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Investigation of Cancer Risk Assessment Methods
Volume 2. Bioassay Data Base

Clement Associates, Inc., Ruston, LA

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Investigation of Cancer Risk Assessment Methods:

Volume 2. Bioassay Data Base

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Section 1

BIOASSAY DATA COLLECTION AND SUMMARIZATION

BACKGROUND

The goal of the study is to characterize the uncertainty associated with various components of bioassay-based risk assessment. This is accomplished by constructing a data base of bioassays and applying a number of different analyses to that data base. Differences that result from different analyses inform the characterization of uncertainty.

For each chemical selected for inclusion in the study (as described in Volume 1), the available bioassay literature was acquired and, when appropriate, abstracted for entry into the data base. In this manner, a source of data that has uniform format and the flexibility to support an array of different types of analyses has been created. This section describes the manner in which bioassay data was summarized. The following section provides details of the contents of the data base for each chemical represented.

DATA ABSTRACTION

The data from an experiment are included in the data base if the experiment is a chronic carcinogenicity bioassay satisfying the following conditions:

- the test species is a non-human mammalian species;
- the protocol includes matched controls, preferably vehicle (or sham inhalation) treated animals;
- dosing is consistent within a dose group, with dosages and dosing patterns clearly stated;

- a single route of exposure is employed;

- the test compound is administered alone or in an acceptable vehicle, without pretreatment or concurrent treatment of any kind;

- tumor incidence is reported as number of tumor-bearing animals as opposed to number of tumors.

Since it was decided early in the course of the project not to include in the analysis experiments that exposed the test animals by skin painting or subcutaneous injection, the data base does not include some such experiments that would be otherwise eligible.

Table 1-1 lists the data that were abstracted from each acceptable experiment. The coding of the responses deserves further comment. For each experiment, each tumor occurring significantly more often in a dosed group compared to the control group (as determined by the original authors or by Fisher's exact test at the 0.05 level) was included. If there were no such responses, the tumor type that was most nearly significant was coded. In addition, an attempt was made to code the number of animals in each dose group with the following carcinogenic responses:

- the combination of all significantly increased tumors (as defined above), coded with the code 1000-7000/4;

- the combination of all significantly increased malignant tumors, coded 1000-7000/3;

- "all" tumors, coded 1000-8000/4;

- "all" malignant tumors, coded 1000-8000/3; and

- the tumor designated as the response of interest in humans (cf. Table 1-2).

Any one of these additional responses could be coded only if that response was specifically reported in the study, if only one tumor type occurred, or if individual animal pathologies were presented. It is not appropriate, for example, to add together the number of animals with individual responses because a single animal may have multiple responses.

Certain tumor types have not been considered in the definition of "all" tumors or "all" malignant tumors. They are interstitial cell tumors of the testes in male F344 rats, mammary gland benign tumors in female Sprague-Dawley rats, malignant lymphomas in AKR and AKR/J mice, and mammary tumors in MTV+ mice. These tumors have high background rates in the indicated strains. Inclusion of such responses in the "all" category would tend to obscure any dose-related effect that is manifested in many sites or as many tumor types, which is the very effect we are attempting to capture by the use of the "all" categories. When it has not been possible to separate the above-mentioned tumors from others in the definition of total tumor-bearing (or total malignancy-bearing) animals, the response has been coded as 1001-8000/4 (or 1001-8000/3). The "1001" codes are not included in the analyses.

DISCUSSION

The manner in which the bioassay data has been abstracted influences the use of the data base. Consider, for example, the coding of the dosing pattern for each dose group. The form of the data included in the data base includes the week when a particular regimen was started as well as its frequency and its intensity. It is possible, therefore, to indicate all the changes in dosing pattern that occurred in any dose group throughout an experiment. Consequently, many possible manipulations of the exposure calculations can be examined. There are, however, limitations imposed by the choice of weeks (as opposed to days, for example) the unit of time for indicating dosing changes. A bioassay with two groups, one administered a single dose of chemical on the ninth and the other administered the same dose on the thirteenth day of experiment, provides an example of the limitation. Both dose groups coded in the same manner to indicate a single dose given in the

second week. In some cases, such as transplacental exposure to DES, the four-day difference in timing of exposure could be very important. It is not expected, for the gross differences in analysis approaches that are the subject of this project, that these limitations will unduly influence the results. Any future plans for the data base should consider possible limitations posed by the form of the data collected and the manner in which it was coded.

Table 1-1

DATA ITEMS ABSTRACTED FROM ANIMAL BIOASSAYS

Data Item	Description, Values
Chemical Code	CAS number of the chemical under investigation.
Study Code	Numerical code for source of data; corresponding code on original research article.
Animal Code	Code which will specify species, strain, and sex of the animal model. The first digit will represent species - 0-3: mouse 4-6: rat 7-9: other
Route	Code for route of exposure 1 = oral, food 2 = gavage 3 = intracolonic 4 = intragastric 5 = injection 6 = implant 7 = intramuscular injection 8 = intranostril 9 = inhalation 10 = intrathoracic 11 = intraperitoneal injection 12 = intratrachial 13 = subcutaneous 14 = skin paint 15 = oral, water 16 = oral, peros 17 = transplacental 18 = intrafemoral 19 = intrapleural injection 20 = paranasal injection 21 = intrarenal injection 22 = mouth painting 23 = intraocular injection 24 = intratesticular injection

Table 1-1 (continued)

DATA ITEMS ABSTRACTED FROM ANIMAL BIOASSAYS

Data Item	Description, Values
Route (continued)	Code for route of exposure (continued): 25 = intravenous 26 = transplacental, then oral 27 = transplacental, then transmammary 28 = transmammary 29 = intrahepatic injection
Length of Experiment	As stated, expressed in weeks.
Individual Pathologies	Flag to indicate presence or absence of individual pathologies 0 = no pathologies 1 = pathologies present
Number Dose Groups	Number of dose groups in the experiment.
Number Responses	Number of carcinogenic responses coded; two digit number between 01 and 99, inclusive.
Chemical Class	Chemical class of the compound being tested 01 = Aromatic hydrocarbon 02 = Aromatic amine 03 = Aromatic halogenated hydrocarbon 04 = Aliphatic halogenated hydrocarbon 05 = Natural product 06 = Inorganic polymer 07 = Inorganic metal 08 = Mustard 09 = Hormone 10 = Polycyclic aromatic hydrocarbon 11 = Aldehyde

Table 1-1 (continued)

DATA ITEMS ABSTRACTED FROM ANIMAL BIOASSAYS

Data Item	Description, Values
Mechanism of Action	Code to describe the putative mechanism of carcinogenic action 1 = Genetic, direct 2 = Genetic, procarcinogen 3 = Epigenetic 4 = Genetic and epigenetic 5 = Unknown
IARC Class	The classification of the chemical done by IARC: 1 = IARC Class 1 2 = IARC Class 2A 3 = IARC Class 2B 4 = IARC Class 3 5 = No IARC Class
Response	Code for a carcinogenic response noted in the experiment. The code will be based on the ICDO code of 1976 and will include topography and morphology, including degree of malignancy.
Dose Group	Number identifying the dose group The control group will always be given the number 1.
Initial Number of Animals	The number of animals originally assigned to the dose group.
Average Age at Start	Average age (in weeks) of the dose group at start of experiment.
Median Time to Death	Week by which time half the dose group had died.
Number of Dose Levels	Number of distinct dose regimens for the dose group (=number of dose changes plus one).

Table 1-1 (continued)

DATA ITEMS ABSTRACTED FROM ANIMAL BIOASSAYS

Data Item	Description, Values
Time Started Dose	The week (counting from start of experiment) in which a particular dose started.
Dose Level	Number of units of dose received at one administration.
Units	Code for units of dose measurement: 1 = mg 2 = mg/kg 3 = ppm air 4 = ppm food 5 = ppm water 6 = % food 7 = % water 10 = g 11 = g/kg 12 = ng/kg 13 = ppt air 14 = mg/m^3 15 = µg/g 16 = ng
Frequency	Code for frequency of administration of dose. Codes to indicate the number of administrations per unit of time, the number of hours per administration (for inhalation route), or continuous exposure situations.
Number of Weight Measurements	Number of times an average weight measurement is recorded for the dose group.
Number of Food Intake Measurements	Number of times an average food intake measurement is recorded for the dose group.

Table 1-1 (continued)

DATA ITEMS ABSTRACTED FROM ANIMAL BIOASSAYS

Data Item	Description, Values
Weight Units	Units for expressing weights 01 = grams 02 = pounds
Food Intake Units	Units for expressing food intake = wgt. of food/animal/wk. 01 = grams 02 = pounds 03 = grams per kilogram body weight 04 = pounds per pound body
Average Weight	Average weight of dose group.
Time of Weight Measurement	Week from start of experiment in which a measurement was made.
Average Food Intake	Average food intake of the dose group.
Time of Food Intake Measurement	Week from start of experiment in which a measurement was made.
Flag	Flag indicating whether the following five variables are known with certainty or whether we had to estimate what some of them were: 0 = estimated 1 = known with certainty
Number Eligible	Number of animals in the dose group who were examined for the response of interest.
Time to First Response	Time in weeks from start of experiment until development of this response in this dose group.

Table 1-1 (continued)

DATA ITEMS ABSTRACTED FROM ANIMAL BIOASSAYS

Data Item	Description, Values
Number Alive at First Response	Number of animals in the dose group who were alive just prior to the first death of any animal in any dose group due to the response of interest.
Number Eligible at First Response	Number of animals in the dose group who were alive (and examined for the response) just prior to the first death of any animal due to the response of interest.
Number of Responses	Number of animals in the dose group who demonstrated the response of interest.
Number of Responses Without Sacrifices	Number of animals in the dose group demonstrating the response, excluding those animals who died from scheduled sacrifices.
Animal Identification	Identifying number for an individual animal if individual pathologies are available.
Week of Death	Week from start of experiment to death of individual animal.
Cause of Death	Code for cause of death 1 = Natural death 2 = Moribund sacrifice 3 = Interim sacrifice 4 = Terminal sacrifice 5 = Accident 9 = Unknown

Table 1-1 (continued)

DATA ITEMS ABSTRACTED FROM ANIMAL BIOASSAYS

Data Item	Description, Values
Response indicator	In column (i+11) of the "Individual Pathology Card" is an indicator for response i for a particular animal; values are as follows 2 = positive for response of interest 1 = negative for response of interest 0 = animal not examined for the response of interest

Table 1-2

THE RESPONSES OF INTEREST IN HUMANS
FOR CHEMICALS WITH SUITABLE HUMAN DATA

Chemical	Response
Aflatoxin	Liver Cancer
Arsenic	Lung Cancer
Asbestos	Mesothelioma; Lung Cancer
Benzene	Leukemia
Benzidine	Bladder Cancer
Cadmium	Prostate of Lung Cancer
Cigarette smoke	Lung Cancer
Chlorambucil	Leukemia
Chromium	Pharynx or Lung Cancer
DES	Cancer of the Genital Tract
Epichlorohydrin	All Malignant Neoplams
Estrogens	Mammary, Endometrial, or Uterine Cancer
Ethylene oxide	Leukemia
Isoniazid	All Malignant Neoplasms
Melphalan	Leukemia
Methylene chloride	All Malignant Neoplasms
Nickel	Nasal or Lung Cancer
PCBs	All Malignant Neoplasms
Phenacetin	Bladder or Renal Pelvis Cancer
Reserpine	Breast Cancer
Saccharin	Bladder Cancer
Trichloroethylene	All Malignant Neoplasms
Vinyl chloride	Angiosarcoma of the Liver

Section 2

DATA BASE CONTENTS

INTRODUCTION

This section contains a brief description of the experiments that have been reviewed for inclusion in the bioassay data base. Not all experiments are suitable for the purposes of this project. Nevertheless, a summary of the entire literature reviewed, what we have called the data matrix, is provided as well as a more complete description of the bioassays that satisfy the inclusion criteria. The text of this section describes any special situations encountered with respect to calculation of dosage, route of administration, or identity of chemical.

It should be noted that several of the chemicals under investigation, especially the metals, exist in more than one form or complex. For example, studies exist for nickel subsulfide and for nickel carbonyl. Each form or complex is identified by a unique Chemical Abstract Service (CAS) number so that it is possible to treat each form as a separate chemical. In accordance with this possibility, the data on dosages applies to the complex rather than the corresponding element. Thus, for an experiment testing nickel subsulfide, a dose coded as 1 mg/kg/day indicates that 1 mg/kg/day of nickel subsulfide, not nickel itself, was administered. No calculation of the amount of the elemental form in the complex was undertaken. The different forms of a chemical have been grouped together in this summary of data base contents and in the analyses.

ACRYLONITRILE

A summary of the data sets in the data matrix for acrylonitrile is presented in Table 2-1. Nineteen carcinogenicity bioassay data sets are included in the data matrix, all of which are considered suitable

for risk assessment and all of which tested rats. This carcinogenicity bioassay data is summarized in Table 2-2.

AFLATOXIN

There are a total of eighty-six carcinogenicity bioassay data sets included in the data matrix, of which 33 are suitable for risk assessment (Table 2-3). Although an abundance of data are available for non-mammalian species, only studies utilizing mammalian species were abstracted and included in the quantitative risk assessment. These studies are summarized in Table 2-4.

Several types of aflatoxin exist in nature including aflatoxins B_1, B_2, G_1, G_2, M_1. In some experimental studies, the specific type of aflatoxin tested is identified and was assigned a unique CAS registry number. In studies where the type of aflatoxin was unspecified or a combination of aflatoxins was used, the term "general aflatoxin" was applied. The molecular weight of this "general aflatoxin" was derived by determining the arithmetic mean of the specific forms of aflatoxin.

ALLYL CHLORIDE

Six carcinogenicity data sets are included in the data matrix (Table 2-5). Of these data sets, four are suitable for risk assessment, and are summarized in Table 2-6.

4-AMINOBIPHENYL

Carcinogenicity bioassay data sets for 4-aminobiphenyl are summarized in Table 2-7. Eight data sets are included in the data matrix, of which two are suitable for carcinogenic potency estimation. Several of those data sets that were unsuitable utilized dogs as the test animal but did not employ suitable controls. The two experiments included in the data base administered 4-aminobiphenyl to mice in drinking water (Table 2-8).

ARSENIC

Thirty-three carcinogenicity bioassay data sets are included in the data matrix and are summarized in Table 2-9. S[illegible]een of these data sets are suitable for risk analysis (Table 2-10).

Various forms of arsenic were used in the bioassays. In abstracting data for analysis, each form was identified by a unique CAS number. The arsenic compounds included sodium arsenate, lead arsenate, calcium arsenate and arsenic trioxide, as well as elemental arsenic itself.

ASBESTOS

The data sets in the data matrix for asbestos are summarized in Table 2-11. There are a total of eighty-four carcinogenicity bioassay data sets in the data matrix. Of these, sixty-four are considered suitable for analysis, none of them testing mice. A summary of this carcinogenicity bioassay data is presented in Table 2-12.

Asbestos is a term applied to a group of compounds which exist in fibrous form with various possible types or sizes of fibers, rather than a single unique substance. In some of the studies from which data sets were taken, the type of asbestos was not clearly defined and was assigned a CAS number for unspecified asbestos. An average molecular weight for this general class of asbestos was derived from the molecular weight of the individual types. Those studies which did state the type or types of asbestos used were treated as separate data sets with different CAS numbers employed as a means of identification. Hence analysis is possible for specific asbestos types (amosite, chrysotile and crocidolite being the primary examples) or for the asbestos class as a whole.

BENZENE

A total of twenty-six carcinogenicity bioassays for benzene were obtained and entered into the data matrix (Table 2-13). Of these,

fifteen data sets are considered suitable for quantitative risk estimation. These data sets are summarized in Table 2-14.

BENZIDINE

Ten carcinogenesis bioassay data sets were selected from the literature for benzidene and are summarized in Table 2-15. Only three are considered suitable for carcinogenic potency estimation. These data sets are summarized in Table 2-16. The studies not considered suitable for inclusion in the data base were flawed by poor exposure information or contained only one animal per dose group without concurrent controls.

BENZO[A]PYRENE

A summary of the data sets for benzo[a]pyrene in the data matrix is presented in Table 2-17. Fifty-one carcinogenicity bioassay data sets are included in the matrix, and of these, fourteen are considered suitable for risk assessment. This carcinogenicity bioassay data is summarized in Table 2-18. Twenty-six of the fifty-one data sets available for analysis employed subcutaneous injection or skin painting. These experiments were not included in the data base ever if they met the inclusion criteria.

CADMIUM

The data sets in the data matrix for cadmium are summarized in Table 2-19. Thirty carcinogenicity bioassay data sets are included in the data matrix. Of these, eight are considered suitable for analysis. A summary of this carcinogenicity bioassay data is presented in Table 2-20. Sixteen of the thirty data sets included in the data matrix employed subcutaneous injection as the route of exposure and were not coded. An additional six data sets did not employ suitable controls and could therefore not be analyzed.

rise this chemical classification,
nium oxide and cadmium chloride. These
AS numbers, enabling analysis of the
group as a whole.

bon tetrachloride included in the data matrix are
2-21. Twenty-one carcinogenicity bioassay data sets
e data matrix; six are considered suitable for our
y of this carcinogenicity bioassay data is presented
the twenty-one data sets available for analysis,
ocutaneous injection as the route of administration and
d in the data base. Some data sets were excluded due to
controls.

ets in the data matrix for chlorambucil are summarized in
-23. Six carcinogenicity bioassay data sets are included in the
matrix. Only one is suitable for analysis. A summary of this
assay is presented in Table 2-24.

CHLORDANE

The data sets in the data matrix for chlordane are summarized in Table 2-25. Eight carcinogenicity bioassay data sets are included in the data matrix. All of these are abstracted for analysis. This data is summarized in Table 2-26.

CHLOROFORM

Thirty-one carcinogenicity bioassay data sets are included in the data matrix (Table 2-27). Twenty of these are suitable for risk assessment.

The remaining studies are unsuitable due to poor experimental protocols (no controls, reporting of number of tumors rather than number of animals with tumors, etc.) or were not coded because chloroform was administered by subcutaneous injection. The experimental protocols for the data sets included in the data base are summarized in Table 2-28.

CHROMIUM

Sixteen carcinogenicity bioassays are included in the data matrix (Table 2-29). Of those, eight are suitable for risk assessment and are summarized in Table 2-30. Several of the data sets presented the data in a form that could not be used (such as number of tumors as opposed to number of animals with tumors) or did not have a control group.

Various forms of chromium were administered in the bioassays. Each form is identified by a unique CAS number. The different forms of chromium include calcium chromate, strontium chromate, zinc chromate, sodium dichromate, chromium acetate and chromium itself.

CIGARETTE SMOKE

The data sets in the data matrix for cigarette smoke are summarized in Table 2-31. Forty-one carcinogenicity bioassay data sets are included for this chemical in the data matrix. However, only nine are considered suitable for risk assessment. A summary of this carcinogenicity bioassay data is presented in Table 2-32. Derivations of RRDs from selected data sets are presented below. These derivations are presented in more detail than those for other chemicals because of the special dosing considerations for cigarette smoke and because several RRDs calculated from animal data are smaller than epidemiologically derived estimates, which is contrary to the possibly prevailing opinion that cigarette smoke is a less potent carcinogen in animals than in humans.

Twenty-four of the forty-one data sets available for analysis employed skin painting as the route of exposure, frequently with benzene or other unacceptable solvents as the vehicle. These twenty-four data sets have

not been entered in the data base. In some studies, a particular fraction of cigarette smoke condensate, rather than whole smoke, was administered. The data base includes only those studies (or portions of studies) that dosed with whole smoke or whole tar. Several studies either had no controls or treated animals with tumor-promoting agents. These studies were also excluded from the data base.

There was not a clearly-defined, uniform method of expressing dosages among the inhalation studies. For those data sets considered suitable for analysis, the following method was employed when necessary to calculate dosages.

Standard cigarette smoke values (1) include

weight of cigarette smoke per cigarette = 505.6 mg
butt length = 30 mm
number of puffs per cigarette = 10
volume per puff = 38.9 mℓ.

Therefore, the weight (in mg) of cigarette smoke administered is determined using one or a combination of the following:

weight(mg)/puff =

$$\frac{\text{std. puff weight (50.6 mg)} \times \text{experimental puff vol (in m}\ell)}{\text{std. puff vol (38.9 m}\ell)} \qquad (2\text{-}1)$$

mg/day cigarette smoke =

$$\frac{\text{puff weight (mg)}}{\text{chamber volume}(m^3)} \times \text{breathing rate } (m^3/\text{hour}) \times \frac{\text{hours exposed}}{\text{day}}. \qquad (2\text{-}2)$$

(Hours exposure per day is derived by using the reported puff duration times the number of puffs per exposure times exposures/day.)

Of the nine experiments testing cigarette smoke, the study yielding the smallest RRD estimates (lower bound, MLE, and upper bound) is that by Stanton *et al.* (2). This was a 107-week study with only one noncontrol

dose group of 105 rats. Cigarette smoke condensate mixed with beeswax was injected into the lungs of the animals. The total dose was 24 mg of cigarette smoke that leached out of the beeswax over the entire two years of the experiment. Consequently the calculated daily dose was 24 mg/0.35 kg/749 days = 0.09 mg/kg/day, which is a relatively small dose when compared to dose groups in other cigarette smoke experiments. Nevertheless, 14 of the 58 eligible dosed animals developed epidermoid carcinoma so that the lower bound, maximum likelihood, and upper bound estimates of dose corresponding to an extra risk of one in four are 1.34×10^{-2}, 2.02×10^{-2}, and 3.25×10^{-2} mg/kg/day, respectively, when mg/m^2/day are the units used in animal-to-human extrapolation. For comparison, the lower bound, maximum likelihood, and upper bound estimates obtained directly from the epidemiological investigation are 2.79×10^2, 6.41×10^2, and 1.47×10^3, respectively.

Of the inhalation studies, that by Hammond et al. (3) provided the smallest RRD estimates. In this case male beagles were given tracheostomies, so that they could smoke cigarettes directly through the holes in their tracheas. The control group, consisting of 8 dogs, got tracheostomies but no cigarettes. Over the entire 125 weeks of the experiment, a low dose group received an average of 1754.6 mg/day and a high dose group received 3452.7 mg/day of cigarette smoke. These doses were calculated using data given in the study about the weight of smoke per cigarette and the number of cigarettes per day. Lung cancers appeared significantly more often in the dosed group: only 2 out of 8 controls developed lung cancers (nonmalignant), whereas 7 of 12 low-dose animals and 19 of 24 high-dose animals developed lung cancer (0 of 12, and 10 of 24, respectively, had malignant lung tumors). Adjusting for the shortness of the experiment (312 weeks is considered a standard duration for a dog experiment) the calculated RRD lower bound, MLE, and upper bound are 1.73, 3.11, and 8.39 mg/kg/day, respectively, when mg/m^2/day are the units used in animal-to-human extrapolation.

If attention is limited to inhalation experiments of fairly long duration, the one by Bernfeld et al. (4) yields the smallest RRD estimates. This experiment utilized a smoking machine to expose male hamsters to the smoke of four cigarettes twice a day, five days per week. Equations 2-1 and 2-2 were used to calculate an average daily dose of 150

$mg/m^2/day$ for the single exposed group. In that group, laryngeal tumors developed in 9 of the 29 eligible animals compared to 0 of the 13 eligible controls. Again, if one uses $mg/m^2/day$ as the units for animal-to-human extrapolation the lower bound, MLE, and upper bound RRDs are 9.95, 1.65×10^1, and 3.18×10^1 mg/kg/day, respectively, values closer to those derived from the epidemiology than those reported for previous studies. If mg/kg/day are the units assumed to give equivalence between animals and humans, the three RRD estimates are 6.98×10^1, 1.16×10^2, and 2.23×10^2, which are even closer to the epidemiologically derived values.

One further example will serve to confirm that several bioassays performed using various species in our data base underestimate RRDs for cigarette smoke in comparison with the direct epidemiological estimates. (Note, however, that some, for example the inhalation study of rats by Dalbey *et al.* (5) in which subcutaneous sarcoma was the only significantly increased tumor among treated animals, do yield estimates that are larger than the epidemiologically based estimates). DiPaolo and Levin (6) tested female mice by painting the oral cavity with a solution of whole tar. The daily dose (for 5 days per week, 63 weeks of the 82 week experiment) was 26 mg of whole tar. Although only the lungs were examined for carcinogenesis, the treated group of 81 animals contained 52 that developed lung tumors whereas 20 of 89 control animals developed such cancers. The calculation of RRDs, including adjustment for the length of the experiment (82 as opposed to the standard 104 weeks), yields values of 6.03, 8.22, and 1.21×10^1 mg/kg/day as the lower bound, maximum likelihood, and upper bound estimates corresponding to a one-in-four risk. Again, $mg/m^2/day$ are the units used in the animal-to-human extrapolation.

3,3-DICHLOROBENZIDENE

Eight carcinogenicity bioassay data sets are included in the data matrix (Table 2-33). Five of these data sets, all employing the oral route of exposure, are suitable for risk assessment (Table 2-34). None of the experiments in the data base tested mice.

1,2-DICHLOROETHANE (ETHYLENE DICHLORIDE)

Fourteen carcinogenicity bioassay data sets are included in the data matrix (Table 2-35); eight are considered suitable for risk assessment (Table 2-36). The remaining data sets were excluded because dosing information was non-specific. Skin painting experiments have not been included.

DICHLOROMETHANE

Fourteen carcinogenic bioassay data sets are included in the data matrix (Table 2-37). Of these, twelve were considered suitable for risk assessment (Table 2-38).

DIETHYLSTILBESTROL

The data sets for diethylstilbestrol in the data matrix are summarized in Table 2-39. Eighty-one carcinogenicity bioassay data sets are represented in the data matrix and, of these, sixteen were abstracted for analysis. A summary of these data sets is presented in Table 2-40.

Of the eighty-one data sets available for analysis, ten employed subcutaneous injection as the route of exposure and were not coded. Thirty-six data sets employed implantation of diethylstilbestrol pellets, with only five of these data sets considered suitable for analysis. Many of these implantation studies did not use adequate controls or did not sufficiently identify dosing. Several studies employed unacceptable vehicles or used inappropriate animals, such as castrated males or carriers of the mammary tumor virus.

The transplacental studies from which data were abstracted present some unique problems in determination of exposure. It is necessary first to assume that 100% of the administered dose crossed the placental barrier, and that the entire dose was equally divided among the fetuses with 100% absorption by each fetus. The dose per dam is then divided by the actual litter size, if stated, or the average litter size for the species

tested. If the administered dose was expressed in units/body weight of the dam, this is first converted to simple units (by multiplying by the average dam body weight) before dividing by litter size, rather than attempting to report dosage in units/dam body weight/fetus.

DIPHENYLHYDRAZINE

A summary of the data sets in the data matrix for diphenylhydrazine is presented in Table 2-41. There is very little information available on this chemical and only two carcinogenicity experiments are included in the data matrix. Although the route of administration employed in one study was subcutaneous injection, this data set is included in the analysis due to the lack of data available for this chemical. The data set is summarized in Table 2-42.

EPICHLOROHYDRIN

Seven carcinogenicity bioassay data sets are included in the data matrix (Table 2-43) three of which are suitable for risk assessment (Table 2-44). The remaining data sets were either subcutaneous injection or skin painting studies.

ESTROGEN

The data sets in the data matrix for estrogen are summarized in Table 2-45. Thirty-four carcinogenicity bioassay data sets are included in the data matrix; only two are considered suitable for analysis. A summary of these two experiments is presented in Table 2-46.

Of the thirty-four data sets available for analysis, twelve were excluded due to lack of appropriate controls. An additional ten data sets were excluded because of insufficient dosing information. Two specific types of estrogen (17-B-estradiol, mestranol) are included in the data matrix in addition to the general designation estrogen, and are identified by unique CAS numbers.

ETHYLENE DIBROMIDE

The data sets in the data matrix for ethylene dibromide are summarized in Table 2-47. Nineteen carcinogenicity bioassay data sets are included in the data matrix, ten of which were abstracted for analysis and summarized in Table 2-48.

Four of the nineteen data sets were obtained from a study which gave no length of experiment. The remaining data sets that were not selected for analysis were taken from abstracts of articles and did not provide sufficient information for analysis.

ETHYLENE OXIDE

A summary of the ethylene oxide bioassays in the data matrix is presented in Table 2-49. Fifteen carcinogenicity bioassay data sets are included in the data matrix. Of these, ten are considered suitable for risk assessment and are summarized in Table 2-50. All experiments in the data base employed rats as the test species.

FORMALDEHYDE

There are fifteen carcinogenic bioassay data sets included in the data matrix (Table 2-51) of which ten are suitable for risk assessment. Those that are suitable for risk assessment were abstracted for analysis and are summarized in Table 2-52.

HEXACHLOROBENZENE

Seven carcinogenicity bioassay data sets are listed in the data matrix (Table 2-53), six of which are suitable for risk assessment. These six are described in Table 2-54.

HYDRAZINE

Thirty-one carcinogenicity bioassay data sets are included in the data matrix (Table 2-55); 19 were abstracted for analysis. These data sets are summarized in Table 2-56. The remaining data sets were not considered suitable due to lack of specific tumor data, or lack of control groups.

ISONIAZID

A total of sixty-six carcinogenicity bioassay data sets are included in the data matrix (Table 2-57), forty of which are suitable for risk assessment. These latter are summarized in Table 2-58. The remaining data sets were excluded due to the routes of exposure (subcutaneous injection), insufficient information (no number of animals, no specific tumor incidences) or poor experimental protocols (no controls, unacceptable vehicle).

LEAD

A summary of the data sets in the data matrix for lead compounds is presented in Table 2-59. Thirty-three carcinogenicity bioassay data sets are included in the data matrix. Of these, fifteen are abstracted for analysis. This bioassay data is summarized in Table 2-60.

Studies were excluded from analysis due to one or more of several deficiencies, such as lack of appropriate controls or multiple routes of exposure. In several studies, the number of tumors rather than the number of animals with a particular tumor was reported. Several lead compounds are included in this chemical classification, and are identified with unique CAS numbers, enabling examination of the group as a generic entity or as the individual compounds. Lead arsenate studies are not included in this group, but are instead classified under the arsenic group.

MELPHALAN

The data sets in the data matrix for melphalan are summarized in Table 2-61. Seven carcinogenicity bioassays are included in the data matrix, and of these, one is considered suitable for analysis. This carcinogenicity bioassay is summarized in Table 2-62.

METHOTREXATE

Methotrexate data sets included in the data matrix are summarized in Table 2-63. There are a total of sixteen data sets of which six are considered suitable for risk assessment. These data sets are summarized in Table 2-64.

MUSTARD GAS

Of the available information on the carcinogenicity of mustard gas in animal bioassays, four data sets were abstracted from the literature and included in the data matrix (Table 2-65). The data sets that are included in risk assessment analyses are summarized in Table 2-66.

2-NAPHTHYLAMINE

A summary of the data sets in the data matrix for 2-naphthylamine is presented in Table 2-67. Thirty-seven carcinogenicity bioassay data sets are included in the data matrix. Many of these studies are older (pre-1980) studies, and many utilized dogs as the test animal and were poorly controlled. Twenty-one are considered suitable for risk assessment. This carcinogenicity bioassay data is summarized in Table 2-68.

NICKEL

Seventy-seven carcinogenicity bioassay data sets are listed in the data matrix (Table 2-69), of which 28 were suitable for risk assessment (Table 2-70). The data sets that are not suitable for this risk

analysis are those that did not use control animals, reported number of tumors instead of number of animals with tumors, or did not report the number of animals being tested.

Only a small number of the data sets used for risk analysis involved the use of elemental nickel. Therefore, data sets which utilized nickel compounds are abstracted for analysis. These nickel compounds include nickel carbonyl, nickel subsulfide, nickel acetate, nickel monosulfide and nickel-iron-sulfide matte. Each compound is identified by its own CAS number.

NITRILOTRIACETIC ACID

Eighteen carcinogenic bioassay data sets are listed in the data matrix (Table 2-71). Of these, fifteen are suitable for risk assessment and are summarized in Table 2-72.

PHENACETIN

The data sets in the data matrix for phenacetin are summarized in Table 2-73. Twenty-one carcinogenicity bioassay data sets are included in the data matrix. Of these, twelve are considered suitable for analysis. A summary of this carcinogenicity bioassay data is presented in Table 2-74.

POLYCHLORINATED BIPHENYLS

The data sets in the data matrix for polychlorinated biphenyls are summarized in Table 2-75. Twelve carcinogenicity bioassay data sets are included in the matrix, and of these, six are considered suitable for our analysis. A summary of this carcinogenicity bioassay data is presented in Table 2-76. The data sets which were abstracted for analysis are primarily studies on Aroclor 1254 or Aroclor 1260 (Aroclor is the registered trademark of the Monsanto Chemical Company for their polychlorinated biphenyls).

RESERPINE

The reserpine experiments in the data matrix are summarized in Table 2-77. There is little data available for this chemical. Six carcinogenicity bioassay data sets are included in the data matrix, of which four were abstracted for analysis. A summary of the suitable bioassay data is presented in Table 2-78.

SACCHARIN

A summary of the data sets in the data matrix for saccharin is presented in Table 2-79. Twenty-seven carcinogenicity bioassay data sets are included in the data matrix and, of these, eighteen were abstracted for analysis. The appropriate bioassay data is summarized in Table 2-80. The bioassay reported by R. A. Squire in "Histopathological Evaluation of Rat Urinary Bladders from the IRDC Two-Generation Bioassay of Sodium Saccharin" (Fd. Chem. Toxic. 23(4/5):491-497) was inadvertently omitted.

2,3,7,8-TETRACHLORODIBENZO-*P*-DIOXIN (TCDD)

A summary of the data sets in the data matrix for TCDD is presented in Table 2-81. Nineteen carcinogenicity bioassay data sets are included in the data matrix. Of these, ten were abstracted for analysis. This carcinogenicity bioassay data is summarized in Table 2-82. Most of the data sets which were excluded from the analysis employed subcutaneous injection as the route of administration. There are two studies abstracted for analysis which employed dermal exposure, the route determined to be most pertinent to human exposure for this chemical.

TETRACHLOROETHYLENE

The tetrachloroethylene experiments in the data matrix are summarized in Table 2-83. Fourteen carcinogenicity bioassay data sets are included in the matrix, of which eight are considered suitable for risk assessment. A summary of the suitable data is presented in Table 2-84.

