SM-32 (REV. 5-78)

Shell Oil Company
Interoffice Memorandum

ENVIRONMENTAL/IND. HYGIENE
DATE 10/13/87 NAME J. A. Gillespie
Return Document to File
Record Copy in File
Information Copy
Record Copy in
Copy:
Circulate:

811.

PLAINTIFF'S EXHIBIT
SH-2037

OCTOBER 9, 1987

FROM: STAFF ENGINEER - ENVIRONMENTAL CONSERVATION - MANUFACTURING & TECHNICAL

TO: ATTACHED DISTRIBUTION

SUBJECT: EPA DRAFT GUIDANCE DOCUMENT: ESTIMATING RELEASES AND WASTE-TREATMENT EFFICIENCY FOR THE TOXIC CHEMICAL RELEASE INVENTORY FORM

cliff
pete

As requested at the SARA Ttile III meeting held on October 6, 1987, the subject document is attached.

As discussed at the above meeting, the guidance document should be used carefully. For one reason, it is a draft document and could change, though further substantial changes are not expected. For another, the information given for estimating releases is rather general and probably will not give results in all cases that depict the situation at your location. The best bet in completing the forms is to use available data and refer to the guidance document only when there is no other reasonable method of obtaining the information required.

As soon as the final document is available, we will obtain copies and forward them to you.

F. W. Hill

cc: w/o attach
Manager Environmental Programs - Environmental Affairs - Health, Safety & Environment - J. A. Mullins
Environmental Conservation Staff - Manufacturing & Technical
HS&E-AS(2)

Under Separate Cover Letter
Manager Regulations & Maintenance Standards - Shell Pipe Line
Manager Health, Safety & Environment - Western Farm

LAM 005613

DPMC-03204

CW8728105

DISTRIBUTION

SUPERINTENDENT HEALTH, SAFETY & ENVIRONMENT - DEER PARK
SUPERINTENDENT ENVIRONMENTAL CONSERVATION/UTILITIES - WOOD RIVER
MANAGER ENVIRONMENTAL CONSERVATION
  MARTINEZ
  NORCO
MANAGER HEALTH, SAFETY & ENVIRONMENT
  ANACORTES
  GEISMAR
  MARIETTA
  ODESSA
  WILMINGTON
MANAGER TECHNICAL
  TAFT
  WOODBURY
MANAGER HEALTH, SAFETY & ENVIRONMENT - MARKETING ENGINEERING - REFINING & MARKETING
MANAGER HS&E - PRODUCTS DISTRIBUTION - REFINING & MARKETING
  EASTERN AREA
  MID-CONTINENT AREA
  WESTERN AREA
MANAGER HS&E & QUALITY ASSURANCE
  METAIRIE
  SEWAREN
MANAGER TECHNICAL/OPERATIONS - POLYMERS & CATALYSTS - CHEMICAL (4)

DRAFT

ESTIMATING RELEASES AND WASTE-TREATMENT EFFICIENCY FOR THE TOXIC CHEMICAL RELEASE INVENTORY FORM (FOR REVIEW ONLY)

by

PEI Associates, Inc.
11499 Chester Road
Cincinnati, Ohio 45246

PN 3687-33, 3687-40
Contract No. 68-02-4248
Work Assignment No. P2-10 and P2-17

U.S. ENVIRONMENTAL PROTECTION AGENCY
OFFICE OF TOXIC SUBSTANCES
WASHINGTON, D.C. 20460

May 1987

DISCLAIMER

This document is a draft report for public review and comment. It is being circulated for comments on its technical merit and policy implications. Mention of trade names or commercial products does not constitute endorsement or recommendation for use by the U.S. Environmental Protection Agency.

CONTENTS

CONTENTS (continued)

FIGURES

TABLES

SECTION 1

INTRODUCTION

Section 313, Title III, of the Superfund Amendments and Reauthorization Act (SARA) of 1986 (Public Law 99-499) requires certain chemical manufacturers, processors, and users to report total annual releases of listed substances to the environment.

This manual provides guidance on estimating environmental releases and treatment efficiencies required by the inventory in Parts VII and VIII, respectively, of the Toxic Chemical Release Inventory Form. Appendix A presents the Form and listings of the chemicals and chemical categories for which reports are required. Appendix B presents instructions for completing the form.

