October 23, 2015

Project No.

Michelle Robinson
Office of Environmental Health Hazard Assessment ("OEHHA")
P.O. Box 4010, MS-19B Sacramento, California 95812-4010
P65Public.comments@oehha.ca.gov

Subject: Relevant comments on the delisting of diaminotoluene (mixed)

Dear Chairman Mack and CIC Members

On behalf of Petitioner Big Lots Stores, Inc. ("Big Lots"), I am submitting the following technical comments in response to OEHHA's Notice for Relevant Information concerning diaminotoluene (mixed) (9/9/15). The comments support the following points: 1) The current designation of diaminotoluene (mixed) as a carcinogen is unclear, arbitrary, and unjustified; and 2) there is no credible evidence to support the listing of 2,5 diaminotoluene.

I. The current designation of diaminotoluene (mixed) as a carcinogen is unclear, arbitrary, and unjustified. Individual isomers should be evaluated separately.

Background

I have examined the State's file on the listing of diaminotoluene mixed that was attained by a Freedom of Information Request on September 30, 2014. From a reading of the file's contents, I have found the following:

In 1989, the California Health and Welfare Agency published a 'Notice of Intent to List Chemicals' (November 1, 1989; Exhibit A). This three page document listed together 53 chemicals nominated for addition to the Proposition 65 list. Ten of the listed chemicals were justified solely by a reference (number 7) to USEPA's External Review Draft Version of 'Methodology for evaluating Potential Carcinogenicity…' [1986]. This document contained an appendices listing a number of chemicals with their carcinogenicity ranking based on the proposed EPA methodology. There was no listing in the document for 2,4-diaminotoluene but did include one listing for diaminotoluene (mixed) with a potency factor of 2.94.

In the same month that the methodology document was finalized (June 1988), EPA released a report written by Syracuse entitled 'Evaluation of the Potential Carcinogenicity of Diaminotoluene (Mixed) (95-80-7).' Note that the cited CAS number in the title of this document is assigned specifically to 2,4-diaminotoluene. This document reviewed the toxicity data for only one isomer of diaminotoluene: 2,4-diaminotoluene. No other data was considered. The Weight of Evidence Assessment contained a single conclusion as follows:

> "Thus, using the EPA guidelines for Carcinogen Risk Assessment (USEPA 1986a) for evaluating the overall weight of evidence to humans, 2,4-diaminotoluene is most appropriately classified as a B2 chemical."

From this sole conclusion presented in the document, the final sentence in the final section of the narrative (Hazard Ranking) contained the following statement:

Amec Foster Wheeler Environment & Infrastructure, Inc.
121 Innovation Drive, Suite 200
Irvine, CA
USA 92617-3094
Tel (949) 642-0245
Fax (949) 642-4474
www.amecfw.com

> "This hazard ranking, which is based on the isomer 2,4-diaminotoluene, is applicable to all isomers of diaminotoluene."

Generalization of Diaminotoluene (Mixed)

The designation of diaminotoluene (mixed) was an invention of the US EPA. I surmise from personal experience information presented below that it may have been the result of analytical limitations at the time. This is supported by the evidence that the listing for diaminotoluene in the 'Methodology for evaluating Potential Carcinogenicity…' was only for the "Mixed" even though 2,4-diaminotoluene was listed in the 'Report to Congress on Carcinogens' and therefore known to EPA to be a carcinogen. In effect, in the inclusion of "Mixed" in the CECLA 102 reporting prioritization was not an adjunct to 2,4-diaminotolunene (as it is on the Proposition 65 list), but rather a substitution.

Prior to the wide-spread use of capillary gas chromatography coupled with mass spectrometry and high resolution HPLC, it was very difficult to analytically distinguish aromatic amine isomers. Their relatively high hydrophilicity and high boiling points tended to produce very broad signal peaks that could not be resolved. When dealing with unknown waste streams that may contain a carcinogen such as 2,4-diaminotoluene, but cannot be identified beyond being a diamine toluene, the prudent approach would be to control all such as if it were 2,4-diamino toluene. The recommended chromatographic method used in the mid-1980's (Method 8250) would not have been able to identify isomers without extraneous derivitization (Exhibit B). Even today, the most current GC/MS analytical method (EPA Method 8270) is only validated for 2,4-diaminotoluene and none of the other isomers (Exhibit C). That said, modern advances in analytical methods permit for the identification of isomers through secondary fragment analysis.

To further support that the diaminotoluene (mixed) generalization was practical, and not toxicological, I point out that EPA itself no longer uses the designation of diaminotoluene (mixed) in current regulations. Diaminotoluene (aka toluenediamine) is now identified in 40CFR 302.4 as by the CASRNs 95-80-7 (specific to 2,4-diaminoitoluene), 496–72–0 (specific to 3,4-diaminoitoluene), 823–40–5 (specific to 2,6-diaminoitoluene), and 25376–45–8 (specific to meta-DAT consisting of 2,4- and 2,6-diaminotoluene) (Exhibit D). There is currently no listing, explicitly or by inference, for the 2,3-, 3,5- or 2,5- isomers of diaminotoluene under CERCLA. This is further indicative of EPA's use of the generalized diaminotoluene to represent the hazard specifically and solely attributed to 2,4-diaminotoluene.

In conclusion, the pragmatic use of the generalized diaminotoluene (mixed) applied in the 1980's is no longer necessary nor used by the EPA. Furthermore, in the mass listing of carcinogens by the California Health and Welfare Agency in 1989, they failed to take into account the justification for the mixed identifier was based solely on the properties of 2,4-diaminotoluene that was already listed at the time. Finally, while EPA has stopped using the diaminotoluene (mixed) identifier, the State of California has not. Therefore, the State of California can no longer rely on the authority of the USEPA for this specific group designation and strongly urged that the committee follow suite and evaluate the various isomers of diaminotoluene on their own merit.

II. There Is No Credible Evidence to Support the Listing of 2,5 diaminotoluene as a Proposition 65 Carcinogen.

Background

The There is no evidence that 2,5-diaminotoluene was considered , or listed as a chemical known to the State of California to cause cancer by its inclusion in the generalized "Diaminotoluene (Mixed)". Diaminotoluene (mixed) was first proposed for listing in the Health and Welfare Agency's 'Notice of Intent to List Chemicals' (November 1, 1989). This three page document listed together 53 chemicals; ten of which were justified by a single reference: USEPA's External Review Draft Version of: Methodology for evaluating Potential Carcinogenicity. Inclusion on the list was explicitly stated to be justified as follows:

> "The panel has identified the U.S. Environmental Protection Agency (EPA), the International Agency for Research on Cancer (IARC), and the National Toxicology program as authoritative bodies."

The following sections describe the position of the recognized authoritative bodies as well as other toxicological authorities on the carcinogenicity of 2,5-diaminotoluene

EPA and 2,5-diaminotoluene

The EPA has never undertaken a determination of the carcinogenic hazard of 2,5-diaminotoluene. 2,5-diaminotoluene is currently not listed by EPA under any hazardous reporting requirements including TSCA, CERCLA hazardous substance, the Clean Water Act, the Clean Water Act (307(a) and 112), or the Resource Conservation and Recovery Act (RCRA). Since 1) EPA based their evaluation of diaminotoluene (mixed) solely based on the properties of 2,4-diaminotolurene with no review of the other isomers; 2) that the past use of the generalized designation was a substitute for 2,4-diaminotoluene; and 3) EPA no longer uses the designation of diaminotoluene (mixed) and recognizes the generalized toluenediamine as being synonymous only with the 2,4-, 2,6- and 3,4- isomers of toluenediamine (40CFR 302.4), the State of California, who has separately listed both 2,4-diaminotoluene and diaminotoluene (mixed), cannot rely on the authority of the EPA for the inclusion of 2,5-diaminotoluene as a carcinogen under Proposition 65.

IARC and 2,5-diaminotoluene

IARC specifically lists 2,5-diaminotoluene as a Group 3 chemical defined as "Not classifiable as to its carcinogenicity to humans". Therefore, IARC as an authority does not support the inclusion of 2,5-diaminotoluene as a carcinogen. Therefore the State of California cannot rely on the authority of IARC for the inclusion of 2,5-diaminotoluene as a carcinogen under Proposition 65.

NTP and 2,5-diaminotoluene

The NTP is mandated to provide to Congress an annual report on carcinogens. The last report was provided in October, 2014 (Exhibit). In this report 2,5-diaminotoluene was not listed as either a known human carcinogen, or a chemical suspected of being a human carcinogen.

In 1978, the National Cancer Institute (NCI), forerunner to the NTP responsible for cancer testing under the US Department of Health, undertook a 2-year study into the carcinogenicity of

2,5-diaminotoluene. Their conclusive findings were no evidence of carcinogenicity resulting from the oral administration of 2,5-diaminotoluene. Excerpts from the study report are provided in the following to expand on the portions excerpted by the Office of Environmental Health Hazard Assessment in their submission (emphasis added):

> "In male rats, the Fisher exact test indicated a significant incidence of interstitial-cell tumors of the testis when the high dose group was compared to the high dose control (P = 0.014). The comparison of low dose to low dose control had a probability level of P = 0.039, which was not significant under the Bonferroni criterion. These results were discounted, however, due to the well-known high variation in the spontaneous incidence of this tumor (Cockrell and Garner, 1976)…"No other test for any site in either male or female rats was significant under the Bonferroni criterion. Based upon these statistical results there was no convincing evidence of the carcinogenicity of 2,5-toluenediamine sulfate in rats." [Pg 25]
>
> "However, it should be noted that high dose control mice were housed in a separate room from dosed mice and received in separate shipments from dosed mice. Because of these factors, this increased incidence does not provide sufficient evidence of a compound-related effect. No significant increase in tumor incidence was observed among dosed male mice." [Pg 44]
>
> "Under the conditions of this bioassay, sufficient evidence was not provided to conclusively demonstrate the carcinogenicity of 2,5-toluenediamine sulfate in either Fischer 344 rats or B6C3F1 mice." [Pg 45]

While the Clearinghouse did recommend retesting, the NCI/NTP has not felt it necessary in the intervening 37 years. Therefore the State of California cannot rely on the authority of the NTP for the inclusion of 2,5-diaminotoluene as a carcinogen under Proposition 65.

The EU Scientific Committee on Consumer Safety and 2,5-diaminotoluene

The EU Scientific Committee on Consumer Safety (SCCS) examined all potential modes of toxicity specific for 2,5-diamino toluene as used in hair dye products. They examined both the above-mentioned NTP study as well as a study by *** that showed no carcinogenicity with the application of hair dye constituents with hydrogen peroxide. Their conclusion was no basis to identify 2,5-diaminotouene as a carcinogen. With regards to mutagenicity, they concluded that 2,5-diaminotoluene was not a mutagen *in vivo*. Verbatim (emphasis added):

> "Overall, the genotoxicity of toluene-2,5-diamine sulfate is sufficiently investigated for the three types of mutation: gene mutation, structural chromosome mutation and aneuploidy. Toluene-2,5-diamine sulfate is genotoxic in vitro inducing gene mutations in bacteria but not in mammalian cells, chromosomal aberrations, and unscheduled DNA-repair synthesis in primary hepatocytes in vitro. The positive in vitro results could not be confirmed in in vivo experiments covering the same endpoints. Toluene-2,5-diamine sulfate was negative in two mouse bone marrow micronucleus tests, following oral and i.p. administration and in an in vivo UDS test following oral administration. The results of the in vivo Comet assay (oral gavage) in mice and rats in all organs evaluated except for the rat stomach [ed. Note that no stomach tumors were found in the 2-year NTP study in the same species.] may confirm the lack of genotoxic activity of toluene-2,5-diamine sulfate in vivo. However, issues with regard to interpretation and validity of the in vivo Comet assay in general and of the positive result in the rat stomach in particular remain. In addition, toluene-2,5-diamine sulfate was negative in two dominant lethal assays

> indicating lack of genotoxic activity in germ cells in vivo. The negative results in two in vivo mouse spot tests following dermal and ip administration may confirm the lack of potential of toluene-2,5-diamine sulfate to induce gene mutations. As the clastogenic effects found in vitro were not confirmed in in vivo tests, toluene-2,5-diamine sulfate can be considered to have no in vivo genotoxic potential and additional tests are unnecessary."

As a result of this examination into the toxic properties of 2,4-diaminotoluene, the chemical is not recognized as a categorical carcinogen, mutagen, reproductive toxicant (CMR), Is not considered for authorization, and is permitted for use in hair colorings in the EU.

American College of Toxicology and 2,5-diaminotoluene

In 1992, the American College of Toxicology undertook and published an extensive report on the safety of 2,5-diaminotoluene (Exhibit E). After examining all the information to date, they found that while there may be concern for sensitization to professionals exposed regularly, "There is inadequate evidence to regard 2,5-TD [ed. toluenediamine] as carcinogenic to animals." Their final conclusion was as follows:

> "On the basis of the animal and clinical data presented in this report, the CIR Expert Panel concludes that Toluene-2,5-Diamine and Toluene-2,5-Diamine Sulfate are safe as cosmetic ingredients in the present practices of use. Although Toluene-3,4-Diamine is not reported to be presently in use, the available data are supportive of its safety at the same use levels as Toluene-2,5-Diamine and its sulfate."

III. Conclusion

The CIC should delist the archaic generalization of diaminotoluene (mixed). If CIC decides not to remove diaminotoluene (mixed) from the Proposition 65 list of carcinogens, CIC should clarify the listing by including the CIC number (95-80-7) that described the chemical in the 1989 listing documents on which the original listing was based. Or, if the CIC decides to revise (or remove and replace) the diaminotoluene (mixed) listing as a result of the current review, the CIC may should clearly define what it is, and include the relevant CIC number.

The CIC should consider listing of each diaminotoluene isomer on its individual merit.

The CIC should not list 2,5-diaminotoluene as a carcinogen, because there is insufficient evidence to support such listing. The CIC should take into account that EPA, IARC, NTP, EU SCCS, and the American College of Toxicology were unable to find sufficient evidence of its characterization as a carcinogen.

Thank-you for your attention to these issues

Chris Mackay, MSc, PhD, CPM

Sr. Associate Toxicologist
AMEC Foster Wheeler
Direct Tel.: (425) 922-7435
E-mail: chris.mackay@amecfw.com

Exhibit A

14-093

OFFICE of ENVIRONMENTAL HEALTH HAZARD ASSESSMENT

1001 I Street
Post Office Box 4010, MS 23B (#58c)
Sacramento, CA 95812-4010
Attn: Monet Vela
Fax (916) 323-2610
monet.vela@oehha.ca.gov

California Public Records Act Request

Name of Individual and/or Company Requesting Records: **AMEC Environment and Infrastructure**			**Date: 9/30/14**
Address: 121 Innovation Dr			
City: Irvine		**State: CA**	**Zip Code: 92617**
Telephone: (949) 764-1584	**Fax:** (949) 642-4474	**E-Mail Address:** **chris.mackay@amec.com**	**Contact Person:** **Chris Mackay**

Please complete one copy of this form for each Public Records Act request. Mail, fax, or e-mail the form. You will be advised as to whether or not we have records subject to release within 10 calendar days of receipt of the request. There will be a $0.25 per page charge, and you will be notified of the cost in advance of copies being made. There will be additional charges for copies of information in other forms (i.e., cassette tapes, VHS, etc.).

REQUEST FOR RECORDS PERTAINING TO:

Name: Facility Name, Location, Project, Individual, etc. **All documents required by regulation related to the listing of diaminotoluene (mixed) on the Proposition 65 list (1/1/1990)**		
Address:		
City:	**State:**	**Zip Code:**

Specify Types of Information Requested:

Notice of intent to list diaminotoluene (mixed) as a known carcinogen including 'Background on listing via the authoritative bodies mechanism', 'Formal identification and sufficiency of evidence', 'OEHHA's determination', and any associated technical documents related to the notice of intent.

HEALTH AND WELFARE AGENCY
SAFE DRINKING WATER AND TOXIC ENFORCEMENT ACT OF 1986
(PROPOSITION 65)

NOTICE OF INTENT TO LIST CHEMICALS

November 1, 1989

Under the Safe Drinking Water and Toxic Enforcement Act of 1986 [Health and Safety Code Section 25249.8(b)], one of the ways a chemical is known to the State to cause cancer or reproductive toxicity is if a body considered to be authoritative by the Scientific Advisory Panel has formally identified it as causing cancer or reproductive toxicity. The Health and Welfare Agency has adopted a regulation to guide this part of the implementation of the Act (Title 22, California Code of Regulations, Section 12306).

The Panel has identified the U.S. Environmental Protection Agency (EPA), the International Agency for Research on Cancer (IARC), and the National Toxicology Program (NTP) as authoritative bodies.

Pursuant to Section 12306, the Agency intends to designate the following chemicals for listing as known to the State to cause cancer. Anyone objecting to the addition of a chemical to the list of chemicals known to the State to cause cancer on the basis that there is no substantial evidence that the criteria identified in 22 CCR Section 12306(d) have been satisfied should provide comments, along with supporting documentation, to the Health and Welfare Agency no later than December 1, 1989. Comments should be directed to:

Dr. Steven A. Book
California Health and Welfare Agency
1600 Ninth Street, Room 460
Sacramento, CA 95814

Chemical name	Reference
A-alpha-C(2-amino-9H-pyrido[2,3,-b]indole)	8
Acetamide	8
Acetamide, N-fluoren-2-yl	7
Acifluorfen	4,6
Acrylamide	1,2,8
Allyl chloride	3
Amdro	6
p-Aminoazobenzene	8
Aniline	1
Aziridine	7
Azobenzene	1
Benzyl chloride	7
Betel quid with tobacco	8
Bitumens, extracts of steam-refined and air refined	8
Bleomycins	8
Bracken fern	8
Bromodichloromethane	5
Butylated hydroxyanisole	8

Captan	6
Carbon-black extracts	8
Chlorodibromomethane	5
p-Chloro-o-toluidine	7,8
Chrysene	7
Daminozide	6
Diaminotoluene (mixed)	7
1,4-Dichloro-2-butene	5
1,1-Dichloroethane	5
1,2-Dichloropropane	4,9
Dicofol	6
7,12-Dimethylbenz(a)anthracene	7
Ethyl-4,4'-dichlorobenzilate	7
Furazolidone	5
Furium	5
Furmecyclox	1
Glu-P-1 (2-Amino-6-methyldipyrido[1,2-a:3',2'-d]imidazole)	8
Glu-P-2 (2-Aminodipyrido[1,2-a:3',2'-d]indole)	8
Griseolfulvin	8
Mancozeb	6
Maneb	6
Me-A-alpha-C (2-Amino-3-methyl-9H-pyrido[2,3-b]indole)	8
Medroxyprogesterone acetate	8
3-Methylcholanthrene	7
N-Methyl-N-nitrosourethane	8
Metiram	6
Nitrofurazone	5
Pentachlorophenol	10,11
Phenobarbital	8
Potassium bromate	8
1,2-Propyleneimine	7
Sodium o-phenylphenate	8
p,α,α,α-Tetrachlorotoluene	5
p-Toluidine	7
Zineb	6

<u>References</u>

1. U.S. Environmental Protection Agency, 1989, Integrated Risk Information System (IRIS), database search 6/19/89.

2. U.S. Environmental Protection Agency, Office of Drinking Water, Federal Register 50:46982-46984, November 13, 1985, and Federal Register 54:22079-22080, May 22, 1989.

3. U.S. Environmental Protection Agency, Carcinogen Assessment Group, 1987. Health Assessment Document for Beryllium, EPA/600/8-84/026F, Table 7-18, pg 7-82 - 7-85.

4. U.S. Environmental Protection Agency, 1989, Health Advisory Summaries, Office of Drinking Water.

5. U.S. Environmental Protection Agency, Health Effects Assessment Summary Tables, First Quarter, FY 1989 (March, 1989).

6. U.S. Environmental Protection Agency, Federal Register 53:41118-41123, October 19, 1988.

7. U.S. Environmental Protection Agency, 1986, External Review Draft Version of: Methodology for Evaluating Potential Carcinogenicity in Support of Reportable Quantity Adjustments Pursuant to CERCLA Section 102, Office of Health and Environmental Assessment, OHEA-C-073.

8. International Agency for Research on Cancer, Overall Evaluations of Carcinogenicity: An Updating of IARC Monographs Volumes 1 to 42, Supplement 7, 1987.

9. U.S. Environmental Protection Agency, Office of Drinking Water, Federal Register 54:22084-22085, May 22, 1989.

10. U.S. Environmental Protection Agency, Office of Drinking Water, Federal Register 54:22089-22090, May 22, 1989.

11. National Toxicology Program, NTP Technical Report on the Toxicology and Carcinogenesis Studies of Two Pentachlorophenol Technical-Grade Mixtures in B6C3F1 Mice, NTP TR 349, NIH Publication No. 89-2804, March, 1989.

Exhibit B

Other columns were prepared to verify the above data. One column filled with a refined diatomaceous earth support, 80/100-mesh, acid-washed, DMCS-treated, and coated with 1.43% DC-710, gave identical results to column 1. All other columns, some 35 in number, were filled with surface-textured glass beads. The DC-710 loading on these columns ranged from 0.008 to 1.52%. No decomposition of endrin was detected on any of these 35 glass bead columns.

A mixture of six pesticides was prepared for a further comparison of diatomaceous earth and surface-textured glass bead supports. Lindane, heptachlor, aldrin, dieldrin, endrin, and DDT were dissolved in hexane, so the final solution contained 1 μg per μl of each pesticide. The appearance of endrin decomposition peaks just before the DDT response, and the reduction of the endrin response itself, confirm the decomposition of this pesticide on diatomaceous earth support. Again, the surface-textured glass beads allowed a single, symmetrical response to endrin. This support material is ideally suited for the separation and analysis of biomedical, pharmaceutical, and lower-molecular-weight polymer compounds, because surface-textured glass beads permit shorter retention times and lower operating temperatures than conventional supports.

RECEIVED for review March 4, 1968. Accepted May 27, 1968.

Direct Gas Chromatographic Analysis of Isomeric Diaminotoluenes

Friso Willeboordse, Quentin Quick, and E. T. Bishop

Research and Development Department, Union Carbide Corporation, South Charleston, W. Va. 25303

A direct gas chromatographic method has been developed for the determination of isomer content in diaminotoluenes. Mixtures of 2,3-, 3,4-, 2,4-, 2,5-, and 2,6-diaminotoluenes can be readily and accurately determined. The method utilizes a mixed partitioning agent of Carbowax 20M and Siponate DS-10 on base-loaded Chromosorb G, followed by Siponate DS-10 on the same solid support. The present method compares very favorably with the NMR method and the derivatives' GC method which are generally employed.

THE diaminotoluenes (TDAs, tolylene diamines) are important as intermediates in the manufacture of tolylene diisocyanate (TDI) which is widely used in the preparation of polyurethane foam and elastomers. Commercial TDA consists of a mixture of the 2,4- and 2,6-isomers (about 79% and 19%, respectively) together with smaller amounts of the 2,3-, 3,4- (these are named the two *ortho*-isomers), and the 2,5-isomer (each about 0.5% by weight). A knowledge of the isomer ratio of a TDA mixture allows one to predict the ratio of isomers in the TDI.

A previous paper by Brydia and Willeboordse (*1*) discussed the use of trifluoroacetic anhydride derivatives to effect the quantitative gas chromatographic determination of TDA isomers. Until recently, this was the only satisfactory single method available to us for a complete analysis of TDA mixtures. However, the use of the derivatives' determination involves a conversion operation and the choice of one of two procedures: one which is fairly rapid but does not resolve the 2,4- and 2,5- isomers, the second one resolving all the isomers but consuming more time because of an extra evaporation step. In addition, the 2,5-isomer (small amount) is exhibited in the tail-end of the 2,4-isomer (major component) which constitutes an inherently undesirable facet of this method. An NMR method for the analysis of mixtures of TDA has been described by Mathias (*2*). The NMR method has poor accuracy for the minor isomers and does not lend itself readily to control applications.

The approach in the present study was to effect a complete *direct* gas chromatographic analysis of the five TDA isomers in a more simple manner than either of the derivatives' procedures or the NMR method.

EXPERIMENTAL

Apparatus. An F and M Model 500 gas chromatograph equipped with thermal conductivity detector was used. The detector was equipped with W-2 filaments. Detailed experimental parameters are summarized in Table I.

Chemicals. The 2,4-, 2,6-, and 3,4-diaminotoluenes are available from commercial sources. The 2,5-isomer is available as the dihydrochloride which was converted to the free diamine by reaction with an equivalent amount of potassium hydroxide and extraction with ether. The sample of crude *ortho*-TDA is a product of the Union Carbide Corp. Siponate DS-10 (dodecyl benzene sodium sulfonate) was obtained from Alcolac Chemical Corp., Carbowax 20M is a product of the Union Carbide Corp., and Chromosorb G, NAW (non-acid washed), 60/80 mesh, was obtained from the Johns-Manville Corp.

Preparation of Base-Loaded Support. To prepare a 1% base-loaded solid support, 1 gram of KOH was dissolved in 175 ml of methanol and 99 grams of Chromosorb G were dispersed in this solution. The slurry was mixed well, and the methanol was evaporated on a rotating evaporator (Rinco) until the support appeared dry.

Preparation of Columns. FOURTEEN-FOOT COLUMN. Four grams of Carbowax 20M and 2 grams of DS-10 were dissolved in a minimum quantity of methylene chloride, and then added to the solid support (94 grams). The methylene chloride was evaporated by stirring the slurry periodically under a stream of dry nitrogen until the loaded support appeared dry. This material was then transferred to a 14-foot, 0.25-inch-o.d. aluminum column with gentle vibration to assure a uniform packing. Exposure to the air should be minimized during the loading operation.

SIX-FOOT COLUMN. Five grams of DS-10 were dissolved in methylene chloride, added to the base-loaded support (95 grams), and then processed in much the same way as described for the 14-foot column.

The two columns were connected with a union. The DS-10 column follows the mixed column. No glass wool

(1) L. E. Brydia and F. Willeboordse, ANAL. CHEM., **40**, 110 (1968).
(2) A. Mathias, *ibid.*, **38**, 1931 (1966).

Table I. Instrument Parameters and Relative Retention Times of TDA Isomers

Instrument parameters

Instrument	F and M Model 500 Gas Chromatograph
Bridge current	130 mA
Injection port temperature	280 °C
Detector temperature	300 °C
Oven temperature	215 °C (isothermal)
Helium flow	100 ml/minute
Sample size	10 μl of sample solution
Column	Inlet side: 14-ft by 0.25-inch-o.d. aluminum tubing packed with a mixture of 2.0% Siponate DS-10 and 4.0% Carbowax 20M on Chromosorb G, NAW, 60/80 mesh, 1% KOH-loaded. Exit side: 6-ft by 0.25-inch o.d. aluminum tubing packed with 5.0% Siponate DS-10 on Chromosorb G, NAW, 60/80 mesh, 1% KOH-loaded.

Relative retention times

Isomer	B.P. (°C)	Rel. retention
2,3	255	0.707
3,4	265 sub	0.746
2,5	273.4	0.820
2,6	289°[a]	1.00
2,4	292°	1.12

[a] Boiling point was obtained by extrapolation from vapor pressure-temperature data and Antoine constants. Other boiling point data were obtained from: I. Heilbron, "Dictionary of Organic Compounds," 4th ed., Oxford University Press, New York, N. Y., 1965, Vol. 2, pp 880–1.

Table II. Response Factors of TDA Isomers

Isomer	Factor (wt/area) in composition range	
2,3-TDA[a]	1.18	(0–30%); 1.17 (30–60%)
3,4-TDA	1.18	(0–30%); 1.17 (30–60%)
2,5-TDA	1.16	(0–30%); Other range not investigated
2,6-TDA	1.00	(entire composition range)
2,4-TDA	0.99	(entire composition range)

[a] Pure material not available for determination of response factor. Response factor assumed to be the same as that for the 3,4-isomer.

Table III. Weight Per Cent Analyses of TDA Isomers by Gas Chromatography

	Per cent isomers			
Synthetic No. 1	3,4	2,5	2,6	2,4
Added	1.75	1.83	19.98	76.44
Determined[a]	1.73	1.81	19.99	76.47
Standard deviation	0.02	0.03	0.03	0.04
Relative standard, deviation	1.4%	1.9%	0.2%	0.1%
Synthetic No. 2				
Added	6.17	9.71	17.13	66.99
Determined[a]	6.35	9.74	16.98	66.93
Standard deviation	0.12	0.08	0.19	0.16
Relative standard deviation	1.9%	0.8%	1.1%	0.3%

[a] Average of six determinations, response factors taken into account.

plugs were used. Care was taken to fill the union as completely as possible with packing material to minimize dead space. The column was conditioned in the gas chromatograph for 8 to 10 hours at 235 °C with a helium flow of 100 ml/minute prior to use. A vent was used over the exit port because of the slight, initial bleeding of the liquid phases. Stored columns were capped to protect the base-loaded materials from contact with air.

Procedure. The TDA mixed-isomer sample (0.4 gram), finely ground, was dissolved in 2 ml of 10:1 (v/v) pyridine–methanol solution in a 15-ml-capacity vial. Samples were introduced into the gas chromatograph by means of a 10-μl hypodermic syringe. The dissolved sample was chromatographed on the same day as it was prepared to minimize the possibility of amine oxidation, preferential precipitation, etc.

Synthetic samples were made using known weight concentrations of pure 3,4-, 2,5-, 2,6-, and 2,4-isomers; the synthetic samples were analyzed with two identical two-column systems, prepared in the way described earlier but at different times.

Response Factors. The response factors were obtained from the analysis data of the synthetic samples described above. In the analysis of plant samples and other unknown mixtures, the peak areas were measured, and the weight per cents were calculated using the appropriate response factors.

RESULTS AND DISCUSSION

Initial attempts to develop a direct gas chromatographic method, as opposed to the derivatives' approach (*1*), using Carbowax 20M in varying concentrations on a host of solid supports proved unsuccessful: the two major isomers, 2,6- and 2,4-TDA could not be resolved. In addition, the primary objective of our study centered on a specific order of retention times, namely first the minor components (2,3-, 2,5-, and 3,4-TDA), then the 2,6-component, and finally the 2,4-component because of their respective quantities in typical plant samples. Usage of a 3.0% Alcolac Siponate DS-10 on Haloport F column which provides a good separation of isomeric naphthylamines (*3*), resolves the *ortho*-isomers, and also the 2,6-and the 2,4-isomer in the desired sequence. However, this column does not separate the 2,5- and 2,6-isomers, nor does it separate the 2,4- from the 3,4-isomer.

A systematic effort to arrive at a suitable composition of mixed liquid phases involving the approach described by Hildebrand and Reilley (*4*) was not successful. However, it was evident that a Chromosorb G column containing about 26% of Siponate DS-10 and 74% of Carbowax 20M (Figure 1) would be the best choice for a gas chromatographic separation. Unfortunately, the peaks of 2,3- and 3,4-TDA were incompletely resolved, and so were the peaks of 2,6- and 2,4-TDA. Yet, this mixed liquid phase composition (*a*) constituted the best separation. In order to improve on the separation of the *ortho*-isomers and on that of the major components (2,6- and 2,4-TDA) an additional DS-10 containing column was placed in series, the length and liquid phase con-

(3) Q. Quick, R. F. Layton, H. R. Harless, and O. R. Haynes, *J. Gas Chromatog.*, **6**, 46 (1968).
(4) G. P. Hildebrand and C. N. Reilley, ANAL. CHEM., **36**, 47 (1964).

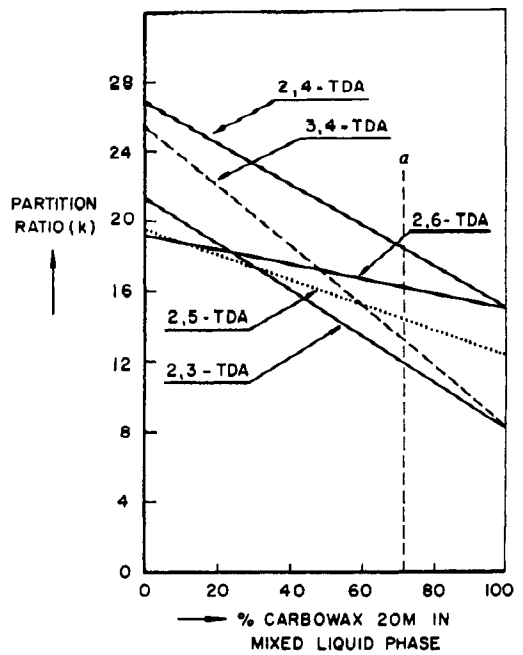


Figure 1. Dependence of the partition ratios of the TDA isomers on the composition of the liquid phase

Mixed liquid phase: Carbowax 20M and Siponate DS-10 of variable fractional combination
TDA = Tolylene diamine
***a* = Best composition conditions for separation**

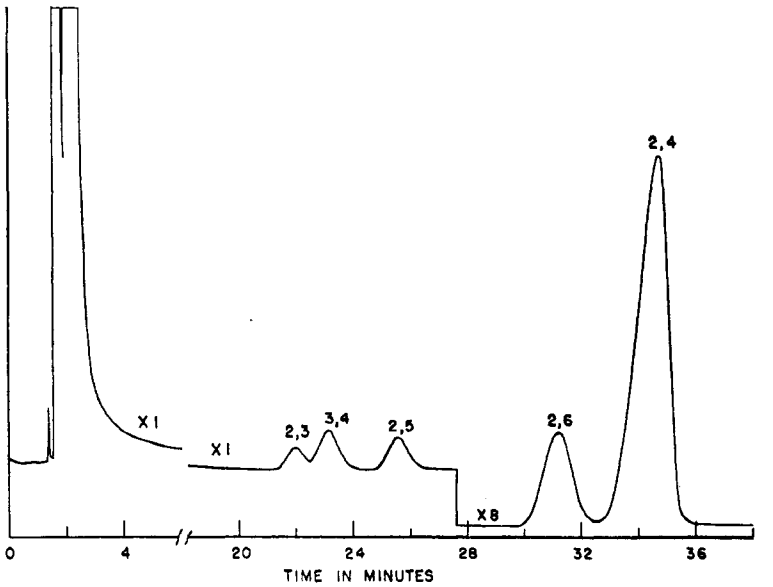


Figure 2. Direct gas chromatographic separation of the five isomers of TDA

centration of which had to be established by trial and error. Thus, a combination of two columns, one containing a mixture of DS-10 and Carbowax 20M, and the other one containing merely Siponate DS-10 (Table I), proved to be very successful in an overall separation.

One of the reasons for treating the Chromosorb column with KOH was to minimize the adsorptive losses of the amine isomers (*5*). However, the most beneficial reason for using a base-loaded column is the apparent enhancement of the number of theoretical plates. After base-treatment, the resolution R (*6*) between two close peaks almost doubled—*e.g.*, $R_{2,3/3,4}$ increased from 1.7 to 3.0, and $R_{2,6/2,4}$ from 1.9 to 3.6.

(5) R. E. Nygren and G. R. Umbreit, Pittsburgh Conference on Analytical Chemistry and Applied Spectroscopy, Pittsburgh, Pa., March 1967.
(6) A. B. Littlewood, "Gas Chromatography: Principles, Techniques, and Applications," Academic Press, New York, 1962, p 138.

No significant variation in the improvement of R was observed by increasing the degree of base-loading from 1 to 5% by weight. Because of this, the 1% KOH level in the column was maintained. A further reason for minimizing the KOH content in the column was to avoid any possibility of decomposition of liquid phase materials by base, and to create optimum conditions for reproducibility in the determination of the isomers.

The resolution of the five TDA isomers under the column conditions cited is illustrated in Figure 2. Peak symmetry of all the isomers was very good. Relative retentions are noted in Table I with the respective boiling point data (obtained experimentally and by extrapolation). It is remarkable that the sequence in retention times of the five isomers is identical to the sequence in boiling points.

Although response factors of the amine isomers were expected to be identical, this was not the case. These factors are shown in Table II in the relevant composition areas where the values were found to be valid with analytically insignificant deviations.

Typical accuracy and precision data provided by the direct analysis technique are presented in Table III for two synthetic samples. These data were obtained from six separate determinations of each sample. Isomer contents were calculated taking the respective response factors into account.

Table IV. Gas Chromatographic Analysis of Commercial TDA

	Isomer content, per cent by weight				
	2,3	3,4	2,5	2,6	2,4
Average value	0.34	0.78	0.67	18.72	79.49
Standard deviation	0.01	0.07	0.04	0.11	0.17
Relative standard deviation	3%	9%	6%	0.6%	0.2%
Derivatives' method value[a]	0.39 ± 0.03	0.70 ± 0.08	0.61 ± 0.08	18.59 ± 0.38	79.70 ± 0.41
NMR method value[b]	Nil	0.9 ± 0.4	Nil	21.3 ± 1.3	77.8 ± 2.1

[a] See Ref. (*1*), Procedure B
[b] See Ref. (*2*), $CHCl_3$ was used as solvent

Table V. Gas Chromatographic Analysis of a Crude *ortho*-TDA Sample

	Isomer content, per cent by weight					
	Unknowns[a]	2,3	3,4	2,5	2,6	2,4
Average value	0.92	35.68	57.73	0.23	1.65	3.79
Standard deviation	0.01	0.24	0.23	0.03	0.03	0.04
Relative standard deviation	1%	0.7%	0.4%	13%	2%	1%

[a] Three unknowns elute with relative retentions (with respect to 2,6-TDA) of 0.161, 0.186, and 0.196, which have tentatively been identified as *m*-toluidine, *o*-toluidine, and *p*-toluidine, respectively.

Agreement between the weighed amounts and determined amounts of isomers are within the limits of experimental error.

Table IV provides the gas chromatographic analysis results on a typical commercial TDA sample. The precision of the method is very satisfactory. The accuracy of the direct gas chromatographic procedure can only be estimated by comparing the results with the values obtained by other methods. Two methods, the derivatives' procedure B (*1*) and the NMR method (*2*), were used for the comparison. The comparison with the derivatives' method delineates that the results of the direct gas chromatographic procedure are, in all likelihood, the more accurate ones. The precision of the direct method also proves to be superior by virtue of the fact that the 2,5-isomer elutes before the appearance of the two major peaks of 2,6- and 2,4-TDA. The 2,5-isomer elutes at the tail-end of the 2,4-isomer in the derivatives' method (*1*).

A comparison of the present method with Mathias' NMR method (*2*) reveals that the direct gas chromatographic procedure is more sensitive and precise.

Table V presents typical results of the analysis of crude, plant-grade *ortho*-TDA which contains predominantly the two *ortho* products, 2,3- and 3,4-TDA. The standard deviation values of 2,3- and 3,4-isomer contents are higher than those obtained for 2,6- and 2,4-TDA in a commercial TDA sample, presumably because of the less efficient resolution of the *ortho*-isomer peaks with the present procedure.

ACKNOWLEDGMENT

The authors express their appreciation to Miss M. Stephens and W. S. Tamplin, both of this laboratory, for the vapor pressure-temperature experiments and Antoine constants' determinations on selected TDA isomers.

RECEIVED for review March 19, 1968. Accepted May 15, 1968. Presented at the Pittsburgh Conference on Analytical Chemistry and Applied Spectroscopy, Cleveland, Ohio, March 1968.

Determination of Double Bond Position in Monounsaturated Fatty Acid Esters by Mass Spectrometry of Their Trimethylsilyloxy Derivatives

Pompeo Capella and C. M. Zorzut

Istituto di Industrie Agrarie e di Chimica Agraria, University of Bologna, 40126 Bologna, Italy

Trimethylsilyloxy (TMSO) derivatives of monounsaturated fatty esters were used for the location of double bond position by the combination gas chromatography-mass spectrometry, which affords the possibility of studying complex mixtures of these compounds differing for both the position of the double bond and the chain length, without previous separation steps. The principal fragmentation modes have been studied with the aid of deuterium and ^{18}O labeled analogs. The main fragments in the mass spectra of TMSO derivatives originate from simple cleavage of the carbon-carbon bond between the two TMSO groups, and clearly indicate the position of the original double bond. The present work supplies, however, further evidence of the tendency of the trimethylsilyl (TMS) groups to undergo skeletal rearrangements. In particular, transfer of a TMS group in a large membered transition state to the charge bearing carbomethoxyl group and final elimination of CH_3OTMS—which is analogous to elimination of methanol in the hydroxy ester mass spectra—is postulated, on the basis of the experimental evidence, to explain the formation of a series of fragment ions.

The knowledge of TMS derivative fragmentation modes is therefore necessary when structural deductions have to be derived from their mass spectra.

THE POSITION OF double bonds in unsaturated fatty acids is usually determined by oxidative methods, recently reviewed by Stein (*1*). In the past few years ozonolysis, followed by GLC analysis of the fragments, has been widely used also when very small amounts of material were available (*2–5*). Very recently a micro ozonization method, requiring 1 to 5 μg of sample, has been developed (*6*).

In these methods, the positions of double bonds are deduced from the chain length of the fragments. Some difficulties may arise, however, when dealing with complex mixtures of compounds differing for both the position of double bonds and the chain length. Tedious separation and purification steps, which can be extremely difficult when the amount of material available is very small, may therefore be necessary.

(1) A. Stein, *J. Amer. Oil Chem. Soc.*, **42**, 326 (1965).
(2) O. S. Privett, M. L. Blank and O. Romanus, *J. Lipid Res.*, **4**, 260 (1963).
(3) V. L. Davison and H. J. Dutton, ANAL. CHEM., **38**, 1302 (1966).
(4) E. C. Nickell and O. S. Privett, *Lipids*, **1**, 166 (1966).
(5) O. S. Privett and E. C. Nickell, *J. Amer. Oil Chem. Soc.*, **43**, 393 (1966).
(6) M. Beroza and B. Bierl, ANAL. CHEM., **39**, 1131 (1967).

Exhibit C

METHOD 8270 ANALYSIS OF SEMIVOLATILE ORGANIC COMPOUNDS BY COMBINED GAS CHROMATOGRAPHY/ MASS SPECTROMETRY (GC/MS)

REV 7

Copy No. _____

Revised By: _____ Date: 3-16-2011

Technical Review: _____ Date: 3/17/2011

QA Review: _____ Date: 3/18/11

Director: _____ Date: 3-17-2011

1.0 SCOPE

Method 8270 is a combined Gas Chromatography/Mass Spectrometry (GC/MS) method used for the identification and quantitation of a wide range of organic compounds and is suitable for extracts generated from soil, water, air, biota, or chemical waste media. Table 1 of the US EPA method 8270D is a comprehensive listing of compounds amenable for identification using this methodology. The laboratory however, in the absence of a client-specified target analyte list (TAL), will analyze for the compounds listed in Table 11 of this TAP.

Estimated quantitation limits for samples prepared as described in the method are 330 to 1000 μg/kg for soil/sediment, 10 to 50 μg/L for water, and 1.0 to 200 mg/kg for wastes. Quantitation limits are highly dependent on the sample matrix.

The following compounds may require special attention when being determined by this method:

benzidine, hexachlorocyclopentadiene, N-nitrosodimethylamine, N-nitrosodipehnylamine, 1,2-diphenylhydrazine, pentachlorophenol, 2,4-dinitrophenol, 4-nitrophenol, 4,6-dinitro-2-methylphenol, 4-chloro-3-methylphenol, 2-nitroaniline, 3-nitroaniline, 4-nitroaniline, benzyl alcohol, and benzoic acid

This method is not suitable for the quantitation of multi-component analytes such as Toxaphene, Aroclors, and Technical Chlordane due to low sensitivity for these analytes in the electron impact (EI) mode of ionization. It can, however, be used as a confirmatory method if the concentrations in the extracts generated for Methods 8081and 8082 are sufficiently high enough to be detected by GC/MS.

Modifications to this method may be performed but should be performed with the prior approval of the client and should be documented in the case narrative of a data package.

2.0 PURPOSE

To describe the procedure for the analysis of samples for semi-volatile compounds by combined gas chromatography/mass spectrometry (GC/MS) by Method 8270D.

3.0 RESPONSIBILITIES

3.1 It is the responsibility of the Study Director (Project Manager) to assure that all steps described in this procedure are performed.

3.2 It is the responsibility all laboratory personnel to follow the procedure.

4.0 REFERENCES

4.1 Identification of the Test Method(s):

SW-846 Methods:

8270C, Revision 3, December 1996
8270D, Revision 4, February 2007
8000C, Revision 3, March 2003

4.2 For extraction, refer to the following SwRI Test/Analytical Procedures:

4.2.1 **TAP-01-0402-019**, *Extraction of Base/Neutral and Acid Semivolatiles from Water by Separatory Funnel by Method 8270*

4.2.2 **TAP-01-0402-113**, *Extraction of Base Neutral and Acid Semivolatiles (BNAs, 8270C) from Water by Continuous Liquid – Liquid Extraction*

4.2.3 **TAP-01-0402-020**, *Extraction by Sonication of Base Neutral and Acid Semivolatiles (BNAs), Pesticides and/or PCBs (AROCLORs) from Soils/Sediment for GC and GC/MS Analysis by Methods 8081, 8082, and 8270C.*

4.2.4 **TAP-01-0402-099**, *Preparation and Extraction of Soil and/or Sediment Matrices Samples by Soxhlet for 8270C BNA Analysis*

4.3 Reference/Operations manuals for instruments utilized are readily available for use in troubleshooting and maintenance of equipment.

5.0 PROCEDURE

5.1 Definitions

5.1.1 Contract Required Detection Limit (CRQL) – The detection limit, usually in parts per billion (ppb), is outlined in the contractual agreement between the client and the provider of analytical services. This is not the Method Detection Limit.

5.1.2 Method Detection Limit (MDL) – The minimum concentration of a substance that can be measured and reported with 99% confidence that the analyte concentration is greater than zero, as determined from analysis of a sample containing the analyte in a given matrix.

5.1.3 The laboratory will also establish a Level of Detection (LOD) for each analyte of interest. This LOD may not necessarily be the same value as the MDL.

5.1.4 Definitions are provided in **QAP-004**, *Quality Assurance Plan for Analytical and Environmental Services*.

5.2 Level of Quantiation (LOQ)t

The LOQ is typically near the lab's low point calibration standard and will be established for each analyte. In all cases, the LOQ is higher than the LOD.. In SIM mode, lower LOQs can be achieved.

5.3 Interferences

5.3.1 Raw GC/MS data from all Blanks, samples and spikes shall be evaluated for interferences. The source of interference shall be determined whether it is in the preparation and/or clean up of the samples. Corrective action should be taken to eliminate the problem.

5.3.2 Occasional carryover contamination may occur whenever high concentration samples are analyzed. To reduce carryover contamination,

an instrument blank shall be analyzed especially when dirty samples are analyzed.

5.4 Equipment and Supplies

5.4.1 Gas Chromatograph/Mass Spectrometer system

5.4.1.1 Gas Chromatograph – A Agilent 6890N Network GC equipped with a Agilent 7683B auto-sampler, split/splitless injection, and temperature programmable capabilities with other accessories, such as syringes, gas lines, etc.

(a) Alternate GC - A Agilent 7890A GC system equipped with a 7683 injector auto sampler, split/splitless injection and temperature programmable capabilities with other accessories, such as syringes, gas lines, etc.

5.4.1.2 Analytical Column:

(a) A fused silica capillary column 30m long with a 0.25mm ID [or 0.18mm ID if needed] 0.25µm film thickness [J&W Scientific DB-5MS or equivalent].

(b) A capillary column 20m long with 0.18mm ID and 0.36µm film thickness [J&W Scientific DB-5.625 or equivalent].

5.4.1.3 Mass Spectrometer – 1.) Agilent 5975 Inert MSD capable of scanning from 35 to 550amu every 1 second or less, using 70 volts nominal electron energy in the electron impact ionization mode. 2.) Agilent 5975C Inert MSD with triple axis detector capable of scanning from 35 to 550amu every 1 second or less, using 70 volts nominal electron energy in the electron impact ionization mode.

5.4.1.4 GC/MS Data System – Data acquisition and reduction is accomplished by using a PC interfaced with MS ChemStation

Software. Data processing software is capable of plotting Extracted Ion Current Profile [EICP] which is a plot of ion abundances versus time.

