100.3%
3B	87.0	99.5%	393.0	98.3%	443.0	99.3%	1630.0	99.8%	4829.0	98.6%
4B	87.0	99.5%	394.0	98.6%	443.0	99.3%	1635.0	100.1%	4916.0	100.3%
5B	87.0	99.5%	391.0	97.8%	453.0	101.6%	1624.0	99.5%	4969.0	101.4%
6B	89.0	101.8%	397.0	99.3%	460.0	103.1%	1599.0	97.9%	4910.0	100.2%
FRONT: 1F	87.0	99.5%	408.0	102.1%	442.0	99.1%	1672.0	102.4%	4902.0	100.1%
2F	85.0	97.2%	406.0	101.6%	437.0	98.0%	1641.0	100.5%	4860.0	99.2%
3F	87.0	99.5%	407.0	101.8%	440.0	98.7%	1642.0	100.6%	4887.0	99.8%
4F	89.0	101.8%	412.0	103.1%	440.0	98.7%	1641.0	100.5%	4869.0	99.4%
5F	88.0	100.7%	405.0	101.3%	439.0	98.4%	1648.0	100.9%	4844.0	98.9%
6F	88.0	100.7%	397.0	99.3%	439.0	98.4%	1609.0	98.5%	4881.0	99.6%
MEAN:	87.4	100.0%	399.8	100.0%	446.0	100.0%	1632.8	100.0%	4899.2	100.0%
TPV:	1.08	1.2%	7.33	1.8%	9.63	2.2%	18.85	1.2%	51.21	1.0%
BPV:	//////////////	≤0%	//////////////	≤0%	//////////////	≤0%	//////////////	≤0%	//////////////	≤0%

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WPV MEASUREMENTS

IN-LINE 1st	88.0	101.1%	395.0	99.4%	460.0	103.1%	1630.0	99.4%	5011.0	101.8%
2nd	88.0	101.1%	390.0	98.2%	441.0	98.9%	1615.0	98.5%	4873.0	99.0%
3rd	85.0	97.7%	407.0	102.4%	437.0	98.0%	1675.0	102.1%	4888.0	99.3%
MEAN:	87.0	100.0%	397.3	100.0%	446.0	100.0%	1640.0	100.0%	4924.0	100.0%
WPV:	1.73	2.0%	8.74	2.2%	12.29	2.8%	31.22	1.9%	75.72	1.5%

MONITOR TYPE: Gas Chromatograph SERIAL #: BNW 809569

MONITOR DATA LOCATION:

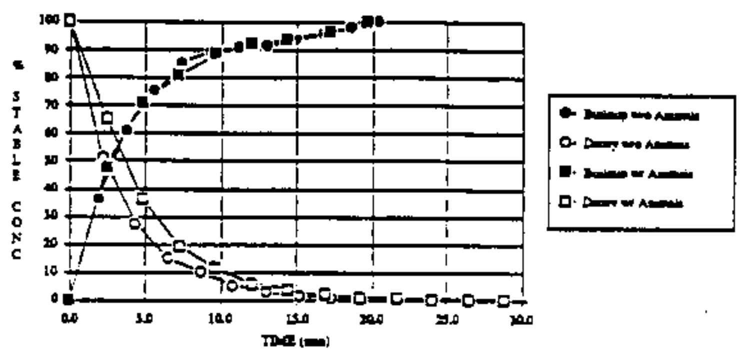
COMMENTS: Pre exposure chamber homogeneity measurements without animals. Data taken from lab notebook #BNW 12272, page 41.