The regulations implementing this reporting requirement describe its applicability in detail. In summary:

- Facilities in Standard Industrial Classification codes 20 to 39 (the manufacturing sector of the economy) are subject if they have 10 or more full-time employees.
- Manufacturers or processors of 75,000 lb or more (of any listed chemical) in 1987, 50,000 lb or more in 1988, and 25,000 lb or more annually thereafter are subject.
- Users of 10,000 lb or more annually are subject.

Reports are to be filed by July each year for the preceding calendar year. Facilities are urged to consult the Code of Federal Regulations to determine their legal responsibilities (reference will be provided when the rule is codified).

Each facility must file a report for each chemical or chemical category for which the thresholds listed above are exceeded. For chemical categories based on metal content (e.g., copper compounds), releases of the metal, in

whatever form, are to be reported (even though the thresholds for amounts manufactured, processed, or used are based on the metal compounds.) For other chemical categories (e.g., glycol ethers), total releases of all members of the category are to be reported.

This manual is intended to provide an overview of the general methods by which releases can be calculated or estimated. Examples of the application of most of the methods are included. Where possible, the manual indicates the preferred method of estimation for these examples. The manual focuses on processes that occur in facilities within SIC codes 20 to 39; methods specific to commercial establishments providing services, waste sites, mobile sources, etc., are not covered. Sources of information on release estimation are included.

It is not the purpose of this manual to cover all situations; many types of releases will require case-by-case analysis. Nor is its purpose to describe monitoring/analytical programs that could be used to generate data for completing the form. Although no monitoring is required to respond to this requirement, facilities are urged to use monitoring data gathered under other regulatory programs or research efforts and to initiate monitoring of waste streams, particularly where estimation is complex and of limited accuracy.

Most users of chemicals subject to reporting will not need many of the techniques covered here. In some cases, a single calculation based on monitoring data may yield the only release estimate that must be reported. In others, a few calculations based on physical/chemical properties may suffice. The EPA believes that many affected facilities will be able to meet their regulatory obligations based on methods documented herein, but it also recognizes that complex chemical manufacturing processes or "unique" uses present difficulties that are not covered. Furthermore, EPA is currently developing guidance specific to some industry segments that process or use many of the listed chemicals.

Section 2 of this manual presents an overview of the information that must be reported and the types of analyses that a facility can use. Sections 3, 4, and 5 describe methods specific to estimating air releases, water releases, and "solid" wastes, respectively. Examples are provided to illustrate source of information, manipulation of data, and calculation procedures. Section 6 briefly describes procedures for estimating accidental releases.

OUTLINE FOR SECTION 2

GENERAL PRINCIPLES AND CONSIDERATIONS

2.1 Data to be Reported

2.2 Sources of Wastes/Releases

2.3 An Overview of the Analysis

2.4 Definitions of Major Approaches

2.5 Some Observations on the Use of Data

2.6 Which Approach to Use

- 2.6.1 Fugitive Air Emissions
- 2.6.2 Point Source Air Emission
- 2.6.3 Water Releases
- 2.6.4 Solids, Slurries, Nonaqueous Liquids

2.7 Example Release Calculation

- 2.7.1 Atmospheric Releases
- 2.7.2 Wastewater Releases

SECTION 2

GENERAL PRINCIPLES AND CONSIDERATIONS

This section briefly describes the data that a facility must report and discusses the information and approaches the facility will need to generate the data. If you have not already read the Form and instructions, it would be helpful to do so before proceeding (see Appendices A and B).

2.1 DATA TO BE REPORTED

Section VII of the Form requires reporting, in pounds per year, of releases of the chemical:

- To air from fugitive or nonpoint sources
- To air from stack or point sources
- In water directly discharged to a receiving stream
- In wastes injected underground
- To land on site, including landfill, impoundment, or landspreading
- In water discharged to a publicly owned treatment works (POTW)
- In other wastes transferred offsite for treatment or disposal.

Quantities reported on the form should reflect the amounts of chemical released after any onsite treatment and are specific to the chemical, metal, or chemical category subject to reporting, not to the total waste or its other constituents.