TOXAPHENE

Only one study, containing four carcinogenicity bioassays, is listed in the data matrix (Table 2-85). All four of these data sets were abstracted for analysis and are summarized in Table 2-86.

TRICHLOROETHYLENE

The data sets in the data matrix for trichloroethylene are summarized in Table 2-87. Thirty-four carcinogenicity bioassay data sets are included in the matrix and, of these, twenty-two were abstracted for analysis. The abstracted bioassay data are summarized in Table 2-88.

2,4,6-TRICHLOROPHENOL

The data sets for trichlorophenol that are included in the data matrix are summarized in Table 2-89 and those data sets included in the data base are summarized in Table 2-90.

VINYL CHLORIDE

Data matrix information on vinyl chloride is summarized in Table 2-91. Sixty-five carcinogenesis bioassay data sets are included in the data matrix. Of these, fifty-six were abstracted for the data base, and are summarized in Table 2-92. Twenty-seven of those data sets abstracted for analysis are taken from *Experimental Research on Vinyl Chloride Carcinogenesis* (7).

VINYLIDENE CHLORIDE

A summary of the data sets in the data matrix for vinylidene chloride is presented in Table 2-93. Forty-six carcinogenicity bioassay data sets are included in the data matrix. Of these, thirty-two were abstracted for analysis. This carcinogenicity bioassay data is summarized in Table 2-94.

Table 2-1

SUMMARY OF CARCINOGENIC DATA SETS FOR ACRYLONITRILE[a]

Animal Model		Route of Administration							
Species	Sex	Oral	Gavage	Inhalation	Subcu-taneous	Skin Painting	Injection	Instil-lation	TP
Mouse	Male	0	0	0	0	0	0	0	0
Mouse	Female	0	0	0	0	0	0	0	0
Mouse	Mixed[b]	0	0	0	0	0	0	0	0
Rat	Male	4(4)[c]	2(2)	3(3)	0	0	0	0	0
Rat	Female	5(5)	2(2)	3(3)	0	0	0	0	0
Rat	Mixed	0	0	0	0	0	0	0	0
Other	Male	0	0	0	0	0	0	0	0
Other	Female	0	0	0	0	0	1(0)	0	0
Other	Mixed	0	0	0	0	0	0	0	0

[a]There were a total of 19 data sets of which 19 were considered suitable for risk assessment.

[b]The "mixed" sex indicates that either both sexes were tested, but results were not reported separately, or sex of test animal was unknown.

[c]The number in parenthesis indicates the number of data sets that were considered suitable for risk assessment, and were further abstracted for inclusion in the data base and subsequent analyses.

Table 2-2

SUMMARY OF ACRYLONITRILE CARCINOGENIC BIOASSAY DATA

Species	Route of Administration	Nature of Exposure	Lowest Effective Dose	Highly Affected Organ(s)	Reference
Rat Spartan Sprague-Dawley Male	Inhalation	0, 20 or 80 ppm 6 hrs/day, 5 days/week for length of experiment (104 weeks); 100 controls, 100/dose group.	20 ppm	Nervous system (brain/spinal cord)	Quast *et al.*, in EPA (8)
Rat Spartan Sprague-Dawley Female	Inhalation	0, 20 or 80 ppm 6 hrs/day, 5 days/week for length of experiment (104 weeks); 100 controls, 100/dose group.	20 ppm	Mammary gland Nervous system (brain/spinal cord)	Quast *et al.*, in EPA (8)
Rat Spartan Sprague-Dawley Male	Gavage	0, 0.1 or 10.0 mg/kg/day 5 days/week for length of experiment (86 weeks); 100 controls, 100/dose group.	0.1 mg/kg/day	Stomach	Bio/Dynamics, in EPA (8)
Rat Spartan Sprague-Dawley Female	Gavage	0, 0.1 or 10.0 mg/kg/day 5 days/week for length of experiment (86 weeks); 101 controls, 100 dosed (0.1 mg/kg/day), 101 dosed (10.0 mg/kg/day).	0.1 mg/kg/day	Mammary gland	Bio/Dynamics, in EPA (8)
Rat Fischer 344 Male	Oral-water	0, 1, 3, 10, 30 and 100 ppm continuously for length of experiment (111 weeks); 200 controls, 100/dose group.	1 ppm	Brain	Bio/Dynamics, in EPA (8)

Table 2-2 (continued)

SUMMARY OF ACRYLONITRILE CARCINOGENIC BIOASSAY DATA

Species	Route of Administration	Nature of Exposure	Lowest Effective Dose	Highly Affected Organ(s)	Reference
Rat Fischer 344 Female	Oral-water	0, 1, 3, 10, 30 and 100 ppm continuously for length of experiment (99 weeks); 200 controls, 100/dose group.	1 ppm	Brain	Bio/Dynamics, in EPA (8)
Rat Charles River Female	Oral-water	0, 100, 500 ppm water continuously for 20 weeks; length of experiment 45 weeks; 39 controls, 39 dosed (100 ppm), 42 dosed (500 ppm).	100 ppm	Brain	Belilos *et al.*, in EPA (8)
Rat Sprague-Dawley Male	Oral-water	0 or 35 ppm continuously for length of experiment; 85 or 210 ppm continuously for 3 weeks, then raised to 100 or 300 ppm, respectively for remainder of experiment; length of experiment 106 weeks; 80 controls, 48/dose group.	35 ppm	Stomach	Quast *et al.*, in EPA (8)
Rat Sprague-Dawley Female	Oral-water	0 or 35 ppm continuously for length of experiment; 85 or 210 ppm continuously for 3 weeks, then raised to 100 or 300 ppm, respectively for remainder of experiment; length of experiment 106 weeks; 80 controls, 48/dose group.	35 ppm	Mammary gland	Quast *et al.*, in EPA (8)

Table 2-2 (continued)

SUMMARY OF ACRYLONITRILE CARCINOGENIC BIOASSAY DATA

Species	Route of Administration	Nature of Exposure	Lowest Effective Dose	Highly Affected Organ(s)	Reference
Rat Spartan Sprague-Dawley Male	Oral-water	0, 1 or 100 ppm continuously for length of experiment (94 weeks); 100 controls, 100/dose group.	1 ppm	Brain	Bio/Dynamics, in EPA (8)
Rat Spartan Sprague-Dawley Female	Oral-water	0, 1 or 100 ppm continuously for length of experiment (81 weeks); 100 controls, 100/dose group.	1 ppm	Brain	Bio/Dynamics, in EPA (8)
Rat Sprague-Dawley Male	Inhalation	0, 5, 10, 20 or 40 ppm 4 hrs/day, 5 days/week for 52 weeks; length of experiment 134 weeks); 30 controls, 30/dose group.	--	None	Maltoni *et al.* (9)
Rat Sprague-Dawley Female	Inhalation	0, 5, 10, 20 or 40 ppm 4 hrs/day, 5 days/week for 52 weeks; length of experiment 134 weeks; 30 controls, 30/dose group.	--	None	Maltoni *et al.* (9)
Rat Sprague-Dawley Male	Gavage	0 or 5 mg/kg 3 times a week for 52 weeks; length of experiment 130 weeks; 75 controls, 40 dosed.	--	None	Maltoni *et al.* (9)
Rat Sprague-Dawley Female	Gavage	0 or 5 mg/kg 3 times a week for 52 weeks; length of experiment 130 weeks; 75 controls, 40 dosed.	--	None	Maltoni *et al.* (9)

Table 2-2 (continued)

SUMMARY OF ACRYLONITRILE CARCINOGENIC BIOASSAY DATA

Species	Route of Administration	Nature of Exposure	Lowest Effective Dose	Highly Affected Organ(s)	Reference
Rat Sprague-Dawley Male	Inhalation	0, 5, 10, 20 or 40 ppm 5 days/week, 4 hrs/day for 52 weeks; length of experiment 136 weeks; 30/dose group.	20 ppm	None	Maltoni *et al.* (10)
Rat Sprague-Dawley Female	Inhalation	0, 5, 10, 20 or 40 ppm 5 days/week, 4 hrs/day for 52 weeks; length of experiment 136 weeks; 30/dose group.	5 ppm	None	Maltoni *et al.* (10)
Rat Sprague-Dawley Male	Gavage	0 or 5 mg/kg 3 times a week for 52 weeks; length of experiment 131 weeks; 77 controls, 40 dosed.	--	None	Maltoni *et al.* (10)
Rat Sprague-Dawley Female	Gavage	0 or 5 mg/kg 3 times a week for 52 weeks; length of experiment 131 weeks; 82 controls, 40 dosed.	--	None	Maltoni *et al.* (10)

Table 2-3

SUMMARY OF CARCINOGENIC DATA SETS FOR AFLATOXIN[a]

Animal Model		Route of Administration							
Species	Sex	Oral	Gavage	Inhalation	Subcu-taneous	Skin Painting	Injection	Instil-lation	TP
Mouse	Male	0	1(1)[b]	1(1)	1(1)	0	1(1)	0	0
Mouse	Female	0	0	0	0	0	2(0)	0	0
Mouse	Mixed[c]	0	0	0	0	0	0	0	0
Rat	Male	23(14)	10(2)	0	1(0)	0	5(0)	0	0
Rat	Female	6(4)	3(1)	0	0	0	0	0	0
Rat	Mixed	7(5)	0	0	0	0	0	0	0
Other	Male	3(1)	0	0	0	0	0	0	0
Other	Female	4(1)	0	0	0	0	0	0	0
Other	Mixed	15(1)	1(0)	0	0	2(0)	0	0	0

[a]There were a total of 88 data sets of which 33 were considered suitable for risk assessment.

[b]The number in parenthesis indicates the number of data sets that were considered suitable for risk assessment, and were further abstracted for inclusion in the data base and subsequent analyses.

[c]The "mixed" sex indicates that either both sexes were tested, but results were not reported separately, or sex of test animal was unknown.

Table 2-4

SUMMARY OF AFLATOXIN CARCINOGENIC BIOASSAY DATA

Species	Route of Administration	Nature of Exposure	Lowest Effective Dose	Highly Affected Organ(s)	Reference
Mouse C57BLXC3H F1 Male	Intraperitoneal injection	100 animals injected with vehicle (0 μg/kg) at 1 day of age; 22 animals received a single injection of 2,000 μg/kg at 1 day of age; 29 or 16 animals received either 1,000 or 2,000 μg/kg, respectively, at 4, 7 and 10 days of age; 18 animals received 250 μg/kg at 4, 7, 10, 13 or 17 days of age; and 20 animals received a single dose of 6,000 μg/kg at 7 days of age. All animals sacrificed at 82 weeks.	250 μg/kg	Liver	Vesselinovitch *et al.* (11)
Rat Buffalo Male	Oral-food	0 or 1 ppm continuously for 35 weeks. Observed 65 weeks. 25 controls, 21 dosed.	1 ppm	Liver	Angsubhakorn *et al.* (12)
Rat Sprague-Dawley Male & Female	Oral-food	0 or 0.006 ppm for 95 weeks (end of experiment). 90/dose group.	None		Fong and Chan (13)

Table 2-4 (continued)

SUMMARY OF AFLATOXIN CARCINOGENIC BIOASSAY DATA

Species	Route of Administration	Nature of Exposure	Lowest Effective Dose	Highly Affected Organ(s)	Reference
Rat Wistar-Porton Female	Gavage	0, 5.1 or 7.65 mg/kg as a single dose, 19 controls, 18 in the mid dose, 16 in the high dose. Length of experiment was 139 weeks.	5.1 mg/kg	Liver	Carnaghan (14)
Rat Fischer Male	Oral-food	0, 1, 0.3 or 0.015 ppm for 82 weeks and killed; 1 ppm for 3 weeks and observed for 80 weeks. 25/dose group.	0.015 ppm	Liver	Wogan and Newberne (15)
Rat Fischer Female	Oral-food	0, 1, 0.3 or 0.015 ppm for 82 weeks and killed; 1 ppm for 3 weeks and observed for 80 weeks. 25/dose group.	0.015 ppm	Liver	Wogan and Newberne (15)
Rat Porton Albino Male	Oral-food	0 or 10 ppm continuous dosing for 9 weeks, then control diet to 104 weeks. 10 controls, 20/dose group.	10 ppm	Liver	McLean and Marshall (16)
Monkey Rhesus & Cynomolgus Male & Female	Oral-food & intraperitoneal injection	0 or 1.78 mg dosing once a week for length of experiment (676 weeks). 211 controls, 21 dosed.	1.78 mg	Gall bladder; Liver	Sieber *et al.* (17)
Rat Charles River CD Male	Oral-food	0 or 1 ppm continuous dosing for length of experiment (60 weeks). 10/dose group.	1 ppm	Liver	Newberne *et al.* (18)

Table 2-4 (continued)

SUMMARY OF AFLATOXIN CARCINOGENIC BIOASSAY DATA

Species	Route of Administration	Nature of Exposure	Lowest Effective Dose	Highly Affected Organ(s)	Reference
Rat Charles River CD Male	Oral-food	0 or 0.2 ppm continuously for length of experiment (71 weeks). 20 controls, 35 dosed.	0.2 ppm	Liver	Newberne & Williams (19)
Rat Long Evans Male	Oral-food	0 or 0.018 or 0.184 ppm for 52 weeks. Terminated at 77 weeks. 10/group.	--	None	Lee *et al.* (20)
Rat Long Evans Male	Oral-food	0, 0.552 or 0.736 ppm for 51 weeks (length of experiment). 10 controls, 10 in low dose, 15 in high dose.	0.552 ppm	Kidney	Lee *et al.* (20)
Rat Fischer 344 Female	Oral-food	0 or 2 ppm for 75 weeks (length of experiment). 12 in controls, 19 in treated.	--	None	Ward *et al.* (21)
Rat Fischer 344 Male	Oral-food	0 or 2 ppm for 75 weeks (length of experiment). 6/dose group.	--	None	Ward *et al.* (21)
Rat Wistar Male	Oral-food	0, 0.25, 0.5 or 1.0 ppm for 21 weeks. Observed for 131 weeks (life). 26 controls, 17 in low dose, 18 in mid dose, and 16 in high dose.	0.25 ppm	Liver	Epstein *et al.* (22)

Table 2-4 (continued)

SUMMARY OF AFLATOXIN CARCINOGENIC BIOASSAY DATA

Species	Route of Administration	Nature of Exposure	Lowest Effective Dose	Highly Affected Organ(s)	Reference
Monkey Cynomolgus Male	Oral-food	0 or 0.07, up to 0.36 or 1.8 ppm for 160 weeks (length of experiment). 2 controls, 2 in low and mid dose, 4 in high dose.	--	None	Cuthbertson *et al.* (23)
Monkey Cynomolgus Female	Oral-food	0 or 0.07, up to 0.35 or 1.8 ppm for 160 weeks (length of experiment). 3 controls, 2 in low and mid dose, 3 in high dose.	--	None	Cuthbertson *et al.* (23)
Rat MRC Male & Female	Oral-water	0 or 0.1 mg 5 days/week for 10 weeks or 0.02 mg 5 days/week for 20 weeks (length of experiment, 100 weeks). 30 controls, 10 in low dose and 30 in high dose.	0.02 mg	Liver	Butler *et al.* (24)
Rat MRC Male & Female	Oral-water	0 or 0.02 mg 5 days/week for 10 weeks; length of experiment 100 weeks; 30 controls, 10 dosed.	--	None	Butler *et al.* (24)

Table 2-4 (continued)

SUMMARY OF AFLATOXIN CARCINOGENIC BIOASSAY DATA

Species	Route of Administration	Nature of Exposure	Lowest Effective Dose	Highly Affected Organ(s)	Reference
Rat MRC Male & Female	Oral-water	0 or 0.02 mg 5 days week for 10 weeks or 0.02 mg 5 days/week for 20 weeks, 0.08 mg 5 days/week for 20 weeks. 30 controls, 10 in low dose for 10 weeks, 30 in low dose for 20 weeks, and 28 in high dose; observed 100 weeks.	0.06 mg	Liver	Butler *et al.* (24)
Rat Fischer 344 Male	Oral-food	0 or 50 ppb for 52 weeks; observed for 114 weeks, 20/dose group.	50 ppb	Liver	Nixon *et al.* (25)
Rat Porton Male	Oral-food	0, 0.1 or 0.5 ppm for 130 weeks, 51 in control, 48 in 0.1 ppm group and 38 in 0.5 ppm group; other groups fed 5 ppm for 1, 3, 6 or 9 weeks and observed for 130 weeks, 15 in 1 week group, 20 in 3 weeks, 22 in 6 weeks, and 6 in 9 weeks.	5 ppm (6 weeks)	Liver	Butler and Barnes (26)
Rat Porton Female	Oral-food	0, 0.1 or 0.5 ppm for 130 weeks, 36/dose group.	0.1 ppm	Liver	Butler and Barnes (26)

Table 2-4 (continued)

SUMMARY OF AFLATOXIN CARCINOGENIC BIOASSAY DATA

Species	Route of Administration	Nature of Exposure	Lowest Effective Dose	Highly Affected Organ(s)	Reference
Rat Fischer 344 Male & Female	Oral-per os	0 or 0.025 mg for 20 weeks, observed 77 weeks, 28 controls, 37 dosed.	0.025 mg	Liver	Chedid *et al.* (27)
Rat Fischer 344 Male	Oral-food	0, 1, 5, 15, 50 and 100 ppb for up to 109 weeks (length of experiment). 18 controls 21-28/dose group.	50 ppb	Liver	Wogan *et al.* (28)
Rat USC Male	Oral-food	0, 1 or 10 ppb for 104 weeks (length of experiment). 24/dose group.	--	None	Alfin-Slater *et al.* (29)
Rat USC Female	Oral-food	0, 1 or 10 ppb for 104 weeks (length of experiment). 24/dose group.	--	None	Alfin-Slater *et al.* (29)
Mouse Swiss Male	Gavage	0 or 0.1 mg 5 days/week for 52 weeks (length of experiment). 37 controls, 14 dosed.	0.1	Lymphatics	Louria *et al.* (30)
Mouse Swiss Male	Subcutaneous injection	0 or 0.1 mg 5 days/week for 52 weeks (length of experiment), 37 controls, 15 dosed.	--	None	Louria *et al.* (30)
Rat Charles River Male	Oral-food	0, 0.4 or 1.5 ppm for up to 87 weeks (length of experiment). 9 controls, 20 low dose, 10 in high dose.	0.4 ppm	Liver	Newberne *et al.* (31)

Table 2-4 (continued)

SUMMARY OF AFLATOXIN CARCINOGENIC BIOASSAY DATA

Species	Route of Administration	Nature of Exposure	Lowest Effective Dose	Highly Affected Organ(s)	Reference
Rat Fischer Male	Gavage	0 or 25 μg/day, 5 days/week for 8 weeks. Length of experiment 100 weeks. 15 controls, 30 dosed.	--	None	Wogan and Paglialunga (32)
Rat Fischer Male	Gavage	0 or 25 μg/day 5 days/week for 8 weeks. Length of experiment 100 weeks (dosed animals killed at 53 weeks). 15 controls, 10 dosed.	25 μg	Liver	Wogan and Paglialunga (32)
Mouse Swiss Male	Inhalation	0 or 1 mg of aerosol 2 times/day for 3 months, then 1 time/day for 9 months. 37 controls, 22 dosed. Length of experiment 12 months.	1 mg	Lymphatics	Louria *et al.* (30)

Table 2-5

SUMMARY OF CARCINOGENIC DATA SETS FOR ALLYL CHLORIDE[a]

Animal Model		Route of Administration							
Species	Sex	Oral	Gavage	Inhalation	Subcu-taneous	Skin Painting	Injection	Instil-lation	TP
Mouse	Male	1(1)[b]	0	0	0	0	0	0	0
Mouse	Female	1(1)	0	0	1(0)	1(0)	0	0	0
Mouse	Mixed[c]	0	0	0	0	0	0	0	0
Rat	Male	1(1)	0	0	0	0	0	0	0
Rat	Female	1(1)	0	0	0	0	0	0	0
Rat	Mixed	0	0	0	0	0	0	0	0
Other	Male	0	0	0	0	0	0	0	0
Other	Female	0	0	0	0	0	0	0	0
Other	Mixed	0	0	0	0	0	0	0	0

[a]There were a total of 6 data sets of which 4 were considered suitable for risk assessment.

[b]The number in parenthesis indicates the number of data sets that were considered suitable for risk assessment, and were further abstracted for inclusion in the data base and subsequent analyses.

[c]The "mixed" sex indicates that either both sexes were tested, but results were not reported separately, or sex of test animal was unknown.

Table 2-6

SUMMARY OF ALLYL CHLORIDE CARCINOGENIC BIOASSAY DATA

Species	Route of Administration	Nature of Exposure	Lowest Effective Dose	Highly Affected Organ(s)	Reference
Rat Osborne-Mendel Male	Gavage	Animals received time-weighted average doses of 0, 57 or 77 mg/kg 5 days/week for 78 weeks; length of experiment 110 weeks; 20 animals/control, 50/dose group.	--	None	NCI (33)
Rat Osborne-Mendel Female	Gavage	Animals received time-weighted average doses of 0, 55 or 73 mg/kg 5 days/week for 78 weeks; length of experiment 110 weeks; 20 animals/control, 50/dose group.	--	None	NCI (33)
Mice $B6C3F_1$ Male	Gavage	Animals received time-weighted average doses of 0, 172 or 199 mg/kg 5 days/week for 78 weeks; length of experiment 91 weeks; 20/control, 50/dose group.	--	None	NCI (33)
Mice $B6C3F_1$ Female	Gavage	Animals received time-weighted average doses of 0, 129 or 258 mg/kg 5 days/week for 90 weeks; length of experiment 92 weeks, 20/control, 50/dose group.	--	None	NCI (33)

Table 2-7

SUMMARY OF CARCINOGENIC DATA SETS FOR 4-AMINOBIPHENYL[a]

Animal Model		Route of Administration							
Species	Sex	Oral	Gavage	Inhalation	Subcu-taneous	Skin Painting	Injection	Instil-lation	TP
Mouse	Male	1(1)[b]	0	0	0	0	0	0	0
Mouse	Female	1(1)	0	0	0	0	0	0	0
Mouse	Mixed[c]	0	0	0	0	0	0	0	0
Rat	Male	1(0)	0	0	0	0	0	0	0
Rat	Female	0	0	0	0	0	0	0	0
Rat	Mixed	0	0	0	0	0	0	0	0
Other	Male	0	0	0	0	0	0	0	0
Other	Female	3(0)	0	0	0	0	0	0	0
Other	Mixed	2(1)	0	0	0	0	0	0	0

[a]There were a total of 8 data sets of which 2 were considered suitable for risk assessment.

[b]The number in parenthesis indicates the number of data sets that were considered suitable for risk assessment, and were further abstracted for inclusion in the data base and subsequent analyses.

[c]The "mixed" sex indicates that either both sexes were tested, but results were not reported separately, or sex of test animal was unknown.

Table 2-8

SUMMARY OF 4-AMINOBIPHENYL CARCINOGENIC BIOASSAY DATA

Species	Route of Administration	Nature of Exposure	Lowest Effective Dose	Highly Affected Organ(s)	Reference
Mouse BALB/c StCrlf C_3Hf/ Nctr Male	Oral-water	0, 7, 14, 28, 55, 110 and 220 ppm in drinking water; serial sacrifices at 13, 26, 39, 52 and 96 weeks (length of experiment); only natural deaths and terminal sacrifice information utilized; approximately 30-60/ dose group died natural deaths or were sacrificed at 96 weeks.	55 ppm	Bladder; Subcutaneous tissue	Schieferstein *et al.* (34)
Mouse BALB/c StCrlf C_3Hf/ Nctr Female	Oral-water	0, 7, 19, 38, 75, 150 or 300 ppm in drinking water; serial sacrifices at 13, 26, 39 52 and 96 weeks (length of experiment); only natural deaths and terminal sacrifice information utilized; approximately 30-60/ dose group died natural deaths or were sacrificed at 96 weeks.	75 ppm	Liver; Subcutaneous tissue	Schieferstein *et al.* (34)

Table 2-9

SUMMARY OF CARCINOGENIC DATA SETS FOR ARSENIC[a]

Animal Model		Route of Administration							
Species	Sex	Oral	Gavage	Inhalation	Subcu-taneous	Skin Painting	Injection	Instil-lation	TP
Mouse	Male	2(0)[b]	0	0	0	1(1)	0	0	0
Mouse	Female	6(1)	0	1(0)	0	1(1)	0	0	0
Mouse	Mixed[c]	3(1)	0	0	0	0	0	0	0
Rat	Male	3(2)	0	0	0	0	1(1)	2(2)	0
Rat	Female	3(2)	0	0	0	0	1(1)	0	0
Rat	Mixed	4(3)	0	0	0	0	1(1)	0	0
Other	Male	0	0	0	0	0	0	0	0
Other	Female	0	0	0	0	0	0	1(1)	0
Other	Mixed	2(0)	0	0	0	0	1(0)	0	0

[a]There were a total of 33 data sets of which 17 were considered suitable for risk assessment.

[b]The number in parenthesis indicates the number of data sets that were considered suitable for risk assessment, and were further abstracted for inclusion in the data base and subsequent analyses.

[c]The "mixed" sex indicates that either both sexes were tested, but results were not reported separately, or sex of test animal was unknown.

Table 2-10 (continued)

SUMMARY OF ARSENIC CARCINOGENIC BIOASSAY DATA

Species	Route of Administration	Nature of Exposure	Lowest Effective Dose	Highly Affected Organ(s)	Reference
Rat Wistar-King Albino Male	Intratracheal instillation	0 or 0.26 mg once a week for 15 weeks; length of experiment 97 weeks; 23 controls, 14 dosed.	--	None	Ishinishi *et al.* (41)
Mice C_3H/St Female	Oral-water	0 or 2 ppm in water continuously for length of experiment (86 weeks); 30/dose group.	--	None	Schrauzer *et al.* (42)
Hamster Syrian Golden Female	Intratracheal instillation	Instilled once a week according to following schedule: 0 mg for 15 weeks; 1 mg for 1 week, then 0.5 mg for 3 weeks, then 0.25 mg for 11 weeks; or 0.25 mg for 15 weeks; observed 105 weeks total; 50 controls, 20 or 30/dose group.	0.25 mg	Lung	Ishinishi *et al.* (43)
Mice Swiss Male & Female	Oral-per os	0 or 0.38 mg/kg/day continuously for length of experiment (140 weeks); 198 controls, 108 dosed.	--	None	Kanisawa and Schroeder (44)

Table 2-11

SUMMARY OF CARCINOGENIC DATA SETS FOR ASBESTOS[a]

Animal Model		Route of Administration							
Species	Sex	Oral	Gavage	Inhalation	Subcu-taneous	Skin Painting	Injection	Instil-lation	TP
Mouse	Male	0	0	0	0	1(0)[b]	0	0	0
Mouse	Female	0	0	0	1(0)	0	3(0)	0	0
Mouse	Mixed[c]	0	0	0	0	0	0	0	0
Rat	Male	0	0	1(1)	0	0	1(0)	0	0
Rat	Female	0	0	0	0	0	2(2)	3(0)	0
Rat	Mixed	2(1)	0	12(10)	0	0	12(12)	3(3)	0
Other	Male	6(4)	0	0	0	0	1(0)	1(1)	0
Other	Female	4(4)	0	0	0	0	0	0	0
Other	Mixed	0	0	10(9)	0	0	12(9)	9(8)	0

[a]There were a total of 84 data sets of which 64 were considered suitable for risk assessment.

[b]The number in parenthesis indicates the number of data sets that were considered suitable for risk assessment, and were further abstracted for inclusion in the data base and subsequent analyses.

[c]The "mixed" sex indicates that either both sexes were tested, but results were not reported separately, or sex of test animal was unknown.

Table 2-12

SUMMARY OF ASBESTOS CARCINOGENIC BIOASSAY DATA

Species	Route of Administration	Nature of Exposure	Lowest Effective Dose	Highly Affected Organ(s)	Reference
Rat Fischer 344 Male & Female	Oral-food	0 or 10% in food for length of experiment (135 weeks); 121 controls, 240 dosed.	--	None	Donham *et al.* (45)
Rat Wistar Male & Female	Inhalation	0 or 12.5 mg/m^3 for one day; 12.6 mg/m^3 for 12 weeks; 10.7 mg/m^3 for 25 weeks; 10.6 mg/m^3 for 5 weeks; 10.3 mg/m^3 for 103 weeks; 154 controls, 20-50/dose group. Dosing was 5 days/week, 7 hrs/day; length of experiment 135 weeks.	10.6 mg/m^3	Lung	Wagner *et al.* (46)
Rat Wistar Male & Female	Inhalation	0 or 14.1 mg/m^3 for one day; 12.4 mg/m^3 for 12 weeks; 11.2 mg/m^3 for 25 weeks; 10.8 mg/m^3 for 51 weeks; or 10.6 mg/m^3 for 103 weeks; 154 controls, 18-45/dose group. Dosing was 5 days/week, 7 hrs/day; length of experiment 143 weeks.	10.6 mg/m^3	Lung	Wagner *et al.* (46)

Table 2-12 (continued)

SUMMARY OF ASBESTOS CARCINOGENIC BIOASSAY DATA

Species	Route of Administration	Nature of Exposure	Lowest Effective Dose	Highly Affected Organ(s)	Reference
Rat Wistar Male & Female	Inhalation	Groups received 0 or 12.2 mg/m^3 for one day; 12.2 mg/m^3 for 12 weeks; 10.5 mg/m^3 for 25 weeks; 10.8 mg/m^3 for 51 weeks; or 10.6 mg/m^3 for 103 weeks; 154 controls, 38-87/dose group. Dosing was 5 days/week, 7 hrs/day; length of experiment 143 weeks.	10.8 mg/m^3	Lung	Wagner *et al.* (46)
Rat Wistar Male & Female	Inhalation	Groups received 0 or 12.8 mg/m^3 for one day; 13.5 mg/m^3 for 12 weeks; 10.9 mg/m^3 for 25 weeks; 11.4 mg/m^3 for 51 weeks; or 10.6 mg/m^3 for 103 weeks; 154 controls, 18-45/dose group; dosing 5 days/week, 7 hrs/day; length of experiment 143 weeks.	11.4 mg/m^3	Lung	Wagner *et al.* (46)
Hamster Syrian Golden Male	Oral-water	0, 0.675, 0.068 or 0.007 mg/day for length of experiment (93 weeks); 60 controls, 30/dose group.	--	None	Smith *et al.* (47)
Hamster Syrian Golden Female	Oral-water	0, 0.675, 0.068 or 0.007 mg/day for length of experiment (88 weeks); 60 controls, 30/dose group.	--	None	Smith *et al.* (47)

Table 2-12 (continued)

SUMMARY OF ASBESTOS CARCINOGENIC BIOASSAY DATA

Species	Route of Administration	Nature of Exposure	Lowest Effective Dose	Highly Affected Organ(s)	Reference
Rat SPF Wan Male & Female	Inhalation	2 or 10 mg/m^3 chrysotile 5 days/week, 7 hrs/day for 52 weeks, 20 untreated controls, 48/dose group. Length of experiment 123 weeks.	2 mg/m^3	Lung	Davis et al. (48)
		10 mg/m^3 amosite 5 days/week, 7 hrs/day for 52 weeks, 20 untreated controls, 47 dosed. Length of experiment 123 weeks.	--	None	Davis et al. (48)
		5 or 10 mg/m^3 crocidolite 5 days/week, 7 hrs/day for 52 weeks, 20 untreated controls, 48 dosed. Length of experiment 123 weeks.[a]	2 mg/m^3	Lung	Davis et al. (48)
Rat Wistar Male & Female	Intrapleural injection	0 or 20 mg amosite in a single injection. 98/dose group, length of experiment 165 weeks.	20 mg	Pleura	Wagner and Berry (49)
Rat Sprague-Dawley Male & Female	Intrapleural injection	0 or 20 mg amosite in a single injection 85/dose group, length of experiment 158 weeks.	20 mg	Pleura	Wagner and Berry (49)
Rat Wistar Male & Female	Intrapleural injection	0 or 20 mg chrysotile in a single injection, 98/dose group, length of experiment 165 weeks.	20 mg	Pleura	Wagner and Berry (49)

Table 2-12 (continued)

SUMMARY OF ASBESTOS CARCINOGENIC BIOASSAY DATA

Species	Route of Administration	Nature of Exposure	Lowest Effective Dose	Highly Affected Organ(s)	Reference
Rat Sprague-Dawley Male & Female	Intra-pleural injection	0 or 20 mg chrysotile in a single injection, 85 controls, 90 dosed, length of experiment 158 weeks.	20 mg	Pleura	Wagner and Berry (49)
Rat Wistar Male & Female	Intra-pleural injection	0 or 20 mg crocidolite in a single injection, 96 controls, 189 dosed, length of experiment 165 weeks.	20 mg	Pleura	Wagner and Berry (49)
Rat Sprague-Dawley Male & Female	Intra-pleural injection	0 or 20 mg crocidolite in a single injection, 85 controls, 180 dosed, length of experiment 158 weeks.	20 mg	Pleura	Wagner and Berry (49)
Hamster Syrian Golden Male	Intra-tracheal injection	0 or 0.25 mg once a week for 25 weeks, length of experiment 43 weeks, 10/dose group.	--	None	Miller *et al.* (50)
Hamster Syrian Golden Male	Oral-food	0 or 1% amosite in food for length of experiment (135 weeks); 127 controls, 252 dosed.	--	None	NTP (51)
Hamster Syrian Golden Female	Oral-food	0 or 1% amosite in food for length of experiment (108 weeks); 126 controls, 254 dosed.	--	None	NTP (51)

Table 2-12 (continued)

SUMMARY OF ASBESTOS CARCINOGENIC BIOASSAY DATA

Species	Route of Administration	Nature of Exposure	Lowest Effective Dose	Highly Affected Organ(s)	Reference
Hamster Syrian Golden Male	Oral-food	0 or 1% chrysotile in food for length of experiment (130 weeks); 126 controls, 253 dosed.	--	None	NTP (51)
Hamster Syrian Golden Female	Oral-food	0 or 1% chrysotile in food for length of experiment (103 weeks); 126 controls, 252 dosed.	--	None	NTP (51)
Hamster Syrian Golden Male	Oral-food	0 or 1% chrysotile in food for length of experiment (139 weeks); 126 controls, 251 dosed.	--	None	NTP (51)
Hamster Syrian Golden Female	Oral-food	0 or 1% chrysotile in food for length of experiment (98 weeks); 126 controls, 252 dosed.	--	None	NTP (51)
Rat Osborne-Mendel Male	Intrafemoral injection	0 or 0.58 mg in a single injection, 25 controls, 25 dosed. Length of experiment 104 weeks.	--	None	Hueper (38)
Rat Osborne-Mendel Female	Intrapleural injection	0 or 0.58 mg injected once a month for 6 months, 25/dose group. Length of experiment 104 weeks.	--	None	Hueper (38)

