NIOSH

1977 EDITION

REGISTRY of TOXIC EFFECTS of CHEMICAL SUBSTANCES VOL. II

U. S. DEPARTMENT OF HEALTH, EDUCATION, AND WELFARE
Public Health Service
Center for Disease Control
National Institute for Occupational Safety and Health

Registry of Toxic Effects of Chemical Substances

1977 Edition

Volume II

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U.S. DEPARTMENT OF HEALTH, EDUCATION, AND WELFARE
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Cincinnati, Ohio 45226
September 1977

Prepared for
the National Institute for Occupational
Safety and Health

under

Contract Number 210-75-0034

by

Tracor Jitco, Incorporated
Rockville, Maryland 20852

DHEW Publication No. (NIOSH) 78-104-B

For sale by the Superintendent of Documents, U.S. Government
Printing Office, Washington, D.C. 20402

GPO Stock No. 017-033-00271-1

NOTE TO READER: THE FOLLOWING INFORMATION IS REPEATED FROM VOLUME I FOR CONVENIENCE OF THE USER.

DETAILED FILE DESCRIPTION

Selection

1. *Substances Included* — For the purpose of this publication, the phrase "all known toxic substances" was interpreted by the editors to include all mined, manufactured, processed, synthesized, and naturally occurring inorganic and organic compounds. The list includes drugs, food additives, preservatives, ores, pesticides, dyes, detergents, lubricants, soaps, plastics, extracts from plant and animal sources, plants and animals which are toxic by contact or consumption, and industrial intermediates and waste products from production processes. The chemical substances included in this list are assumed to exhibit the reported toxic effect in their pure state unless otherwise noted.

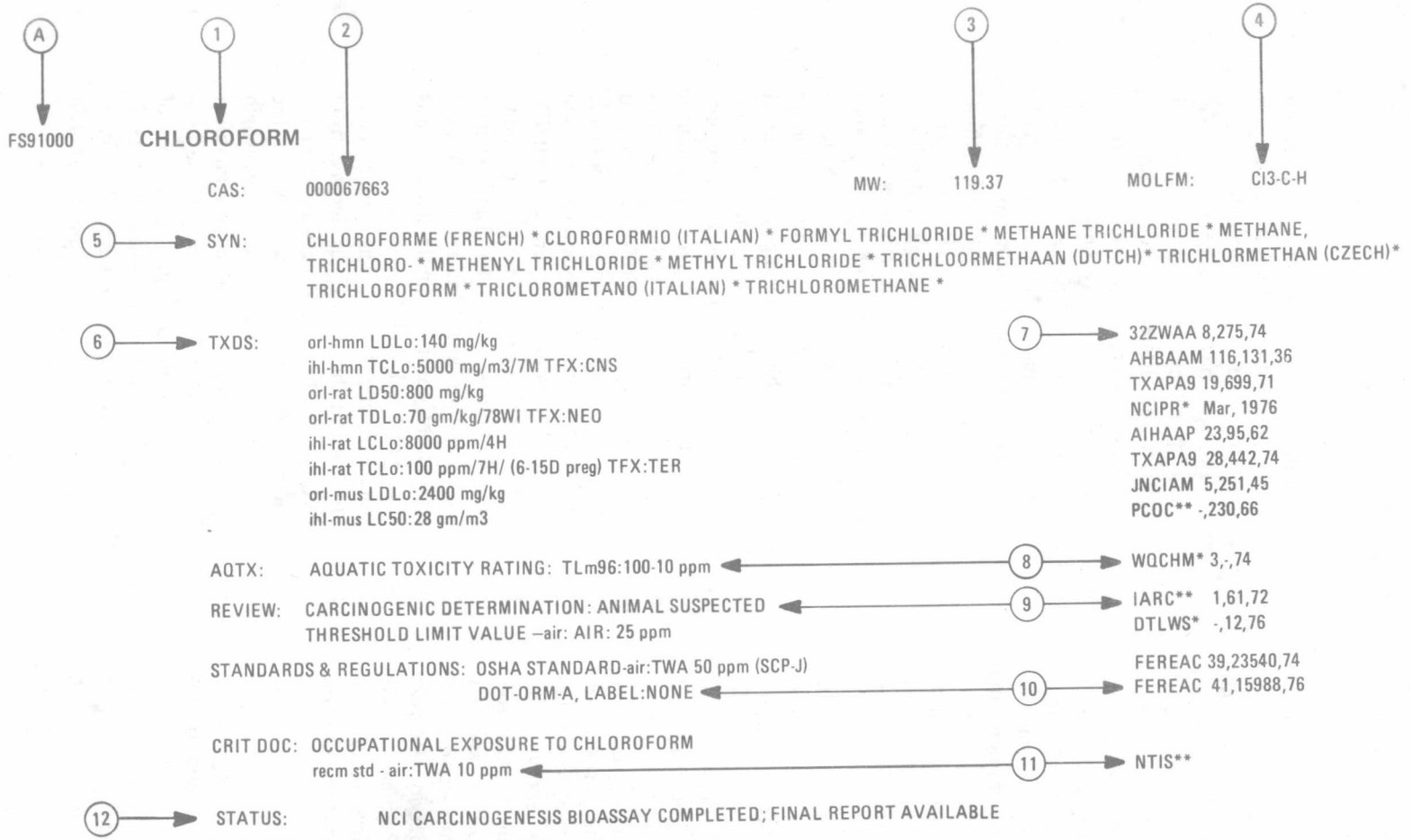
2. *Substances Excluded* — Excluded from the Registry are trade name products representing compounded or formulated proprietary mixtures available as commercial products. These exclusions are necessary because of difficulties in assessing the contribution to the toxicity by each component of the mixture and because the formulations are often changed by varying the components, their concentration, or the purity of the ingredients. Trade names are included where they represent a single active chemical entity. Some listed substances may be impure commercial products of relatively constant composition and will be identified by definitions of composition rather than by a Chemical Abstracts Service Registry Number or molecular formula. Radioactive substances are included but the effect reported is the chemically produced effect rather than the radiation effect.