ENTERED BY: [signature] DATE: 1/14/87 REVIEWED BY: [signature] DATE: 1/15/87

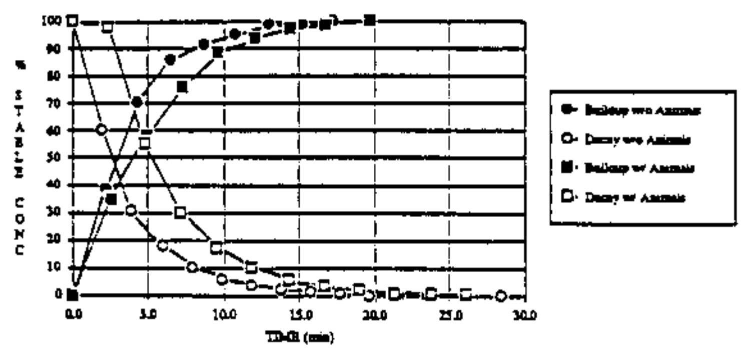
Figure 9. Results of Chamber Homogeneity Measurements.

Buildup and Decay diagrams for Tetrahydrofuran

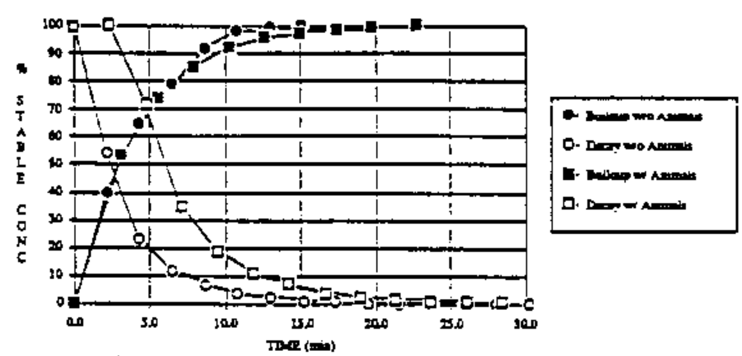
NTP THF: 600 ppm Chamber



NTP THF: 1800 ppm Chamber



NTP THF: 5000 ppm Chamber



Oct. 15, 1987

To: Tetrahydrofuran: Rat Teratology File

From: Study Director
Terryl J. Mast TJ Mast

Re: Randomization of Sperm-positive Rats for Teratology Study

Sperm-positive females were assigned to exposure groups on the basis of eartag number, rather than body weight as specified in the study protocol. This error occurred when the eartag number instead of the body weight was specified as the blocking variable for the computerized randomization program. Computer printouts listing treatment assignments were entered in the THF study logbook on Aug. 11-17, 1987; however, the error was not noted until October 15, 1987. Since all assigned groups had mean body weights with acceptable percent relative standard deviations, all were ≤11%, this error did not cause a significant between group weight variation.

Project officers, Drs. Schwetz and Morrisey, were informed of this protocol deviation on October 13, 1987.

cc: Ann Gelman
September Monthly Report
Study Logbook

SPONSER: NTP-IRT
STUDY: MOUSE TERATOLOGY
DOM: 424
DATE: 07/21/87 DJR

CHEMICAL: THF
CHAMBER: 1
CONCENTRATION: 0 PPM

LEVEL 3

15		30		45		60	
14		29		44		59	
13	302	28		43		58	
12	296	27		42		57	
11	276	26	326	41		56	
10	80	25	236	40		55	
9	(GRP B)	24	223	39		54	
8	271	23	190	38		53	
7	269	22	185	37	325	52	
6	256	21	130	36	308	51	
5	159	20	122	35	306	50	
4	139	19	120	34	305	49	
3	71	18	118	33	192	48	228
2	64	17	100	32	154	47	212
1	54	16	34	31	9	46	137
	(GRP A)		(GRP C)		(GRP D)		(GRP E)

LEVEL 4

15		30		45		60	
14		29		44		59	
13		28		43		58	
12		27		42		57	
11		26		41		56	
10	328	25		40		55	
9	283	24		39		54	
8	278	23		38		53	
7	248	22		37		52	
6	245	21		36		51	
5	174	20		35		50	
4	91	19		34		49	
3	32	18		33		48	
2	19	17		32		47	
1	17	16		31		46	
	(VIRGINS)						

COMMENTS WEIGHED GRP A (d0 12-27 TOTAL) & GRP D (d0 9-27 TOTAL)