Section VIII of the Form requires reporting of the percentage by which any onsite treatment of any wastes containing the chemical reduces the amount of the chemical in the wastestream (weight percent reduction). The instructions for the Form tell how to list the treatment method by code and the concentration of the chemical in the waste as it enters treatment.

2.2 SOURCES OF WASTES/RELEASES

All sources of wastes should be considered in estimating releases of a chemical from your facility. Sources include but are not limited to the following:

Fugitive air sources:

- Volatilization from open vessels, waste-treatment facilities, spills, shipping containers
- Leaks from pumps, valves, flanges
- Building ventilation systems

Stack or point air sources:

- Vents from reactors and other process vessels
- Storage tank vents
- Stacks or vents from pollution control devices, incinerators, etc.

Water sources:

- Process steps
- Pollution control devices
- Washings from vessels, containers, etc.
- Storm water (if your permit includes storm water sources of a listed chemical)

Solids, slurries, and nonaqueous liquid sources:

- Filter cakes, filter media
- Distillation fractions
- Pollution control wastes, such as baghouse particulates, absorber sludges, spent activated carbon, wastewater treatment sludge
- Spent catalysts
- Vessel or tank residues (if not included under water sources)
- Spills and sweepings
- Off-specification product
- Spent solvents
- Byproducts

Accidental or nonroutine releases should be included in the release totals, and are not to be listed separately. The quantities reported in Section VII of the Form will be the totals of releases from individual release points of waste streams for each medium. For example, fugitive air emissions estimated separately for leaks, open vessels, and spills would be added and entered on line VII A ["Emissions to the Air--Fugitive or nonpoint air emissions" (see page 3 of the Form, Appendix A)].

LAM 005624

To assure that consideration is given to all possible sources, it will be useful to prepare or refer to (simplified) flow diagrams for those processes involving the chemical; for example, a schematic of the major pieces of equipment in which a polymerization using a listed solvent is carried out, the associated storage vessels, and the treatment steps for wastes containing the solvent. If the chemical is made or used in multiple processes, the quantities to be reported are total releases for all processes, and a flow diagram for each may be helpful.

2.3 AN OVERVIEW OF THE ANALYSIS

The level of detail of the analysis and the resulting effort required depends on your specific circumstances. Before data needs are described and methods are outlined for estimating quantities to be entered on the Form, it should be noted that many (if not most) processors and users will have only one or two releases of a given chemical to report. Further, if monitoring data are available for that release, simple multiplication of the concentration in the waste times the volume of waste may yield an acceptable estimate.

The following are examples of this "simple" solution:

- A maker of furniture uses a listed solvent in coatings. The solvent evaporates in a drying area, from which it is ducted to a discharge stack and then released to air without treatment. The discharge to air is simply the amount of solvent used in a year, i.e. the amount purchased in the coating(s), adjusted for any inventory change, and it would be entered on the Form under point-source emissions to air.

- For a nonvolatile component of an aqueous cleaning solution used to wash down food processing equipment, again the amount used equals the amount discharged (assuming no treatment), say to a POTW. This amount should be entered in Section VII.D.1, "Discharge to POTW."

- The manufacture of a chemical compound in solution yields a solid filter cake that is landfilled on site. The amount of chemical released is the chemical concentration in the filter cake times the weight of the cake landfilled yearly. This amount should be entered in VII.C., "Releases to land," with the code ID for landfill (see instructions for codes).

- A processor of copper-containing compounds has measured the concentration of copper in wastewater to comply with a water discharge permit. The copper concentration times the daily volume of wastewater times the number of days on which discharge occurs yields the release quantity. This amount should be entered in VII.B, "Discharge to water."

In all of these situations, readily available data on the volume of the chemical made or used and concentration measurements are all that is needed. Of course, careful scrutiny of the process(es) at the facility is necessary to ensure that no sources are overlooked. For example, discarded containers of coating or water used to wash a filter press may be additional sources in the first and third examples, respectively.