5.4.1.5 Accessories

(a) Syringes of various sizes capable of measuring standards from 5µL to 1mL.

(b) Volumetric flasks – Appropriate sizes with ground-glass stoppers.

(c) Analytical balance – Capable of weighing 0.0001g.

(d) Glassvials – Various sizes to hold standard stock solutions.

5.5 Reagents and Standards

5.5.1 Preservation, Shipment, and Storage of Standards

5.5.1.1 The following are the general procedures to be followed for correct usage, storage, and inventory of chemicals used in the GC/MS labs for semivolatile analysis.

5.5.1.2 Ordering of New Chemicals - No new chemicals are to be ordered until a thorough check has been completed to ensure that the chemical is not available in-house. If a chemical must be purchased, efforts must be made to obtain the minimum amount required. Material Safety Data Sheets and Certificates of Analysis must be explicitly requested on the purchase requisition when a chemical is ordered.

5.5.2 Receipt and Login

Chemicals must be logged into the appropriate freezer. Their receipt must be documented in the database used for chemical inventory. Date received

must be marked on the bottle. This database should contain lot number, date received, amount received, type of usage expected (ie, Appendix IX, Met 8270, etc), and the chemical's expiration date. The MSDS sheet must be filed in alphabetical order using the chemical's most common name.

5.5.3 Usage

When the container is first opened, date opened must be clearly marked on the outside of the bottle.

5.5.4 Expiration Dates and Chemical Disposal:

Except in special circumstances, such as with chemicals that are extremely volatile or unstable, neat chemicals will be stored for an indefinite period of time. Due to the high costs of disposal and the need to stock a wide variety of chemicals required for preparation of standards, it is, in general, more cost efficient to retain chemicals and evaluate their suitability each time their use is required. Since the chemicals used for semi-volatile analysis are often required on a sporadic basis for qualitative standards, it is possible to evaluate them for degradation prior to each use by preparing a stock solution and analyzing it by GC/MS.

Under certain circumstances such as those outlined below, chemicals must be removed from inventory and properly disposed of if:

- The label has peeled off or is no longer legible and the identity of the compound cannot be conclusively determined, a stock solution of the chemical must be prepared and analyzed by GC/MS. Once a tentative identification is made, the chemical must be disposed of according to procedures established by the Safety Office.

- Chemicals showing obvious signs of degradation or decomposition, such as rusting around the lid or marked discoloration, crusting, or abnormal sedimentation, must also be removed from inventory and disposed of properly.

When a given chemical is used to prepare a standard, the entry in the standards-preparation log-book must contain the following information, if available, vendor or supplier, percent purity, lot number, date prepared, and name of analyst preparing the solution.

In all cases, when a chemical is used to prepare a standard, the suitability of available inventory of the given chemical must be evaluated for the specific application required, i.e. an out-dated chemical will be appropriate for preparing a qualitative standard in which precise quantitation is not necessary, but should not be used to prepare a standard used in a project requiring rigorous quality control and precise quantitation of the analytical standard.

5.5.5 All standards and solutions shall be recorded in a standards notebook and appropriately labeled.

5.5.6 Standards used in this laboratory may be purchased as mixes or as individual components from various commercial sources. These standards may then be diluted to the working level or combined with other mixes to make the following:

- INTERNAL STANDARD solution
- DFTPP solution
- MATRIX SPIKE solution
- SURROGATE solution
- INITIAL and CONTINUING CALIBRATION standards.

Note: All solutions should be put back into the appropriate freezer as soon after injection onto the GC/MS system as possible in order to preserve the integrity of the solutions. Stock standard solutions and working level solutions will be prepared at a minimum of every 12 months. If degradations are detected, standards will be prepared on a more frequent basis.

5.5.7 Before beginning preparation of the above-mentioned solutions, make sure that the steps mentioned below are followed:

5.5.7.1 Allow mixes to come up to room temperature.

5.5.7.2 Check mix for any precipitates - if any, the mix may be warmed up using hot tap water to get precipitates back into solution

5.5.7.3 Additionally, a sonicator may be used in conjunction with the warm tap water to get precipitates back into solution.

5.5.7.4 Check all syringes and volumetric glassware for cleanliness and dryness.

5.5.7.5 Carefully transfer mixes from ampoule to clean vials.

5.5.8 **Tuning Check Solution** containing Decafluorotriphenylphosphine [DFTPP], Pentachlorophenol, Benzidine, and 4,4'-DDT @ 50 or 25 ng/µL .

5.5.9 **Semi-volatile Internal Standard Solution** containing six internal standards is prepared at 1000 ng/µL .

5.5.10 Additional notes:

5.5.10.1 Internal Standard is spiked into every sample analyzed prior to injection onto the GC/MS system.

5.5.10.2 To a 200uL aliquot of a water or soil sample extract, add 4 µL of internal standard solution (at 1000 ng/µL) such that the concentration of the internal standards is at 20 ng/µL.

5.5.11 **Semi-volatile Surrogate Spiking Solution** is prepared at 100 µg/mL for Base/Neutral components and 150 µg/mL for Acid components .

Note: The surrogate spiking solution, once prepared, should be given to the extraction laboratory.

5.5.12 **Semi-volatile Matrix Spike Spiking Solution** is prepared at 100 µg/mL for spiked components from second source different with one for initial calibration standards.

Note: The matrix spike solution, once prepared, should be given to the extraction laboratory.

5.5.13 A stock solution containing all target analytes is prepared and dilutions can be made to prepare the **Initial and Continuing Calibration** solutions .

5.6 Quality Control

5.6.1 Laboratory Method Blank

Analysis of a laboratory method blank serves the purpose of checking the purity of solvents and reagents used in the preparation/extraction of a set of samples as well as provide information regarding potential sources of contamination.

No interferences can be present which may affect the identification of target analytes. Detected analytes shall be less than the Contract Required Quantitaion Limit [CRQL]. Phthalate esters detected shall be less than 2.5 times the CRQL.

5.6.2 Surrogate Recoveries

All samples, blanks, and MS/MSD will be checked for surrogate recoveries. The QC limits are as stated in Table 2 or from updated control charts. If surrogate recoveries are not met, the following corrective action must be taken:

- Check instrument for malfunction.
- Check calculations (i.e.-surrogate, internal standard, and raw data).
- Re-analyze sample extract, as per Project Manager or client request

If upon reanalysis, the problem still exists, sample re-extraction and re-analysis may be required upon client request. Otherwise, the data shall be flagged "estimated concentration".

5.6.3 Matrix Spike Recoveries. The QC limits are as stated in Table 3 or updated control charts. For MS/MSDs outside criteria, corrective action may only be required if LCS recoveries also fall outside QC limits. If calibration method blank, and LCS meet criteria, these MS/MSD recovery criteria may be attributed to matrix effects.

5.6.3.1 An MS/MSD shall be extracted at a frequency of one pair per extraction batch of 20 samples or less per SDG unless otherwise instructed by the Project Manager or the client.

5.6.4 In addition to an MS/MSD pair, a Laboratory Controlled Sample [LCS] shall be extracted at a frequency of one per extraction batch of 20 samples or less per SDG per sample matrix unless otherwise instructed by the Project Manager or the client. LCS recoveries shall meet QC limits as shown in Table 3 or updated control charts.

Note: For projects that require NELAC protocol to be followed, at a minimum, one set of sample MS/MSD, and one LCS sample MUST be generated per extraction batch of 20 samples or less per SDG per sample matrix without exception.

5.6.5 For compounds spiked into the LCS, MS, and MSD other than those listed in Table 3, the advisory limits shall be 20-150%.

5.6.6 Initial Demonstration of Proficiency (IPR)

The laboratory shall generate accuracy and precision data to demonstrate proficiency in sample preparation and analysis as per section 8.0 of Method 8000C.

5.6.7 In-house QC limits

5.6.7.1 In-house QC limits for recovery of matrix spike, LCS, IPR, and OPR shall be generated using a minimum of 15-20 data points.

5.6.7.2 As per section 9.7.3 of Method 8000C, control limits and warning limits shall be calculated in the following manner:

Upper Control Limit (UCL) = X + 3S
Lower Control Limit (LCL) = X - 3S

Upper Warning Limit (UWL) = X + 2S
Lower Warning Limit (LWL) = X - 2S

Where
X is the mean recovery
S is the standard deviation

5.6.8 50ng on column of DFTPP (Decafluorotriphenylphophine) are injected and a mass listing is generated. Relative abundances should meet the criteria in Table 1 for a mass spectrum generated by MSD.

Alternatively, other documented tuning criteria may be used (e.g. CLP, or Method 625), provided that method performance is not adversely affected and used consistently throughout the initial calibration, calibration verification, and sample analyses.

5.6.9 If these criteria are not met, the system must be re-tuned and DFTPP re-injected until relative abundances meet criteria.

5.6.10 A chromatogram, spectrum, and mass listing are generated for DFTPP that meets criteria. The recorded injection time of DFTPP that meets criteria is the beginning of the 12-hour time period (or **12 hour clock**) for the analysis of standards and/or samples.

5.6.11 In addition, an assessment must be made of GC column performance and injection port inertness by examining the peaks for Pentachlorophenol, Benzidine, and 4,4'-DDT in the tuning check solution analysis. No

excessive tailing should be seen on the Pentachlorophenol or the Benzidine peaks. Excessive tailing is defined as the intensity of the base peak ion at 10 seconds after the apex is no more than 5% of the intensity of the apex. Degradation of DDT to DDD and DDE shall not exceed 20%. Corrective action in the form of injector port cleaning or pre-column maintenance may be required if excessive tailing and/or degradation is seen.

5.6.12 Initial and Continuing Calibration Standards - The following describes steps taken in performing an initial and/or a continuing calibration. As per the client, the target analytes may be all or a subgroup of the compounds listed in the method. If no target analyte list is specified by the client, the laboratory will analyze samples for the compounds listed in Table 4.

5.6.12.1 The following operating conditions are used for the analysis of all standards and samples.

Mass Spectrometer: Electron Impact Ionization Mode
70 V nominal electron energy
One second/scan from 40 - 550 amu
Transfer line: 280° C
Source Temp: 230° C

Gas Chromatograph: Injector Temp: 250° C
Start Temp: 40° C
Hold Time: 2 minutes
Ramp Rate 1: 20° C/minute to 130° C, hold 0 minutes
Ramp Rate 2: 15° C/minute to 250° C, hold 0 minutes
Ramp Rate 3: 10° C/minute to 310° C, hold 5 minutes

GC temperature program may be different with above parameters depending on columns, project requirements, target compounds list, and so on.

5.6.12.2 For routine analysis, each GC/MS system must be calibrated at a minimum of five concentrations to determine instrument sensitivity and the linearity of the GC/MS response for the semi-volatile target compounds.

(a) The concentrations routinely analyzed are 80ng/µL, 60ng/µL, 40ng/µL, 25ng/µL, 10ng/µL , and 5ng/µL per 1µL injection.

5.6.12.3 After completion of acquisition of standards, open Environmental Data Analysis Software. Be sure to have the Bnalist.M or the corresponding processing method loaded. This "method" has been created by lab personnel and contains information regarding tune criteria, compound spectra, retention times, and response references. The ions selected for quantitation (unless there is interference) are those listed in Table 3 of Method 8270D.

(a) Select **Q**uant, **C**alculate and Generate Report.

(b) Make necessary integration changes by selecting the **Q**edit option under the **Q**uant option in the menu bar.

(c) Update calibration levels from the **U**pdate levels option under **I**nitcal on the menu bar.

(d) Select **R**eport Response Factors to Screen under the **I**nitcal option on the menu bar. A table with calculated response factors for each compound at each level will appear on the screen. The response factor is calculated as per 9.3.4.1 of the Method 8270D [or as shown in section 5.9.1 of this document] using the peak area for the characteristic ion for each compound.

5.6.12.4 The average RF should be calculated for each compound [section 5.9]. The %RSD [section 5.9] should be less than or equal to 20% for each of the compounds. . In addition, all target

compounds must meet minimum response factor listed in Table 4 of the Method 8270D. If criteria are met and time remains in the 12-hour clock, samples may be analyzed.

(a) If more than 10% of the compounds included with the initial calibration exceed the 20% RSD limit and failed to meet the minimum correlation coefficient (0.990) for alternate curve fits, clean the GC/MSD system and repeat the initial calibration procedure.

(b) If the %RSD of any target analyte exceeds 20% over the calibration range, a regression equation that does not pass through the origin may be employed as long as the coefficient of the determination (COD) is greater then or equal to 0.990.

5.6.12.5 A check of the calibration curve must be performed once every 12-hour time period. This is accomplished by first analyzing a 50ng injection of DFTPP. The ion abundances must meet the criteria as stated in section 5.7.5.

(a) Analysis of the mid-level [CC] standard (e.g. 25ng/µL for targets and surrogates; 20ng/µL for internal standards) is required. The percent difference [%D] shall be calculated for each compound. The %D should be less than or equal to 20% criteriafor each target compound for the initial calibration to be valid. If acceptance criteria are met, sample analysis may begin.

Note: Projects that require NELAC protocol to be followed, the initial calibration curve shall be verified using a mid-point standard (ICV) prepared from a second source each time a fresh ICAL curve is prepared. When a second source is not available or there are time constraints that prohibit the purchase of a second source in a timely manner, a person other than the one preparing the calibration standards shall prepare an ICV

solution from the same source materials. The value determined from the ICV should be within 30% of the expected concentration. Additionally, at least once a year a different CC standard level will be used.

(b) Internal standard area response shall not differ by more than + 100% or -50%, as compared with the mid-point standard from the most recent initial calibration.

5.6.12.6 If at any point, criteria are not met, the GC/MS system must be evaluated and corrective action taken as required. This may involve installing a new analytical column or thoroughly cleaning the injector (if the problem seems to be poor performance), or cleaning the ion source collector, ion volume, or lenses. It is the responsibility of the analyst to evaluate and determine the cause of non-compliant performance and make corrections as required before proceeding to sample analysis.

5.7 Procedure

5.7.1 Sample Analysis

5.7.1.1 Locate and remove sample extracts from appropriate freezer and allow to come to room temperature. Transfer a 200µL aliquot of sample extract into an injection vial. Add 4µL of internal standard (1000ng/µL) to each of the samples including any and all QC samples.

5.7.1.2 Set up analysis sequence.

5.7.1.3 An extraction blank will be analyzed after the calibration verification standard in order to ensure that the GC/MSD system is free of contamination. If the method blank indicates contamination, a solvent blank spiked with internal standard shall be analyzed in subsequent sequences to show no carryover and/or contamination from the instrumentation.

5.7.1.4 After acquisition of sample(s) is completed, open the Environmental Data Analysis Software. Select "Quantitate using initial Cal RFs" under the **Q**uant option on the menu bar.

5.7.1.5 To generate quan reports for each sample, select "**C**alculate and Generate" report under the **Q**uant option of the menu bar. Multiple files may be processed by selecting **T**ools, **D**o-list, **S**ummary Quant w/o calc. no print. (Screen will request selection of files for processing.)

5.7.1.6 As with the standards files, manual integrations may be required for missed or incorrectly integrated compounds in the quantitation report of the sample(s). Select **Q**uant, **Q**edit on the menu bar to affect changes needed to the quan report.

5.7.1.7 Positive identification of target analytes will be made using criteria as given in section 7.6 of the Method 8270. A hardcopy of the sample and standard spectrum will be included in the data package.

5.7.1.8 Up to ten peaks not associated with the calibration standard (i.e. - surrogates, internal standards, etc) will be tentatively identified and quantitated.

5.7.1.9 Internal standard area responses will be validated. Area responses shall not differ by more than + 100% or -50% as compared with the most recent calibration verification standard. If outside criteria, the instrument shall be checked for malfunctions. Additionally, spiking calculations will be verified and if no errors are found, the poor response may be due to matrix interference and should be reanalyzed. If the majority of the samples in an SDG fail to meet area and/or retention time criteria due to suspected matrix interference, the laboratory shall reanalyze only one or two samples to show proof of matrix interference assumption.

5.7.1.10 If any quantitated analyte exceeds the calibration range, the sample extract shall be diluted appropriately and reanalyzed.

5.7.1.11 A Selected Ion Monitoring (SIM) technique may be used if quantitation limits are lower than the normal range of EI Mass Spectrometry. The 12-hour time period begins at the moment of injection of the first initial calibration standard or a continuing calibration standard. The GC/MS system must be calibrated at a minimum of five concentrations, prior to the analysis of samples and required blanks, to determine instrument sensitivity and linearity. The RF of each target compound must be greater than or equal to the compound's minimum acceptable RF list in Table 4 of Method 8270D. The %RSD of each target compound should be less than or equal to 20% or meet the minimum correlation coefficient (0.990) for alternate curve fits.

5.8 Calculations

5.8.1 The response factors [RFs] for each target analyte relative to the corresponding internal standards are calculated as follows:

$$RF = \frac{A_s * C_{is}}{A_{is} * C_s}$$

Where,

A_s – Peak area of the analyte or surrogate.
A_{is} – Peak area of the corresponding internal standard.
C_s – Concentration of the analyte or surrogate.
C_{is} – Concentration of the corresponding internal standard.

5.8.2 The mean response factor, standard deviation, the %RSD, and %D are calculated as follows:

5.8.2.1 Mean response factor (mRF)

$$\text{MeanRF} = \frac{\sum_{i=1}^{n} RF_i}{n}$$

5.8.2.2 Standard Deviation (SD)

$$SD = \sqrt{\frac{\sum_{i=1}^{n} (RF_i - mRF)2}{n-1}}$$

5.8.2.3 Relative Standard Deviation expressed as a % (%RSD)

$$\%\,RSD = \frac{SD}{mRF} * 100$$

5.8.2.4 Percent Deviation (%D)

$$\%\,D = \frac{RFi - RFc}{mRF} * 100$$

5.8.3 The concentration of the target analytes in the samples are calculated as follows:

$$C_s = \frac{A_s * C_{is}}{A_{is} * mRF}$$

5.8.4 ChemStation files cannot be re-processed once a data package is submitted unless the original file has been backed up already.

5.9 Method Performance

5.9.1 Method performance shall be monitored through the use of surrogate and matrix spike compounds. Recoveries will be used to generate statistical data for control charting as indicated in section 5.6.7.

5.10 Pollution Prevention

Pollution Prevention will be performed in accordance with section 4.1-I of the SwRI Safety Policies and Procedures Manual (**SPPM**).

5.11 Waste management is performed in accordance with the requirements of **TAP-01-0407-005**, *Disposal of Hazardous Material*, and **TAP-01-0407-008**, *Disposal of Non-Hazardous Material*.

6.0 MAINTENANCE

6.1 GC Maintenance

6.1.1 Daily GC maintenance is performed to ensure generation of reliable and reproducible results.

6.1.2 Oven, injector, interface, and transfer line temperatures should be cooled down before maintenance on the GC is performed. If the GC is also equipped with liquid nitrogen, close valve to tank.

6.1.3 Once the GC is cooled, the following steps may be taken:

6.1.3.1 Replace the quartz liner in injector port.

6.1.3.2 Change the septum in injector nut.

6.1.3.3 Swab the inside of the injector port with methylene chloride.

Note: Caution must be taken in performing this step as methylene chloride vapors, if inhaled, may cause dizziness.

6.1.3.4 Cut and discard the pre-column [~1meter] and replace with an equal length cut from an unused similar analytical column.

6.1.4 Once maintenance is finished, reset temperatures to original values. Reopen valve to liquid nitrogen tank, if applicable.

6.1.5 More extensive maintenance is performed on an as needed basis. This may include a cleaning of the source and/or the quadrapole rods. Additionally, repair to hardware components may also be required. All such instances of repair/maintenance shall be recorded in an instrument maintenance logbook.

7.0 SAFETY

7.1 In all cases, the Material Safety Data Sheet must be made available to the laboratory personnel. It is the responsibility of the individual user to consult the Material Safety Data Sheet and take any precautions necessary in the usage of a chemical. As a bare minimum, all standards must be prepared in a hood, and safety glasses and lab-coats must be worn at all times when working with neat chemicals. In many cases, it is also recommended that disposable gloves be worn, and all glassware used in the preparation of the standard be disposed of immediately in a proper fashion. In no case is any piece of glassware that has come in contact with a neat chemical or stock solution to be left unlabeled on an open counter. No unlabeled containers of any kind are to be stored in the chemical storage freezers.

7.2 Safety shall be performed in accordance with requirements of **CHP-008**, *Chemical Hygiene Plan for Chemistry and Chemical Engineering Division*.

8.0 RECORDS

8.1 Instrument Logbook

8.1.1 BNA GC/MS analysis records are documented on a daily basis in the appropriate instrument logbook. This logbook also will contain instrument operating conditions and all maintenance and/or repairs, as well as difficulties or special circumstances noted with each analysis. Each logbook entry will be signed and dated by the responsible analyst. In addition, all logbook pages associated with a specific case will be

reviewed and signed by another analyst before the data is turned over to the sample management group for data entry.

8.1.2 All documentation in instrument logbooks shall be in black non-soluble ink. Corrections shall be made by crossing a single line through the error and entering the correct information.

8.1.3 Corrections will be initialed and dated. No information shall be obliterated or rendered unreadable.

8.2 Data Reports

Data reports for standards and samples are generated using automated search routines. The resulting data reports are checked by the analyst and corrections are made as required. Corrections on the data report are initialed and dated by the analyst.

8.3 Records

8.3.1 All analytical procedures are recorded in proper laboratory notebooks in accordance with client/contract requirements.

8.3.2 Records generated by the processes of this procedure will be maintained in accordance with Division 01 **SOP-01-4.2.4**, *Storage and Maintenance of Quality Records*.

Correction
06-08-11 Corrected the number sequence from section 5.7 to 5.11

Revision 7
Entire document revised to incorporate changes from version D of the EPA method.

Revision 6
Updated section 5 to reflect current procedure practices.

Revision 5
Revised references, 5.4.1, 5.6.6, 5.7, 5.10

Revision 4
TAP revised to expand the summary of the test method
Step 5.6.1 revised to include new first paragraph for further detail concerning Laboratory method blank
Removed references to inactivated procedures.

Lot #/Stock #	Compound	Stock Conc. (ng/µL)	Amount to F.V. = 4 mL	Final Conc. (ng/µL)
127-01-03-92	Benzidine	5000	20 µL	25
33-04-0191	4,4'-DDT	1000	100 µL	25
	DFTPP	1000	100 µL	25
	Pentachlorophenol	5000	20 µL	25

Cat #	Lot #	Orig. Conc.	Amt. of Mix Used	Amt. of DCM	Final Conc.
31006	A000749	4000 µg/mL	2 mL	6 mL	1000 µg/mL

Internal Std. Mix @ 1000 µg/mL from 4000 µg/mL
(4000 µg/mL) (X mL) = (1000 µg/mL) (8 mL)

$$XmL = \frac{(1000\ \mu g/mL)\ (8\ mL)}{4000\ \mu g/mL}$$

X = 2 mL of 4000 µg/mL Internal Std. Mix

2 mL of 4000 µg/mL + 6 mL of DCM = 8 mL final vol. @ 1000 µg/mL

Supplier/Lot #	Initial Conc. (µg/mL)	Initial Vol. (mL)	Final Volume (mL)	Final Conc. (µg/mL)
Acid Surr Mix Restek /A001647	7500	5.0	250	150
B/N Surr Mix/Restek/ A001702	5000	5.0	250	100

The solution was brought up to a final volume of 250 mL with a mixture of Acetone/MeOH/DCM (60/30/10)

Table 1

DFTPP MASS ION ABUNDANCE CRITERIA	
51	10 to 80% of Base Peak
68	< 2% of mass 69
70	< 2% of mass 69
127	10 to 80% of Base Peak
197	< 2% of mass 198
198	Base Peak, or > 50% of Mass 442
199	5 to 9% of mass 198
275	10 to 60% of Base Peak
365	> 1.0% of mass 198
441	present but < 24% of mass 442
442	Base Peak, or > 50% of mass 198
443	15 to 24% of mass 442

The criteria in this table comes from EPA Method 8270D.
Alternate tuning criteria may be employed (e.g., CLP or Method 625), provided that method performance is not adversely affected.

SUPPLIER	MIX ID	MIX CONC µg/mL	AMT TO 8 mL	FINAL CONC ng/µL
RESTEK	SV Calibration Mix #1	2000	320 µL	80
RESTEK	SV Calibration Mix #2	2000	320 µL	80
RESTEK	SV Calibration Mix #3	2000	320 µL	80
RESTEK	SV Calibration Mix #4	2000	320 µL	80
RESTEK	SV Calibration Mix #5	2000	320 µL	80
RESTEK	SV Calibration Mix #7	2000	320 µL	80
RESTEK	3,3-Dichlorobenzidine	2000	320 µL	80
RESTEK	Acid Surrogate	7500	85.3 µL	80
RESTEK	B/N Surrogate	5000	128 µL	80

This solution was brought to a final volume of 8 ml.

STD ID	Desired Final conc ng/µL	Final Vol µL	AMT of 80 ng/µL used	AMT of IS (1000 ng/µL) added	DCM Added To Volume
SSTD160	80	500	500	10	--
SSTD120	60	500	375	10	125 µL
SSTD080	40	500	250	10	250
SSTD050	25	1000	312	20	688
SSTD020	10	500	62.5	10	437.5

Base/Neutral Fraction	Acid Fraction
Acenaphthene	4-Chloro-3-methylphenol
1,4-Dichlorobenzene	2,4-Dichlorophenol
Hexachlorobutadiene	2-Nitrophenol
N-Nitroso-di-n-phenylamine	Phenol
Di-n-octylphthalate	Pentachlorophenol
Fluoranthene	2,4,6-Trichlorophenol
Benzo(a)Pyrene	

SPCC Compounds
N-nitroso-di-n-propylamine
Hexachlorocyclopentadiene
2,4-Dinitrophenol
4-Nitrophenol

Table 2 - Surrogate Recovery Limits

Surrogate	Low/Medium Water	Low/Medium Soil
Nitrobenzene-d5	35-114	23-120
2-Fluorobiphenyl	43-116	30-115
p-Terphenyl-d14	33-141	18-137
Phenol-d6	10-94	24-113
2-Fluorophenol	21-100	25-121
2,4,6-Tribromophenol	10-123	19-122

Table 3 - Matrix Spike Recovery Limits

Compound	% Recovery Water	RPD Water	% Recovery Soil	RPD Soil
Phenol	12-110	42	26-90	35
2-Chlorophenol	27-123	40	25-102	50
1,4-Dichlorobenzene	36-97	28	28-104	27
N-Nitroso-di-n-proylamine	41-116	38	41-126	38
1,2,4-Trichlorobenzene	39-98	28	38-107	23
4-Chloro-3-methylphenol	23-97	42	26-103	33
Acenaphthene	46-118	31	31-137	19
4-Nitrophenol	10-80	50	11-114	50
2,4-Dintrotoluene	24-96	38	28-89	47
Pentachlorophenol	9-103	50	17-109	47
Pyrene	26-127	31	35-142	36
Naphthalene	20-150	50	20-150	50
Fluoranthene	20-150	50	20-150	50
Benzo[a]pyrene	20-150	50	20-150	50
2,4,6-Trichlorophenol	20-150	50	20-150	50
2,4-Dichlorophenol	20-150	50	20-150	50

Table 4

CAS #	Name	Approximate RT (min)	CAS#	Name	Approximate RT (min)
108-95-2	Phenol	6.42	99-09-2	3-Nitroaniline	14.15
111-44-4	bis(2-chloroethyl)ether	6.47	83-32-9	Acenaphthene	14.17
95-57-8	2-Chlorophenol	6.47	51-28-5	2,4-Dinitrophenol	14.35
541-73-1	1,3-Dichlorobenzene	6.72	100-02-7	4-Nitrophenol	14.78
106-46-7	1,4-Dichlorobenzene	6.87	132-64-9	Dibenzofuran	14.53
95-50-1	1,2-Dichlorobenzene	7.25	121-14-2	2,4-Dinitrotoluene	14.77
95-48-7	2-Methylphenol	7.73	84-66-2	Diethylphthalate	15.50
108-60-1	2,2-oxybis(1-Chloropropane)	7.70	7005-72-3	4-Chlorophenyl-phenylether	15.48
106-44-5	4-Methylphenol	8.12	86-73-7	Fluorene	15.40
621-64-7	N-Nitroso-di-n-propylamine	8.07	100-01-6	4-Nitroaniline	15.63
67-72-1	Hexachloroethane	7.97	534-52-1	4,6-Dinitro-2-methylphenol	15.72
98-95-3	Nitrobenzene	8.23	86-30-6	N-Nitrosodiphenylamine (1)	15.83
78-59-1	Isophorone	8.85	101-55-3	4-Bromophenyl-phenylether	16.67
88-75-5	2-Nitrophenol	8.97	118-74-1	Hexachlorobenzene	16.95
105-67-9	2,4-Dimethylphenol	9.33	87-86-5	Pentachlorophenol	17.45
111-91-1	bis(2-Chloroethoxy)methane	9.48	85-01-8	Phenanthrene	17.70
120-83-2	2,4-Dichlorophenol	9.58	120-12-7	Anthracene	17.85
120-82-1	1,2,4-Trichlorobenzene	9.73	86-74-8	Carbazole	18.30
91-20-3	Naphthalene	9.87	84-74-2	Di-n-butylphthalate	19.58
106-47-8	4-Chloroaniline	10.10	206-44-0	Fluoranthene	20.73
87-68-3	Hexachlorobutadiene	10.40	129-00-0	Pyrene	21.25
59-50-7	4-Chloro-3-methylphenol	11.50	85-68-7	Butylbenzylphthalate	23.35
91-57-6	2-Methylnaphthalene	11.50	91-94-1	3,3'-Dichlorobenzidine	24.45
77-47-4	Hexachlorocyclopentadiene	12.12	56-55-3	Benzo(a)anthracene	24.35
88-06-2	2,4,5-Trichlorophenol	12.37	218-01-9	Chrysene	24.47
95-95-4	2,4,6-Trichlorophenol	12.48	117-81-7	bis(2-Ethylhexyl)phthalate	25.00
91-58-7	2-Chloronaphthalene	12.65	117-84-0	Di-n-octylphthalate	26.57
88-74-4	2-Nitroaniline	13.10	205-99-2	Benzo(b)fluoranthene	27.02
131-11-3	Dimethylphthalate	13.73	207-08-9	Benzo(k)fluoranthene	27.08
208-96-8	Acenaphthylene	13.68	50-32-8	Benzo(a)pyrene	27.78
606-20-2	2.6-Dinitrotoluene	13.82	193-39-5	Indeno(1,2,3-cd)pyrene	30.75
53-70-3	Dibenz(a,h)anthracene	30.90	100-51-6	Benzyl Alcohol	7.30
191-24-2	Benzo(ghi)perylene	31.65	65-85-0	Benzoic Acid	9.87

Figure 1

```
File        : C:\ELINK\FINN8\DATA\100302\810032T2.D
Operator    : SA
Acquired    :  3 Oct 2002  14:33    using AcqMethod METHOD.M
Instrument  :   FINN8
Sample Name: SWRI FINN8 DFTPP
Misc Info   : DFTPP TUNING SOLUTION #236-10-01-02
Vial Number: 1
```

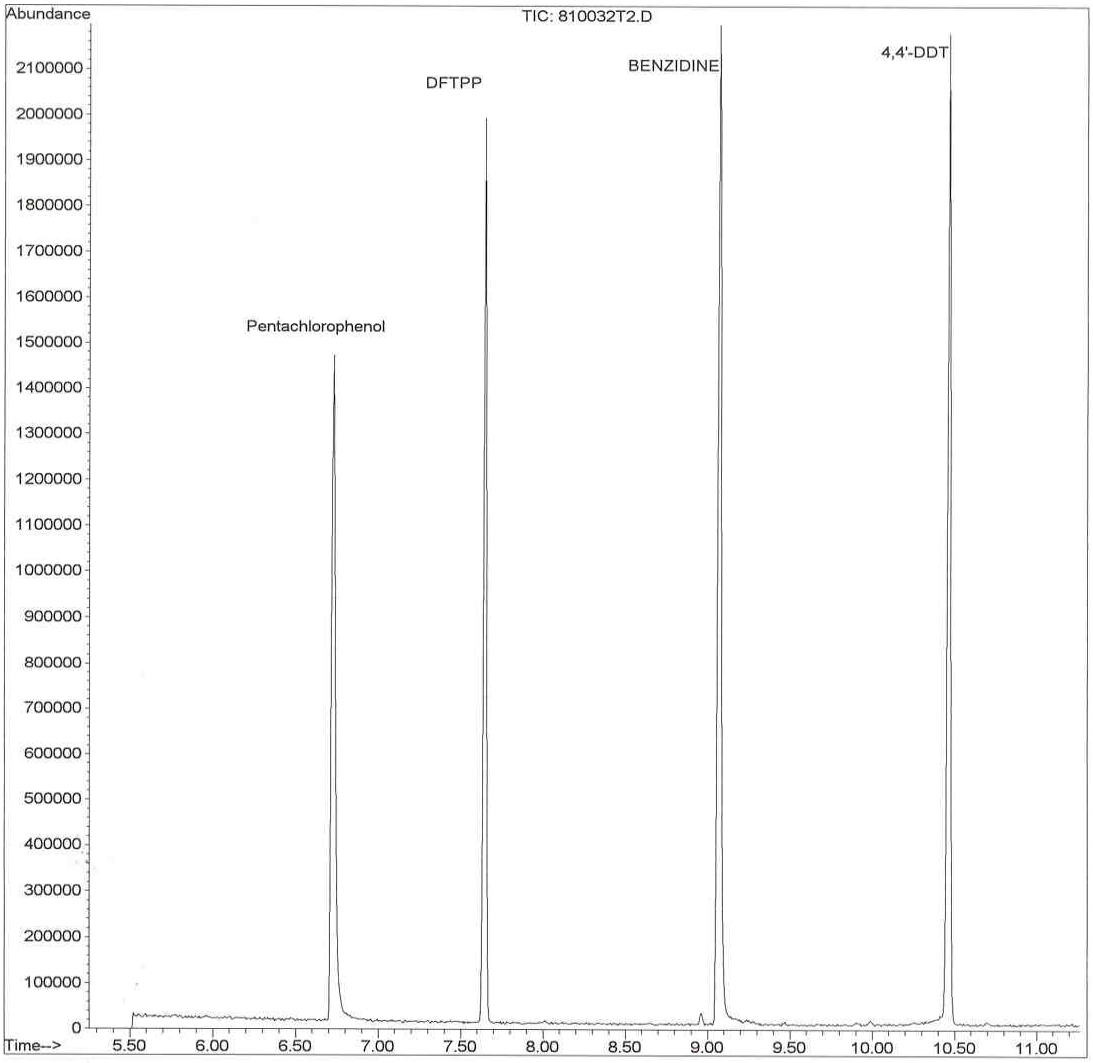
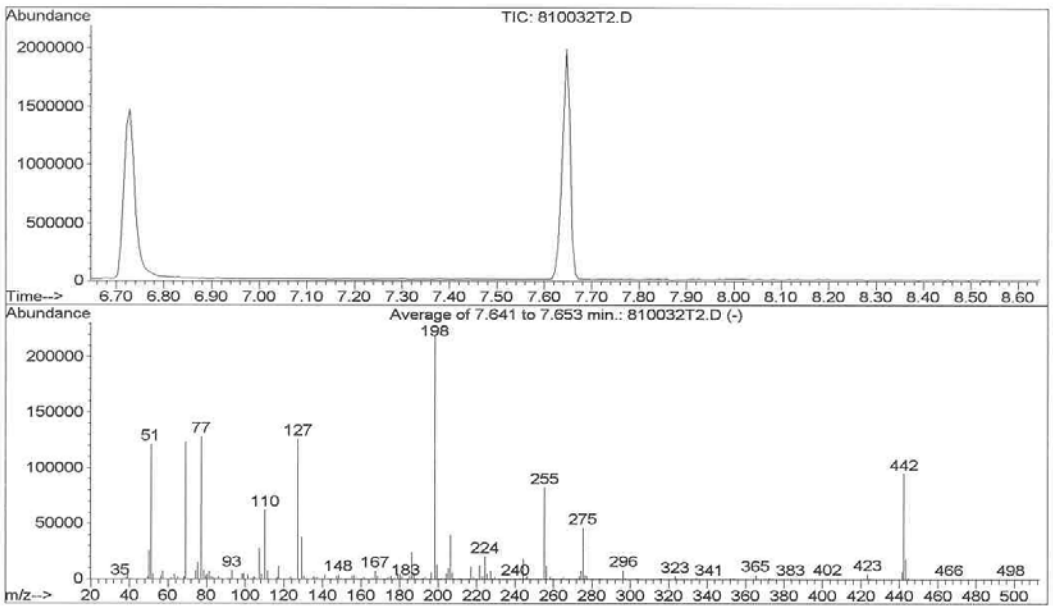


Figure 1A

DFTPP Tune Evaluation

```
Data File : C:\ELINK\FINN8\DATA\100302\810032T2.D        Vial: 1
Acq On    :  3 Oct 2002  14:33                        Operator: SA
Sample    : SWRI FINN8 DFTPP                          Inst    : FINN8
Misc      : DFTPP TUNING SOLUTION #236-10-01-02       Multiplr: 1.00
MS Integration Params: RTEINT.P
Method    : C:\ELINK\FINN8\QUANT\8270.M (RTE Integrator)
Title     : 8270C/CLP BNA CALIBRATION CURVE
```



Peak Apex is scan: 670 (7.65 min)
Average of 3 scans: 669,670,671 minus background scan 650 (7.52 min)

Target Mass	Rel. to Mass	Lower Limit,%	Upper Limit,%	Rel. Abn,%	Raw Abn	Result Pass/Fail
51	198	30	60	55.1	121378	PASS
68	69	0	2	1.7	2106	PASS
69	198	0	100	56.1	123589	PASS
70	69	0	2	0.3	348	PASS
127	198	40	60	57.1	125837	PASS
197	198	0	1	0.0	0	PASS
198	198	100	100	100.0	220288	PASS
199	198	5	9	5.8	12805	PASS
275	198	10	30	20.9	46037	PASS
365	198	1	100	1.6	3614	PASS
441	443	0	100	38.2	6922	PASS
442	198	39	100	43.2	95136	PASS
443	442	17	23	19.1	18135	PASS

810032T2.D 8270.M Tue Oct 29 17:43:14 2002

Figure 1B

Average of 7.641 to 7.653 min.: 810032T2.D
SWRI FINN8 DFTPP
Modified:subtracted

m/z	abund.	m/z	abund.	m/z	abund.	m/z	abund.
38.35	1411	69.10	123589	86.20	2271	116.25	1640
39.30	9501	74.30	7835	93.20	7703	117.20	11348
49.30	2203	75.20	14811	98.25	4751	123.30	2070
50.20	25707	77.25	128101	99.20	4845	127.15	125837
51.20	121378	78.45	7874	101.20	3669	129.10	37637
52.35	4736	79.40	3095	104.30	1850	130.30	2560
56.20	3135	80.25	4322	105.20	1507	135.35	1766
57.20	6746	81.30	6959	107.25	27813	137.35	1508
63.25	4275	82.25	2419	108.35	4076	141.20	3988
65.20	1921	83.35	1531	110.20	62312	147.30	2509
68.20	2106	85.35	1261	111.30	7658	148.25	3755

Average of 7.641 to 7.653 min.: 810032T2.D
SWRI FINN8 DFTPP
Modified:subtracted

m/z	abund.	m/z	abund.	m/z	abund.	m/z	abund.
155.30	2546	185.25	2609	217.15	10640	255.25	82371
156.30	3346	186.30	23781	218.25	1305	256.30	11558
161.30	1619	187.35	6190	221.40	11749	258.10	1669
167.30	7077	193.30	1686	223.20	2130	258.35	1922
168.30	2488	196.30	5712	224.35	20421	265.25	1573
174.25	1305	198.10	220288	225.35	4704	273.40	2327
175.35	2757	199.25	12805	227.20	7372	274.25	7341
177.25	1145	204.25	4981	229.25	1806	275.30	46037
179.10	4356	205.30	10042	244.30	17633	276.55	3789
180.30	4012	206.25	39443	245.50	1421	277.35	2671
181.30	1751	207.40	5578	246.30	2355	296.30	7751

Average of 7.641 to 7.653 min.: 810032T2.D
SWRI FINN8 DFTPP
Modified:subtracted

m/z	abund.	m/z	abund.	m/z	abund.	m/z	abund.
323.35	2612						
334.40	1527						
365.30	3614						
372.45	1533						
423.45	4572						
441.35	6922						
442.25	95136						
443.40	18135						
444.50	1293						

Exhibit D

State, municipality, commission, political subdivision of a State, or any interstate body;

Release means any spilling, leaking, pumping, pouring, emitting, emptying, discharging, injecting, escaping, leaching, dumping, or disposing into the environment (including the abandonment or discarding of barrels, containers, and other closed receptacles containing any hazardous substance or pollutant or contaminant), but excludes:

(1) Any release which results in exposure to persons solely within a workplace, with respect to a claim which such persons may assert against the employer of such persons;

(2) Emissions from the engine exhaust of a motor vehicle, rolling stock, aircraft, vessel, or pipeline pumping station engine;

(3) Release of source, byproduct, or special nuclear material from a nuclear incident, as those terms are defined in the Atomic Energy Act of 1954, if such release is subject to requirements with respect to financial protection established by the Nuclear Regulatory Commission under section 170 of such Act, or for the purposes of section 104 of the Comprehensive Environmental Response, Compensation, and Liability Act or any other response action, any release of source, byproduct, or special nuclear material from any processing site designated under section 102(a)(1) or 302(a) of the Uranium Mill Tailings Radiation Control Act of 1978; and

(4) The normal application of fertilizer;

Reportable quantity ("RQ") means that quantity, as set forth in this part, the release of which requires notification pursuant to this part;

United States include the several States of the United States, the District of Columbia, the Commonwealth of Puerto Rico, Guam, American Samoa, the United States Virgin Islands, the Commonwealth of the Northern Marianas, and any other territory or possession over which the United States has jurisdiction; and

Vessel means every description of watercraft or other artificial contrivance used, or capable of being used, as a means of transportation on water.

[50 FR 13474, Apr. 4, 1985, as amended at 67 FR 45321, July 9, 2002]

§ 302.4 Designation of hazardous substances.

(a) *Listed hazardous substances.* The elements and compounds and hazardous wastes appearing in table 302.4 are designated as hazardous substances under section 102(a) of the Act.

(b) *Unlisted hazardous substances.* A solid waste, as defined in 40 CFR 261.2, which is not excluded from regulation as a hazardous waste under 40 CFR 261.4(b), is a hazardous substance under section 101(14) of the Act if it exhibits any of the characteristics identified in 40 CFR 261.20 through 261.24.

NOTE: The numbers under the column headed "CASRN" are the Chemical Abstracts Service Registry Numbers for each hazardous substance. The "Statutory Code" column indicates the statutory source for designating each substance as a CERCLA hazardous substance: "1" indicates that the statutory source is section 311(b)(2) of the Clean Water Act, "2" indicates that the source is section 307(a) of the Clean Water Act, "3" indicates that the source is section 112 of the Clean Air Act, and "4" indicates that the source is section 3001 of the Resource Conservation and Recovery Act (RCRA). The "RCRA Waste Number" column provides the waste identification numbers assigned to various substances by RCRA regulations. The "Pounds (kg)" column provides the reportable quantity adjustment for each hazardous substance in pounds and kilograms. Appendix A to § 302.4, which lists CERCLA hazardous substances in sequential order by CASRN, provides a per-substance grouping of regulatory synonyms (i.e., names by which each hazardous substance is identified in other statutes and their implementing regulations).