Format

The format of this edition of the Registry has been changed from that of previous years. It now consists of two volumes. Volume I, which includes indexes to the substances contained in the Registry file, contains five chapters. Chapter 1 is a listing of all substance prime names and synonyms in the file, alphabetized by compound name, ignoring special characters such as numerals, Greek letters, and prefixes indicating substituent locations, and stereochemical or other structural features. These components are taken into account for secondary ordering in ascending alphabetical and numerical order. Similarly, Chapters 2 through 5 are alphabetical indexes of substance prime names and synonyms of those compounds that have been identified in the literature as having carcinogenic and neoplastigenic, teratogenic, mutagenic, or human toxic effects.

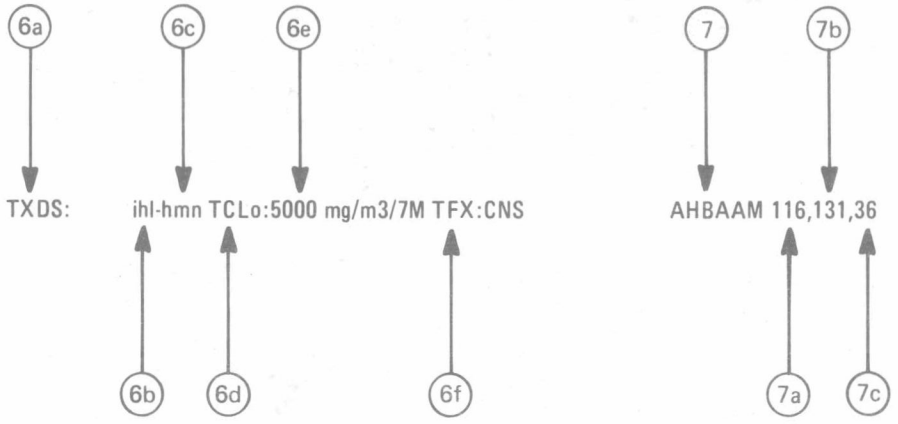
Each name in Chapters 1 through 5 of Volume I appears with a seven character RTECS alphanumeric accession number consisting of two letters and five numerals. This number varies directly with the alphabetic sequence of the substance prime name in the Registry. The RTECS accession number directs the reader to the appropriate data in Volume II, which is arranged in order of increasing accession number. For each accession number in Volume II, the following data are provided: the substance prime name, a description of the substance (where necessary), synonymous names, toxic dose information with references, and citations to existing and recommended standards and to the NIOSH criteria document program for recommended standards. Reference CODEN abbreviations and their respective titles are found at the end of Volume II under Bibliographic References. Standard abbreviations are located on the inside front covers. Sample data records are shown in Figures 1 and 2.

1. *Substance Prime Name.* The prime name of each substance in the Registry is derived from the nomenclature used by the American Chemical Society Chemical Abstracts Service (CAS) in the 8th Collective Index of Chemical Abstracts, which is in the inverted form. The names are modified by NIOSH for certain substances to provide convenience to the user in grouping substances of similar occupational pertinence, such as metallic salts. For each substance prime name, the reader will find the associated data in Volume II listed in the order described below.



A. SEQUENCE NUMBER IN THIS LISTING.
1. PRIME NAME OF COMPOUND, SEE 1 IN TEXT BELOW.
2. CHEMICAL ABSTRACTS REGISTRY NUMBER WHICH IS A NUMBER ASSIGNED TO THIS COMPOUND SO THAT IT MAY BE UNIQUELY IDENTIFIED, SEE 2 IN TEXT BELOW.
3. MOLECULAR WEIGHT OF THIS COMPOUND, SEE 3 IN TEXT BELOW.
4. MOLECULAR FORMULA OR ELEMENTAL FORMULA OF THIS COMPOUND, SEE 4 IN TEXT BELOW.
5. SYNONYMS, COMMON NAMES, TRADE NAMES, AND OTHER CHEMICAL NAMES, SEE 5 IN TEXT BELOW.
6. TOXIC DOSE LINE, SEE 6 IN TEXT BELOW. ALSO SEE FIGURE 2.
7. THIS IS THE REFERENCE TO THE ORIGINAL ARTICLE OR SOURCE FROM WHICH THE TOXIC DATA WAS DERIVED, SEE 7 IN TEXT BELOW.
8. AQUATIC TOXICITY RATING IS A RELATIVE TOXICITY TO AQUATIC LIFE, SEE 8 IN TEXT BELOW.
9. REVIEW OF THIS COMPOUND, SEE 9 IN TEXT BELOW.
10. STANDARDS AND REGULATIONS ENTRIES INDICATE A STANDARD FOR THIS SUBSTANCE HAS BEEN PROMULGATED BY A FEDERAL AGENCY, SEE 10 IN TEXT BELOW.
11. A CRITERIA DOCUMENT SUPPORTING A RECOMMENDED STANDARD HAS BEEN PUBLISHED BY NIOSH, U.S. DEPARTMENT OF HEALTH, EDUCATION AND WELFARE, SEE 11 IN TEXT BELOW.
12. THE CURRENT TESTING STATUS OF THIS COMPOUND, SEE 12 IN TEXT BELOW.