Table 2-12 (continued)

SUMMARY OF ASBESTOS CARCINOGENIC BIOASSAY DATA

Species	Route of Administration	Nature of Exposure	Lowest Effective Dose	Highly Affected Organ(s)	Reference
Rat Osborne-Mendel Male	Injection into paranasal sinuses	0 or 29 mg injected once every 2 months for total of 3 injections, 20/dose group. Length of experiment 104 weeks.	--	None	Hueper (38)
Rat Charles River CD Male & Female	Inhalation	0 or 48.2 mg/m^3 amosite 4 hrs/day, 4 days/week for life, 10 controls, 77 dosed; 0 or 48.7 mg/m^3 crocidolite 4 hrs/day, 4 days/week for life, 10 controls, 69 dosed; 0 or 47.4 mg/m^3 chrysotile 4 hrs/day, 4 days/week for life, 10 controls, 60 dosed. Each of these 3 experiments lasted 156 weeks.[a]	--	None	Reeves *et al.* (52)
Rabbit Male & Female	Inhalation	0 or 48.2 mg/m^3 amosite 4 hrs/day, 4 days/week for life, 10 controls, 38 dosed; 0 or 48.7 mg/m^3 crocidolite 4 hrs/day, 4 days/week for life, 10 controls, 32 dosed; 0 or 47.4 mg/m^3 chrysotile 4 hrs/day, 4 days/week for life, 10 controls, 36 dosed. Each of these 3 experiments lasted 156 weeks.[a]	--	None	Reeves *et al.* (52)

Table 2-12 (continued)

SUMMARY OF ASBESTOS CARCINOGENIC BIOASSAY DATA

Species	Route of Administration	Nature of Exposure	Lowest Effective Dose	Highly Affected Organ(s)	Reference
Guinea Pig Hartley Male & Female	Inhalation	0 or 48.2 mg/m^3 amosite 4 hrs/day, 4 days/week for life, 12 controls, 45 dosed; 0 or 48.7 mg/m^3 crocidolite 4 hrs/day, 4 days/week for life, 12 controls, 50 dosed; 0 or 47.4 chrysotile mg/m^3 4 hrs/day, 4 days/week for life, 12 controls, 44 dosed. Each of these 3 experiments lasted 156 weeks.[a]	--	None	Reeves *et al.* (52)
Hamster Syrian Golden Male & Female	Inhalation	0 or 48.2 mg/m^3 amosite 4 hrs/day, 4 days/week for life, 8 controls, 73 dosed; 0 or 48.7 mg/m^3 crocidolite 4 hrs/day, 4 days/week for life, 8 controls, 67 dosed; 0 or 47.4 mg/m^3 chrysotile 4 hrs/day, 4 days/week for life, 8 controls, 74 dosed. Each of these 3 experiments lasted 104 weeks.[a]	--	None	Reeves *et al.* (52)
Rat Charles River CD Male & Female	Intratracheal injection	Single injection of either 0 or 6 mg of amosite, crocidylite or chrysotile asbestos, 10 controls, 13-16/dose group. Each of these 3 experiments lasted 156 weeks.[a]	--	None	Reeves *et al.* (52)

Table 2-12 (continued)

SUMMARY OF ASBESTOS CARCINOGENIC BIOASSAY DATA

Species	Route of Administration	Nature of Exposure	Lowest Effective Dose	Highly Affected Organ(s)	Reference
Rabbit Male & Female	Intratracheal injection	Single injection of either 0 or 10 mg of amosite, crocidylite or chrysotile asbestos, 10 controls, 12-15/dose group. Each of these 3 experiments lasted 156 weeks.[a]	--	None	Reeves *et al.* (52)
Guinea Pig Hartley Male & Female	Intratracheal injection	Single injection of either 0 or 6 mg of amosite, crocidylite or chrysotile asbestos, 12 controls, 15-16/dose group. Each of these 3 experiments lasted 156 weeks.[a]	--	None	Reeves *et al.* (52)
Hamster Syrian Golden Male & Female	Intratracheal injection	Single injection of either 0 or 4 mg of amosite or crocidylite asbestos, 8 controls, 10-13/dose group. Both of these experiments lasted 104 weeks.[b]	--	None	Reeves *et al.* (52)
Rat Charles River CD Male & Female	Intrapleural injection	Single injection of either 0 or 10 mg of amosite, crocidylite or chrysotile asbestos, 10 controls, 12-15/dose group. Each of these 3 experiments lasted 104 weeks.[a]	--	None	Reeves *et al.* (52)

Table 2-12 (continued)

SUMMARY OF ASBESTOS CARCINOGENIC BIOASSAY DATA

Species	Route of Administration	Nature of Exposure	Lowest Effective Dose	Highly Affected Organ(s)	Reference
Rabbit Male & Female	Intra-pleural injection	Single injection of either 0 or 16 mg of amosite, crocidylite or chrysotile asbestos, 10 controls, 13-14/dose group. Each of these 3 experiments lasted 156 weeks.[a]	--	None	Reeves *et al.* (52)
Guinea Pig Hartley Male & Female	Intra-pleural injection	Single injection of either 0 or 10 mg of amosite, crocidylite or chrysotile asbestos, 12 controls, 11-17/dose group. Each of these 3 experiments lasted 104 weeks.[a]	--	None	Reeves *et al.* (52)
Hamster Syrian Golden Male & Female	Intra-pleural injection	Single injection of either 0 or 10 mg of amosite, crocidylite or chrysotile asbestos, 8 controls, 9-14/dose group. Each of these 3 experiments lasted 104 weeks.[a]	--	None	Reeves *et al.* (52)
Rat Charles River CD Male & Female	Intra-peritoneal injection	Single injection of either 0 or 20 mg of amosite, crocidylite or chrysotile asbestos, 10 controls, 11-13/dose group. Each of these 3 experiments lasted 104 weeks.[a]	--	None	Reeves *et al.* (52)

[a]Abstracted as three data sets; one for each asbestos compound tested.
[b]Abstracted as two data sets; one for each asbestos compound tested.

Table 2-13

SUMMARY OF CARCINOGENIC DATA SETS FOR BENZENE[a]

Animal Model		Route of Administration							
Species	Sex	Oral	Gavage	Inhalation	Subcu-taneous	Skin Painting	Injection	Instil-lation	TP
Mouse	Male	0	1(1)[b]	3(3)	2(1)	0	0	0	0
Mouse	Female	0	1(1)	2(1)	2(0)	0	0	0	0
Mouse	Mixed[c]	3(0)	0	1(0)	0	1(0)	0	0	0
Rat	Male	0	3(3)	2(1)	0	0	0	0	0
Rat	Female	0	3(3)	2(1)	0	0	0	0	0
Rat	Mixed	0	0	0	0	0	0	0	0
Other	Male	0	0	0	0	0	0	0	0
Other	Female	0	0	0	0	0	0	0	0
Other	Mixed	0	0	0	0	0	0	0	0

[a]There were a total of 26 data sets of which 15 were considered suitable for risk assessment.

[b]The number in parenthesis indicates the number of data sets that were considered suitable for risk assessment, and were further abstracted for inclusion in the data base and subsequent analyses.

[c]The "mixed" sex indicates that either both sexes were tested, but results were not reported separately, or sex of test animal was unknown.

Table 2-14

SUMMARY OF BENZENE CARCINOGENIC BIOASSAY DATA

Species	Route of Adminis-tration	Nature of Exposure	Lowest Effective Dose	Highly Affected Organ(s)	Reference
Mouse $B6C3F_1$ Male	Gavage	0, 25, 50 or 100 mg/kg/day for 104 weeks (length of experiment); 50/dose group.	25 mg/kg/day	Preputial, Harderian, & Zymbal's gland	NTP (53)
Mouse $B6C3F_1$ Female	Gavage	0, 25, 50, or 100 mg/kg/day for 104 weeks (length of experiment; 50/dose group.	25 mg/kg/day	Liver; Ovary; Lung	NTP (53)
Rat F344 Male	Gavage	0, 50, 100 or 200 mg/kg/day for 104 weeks (length of experiment); 50/dose group.	50 mg/kg/day	Oral cavity; Zymbal's gland; Skin	NTP (53)
Rat F344 Female	Gavage	0, 50, 100 or 200 mg/kg/day for 104 weeks (length of experiment); 50/dose group.	50 mg/kg/day	Zymbal's gland; Oral cavity	NTP (53)
Rat Sprague-Dawley Female	Inhalation	0 or 200 ppm 5 days/week, 4 hr/day for 19 weeks; then 300 ppm 5 days/week, 4 hr/day for 85 weeks; length of experiment 150 weeks; 54/dose group.	--	None	Maltoni et al. (54)
Rat Sprague-Dawley Male	Gavage	0, 50 or 250 mg/kg/day for 51 weeks; length of experiment 144 weeks; 30-35/dose group.	--	None	Maltoni et al. (54)

Table 2-14 (continued)

SUMMARY OF BENZENE CARCINOGENIC BIOASSAY DATA

Species	Route of Administration	Nature of Exposure	Lowest Effective Dose	Highly Affected Organ(s)	Reference
Rat Sprague-Dawley Female	Gavage	0, 50 or 250 mg/kg/day for 51 weeks; length of experiment 144 weeks; 30-35/dose group.	250 mg/kg/day	Zymbal's gland	Maltoni *et al.* (54)
Mouse C57BL/6J Male	Inhalation	0 or 300 ppm 5 days/week, 4 hr/day for 70 weeks (length of experiment); 40/dose group.	--	None	Snyder *et al.* (55)
Mouse AKR/J Male	Inhalation	0 or 100 ppm 5 days/week, 5 hr/day for 72 weeks (length of experiment); 50/dose group.	--	None	Snyder *et al.* (55)
Mouse C57BL/6N Male	Subcutaneous injection	0 or 13.2-39.6 mℓ 2 times/week for 3 weeks, or 52.8 mℓ 1 time/week for 9 weeks; length of experiment 104 weeks; 20/dose group.	--	None	Ward *et al.* (56)
Rat Sprague-Dawley Male	Inhalation	0 or 300 ppm, 5 days/week, 6 hr/day for 99 weeks (length of experiment); 27 controls, 45/dose group.	--	None	Snyder *et al.* (57)
Mouse AKR/J Male	Inhalation	0 or 300 ppm, 5 days/week, 6 hr/day for 28 weeks; length of experiment 52 weeks; 60/dose group.	--	None	Snyder *et al.* (57)

Table 2-14 (continued)

SUMMARY OF BENZENE CARCINOGENIC BIOASSAY DATA

Species	Route of Administration	Nature of Exposure	Lowest Effective Dose	Highly Affected Organ(s)	Reference
Mouse C57BL/6 Female	Inhalation	0 or 300 ppm 5 days/week, 6 hr/day for 16 weeks; length of experiment approximately 99 weeks; approximately 90/dose group.	300 ppm	Lymphatics	Cronkite *et al.* (58)
Rat Sprague-Dawley Male	Gavage	0 or 500 mg/kg 5 days week for 92 weeks; length of experiment 141 weeks; 50 controls, 40 dosed.	500 mg/kg/day	Zymbal's gland; Oral cavity; Skin	Maltoni *et al.* (54)
Rat Sprague-Dawley Female	Gavage	0 or 500 mg/kg 5 days week for 92 weeks; length of experiment 141 weeks; 50 controls, 40 dosed.	500 mg/kg/day	Zymbal's gland; Oral cavity	Maltoni *et al.* (54)

Table 2-15

SUMMARY OF CARCINOGENIC DATA SETS FOR BENZIDINE[a]

Animal Model		Route of Administration							
Species	Sex	Oral	Gavage	Inhalation	Subcu-taneous	Skin Painting	Injection	Instil-lation	TP
Mouse	Male	0	0	0	0	0	0	0	0
Mouse	Female	0	0	0	0	0	0	0	0
Mouse	Mixed[b]	0	0	0	1(1)[c]	0	0	0	0
Rat	Male	1(0)	0	0	0	0	0	0	0
Rat	Female	1(0)	1(1)	0	0	0	0	0	0
Rat	Mixed	0	0	0	1(1)	0	0	0	0
Other	Male	1(0)	0	0	0	0	0	0	0
Other	Female	2(0)	0	0	0	0	0	0	0
Other	Mixed	2(0)	0	0	0	0	0	0	0

[a]There were a total of 10 data sets of which 3 were considered suitable for risk assessment.

[b]The "mixed" sex indicates that either both sexes were tested, but results were not reported separately, or sex of test animal was unknown.

[c]The number in parenthesis indicates the number of data sets that were considered suitable for risk assessment, and were further abstracted for inclusion in the data base and subsequent analyses.

Table 2-16

SUMMARY OF BENZIDINE CARCINOGENIC BIOASSAY DATA

Species	Route of Administration	Nature of Exposure	Lowest Effective Dose	Highly Affected Organ(s)	Reference
Mouse Unspecified Male & Female Mixed	Subcutaneous injection	0 or 3 mg, 2 days/week for 52 weeks; length of experiment 98 weeks; 60/dose group.	--	None	Bonser et al. (59)
Rat Sprague-Dawley Female	Gavage	0, 1.2, 2.5, 3.5 or 5.0 mg every 3rd day for 4 weeks; length of experiment 36 weeks; 10-20/dose group, 140 controls.	--	None	Griswold et al. (60)
Rat Sherman Male & Female Mixed	Subcutaneous injection	0 or 15 mg 1 day/week for 42 weeks; 50/controls; length of experiment 130 weeks; 385/dose group.	15 mg	Zymbal's gland	Spitz et al. (61)

Table 2-17

SUMMARY OF CARCINOGENIC DATA SETS FOR BENZO(A)PYRENE[a]

Animal Model		Route of Administration							
Species	Sex	Oral	Gavage	Inhalation	Subcutaneous	Skin Painting	Injection	Instillation	TP
Mouse	Male	0	0	0	1(0)[b]	2(0)	1(0)	0	0
Mouse	Female	0	2(2)	0	3(0)	10(0)	1(0)	0	0
Mouse	Mixed[c]	2(0)	0	0	1(1)	3(0)	4(1)	1(0)	0
Rat	Male	0	0	0	0	0	1(1)	3(1)	0
Rat	Female	0	1(1)	0	1(1)	1(0)	0	0	0
Rat	Mixed	0	0	0	0	0	0	0	0
Other	Male	1(0)	0	0	0	0	0	4(2)	0
Other	Female	0	0	0	0	0	0	2(1)	0
Other	Mixed	0	0	0	1(0)	0	0	5(3)	0

[a]There were a total of 51 data sets of which 14 were considered suitable for risk assessment.

[b]The number in parenthesis indicates the number of data sets that were considered suitable for risk assessment, and were further abstracted for inclusion in the data base and subsequent analyses.

[c]The "mixed" sex indicates that either both sexes were tested, but results were not reported separately, or sex of test animal was unknown.

Table 2-18

SUMMARY OF BENZO(A)PYRENE CARCINOGENIC BIOASSAY DATA

Species	Route of Administration	Nature of Exposure	Lowest Effective Dose	Highly Affected Organ(s)	Reference
Mouse Ha/ICR Female	Gavage	0 or 252 μg 3 times/week for 6 weeks. Observed 41 weeks, 20 controls, 17 dosed.	252 μg	Cardia (fore-stomach)	Wattenberg *et al.* (62)
Hamster Syrian Golden Combined	Intratracheal instillation	0 or 1 mg/week for 10 weeks. Observed 60 weeks, 30 controls, 30 dosed.	--	None	Kobayashi and Okamoto (63)
Rat Fischer Male	Intramuscular injection	0 or 10 mg injected one time into thighs (1/2 of dose in each thigh). Observed 104 weeks. 30 controls, 30 dosed.	10 mg	Thigh (injection site)	Maenza *et al.* (64)
Rat Wistar Albino Male	Intratracheal instillation	0 or 0.4 mg instilled once a week for 15 weeks. Observed 150 weeks. 23 controls, 21 dosed.	--	None	Ishinishi *et al.* (41)
Rat Sprague-Dawley Female	Subcutaneous injection	0, 3, 12.5, 25, 50, 100, 200 or 400 μg in sesame oil every 2 days for 30 doses (60 days). Observed 54 weeks, 20/dose group.	3 μg	Thigh (injection site)	Sydnor *et al.* (65)
Rat Sprague-Dawley Female	Gavage	0 or 100 mg as a single dose, or 20 mg every week for 5 weeks. 40 controls, 20/dose group. Length of experiment 54 weeks.	20 mg (x5)	Mammary gland	Sydnor *et al.* (65)

Table 2-18 (continued)

SUMMARY OF BENZO(A)PYRENE CARCINOGENIC BIOASSAY DATA

Species	Route of Administration	Nature of Exposure	Lowest Effective Dose	Highly Affected Organ(s)	Reference
Hamster Syrian Golden Male	Intratracheal injection	0 or 0.5 mg in "Tween 60" once/week for 25 weeks, observed until 214 days (0.5), or 300 days (control), 10/dose group.	0.5 mg	Lung	Miller *et al.* (50)
Hamster Syrian Golden Male	Intratracheal injection	0, 0.5 or 1.0 mg once a week for 52 weeks; observed to 105 weeks; 70 animals for 0.5, 105 animals for 1.0, 35 controls.	0.5 mg	Lung	Feron *et al.* (66)
Hamster Syrian Golden Female	Intratracheal injection	0, 0.5 or 1.0 mg once a week for 52 weeks; observed to 105 weeks; 70 animals for 0.5, 105 animals for 1.0, 35 controls.	0.5 mg	Lung	Feron *et al.* (66)
Hamster Syrian Golden Male & Female	Intratracheal injection	0 or 3 mg in saline once a week for 20 weeks, observed until death, 48/dose group. Length of experiment 80 weeks.	3 mg	Forestomach	Stenback and Rowland (67)
Hamster Syrian Golden Male & Female	Intratracheal injection	0 or 3 mg in gelatin/saline once a week for 20 weeks, observed until death, 48/dose group. Length of experiment 80 weeks.	--	None	Stenback and Rowland (67)

Table 2-18 (continued)

SUMMARY OF BENZO(A)PYRENE CARCINOGENIC BIOASSAY DATA

Species	Route of Administration	Nature of Exposure	Lowest Effective Dose	Highly Affected Organ(s)	Reference
Mouse Swiss Albino Male & Female	Subcutaneous injection	0 or 35 μg once at birth (single injection), observed until natural death, 32 dosed, 17 controls.	35 μg	Lung	Pietra *et al.* (68)
Mouse Swiss Albino Male & Female	Intraperitoneal injection	0 or 35 μg once at birth (single injection), observed until natural death, 24 dosed, 20 controls.	35 μg	Lung; Lymphoma	Pietra *et al.* (68)
Mouse Swiss Albino Female	Gavage	0 or 50 μg in single dose; observed for 77 weeks (length of experiment). 50 per group.	50 μg	Forestomach	Roe *et al.* (69)

Table 2-19

SUMMARY OF CARCINOGENIC DATA SETS FOR CADMIUM[a]

Animal Model		Route of Administration							
Species	Sex	Oral	Gavage	Inhalation	Subcu-taneous	Skin Painting	Injection	Instil-lation	TP
Mouse	Male	0	1(1)[b]	0	3(0)	0	0	0	0
Mouse	Female	0	0	0	0	0	0	0	0
Mouse	Mixed[c]	1(0)	0	0	0	0	1(1)	0	0
Rat	Male	1(1)	1(1)	1(1)	8(0)	0	1(0)	1(1)	0
Rat	Female	1(1)	0	0	2(0)	0	2(0)	0	0
Rat	Mixed	2(1)	0	0	0	0	3(0)	0	0
Other	Male	0	0	0	0	0	0	0	0
Other	Female	0	0	0	0	0	0	0	0
Other	Mixed	0	0	0	1(0)	0	0	0	0

[a]There were a total of 30 data sets of which 8 were considered suitable for risk assessment.

[b]The number in parenthesis indicates the number of data sets that were considered suitable for risk assessment, and were further abstracted for inclusion in the data base and subsequent analyses.

[c]The "mixed" sex indicates that either both sexes were tested, but results were not reported separately, or sex of test animal was unknown.

Table 2-20

SUMMARY OF CADMIUM CARCINOGENIC BIOASSAY DATA

Species	Route of Administration	Nature of Exposure	Lowest Effective Dose	Highly Affected Organ(s)	Reference
Rat Wistar Male	Inhalation	0, 0.003, 0.006 or 0.012 ppm (air) continously for 78 weeks; observed an additional 56 weeks. 40/dose group, 41 controls.	0.003 ppm	Lung	Takenaka *et al.* (70)
Rat Fischer 344 Male	Intratracheal instillation	0 or 25 μg at age 70 days (48 animals), 25 μg at age 70 and 100 days for 50 μg total (46 animals); or 25 μg at age 70, 100 and 130 days for 75 μg total (50 animals); all observed until natural death (130 weeks).	75 μg	Mammary fibroadenoma	Sanders and Mahaffey (71)
Mice A/Strong Male & Female	Intraperitoneal injection	0, 0.3 or 0.61 mg/kg 3 times/week for 8 weeks for a total of 23 injections, 20/dose group, observed for 30 weeks.	--	None	Stoner *et al.* (72)
Rat SPF-Wistar Male	Oral-food	0, 1, 3, 10 or 50 ppm continuously for length of experiment. Observed 104 weeks, 100 controls, 50/dose group.	3 ppm	Adrenals	Loser (73)
Rat SPF-Wistar Female	Oral-food	0, 1, 3, 10 or 50 ppm continuously for length of experiment. Observed 104 weeks, 100 controls, 50/dose group.	--	None	Loser (73)

Table 2-20 (continued)

SUMMARY OF CADMIUM CARCINOGENIC BIOASSAY DATA

Species	Route of Adminis-tration	Nature of Exposure	Lowest Effective Dose	Highly Affected Organ(s)	Reference
Rat Long Evans Male & Female	Oral-food	0 or 359 μg/kg/day for length of experiment (167 weeks). 34 controls, 47 dosed.	--	None	Kanisawa and Schroeder (35)
Rat CB Male	Gavage	0, 0.087, 0.18 or 0.35 mg/kg cadmium in distilled water one time a week for length of experiment (104 weeks). 90 controls, 30/dose group.	--	None	Levy and Clack (74)
Mice Swiss Male	Gavage	0, 0.44, 0.88 or 1.75 mg/kg in distilled water once a week for 77 weeks. Length of experiment 86 weeks. 150 controls, 50/dose group.	--	None	Levy *et al.* (74)

Table 2-21

SUMMARY OF CARCINOGENIC DATA SETS FOR CARBON TETRACHLORIDE[a]

Animal Model		Route of Administration							
Species	Sex	Oral	Gavage	Inhalation	Subcu-taneous	Skin Painting	Injection	Instil-lation	TP
Mouse	Male	0	3(2)[b]	0	1(0)	0	0	0	0
Mouse	Female	0	3(2)	0	1(0)	0	0	0	0
Mouse	Mixed[c]	0	0	0	0	0	0	0	0
Rat	Male	0	2(1)	0	6(0)	0	0	0	0
Rat	Female	0	2(1)	0	0	0	0	0	0
Rat	Mixed	0	0	0	0	0	0	0	0
Other	Male	0	1(0)	0	0	0	0	0	0
Other	Female	0	1(0)	0	0	0	0	0	0
Other	Mixed	1(0)	0	0	0	0	0	0	0

[a]There were a total of 21 data sets of which 6 were considered suitable for risk assessment.

[b]The number in parenthesis indicates the number of data sets that were considered suitable for risk assessment, and were further abstracted for inclusion in the data base and subsequent analyses.

[c]The "mixed" sex indicates that either both sexes were tested, but results were not reported separately, or sex of test animal was unknown.

Table 2-22

SUMMARY OF CARBON TETRACHLORIDE CARCINOGENIC BIOASSAY DATA

Species	Route of Administration	Nature of Exposure	Lowest Effective Dose	Highly Affected Organ(s)	Reference
Mouse C_3H Male	Gavage	0 mg once/week for 20 weeks or 4 mg once/week for 2 weeks, then 6 mg once/week for 17 weeks; length of experiment 40 weeks; 45 controls, 77 dosed.	6 mg/week	Liver	Andervont (75)
Mouse C_3H Female	Gavage	0 mg once/week for 20 weeks or 4 mg once/week for 2 weeks, then 6 mg once/week for 17 weeks; length of experiment 43 weeks; 30 controls, 37 dosed.	6 mg/week	Liver	Andervont (75)
Mouse $B6C3F_1$ Male	Gavage	0, 1250 or 2500 mg/kg once/day, 5 days/week for 78 weeks; length of experiment 90 weeks; 20 controls, 50/dose group.	1250 mg/kg	Liver	NCI (76)
Mouse $B6C3F_1$ Female	Gavage	0, 1250 or 2500 mg/kg once/day, 5 days/week for 78 weeks; length of experiment 90 weeks; 20 controls, 50/dose group.	1250 mg/kg	Liver	NCI (76)

Table 2-22 (continued)

SUMMARY OF CARBON TETRACHLORIDE CARCINOGENIC BIOASSAY DATA

Species	Route of Administration	Nature of Exposure	Lowest Effective Dose	Highly Affected Organ(s)	Reference
Rat Osborne-Mendel Male	Gavage	Doses administered once/day, 5 days/week according to following schedule: 0 mg/kg for 78 weeks; 25 mg/kg for 10 weeks, then 50 mg/kg for 68 weeks; 50 mg/kg for 10 weeks, then 100 mg/kg for 68 weeks; length of experiment 111 weeks; 20 controls, 50/dose group.	--	None	NCI (76)
Rat Osborne-Mendel Female	Gavage	Doses administered once/day, 5 days/week according to following schedule: 0 mg/kg for 78 weeks; 100 mg/kg for 14 weeks, then 75 mg/kg for 64 weeks; 200 mg/kg for 14 weeks, then 150 mg/kg for 64 weeks; length of experiment 110 weeks; 20 controls, 50/dose group.	--	None	NCI (76)

Table 2-23

SUMMARY OF CARCINOGENIC DATA SETS FOR CHLORAMBUCIL[a]

Animal Model		Route of Administration							
Species	Sex	Oral	Gavage	Inhalation	Subcu-taneous	Skin Painting	Injection	Instil-lation	TP
Mouse	Male	0	0	0	0	0	1(0)[b]	0	0
Mouse	Female	0	0	0	0	0	2(0)	0	0
Mouse	Mixed[c]	0	0	0	0	0	1(1)	0	0
Rat	Male	0	0	0	0	0	1(0)	0	0
Rat	Female	0	0	0	0	0	1(0)	0	0
Rat	Mixed	0	0	0	0	0	0	0	0
Other	Male	0	0	0	0	0	0	0	0
Other	Female	0	0	0	0	0	0	0	0
Other	Mixed	0	0	0	0	0	0	0	0

[a]There were a total of 6 data sets of which 1 was considered suitable for risk assessment.

[b]The number in parenthesis indicates the number of data sets that were considered suitable for risk assessment, and were further abstracted for inclusion in the data base and subsequent analyses.

[c]The "mixed" sex indicates that either both sexes were tested, but results were not reported separately, or sex of test animal was unknown.

Table 2-24

SUMMARY OF CHLORAMBUCIL CARCINOGENIC BIOASSAY DATA

Species	Route of Administration	Nature of Exposure	Lowest Effective Dose	Highly Affected Organ(s)	Reference
Mouse A/J Male & Female	Intraperitoneal injection	0, 0.80, 3.09, 12.5 or 35 mg/kg 3 times/week for 4 weeks; observed 39 weeks total; 330 controls, 45-60/dose group.	0.80 mg/kg	Lung	Shimkin *et al.* (77)

Table 2-25

SUMMARY OF CARCINOGENIC DATA SETS FOR CHLORDANE[a]

Animal Model		Route of Administration							
Species	Sex	Oral	Gavage	Inhalation	Subcu-taneous	Skin Painting	Injection	Instil-lation	TP
Mouse	Male	3(3)[b]	0	0	0	0	0	0	0
Mouse	Female	3(3)	0	0	0	0	0	0	0
Mouse	Mixed[c]	0	0	0	0	0	0	0	0
Rat	Male	1(1)	0	0	0	0	0	0	0
Rat	Female	1(1)	0	0	0	0	0	0	0
Rat	Mixed	0	0	0	0	0	0	0	0
Other	Male	0	0	0	0	0	0	0	0
Other	Female	0	0	0	0	0	0	0	0
Other	Mixed	0	0	0	0	0	0	0	0

[a]There were a total of 8 data sets, all of which were considered suitable for risk assessment.

[b]The number in parenthesis indicates the number of data sets that were considered suitable for risk assessment, and were further abstracted for inclusion in the data base and subsequent analyses.

[c]The "mixed" sex indicates that either both sexes were tested, but results were not reported separately, or sex of test animal was unknown.

Table 2-26

SUMMARY OF CHLORDANE CARCINOGENIC BIOASSAY DATA

Species	Route of Administration	Nature of Exposure	Lowest Effective Dose	Highly Affected Organ(s)	Reference
Mouse Charles River CD-1 Male	Oral-food	0, 5, 25 or 50 ppm continuously for length of experiment (77 weeks), 100 controls, 100/dose group.	--	None	IRDC, in Epstein (78)
Mouse Charles River CD-1 Female	Oral-food	0, 5, 25 or 50 ppm continuously for length of experiment (77 weeks), 100 controls, 100/dose group.	--	None	IRDC, in Epstein (78)
Mouse $B6C3F_1$ Male	Oral-food	0 ppm continuously for length of experiment; 20 ppm for 1 week, then 30 ppm for 79 weeks; 40 ppm for 16 weeks, then 60 ppm for 65 weeks; length of experiment 91 weeks; 20 controls, 50/dose group.	30 ppm	Liver	NCI (79)
Mouse $B6C3F_1$ Female	Oral-food	0 ppm continuously for length of experiment; 40 ppm for 1 week, then 30 ppm for 79 weeks; 80 ppm for 16 weeks, then 60 ppm for 65 weeks; length of experiment 91 weeks; 20 controls, 50/dose group.	30 ppm	Liver	NCI (79)

Table 2-26 (continued)

SUMMARY OF CHLORDANE CARCINOGENIC BIOASSAY DATA

Species	Route of Administration	Nature of Exposure	Lowest Effective Dose	Highly Affected Organ(s)	Reference
Rat Osborne-Mendel Male	Oral-food	Dosage administered as follows: 0 ppm continuously; 400 ppm for 33 weeks, then 100 ppm for 14 weeks, then 50 ppm for 33 weeks; 800 ppm for 33 weeks, then 200 ppm for 14 weeks, then 100 ppm for 33 weeks; length of experiment 109 weeks; 10 controls, 50/dose group.	800/ 200/ 100 ppm	Thyroid	NCI (79)
Rat Osborne-Mendel Female	Oral-food	Dosage administered as follows: 0 ppm continuously; 200 ppm for 33 weeks, then 100 ppm for 14 weeks, then 50 ppm for 33 weeks; 400 ppm for 33 weeks, then 200 ppm for 14 weeks, then 100 ppm for 33 weeks; length of experiment 109 weeks; 10 controls, 50/dose group.	--	None	NCI (79)
Mouse ICR Male	Oral-food	0, 1, 5 or 12.5 ppm continuously for length of experiment (106 weeks), 80/dose group.	1 ppm	Skin; Liver	Velsicol Chemical Corp. (80)
Mouse ICR Female	Oral-food	0, 1, 5 or 12.5 ppm continuously for length of experiment (106 weeks), 80/dose group.	--	None	Velsicol Chemical Corp. (80)

Table 2-27

SUMMARY OF CARCINOGENIC DATA SETS FOR CHLOROFORM[a]

Animal Model		Route of Administration							
Species	Sex	Oral	Gavage	Inhalation	Subcu-taneous	Skin Painting	Injection	Instil-lation	TP
Mouse	Male	0	10(9)[b]	1(0)	1(0)	0	1(0)	0	0
Mouse	Female	1(1)	5(4)	1(0)	1(0)	0	0	0	0
Mouse	Mixed[c]	0	0	0	1(0)	0	0	0	0
Rat	Male	1(1)	3(2)	0	0	0	0	0	0
Rat	Female	0	2(1)	0	0	0	0	0	0
Rat	Mixed	0	1(0)	0	0	0	0	0	0
Other	Male	1(1)	0	0	0	0	0	0	0
Other	Female	1(1)	0	0	0	0	0	0	0
Other	Mixed	0	0	0	0	0	0	0	0

[a]There were a total of 31 data sets of which 20 were considered suitable for risk assessment.

[b]The number in parenthesis indicates the number of data sets that were considered suitable for risk assessment, and were further abstracted for inclusion in the data base and subsequent analyses.

[c]The "mixed" sex indicates that either both sexes were tested, but results were not reported separately, or sex of test animal was unknown.