TABLE 302.4—LIST OF HAZARDOUS SUBSTANCES AND REPORTABLE QUANTITIES

[Note: All Comments/Notes Are Located at the End of This Table]

Hazardous substance	CASRN	Statutory codedagger;	RCRA waste No.	Final RQ pounds (Kg)
Acenaphthene	83–32–9	2		100 (45.4)
Acenaphthylene	208–96–8	2		5000 (2270)
Acetaldehyde	75–07–0	1,3,4	U001	1000 (454)
Acetaldehyde, chloro-	107–20–0	4	P023	1000 (454)

TABLE 302.4—LIST OF HAZARDOUS SUBSTANCES AND REPORTABLE QUANTITIES—Continued

[Note: All Comments/Notes Are Located at the End of This Table]

Hazardous substance	CASRN	Statutory codedagger;	RCRA waste No.	Final RQ pounds (Kg)
Acetaldehyde, trichloro-	75–87–6	4	U034	5000 (2270)
Acetamide	60–35–5	3		100 (45.4)
Acetamide, N-(aminothioxomethyl)-	591–08–2	4	P002	1000 (454)
Acetamide, N-(4-ethoxyphenyl)-	62–44–2	4	U187	100 (45.4)
Acetamide, N-9H-fluoren-2-yl-	53–96–3	3,4	U005	1 (0.454)
Acetamide, 2-fluoro-	640–19–7	4	P057	100 (45.4)
Acetic acid	64–19–7	1		5000 (2270)
Acetic acid, (2,4-dichlorophenoxy)-, salts & esters	94–75–7	1,3,4	U240	100 (45.4)
Acetic acid, ethyl ester	141–78–6	4	U112	5000 (2270)
Acetic acid, fluoro-, sodium salt	62–74–8	4	P058	10 (4.54)
Acetic acid, lead(2+) salt	301–04–2	1,4	U144	10 (4.54)
Acetic acid, thallium(1+) salt	563–68–8	4	U214	100 (45.4)
Acetic acid, (2,4,5-trichlorophenoxy)-	93–76–5	1,4	See F027	1000 (454)
Acetic anhydride	108–24–7	1		5000 (2270)
Acetone	67–64–1	4	U002	5000 (2270)
Acetone cyanohydrin	75–86–5	1,4	P069	10 (4.54)
Acetonitrile	75–05–8	3,4	U003	5000 (2270)
Acetophenone	98–86–2	3,4	U004	5000 (2270)
2-Acetylaminofluorene	53–96–3	3,4	U005	1 (0.454)
Acetyl bromide	506–96–7	1		5000 (2270)
Acetyl chloride	75–36–5	1,4	U006	5000 (2270)
1-Acetyl-2-thiourea	591–08–2	4	P002	1000 (454)
Acrolein	107–02–8	1,2,3,4	P003	1 (0.454)
Acrylamide	79–06–1	3,4	U007	5000 (2270)
Acrylic acid	79–10–7	3,4	U008	5000 (2270)
Acrylonitrile	107–13–1	1,2,3,4	U009	100 (45.4)
Adipic acid	124–04–9	1		5000 (2270)
Aldicarb	116–06–3	4	P070	1 (0.454)
Aldrin	309–00–2	1,2,4	P004	1 (0.454)
Allyl alcohol	107–18–6	1,4	P005	100 (45.4)
Allyl chloride	107–05–1	1,3		1000 (454)
Aluminum phosphide	20859–73–8	4	P006	100 (45.4)
Aluminum sulfate	10043–01–3	1		5000 (2270)
4-Aminobiphenyl	92–67–1	3		1 (0.454)
5-(Aminomethyl)-3-isoxazolol	2763–96–4	4	P007	1000 (454)
4-Aminopyridine	504–24–5	4	P008	1000 (454)
Amitrole	61–82–5	4	U011	10 (4.54)
Ammonia	7664–41–7	1		100 (45.4)
Ammonium acetate	631–61–8	1		5000 (2270)
Ammonium benzoate	1863–63–4	1		5000 (2270)
Ammonium bicarbonate	1066–33–7	1		5000 (2270)
Ammonium bichromate	7789–09–5	1		10 (4.54)
Ammonium bifluoride	1341–49–7	1		100 (45.4)
Ammonium bisulfilte	10192–30–0	1		5000 (2270)
Ammonium carbamate	1111–78–0	1		5000 (2270)
Ammonium carbonate	506–87–6	1		5000 (2270)
Ammonium chloride	12125–02–9	1		5000 (2270)
Ammonium chromate	7788–98–9	1		10 (4.54)
Ammonium citrate, dibasic	3012–65–5	1		5000 (2270)
Ammonium fluoborate	13826–83–0	1		5000 (2270)
Ammonium fluoride	12125–01–8	1		100 (45.4)
Ammonium hydroxide	1336–21–6	1		1000 (454)
Ammonium oxalate	6009–70–7	1		5000 (2270)
	5972–73–6			
	14258–49–2			
Ammonium picrate	131–74–8	4	P009	10 (4.54)
Ammonium silicofluoride	16919–19–0	1		1000 (454)
Ammonium sulfamate	7773–06–0	1		5000 (2270)
Ammonium sulfide	12135–76–1	1		100 (45.4)
Ammonium sulfite	10196–04–0	1		5000 (2270)
Ammonium tartrate	14307–43–8	1		5000 (2270)
	3164–29–2			
Ammonium thiocyanate	1762–95–4	1		5000 (2270)
Ammonium vanadate	7803–55–6	4	P119	1000 (454)
Amyl acetate	628–63–7	1		5000 (2270)
iso-Amyl acetate	123–92–2			
sec-Amyl acetate	626–38–0			
tert-Amyl acetate	625–16–1			
Aniline	62–53–3	1,3,4	U012	5000 (2270)

TABLE 302.4—LIST OF HAZARDOUS SUBSTANCES AND REPORTABLE QUANTITIES—Continued

[Note: All Comments/Notes Are Located at the End of This Table]

Hazardous substance	CASRN	Statutory codedagger;	RCRA waste No.	Final RQ pounds (Kg)
o-Anisidine	90–04–0	3		100 (45.4)
Anthracene	120–12–7	2		5000 (2270)
Antimonydagger;dagger;	7440–36–0	2		5000 (2270)
ANTIMONY AND COMPOUNDS	N.A.	2,3		**
Antimony Compounds	N.A.	2,3		**
Antimony pentachloride	7647–18–9	1		1000 (454)
Antimony potassium tartrate	28300–74–5	1		100 (45.4)
Antimony tribromide	7789–61–9	1		1000 (454)
Antimony trichloride	10025–91–9	1		1000 (454)
Antimony trifluoride	7783–56–4	1		1000 (454)
Antimony trioxide	1309–64–4	1		1000 (454)
Argentate(1-), bis(cyano-C)-, potassium	506–61–6	4	P099	1 (0.454)
Aroclor 1016	12674–11–2	1,2,3		1 (0.454)
Aroclor 1221	11104–28–2	1,2,3		1 (0.454)
Aroclor 1232	11141–16–5	1,2,3		1 (0.454)
Aroclor 1242	53469–21–9	1,2,3		1 (0.454)
Aroclor 1248	12672–29–6	1,2,3		1 (0.454)
Aroclor 1254	11097–69–1	1,2,3		1 (0.454)
Aroclor 1260	11096–82–5	1,2,3		1 (0.454)
Aroclors	1336–36–3	1,2,3		1 (0.454)
Arsenicdagger;dagger;	7440–38–2	2,3		1 (0.454)
Arsenic acid H3AsO4	7778–39–4	4	P010	1 (0.454)
ARSENIC AND COMPOUNDS	N.A.	2,3		**
Arsenic Compounds (inorganic including arsine)	N.A.	2,3		**
Arsenic disulfide	1303–32–8	1		1 (0.454)
Arsenic oxide As2O3	1327–53–3	1,4	P012	1 (0.454)
Arsenic oxide As2O5	1303–28–2	1,4	P011	1 (0.454)
Arsenic pentoxide	1303–28–2	1,4	P011	1 (0.454)
Arsenic trichloride	7784–34–1	1		1 (0.454)
Arsenic trioxide	1327–53–3	1,4	P012	1 (0.454)
Arsenic trisulfide	1303–33–9	1		1 (0.454)
Arsine, diethyl-	692–42–2	4	P038	1 (0.454)
Arsinic acid, dimethyl-	75–60–5	4	U136	1 (0.454)
Arsonous dichloride, phenyl-	696–28–6	4	P036	1 (0.454)
Asbestosdagger;dagger;dagger;	1332–21–4	2,3		1 (0.454)
Auramine	492–80–8	4	U014	100 (45.4)
Azaserine	115–02–6	4	U015	1 (0.454)
Aziridine	151–56–4	3,4	P054	1 (0.454)
Aziridine, 2-methyl-	75–55–8	3,4	P067	1 (0.454)
Azirino[2',3':3,4]pyrrolo[1,2–a]indole-4,7-dione, 6-amino-8-[[(aminocarbonyl)oxy]methyl]-1,1a,2,8,8a,8b-hexahydro-8a-methoxy-5- methyl-,[1aS-(1aalpha,8beta,8aalpha, 8balpha)]-.	50–07–7	4	U010	10 (4.54)
Barium cyanide	542–62–1	1,4	P013	10 (4.54)
Benz[j]aceanthrylene, 1,2-dihydro-3-methyl-	56–49–5	4	U157	10 (4.54)
Benz[c]acridine	225–51–4	4	U016	100 (45.4)
Benzal chloride	98–87–3	4	U017	5000 (2270)
Benzamide, 3,5-dichloro-N-(1,1-dimethyl-2propynyl)-	23950–58–5	4	U192	5000 (2270)
Benz[a]anthracene	56–55–3	2,4	U018	10 (4.54)
1,2-Benzanthracene	56–55–3	2,4	U018	10 (4.54)
Benz[a]anthracene, 7,12-dimethyl-	57–97–6	4	U094	1 (0.454)
Benzenamine	62–53–3	1,3,4	U012	5000 (2270)
Benzenamine, 4,4'-carbonimidoylbis (N,N dimethyl-	492–80–8	4	U014	100 (45.4)
Benzenamine, 4-chloro-	106–47–8	4	P024	1000 (454)
Benzenamine, 4-chloro-2-methyl-, hydrochloride	3165–93–3	4	U049	100 (45.4)
Benzenamine, N,N-dimethyl-4-(phenylazo)-	60–11–7	3,4	U093	10 (4.54)
Benzenamine, 2-methyl-	95–53–4	3,4	U328	100 (45.4)
Benzenamine, 4-methyl-	106–49–0	4	U353	100 (45.4)
Benzenamine, 4,4'-methylenebis [2-chloro-	101–14–4	3,4	U158	10 (4.54)
Benzenamine, 2-methyl-,hydrochloride	636–21–5	4	U222	100 (45.4)
Benzenamine, 2-methyl-5-nitro-	99–55–8	4	U181	100 (45.4)
Benzenamine, 4-nitro-	100–01–6	4	P077	5000 (2270)
Benzene[a]	71–43–2	1,2,3,4	U019	10 (4.54)
Benzeneacetic acid, 4-chloro-α-(4-chlorophenyl)- α-hydroxy-, ethyl ester.	510–15–6	3,4	U038	10 (4.54)
Benzene, 1-bromo-4-phenoxy-	101–55–3	2,4	U030	100 (45.4)
Benzenebutanoic acid, 4-[bis(2- chloroethyl)amino]-	305–03–3	4	U035	10 (4.54)
Benzene, chloro-	108–90–7	1,2,3,4	U037	100 (45.4)
Benzene, (chloromethyl)-	100–44–7	1,3,4	P028	100 (45.4)

TABLE 302.4—LIST OF HAZARDOUS SUBSTANCES AND REPORTABLE QUANTITIES—Continued

[Note: All Comments/Notes Are Located at the End of This Table]

Hazardous substance	CASRN	Statutory codedagger;	RCRA waste No.	Final RQ pounds (Kg)
Benzenediamine, ar-methyl-	95–80–7 496–72–0 823–40–5 25376–45–8	3,4	U221	10 (4.54)
1,2-Benzenedicarboxylic acid, bis(2-ethylhexyl) ester	117–81–7	2,3,4	U028	100 (45.4)
1,2-Benzenedicarboxylic acid, dibutyl ester	84–74–2	1,2,3,4	U069	10 (4.54)
1,2-Benzenedicarboxylic acid, diethyl ester	84–66–2	2,4	U088	1000 (454)
1,2-Benzenedicarboxylic acid, dimethyl ester	131–11–3	2,3,4	U102	5000 (2270)
1,2-Benzenedicarboxylic acid, dioctyl ester	117–84–0	2,4	U107	5000 (2270)
Benzene, 1,2-dichloro-	95–50–1	1,2,4	U070	100 (45.4)
Benzene, 1,3-dichloro-	541–73–1	2,4	U071	100 (45.4)
Benzene, 1,4-dichloro-	106–46–7	1,2,3,4	U072	100 (45.4)
Benzene, 1,1'-(2,2-dichloroethylidene) bis[4-chloro-	72–54–8	1,2,4	U060	1 (0.454)
Benzene, (dichloromethyl)-	98–87–3	4	U017	5000 (2270)
Benzene, 1,3-diisocyanatomethyl-	91–08–7 584–84–9 26471–62–5	3,4	U223	100 (45.4)
Benzene, dimethyl-	1330–20–7	1,3,4	U239	100 (45.4)
1,3-Benzenediol	108–46–3	1,4	U201	5000 (2270)
1,2-Benzenediol,4-[1-hydroxy-2-(methyl amino)ethyl]-	51–43–4	4	P042	1000 (454)
Benzeneethanamine, alpha,alpha-dimethyl-	122–09–8	4	P046	5000 (2270)
Benzene, hexachloro-	118–74–1	2,3,4	U127	10 (4.54)
Benzene, hexahydro-	110–82–7	1,4	U056	1000 (454)
Benzene, methyl-	108–88–3	1,2,3,4	U220	1000 (454)
Benzene, 1-methyl-2,4-dinitro-	121–14–2	1,2,3,4	U105	10 (4.54)
Benzene, 2-methyl-1,3-dinitro-	606–20–2	1,2,4	U106	100 (45.4)
Benzene, (1-methylethyl)-	98–82–8	3,4	U055	5000 (2270)
Benzene, nitro-	98–95–3	1,2,3,4	U169	1000 (454)
Benzene, pentachloro-	608–93–5	4	U183	10 (4.54)
Benzene, pentachloronitro-	82–68–8	3,4	U185	100 (45.4)
Benzenesulfonic acid chloride	98–09–9	4	U020	100 (45.4)
Benzenesulfonyl chloride	98–09–9	4	U020	100 (45.4)
Benzene,1,2,4,5-tetrachloro-	95–94–3	4	U207	5000 (2270)
Benzenethiol	108–98–5	4	P014	100 (45.4)
Benzene,1,1'-(2,2,2-trichloroethylidene) bis[4-chloro-	50–29–3	1,2,4	U061	1 (0.454)
Benzene,1,1'-(2,2,2-trichloroethylidene) bis[4-methoxy-	72–43–5	1,3,4	U247	1 (0.454)
Benzene, (trichloromethyl)-	98–07–7	3,4	U023	10 (4.54)
Benzene, 1,3,5-trinitro-	99–35–4	4	U234	10 (4.54)
Benzidine	92–87–5	2,3,4	U021	1 (0.454)
1,2-Benzisothiazol-3(2H)-one, 1,1-dioxide, & salts	81–07–2	4	U202	100 (45.4)
Benzo[a]anthracene	56–55–3	2,4	U018	10 (4.54)
1,3-Benzodioxole, 5-(1-propenyl)-1	120–58–1	4	U141	100 (45.4)
1,3-Benzodioxole, 5-(2-propenyl)-	94–59–7	4	U203	100 (45.4)
1,3-Benzodioxole, 5-propyl-	94–58–6	4	U090	10 (4.54)
1,3-Benzodioxol-4-ol, 2,2-dimethyl-, (Bendiocarb phenol)	22961–82–6	4	U364	##
1,3-Benzodioxol-4-ol, 2,2-dimethyl-, methyl carbamate (Bendiocarb).	22781–23–3	4	U278	##
Benzo[b]fluoranthene	205–99–2	2		1 (0.454)
Benzo(k)fluoranthene	207–08–9	2		5000 (2270)
7-Benzofuranol, 2,3-dihydro-2,2-dimethyl- (Carbofuran phenol).	1563–38–8	4	U367	##
7-Benzofuranol, 2,3-dihydro-2,2- dimethyl-, methylcarbamate.	1563–66–2	1,4	P127	10 (4.54)
Benzoic acid	65–85–0	1		5000 (2270)
Benzoic acid, 2-hydroxy-, compd. with (3aS- cis)-1,2,3,3a,8,8a- hexahydro-1,3a,8- trimethylpyrrolo [2,3-b]indol-5-yl methylcarbamate ester (1:1) (Physostigmine salicylate).	57–64–7	4	P188	##
Benzonitrile	100–47–0	1		5000 (2270)
Benzo[rst]pentaphene	189–55–9	4	U064	10 (4.54)
Benzo[ghi]perylene	191–24–2	2		5000 (2270)
2H-1-Benzopyran-2-one, 4-hydroxy-3-(3-oxo- 1-phenylbutyl)-, & salts.	81–81–2	4	P001 U248	100 (45.4)
Benzo[a]pyrene	50–32–8	2,4	U022	1 (0.454)
3,4-Benzopyrene	50–32–8	2,4	U022	1 (0.454)
ρ-Benzoquinone	106–51–4	3,4	U197	10 (4.54)
Benzotrichloride	98–07–7	3,4	U023	10 (4.54)
Benzoyl chloride	98–88–4	1		1000 (454)
Benzyl chloride	100–44–7	1,3,4	P028	100 (45.4)

TABLE 302.4—LIST OF HAZARDOUS SUBSTANCES AND REPORTABLE QUANTITIES—Continued

[Note: All Comments/Notes Are Located at the End of This Table]

Hazardous substance	CASRN	Statutory codedagger;	RCRA waste No.	Final RQ pounds (Kg)
Beryllium dagger;dagger;	7440–41–7	2,3,4	P015	10 (4.54)
BERYLLIUM AND COMPOUNDS	N.A.	2,3		**
Beryllium chloride	7787–47–5	1		1 (0.454)
Beryllium compounds	N.A.	2,3		**
Beryllium fluoride	7787–49–7	1		1 (0.454)
Beryllium nitrate	13597–99–4 7787–55–5	1		1 (0.454)
Beryllium powder dagger;dagger;	7440–41–7	2,3,4	P015	10 (4.54)
alpha-BHC	319–84–6	2		10 (4.54)
beta-BHC	319–85–7	2		1 (0.454)
delta-BHC	319–86–8	2		1 (0.454)
gamma-BHC	58–89–9	1,2,3,4	U129	1 (0.454)
2,2′-Bioxirane	1464–53–5	4	U085	10 (4.54)
Biphenyl	92–52–4	3		100 (45.4)
[1,1′-Biphenyl]-4,4′-diamine	92–87–5	2,3,4	U021	1 (0.454)
[1,1′-Biphenyl]-4,4′-diamine,3,3′-dichloro-	91–94–1	2,3,4	U073	1 (0.454)
[1,1′-Biphenyl]-4,4′-diamine,3,3′-dimethoxy-	119–90–4	3,4	U091	100 (45.4)
[1,1′-Biphenyl]-4,4′-diamine,3,3′-dimethyl-	119–93–7	3,4	U095	10 (4.54)
Bis(2-chloroethoxy) methane	111–91–1	2,4	U024	1000 (454)
Bis(2-chloroethyl) ether	111–44–4	2,3,4	U025	10 (4.54)
Bis(chloromethyl) ether	542–88–1	2,3,4	P016	10 (4.54)
Bis(2-ethylhexyl) phthalate	117–81–7	3,4	U028	100 (45.4)
Bromoacetone	598–31–2	4	P017	1000 (454)
Bromoform	75–25–2	2,3,4	U225	100 (45.4)
Bromomethane	74–83–9	2,3,4	U029	1000 (454)
4-Bromophenyl phenyl ether	101–55–3	2,4	U030	100 (45.4)
Brucine	357–57–3	4	P018	100 (45.4)
1,3-Butadiene	106–99–0	3		10 (4.54)
1,3-Butadiene, 1,1,2,3,4,4-hexachloro-	87–68–3	2,3,4	U128	1 (0.454)
1-Butanamine, N-butyl-N-nitroso-	924–16–3	4	U172	10 (4.54)
1-Butanol	71–36–3	4	U031	5000 (2270)
2-Butanone	78–93–3	3,4	U159	5000 (2270)
2-Butanone, 3,3-dimethyl-1(methylthio)-, O-[(methylamino)carbonyl] oxime.	39196–18–4	4	P045	100 (45.4)
2-Butanone peroxide	1338–23–4	4	U160	10 (4.54)
2-Butenal	123–73–9 4170–30–3	1,4	U053	100 (45.4)
2-Butene, 1,4-dichloro-	764–41–0	4	U074	1 (0.454)
2-Butenoic acid, 2-methyl-, 7-[[2,3-dihydroxy-2-(1-methoxyethyl)-3- methyl-1-oxobutoxy] methyl]-2,3, 5,7a-tetrahydro- 1H-pyrrolizin-1-yl ester, [1S-[1alpha(Z), 7(2S*,3R*),7aalpha]]-.	303–34–4	4	U143	10 (4.54)
Butyl acetate	123–86–4	1		5000 (2270)
iso-Butyl acetate	110–19–0			
sec-Butyl acetate	105–46–4			
tert-Butyl acetate	540–88–5			
n-Butyl alcohol	71–36–3	4	U031	5000 (2270)
Butylamine	109–73–9	1		1000 (454)
iso-Butylamine	78–81–9			
sec-Butylamine	513–49–5 13952–84–6			
tert-Butylamine	75–64–9			
Butyl benzyl phthalate	85–68–7	2		100 (45.4)
n-Butyl phthalate	84–74–2	1,2,3,4	U069	10 (4.54)
Butyric acid	107–92–6	1		5000 (2270)
iso-Butyric acid	79–31–2			
Cacodylic acid	75–60–5	4	U136	1 (0.454)
Cadmium dagger;dagger;	7440–43–9	2		10 (4.54)
Cadmium acetate	543–90–8	1		10 (4.54)
CADMIUM AND COMPOUNDS	N.A.	2,3		**
Cadmium bromide	7789–42–6	1		10 (4.54)
Cadmium chloride	10108–64–2	1		10 (4.54)
Cadmium compounds	N.A.	2,3		**
Calcium arsenate	7778–44–1	1		1 (0.454)
Calcium arsenite	52740–16–6	1		1 (0.454)
Calcium carbide	75–20–7	1		10 (4.54)
Calcium chromate	13765–19–0	1,4	U032	10 (4.54)
Calcium cyanamide	156–62–7	3		1000 (454)
Calcium cyanide Ca(CN)2	592–01–8	1,4	P021	10 (4.54)

TABLE 302.4—LIST OF HAZARDOUS SUBSTANCES AND REPORTABLE QUANTITIES—Continued

[Note: All Comments/Notes Are Located at the End of This Table]

Hazardous substance	CASRN	Statutory codedagger;	RCRA waste No.	Final RQ pounds (Kg)
Calcium dodecylbenzenesulfonate	26264–06–2	1		1000 (454)
Calcium hypochlorite	7778–54–3	1		10 (4.54)
Captan	133–06–2	1,3		10 (4.54)
Carbamic acid, 1H-benzimidazol-2-yl, methyl ester (Carbendazim).	10605–21–7	4	U372	##
Carbamic acid, [1-[(butylamino)carbonyl]-1H-benzimidazol-2-yl]-, methyl ester (Benomyl).	17804–35–2	4	U271	##
Carbamic acid, (3-chlorophenyl)-, 4-chloro-2-butynyl ester (Barban).	101–27–9	4	U280	##
Carbamic acid, [(dibutylamino)thio]methyl-, 2,3-dihydro-2,2-dimethyl-7-benzofuranyl ester (Carbosulfan).	55285–14–8	4	P189	##
Carbamic acid, dimethyl-,1-[(dimethylamino)carbonyl]-5-methyl-1H-pyrazol-3-yl ester (Dimetilan).	644–64–4	4	P191	##
Carbamic acid, dimethyl-, 3-methyl-1-(1-methylethyl)-1H-pyrazol-5-yl ester (Isolan).	119–38–0	4	P192	##
Carbamic acid, ethyl ester	51–79–6	3,4	U238	100 (45.4)
Carbamic acid, methyl-, 3-methylphenyl ester (Metolcarb)	1129–41–5	4	P190	##
Carbamic acid, methylnitroso-, ethyl ester	615–53–2	4	U178	1 (0.454)
Carbamic acid, [1,2-phenylenebis(iminocarbonothioyl)] bis-, dimethyl ester (Thiophanate-methyl).	23564–05–8	4	U409	##
Carbamic acid, phenyl-, 1-methylethyl ester (Propham)	122–42–9	4	U373	##
Carbamic chloride, dimethyl-	79–44–7	3,4	U097	1 (0.454)
Carbamodithioic acid, 1,2-ethanediylbis-, salts & esters	111–54–6	4	U114	5000 (2270)
Carbamothioic acid, bis(1-methylethyl)-, S-(2,3-dichloro-2-propenyl) ester.	2303–16–4	4	U062	100 (45.4)
Carbamothioic acid, bis(1-methylethyl)-, S-(2,3,3-trichloro-2- propenyl) ester (Triallate).	2303–17–5	4	U389	##
Carbamothioic acid, dipropyl-, S - (phenylmethyl) ester (Prosulfocarb).	52888–80–9	4	U387	##
Carbaryl	63–25–2	1,3,4	U279	100 (45.4)
Carbofuran	1563–66–2	1,4	P127	10 (4.54)
Carbon disulfide	75–15–0	1,3,4	P022	100 (45.4)
Carbonic acid, dithallium(1+) salt	6533–73–9	4	U215	100 (45.4)
Carbonic dichloride	75–44–5	1,3,4	P095	10 (4.54)
Carbonic difluoride	353–50–4	4	U033	1000 (454)
Carbonochloridic acid, methyl ester	79–22–1	4	U156	1000 (454)
Carbon oxyfluoride	353–50–4	4	U033	1000 (454)
Carbon tetrachloride	56–23–5	1,2,3,4	U211	10 (4.54)
Carbonyl sulfide	463–58–1	3		100 (45.4)
Catechol	120–80–9	3		100 (45.4)
Chloral	75–87–6	4	U034	5000 (2270)
Chloramben	133–90–4	3		100 (45.4)
Chlorambucil	305–03–3	4	U035	10 (4.54)
Chlordane	57–74–9	1,2,3,4	U036	1 (0.454)
Chlordane, alpha & gamma isomers	57–74–9	1,2,3,4	U036	1 (0.454)
CHLORDANE (TECHNICAL MIXTURE AND METABOLITES).	57–74–9	1,2,3,4	U036	1 (0.454)
CHLORINATED BENZENES	N.A.	2		**
Chlorinated camphene	8001–35–2	1,2,3,4	P123	1 (0.454)
CHLORINATED ETHANES	N.A.	2		**
CHLORINATED NAPHTHALENE	N.A.	2		**
CHLORINATED PHENOLS	N.A.	2		**
Chlorine	7782–50–5	1,3		10 (4.54)
Chlornaphazine	494–03–1	4	U026	100 (45.4)
Chloroacetaldehyde	107–20–0	4	P023	1000 (454)
Chloroacetic acid	79–11–8	3		100 (45.4)
2-Chloroacetophenone	532–27–4	3		100 (45.4)
CHLOROALKYL ETHERS	N.A.	2		**
p-Chloroaniline	106–47–8	4	P024	1000 (454)
Chlorobenzene	108–90–7	1,2,3,4	U037	100 (45.4)
Chlorobenzilate	510–15–6	3,4	U038	10 (4.54)
p-Chloro-m-cresol	59–50–7	2,4	U039	5000 (2270)
Chlorodibromomethane	124–48–1	2		100 (45.4)
1-Chloro-2,3-epoxypropane	106–89–8	1,3,4	U041	100 (45.4)
Chloroethane	75–00–3	2,3		100 (45.4)
2-Chloroethyl vinyl ether	110–75–8	2,4	U042	1000 (454)
Chloroform	67–66–3	1,2,3,4	U044	10 (4.54)
Chloromethane	74–87–3	2,3,4	U045	100 (45.4)
Chloromethyl methyl ether	107–30–2	3,4	U046	10 (4.54)

TABLE 302.4—LIST OF HAZARDOUS SUBSTANCES AND REPORTABLE QUANTITIES—Continued

[Note: All Comments/Notes Are Located at the End of This Table]

Hazardous substance	CASRN	Statutory codedagger;	RCRA waste No.	Final RQ pounds (Kg)
beta-Chloronaphthalene	91–58–7	2,4	U047	5000 (2270)
2-Chloronaphthalene	91–58–7	2,4	U047	5000 (2270)
2-Chlorophenol	95–57–8	2,4	U048	100 (45.4)
o-Chlorophenol	95–57–8	2,4	U048	100 (45.4)
4-Chlorophenyl phenyl ether	7005–72–3	2		5000 (2270)
1-(o-Chlorophenyl)thiourea	5344–82–1	4	P026	100 (45.4)
Chloroprene	126–99–8	3		100 (45.4)
3-Chloropropionitrile	542–76–7	4	P027	1000 (454)
Chlorosulfonic acid	7790–94–5	1		1000 (454)
4-Chloro-o-toluidine, hydrochloride	3165–93–3	4	U049	100 (45.4)
Chlorpyrifos	2921–88–2	1		1 (0.454)
Chromic acetate	1066–30–4	1		1000 (454)
Chromic acid	11115–74–5 7738–94–5	1		10 (4.54)
Chromic acid H2CrO4, calcium salt	13765–19–0	1,4	U032	10 (4.54)
Chromic sulfate	10101–53–8	1		1000 (454)
Chromium dagger;dagger;	7440–47–3	2		5000 (2270)
CHROMIUM AND COMPOUNDS	N.A.	2,3		**
Chromium Compounds	N.A.	2,3		**
Chromous chloride	10049–05–5	1		1000 (454)
Chrysene	218–01–9	2,4	U050	100 (45.4)
Cobalt Compounds	N.A.	3		**
Cobaltous bromide	7789–43–7	1		1000 (454)
Cobaltous formate	544–18–3	1		1000 (454)
Cobaltous sulfamate	14017–41–5	1		1000 (454)
Coke Oven Emissions	N.A.	3		1 (0.454)
Copper dagger;dagger;	7440–50–8	2		5000 (2270)
COPPER AND COMPOUNDS	N.A.	2		**
Copper cyanide Cu(CN)	544–92–3	4	P029	10 (4.54)
Coumaphos	56–72–4	1		10 (4.54)
Creosote	N.A.	4	U051	1 (0.454)
Cresol (cresylic acid)	1319–77–3	1,3,4	U052	100 (45.4)
m-Cresol	108–39–4	3		100 (45.4)
o-Cresol	95–48–7	3		100 (45.4)
p-Cresol	106–44–5	3		100 (45.4)
Cresols (isomers and mixture)	1319–77–3	1,3,4	U052	100 (45.4)
Cresylic acid (isomers and mixture)	1319–77–3	1,3,4	U052	100 (45.4)
Crotonaldehyde	123–73–9 4170–30–3	1,4	U053	100 (45.4)
Cumene	98–82–8	3,4	U055	5000 (2270)
Cupric acetate	142–71–2	1		100 (45.4)
Cupric acetoarsenite	12002–03–8	1		1 (0.454)
Cupric chloride	7447–39–4	1		10 (4.54)
Cupric nitrate	3251–23–8	1		100 (45.4)
Cupric oxalate	5893–66–3	1		100 (45.4)
Cupric sulfate	7758–98–7	1		10 (4.54)
Cupric sulfate, ammoniated	10380–29–7	1		100 (45.4)
Cupric tartrate	815–82–7	1		100 (45.4)
Cyanide Compounds	N.A.	2,3		**
CYANIDES	N.A.	2,3		**
Cyanides (soluble salts and complexes) not otherwise specified.	N.A.	4	P030	10 (4.54)
Cyanogen	460–19–5	4	P031	100 (45.4)
Cyanogen bromide (CN)Br	506–68–3	4	U246	1000 (454)
Cyanogen chloride (CN)Cl	506–77–4	1,4	P033	10 (4.54)
2,5-Cyclohexadiene-1,4-dione	106–51–4	3,4	U197	10 (4.54)
Cyclohexane	110–82–7	1,4	U056	1000 (454)
Cyclohexane, 1,2,3,4,5,6-hexachloro-, (1α, 2α, 3β–, 4α, 5α, 6β).	58–89–9	1,2,3,4	U129	1 (0.454)
Cyclohexanone	108–94–1	4	U057	5000 (2270)
2-Cyclohexyl-4,6-dinitrophenol	131–89–5	4	P034	100 (45.4)
1,3-Cyclopentadiene, 1,2,3,4,5,5-hexachloro-	77–47–4	1,2,3,4	U130	10 (4.54)
Cyclophosphamide	50–18–0	4	U058	10 (4.54)
2,4-D Acid	94–75–7	1,3,4	U240	100 (45.4)

TABLE 302.4—LIST OF HAZARDOUS SUBSTANCES AND REPORTABLE QUANTITIES—Continued

[Note: All Comments/Notes Are Located at the End of This Table]

Hazardous substance	CASRN	Statutory codedagger;	RCRA waste No.	Final RQ pounds (Kg)
2,4-D Ester	94–11–1	1		100 (45.4)
	94–79–1			
	94–80–4			
	1320–18–9			
	1928–38–7			
	1928–61–6			
	1929–73–3			
	2971–38–2			
	25168–26–7			
	53467–11–1			
2,4-D, salts and esters	94–75–7	1,3,4	U240	100 (45.4)
Daunomycin	20830–81–3	4	U059	10 (4.54)
DDD	72–54–8	1,2,4	U060	1 (0.454)
4,4′-DDD	72–54–8	1,2,4	U060	1 (0.454)
DDE [b]	72–55–9	2		1 (0.454)
DDE [b]	3547–04–4	3		5000 (2270)
4,4′-DDE	72–55–9	2		1 (0.454)
DDT	50–29–3	1,2,4	U061	1 (0.454)
4,4′-DDT	50–29–3	1,2,4	U061	1 (0.454)
DDT AND METABOLITES	N.A.	2		**
DEHP	117–81–7	2,3,4	U028	100 (45.4)
Diallate	2303–16–4	4	U062	100 (45.4)
Diazinon	333–41–5	1		1 (0.454)
Diazomethane	334–88–3	3		100 (45.4)
Dibenz[a,h]anthracene	53–70–3	2,4	U063	1 (0.454)
1,2:5,6-Dibenzanthracene	53–70–3	2,4	U063	1 (0.454)
Dibenzo[a,h]anthracene	53–70–3	2,4	U063	1 (0.454)
Dibenzofuran	132–64–9	3		100 (45.4)
Dibenzo[a,i]pyrene	189–55–9	4	U064	10 (4.54)
1,2-Dibromo-3-chloropropane	96–12–8	3,4	U066	1 (0.454)
Dibromoethane	106–93–4	1,3,4	U067	1 (0.454)
Dibutyl phthalate	84–74–2	1,2,3,4	U069	10 (4.54)
Di-n-butyl phthalate	84–74–2	1,2,3,4	U069	10 (4.54)
Dicamba	1918–00–9	1		1000 (454)
Dichlobenil	1194–65–6	1		100 (45.4)
Dichlone	117–80–6	1		1 (0.454)
Dichlorobenzene	25321–22–6	1		100 (45.4)
1,2-Dichlorobenzene	95–50–1	1,2,4	U070	100 (45.4)
1,3-Dichlorobenzene	541–73–1	2,4	U071	100 (45.4)
1,4-Dichlorobenzene	106–46–7	1,2,3,4	U072	100 (45.4)
m-Dichlorobenzene	541–73–1	2,4	U071	100 (45.4)
o-Dichlorobenzene	95–50–1	1,2,4	U070	100 (45.4)
p-Dichlorobenzene	106–46–7	1,2,3,4	U072	100 (45.4)
DICHLOROBENZIDINE	N.A.	2		**
3,3′-Dichlorobenzidine	91–94–1	2,3,4	U073	1 (0.454)
Dichlorobromomethane	75–27–4	2		5000 (2270)
1,4-Dichloro-2-butene	764–41–0	4	U074	1 (0.454)
Dichlorodifluoromethane	75–71–8	4	U075	5000 (2270)
1,1-Dichloroethane	75–34–3	2,3,4	U076	1000 (454)
1,2-Dichloroethane	107–06–2	1,2,3,4	U077	100 (45.4)
1,1-Dichloroethylene	75–35–4	1,2,3,4	U078	100 (45.4)
1,2-Dichloroethylene	156–60–5	2,4	U079	1000 (454)
Dichloroethyl ether	111–44–4	2,3,4	U025	10 (4.54)
Dichloroisopropyl ether	108–60–1	2,4	U027	1000 (454)
Dichloromethane	75–09–2	2,3,4	U080	1000 (454)
Dichloromethoxyethane	111–91–1	2,4	U024	1000 (454)
Dichloromethyl ether	542–88–1	2,3,4	P016	10 (4.54)
2,4-Dichlorophenol	120–83–2	2,4	U081	100 (45.4)
2,6-Dichlorophenol	87–65–0	4	U082	100 (45.4)
Dichlorophenylarsine	696–28–6	4	P036	1 (0.454)
Dichloropropane	26638–19–7	1		1000 (454)
1,1-Dichloropropane	78–99–9			
1,3-Dichloropropane	142–28–9			
1,2-Dichloropropane	78–87–5	1,2,3,4	U083	1000 (454)
Dichloropropane—Dichloropropene (mixture)	8003–19–8	1		100 (45.4)
Dichloropropene	26952–23–8	1		100 (45.4)
2,3-Dichloropropene	78–88–6			
1,3-Dichloropropene	542–75–6	1,2,3,4	U084	100 (45.4)
2,2-Dichloropropionic acid	75–99–0	1		5000 (2270)

TABLE 302.4—LIST OF HAZARDOUS SUBSTANCES AND REPORTABLE QUANTITIES—Continued

[Note: All Comments/Notes Are Located at the End of This Table]

Hazardous substance	CASRN	Statutory codedagger;	RCRA waste No.	Final RQ pounds (Kg)
Dichlorvos	62–73–7	1,3		10 (4.54)
Dicofol	115–32–2	1		10 (4.54)
Dieldrin	60–57–1	1,2,4	P037	1 (0.454)
1,2:3,4-Diepoxybutane	1464–53–5	4	U085	10 (4.54)
Diethanolamine	111–42–2	3		100 (45.4)
Diethylamine	109–89–7	1		100 (45.4)
N,N-Diethylaniline	91–66–7	3		1000 (454)
Diethylarsine	692–42–2	4	P038	1 (0.454)
1,4-Diethyleneoxide	123–91–1	3,4	U108	100 (45.4)
Diethylhexyl phthalate	117–81–7	2,3,4	U028	100 (45.4)
N,N′-Diethylhydrazine	1615–80–1	4	U086	10 (4.54)
O,O-Diethyl S-methyl dithiophosphate	3288–58–2	4	U087	5000 (2270)
Diethyl-p-nitrophenyl phosphate	311–45–5	4	P041	100 (45.4)
Diethyl phthalate	84–66–2	2,4	U088	1000 (454)
O,O-Diethyl O-pyrazinyl phosphorothioate	297–97–2	4	P040	100 (45.4)
Diethylstilbestrol	56–53–1	4	U089	1 (0.454)
Diethyl sulfate	64–67–5	3		10 (4.54)
Dihydrosafrole	94–58–6	4	U090	10 (4.54)
Diisopropylfluorophosphate (DFP)	55–91–4	4	P043	100 (45.4)
1,4:5,8-Dimethanonaphthalene, 1,2,3,4,10,10-hexachloro-1,4,4a,5,8,8a-hexahydro-, (1alpha,4alpha,4abeta,5alpha, 8alpha,8abeta)-.	309–00–2	1,2,4	P004	1 (0.454)
1,4:5,8-Dimethanonaphthalene, 1,2,3,4,10,10-hexachloro-1,4,4a,5,8,8a-hexahydro-, (1alpha,4alpha,4abeta, 5beta,8beta,8abeta)-.	465–73–6	4	P060	1 (0.454)
2,7:3,6-Dimethanonaphth[2,3- b]oxirene,3,4,5,6,9,9-hexachloro-1a,2,2a,3,6,6a,7,7a- octahydro-,(1aalpha,2beta, 2aalpha,3beta,6beta,6aalpha, 7beta,7aalpha)-.	60–57–1	1,2,4	P037	1 (0.454)
2,7:3,6-Dimethanonaphth[2, 3-b]oxirene,3,4,5,6,9,9-hexachloro-1a,2,2a,3,6,6a,7,7a- octahydro-,(1aalpha,2beta, 2abeta,3alpha,6alpha, 6abeta,7beta,7aalpha)-, & metabolites.	72–20–8	1,2,4	P051	1 (0.454)
Dimethoate	60–51–5	4	P044	10 (4.54)
3,3′-Dimethoxybenzidine	119–90–4	3,4	U091	100 (45.4)
Dimethylamine	124–40–3	1,4	U092	1000 (454)
Dimethyl aminoazobenzene	60–11–7	3,4	U093	10 (4.54)
p-Dimethylaminoazobenzene	60–11–7	3,4	U093	10 (4.54)
N,N-Dimethylaniline	121–69–7	3		100 (45.4)
7,12-Dimethylbenz[a]anthracene	57–97–6	4	U094	1 (0.454)
3,3′-Dimethylbenzidine	119–93–7	3,4	U095	10 (4.54)
alpha,alpha-Dimethylbenzylhydroperoxide	80–15–9	4	U096	10 (4.54)
Dimethylcarbamoyl chloride	79–44–7	3,4	U097	1 (0.454)
Dimethylformamide	68–12–2	3		100 (45.4)
1,1-Dimethylhydrazine	57–14–7	3,4	U098	10 (4.54)
1,2-Dimethylhydrazine	540–73–8	4	U099	1 (0.454)
alpha,alpha-Dimethylphenethylamine	122–09–8	4	P046	5000 (2270)
2,4-Dimethylphenol	105–67–9	2,4	U101	100 (45.4)
Dimethyl phthalate	131–11–3	2,3,4	U102	5000 (2270)
Dimethyl sulfate	77–78–1	3,4	U103	100 (45.4)
Dinitrobenzene (mixed)	25154–54–5	1		100 (45.4)
m-Dinitrobenzene	99–65–0			
o-Dinitrobenzene	528–29–0			
p-Dinitrobenzene	100–25–4			
4,6-Dinitro-o-cresol, and salts	534–52–1	2,3,4	P047	10 (4.54)
Dinitrophenol	25550–58–7	1		10 (4.54)
2,5-Dinitrophenol	329–71–5			
2,6-Dinitrophenol	573–56–8			
2,4-Dinitrophenol	51–28–5	1,2,3,4	P048	10 (4.54)
Dinitrotoluene	25321–14–6	1,2		10 (4.54)
3,4-Dinitrotoluene	610–39–9			
2,4-Dinitrotoluene	121–14–2	1,2,3,4	U105	10 (4.54)
2,6-Dinitrotoluene	606–20–2	1,2,4	U106	100 (45.4)
Dinoseb	88–85–7	4	P020	1000 (454)
Di-n-octyl phthalate	117–84–0	2,4	U107	5000 (2270)
1,4-Dioxane	123–91–1	3,4	U108	100 (45.4)
DIPHENYLHYDRAZINE	N.A.	2		**
1,2-Diphenylhydrazine	122–66–7	2,3,4	U109	10 (4.54)
Diphosphoramide, octamethyl-	152–16–9	4	P085	100 (45.4)

TABLE 302.4—LIST OF HAZARDOUS SUBSTANCES AND REPORTABLE QUANTITIES—Continued

[Note: All Comments/Notes Are Located at the End of This Table]

Hazardous substance	CASRN	Statutory codedagger;	RCRA waste No.	Final RQ pounds (Kg)
Diphosphoric acid, tetraethyl ester	107–49–3	1,4	P111	10 (4.54)
Dipropylamine	142–84–7	4	U110	5000 (2270)
Di-n-propylnitrosamine	621–64–7	2,4	U111	10 (4.54)
Diquat	85–00–7 2764–72–9	1		1000 (454)
Disulfoton	298–04–4	1,4	P039	1 (0.454)
Dithiobiuret	541–53–7	4	P049	100 (45.4)
1,3-Dithiolane-2- carboxaldehyde, 2,4- dimethyl-O-[(methylamino)carbonyl] oxime (Tirpate).	26419–73–8	4	P185	##
Diuron	330–54–1	1		100 (45.4)
Dodecylbenzenesulfonic acid	27176–87–0	1		1000 (454)
Endosulfan	115–29–7	1,2,4	P050	1 (0.454)
alpha-Endosulfan	959–98–8	2		1 (0.454)
beta-Endosulfan	33213–65–9	2		1 (0.454)
ENDOSULFAN AND METABOLITES	N.A.	2		**
Endosulfan sulfate	1031–07–8	2		1 (0.454)
Endothall	145–73–3	4	P088	1000 (454)
Endrin	72–20–8	1,2,4	P051	1 (0.454)
Endrin aldehyde	7421–93–4	2		1 (0.454)
ENDRIN AND METABOLITES	N.A.	2		**
Endrin, & metabolites	72–20–8	1,2,4	P051	1 (0.454)
Epichlorohydrin	106–89–8	1,3,4	U041	100 (45.4)
Epinephrine	51–43–4	4	P042	1000 (454)
1,2-Epoxybutane	106–88–7	3		100 (45.4)
Ethanal	75–07–0	1,3,4	U001	1000 (454)
Ethanamine, N,N-diethyl-	121–44–8	1,3,4	U404	5000 (2270)
Ethanamine, N-ethyl-N-nitroso-	55–18–5	4	U174	1 (0.454)
1,2-Ethanediamine, N,N-dimethyl-N′-2- pyridinyl-N′-(2-thienylmethyl)-.	91–80–5	4	U155	5000 (2270)
Ethane, 1,2-dibromo-	106–93–4	1,3,4	U067	1 (0.454)
Ethane, 1,1-dichloro-	75–34–3	2,3,4	U076	1000 (454)
Ethane, 1,2-dichloro-	107–06–2	1,2,3,4	U077	100 (45.4)
Ethanedinitrile	460–19–5	4	P031	100 (45.4)
Ethane, hexachloro-	67–72–1	2,3,4	U131	100 (45.4)
Ethane, 1,1′-[methylenebis(oxy)]bis[2- chloro-	111–91–1	2,4	U024	1000 (454)
Ethane, 1,1′-oxybis-	60–29–7	4	U117	100 (45.4)
Ethane, 1,1′-oxybis[2-chloro-	111–44–4	2,3,4	U025	10 (4.54)
Ethane, pentachloro-	76–01–7	4	U184	10 (4.54)
Ethane, 1,1,1,2-tetrachloro-	630–20–6	4	U208	100 (45.4)
Ethane, 1,1,2,2-tetrachloro-	79–34–5	2,3,4	U209	100 (45.4)
Ethanethioamide	62–55–5	4	U218	10 (4.54)
Ethane, 1,1,1-trichloro-	71–55–6	2,3,4	U226	1000 (454)
Ethane, 1,1,2-trichloro-	79–00–5	2,3,4	U227	100 (45.4)
Ethanimidothioic acid, 2-(dimethylamino)-N-hydroxy-2-oxo-, methyl ester (A2213).	30558–43–1	4	U394	##
Ethanimidothioic acid, 2-(dimethylamino)-N-[[(methylamino)carbonyl]oxy]-2-oxo-, methyl ester (Oxamyl).	23135–22–0	4	P194	##
Ethanimidothioic acid, N-[[(methylamino) carbonyl]oxy]-, methyl ester.	16752–77–5	4	P066	100 (45.4)
Ethanimidothioic acid, N,N′[thiobis[(methylimino) carbonyloxy]]bis-, dimethyl ester (Thiodicarb).	59669–26–0	4	U410	##
Ethanol, 2-ethoxy-	110–80–5	4	U359	1000 (454)
Ethanol, 2,2′-(nitrosoimino)bis-	1116–54–7	4	U173	1 (0.454)
Ethanol, 2,2′-oxybis-, dicarbamate (Diethylene glycol, dicarbamate).	5952–26–1	4	U395	##
Ethanone, 1-phenyl-	98–86–2	3,4	U004	5000 (2270)
Ethene, chloro-	75–01–4	2,3,4	U043	1 (0.454)
Ethene, (2-chloroethoxy)-	110–75–8	2,4	U042	1000 (454)
Ethene, 1,1-dichloro-	75–35–4	1,2,3,4	U078	100 (45.4)
Ethene, 1,2-dichloro-(E)	156–60–5	2,4	U079	1000 (454)
Ethene, tetrachloro-	127–18–4	2,3,4	U210	100 (45.4)
Ethene, trichloro-	79–01–6	1,2,3,4	U228	100 (45.4)
Ethion	563–12–2	1		10 (4.54)
Ethyl acetate	141–78–6	4	U112	5000 (2270)
Ethyl acrylate	140–88–5	3,4	U113	1000 (454)
Ethylbenzene	100–41–4	1,2,3		1000 (454)
Ethyl carbamate	51–79–6	3,4	U238	100 (45.4)
Ethyl chloride	75–00–3	2,3		100 (45.4)

TABLE 302.4—LIST OF HAZARDOUS SUBSTANCES AND REPORTABLE QUANTITIES—Continued

[Note: All Comments/Notes Are Located at the End of This Table]

Hazardous substance	CASRN	Statutory codedagger;	RCRA waste No.	Final RQ pounds (Kg)
Ethyl cyanide	107–12–0	4	P101	10 (4.54)
Ethylenebisdithiocarbamic acid, salts & esters	111–54–6	4	U114	5000 (2270)
Ethylenediamine	107–15–3	1		5000 (2270)
Ethylenediamine-tetraacetic acid (EDTA)	60–00–4	1		5000 (2270)
Ethylene dibromide	106–93–4	1,3,4	U067	1 (0.454)
Ethylene dichloride	107–06–2	1,2,3,4	U077	100 (45.4)
Ethylene glycol	107–21–1	3		5000 (2270)
Ethylene glycol monoethyl ether	110–80–5	4	U359	1000 (454)
Ethylene oxide	75–21–8	3,4	U115	10 (4.54)
Ethylenethiourea	96–45–7	3,4	U116	10 (4.54)
Ethylenimine	151–56–4	3,4	P054	1 (0.454)
Ethyl ether	60–29–7	4	U117	100 (45.4)
Ethylidene dichloride	75–34–3	2,3,4	U076	1000 (454)
Ethyl methacrylate	97–63–2	4	U118	1000 (454)
Ethyl methanesulfonate	62–50–0	4	U119	1 (0.454)
Famphur	52–85–7	4	P097	1000 (454)
Ferric ammonium citrate	1185–57–5	1		1000 (454)
Ferric ammonium oxalate	2944–67–4 55488–87–4	1		1000 (454)
Ferric chloride	7705–08–0	1		1000 (454)
Ferric fluoride	7783–50–8	1		100 (45.4)
Ferric nitrate	10421–48–4	1		1000 (454)
Ferric sulfate	10028–22–5	1		1000 (454)
Ferrous ammonium sulfate	10045–89–3	1		1000 (454)
Ferrous chloride	7758–94–3	1		100 (45.4)
Ferrous sulfate	7720–78–7 7782– 63–0	1		1000 (454)
Fine mineral fibers[c]	N.A.	3		**
Fluoranthene	206–44–0	2,4	U120	100 (45.4)
Fluorene	86–73–7	2		5000 (2270)
Fluorine	7782–41–4	4	P056	10 (4.54)
Fluoroacetamide	640–19–7	4	P057	100 (45.4)
Fluoroacetic acid, sodium salt	62–74–8	4	P058	10 (4.54)
Formaldehyde	50–00–0	1,3,4	U122	100 (45.4)
Formic acid	64–18–6	1,4	U123	5000 (2270)
Fulminic acid, mercury(2+)salt	628–86–4	4	P065	10 (4.54)
Fumaric acid	110–17–8	1		5000 (2270)
Furan	110–00–9	4	U124	100 (45.4)
2-Furancarboxaldehyde	98–01–1	1,4	U125	5000 (2270)
2,5-Furandione	108–31–6	1,3,4	U147	5000 (2270)
Furan, tetrahydro-	109–99–9	4	U213	1000 (454)
Furfural	98–01–1	1,4	U125	5000 (2270)
Furfuran	110–00–9	4	U124	100 (45.4)
Glucopyranose, 2-deoxy-2–(3-methyl-3-nitrosoureido)-,D-	18883–66–4	4	U206	1 (0.454)
D-Glucose, 2-deoxy-2-[[(methylnitrosoamino)-carbonyl]amino]-.	18883–66–4	4	U206	1 (0.454)
Glycidylaldehyde	765–34–4	4	U126	10 (4.54)
Glycol ethers[d]	N.A.	3		**
Guanidine, N-methyl-N'-nitro-N-nitroso-	70–25–7	4	U163	10 (4.54)
Guthion	86–50–0	1		1 (0.454)
HALOETHERS	N.A.	2		**
HALOMETHANES	N.A.	2		**
Heptachlor	76–44–8	1,2,3,4	P059	1 (0.454)
HEPTACHLOR AND METABOLITES	N.A.	2		**
Heptachlor epoxide	1024–57–3	2		1 (0.454)
Hexachlorobenzene	118–74–1	2,3,4	U127	10 (4.54)
Hexachlorobutadiene	87–68–3	2,3,4	U128	1 (0.454)
HEXACHLOROCYCLOHEXANE (all isomers)	608–73–1	2		**
Hexachlorocyclopentadiene	77–47–4	1,2,3,4	U130	10 (4.54)
Hexachloroethane	67–72–1	2,3,4	U131	100 (45.4)
Hexachlorophene	70–30–4	4	U132	100 (45.4)
Hexachloropropene	1888–71–7	4	U243	1000 (454)
Hexaethyl tetraphosphate	757–58–4	4	P062	100 (45.4)
Hexamethylene-1,6–diisocyanate	822–06–0	3		100 (45.4)
Hexamethylphosphoramide	680–31–9	3		1 (0.454)
Hexane	110–54–3	3		5000 (2270)
Hexone	108–10–1	3,4	U161	5000 (2270)
Hydrazine	302–01–2	3,4	U133	1 (0.454)
Hydrazinecarbothioamide	79–19–6	4	P116	100 (45.4)