FIGURE 1. AN EXAMPLE OF A TYPICAL ENTRY IN THE REGISTRY OF TOXIC EFFECTS OF CHEMICAL SUBSTANCES 1977



6a. AN ACRONYM WHICH STANDS FOR "TOXIC DOSE."
6b. THIS IS AN ABBREVIATION FOR THE ROUTE OF ADMINISTRATION OR ENTRY OF THIS SUBSTANCE. SEE TABLE II FOR OTHER ROUTES OF ENTRY USED IN THE LIST.
6c. THIS IS AN ABBREVIATION FOR THE SPECIES. SEE TABLE III FOR THE OTHER SPECIES USED IN THE LIST.
6d. THIS IS THE TYPE OF DOSE REPORTED. SEE 6d IN TEXT BELOW.
6e. THIS IS THE DOSE WHICH CAUSED THE TOXIC EFFECT. SEE 6e IN TEXT BELOW.
6f. THE FIRST PART OF THIS NOTATION, "TFX," IS AN ACRONYM WHICH STANDS FOR "TOXIC EFFECTS." THE LAST PART OF THIS NOTATION REFERS TO THE ORGAN SYSTEM AFFECTED BY THE DOSE ADMINISTERED. SEE TABLE V BELOW.
7. THIS IS A CODE DENOTING THE REFERENCE FROM WHICH THE TOXIC DATA WAS DERIVED. THE REFERENCE FOR THIS CODE MAY BE FOUND IN THE BIBLIOGRAPHY. SEE 7 IN TEXT BELOW.
7a. VOLUME NUMBER OF THE REFERENCE.
7b. PAGE NUMBER OF THE REFERENCE.
7c. THESE TWO DIGITS STAND FOR THE YEAR OF PUBLICATION, I.E., 1936.

FIGURE 2. A TYPICAL TOXIC DOSE LINE FROM THE REGISTRY OF TOXIC EFFECTS OF CHEMICAL SUBSTANCES 1977

(THIS FIGURE IS A FURTHER EXPLANATION OF ITEM 6 IN FIGURE 1)

Some entries, however, appear as a chemical or descriptive name as published in the source from which the toxic data were obtained. This is particularly true for those substances for which some aspects of their composition are in question, such as plant or animal extracts. These prime names are accompanied by a description or definition (DEF:) which may be a narrative listing the source of the substance, a general statement of constituents, or other helpful information, with a reference.

2. *Chemical Abstracts Service Registry Number,* (CAS:) is a numeric designation which uniquely identifies a specific chemical compound. The value of such an entry is that it allows one to conclusively identify a substance regardless of the name or naming system used. The numbers used in this publication were derived from the Desk Top Analysis Tool* (DAT), the Chemical Abstracts Indexes, and various other sources, and may not reflect the currently assigned CAS number.

3. *Molecular Weight,* (MW:) is calculated from the molecular formula.

4. *Molecular Formula,* (MOLFM:) designates the elemental composition of the substance and is structured according to the NOPS System, as specified in the DAT. It was obtained from one of the cited references, from the DAT, or derived from the name of the substance.

5. *Synonyms,* (SYN:) This line includes synonyms for the substance prime name. All synonyms appear following "SYN:" and are listed alphabetically according to the same rules presented above. Each synonym is separated by an asterisk. Synonyms include other chemical names, trade names, common or generic names, or codes.

6. *Toxic Dose Data,* (TXDS:) (See Figure 2.) All of the entries in the toxic dose data section contain information entered as follows: the first line starts with the notation "TXDS:" immediately followed by the toxic dose information. The notations indicate, in sequence, the route of exposure; the species of animal studied; the type of dose; the amount of substance per body weight or concentration per unit air volume and, where applicable, the duration of exposure; a descriptive notation of the type of effect reported; the reference source from which the information was extracted. Only the first toxic dose data line is identified by "TXDS." Each element of this toxic dose data line is discussed below.

a. *Qualifying Toxic Dose.* All toxic doses appearing in the Registry are derived from reports of the toxic effects produced by individual substances. A toxic effect is defined as any noxious effect on the body — reversible or irreversible; any tumor — benign or malignant; any mutagenic or teratogenic effect which includes fetal resorption or other disturbances to a normal gestation; or death which has been reported to have resulted from exposure to a substance via the respiratory tract, skin, eye, mouth, or any other route. For humans, the toxic effect is any effect that was reported in the source reference. There is no qualifying limitation as to the duration of exposure or for the quantity or concentration of the substance, nor is there a qualifying limitation with respect to the circumstances that resulted in the exposure. Regardless of the absurdity of the circumstances that were involved in a toxic exposure, it is assumed that the same circumstances could recur. The qualifying symptomatology for animals cannot be elucidated with any practicality; therefore, more objective signs of toxic effects must be relied upon. The production of tumors (neoplastigenesis), benign or malignant (carcinogenesis); the production of changes in the offspring, whether transmissible (mutagenesis) or not (teratogenesis); and death are the criteria that are used as the toxic effects for animal data. There is no limitation with respect to the duration of exposure, nor the quantity or concentration of the dose of the substance reported to have caused these effects.