SPONSER: NTP-IRT
STUDY: MOUSE TERATOLOGY
ROOM: 424
DATE: 07/21/87

CHEMICAL: THF
CHAMBER: 2
CONCENTRATION: 600 PPM

LEVEL 3

15		30		45		60	
14		29		44		59	
13	331	28		43		58	
12	294	27	313	42		57	
11	70	26	303	41		56	
10	37	25	210	40		55	
9	(GRP B)	24	205	39		54	
8		23	187	38		53	
7	240	22	184	37	330	52	
6	220	21	165	36	288	51	
5	183	20	132	35	275	50	
4	177	19	104	34	255	49	
3	140	18	55	33	249	48	168
2	83	17	51	32	114	47	38
1	76	16	39	31	113	46	24
	(GRP A)		(GRP C)		(GRP D)		(GRP E)

LEVEL 4

15		30		45		60	
14		29		44		59	
13		28		43		58	
12		27		42		57	
11		26		41		56	
10	257	25		40		55	
9	247	24		39		54	
8	242	23		38		53	
7	221	22		37		52	
6	204	21		36		51	
5	167	20		35		50	
4	115	19		34		49	
3	68	18		33		48	
2	50	17		32		47	
1	43	16		31		46	
	(VIRGINS)						

COMMENTS WEIGHED GRP A (do 12-27 TOTAL) & GRP D (do 9-27 TOTAL)

SPONSER: NTP-IRT

STUDY: MOUSE TERATOLOGY

ROOM: 424

DATE: 07/21/87 [illegible]

CHEMICAL: THF

CHAMBER: 3

CONCENTRATION: 1800 PPM

LEVEL 3

15		30		45		60	
14	329	29		44		59	
13	226	28		43		58	
12	149	27		42		57	
11	85	26	287	41		56	
10	66	25	260	40		55	
9	(GRP B)	24	239	39		54	
8		23	200	38		53	
7	208	22	176	37		52	
6	157	21	108	36	293	51	
5	138	20	75	35	270	50	
4	92	19	61	34	263	49	321
3	44	18	58	33	88	48	311
2	27	17	45	32	53	47	298
1	20	16	13	31	47	46	274
	(GRP A)		(GRP C)		(GRP D)		(GRP E)

LEVEL 4

15		30		45		60	
14		29		44		59	
13		28		43		58	
12		27		42		57	
11		26		41		56	
10	309	25		40		55	
9	301	24		39		54	
8	267	23		38		53	
7	211	22		37		52	
6	164	21		36		51	
5	141	20		35		50	
4	131	19		34		49	
3	77	18		33		48	
2	12	17		32		47	
1	8	16		31		46	
	(VIRGINS)						

COMMENTS WEIGHED GRP A (dg 12 - 27 TOTAL) & GRP D (dg 9 - 27 TOTAL)

SPONSER: NTP-IRT
STUDY: MOUSE TERATOLOGY
ROOM: 424
DATE: 07 / 21 / 87 CHR

CHEMICAL: THF
CHAMBER: 4
CONCENTRATION: 5000 PPM

LEVEL 3

15		30		45		60	
14	~~268~~ (DEAD)	29		44		59	
13	~~238~~ (DEAD)	28		43		58	
12	219	27		42		57	
11	218	26	~~273~~ (DEAD)	41		56	
10	162	25	222	40		55	
9	(GRP B)	24	213	39		54	
8		23	125	38		53	
7		22	~~106~~ (DEAD)	37	327	52	
6		21	~~90~~ (DEAD)	36	~~265~~ (DEAD)	51	
5		20	82	35	155	50	
4		19	81	34	151	49	
3		18	48	33	105	48	280
2		17	36	32	33	47	225
1		16	28	31	26	46	179
			(GRP C)		(GRP D)		(GRP E)

LEVEL 4

15		30		45		60	
14		29		44		59	
13		28		43		58	
12		27		42		57	
11		26		41		56	
10		25		40		55	
9		24		39		54	
8		23		38		53	
7		22		37		52	
6		21		36		51	
5		20		35		50	
4		19		34		49	
3		18		33		48	
2		17		32		47	
1		16		31		46	

COMMENTS WEIGHED GRP A (dg 12-27 TOTAL) & GRP D (dg 9-27 TOTAL). REMOVED GRP A & VIRGINS INTO HOLDING CHAMBER DUE TO MORTALITY.