The task will be somewhat more complicated when, for example, there are several waste streams, treatment is used, or wastewater is discharged but the chemical in the wastewater has not been measured. The following are examples of slightly more complex situations:

- A paint formulator incorporates a listed pigment into coatings. Releases include 1) fine solids emitted to air from a milling step, and 2) solvent cleaning wastes sent to an offsite location for incineration. Total "losses" equal the amount of pigment used (purchases adjusted for inventory change) minus the amount of pigment sold in the product (concentration times volume of coating). Because there are two wastes, it is necessary to apportion the "loss" between them. It is unlikely that "fugitive" solids to air will have been measured; therefore, the best approach may be to estimate the amount of cleaning waste (perhaps based on the known volume of the waste shipped offsite), the concentration of coatings in the waste, and the concentration of the pigment in the coating. This release, entered in Section VII.D., can be subtracted from the total "loss" to yield amount of "fugitive air emissions" (which should be entered in Section VII.A.). In Section III, the code 6I for "other incineration" should be entered with the offsite location and address.

- The formulator of copper-bearing compounds precipitates solids from wastewater. In addition to the discharge cited previously, some precipitate may be shipped to a waste broker. This second copper release can be estimated from its volume and copper concentration. Enter the estimate under Section VII.D with the corresponding offsite location block number from Section III.B. The type of disposal (transfer to waste broker) is indicated by entering Code 50 in Section III.B. Treatment efficiency can be specified in Section VIII (Code 14WT for precipitation); amount of copper in solids divided by (amount in solids plus amount in treated water) times 100 gives the percentage reduction of copper in water resulting

from the treatment. The concentration of copper in the influent is simply the total copper in the two "releases" divided by the wastewater volume. (Alternatively, copper concentration in influent water may already have been measured).

Calculations will be more complicated when a volatile material is made or used and air emissions must be estimated for leaks, vents, etc., or when no data are available on water releases and the water comes from several points in the process.

- The manufacture of a solvent occurs in a continuous process that involves a reactor, distillation columns, pumps, compressors, miles of piping, and hundreds of fittings as well as associated storage tanks and pollution control devices. Generally, the air release points will not have been monitored, and no "emission factor" for the process will be available to facilitate estimating releases for the process as a whole (emission factors are discussed further in Subsection 2.4). Estimates of air releases must then be based on the other calculation techniques for air releases described in Section 3.

- The manufacture of a chemical produces water formed during reaction; this wastewater is separated for treatment prior to discharge. Additional wastewaters arise from product washings and pollution control equipment. The amount of chemical released can be estimated by considering the losses from each part of the process and then using mass balances and engineering calculations (defined in Subsection 2.4). Obviously, the larger the number of sources, the more difficult it will be to estimate the total release. A detailed example on acrylonitrile production illustrates some of these more complicated situations (Section 2.7).

2.4 DEFINITIONS OF MAJOR APPROACHES

The examples above illustrate several approaches that can be taken to estimate releases after release points have been identified. These approaches are of four general types:

- Calculations based on measured concentrations of the chemical in a waste stream and the volume/flow rate of that stream.

- Mass balance around entire processes or pieces of process equipment. The amount of a chemical leaving a vessel equals the amount entering. If input and output or "product" streams are known (based on measured values), a waste stream can be calculated as the difference between input and product (any accumulation/depletion of the chemical in the equipment, e.g., by reaction, must also be accounted for).

- Emission factors, which (usually) express releases as a ratio of amount released to process or equipment throughput. Emissions factors, which are commonly used for air emissions, are based on the average measured emissions at several facilities in the same industry.

- Engineering calculations or judgment in which physical/chemical properties and relationships such as the ideal gas law are used to calculate releases.

A single release estimate may involve the use of more than one of these estimation techniques; for example, when a mass balance is used to estimate the amount of wastewater leaving a process, and water solubility is used to calculate the maximum amount of chemical in the water.

Estimates may be based on analogy. The emission factor approach relies on determining that your process is analogous to the process for which data were used to derive the factor. The use of any published data (for example, on the effectiveness of wastewater treatment for a chemical or on the releases from a papermaking plant) implies that the treatment schemes of processes are analogous to those you are using. Extreme caution should be used in the application of an analogy, especially from one facility to another.