We have accepted claims by the authors that the neoplastic effects were reported in accordance with recognized classification schemes. Thus, if the effects were characterized as being carcinogenic, mutagenic, or teratogenic by the author, those reported classifications were entered in the Registry. A substance is listed according to the following rules:

(1) *A neoplastigen (NEO) is a substance that produces a benign tumor, a tumor that cannot definitely be classified as carcinogenic, or tumors produced in a study where the results are equivocal because of poor study design.*

(2) *A substance is considered a carcinogen (CAR) if it was reported to have pro-*

*Desk Top Analysis Tool for the Common Data Base (6 volumes) 1968: NTIS**PB 179-900.

duced a malignant tumor or one that metastasized to other parts of the body.

The report of the lowest total dose administered over the shortest time to produce the toxic effect was given preference, although some editorial license was taken in order that additional references might be cited for the user. No restrictions were placed on the amount of a substance producing death in an experimental animal nor on the time period over which the dose was given. By law, however, a toxic effect must be produced for the dose published. Therefore, terms suggesting that a toxic or lethal effect may exist at quantities greater than those tried cannot be used. Table I presents a guide for the reader's evaluation of acute lethal doses administered by different routes to animals relative to the expected acute lethal effects in humans.

b. *Route of Exposure or Administration.* Although many exposures to substances in the industrial community occur via the respiratory tract or skin, most studies in the published literature report exposures of experimental animals in which the test substances were introduced primarily through the mouth by pills, in food, in drinking water, or by intubation directly into the stomach.

For purposes of developing information concerning the relative toxicity of substances, studies in which oral administration is reported are always listed when available. Because of the importance of information dealing with the effects of respiratory exposure, any studies concerning toxic effects of exposure by inhalation are also listed. However, inhalation studies are generally not as useful for comparing the toxicity of different substances because of the limited number of studies reported and because of the wide variability of test programs that are employed in this field of research. Skin absorption studies, as available, are also reported. The abbreviations and definitions of the various routes of exposure reported in the Registry are found in Table II.

c. *Species Exposed.* Since the effects of exposure of humans are of primary concern, we have indicated, when available, whether the results were observed in man, woman, child or infant. If no such distinction was made in the reference, the term "human" is used. Results of studies on rats or mice are the most frequently reported and hence provide the most useful data for comparative purposes. The species and abbreviations used are listed alphabetically in Table III.

d. *Description of Exposure.* In order to better describe the administered dose reported in the literature, six abbreviations are used. These terms indicate whether the dose caused death (LD) or other toxic effects (TD) and whether it was administered as a lethal concentration (LC) or toxic concentration (TC) in the inhaled air. In general, the term "Lo" is used where the number of subjects studied was not a significant number from the population or the calculated percentage of subjects showing an effect was listed as 100. The definition of terms is as follows:

TDLo-Toxic Dose Low — the lowest dose of a substance introduced by any route, other than inhalation, over any given period of time and reported to produce any toxic effect in humans or to produce carcinogenic, teratogenic, mutagenic, or neoplastigenic effects in humans or animals.

TCLo-Toxic Concentration Low — the lowest concentration of a substance in air to which humans or animals have been exposed for any given period of time that has been reported to produce any toxic effect in humans or to produce a carcinogenic, teratogenic, mutagenic, or neoplastigenic toxic effect in animals or humans.

LDLo-Lethal Dose Low — the lowest dose (other than LD50) of a substance introduced by any route, other than inhalation, over any given period of time in one or more divided portions and reported to have caused death in humans or animals.

LD50-Lethal Dose Fifty — A calculated dose of a substance which is expected to cause the death of 50% of an entire defined experimental animal population, as determined from the exposure to the substance by any route, other than inhalation, of a significant number from that population. Other lethal dose percentages, such as LD1, LD10, LD30, LD99, may be published in the scientific literature for the specific purposes of the author. Such data would be published in the list if these figures, in the absence of a calculated lethal dose (LD50), were the lowest published in the article.

LCLo-Lethal Concentration Low — the lowest concentration of a substance in air, other than LC50, which has been reported to have caused death in humans or animals. The reported concentrations may be entered for periods of expo-

sure which are less than 24 hours (acute) and greater than 24 hours (subacute and chronic).

LC50-Lethal Concentration Fifty — a calculated concentration of a substance in air, exposure to which for a specified length of time is expected to cause the death of 50% of an entire defined experimental animal population as determined from the exposure to the substance of a significant number from that population.

The following table summarizes the above information:

Category	Exposure Time	Route of Exposure	TOXIC EFFECTS Human	Animal
TDLo	Acute or Chronic	All except Inhalation	Any Non-Lethal	CAR, NEO TER, MUT
TCLo	Acute or Chronic	Inhalation	Any Non-Lethal	CAR, NEO TER, MUT
LDLo	Acute or Chronic	All except Inhalation	Death	Death
LD50	Acute	All except Inhalation	Not Applicable	Death (Statistically Determined)
LCLo	Acute or Chronic	Inhalation	Death	Death
LC50	Acute	Inhalation	Not Applicable	Death (Statistically Determined)

e. *Units of Dose Measurement.* As is found in almost all experimental toxicology, the doses given are expressed in terms of the quantity administered per unit body weight or quantity per skin surface area, or quantity per unit volume of the respired air. In addition, the duration of time over which the dose was administered is also listed, where available.