TABLE 302.4—LIST OF HAZARDOUS SUBSTANCES AND REPORTABLE QUANTITIES—Continued

[Note: All Comments/Notes Are Located at the End of This Table]

Hazardous substance	CASRN	Statutory codedagger;	RCRA waste No.	Final RQ pounds (Kg)
Hydrazine, 1,2-diethyl-	1615–80–1	4	U086	10 (4.54)
Hydrazine, 1,1-dimethyl-	57–14–7	3,4	U098	10 (4.54)
Hydrazine, 1,2-dimethyl-	540–73–8	4	U099	1 (0.454)
Hydrazine, 1,2-diphenyl-	122–66–7	2,3,4	U109	10 (4.54)
Hydrazine, methyl-	60–34–4	3,4	P068	10 (4.54)
Hydrochloric acid	7647–01–0	1,3		5000 (2270)
Hydrocyanic acid	74–90–8	1,4	P063	10 (4.54)
Hydrofluoric acid	7664–39–3	1,3,4	U134	100 (45.4)
Hydrogen chloride	7647–01–0	1,3		5000 (2270)
Hydrogen cyanide	74–90–8	1,4	P063	10 (4.54)
Hydrogen fluoride	7664–39–3	1,3,4	U134	100 (45.4)
Hydrogen phosphide	7803–51–2	3,4	P096	100 (45.4)
Hydrogen sulfide H2S	7783–06–4	1,4	U135	100 (45.4)
Hydroperoxide, 1-methyl-1-phenylethyl-	80–15–9	4	U096	10 (4.54)
Hydroquinone	123–31–9	3		100 (45.4)
2-Imidazolidinethione	96–45–7	3,4	U116	10 (4.54)
Indeno(1,2,3-cd)pyrene	193–39–5	2,4	U137	100 (45.4)
Iodomethane	74–88–4	3,4	U138	100 (45.4)
1,3-Isobenzofurandione	85–44–9	3,4	U190	5000 (2270)
Isobutyl alcohol	78–83–1	4	U140	5000 (2270)
Isodrin	465–73–6	4	P060	1 (0.454)
Isophorone	78–59–1	2,3		5000 (2270)
Isoprene	78–79–5	1		100 (45.4)
Isopropanolamine dodecylbenzenesulfonate	42504–46–1	1		1000 (454)
Isosafrole	120–58–1	4	U141	100 (45.4)
3(2H)-Isoxazolone, 5–(aminomethyl)-	2763–96–4	4	P007	1000 (454)
Kepone	143–50–0	1,4	U142	1 (0.454)
Lasiocarpine	303–34–4	4	U143	10 (4.54)
Lead††	7439–92–1	2		10 (4.54)
Lead acetate	301–04–2	1,4	U144	10 (4.54)
LEAD AND COMPOUNDS	N.A.	2,3		**
Lead arsenate	7784–40–9	1		1 (0.454)
	7645–25–2			
	10102–48–4			
Lead, bis(acetato-O)tetrahydroxytri-	1335–32–6	4	U146	10 (4.54)
Lead chloride	7758–95–4	1		10 (4.54)
Lead compounds	N.A.	2,3		**
Lead fluoborate	13814–96–5	1		10 (4.54)
Lead fluoride	7783–46–2	1		10 (4.54)
Lead iodide	10101–63–0	1		10 (4.54)
Lead nitrate	10099–74–8	1		10 (4.54)
Lead phosphate	7446–27–7	4	U145	10 (4.54)
Lead stearate	1072–35–1	1		10 (4.54)
	7428–48–0			
	52652–59–2			
	56189–09–4			
Lead subacetate	1335–32–6	4	U146	10 (4.54)
Lead sulfate	7446–14–2	1		10 (4.54)
	15739–80–7			
Lead sulfide	1314–87–0	1		10 (4.54)
Lead thiocyanate	592–87–0	1		10 (4.54)
Lindane	58–89–9	1,2,3,4	U129	1 (0.454)
Lindane (all isomers)	58–89–9	1,2,3,4	U129	1 (0.454)
Lithium chromate	14307–35–8	1		10 (4.54)
Malathion	121–75–5	1		100 (45.4)
Maleic acid	110–16–7	1		5000 (2270)
Maleic anhydride	108–31–6	1,3,4	U147	5000 (2270)
Maleic hydrazide	123–33–1	4	U148	5000 (2270)
Malononitrile	109–77–3	4	U149	1000 (454)
Manganese, bis(dimethylcarbamodithioato-S,S′)-Manganese dimethyldithio- carbamate).	15339–36–3	4	P196	##
Manganese Compounds	N.A.	3		**
MDI	101–68–8	3		5000 (2270)
MEK	78–93–3	3,4	U159	5000 (2270)
Melphalan	148–82–3	4	U150	1 (0.454)
Mercaptodimethur	2032–65–7	1,4	P199	10 (4.54)
Mercuric cyanide	592–04–1	1		1(0.454)
Mercuric nitrate	10045–94–0	1		10 (4.54)
Mercuric sulfate	7783–35–9	1		10 (4.54)

TABLE 302.4—LIST OF HAZARDOUS SUBSTANCES AND REPORTABLE QUANTITIES—Continued

[Note: All Comments/Notes Are Located at the End of This Table]

Hazardous substance	CASRN	Statutory codedagger;	RCRA waste No.	Final RQ pounds (Kg)
Mercuric thiocyanate	592–85–8	1		10 (4.54)
Mercurous nitrate	10415–75–5	1	10 (4.54)	7782–86–7
Mercury	7439–97–6	2,3,4	U151	1 (0.454)
MERCURY AND COMPOUNDS	N.A.	2,3		**
Mercury, (acetato-O)phenyl-	62–38–4	4	P092	100 (45.4)
Mercury Compounds	N.A.	2,3		**
Mercury fulminate	628–86–4	4	P065	10 (4.54)
Methacrylonitrile	126–98–7	4	U152	1000 (454)
Methanamine, N-methyl-	124–40–3	1,4	U092	1000 (454)
Methanamine, N-methyl-N-nitroso-	62–75–9	2,3,4	P082	10 (4.54)
Methane, bromo-	74–83–9	2,3,4	U029	1000 (454)
Methane, chloro-	74–87–3	2,3,4	U045	100 (45.4)
Methane, chloromethoxy-	107–30–2	3,4	U046	10 (4.54)
Methane, dibromo-	74–95–3	4	U068	1000 (454)
Methane, dichloro-	75–09–2	2,3,4	U080	1000 (454)
Methane, dichlorodifluoro-	75–71–8	4	U075	5000 (2270)
Methane, iodo-	74–88–4	3,4	U138	100 (45.4)
Methane, isocyanato-	624–83–9	3,4	P064	10 (4.54)
Methane, oxybis(chloro-	542–88–1	2,3,4	P016	10 (4.54)
Methanesulfenyl chloride, trichloro-	594–42–3	4	P118	100 (45.4)
Methanesulfonic acid, ethyl ester	62–50–0	4	U119	1 (0.454)
Methane, tetrachloro-	56–23–5	1,2,3,4	U211	10 (4.54)
Methane, tetranitro-	509–14–8	4	P112	10 (4.54)
Methanethiol	74–93–1	1,4	U153	100 (45.4)
Methane, tribromo-	75–25–2	2,3,4	U225	100 (45.4)
Methane, trichloro-	67–66–3	1,2,3,4	U044	10 (4.54)
Methane, trichlorofluoro-	75–69–4	4	U121	5000 (2270)
Methanimidamide, N,N-dimethyl-N′-[3-[[(methylamino)carbonyl]oxy]phenyl]-, monohydrochloride (Formetanate hydrochloride).	23422–53–9	4	P198	##
Methanimidamide, N,N-dimethyl-N′-[2-methyl-4-[[(methylamino)carbonyl]oxy]phenyl]-(Formparanate).	17702–57–7	4	P197	##
6,9-Methano-2,4,3-benzodioxathiepin, 6,7,8,9,10,10-hexachloro- 1,5,5a,6,9,9a-hexahydro-, 3-oxide.	115–29–7	1,2,4	P050	1 (0.454)
4,7-Methano-1H-indene, 1,4,5,6,7,8,8-heptachloro-3a,4,7,7a-tetrahydro-.	76–44–8	1,2,3,4	P059	1 (0.454)
4,7-Methano-1H-indene, 1,2,4,5,6,7,8,8-octachloro-2,3,3a,4,7,7a-hexahydro-—.	57–74–9	1,2,3,4	U036	1 (0.454)
Methanol	67–56–1	3,4	U154	5000 (2270)
Methapyrilene	91–80–5	4	U155	5000 (2270)
1,3,4-Metheno-2H-cyclobuta[cd]pentalen-2-one, 1,1a,3,3a,4,5,5,5a,5b,6-decachlorooctahydro-.	143–50–0	1,4	U142	1 (0.454)
Methiocarb	2032–65–7	1,4	P199	10 (4.54)
Methomyl	16752–77–5	4	P066	100 (45.4)
Methoxychlor	72–43–5	1,3,4	U247	1 (0.454)
Methyl alcohol	67–56–1	3,4	U154	5000 (2270)
2-Methyl aziridine	75–55–8	3,4	P067	1 (0.454)
Methyl bromide	74–83–9	2,3,4	U029	1000 (454)
1-Methylbutadiene	504–60–9	4	U186	100 (45.4)
Methyl chloride	74–87–3	2,3,4	U045	100 (45.4)
Methyl chlorocarbonate	79–22–1	4	U156	1000 (454)
Methyl chloroform	71–55–6	2,3,4	U226	1000 (454)
3-Methylcholanthrene	56–49–5	4	U157	10 (4.54)
4,4′-Methylenebis(2-chloroaniline)	101–14–4	3,4	U158	10 (4.54)
Methylene bromide	74–95–3	4	U068	1000 (454)
Methylene chloride	75–09–2	2,3,4	U080	1000 (454)
4,4′-Methylenedianiline	101–77–9	3		10 (4.54)
Methylene diphenyl diisocyanate	101–68–8	3		5000 (2270)
Methyl ethyl ketone	78–93–3	3,4	U159	5000 (2270)
Methyl ethyl ketone peroxide	1338–23–4	4	U160	10 (4.54)
Methyl hydrazine	60–34–4	3,4	P068	10 (4.54)
Methyl iodide	74–88–4	3,4	U138	100 (45.4)
Methyl isobutyl ketone	108–10–1	3,4	U161	5000 (2270)
Methyl isocyanate	624–83–9	3,4	P064	10 (4.54)
2-Methyllactonitrile	75–86–5	1,4	P069	10 (4.54)
Methyl mercaptan	74–93–1	1,4	U153	100 (45.4)
Methyl methacrylate	80–62–6	1,3,4	U162	1000 (454)
Methyl parathion	298–00–0	1,4	P071	100 (45.4)
4-Methyl-2-pentanone	108–10–1	3,4	U161	5000 (2270)

TABLE 302.4—LIST OF HAZARDOUS SUBSTANCES AND REPORTABLE QUANTITIES—Continued

[Note: All Comments/Notes Are Located at the End of This Table]

Hazardous substance	CASRN	Statutory codedagger;	RCRA waste No.	Final RQ pounds (Kg)
Methyl tert-butyl ether	1634–04–4	3		1000 (454)
Methylthiouracil	56–04–2	4	U164	10 (4.54)
Mevinphos	7786–34–7	1		10 (4.54)
Mexacarbate	315–18–4	1,4	P128	1000 (454)
Mitomycin C	50–07–7	4	U010	10 (4.54)
MNNG	70–25–7	4	U163	10 (4.54)
Monoethylamine	75–04–7	1		100 (45.4)
Monomethylamine	74–89–5	1		100 (45.4)
Naled	300–76–5	1		10 (4.54)
5,12-Naphthacenedione, 8-acetyl-10-[(3-amino-2,3,6-trideoxy-alpha-L-lyxo-hexopyranosyl)oxy]-7,8,9,10-tetrahydro-6,8,11-trihydroxy-1-methoxy-, (8S-cis)-.	20830–81–3	4	U059	10 (4.54)
1-Naphthalenamine	134–32–7	4	U167	100 (45.4)
2-Naphthalenamine	91–59–8	4	U168	10 (4.54)
Naphthalenamine, N,N'-bis(2-chloroethyl)-	494–03–1	4	U026	100 (45.4)
Naphthalene	91–20–3	1,2,3,4	U165	100 (45.4)
Naphthalene, 2-chloro-	91–58–7	2,4	U047	5000 (2270)
1,4-Naphthalenedione	130–15–4	4	U166	5000 (2270)
2,7-Naphthalenedisulfonic acid, 3,3′-[(3,3′-dimethyl-(1,1′-biphenyl)-4,4′-diyl)-bis(azo)]bis(5-amino-4-hydroxy)-tetrasodium salt.	72–57–1	4	U236	10 (4.54)
1-Naphthalenol, methylcarbamate	63–25–2	1,3,4	U279	100 (45.4)
Naphthenic acid	1338–24–5	1		100 (45.4)
1,4-Naphthoquinone	130–15–4	4	U166	5000 (2270)
alpha-Naphthylamine	134–32–7	4	U167	100 (45.4)
beta-Naphthylamine	91–59–8	4	U168	10 (4.54)
alpha-Naphthylthiourea	86–88–4	4	P072	100 (45.4)
Nickel††	7440–02–0	2		100 (45.4)
Nickel ammonium sulfate	15699–18–0	1		100 (45.4)
NICKEL AND COMPOUNDS	N.A.	2,3		**
Nickel carbonyl Ni(CO)4, (T-4)-	13463–39–3	4	P073	10 (4.54)
Nickel chloride	7718–54–9 37211–05–5	1		100 (45.4)
Nickel compounds	N.A.	2,3		**
Nickel cyanide Ni(CN)2	557–19–7	4	P074	10 (4.54)
Nickel hydroxide	12054–48–7	1		10 (4.54)
Nickel nitrate	14216–75–2	1		100 (45.4)
Nickel sulfate	7786–81–4	1		100 (45.4)
Nicotine, & salts	54–11–5	4	P075	100 (45.4)
Nitric acid	7697–37–2	1		1000 (454)
Nitric acid, thallium (1+) salt	10102–45–1	4	U217	100 (45.4)
Nitric oxide	10102–43–9	4	P076	10 (4.54)
p-Nitroaniline	100–01–6	4	P077	5000 (2270)
Nitrobenzene	98–95–3	1,2,3,4	U169	1000 (454)
4-Nitrobiphenyl	92–93–3	3		10 (4.54)
Nitrogen dioxide	10102–44–0 10544–72–6	1,4	P078	10 (4.54)
Nitrogen oxide NO	10102–43–9	4	P076	10 (4.54)
Nitrogen oxide NO2	10102–44–0 10544–72–6	1,4	P078	10 (4.54)
Nitroglycerine	55–63–0	4	P081	10 (4.54)
Nitrophenol (mixed)	25154–55–6	1		100 (45.4)
m-Nitrophenol	554–84–7	.....		.....
o-Nitrophenol	88–75–5	1,2		100 (45.4)
p-Nitrophenol	100–02–7	1,2,3,4	U170	100 (45.4)
2-Nitrophenol	88–75–5	1,2		100 (45.4)
4-Nitrophenol	100–02–7	1,2,3,4	U170	100 (45.4)
NITROPHENOLS	N.A.	2		**
2-Nitropropane	79–46–9	3,4	U171	10 (4.54)
NITROSAMINES	N.A.	2		**
N-Nitrosodi-n-butylamine	924–16–3	4	U172	10 (4.54)
N-Nitrosodiethanolamine	1116–54–7	4	U173	1 (0.454)
N-Nitrosodiethylamine	55–18–5	4	U174	1 (0.454)
N-Nitrosodimethylamine	62–75–9	2,3,4	P082	10 (4.54)
N-Nitrosodiphenylamine	86–30–6	2		100 (45.4)
N-Nitroso-N-ethylurea	759–73–9	4	U176	1 (0.454)
N-Nitroso-N-methylurea	684–93–5	3,4	U177	1 (0.454)
N-Nitroso-N-methylurethane	615–53–2	4	U178	1 (0.454)
N-Nitrosomethylvinylamine	4549–40–0	4	P084	10 (4.54)

TABLE 302.4—LIST OF HAZARDOUS SUBSTANCES AND REPORTABLE QUANTITIES—Continued

[Note: All Comments/Notes Are Located at the End of This Table]

Hazardous substance	CASRN	Statutory codedagger;	RCRA waste No.	Final RQ pounds (Kg)
N-Nitrosomorpholine	59–89–2	3		1 (0.454)
N-Nitrosopiperidine	100–75–4	4	U179	10 (4.54)
N-Nitrosopyrrolidine	930–55–2	4	U180	1 (0.454)
Nitrotoluene	1321–12–6	1		1000 (454)
m-Nitrotoluene	99–08–1	.....		.....
o-Nitrotoluene	88–72–2	.....		.....
p-Nitrotoluene	99–99–0	.....		.....
5-Nitro-o-toluidine	99–55–8	4	U181	100 (45.4)
Octamethylpyrophosphoramide	152–16–9	4	P085	100 (45.4)
Osmium oxide OsO4, (T–4)–	20816–12–0	4	P087	1000 (454)
Osmium tetroxide	20816–12–0	4	P087	1000 (454)
7-Oxabicyclo[2.2.1]heptane-2,3-dicarboxylic acid	145–73–3	4	P088	1000 (454)
1,2-Oxathiolane, 2,2-dioxide	1120–71–4	3,4	U193	10 (4.54)
2H-1,3,2-Oxazaphosphorin-2–amine, N,N- bis(2-chloroethyl)tetrahydro-, 2-oxide.	50–18–0	4	U058	10 (4.54)
Oxirane	75–21–8	3,4	U115	10 (4.54)
Oxiranecarboxyaldehyde	765–34–4	4	U126	10 (4.54)
Oxirane, (chloromethyl)-	106–89–8	1,3,4	U041	100 (45.4)
Paraformaldehyde	30525–89–4	1		1000 (454)
Paraldehyde	123–63–7	4	U182	1000 (454)
Parathion	56–38–2	1,3,4	P089	10 (4.54)
PCBs	1336–36–3	1,2,3		1 (0.454)
PCNB	82–68–8	3,4	U185	100 (45.4)
Pentachlorobenzene	608–93–5	4	U183	10 (4.54)
Pentachloroethane	76–01–7	4	U184	10 (4.54)
Pentachloronitrobenzene	82–68–8	3,4	U185	100 (45.4)
Pentachlorophenol	87–86–5	1,2,3,4	See F027	10 (4.54)
1,3-Pentadiene	504–60–9	4	U186	100 (45.4)
Perchloroethylene	127–18–4	2,3,4	U210	100 (45.4)
Phenacetin	62–44–2	4	U187	100 (45.4)
Phenanthrene	85–01–8	2		5000 (2270)
Phenol	108–95–2	1,2,3,4	U188	1000 (454)
Phenol, 2-chloro-	95–57–8	2,4	U048	100 (45.4)
Phenol, 4-chloro-3-methyl-	59–50–7	2,4	U039	5000 (2270)
Phenol, 2-cyclohexyl-4,6-dinitro-	131–89–5	4	P034	100 (45.4)
Phenol, 2,4-dichloro-	120–83–2	2,4	U081	100 (45.4)
Phenol, 2,6-dichloro-	87–65–0	4	U082	100 (45.4)
Phenol, 4,4′-(1,2-diethyl-1,2-ethenediyl)bis-, (E)	56–53–1	4	U089	1 (0.454)
Phenol, 2,4-dimethyl-	105–67–9	2,4	U101	100 (45.4)
Phenol, 4-(dimethylamino)-3,5-dimethyl-, 4 methylcarbamate (ester).	315–18–4	1,4	P128	1000 (454)
Phenol, (3,5-dimethyl-4-(methylthio)-, methylcarbamate	2032–65–7	1,4	P199	10 (4.54)
Phenol, 2,4-dinitro-	51–28–5	1,2,3,4	P048	10 (4.54)
Phenol, methyl-	1319–77–3	1,3,4	U052	100 (45.4)
Phenol, 2-methyl-4,6-dinitro-, & salts	534–52–1	2,3,4	P047	10 (4.54)
Phenol, 2,2′-methylenebis[3,4,6- trichloro-	70–30–4	4	U132	100 (45.4)
Phenol, 2-(1-methylethoxy)-, methylcarbamate	114–26–1	3,4	U411	100 (45.4)
Phenol, 3-(1-methylethyl)-, methyl carbamate (m-Cumenyl methylcarbamate).	64–00–6	4	P202	##
Phenol, 3-methyl-5-(1-methylethyl)-, methyl carbamate (Promecarb).	2631-37–0	4	P201	##
Phenol, 2-(1-methylpropyl)-4,6-dinitro-	88–85–7	4	P020	1000 (454)
Phenol, 4-nitro-	100–02–7	1,2,3,4	U170	100 (45.4)
Phenol, pentachloro-	87–86–5	1,2,3,4	See F027	10 (4.54)
Phenol, 2,3,4,6-tetrachloro-	58–90–2	4	See F027	10 (4.54)
Phenol, 2,4,5-trichloro-	95–95–4	1,3,4	See F027	10 (4.54)
Phenol, 2,4,6-trichloro-	88–06–2	1,2,3,4	See F027	10 (4.54)
Phenol, 2,4,6-trinitro-, ammonium salt	131–74–8	4	P009	10 (4.54)
L-Phenylalanine, 4-[bis(2-chloroethyl)amino]-	148–82–3	4	U150	1 (0.454)
p-Phenylenediamine	106–50–3	3		5000 (2270)
Phenylmercury acetate	62–38–4	4	P092	100 (45.4)
Phenylthiourea	103–85–5	4	P093	100 (45.4)
Phorate	298–02–2	4	P094	10 (4.54)
Phosgene	75–44–5	1,3,4	P095	10 (4.54)
Phosphine	7803–51–2	3,4	P096	100 (45.4)
Phosphoric acid	7664–38–2	1		5000 (2270)
Phosphoric acid, diethyl 4-nitrophenyl ester	311–45–5	4	P041	100 (45.4)
Phosphoric acid, lead(2+) salt (2:3)	7446–27–7	4	U145	10 (4.54)
Phosphorodithioic acid, O,O-diethyl S-[2-(ethylthio)ethyl] ester.	298–04–4	1,4	P039	1 (0.454)

TABLE 302.4—LIST OF HAZARDOUS SUBSTANCES AND REPORTABLE QUANTITIES—Continued

[Note: All Comments/Notes Are Located at the End of This Table]

Hazardous substance	CASRN	Statutory codedagger;	RCRA waste No.	Final RQ pounds (Kg)
Phosphorodithioic acid, O,O-diethyl S-[(ethylthio)methyl] ester.	298–02–2	4	P094	10 (4.54)
Phosphorodithioic acid, O,O-diethyl S-methyl ester	3288-58–2	4	U087	5000 (2270)
Phosphorodithioic acid, O,O-dimethyl S-[2(methylamino)-2-oxoethyl] ester.	60–51–5	4	P044	10 (4.54)
Phosphorofluoridic acid, bis(1-methylethyl) ester	55–91–4	4	P043	100 (45.4)
Phosphorothioic acid, O,O-diethyl O-(4-nitrophenyl) ester	56–38–2	1,3,4	P089	10 (4.54)
Phosphorothioic acid, O,O-diethyl O-pyrazinyl ester	297–97–2	4	P040	100 (45.4)
Phosphorothioic acid, O-[4-[(dimethylamino) sulfonyl]phenyl] O,O-dimethyl ester.	52–85–7	4	P097	1000 (454)
Phosphorothioic acid, O,O-dimethyl O-(4-nitrophenyl) ester.	298–00–0	1,4	P071	100 (45.4)
Phosphorus	7723–14–0	1,3		1 (0.454)
Phosphorus oxychloride	10025–87–3	1		1000 (454)
Phosphorus pentasulfide	1314–80–3	1,4	U189	100 (45.4)
Phosphorus sulfide	1314–80–3	1,4	U189	100 (45.4)
Phosphorus trichloride	7719–12–2	1		1000 (454)
PHTHALATE ESTERS	N.A.	2		**
Phthalic anhydride	85–44–9	3,4	U190	5000 (2270)
2-Picoline	109–06–8	4	U191	5000 (2270)
Piperidine, 1-nitroso-	100–75–4	4	U179	10 (4.54)
Plumbane, tetraethyl-	78–00–2	1,4	P110	10 (4.54)
POLYCHLORINATED BIPHENYLS	1336–36–3	1,2,3		1 (0.454)
Polycyclic Organic Matter[e]	N.A.	3		**
POLYNUCLEAR AROMATIC HYDROCARBONS	N.A.	2		**
Potassium arsenate	7784–41–0	1		1 (0.454)
Potassium arsenite	10124–50–2	1		1 (0.454)
Potassium bichromate	7778–50–9	1		10 (4.54)
Potassium chromate	7789–00–6	1		10 (4.54)
Potassium cyanide K(CN)	151–50–8	1,4	P098	10 (4.54)
Potassium hydroxide	1310–58–3	1		1000 (454)
Potassium permanganate	7722–64–7	1		100 (45.4)
Potassium silver cyanide	506–61–6	4	P099	1 (0.454)
Pronamide	23950–58–5	4	U192	5000 (2270)
Propanal, 2-methyl-2-(methylsulfonyl)-, O-[(methylamino)carbonyl] oxime (Aldicarb sulfone).	1646–88–4	4	P203	##
Propanal, 2-methyl-2-(methylthio)-, O-[(methylamino)carbonyl]oxime.	116–06–3	4	P070	1 (0.454)
1-Propanamine	107–10–8	4	U194	5000 (2270)
1-Propanamine, N-propyl-	142–84–7	4	U110	5000 (2270)
1-Propanamine, N-nitroso-N-propyl-	621–64–7	2,4	U111	10 (4.54)
Propane, 1,2-dibromo-3-chloro-	96–12–8	3,4	U066	1 (0.454)
Propane, 1,2-dichloro-	78–87–5	1,2,3,4	U083	1000 (454)
Propanedinitrile	109–77–3	4	U149	1000 (454)
Propanenitrile	107–12–0	4	P101	10 (4.54)
Propanenitrile, 3-chloro-	542–76–7	4	P027	1000 (454)
Propanenitrile, 2-hydroxy-2-methyl-	75–86–5	1,4	P069	10 (4.54)
Propane, 2-nitro-	79–46–9	3,4	U171	10 (4.54)
Propane, 2,2'-oxybis[2-chloro-	108–60–1	2,4	U027	1000 (454)
1,3-Propane sultone	1120–71–4	3,4	U193	10 (4.54)
1,2,3-Propanetriol, trinitrate	55–63–0	4	P081	10 (4.54)
Propanoic acid, 2-(2,4,5-trichlorophenoxy)-	93–72–1	1,4	See F027	100 (45.4)
1-Propanol, 2,3-dibromo-, phosphate (3:1)	126–72–7	4	U235	10 (4.54)
1-Propanol, 2-methyl-	78–83–1	4	U140	5000 (2270)
2-Propanone	67–64–1	4	U002	5000 (2270)
2-Propanone, 1-bromo-	598–31–2	4	P017	1000 (454)
Propargite	2312–35–8	1		10 (4.54)
Propargyl alcohol	107–19–7	4	P102	1000 (454)
2-Propenal	107–02–8	1,2,3,4	P003	1 (0.454)
2-Propenamide	79–06–1	3,4	U007	5000 (2270)
1-Propene, 1,3-dichloro-	542–75–6	1,2,3,4	U084	100 (45.4)
1-Propene, 1,1,2,3,3,3-hexachloro-	1888–71–7	4	U243	1000 (454)
2-Propenenitrile	107–13–1	1,2,3,4	U009	100 (45.4)
2-Propenenitrile, 2-methyl-	126–98–7	4	U152	1000 (454)
2-Propenoic acid	79–10–7	3,4	U008	5000 (2270)
2-Propenoic acid, ethyl ester	140–88–5	3,4	U113	1000 (454)
2-Propenoic acid, 2-methyl-, ethyl ester	97–63–2	4	U118	1000 (454)
2-Propenoic acid, 2-methyl-, methyl ester	80–62–6	1,3,4	U162	1000 (454)
2-Propen-1-ol	107–18–6	1,4	P005	100 (45.4)

TABLE 302.4—LIST OF HAZARDOUS SUBSTANCES AND REPORTABLE QUANTITIES—Continued

[Note: All Comments/Notes Are Located at the End of This Table]

Hazardous substance	CASRN	Statutory codedagger;	RCRA waste No.	Final RQ pounds (Kg)
beta-Propiolactone	57–57–8	3		10 (4.54)
Propionaldehyde	123–38–6	3	1000 (454)	
Propionic acid	79–09–4	1		5000 (2270)
Propionic anhydride	123–62–6	1		5000 (2270)
Propoxur (Baygon)	114–26–1	3,4	U411	100 (45.4)
n-Propylamine	107–10–8	4	U194	5000 (2270)
Propylene dichloride	78–87–5	1,2,3,4	U083	1000 (454)
Propylene oxide	75–56–9	1,3		100 (45.4)
1,2-Propylenimine	75–55–8	3,4	P067	1 (0.454)
2-Propyn-1-ol	107–19–7	4	P102	1000 (454)
Pyrene	129–00–0	2		5000 (2270)
Pyrethrins	121–29–9	1		1 (0.454)
	121–21–1			
	8003–34–7			
3,6-Pyridazinedione, 1,2-dihydro-	123–33–1	4	U148	5000 (2270)
4-Pyridinamine	504–24–5	4	P008	1000 (454)
Pyridine	110–86–1	4	U196	1000 (454)
Pyridine, 2-methyl-	109–06–8	4	U191	5000 (2270)
Pyridine, 3-(1-methyl-2-pyrrolidinyl)-, (S)-, & salts	54–11–5	4	P075	100 (45.4)
2,4-(1H,3H)-Pyrimidinedione, 5-[bis(2- chloroethyl)amino]-	66–75–1	4	U237	10 (4.54)
4(1H)-Pyrimidinone, 2,3-dihydro-6-methyl-2-thioxo-	56–04–2	4	U164	10 (4.54)
Pyrrolidine, 1-nitroso-	930–55–2	4	U180	1 (0.454)
Pyrrolo[2,3-b] indol-5-ol, 1,2,3,3a,8,8a-hexahydro-1,3a,8-trimethyl-, methylcarbamate (ester), (3aS-cis)-(Physostigmine).	57–47–6	4	P204	##
Quinoline	91–22–5	1,3		5000 (2270)
Quinone	106–51–4	3,4	U197	10 (4.54)
Quintobenzene	82–68–8	3,4	U185	100 (45.4)
Radionuclides (including radon)	N.A.	3		§
Reserpine	50–55–5	4	U200	5000 (2270)
Resorcinol	108–46–3	1,4	U201	5000 (2270)
Saccharin, & salts	81–07–2	4	U202	100 (45.4)
Safrole	94–59–7	4	U203	100 (45.4)
Selenious acid	7783–00–8	4	U204	10 (4.54)
Selenious acid, dithallium (1+) salt	12039–52–0	4	P114	1000 (454)
Seleniumdagger;dagger;	7782–49–2	2		100 (45.4)
SELENIUM AND COMPOUNDS	N.A.	2,3		**
Selenium Compounds	N.A.	2,3		**
Selenium dioxide	7446–08–4	1,4	U204	10 (4.54)
Selenium oxide	7446–08–4	1,4	U204	10 (4.54)
Selenium sulfide SeS2	7488–56–4	4	U205	10 (4.54)
Selenourea	630–10–4	4	P103	1000 (454)
L-Serine, diazoacetate (ester)	115–02–6	4	U015	1 (0.454)
Silver dagger;dagger;	7440–22–4	2		1000 (454)
SILVER AND COMPOUNDS	N.A.	2		**
Silver cyanide Ag(CN)	506–64–9	4	P104	1 (0.454)
Silver nitrate	7761–88–8	1		1 (0.454)
Silvex (2,4,5-TP)	93–72–1	1,4	See F027	100 (45.4)
Sodium	7440–23–5	1		10 (4.54)
Sodium arsenate	7631–89–2	1		1 (0.454)
Sodium arsenite	7784–46–5	1		1 (0.454)
Sodium azide	26628–22–8	4	P105	1000 (454)
Sodium bichromate	10588–01–9	1		10 (4.54)
Sodium bifluoride	1333–83–1	1		100 (45.4)
Sodium bisulfite	7631–90–5	1		5000 (2270)
Sodium chromate	7775–11–3	1		10 (4.54)
Sodium cyanide Na(CN)	143–33–9	1,4	P106	10 (4.54)
Sodium dodecylbenzenesulfonate	25155–30–0	1		1000 (454)
Sodium fluoride	7681–49–4	1		1000 (454)
Sodium hydrosulfide	16721–80–5	1		5000 (2270)
Sodium hydroxide	1310–73–2	1		1000 (454)
Sodium hypochlorite	7681–52–9	1		100 (45.4)
	10022–70–5			
Sodium methylate	124–41–4	1		1000 (454)
Sodium nitrite	7632–00–0	1		100 (45.4)
Sodium phosphate, dibasic	7558–79–4	1		5000 (2270)
	10039–32–4			
	10140–65–5			

TABLE 302.4—LIST OF HAZARDOUS SUBSTANCES AND REPORTABLE QUANTITIES—Continued

[Note: All Comments/Notes Are Located at the End of This Table]

Hazardous substance	CASRN	Statutory codedagger;	RCRA waste No.	Final RQ pounds (Kg)
Sodium phosphate, tribasic	7601–54–9	1		5000 (2270)
	7758–29–4			
	7785–84–4			
	10101–89–0			
	10124–56–8			
	10361–89–4			
Sodium selenite	7782–82–3	1		100 (45.4)
	10102–18–8			
Streptozotocin	18883–66–4	4	U206	1 (0.454)
Strontium chromate	7789–06–2	1		10 (4.54)
Strychnidin-10-one, & salts	57–24–9	1,4	P108	10 (4.54)
Strychnidin-10-one, 2,3-dimethoxy-	357–57–3	4	P018	100 (45.4)
Strychnine, & salts	57–24–9	1,4	P108	10 (4.54)
Styrene	100–42–5	1,3		1000 (454)
Styrene oxide	96–09–3	3		100 (45.4)
Sulfuric acid	7664–93–9	1		1000 (454)
	8014–95–7			
Sulfuric acid, dimethyl ester	77–78–1	3,4	U103	100 (45.4)
Sulfuric acid, dithallium (1+) salt	7446–18–6	1,4	P115	100 (45.4)
	10031–59–1			
Sulfur monochloride	12771–08–3	1		1000 (454)
Sulfur phosphide	1314–80–3	1,4	U189	100 (45.4)
2,4,5-T	93–76–5	1,4	See F027	1000 (454)
2,4,5-T acid	93–76–5	1,4	See F027	1000 (454)
2,4,5-T amines	2008–46–0	1		5000 (2270)
	1319–72–8			
	3813–14–7			
	6369–96–6			
	6369–97–7			
2,4,5-T esters	93–79–8	1		1000 (454)
	1928–47–8			
	2545–59–7			
	25168–15–4			
	61792–07–2			
2,4,5-T salts	13560–99–1	1		1000 (454)
TCDD	1746–01–6	2,3		1 (0.454)
TDE	72–54–8	1,2,4	U060	1 (0.454)
1,2,4,5-Tetrachlorobenzene	95–94–3	4	U207	5000 (2270)
2,3,7,8-Tetrachlorodibenzo-p-dioxin	1746–01–6	2,3		1 (0.454)
1,1,1,2-Tetrachloroethane	630–20–6	4	U208	100 (45.4)
1,1,2,2-Tetrachloroethane	79–34–5	2,3,4	U209	100 (45.4)
Tetrachloroethylene	127–18–4	2,3,4	U210	100 (45.4)
2,3,4,6-Tetrachlorophenol	58–90–2	4	See F027	10 (4.54)
Tetraethyl pyrophosphate	107–49–3	1,4	P111	10 (4.54)
Tetraethyl lead	78–00–2	1,4	P110	10 (4.54)
Tetraethyldithiopyrophosphate	3689–24–5	4	P109	100 (45.4)
Tetrahydrofuran	109–99–9	4	U213	1000 (454)
Tetranitromethane	509–14–8	4	P112	10 (4.54)
Tetraphosphoric acid, hexaethyl ester	757–58–4	4	P062	100 (45.4)
Thallic oxide	1314–32–5	4	P113	100 (45.4)
Thallium dagger;dagger;	7440–28–0	2		1000 (454)
THALLIUM AND COMPOUNDS	N.A.	2		**
Thallium (I) acetate	563–68–8	4	U214	100 (45.4)
Thallium (I) carbonate	6533–73–9	4	U215	100 (45.4)
Thallium chloride TlCl	7791–12–0	4	U216	100 (45.4)
Thallium (I) nitrate	10102–45–1	4	U217	100 (45.4)
Thallium oxide Tl2O3	1314–32–5	4	P113	100 (45.4)
Thallium (I) selenite	12039–52–0	4	P114	1000 (454)
Thallium (I) sulfate	7446–18–6	1,4	P115	100 (45.4)
	10031–59–1			
Thioacetamide	62–55–5	4	U218	10 (4.54)
Thiodiphosphoric acid, tetraethyl ester	3689–24–5	4	P109	100 (45.4)
Thiofanox	39196–18–4	4	P045	100 (45.4)
Thioimidodicarbonic diamide [(H2N)C(S)] 2NH	541–53–7	4	P049	100 (45.4)
Thiomethanol	74–93–1	1,4	U153	100 (45.4)
Thioperoxydicarbonic diamide [(H2N)C(S)] 2S2, tetramethyl-.	137–26–8	4	U244	10 (4.54)
Thiophenol	108–98–5	4	P014	100 (45.4)
Thiosemicarbazide	79–19–6	4	P116	100 (45.4)

TABLE 302.4—LIST OF HAZARDOUS SUBSTANCES AND REPORTABLE QUANTITIES—Continued

[Note: All Comments/Notes Are Located at the End of This Table]

Hazardous substance	CASRN	Statutory codedagger;	RCRA waste No.	Final RQ pounds (Kg)
Thiourea	62–56–6	4	U219	10 (4.54)
Thiourea, (2-chlorophenyl)-	5344–82–1	4	P026	100 (45.4)
Thiourea, 1-naphthalenyl-	86–88–4	4	P072	100 (45.4)
Thiourea, phenyl-	103–85–5	4	P093	100 (45.4)
Thiram	137–26–8	4	U244	10 (4.54)
Titanium tetrachloride	7550–45–0	3		1,2,41000 (454)
Toluene	108–88–3	1,2,3,4	U220	1000 (454)
Toluenediamine	95–80–7 496–72–0 823–40–5 25376–45–8	3,4	U221	10 (4.54)
2,4-Toluene diamine	95–80–7 496–72–0 823–40–5 25376–45–8	3,4	U221	10 (4.54)
Toluene diisocyanate	91–08–7 584–84–9 26471–62–5	3,4	U223	100 (45.4)
2,4-Toluene diisocyanate	91–08–7 584–84–9 26471–62–5	3,4	U223	100 (45.4)
o-Toluidine	95–53–4	3,4	U328	100 (45.4)
p-Toluidine	106–49–0	4	U353	100 (45.4)
o-Toluidine hydrochloride	636–21–5	4	U222	100 (45.4)
Toxaphene	8001–35–2	1,2,3,4	P123	1 (0.454)
2,4,5-TP acid	93–72–1	1,4	See F027	100 (45.4)
2,4,5-TP esters	32534–95–5	1		100 (45.4)
1H-1,2,4-Triazol-3-amine	61–82–5	4	U011	10 (4.54)
Trichlorfon	52–68–6	1		100 (45.4)
1,2,4-Trichlorobenzene	120–82–1	2,3		100 (45.4)
1,1,1-Trichloroethane	71–55–6	2,3,4	U226	1000 (454)
1,1,2-Trichloroethane	79–00–5	2,3,4	U227	100 (45.4)
Trichloroethylene	79–01–6	1,2,3,4	U228	100 (45.4)
Trichloromethanesulfenyl chloride	594–42–3	4	P118	100 (45.4)
Trichloromonofluoromethane	75–69–4	4	U121	5000 (2270)
Trichlorophenol	25167–82–2	1		10 (4.54)
2,3,4-Trichlorophenol	15950–66–0			
2,3,5-Trichlorophenol	933–78–8			
2,3,6-Trichlorophenol	933–75–5			
3,4,5-Trichlorophenol	609–19–8			
2,4,5-Trichlorophenol	95–95–4	1,3,4	See F027	10 (4.54)
2,4,6-Trichlorophenol	88–06–2	1,2,3,4	See F027	10 (4.54)
Triethanolamine dodecylbenzenesulfonate	27323–41–7	1		1000 (454)
Triethylamine	121–44–8	1,3,4	U404	5000 (2270)
Trifluralin	1582–09–8	3		10 (4.54)
Trimethylamine	75–50–3	1		100 (45.4)
2,2,4-Trimethylpentane	540–84–1	3		1000 (454)
1,3,5-Trinitrobenzene	99–35–4	4	U234	10 (4.54)
1,3,5-Trioxane, 2,4,6-trimethyl-	123–63–7	4	U182	1000 (454)
Tris(2,3-dibromopropyl) phosphate	126–72–7	4	U235	10 (4.54)
Trypan blue	72–57–1	4	U236	10 (4.54)
Unlisted Hazardous Wastes Characteristic of Corrosivity	N.A.	4	D002	100 (45.4)
Unlisted Hazardous Wastes Characteristic of Ignitability	N.A.	4	D001	100 (45.4)
Unlisted Hazardous Wastes Characteristic of Reactivity	N.A.	4	D003	100 (45.4)
Unlisted Hazardous Wastes Characteristic of Toxicity:				
Arsenic (D004)	N.A.	4	D004	1 (0.454)
Barium (D005)	N.A.	4	D005	1000 (454)
Benzene (D018)	N.A.	1,2,3,4	D018	10 (4.54)
Cadmium (D006)	N.A.	4	D006	10 (4.54)
Carbon tetrachloride (D019)	N.A.	1,2,4	D019	10 (4.54)
Chlordane (D020)	N.A.	1,2,4	D020	1 (0.454)
Chlorobenzene (D021)	N.A.	1,2,4	D021	100 (45.4)
Chloroform (D022)	N.A.	1,2,4	D022	10 (4.54)
Chromium (D007)	N.A.	4	D007	10 (4.54)
o-Cresol (D023)	N.A.	4	D023	100 (45.4)
m-Cresol (D024)	N.A.	4	D024	100 (45.4)
p-Cresol (D025)	N.A.	4	D025	100 (45.4)
Cresol (D026)	N.A.	4	D026	100 (45.4)

TABLE 302.4—LIST OF HAZARDOUS SUBSTANCES AND REPORTABLE QUANTITIES—Continued

[Note: All Comments/Notes Are Located at the End of This Table]

Hazardous substance	CASRN	Statutory codedagger;	RCRA waste No.	Final RQ pounds (Kg)
2,4-D (D016)	N.A.	1,4	D016	100 (45.4)
1,4-Dichlorobenzene (D027)	N.A.	1,2,4	D027	100 (45.4)
1,2-Dichloroethane (D028)	N.A.	1,2,4	D028	100 (45.4)
1,1-Dichloroethylene (D029)	N.A.	1,2,4	D029	100 (45.4)
2,4-Dinitrotoluene (D030)	N.A.	1,2,4	D030	10 (4.54)
Endrin (D012)	N.A.	1,4	D012	1 (0.454)
Heptachlor (and epoxide) (D031)	N.A.	1,2,4	D031	1 (0.454)
Hexachlorobenzene (D032)	N.A.	2,4	D032	10 (4.54)
Hexachlorobutadiene (D033)	N.A.	2,4	D033	1 (0.454)
Hexachloroethane (D034)	N.A.	2,4	D034	100 (45.4)
Lead (D008)	N.A.	4	D008	10 (4.54)
Lindane (D013)	N.A.	1,4	D013	1 (0.454)
Mercury (D009)	N.A.	4	D009	1 (0.454)
Methoxychlor (D014)	N.A.	1,4	D014	1 (0.454)
Methyl ethyl ketone (D035)	N.A.	4	D035	5000 (2270)
Nitrobenzene (D036)	N.A.	1,2,4	D036	1000 (454)
Pentachlorophenol (D037)	N.A.	1,2,4	D037	10 (4.54)
Pyridine (D038)	N.A.	4	D038	1000 (454)
Selenium (D010)	N.A.	4	D010	10 (4.54)
Silver (D011)	N.A.	4	D011	1 (0.454)
Tetrachloroethylene (D039)	N.A.	2,4	D039	100 (45.4)
Toxaphene (D015)	N.A.	1,4	D015	1 (0.454)
Trichloroethylene (D040)	N.A.	1,2,4	D040	100 (45.4)
2,4,5-Trichlorophenol (D041)	N.A.	1,4	D041	10 (4.54)
2,4,6-Trichlorophenol (D042)	N.A.	1,2,4	D042	10 (4.54)
2,4,5-TP (D017)	N.A.	1,4	D017	100 (45.4)
Vinyl chloride (D043)	N.A.	2,3,4	D043	1 (0.454)
Uracil mustard	66–75–1	4	U237	10 (4.54)
Uranyl acetate	541–09–3	1		100 (45.4)
Uranyl nitrate	10102–06–4	1		100 (45.4)
	36478–76–9			
Urea, N-ethyl-N-nitroso-	759–73–9	4	U176	1 (0.454)
Urea, N-methyl-N-nitroso-	684–93–5	3,4	U177	1 (0.454)
Urethane	51–79–6	3,4	U238	100 (45.4)
Vanadic acid, ammonium salt	7803–55–6	4	P119	1000 (454)
Vanadium oxide V2O5	1314–62–1	1,4	P120	1000 (454)
Vanadium pentoxide	1314–62–1	1,4	P120	1000 (454)
Vanadyl sulfate	27774–13–6	1		1000 (454)
Vinyl acetate	108–05–4	1,3		5000 (2270)
Vinyl acetate monomer	108–05–4	1,3		5000 (2270)
Vinylamine, N-methyl-N-nitroso-	4549–40–0	4	P084	10 (4.54)
Vinyl bromide	593–60–2	3		100 (45.4)
Vinyl chloride	75–01–4	2,3,4	U043	1 (0.454)
Vinylidene chloride	75–35–4	1,2,3,4	U078	100 (45.4)
Warfarin, & salts	81–81–2	4	P001, U248	100 (45.4)
Xylene	1330–20–7	1,3,4	U239	100 (45.4)
m-Xylene	108–38–3	3		1000 (454)
o-Xylene	95–47–6	3		1000 (454)
p-Xylene	106–42–3	3		100 (45.4)
Xylene (mixed)	1330–20–7	1,3,4	U239	100 (45.4)
Xylenes (isomers and mixture)	1330–20–7	1,3,4	U239	100 (45.4)
Xylenol	1300–71–6	1		1000 (454)
Yohimban-16-carboxylic acid,11,17-dimethoxy-18-[(3,4,5-trimethoxybenzoyl)oxy]-, methyl ester (3beta,16beta,17alpha, 18beta,20alpha).	50–55–54	4	U200	5000 (2270)
Zinc dagger;dagger;	7440–66–6	2		1000 (454)
ZINC AND COMPOUNDS	N.A.	2		**
Zinc acetate	557–34–6	1		1000 (454)
Zinc ammonium chloride	52628–25–8	1		1000 (454)
	14639–97–5			
	14639–98–6			
Zinc, bis(dimethylcarbamodithioato-S,S')-, (Ziram)	137–30–4	4	P205	##
Zinc borate	1332–07–6	1		1000 (454)
Zinc bromide	7699–45–8	1		1000 (454)
Zinc carbonate	3486–35–9	1		1000 (454)
Zinc chloride	7646–85–7	1		1000 (454)
Zinc cyanide Zn(CN)2	557–21–1	1,4	P121	10 (4.54)
Zinc fluoride	7783–49–5	1		1000 (454)
Zinc formate	557–41–5	1		1000 (454)