2.5 SOME OBSERVATIONS ON THE USE OF DATA

You may be able to calculate a specific release in several ways based on several sets of data. A decision must be made on which approach to use, based primarily on the expected accuracy of estimates derived from each. Assuming that equally valid, accurate data are available for each approach, the following caveats should be noted:

- Data on the actual released waste will generally provide a better estimate than data on the waste before treatment (to which a treatment efficiency must be applied).

- Data on the aggregate stream are preferable to data on the several streams that make up the aggregate.

- Data on the specific chemical are preferable to data on an analogue.

- Data on the chemical for a specific process are preferable to published data on similar processes. In fact, data on the treatment efficiency for a close analogue chemical treated at a specific facility will probably provide a better estimate than published data on the actual chemical, as operating conditions vary greatly from plant to plant. It may be easier to make a good chemical analogy based on physical/chemical properties than to make a process analogy.

Data (for example, on the concentration of chemical in wastewater) may be available as a range of measured values. In this case, the average value of all measurements should be used for data specific to the facility as it operated in the reporting year, unless it can be demonstrated that some data points can be disregarded. If operating conditions varied during the year (e.g., the listed chemical was used periodically or new equipment was installed at midyear), releases should be estimated for each set of conditions (e.g., 3 months during which the chemical was used, 9 months during which it was not), and these values should be added. Representative data taken during the reporting year should be used. You should, however, consider whether including data from previous years might improve the estimate because so few samples are taken each year.

With regard to published data on other processes, the average for facilities/equipment/operating conditions most closely analogous to the one in question should be used.

2.6 WHICH APPROACH TO USE

Selection of the best approach to estimating releases depends on the circumstances, as was illustrated in the examples above. Available information on a process may be the single most important factor in determining how to proceed. This subsection provides some general guidelines on the most effective approach(es), assuming that information is available to complete the analysis. It is organized according to type of release.

2.6.1 Fugitive Air Emissions

You will rarely be able to measure fugitive releases. Furthermore, the fugitive emissions from most single sources is small compared with the total volume of chemical handled; therefore, inaccuracies in measurements of input

and output can totally mask the magnitude of the release if mass balance is attempted. (An exception is the example of all solvent volatilized after application of a coating.) For this reason, the use of emission factors is a major method for estimating fugitives. This approach requires the following:

- A published factor (usually pounds emitted per pound of chemical processed or pounds emitted per piece of equipment, such as a valve).
- The amount of chemical handled at a facility and/or a count of the valves, pumps, etc., for which factors are available.

Specific emission factors are available for only a few processes as a whole (see Appendix H), and a process-specific factor can only be applied to a process that is very similar.

Volatilization equations, which can be used for open vessels or spills, require that the vapor pressure of the chemical at the appropriate temperature, its molecular weight, and the open surface area be known or estimated (see Sections 3 and 6).

2.6.2 Point Source Air Emission

Point source emissions are enclosed; thus, such releases are much more likely to have been measured (compared with fugitives). This permits calculations based on data for the concentration and flow rate of the emission. For example, measured benzene concentration and flow rate through a vent yield the quantity of benzene released. Unavailability of analytical techniques for determining airborne concentration of many of the chemicals on the list limits this approach. When this is the case, total hydrocarbon analysis can be used to set an upper limit to the estimate.

Emission factors specific to some point sources (e.g., the reactor vent for ethylene dichloride production) are available and should be used if monitoring data are not available.

When these approaches are not possible, estimates for point sources must be based on mass balance calculations or on engineering calculations, design data, etc. Point sources such as storage tanks will usually require a calculation based on physical properties of the chemical, the throughput, and the configuration of the storage tank. (See Section 3 for example of storage tank release calculations.)

2.6.3 Water Releases

Many of the listed chemicals are controlled under Federal, State, and local regulations. Frequently, wastewater discharges will have been monitored. In this case, release can be calculated directly. In fact, your discharge permit and Discharge Monitoring Reports may contain sufficient information to support any needed calculations (i.e., concentration of the chemical and the waste flow rate).