Milligrams (one thousandth of a gram) per kilogram (mg/kg) are preferred, but in some cases, because of dose size and its practical presentation in the file, grams per kilogram (gm/kg), micrograms (one millionth of a gram) per kilogram (ug/kg), or nanograms (one billionth of a gram) per kilogram (ng/kg) are used. Volume measurements of dose were converted to weight units by appropriate calculations, assuming all liquids to have a density of one gram per milliliter.

All body weights have been converted to kilograms (kg) for uniformity. For those references in which the dose was reported to have been administereed to an animal of unspecified weight or a given number of animals in a group (e.g., feeding studies) without weight data, the weights of the respective animal species were assumed to be those listed in Table III and the dose is listed on a per kilogram body weight basis. Assumptions for daily food and water intake are found in Table III to allow approximating doses for humans and species of experimental animals where the dose was originally reported as a concentration in food or water. The values presented are selections which are reasonable for the species and convenient for dose calculations.

All concentrations of a gaseous substance in air are listed preferably as parts of vapor or gas per million parts of air by volume (ppm). However, parts per hundred (pph or per cent), parts per billion (ppb), or parts per trillion (ppt) may be used for convenience of presentation. If the substance is a solid or a liquid, the concentrations are listed preferably as milligrams per cubic meter (mg/m3) but may, as applicable, be listed as micrograms per cubic meter (ug/m3), nanograms per cubic meter (ng/m3), or picograms (one trillionth of a gram) per cubic meter (pg/m3) of air. For those cases in which other measurements of contaminants are used, such as fibers or particles, the measurement is spelled out.

Where the duration of exposure is available, time is presented as minutes (M), hours (H), days (D), weeks (W), years (Y), continuous (C), or intermittent (I). Continuous (C) indicates that the exposure was continuous over the time administered, such as ad lib. feeding exposures or 24 hour, seven day week inhalation exposures. Intermittent (I) indicates that the dose was administered during discrete periods, such as daily, twice weekly, etc. In all cases, the total duration of exposure appears first after the kilogram body weight and slash, followed by descriptive data; e.g., 10 mg/kg/3WI means ten milligrams per kilogram body weight administered over a period of three weeks, intermittently in a number of separate, discrete doses. Other notations of time duration are found on the inside front covers. This description is intended to provide the reader with enough information for an approximation of the experimental conditions which can be further clarified by studying the article cited.

f. *Frequency of Exposure.* Frequency of exposure to the test substance varies depending on the nature of the experiment. For the purpose of the Registry, frequency of exposure is given only in the case of an inhalation experiment.

g. *Duration of Exposure.* For assessment of tumorigenic effect, the testing period should be the life-span of the animal, or until statistically

valid calculations can be obtained regarding tumor incidence. In the TXDS line, the *total* toxic dose causing the neoplastic effect is given. The duration of exposure is included to give some indication of the testing period during which the animal was exposed to the toxic dose reported.

h. *Notations Descriptive of the Toxicology.* The toxic dose line thus far has indicated the route of entry, the species involved, the description of the dose, and the amount of the dose. The next entry found on this line when a toxic exposure (TD or TC) has been listed is the term "TFX:" (Toxic Effect). Following "TFX:" will be one of the notations found in Table IV. These notations will indicate the organ system affected or will indicate, in the case of animal experiments, special effects that the substance produced, e.g., CAR = carcinogen. No attempt was made to be definitive in reporting the effect because such definition requires much detailed qualification and is beyond the scope of the publication at this time. The selection of the dose was based first on the lowest dose producing an effect and second on the latest study published.

7. *Cited Reference.* The final entry of the TXDS line is the reference from which the toxic dose information was extracted. All references from which information has been gathered are and must be publicly available. No governmental classified documents have been used for source information. All references have been given a unique six-letter CODEN* character code which identifies periodicals and serial publications as well as individual published works. The CODEN references are found in the Bibliographic References at the end of Volume II. For those references for which no CODEN was found, the corresponding six-letter code includes asterisks (*) in the last one or two positions following the first four or five letters of an acronym for the publication title. In this manner, all CODEN acronyms are arranged in alphabetical order. Following the CODEN designation (for most entries) will be the number of the volume, followed by a comma; the page number of the first page of the article, followed by a comma; and the last two numbers indicating the year of publication. In a special situation where contributors have provided information on their unpublished studies, the first three letters of the last name, the initials of the first and middle name along with a number sign (#), and the date of the letter supplying the information will be found. Any other designation found will be explained with its reference CODEN in the Bibliographic References.

*CODEN for Periodical Titles, Chemical Abstracts Service, Columbus, Ohio 43210.

8. *Aquatic Toxicity* ratings were extracted from *Water Quality Characteristics of Hazardous Materials* by Dr. W. Hahn and Paul Jensen, Texas A & M University, 1974. The format for this line is "AQUATIC TOXICITY RATING: TLm96 ____ ppm" where TLm96 is defined as the 96-hour static or continuous flow standard protocol. Because of the lack of standardization and the wide variety of species investigated, ratings are used to give an indication of the toxicity of substances to aquatic life.