TABLE 302.4—LIST OF HAZARDOUS SUBSTANCES AND REPORTABLE QUANTITIES—Continued

[Note: All Comments/Notes Are Located at the End of This Table]

Hazardous substance	CASRN	Statutory codedagger;	RCRA waste No.	Final RQ pounds (Kg)
Zinc hydrosulfite	7779–86–4	1		1000 (454)
Zinc nitrate	7779–88–6	1		1000 (454)
Zinc phenolsulfonate	127–82–2	1		5000 (2270)
Zinc phosphide Zn3P2	1314–84–7	1,4	P122, U249	100 (45.4)
Zinc silicofluoride	16871–71–9	1		5000 (2270)
Zinc sulfate	7733–02–0	1		1000 (454)
Zirconium nitrate	13746–89–9	1		5000 (2270)
Zirconium potassium fluoride	16923–95–8	1		1000 (454)
Zirconium sulfate	14644–61–2	1		5000 (2270)
Zirconium tetrachloride	10026–11–6	1		5000 (2270)
F001		4	F001	10 (4.54)
The following spent halogenated solvents used in degreasing; all spent solvent mixtures/blends used in degreasing containing, before use, a total of ten percent or more (by volume) of one or more of the halogenated solvents listed below or those solvents listed in F002, F004, and F005; and still bottoms from the recovery of these spent solvents and spent solvent mixtures.				
(a) Tetrachloroethylene	127–18–4	2,3,4	U210	100 (45.4)
(b) Trichloroethylene	79–01–6	1,2,3,4	U228	100 (45.4)
(c) Methylene chloride	75–09–2	2,3,4	U080	1000 (454)
(d) 1,1,1-Trichloroethane	71–55–6	2,3,4	U226	1000 (454)
(e) Carbon tetrachloride	56–23–5	1,2,3,4	U211	10 (4.54)
(f) Chlorinated fluorocarbons	N.A.			5000 (2270)
F002		4	F002	10 (4.54)
The following spent halogenated solvents; all spent solvent mixtures/blends containing, before use, a total of ten percent or more (by volume) of one or more of the halogenated solvents listed below or those solvents listed in F001, F004, or F005; and still bottoms from the recovery of these spent solvents and spent solvent mixtures.				
(a) Tetrachloroethylene	127–18–4	2,3,4	U210	100 (45.4)
(b) Methylene chloride	75–09–2	2,3,4	U080	1000 (454)
(c) Trichloroethylene	79–01–6	1,2,3,4	U228	100 (45.4)
(d) 1,1,1-Trichloroethane	71–55–6	2,3,4	U226	1000 (454)
(e) Chlorobenzene	108–90–7	1,2,3,4	U037	100 (45.4)
(f) 1,1,2-Trichloro-1,2,2-trifluoroethane	76–13–1			5000 (2270)
(g) o-Dichlorobenzene	95–50–1	1,2,4	U070	100 (45.4)
(h) Trichlorofluoromethane	75–69–4	4	U121	5000 (2270)
(i) 1,1,2-Trichloroethane	79–00–5	2,3,4	U227	100 (45.4)
F003		4	F003	100 (45.4)
The following spent non-halogenated solvents and the still bottoms from the recovery of these solvents.				
(a) Xylene	1330-20–7			1000 (454)
(b) Acetone	67–64–1			5000 (2270)
(c) Ethyl acetate	141–78–6			5000 (2270)
(d) Ethylbenzene	100–41–4			1000 (454)
(e) Ethyl ether	60–29–7			100 (45.4)
(f) Methyl isobutyl ketone	108–10–1			5000 (2270)
(g) n-Butyl alcohol	71–36–3			5000 (2270)
(h) Cyclohexanone	108–94–1			5000 (2270)
(i) Methanol	67–56–1			5000 (2270)
F004		4	F004	100 (45.4)
The following spent non-halogenated solvents and the still bottoms from the recovery of these solvents:				
(a) Cresols/Cresylic acid	1319–77–3	1,3,4	U052	100 (45.4)
(b) Nitrobenzene	98–95–3	1,2,3,4	U169	1000 (454)
F005		4	F005	100 (45.4)
The following spent non-halogenated solvents and the still bottoms from the recovery of these solvents:				
(a) Toluene	108–88–3	1,2,3,4	U220	1000 (454)
(b) Methyl ethyl ketone	78–93–3	3,4	U159	5000 (2270)
(c) Carbon disulfide	75–15–0	1,3,4	P022	100 (45.4)
(d) Isobutanol	78–83–1	4	U140	5000 (2270)
(e) Pyridine	110–86–1	4	U196	1000 (454)
F006		4	F006	10 (4.54)

TABLE 302.4—LIST OF HAZARDOUS SUBSTANCES AND REPORTABLE QUANTITIES—Continued

[Note: All Comments/Notes Are Located at the End of This Table]

Hazardous substance	CASRN	Statutory codedagger;	RCRA waste No.	Final RQ pounds (Kg)
Wastewater treatment sludges from electroplating operations except from the following processes: (1) sulfuric acid anodizing of aluminum, (2) tin plating on carbon steel, (3) zinc plating (segregated basis) on carbon steel, (4) aluminum or zinc-aluminum plating on carbon steel, (5) cleaning/stripping associated with tin, zinc and aluminum plating on carbon steel, and (6) chemical etching and milling of aluminum.				
F007	.....	4	F007	10 (4.54)
Spent cyanide plating bath solutions from electroplating operations.				
F008	.....	4	F008	10 (4.54)
Plating bath residues from the bottom of plating baths from electroplating operations where cyanides are used in the process.				
F009	.....	4	F009	10 (4.54)
Spent stripping and cleaning bath solutions from electroplating operations where cyanides are used in the process.				
F010	.....	4	F010	10 (4.54)
Quenching bath residues from oil baths from metal heat treating operations where cyanides are used in the process.				
F011	.....	4	F011	10 (4.54)
Spent cyanide solutions from salt bath pot cleaning from metal heat treating operations.				
F012	.....	4	F012	10 (4.54)
Quenching wastewater treatment sludges from metal heat treating operations where cyanides are used in the process.				
F019	.....	4	F019	10 (4.54)
Wastewater treatment sludges from the chemical conversion coating of aluminum except from zirconium phosphating in aluminum can washing when such phosphating is an exclusive conversion coating process.				
F020	.....	4	F020	1 (0.454)
Wastes (except wastewater and spent carbon from hydrogen chloride purification) from the production or manufacturing use (as a reactant, chemical intermediate, or component in a formulating process) of tri- or tetrachlorophenol or of intermediates used to produce their pesticide derivatives. (This listing does not include wastes from the production of hexachlorophene from highly purified 2,4,5-trichlorophenol.)				
F021	.....	4	F021	1 (0.454)
Wastes (except wastewater and spent carbon from hydrogen chloride purification) from the production or manufacturing use (as a reactant, chemical intermediate, or component in a formulating process) of pentachlorophenol or of intermediates used to produce its derivatives.				
F022	.....	4	F022	1 (0.454)
Wastes (except wastewater and spent carbon from hydrogen chloride purification) from the manufacturing use (as a reactant, chemical intermediate, or component in a formulating process) of tetra-, penta-, or hexachlorobenzenes under alkaline conditions.				
F023	.....	4	F023	1 (0.454)
Wastes (except wastewater and spent carbon from hydrogen chloride purification) from the production of materials on equipment previously used for the production or manufacturing use (as a reactant, chemical intermediate, or a component in a formulating process) of tri- and tetrachlorophenols. (This listing does not include wastes from equipment used only for the production or use of hexachlorophene from highly purified 2,4,5-trichlorophenol.)				
F024	.....	4	F024	1 (0.454)

TABLE 302.4—LIST OF HAZARDOUS SUBSTANCES AND REPORTABLE QUANTITIES—Continued

[Note: All Comments/Notes Are Located at the End of This Table]

Hazardous substance	CASRN	Statutory codedagger;	RCRA waste No.	Final RQ pounds (Kg)
Process wastes, including but not limited to, distillation residues, heavy ends, tars, and reactor clean-out wastes, from the production of certain chlorinated aliphatic hydrocarbons by free radical catalyzed processes. These chlorinated aliphatic hydrocarbons are those having carbon chain lengths ranging from one to and including five, with varying amounts and positions of chlorine substitution. (This listing does not include wastewaters, wastewater treatment sludges, spent catalysts, and wastes listed in 40 CFR 261.31 or 261.32.)				
F025	.....	4	F025	1 (0.454)
Condensed light ends, spent filters and filter aids, and spent desiccant wastes from the production of certain chlorinated aliphatic hydrocarbons, by free radical catalyzed processes. These chlorinated aliphatic hydrocarbons are those having carbon chain lengths ranging from one to and including five, with varying amounts and positions of chlorine substitution.				
F026	.....	4	F026	1 (0.454)
Wastes (except wastewater and spent carbon from hydrogen chloride purification) from the production of materials on equipment previously used for the manufacturing use (as a reactant, chemical intermediate, or component in a formulating process) of tetra-, penta-, or hexachlorobenzene under alkaline conditions.				
F027	.....	4	F027	1 (0.454)
Discarded unused formulations containing tri-, tetra-, or pentachlorophenol or discarded unused formulations containing compounds derived from these chlorophenols. (This listing does not include formulations containing hexachlorophene synthesized from prepurified 2,4,5- trichlorophenol as the sole component.)				
F028	.....	4	F028	1 (0.454)
Residues resulting from the incineration or thermal treatment of soil contaminated with EPA Hazardous Waste Nos. F020, F021, F022, F023, F026, and F027.				
F032	.....	4	F032	1 (0.454)
Wastewaters (except those that have not come into contact with process contaminants), process residuals, preservative drippage, and spent formulations from wood preserving processes generated at plants that currently use or have previously used chlorophenolic formulations (except potentially cross-contaminated wastes that have had the F032 waste code deleted in accordance with § 261.35 of this chapter or potentially cross-contaminated wastes that are otherwise currently regulated as hazardous wastes (i.e., F034 or F035), and where the generator does not resume or initiate use of chlorophenolic formulations). This listing does not include K001 bottom sediment sludge from the treatment of wastewater from wood preserving processes that use creosote and/or pentachlorophenol.				
F034	.....	4	F034	1 (0.454)
Wastewaters (except those that have not come into contact with process contaminants), process residuals, preservative drippage, and spent formulations from wood preserving processes generated at plants that use creosote formulations. This listing does not include K001 bottom sediment sludge from the treatment of wastewater from wood preserving processes that use creosote and/or pentachlorophenol.				
F035	.....	4	F035	1 (0.454)

TABLE 302.4—LIST OF HAZARDOUS SUBSTANCES AND REPORTABLE QUANTITIES—Continued

[Note: All Comments/Notes Are Located at the End of This Table]

Hazardous substance	CASRN	Statutory codedagger;	RCRA waste No.	Final RQ pounds (Kg)
Wastewaters (except those that have not come into contact with process contaminants), process residuals, preservative drippage, and spent formulations from wood preserving processes generated at plants that use inorganic preservatives containing arsenic or chromium. This listing does not include K001 bottom sediment sludge from the treatment of wastewater from wood preserving processes that use creosote and/or pentachlorophenol.				
F037	.....	4	F037	1 (0.454)
Petroleum refinery primary oil/water/solids separation sludge-Any sludge generated from the gravitational separation of oil/water/solids during the storage or treatment of process wastewaters and oily cooling wastewaters from petroleum refineries. Such sludges include, but are not limited to those generated in oil/water/solids separators; tanks and impoundments; ditches and other conveyances; sumps; and stormwater units receiving dry weather flow. Sludges generated in stormwater units that do not receive dry weather flow, sludges generated from non-contact once-through cooling waters segregated for treatment from other process or oily cooling waters, sludges generated in aggressive biological treatment units as defined in § 261.31(b)(2) (including sludges generated in one or more additional units after wastewaters have been treated in aggressive biological treatment units) and K051 wastes are not included in this listing. This listing does include residuals generated from processing or recycling oil-bearing hazardous secondary materials excluded under § 261.4(a)(12)(i), if those residuals are to be disposed of.				
F038	.....	4	F038	1 (0.454)
Petroleum refinery secondary (emulsified) oil/water/solids separation sludge-Any sludge and/or float generated from the physical and/or chemical separation of oil/water/solids in process wastewaters and oily cooling wastewaters from petroleum refineries. Such wastes include, but are not limited to, all sludges and floats generated in: induced air flotation (IAF) units, tanks and impoundments, and all sludges generated in DAF units. Sludges generated in stormwater units that do not receive dry weather flow, sludges generated from non-contact once-through cooling waters segregated for treatment from other process or oily cooling waters, sludges and floats generated in aggressive biological treatment units as defined in § 261.31(b)(2) (including sludges and floats generated in one or more additional units after wastewaters have been treated in aggressive biological treatment units) and F037, K048, and K051 wastes are not included in this listing.				
F039	.....	4	F039	1 (0.454)
Leachate (liquids that have percolated through land disposed wastes) resulting from the disposal of more than one restricted waste classified as hazardous under subpart D of 40 CFR part 261. (Leachate resulting from the disposal of one or more of the following EPA Hazardous Wastes and no other hazardous wastes retains its EPA Hazardous Waste Number(s): F020, F021, F022, F026, F027, and/or F028.)				
K001	.....	4	K001	1 (0.454)
Bottom sediment sludge from the treatment of wastewaters from wood preserving processes that use creosote and/or pentachlorophenol.				
K002	.....	4	K002	10 (4.54)
Wastewater treatment sludge from the production of chrome yellow and orange pigments.				
K003	.....	4	K003	10 (4.54)

TABLE 302.4—LIST OF HAZARDOUS SUBSTANCES AND REPORTABLE QUANTITIES—Continued

[Note: All Comments/Notes Are Located at the End of This Table]

Hazardous substance	CASRN	Statutory codedagger;	RCRA waste No.	Final RQ pounds (Kg)
Wastewater treatment sludge from the production of molybdate orange pigments.				
K004	.....	4	K004	10 (4.54)
Wastewater treatment sludge from the production of zinc yellow pigments.				
K005	.....	4	K005	10 (4.54)
Wastewater treatment sludge from the production of chrome green pigments.				
K006	.....	4	K006	10 (4.54)
Wastewater treatment sludge from the production of chrome oxide green pigments (anhydrous and hydrated).				
K007	.....	4	K007	10 (4.54)
Wastewater treatment sludge from the production of iron blue pigments.				
K008	.....	4	K008	10 (4.54)
Oven residue from the production of chrome oxide green pigments.				
K009	.....	4	K009	10 (4.54)
Distillation bottoms from the production of acetaldehyde from ethylene.				
K010	.....	4	K010	10 (4.54)
Distillation side cuts from the production of acetaldehyde from ethylene.				
K011	.....	4	K011	10 (4.54)
Bottom stream from the wastewater stripper in the production of acrylonitrile.				
K013	.....	4	K013	10 (4.54)
Bottom stream from the acetonitrile column in the production of acrylonitrile.				
K014	.....	4	K014	5000 (2270)
Bottoms from the acetonitrile purification column in the production of acrylonitrile.				
K015	.....	4	K015	10 (4.54)
Still bottoms from the distillation of benzyl chloride.				
K016	.....	4	K016	1 (0.454)
Heavy ends or distillation residues from the production of carbon tetrachloride.				
K017	.....	4	K017	10 (4.54)
Heavy ends (still bottoms) from the purification column in the production of epichlorohydrin.				
K018	.....	4	K018	1 (0.454)
Heavy ends from the fractionation column in ethyl chloride production.				
K019	.....	4	K019	1 (0.454)
Heavy ends from the distillation of ethylene dichloride in ethylene dichloride production.				
K020	.....	4	K020	1 (0.454)
Heavy ends from the distillation of vinyl chloride in vinyl chloride monomer production.				
K021	.....	4	K021	10 (4.54)
Aqueous spent antimony catalyst waste from fluoromethanes production.				
K022	.....	4	K022	1 (0.454)
Distillation bottom tars from the production of phenol/acetone from cumene.				
K023	.....	4	K023	5000 (2270)
Distillation light ends from the production of phthalic anhydride from naphthalene.				
K024	.....	4	K024	5000 (2270)
Distillation bottoms from the production of phthalic anhydride from naphthalene.				
K025	.....	4	K025	10 (4.54)
Distillation bottoms from the production of nitrobenzene by the nitration of benzene.				
K026	.....	4	K026	1000 (454)
Stripping still tails from the production of methyl ethyl pyridines.				
K027	.....	4	K027	10 (4.54)

TABLE 302.4—LIST OF HAZARDOUS SUBSTANCES AND REPORTABLE QUANTITIES—Continued

[Note: All Comments/Notes Are Located at the End of This Table]

Hazardous substance	CASRN	Statutory codedagger;	RCRA waste No.	Final RQ pounds (Kg)
Centrifuge and distillation residues from toluene diisocyanate production.				
K028		4	K028	1 (0.454)
Spent catalyst from the hydrochlorinator reactor in the production of 1,1,1-trichloroethane.				
K029		4	K029	1 (0.454)
Waste from the product steam stripper in the production of 1,1,1- trichloroethane.				
K030		4	K030	1 (0.454)
Column bottoms or heavy ends from the combined production of trichloroethylene and perchloroethylene.				
K031		4	K031	1 (0.454)
By-product salts generated in the production of MSMA and cacodylic acid.				
K032		4	K032	10 (4.54)
Wastewater treatment sludge from the production of chlordane.				
K033		4	K033	10 (4.54)
Wastewater and scrub water from the chlorination of cyclopentadiene in the production of chlordane.				
K034		4	K034	10 (4.54)
Filter solids from the filtration of hexachlorocyclopentadiene in the production of chlordane.				
K035		4	K035	1 (0.454)
Wastewater treatment sludges generated in the production of creosote.				
K036		4	K036	1 (0.454)
Still bottoms from toluene reclamation distillation in the production of disulfoton.				
K037		4	K037	1 (0.454)
Wastewater treatment sludges from the production of disulfoton.				
K038		4	K038	10 (4.54)
Wastewater from the washing and stripping of phorate production.				
K039		4	K039	10 (4.54)
Filter cake from the filtration of diethylphosphorodithioic acid in the production of phorate.				
K040		4	K040	10 (4.54)
Wastewater treatment sludge from the production of phorate.				
K041		4	K041	1 (0.454)
Wastewater treatment sludge from the production of toxaphene.				
K042		4	K042	10 (4.54)
Heavy ends or distillation residues from the distillation of tetrachlorobenzene in the production of 2,4,5-T.				
K043		4	K043	10 (4.54)
2,6-Dichlorophenol waste from the production of 2,4-D.				
K044		4	K044	10 (4.54)
Wastewater treatment sludges from the manufacturing and processing of explosives.				
K045		4	K045	10 (4.54)
Spent carbon from the treatment of wastewater containing explosives.				
K046		4	K046	10 (4.54)
Wastewater treatment sludges from the manufacturing, formulation and loading of lead-based initiating compounds.				
K047		4	K047	10 (4.54)
Pink/red water from TNT operations.				
K048		4	K048	10 (4.54)
Dissolved air flotation (DAF) float from the petroleum refining industry.				
K049		4	K049	10 (4.54)
Slop oil emulsion solids from the petroleum refining industry.				
K050		4	K050	10 (4.54)

TABLE 302.4—LIST OF HAZARDOUS SUBSTANCES AND REPORTABLE QUANTITIES—Continued

[Note: All Comments/Notes Are Located at the End of This Table]

Hazardous substance	CASRN	Statutory codedagger;	RCRA waste No.	Final RQ pounds (Kg)
Heat exchanger bundle cleaning sludge from the petroleum refining industry.				
K051		4	K051	10 (4.54)
API separator sludge from the petroleum refining industry.				
K052		4	K052	10 (4.54)
Tank bottoms (leaded) from the petroleum refining industry.				
K060		4	K060	1 (0.454)
Ammonia still lime sludge from coking operations.				
K061		4	K061	10 (4.54)
Emission control dust/sludge from the primary production of steel in electric furnaces.				
K062		4	K062	10 (4.54)
Spent pickle liquor generated by steel finishing operations of facilities within the iron and steel industry (SIC Codes 331 and 332).				
K064		4	K064	10 (4.54)
Acid plant blowdown slurry/sludge resulting from the thickening of blowdown slurry from primary copper production.				
K065		4	K065	10 (4.54)
Surface impoundment solids contained in and dredged from surface impoundments at primary lead smelting facilities.				
K066		4	K066	10 (4.54)
Sludge from treatment of process wastewater and/or acid plant blowdown from primary zinc production.				
K069		4	K069	10 (4.54)
Emission control dust/sludge from secondary lead smelting. (Note: This listing is stayed administratively for sludge generated from secondary acid scrubber systems. The stay will remain in effect until further administrative action is taken. If EPA takes further action effecting the stay, EPA will publish a notice of the action in the **Federal Register**.)				
K071		4	K071	1 (0.454)
Brine purification muds from the mercury cell process in chlorine production, where separately prepurified brine is not used.				
K073		4	K073	10 (4.54)
Chlorinated hydrocarbon waste from the purification step of the diaphragm cellprocess using graphite anodes in chlorine production.				
K083		4	K083	100 (45.4)
Distillation bottoms from aniline production.				
K084		4	K084	1 (0.454)
Wastewater treatment sludges generated during the production of veterinary pharmaceuticals from arsenic or organo-arsenic compounds.				
K085		4	K085	10 (4.54)
Distillation or fractionation column bottoms from the production of chlorobenzenes.				
K086		4	K086	10 (4.54)
Solvent washes and sludges, caustic washes and sludges, or water washes and sludges from cleaning tubs and equipment used in the formulation of ink from pigments, driers, soaps, and stabilizers containing chromium and lead.				
K087		4	K087	100 (45.4)
Decanter tank tar sludge from coking operations.				
K088		4	K088	10 (4.54)
Spent potliners from primary aluminum reduction.				
K090		4	K090	10 (4.54)
Emission control dust or sludge from ferrochromiumsilicon production.				
K091		4	K091	10 (4.54)
Emission control dust or sludge from ferrochromium production.				
K093		4	K093	5000 (2270)

TABLE 302.4—LIST OF HAZARDOUS SUBSTANCES AND REPORTABLE QUANTITIES—Continued

[Note: All Comments/Notes Are Located at the End of This Table]

Hazardous substance	CASRN	Statutory codedagger;	RCRA waste No.	Final RQ pounds (Kg)
Distillation light ends from the production of phthalic anhydride from ortho-xylene.				
K094	.....	4	K094	5000 (2270)
Distillation bottoms from the production of phthalic anhydride from ortho-xylene.				
K095	.....	4	K095	100 (45.4)
Distillation bottoms from the production of 1,1,1-trichloroethane.				
K096	.....	4	K096	100 (45.4)
Heavy ends from the heavy ends column from the production of 1,1,1-trichloroethane.				
K097	.....	4	K097	1 (0.454)
Vacuum stripper discharge from the chlordane chlorinator in the production of chlordane.				
K098	.....	4	K098	1 (0.454)
Untreated process wastewater from the production of toxaphene.				
K099	.....	4	K099	10 (4.54)
Untreated wastewater from the production of 2,4-D.				
K100	.....	4	K100	10 (4.54)
Waste leaching solution from acid leaching of emission control dust/sludge from secondary lead smelting.				
K101	.....	4	K101	1 (0.454)
Distillation tar residues from the distillation of aniline-based compounds in the production of veterinary pharmaceuticals from arsenic or organo-arsenic compounds.				
K102	.....	4	K102	1 (0.454)
Residue from the use of activated carbon for decolorization in the production of veterinary pharmaceuticals from arsenic or organo-arsenic compounds.				
K103	.....	4	K103	100 (45.4)
Process residues from aniline extraction from the production of aniline.				
K104	.....	4	K104	10 (4.54)
Combined wastewater streams generated from nitrobenzene/aniline production.				
K105	.....	4	K105	10 (4.54)
Separated aqueous stream from the reactor product washing step in the production of chlorobenzenes.				
K106	.....	4	K106	1 (0.454)
Wastewater treatment sludge from the mercury cell process in chlorine production.				
K107	.....	4	K107	10 (4.54)
Column bottoms from product separation from the production of 1,1- dimethylhydrazine (UDMH) from carboxylic acid hydrazines.				
K108	.....	4	K108	10 (4.54)
Condensed column overheads from product separation and condensed reactor vent gases from the production of 1,1- dimethylhydrazine (UDMH) from carboxylic acid hydrazides.				
K109	.....	4	K109	10 (4.54)
Spent filter cartridges from product purification from the production of 1,1-dimethylhydrazine (UDMH) from carboxylic acid hydrazides.				
K110	.....	4	K110	10 (4.54)
Condensed column overheads from intermediate separation from the production of 1,1- dimethylhydrazine (UDMH) from carboxylic acid hydrazides.				
K111	.....	4	K111	10 (4.54)
Product washwaters from the production of dinitrotoluene via nitration of toluene.				
K112	.....	4	K112	10 (4.54)
Reaction by-product water from the drying column in the production of toluenediamine via hydrogenation of dinitrotoluene.				
K113	.....	4	K113	10 (4.54)

TABLE 302.4—LIST OF HAZARDOUS SUBSTANCES AND REPORTABLE QUANTITIES—Continued

[Note: All Comments/Notes Are Located at the End of This Table]

Hazardous substance	CASRN	Statutory codedagger;	RCRA waste No.	Final RQ pounds (Kg)
Condensed liquid light ends from the purification of toluenediamine in the production of toluenediamine via hydrogenation of dinitrotoluene.				
K114	.....	4	K114	10 (4.54)
Vicinals from the purification of toluenediamine in the production of toluenediamine via hydrogenation of dinitrotoluene.				
K115	.....	4	K115	10 (4.54)
Heavy ends from the purification of toluenediamine in the production of toluenediamine via hydrogenation of dinitrotoluene.				
K116	.....	4	K116	10 (4.54)
Organic condensate from the solvent recovery column in the production of toluene diisocyanate via phosgenation of toluenediamine.				
K117	.....	4	K117	1 (0.454)
Wastewater from the reactor vent gas scrubber in the production of ethylene dibromide via bromination of ethene.				
K118	.....	4	K118	1 (0.454)
Spent adsorbent solids from purification of ethylene dibromide in the production of ethylene dibromide via bromination of ethene.				
K123	.....	4	K123	10 (4.54)
Process wastewater (including supernates, filtrates, and washwaters) from the production of ethylenebisdithiocarbamic acid and its salts.				
K124	.....	4	K124	10 (4.54)
Reactor vent scrubber water from the production of ethylenebisdithiocarbamic acid and its salts.				
K125	.....	4	K125	10 (4.54)
Filtration, evaporation, and centrifugation solids from the production of ethylenebisdithiocarbamic acid and its salts.				
K126	.....	4	K126	10 (4.54)
Baghouse dust and floor sweepings in milling and packaging operations from the production or formulation of ethylenebisdithiocarbamic acid and its salts.				
K131	.....	4	K131	100 (45.4)
Wastewater from the reactor and spent sulfuric acid from the acid dryer from the production of methyl bromide.				
K132	.....	4	K132	1000 (454)
Spent absorbent and wastewater separator solids from the production of methyl bromide.				
K136	.....	4	K136	1 (0.454)
Still bottoms from the purification of ethylene dibromide in the production of ethylene dibromide via bromination of ethene.				
K141	.....	4	K141	1 (0.454)
Process residues from the recovery of coal tar, including, but not limited to, collecting sump residues from the production of coke from coal or the recovery of coke by-products produced from coal. This listing does not include K087 (decanter tank tar sludges from coking operations).				
K142	.....	4	K142	1 (0.454)
Tar storage tank residues from the production of coke from coal or from the recovery of coke by-products produced from coal.				
K143	.....	4	K143	1 (0.454)
Process residues from the recovery of light oil, including, but not limited to, those generated in stills, decanters, and wash oil recovery units from the recovery of coke by- products produced from coal.				
K144	.....	4	K144	1 (0.454)
Wastewater sump residues from light oil refining, including, but not limited to, intercepting or contamination sump sludges from the recovery of coke by-products produced from coal.				

TABLE 302.4—LIST OF HAZARDOUS SUBSTANCES AND REPORTABLE QUANTITIES—Continued

[Note: All Comments/Notes Are Located at the End of This Table]

Hazardous substance	CASRN	Statutory codedagger;	RCRA waste No.	Final RQ pounds (Kg)
K145		4	K145	1 (0.454)
Residues from naphthalene collection and recovery operations from the recovery of coke by-products produced from coal.				
K147		4	K147	1 (0.454)
Tar storage tank residues from coal tar refining.				
K148		4	K148	1 (0.454)
Residues from coal tar distillation, including, but not limited to, still bottoms.				
K149		4	K149	10 (4.54)
Distillation bottoms from the production of alpha-(or methyl-) chlorinated toluenes, ring-chlorinated toluenes, benzoyl chlorides, and compounds with mixtures of these functional groups. [This waste does not include still bottoms from the distillation of benzyl chloride.]				
K150		4	K150	10 (4.54)
Organic residuals, excluding spent carbon adsorbent, from the spent chlorine gas and hydrochloric acid recovery processes associated with the production of alpha- (or methyl-) chlorinated toluenes, ring-chlorinated toluenes, benzoyl chlorides, and compounds with mixtures of these functional groups.				
K151		4	K151	10 (4.54)
Wastewater treatment sludges, excluding neutralization and biological sludges, generated during the treatment of waste-waters from the production of alpha- (or methyl-) chlorinated toluenes, ring-chlorinated toluenes, benzoyl chlorides, and compounds with mixtures of these functional groups.				
K156		4	K156	##
Organic waste (including heavy ends, still bottoms, light ends, spent solvents, filtrates, and decantates) from the production of carbamates and carbamoyl oximes. (This listing does not apply to wastes generated from the manufacture of 3-iodo-2-propynyl n-butylcarbamate.)				
K157		4	K157	##
Wastewaters (including scrubber waters, condenser waters, washwaters, and separation waters) from the production of carbamates and carbamoyl oximes. (This listing does not apply to wastes generated from the manufacture of 3-iodo-2-propynyl n-butylcarbamate.)				
K158		4	K158	##
Bag house dusts and filter/separation solids from the production of carbamates and carbamoyl oximes. (This listing does not apply to wastes generated from the manufacture of 3-iodo-2-propynyl n-butylcarbamate.)				
K159		4	K159	##
Organics from the treatment of thiocarbamate wastes.				
K161		4	K161	##
Purification solids (including filtration, evaporation, and centrifugation solids), baghouse dust and floor sweepings from the production of dithiocarbamate acids and their salts. (This does not include K125 or K126.)				
K169[f]		4	K169	10 (4.54)
Crude oil storage tank sediment from petroleum refining operations.				
K170[f]		4	K170	1 (0.454)
Clarified slurry oil tank sediment and/or in-line filter/separation solids from petroleum refining operations.				
K171[f]		4	K171	1 (0.454)
Spent hydrotreating catalyst from petroleum refining operations. (This listing does not include inert support media.)				
K172[f]		4	K172	1 (0.454)
Spent hydrorefining catalyst from petroleum refining operations. (This listing does not include inert support media.)				
K174[f]		4	K174	1 (0.454)
K175[f]		4	K175	1 (0.454)

TABLE 302.4—LIST OF HAZARDOUS SUBSTANCES AND REPORTABLE QUANTITIES—Continued

[Note: All Comments/Notes Are Located at the End of This Table]

Hazardous substance	CASRN	Statutory codedagger;	RCRA waste No.	Final RQ pounds (Kg)
K176				
Baghouse filters from the production of antimony oxide, including filters from the production of intermediates (e.g., antimony metal or crude antimony oxide)		4	K176	1 (0.454)
K177				
Slag from the production of antimony oxide that is speculatively accumulated or disposed, including slag from the production of intermediates (e.g., antimony metal or crude antimony oxide)		4	K177	5,000 (2270)
K178				
Residues from manufacturing and manufacturing-site storage of ferric chloride from acids formed during the production of titanium dioxide using the chloride ilmenite process		4	K178	1 (0.454)

dagger; Indicates the statutory source defined by 1,2,3, and 4, as described in the note preceding Table 302.4.

dagger;dagger; No reporting of releases of this hazardous substance is required if the diameter of the pieces of the solid metal released is larger than 100 micrometers (0.004 inches).

dagger;dagger;dagger; The RQ for asbestos is limited to friable forms only.

The Agency may adjust the statutory RQ for this hazardous substance in a future rulemaking; until then the statutory one-pound RQ applies.

§ The adjusted RQs for radionuclides may be found in Appendix B to this table.

** Indicates that no RQ is being assigned to the generic or broad class.

[a] Benzene was already a CERCLA hazardous substance prior to the CAA Amendments of 1990 and received an adjusted 10-pound RQ based on potential carcinogenicity in an August 14, 1989, final rule (54 FR 33418). The CAA Amendments specify that "benzene (including benzene from gasoline)" is a hazardous air pollutant and, thus, a CERCLA hazardous substance.

[b] The CAA Amendments of 1990 list DDE (3547–04–4) as a CAA hazardous air pollutant. The CAS number, 3547–04–4, is for the chemical, p,p'dichlorodiphenylethane. DDE or p,p'-dichlorodiphenyldichloroethylene, CAS number 72–55–9, is already listed in Table 302.4 with a final RQ of 1 pound. The substance identified by the CAS number 3547–04–4 has been evaluated and listed as DDE to be consistent with the CAA section 112 listing, as amended.

[c] Includes mineral fiber emissions from facilities manufacturing or processing glass, rock, or slag fibers (or other mineral derived fibers) of average diameter 1 micrometer or less.

[d] Includes mono- and di-ethers of ethylene glycol, diethylene glycol, and triethylene glycol R-(OCH2CH2)n-OR' where:

n = 1, 2, or 3;
R = alkyl C7 or less; or
R = phenyl or alkyl substituted phenyl;
R' = H or alkyl C7 or less; or
OR' consisting of carboxylic acid ester, sulfate, phosphate, nitrate, or sulfonate.

[e] Includes organic compounds with more than one benzene ring, and which have a boiling point greater than or equal to 100 °C.

[f] See 40 CFR 302.6(b)(1) for application of the mixture rule to this hazardous waste.

APPENDIX A TO § 302.4—SEQUENTIAL CAS REGISTRY NUMBER LIST OF CERCLA HAZARDOUS SUBSTANCES

CASRN	Hazardous substance
50000	Formaldehyde.
50077	Azirino[2′,3′:3,4]pyrrolo[1,2-a]indole-4,7-dione,6-amino-8-[[(aminocarbonyl)oxy]methyl]-1,1a,2,8,8a, 8b-hexahydro-8a-methoxy-5-methyl-, [1aS-(1aalpha, 8beta,8aalpha,8balpha)]-
	Mitomycin C.
50180	Cyclophosphamide.
	2H-1,3,2-Oxazaphosphorin-2-amine, N,N-bis(2-chloroethyl)tetrahydro-, 2-oxide.
50293	Benzene, 1,1′-(2,2,2- trichloroethylidene)bis[4-chloro-.
	DDT.
	4,4′-DDT.
50328	Benzo[a]pyrene.
	3,4-Benzopyrene.
50555	Reserpine.
	Yohimban-16-carboxylic acid,11,17-dimethoxy-18-[(3 ,4,5-trimethoxybenzoyl)oxy]-, methyl ester (3beta, 16beta,17alpha,18beta,20alpha)- .
51285	Phenol, 2,4-dinitro-.
	2,4-Dinitrophenol.
51434	Epinephrine.

APPENDIX A TO § 302.4—SEQUENTIAL CAS REGISTRY NUMBER LIST OF CERCLA HAZARDOUS SUBSTANCES—Continued

CASRN	Hazardous substance
	1,2-Benzenediol,4-[1-hydroxy-2-(methylamino) ethyl]-.
51796	Carbamic acid, ethyl ester.
	Ethyl carbamate.
	Urethane.
52686	Trichlorfon.
52857	Famphur.
	[(dimethylamino)sulfonyl]phenyl] O,O-dimethyl ester.
Phosphorothioic	
53703	Dibenz[a,h]anthracene.
acid, O-	Dibenzo[a,h]anthracene.
[4-	1,2:5,6-Dibenzanthracene.
53963	Acetamide, N-9H-fluoren-2-yl-.
	2-Acetylaminofluorene.
54115	Nicotine, & salts.
	Pyridine, 3-(1-methyl-2-pyrrolidinyl)-, (S)-, & salts.
55185	Ethanamine, N-ethyl-N-nitroso-.
	N-Nitrosodiethylamine.
55630	Nitroglycerine.
	1,2,3-Propanetriol, trinitrate.

APPENDIX A TO § 302.4—SEQUENTIAL CAS REGISTRY NUMBER LIST OF CERCLA HAZARDOUS SUBSTANCES—Continued

CASRN	Hazardous substance
55914	Diisopropylfluorophosphate (DFP).
	Phosphorofluororidic acid, bis(1-methylethyl) ester.
56042	Methylthiouracil.
	4(1H)-Pyrimidinone, 2,3-dihydro-6-methyl-2-thioxo-.
56235	Carbon tetrachloride.
	Methane, tetrachloro-.
56382	Parathion.
	Phosphorothioic acid, O,O-diethyl O-(4-nitrophenyl) ester.
56495	Benz[j]aceanthrylene, 1,2-dihydro-3-methyl-.
	3-Methylcholanthrene.
56531	Diethylstilbestrol.
	Phenol, 4,4′-(1,2-diethyl-1,2-ethenediyl)bis-, (E).
56553	Benz[a]anthracene.
	Benzo[a]anthracene.
	1,2-Benzanthracene.
56724	Coumaphos.
57147	Hydrazine, 1,1-dimethyl-.
	1,1-Dimethylhydrazine.
57249	Strychnidin-10-one, & salts.
	Strychnine, & salts.
57476	Pyrrolo[2,3-b]indol-5-ol, 1,2,3,3a,8,8a-hexahydro-1,3a,8-trimethyl-, methylcarbamate (ester), (3aS-cis)- (Physostigmine).
57578	beta-Propiolactone.
57647	Benzoic acid, 2-hydroxy-, compd. with (3aS-cis)-1,2,3,3a,8,8a-hexahydro-1,3a,8-trimethylpyrrolo[2,3-b]indol-5-yl methylcarbamate ester (1:1) (Physostigmine salicylate).
57749	Chlordane.
	Chlordane, alpha & gamma isomers.
	CHLORDANE (TECHNICAL MIXTURE AND METABOLITES).
	4,7-Methano-1H-indene, 1,2,4,5,6,7,8,8-octachloro-2,3,3a,4,7,7a-hexahydro-.
57976	Benz[a]anthracene, 7,12-dimethyl-.
	7,12-Dimethylbenz[a]anthracene.
58899	γ-BHC.
	Cyclohexane, 1,2,3,4,5,6-hexachloro-(1α,2α,3β,4α,5α,6β)-.
	Lindane.
	Lindane (all isomers).
58902	Phenol, 2,3,4,6-tetrachloro-.
	2,3,4,6-Tetrachlorophenol.
59507	p-Chloro-m-cresol.
	Phenol, 4-chloro-3-methyl-.
59892	N-Nitrosomorpholine.
60004	Ethylenediamine-tetraacetic acid (EDTA).
60117	Benzenamine, N,N-dimethyl-4-(phenylazo)-.
	Dimethyl aminoazobenzene.
	p-Dimethylaminoazobenzene.
60297	Ethane, 1,1′-oxybis-.
	Ethyl ether.
60344	Hydrazine, methyl-.
	Methyl hydrazine.
60355	Acetamide.
60515	Dimethoate.
	Phosphorodithioic acid, O,O-dimethyl S-[2(methylamino)-2-oxoethyl] ester.
60571	Dieldrin.
	2,7:3,6-Dimethanonaphth[2,3-b]oxirene, 3,4,5,6,9,9-hexachloro-1a,2, 2a,3,6,6a,7,7a-octahydro-, (1aalpha,2beta,2aalpha,3beta,6beta, 6aalpha,7beta, 7aalpha)-.
61825	Amitrole.
	1H-1,2,4-Triazol-3-amine.

APPENDIX A TO § 302.4—SEQUENTIAL CAS REGISTRY NUMBER LIST OF CERCLA HAZARDOUS SUBSTANCES—Continued

CASRN	Hazardous substance
62384	Mercury, (acetato-O)phenyl-.
	Phenylmercury acetate.
62442	Acetamide, N-(4-ethoxyphenyl)-.
	Phenacetin.
62500	Ethyl methanesulfonate.
	Methanesulfonic acid, ethyl ester.
62533	Aniline.
	Benzenamine.
62555	Ethanethioamide.
	Thioacetamide.
62566	Thiourea.
62737	Dichlorvos.
62748	Acetic acid, fluoro-, sodium salt.
	Fluoroacetic acid, sodium salt.
62759	Methanamine, N-methyl-N-nitroso-.
	N-Nitrosodimethylamine.
63252	Carbaryl.
	1-Naphthalenol, methylcarbamate.
64006	Phenol, 3-(1-methylethyl)-, methyl carbamate (m-Cumenyl methylcarbamate).
64186	Formic acid.
64197	Acetic acid.
64675	Diethyl sulfate.
65850	Benzoic acid.
66751	Uracil mustard.
	2,4-(1H,3H)-Pyrimidinedione, 5-[bis(2-chloroethyl) amino]-.
67561	Methanol.
	Methyl alcohol.
67641	Acetone.
	2-Propanone.
67663	Chloroform.
	Methane, trichloro-.
67721	Ethane, hexachloro-.
	Hexachloroethane.
68122	Dimethylformamide.
70257	Guanidine, N-methyl-N′-nitro-N-nitroso-.
	MNNG.
70304	Hexachlorophene.
	Phenol, 2,2′-methylenebis[3,4,6-tri- chloro-.
71363	n-Butyl alcohol.
	1-Butanol.
71432	Benzene.
71556	Ethane, 1,1,1-trichloro-.
	Methyl chloroform.
	1,1,1-Trichloroethane.
72208	Endrin.
	Endrin, & metabolites.
	2,7:3.6-Dimethanonaphth[2,3-b]oxirene,3,4,5,6,9,9-hexachloro-1a,2,2a,3,6,6a,7,7a-octahydro-, (1aalpha,2beta,2abeta,3alpha, 6alpha,6abeta,7beta,7aalpha)-, & metabolites.
72435	Benzene, 1,1′-(2,2,2-trichloroethylidene)bis[4-methoxy-.
	Methoxychlor.
72548	Benzene, 1,1′-(2,2-dichloroethylidene)bis[4-chloro-.
	DDD.
	TDE.
	4,4′-DDD.
72559	DDE
	4,4′-DDE.
72571	Trypan blue.
	2,7-Naphthalenedisulfonic acid, 3,3′-[(3,3′-dimethyl-(l,1′-biphenyl)-4,4′-diyl)-bis(azo)]bis(5-amino-4-hydroxy)-tetrasodium salt.
74839	Bromomethane.
	Methane, bromo-.
	Methyl bromide.

APPENDIX A TO § 302.4—SEQUENTIAL CAS REGISTRY NUMBER LIST OF CERCLA HAZARDOUS SUBSTANCES—Continued

CASRN	Hazardous substance
74873	Chloromethane.
	Methane, chloro-.
	Methyl chloride.
74884	Iodomethane
	Methane, iodo-.
	Methyl iodide.
74895	Monomethylamine.
74908	Hydrocyanic acid.
	Hydrogen cyanide.
74931	Methanethiol.
	Methyl mercaptan.
	Thiomethanol.
74953	Methane, dibromo-.
	Methylene bromide.
75003	Chloroethane.
	Ethyl chloride.
75014	Ethene, chloro-.
	Vinyl chloride.
75047	Monoethylamine.
75058	Acetonitrile.
75070	Acetaldehyde.
	Ethanal.
75092	Dichloromethane.
	Methane, dichloro-.
	Methylene chloride.
75150	Carbon disulfide.
75207	Calcium carbide.
75218	Ethylene oxide.
	Oxirane.
75252	Bromoform.
	Methane, tribromo-.
75274	Dichlorobromomethane.
75343	Ethane, 1,1-dichloro-.
	Ethylidene dichloride.
	1,1-Dichloroethane.
75354	Ethene, 1,1-dichloro-.
	Vinylidene chloride.
	1,1-Dichloroethylene.
75365	Acetyl chloride.
75445	Carbonic dichloride.
	Phosgene.
75503	Trimethylamine.
75558	Aziridine, 2-methyl-.
	2-Methyl aziridine.
	1,2-Propylenimine.
75569	Propylene oxide.
75605	Arsinic acid, dimethyl-.
	Cacodylic acid.
75649	tert-Butylamine.
75694	Methane, trichlorofluoro-.
	Trichloromonofluoromethane.
75718	Dichlorodifluoromethane.
	Methane, dichlorodifluoro-.
75865	Acetone cyanohydrin.
	Propanenitrile, 2-hydroxy-2-methyl-.
	2-Methyllactonitrile.
75876	Acetaldehyde, trichloro-.
	Chloral.
75990	2,2-Dichloropropionic acid.
76017	Ethane, pentachloro-.
	Pentachloroethane.
76448	Heptachlor.
	4,7-Methano-1H-indene, 1,4,5,6,7,8,8-heptachloro-3a,4,7,7a-tetrahydro-.
77474	Hexachlorocyclopentadiene.
	1,3-Cyclopentadiene, 1,2,3,4,5,5-hexa- chloro-.
77781	Dimethyl sulfate.
	Sulfuric acid, dimethyl ester.
78002	Plumbane, tetraethyl-.
	Tetraethyl lead.