Table 2-28

SUMMARY OF CHLOROFORM CARCINOGENIC BIOASSAY DATA

Species	Route of Administration	Nature of Exposure	Lowest Effective Dose	Highly Affected Organ(s)	Reference
Mouse CBA Male	Gavage	0 or 60 mg/kg, 6 days/week for 80 weeks; observed 104 weeks; 52 controls, 52 dosed.	--	None	Roe *et al.* (81)
Mouse C57BL Male	Gavage	0 or 60 mg/kg, 6 days/week for 80 weeks; observed 104 weeks; 52 controls, 52 dosed.	--	None	Roe *et al.* (81)
Mouse CF-1 Male	Gavage	0 or 60 mg/kg, 6 days/week for 80 weeks; observed 93 weeks; 52 controls, 52 dosed.	--	None	Roe *et al.* (81)
Mouse ICI Male	Gavage	0 or 60 mg/kg, 6 days/week for 80 weeks; observed 98 weeks; 52 controls, 52 dosed.	--	None	Roe *et al.* (81)
Mouse SPF CFLP Male	Gavage	0 or 60 mg/kg, 6 days/week for 80 weeks; observed 96 weeks, 260 controls, 52 dosed.	--	None	Roe *et al.* (81)
Mouse ICI Albino Male	Gavage	0, 17 or 60 mg/kg 6 days/week for 80 weeks; observed 96 weeks; 104 controls, 52/dose group.	--	None	Roe *et al.* (81)
Mouse ICI Albino Female	Gavage	0, 17 or 60 mg/kg 6 days/week for 80 weeks; observed 96 weeks; 104 controls, 52/dose group.	--	None	Roe *et al.* (81)

Table 2-28 (continued)

SUMMARY OF CHLOROFORM CARCINOGENIC BIOASSAY DATA

Species	Route of Administration	Nature of Exposure	Lowest Effective Dose	Highly Affected Organ(s)	Reference
Mouse ICI Male	Gavage	0 or 60 mg/kg 6 days/week for 80 weeks; observed 98 weeks; 52 controls, 52/dose group.	--	None	Roe *et al.* (81)
Rat SPF Sprague-Dawley Male	Gavage	0 or 60 mg/kg 6 days/weeks for length of experiment (95 weeks); 50 controls, 50 dosed.	--	None	Palmer *et al.* (82)
Rat SPF Sprague-Dawley Female	Gavage	0 or 60 mg/kg 6 days/weeks for length of experiment (95 weeks); 50 controls, 50 dosed.	--	None	Palmer *et al.* (82)
Dog Beagle Male	Oral- per os	0, 15 or 30 mg/kg 6 days/week for 390 weeks; observed 420 weeks; 16 controls, 8/dose group.	--	None	Heywood *et al.* (83)
Dog Beagle Female	Oral- per os	0, 15 or 30 mg/kg 6 days/week for 390 weeks; observed 420 weeks; 16 controls, 8/dose group.	--	None	Heywood *et al.* (83)
Rat Osborne-Mendel Male	Gavage	0, 90 or 180 mg/kg/day, 5 days/week for 79 weeks; observed 111 weeks; 20 controls, 50/dose group.	90 mg/kg/day	Kidney	NCI (84)

Table 2-28 (continued)

SUMMARY OF CHLOROFORM CARCINOGENIC BIOASSAY DATA

Species	Route of Administration	Nature of Exposure	Lowest Effective Dose	Highly Affected Organ(s)	Reference
Rat Osborne-Mendel Female	Gavage	Dosages administered 5 days/week according to following schedule: 0 mg/kg for 78 weeks; 125 mg/kg for 22 weeks, then 90 mg/kg for 56 weeks; 250 mg/kg for 22 weeks, then 180 mg/kg for 56 weeks; observed 111 weeks; 20 controls, 50/dose group.	--	None	NCI (84)
Mouse $B6C3F_1$ Male	Gavage	Dosages administered 5 days/week according to following schedule: 0 mg/kg for 78 weeks; 100 mg/kg for 18 weeks, then 150 mg/kg for 60 weeks; 200 mg/kg for 18 weeks, then 300 mg/kg for 60 weeks; 20 controls, 50/dose group. Length of experiment 93 weeks.	100/150 mg/kg	Liver	NCI (84)
Mouse $B6C3F_1$ Female	Gavage	Dosages administered 5 days/week according to following schedule: 0 mg/kg for 78 weeks; 200 mg/kg for 18 weeks, then 250 mg/kg for 60 weeks; 400 mg/kg for 18 weeks, then 500 mg/kg for 60 weeks; 20 controls, 50/dose group. Length of experiment 93 weeks.	200/250 mg/kg	Liver	NCI (84)

Table 2-28 (continued)

SUMMARY OF CHLOROFORM CARCINOGENIC BIOASSAY DATA

Species	Route of Administration	Nature of Exposure	Lowest Effective Dose	Highly Affected Organ(s)	Reference
Mouse Strain A Male	Gavage	0, 0.1 or 0.2 cc/kg in corn oil every 4 days for 30 doses, then observed for one month; 5 animals/group.	--	None	Eschenbrenner (85)
Mouse Strain A Female	Gavage	0, 0.1, 0.2, 0.4 or 0.8 cc/kg in corn oil every 4 days for 30 doses, then observed for one month; 5 animals/group.	--	None	Eschenbrenner (85)
Mouse Osborne-Mendel Female	Oral-water	0, 200, 400, 900 or 1800 ppm continuously for length of experiment (104 weeks). 50 controls, 50-430/dose group.	200 ppm	Liver	Jorgenson *et al.* (86)
Mouse Osborne-Mendel Male	Oral-water	0, 200, 400, 900 or 1800 ppm continuously for length of experiment (104 weeks). 50 controls, 50-330/dose group.	200 ppm	Kidney	Jorgenson *et al.* (86)

Table 2-29

SUMMARY OF CARCINOGENIC DATA SETS FOR CHROMIUM[a]

Animal Model		Route of Administration							
Species	Sex	Oral	Gavage	Inhalation	Subcu-taneous	Skin Painting	Injection	Instil-lation	TP
Mouse	Male	1(0)	0	0	0	0	0	0	0
Mouse	Female	0	0	0	0	0	0	0	0
Mouse	Mixed[c]	1(0)	0	0	1(0)	0	1(1)	1(0)	0
Rat	Male	0	0	0	0	0	2(2)	0	0
Rat	Female	0	0	0	0	0	1(0)	0	0
Rat	Mixed	2(1)	0	0	0	0	1(1)	6(3)	0
Other	Male	0	0	0	0	0	0	0	0
Other	Female	0	0	0	0	0	0	0	0
Other	Mixed	0	0	0	0	0	0	0	0

[a]There were a total of 16 data sets of which 8 were considered suitable for risk assessment.

[b]The number in parenthesis indicates the number of data sets that were considered suitable for risk assessment, and were further abstracted for inclusion in the data base and subsequent analyses.

[c]The "mixed" sex indicates that either both sexes were tested, but results were not reported separately, or sex of test animal was unknown.

Table 2-30

SUMMARY OF CHROMIUM CARCINOGENIC BIOASSAY DATA

Species	Route of Administration	Nature of Exposure	Lowest Effective Dose	Highly Affected Organ(s)	Reference
Rat CB Male	Intramuscular injection	0 mg once a week for 20 weeks; or 5 mg once a week for 2 weeks, then 0.5 mg once a week for 18 weeks. Length of experiment 63 weeks, 16 controls, 24 dosed.	0.5 mg	Right flank (injection site)	Roe and Carter (87)
Rat Bethesda Black Male & Female	Intrapleural injection	0 or 2 mg sodium dichromate once a month for 16 months, observed to 24 months, 60 untreated controls, 39 dosed.	--	None	Hueper and Payne (88)
Rat Bethesda Black Male & Female	Intratracheal	0 or 2 mg of calcium chromate, strontium chromate, or zinc chromate[a] once every 2 months for a total of 5 administrations; length of experiment 104 weeks. 3 experiments: 35 controls, 85 in calcium chromate group, 60 in strontium chromate group, 73 in zinc chromate group.	--	None	Hueper and Payne (88)
Rat Long Evans Male & Female	Oral-food	0 or 364 mg chromium acetate/kg/day for length of experiment (170 weeks); 34 controls, 56 dosed.	--	None	Kanisawa and Schroeder (35)

Table 2-30 (continued)

SUMMARY OF CHROMIUM CARCINOGENIC BIOASSAY DATA

Species	Route of Administration	Nature of Exposure	Lowest Effective Dose	Highly Affected Organ(s)	Reference
Mouse Strong/A Male & Female	Intraperitoneal injection	0, 20, 50 or 100 mg/kg 3 times a week for 8 weeks (24 injections); observed 30 weeks, 20 controls, 20/dose group.	--	None	Stoner *et al.* (72)
Rat Fischer 344 Male	Intramuscular injection	0, 0.5, 1.0, 2.0 or 4.0 mg in a single injection, length of experiment 104 weeks, 60 controls, 15/dose group.	--	None	Sunderman *et al.* (89)

[a]Abstracted as three data sets; one for each chromium compound tested.

Table 2-31

SUMMARY OF CARCINOGENIC DATA SETS FOR CIGARETTE SMOKE[a]

Animal Model		Route of Administration							
Species	Sex	Oral	Gavage	Inhalation	Subcu-taneous	Skin Painting	Injection	Instil-lation	TP
Mouse	Male	1(0)[b]	0	0	0	1(0)	0	0	0
Mouse	Female	1(1)	0	0	0	16(0)	0	0	0
Mouse	Mixed[c]	2(2)	0	1(0)	0	6(0)	0	0	0
Rat	Male	0	0	1(0)	0	0	0	0	0
Rat	Female	0	0	4(2)	0	0	0	2(1)	0
Rat	Mixed	0	0	1(1)	0	1(0)	0	0	0
Other	Male	0	0	2(1)	0	0	1(0)	0	0
Other	Female	0	0	1(0)	0	0	0	2(1)	0
Other	Mixed	0	0	2(0)	0	0	0	0	0

[a]There were a total of 41 data sets of which 9 were considered suitable for risk assessment.

[b]The number in parenthesis indicates the number of data sets that were considered suitable for risk assessment, and were further abstracted for inclusion in the data base and subsequent analyses.

[c]The "mixed" sex indicates that either both sexes were tested, but results were not reported separately, or sex of test animal was unknown.

Table 2-32

SUMMARY OF CIGARETTE SMOKE CARCINOGENIC BIOASSAY DATA

Species	Route of Administration	Nature of Exposure	Lowest Effective Dose	Highly Affected Organ(s)	Reference
Rat Wistar SPF Female	Inhalation	1 cigarette (11 puffs 25 mℓ ea) 2 times/day, 5 times/week (234 mg/day, 5 days/week); sham controls; 102 controls, 408 dosed. Dosed for length of experiment (160 weeks).	--	None	Davis *et al.* (90)
Rat Osborne-Mendel CD/SPF Female	Intra-pleural implant	0 or 24 mg cigarette smoke condensate in pellet; length of experiment 107 weeks; 108 controls, 105 dosed.	24 mg	Lung	Stanton *et al.* (2)
Rat White Male & Female	Inhalation	0 or 416 mg/day, 7 days/week for length of experiment (148 weeks); controls sham-exposed for first 400 days, then unexposed; 16 animals/group.	--	None	Haag *et al.* (91)
Mouse Swiss ICR/Ha Male & Female	Oral painting	0 or 25 mg 5 times/week for 56 wks; length of experiment 78 weeks; 50 animals/group.	25 mg	Lung	DiPaolo and Moore (92)
Rat F344 Female	Inhalation	0 or 598 mg/day, 5 days/week for 126 weeks; length of experiment 152 weeks; 30 controls (sham) and 80 dosed.	598 mg	Dermis (subcutaneous sarcoma)	Dalbey *et al.* (5)

Table 2-32 (continued)

SUMMARY OF CIGARETTE SMOKE CARCINOGENIC BIOASSAY DATA

Species	Route of Administration	Nature of Exposure	Lowest Effective Dose	Highly Affected Organ(s)	Reference
Hamster Syrian BIO Male	Inhalation	0 or 12.43 mg/day, 5 days/week for length of experiment (100 weeks). 22 controls, 60 dosed.	12.43 mg	Larynx	Bernfeld *et al.* (4)
Mouse Swiss ICR/Ha Female	Oral-mouth painting	0 or 26.4 mg, 5 times/week for 64 weeks; observed 82 weeks; 100 controls, 100 dosed.	26.4 mg	Lung	DiPaolo and Levin (6)
Mouse Mixed Strain Male & Female	Oral-mouth painting	0 or 30 mg, 6 days/weeks for 20 weeks; length of experiment 52 weeks; 40 controls, 60 dosed.	30 mg	Bladder	Holsti and Ermala (93)
Dog Beagle Male	Inhalation	Untreated (non-smoking) controls; 3 treatment groups exposed to cigarette smoke from 1 filtered cigarette/day increasing to 4/day by week 8 (approximately 486 mg/cigarette); these 3 groups then exposed to variable number of unfiltered cigarettes/day (approximately 504 mg/cigarette), ranging from 3 to 9/day, for length of experiment, 125 weeks.	High dose, unfiltered cigarettes	Lung	Hammond *et al.* (3) and Auerbach *et al.* (94)

Table 2-33

SUMMARY OF CARCINOGENIC DATA SETS FOR 3,3-DICHLOROBENZIDENE[a]

Animal Model		Route of Administration							
Species	Sex	Oral	Gavage	Inhalation	Subcu-taneous	Skin Painting	Injection	Instil-lation	TP
Mouse	Male	0	0	0	0	0	0	0	0
Mouse	Female	0	0	0	0	0	0	0	0
Mouse	Mixed[b]	0	0	0	0	0	0	0	0
Rat	Male	3(3)[c]	0	0	0	0	0	0	0
Rat	Female	1(1)	0	0	0	0	0	0	0
Rat	Mixed	1(0)	0	0	0	0	0	0	0
Other	Male	1(0)	0	0	0	0	0	0	0
Other	Female	2(1)	0	0	0	0	0	0	0
Other	Mixed	0	0	0	0	0	0	0	0

[a]There were a total of 8 data sets of which 5 were considered suitable for risk assessment.

[b]The "mixed" sex indicates that either both sexes were tested, but results were not reported separately, or sex of test animal was unknown.

[c]The number in parenthesis indicates the number of data sets that were considered suitable for risk assessment, and were further abstracted for inclusion in the data base and subsequent analyses.

Table 2-34

SUMMARY OF 3,3-DICHLOROBENZIDENE CARCINOGENIC BIOASSAY DATA

Species	Route of Administration	Nature of Exposure	Lowest Effective Dose	Highly Affected Organ(s)	Reference
Dog Beagle Female	Oral-per os	0 (untreated controls) or 100 mg 3 times/week for 6 weeks, then 100 mg 5 times/week until end (7 years for treated dogs); 6/dose group; length of experiment 9 years.	100 mg	Bladder; Liver.	Tsuda et al. (95)
Rat Sprague-Dawley Charles River CD Male	Oral-food	0 or 1000 ppm continuously for length of experiment (104 weeks); 44 controls, 44 dosed.	1000 ppm	Hemopoietic system; Mammary & Zymbal Glands	Stula et al. (96)
Rat Sprague-Dawley Charles River CD Female	Oral-food	0 or 1000 ppm continuously for length of experiment (105 weeks); 44 controls, 44 dosed.	1000 ppm	Mammary gland	Stula et al. (96)
Rat Wistar Male	Oral-food	0 or 0.03% continuously for length of experiment (40 weeks); 18/dose group.	--	None	Tsuda et al. (97)
Rat Wistar Male	Oral-food	0 or 0.03% continuously from weeks 12-16; length of experiment 40 weeks; 12 controls, 22 dosed.	--	None	Tatematsu et al. (98)

Table 2-35

SUMMARY OF CARCINOGENIC DATA SETS FOR 1,2-DICHLOROETHANE[a]

Animal Model		Route of Administration							
Species	Sex	Oral	Gavage	Inhalation	Subcu-taneous	Skin Painting	Injection	Instil-lation	TP
Mouse	Male	0	2(1)[b]	1(1)	0	0	0	1(0)	0
Mouse	Female	0	2(1)	1(1)	0	1(0)	0	0	0
Mouse	Mixed[c]	0	0	0	0	0	0	0	0
Rat	Male	0	2(1)	1(1)	0	0	0	0	0
Rat	Female	0	2(1)	1(1)	0	0	0	0	0
Rat	Mixed	0	0	0	0	0	0	0	0
Other	Male	0	0	0	0	0	0	0	0
Other	Female	0	0	0	0	0	0	0	0
Other	Mixed	0	0	0	0	0	0	0	0

[a]There were a total of 14 data sets of which 8 were considered suitable for risk assessment.

[b]The number in parenthesis indicates the number of data sets that were considered suitable for risk assessment, and were further abstracted for inclusion in the data base and subsequent analyses.

[c]The "mixed" sex indicates that either both sexes were tested, but results were not reported separately, or sex of test animal was unknown.

Table 2-36

SUMMARY OF 1,2-DICHLOROETHANE CARCINOGENIC BIOASSAY DATA

Species	Route of Administration	Nature of Exposure	Lowest Effective Dose	Highly Affected Organ(s)	Reference
Rat Osborne-Mendel Male	Gavage	Dosages administered 5 days/week for number of weeks indicated: Group 1: 0 mg/kg for 78 weeks; Group 2: 50 mg/kg for 59 weeks, 75 mg/kg for 10 weeks; Group 3: 100 mg/kg for 59 weeks, 150 mg/kg for 10 weeks; length of experiment 110 weeks, 20 controls, 50/dose group.	50/75 mg/kg	Stomach	NCI (99)
Rat Osborne-Mendel Female	Gavage	Dosages administered 5 days/week for number of weeks indicated: Group 1: 0 mg/kg for 78 weeks; Group 2: 50 mg/kg for 59 weeks, 75 mg/kg for 10 weeks; Group 3: 100 mg/kg for 59 weeks, 150 mg/kg for 10 weeks; length of experiment 110 weeks, 20 controls, 50/dose group.	50/75 mg/kg	Mammary gland	NCI (99)

Table 2-36 (continued)

SUMMARY OF 1,2-DICHLOROETHANE CARCINOGENIC BIOASSAY DATA

Species	Route of Administration	Nature of Exposure	Lowest Effective Dose	Highly Affected Organ(s)	Reference
Mouse $B6C3F_1$ Male	Gavage	Dosages administered 5 days/week according to following schedule: Group 1: 0 mg/kg for 78 weeks; Group 2: 75 mg/kg for 8 weeks, 100 mg/kg for 70 weeks; Group 3, 150 mg/kg for 8 weeks, 200 mg/kg for 70 weeks; length of experiment 90 weeks, 20 controls, 50/dose group.	75/100 mg/kg	Lung	NCI (99)
Mouse $B6C3F_1$ Female	Gavage	Dosages administered 5 days/week according to following schedule: Group 1: 0 mg/kg for 78 weeks; Group 2: 125 mg/kg for 8 weeks, 200 mg/kg for 3 weeks, 150 mg for 67 weeks; Group 3, 250 mg/kg for 8 weeks, 400 mg/kg for 3 weeks, 300 mg/kg for 67 weeks; length of experiment 90 weeks, 20 controls, 50/dose group.	125/200 mg/kg (low dose)	Lung; Mammary gland	NCI (99)

Table 2-36 (continued)

SUMMARY OF 1,2-DICHLOROETHANE CARCINOGENIC BIOASSAY DATA

Species	Route of Adminis-tration	Nature of Exposure	Lowest Effective Dose	Highly Affected Organ(s)	Reference
Mouse Swiss Male	Inhalation	0, 5, 10 or 50 ppm 5 days/week, 7 hrs/day for 78 weeks or 250 ppm 5 days/week, 7 hrs/day for 3 weeks, then reduced to 150 ppm for 76 weeks; length of experiment 119 weeks, 115 controls, 90/dose group.	--	None	Maltoni *et al.* (100)
Mouse Swiss Female	Inhalation	0, 5, 10 or 50 ppm 5 days/week, 7 hrs/day for 78 weeks or 250 ppm 5 days/week, 7 hrs/day for 3 weeks, then reduced to 150 ppm for 76 weeks; length of experiment 119 weeks, 134 controls, 90/dose group.	--	None	Maltoni *et al.* (100)
Rat Sprague-Dawley Male	Inhalation	0, 5, 10 or 50 ppm 5 days/week, 7 hrs/day for 78 weeks or 250 ppm 5 days/week, 7 hrs/day for 3 weeks, then reduced to 150 ppm for 76 weeks; length of experiment 148 weeks, 90 controls, 90/dose group.	--	None	Maltoni *et al.* (100)

Table 2-36 (continued)

SUMMARY OF 1,2-DICHLOROETHANE CARCINOGENIC BIOASSAY DATA

Species	Route of Administration	Nature of Exposure	Lowest Effective Dose	Highly Affected Organ(s)	Reference
Rat Sprague-Dawley Female	Inhalation	0, 5, 10 or 50 ppm 5 days/week, 7 hrs/day for 78 weeks, or 250 ppm 5 days/week, 7 hrs/day for 3 weeks, then reduced to 150 ppm for 76 weeks; length of experiment 148 weeks, 90 controls, 90/dose group.	5 ppm	Mammary gland	Maltoni *et al.* (100)

Table 2-37

SUMMARY OF CARCINOGENIC DATA SETS FOR DICHLOROMETHANE[a]

Animal Model		Route of Administration							
Species	Sex	Oral	Gavage	Inhalation	Subcu-taneous	Skin Painting	Injection	Instil-lation	TP
Mouse	Male	1(1)[b]	0	1(1)	0	0	0	0	0
Mouse	Female	1(1)	0	1(1)	0	0	0	0	0
Mouse	Mixed[c]	0	0	0	0	0	0	0	0
Rat	Male	1(1)	0	3(3)	0	0	0	0	0
Rat	Female	1(1)	0	3(3)	0	0	0	0	0
Rat	Mixed	0	0	0	0	0	0	0	0
Other	Male	0	0	1(0)	0	0	0	0	0
Other	Female	0	0	1(0)	0	0	0	0	0
Other	Mixed	0	0	0	0	0	0	0	0

[a]There were a total of 14 data sets of which 12 were considered suitable for risk assessment.

[b]The number in parenthesis indicates the number of data sets that were considered suitable for risk assessment, and were further abstracted for inclusion in the data base and subsequent analyses.

[c]The "mixed" sex indicates that either both sexes were tested, but results were not reported separately, or sex of test animal was unknown.

Table 2-38

SUMMARY OF DICHLOROMETHANE CARCINOGENIC BIOASSAY DATA

Species	Route of Adminis-tration	Nature of Exposure	Lowest Effective Dose	Highly Affected Organ(s)	Reference
Rat F344/N Male	Inhalation	0, 100, 2000 or 4000 ppm 5 days/week, 6 hrs/day for 102 weeks; length of experiment 104 weeks; 50 controls, 50/dose group.	--	None	NTP (101)
Rat F344/N Female	Inhalation	0, 100, 2000 or 4000 ppm 5 days/week, 6 hrs/day for 102 weeks; length of experiment 104 weeks; 50 controls, 50/dose group.	1000 ppm	Mammary gland	NTP (101)
Mouse $B6C3F_1$ Male	Inhalation	0, 2000 or 4000 ppm 5 days/week, 6 hrs/day for 102 weeks; length of experiment 104 weeks; 50 controls, 50/dose group.	2000 ppm	Liver; Lung	NTP (101)
Mouse $B6C3F_1$ Female	Inhalation	0, 2000 or 4000 ppm 5 days/week, 6 hrs/day for 102 weeks; length of experiment 104 weeks; 50 controls, 50/dose group.	2000 ppm	Liver; Lung	NTP (101)
Rat Sprague-Dawley Male	Inhalation	0, 500, 1,500 or 3,500 ppm 5 days/week, 6 hrs/day for length of experiment (104 weeks); 129 controls, 129/dose group.	1500 ppm	Salivary gland region	Burek *et al.* (102)

Table 2-38 (continued)

SUMMARY OF DICHLOROMETHANE CARCINOGENIC BIOASSAY DATA

Species	Route of Administration	Nature of Exposure	Lowest Effective Dose	Highly Affected Organ(s)	Reference
Rat Sprague-Dawley Female	Inhalation	0, 500, 1,500 or 3,500 ppm 5 days/week, 6 hrs/day for length of experiment (104 weeks); 129 controls, 129/dose group.	--	None	Burek *et al.* (102)
Mice $B6C3F_1$ Male	Oral-water	0, 60.6, 124, 177 or 234 mg/kg/day for length of experiment (104 weeks); 125 controls, 100-200/dose group.	--	None	NCA (103)
Mice $B6C3F_1$ Female	Oral-water	0, 59.5, 118, 172 or 238 mg/kg/day for length of experiment (104 weeks); 100 controls, 50-100/dose group.	--	None	NCA (103)
Rat Sprague-Dawley Male	Inhalation	0, 50, 200 or 500 ppm 6 hrs/day, 5 days/week for length of experiment (87 weeks); 70 controls, 70 dose group.	--	None	Nitschke *et al.* (104)

Table 2-38 (continued)

SUMMARY OF DICHLOROMETHANE CARCINOGENIC BIOASSAY DATA

Species	Route of Administration	Nature of Exposure	Lowest Effective Dose	Highly Affected Organ(s)	Reference
Rat Sprague-Dawley Female	Inhalation	Exposures were for 6 hrs/day, 5 days/week for time indicated: 0 ppm - 104 weeks, or 50 ppm - 104 weeks, or 200 ppm - 104 weeks, or 500 ppm - 104 weeks, or 500 ppm - 52 weeks, then 0 ppm for 52 weeks; or 0 - 52 weeks, then 500 ppm for 52 weeks; observed 104 weeks; 70 controls, 25-70/dose group.	50 ppm	Mammary gland	Nitschke *et al.* (104)
Rat Fischer 344 Male	Oral-water	0, 5.85, 52.3, 125, or 235 mg/kg/day for 104 weeks or 232 mg/kg/day for 78 weeks; observed 104 weeks; 135 controls, 25-85/dose group.	--	None	NCA (105)
Rat Fischer 344 Female	Oral-water	0, 6.47, 58.3, 136, or 263 mg/kg/day for 104 weeks or 269 mg/kg/day for 78 weeks; observed 104 weeks; 135 controls, 25-85/dose group.	--	None	NCA (105)

Table 2-39

SUMMARY OF CARCINOGENIC DATA SETS FOR DIETHYLSTILBESTROL[a]

Animal Model		Route of Administration							
Species	Sex	Oral	Gavage	Inhalation	Subcu-taneous	Skin Painting	Injection	Instil-lation	TP
Mouse	Male	5(1)[b]	0	0	0	0	0	8(0)	1(0)
Mouse	Female	6(1)	0	0	1(0)	0	1(0)	0	11(8)
Mouse	Mixed[c]	1(0)	0	0	0	0	0	0	1(1)
Rat	Male	1(0)	0	0	2(0)	0	0	7(0)	0
Rat	Female	0	0	0	0	0	0	9(2)	2(0)
Rat	Mixed	0	0	0	0	0	0	1(0)	1(0)
Other	Male	0	0	0	5(0)	0	1(0)	6(3)	0
Other	Female	0	0	0	0	0	2(0)	2(0)	3(0)
Other	Mixed	0	0	0	2(0)	0	0	0	1(0)

[a]There were a total of 81 data sets of which 16 were considered suitable for risk assessment.

[b]The number in parenthesis indicates the number of data sets that were considered suitable for risk assessment, and were further abstracted for inclusion in the data base and subsequent analyses.

[c]The "mixed" sex indicates that either both sexes were tested, but results were not reported separately, or sex of test animal was unknown.

Table 2-40

SUMMARY OF DIETHYLSTILBESTROL (DES) CARCINOGENIC BIOASSAY DATA

Species	Route of Administration	Nature of Exposure	Lowest Effective Dose	Highly Affected Organ(s)	Reference
Mouse C3H Male	Oral-food	0, 0.006, 0.013, 0.025, 0.05, 0.1, 0.5 and 1.0 ppm continuously for length of experiment (85 weeks); 115 controls, 58-71/dose group.	0.013 ppm	Mammary gland	Gass *et al.* (106)
Mouse C3H Female	Oral-food	0, 0.006, 0.013, 0.025, 0.05, 0.1, 0.5 and 1.0 ppm continuously for length of experiment (85 weeks); 121 controls, 56-68/dose group.	0.006 ppm	Mammary gland	Gass *et al.* (106)
Rat ACI Female	Pellet implant	20 mg pellet implanted at start in intrascapular region. (Dosed animals received 2.9 μg DES/day.) Observed 31 weeks; 10 controls, 10 dosed.	2.9 μg/day	Mammary gland	Stone *et al.* (107)
Rat Sprague-Dawley Female	Pellet implant	20 mg pellet implanted at start in intrascapular region. (Dosed animals received 2.4 μg DES/day.) Observed 31 weeks; 10 controls, 6 dosed.	--	None	Stone *et al.* (107)
Hamster Syrian Golden Male	Pellet implant	25 mg pellet implanted every 5 months. (Controls received only the implanting operation with no pellet.) Observed 108 weeks; 15 controls, 50 dosed.	25 mg every 5 months	Adenohypophysis	Reznik-Schuller (108)

Table 2-40 (continued)

SUMMARY OF DIETHYLSTILBESTROL (DES) CARCINOGENIC BIOASSAY DATA

Species	Route of Administration	Nature of Exposure	Lowest Effective Dose	Highly Affected Organ(s)	Reference
Hamster European Male	Pellet implant	25 mg pellet implanted every 5 months. (Controls received only the implanting operation with no pellet.) Observed 108 weeks; 15 controls, 50 dosed.	25 mg every 5 months	Adenohypophysis	Reznik-Schuller (108)
Hamster Syrian Male	Pellet implant	0 or 36 mg implanted at start and at 3 months; observed 25 weeks; 10 controls, 15 dosed.	36 mg	Kidney	Liehr and Wheeler, (109)
Mouse CD-1 Female	Transplacental	The following doses were administered by subcutaneous injection to pregnant mice on days 9-16 of gestation: 0, 0.01, 1, 10, 100 μg/kg/day. Dose received by fetus estimated by: $\frac{\text{[Maternal dose x avg. maternal weight (30 gm)]}}{\text{avg. litter size (8)}}$ Estimated fetal doses: 0, 0.038 ng/day, 3.75 ng/day, 37.5 ng/day, 375 ng/day. Observed 54 weeks; 11 controls, 4-15/dose group.	--	None	McLachlan *et al.* (110)

Table 2-40 (continued)

SUMMARY OF DIETHYLSTILBESTROL (DES) CARCINOGENIC BIOASSAY DATA

Species	Route of Administration	Nature of Exposure	Lowest Effective Dose	Highly Affected Organ(s)	Reference
Mouse CD-1 Female	Transplacental	Maternal, subcutaneous injection on days 9-16 of gestation. Maternal dose: 0, 0.01, 1, 2.5, 5, 10 or 100 μg/kg/day. Estimated fetal doses: 0, 0.038, 3.75, 9.38, 18.8, 37.5 or 375 ng/day. Observed 58 weeks, 31 controls, 3-12/dose group.	--	None	McLachlan *et al.* (110)
Mouse CD-1 Female	Transplacental	Maternal, subcutaneous injection on days 9-16 of gestation. Maternal dose: 0, 1 or 100 μg/kg/day. Estimated fetal doses: 0, 3.75 or 375 ng/day. Observed 63 weeks, 4 controls, 1/dose group.	--	None	McLachlan *et al.* (110)
Mouse CD-1 Female	Transplacental	Maternal, subcutaneous injection on days 9-16 of gestation. Maternal dose: 0, 0.01 or 5 μg/kg/day. Estimated fetal doses: 0, 0.038 or 18.8 ng/day. Observed 67 weeks, 4 controls, 1-2/dose group.	--	None	McLachlan *et al.* (110)

Table 2-40 (continued)

SUMMARY OF DIETHYLSTILBESTROL (DES) CARCINOGENIC BIOASSAY DATA

Species	Route of Administration	Nature of Exposure	Lowest Effective Dose	Highly Affected Organ(s)	Reference
Mouse CD-1 Female	Trans-placental	Maternal, subcutaneous injection on days 9-16 of gestation. Maternal dose: 0, 1, 2.5, 5 or 10 μg/kg/day. Estimated fetal doses: 0, 3.75, 9.38 18.8 or 37.5 ng/day. Observed 71 weeks, 4 controls, 1-2/dose group.	--	None	McLachlan *et al.* (110)
Mouse CD-1 Female	Trans-placental	Maternal, subcutaneous injection on days 9-16 of gestation. Maternal dose: 0, 0.01, 2.5, 5, 10 or 100 μg/kg/day. Estimated fetal doses: 0, 0.038, 9.38, 18.8, 37.5 or 375 ng/day. Observed 76 weeks, 7 controls, 1-7/dose group.	--	None	McLachlan *et al.* (110)
Mouse CD-1 Female	Trans-placental	Maternal, subcutaneous injection on days 9-16 of gestation. Maternal dose: 0, 1, 2.5, 5 or 10 μg/kg/day. Estimated fetal doses: 0, 3.75, 9.38, 18.8 or 37.5, ng/day. Observed 80 weeks, 24 controls, 4-12/dose group.	--	None	McLachlan *et al.* (110)

Table 2-40 (continued)

SUMMARY OF DIETHYLSTILBESTROL (DES) CARCINOGENIC BIOASSAY DATA

Species	Route of Administration	Nature of Exposure	Lowest Effective Dose	Highly Affected Organ(s)	Reference
Mouse ICR/Jcl Male & Female	Transplacental	Groups of animals received a single dose of 10 μg/g body weight/dam on either day 7, 9, 11, 13, 15, 17 or 19 of gestation; 123 controls; treated groups contained from 6 to 60 animals/group. Terminated 12 months after birth.	10 μg/g to dam	Lung	Nomura and Kanzaki (111)
Mouse ICR/Jcl Female	Transplacental	Groups of animals received a single dose of 10 μg/g body weight/dam on either day 7, 9, 11, 13, 15, 17 or 19 of gestation; 77 controls; treated groups contained from 3 to 33 animals/group. Terminated 12 months after birth.	10 μg/g to dam	Ovary	Nomura and Kanzaki (111)

Table 2-41

SUMMARY OF CARCINOGENIC DATA SETS FOR DIPHENYLHYDRAZINE[a]

Animal Model		Route of Administration							
Species	Sex	Oral	Gavage	Inhalation	Subcu-taneous	Skin Painting	Injection	Instil-lation	TP
Mouse	Male	0	0	0	0	0	0	0	0
Mouse	Female	0	0	0	0	0	0	0	0
Mouse	Mixed[b]	0	0	0	0	0	0	0	0
Rat	Male	1(0)	0	0	0	0	0	0	0
Rat	Female	0	0	0	0	0	0	0	0
Rat	Mixed	0	0	0	1(1)[c]	0	0	0	0
Other	Male	0	0	0	0	0	0	0	0
Other	Female	0	0	0	0	0	0	0	0
Other	Mixed	0	0	0	0	0	0	0	0

[a]There were a total of 2 data sets of which 1 was considered suitable for risk assessment.

[b]The "mixed" sex indicates that either both sexes were tested, but results were not reported separately, or sex of test animal was unknown.

[c]The number in parenthesis indicates the number of data sets that were considered suitable for risk assessment, and were further abstracted for inclusion in the data base and subsequent analyses.