9. *Reviews.* This section supplies additional information to enable the reader to make knowledgeable evaluations of potential chemical hazards. There are three types of reviews listed: (a) Threshold Limit Values, which are recommended limits proposed by the American Conference of Governmental Industrial Hygienists (ACGIH) based on a consensus, (b) International Agency for Research on Cancer (IARC) monograph reviews, which are published by the United Nations, and (c) general toxicology review articles.

a. *Threshold Limit Value* (TLV). The TLV is an ACGIH-recommended upper limit (ceiling) or time-weighted average concentration of a substance to which most workers can be exposed without adverse effect. This concentration may be designated as a ceiling (Cl) or time-weighted average concentration (TWA), or as a notation ("SKN") indicating that even though the air concentration may be below the limit value, significant additional exposure to the skin may be dangerous. These TLV's were taken from *Documentation of the Threshold Limit Values for Substances in Workroom Air* (third edition, 1971), its supplement, or from documentation which appears in the ACGIH annual reports.

b. *Cancer Reviews.* In the U.N. International Agency for Research on Cancer (IARC) monographs, suspected environmental carcinogens are examined and summaries of available data with appropriate references are presented. Included in these reviews are synonyms, physical and chemical properties, uses and occurrence, and biological data relevant to the evaluation of carcinogenic risk to humans. The fourteen monographs in the

series contain an evaluation of approximately 340 substances.

The format of the IARC data line is shown in Figure 1. The entry "CARCINOGENIC DETERMINATION" indicates that some carcinogenicity data pertaining to a compound has been reviewed by the IARC committee. The committee's conclusion is summarized in two words. The first indicates whether the data pertains to humans or to animals. The second word indicates the results of the determination as either positive, suspected, indefinite, or negative.

This cancer review reflects only the conclusion made by the IARC committee based on the data available for the committee's evaluation. Hence, it is to be expected that in some cases there is disagreement between the IARC determination and the carcinogenicity information in the toxicity data lines for the substance.

c. *Toxicology Reviews.* The citation "TOXICOLOGY REVIEW" indicates that the specified number of general review articles have been located in the literature. These articles are reviews of the toxicological literature relating to the substance and can provide more detailed information regarding its toxicity.

Because of space limitations, individual citations to the specific articles were not included in this edition of the Registry. However, they do appear on the microfiche edition of the Registry available from the Superintendent of Documents. Alternatively, a request for this information can be made to the editor at the address given in the Introduction.

10. *Standards and Regulations.* This section contains notations indicating that the substance is regulated by an agency of the United States Government. The heading of these reference lines is "STANDARDS AND REGULATIONS" followed either by "OSHA," "EPA," or "DOT." "OSHA" refers to standards promulgated under section six of the Occupational Safety and Health Act of 1970. "EPA" refers to Worker Protection Standards for Agricultural Pesticides promulgated under the Federal Insecticide, Fungicide, and Rodenticide Act. "DOT" refers to substances regulated for shipment by the Department of Transportation.

If the entry following OSHA is "air," then this is an air contaminant standard. TWA or Cl refers to either time-weighted average or ceiling value, respectively. For some substances, TWA, Cl, and Pk (peak) values are given in the standard. In those cases, all three are listed. Finally, some entries may be followed by the designation "(skin)." This designation indicates that the compound may be absorbed by the skin and, even though the air concentration may be below the standard, significant additional exposure through the skin may be possible. The FEREAC reference is to the volume, page, and year of the Federal Register.

Standards Completion Program — The entry "(SCP)" indicates that a draft technical standard has been developed for the substance under the joint NIOSH/OSHA Standards Completion Program. This draft technical standard, upon promulgation by OSHA, would fulfill requirements of Sections 6 and 8 of the Occupational Safety and Health Act for a complete standard for the substance as listed in 29 CFR 1910.1000. A draft technical standard includes requirements for apprising employees of all hazards to which they are exposed, acceptable personal protective equipment, engineering control procedures, air sampling and analytical procedures, medical surveillance, and recordkeeping. Copies of the draft technical standards are available for review in each of the NIOSH and OSHA Regional Offices. The letter entry following SCP, for example "(SCP-A)," refers to a set of draft standards which were prepared concurrently. Acceptable methods for sampling and analysis have been developed for some of the substances covered by a draft technical standard. These can be acquired as described in Appendix II.

The information following the DOT notation for each substance has been obtained from the Department of Transportation to reflect (a) the hazard class, (b) the label(s) required, and (c) the proper shipping name(s) as specified for transportation. Except as provided for certain export and import shipments, no person may offer or accept a hazardous material, as defined by the Code of Federal Regulations, Title 49, for transportation in commerce within the United States unless that material is properly classed, described, packaged, marked, labeled, and in the condition for shipment as specified by 49 CFR, Parts 100 to 189. For transportation purposes, a hazardous material means a substance or material which has been determined by the Secretary of Transportation to be capable of posing an unreasonable risk to health, safety, and property when transported

in commerce and which has been so designated.

Specific definitions are given for each hazard class addressed in 49 CFR; however, DOT reserves the right to regulate or deregulate materials whether or not they meet these definitions. The basic hazard classes include compressed gases, flammables, oxidizers, corrosives, explosives, radioactive materials, and poisons. Although a material may be designated by only one hazard class, additional hazards may be indicated by adding labels or by other means as directed by DOT.

It is essential, therefore, that all required label(s) as well as the hazard class be known. Generally, a material meeting the DOT definition of a poison must always be labeled as a poison regardless of the other labeling requirements in order that adherence to the prohibition against shipping poisons with foodstuffs can be assured.

Specific shipping names are designated for hazardous materials in 49 CFR. Because of the presence of many nontechnical names or the use of archaic names for some materials, it is necessary to identify the DOT shipping names. The approved DOT shipping names are included as synonyms of the prime names and are identified by the addition of "DOT" to the name.