SPONSER: NTP-IRT
STUDY: MOUSE TERATOLOGY
ROOM: 424
DATE: 7 / 21 / 87 QLR

CHEMICAL: THF
CHAMBER: HOLDING
CONCENTRATION: Ø ppm

LEVEL 1

LEVEL 2

LEVEL 3

310			
264			
201			
142			
124			
87			
52			

VIRGINS

LEVEL 4

231			
206			
97			
84			
31			

GRP A

LEVEL 5

LEVEL 6

NoTe - no animals Left in Holding chamber 8-21-87 RER

PROJECT: NTP-IRT
STUDY: RAT TERATOLOGY
ROOM: 424
DATE: ~~8 / 21 / 87~~ through 8-~~20~~31-87

RER Recording Error TMB 8-27-87

CHEMICAL: THF
CHAMBER: 1
CONCENTRATION: Ø PPM

LEVEL 4

616	
596	
578	
574	
557	618
537	608
521	597
471	573
452	560
433	525
405	502
(GRP D)	(GRP E)

LEVEL 3

529	
515	
495	617
491	541
477	464
466	(GRP C)
425	612
416	564
403	499
(GRP A)	(GRP B)

LEVEL 5

624	
600	
592	
548	
490	
486	
470	
460	
449	
428	
(VIRGINS)	

Note: Grp A sacrificed 8-31-87 RER

PROJECT: NTP-IRT
STUDY: RAT TERATOLOGY
ROOM: 424
DATE: 8 / 21 / 87 through 8-~~30~~31-87
Recording Error

CHEMICAL: THF
CHAMBER: 2
CONCENTRATION: 600 PPM

LEVEL 4

629	
594	
587	
567	
550	
540	626
484	615
482	598
444	542
420	509
419	421
(GRP D)	(GRP E)

LEVEL 3

527	633
519	571
513	505
494	469
446	(GRP C)
436	606
412	603
401	559
(GRP A)	(GRP B)

LEVEL 5

632	
590	
589	
581	
539	
475	
467	
451	
437	
415	
(VIRGINS)	

Note: Grp A sacrificed 8-31-87

PROJECT: NTP-IRT
STUDY: RAT TERATOLOGY
ROOM: 424
DATE: 8/21/87 through 8-~~30~~ 31-87
Recording Error [illegible] 8-27-87
CHEMICAL: THF
CHAMBER: 3
CONCENTRATION: 18ØØ PPM

LEVEL 4

623	
601	
583	
577	
544	
532	630
504	604
478	595
445	545
432	526
411	454
(GRP D)	(GRP E)

LEVEL 3

531	607
522	538
500	496
479	481
455	(GRP C)
426	613
413	562
408	534
(GRP A)	(GRP B)

LEVEL 5

610	
599	
588	
585	
572	
565	
556	
434	
427	
422	
(VIRGINS)	

Note: Grp A sacrificed 8-31-87 RYR

PROJECT: NTP-IRT
STUDY: RAT TERATOLOGY
ROOM: 424
DATE: 8/21/87 through 8-~~30~~ 31-87
QLR Recording Error MLS 8-27-87

CHEMICAL: THF
CHAMBER: 4
CONCENTRATION: 5000 PPM

LEVEL 4

638	
614	
580	
566	
549	
528	620
503	611
458	593
456	563
429	506
414	447
(GRP D)	(GRP E)

LEVEL 3

524	631
518	575
497	507
480	488
473	(GRP C)
431	639
418	584
406	553
(GRP A)	(GRP B)

LEVEL 5

605	
570	
530	
510	
508	
485	
483	
474	
462	
404	
(VIRGINS)	

Note Grp A sacrificed 8-31-87 QLR

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