Table 2-42

SUMMARY OF DIPHENYLHYDRAZINE CARCINOGENIC BIOASSAY DATA

Species	Route of Administration	Nature of Exposure	Lowest Effective Dose	Highly Affected Organ(s)	Reference
Rat Sherman Male & Female	Subcutaneous injection	0 or 60 mg injected once weekly until spontaneous death; length of experiment 130 weeks, 50 controls, 52 dosed.	--	None	Spitz *et al.* (61)

Table 2-43

SUMMARY OF CARCINOGENIC DATA SETS FOR EPICHLOROHYDRIN[a]

Animal Model		Route of Administration							
Species	Sex	Oral	Gavage	Inhalation	Subcu-taneous	Skin Painting	Injection	Instil-lation	TP
Mouse	Male	0	0	0	0	0	0	0	0
Mouse	Female	0	0	0	2(0)[b]	1(0)	1(0)	0	0
Mouse	Mixed[c]	0	0	0	0	0	0	0	0
Rat	Male	1(1)	0	2(2)	0	0	0	0	0
Rat	Female	0	0	0	0	0	0	0	0
Rat	Mixed	0	0	0	0	0	0	0	0
Other	Male	0	0	0	0	0	0	0	0
Other	Female	0	0	0	0	0	0	0	0
Other	Mixed	0	0	0	0	0	0	0	0

[a]There were a total of 7 data sets of which 3 were considered suitable for risk assessment.

[b]The number in parenthesis indicates the number of data sets that were considered suitable for risk assessment, and were further abstracted for inclusion in the data base and subsequent analyses.

[c]The "mixed" sex indicates that either both sexes were tested, but results were not reported separately, or sex of test animal was unknown.

Table 2-44

SUMMARY OF EPICHLOROHYDRIN CARCINOGENIC BIOASSAY DATA

Species	Route of Administration	Nature of Exposure	Lowest Effective Dose	Highly Affected Organ(s)	Reference
Rat Sprague-Dawley Male	Inhalation	0 or 100 ppm 6 hrs/day for 30 days, examined until week 144, 100 controls, 140/dosed.	100 ppm	Nasal cavity	Laskin *et al.* (112)
Rat Wistar Male	Oral-water	0, 375, 750 or 1500 ppm administered continuously with periodic cessation of dosing according to the following schedule: 0 ppm - uninterrupted; 375 ppm - 77 weeks dosing, 4 weeks interruptions; 750 ppm - 79 weeks dosing, 2 weeks interruptions; 1500 ppm - 76 weeks dosing, 5 weeks interruptions; observed 81 weeks, 18 controls, 18/dose group.	750 ppm	Forestomach (cardia)	Konishi *et al.* (113)
Rat Sprague-Dawley Male	Inhalation	0, 10 or 30 ppm, 6 hr/day, 5 days/week for life (144 weeks). 100 animals/group.	--	None	Laskin *et al.* (112)

Table 2-45

SUMMARY OF CARCINOGENIC DATA SETS FOR ESTROGEN[a]

Animal Model		Route of Administration							
Species	Sex	Oral	Gavage	Inhalation	Subcu-taneous	Skin Painting	Injection	Instil-lation	TP
Mouse	Male	0	0	0	0	0	1(0)[b]	3(0)	0
Mouse	Female	3(0)	0	0	3(0)	0	1(0)	1(0)	0
Mouse	Mixed[c]	0	0	0	0	0	0	0	0
Rat	Male	1(0)	0	0	0	0	0	1(0)	0
Rat	Female	2(1)	0	0	0	0	0	3(0)	0
Rat	Mixed	0	0	0	0	0	0	1(0)	0
Other	Male	0	0	0	0	0	0	6(1)	0
Other	Female	1(0)	2(0)	0	0	0	0	2(0)	0
Other	Mixed	1(0)	0	0	0	0	2(0)	0	0

[a]There were a total of 34 data sets of which 2 were considered suitable for risk assessment.

[b]The number in parenthesis indicates the number of data sets that were considered suitable for risk assessment, and were further abstracted for inclusion in the data base and subsequent analyses.

[c]The "mixed" sex indicates that either both sexes were tested, but results were not reported separately, or sex of test animal was unknown.

Table 2-46

SUMMARY OF ESTROGEN CARCINOGENIC BIOASSAY DATA

Species	Route of Administration	Nature of Exposure	Lowest Effective Dose	Highly Affected Organ(s)	Reference
Hamster Syrian Male	Pellet implant	0 or 27.9 mg implanted at start, then 0 or 40.5 mg implanted at week 13; observed 28 weeks; 10 controls, 25 dosed.	27.9/ 40.5 mg	Kidney	Liehr and Wheeler (109)
Rat McCollum Female	Oral-food	0 μg/kg in diet, 60 controls; 30 dosed - 30 μg/kg/day for 26 weeks, then 60 μg/kg/day for 79 weeks, sacrificed.	--	None	McKinney *et al.* (114)

Table 2-47

SUMMARY OF CARCINOGENIC DATA SETS FOR ETHYLENE DIBROMIDE[a]

Animal Model		Route of Administration							
Species	Sex	Oral	Gavage	Inhalation	Subcu-taneous	Skin Painting	Injection	Instil-lation	TP
Mouse	Male	0	2(1)[b]	1(1)	0	0	0	0	0
Mouse	Female	0	2(1)	1(1)	0	1(0)	0	0	0
Mouse	Mixed[c]	1(0)	1(0)	0	0	0	0	0	0
Rat	Male	0	2(1)	2(2)	0	0	0	0	0
Rat	Female	0	2(1)	2(2)	0	0	0	0	0
Rat	Mixed	1(0)	1(0)	0	0	0	0	0	0
Other	Male	0	0	0	0	0	0	0	0
Other	Female	0	0	0	0	0	0	0	0
Other	Mixed	0	0	0	0	0	0	0	0

[a]There were a total of 19 data sets of which 10 were considered suitable for risk assessment.

[b]The number in parenthesis indicates the number of data sets that were considered suitable for risk assessment, and were further abstracted for inclusion in the data base and subsequent analyses.

[c]The "mixed" sex indicates that either both sexes were tested, but results were not reported separately, or sex of test animal was unknown.

Table 2-48

SUMMARY OF ETHYLENE DIBROMIDE CARCINOGENIC BIOASSAY DATA

Species	Route of Administration	Nature of Exposure	Lowest Effective Dose	Highly Affected Organ(s)	Reference
Rat Sprague-Dawley Male	Inhalation	0 or 20 ppm 5 days/week, 7 hr/day for length of experiment (77 weeks); 48 controls, 48 dosed.	20 ppm	Suprarenal gland; Subcutaneous connective tissue	Wong *et al.* (115)
Rat Sprague-Dawley Female	Inhalation	0 or 20 ppm 5 days/week, 7 hr/day for length of experiment (77 weeks); 48 controls, 48 dosed.	20 ppm	Mammary gland	Wong *et al.* (115)
Rat F344 Male	Inhalation	0, 10 or 40 ppm 5 days/week, 6 hr/day for length of experiment; observed 106 weeks (high-dose group observed 89 weeks); 50 controls, 50/dose group.	10 ppm	Nasal cavity; Testes	NCI and NTP (116)
Rat F344 Female	Inhalation	0, 10 or 40 ppm 5 days/week, 6 hr/day for length of experiment; observed 106 weeks (high-dose group observed 92 weeks); 50 controls, 50/dose group.	10 ppm	Nasal cavity; Mammary gland	NCI and NTP (116)
Mouse $B6C3F_1$ Male	Inhalation	0, 10 or 40 ppm 5 days/week, 6 hr/day for length of experiment; observed 79 weeks; 50 controls, 50/dose group.	10 ppm	Lung	NCI and NTP (116)

Table 2-48 (continued)

SUMMARY OF ETHYLENE DIBROMIDE CARCINOGENIC BIOASSAY DATA

Species	Route of Administration	Nature of Exposure	Lowest Effective Dose	Highly Affected Organ(s)	Reference
Mouse B6C3F$_1$ Female	Inhalation	0, 10 or 40 ppm 5 days/week, 6 hr/day for length of experiment; observed 106 weeks (high-dose group observed 91 weeks); 50 controls, 50/dose group.	10 ppm	Lung	NCI and NTP (116)
Rat Osborne-Mendel Male	Gavage	20 vehicle controls treated for 49 weeks, 5 days/week, then untreated for 14 weeks; sacrificed at 63 weeks. Dose groups treated 5 days/week on variable regimens for length of experiment, with initial dosages 40 and 80 mg/kg; sacrificed at 49 weeks (50 animals/group).	40 mg/kg (low dose)	Forestomach; Circulatory system	NCI (117)
Rat Osborne-Mendel Female	Gavage	Controls treated 5 days/week for 61 weeks, then untreated for 2 weeks; sacrificed at 63 weeks (20 animals). Dose groups treated 5 days/week on variable regimens for length of experiment with initial dosages of 40 and 80 mg/kg; sacrificed at 61 weeks (50 animals/group).	40 mg/kg (low dose)	Forestomach; Circulatory system	NCI (117)

Table 2-48 (continued)

SUMMARY OF ETHYLENE DIBROMIDE CARCINOGENIC BIOASSAY DATA

Species	Route of Administration	Nature of Exposure	Lowest Effective Dose	Highly Affected Organ(s)	Reference
Mouse $B6C3F_1$ Male	Gavage	Controls treated 5 days/week for 53 weeks, then untreated for 6 weeks; sacrificed at 59 wks (20 animals). Dose groups treated 5 days/week on variable regimens for length of experiment with initial dosages of 60 and 120 mg/kg; sacrificed at 77-78 weeks (50 animals/ group).	60 mg/kg (low dose)	Lung; Stomach	NCI (117)
Mouse $B6C3F_1$ Female	Gavage	Controls treated 5 days/week for 53 weeks, then untreated for 7 weeks; sacrificed at 60 weeks (20 animals). Dose groups treated 5 days/week on variable regimens for length of experiment with initial dosages of 60 and 120 mg/kg; sacrificed at 90 weeks (low dose) or 78 weeks (high dose).	60 mg/kg (low dose)	Lung; Stomach	NCI (117)

Table 2-49

SUMMARY OF CARCINOGENIC DATA SETS FOR ETHYLENE OXIDE[a]

Animal Model		Route of Administration							
Species	Sex	Oral	Gavage	Inhalation	Subcu-taneous	Skin Painting	Injection	Instil-lation	TP
Mouse	Male	0	0	0	0	1(0)[b]	0	0	0
Mouse	Female	0	0	0	1(0)	0	0	0	0
Mouse	Mixed[c]	1(0)	0	0	0	0	0	0	0
Rat	Male	0	0	6(5)	0	0	0	0	0
Rat	Female	0	1(1)	5(4)	0	0	0	0	0
Rat	Mixed	0	0	0	0	0	0	0	0
Other	Male	0	0	0	0	0	0	0	0
Other	Female	0	0	0	0	0	0	0	0
Other	Mixed	0	0	0	0	0	0	0	0

[a]There were a total of 15 data sets of which 10 were considered suitable for risk assessment.

[b]The number in parenthesis indicates the number of data sets that were considered suitable for risk assessment, and were further abstracted for inclusion in the data base and subsequent analyses.

[c]The "mixed" sex indicates that either both sexes were tested, but results were not reported separately, or sex of test animal was unknown.

Table 2-50

SUMMARY OF ETHYLENE OXIDE CARCINOGENIC BIOASSAY DATA

Species	Route of Administration	Nature of Exposure	Lowest Effective Dose	Highly Affected Organ(s)	Reference
Rat Fischer Albino Male	Inhalation	0, 50 or 100 ppm 5 days/week, 7 hrs/day for length of experiment; observed 105 weeks; 40 controls, 80/dose group.	50 ppm	Peritoneum	Lynch *et al.* (118)
Rat Fischer 344 Male	Inhalation	0, 10, 33 or 100 ppm 5 days/week, 6 hrs/day for length of experiment; observed 104 weeks; 240 controls, 120/dose group.	10 ppm	Peritoneum	Snellings *et al.* (119)
Rat Fischer 344 Female	Inhalation	0, 10, 33 or 100 ppm 5 days/week, 6 hrs/day for length of experiment; observed 104 weeks; 240 controls, 120/dose group.	10 ppm	Spleen (leukemia)	Snellings *et al.* (119)
Rat Fischer 344 Male	Inhalation	0, 10, 33 or 100 ppm 5 days/week, 6 hrs/day for length of experiment; observed 78 weeks; 240 controls (40 examined), 120/dose group (20 examined/group).	--	None	Snellings *et al.* (119)
Rat Fischer 344 Female	Inhalation	0, 10, 33 or 100 ppm 5 days/week, 6 hrs/day for length of experiment; observed 78 weeks; 240 controls (40 examined), 120/dose group (20 examined/group).	--	None	Snellings *et al.* (119)

Table 2-50 (continued)

SUMMARY OF ETHYLENE OXIDE CARCINOGENIC BIOASSAY DATA

Species	Route of Administration	Nature of Exposure	Lowest Effective Dose	Highly Affected Organ(s)	Reference
Rat Fischer 344 Male	Inhalation	0, 10, 33 or 100 ppm 5 days/week, 6 hrs/day for length of experiment; observed 52 weeks; 240 controls (20 examined), 120/ dose group (10 examined/group).	--	None	Snellings *et al.* (119)
Rat Fischer 344 Female	Inhalation	0, 10, 33 or 100 ppm 5 days/week, 6 hrs/day for length of experiment; observed 52 weeks; 240 controls (20 examined), 120/ dose group (10 examined/group).	--	None	Snellings *et al.* (119)
Rat Fischer 344 Male	Inhalation	0, 10, 33 or 100 ppm 5 days/week, 6 hrs/day for length of experiment; observed 26 weeks; 240 controls (20 examined), 120/ dose group (10 examined/group).	--	None	Snellings *et al.* (119)
Rat Fischer 344 Female	Inhalation	0, 10, 33 or 100 ppm 5 days/week, 6 hrs/day for length of experiment; observed 26 weeks; 240 controls (20 examined), 120/ dose group (10 examined/group).	--	None	Snellings *et al.* (119)

Table 2-50 (continued)

SUMMARY OF ETHYLENE OXIDE CARCINOGENIC BIOASSAY DATA

Species	Route of Administration	Nature of Exposure	Lowest Effective Dose	Highly Affected Organ(s)	Reference
Rat Sprague-Dawley Female	Gavage	0, 7.5 or 30 mg/kg body weight, 2 times per week for length of experiment (130 weeks); 50/dose group.	7.5 mg/kg	Fore-stomach	Dunkelberg (120)

Table 2-51

SUMMARY OF CARCINOGENIC DATA SETS FOR FORMALDEHYDE[a]

Animal Model		Route of Administration							
Species	Sex	Oral	Gavage	Inhalation	Subcu-taneous	Skin Painting	Injection	Instil-lation	TP
Mouse	Male	0	0	2(1)[b]	0	0	0	0	0
Mouse	Female	0	0	2(1)	0	0	0	0	0
Mouse	Mixed[c]	0	0	2(2)	0	0	0	0	0
Rat	Male	0	0	5(3)	0	0	0	0	0
Rat	Female	0	0	2(1)	0	0	0	0	0
Rat	Mixed	0	0	1(1)	0	0	0	0	0
Other	Male	0	0	1(1)	0	0	0	0	0
Other	Female	0	0	0	0	0	0	0	0
Other	Mixed	0	0	0	0	0	0	0	0

[a]There were a total of 15 data sets of which 10 were considered suitable for risk assessment.

[b]The number in parenthesis indicates the number of data sets that were considered suitable for risk assessment, and were further abstracted for inclusion in the data base and subsequent analyses.

[c]The "mixed" sex indicates that either both sexes were tested, but results were not reported separately, or sex of test animal was unknown.

Table 2-52

SUMMARY OF FORMALDEHYDE CARCINOGENIC BIOASSAY DATA

Species	Route of Administration	Nature of Exposure	Lowest Effective Dose	Highly Affected Organ(s)	Reference
Rat Fischer 344 Male & Female	Inhalation	0, 2, 6 or 15 ppm 6 hrs/day, 5 days/week for length of experiment (78 weeks); 42 to 84/dose group.	15 ppm	Nasal cavity	Swenberg *et al.* (121)
Hamster Syrian Golden Male	Inhalation	0 or 10 ppm 5 days/week, 5 hrs/day or 30 ppm 1 day/week, 5 hrs/day for length of experiment (118 weeks); 132 controls, 88 and 50/dose group, respectively.	--	None	Dalbey (122)
Mouse C3H Male & Female	Inhalation	0 or 50 mg/m^3 3 days/week, 1 hr/day for 35 weeks, then 0 or 150 mg/m^3 3 days/week, 1 hr/day for 35 weeks; length of experiment 70 weeks; 30 controls, 60 dosed.	--	None	Horton *et al.* (123)
Mouse C3H Male & Female	Inhalation	0 or 100 mg/m^3 3 days/week, 1 hr/day for length of experiment, or 200 mg/m^3 3 days/week, 1 hr/day for 4 weeks; length of experiment 35 weeks; 59 controls, 60 in 100 mg/m^3, 42 in 200 mg/m^3.	--	None	Horton *et al.* (123)

Table 2-52 (continued)

SUMMARY OF FORMALDEHYDE CARCINOGENIC BIOASSAY DATA

Species	Route of Administration	Nature of Exposure	Lowest Effective Dose	Highly Affected Organ(s)	Reference
Rat Sprague-Dawley Male	Inhalation	0 or 14.8 ppm, 5 days/week, 6 hrs/day for length of experiment (130 weeks); 100 controls, 100 dosed.	14.8 ppm	Nasal cavity	Sellakumar *et al.* (124)
Mouse $B6C3F_1$ Male	Inhalation	0, 2, 6 or 15 ppm 5 days/week, 6 hrs/day for length of experiment (104 weeks); 100/dose group (interim sacrifices excluded).	--	None	CIIT (124)
Mouse $B6C3F_1$ Female	Inhalation	0, 2, 6 or 15 ppm 5 days/week, 6 hrs/day for length of experiment (104 weeks); 60-62 animals/dose group (interim sacrifices excluded).	--	None	CIIT (124)
Rat Fischer 344 Male	Inhalation	0, 2, 6 or 15 ppm 5 days/week, 6 hrs/day for length of experiment (104 weeks); 60-70/dose group (interim sacrifices excluded).	15 ppm	Nose	CIIT (124)

Table 2-52 (continued)

SUMMARY OF FORMALDEHYDE CARCINOGENIC BIOASSAY DATA

Species	Route of Administration	Nature of Exposure	Lowest Effective Dose	Highly Affected Organ(s)	Reference
Rat Fischer 344 Male	Inhalation	0, 2, 6 or 15 ppm 5 days/week, 6 hrs/day for length of experiment (104 weeks); 60/dose group for 0, 2, or 6 ppm, 80/dose group for 15 ppm (interim sacrifices excluded).	15 ppm	Nose	CIIT (124)
Rat Fischer 344 Male	Inhalation	0, 0.3, 2 or 15 ppm 6 hrs/day, 5 days/week for length of experiment (121 weeks); 17/group for 0, 0.3, 2 ppm; 20/group for 15 ppm; (interim sacrifices excluded).	15 ppm	Nasal (squamous cell carcinoma)	Tobe *et al.* (126)

Table 2-53

SUMMARY OF CARCINOGENIC DATA SETS FOR HEXACHLOROBENZENE[a]

Animal Model		Route of Administration							
Species	Sex	Oral	Gavage	Inhalation	Subcu-taneous	Skin Painting	Injection	Instil-lation	TP
Mouse	Male	1(1)[b]	0	0	0	0	1(0)	0	0
Mouse	Female	1(1)	0	0	0	0	0	0	0
Mouse	Mixed[c]	0	0	0	0	0	0	0	0
Rat	Male	0	0	0	0	0	0	0	0
Rat	Female	2(2)	0	0	0	0	0	0	0
Rat	Mixed	0	0	0	0	0	0	0	0
Other	Male	1(1)	0	0	0	0	0	0	0
Other	Female	1(1)	0	0	0	0	0	0	0
Other	Mixed	0	0	0	0	0	0	0	0

[a]There were a total of 7 data sets of which 6 were considered suitable for risk assessment.

[b]The number in parenthesis indicates the number of data sets that were considered suitable for risk assessment, and were further abstracted for inclusion in the data base and subsequent analyses.

[c]The "mixed" sex indicates that either both sexes were tested, but results were not reported separately, or sex of test animal was unknown.

Table 2-54

SUMMARY OF HEXACHLOROBENZENE CARCINOGENIC BIOASSAY DATA

Species	Route of Administration	Nature of Exposure	Lowest Effective Dose	Highly Affected Organ(s)	Reference
Hamster Syrian Golden Male	Oral-food	0, 50, 100 or 200 ppm continuously for length of experiment (70 weeks); 40 controls, 30-59/dose group.	--	None	Cabral *et al.* (127)
Hamster Syrian Golden Female	Oral-food	0, 50, 100 or 200 ppm continuously for length of experiment (70 weeks); 40 controls, 30-60/dose group.	--	None	Cabral *et al.* (127)
Mouse Swiss Male	Oral-food	0, 50, 100 or 200 ppm continuously for length of experiment, or 300 ppm continuously for 15 weeks; length of experiment 120 weeks; 50 controls, 30-50/dose group.	100 ppm	Liver	Cabral *et al.* (128)
Mouse Swiss Female	Oral-food	0, 50, 100 or 200 ppm continuously for length of experiment, or 300 ppm continuously for 15 weeks; length of experiment 120 weeks; 50 controls 30-50/dose group.	100 ppm	Liver	Cabral *et al.* (128)
Rat Wistar Female	Oral-food	0 or 100 ppm conuously for length of experiment (75 weeks); 4 controls, 6 dosed.	--	None	Smith and Cabral (129)

Table 2-54 (continued)

SUMMARY OF HEXACHLOROBENZENE CARCINOGENIC BIOASSAY DATA

Species	Route of Administration	Nature of Exposure	Lowest Effective Dose	Highly Affected Organ(s)	Reference
Rat Agus Female	Oral-food	0 or 100 ppm continuously for length of experiment (90 weeks); 12 controls, 14 dosed.	100 ppm	Liver	Smith and Cabral (129)

Table 2-55

SUMMARY OF CARCINOGENIC DATA SETS FOR HYDRAZINE[a]

Animal Model		Route of Administration							
Species	Sex	Oral	Gavage	Inhalation	Subcu-taneous	Skin Painting	Injection	Instil-lation	TP
Mouse	Male	5(4)[b]	3(3)	0	0	0	1(0)	0	0
Mouse	Female	5(3)	6(4)	0	0	0	0	0	0
Mouse	Mixed[c]	1(0)	1(1)	0	0	0	2(0)	0	0
Rat	Male	0	2(2)	0	0	0	0	0	0
Rat	Female	0	2(2)	0	0	0	0	0	0
Rat	Mixed	0	0	0	0	0	0	0	0
Other	Male	1(0)	0	0	0	0	0	0	0
Other	Female	1(0)	0	0	0	0	0	0	0
Other	Mixed	0	1(0)	0	0	0	0	0	0

[a]There were a total of 31 data sets of which 19 were considered suitable for risk assessment.

[b]The number in parenthesis indicates the number of data sets that were considered suitable for risk assessment, and were further abstracted for inclusion in the data base and subsequent analyses.

[c]The "mixed" sex indicates that either both sexes were tested, but results were not reported separately, or sex of test animal was unknown.

Table 2-56

SUMMARY OF HYDRAZINE CARCINOGENIC BIOASSAY DATA

Species	Route of Administration	Nature of Exposure	Lowest Effective Dose	Highly Affected Organ(s)	Reference
Mouse A/J Male	Oral-water	0 or 0.033% in drinking water for 48 weeks, 20 controls, 38 dosed; length of experiment 48 weeks.	0.033%	Lung	Yammamoto and Weisburger (130)
Mouse BALB/Cb/Se Male	Gavage	0 or 1.14 mg/day for 4 weeks, 22 controls, 10 dosed; length of experiment 105 weeks.	1.14 mg/day	Lung	Biancifiori et al. (131)
Mouse BALB/Cb/Se Female	Gavage	0 or 1.14 mg/day for 4 weeks, 23 controls, 10 dosed; length of experiment 99 weeks.	1.14 mg/day	Lung	Biancifiori et al. (131)
Mouse CBA/Cbl Se Male	Gavage	0 or 1.12 mg/day for 36 weeks, length of experiment weeks; 37 controls, 21 dosed.	1.12 mg/day	Lung; Liver	Biancifiori et al. (131)
Mouse CBA/Cbl Se Female	Gavage	0 or 1.12 mg/day for 36 weeks, length of experiment 110 weeks, 47 controls, 21 dosed.	1.12 mg/day	Lung; Liver	Biancifiori et al. (131)
Mouse C3H Male	Oral-water	0 or 0.012% continuously for length of experiment (104 weeks); 30 controls, 41 dosed.	0.012%	Lung	Toth (132)

Table 2-56 (continued)

SUMMARY OF HYDRAZINE CARCINOGENIC BIOASSAY DATA

Species	Route of Administration	Nature of Exposure	Lowest Effective Dose	Highly Affected Organ(s)	Reference
Mouse C3H Female	Oral-water	0 or 0.012% continuously for length of experiment (84 weeks); 30 controls, 41 dosed.	--	None	Toth, 1969
Mouse Swiss Male	Oral-water	0 or 0.012% continuously for length of experiment (104 weeks); 110 controls, 50 dosed.	0.012%	Lung	Toth (132)
Mouse Swiss Female	Oral-water	0 or 0.012% continuously for length of experiment (114 weeks); 110 controls, 50 dosed.	0.012%	Lung	Toth (132)
Rat CBRI/Se Male	Gavage	0 or 56.9 mg once weekly for 68 weeks, length of experiment 109 weeeks, 28 controls, 14 dosed.	56.9 mg/week	Lung	Biancifiori *et al.* (133)
Rat CBRI/Se Female	Gavage	0 or 37.9 mg once weekly for 68 weeks, length of experiment 109 weeks, 22 controls, 18 dosed.	37.9 mg/week	Lung	Biancifiori *et al.* (133)
Mouse CBA/Cb/Se Male	Gavage	0 or 1.13 mg/day for 36 weeks; length of experiment 148 weeks; 37 controls, 21 dosed.	1.13 mg/day	Lung	Severi and Biancifiori (134)

Table 2-56 (continued)

SUMMARY OF HYDRAZINE CARCINOGENIC BIOASSAY DATA

Species	Route of Administration	Nature of Exposure	Lowest Effective Dose	Highly Affected Organ(s)	Reference
Mouse CBA/Cb/Se Female	Gavage	0 or 1.13 mg/day for 36 weeks; length of experiment 99 weeks; 47 controls, 21 dosed.	1.13 mg/day	Lung	Severi and Biancifiori (134)
Rat CB/Se Male	Gavage	0, 12 or 18 mg/day for 68 weeks; length of experiment 109 weeks; 28 controls, 13 dosed (12 mg/day), 14 dosed (18 mg/day).	12 mg/day	Liver; Lung	Severi and Biancifiori (134)
Rat CB/Se Female	Gavage	0, 12 or 18 mg/day daily for 68 weeks; length of experiment 109 weeks; 22 controls, 13 dosed (12 mg/day) 18 dosed (18 mg/day).	12 mg/day	Lung	Severi and Biancifiori (134)
Mouse BALB/c/Cb/Se Female	Gavage	0 or 1.13 mg/day, 5 days/week for 30 weeks; length of experiment 102 weeks; 25 controls, 22 dosed.	1.13 mg/day	Lung	Biancifiori (135)
Mouse CBA/Cb/Se Male & Female	Gavage	0, 0.14, 0.28, 0.56 or 1.13 mg/day 6 days/week for 25 weeks; length of experiment 100 weeks, 59 controls, 49-51/dose group.	0.14 mg/day	Liver	Biancifiori (135)
Mouse Swiss Male	Oral-water	0 or 0.001% (10 ppm) continuously for life (120 weeks); 110 controls, 50 dosed.	10 ppm	Lung	Toth (136)

Table 2-56 (continued)

SUMMARY OF HYDRAZINE CARCINOGENIC BIOASSAY DATA

Species	Route of Adminis-tration	Nature of Exposure	Lowest Effective Dose	Highly Affected Organ(s)	Reference
Mouse Swiss Female	Oral-water	0 or 0.001% (10 ppm) continuously for life (120 weeks); 110 controls, 50 dosed.	10 ppm	Lung	Toth (136)

Table 2-57

SUMMARY OF CARCINOGENIC DATA SETS FOR ISONIAZID[a]

Animal Model		Route of Administration							
Species	Sex	Oral	Gavage	Inhalation	Subcu-taneous	Skin Painting	Injection	Instil-lation	TP
Mouse	Male	10(9)[b]	7(6)	0	5(2)	0	0	0	0
Mouse	Female	11(8)	6(5)	0	5(2)	0	1(0)	0	0
Mouse	Mixed[c]	1(0)	0	0	0	0	0	0	0
Rat	Male	5(2)	1(0)	0	1(0)	0	1(0)	0	0
Rat	Female	4(2)	0	0	1(0)	0	1(0)	0	0
Rat	Mixed	0	0	0	0	0	0	0	0
Other	Male	2(2)	0	0	0	0	1(0)	0	0
Other	Female	2(2)	0	0	0	0	1(0)	0	0
Other	Mixed	0	0	0	0	0	0	0	0

[a]There were a total of 66 data sets of which 40 were considered suitable for risk assessment.

[b]The number in parenthesis indicates the number of data sets that were considered suitable for risk assessment, and were further abstracted for inclusion in the data base and subsequent analyses.

[c]The "mixed" sex indicates that either both sexes were tested, but results were not reported separately, or sex of test animal was unknown.