Substances not specifically identified in 49 CFR and not appearing in the Registry are not necessarily exempt from DOT regulations. The Registry contains only those substances specifically identified in 49 CFR. Generic names or general descriptive names such as "insecticide, liquid" are not included in the Registry. Determination of the correct classification for transportation of materials not specifically identified in 49 CFR is the responsibility of the shipper. Future editions of the Registry may include classification data and other information on some of these substances as provided by DOT.

11. *NIOSH Criteria Documents.* Following the "STANDARDS AND REGULATIONS" citation may be an entry indicating that a NIOSH criteria document recommending a certain environmental (occupational) exposure is currently available. This line begins with "CRIT DOC:" followed by the title of the document and the recommended standard. The reference citation (NTIS**) is to the National Technical Information Service, U.S. Department of Commerce. The NTIS publication number and instructions for ordering paper or microfiche copy appear in Appendix I.

12. *NCI Status.* This edition of the Registry cites those substances that are being tested by the National Cancer Institute under its carcinogenesis bioassay program. This citation reflects the status of the substance: selected for test, undergoing test, test results incomplete, test completed, or report available.

TABLE I

GUIDELINES FOR EVALUATING ACUTE* DOSAGES DIFFERENTIATING RELATIVELY TOXIC FROM NONTOXIC SUBSTANCES TAKING INTO CONSIDERATION THE ROUTE OF ADMINISTRATION TO EXPERIMENTAL ANIMALS AND THE DOSE CAUSING DEATH**

SPECIES	Routes of Administration								
	Oral Rectal Intraduodenum Intracervix	24-Hour Inhalation Maximum		Skin	Parenteral Intraperitoneal Intrapleural	Parenteral Subcutaneous Intradermal Implant	Parenteral Intravenous Intramuscular Ocular Intracerebral Intratracheal Intraplacental Intravaginal Intrarenal	Parenteral Other	Unreported
	mg/kg	ppm	mg/m³	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg
Hamster, Frog, Gerbil	2,500	5,000 (0.5%)	1,000	1,400	1,000	5,000	750	1,000	2,500
Rat, Mouse, Squirrel, Mammal, unspecified	5,000***	10,000 (1%)	2,000	2,800	2,000	10,000***	1,500	2,000	5,000
Rabbit, Guinea Pig, Chicken, Pigeon, Quail, Duck, Turkey, Bird	10,000	20,000 (2%)	4,000	2,800***	4,000	20,000	3,000	4,000	10,000
Dog, Monkey, Cat, Pig, Cattle, Domestic Animals: Sheep, Goat, Horse	10,000	20,000 (2%)	4,000	5,600	4,000	20,000	3,000	4,000	10,000

*Applies to those substances for which acute or short term toxicity characterizes the response, e.g., fast-acting substances, irritants, narcosis-producing substances and most drugs. Does not apply to substances whose characteristic response results from prolonged exposures, e.g., silica, lead, benzene, carbon disulfide, carcinogens. Concentrations more appropriately characterizing the toxicity of long- or slow-acting substances are derived from non-acute toxicity studies.

**Calculated from experimental data (Stokinger).

***From Hine and Jacobson, AIHAAP 15, 141, 54.

TABLE II

ROUTES OF ADMINISTRATION TO, OR EXPOSURE OF, ANIMAL SPECIES TO TOXIC SUBSTANCES

Route	Abbreviation	Definition
Intraarterial	iat	Administration into the artery
Intraaural	ial	Administration into the ear
Intracerebral	ice	Administration into the cerebrum
Intracervical	icv	Administration into the cervix
Intradermal	idr	Administration within the dermis by hypodermic needle
Intraduodenal	idu	Administration into the duodenum
Inhalation	ihl	Inhalation in chamber, by cannulation, or through mask
Implant	imp	Placed surgically within the body — location described in reference
Intramuscular	ims	Administration into the muscle by hypodermic needle
Intraplacental	ipc	Administration into the placenta
Intrapleural	ipl	Administration into the pleural cavity by hypodermic needle
Intraperitoneal	ipr	Administration into the peritoneal cavity
Intrarenal	irn	Administration into the kidney
Intraspinal	isp	Administration into the spinal canal
Intratracheal	itr	Administration into the trachea
Intravaginal	ivg	Administration into the vagina
Intravenous	ivn	Administration directly into the vein by hypodermic needle
Ocular	ocu	Administration directly onto the surface of the eye or into the conjunctival sac
Oral	orl	Per os, intragastric, feeding, or introduction with drinking water
Parenteral	par	Administration into the body through the skin. Reference cited is not specific concerning the route used. Could be ipr, scu, ivn, ipl, ims, irn, or ice
Rectal	rec	Administration into the rectum or colon in the form of enema or suppository
Skin	skn	Application to the intact skin, dermal, cutaneous
Subcutaneous	scu	Administration under the skin
Unreported	unk	Dose, but not route, is specified in the reference