APPENDIX A TO § 302.4—SEQUENTIAL CAS REGISTRY NUMBER LIST OF CERCLA HAZARDOUS SUBSTANCES—Continued

CASRN	Hazardous substance
78591	Isophorone.
78795	Isoprene.
78819	iso-Butylamine.
78831	Isobutyl alcohol.
	1-Propanol, 2-methyl-.
78875	Propane, 1,2-dichloro-.
	Propylene dichloride.
	1,2-Dichloropropane.
78886	2,3-Dichloropropene.
78933	2-Butanone.
	MEK.
	Methyl ethyl ketone.
78999	1,1-Dichloropropane.
79005	Ethane, 1,1,2-trichloro-.
	1,1,2-Trichloroethane.
79016	Ethene, trichloro-.
	Trichloroethylene.
79061	Acrylamide.
	2-Propenamide.
79094	Propionic acid.
79107	Acrylic acid.
	2-Propenoic acid.
79118	Chloroacetic acid.
79196	Hydrazinecarbothioamide.
	Thiosemicarbazide.
79221	Carbonochloridic acid, methyl ester.
	Methyl chlorocarbonate.
79312	iso-Butyric acid.
79345	Ethane, 1,1,2,2-tetrachloro-.
	1,1,2,2-Tetrachloroethane.
79447	Carbamic chloride, dimethyl-.
	Dimethylcarbamoyl chloride.
79469	Propane, 2-nitro-.
	2-Nitropropane.
80159	alpha,alpha-Dimethylbenzylhydroperoxide.
	Hydroperoxide, 1-methyl-1-phenylethyl-.
80626	Methyl methacrylate.
	2-Propenoic acid, 2-methyl-, methyl ester.
81072	Saccharin, & salts.
	1,2-Benzisothiazol-3(2H)-one, 1,1-dioxide, & salts.
81812	Warfarin, & salts.
	2H-1-Benzopyran-2-one, 4-hydroxy-3-(3-oxo-1-phenylbutyl)-, & salts.
82688	Benzene, pentachloronitro-.
	PCNB.
	Pentachloronitrobenzene.
	Quintobenzene.
83329	Acenaphthene.
84662	Diethyl phthalate.
	1,2-Benzenedicarboxylic acid, diethyl ester.
84742	Di-n-butyl phthalate.
	Dibutyl phthalate.
	n-Butyl phthalate.
	1,2-Benzenedicarboxylic acid, dibutyl ester.
85007	Diquat.
85018	Phenanthrene.
85449	Phthalic anhydride.
	1,3-Isobenzofurandione.
85687	Butyl benzyl phthalate.
86306	N-Nitrosodiphenylamine.
86500	Guthion.
86737	Fluorene.
86884	alpha-Naphthylthiourea.
	Thiourea, 1-naphthalenyl-.
87650	Phenol, 2,6-dichloro-.
	2,6-Dichlorophenol.
87683	Hexachlorobutadiene.
	1,3-Butadiene, 1,1,2,3,4,4-hexachloro-.
87865	Pentachlorophenol.

APPENDIX A TO § 302.4—SEQUENTIAL CAS REGISTRY NUMBER LIST OF CERCLA HAZARDOUS SUBSTANCES—Continued

CASRN	Hazardous substance
	Phenol, pentachloro-.
88062	Phenol, 2,4,6-trichloro-.
	2,4,6-Trichlorophenol.
88722	o-Nitrotoluene.
88755	o-Nitrophenol.
	2-Nitrophenol.
88857	Dinoseb.
	Phenol, 2-(1-methylpropyl)-4,6-dinitro-.
90040	o-Anisidine.
91087	Benzene, 1,3-diisocyanatomethyl-.
	Toluene diisocyanate.
	2,4-Toluene diisocyanate.
91203	Naphthalene.
91225	Quinoline.
91587	beta-Chloronaphthalene.
	Naphthalene, 2-chloro-.
	2-Chloronaphthalene.
91598	beta-Naphthylamine.
	2-Naphthalenamine.
91667	N,N-Diethylaniline.
91805	Methapyrilene.
	1,2-Ethanediamine, N,N-dimethyl-N′-2-pyridinyl-N′- (2-thienylmethyl)-.
91941	[1,1′-Biphenyl]-4,4′-diamine,3,3′-dichloro-.
	3,3′-Dichlorobenzidine.
92524	Biphenyl.
92671	4-Aminobiphenyl.
92875	Benzidine.
	[1,1′-Biphenyl]-4,4′-diamine.
92933	4-Nitrobiphenyl.
	Propanoic acid, 2-(2,4,5-trichlorophenoxy)-.
	Silvex (2,4,5-TP).
	2,4,5-TP acid.
93765	Acetic acid, (2,4,5-trichlorophenoxy)-.
93721	2,4,5-T.
	2,4,5-T acid.
93798	2,4,5-T esters.
94111	2,4-D Ester.
94586	Dihydrosafrole.
	1,3-Benzodioxole, 5-propyl-.
94597	Safrole.
	1,3-Benzodioxole, 5-(2-propenyl)-.
94791	2,4-D Ester.
94804	2,4-D Ester.
95476	o-Xylene.
95487	o-Cresol.
95501	Benzene, 1,2-dichloro-.
	o-Dichlorobenzene.
	1,2-Dichlorobenzene.
95534	Benzenamine, 2-methyl-.
	o-Toluidine.
95578	o-Chlorophenol.
	Phenol, 2-chloro-.
	2-Chlorophenol.
95807	Benzenediamine, ar-methyl-.
	Toluenediamine.
	2,4-Toluene diamine.
95943	Benzene, 1,2,4,5-tetrachloro-.
	1,2,4,5-Tetrachlorobenzene.
95954	Phenol, 2,4,5-trichloro-.
	2,4,5-Trichlorophenol.
96093	Styrene oxide.
96128	Propane, 1,2-dibromo-3-chloro-.
	1,2-Dibromo-3-chloropropane.
96457	Ethylenethiourea.
	2-Imidazolidinethione.
97632	Ethyl methacrylate.
	2-Propenoic acid, 2-methyl-, ethyl ester.
98011	Furfural.
	2-Furancarboxaldehyde.

APPENDIX A TO § 302.4—SEQUENTIAL CAS REGISTRY NUMBER LIST OF CERCLA HAZARDOUS SUBSTANCES—Continued

CASRN	Hazardous substance
98077	Benzene, (trichloromethyl)-.
	Benzotrichloride.
98099	Benzenesulfonic acid chloride.
	Benzenesulfonyl chloride.
98828	Benzene, (1-methylethyl)-.
	Cumene.
98862	Acetophenone.
	Ethanone, 1-phenyl-.
98873	Benzal chloride.
	Benzene, (dichloromethyl)-.
98884	Benzoyl chloride.
98953	Benzene, nitro-.
	Nitrobenzene.
99081	m-Nitrotoluene.
99354	Benzene, 1,3,5-trinitro-.
	1,3,5-Trinitrobenzene.
99558	Benzenamine, 2-methyl-5-nitro-.
	5-Nitro-o-toluidine.
99650	m-Dinitrobenzene.
99990	p-Nitrotoluene.
100016	Benzenamine, 4-nitro-.
	p-Nitroaniline.
100027	p-Nitrophenol.
	Phenol, 4-nitro-.
	4-Nitrophenol.
100254	p-Dinitrobenzene.
100414	Ethylbenzene.
100425	Styrene.
100447	Benzene, (chloromethyl)-.
	Benzyl chloride.
100470	Benzonitrile.
100754	N-Nitrosopiperidine.
	Piperidine, 1-nitroso-.
101144	Benzenamine, 4,4′-methylenebis[2-chloro-.
	4,4′-Methylenebis(2-chloroaniline).
101279	Carbamic acid, (3-chlorophenyl)-, 4-chloro-2-butynyl ester (Barban).
101553	Benzene, 1-bromo-4-phenoxy-.
	4-Bromophenyl phenyl ether.
101688	MDI.
	Methylene diphenyl diisocyanate.
101779	4,4′-Methylenedianiline.
103855	Phenylthiourea.
	Thiourea, phenyl-.
105464	sec-Butyl acetate.
105679	Phenol, 2,4-dimethyl-.
	2,4-Dimethylphenol.
106423	p-Xylene.
106445	p-Cresol.
106467	Benzene, 1,4-dichloro-.
	p-Dichlorobenzene.
	1,4-Dichlorobenzene.
106478	Benzenamine, 4-chloro-.
	p-Chloroaniline.
106490	Benzenamine, 4-methyl-.
	p-Toluidine.
106503	p-Phenylenediamine.
106514	p-Benzoquinone.
	2,5-Cyclohexadiene-1,4-dione.
	Quinone.
106887	1,2-Epoxybutane.
106898	1-Chloro-2,3-epoxypropane.
	Epichlorohydrin.
	Oxirane, (chloromethyl)-.
106934	Dibromoethane.
	Ethane, 1,2-dibromo-.
	Ethylene dibromide.
106990	1,3-Butadiene.
107028	Acrolein.
	2-Propenal.

APPENDIX A TO § 302.4—SEQUENTIAL CAS REGISTRY NUMBER LIST OF CERCLA HAZARDOUS SUBSTANCES—Continued

CASRN	Hazardous substance
107051	Allyl chloride.
107062	Ethane, 1,2-dichloro-.
	Ethylene dichloride.
	1,2-Dichloroethane.
107108	n-Propylamine.
	1-Propanamine.
107120	Ethyl cyanide.
	Propanenitrile.
107131	Acrylonitrile.
	2-Propenenitrile.
107153	Ethylenediamine.
107186	Allyl alcohol.
	2-Propen-1-ol.
107197	Propargyl alcohol.
	2-Propyn-1-ol.
107200	Acetaldehyde, chloro-.
	Chloroacetaldehyde.
107211	Ethylene glycol.
107302	Chloromethyl methyl ether.
	Methane, chloromethoxy-.
107493	Diphosphoric acid, tetraethyl ester.
	Tetraethyl pyrophosphate.
107926	Butyric acid.
108054	Vinyl acetate.
	Vinyl acetate monomer.
108101	Hexone.
	Methyl isobutyl ketone.
	4-Methyl-2-pentanone.
108247	Acetic anhydride.
108316	Maleic anhydride.
	2,5-Furandione.
108383	m-Xylene.
108394	m-Cresol.
108463	Resorcinol.
	1,3-Benzenediol.
108601	Dichloroisopropyl ether.
	Propane, 2,2″-oxybis[2-chloro-.
108883	Benzene, methyl-.
	Toluene.
108907	Benzene, chloro-.
	Chlorobenzene.
108941	Cyclohexanone.
108952	Phenol.
108985	Benzenethiol.
	Thiophenol.
109068	Pyridine, 2-methyl-.
	2-Picoline.
109739	Butylamine.
109773	Malononitrile.
	Propanedinitrile.
109897	Diethylamine.
109999	Furan, tetrahydro-.
	Tetrahydrofuran.
110009	Furan.
	Furfuran.
110167	Maleic acid.
110178	Fumaric acid.
110190	iso-Butyl acetate.
110543	Hexane.
110758	Ethene, (2-chloroethoxy)-.
	2-Chloroethyl vinyl ether.
110805	Ethanol, 2-ethoxy-.
	Ethylene glycol monoethyl ether.
110827	Benzene, hexahydro-.
	Cyclohexane.
110861	Pyridine.
111422	Diethanolamine.
111444	Bis(2-chloroethyl) ether.
	Dichloroethyl ether.
	Ethane, 1,1′-oxybis[2-chloro-.

APPENDIX A TO § 302.4—SEQUENTIAL CAS REGISTRY NUMBER LIST OF CERCLA HAZARDOUS SUBSTANCES—Continued

CASRN	Hazardous substance
111546	Carbamodithioic acid, 1,2-ethanediylbis-, salts & esters.
	Ethylenebisdithiocarbamic acid, salts & esters.
111911	Bis(2-chloroethoxy) methane.
	Dichloromethoxyethane.
	Ethane, 1,1′-[methylenebis(oxy)]bis(2-chloro-.
114261	Phenol, 2-(1-methylethoxy)-, methylcarbamate.
	Propoxur (Baygon).
115026	Azaserine.
	L-Serine, diazoacetate (ester).
115297	Endosulfan.
	6,9-Methano-2,4,3-benzodioxathiepin, 6,7,8,9,10,10-hexachloro-1,5,5a,6,9,9a-hexahydro-, 3-oxide.
115322	Dicofol.
116063	Aldicarb.
	Propanal, 2-methyl-2-(methylthio)-, O-[(methylamino)carbonyl]oxime.
117806	Dichlone.
117817	1,2-Benzenedicarboxylic acid, bis(2-ethylhexyl) ester.
	Bis(2-ethylhexyl)phthalate.
	DEHP.
	Diethylhexyl phthalate.
117840	Di-n-octyl phthalate.
	1,2-Benzenedicarboxylic acid, dioctyl ester.
118741	Benzene, hexachloro-.
	Hexachlorobenzene.
119380	Carbamic acid, dimethyl-, 3-methyl-1-(1-methylethyl)-1H-pyrazol-5-yl ester (Isolan).
119904	[1,1′-Biphenyl]-4,4′-diamine,3,3′-dimethoxy-.
	3,3′-Dimethoxybenzidine.
119937	[1,1′-Biphenyl]-4,4′-diamine,3,3′- dimethyl-.
	3,3′-Dimethylbenzidine.
120127	Anthracene.
120581	Isosafrole.
	1,3-Benzodioxole, 5-(1-propenyl)-.
120809	Catechol.
120821	1,2,4-Trichlorobenzene.
120832	Phenol, 2,4-dichloro-.
	2,4-Dichlorophenol.
121142	Benzene, 1-methyl-2,4-dinitro-.
	2,4-Dinitrotoluene.
121211	Pyrethrins.
121299	Pyrethrins.
121448	Ethanamine, N,N-diethyl-.
	Triethylamine.
121697	N,N-Dimethylaniline.
121755	Malathion.
122098	alpha,alpha-Dimethylphenethylamine.
	Benzeneethanamine, alpha,alpha-dimethyl-.
122429	Carbamic acid, phenyl-, 1-methylethyl ester (Propham).
122667	Hydrazine, 1,2-diphenyl-.
	1,2-Diphenylhydrazine.
123319	Hydroquinone.
123331	Maleic hydrazide.
	3,6-Pyridazinedione, 1,2-dihydro-.
123386	Propionaldehyde.
123626	Propionic anhydride.
123637	Paraldehyde.
	1,3,5-Trioxane, 2,4,6-trimethyl-.
123739	Crotonaldehyde.
	2-Butenal.
123864	Butyl acetate.
123911	1,4-Diethyleneoxide.
	1,4-Dioxane.
123922	iso-Amyl acetate.
124049	Adipic acid.
124403	Dimethylamine.

APPENDIX A TO § 302.4—SEQUENTIAL CAS REGISTRY NUMBER LIST OF CERCLA HAZARDOUS SUBSTANCES—Continued

CASRN	Hazardous substance
	Methanamine, N-methyl-.
124414	Sodium methylate.
124481	Chlorodibromomethane.
126727	Tris(2,3-dibromopropyl) phosphate.
	1-Propanol, 2,3-dibromo-, phosphate (3:1).
126987	Methacrylonitrile.
	2-Propenenitrile, 2-methyl-.
126998	Chloroprene.
127184	Ethene, tertrachloro-.
	Perchloroethylene.
	Tetrachloroethylene.
127822	Zinc phenolsulfonate.
129000	Pyrene.
130154	1,4-Naphthalenedione.
	1,4-Naphthoquinone.
131113	Dimethyl phthalate.
	1,2-Benzenedicarboxylic acid, dimethyl ester.
131748	Ammonium picrate.
	Phenol, 2,4,6-trinitro-, ammonium salt.
131895	Phenol, 2-cyclohexyl-4,6-dinitro-.
	2-Cyclohexyl-4,6-dinitrophenol.
132649	Dibenzofuran.
133062	Captan.
133904	Chloramben.
134327	alpha-Naphthylamine.
	1-Naphthalenamine.
137268	Thioperoxydicarbonic diamide ([H2N)C(S)]2S2, tetramethyl-.
	Thiram.
137304	Zinc, bis(dimethylcarbamodithioato-S,S′)-, (Ziram).
140885	Ethyl acrylate.
	2-Propenoic acid, ethyl ester.
141786	Acetic acid, ethyl ester.
	Ethyl acetate.
142289	1,3-Dichloropropane.
142712	Cupric acetate.
142847	Dipropylamine.
	1-Propanamine, N-propyl-.
143339	Sodium cyanide Na(CN).
143500	Kepone.
	1,3,4-Metheno-2H-cyclobuta[cd]pentalen-2-one,1,1a,3,3a,4,5,5,5a,5b,6-decachlorooctahydro-.
145733	Endothall.
	7-Oxabicyclo[2.2.1]heptane-2,3-dicarboxylic acid.
148823	L-Phenylalanine, 4-[bis(2-chloroethyl)amino]-.
	Melphalan.
151508	Potassium cyanide K(CN).
151564	Aziridine.
	Ethylenimine.
152169	Diphosphoramide, octamethyl-.
	Octamethylpyrophosphoramide.
156605	Ethene, 1,2-dichloro- (E).
	1,2-Dichloroethylene.
156627	Calcium cyanamide.
189559	Benzo[rst]pentaphene.
	Dibenzo[a,i]pyrene.
191242	Benzo[ghi]perylene.
193395	Indeno(1,2,3-cd)pyrene.
205992	Benzo[b]fluoranthene.
206440	Fluoranthene.
207089	Benzo(k)fluoranthene.
208968	Acenaphthylene.
218019	Chrysene.
225514	Benz[c]acridine.
297972	O,O-Diethyl O-pyrazinyl phosphorothioate.

APPENDIX A TO § 302.4—SEQUENTIAL CAS REGISTRY NUMBER LIST OF CERCLA HAZARDOUS SUBSTANCES—Continued

CASRN	Hazardous substance
	Phosphorothioic acid, O,O-diethyl O-pyrazinyl ester.
298000	Methyl parathion.
	Phosphorothioic acid, O,O-dimethyl O-(4-nitrophenyl) ester.
298022	Phorate.
	Phosphorodithioic acid, O,O-diethyl S-[(ethylthio) methyl] ester.
298044	Disulfoton.
	Phosphorodithioic acid, O,O-diethyl S-[2-(ethylthio)ethyl] ester.
300765	Naled.
301042	Acetic acid, lead(2+) salt.
	Lead acetate.
302012	Hydrazine.
303344	Lasiocarpine.
	2-Butenoic acid, 2-methyl-, 7-[[2,3-dihydroxy-2-(1-methoxyethyl)-3-methyl-1-oxobutoxy]methyl]-2,3,5,7a-tetrahydro-1H-pyrrolizin-1-yl ester, [1S-[1alpha(Z),7(2S*,3R*), 7aalpha]]-.
305033	Benzenebutanoic acid, 4-[bis(2-chloroethyl)amino]-.
	Chlorambucil.
309002	Aldrin.
	1,4:5,8-Dimethanonaphthalene, 1,2,3,4,10,10-hexachloro-1,4,4a,5,8,8a-hexahydro-, (1alpha,4alpha,4abeta,5alpha,8alpha, 8abeta)-.
311455	Diethyl-p-nitrophenyl phosphate.
	Phosphoric acid, diethyl 4-nitrophenyl ester.
315184	Mexacarbate.
	Phenol, 4-(dimethylamino)-3,5-dimethyl-, methylcarbamate (ester).
319846	alpha—BHC.
319857	beta—BHC.
319868	delta—BHC.
329715	2,5-Dinitrophenol.
330541	Diuron.
333415	Diazinon.
334883	Diazomethane.
353504	Carbon oxyfluoride.
	Carbonic difluoride.
357573	Brucine.
	Strychnidin-10-one, 2,3-dimethoxy-.
460195	Cyanogen.
	Ethanedinitrile.
463581	Carbonyl sulfide.
465736	Isodrin.
	1,4:5,8-Dimethanonaphthalene,1,2,3,4,10,10-hexachloro-1,4,4a,5,8,8a-hexahydro-, (1alpha,4alpha,4abeta,5beta,8beta, 8abeta)-.
492808	Auramine.
	Benzenamine, 4,4′-carbonimidoylbis[N,N-dimethyl-.
494031	Chlornaphazine.
	Naphthalenamine, N,N′-bis(2-chloroethyl)-.
496720	Benzenediamine, ar-methyl-.
	Toluenediamine.
	2,4-Toluene diamine.
504245	4-Aminopyridine.
	4-Pyridinamine.
504609	1-Methylbutadiene.
	1,3-Pentadiene.
506616	Argentate(1-), bis(cyano-C)-, potassium.
	Potassium silver cyanide.
506649	Silver cyanide Ag(CN).
506683	Cyanogen bromide (CN)Br.
506774	Cyanogen chloride (CN)Cl.

APPENDIX A TO § 302.4—SEQUENTIAL CAS REGISTRY NUMBER LIST OF CERCLA HAZARDOUS SUBSTANCES—Continued

CASRN	Hazardous substance
506876	Ammonium carbonate.
506967	Acetyl bromide.
509148	Methane, tetranitro-.
	Tetranitromethane.
510156	Benzeneacetic acid, 4-chloro-α- (4-chlorophenyl)-α-hydroxy-, ethyl ester.
	Chlorobenzilate.
513495	sec-Butylamine.
528290	o-Dinitrobenzene.
532274	2-Chloroacetophenone.
534521	4,6-Dinitro-o-cresol, and salts.
	Phenol, 2-methyl-4,6-dinitro-, & salts.
540738	Hydrazine, 1,2-dimethyl-.
	1,2-Dimethylhydrazine.
540841	2,2,4-Trimethylpentane.
540885	tert-Butyl acetate.
541093	Uranyl acetate.
541537	Dithiobiuret.
	Thioimidodicarbonic diamide [(H2N)C(S)]2NH.
541731	Benzene, 1,3-dichloro-.
	m-Dichlorobenzene.
	1,3-Dichlorobenzene.
542621	Barium cyanide.
542756	1-Propene, 1,3-dichloro-.
	1,3-Dichloropropene.
542767	Propanenitrile, 3-chloro-.
	3-Chloropropionitrile.
542881	Bis(chloromethyl)ether.
	Dichloromethyl ether.
	Methane, oxybis(chloro-.
543908	Cadmium acetate.
544183	Cobaltous formate.
544923	Copper cyanide Cu(CN).
554847	m-Nitrophenol.
557197	Nickel cyanide $Ni(CN)_2$.
557211	Zinc cyanide $Zn(CN)_2$.
	Zinc cyanide Zn(CN)2.
557346	Zinc acetate.
557415	Zinc formate.
563122	Ethion.
563688	Acetic acid, thallium(1+) salt.
	Thallium(I) acetate.
573568	2,6-Dinitrophenol.
584849	Benzene, 1,3-diisocyanatomethyl-.
	Toluene diisocyanate.
	2,4-Toluene diisocyanate.
591082	Acetamide, N-(aminothioxomethyl)-.
	1-Acetyl-2-thiourea.
592018	Calcium cyanide $Ca(CN)_2$.
592041	Mercuric cyanide.
592858	Mercuric thiocyanate.
592870	Lead thiocyanate.
593602	Vinyl bromide.
594423	Methanesulfenyl chloride, trichloro-.
	Trichloromethanesulfenyl chloride.
598312	Bromoacetone.
	2-Propanone, 1-bromo-.
606202	Benzene, 2-methyl-1,3-dinitro-.
	2,6-Dinitrotoluene.
608731	HEXACHLOROCYCLOHEXANE (all isomers).
608935	Benzene, pentachloro-.
	Pentachlorobenzene.
609198	3,4,5-Trichlorophenol.
610399	3,4-Dinitrotoluene.
615532	Carbamic acid, methylnitroso-, ethyl ester.
	N-Nitroso-N-methylurethane.
621647	Di-n-propylnitrosamine.
	1-Propanamine, N-nitroso-N-propyl-.
624839	Methane, isocyanato-.

APPENDIX A TO § 302.4—SEQUENTIAL CAS REGISTRY NUMBER LIST OF CERCLA HAZARDOUS SUBSTANCES—Continued

CASRN	Hazardous substance
	Methyl isocyanate.
625161	tert-Amyl acetate.
626380	sec-Amyl acetate.
628637	Amyl acetate.
628864	Fulminic acid, mercury(2+)salt.
	Mercury fulminate.
630104	Selenourea.
630206	Ethane, 1,1,1,2-tetrachloro-.
	1,1,1,2-Tetrachloroethane.
631618	Ammonium acetate.
636215	Benzenamine, 2-methyl-, hydrochloride.
	o-Toluidine hydrochloride.
640197	Acetamide, 2-fluoro-.
	Fluoroacetamide.
644644	Carbamic acid, dimethyl-,1-[(dimethylamino)carbonyl]-5-methyl-1H-pyrazol-3-yl ester (Dimetilan).
680319	Hexamethylphosphoramide.
684935	N-Nitroso-N-methylurea.
	Urea, N-methyl-N-nitroso-.
692422	Arsine, diethyl-.
	Diethylarsine.
696286	Arsonous dichloride, phenyl-.
	Dichlorophenylarsine.
757584	Hexaethyl tetraphosphate.
	Tetraphosphoric acid, hexaethyl ester.
759739	N-Nitroso-N-ethylurea.
	Urea, N-ethyl-N-nitroso-.
764410	1,4-Dichloro-2-butene.
	2-Butene, 1,4-dichloro-.
765344	Glycidylaldehyde.
	Oxiranecarboxyaldehyde.
815827	Cupric tartrate.
822060	Hexamethylene-1,6-diisocyanate.
823405	Benzenediamine, ar-methyl-.
	Toluenediamine.
	2,4-Toluene diamine.
924163	N-Nitrosodi-n-butylamine.
	1-Butanamine, N-butyl-N-nitroso-.
930552	N-Nitrosopyrrolidine.
	Pyrrolidine, 1-nitroso-.
933755	2,3,6-Trichlorophenol.
933788	2,3,5-Trichlorophenol.
959988	alpha-Endosulfan.
1024573	Heptachlor epoxide.
1031078	Endosulfan sulfate.
1066304	Chromic acetate.
1066337	Ammonium bicarbonate.
1072351	Lead stearate.
1111780	Ammonium carbamate.
1116547	Ethanol, 2,2′-(nitrosoimino)bis-.
	N-Nitrosodiethanolamine.
1120714	1,2-Oxathiolane, 2,2-dioxide.
	1,3-Propane sultone.
1129415	Carbamic acid, methyl-, 3-methylphenyl ester (Metolcarb).
1185575	Ferric ammonium citrate.
1194656	Dichlobenil.
1300716	Xylenol.
1303282	Arsenic oxide As2O5.
	Arsenic pentoxide.
1303328	Arsenic disulfide.
1303339	Arsenic trisulfide.
1309644	Antimony trioxide.
1310583	Potassium hydroxide.
1310732	Sodium hydroxide.
1314325	Thallic oxide.
	Thallium oxide Tl2O3.
1314621	Vanadium oxide V2O5.
	Vanadium pentoxide.

APPENDIX A TO § 302.4—SEQUENTIAL CAS REGISTRY NUMBER LIST OF CERCLA HAZARDOUS SUBSTANCES—Continued

CASRN	Hazardous substance
1314803	Phosphorus pentasulfide.
	Phosphorus sulfide.
	Sulfur phosphide.
1314847	Zinc phosphide Zn_3P_2.
1314870	Lead sulfide.
1319728	2,4,5-T amines.
1319773	Cresol (cresylic acid).
Cresols (isomers and mixture).	
Cresylic acid (isomers and mixture).	
Phenol, methyl-.	
1320189	2,4-D Ester.
1321126	Nitrotoluene.
1327533	Arsenic oxide As2O3.
	Arsenic trioxide.
1330207	Benzene, dimethyl-.
Xylene.	
Xylene (mixed).	
Xylenes (isomers and mixture).	
1332076	Zinc borate.
1332214	Asbestos.
1333831	Sodium bifluoride.
1335326	Lead subacetate.
	Lead, bis(acetato-O)tetrahydroxytri.
1336216	Ammonium hydroxide.
1336363	Aroclors.
	PCBs.
	POLYCHLORINATED BIPHENYLS.
1338234	Methyl ethyl ketone peroxide.
	2-Butanone peroxide.
1338245	Naphthenic acid.
1341497	Ammonium bifluoride.
1464535	1,2:3,4-Diepoxybutane.
	2,2′-Bioxirane.
1563388	7-Benzofuranol, 2,3-dihydro-2,2-dimethyl- (Carbofuran phenol).
1563662	7-Benzofuranol, 2,3-dihydro-2,2-dimethyl-, methylcarbamate.
Carbofuran.	
1582098	Trifluralin.
1615801	Hydrazine, 1,2-diethyl-.
	N,N′-Diethylhydrazine.
1634044	Methyl tert-butyl ether.
1646884	Propanal, 2-methyl-2-(methylsulfonyl)-, O-[(methylamino)carbonyl] oxime (Aldicarb sulfone).
1746016	TCDD.
	2,3,7,8-Tetrachlorodibenzo-p-dioxin.
1762954	Ammonium thiocyanate.
1863634	Ammonium benzoate.
1888717	Hexachloropropene.
	1-Propene, 1,1,2,3,3,3-hexachloro-.
1918009	Dicamba.
1928387	2,4-D Ester.
1928478	2,4,5-T esters.
1928616	2,4-D Ester.
1929733	2,4-D Ester.

APPENDIX A TO § 302.4—SEQUENTIAL CAS REGISTRY NUMBER LIST OF CERCLA HAZARDOUS SUBSTANCES—Continued

CASRN	Hazardous substance
2008460	2,4,5-T amines.
2032657	Mercaptodimethur.
	Methiocarb.
	Phenol, (3,5-dimethyl-4-(methylthio)-, methylcarbamate.
2303164	Carbamothioic acid, bis(1-methylethyl)-, S-(2,3-dichloro-2-propenyl) ester.
	Diallate.
2303175	Carbamothioic acid, bis(1-methylethyl)-, S-(2,3,3-trichloro-2-propenyl) ester (Triallate).
2312358	Propargite.
2545597	2,4,5-T esters.
2631370	Phenol, 3-methyl-5-(1-methylethyl)-, methyl carbamate (Promecarb).
2763964	3(2H)-Isoxazolone, 5-(aminomethyl)-.
	5-(Aminomethyl)-3-isoxazolol.
2764729	Diquat
2921882	Chlorpyrifos.
2944674	Ferric ammonium oxalate.
2971382	2,4-D Ester.
3012655	Ammonium citrate, dibasic.
3164292	Ammonium tartrate.
3165933	Benzenamine, 4-chloro-2-methyl-, hydrochloride.
	4-Chloro-o-toluidine, hydrochloride.
3251238	Cupric nitrate.
3288582	O,O-Diethyl S-methyl dithiophosphate.
	Phosphorodithioic acid, O,O-diethyl S-methyl ester.
3486359	Zinc carbonate.
3547044	DDE.
3689245	Tetraethyldithiopyrophosphate.
	Thiodiphosphoric acid, tetraethyl ester.
3813147	2,4,5-T amines.
4170303	Crotonaldehyde.
	2-Butenal.
4549400	N-Nitrosomethylvinylamine.
	Vinylamine, N-methyl-N-nitroso-.
5344821	Thiourea, (2-chlorophenyl)-.
	1-(o-Chlorophenyl)thiourea.
5893663	Cupric oxalate.
5952261	Ethanol, 2,2′-oxybis-, dicarbamate (Diethylene glycol, dicarbamate).
5972736	Ammonium oxalate.
6009707	Ammonium oxalate.
6369966	2,4,5-T amines.
6369977	2,4,5-T amines.
6533739	Carbonic acid, dithallium(1+) salt.
	Thallium(I) carbonate.
7005723	4-Chlorophenyl phenyl ether.
7421934	Endrin aldehyde.
7428480	Lead stearate.
7439921	Lead.
7439976	Mercury.
7440020	Nickel.
7440224	Silver.
7440235	Sodium.
7440280	Thallium.
7440360	Antimony.
7440382	Arsenic.
7440417	Beryllium.
	Beryllium powder.
7440439	Cadmium.
7440473	Chromium.
7440508	Copper.
7440666	Zinc.
7446084	Selenium dioxide.
	Selenium oxide.
7446142	Lead sulfate.
7446186	Sulfuric acid, dithallium(1+) salt.

APPENDIX A TO § 302.4—SEQUENTIAL CAS REGISTRY NUMBER LIST OF CERCLA HAZARDOUS SUBSTANCES—Continued

CASRN	Hazardous substance
	Thallium(I) sulfate.
7446277	Lead phosphate.
	Phosphoric acid, lead(2+) salt (2:3).
7447394	Cupric chloride.
7488564	Selenium sulfide SeS_2.
7550450	Titanium tetrachloride.
7558794	Sodium phosphate, dibasic.
7601549	Sodium phosphate, tribasic.
7631892	Sodium arsenate.
7631905	Sodium bisulfite.
7632000	Sodium nitrite.
7645252	Lead arsenate.
7646857	Zinc chloride.
7647010	Hydrochloric acid.
	Hydrogen chloride.
7647189	Antimony pentachloride.
7664382	Phosphoric acid.
7664393	Hydrofluoric acid.
	Hydrogen fluoride.
7664417	Ammonia.
7664939	Sulfuric acid.
7681494	Sodium fluoride.
7681529	Sodium hypochlorite.
7697372	Nitric acid.
7699458	Zinc bromide.
7705080	Ferric chloride.
7718549	Nickel chloride.
7719122	Phosphorus trichloride.
7720787	Ferrous sulfate.
7722647	Potassium permanganate.
7723140	Phosphorus.
7733020	Zinc sulfate.
7738945	Chromic acid.
7758294	Sodium phosphate, tribasic.
7758943	Ferrous chloride.
7758954	Lead chloride.
7758987	Cupric sulfate.
7761888	Silver nitrate.
7773060	Ammonium sulfamate.
7775113	Sodium chromate.
7778394	Arsenic acid H_3AsO_4.
7778441	Calcium arsenate.
7778509	Potassium bichromate.
7778543	Calcium hypochlorite.
7779864	Zinc hydrosulfite.
7779886	Zinc nitrate.
7782414	Fluorine.
7782492	Selenium.
7782505	Chlorine.
7782630	Ferrous sulfate.
7782823	Sodium selenite.
7782867	Mercurous nitrate.
7783008	Selenious acid.
7783064	Hydrogen sulfide H_2S.
7783359	Mercuric sulfate.
7783462	Lead fluoride.
7783495	Zinc fluoride.
7783508	Ferric fluoride.
7783564	Antimony trifluoride.
7784341	Arsenic trichloride.
7784409	Lead arsenate.
7784410	Potassium arsenate.
7784465	Sodium arsenite.
7785844	Sodium phosphate, tribasic.
7786347	Mevinphos.
7786814	Nickel sulfate.
7787475	Beryllium chloride.
7787497	Beryllium fluoride.
7787555	Beryllium nitrate.
7788989	Ammonium chromate.

APPENDIX A TO § 302.4—SEQUENTIAL CAS REGISTRY NUMBER LIST OF CERCLA HAZARDOUS SUBSTANCES—Continued

CASRN	Hazardous substance
7789006	Potassium chromate.
7789062	Strontium chromate.
7789095	Ammonium bichromate.
7789426	Cadmium bromide.
7789437	Cobaltous bromide.
7789619	Antimony tribromide.
7790945	Chlorosulfonic acid.
7791120	Thallium chloride TlCl.
7803512	Hydrogen phosphide.
	Phosphine.
7803556	Ammonium vanadate.
	Vanadic acid, ammonium salt.
8001352	Chlorinated camphene.
Toxaphene.	
8003198	Dichloropropane—Dichloropropene (mixture).
8003347	Pyrethrins.
8014957	Sulfuric acid.
10022705	Sodium hypochlorite.
10025873	Phosphorus oxychloride.
10025919	Antimony trichloride.
10026116	Zirconium tetrachloride.
10028225	Ferric sulfate.
10031591	Sulfuric acid, dithallium(1+) salt.
	Thallium(I) sulfate.
10039324	Sodium phosphate, dibasic.
10043013	Aluminum sulfate.
10045893	Ferrous ammonium sulfate.
10045940	Mercuric nitrate.
10049055	Chromous chloride.
10099748	Lead nitrate.
10101538	Chromic sulfate.
10101630	Lead iodide.
10101890	Sodium phosphate, tribasic.
10102064	Uranyl nitrate.
10102188	Sodium selenite.
10102439	Nitric oxide.
	Nitrogen oxide NO.
10102440	Nitrogen dioxide.
	Nitrogen oxide NO2.
10102451	Nitric acid, thallium(1+) salt.
	Thallium(I) nitrate.
10102484	Lead arsenate.
10108642	Cadmium chloride.
10124502	Potassium arsenite.
10124568	Sodium phosphate, tribasic.
10140655	Sodium phosphate, dibasic.
10192300	Ammonium bisulfite.
10196040	Ammonium sulfite.
10361894	Sodium phosphate, tribasic.
10380297	Cupric sulfate, ammoniated.
10415755	Mercurous nitrate.
10421484	Ferric nitrate.
10544726	Nitrogen dioxide.
	Nitrogen oxide NO2.
10588019	Sodium bichromate.
10605217	Carbamic acid, 1H-benzimidazol-2-yl, methyl ester (Carbendazim).
11096825	Aroclor 1260.
11097691	Aroclor 1254.
11104282	Aroclor 1221.
11115745	Chromic acid.
11141165	Aroclor 1232.
12002038	Cupric acetoarsenite.
12039520	Selenious acid, dithallium(1+) salt.
Thallium (I) selenite.	
12054487	Nickel hydroxide.

APPENDIX A TO § 302.4—SEQUENTIAL CAS REGISTRY NUMBER LIST OF CERCLA HAZARDOUS SUBSTANCES—Continued

CASRN	Hazardous substance
12125018	Ammonium fluoride.
12125029	Ammonium chloride.
12135761	Ammonium sulfide.
12672296	Aroclor 1248.
12674112	Aroclor 1016.
12771083	Sulfur monochloride.
13463393	Nickel carbonyl $Ni(CO)_4$, (T–4)-.
13560991	2,4,5-T salts.
13597994	Beryllium nitrate.
13746899	Zirconium nitrate.
13765190	Calcium chromate.
	Chromic acid H2CrO4, calcium salt.
13814965	Lead fluoborate.
13826830	Ammonium fluoborate.
13952846	sec-Butylamine.
14017415	Cobaltous sulfamate.
14216752	Nickel nitrate.
14258492	Ammonium oxalate.
14307358	Lithium chromate.
14307438	Ammonium tartrate.
14639975	Zinc ammonium chloride.
14639986	Zinc ammonium chloride.
14644612	Zirconium sulfate.
15339363	Manganese, bis(dimethylcarbamodithioato-S,S′)-(Manganese dimethyldithiocarbamate).
15699180	Nickel ammonium sulfate.
15739807	Lead sulfate.
15950660	2,3,4-Trichlorophenol.
16721805	Sodium hydrosulfide.
16752775	Ethanimidothioic acid, N-[[(methylamino)carbonyl] oxy]-, methyl ester.
Methomyl.	
16871719	Zinc silicofluoride.
16919190	Ammonium silicofluoride.
16923958	Zirconium potassium fluoride.
17702577	Methanimidamide, N,N-dimethyl-N′-[2-methyl-4-[[(methylamino)carbonyl]oxy]phenyl]-(Formparanate).
17804352	Carbamic acid, [1-[(butylamino)carbonyl]-1H-benzimidazol-2-yl]-, methyl ester (Benomyl).
18883664	D-Glucose, 2-deoxy-2[[(methylnitrosoamino)-carbonyl]amino]-.
Glucopyranose, 2-deoxy-2-(3-methyl-3-nitrosoureido)-, D-.	
Streptozotocin.	
20816120	Osmium oxide OsO_4, (T–4)-.
Osmium tetroxide.	
20830813	Daunomycin.
	5,12-Naphthacenedione, 8-acetyl-10-[(3-amino-2,3,6-trideoxy-alpha-L-lyxo-hexopyranosyl)oxy]-7,8,9,10-tetrahydro-6,8,11-trihydroxy-1-methoxy-, (8S-cis)-.
20859738	Aluminum phosphide.
22781233	1,3-Benzodioxol-4-ol, 2,2-dimethyl-, methyl carbamate (Bendiocarb).
22961826	1,3-Benzodioxol-4-ol, 2,2-dimethyl-, (Bendiocarb phenol).

APPENDIX A TO § 302.4—SEQUENTIAL CAS REGISTRY NUMBER LIST OF CERCLA HAZARDOUS SUBSTANCES—Continued

CASRN	Hazardous substance
23135220	Ethanimidothioic acid, 2-(dimethylamino)-N-[[(methylamino)carbonyl]oxy]-2-oxo-, methyl ester (Oxamyl).
23422539	Methanimidamide, N,N-dimethyl-N′-[3-[[(methylamino)carbonyl]oxy]phenyl]-, monohydrochloride (Formetanate hydrochloride).
23564058	Carbamic acid, [1,2-phenylenebis(iminocarbonothioyl)]bis-, dimethyl ester (Thiophanate-methyl).
23950585	Benzamide, 3,5-dichloro-N-(1,1- dimethyl-2-propynyl)-.
	Pronamide.
25154545	Dinitrobenzene (mixed).
25154556	Nitrophenol (mixed).
25155300	Sodium dodecylbenzenesulfonate.
25167822	Trichlorophenol.
25168154	2,4,5-T esters.
25168267	2,4-D Ester.
25321146	Dinitrotoluene.
25321226	Dichlorobenzene.
25376458	Benzenediamine, ar-methyl-.
	Toluenediamine.
	2,4-Toluene diamine.
25550587	Dinitrophenol.
26264062	Calcium dodecylbenzenesulfonate.
26419738	1,3-Dithiolane-2-carboxaldehyde, 2,4-dimethyl-, O-[(methylamino)carbonyl]oxime (Tirpate).
26471625	Benzene, 1,3-diisocyanatomethyl-.
	Toluene diisocyanate.
	2,4-Toluene diisocyanate.
26628228	Sodium azide.
26638197	Dichloropropane.
26952238	Dichloropropene.
27176870	Dodecylbenzenesulfonic acid.
27323417	Triethanolamine dodecylbenzene sulfonate.
27774136	Vanadyl sulfate.
28300745	Antimony potassium tartrate.
30525894	Paraformaldehyde.
30558431	Ethanimidothioic acid, 2-(dimethylamino)-N-hydroxy-2-oxo-, methyl ester (A2213).
32534955	2,4,5-TP esters.
33213659	beta - Endosulfan.
36478769	Uranyl nitrate.
37211055	Nickel chloride.
39196184	Thiofanox.
	2-Butanone, 3,3-dimethyl-1-(methylthio)-,O-[(methylamino)carbonyl] oxime.
42504461	Isopropanolamine dodecylbenzenesulfonate.
52628258	Zinc ammonium chloride.
52652592	Lead stearate.
52740166	Calcium arsenite.
52888809	Carbamothioic acid, dipropyl-, S-(phenylmethyl) ester (Prosulfocarb).
53467111	2,4-D Ester.
53469219	Aroclor 1242.
55285148	Carbamic acid, [(dibutylamino)thio]methyl-, 2,3-dihydro-2,2-dimethyl-7-benzofuranyl ester (Carbosulfan).
55488874	Ferric ammonium oxalate.
56189094	Lead stearate.
59669260	Ethanimidothioic acid, N,N′-[thiobis[(methylimino)carbonyloxy]]bis-, dimethyl ester (Thiodicarb).
61792072	2,4,5-T esters.