Table 2-58

SUMMARY OF ISONIAZID CARCINOGENIC BIOASSAY DATA

Species	Route of Administration	Nature of Exposure	Lowest Effective Dose	Highly Affected Organ(s)	Reference
Mouse AKR Male	Oral-water	0 or 0.1% in drinking water for 80 weeks; length of experiment 80 weeks; 30 controls, 30/dose group.	--	None	Toth and Rustia (137)
Mouse AKR Female	Oral-water	0 or 0.1% in drinking water for 80 weeks; length of experiment 80 weeks; 30 controls, 30/dose group.	--	None	Toth and Rustia (137)
Mouse Swiss Albino Male	Oral-water	0, 0.15 or 0.05% in drinking water for 110 weeks; length of experiment 110 weeks; 110 controls, 40/dose group.	0.05%	Lung	Toth and Rustia (137)
Mouse Swiss Albino Female	Oral-water	0, 0.15 or 0.05% in drinking water for 120 weeks for length of experiment (120 weeks); 110 controls, 40/dose group.	0.05%	Lung	Toth and Rustia (137)
Mouse ASW/SN Male	Oral-water	0 or 0.1% in drinking water for 130 weeks (length of experiment); 103 controls, 50/dose group.	--	None	Toth and Toth (138)
Mouse ASW/SN Female	Oral-water	0 or 0.1% in drinking water for 150 weeks (length of experiment); 106 controls, 50/dose group.	0.1%	Lung	Toth and Toth (138)

Table 2-58 (continued)

SUMMARY OF ISONIAZID CARCINOGENIC BIOASSAY DATA

Species	Route of Administration	Nature of Exposure	Lowest Effective Dose	Highly Affected Organ(s)	Reference
Rat MRC Male	Oral-water	0 or 0.1% in drinking water for 170 weeks (length of experiment); 100 controls, 50/dose group.	0.1%	Liver	Toth and Toth (138)
Rat MRC Female	Oral-water	0 or 0.1% in drinking water for 170 weeks (length of experiment); 101 controls, 50/dose group.	--	None	Toth and Toth (138)
Mouse Swiss Albino Male	Oral-water	0 or 0.1% in drinking water for 110 weeks (length of experiment); 110 controls, 55/dose group.	0.1%	Lung	Toth and Shubik (139)
Mouse Swiss Albino Female	Oral-water	0 or 0.1% in drinking water for 110 weeks (length of experiment); 110 controls, 55/dose group.	0.1%	Lung	Toth and Shubik (139)
Mouse C3H Male	Oral-water	0 or 0.1% in drinking water for 90 weeks (length of experiment); 30 controls, 30/dose group.	--	None	Toth and Shubik (140)
Mouse C3H Female	Oral-water	0 or 0.1% in drinking water for 80 weeks (length of experiment); 30 controls, 30/dose group.	--	None	Toth and Shubik (140)

Table 2-58 (continued)

SUMMARY OF ISONIAZID CARCINOGENIC BIOASSAY DATA

Species	Route of Administration	Nature of Exposure	Lowest Effective Dose	Highly Affected Organ(s)	Reference
Hamster Syrian Golden Male	Oral-water	0 or 0.1% in drinking water for 140 weeks (length of experiment); 100 controls, 50/dose group.	--	None	Toth and Boreisha (141)
Hamster Syrian Golden Female	Oral-water	0 or 0.1% in drinking water for 120 weeks (length of experiment); 100 controls, 50/dose group.	0.1%	Forestomach	Toth and Boreisha (141)
Mouse A/J Male	Oral-water	0 or 0.1% in drinking water for 48 weeks (length of experiment); 20 controls, 38/dose group.	0.1%	Lung	Yamamoto and Weisburger (130)
Mouse BALB/C Male	Gavage	0 or 1.76 mg twice/week for 44 weeks, length of experiment 92 weeks; 9 controls, 24/dose group.	--	None	Peacock & Peacock (142)
Mouse BALB/C Female	Gavage	0 or 1.79 mg twice/week for 44 weeks, length of experiment 102 weeks; 36 controls, 17/dose group.	--	None	Peacock & Peacock (142)
Mouse C3Hf Female	Oral-water	0 or 0.1% in drinking water for 119 weeks (length of experiment); 28 controls, 14/dose group.	0.1%	Lung	Peacock & Peacock (142)

Table 2-58 (continued)

SUMMARY OF ISONIAZID CARCINOGENIC BIOASSAY DATA

Species	Route of Administration	Nature of Exposure	Lowest Effective Dose	Highly Affected Organ(s)	Reference
Mouse C3Hf Male	Oral-water	0 or 0.1% in drinking water for 110 weeks (length of experiment); 26 controls, 36/dose group.	0.1%	Lung	Peacock & Peacock (142)
Mouse BALB/C Male	Oral-water	0 or 0.1% in drinking water for 94 weeks (length of experiment); 9 controls, 15/dose group.	--	None	Peacock & Peacock (142)
Mouse BALB/C Female	Oral-water	0 or 0.1% in drinking water for 102 weeks (length of experiment); 36 controls, 20/dose group.	--	None	Peacock & Peacock (142)
Mouse BALB/C Male	Subcutaneous	0 or 2 mg every other day for 18 weeks; length of experiment 30 weeks; 102 controls, 71/dose group.	2 mg	Lung	Jones *et al.* (143)
Mouse BALB/C Female	Subcutaneous	0 or 2 mg every other day for 18 weeks; length of experiment 30 weeks; 90 controls, 53/dose group.	2 mg	Lung	Jones *et al.* (143)

Table 2-58 (continued)

SUMMARY OF ISONIAZID CARCINOGENIC BIOASSAY DATA

Species	Route of Administration	Nature of Exposure	Lowest Effective Dose	Highly Affected Organ(s)	Reference
Mouse Strong-A Male	Subcutaneous	0, 2 or 4 mg every other day for 18 weeks; length of experiment 30 weeks; 210 controls, 99 or 112/dose group.	2 mg	Lung	Jones *et al.* (143)
Mouse Strong-A Female	Subcutaneous	0, 2 or 4 mg every other day for 18 weeks; length of experiment 30 weeks; 209 controls, 95 or 105/dose group.	2 mg	Lung	Jones *et al.* (143)
Hamster Syrian Golden Male	Oral-water	0, 0.1 or 0.2% continuously for length of experiment, 0.3% for 42 weeks (given in cycle of 6 weeks on, 2 weeks off), length of experiment 140 weeks, 100 controls, 50/dose group (0.1 and 0.2%), 36 dosed (0.3%).	--	None	Toth and Shubik (144)
Hamster Syrian Golden Female	Oral-water	0, 0.1 or 0.2% continuously for length of experiment, 0.3% for 42 weeks (given in cycle of 6 weeks on, 2 weeks off), length of experiment 120 weeks; 100 controls, 50/dose group (0.1 and 0.2%), 35 dosed (0.3%).	--	None	Toth and Shubik (144)

Table 2-58 (continued)

SUMMARY OF ISONIAZID CARCINOGENIC BIOASSAY DATA

Species	Route of Administration	Nature of Exposure	Lowest Effective Dose	Highly Affected Organ(s)	Reference
Mouse CBA/CB/Se Male	Gavage	0 or 1.99 mg/day for 36 weeks, length of experiment 105 weeks; 37 controls, 18/dose group.	1.99 mg/day	Lung	Biancifiori *et al.* (131)
Mouse CBA/CB/Se Female	Gavage	0 or 1.99 mg/day for 36 weeks, length of experiment 99 weeks; 47 controls, 17/dose group.	1.99 mg/day	Lung	Biancifiori *et al.* (131)
Mouse BALB/c/Cb/Se Male	Gavage	0 or 2 mg/day for 4 weeks, length of experiment 99 weeks; 22 controls, 10/dose group.	--	None	Biancifiori *et al.* (131)
Mouse BALB/c/Cb/Se Female	Gavage	0 or 2 mg/day for 4 weeks, length of experiment 99 weeks; 23 controls, 10/dose group.	--	None	Biancifiori *et al.* (131)
Mouse CBA/CB/Se Male	Gavage	0 or 2 mg/day for 36 weeks, length of experiment 148 weeks; 37 controls, 18/dose group.	2 mg/day	Lung	Severi and Biancifiori (134)
Mouse CBA/CB/Se Female	Gavage	0 or 2 mg/day for 36 weeks, length of experiment 99 weeks; 47 controls, 17/dose group.	2 mg/day	Lung	Severi and Biancifiori (134)

Table 2-58 (continued)

SUMMARY OF ISONIAZID CARCINOGENIC BIOASSAY DATA

Species	Route of Administration	Nature of Exposure	Lowest Effective Dose	Highly Affected Organ(s)	Reference
Rat Cb/Se Male	Oral-water	0 or 0.35% continuously for 48 weeks, length of experiment 109 weeks; 28 controls, 49/dose group.	--	None	Severi and Biancifiori (134)
Rat Cb/Se Female	Oral-water	0 or 0.35% continuously for 48 weeks, length of experiment 109 weeks; 22 controls, 40/dose group.	0.35%	Breast	Severi and Biancifiori (134)
Mouse Swiss Male	Gavage	0, 0.55, 1.1 or 2.2 mg/day 6 days/week for 104 weeks, or 2.2 mg/day, 6 days/week for 17 weeks. 30 controls, 30/dose group (0.55 and 1.1), 24 in group getting 2.2 mg/day for 104 weeks, 6 in group 2.2 getting mg/day for 17 weeks. Length of experiment 104 weeks.	0.55 mg/day	Lung	Bhide *et al.* (145)
Mouse Swiss Female	Gavage	0 or 1.1 mg/day, 6 days/week for length of experiment, observed 104 weeks; 60 controls, 44/dose group.	1.1 mg/day	Lung	Bhide *et al.* (145)
Mouse Strain A Male	Gavage	0, 1.1 or 2.2 mg/kg, 6 days/week for length of experiment, observed 91 weeks; 20 controls, 20/dose group.	1.1 mg/day	Lung	Bhide *et al.* (145)

Table 2-58 (continued)

SUMMARY OF ISONIAZID CARCINOGENIC BIOASSAY DATA

Species	Route of Administration	Nature of Exposure	Lowest Effective Dose	Highly Affected Organ(s)	Reference
Mouse Strong-A Male	Oral-food	0 or 35 mg/day for 6 weeks, then 26.3 mg/day for 12 weeks. Length of experiment 30 30 weeks; 106 controls, 139/dose group.	35/26.3 mg/day	Lung	Jones *et al.* (143)
Mouse Strong-A Female	Oral-food	0 mg/day; or 35 mg/day for 6 weeks, then 26.3 mg/day for 12 weeks. Length of experiment 30 weeks; 108 controls, 145/dose group.	35/26.3 mg/day	Lung	Jones *et al.* (143)

Table 2-59

SUMMARY OF CARCINOGENIC DATA SETS FOR LEAD[a]

Animal Model		Route of Administration							
Species	Sex	Oral	Gavage	Inhalation	Subcu-taneous	Skin Painting	Injection	Instil-lation	TP
Mouse	Male	1(1)[b]	0	0	0	0	0	0	0
Mouse	Female	1(1)	0	0	0	0	1(0)	0	0
Mouse	Mixed[c]	1(0)	0	0	0	0	1(1)	0	0
Rat	Male	11(5)	1(0)	0	0	0	2(0)	0	0
Rat	Female	3(2)	1(0)	0	0	0	2(0)	0	0
Rat	Mixed	3(2)	0	0	0	0	1(0)	0	0
Other	Male	2(1)	0	0	0	0	0	0	0
Other	Female	1(1)	0	0	0	0	0	0	0
Other	Mixed	0	0	0	0	0	0	1(1)	0

[a]There were a total of 33 data sets of which 15 were considered suitable for risk assessment.

[b]The number in parenthesis indicates the number of data sets that were considered suitable for risk assessment, and were further abstracted for inclusion in the data base and subsequent analyses.

[c]The "mixed" sex indicates that either both sexes were tested, but results were not reported separately, or sex of test animal was unknown.

Table 2-60

SUMMARY OF LEAD CARCINOGENIC BIOASSAY DATA

Species	Route of Administration	Nature of Exposure	Lowest Effective Dose	Highly Affected Organ(s)	Reference
Rat Fischer 344 Male	Oral-food	0 or 1% continuously for length of experiment (52 weeks); 150 controls, 150 dosed.	--	None	Hinton *et al.* (146)
Rat Long-Evans Male	Oral-water	0 or 25 ppm continuously for length of experiment (180 weeks); 52 controls, 52 dosed.	--	None	Schroeder *et al.* (147)
Rat Wistar Male	Oral-food	0 or 0.1% continuously for length of experiment (124 weeks); 14 controls, 16 dosed.	0.1%	Kidney	Van Esch *et al.* (148)
Rat Wistar Female	Oral-food	0 or 0.1% continuously for length of experiment (124 weeks); 15 controls, 16 dosed.	0.1%	Kidney	Van Esch *et al.* (148)
Rat Wistar Male	Oral-food	0 or 1% continuously for length of experiment (104 weeks); 13 controls, 13 dosed.	1%	Kidney	Van Esch *et al.* (148)
Rat Wistar Female	Oral-food	0 or 1% continuously for length of experiment (104 weeks); 13 controls, 11 dosed.	1%	Kidney	Van Esch *et al.* (148)
Rat Wistar Male	Oral-food	0 or 1% continuously for length of experiment (99 weeks); 20 controls, 40 dosed.	1%	Kidney	Mao and Molnar (149)

Table 2-60 (continued)

SUMMARY OF LEAD CARCINOGENIC BIOASSAY DATA

Species	Route of Administration	Nature of Exposure	Lowest Effective Dose	Highly Affected Organ(s)	Reference
Rat Long-Evans Male & Female	Oral-food	0 or 369 μg/kg/day for length of experiment (167 weeks); 34 controls, 32 dosed.	--	None	Kanisawa and Schroeder (35)
Mouse Swiss Male	Oral-food	0 or 0.1% continuously for length of experiment or 1% continuously for 13 weeks, then 0.5% for 91 weeks; observed 104 weeks, 25 controls, 25/dose group.	--	None	Van Esch and Kroes (150)
Mouse Swiss Female	Oral-food	0 or 0.1% continuously for length of experiment or 1% continuously for 13 weeks, then 0.5% for 91 weeks; observed 104 weeks, 25 controls, 25/dose group.	--	None	Van Esch and Kroes (150)
Hamster Golden Male	Oral-food	0, 0.1 or 0.5% continuously for length of experiment (104 weeks); 22 controls, 22/dose group.	--	None	Van Esch and Kroes (150)
Hamster Golden Female	Oral-food	0, 0.1 or 0.5% continuously for length of experiment (104 weeks); 23 controls, 24/dose group.	--	None	Van Esch and Kroes (150)

Table 2-60 (continued)

SUMMARY OF LEAD CARCINOGENIC BIOASSAY DATA

Species	Route of Administration	Nature of Exposure	Lowest Effective Dose	Highly Affected Organ(s)	Reference
Mouse Strong/A Male & Female	IP Injection	0, 2, 5 and 10 mg/kg 3 times/week for 5 weeks (15 injections); observed 30 weeks, 20 controls, 20/dose group.	2 mg/kg	Lung	Stoner *et al.* (72)
Hamster Syrian Golden Male & Female	Intratracheal instillation	0 or 1 mg/week for 10 weeks; observed 60 weeks, 30 controls, 30 dosed.	--	None	Kobayashi and Okamoto (63)
Rat Wistar Male & Female	Oral-food	0 or 3 mg/day in diet, length of dosing varied from 9 weeks to 114 weeks (length of experiment); 8-26/dose group; 94 controls.	3 mg/day	Hypophysis brain; Lung	Zawirska (151)

Table 2-61

SUMMARY OF CARCINOGENIC DATA SETS FOR MELPHALAN[a]

Animal Model		Route of Administration							
Species	Sex	Oral	Gavage	Inhalation	Subcu-taneous	Skin Painting	Injection	Instil-lation	TP
Mouse	Male	0	0	0	0	0	1(0)[b]	0	0
Mouse	Female	0	0	0	0	0	2(0)	0	0
Mouse	Mixed[c]	0	0	0	0	0	2(1)	0	0
Rat	Male	0	0	0	0	0	1(0)	0	0
Rat	Female	0	0	0	0	0	1(0)	0	0
Rat	Mixed	0	0	0	0	0	0	0	0
Other	Male	0	0	0	0	0	0	0	0
Other	Female	0	0	0	0	0	0	0	0
Other	Mixed	0	0	0	0	0	0	0	0

[a]There were a total of 7 data sets of which 1 was considered suitable for risk assessment.

[b]The number in parenthesis indicates the number of data sets that were considered suitable for risk assessment, and were further abstracted for inclusion in the data base and subsequent analyses.

[c]The "mixed" sex indicates that either both sexes were tested, but results were not reported separately, or sex of test animal was unknown.

Table 2-62

SUMMARY OF MELPHALAN CARCINOGENIC BIOASSAY DATA

Species	Route of Administration	Nature of Exposure	Lowest Effective Dose	Highly Affected Organ(s)	Reference
Mouse A/J Male & Female	Intraperitoneal injection	0, 0.02, 0.09, 0.39 or 1.6 mg/kg, 3 times a week for 4 weeks. Observed 39 weeks. 330 controls, 60/dose group.	0.02 mg/kg	Lung	Shimkin et al. (77)

Table 2-63

SUMMARY OF CARCINOGENIC DATA SETS FOR METHOTREXATE[a]

Animal Model		Route of Administration							
Species	Sex	Oral	Gavage	Inhalation	Subcu-taneous	Skin Painting	Injection	Instil-lation	TP
Mouse	Male	1(1)[b]	0	0	0	0	1(0)	0	0
Mouse	Female	1(1)	0	0	0	1(0)	2(0)	0	0
Mouse	Mixed[c]	0	0	0	0	0	0	0	0
Rat	Male	0	0	0	0	0	2(1)	0	0
Rat	Female	0	0	0	0	0	3(1)	0	0
Rat	Mixed	0	1(0)	0	0	0	0	0	0
Other	Male	1(1)	0	0	0	0	0	0	0
Other	Female	1(1)	0	0	0	0	0	0	0
Other	Mixed	0	0	0	2(0)	0	0	0	0

[a]There were a total of 16 data sets of which 6 were considered suitable for risk assessment.

[b]The number in parenthesis indicates the number of data sets that were considered suitable for risk assessment, and were further abstracted for inclusion in the data base and subsequent analyses.

[c]The "mixed" sex indicates that either both sexes were tested, but results were not reported separately, or sex of test animal was unknown.

Table 2-64

SUMMARY OF METHOTREXATE CARCINOGENIC BIOASSAY DATA

Species	Route of Administration	Nature of Exposure	Lowest Effective Dose	Highly Affected Organ(s)	Reference
Mice Swiss Male	Oral-food	0, 3, 5, 8 or 10 ppm in diet daily on alternate weeks for length of experiment (120 weeks). 70 controls, 36 in 3 ppm, 36 in 5 ppm, 42 in 8 ppm, and 48 in 10 ppm dose groups.	--	None	Rustia and Shubik (152)
Mice Swiss Female	Oral-food	0, 3, 5, 8 or 10 ppm in diet daily on alternate weeks for length of experiment (120 weeks). 70 controls, 36 in 3 ppm, 36 in 5 ppm, 42 in 8 ppm, and 48 in 10 ppm dose groups.	--	None	Rustia and Shubik (152)
Hamsters Syrian Golden Male	Oral-food	0, 5, 10 or 20 ppm in diet daily on alternate weeks for length of experiment (120 weeks). 49 controls, 42 in 5 ppm 42 in 10 ppm, and 40 in 20 ppm dose groups.	--	None	Rustia and Shubik (152)
Hamsters Syrian Golden Female	Oral-food	0, 5, 10 or 20 ppm in diet daily on alternate weeks for length of experiment (120 weeks). 49 controls, 42 in 5 ppm, 42 in 10 ppm, and 39 in 20 ppm dose groups.	--	None	Rustia and Shubik (152)

Table 2-64 (continued)

SUMMARY OF METHOTREXATE CARCINOGENIC BIOASSAY DATA

Species	Route of Administration	Nature of Exposure	Lowest Effective Dose	Highly Affected Organ(s)	Reference
Rats Sprague-Dawley Male	Intraperitoneal injection	0 or 0.625 mg/kg once a week for length of experiment (130 weeks). 36 controls, 30 dosed.	--	None	Schmahl and Habs (153)
Rats Sprague-Dawley Female	Intraperitoneal injection	0 or 0.625 mg/kg once a week for length of experiment (130 weeks). 33 controls, 31 dosed.	--	None	Schmahl and Habs (153)

Table 2-65

SUMMARY OF CARCINOGENIC DATA SETS FOR MUSTARD GAS

Animal Model		Route of Administration							
Species	Sex	Oral	Gavage	Inhalation	Subcu-taneous	Skin Painting	Injection	Instil-lation	TP
Mouse	Male	0	0	0	0	0	0	0	0
Mouse	Female	0	0	0	0	0	0	0	0
Mouse	Mixed[b]	0	0	0	3(3)[b]	0	1(1)	0	0
Rat	Male	0	0	0	0	0	0	0	0
Rat	Female	0	0	0	0	0	0	0	0
Rat	Mixed	0	0	0	0	0	0	0	0
Other	Male	0	0	0	0	0	0	0	0
Other	Female	0	0	0	0	0	0	0	0
Other	Mixed	0	0	0	0	0	0	0	0

[a]There were a total of 4 data sets all of which were considered suitable for risk assessment.

[b]The "mixed" sex indicates that either both sexes were tested, but results were not reported separately, or sex of test animal was unknown.

[c]The number in parenthesis indicates the number of data sets that were considered suitable for risk assessment, and were further abstracted for inclusion in the data base and subsequent analyses.

Table 2-66

SUMMARY OF MUSTARD GAS CARCINOGENIC BIOASSAY DATA

Species	Route of Administration	Nature of Exposure	Lowest Effective Dose	Highly Affected Organ(s)	Reference
Mouse A Strain Male & Female	Intravenous	0 or 0.16 μg every other day for a total of 4 injections, 48/dose group. Length of experiment 16 weeks.	0.16 μg	Lungs (only organ examined)	Heston (154)
Mouse C_3H Male & Female	Subcutaneous injection	0 or 0.1 mg in a single injection or 0.025 mg weekly for 6 weeks; 16 controls, 16-24/dose group; observed until natural death (104 weeks).	--	None	Heston (155)
Mouse C_3Hf Male & Female	Subcutaneous injection	40 untreated controls; 50 animals received 0.025 mg weekly for 6 weeks; observed until natural death (104 weeks).	--	None	Heston (155)
Mouse A Strain Male & Female	Subcutaneous injection	0 or 0.25 mg weekly for 5 weeks; observed until natural death (104 weeks); 30 animals/group.	--	None	Heston (155)

Table 2-67

SUMMARY OF CARCINOGENIC DATA SETS FOR 2-NAPHTHYLAMINE[a]

Animal Model		Route of Administration							
Species	Sex	Oral	Gavage	Inhalation	Subcu-taneous	Skin Painting	Injection	Instil-lation	TP
Mouse	Male	1(0)[b]	2(2)	0	1(1)	0	0	0	0
Mouse	Female	2(1)	2(2)	0	1(1)	0	0	0	0
Mouse	Mixed[c]	0	0	0	3(1)	0	1(1)	0	0
Rat	Male	0	1(0)	0	0	0	0	0	0
Rat	Female	0	2(1)	0	0	0	0	0	0
Rat	Mixed	1(1)	0	0	0	0	0	0	0
Other	Male	1(0)	2(0)	0	0	0	0	0	0
Other	Female	6(1)	2(1)	0	0	0	0	0	0
Other	Mixed	8(8)	0	0	0	0	0	1(0)	0

[a]There were a total of 37 data sets of which 21 were considered suitable for risk assessment.

[b]The number in parenthesis indicates the number of data sets that were considered suitable for risk assessment, and were further abstracted for inclusion in the data base and subsequent analyses.

[c]The "mixed" sex indicates that either both sexes were tested, but results were not reported separately, or sex of test animal was unknown.

Table 2-68

SUMMARY OF 2-NAPHTHYLAMINE CARCINOGENIC BIOASSAY DATA

Species	Route of Administration	Nature of Exposure	Lowest Effective Dose	Highly Affected Organ(s)	Reference
Mouse A/J Male & Female	Intraperitoneal injection	0, 6.25 25, 100 or 400 mg/kg 3 times/week for 4 weeks; 330 controls, 30/dose group. Length of experiment 39 weeks.	6.25 mg/kg	Lung	Shimkin *et al.* (77)
Rat Wistar Female	Gavage	0 or 300 mg/kg one day/week for 57 weeks, observed 100 weeks; 20 controls, 20 dosed.	--	None	Hicks *et al.* (156)
Mouse Swiss Male	S.C. injection	0 or 100 μg injected 3 times/week for one week; observed 52 weeks; 24 controls, 28 dosed.	--	None	Radomski *et al.* (157)
Mouse Swiss Female	S.C. injection	0 or 100 μg injected 3 times/week for one week; observed 52 weeks; 30 controls, 23 dosed.	--	None	Radomski *et al.* (157)
Mouse Swiss Male & Female Combined	S.C. injection	Single injection of 0 or 30 μg; observed 43 weeks; 58 controls; 68 dosed.	--	None	Radomski *et al.* (157)
Dog Beagle Female	Oral (capsule)	0 or 5 mg/kg daily for 4 weeks; observed 156 weeks; 4 controls, 4 dosed.	--	None	Radomski *et al.* (158)

Table 2-68 (continued)

SUMMARY OF 2-NAPHTHYLAMINE CARCINOGENIC BIOASSAY DATA

Species	Route of Administration	Nature of Exposure	Lowest Effective Dose	Highly Affected Organ(s)	Reference
Mouse IF Male	Gavage	0 or 5 mg in arachis oil twice/week for length of experiment (72 weeks); 6 controls, 13 dosed.	5 mg	Liver	Bonser *et al.* (159)
Mouse IF Female	Gavage	0 or 5 mg in arachis oil twice/week for length of experiment (72 weeks); 5 controls, 12 dosed.	5 mg	Liver	Bonser *et al.* (159)
Mouse CBA Male	Gavage	0 or 5 mg in arachis oil twice/week for length of experiment (89 weeks); 7 controls, 9 dosed.	5 mg	Liver	Bonser *et al.* (159)
Mouse CBA Female	Gavage	0 or 5 mg in arachis oil twice/week for length of experiment (89 weeks); 7 controls, 14 dosed.	5 mg	Liver	Bonser *et al.* (159)
Monkey Rhesus Female	Gavage	13 dose groups with variable doses and dosing schedules received 0 or from 6.25 to 400 mg/kg for up to 257 weeks, 6 times/week; length of experiment 257 weeks; 1 to 3 animals/dose group.	6.25/ 12.5 mg/kg	Bladder	Conzelman *et al.* (160)
Dog Beagle Male & Female	Oral, p.o.	0, 6.25 or 12.5 mg/kg 6 days/week for length of experiment (26 weeks); 1 animal/group.	--	None	Conzelman and Moulton (161)

Table 2-68 (continued)

SUMMARY OF 2-NAPHTHYLAMINE CARCINOGENIC BIOASSAY DATA

Species	Route of Administration	Nature of Exposure	Lowest Effective Dose	Highly Affected Organ(s)	Reference
Dog Beagle Male & Female	Oral, p.o.	0, 6.25, 12.5, 25 or 50 mg/kg 6 days/ week for length of experiment (39 weeks); 1/dose group.	--	None	Conzelman and Moulton (161)
Dog Beagle Male & Female	Oral, p.o.	0, 6.25, 12.5 or 25 mg/kg 6 days/ week for length of experiment (52 weeks); 1/dose group.	25 mg/kg	Bladder	Conzelman and Moulton (161)
Dog Beagle Male & Female	Oral, p.o.	0, 6.25, 12.5 or 25 mg/kg 6 days/ week for 65 weeks (length of experiment); 1/dose group.	25 mg/kg	Bladder	Conzelman and Moulton (161)
Dog Beagle Male & Female	Oral, p.o.	0, 6.25, 12.5 or 25 mg/kg 6 days/ week for 78 weeks (length of experiment); 1/dose group.	--	None	Conzelman and Moulton (161)
Dog Beagle Male & Female	Oral, p.o.	0, 6.25, 12.5 or 25 mg/kg 6 days/ week for 104 weeks (length of experiment); 1/dose group.	6.25 mg/kg	Bladder	Conzelman and Moulton (161)
Dog Beagle Male & Female	Oral, p.o.	0, 6.25, 12.5, 25 or 50 mg/kg 6 days/ week for length of experiment (95 weeks); 1-3 animals/group.	25 mg/kg	Bladder	Conzelman and Moulton (161)
Dog Beagle Male & Female	Oral, p.o.	0, 6.25, 12.5 or 25 mg/kg 6 days/ week for length of experiment (130 weeks); 1-3 animals/group.	6.25 mg/kg	Bladder	Conzelman and Moulton (161)

Table 2-68 (continued)

SUMMARY OF 2-NAPHTHYLAMINE CARCINOGENIC BIOASSAY DATA

Species	Route of Administration	Nature of Exposure	Lowest Effective Dose	Highly Affected Organ(s)	Reference
Mouse BALB/c Female	Oral-food	0 or 2,000 ppm continuously for 40 weeks; length of experiment 55 weeks; 20/group.	2,000 ppm	Liver	Yoshida *et al.* (162)
Rat Albino Male & Female	Oral-food	0 or 43 mg/kg/day, 7 days/week for 90 weeks; length of experiment 90 weeks; 49 controls, 50 dosed.	--	None	Bonser *et al.* (159)

Table 2-69

SUMMARY OF CARCINOGENIC DATA SETS FOR NICKEL[a]

Animal Model		Route of Administration							
Species	Sex	Oral	Gavage	Inhalation	Subcu-taneous	Skin Painting	Injection	Instil-lation	TP
Mouse	Male	0	0	0	0	0	2(0)[b]	0	0
Mouse	Female	0	0	1(0)	1(0)	0	0	0	0
Mouse	Mixed[c]	1(0)	0	0	0	0	7(1)	0	0
Rat	Male	0	0	3(3)	0	1(0)	22(15)	1(0)	1(0)
Rat	Female	0	0	2(1)	0	0	14(3)	2(0)	1(0)
Rat	Mixed	0	0	2(1)	0	0	7(1)	4(1)	0
Other	Male	1(1)	0	0	0	0	1(1)	0	0
Other	Female	0	0	0	0	0	0	0	0
Other	Mixed	0	0	1(0)	0	0	1(0)	1(0)	0

[a]There were a total of 77 data sets of which 28 were considered suitable for risk assessment.

[b]The number in parenthesis indicates the number of data sets that were considered suitable for risk assessment, and were further abstracted for inclusion in the data base and subsequent analyses.

[c]The "mixed" sex indicates that either both sexes were tested, but results were not reported separately, or sex of test animal was unknown.

Table 2 /0

SUMMARY OF NICKEL CARCINOGENIC BIOASSAY DATA

Species	Route of Administration	Nature of Exposure	Lowest Effective Dose	Highly Affected Organ(s)	Reference
Rat Fischer 344 Male	Intra-renal injection	0, 0.6, 1.2, 2.5, 5.0 or 10.0 mg/rat nickel subsulfide administered in a single injection; length of experiment 104 weeks, 35 controls, 11-24/dose group.	5.0 mg	Kidney	Sunderman *et al.* (163)
Rat Fischer 344 Female	Intra-renal injection	0, 5.0, and 10.0 mg/rat nickel sulfide administered in a single injection; length of experiment 104 weeks, 17 controls, 14/dose group.	5.0 mg	Kidney	Sunderman *et al.* (163)
Rat Wistar Male	Inhalation	0 or 40 ppm nickel carbonyl for one hour. Length of experiment 171 weeks; 19 controls, 285 dosed.	--	None	Sunderman & Donnelly (164)
Rat Wistar Male	Inhalation	0 or 2 ppm nickel carbonyl 3 days/week, 1 hr/day for 154 weeks (length of experiment); 32 controls, 64 dosed.	--	None	Sunderman & Donnelly (164)
Rat Fischer 344 Albino Male	Intra-muscular injection	0, 0.6, 1.2, 2.5 or 5.0 mg nickel subsulfide in a single injection; length of experiment 111 weeks; 60 controls, 30/dose group.	0.6 mg	Hind leg (injection site)	Sunderman *et al.* (89)

Table 2-70 (continued)

SUMMARY OF NICKEL CARCINOGENIC BIOASSAY DATA

Species	Route of Administration	Nature of Exposure	Lowest Effective Dose	Highly Affected Organ(s)	Reference
Rat Wistar Male & Female	Intrafemoral instillation	0 or 5 mg nickel injected at weeks 1 and 78; length of experiment 120 weeks; 23 controls, 100 dosed.	5 mg	Thigh (injection site)	Heuper (165)
Rat Fischer 344 Male	Inhalation	0 and 0.97 mg/m^3 nickel subsulfide 5 days/week, 6 hrs/day for 80 weeks; length of experiment 114 weeks; 120 controls, 122 dosed.	--	None	Ottolenghi *et al.* (166)
Rat Fischer 344 Female	Inhalation	0 and 0.97 mg/m^3 nickel subsulfide 5 days/week, 6 hrs/day for 80 weeks; length of experiment 114 weeks, 121 controls, 104 dosed.	--	None	Ottolenghi *et al.* (166)
Mouse A/Strong Male & Female	Intraperitoneal injection	0, 3, 7.5 and 15 mg/kg nickel acetate 3 times/week, length of experiment 30 weeks, 20 controls, 20/dose group.	--	None	Stoner *et al.* (72)
Rat Fischer Male	IM injection	0 or 20 mg nickel sulfide injected once into thighs (1/2 of dose in each thigh); length of experiment 104; 30 controls, 30 dosed.	20 mg	Thigh (injection site)	Maenza *et al.* (64)

Table 2-70 (continued)

SUMMARY OF NICKEL CARCINOGENIC BIOASSAY DATA

Species	Route of Administration	Nature of Exposure	Lowest Effective Dose	Highly Affected Organ(s)	Reference
Rat Unknown	Inhalation	0, 0.015 or 0.03 ppm nickel carbonyl 3 times/week for one hr or single one hr exposure to 0.125 ppm; length of experiment 103 weeks; 41 controls, 32-80/dose group.	--	None	Sunderman *et al.* (167)
Rat Fischer 344 Male	Intramuscular injection	0 or 10 mg nickel subsulfide in a single injection, length of experiment 104 weeks; 20 controls, 23 dosed.	10 mg	Thigh (injection site)	Sunderman *et al.* (168)
Hamster Syrian Male	IM injection	0, 5 or 10 mg nickel subsulfide in a single injection, observed 104 weeks; 14 controls, 15-17/dose group.	5 mg	Thigh (injection site)	Sunderman *et al.* (168)
Rat Fischer 344 Male	Intrahepatic injection	0 or 5 mg nickel in a single injection, observed 104 weeks, 6 controls, 13 dosed.	--	None	Sunderman *et al.* (168)
Hamster Syrian Male	Oral-mouth painting	1 or 2 mg nickel subsulfide 3 times/week for 18 weeks or 0, 5, or 10 mg nickel subsulfide 3 times/week for 36 weeks, length of experiment 104 weeks; 21 controls, 6-15/dose group.	--	None	Sunderman *et al.* (168)

Table 2-70 (continued)

SUMMARY OF NICKEL CARCINOGENIC BIOASSAY DATA

Species	Route of Administration	Nature of Exposure	Lowest Effective Dose	Highly Affected Organ(s)	Reference
Rat Wistar Male	IM injection	7 mg nickel subsulfide in a single injection or control vehicle every 2 days for 4 weeks, 20/dose group, length of experiment 104 weeks.	7 mg	Thigh muscle	Kasprzak *et al.* (169)
Rat Wistar Male	IM injection	0 or 258 μg nickel sulfate in a single injection, every 2 days for 4 weeks, 20/dose group, length of experiment 104 weeks.	--	None	Kasprzak *et al.* (169)
Rat Fischer 344 Male	Intratesticular	0 or 10 mg nickel subsulfide in a single injection; length of experiment 87 weeks; 18 controls, 19 dosed.	10 mg	Testis	Damjanov *et al.* (170)
Rat Sprague-Dawley Male	Intrarenal injection	0 or 10 mg nickel subsulfide in a single injection, observed 52 weeks, 16 controls, 16 dosed.	10 mg	Kidney	Jasmin and Riopelle (171)
Rat Fischer 344 Male & Female	Intraocular injection	0 or 0.5 mg nickel subsulfide in a single injection, observed 42 weeks, 11 controls, 15 dosed.	0.5 mg	Eye	Albert *et al.* (172)

Table 2-70 (continued)

SUMMARY OF NICKEL CARCINOGENIC BIOASSAY DATA

Species	Route of Administration	Nature of Exposure	Lowest Effective Dose	Highly Affected Organ(s)	Reference
Rat Fischer Albino Male	IM injection	0 or 2.5 mg nickel subsulfide injected into muscle of right thigh at start of experiment, observed 100 weeks; 24 controls, 24 dosed.	2.5 mg	Thigh (injection site)	Sunderman and McCully (173)
Rat Fischer Albino Male	IM injection	0 or 1.2 mg nickel subsulfide injected into muscle of right thigh at start of experiment, observed 100 weeks, 49 controls, 27 dosed.	1.2 mg	Thigh (injection site)	Sunderman and McCully (173)
Rat Sprague-Dawley Male	IV injection	0 or 22 mg/kg nickel carbonyl injected at start of experiment or 9 mg/kg every 3 weeks for 18 weeks, length of experiment 130 weeks; 15 controls, 26 or 61/dose group.	--	None	Lau *et al.* (174)
Rat Sprague-Dawley Female	IV injection	0 or 22 mg/kg nickel carbonyl injected at start of experiment or 9 mg/kg every 3 weeks for 18 weeks, length of experiment 161 weeks; 32 controls, 46 or 60/dose group.	22 mg/kg	Total malignant TBAs	Lau *et al.* (174)
Rat Fischer Albino Male	IM injection	Single injection of 0, 3.6 or 14.4 mg nickel observed 104 weeks; 20 controls, 10/dose group.	--	None	Sunderman and Maenza (89)

Table 2-70 (continued)

SUMMARY OF NICKEL CARCINOGENIC BIOASSAY DATA

Species	Route of Administration	Nature of Exposure	Lowest Effective Dose	Highly Affected Organ(s)	Reference
Rat Fischer Albino Male	IM injection	Single injection of 0, 5.6 or 22.4 mg nickel monosulfide, observed 104 weeks; 20 controls, 10/dose group.	--	None	Sunderman and Maenza (89)
Rat Fischer Albino Male	IM injection	Single injection of 0, 5 or 20 mg nickel subsulfide, observed 104 weeks; 20 controls, 9 or 10/dose group.	5 mg	Thigh (injection site)	Sunderman and Maenza (89)
Rat Fischer Albino Male	IM injection	Single injection of 0, 9.2 or 36.8 mg nickel iron-sulfide matte, observed 104 weeks; 20 controls, 10/dose group.	36.8 mg	Thigh (injection site)	Sunderman and Maenza (89)

Table 2-71

SUMMARY OF CARCINOGENIC DATA SETS FOR NITRILOTRIACETIC ACID[a]

Animal Model		Route of Administration							
Species	Sex	Oral	Gavage	Inhalation	Subcu-taneous	Skin Painting	Injection	Instil-lation	TP
Mouse	Male	3(3)[b]	0	0	0	0	0	0	0
Mouse	Female	3(3)	0	0	1(0)	0	0	0	0
Mouse	Mixed[c]	0	0	0	0	0	0	0	0
Rat	Male	6(5)	0	0	0	0	0	0	0
Rat	Female	5(4)	0	0	0	0	0	0	0
Rat	Mixed	0	0	0	0	0	0	0	0
Other	Male	0	0	0	0	0	0	0	0
Other	Female	0	0	0	0	0	0	0	0
Other	Mixed	0	0	0	0	0	0	0	0

[a]There were a total of 18 data sets of which 15 were considered suitable for risk assessment.