TABLE III

SPECIES

With Assumptions For Toxic Dose Calculation From Non-Specific Data*

Species	Abbrev.	Age	Weight	Consumption Food gm/day	Water ml/day (Approx.)
Bird — any domestic or laboratory bird reported but not otherwise identified	brd		1 kg		
Bird — wild bird species	bwd		40 gm		
Cat, adult	cat		2 kg	100	100
Cattle, Horse	ctl		500 kg	10,000	
Chicken, adult (male or female)	ckn	8 W	800 gm	140	200
Child	chd	1-13 Y	20 kg		
Dog, adult	dog	52 W	10 kg	250	500
Domestic animals: goat, sheep	dom		60 kg	2,500	
Duck, adult (domestic)	dck	8 W	2.5 kg	250	500
Frog, adult	frg		33 gm		
Gerbil	grb		100 gm	5	5
Guinea pig, adult	gpg		500 gm	30	85
Hamster	ham	14 W	125 gm	15	85
Human	hmn	Adult	70 kg		
Infant	inf	0-1 Y	5 kg		
Mammal — species unspecified in reference	mam		200 gm		
Man	man	Adult	70 kg		
Monkey	mky	2.5 Y	5 kg	400	500
Mouse	mus	8 W	25 gm	5	5
Pig	pig		60 kg	2,400	
Pigeon	pgn	8 W	500 gm		
Quail (Laboratory)	qal		100 gm		
Rabbit, adult	rbt	12 W	2 kg	100	330
Rat, adult female	rat	14 W	200 gm	10	20
Rat, adult male	rat	14 W	250 gm	15	25
Rat, adult, sex unspecified	rat	14 W	200 gm	15	25
Rat, weanling	rat	3 W	50 gm	15	25
Squirrel	sql		500 gm		
Toad	tod		100 gm		
Turkey	trk	18 W	5 kg		
Woman	wmn	Adult	50 kg		

*NOTE: Values given here are within reasonable limits usually found in the published literature and are selected to facilitate calculations for data from publications in which toxic dose information has not been presented for an individual animal of the study. Data for lifetime exposure are calculated from the assumptions for adult animals for the entire period of exposure. For definitive data, the reader must review the referenced publication.

TABLE IV

NOTATIONS DESCRIPTIVE OF THE TOXICOLOGY

Abbreviations	Definitions (not limited to effects listed)
ALR	Allergic systemic reaction such as might be experienced by individuals sensitized to penicillin.
BCM	Blood clotting mechanism effects — any effect which increases or decreases clotting time.
BLD	Blood effects — effect on all blood elements, electrolytes, pH, protein, oxygen carrying or releasing capacity.
BPR	Blood pressure effects — any effect which increases or decreases any aspect of blood pressure.
CAR	Carcinogenic effects — producing cancer, a cellular tumor the nature of which is fatal, or is associated with the formation of secondary tumors (metastasis).
CNS	Central nervous system effects — includes effects such as headaches, tremor, drowsiness, convulsions, hypnosis, anesthesia.
COR	Corrosive effects — burns, desquamation.
CUM	Cumulative effects — where substance is retained by the body in greater quantities than is excreted, or the effect is increased in severity by repeated body insult.
CVS	Cardiovascular effects — such as an increase or decrease in the heart activity through effect on ventricle or auricle; fibrillation; constriction or dilation of the arterial or venous system.
DDP	Drug dependence effects — any indication of addiction or dependence.
EYE	Eye effects — irritation, diploplia, cataracts, eye ground, blindness by affecting the eye or the optic nerve.
GIT	Gastrointestinal tract effects — diarrhea, constipation, ulceration.
GLN	Glandular effects — any effect on the endocrine glandular system.
IRR	Irritant effects — any irritant effect on the skin, eye, or mucous membrane.
MMI	Mucous membrane effects — irritation, hyperplasia, changes in ciliary activity.
MSK	Musculo-skeletal effects — such as osteoporosis, muscular degeneration.
MUT	Mutation or mutagenic effects — transmissible changes produced in the offspring.
NEO	Neoplastic effects — the production of tumors not clearly defined as carcinogenic by the author(s) of the cited reference.
PNS	Peripheral nervous system effects.
PSY	Psychotropic effects — exerting an effect upon the mind.
PUL	Pulmonary system effects — effects on respiration and respiratory pathology.
RBC	Red blood cell effects — includes the several anemias.
SKN	Skin effects — such as erythema, rash, sensitization of skin, petechial hemorrhage.
SYS	Systemic effects — effects on the metabolic and excretory function of the liver or kidneys.
TER	Teratogenic effects — nontransmissible changes produced in the offspring.
TFX	Toxic effects — used to introduce the pathology or the principal organ system affected.
UNS	Unspecified effects — the toxic effects were unspecified in the reference.
WBC	White blood cell effects — effects on any of the cellular units other than erythrocytes, including any change in number or form.

HOW TO USE THIS REGISTRY

To find toxicity data for a substance:

1. Look up the substance name in the alphabetical index in Chapter of Volume I. A seven character RTECS accession number precedes ea prime name and follows each synonym.

2. Look up the indicated RTECS accession number in Volume II, whe the toxicity data are arranged by increasing accession number.

3. The Volume II data record for each substance includes, where appli cable and available:

   substance prime name and synonyms
   CAS number
   molecular weight
   molecular formula
   toxic dose data and references
   aquatic toxicity rating
   toxicology reviews
   standards and regulations
   NIOSH criteria document citations
   NCI bioassay status

   An example of this record appears on the inside back cover of each volume. An explanation of each data field appears in the Detailed File Description in Volume I.

4. Chapters 2-5 of Volume I contain subfile indexes which group substance prime names and their synonyms alphabetically by the following data types, as classified by the author of the cited reference:

   Chapter 2. Carcinogenic and Neoplastigenic Citations Index
   Chapter 3. Teratogenic Citations Index
   Chapter 4. Mutagenic Citations Index
   Chapter 5. Human Effects Citations Index

   All substance prime names and synonyms are included in Chapter 1. A substance may appear in one or more subfile index chapters, depending upon the types of toxicity citations in the references.

5. A complete list of bibliographic references appears at the end of Volume II.