When monitoring data are not available for the chemical at a facility, the following approaches may be applicable (in approximate order of preference):

- Identifying individual process points that contribute to water discharge, performing a mass balance calculation around each to determine individual releases, and then totaling them.
- Conducting a mass balance around the process as a whole. For example, input of dye equals output on dyed fabric plus output in wastewater (individual sources of that water need not be estimated). This approach is most appropriate if the only release of the chemical is to a wastewater stream.
- Using discharge data on the chemical from similar facilities. This approach is particularly useful if the industry has been studied by EPA's Office of Water Regulations and Standards and an Effluent Guidelines Background Document containing release quantities or typical waste stream concentrations is available.

2.6.4 Solids, Slurries, Nonaqueous Liquids

Some of these wastes may be regulated as hazardous wastes under the Resource Conservation and Recovery Act. Information in the permit and manifests for disposing of the waste provide a basis for estimating released quantities of a listed chemical. Frequently, however, the concentration of individual chemicals in the waste will not have been measured. In this case, the concentration will have to be determined, either by measurement or by an estimation based on mass balance, engineering calculations, etc.

For nonhazardous wastes in this category, the volume or total weight of the waste should be readily derivable from shipping records, a count of waste containers, etc. Again, the important factor to determine is the concentration of the listed chemical.

Unfortunately, there are no solid waste emission factors and little published data on concentrations of chemicals in such wastes. When monitoring data are not available for a waste, mass balance and engineering calculation approaches will be necessary.

2.7 EXAMPLE RELEASE CALCULATION

This section presents an example illustrating the procedures used to estimate releases. This example involves a complex manufacturing process for producing acrylonitrile, which has air and water waste streams. Several methods of estimating the releases are shown. In this example, and in others in this manual, the values used are for purposes of illustration only; they are not meant to predict actual release.

This complex manufacturing process (illustrated in Figure 2-1) produces three listed chemicals: acrylonitrile (AN), acetonitrile, and hydrogen cyanide. It also uses ammonia as a raw material and sulfuric acid as a quenching aid, and produces ammonium sulfate as a byproduct. Separate toxic chemical release forms would be completed for each of these compounds. In this example, only the main product (AN) is discussed. Only routine releases occurring during normal operation are considered here; however, estimates of startup releases and any accidental releases would normally be included.

2.7.1 Atmospheric Releases

Absorber Vent B

Releases from this vent contain nitrogen, oxygen, unreacted propylene, other organic impurities present in the propylene feed, carbon monoxide, carbon dioxide, water, and small amounts of AN. Hydrogen cyanide and acetonitrile are other toxic compounds in this stream. This vent stream may be sent to a fume incinerator prior to discharge to the atmosphere.