[b]The number in parenthesis indicates the number of data sets that were considered suitable for risk assessment, and were further abstracted for inclusion in the data base and subsequent analyses.

[c]The "mixed" sex indicates that either both sexes were tested, but results were not reported separately, or sex of test animal was unknown.

Table 2-72

SUMMARY OF NITRILOTRIACETIC ACID CARCINOGENIC BIOASSAY DATA

Species	Route of Administration	Nature of Exposure	Lowest Effective Dose	Highly Affected Organ(s)	Reference
Rat Fischer 344 Male	Oral-food	0, 0.02, 0.2 or 2% continuously for length of experiment (104 weeks); 24 controls, 24/dose group.	0.2%	Urinary system	NCI (175)
Rat Fischer 344 Female	Oral-food	0, 0.02, 0.2 or 2% continuously for length of experiment (104 weeks); 24 controls, 24/dose group.	0.02%	Respiratory system	NCI (175)
Rat Fischer 344 Male	Oral-food	0, 0.75 and 1.5% for 77 weeks; length of experiment 104 weeks; 20 controls, 50/dose group.	--	None	NCI (175)
Rat Fischer 344 Female	Oral-food	0, 0.75 and 1.5% for 77 weeks; length of experiment 104 weeks; 20 controls, 50/dose group.	--	None	NCI (175)
Mouse $B6C3F_1$ Male	Oral-food	0, 0.25 and 0.5% for 77 weeks; length of experiment 90 weeks; 20 controls, 50/dose group.	0.25%	Hemopoietic system	NCI (175)
Mouse $B6C3F_1$ Female	Oral-food	0, 0.25 and 0.5% for 77 weeks; length of experiment 90 weeks; 20 controls, 50/dose group.	--	None	NCI (175)

Table 2-72 (continued)

SUMMARY OF NITRILOTRIACETIC ACID CARCINOGENIC BIOASSAY DATA

Species	Route of Administration	Nature of Exposure	Lowest Effective Dose	Highly Affected Organ(s)	Reference
Mouse $B6C3F_1$ Male	Oral-food	0, 0.75 and 1.5% for 77 weeks; length of experiment 90 weeks; 20 controls, 50/dose group.	0.75%	Urinary system	NCI (175)
Mouse $B6C3F_1$ Female	Oral-food	0, 0.75 and 1.5% for 77 weeks; length of experiment 90 weeks; 20 controls, 50/dose group.	--	None	NCI (175)
Rat Fischer 344 Male	Oral-food	0, 0.75 and 1.5% for 77 weeks; length of experiment 104 weeks; 20 controls, 50/dose group.	0.75%	Endocrine glands	NCI (175)
Rat Fischer 344 Female	Oral-food	0, 0.75 and 1.5% for 77 weeks; length of experiment 104 weeks; 20 controls, 50/dose group.	0.75%	Liver; Digestive system	NCI (175)
Mouse Swiss Male	Oral-water	0 or 25 mg/day, 5 days/week for 26 weeks; length of experiment 38 weeks; 40 con-controls, 40 dosed.	--	None	Greenblatt and Lijinsky (176)
Mouse Swiss Female	Oral-water	0 or 25 mg/day, 5 days/week for 26 weeks; length of experiment 38 weeks; 40 controls, 40 dosed.	--	None	Greenblatt and Lijinsky (176)

Table 2-72 (continued)

SUMMARY OF NITRILOTRIACETIC ACID CARCINOGENIC BIOASSAY DATA

Species	Route of Administration	Nature of Exposure	Lowest Effective Dose	Highly Affected Organ(s)	Reference
Rat MRC Male	Oral-water	0 or 100 mg/day 5 days/week for 84 weeks; length of experiment 104 weeks; 15 controls, 15 dosed.	--	None	Lijinsky *et al.* (177)
Rat MRC Female	Oral-water	0 or 100 mg/day 5 days/week for 84 weeks; length of experiment 104 weeks; 15 controls, 15 dosed.	--	None	Lijinsky *et al.* (177)
Rat Sprague-Dawley Male	Oral-water	0 or 1,000 ppm continuously for length of experiment (104 weeks); 192 controls, 196 dosed.	1000 ppm	Kidney	Goyer *et al.* (178)

Table 2-73

SUMMARY OF CARCINOGENIC DATA SETS FOR PHENACETIN[a]

Animal Model		Route of Administration							
Species	Sex	Oral	Gavage	Inhalation	Subcu-taneous	Skin Painting	Injection	Instil-lation	TP
Mouse	Male	3(3)[b]	0	0	0	0	0	0	0
Mouse	Female	3(3)	0	0	0	0	0	0	0
Mouse	Mixed[c]	0	0	0	0	0	0	0	0
Rat	Male	7(3)	0	0	0	0	0	0	0
Rat	Female	5(2)	1(1)	0	0	0	0	0	0
Rat	Mixed	1(0)	0	0	0	0	0	0	0
Other	Male	0	0	0	0	0	0	0	0
Other	Female	0	0	0	0	0	0	0	0
Other	Mixed	1(0)	0	0	0	0	0	0	0

[a]There were a total of 21 data sets of which 12 were considered suitable for risk assessment.

[b]The number in parenthesis indicates the number of data sets that were considered suitable for risk assessment, and were further abstracted for inclusion in the data base and subsequent analyses.

[c]The "mixed" sex indicates that either both sexes were tested, but results were not reported separately, or sex of test animal was unknown.

Table 2-74

SUMMARY OF PHENACETIN CARCINOGENIC BIOASSAY DATA

Species	Route of Administration	Nature of Exposure	Lowest Effective Dose	Highly Affected Organ(s)	Reference
Rat Sprague-Dawley Male	Oral-food	0, 1.25% or 2.5% for 77 weeks; observed for 104 weeks. 65 controls, 50/dose group.	1.25%	Nasal cavity; Urinary passages; Hemopoietic systems	Isaka *et al.* (179)
Rat Sprague-Dawley Female	Oral-food	0, 1.25% or 2.5% for 77 weeks; observed for 104 weeks. 65 controls, 50/dose group.	1.25%	Nasal cavity; Urinary passages; Hemopoietic systems	Isaka *et al.* (179)
Rat SPF Sprague-Dawley Male	Oral-food	0 or 0.535% continuously for length of experiment (117 weeks); 30 controls, 30 dosed.	--	None	Johansson (180)
Mouse $B6C3F_1$ Male	Oral-food	0, 0.6 and 1.25% continuously for 96 weeks; length of experiment 104 weeks; 50 controls, 52/dose group.	0.6%	Kidney	Nakanishi *et al.* (181)
Mouse $B6C3F_1$ Female	Oral-food	0, 0.6 and 1.25% continuously for 96 weeks; length of experiment 104 weeks; 50 controls, 52/dose group.	--	None	Nakanishi *et al.* (181)
Mouse C57BL/6 Male	Oral-food	0, 268 and 754 mg/kg/day for length of experiment (80 weeks); 40 controls, 40/dose group.	--	None	Macklin and Szot (182)

Table 2-74 (continued)

SUMMARY OF PHENACETIN CARCINOGENIC BIOASSAY DATA

Species	Route of Administration	Nature of Exposure	Lowest Effective Dose	Highly Affected Organ(s)	Reference
Mouse C57BL/6 Female	Oral-food	0, 268 and 754 mg/kg/day for length of experiment (80 weeks); 40 controls, 40 (268 mg/kg/day), 41 (754 mg/kg/day).	--	None	Macklin and Szot (182)
Rat Wistar Female	Gavage	0 or 1000 mg/kg 3 times/week for one week; observed 104 weeks; 30 controls, 60 dosed.	--	None	Kunze et al. (183)
Rat Fischer 344 Male	Oral-food	0, 0.322 and 0.644% continuously for 79 weeks; observed weeks; 50 controls, 50/dose group.	0.322	Adrenal	NCI (184)
Rat Fischer 344 Female	Oral-food	0, 0.322 and 0.644% continuously for 79 weeks; observed 113 weeks; 50 controls, 50/dose group.	--	None	NCI (184)
Mouse $B6C3F_1$ Male	Oral-food	0, 0.322 and 0.644% continuously for 79 weeks; observed 94 weeks; 50 controls, 50/dose group.	--	None	NCI (184)
Mouse $B6C3F_1$ Female	Oral-food	0, 0.322 and 0.644% continuously for 79 weeks; observed 94 weeks; 50 controls, 50/dose group.	--	None	NCI (184)

Table 2-75

SUMMARY OF CARCINOGENIC DATA SETS FOR POLYCHLORINATED BIPHENYLS[a]

Animal Model		Route of Administration							
Species	Sex	Oral	Gavage	Inhalation	Subcu-taneous	Skin Painting	Injection	Instil-lation	TP
Mouse	Male	4(3)[b]	0	0	0	0	0	0	0
Mouse	Female	0	0	0	0	0	0	0	0
Mouse	Mixed[c]	0	0	0	0	0	0	0	0
Rat	Male	4(1)	0	0	0	0	0	0	0
Rat	Female	4(2)	0	0	0	0	0	0	0
Rat	Mixed	0	0	0	0	0	0	0	0
Other	Male	0	0	0	0	0	0	0	0
Other	Female	0	0	0	0	0	0	0	0
Other	Mixed	0	0	0	0	0	0	0	0

[a]There were a total of 12 data sets of which 6 were considered suitable for risk assessment.

[b]The number in parenthesis indicates the number of data sets that were considered suitable for risk assessment, and were further abstracted for inclusion in the data base and subsequent analyses.

[c]The "mixed" sex indicates that either both sexes were tested, but results were not reported separately, or sex of test animal was unknown.

Table 2-76

SUMMARY OF POLYCHLORINATED BIPHENYLS CARCINOGENIC BIOASSAY DATA

Species	Administration	Nature of Exposure	Effective Dose	Affected Organ(s)	Reference
Rat Fischer 344 Male	Oral-food	0, 25, 50 or 100 ppm for length of experiment (105 weeks); 24 controls, 24/dose group.	--	None	NCI (185)
Rat Fischer 344 Female	Oral-food	0, 25, 50 or 100 ppm for length of experiment (105 weeks); 24 controls, 24/dose group.	--	None	NCI (185)
Mouse DD Male	Oral-food	0, 100, 250 or 500 ppm continuously for length of experiment (32 weeks); 12 controls, 36/dose group.	--	None	Ito *et al.* (186)
Mouse BALB/CJ Male & Female	Oral-food	0 or 300 ppm continuously for length of experiment (47 weeks); 100 controls, 50/dose group.	300 ppm	Liver	Kimbrough & Linder (187)
Rat Sherman Female	Oral-food	0 or 100 ppm continuously for length of experiment (99 weeks); 200 controls, 200/dose group.	100 ppm	Liver	Kimbrough *et al.* (188)
Mouse DD Male	Oral-food	0 or 250 ppm continuously for length of experiment (24 weeks); 20 controls, 20/dose group.	--	None	Ito *et al.* (186)

Table 2-77

SUMMARY OF CARCINOGENIC DATA SETS FOR RESERPINE[a]

Animal Model		Route of Administration							
Species	Sex	Oral	Gavage	Inhalation	Subcu-taneous	Skin Painting	Injection	Instil-lation	TP
Mouse	Male	1(1)[b]	0	0	0	0	0	0	0
Mouse	Female	1(1)	0	0	0	0	0	0	0
Mouse	Mixed[c]	0	0	0	0	0	0	0	0
Rat	Male	2(1)	0	0	0	0	0	0	0
Rat	Female	2(1)	0	0	0	0	0	0	0
Rat	Mixed	0	0	0	0	0	0	0	0
Other	Male	0	0	0	0	0	0	0	0
Other	Female	0	0	0	0	0	0	0	0
Other	Mixed	0	0	0	0	0	0	0	0

[a]There were a total of 6 data sets of which 4 were considered suitable for risk assessment.

[b]The number in parenthesis indicates the number of data sets that were considered suitable for risk assessment, and were further abstracted for inclusion in the data base and subsequent analyses.

[c]The "mixed" sex indicates that either both sexes were tested, but results were not reported separately, or sex of test animal was unknown.

Table 2-78

SUMMARY OF RESERPINE CARCINOGENIC BIOASSAY DATA

Species	Route of Adminis-tration	Nature of Exposure	Lowest Effective Dose	Highly Affected Organ(s)	Reference
Rat Fischer 344 Male	Oral-food	0, 5 or 10 ppm continuously for 103 weeks; length of experiment 106 weeks; 50 controls, 50/dose group.	5 ppm	Adrenal gland	NCI (189)
Rat Fischer 344 Female	Oral-food	0, 5 or 10 ppm continuously for 103 weeks; length of experiment 106 weeks; 50 controls, 50/dose group.	5 ppm	Pituitary gland	NCI (189)
Mouse $B6C3F_1$ Male	Oral-food	0, 5 or 10 ppm continuously for 103 weeks; length of experiment 106 weeks; 50 controls, 50/dose group.	5 ppm	Seminal vesicle	NCI (189)
Mouse $B6C3F_1$ Female	Oral-food	0, 5 or 10 ppm continuously for 103 weeks; length of experiment 106 weeks; 50 controls, 50/dose group.	5 ppm	Mammary gland	NCI (189)

Table 2-79

SUMMARY OF CARCINOGENIC DATA SETS FOR SACCHARIN[a]

Animal Model		Route of Administration							
Species	Sex	Oral	Gavage	Inhalation	Subcu-taneous	Skin Painting	Injection	Instil-lation	TP
Mouse	Male	1(0)[b]	0	0	0	0	0	0	0
Mouse	Female	2(1)	0	0	0	0	0	1(1)	0
Mouse	Mixed[c]	1(0)	0	0	0	1(0)	1(1)	0	0
Rat	Male	11(9)	0	0	0	0	0	0	0
Rat	Female	7(5)	0	0	0	0	0	0	0
Rat	Mixed	0	0	0	0	0	0	0	0
Other	Male	0	0	0	0	0	0	0	0
Other	Female	0	0	0	0	0	0	0	0
Other	Mixed	2(1)	0	0	0	0	0	0	0

[a]There were a total of 27 data sets of which 18 were considered suitable for risk assessment.

[b]The number in parenthesis indicates the number of data sets that were considered suitable for risk assessment, and were further abstracted for inclusion in the data base and subsequent analyses.

[c]The "mixed" sex indicates that either both sexes were tested, but results were not reported separately, or sex of test animal was unknown.

Table 2-80

SUMMARY OF SACCHARIN CARCINOGENIC BIOASSAY DATA

Species	Route of Administration	Nature of Exposure	Lowest Effective Dose	Highly Affected Organ(s)	Reference
Mice Swiss Female	Oral-food	0 or 5% in diet for length of experiment (77 weeks); 100 controls, 50 dosed.	--	None	Roe *et al.* (69)
Rat Charles River CD Sprague-Dawley Male	Oral-food	0 or 5% sodium saccharin in diet continuously for length of experiment (142 weeks); 50 controls, 50 dosed.	5%	Parathyroid; Bladder	Arnold *et al.* (190)
Rat Charles River CD Sprague-Dawley Female	Oral-food	0 or 5% sodium saccharin in diet diet continuously for length of experiment (142 weeks); 50 controls, 50 dosed.	--	None	Arnold *et al.* (190)
Mouse A/He Female	Intraperitoneal injection	0, 650 or 3250 mg/kg 3 times/week for 8 weeks; length of experiment 24 weeks; 30 controls, 20/dose group.	--	None	Stoner *et al.* (191)
Rat Charles River CD Male	Oral-food	0, 90, 270, 810 or 2430 mg/kg/day for length of experiment (111 weeks); 60 controls, 60/dose group.	--	None	Munro *et al.* (192)

Table 2-80 (continued)

SUMMARY OF SACCHARIN CARCINOGENIC BIOASSAY DATA

Species	Route of Administration	Nature of Exposure	Lowest Effective Dose	Highly Affected Organ(s)	Reference
Rat Charles River CD Female	Oral-food	0, 90, 270, 810 or 2430 mg/kg/day for length of experiment (111 weeks); 60 controls, 60/dose group.	--	None	Munro *et al.* (192)
Rat Wistar Male	Oral-food	0 or 5% continuously for 32 weeks from week 5 to week 36; length of experiment 36 weeks; 18 controls, 32 dosed.	--	None	Nakanishi *et al.* (193)
Rat Wistar Male	Oral-food	0 or 5% continuously for length of experiment (40 weeks); 18 controls, 24 dosed.	--	None	Nakanishi *et al.* (193)
Rat Wistar Male	Oral-food	0 or 5% continuously for 32 weeks from week 7 to week 83; length of experiment 104 weeks; 42 controls, 20 dosed.	--	None	Cohen *et al.* (194)
Rat Wistar SPF Male	Oral-food	0 or 4000 mg/kg/day for length of experiment (105 weeks); 55 controls, 75 dosed.	--	None	Chowaniec and Hicks (195)

Table 2-80 (continued)

SUMMARY OF SACCHARIN CARCINOGENIC BIOASSAY DATA

Species	Route of Administration	Nature of Exposure	Lowest Effective Dose	Highly Affected Organ(s)	Reference
Rat Wistar SPF Female	Oral-food	0 or 4000 mg/kg/day for length of experiment (105 weeks); 50 controls, 75 dosed.	--	None	Chowaniec and Hicks (195)
Rat Wistar Male	Oral-water	0 or 2000 mg/kg/day for length of experiment (105 weeks; 50 controls, 70 dosed.	--	None	Chowaniec and Hicks (195)
Rat Wistar Female	Oral-water	0 or 2000 mg/kg/day for length of experiment (105 weeks; 50 controls, 50 dosed.	--	None	Chowaniec and Hicks (195)
Rat Fischer 344 Male	Oral-food	0 or 5% continuously for length of experiment or 5% continuously for 102 weeks. length of experiment 104 weeks: 37 controls, 21/dose group.	--	None	Cohen et al. (196)
Monkey Rhesus Male & Female	Oral-per os	0, 20, 100 or 500 mg/kg/day, 6 days/week for length of experiment (339 weeks); 6 controls, 4-5/dose group.	--	None	McChesney et al. (197)

Table 2-80 (continued)

SUMMARY OF SACCHARIN CARCINOGENIC BIOASSAY DATA

Species	Route of Administration	Nature of Exposure	Lowest Effective Dose	Highly Affected Organ(s)	Reference
Mouse Swiss Female	Pellet implant	22 mg pellet containing 0 or 20% (0 or 4.4 mg) saccharin implanted at start of study, length of experiment 57 weeks; 200 controls, 200 dosed.	4.4 mg	Bladder	Bryan *et al.* (198)
Rat Fischer 344 Male	Oral-food	0, 400, 2000, 10,000 or 50,000 ppm in food (*ad libitum*) from week 4 to end of experiment (36 weeks); 30-31/dose group.	--	None	Nakanishi *et al.* (199)
Rat Fischer 344 Female	Oral-food	0, 400, 2000, 10,000 or 50,000 ppm in food (*ad libitum*) from week 4 to end of experiment (36 weeks); 30-31/dose group.	--	None	Nakanishi *et al.* (199)

Table 2-81

SUMMARY OF CARCINOGENIC DATA SETS FOR
2,3,7,8-TETRACHLORODIBENZO-*P*-DIOXIN (TCDD)[a]

Animal Model		Route of Administration							
Species	Sex	Oral	Gavage	Inhalation	Subcu-taneous	Skin Painting	Injection	Instil-lation	TP
Mouse	Male	0	2(2)[b]	0	0	2(1)	0	0	0
Mouse	Female	0	1(1)	0	0	4(1)	0	0	0
Mouse	Mixed[c]	0	0	0	2(0)	0	2(0)	0	0
Rat	Male	2(2)	1(1)	0	0	0	0	0	0
Rat	Female	1(1)	1(1)	0	1(0)	0	0	0	0
Rat	Mixed	0	0	0	0	0	0	0	0
Other	Male	0	0	0	0	0	0	0	0
Other	Female	0	0	0	0	0	0	0	0
Other	Mixed	0	0	0	0	0	0	0	0

[a]There were a total of 19 data sets of which 10 were considered suitable for risk assessment.

[b]The number in parenthesis indicates the number of data sets that were considered suitable for risk assessment, and were further abstracted for inclusion in the data base and subsequent analyses.

[c]The "mixed" sex indicates that either both sexes were tested, but results were not reported separately, or sex of test animal was unknown.

Table 2-82

SUMMARY OF 2,3,7,8-TETRACHLORODIBENZO-P-DIOXIN CARCINOGENIC BIOASSAY DATA

Species	Route of Administration	Nature of Exposure	Lowest Effective Dose	Highly Affected Organ(s)	Reference
Mouse Swiss Webster Male	Skin painting	0 or 0.001 μg TCDD applied 3 times/week for 99 weeks. Length of experiment 104 weeks; 45 controls; 30 dosed.	--	None	NTP (200)
Mouse Swiss Webster Female	Skin painting	0 or 0.005 μg TCDD applied 3 times/week for 104 weeks (length of experiment); 45 controls; 30 dosed.	0.005	Skin	NTP (200)
Rat Sprague-Dawley Male	Oral-food	0, 1, 5, 50 or 500 parts per trillion or 1, 5, 50, 500 or 1000 parts per billion in feed for 78 weeks; length of experiment 95 weeks; 10/dose group.	5 ppt	Liver	Van Miller et al. (201)
Rat Osborne-Mendel Male	Gavage	0, 0.005, 0.025 or 0.25 μg/kg administered 2 times/week for 104 weeks; length of experiment 107 weeks; 75 controls, 50/dose group.	0.005 μg/kg	Thyroid; Subcutaneous tissue	NTP (200)

Table 2-82 (continued)

SUMMARY OF 2,3,7,8-TETRACHLORODIBENZO-P-DIOXIN CARCINOGENIC BIOASSAY DATA

Species	Route of Administration	Nature of Exposure	Lowest Effective Dose	Highly Affected Organ(s)	Reference
Rat Osborne-Mendel Female	Gavage	0, 0.005, 0.025 or 0.25 μg/kg administered 2 times/week for 104 weeks; length of experiment 107 weeks; 75 controls, 50/dose group.	0.005 μg/kg	Liver; Adrenal gland	NTP (200)
Mouse $B6C3F_1$ Male	Gavage	0, 0.005, 0.025 or 0.25 μg/kg administered 2 times week for 104 weeks; length of experiment 107 weeks; 75 controls, 50/dose group.	0.25 μg/kg	Liver	NTP (200)
Mouse $B6C3F_1$ Female	Gavage	0, 0.02, 0.1 or 1.0 μg/kg administered 2 times/week for 104 weeks; length of experiment 107 weeks; 75 controls, 50/dose group.	1.0 μg/kg	Hematopoietic system; Liver	NTP (200)
Mouse Swiss/H/Riop Male	Gavage	0, 0.007, 0.7 or 7.0 μg/kg TCDD once a week for 52 weeks; length of experiment 100 weeks; 45/dose group.	0.007 μg/kg	Lung; Hematopoietic system	Toth *et al.* (202)

Table 2-82 (continued)

SUMMARY OF 2,3,7,8-TETRACHLORODIBENZO-P-DIOXIN CARCINOGENIC BIOASSAY DATA

Species	Route of Administration	Nature of Exposure	Lowest Effective Dose	Highly Affected Organ(s)	Reference
Rat Sprague-Dawley Male	Oral-food	0, 0.001, 0.01 or 0.1 μg/kg/day TCDD for length of experiment (104 weeks); 86 controls, 50/dose group.	0.1 μg/kg	Oral cavity; Adrenal gland	Kociba *et al.* (203)
Rat Sprague-Dawley Female	Oral-food	0, 0.001, 0.01 or 0.1 μg/kg/day TCDD for length of experiment (104 weeks); 86 controls, 50/dose group.	0.1 μg/kg	Liver; Lung	Kociba *et al.* (203)

Table 2-83

SUMMARY OF CARCINOGENIC DATA SETS FOR TETRACHLOROETHYLENE[a]

Animal Model		Route of Administration							
Species	Sex	Oral	Gavage	Inhalation	Subcu-taneous	Skin Painting	Injection	Instil-lation	TP
Mouse	Male	0	2(1)[b]	1(1)	0	0	1(0)	0	0
Mouse	Female	0	2(1)	1(1)	0	1(0)	0	0	0
Mouse	Mixed[c]	0	0	0	0	0	0	0	0
Rat	Male	0	2(1)	1(1)	0	0	0	0	0
Rat	Female	0	2(1)	1(1)	0	0	0	0	0
Rat	Mixed	0	0	0	0	0	0	0	0
Other	Male	0	0	0	0	0	0	0	0
Other	Female	0	0	0	0	0	0	0	0
Other	Mixed	0	0	0	0	0	0	0	0

[a]There were a total of 14 data sets of which 8 were considered suitable for risk assessment.

[b]The number in parenthesis indicates the number of data sets that were considered suitable for risk assessment, and were further abstracted for inclusion in the data base and subsequent analyses.

[c]The "mixed" sex indicates that either both sexes were tested, but results were not reported separately, or sex of test animal was unknown.

Table 2-84

SUMMARY OF TETRACHLOROETHYLENE CARCINOGENIC BIOASSAY DATA

Species	Route of Administration	Nature of Exposure	Lowest Effective Dose	Highly Affected Organ(s)	Reference
Mouse B6C3F$_1$ Male	Gavage	Dosage administered 5 days/week as follows: 0 mg/kg for 78 weeks, or 450 mg/kg for 11 weeks, then 550 mg/kg for 67 weeks; or 900 mg/kg for 11 weeks, then 1100 mg/kg for 67 weeks; length of experiment 90 weeks, 20 controls, 50/dose group.	450/500 mg/kg	Liver	NCI (204)
Mouse B6C3F$_1$ Female	Gavage	Dosage administered 5 days/week as follows: 0 mg/kg for 78 weeks, or 300 mg/kg for 11 weeks, then 400 mg/kg for 67 weeks; or 600 mg/kg for 11 weeks, then 800 mg/kg for 67 weeks; length of experiment 90 weeks; 20 controls, 50/dose group.	300/400 mg/kg	Liver	NCI (204)
Rat F333/N Male	Inhalation	0, 200 or 400 ppm 5 days/week, 6 hrs/day for 104 weeks. Length of experiment 104 weeks; 50/dose group.	200 ppm	Hemopoietic system	NTP (205)
Rat F333/N Female	Inhalation	0, 200 or 400 ppm 5 days/week, 6 hrs/day for 104 weeks. Length of experiment 104 weeks; 50/dose group.	200 ppm	Hemopoietic system	NTP (205)

Table 2-84 (continued)

SUMMARY OF TETRACHLOROETHYLENE CARCINOGENIC BIOASSAY DATA

Species	Route of Administration	Nature of Exposure	Lowest Effective Dose	Highly Affected Organ(s)	Reference
Mouse B6C3F$_1$ Male	Inhalation	0, 100 or 200 ppm 5 days/week, 6 hrs/day for 104 weeks. Length of experiment 104 weeks; 49 or 50/ dose group.	100 ppm	Liver	NTP (205)
Mouse B6C3F$_1$ Female	Inhalation	0, 100 or 200 ppm 5 days/week, 6 hrs/dcy for 104 weeks. Length of experiment 104 weeks; 49 or 50/ dose group.	100 ppm	Liver	NTP (205)
Rat Osborne-Mendel Male	Gavage	Dosage administered 5 days/week as follows: 0 mg/kg for 78 weeks, or 500 mg/kg for 26 weeks, then 700 mg/kg for 6 weeks, or 1000 mg/kg for 26 weeks, then 1400 for 6 weeks; length of experiment 110 weeks; 20 controls, 50/dose group.	--	None	NCI (204)
Rat Osborne-Mendel Female	Gavage	Dosage administered 5 days/week as follows: 0 mg/kg for 78 weeks, or 500 mg/kg for 56 weeks, then 600 mg/kg for 3 weeks, then 700 mg/kg for 6 weeks, or 1000 mg/kg for 56 weeks, then 1200 mg/kg for 3 weeks, then 1400 mg/kg for 6 weeks; length of experiment 110 weeks; 20 controls, 50/dose group.	--	None	NCI (204)

Table 2-85

SUMMARY OF CARCINOGENIC DATA SETS FOR TOXAPHENE[a]

Animal Model		Route of Administration							
Species	Sex	Oral	Gavage	Inhalation	Subcu-taneous	Skin Painting	Injection	Instil-lation	TP
Mouse	Male	1(1)[b]	0	0	0	0	0	0	0
Mouse	Female	1(1)	0	0	0	0	0	0	0
Mouse	Mixed[c]	0	0	0	0	0	0	0	0
Rat	Male	1(1)	0	0	0	0	0	0	0
Rat	Female	1(1)	0	0	0	0	0	0	0
Rat	Mixed	0	0	0	0	0	0	0	0
Other	Male	0	0	0	0	0	0	0	0
Other	Female	0	0	0	0	0	0	0	0
Other	Mixed	0	0	0	0	0	0	0	0

[a]There were a total of 4 data sets all of which were considered suitable for risk assessment.

[b]The number in parenthesis indicates the number of data sets that were considered suitable for risk assessment, and were further abstracted for inclusion in the data base and subsequent analyses.

[c]The "mixed" sex indicates that either both sexes were tested, but results were not reported separately, or sex of test animal was unknown.

Table 2-86

SUMMARY OF TOXAPHENE CARCINOGENIC BIOASSAY DATA

Species	Route of Administration	Nature of Exposure	Lowest Effective Dose	Highly Affected Organ(s)	Reference
Rat Osborne-Mendel Male	Oral-food	Dosage administered daily in the diet according to the following schedule: 0 ppm for 109 weeks; 1280 ppm for 2 weeks, then 640 ppm for 53 weeks, then 320 ppm for 25 weeks, or 2560 ppm for 2 weeks, then 1280 ppm for 53 weeks, then 640 ppm for 25 weeks; length of experiment 109 weeks; 10 controls, 50/dose group.	--	None	NCI (206)
Rat Osborne-Mendel Female	Oral-food	Dosage administered daily in the diet according to the following schedule: 0 ppm for 109 weeks; or 640 ppm for 55 weeks, then 320 ppm for 25 weeks, or 1280 ppm for 55 weeks, or 640 ppm for 25 weeks; length of experiment 109 weeks; 10 controls, 50/dose group.	--	None	NCI (206)

Table 2-86 (continued)

SUMMARY OF TOXAPHENE CARCINOGENIC BIOASSAY DATA

Species	Route of Administration	Nature of Exposure	Lowest Effective Dose	Highly Affected Organ(s)	Reference
Mouse $B6C3F_1$ Male	Oral-food	Dosage administered daily in the diet according to the following schedule: 0 ppm for 91 weeks; 160 ppm for 19 weeks, then 80 ppm for 61 weeks; or 320 ppm for 19 weeks, then 160 ppm for 61 weeks; length of experiment 91 weeks; 10 controls, 50/dose group.	80/160 ppm	Liver	NCI (206)
Mouse $B6C3F_1$ Female	Oral-food	Dosage administered daily in the diet according to the following schedule: 0 ppm for 91 weeks; 160 ppm for 19 weeks, then 80 ppm for 61 weeks; or 320 ppm for 19 weeks, then 160 ppm for 61 weeks; length of experiment 91 weeks; 10 controls, 50/dose group.	80/160 ppm	Liver	NCI (206)

Table 2-87

SUMMARY OF CARCINOGENIC DATA SETS FOR TRICHLOROETHYLENE[a]

Animal Model		Route of Administration							
Species	Sex	Oral	Gavage	Inhalation	Subcu-taneous	Skin Painting	Injection	Instil-lation	TP
Mouse	Male	0	5(4)[b]	1(1)	0	0	0	0	0
Mouse	Female	0	5(4)	2(2)	1(1)	1(1)	0	0	0
Mouse	Mixed[c]	0	0	0	0	0	0	0	0
Rat	Male	0	7(2)	1(1)	0	0	0	0	0
Rat	Female	0	7(2)	2(2)	0	0	0	0	0
Rat	Mixed	0	0	0	0	0	0	0	0
Other	Male	0	0	1(1)	0	0	0	0	0
Other	Female	0	0	1(1)	0	0	0	0	0
Other	Mixed	0	0	0	0	0	0	0	0

[a]There were a total of 34 data sets of which 22 were considered suitable for risk assessment.

[b]The number in parenthesis indicates the number of data sets that were considered suitable for risk assessment, and were further abstracted for inclusion in the data base and subsequent analyses.

[c]The "mixed" sex indicates that either both sexes were tested, but results were not reported separately, or sex of test animal was unknown.