APPENDIX B TO § 302.4—RADIONUCLIDES

Radionuclide	Atomic Number	Final RQ Ci (Bq)
Radionuclides@	.....	1&(3.7E 10)
Actinium-224	89	100 (3.7E 12)
Actinium-225	89	1 (3.7E 10)
Actinium-226	89	10 (3.7E 11)
Actinium-227	89	0.001 (3.7E 7)
Actinium-228	89	10 (3.7E 11)
Aluminum-26	13	10 (3.7E 11)
Americium-237	95	1000 (3.7E 13)
Americium-238	95	100 (3.7E 12)
Americium-239	95	100 (3.7E 12)
Americium-240	95	10 (3.7E 11)
Americium-241	95	0.01 (3.7E 8)
Americium-242m	95	0.01 (3.7E 8)
Americium-242	95	100 (3.7E 12)
Americium-243	95	0.01 (3.7E 8)
Americium-244m	95	1000 (3.7E 13)
Americium-244	95	10 (3.7E 11)
Americium-245	95	1000 (3.7E 13)
Americium-246m	95	1000 (3.7E 13)
Americium-246	95	1000 (3.7E 13)
Antimony-115	51	1000 (3.7E 13)
Antimony-116m	51	100 (3.7E 12)
Antimony-116	51	1000 (3.7E 13)
Antimony-117	51	1000 (3.7E 13)
Antimony-118m	51	10 (3.7E 11)
Antimony-119	51	1000 (3.7E 13)
Antimony-120 (16 min)	51	1000 (3.7E 13)
Antimony-120 (5.76 day)	51	10 (3.7E 11)
Antimony-122	51	10 (3.7E 11)
Antimony-124m	51	1000 (3.7E 13)
Antimony-124	51	10 (3.7E 11)
Antimony-125	51	10 (3.7E 11)
Antimony-126m	51	1000 (3.7E 13)
Antimony-126	51	10 (3.7E 11)
Antimony-127	51	10 (3.7E 11)
Antimony-128 (10.4 min)	51	1000 (3.7E 13)
Antimony-128 (9.01 hr)	51	10 (3.7E 11)
Antimony-129	51	100 (3.7E 12)
Antimony-130	51	100 (3.7E 12)
Antimony-131	51	1000 (3.7E 13)
Argon-39	18	1000 (3.7E 13)
Argon-41	18	10 (3.7E 11)
Arsenic-69	33	1000 (3.7E 13)
Arsenic-70	33	100 (3.7E 12)
Arsenic-71	33	100 (3.7E 12)
Arsenic-72	33	10 (3.7E 11)
Arsenic-73	33	100 (3.7E 12)
Arsenic-74	33	10 (3.7E 11)
Arsenic-76	33	100 (3.7E 12)
Arsenic-77	33	1000 (3.7E 13)
Arsenic-78	33	100 (3.7E 12)
Astatine-207	85	100 (3.7E 12)
Astatine-211	85	100 (3.7E 12)
Barium-126	56	1000 (3.7E 13)
Barium-128	56	10 (3.7E 11)
Barium-131m	56	1000 (3.7E 13)
Barium-131	56	10 (3.7E 11)
Barium-133m	56	100 (3.7E 12)
Barium-133	56	10 (3.7E 11)
Barium-135m	56	1000 (3.7E 13)
Barium-139	56	1000 (3.7E 13)
Barium-140	56	10 (3.7E 11)
Barium-141	56	1000 (3.7E 13)
Barium-142	56	1000 (3.7E 13)
Berkelium-245	97	100 (3.7E 12)
Berkelium-246	97	10 (3.7E 11)
Berkelium-247	97	0.01 (3.7E 8)
Berkelium-249	97	1 (3.7E 10)
Berkelium-250	97	100 (3.7E 12)
Beryllium-7	4	100 (3.7E 12)
Beryllium-10	4	1 (3.7E 10)

APPENDIX B TO § 302.4—RADIONUCLIDES—Continued

Radionuclide	Atomic Number	Final RQ Ci (Bq)
Bismuth-200	83	100 (3.7E 12)
Bismuth-201	83	100 (3.7E 12)
Bismuth-202	83	1000 (3.7E 13)
Bismuth-203	83	10 (3.7E 11)
Bismuth-205	83	10 (3.7E 11)
Bismuth-206	83	10 (3.7E 11)
Bismuth-207	83	10 (3.7E 11)
Bismuth-210m	83	0.1 (3.7E 9)
Bismuth-210	83	10 (3.7E 11)
Bismuth-212	83	100 (3.7E 12)
Bismuth-213	83	100 (3.7E 12)
Bismuth-214	83	100 (3.7E 12)
Bromine-74m	35	100 (3.7E 12)
Bromine-74	35	100 (3.7E 12)
Bromine-75	35	100 (3.7E 12)
Bromine-76	35	10 (3.7E 11)
Bromine-77	35	100 (3.7E 12)
Bromine-80m	35	1000 (3.7E 13)
Bromine-80	35	1000 (3.7E 13)
Bromine-82	35	10 (3.7E 11)
Bromine-83	35	1000 (3.7E 13)
Bromine-84	35	100 (3.7E 12)
Cadmium-104	48	1000 (3.7E 13)
Cadmium-107	48	1000 (3.7E 13)
Cadmium-109	48	1 (3.7E 10)
Cadmium-113m	48	0.1 (3.7E 9)
Cadmium-113	48	0.1 (3.7E 9)
Cadmium-115m	48	10 (3.7E 11)
Cadmium-115	48	100 (3.7E 12)
Cadmium-117m	48	10 (3.7E 11)
Cadmium-117	48	100 (3.7E 12)
Calcium-41	20	10 (3.7E 11)
Calcium-45	20	10 (3.7E 11)
Calcium-47	20	10 (3.7E 11)
Californium-244	98	1000 (3.7E 13)
Californium-246	98	10 (3.7E 11)
Californium-248	98	0.1 (3.7E 9)
Californium-249	98	0.01 (3.7E 8)
Californium-250	98	0.01 (3.7E 8)
Californium-251	98	0.01 (3.7E 8)
Californium-252	98	0.1 (3.7E 9)
Californium-253	98	10 (3.7E 11)
Californium-254	98	0.1 (3.7E 9)
Carbon-11	6	1000 (3.7E 13)
Carbon-14	6	10 (3.7E 11)
Cerium-134	58	10 (3.7E 11)
Cerium-135	58	10 (3.7E 11)
Cerium-137m	58	100 (3.7E 12)
Cerium-137	58	1000 (3.7E 13)
Cerium-139	58	100 (3.7E 12)
Cerium-141	58	10 (3.7E 11)
Cerium-143	58	100 (3.7E 12)
Cerium-144	58	1 (3.7E 10)
Cesium-125	55	1000 (3.7E 13)
Cesium-127	55	100 (3.7E 12)
Cesium-129	55	100 (3.7E 12)
Cesium-130	55	1000 (3.7E 13)
Cesium-131	55	1000 (3.7E 13)
Cesium-132	55	10 (3.7E 11)
Cesium-134m	55	1000 (3.7E 13)
Cesium-134	55	1 (3.7E 10)
Cesium-135m	55	100 (3.7E 12)
Cesium-135	55	10 (3.7E 11)
Cesium-136	55	10 (3.7E 11)
Cesium-137	55	1 (3.7E 10)
Cesium-138	55	100 (3.7E 12)
Chlorine-36	17	10 (3.7E 11)
Chlorine-38	17	100 (3.7E 12)
Chlorine-39	17	100 (3.7E 12)
Chromium-48	24	100 (3.7E 12)

APPENDIX B TO § 302.4—RADIONUCLIDES—Continued

Radionuclide	Atomic Number	Final RQ Ci (Bq)
Chromium-49	24	1000 (3.7E 13)
Chromium-51	24	1000 (3.7E 13)
Cobalt-55	27	10 (3.7E 11)
Cobalt-56	27	10 (3.7E 11)
Cobalt-57	27	100 (3.7E 12)
Cobalt-58m	27	1000 (3.7E 13)
Cobalt-58	27	10 (3.7E 11)
Cobalt-60m	27	1000 (3.7E 13)
Cobalt-60	27	10 (3.7E 11)
Cobalt-61	27	1000 (3.7E 13)
Cobalt-62m	27	1000 (3.7E 13)
Copper-60	29	100 (3.7E 12)
Copper-61	29	100 (3.7E 12)
Copper-64	29	1000 (3.7E 13)
Copper-67	29	100 (3.7E 12)
Curium-238	96	1000 (3.7E 13)
Curium-240	96	1 (3.7E 10)
Curium-241	96	10 (3.7E 11)
Curium-242	96	1 (3.7E 10)
Curium-243	96	0.01 (3.7E 8)
Curium-244	96	0.01 (3.7E 8)
Curium-245	96	0.01 (3.7E 8)
Curium-246	96	0.01 (3.7E 8)
Curium-247	96	0.01 (3.7E 8)
Curium-248	96	0.001 (3.7E 7)
Curium-249	96	1000 (3.7E 13)
Dysprosium-155	66	100 (3.7E 12)
Dysprosium-157	66	100 (3.7E 12)
Dysprosium-159	66	100 (3.7E 12)
Dysprosium-165	66	1000 (3.7E 13)
Dysprosium-166	66	10 (3.7E 11)
Einsteinium-250	99	10 (3.7E 11)
Einsteinium-251	99	1000 (3.7E 13)
Einsteinium-253	99	10 (3.7E 11)
Einsteinium-254m	99	1 (3.7E 10)
Einsteinium-254	99	0.1 (3.7E 9)
Erbium-161	68	100 (3.7E 12)
Erbium-165	68	1000 (3.7E 13)
Erbium-169	68	100 (3.7E 12)
Erbium-171	68	100 (3.7E 12)
Erbium-172	68	10 (3.7E 11)
Europium-145	63	10 (3.7E 11)
Europium-146	63	10 (3.7E 11)
Europium-147	63	10 (3.7E 11)
Europium-148	63	10 (3.7E 11)
Europium-149	63	100 (3.7E 12)
Europium-150 (12.6 hr)	63	1000 (3.7E 13)
Europium-150 (34.2 yr)	63	10 (3.7E 11)
Europium-152m	63	100 (3.7E 12)
Europium-152	63	10 (3.7E 11)
Europium-154	63	10 (3.7E 11)
Europium-155	63	10 (3.7E 11)
Europium-156	63	10 (3.7E 11)
Europium-157	63	10 (3.7E 11)
Europium-158	63	1000 (3.7E 13)
Fermium-252	100	10 (3.7E 11)
Fermium-253	100	10 (3.7E 11)
Fermium-254	100	100 (3.7E 12)
Fermium-255	100	100 (3.7E 12)
Fermium-257	100	1 (3.7E 10)
Fluorine-18	9	1000 (3.7E 13)
Francium-222	87	100 (3.7E 12)
Francium-223	87	100 (3.7E 12)
Gadolinium-145	64	100 (3.7E 12)
Gadolinium-146	64	10 (3.7E 11)
Gadolinium-147	64	10 (3.7E 11)
Gadolinium-148	64	0.001 (3.7E7)
Gadolinium-149	64	100 (3.7E 12)
Gadolinium-151	64	100 (3.7E 12)
Gadolinium-152	64	0.001 (3.7E 7)

APPENDIX B TO § 302.4—RADIONUCLIDES—Continued

Radionuclide	Atomic Number	Final RQ Ci (Bq)
Gadolinium-153	64	10 (3.7E 11)
Gadolinium-159	64	1000 (3.7E 13)
Gallium-65	31	1000 (3.7E 13)
Gallium-66	31	10 (3.7E 11)
Gallium-67	31	100 (3.7E 12)
Gallium-68	31	1000 (3.7E 13)
Gallium-70	31	1000 (3.7E 13)
Gallium-72	31	10 (3.7E 11)
Gallium-73	31	100 (3.7E 12)
Germanium-66	32	100 (3.7E 12)
Germanium-67	32	1000 (3.7E 13)
Germanium-68	32	10 (3.7E 11)
Germanium-69	32	10 (3.7E 11)
Germanium-71	32	1000 (3.7E 13)
Germanium-75	32	1000 (3.7E 13)
Germanium-77	32	10 (3.7E 11)
Germanium-78	32	1000 (3.7E 13)
Gold-193	79	100 (3.7E 12)
Gold-194	79	10 (3.7E 11)
Gold-195	79	100 (3.7E 12)
Gold-198m	79	10 (3.7E 11)
Gold-198	79	100 (3.7E 12)
Gold-199	79	100 (3.7E 12)
Gold-200m	79	10 (3.7E 11)
Gold-200	79	1000 (3.7E 13)
Gold-201	79	1000 (3.7E 13)
Hafnium-170	72	100 (3.7E 12)
Hafnium-172	72	1 (3.7E 10)
Hafnium-173	72	100 (3.7E 12)
Hafnium-175	72	100 (3.7E 12)
Hafnium-177m	72	1000 (3.7E 13)
Hafnium-178m	72	0.1 (3.7E 9)
Hafnium-179m	72	100 (3.7E 12)
Hafnium-180m	72	100 (3.7E 12)
Hafnium-181	72	10 (3.7E 11)
Hafnium-182m	72	100 (3.7E 12)
Hafnium-182	72	0.1 (3.7E 9)
Hafnium-183	72	100 (3.7E 12)
Hafnium-184	72	100 (3.7E 12)
Holmium-155	67	1000 (3.7E 13)
Holmium-157	67	1000 (3.7E 13)
Holmium-159	67	1000 (3.7E 13)
Holmium-161	67	1000 (3.7E 13)
Holmium-162m	67	1000 (3.7E 13)
Holmium-162	67	1000 (3.7E 13)
Holmium-164m	67	1000 (3.7E 13)
Holmium-164	67	1000 (3.7E 13)
Holmium-166m	67	1 (3.7E 10)
Holmium-166	67	100 (3.7E 12)
Holmium-167	67	100 (3.7E 12)
Hydrogen-3	1	100 (3.7E 12)
Indium-109	49	100 (3.7E 12)
Indium-110 (69.1 min)	49	100 (3.7E 12)
Indium-110 (4.9 hr)	49	10 (3.7E 11)
Indium-111	49	100 (3.7E 12)
Indium-112	49	1000 (3.7E 13)
Indium-113m	49	1000 (3.7E 13)
Indium-114m	49	10 (3.7E 11)
Indium-115m	49	100 (3.7E 12)
Indium-115	49	0.1 (3.7E 9)
Indium-116m	49	100 (3.7E 12)
Indium-117m	49	100 (3.7E 12)
Indium-117	49	1000 (3.7E 13)
Indium-119m	49	1000 (3.7E 13)
Iodine-120m	53	100 (3.7E 12)
Iodine-120	53	10 (3.7E 11)
Iodine-121	53	100 (3.7E 12)
Iodine-123	53	10 (3.7E 11)
Iodine-124	53	0.1 (3.7E 9)
Iodine-125	53	0.01 (3.7E 8)

APPENDIX B TO § 302.4—RADIONUCLIDES—Continued

Radionuclide	Atomic Number	Final RQ Ci (Bq)
Iodine-126	53	0.01 (3.7E 8)
Iodine-128	53	1000 (3.7E 13)
Iodine-129	53	0.001 (3.7E 7)
Iodine-130	53	1 (3.7E 10)
Iodine-131	53	0.01 (3.7E 8)
Iodine-132m	53	10 (3.7E 11)
Iodine-132	53	10 (3.7E 11)
Iodine-133	53	0.1 (3.7E 9)
Iodine-134	53	100 (3.7E 12)
Iodine-135	53	10 (3.7E 11)
Iridium-182	77	1000 (3.7E 13)
Iridium-184	77	100 (3.7E 12)
Iridium-185	77	100 (3.7E 12)
Iridium-186	77	10 (3.7E 11)
Iridium-187	77	100 (3.7E 12)
Iridium-188	77	10 (3.7E 11)
Iridium-189	77	100 (3.7E 12)
Iridium-190m	77	1000 (3.7E 13)
Iridium-190	77	10 (3.7E 11)
Iridium-192m	77	100 (3.7E 12)
Iridium-192	77	10 (3.7E 11)
Iridium-194m	77	10 (3.7E 11)
Iridium-194	77	100 (3.7E 12)
Iridium-195m	77	100 (3.7E 12)
Iridium-195	77	1000 (3.7E 13)
Iron-52	26	100 (3.7E 12)
Iron-55	26	100 (3.7E 12)
Iron-59	26	10 (3.7E 11)
Iron-60	26	0.1 (3.7E 9)
Krypton-74	36	10 (3.7E 11)
Krypton-76	36	10 (3.7E 11)
Krypton-77	36	10 (3.7E 11)
Krypton-79	36	100 (3.7E 12)
Krypton-81	36	1000 (3.7E 13)
Krypton-83m	36	1000 (3.7E 13)
Krypton-85m	36	100 (3.7E 12)
Krypton-85	36	1000 (3.7E 13)
Krypton-87	36	10 (3.7E 11)
Krypton-88	36	10 (3.7E 11)
Lanthanum-131	57	1000 (3.7E 13)
Lanthanum-132	57	100 (3.7E 12)
Lanthanum-135	57	1000 (3.7E 13)
Lanthanum-137	57	10 (3.7E 11)
Lanthanum-138	57	1 (3.7E 10)
Lanthanum-140	57	10 (3.7E 11)
Lanthanum-141	57	1000 (3.7E 13)
Lanthanum-142	57	100 (3.7E 12)
Lanthanum-143	57	1000 (3.7E 13)
Lead-195m	82	1000 (3.7E 13)
Lead-198	82	100 (3.7E 12)
Lead-199	82	100 (3.7E 12)
Lead-200	82	100 (3.7E 12)
Lead-201	82	100 (3.7E 12)
Lead-202m	82	10 (3.7E 11)
Lead-202	82	1 (3.7E 10)
Lead-203	82	100 (3.7E 12)
Lead-205	82	100 (3.7E 12)
Lead-209	82	1000 (3.7E 13)
Lead-210	82	0.01 (3.7E 8)
Lead-211	82	100 (3.7E 12)
Lead-212	82	10 (3.7E 11)
Lead-214	82	100 (3.7E 12)
Lutetium-169	71	10 (3.7E 11)
Lutetium-170	71	10 (3.7E 11)
Lutetium-171	71	10 (3.7E 11)
Lutetium-172	71	10 (3.7E 11)
Lutetium-173	71	100 (3.7E 12)
Lutetium-174m	71	10 (3.7E 11)
Lutetium-174	71	10 (3.7E 11)
Lutetium-176m	71	1000 (3.7E 13)

APPENDIX B TO § 302.4—RADIONUCLIDES—Continued

Radionuclide	Atomic Number	Final RQ Ci (Bq)
Lutetium-176	71	1 (3.7E 10)
Lutetium-177m	71	10 (3.7E 11)
Lutetium-177	71	100 (3.7E 12)
Lutetium-178m	71	1000 (3.7E 13)
Lutetium-178	71	1000 (3.7E 13)
Lutetium-179	71	1000 (3.7E 13)
Magnesium-28	12	10 (3.7E 11)
Manganese-51	25	1000 (3.7E 13)
Manganese-52m	25	1000 (3.7E 13)
Manganese-52	25	10 (3.7E 11)
Manganese-53	25	1000 (3.7E 13)
Manganese-54	25	10 (3.7E 11)
Manganese-56	25	100 (3.7E 12)
Mendelevium-257	101	100 (3.7E 12)
Mendelevium-258	101	1 (3.7E 10)
Mercury-193m	80	10 (3.7E 11)
Mercury-193	80	100 (3.7E 12)
Mercury-194	80	0.1 (3.7E 9)
Mercury-195m	80	100 (3.7E 12)
Mercury-195	80	100 (3.7E 12)
Mercury-197m	80	1000 (3.7E 13)
Mercury-197	80	1000 (3.7E 13)
Mercury-199m	80	1000 (3.7E 13)
Mercury-203	80	10 (3.7E 11)
Molybdenum-90	42	100 (3.7E 12)
Molybdenum-93m	42	10 (3.7E 11)
Molybdenum-93	42	100 (3.7E 12)
Molybdenum-99	42	100 (3.7E 12)
Molybdenum-101	42	1000 (3.7E 13)
Neodymium-136	60	1000 (3.7E 13)
Neodymium-138	60	1000 (3.7E 13)
Neodymium-139m	60	100 (3.7E 12)
Neodymium-139	60	1000 (3.7E 13)
Neodymium-141	60	1000 (3.7E 13)
Neodymium-147	60	10 (3.7E 11)
Neodymium-149	60	100 (3.7E 12)
Neodymium-151	60	1000 (3.7E 13)
Neptunium-232	93	1000 (3.7E 13)
Neptunium-233	93	1000 (3.7E 13)
Neptunium-234	93	10 (3.7E 11)
Neptunium-235	93	1000 (3.7E 13)
Neptunium-236 (1.2 E 5 yr)	93	0.1 (3.7E 9)
Neptunium-236 (22.5 hr)	93	100 (3.7E 12)
Neptunium-237	93	0.01 (3.7E 8)
Neptunium-238	93	10 (3.7E 11)
Neptunium-239	93	100 (3.7E 12)
Neptunium-240	93	100 (3.7E 12)
Nickel-56	28	10 (3.7E 11)
Nickel-57	28	10 (3.7E 11)
Nickel-59	28	100 (3.7E 12)
Nickel-63	28	100 (3.7E 12)
Nickel-65	28	100 (3.7E 12)
Nickel-66	28	10 (3.7E 11)
Niobium-88	41	100 (3.7E 12)
Niobium-89 (66 min)	41	100 (3.7E 12)
Niobium-89 (122 min)	41	100 (3.7E 12)
Niobium-90	41	10 (3.7E 11)
Niobium-93m	41	100 (3.7E 12)
Niobium-94	41	10 (3.7E 11)
Niobium-95m	41	100 (3.7E 12)
Niobium-95	41	10 (3.7E 11)
Niobium-96	41	10 (3.7E 11)
Niobium-97	41	100 (3.7E 12)
Niobium-98	41	1000 (3.7E 13)
Osmium-180	76	1000 (3.7E 13)
Osmium-181	76	100 (3.7E 12)
Osmium-182	76	100 (3.7E 12)
Osmium-185	76	10 (3.7E 11)
Osmium-189m	76	1000 (3.7E 13)
Osmium-191m	76	1000 (3.7E 13)

APPENDIX B TO § 302.4—RADIONUCLIDES—Continued

Radionuclide	Atomic Number	Final RQ Ci (Bq)
Osmium-191	76	100 (3.7E 12)
Osmium-193	76	100 (3.7E 12)
Osmium-194	76	1 (3.7E 10)
Palladium-100	46	100 (3.7E 12)
Palladium-101	46	100 (3.7E 12)
Palladium-103	46	100 (3.7E 12)
Palladium-107	46	100 (3.7E 12)
Palladium-109	46	1000 (3.7E 13)
Phosphorus-32	15	0.1 (3.7E 9)
Phosphorus-33	15	1 (3.7E 10)
Platinum-186	78	100 (3.7E 12)
Platinum-188	78	100 (3.7E 12)
Platinum-189	78	100 (3.7E 12)
Platinum-191	78	100 (3.7E 12)
Platinum-193m	78	100 (3.7E 12)
Platinum-193	78	1000 (3.7E 13)
Platinum-195m	78	100 (3.7E 12)
Platinum-197m	78	1000 (3.7E 13)
Platinum-197	78	1000 (3.7E 13)
Platinum-199	78	1000 (3.7E 13)
Platinum-200	78	100 (3.7E 12)
Plutonium-234	94	1000 (3.7E 13)
Plutonium-235	94	1000 (3.7E 13)
Plutonium-236	94	0.1 (3.7E 9)
Plutonium-237	94	1000 (3.7E 13)
Plutonium-238	94	0.01 (3.7E 8)
Plutonium-239	94	0.01 (3.7E 8)
Plutonium-240	94	0.01 (3.7E 8)
Plutonium-241	94	1 (3.7E 10)
Plutonium-242	94	0.01 (3.7E 8)
Plutonium-243	94	1000 (3.7E 13)
Plutonium-244	94	0.01 (3.7E 8)
Plutonium-245	94	100 (3.7E 12)
Polonium-203	84	100 (3.7E 12)
Polonium-205	84	100 (3.7E 12)
Polonium-207	84	10 (3.7E 11)
Polonium-210	84	0.01 (3.7E 8)
Potassium-40	19	1 (3.7E 10)
Potassium-42	19	100 (3.7E 12)
Potassium-43	19	10 (3.7E 11)
Potassium-44	19	100 (3.7E 12)
Potassium-45	19	1000 (3.7E 13)
Praseodymium-136	59	1000 (3.7E 13)
Praseodymium-137	59	1000 (3.7E 13)
Praseodymium-138m	59	100 (3.7E 12)
Praseodymium-139	59	1000 (3.7E 13)
Praseodymium-142m	59	1000 (3.7E 13)
Praseodymium-142	59	100 (3.7E 12)
Praseodymium-143	59	10 (3.7E 11)
Praseodymium-144	59	1000 (3.7E 13)
Praseodymium-145	59	1000 (3.7E 13)
Praseodymium-147	59	1000 (3.7E 13)
Promethium-141	61	1000 (3.7E 13)
Promethium-143	61	100 (3.7E 12)
Promethium-144	61	10 (3.7E 11)
Promethium-145	61	100 (3.7E 12)
Promethium-146	61	10 (3.7E 11)
Promethium-147	61	10 (3.7E 11)
Promethium-148m	61	10 (3.7E 11)
Promethium-148	61	10 (3.7E 11)
Promethium-149	61	100 (3.7E 12)
Promethium-150	61	100 (3.7E 12)
Promethium-151	61	100 (3.7E 12)
Protactinium-227	91	100 (3.7E 12)
Protactinium-228	91	10 (3.7E 11)
Protactinium-230	91	10 (3.7E 11)
Protactinium-231	91	0.01 (3.7E 8)
Protactinium-232	91	10 (3.7E 11)
Protactinium-233	91	100 (3.7E 12)
Protactinium-234	91	10 (3.7E 11)

APPENDIX B TO § 302.4—RADIONUCLIDES—Continued

Radionuclide	Atomic Number	Final RQ Ci (Bq)
Radium-223	88	1 (3.7E 10)
Radium-224	88	10 (3.7E 11)
Radium-225	88	1 (3.7E 10)
Radium-226Φ	88	0.1 (3.7E 9)
Radium-227	88	1000 (3.7E 13)
Radium-228	88	0.1 (3.7E 9)
Radon-220	86	0.1 (3.7E 9)
Radon-222	86	0.1 (3.7E 9)
Rhenium-177	75	1000 (3.7E 13)
Rhenium-178	75	1000 (3.7E 13)
Rhenium-181	75	100 (3.7E 12)
Rhenium-182 (12.7 hr)	75	10 (3.7E 11)
Rhenium-182 (64.0 hr)	75	10 (3.7E 11)
Rhenium-184m	75	10 (3.7E 11)
Rhenium-184	75	10 (3.7E 11)
Rhenium-186m	75	10 (3.7E 11)
Rhenium-186	75	100 (3.7E 12)
Rhenium-187	75	1000 (3.7E 13)
Rhenium-188m	75	1000 (3.7E 13)
Rhenium-188	75	1000 (3.7E 13)
Rhenium-189	75	1000 (3.7E 13)
Rhodium-99m	45	100 (3.7E 12)
Rhodium-99	45	10 (3.7E 11)
Rhodium-100	45	10 (3.7E 11)
Rhodium-101m	45	100 (3.7E 12)
Rhodium-101	45	10 (3.7E 11)
Rhodium-102m	45	10 (3.7E 11)
Rhodium-102	45	10 (3.7E 11)
Rhodium-103m	45	1000 (3.7E 13)
Rhodium-105	45	100 (3.7E 12)
Rhodium-106m	45	10 (3.7E 11)
Rhodium-107	45	1000 (3.7E 13)
Rubidium-79	37	1000 (3.7E 13)
Rubidium-81m	37	1000 (3.7E 13)
Rubidium-81	37	100 (3.7E 12)
Rubidium-82m	37	10 (3.7E 11)
Rubidium-83	37	10 (3.7E 11)
Rubidium-84	37	10 (3.7E 11)
Rubidium-86	37	10 (3.7E 11)
Rubidium-88	37	1000 (3.7E 13)
Rubidium-89	37	1000 (3.7E 13)
Rubidium-87	37	10 (3.7E 11)
Ruthenium-94	44	1000 (3.7E 13)
Ruthenium-97	44	100 (3.7E 12)
Ruthenium-103	44	10 (3.7E 11)
Ruthenium-105	44	100 (3.7E 12)
Ruthenium-106	44	1 (3.7E 10)
Samarium-141m	62	1000 (3.7E 13)
Samarium-141	62	1000 (3.7E 13)
Samarium-142	62	1000 (3.7E 13)
Samarium-145	62	100 (3.7E 12)
Samarium-146	62	0.01 (3.7E 8)
Samarium-147	62	0.01 (3.7E 8)
Samarium-151	62	10 (3.7E 11)
Samarium-153	62	100 (3.7E 12)
Samarium-155	62	1000 (3.7E 13)
Samarium-156	62	100 (3.7E 12)
Scandium-43	21	1000 (3.7E 13)
Scandium-44m	21	10 (3.7E 11)
Scandium-44	21	100 (3.7E 12)
Scandium-46	21	10 (3.7E 11)
Scandium-47	21	100 (3.7E 12)
Scandium-48	21	10 (3.7E 11)
Scandium-49	21	1000 (3.7E 13)
Selenium-70	34	1000 (3.7E 13)
Selenium-73m	34	100 (3.7E 12)
Selenium-73	34	10 (3.7E 11)
Selenium-75	34	10 (3.7E 11)
Selenium-79	34	10 (3.7E 11)
Selenium-81m	34	1000 (3.7E 13)

APPENDIX B TO § 302.4—RADIONUCLIDES—Continued

Radionuclide	Atomic Number	Final RQ Ci (Bq)
Selenium-81	34	1000 (3.7E 13)
Selenium-83	34	1000 (3.7E 13)
Silicon-31	14	1000 (3.7E 13)
Silicon-32	14	1 (3.7E 10)
Silver-102	47	100 (3.7E 12)
Silver-103	47	1000 (3.7E 13)
Silver-104m	47	1000 (3.7E 13)
Silver-104	47	1000 (3.7E 13)
Silver-105	47	10 (3.7E 11)
Silver-106m	47	10 (3.7E 11)
Silver-106	47	1000 (3.7E 13)
Silver-108m	47	10 (3.7E 11)
Silver-110m	47	10 (3.7E 11)
Silver-111	47	10 (3.7E 11)
Silver-112	47	100 (3.7E 12)
Silver-115	47	1000 (3.7E 13)
Sodium-22	11	10 (3.7E 11)
Sodium-24	11	10 (3.7E 11)
Strontium-80	38	100 (3.7E 12)
Strontium-81	38	1000 (3.7E 13)
Strontium-83	38	100 (3.7E 12)
Strontium-85m	38	1000 (3.7E 13)
Strontium-85	38	10 (3.7E 11)
Strontium-87m	38	100 (3.7E 12)
Strontium-89	38	10 (3.7E 11)
Strontium-90	38	0.1 (3.7E 9)
Strontium-91	38	10 (3.7E 11)
Strontium-92	38	100 (3.7E 12)
Sulfur-35	16	1 (3.7E 10)
Tantalum-172	73	100 (3.7E 12)
Tantalum-173	73	100 (3.7E 12)
Tantalum-174	73	100 (3.7E 12)
Tantalum-175	73	100 (3.7E 12)
Tantalum-176	73	10 (3.7E 11)
Tantalum-177	73	1000 (3.7E 13)
Tantalum-178	73	1000 (3.7E 13)
Tantalum-179	73	1000 (3.7E 13)
Tantalum-180m	73	1000 (3.7E 13)
Tantalum-180	73	100 (3.7E 12)
Tantalum-182m	73	1000 (3.7E 13)
Tantalum-182	73	10 (3.7E 11)
Tantalum-183	73	100 (3.7E 12)
Tantalum-184	73	10 (3.7E 11)
Tantalum-185	73	1000 (3.7E 13)
Tantalum-186	73	1000 (3.7E 13)
Technetium-93m	43	1000 (3.7E 13)
Technetium-93	43	100 (3.7E 12)
Technetium-94m	43	100 (3.7E 12)
Technetium-94	43	10 (3.7E 11)
Technetium-96m	43	1000 (3.7E 13)
Technetium-96	43	10 (3.7E 11)
Technetium-97m	43	100 (3.7E 12)
Technetium-97	43	100 (3.7E 12)
Technetium-98	43	10 (3.7E 11)
Technetium-99m	43	100 (3.7E 12)
Technetium-99	43	10 (3.7E 11)
Technetium-101	43	1000 (3.7E 13)
Technetium-104	43	1000 (3.7E 13)
Tellurium-116	52	1000 (3.7E 13)
Tellurium-121m	52	10 (3.7E 11)
Tellurium-121	52	10 (3.7E 11)
Tellurium-123m	52	10 (3.7E 11)
Tellurium-123	52	10 (3.7E 11)
Tellurium-125m	52	10 (3.7E 11)
Tellurium-127m	52	10 (3.7E 11)
Tellurium-127	52	1000 (3.7E 13)
Tellurium-129m	52	10 (3.7E 11)
Tellurium-129	52	1000 (3.7E 13)
Tellurium-131m	52	10 (3.7E 11)
Tellurium-131	52	1000 (3.7E 13)

APPENDIX B TO § 302.4—RADIONUCLIDES—Continued

Radionuclide	Atomic Number	Final RQ Ci (Bq)
Tellurium-132	52	10 (3.7E 11)
Tellurium-133m	52	1000 (3.7E 13)
Tellurium-133	52	1000 (3.7E 13)
Tellurium-134	52	1000 (3.7E 13)
Terbium-147	65	100 (3.7E 12)
Terbium-149	65	100 (3.7E 12)
Terbium-150	65	100 (3.7E 12)
Terbium-151	65	10 (3.7E 11)
Terbium-153	65	100 (3.7E 12)
Terbium-154	65	10 (3.7E 11)
Terbium-155	65	100 (3.7E 12)
Terbium-156m (5.0 hr)	65	1000 (3.7E 13)
Terbium-156m (24.4 hr)	65	1000 (3.7E 13)
Terbium-156	65	10 (3.7E 11)
Terbium-157	65	100 (3.7E 12)
Terbium-158	65	10 (3.7E 11)
Terbium-160	65	10 (3.7E 11)
Terbium-161	65	100 (3.7E 12)
Thallium-194m	81	100 (3.7E 12)
Thallium-194	81	1000 (3.7E 13)
Thallium-195	81	100 (3.7E 12)
Thallium-197	81	100 (3.7E 12)
Thallium-198m	81	100 (3.7E 12)
Thallium-198	81	10 (3.7E 11)
Thallium-199	81	100 (3.7E 12)
Thallium-200	81	10 (3.7E 11)
Thallium-201	81	1000 (3.7E 13)
Thallium-202	81	10 (3.7E 11)
Thallium-204	81	10 (3.7E 11)
Thorium-226	90	100 (3.7E 12)
Thorium-227	90	1 (3.7E 10)
Thorium-228	90	0.01 (3.7E 8)
Thorium-229	90	0.001 (3.7E 7)
Thorium-230	90	0.01 (3.7E 8)
Thorium-231	90	100 (3.7E 12)
Thorium-232Φ	90	0.001 (3.7E 7)
Thorium-234	90	100 (3.7E 12)
Thulium-162	69	1000 (3.7E 13)
Thulium-166	69	10 (3.7E 11)
Thulium-167	69	100 (3.7E 12)
Thulium-170	69	10 (3.7E 11)
Thulium-171	69	100 (3.7E 12)
Thulium-172	69	100 (3.7E 12)
Thulium-173	69	100 (3.7E 12)
Thulium-175	69	1000 (3.7E 13)
Tin-110	50	100 (3.7E 12)
Tin-111	50	1000 (3.7E 13)
Tin-113	50	10 (3.7E 11)
Tin-117m	50	100 (3.7E 12)
Tin-119m	50	10 (3.7E 11)
Tin-121m	50	10 (3.7E 11)
Tin-121	50	1000 (3.7E 13)
Tin-123m	50	1000 (3.7E 13)
Tin-123	50	10 (3.7E 11)
Tin-125	50	10 (3.7E 11)
Tin-126	50	1 (3.7E 10)
Tin-127	50	100 (3.7E 12)
Tin-128	50	1000 (3.7E 13)
Titanium-44	22	1 (3.7E 10)
Titanium-45	22	1000 (3.7E 13)
Tungsten-176	74	1000 (3.7E 13)
Tungsten-177	74	100 (3.7E 12)
Tungsten-178	74	100 (3.7E 12)
Tungsten-179	74	1000 (3.7E 13)
Tungsten-181	74	100 (3.7E 12)
Tungsten-185	74	10 (3.7E 11)
Tungsten-187	74	100 (3.7E 12)
Tungsten-188	74	10 (3.7E 11)
Uranium-230	92	1 (3.7E 10)
Uranium-231	92	1000 (3.7E 13)

APPENDIX B TO § 302.4—RADIONUCLIDES—Continued

Radionuclide	Atomic Number	Final RQ Ci (Bq)
Uranium-232	92	0.01 (3.7E 8)
Uranium-233	92	0.1 (3.7E 9)
Uranium-234φ	92	0.1 (3.7E 9)
Uranium-235φ	92	0.1 (3.7E 9)
Uranium-236	92	0.1 (3.7E 9)
Uranium-237	92	100 (3.7E 12)
Uranium-238φ	92	0.1& (3.7E 9)
Uranium-239	92	1000 (3.7E 13)
Uranium-240	92	1000 (3.7E 13)
Vanadium-47	23	1000 (3.7E 13)
Vanadium-48	23	10 (3.7E 11)
Vanadium-49	23	1000 (3.7E 13)
Xenon-120	54	100 (3.7E 12)
Xenon-121	54	10 (3.7E 11)
Xenon-122	54	100 (3.7E 12)
Xenon-123	54	10 (3.7E 11)
Xenon-125	54	100 (3.7E 12)
Xenon-127	54	100 (3.7E 12)
Xenon-129m	54	1000 (3.7E 13)
Xenon-131m	54	1000 (3.7E 13)
Xenon-133m	54	1000 (3.7E 13)
Xenon-133	54	1000 (3.7E 13)
Xenon-135m	54	10 (3.7E 11)
Xenon-135	54	100 (3.7E 12)
Xenon-138	54	10 (3.7E 11)
Ytterbium-162	70	1000 (3.7E 13)
Ytterbium-166	70	10 (3.7E 11)
Ytterbium-167	70	1000 (3.7E 13)
Ytterbium-169	70	10 (3.7E 11)
Ytterbium-175	70	100 (3.7E 12)
Ytterbium-177	70	1000 (3.7E 13)
Ytterbium-178	70	1000 (3.7E 13)
Yttrium-86m	39	1000 (3.7E 13)
Yttrium-86	39	10 (3.7E 11)
Yttrium-87	39	10 (3.7E 11)
Yttrium-88	39	10 (3.7E 11)
Yttrium-90m	39	100 (3.7E 12)
Yttrium-90	39	10 (3.7E 11)
Yttrium-91m	39	1000 (3.7E 13)
Yttrium-91	39	10 (3.7E 11)
Yttrium-92	39	100 (3.7E 12)
Yttrium-93	39	100 (3.7E 12)
Yttrium-94	39	1000 (3.7E 13)
Yttrium-95	39	1000 (3.7E 13)
Zinc-62	30	100 (3.7E 12)
Zinc-63	30	1000 (3.7E 13)
Zinc-65	30	10 (3.7E 11)
Zinc-69m	30	100 (3.7E 12)
Zinc-69	30	1000 (3.7E 13)
Zinc-71m	30	100 (3.7E 12)
Zinc-72	30	100 (3.7E 12)
Zirconium-86	40	100 (3.7E 12)
Zirconium-88	40	10 (3.7E 11)
Zirconium-89	40	100 (3.7E 12)
Zirconium-93	40	1 (3.7E 10)
Zirconium-95	40	10 (3.7E 11)
Zirconium-97	40	10 (3.7E 11)

Ci—Curie. The curie represents a rate of radioactive decay. One curie is the quantity of any radioactive nuclide which undergoes 3.7E 10 disintegrations per second.

Bq—Becquerel. The becquerel represents a rate of radioactive decay. One becquerel is the quantity of any radioactive nuclide which undergoes one disintegration per second. One curie is equal to 3.7E 10 becquerel.

@—Final RQs for all radionuclides apply to chemical compounds containing the radionuclides and elemental forms regardless of the diameter of pieces of solid material.

&—The adjusted RQ of one curie applies to all radionuclides not otherwise listed. Whenever the RQs in table 302.4 and this appendix to the table are in conflict, the lowest RQ shall apply. For example, uranyl acetate and uranyl nitrate have adjusted RQs shown in table 302.4 of 100 pounds, equivalent to about one-tenth the RQ level for uranium-238 listed in this appendix.

E—Exponent to the base 10. For example, 1.3E 2 is equal to 130 while 1.3E 3 is equal to 1300.

m—Signifies a nuclear isomer which is a radionuclide in a higher energy metastable state relative to the parent isotope.

φ—Notification requirements for releases of mixtures or solutions of radionuclides can be found in § 302.6(b) of this rule. Final RQs for the following four common radionuclide mixtures are provided: radium-226 in secular equilibrium with its daughters (0.053 curie); natural uranium (0.1 curie); natural uranium in secular equilibrium with its daughters (0.052 curie); and natural thorium in secular equilibrium with its daughters (0.011 curie).

[54 FR 33449, Aug. 14, 1989]

EDITORIAL NOTE: For FEDERAL REGISTER citations affecting § 302.4, see the List of CFR Sections Affected, which appears in the Finding Aids section of the printed volume and on GPO Access.

§ 302.5 Determination of reportable quantities.

(a) *Listed hazardous substances.* The quantity listed in the column "Final RQ" for each substance in table 302.4, or in appendix B to table 302.4, is the reportable quantity (RQ) for that substance. The RQs in table 302.4 are in units of pounds based on chemical toxicity, while the RQs in appendix B to table 302.4 are in units of curies based on radiation hazard. Whenever the RQs in table 302.4 and appendix B to the table are in conflict, the lowest RQ shall apply.

(b) *Unlisted hazardous substances.* Unlisted hazardous substances designated by 40 CFR 302.4(b) have the reportable quantity of 100 pounds, except for those unlisted hazardous wastes which exhibit toxicity identified in 40 CFR 261.24. Unlisted hazardous wastes which exhibit toxicity have the reportable quantities listed in Table 302.4 for the contaminant on which the characteristic of toxicity is based. The reportable quantity applies to the waste itself, not merely to the toxic contaminant. If an unlisted hazardous waste exhibits toxicity on the basis of more than one contaminant, the reportable quantity for that waste shall be the lowest of the reportable quantities listed in Table 302.4 for those contaminants. If an unlisted hazardous waste exhibits the characteristic of toxicity and one or more of the other characteristics referenced in 40 CFR 302.4(b), the reportable quantity for that waste

Exhibit E

JOURNAL OF THE AMERICAN COLLEGE OF TOXICOLOGY
Volume 11, Number 4, 1992
Mary Ann Liebert, Inc., Publishers

Final Report on the Safety Assessment of Toluene-2,5-Diamine, Toluene-2,5-Diamine Sulfate, and Toluene-3,4-Diamine

ABSTRACT

The diaminotoluenes 2,5-TD, 2,5-TDS, and 3,4-TD are used as colorants in permanent hair dyes and tints. 2,5-TD is used at concentrations up to 1% and 2,5-TDS is used up to 5%. The major routes of excretion after cutaneous absorption by rats were through the urine and feces. The oral LD_{50} of 2,5-TDS in rats was 98 mg/kg. There was no evidence of percutaneous toxicity to rabbits when 6% 2,5-TDS was applied to intact or abraded skin. In a two-year study, no toxicity was reported in rats receiving biweekly cutaneous applications of formulations containing 3% or 4% 2,5-TD. Mice were also unaffected by 3% 2,5-TDS in an 18-month study, or by 3% 2,5-TD in a two-year study. Rabbits had a slight dermal irritation response after exposure to 2.5% 2,5-TDS, but no irritation occurred in guinea pigs after exposure to 10% solutions of 2,5-TDS or 3,4-TD. 2,5-TD (2.5%) caused mild, transitory conjunctival inflammation in rabbits. The results of sensitization tests of 2,5-TD, 2,5-TDS, and 3,4-TD indicated that each of these diaminotoluenes were sensitizers to laboratory animals and humans. 2,5-TDS was toxic to pregnant rats and their embryos at oral doses of 80 mg/kg/day. Doses between 10 and 50 mg/kg/day did not cause congenital or maternal abnormalities. *o*-Toluenediamine, a mixture of 2,3-TD and 3,4-TD (40:60), was not teratogenic when administered orally to rats or rabbits. Cutaneous exposure to hair dye formulations containing 3% 2,5-TDS caused a statistically significant increase in fetal skeletal anomalies in rats. Rats treated with 6% 2,5-TDS did not have this adverse response. In a two-generation reproduction study, mice receiving dermal applications of hair-dye formulations containing either 3% or 6% 2,5-TDS had no signs of pharmacotoxicity, teratogenicity, or reproductive abnormalities. The results cited from various mutagenicity assays of 2,5-TD, 2,5-TDS, and 3,4-TD varied in accordance with the assay system and protocols used. 2,5-TD and 2,5-TDS were noncarcinogenic to rats and mice in both oral and dermal exposure studies. On the basis of the animal and clinical data presented in this report, and the required labeling, it is concluded that Toluene-2,5-Diamine Sulfate and Toluene-3,4-Diamine are safe as cosmetic ingredients in the present practices of use.

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INTRODUCTION

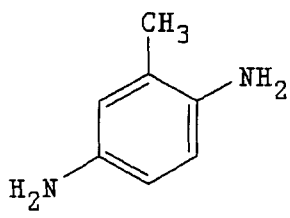
TOLUENE-2,5-DIAMINE (2,5-TD) and Toluene-3,4-Diamine (3,4-TD) are two of six isomers of the diaminotoluenes. A comprehensive review of diaminotoluenes and some selected isomers was conducted by the World Health Organization (WHO, 1987) and the Environmental Protection Agency (EPA, 1984). However, it was felt that in order to evaluate 2,5-TD, its sulfate, and 3,4-TD it was necessary to focus a report specifically on them and their use in cosmetics. The information included in the WHO and EPA reviews was used as a partial guide for this report.

CHEMISTRY

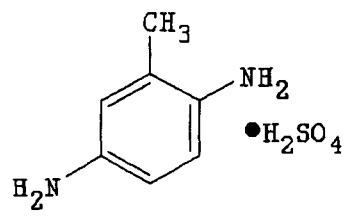
Definition and Structure

2,5-TD (CAS No. 95-70-5) and 2,5-TDS (CAS Nos. 615-50-9 and 6369-59-1) are the substituted aromatic amine and its salt which conform to the structural formulas (Estrin et al., 1982):

2'5-TD

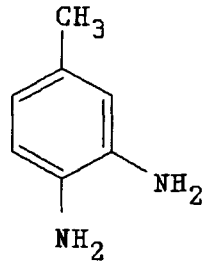


2'5-TDS



Other names for 2,5-TD (and its sulfate) are: 1,4-benzenediamine, 2-methyl-(sulfate); 2,5-diaminotoluene (sulfate); 2-methyl-1,4-benzenediamine (sulfate); *p*-toluenediamine (sulfate); and *p*-tolyenediamine (sulfate) (Estrin et al., 1982; Sax 1979).

3,4-TD (CAS. No. 496-72-0) is the substituted aromatic amine that conforms to the formula:



Other names for 3,4-TD are: 1,2-benzenediamine, 4-methyl-; 3,4-diaminotoluene; 4-methyl-1,2-benzenediamine; and 4-methyl-*o*-phenylenediamine (Estrin et al., 1982).

Properties

2,5-TD is a colorless, crystalline plate which is soluble in water, ethanol, ether, and hot benzene. It is slightly soluble in cold benzene (IARC, 1978; Sax, 1979; Weast,

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1982). The sulfate form of 2,5-TD is a white powder that is soluble in water and ethanol. The molecular weight of 2,5-TD is 122.2 (Anonymous, 1985; Sax, 1979; Weast, 1982), and 220.2 for its sulfate (IARC, 1978). The melting and boiling points for 2,5-TD are 64°C and 273–274°C, respectively (Anonymous, 1985; IARC, 1978; Sax, 1979; Weast, 1982).

3,4-TD forms a colorless crystal with a molecular weight of 122.17. It is soluble in water and has a melting point of 89–90°C and a boiling point of 265°C (sublimes) (Weast, 1982). The absorption maxima of 2,5-TD were 201, 237, and 285 nm; and in a duplicate experiment, 198, 236, and 302 nm (Mederos et al., 1986). 3,4-TD in methanol absorbs at 297 nm (Grasselli, 1973).

Methods of Manufacture

In general, diaminotoluenes are manufactured from dinitrotoluenes using catalytic hydrogenation procedures or by the reaction of iron and hydrochloric acid with dinitrotoluenes (WHO, 1987).

According to the International Agency for Research on Cancer (IARC, 1978), 2,5-TD is manufactured by:

> . . . reductive cleavage of 4-amino-2,3′-dimethylazobenzene (*ortho*-aminoazotoluene[1]) with tin and hydrochloric acid (Prager et al., 1930); reductive cleavage may also be carried out with zinc dust and hydrochloric acid (Thirtle, 1968). It can be prepared by the electrolytic reduction of 2,5-dinitrotoluene (Tallec & Gueguen, 1966) or by condensing 2-amino-1-methylbenzene and toluene-4-sulphonyl chloride to 4-toluenesolphono-2-toluidide, which is then coupled with diazotized aminobenzenesulphonic acid and reduced (Wlodarski, 1971).

Impurities

Commerically produced 2,5-TD contains various concentrations of the other diaminotoluene isomers: 2,3-; 2,4-; 2,6-; 3,4-; and 3,5-diaminotoluenes (WHO, 1987). Of these other five isomeric diaminotoluenes, 2,4-diaminotoluene is an animal carcinogen (IARC, 1987).

According to the International Agency for Research on Cancer (IARC, 1978):

> 2,5-diaminotoluene sulphate is available in the US as a commercial grade with the following typical specifications: purity, 95% min.; residue on ignition, 0.2% max.; loss on drying, 0.5% max.; and iron content, 25 mg/kg max. (Ashland Chemical Co., 1975).

In Japan, 2,5-TD is available with a minimum purity of 95%, and contains nitroaminotoluene as an impurity (IARC, 1978). The location of the nitro and amino groups was not specified.

Analytical Methods

Methods for separation and/or determination of 2,5-TD and 3,4-TD in hair dyes are presented in Table 1 (WHO, 1987).

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TABLE 1. ANALYTICAL METHODS FOR DETERMINING 2,5-TD AND 3,4-TD IN HAIR DYES

Procedure	*Ingredient*	*Detection limit*	*Reference*
Gas-liquid chromatography/flame ionization detector	2,5-TD	5 mg/l	Choudhary (1980)
Thin-layer chromatography	2,5-TD & 3,4-TD	0.2 mg/l	Kottemann (1966)
High-performance liquid chromatography/ultraviolet detection	2,5-TD & 3,4-TD	—	Liem & Rooselaar (1981)

Source: WHO, 1987

USE

Cosmetic Use

United States. 2,5-TD, 2,5-TDS, and 3,4-TD are used in colorants in permanent hair dyes and tints (Nikitakis, 1988). Permanent hair dyes are formed by mixing three classes of chemicals: primary intermediates, couplers, and an oxidant, usually hydrogen peroxide. When mixed, these chemicals undergo oxidation and coupling reactions to form colored material inside the hair shaft. The colors are not removed by shampooing. Subsequent dyeing is necessitated by the need to color new hair growth rather than because of fading of already colored hair (Corbett et al., 1973; Wilkinson and Moore, 1982).

2,5-TD and 2,5-TDS are used as primary intermediates in permanent hair dye formulations to produce black, drab and warm browns, and shades of blond and grey (Wall, 1972). Since most hair dye formulations are proprietary, exact concentrations are not available (IARC, 1978). 2,5-TDS is also used in formulas for bleach toners for silver (at levels of 0.100%), smoke (0.04%) and platinum blond (0.08%) (Tucker, 1968; Wall, 1972).

3,4-TD is a primary intermediate used to produce drab browns, warm browns, reds, drab blonds, and gold blonds (Wall, 1972).

Cosmetic product formulation data made available by the Food and Drug Administration (FDA) are compiled through voluntary filing of such information in accordance with Title 21, Part 720.4 of the Code of Federal Regulations (1984). Data submitted in 1984 and 1989 to the FDA by cosmetic firms participating in this voluntary cosmetic registration program indicated that 2,5-TD was used in five hair dyes, and 2,5-TDS was used in a total of 107 hair coloring formulations (Tables 2 and 3). No cosmetic formulation data on 3,4-TD were submitted to the FDA. Ingredients are listed in preset concentration ranges under specific product type categories. Since certain cosmetic ingredients are supplied by the manufacturer at less than 100% concentration, the value reported by the cosmetic formulator may not necessarily reflect the actual concentration found in the finished product; the actual concentration would be a fraction of that reported to the FDA. Data submitted within the framework of preset concentration ranges provides the opportunity for overestimation of the actual concentration of an ingredient in a particular product. An entry at the lowest end of a concentration range is considered the same as one entered at the highest end of that range, thus introducing the possibility of a two- to tenfold error in the assumed ingredient concentration.