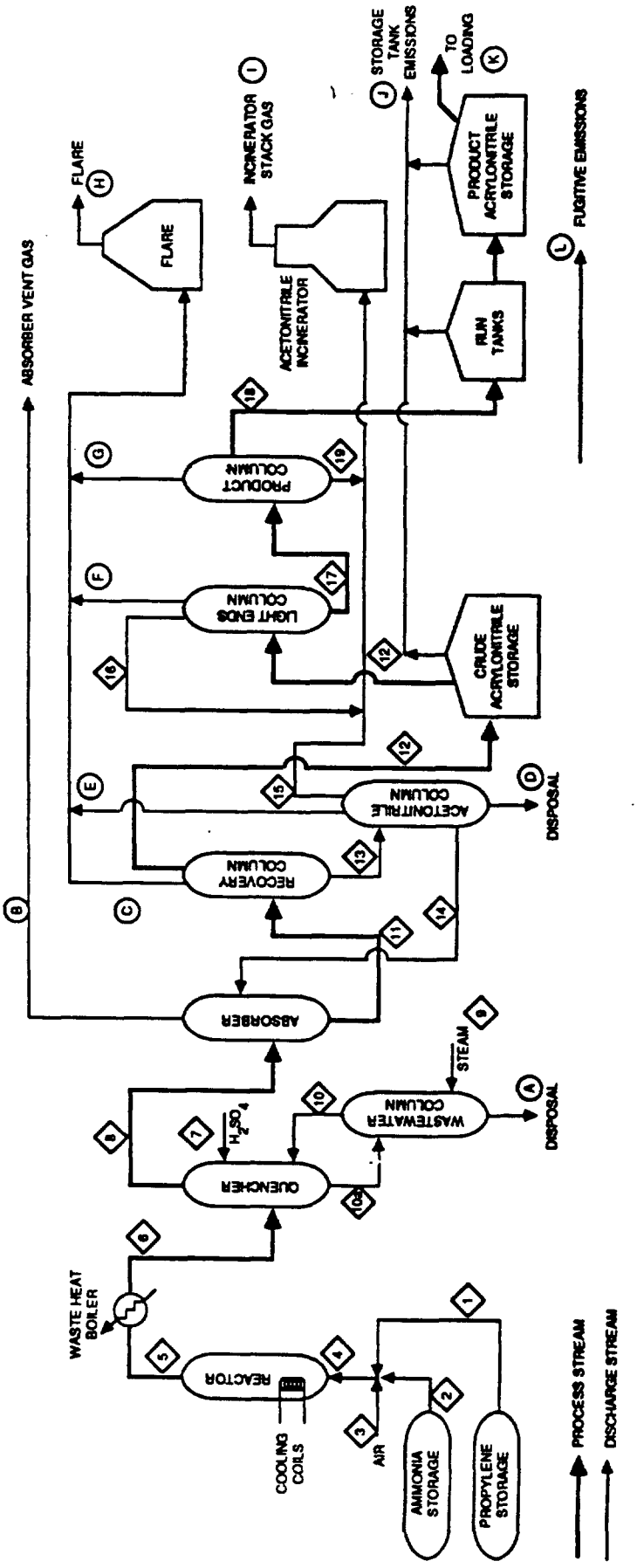


Figure 2-1. Acrylonitrile Production Process.*

*From EPA AP-450/4-84-007a, March 1984.

LAM 005633

DPMC-03224

Problem: Estimate AN emissions from the absorber Vent B.

Available data:

- Vent gas flow rate is 80,000 cubic feet per minute (measured) at 100°F and 1 atmosphere.
- Moisture content is 7 percent by volume (measured).
- AN concentration is 8 parts per million by volume on a dry basis (measured).
- Annual operating hours equal 7000, based on the operating log.

Step 1: Calculate annual volume of gas discharged 80,000 ft^3/min x 60 min/hr x 7000 hours/yr = 3.36 x 10^{10} ft^3/yr.

Step 2: Calculate annual AN volume discharged on dry basis.

3.36 x 10^{10} ft^3 gas/year x 8 x 10^{-6} parts AN/parts gas
x (1 - 0.07) to correct to dry basis
x (70°F + 460)°R/(100°F + 460) °R to correct volume to 70°F
= 236,600 ft^3 AN per year

Step 3: Calculate pounds of AN per year.

236,600 ft^3 x 53.06 lb/lb-mole (molecular weight of AN)
÷ 387 ft^3/lb-mole (the volume occupied by a lb-mole of gas at standard conditions)
= 32,000 lb/year

If the vent stream is controlled by a device such as a fume incinerator, use outlet measurements to estimate releases. If no monitoring data are available, apply a control efficiency based on design data for the incinerator to the value calculated in the example.

Product Recovery Column Vents, C, E, F, G, and H

Gaseous releases from the recovery column, light-ends column, product column, and the acetonitrile column are frequently tied together and vented to a flare. The fact that these streams are combined makes it possible to measure one flow and its concentration. Releases after the flare can only be estimated, however, because quantitative measurements cannot be made in the flare exhaust.

LAM 005634

Problem: Estimate AN emissions from Vents C, E, F, G, and H.

Available data:

- The emission factor for all column vents is 5 g/kg of product (equivalent to 5 lb/1000 lb), based on published data in EPA publication 450/4-84-007a.
- 350 million lb of AN was produced, based on your operating logs or product inventory data.

Step 1: Calculate AN emissions

5 lb emission/1000 lb production x 350 x 10^6 lb/yr production
= 1.75 x 10^6 lb/yr

As an example of a control device applied to an air emission, assume that a flare is used with a destruction efficiency of 98 percent. Actual releases are:

1.75 x 10^6 lb/yr x (1 - 0.98)
= 35,900 lb/year

The alternative of performing mass balances around the columns would be very difficult because of the number of streams involved. Several input and output values, each with an associated error, would be involved to estimate what is a relatively small release value compared with the process stream.