Table 2-88

SUMMARY OF TRICHLOROETHYLENE CARCINOGENIC BIOASSAY DATA

Species	Route of Administration	Nature of Exposure	Lowest Effective Dose	Highly Affected Organ(s)	Reference
Mouse B6C3F$_1$ Male	Gavage	0, 1,200 or 2,400 mg/kg 5 days/week for 77 weeks; length of experiment 90 weeks; 20/controls, 50/dose group.	1200 mg/kg	Liver	NCI (76)
Mouse B6C3F$_1$ Female	Gavage	0, 900 or 1,800 mg/kg 5 days/week for 77 weeks; length of experiment 90 weeks; 20/controls, 50/group.	1800 mg/kg	Liver	NCI (76)
Rat Osborne-Mendel Male	Gavage	0, 500 or 1,000 mg/kg/5 days/week for 78 weeks; every 4th week, no dose, length of experiment 110 weeks; 20 controls, 50/dose group.	--	None	NCI (76)
Rat Osborne-Mendel [illegible]	Gavage	0, 500 or 1,000 mg/kg 5 days/week for 78 weeks; every 4th week, no dose; length of experiment 110 weeks; 20 controls, 50/dose group.	--	None	NCI (76)
	Inhalation	0, 100 or 500 ppm air 5 days/week, 6 hr/day for 77 weeks; length of experiment 128 weeks; 30/dose group.	--	None	Henschler *et al.* (207)

Table 2-88 (continued)

SUMMARY OF TRICHLOROETHYLENE CARCINOGENIC BIOASSAY DATA

Species	Route of Administration	Nature of Exposure	Lowest Effective Dose	Highly Affected Organ(s)	Reference
Mouse NMRI Female	Inhalation	0, 100 or 500 ppm air 5 days/week, 6 hr/day for 77 weeks; length of experiment 128 weeks; 30/dose group.	500 ppm	Hematopoietic	Henschler *et al.* (207)
Rat Wistar Male	Inhalation	0, 100 or 500 ppm air 5 days/week, 6 hr/day for 77 weeks; length of experiment 156 weeks; 30/dose group.	--	None	Henschler *et al.* (207)
Rat Wistar Female	Inhalation	0, 100 or 500 ppm air 5 days/week, 6 hr/day for 77 weeks; length of experiment 156 weeks; 30/dose group.	--	None	Henschler *et al.* (207)
Hamster Syrian Male	Inhalation	0, 100 or 500 ppm air 5 days/week, 6 hr/day for 77 weeks; length of experiment 128 weeks, 30/dose group.	--	None	Henschler *et al.* (207)
Hamster Syrian Female	Inhalation	0, 100 or 500 ppm air 5 days/week, 6 hr/day for 77 weeks; length of experiment 128 weeks, 30/dose group.	--	None	Henschler *et al.* (207)

Table 2-88 (continued)

SUMMARY OF TRICHLOROETHYLENE CARCINOGENIC BIOASSAY DATA

Species	Route of Administration	Nature of Exposure	Lowest Effective Dose	Highly Affected Organ(s)	Reference
Mouse ICR/Ha Female	Skin painting	0 or 1 mg, 3 times/week for 83 weeks (length of experiment); 30/dose group.	--	None	Van Duuren *et al.* (208)
Mouse $B6C3F_1$ Male	Gavage	0 or 1000 mg/kg, 5 days week for 103 weeks (length of experiment); 50/dose group.	1000 mg/kg	Liver	NTP (209)
Mouse $B6C3F_1$ Female	Gavage	0 or 1000 mg/kg, 5 days week for 103 weeks (length of experiment); 50/dose group.	1000 mg/kg	Liver	NTP (209)
Rat F344/N Male	Gavage	0, 500 or 1,000 mg/kg, 5 days/week for 103 weeks (length of experiment); 50/dose group.	--	None	NTP (209)
Rat F344/N Female	Gavage	0, 500 or 1000 mg/kg, 5 days/week for 103 weeks (length of experiment); 50/dose group.	--	None	NTP (209)
Rat Sprague-Dawley Male	Inhalation	0, 50, 150 or 450 ppm, 5 days/week, hr/day for 104 weeks (length of experiment); 50/dose group.	--	None	Fukuda *et al.* (210)

Table 2-88 (continued)

SUMMARY OF TRICHLOROETHYLENE CARCINOGENIC BIOASSAY DATA

Species	Route of Administration	Nature of Exposure	Lowest Effective Dose	Highly Affected Organ(s)	Reference
Mouse CD-1 Female	Inhalation	0, 50, 150 or 450 ppm, 5 days/week, 7 hr/day for 104 weeks (length of experiment); 50/dose group.	150 ppm	Lung	Fukuda *et al.* (210)
Mouse ICR/Ha Male	Gavage	0 or 2.4 g/kg for 34 weeks, then 1.2 g/kg for 28 weeks; length of experiment 128 weeks; 50/dose group.	--	None	Henschler *et al.* (211)
Mouse ICR/Ha Female	Gavage	0 or 1.8 g/kg for 34 weeks, then 0.9 g/kg for 28 weeks; length of experiment 128 weeks; 50/dose group.	--	None	Henschler *et al.* (211)
Mouse ICR/Ha Male	Gavage	0 or 0.5 mg, 1 time/week for 90 weeks (length of experiment); 30/dose group.	--	None	Van Duuren *et al.* (208)
Mouse ICR/Ha Female	Gavage	0 or 0.5 mg, 1 time/week for 90 weeks (length of experiment); 30/dose group.	--	None	Van Duuren *et al.* (208)
Mouse ICR/Ha Female	Subcutaneous injection	0 or 0.5 mg, 1 time/week for 90 weeks (length of experiment); 30/dose group.	--	None	Van Duuren *et al.* (208)

Table 2-89

SUMMARY OF CARCINOGENIC DATA SETS FOR 2,4,6-TRICHLOROPHENOL[a]

Animal Model		Route of Administration							
Species	Sex	Oral	Gavage	Inhalation	Subcu-taneous	Skin Painting	Injection	Instil-lation	IP
Mouse	Male	1(1)[b]	0	0	0	0	0	0	0
Mouse	Female	1(1)	0	0	0	0	0	0	0
Mouse	Mixed[c]	0	0	0	0	0	0	0	0
Rat	Male	1(1)	0	0	0	0	0	0	0
Rat	Female	1(1)	0	0	0	0	0	0	0
Rat	Mixed	0	0	0	0	0	0	0	0
Other	Male	0	0	0	0	0	0	0	0
Other	Female	0	0	0	0	0	0	0	0
Other	Mixed	0	0	0	0	0	0	0	0

[a]There were a total of 4 data sets all of which were considered suitable for risk assessment.

[b]The number in parenthesis indicates the number of data sets that were considered suitable for risk assessment, and were further abstracted for inclusion in the data base and subsequent analyses.

[c]The "mixed" sex indicates that either both sexes were tested, but results were not reported separately, or sex of test animal was unknown.

Table 2-90

SUMMARY OF 2,4,6-TRICHLOROPHENOL CARCINOGENIC BIOASSAY DATA

Species	Route of Administration	Nature of Exposure	Lowest Effective Dose	Highly Affected Organ(s)	Reference
Rat Fischer 344 Male	Oral-water	0, 5,000 or 10,000 ppm in water for 106 weeks (length of experiment); 20 controls, 50/dose group.	5,000 ppm	Hematopoietic system	NCI (212)
Rat Fischer 344 Female	Oral-water	0, 5,000 or 10,000 ppm in water for 106 weeks (length of experiment); 20 controls, 50/dose group.	--	None	NCI (212)
Mouse $B6C3F_1$ Male	Oral-water	0, 5,000 or 10,000 ppm in water for 105 weeks (length of experiment); 20 controls, 50/dose group.	5,000 ppm	Liver	NCI (212)
Mouse $B6C3F_1$ Female	Oral-water	0 or 10,000 ppm for 38 weeks, then reduced to 2,500 ppm for 67 weeks; or 20,000 ppm for 38 weeks, then reduced to 5,000 ppm for 67 weeks; length of experiment 105 weeks; 20 controls, 50/dose group.	20,000/ 5,000 ppm	Liver	NCI (212)

Table 2-91

SUMMARY OF CARCINOGENIC DATA SETS FOR VINYL CHLORIDE[a]

Animal Model		Route of Administration							
Species	Sex	Oral	Gavage	Inhalation	Subcu-taneous	Skin Painting	Injection	Instil-lation	TP
Mouse	Male	0	0	12(11)[b]	0	0	0	0	0
Mouse	Female	0	0	9(8)	0	0	0	0	0
Mouse	Mixed[c]	0	0	1(1)	0	0	0	0	0
Rat	Male	2(2)	2(2)	15(12)	1(1)	0	1(1)	0	0
Rat	Female	2(2)	2(2)	14(10)	1(1)	0	1(1)	0	0
Rat	Mixed	0	0	1(1)	0	0	0	0	0
Other	Male	0	0	1(1)	0	0	0	0	0
Other	Female	0	0	0	0	0	0	0	0
Other	Mixed	0	0	0	0	0	0	0	0

[a]There were a total of 65 data sets of which 56 were considered suitable for risk assessment.

[b]The number in parenthesis indicates the number of data sets that were considered suitable for risk assessment, and were further abstracted for inclusion in the data base and subsequent analyses.

[c]The "mixed" sex indicates that either both sexes were tested, but results were not reported separately, or sex of test animal was unknown.

Table 2-92

SUMMARY OF VINYL CHLORIDE CARCINOGENIC BIOASSAY DATA

Species	Route of Administration	Nature of Exposure	Lowest Effective Dose	Highly Affected Organ(s)	Reference
Mouse Charles River CD1 Male	Inhalation	0, 2,500 or 6,000 ppm 5 hrs/day, 5 days/week for 21 weeks; length of experiment 22 weeks; 4 controls, 3/dose group.	2500 ppm	Lung	Suzuki (213)
Mouse Charles River CD1 Male	Inhalation	0, 2,500 or 6,000 ppm 5 hrs/day, 5 days/week for 26 weeks; length of experiment 26 weeks; 4 controls, 7/2,500 ppm group, 6/6,000 ppm group.	2500 ppm	Lung	Suzuki (213)
Mouse Charles River CD1 Male	Inhalation	0, 2,500 or 6,000 ppm 5 hrs/day, 5 days/week for 26 weeks; length of experiment 31 weeks; 3 controls, 7/2,500 ppm group, 1/6,000 ppm group.	2500 ppm	Lung; Liver	Suzuki (213)
Rat Wistar Male	Oral-food	0, 1.7, 5.0 or 14.1 mg/kg body weight/day for 148 weeks (length of experiment); 60/dose group.	1.7 mg/kg/day	Pituitary; Liver	Feron *et al.* (214)
Rat Wistar Female	Oral-food	0, 1.7, 5.0 or 14.1 mg/kg body weight/day for 135 weeks (length of experiment); 60/dose group.	1.7 mg/kg/day	Liver	Feron *et al.* (214)

Table 2-92 (continued)

SUMMARY OF VINYL CHLORIDE CARCINOGENIC BIOASSAY DATA

Species	Route of Administration	Nature of Exposure	Lowest Effective Dose	Highly Affected Organ(s)	Reference
Rat Wistar Male	Oral-food	0, 0.017, 0.17 or 1.7 mg/kg body weight/day for 148 weeks (length of experiment); 100/dose group at 0, 0.017, 0.17 doses; 50/dose group at 1.7 mg/kg dose.	--	None	Til *et al.* (215)
Rat Wistar Female	Oral-food	0, 0.017, 0.17 or 1.7 mg/kg body weight/day for 148 weeks (length of experiment); 100/dose group at 0, 0.017, 0.17 doses; 50/dose group at 1.7 mg/kg dose.	--	None	Til et al. (215)
Rat CD-1 Albino Male	Inhalation	0, 50, 250 or 1,000 ppm 6 hrs/day, 5 days/week for up to 26 weeks;[a] observed for additional 52 weeks; length of experiment 78 weeks; 20/dose group.	--	None	Hong *et al.* (216)
Rat CD-1 Albino Female	Inhalation	0, 50, 250 or 10,000 ppm 6 hrs/day, 5 days/week for up to 26 weeks;[a] observed for additional 52 weeks; length of experiment 78 weeks; 20/dose group.	50 ppm	Mammary gland	Hong et al. (216)

Table 2-92 (continued)

SUMMARY OF VINYL CHLORIDE CARCINOGENIC BIOASSAY DATA

Species	Route of Administration	Nature of Exposure	Lowest Effective Dose	Highly Affected Organ(s)	Reference
Mouse CD-1 Male	Inhalation	0, 50, 250 or 1000 ppm 6 hours/day, 5 days/week for up to 26 weeks;[a] observed for additional 52 weeks; length of experiment 65-78 weeks. 8-28/dose group.	50 ppm	Lung; Liver	Hong et al. (216)
Mouse CD-1 Female	Inhalation	0, 50, 250 or 1000 ppm 6 hours/day, 5 days a week for up to 26 weeks;[a] observed for additional 52 weeks; length of experiment 65-78 weeks. 8-28/dose group.	50 ppm	Mammary gland; Lung	Hong et al. (216)
Rat Sprague-Dawley Male	Intraperitoneal injection	0 or 4.25 mg once; 4.25 twice at two month intervals and 4.25 three times at two month intervals; length of experiment 144 weeks; 30/dose group.	--	None	Maltoni et al. (7)
Rat Sprague-Dawley Female	Intraperitoneal injection	0 or 4.25 mg once; 4.25 twice at two month intervals, and 4.25 three times at two month intervals; length of experiment 144 weeks; 30/dose group.	--	None	Maltoni et al. (7)
Rat Sprague-Dawley Male	Subcutaneous injection	0 or 4.25 mg once; length of experiment 145 weeks; 35/dose group.	--	None	Maltoni et al. (7)

Table 2-92 (continued)

SUMMARY OF VINYL CHLORIDE CARCINOGENIC BIOASSAY DATA

Species	Route of Administration	Nature of Exposure	Lowest Effective Dose	Highly Affected Organ(s)	Reference
Rat Sprague-Dawley Female	Subcutaneous injection	0 or 4.25 mg once; length of experiment 145 weeks; 35/dose group.	--	None	Maltoni *et al.* (7)
Rat Sprague-Dawley Female	Inhalation	0 or 2500 ppm 5 days/week, 4 hr/day for 7 weeks; then 7 hr/day for 69 weeks; length of experiment 90 weeks; 60/dose group.	2500 ppm	Brain; Liver	Maltoni *et al.* (7)
Rat Sprague-Dawley Male	Inhalation	0, 1, 5, 10 or 25 ppm 5 days/week, 4 hr/day for 52 weeks; length of experiment 147 weeks; 60/dose group.	--	None	Maltoni *et al.* (7)
Rat Sprague-Dawley Female	Inhalation	0, 1, 5, 10 or 25 ppm 5 days/week, 4 hr/day for 52 weeks; length of experiment 147 weeks; 60/dose group.	5 ppm	Mammary gland	Maltoni *et al.* (7)
Rat Wistar Male	Inhalation	0 or 1 ppm 5 days/week, 4 hr/day for 52 weeks; length of experiment 134 weeks; 120/dose group.	--	None	Maltoni *et al.* (7)

Table 2-92 (continued)

SUMMARY OF VINYL CHLORIDE CARCINOGENIC BIOASSAY DATA

Species	Route of Administration	Nature of Exposure	Lowest Effective Dose	Highly Affected Organ(s)	Reference
Rat Sprague-Dawley Male	Gavage	0, 0.03, 0.3 or 1.0 mg/kg/day, 5 days/week for 59 weeks; length of experiment 136 weeks; 75/dose group.	--	None	Maltoni *et al.* (7)
Rat Sprague-Dawley Female	Gavage	0, 0.03, 0.3 or 1.0 mg/kg/day, 5 days/week for 59 weeks; length of experiment 136 weeks; 75/dose group.	--	None	Maltoni *et al.* (7)
Rat Charles River CD Male & Female	Inhalation	0, 50, 250 or 1,000 ppm 5 days/week, 4 hr/day for 52 weeks length of experiment); 32/dose group.	250 ppm	Liver	Lee *et al.* (217)
Mouse CD-1 Male & Female	Inhalation	0, 50, 250 or 1,000 ppm 5 days/week, 4 hr/day for 52 weeks (length of experiment); 32/dose group.	50 ppm	Lung; Liver	Lee *et al.* (217)
Mouse CD-1 Male	Inhalation	0, 50, 250 or 1,000 ppm 5 days/week for 4, 13 or 26 weeks; length of experiment 78 weeks; 16/dose group.	250 ppm	Lung	Hong *et al.* (216)

Table 2-92 (continued)

SUMMARY OF VINYL CHLORIDE CARCINOGENIC BIOASSAY DATA

Species	Route of Administration	Nature of Exposure	Lowest Effective Dose	Highly Affected Organ(s)	Reference
Mouse CD-1 Female	Inhalation	0, 50, 250 or 1,000 ppm 5 days/week for 4, 13 or 26 weeks; length of experiment 78 weeks; 16/dose group.	250 ppm	Lung; Liver	Hong *et al.* (216)
Rat Charles River CD Male	Inhalation	0, 50, 250 or 1,000 ppm 5 days/week, 6 hr/day for 26 or 42 weeks; length of experiment 92 weeks; 10-20/dose group.	--	None	Hong *et al.* (216)
Rat Charles River CD Female	Inhalation	0, 50, 250 or 1,000 ppm 5 days/week, 6 hr/day for 26 or 42 weeks; length of experiment 92 weeks; 10-20/dose group.	--	None	Hong *et al.* (216)
Mouse CD-1 Male	Inhalation	0, 50, 250 or 1,000 ppm 5 days/week, 6 hrs/day for 26 weeks (length of experiment); 6-18/dose group.	1,000 ppm	Lung	Lee *et al.* (218)
Mouse CD-1 Male	Inhalation	0, 50 or 250 ppm 5 days/week, 6 hr/day for 52 weeks (length of experiment); 2-5/dose group.	--	None	Lee *et al.* (218)

Table 2-92 (continued)

SUMMARY OF VINYL CHLORIDE CARCINOGENIC BIOASSAY DATA

Species	Route of Administration	Nature of Exposure	Lowest Effective Dose	Highly Affected Organ(s)	Reference
Mouse CD-1 Female	Inhalation	0, 50, 250 or 1,000 ppm 5 days/week, 6 hr/day for 13 weeks (length of experiment); 12/dose group.	--	None	Lee *et al.* (218)
Mouse CD-1 Female	Inhalation	0, 50, 250 or 1,000 ppm 5 days/week, 6 hr/day for 39 weeks (length of experiment); 4/controls, 15-19/dose group.	250 ppm	Lung; Liver	Lee *et al.* (218)
Mouse CD-1 Female	Inhalation	0 or 50 ppm, 5 days/week, 6 hr/day for 52 weeks (length of experiment); 16/controls, 3/dose group.	--	None	Lee *et al.* (218)
Rat Wistar Male	Inhalation	0 or 5000 ppm, 5 days/week, 7 hr/day for 52 weeks (length of experiment); 10/dose group.	--	None	Feron *et al.* (219)
Rat Wistar Female	Inhalation	0 or 5000 ppm, 5 days/week, 7 hr/day for 52 weeks (length of experiment); 10/dose group.	5000 ppm	Liver; Nasal cavity	Feron *et al.* (219)

2-92 (continued)

IDE CARCINOGENIC BIOASSAY DATA

		ure of posure	Lowest Effective Dose	Highly Affected Organ(s)	Reference
		50, 250 or 1,000 5 days/week, for 38 weeks (length of experiment); 6-15/dose group.	250 ppm	Liver; Lung	Lee et al. (218)
		0, 50, 250 or 1,000 5 days/week, 6 hrs/day for 25 weeks (length of experiment); 16-19/dose group.	--	None	Lee et al. (218)
	on	0, 50, 250 or 1,000 5 days/week, 6 hrs/day for 13 weeks (length of experiment); 12-17/dose group.	--	None	Lee et al. (218)
	Inhalation	0 or 30 ppthou, 5 days/week, 4 hr/day for 52 weeks; length of experiment 54 weeks; 25/dose group.	30 ppthou	Zymbal's gland	Viola et al. (220)
Rat Sprague-Dawley Male	Inhalation	0, 50, 250, 500, 2,500, 6,000 or 10,000 ppm 5 days/week, 4 hr/day for 52 weeks, length of experiment 135 weeks; 30/dose group.	2500 ppm	Liver	Maltoni et al. (7)

Table 2-92 (continued)

SUMMARY OF VINYL CHLORIDE CARCINOGENIC BIOASSAY DATA

Species	Route of Administration	Nature of Exposure	Lowest Effective Dose	Highly Affected Organ(s)	Reference
Rat Sprague-Dawley Female	Inhalation	0, 50, 250, 500, 2,500, 6,000 or 10,000 ppm 5 days/week, 4 hr/day for 52 weeks, length of experiment 135 weeks; 30/dose group.	500 ppm	Liver	Maltoni *et al.* (7)
Rat Sprague-Dawley Male	Inhalation	0, 100, 150 or 200 ppm, 5 days/week for 52 weeks; length of experiment 143 weeks; 85 controls, 60/dose group.	--	None	Maltoni *et al.* (7)
Rat Sprague-Dawley Female	Inhalation	0, 100, 150 or 200 ppm, 5 days/week for 52 weeks; length of experiment 143 weeks; 100 controls, 60/dose group.	--	None	Maltoni *et al.* (7)
Rat Sprague-Dawley Male	Inhalation	0, 50, 250, 500, 2,500, 6,000 or 10,000 ppm, 5 days/week, 4 hr/day for 17 weeks; length of experiment 156 weeks; 30/dose group.	6,000 ppm	Zymbal's gland	Maltoni *et al.* (7)

Table 2-92 (continued)

SUMMARY OF VINYL CHLORIDE CARCINOGENIC BIOASSAY DATA

Species	Route of Administration	Nature of Exposure	Lowest Effective Dose	Highly Affected Organ(s)	Reference
Rat Sprague-Dawley Female	Inhalation	0, 50, 250, 500, 2,500, 6,000 or 10,000 ppm, 5 days/week, 4 hr/day for 17 weeks; length of experiment 158 weeks; 30/dose group.	250 ppm	Zymbal's gland; Mammary gland	Maltoni *et al.* (7)
Mouse Swiss Male	Inhalation	0, 50, 250, 500, 2,500, 6,000 or 10,000 ppm, 5 days/week, 4 hr/day for 30 weeks; length of experiment 81 weeks; 80 controls, 30/dose group.	250 ppm	Lung; Liver	Maltoni *et al.* (7)
Mouse Swiss Female	Inhalation	0, 50, 250, 500, 2,500, 6,000 or 10,000 ppm, 5 days/week, 4 hr/day for 30 weeks; length of experiment 81 weeks; 70 controls, 30/dose group.	50 ppm	Lung; Liver	Maltoni *et al.* (7)
Rat Wistar Male	Inhalation	0, 50, 250, 500, 2,500, 6,000 or 10,000 ppm, 5 days/week, 4 hr/day for 52 weeks, length of experiment 165 weeks; 30/dose group.	10,000 ppm	Liver	Maltoni *et al.* (7)

Table 2-92 (continued)

SUMMARY OF VINYL CHLORIDE CARCINOGENIC BIOASSAY DATA

Species	Route of Administration	Nature of Exposure	Lowest Effective Dose	Highly Affected Organ(s)	Reference
Hamster Golden Male	Inhalation	0, 50, 250, 500, 2,500, 6,000 or 10,000 ppm, 5 days/week, 4 hr/day for 30 weeks; length of experiment 109 weeks; 62 controls, 30/dose group.	2,500 ppm	Stomach	Maltoni *et al.* (7)
Rat Sprague-Dawley Male	Inhalation	0 or 50 ppm 5 days/week, 4 hr/day for 52 weeks; length of experiment 142 weeks; 50 controls, 150/dose group.	--	None	Maltoni *et al.* (7)
Rat Sprague-Dawley Female	Inhalation	0 or 50 ppm 5 days/week, 4 hr/day for 52 weeks; length of experiment 142 weeks; 50 controls, 150/dose group.	50 ppm	Mammary gland	Maltoni *et al.* (7)
Rat Sprague-Dawley Male	Inhalation	0 or 6,000 ppm (1, 4 or 5 times/week), 10,000 ppm (1,4 or 5 times/week), 1 hr/day for 25 weeks; length of experiment 154 weeks; 109 controls, 60/dose group.	--	None	Maltoni *et al.* (7)

Table 2-92 (continued)

SUMMARY OF VINYL CHLORIDE CARCINOGENIC BIOASSAY DATA

Species	Route of Administration	Nature of Exposure	Lowest Effective Dose	Highly Affected Organ(s)	Reference
Rat Sprague-Dawley Female	Inhalation	0 or 6,000 ppm (1, 4 or 5 times/week), 10,000 ppm (1,4 or 5 times/week), 1 hr/day for 25 weeks; length of experiment 154 weeks; 120 controls, 60/dose group.	--	None	Maltoni et al. (7)
Rat Sprague-Dawley Male	Gavage	0, 3.33, 16.6 or 50 mg/kg, 5 days/week for 52 weeks; length of experiment 136 weeks; 40/dose group.	50 mg/kg	Liver	Maltoni et al. (7)
Rat Sprague-Dawley Female	Gavage	0, 3.33, 16.6 or 50 mg/kg, 5 days/week for 52 weeks; length of experiment 136 weeks; 40/dose group.	16.6 mg/kg	Liver	Maltoni et al. (7)

[a]Abstracted as two data sets; one dosing for 13 weeks, the other for 26 weeks.

Table 2-93

SUMMARY OF CARCINOGENIC DATA SETS FOR VINYLIDENE CHLORIDE[a]

Animal Model		Route of Administration							
Species	Sex	Oral	Gavage	Inhalation	Subcu-taneous	Skin Painting	Injection	Instil-lation	TP
Mouse	Male	0	1(1)[b]	7(7)	0	0	0	0	0
Mouse	Female	0	1(1)	7(7)	1(0)	1(0)	0	0	0
Mouse	Mixed[c]	0	0	1(1)	0	0	0	0	0
Rat	Male	3(1)	2(1)	7(5)	0	0	0	0	0
Rat	Female	3(1)	3(2)	7(5)	0	0	0	0	0
Rat	Mixed	0	0	2(0)	0	0	0	0	0
Other	Male	0	0	0	0	0	0	0	0
Other	Female	0	0	0	0	0	0	0	0
Other	Mixed	0	0	0	0	0	0	0	0

[a]There were a total of 46 data sets of which 32 were considered suitable for risk assessment.

[b]The number in parenthesis indicates the number of data sets that were considered suitable for risk assessment, and were further abstracted for inclusion in the data base and subsequent analyses.

[c]The "mixed" sex indicates that either both sexes were tested, but results were not reported separately, or sex of test animal was unknown.

Table 2-94

SUMMARY OF VINYLIDENE CHLORIDE CARCINOGENIC BIOASSAY DATA

Species	Route of Administration	Nature of Exposure	Lowest Effective Dose	Highly Affected Organ(s)	Reference
Rat Wistar Albino Male	Inhalation	0 or 200 ppm, 5 days/week, 4 hrs/day for 26 weeks; 0 or 100 ppm 5 days/week, 4 hrs/day for an additional 26 weeks (52 weeks total exposure); observed 104 weeks, 30 controls, 51 dosed.	--	None	Viola and Caputo (221)
Rat Wistar Albino Female	Inhalation	0 or 200 ppm, 5 days/week, 4 hrs/day for 26 weeks; 0 or 100 ppm 5 days/week, 4 hrs/day for an additional 26 weeks (52 weeks total exposure); observed 104 weeks, 30 controls, 23 dosed.	--	None	Viola and Caputo (221)
Rat BDIV Female	Gavage	0 or 150 mg/kg in single dose; observed 120 weeks, 14 controls; 24 dosed.	--	None	Ponomarkov & Tomatis (222)
Mouse Albino CD-1 Male & Female	Inhalation	0 or 55 ppm, 5 days/week, 6 hrs/day for length of experiment (52 weeks); 38 controls, 36 dosed.	--	None	Lee et al. (217)

Table 2-94 (continued)

SUMMARY OF VINYLIDENE CHLORIDE CARCINOGENIC BIOASSAY DATA

Species	Route of Administration	Nature of Exposure	Lowest Effective Dose	Highly Affected Organ(s)	Reference
Rat Charles River CD Male	Inhalation	0 or 55 ppm, 5 days/week, 6 hrs/day for 43 weeks; length of experiment 94 weeks; 16 controls, 14 dosed.	--	None	Hong *et al.* (216)
Rat Charles River CD Female	Inhalation	0 or 55 ppm, 5 days/week, 6 hrs/day for 43 weeks; length of experiment 94 weeks; 16 controls, 16 dosed.	--	None	Hong *et al.* (216)
Mouse CD-1 Male	Inhalation	0 or 55 ppm, 5 days/week, 6 hrs/day for 4 weeks; observed for 56 weeks; 16 controls, 8 dosed.	--	None	Hong *et al.* (216)
Mouse CD-1 Female	Inhalation	0 or 55 ppm, 5 days/week, 6 hrs/day for 4 weeks; observed for 56 weeks; 16 controls, 8 dosed.	--	None	Hong *et al.* (216)
Rat Charles River CD Male	Inhalation	0 or 55 ppm, 5 days/week, 6 hrs/day for 26 weeks; length of of experiment 77 weeks; 20 controls, 20 dosed.	--	None	Hong *et al.* (216)
Rat Charles River CD Female	Inhalation	0 or 55 ppm, 5 days/week, 6 hrs/day for 26 weeks; length of experiment 77 weeks; 20 controls, 20 dosed.	--	None	Hong *et al.* (216)

Table 2-94 (continued)

SUMMARY OF VINYLIDENE CHLORIDE CARCINOGENIC BIOASSAY DATA

Species	Route of Administration	Nature of Exposure	Lowest Effective Dose	Highly Affected Organ(s)	Reference
Mouse CD-1 Male	Inhalation	0 or 55 ppm, 5 days/week, 6 hrs/day for 12 weeks; observed for 64 weeks; 16 controls, 8 dosed.	--	None	Hong et al. (216)
Mouse CD-1 Female	Inhalation	0 or 55 ppm, 5 days/week, 6 hrs/day for 12 weeks; observed for 64 weeks; 16 controls, 8 dosed.	--	None	Hong et al. (216)
Mouse CD-1 Male	Inhalation	0 or 55 ppm, 5 days/week, 6 hrs/day for 26 weeks; observed for 77 weeks; 28 controls, 12 dosed.	--	None	Hong et al. (216)
Mouse CD-1 Female	Inhalation	0 or 55 ppm, 5 days/week, 6 hrs/day for 26 weeks; observed for 77 weeks; 28 controls, 12 dosed.	--	None	Hong et al. (216)
Mouse Albino CD-1 Male	Inhalation	0 or 55 ppm, 5 days/week, 6 hrs/day for length of experiment (52 weeks); 14 controls, 14 dosed.	--	None	Lee et al. (218)
Mouse Albino CD-1 Female	Inhalation	0 or 55 ppm, 5 days/week, 6 hrs/day for length of experiment (52 weeks); 16 controls, 16 dosed.	--	None	Lee et al. (218)

Table 2-94 (continued)

SUMMARY OF VINYLIDENE CHLORIDE CARCINOGENIC BIOASSAY DATA

Species	Route of Administration	Nature of Exposure	Lowest Effective Dose	Highly Affected Organ(s)	Reference
Rat Charles River CD Male	Inhalation	0 or 55 ppm, 5 days/week, 6 hrs/day for length of experiment (52 weeks); 36 controls, 36 dosed.	--	None	Lee et al. (218)
Rat Charles River CD Female	Inhalation	0 or 55 ppm, 5 days/week, 6 hrs/day for length of experiment (52 weeks); 36 controls, 36 dosed.	--	None	Lee et al. (218)
Mouse Albino CD-1 Male	Inhalation	0 or 55 ppm, 5 days/week, 6 hrs/day for length of experiment (39 weeks); 20 controls, 20 dosed.	--	None	Lee et al. (218)
Mouse Albino CD-1 Female	Inhalation	0 or 55 ppm, 5 days/week, 6 hrs/day for length of experiment (39 weeks); 20 controls, 20 dosed.	--	None	Lee et al. (218)
Mouse Albino CD-1 Male	Inhalation	0 or 55 ppm, 5 days/week, 6 hrs/day for length of experiment (26 weeks); 24 controls, 24 dosed.	--	None	Lee et al. (218)
Mouse Albino CD-1 Female	Inhalation	0 or 55 ppm, 5 days/week, 6 hrs/day for length of experiment (26 weeks); 24 controls, 24 dosed.	--	None	Lee et al. (218)

Table 2-94 (continued)

SUMMARY OF VINYLIDENE CHLORIDE CARCINOGENIC BIOASSAY DATA

Species	Route of Administration	Nature of Exposure	Lowest Effective Dose	Highly Affected Organ(s)	Reference
Mouse Albino CD-1 Male	Inhalation	0 or 55 ppm, 5 days/week, 6 hrs/day for length of experiment (13 weeks); 36 controls, 36 dosed.	--	None	Lee *et al.* (218)
Mouse Albino CD-1 Female	Inhalation	0 or 55 ppm, 5 days/week, 6 hrs/day for length of experiment (13 weeks); 36 controls, 36 dosed.	--	None	Lee et al. (218)
Rat Sprague-Dawley Male	Inhalation	0, 10, 25, 50, 100 and 150 ppm, 5 days/week, 4 hrs/day for 52 weeks, length of experiment 130 weeks; 100 controls, 30/dose group (10, 25, 50 and 100 ppm), 60 dosed (150 ppm).	--	None	Maltoni *et al.* (9)
Rat Sprague-Dawley Female	Inhalation	0, 10, 25, 50, 100 and 150 ppm, 5 days/week, 4 hrs/day for 52 weeks, length of experiment 130 weeks; 100 controls, 30/dose group (10, 25, 50 and 100 ppm), 60 dosed (150 ppm).	--	None	Maltoni *et al.* (9)

Table 2-94 (continued)

SUMMARY OF VINYLIDENE CHLORIDE CARCINOGENIC BIOASSAY DATA

Species	Route of Administration	Nature of Exposure	Lowest Effective Dose	Highly Affected Organ(s)	Reference
Rat Sprague-Dawley Male	Gavage	0, 0.5, 5, 10, 20 mg/kg, 5 days/week for 52 weeks, length of experiment 130 weeks; 175 controls, 50/dose group.	--	None	Maltoni *et al.* (9)
Rat Sprague-Dawley Female	Gavage	0, 0.5, 5, 10, 20 mg/kg, 5 days/week for 52 weeks, length of experiment 130 weeks; 175 controls, 50/dose group.	--	None	Maltoni *et al.* (9)
Rat F344 Male	Gavage	0, 1 or 5 mg/kg, 5 days/week for length of experiment (104 weeks); 50 controls, 50/dose group.	5 mg/kg	Connective tissue; adrenal; pancreatic islets	NTP (223)
Rat F344 Female	Gavage	0, 1 or 5 mg/kg, 5 days/week for length of experiment (104 weeks); 50 controls, 50/dose group.	5 mg/kg	Pituitary	NTP (223)
Mouse B6C3F$_1$ Male	Gavage	0, 2 or 10 mg/kg, 5 days/week for length of experiment (104 weeks); 50 controls, 50/dose group.	--	None	NTP (223)

Table 2-94 (continued)

SUMMARY OF VINYLIDENE CHLORIDE CARCINOGENIC BIOASSAY DATA

Species	Route of Administration	Nature of Exposure	Lowest Effective Dose	Highly Affected Organ(s)	Reference
Mouse B6C3F$_1$ Female	Gavage	0, 2 or 10 mg/kg, 5 days/week for length of experiment (104 weeks); 50 controls, 50/dose group.	2 mg/kg	Hematopoietic system	NTP (223)

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