Permanent hair coloring formulations containing 2,5-TD, 2,5-TDS, or 3,4-TD are applied to or may come in contact with hair, skin (particularly at the scalp), eyes, and

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TABLE 2. PRODUCT FORMULATION DATA FOR TOLUENE-2,5-DIAMINE[a]

Product category	*Total no. containing ingredient*	*No. of product formulations within each concentration range (%)*	
		0.1–1	*0–0.1*
Hair dyes and colors	5	3	2
1984 totals	5	3	2

[a]CIR requests that the cosmetics industry provide current formulation data on each product category.

Source: FDA, 1984.

nails. Individuals dyeing their hair may use such formulations once every few weeks, whereas hairdressers may come in contact with products containing these ingredients several times a day. Forty percent of women in the United States are estimated to be regular users of hair dyes (Corbett et al., 1973). Under normal conditions of use, skin contact with the hair dye is restricted to 30 minutes.

Most permanent hair dyes on the market contain coal tar hair dyes. These dyes are no longer produced from coal but come from petrolatum. Although the term "coal tar" is archaic, it is still used in legal documents (Consumer Reports, 1979; Menkart and Lanman, 1977). Coal tar hair dyes are exempt from the principal adulteration provision and from the color additive provisions in sections 601 and 706 of the Federal Food, Drug, and Cosmetic Act of 1938, when the label bears a caution statement and patch test instructions for determining whether the product causes skin irritation. The following caution statement should be displayed conspicuously on the labels of coal tar hair dyes:

> Caution—This product contains ingredients that may cause skin irritation on certain individuals, and a preliminary test according to accompanying directions should be made. This product must not be used for dyeing eyelashes or eyebrows; to do so may cause blindness.

Patch test instructions call for a 24-hour patch with the intermediates and hydrogen peroxide mixed in the same manner as in use (Corbett et al., 1973; Wilkinson and

TABLE 3. PRODUCT FORMULATION DATA FOR TOLUENE-2,5-DIAMINO SULFATE[a]

Product category	*Total no. of formulations in category*	*Total no. containing ingredient*	*No. of product formulations within each concentration range (%)*		
			>1–5	*>0.1–1*	*≤0.1*
Hair dyes and colors	1095	107	13	74	20
1989 Totals		107	13	74	20

[a]CIR requests that the cosmetics industry provide current formulation data on each product category.

Source: FDA, 1989.

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Moore, 1982). The irritation test is to be performed prior to each and every application of the dye. In actual practice, many beauty salons do a 24-hr patch test prior to the initial hair dyeing procedure, but omit the test on subsequent applications (Fisher, 1974).

International Use. Ingredient labelling is required for the use of 2,5-TD, 2,5-TDS, and 3,4-TD in hair dyes in Japan (CTFA, 1983; IARC, 1978).

The United Kingdom approves the use of 2,5-TD in hair dyes under the Pharmacy and Poisons Act of 1933, which stipulates that all hair dyes containing toluenediamines, phenylenediamines, or other alkylated benzene diamines or their salts must bear a label with the words: "Caution. This preparation may cause serious inflammation of the skin in certain persons and should be used only in accordance with expert advice." This requirement was repeated in the Poison Rules, 1970 (Wilkinson and Moore, 1982).

Noncosmetic Use

The diaminotoluenes are used as intermediates in the production of dyes used for textiles, furs, leathers, biological stains and indicators, spirit varnishes and wood stains, and pigments (WHO, 1987).

2,5-TD is used as an intermediate in the production of two dyes: CI Basic Red 2 and CI Acid Brown 103. CI Basic Red 2 is used to dye fabrics, paper, in spirit inks, biological stains, and solvent dyes. Both dyes are used to color leather (Anonymous, 1985; IARC, 1978). 2,5-TD also has been used as an artificial electron donor in photosystem 1 studies (Anonymous, 1985).

BIOLOGICAL PROPERTIES

Absorption and Excretion

The absorption of 2,5-TD through the skin of dogs was studied by Kiese et al. (1968). A 50 ml solution composed of a typical hair dye formulation and water was used to suspend 1.4 g of 2,5-TD. The gel was applied to the abdominal skin of dogs for 3 hours (the number of dogs was not specified). The amount of 2,5-TD absorbed into the blood was determined using the Schiff base method. One caveat to this method was that it also indicated derivatives produced from 2,5-TD by oxidation *in vivo*. During the 3-hr exposure, the concentration of 2,5-TD increased to 1 μg/ml of blood. The concentration increased more rapidly during the later stage of the experiment than during the earlier stage. After the gel was removed and the area washed, the concentration in the blood decreased slowly.

In order to determine the amount of 2,5-TD which had been absorbed through the skin, the absorption was imitated by a continuous intravenous infusion of 2,5-TD. An infusion of 0.022 mg 2,5-TD/kg/min was administered for 3 h. During the first two hours, the concentration in the blood was greater than that seen in the absorption experiments; after three hours of infusion, the concentrations were the same. Since each dog weighed approximately 10 kg, it was calculated that 40 mg of 2,5-TD had been infused over the 3-h period. Thus, it was assumed that the same amount was absorbed through the skin of the dogs in 3 hours.

The amount of 2,5-TD excreted in the urine of dogs after a cutaneous application also was investigated using the Schiff base method. A 50 ml application of gel

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containing 1.25 g 2,5-TDS was applied to the skin of an unspecified number of dogs for 3 hours. Over 24 h, an average of 0.41 mg of 2,5-TD was found in the urine; 0.1 mg and trace amounts were detected over the following two days (Kiese et al., 1968).

In a similar series of studies regarding the concentrations of 2,5-TD absorbed in the blood and excreted in the urine, the addition of 3% hydrogen peroxide reduced absorption of 2,5-TD. After a 3-h cutaneous exposure to a gel containing 3% hydrogen peroxide and 1.4 mg of 2,5-TD, no 2,5-TD was detected in the blood of dogs. An intravenous infusion of 0.0015 mg of 2,5-TD/kg/min for 3 hours produced a detectable concentration of 2,5-TD. Thus, the absorption through the skin was <3 mg. Absorption of 2,5-TD was proved by the detection of small amounts (60–70 μg) in the urine (Kiese et al., 1968).

The extent of cutaneous absorption was further investigated by Hruby (1977) in rats using radioactive 2,5-TD, [Me-^{14}C] 2,5-TD. The skin of nine female and nine male Sprague-Dawley rats was treated with 0.5 g of a formulation containing 7.5 mg of radioactive 2,5-TD (specific activity: 77.8 mCi/g 2,5-TD). Immediately before application, the formulation was mixed with an equal volume of 6% hydrogen peroxide. After 30 minutes of exposure, the gel was removed and the skin washed. The animals were observed for 24 hours and then terminated. The treated skin was removed and the carcass was homogenized. Over the 24 hours following application, 0.207% of the total dose was absorbed. The majority of the radioactivity (0.14% of the total dose) was found in the urine. Approximately 0.063% of the radioactivity was found in the total-body homogenate.

An identical experiment was conducted using radioactive compound with a specific activity of 22.2 mCi/g. A total of 0.211% of the total dose was absorbed in 24 h; 0.08% was found in the urine, and 0.13% in the total-body homogenate (Hruby, 1977).

A 1 ml subcutaneous administration of 0.4% aqueous [^{14}C]2,5-TD hydrochloride (specific activity: 12.8 mCi/g 2,5-TD) was given to 18 Sprague-Dawley rats. The excretion products were collected daily for five days, and then the animals were sacrificed and their bodies homogenized. Over 65% of the radioactivity was excreted in the urine within 24 h. After 5 days, approximately 15% of the radioactivity was found in the feces and 6.9% was detected in the total-body homogenate (Hruby, 1977).

The extent of cutaneous absorption also was studied using dogs. Fifty milliliters of a formulation containing 1.4 g 2,5-TD ([Me-^{14}C] 2,5-TD, specific activity: 32.0 mCi/g 2,5-TD) was applied for 3 hours to the lateral abdominal region of six Beagle dogs. Blood samples, urine, and feces were collected regularly. Peak concentrations of radioactivity (925.5 pCi/ml) were reached in the blood at 6 h. Over 4 days, 0.092% and 0.840% of the administered dose was excreted in the urine and feces, respectively. The site of application retained 1.79 mCi ^{14}C activity on day 5 (Hruby, 1977).

Three weeks later, the same dogs were used for an intravenous administration. The infusion consisted of 0.224 g 2,5-TD hydrochloride 0.14 g 2,5-TD with a specific reactivity of 15.2 mCi/g 2,5-TD) dissolved in 27.0 ml deionized water. Each dog was infused at a constant rate with 9 ml/h of the solution for 3 hours. Within 2 hours of the start of infusion, peak blood concentrations of radioactivity were achieved. Sixty percent of the radioactivity was found in the urine and 19% in the feces over 4 days. The bulk of this radioactivity was found after the first 24 h (Hruby, 1977).

Eighteen Sprague-Dawley rats were given 1 ml oral doses of a 1.6% aqueous solution of radioactive 2,5-TD hydrochloride (specific activity: 15.8 mCi/g 2,5-TD) by stomach tube. The excretion products were monitored daily and the animals were terminated on day 5. The gastrointestinal tract from the cardia to the anus was removed

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and homogenized separately from the rest of the body. Within 24 hours, over 70% of the radioactivity was excreted in the urine. After 5 days, a total of 10% was detected in the feces, 1.2% in the body homogenate, and 1.4% remained in the gastrointestinal tract (Hruby, 1977).

Kiese and Raucher (1968) assessed the absorption of 2,5-TD through human skin. A simple hair dye containing 2.5 g of 2,5-TD was applied to the hair and scalp of five human subjects for 40 minutes. All urine produced in hours 1–4, 5–8, 9–24, 25–36, and 37–48 following application was collected and analyzed using the Schiff base method. Since humans excrete 2,5-TD as *N,N'*-diacetyl-*p*-toluenediamine (*N,N'*-dpt) rather than as a free amine, ethyl acetate, instead of chloroform, was used as the solvent for extracting this compound from the urine. The greatest rate of excretion was observed during the 5–8-h period following the dyeing. On average, the total amount of *N,N'*-dpt excreted was 3.66 mg, which is equivalent to 2.17 mg of 2,5-TD.

In order to estimate the amount of 2,5-TD absorbed from the amount of the *N,N'*-dpt found in the urine, *N,N'*-dpt concentrations were determined using the same methods after subcutaneous injection of a known amount of 2,5-TD. Three women and three men were injected with 2.6 ml of a solution containing 5.54 mg 2,5-TD. As in the hair dyeing experiment, the rate of excretion was highest during the first few hours after the injection. An average of 4.5 mg of *N,N'*-dpt, or more specifically, 2.64 mg of 2,5-TD, was isolated from the urine; thus, 47.6% of the injected dose was excreted as *N,N'*-dpt. The authors calculated that 4.6 mg of 2,5-TD was either absorbed during the dyeing process or liberated *in vivo* from a compound formed during the preparation of the hair dye and absorbed through the skin (Kiese and Raucher, 1968).

ANIMAL TOXICOLOGY

Acute Toxicity

Oral studies. According to the EPA (1977), the following LD_{LO}s have been reported for Toluene-2,5-Diamine:

Oral: unspecified mammal: 3600 mg/kg
Subcutaneous: rat: 50 mg/kg; rabbit: 100 mg/kg.

The oral LD_{50} of Toluene-2,5-Diamine sulfate in an oil-in-water emulsion in rats was reported as 98 mg/kg; the intraperitoneal LD_{50} of the compound in dimethylsulfoxide in rats was 49 mg/kg (EPA, 1977).

A 10% concentration of 2,5-TD was administered to CFY strain rats by oral intubation. Using a geometric dose progression of 1.6, the LD_{50} value was calculated to be 102 mg/kg. The 95% confidence limits were 69–152 mg/kg. Necropsies were performed on the surviving rats. No abnormalities indicative of residual systemic effects were observed (Lloyd et al., 1977).

Subcutaneous studies. In a study of the ulcerogenic activity of 3,4-TD, Sprague-Dawley rats were given subcutaneous injections of 3,4-TD dissolved in 10% ethanol at doses ranging from 62.5–500 mg/kg. The rats were observed for 24 h. No deaths occurred from doses of 300 mg/kg or lower. Mortality increased progressively at greater doses; groups given 350, 400, 450, and 500 mg/kg had mortalities of 5, 30, 50, and

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94%, respectively. The incidence of duodenal lesions increased progressively up to 80% as doses increased to 400 mg/kg. At the two highest doses (450 and 500 mg/kg), the incidence decreased to 20 and 27%, respectively (Perkins and Green, 1975).

Subchronic Toxicity

Oral studies. Thirteen female Sprague-Dawley rats were fed 3,4-TD in 2 ml water (individual dose: 50 mg/100 g body weight) twice a day for 5 days by stomach tube. Seven rats died before termination, and 6 of these had perforated duodenal ulcers (Selye, 1973). An oral dose of 33.3 mg in 2 ml water also caused duodenal ulcers (Selye and Mecs, 1974).

Dermal studies. Five hair dye formulations were tested for percutaneous toxicity in New Zealand white rabbits. These formulations contained 0.25, 0.4, 0.6, 3.0, and 6.0% 2,5-TDS, as well as various other hair dye constitutents. Dosages of 1 mg/kg were applied for one hour to either intact or abraded skin of 12 animals twice a week for 13 weeks. The animals were monitored for changes in body weight, for changes in urine composition, and for either hematologic or clinical chemistry abnormalities. No evidence of systemic toxicity was reported (Burnett et al., 1976).

Chronic Dermal Toxicity

Kinkel and Holzmann (1973) conducted a long-term percutaneous study of 2,5-TD in rats. Two groups of 50 male and 50 female Sprague-Dawley rats were treated with solutions containing 2,5-TD. One solution contained 4% 2,5-TD and the second solution contained 3% 2,5-TD and two other important hair dye constituents, resorcinol and *m*-diaminoanisole (each at a concentration of 0.75%). A third group of rats served as untreated normal controls, while a fourth group of rats (25 male and 25 female) were treated with the vehicle alone. In order to simulate typical hair-dyeing techniques, the solutions and the vehicle were mixed with 6% hydrogen peroxide immediately before application. Solutions of 0.5 g were applied to the skin of the rats for 30 minutes twice weekly for two years. The rats were weighed weekly and observed regularly for behavioral changes. No cutaneous irritation was evident in any of the rats during the study, and no marked differences in body weight changes were observed among the groups. The mean lifespan and mortality rate were comparable in the experimental and control groups. The behavior of all the rats was normal.

Three hair dye formulations containing 3% 2,5-TDS were tested for cutaneous toxicity in an 18-month study. The formulations contained various concentrations of other chemical intermediates (*p*-phenylenediamine, resorcinol, *m*-phenylenediamine, 2,4-diaminoanisole sulfate, and 2,4-TD), an were mixed with 6% hydrogen peroxide just prior to use to simulate conventional hair-dyeing techniques. Nine groups of Swiss-Webster mice were given the following treatments: six groups were treated with 0.05 ml of the different formulations once weekly or once every other week, two groups had the vehicle alone applied at the two dosing frequencies, and one positive control group received weekly applications of 0.05 ml of a solution of 7,12-dimethylbenz-[*a*]anthracene in acetone (total dose during 18 months was ~1.9 mg). One group of 250 mice served as an untreated control group.

No signs of systemic toxicity were observed in any of the dye-treated groups. The average body weight for each of the groups was comparable throughout the study. Survival varied from 58 to 80% except in the positive controls, in which only 21% of the

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mice were alive at the termination of the study. Moderate alopecia was reported in 50% of the animals in each of the three groups receiving the dyes once weekly. This occurred during the first five months of the study and was not observed in any of the other groups of mice. The alopecia diminished as the study progressed and the hair coat appeared normal after 11 months. Sections of the treated skin were normal when examined microscopically (Burnett et al., 1975).

A two-year toxicity study of hair dye formulations containing 3% 2,5-TD was conducted using Swiss-Webster mice. The formulations also contained 2,4-TD, *p*-phenylenediamine, and resorcinol. Once a week, 0.05 ml of the solutions was applied to the skin of the mice, and the mice were evaluated for signs of toxicity. Survival rates varied greatly in both the experimental and control groups. The average body weight gains for the treated mice were not significantly different from the untreated controls. No abnormal proliferation and maturation of squamous epithelium of the skin were reported (Giles et al., 1976).

Dermal Irritation and Sensitization

An assessment of dermal irritation was conducted using New Zealand White rabbits. The assessment was based on the procedures prescribed in the Code of Federal Regulations (CFR, Title 16, Sec. 1500.42). 2,5-TD was applied as a 2.5% (w/v) preparation to the intact and abraded skin of three rabbits. Slight erythema and edema were observed at the intact site of all the animals. One rabbit had very slight erythema at the abraded site. The primary irritation index was estimated at 0.3. No signs of irritation were observed after 72 h (Lloyd et al., 1977).

Hartley albino guinea pigs were used to study the cutaneous irritation and sensitization potential of 2,5-TDS and 3,4-TD. Concentrations of 0.1, 0.2, 0.5, 1, 2, 5, and 10% 2,5-TDS or 3,4-TD were mixed with white petrolatum and applied under occlusive patches to the flanks of 10 animals for 48 h. No animal treated with 2,5-TD had irritation. However, 30% of the guinea pigs treated with 10% 3,4-TD had cutaneous irritation. No irritation was caused by 3,4-TD at lower concentrations (Ishihara et al., 1985).

During the two-week induction phase of the sensitization experiment, a 1% concentration of either 2,5-TDS or 3,4-TD in white petrolatum was applied under occlusive patches to the nape of 10 guinea pigs for 48 h three times per week. The animals were given a two-week nontreatment period before they received challenge applications of either 1% or 0.1% 2,5-TDS and 3,4-TD. The challenge applications were made under occlusive patches to the flanks of the test animals for 48 h, and the animals were observed 24 and 48 h after the test materials had been removed. The sensitization rates of 0.1% and 1% 2,5-TDS were reported to be 10 and 40%, respectively. 3,4-TD was a strong sensitizer; sensitization rates were 90 and 100% at concentrations of 0.1 and 1.0%, respectively (Ishihara et al., 1985).

Ocular Irritation

Lloyd et al. (1977) conducted an eye irritancy test on New Zealand White rabbits. The study was done in accordance with the Code of Federal Regulations (Title 16, Sec. 1500.42). A 2.5% (w/v) solution of 2,5-TD was instilled into the conjunctival sacs of three rabbits. After 10 seconds of exposure, the eyes were rinsed with water. Mild conjunctival inflammation was observed; however, these reactions did not persist for more than 24 h.

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Teratogenicity and Reproduction Studies

2,5-TDS was administered by gavage at doses of 10, 50, and 80 mg/kg/day to pregnant rats, and at doses of 10, 25, and 50 mg/kg/day to pregnant rabbits. The rats were dosed on days 6–15 of gestation, and the rabbits on days 6–18. The rats and rabbits were sacrificed on days 19 and 28, respectively, and the mothers and fetuses were examined for abnormalities. Evidence of maternal toxicity and embryotoxicity was reported in the rats receiving 80 mg/kg/day of 2,5-TDS. Neither congenital nor material abnormalities were observed in either the rats treated with the smaller doses of 2,5-TDS or in any of the rabbits (Spengler et al., 1986).

The teratogenic potential of 2,5-TD was studied in pregnant JCL:ddN mice. A 50 mg/kg dose of 2,5-TD dihydrochloride dissolved in distilled water was injected subcutaneously into eight groups of 10 or 11 mice on one of days 7–14 of pregnancy. The mice were terminated on day 18 of pregnancy, and the uteri and fetuses were examined for abnormalities. The greatest teratogenic effects were observed in the mice dosed on day 8; 18% of the fetuses had craniofacial malformations. These mice also had a greater incidence of fused or distorted thoracic vertebrae associated with absent or fused ribs. No such observations were made in the control mice, and did not occur at all or occurred to a much lesser extent in mice treated on the other seven days. All of the mice survived to termination, and no significant differences in the incidence of intrauterine deaths were found between groups and the untreated controls (Inouye and Murakami, 1977).

Based on these results, a more detailed analysis of the teratogenicity of 2,5-TD was carried out on an additional two groups of mice. On day 8 of pregnancy, a larger dose of 2,5-TD dihydrochloride (75 mg/kg) was administered subcutaneously to a group 10 mice, and 50 mg/kg was administered intraperitoneally to a group of 12 mice. Six dams from the subcutaneously treated group and four dams from the intraperitoneal group died before termination. Nearly half of the fetuses in both groups were either dead or were reabsorbed. Thirty-five percent of the fetuses from the subcutaneously treated mice, and 45% of those from the intraperitoneally treated mice had craniofacial and skeletal malformations (Inouye and Murakami, 1977).

Pregnant outbred albino (CD-1) mice were given subcutaneous injections of 16, 32, 48, or 64 mg/kg/day 2,5-TDS on days 6–15 of gestation. The mice were sacrificed on day 18, and maternal and fetal abnormalities were recorded. 2,5-TDS was lethal to four of 31 dams, and nine of 11 dams receiving dosages of 48 and 64 mg/kg/day, respectively. A significant trend ($p < 0.05$) toward maternal weight reduction with increased dosage was reported. Also, a significant decrease ($p < 0.05$) in fetal weight was reported for dams receiving dosages above 32 mg/kg/day. The average percentage of malformed fetuses was very small and did not increase significantly at the greater dosages (Marks et al., 1981).

Five hair dye formulations containing various levels of 2,5-TDS (0.25, 0.4, 0.6, 3, and 6% 2,5-TDS) were cutaneously tested for teratogenic effects on pregnant Charles River CD rats. Four of these formulations were permanent hair dyes, which were mixed with hydrogen peroxide before application, and one formulation (containing 0.25% 2,5-TDS) was a semipermanent dye. Five groups of 20 rats were given 2 ml/kg topical applications on days 1,4, 7, 10, 13, 16, and 19 of gestation. A positive control group received acetylsalicylic acid by gavage, and three negative control groups received no treatment. All animals were sacrificed on day 20. No significant differences in the mean number of corpora lutea, live fetuses, and resorptions per pregnancy were reported for

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the experimental animals. There were no significant changes in soft-tissue anomalies between the fetuses of the treated groups and the negative controls. A statistically significant increase in skeletal anomalies (9 of 169 fetuses) was reported for the group of rats receiving the hair dye formulation containing 3% 2,5-TDS. No adverse changes occurred from hair dye formulations containing 6% 2,5-TDS (Burnett et al., 1976).

Becci et al. (1983) studied the teratogenic potential of *o*-toluenediamine, a mixture of 2,3-TD and 3,4-TD (40:60), in rats and rabbits. Groups of pregnant Sprague-Dawley rats (22–25 animals) were given daily oral doses of 10, 30, 100, and 300 mg/kg on days 6–15 of gestation. *o*-Toluenediamine was dissolved in corn oil at appropriate concentrations so that the mixture was administered at 10 ml/kg/day to each group. Positive control rats were given aspirin (2.5% suspension administered at 250 mg/kg/day) and negative controls received corn oil (10 ml/kg/day). The rats were observed daily and weighed regularly. On day 20 of gestation, the dams were killed and the uterine contents examined.

The mean weight gain of the high-dose (300 mg/kg/day) dams and their fetuses was significantly different from that of the negative control group. The fetuses had an elevated incidence of missing sternebrae and of incomplete ossification of vertebrae. An elevated incidence of the latter malformation also occurred in the 100 mg/kg-treated group. The authors noted that these malformations were indicative of delayed fetal development. Weight gain was normal in the dams and fetuses of the lower dosage groups, and the number of live fetuses, implantation sites, and resorption sites were normal for all groups. The fetuses from the rats of the lower dosage groups had neither skeletal nor soft tissue malformations related to treatment with *o*-toluenediamine. The authors concluded that *o*-toluenediamine was not teratogenic to Sprague-Dawley rats. The adverse effects on the fetus occurred only at dosages that were toxic to the dam.

A similar study was also conducted using Dutch-Belted rabbits. Doses of 3, 10, 30, and 100 mg/kg/day were administered orally to groups of pregnant rabbits (15–16 animals) on days 6–18 of gestation. *o*-Toluenediamine was dissolved in corn oil at appropriate concentrations so that 2 ml/kg/day of the mixture was administered. A positive control group was given 6-aminonicotinamide as a 0.125% aqueous solution (2.5 mg/kg on day 9). Negative control animals were given corn oil alone (2 ml/kg/day). On day 29 all the rabbits were terminated and the uterine contents examined.

The mean weight gain of the high-dose (100 mg/kg/day) rabbits and their fetuses was significantly smaller than that of the negative control animals. The dams also had a greater number of resorption sites. The mean number of fetuses per dam was decreased in this group, but the difference was not statistically significant. None of the dams or fetuses from the lower dose groups had any of these changes. No fetuses from any of the treatment groups had skeletal malformations. The authors concluded that *o*-toluenediamine was not teratogenic. Increased resorption rates and delayed fetal development occurred only at dosages that were toxic to the dam (Becci et al., 1983).

Burnett and Goldenthal (1988) conducted a two-generation reproduction study using rats that received cutaneous applications of two oxidative hair-dye formulations containing 3 and 6% 2,5-TDS. Each formulation (0.5 ml) was applied to the skin of 40 Sprague-Dawley rats twice weekly. When the rats were 100 days old, they were mated to produce an F_1 generation. These offspring were subsequently used to produce an F_2 generation using the same procedures. Observations were made during the growth, mating, gestation, and lactation phases of the F_0 parents to the weaning of F_1 and F_2 litters. Comparisons of male and female fertility, gestation, and fetal viability indices and body weights were made between the experimental groups and untreated control

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rats. Mild dermatitis was noted during the treatment period in each generation. However, all the rats appeared to be healthy throughout the study; no signs of pharmacotoxicity, teratogenicity, or reproductive abnormalities were reported.

MUTAGENICITY

2,5-TDS was nonmutagenic when tested in CFY rats with the micronucleus test. A 120 mg/kg dose of 2,5-TDS was administered by gastric intubation to five male and five female rats as two equal doses separated by a 24-h interval. The animals were sacrificed 6 h after the second dose was administered and bone marrow slides were prepared. The mean incidence of micronucleated cells per 2,000 polychromatic erythrocytes per rat was 0.9; this value was similar to that obtained with a vehicle control group, and did not fall outside the laboratory standard range for negative control groups (Hossack and Richardson, 1977).

Soares and Lock (1980) conducted a recessive spot test with 2,5-TD. T stock and C57BL/6J (or C57BL/10J) strains of mice were used in the following matings: C57BL/6J (or C57BL/10J) males X C57BL/6J females, and T stock males X C57BL/6J females. The pregnant females were given intraperitoneal injections of 30 mg/kg 2,5-TD or Hanks' balanced salt solution (to serve as controls). The total volume of each injection was 0.1 ml. There were no significant differences in number or morphology of offspring between the experimental and control groups. No evidence of mutagenicity was reported, as none of the offspring from the experimental groups had recessive spots.

A dominant lethal test of 2,5-TD was conducted on Charles River CD rats. 2,5-TD was administered as a 0.2% aqueous solution in a dose volume of 1 ml/100 g body weight. Twenty male rats were given intraperitoneal injections (20 mg/kg) three times per week. After eight weeks, the rats were mated for five days. The female rats were terminated 17 days later and examined for evidence of increased postimplantation fetal loss. No significant differences were reported between the experimental and control groups (Burnett and Corbett, 1977).

Ames et al. (1975) tested 169 different permanent hair-dyes for mutagenicity using *Salmonella typhimurium* strain TA1538. Of 169 dyes, 150 (89%) were mutagenic both before and after mixing with hydrogen peroxide. Some of these dyes were mutagenic alone, and others required microsomal (S9) activation. 2,5-TD, a common constituent in these hair dyes, was weakly mutagenic when activated with S9. When oxidized with hydrogen peroxide and spot tested with S9, 2,5-TD was strongly mutagenic; there was a 40-fold increase in revertants.

2,5-TD was tested for its ability to enhance the transformation of primary hamster embryo cells (HEC) by simian adenovirus 7 (SA7) and for its ability to transform secondary HEC. Cultures of primary HEC were treated with 2,5-TD (at a concentration range of 3.13–50 μg/ml) 18 h to the addition of SA7, or 48 h immediately after absorption of SA7 (at a concentration range of 1–200 μg/ml). For both protocols, 2,5-TD was active, producing an absolute increase in the number of virus-transformed foci per plate. A dose–response relationship was observed in one set of cells treated prior to the addition of the virus. 2,5-TD also transformed secondary HEC (at concentrations of 5 and 10 μg/ml), but did not produce a clear dose-response relationship. The authors concluded that 2,5-TD has ". . . a low but definite potential for inducing genetic damage" (Greene and Friedman, 1980).

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3,4-TD was also active in the transformation protocols of Greene and Friedman (1980). 3,4-TD was administered at concentrations of 12.5–200 μg/ml to primary HEC prior to the addition of SA7, or at concentrations of 10–200 μg/ml after the addition of SA7. A dose–response relationship was observed in both protocols, and an absolute increase in the number of foci per dish at all dosages occurred when 3,4-TD was administered prior to SA7 addition. 3,4-TD (at concentrations 2.5–10 μg/ml) also enhanced secondary HEC transformation. However, at higher concentrations (15–50 μg/ml) no transformation occurred.

3,4-TD was not active in the standard Ames plate incorporation testing using *S. typhimurium* strains TA98 and TA100 with and without metabolic activation (Greene et al., 1979).

Florin et al. (1980) used the Ames test to evaluate the mutagenic potential of 3,4-TD (3 μmol/plate), using *S. typhimurium* strains TA98, TA100, TA1535, and TA1537 both with and without metabolic activation. 3,4-TD was nonmutagenic.

The mutagenic potential of 3,4-TD was tested alone and with the addition of H_2O_2 using the Ames test. *S. typhimurium* strain TA98 was used both with and without metabolic activation with S9. 3,4-TD and its oxidation products were not mutagenic in either system (Watanabe et al., 1989).

The DNA repair induced by 2,5-TD was determined in rat and hamster hepatocytes using the primary hepatocyte culture/DNA repair assay. Hepatocytes obtained from male Sprague-Dawley rats and male Golden Syrian hamsters were treated with 2,5-TD at molar concentrations of 10^{-4}, 10^{-5}, 10^{-6}, and 2×10^{-7}. Two sets of assays were done. An average net nuclear count of 5 or greater was reported as a positive response, since these values differed from the control net nuclear counts by more than two standard deviations. The 10^{-4} M treatment was toxic in both types of hepatocytes. At 10^{-5} M, 2,5-TD produced a positive response (net nuclear count: 8.2 and 5.9) in the rat hepatocytes, and a weak positive response (net nuclear count: 4.1 and 2.5) in the hamster hepatocytes. The lower concentrations of 2,5-TD had negative responses. The primary purpose of this study was to determine relative differences in DNA repair responses between the rat and hamster hepatocytes, not to evaluate the genotoxic status of 2,5-TD; thus, no statistical comparisons between data from control and experimental hepatocytes were performed (Kornbrust and Barfknecht, 1984).

2,5-TDS significantly inhibited the incorporation of [^{125}I]iododeoxyuridine into murine testicular DNA in a dose-dependent manner. Groups of 10 mice were given intraperitoneal injections of 2,5-TDS at doses of 40, 44.5, 49.5, and 55 mg/kg. Control mice were given 100 mg/kg of dimethylnitrosamine perorally. After three hours, 10 μCi [^{125}I]iododeoxyuridine was injected intraperitoneally. The testes were removed 30 minutes later for analysis. As the doses increased, the radioactivity incorporated into the testicular DNA decreased; the radioactivity in the DNA decreased from 1.77 dpm/μg DNA (control animals) to 0.99 dpm/μg DNA (high-dose animals 55 mg/kg). This inhibition of DNA synthesis was not the result of a drop in body temperature, as the rectal temperature was not significantly reduced; and 2,5-TDS did not inhibit the radioisotope from reaching the testes, as the soluble radioactive pool remained unchanged after treatment. Since 2,5-TDS was capable of reaching the testes and permeating target cell membranes at this site, 2,5-TDS might represent a genetic health hazard to animals (Greene et al., 1981).

The same methods were also used to study the effect of 3,4-TD on murine testicular DNA synthesis. Doses of 200, 229, 262, and 300 mg/kg 3,4-TD were administered intraperitoneally to mice. As seen in the 2,5-TDS treated mice, the amount of

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radioactivity incorporated into the testicular DNA decreased as the dosage of 3,4-TD increased. Radioactivity decreased from 0.79 dpm/μg (control) to 0.44 dpm/μg (high dose: 300). The authors concluded that 3,4-TD was also a potential genetic health hazard to animals (Greene et al., 1981).

A summary of the preceding data is recorded in Table 4.

CARCINOGENICITY

A bioassay of 2,5-TDS for possible carcinogenicity was conducted by the National Cancer Institute (1978). Fifty Fischer 344 rats of each gender and 50 B6C3F1 mice of each gender were given doses of 2,5-TDS in their feed for 78 weeks. The rats received 2,5-TDS at concentrations of either 0.06% (the dose was 0.05% for the first 15 weeks) or 0.2%, and the mice received either 0.06% or 0.1%. The animals were monitored for changes in body weight and rate of survival, and clinical observations were made regularly. Gross and microscopic examination of major tissues, organs, and gross lesions were conducted on all the animals, either at interim death or at termination of the study.

There was no evidence that 2,5-TDS accelerated the mortality of either sex of either species. In both the low- and high-dose male rats, the incidence of interstitial cell neoplasms of the testis was statistically significant (43 of 48 rats in the low dose group, and 47 of 48 rats had such neoplasms). However, the development of these neoplasms was not attributed to 2,5-TDS since spontaneous incidence of these neoplasms is known to be both high and variable in male Fischer 344 rats. The incidence of neoplasms in treated female rats was not significantly different from control rats.

In the study using the B6C3F1 mice, there was no significant increase in the development of neoplasms in the male mice of either treatment group. The high-dose-treated female mice had an elevated incidence of alveolar/bronchiolar adenomas and carcinomas (8 of 45 mice had one or both types of neoplasms). The authors noted that the female high-dose and low-dose–treated mice were received in separate shipments and were housed in different rooms. Thus, it was concluded that the data did not provide sufficient evidence of a compound-related effect (NCI, 1978).

Two groups of 50 male and 50 female Sprague-Dawley rats were treated with hair dyes containing 2,5-TD in a 2.5 year percutaneous study. One solution contained 4% 2,5-TD alone and the second solution contained 3% 2,5-TD with other important hair dye constituents (resorcinol and *m*-diaminoanisole). The hair dyes were mixed with 6% hydrogen peroxide immediately before application, and 0.5 g of the solutions was applied to the skin of the rats for 30 min twice weekly for two years. Fibroadenomas, fibromas, lymphosarcomas, and round-cell sarcomas were reported during the second half of the life of both groups of rats. The incidence of the neoplasms, and the proportion of male and female rats affected were not significantly different from that observed in vehicle and untreated control rats. None of the neoplasms in the experimental animals developed at the site of application. The authors concluded that neither of these hair dyes induced carcinogenic effects (Kinkel and Holzmann, 1973).

In conjunction with the 18-week toxicity study and the two-generation reproduction study, described earlier in this report, Burnett et al. (1975) and Burnett and Goldenthal (1988) reported that no evidence of carcinogenic activity was observed from topical applications of hair dyes containing 3% and 6% 2,5-TDS. In the toxicity study, the incidence of alveologenic adenomas and carcinomas in the three groups of

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Table 4. Mutagenicity Studies

Ingredient	*Strain/cells tested*	*Methodology*	*Results*	*References*
2,5-TDS	CFY rats	Micronucleus test	Negative	Hossack and Richardson (1977)
2,5-TD	T stock and C57BL/6J mice	Recessive spot test	Negative	Soares and Lock (1980)
2,5-TD	Charles River CD rats	Dominant lethal test	Negative	Burnett and Corbett (1977)
2,5-TD	*S. typhimurium* TA1538	Ames test with S9 activation	Weakly mutagenic	Ames et al. (1975)
2,5-TD mixed with H_2O_2	*S. typhimurium* TA1538	Ames test with S9 activation	Strongly mutagenic	Ames et al. (1975)
2,5-TD	Hepatocytes from Sprague-Dawley rats and Golden Syrian hamsters	Primary hepatocyte culture/DNA repair assay	Positive	Kornbrust and Barfknect (1984)
2,5-TD & 3,4-TD	Primary hamster embryo cells (HEC)	Enhancement of transformation by simian adenovirus 7 (SA7)	Positive	Greene and Friedman (1980)
2,5-TD & 3,4-TD	Secondary HEC	Transformation of secondary HEC	Positive	Greene and Friedman (1980)
2,5-TDS & 3,4-TD	Mice	Effects on murine testicular DNA synthesis	Inhibited DNA synthesis	Greene et al. (1981)
3,4-TD	*S. typhimurium:* TA98 and TA100	Ames test with and without S9 activation	Negative	Greene et al. (1979)
3,4-TD	*S. typhimurium:* TA98, TA100, TA1535, and TA1537	Ames test with and without S9 activation	Negative	Florin et al. (1980)
3,4-TD & 3,4-TD mixed with H_2O_2	*S. typhimurium:* TA98	Ames test with and without S9 activation	Negative	Watanabe et al. (1989)

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Swiss-Webster mice treated with 3% 2,5-TDS was comparable to that reported in control groups. The incidence, type and distribution of other neoplasms were not significantly different (Burnett et al., 1975).

In the multigeneration study, 120 F_1 generation Sprague-Dawley rats were given topical applications of the same hair dyes as their parents (containing either 3% or 6% 2,5-TDS) twice a week for two years. A wide variety of nonneoplastic lesions was observed in both the experimental and control groups. The incidence of neoplasms was highly variable in all of the groups and could not be directly correlated to hair dye exposure (Burnett and Goldenthal, 1988).

Hair dye containing 3% 2,5-TDS, 1.5 *p*-phenylenediamine, 0.4% resorcinol, and either 0.2% or 0.6% 2,4-TD was used in a carcinogenicity study conducted by Giles et al. (1976). For two years, 28 Swiss-Webster mice of each gender were given 0.05 ml applications of the dye mixed with 6% hydrogen peroxide once a week for two years. The type, number, incidence and distribution of both benign and malignant neoplasms observed in the experimental groups was comparable to that of the control groups. However, IARC (1978) reported that ". . . a large number of animals were unaccounted for in the final analysis of tumor incidence, thus making the published data inadequate for the evaluation of the carcinogenicity of this chemical [2,5-TDS]." In its overall evaluation of 2,5-TD, the IARC concluded that there was inadequate evidence to regard this amine as carcinogenic to animals (IARC, 1987).

CLINICAL ASSESSMENT OF SAFETY

Dermal Irritation and Sensitization

Lynde and Mitchell (1982) patch tested 66 hairdressers to 1% 2,5-TD in petrolatum. Details of their methods were not given. Five subjects had positive reactions.

Patches of 2,5-TD (1% in petrolatum) were applied to the skin of 9 beauticians with allergic contact dermatitis. Readings were taken 72 h after the patch was applied. Positive reactions were reported in 7 of the beauticians (Matsunaga et al., 1988).

2,5-TD was tested for its sensitization potential using 31 men and the maximization test. Two percent aqueous 2,5-TD was used for induction and challenge. None of the subjects were sensitized (Epstein and Taylor, 1979).

EPIDEMIOLOGY

Approximately 40% of American women dye their hair, often at monthly intervals over a period of years (Corbett and Menkart, 1973). The U.S. EPA reported that [approximately] 15 million people are potentially exposed to hair dye ingredients as a result of personal use or in the application of hair dyes to other people (47 FR 979).

A variety of published studies have assessed the association between occupational exposure to and use of hair dyes and the risk of cancer. These studies do not note which specific hair dye ingredients were involved in the human exposure. A summary of reports of how occupational exposure to hair dye affects the risk of bladder cancer (Anthony and Thomas, 1970; Cole et al., 1972; Dunham et al., 1968; Wynder et al., 1963) and lung cancer (Garfinkel et al., 1977; Menck et al., 1977), or use of hair dyes affects the risk of bladder cancer in men or women (Jain et al., 1977) and breast cancer

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in women (Hennekens et al., 1979; Kinlen et al., 1977; Nasca et al., 1979; Shafer and Shafer, 1976; Shore et al., 1979; Wynder and Goodman, 1983) has been published in previous Cosmetic Ingredient Review reports on *p*-phenylenediamine, 2-nitro-*p*-phenylenediamine, and 4-nitro-*o*-phenylenediamine (Elder, 1985a,b). In the small case-controlled study by Shore et al. (1979), a positive correlation between hair dye and breast cancer was reported. When their study was extended to include 398 breast cancer cases, the same investigators could not implicate hair dye use as an important cause of human breast cancer (Koenig et al., 1991). The latter study indicated that beauticians who work for five or more years in this occupation have an increased breast cancer risk. However, the increased risk was not a strong finding, and "if beauticians are at increased breast cancer risk, exposures other than hair dyes may be responsible" (Koenig et al., 1991).

An epidemiology prospective study involving 118,404 U.S. women concluded that the use of permanent hair dyes appears unlikely to cause any important increase in the risk of breast cancer (Green et al., 1987).

Evidence of any carcinogenic effect from hair dyes on the organs investigated among the occupations and users examined has been insufficient. Clemmesen (1981) discussed the difficulties implicit in epidemiologic studies and reviewed many of the papers that investigated the relationship of the risk of cancer to occupational exposure to or use of hair dyes. He concluded that most researchers used samples that were too small to allow conclusions and that analyses of duration and intensity of exposure, lag time, and the influence of lifestyle factors, such as tobacco use, were deficient in many cases.

SUMMARY

2,5-TD, 2,5-TDS, and 3,4-TD are diaminotoluenes used as colorants in permanent hair dyes and tints. 2,5-TD is used at concentrations up to 1%, and 2,5-TDS is used up to 5%. No formulation data were available for 3,4-TD.

2,5-TD penetrated the skin of rats, dogs, and humans. The extent of penetration varied according to the formulation. The major routes of excretion after cutaneous absorption were through the urine and feces.

The oral LD_{50} levels of 2,5-TDS in an oil-in-water emulsion and 10% 2,5-TD in rats were 98 and 102 mg/kg, respectively. The intraperitoneal LD_{50} of 2,5-TDS for rats was 49 mg/kg.

Subcutaneous doses of 450 and 500 mg/kg of 3,4-TD dissolved in 10% ethanol caused mortality rates of 50% or greater in Sprague-Dawley rats. 3,4-TD also markedly increased the incidence of duodenal lesions when given at doses between 250 and 400 mg/kg.

In a subchronic toxicity study, 3,4-TD was toxic to Sprague-Dawley rats. More than 50% of the rats given twice-daily oral doses (50 mg/100 g body weight) died within 5 days. Most of these animals had perforated duodenal ulcers.

There was no evidence of percutaneous toxicity to New Zealand White rabbits when 6% 2,5-TDS was applied to intact or abraded skin during a 13-week study. In a two-year study, no toxicity was reported in rats receiving bi-weekly cutaneous applications of formulations containing 3–4% 2,5-TD. Swiss-Webster mice were also unaffected by 3% 2,5-TDS in an 18-month study, or by 3% 2,5-TD in a two-year study.

New Zealand White rabbits suffered from slight dermal irritation after exposure to 2.5% 2,5-TDS, but no irritation occurred in guinea pigs after exposure to 10% solutions

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of 2,5-TDS or 3,4-TD. The sensitization rates of 0.1% and 1% 2,5-TDS to guinea pigs were 10% and 40%, respectively. 3,4-TD was a strong sensitizer, having rates of 90% and 100% at concentrations of 0.1% and 1%, respectively.

2,5-TD (2.5%) caused mild, transitory conjunctival inflammation in rabbits. 2,5-TDS was toxic to pregnant rats and their embryos at oral doses of 80 mg/kg/day. Doses between 10 and 50 mg/kg/day did not cause congenital or maternal abnormalities.

o-Toluenediamine, a mixture of 2,3-TD and 3,4-TD (40:60), was not teratogenic when administered orally to Sprague-Dawley rats or Dutch-Belted rabbits. There was an increase in resorption rate and skeletal abnormalities, but these changes occurred only at concentrations which were toxic to the dams (300 mg/kg/day for rats, and 100 mg/kg/day for rabbits).

Subcutaneous doses of 32–70 mg/kg/day, of 2,5-TD dihydrochloride were toxic to dams and their fetuses, and caused fetal, craniofacial malformations.

Cutaneous exposure to hair dye formulations containing 3% 2,5-TDS caused a statistically significant increase in fetal skeletal anomalies in rats. Rats treated with 6% 2,5-TDS did not have this adverse response.

In a two-generation reproduction study, mice receiving cutaneous applications of hair-dye formulations containing either 3% or 6% 2,5-TDS had no signs of pharmacotoxicity, teratogenicity, or reproductive abnormalities.

2,5-TD was nonmutagenic in a recessive spot test or a dominant lethal test. It was weakly mutagenic in the Ames test using *S. typhimurium* strain TA1538 with S9 activation, and was strongly mutagenic when oxidized with hydrogen peroxide and spot tested with S9. 2,5-TDS was nonmutagenic in the micronucleus test using CFY rats.

3,4-TD was not active in the Ames plate incorporation test or spot test. Its oxidation products were also nonmutagenic.

Primary HEC were transformed by 2,5-TD and 3,4-TD both prior to and after the addition of SA7. Dose–response relationships were demonstrated. 2,5-TD and 3,4-TD also transformed secondary hamster embryo cells, but did not demonstrate a dose–response relationship.

2,5-TDS and 3,4-TD were identified as potential genetic health hazards to animals. Murine testicular DNA synthesis decreased in a dose dependent manner when these ingredients were injected intraperitoneally into mice.

A bioassay of 2,5-TDS for carcinogenicity was negative in rats fed either 0.06% or 0.2% 2,5-TDS, and mice fed either 0.06% or 0.1% 2,5-TDS. No evidence of carcinogenicity was reported in several studies of rats and mice treated with cutaneous applications of hair dyes containing either 3% or 4% 2,5-TD, and either 3% or 6% 2,5-TDS.

2,5-TD was a sensitizer in clinical studies.

DISCUSSION

2,5-TD and 2,5-TDS are used as colorants in permanent hair dyes at concentrations up to 5 and 1%, respectively. The oxidative or permanent hair dyes containing 2,5-TD or 2,5-TDS, as "coal tar" hair dye products, are exempt from the principal adulteration provision and from the color additive provision in sections 601 and 706 of the Federal Food, Drug, and Cosmetic Act of 1938 when the label bears a caution statement and appropriate "patch test" instructions for determining whether the product caused skin

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irritation. The patch test, in which the intermediates and hydrogen peroxide are mixed in the same manner as in use, is to be performed prior to each and every application of the hair dye. 3,4-TD is not reported to be presently used in cosmetics.

The toluene diamines exhibit low to medium acute toxicity in rats and rabbits. 2,5-TD is absorbed up to 0.18% through human skin. 2,5-TD is a mild eye irritant. The Panel noted that 3,4-TD has not been tested for ocular irritation. 2,5-TD (2.5%), 2,5-TDS (5%), and 3,4-TD (5%) were not dermal irritants to rabbits or guinea pigs. However, 2,5-TD (1%) is a sensitizer, and 3,4-TD (1%) a strong sensitizer in studies using guinea pigs. Photosensitization data were not available for these toluene diamines. 2,5-TD is mutagenic in the Ames assay, especially in the presence of H_2O_2, and is active in unscheduled DNA synthesis in the rat liver DNA assay. There is inadequate evidence to regard 2,5-TD as carcinogenic to animals. 3,4-TD is inactive in the Ames mutagenicity test.

The Panel cautioned that 2,5-TD may be a sensitizer to hairdressers and beauticians who have frequent contact with hair dyes.

Although there were no available studies regarding either the chronic toxicity or carcinogenic potential of 3,4-TD, the Panel agreed that the available data were sufficient to make a safety evaluation.

CONCLUSION

On the basis of the animal and clinical data presented in this report, the CIR Expert Panel concludes that Toluene-2,5-Diamine and Toluene-2,5-Diamine Sulfate are safe as cosmetic ingredients in the present practices of use. Although Toluene-3,4-Diamine is not reported to be presently in use, the available data are supportive of its safety at the same use levels as Toluene-2,5-Diamine and its sulfate.

ACKNOWLEDGMENT

Susan N.J. Pang, Scientific Analyst and Writer, prepared this report.

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