Storage Tank Releases

Releases of AN from storage tanks and loading operations depend primarily on the quantities handled and the number, size, and type of tanks. Release estimates are calculated according to procedures provided in EPA Publication AP-42, Section 4.3.

Problem: Estimate annual AN releases from storage tanks.

Approach: Because monitoring data are not available, use equations presented in EPA Publication AP-42, Section 4.3.2. Here it is assumed that a fixed-roof tank is used. For floating-roof tanks, which are commonly used, other equations in this section of AP-42 should be used.

Equation for breathing loss:

$$L_B = 0.0226 \times M_V \left(\frac{P}{P_A - P}\right)^{0.68} D^{1.73} \times H^{0.51} \times \Delta T^{0.50} \times F_P C K_C$$

LAM 005635

L_B = fixed-roof breathing loss, lb/yr

M_V = molecular weight of vapor in storage tank, lb/lb-mole

P_A = average atmospheric pressure at tank location, psia

P = true vapor pressure at bulk liquid conditions, psia

D = tank diameter, ft

H = average vapor space height, including roof volume correction, ft

ΔT = average ambient diurnal temperature change, °F

F_P = paint factor, dimensionless

C = adjustment factor for small diameter tanks, dimensionless

K_C = product factor, dimensionless

To complete the calculation in this example:

M_V = 53.6 for acrylonitrile (see Appendix E)

P = 2.4 at 80°F (see Appendix F or standard chemical reference)

D = 30 ft for your tank (measured)

H = 6 ft for your tank (estimated)

F_P = 1.15 for a white tank in poor condition (see Appendix F)

C = 0.89 for a small tank (Appendix F)

K_C = 1.0 for acrylonitrile (Appendix F)

Inserting these values into the equation for L_B produces the following result:

L_B = 1,635 lb/year

For 20 tanks of this size and type, uncontrolled releases due to breathing losses would be:

20 x 1635 = 32,700 lb/year

If scrubbers are used to reduce these emissions by 95 percent, the controlled releases would be:

$$\frac{32{,}700 \text{ lb}}{\text{year}} \times \frac{100 - 95}{100} = 1635 \text{ lb/year}$$

LAM 005636

Problem: Estimate release due to working losses during tank filling.

Approach: Because monitoring data are not available, use equations in AP-42, Section 4.3.2. (See also Appendix F.)

The storage tank working losses can be estimated by the following equation:

$$L_W = 2.4 \times 10^{-5} M_V P V N K_N K_C$$

V = tank volume (gal) = 100,000

where L_W = fixed roof tank working losses, lb/yr

N = turnovers per year = annual throughput ÷ tank capacity = 25

K_N = turnover factor = 1.0 (from Figure 4.3-7 in AP-42)

Other factors are the same as in the preceding L_B equation.

$L_W = 2.4 \times 10^{-5} \times 53 \times 2.4 \times 100{,}000 \times 20 \times 1.0 \times 1.0$
= 6106 lb per year

For 20 tanks, total annual releases would be:

20 x 6106 = 122,100 lb per year (without emission controls)

Working losses are reduced by using scrubbers on the tank vents or by using floating-roof tanks. With a scrubber operating at 95 percent efficiency, the final release would be:

$$\frac{122{,}100 \text{ lb}}{\text{year}} \times \frac{100 - 95}{100} = 6105 \text{ lb per year}$$

Other Fugitive Releases

Emissions from loading operations and from leaks in valves, flanges, pumps, etc., also contribute to the overall annual AN release. Loading releases are estimated by the equations and data in AP-42, Section 4.4.

$$L_L = 12.46 \frac{SPM}{T}$$

L_L = releases in lb/1000 gal of liquid loaded

P = liquid vapor pressure = 2.4 psia

M = molecular weight = 53.6

T = liquid temperature (°F + 460°) = 540°R

S = Saturation factor (use 0.6 for submerged fill into tank truck or rail car)

$$L_L = 12.46 \times 0.6 \times \frac{2.4 \times 53.6}{540°R} = 1.76 \text{ lb per 1000 gal}$$

For a plant loading 51 x 10^6 gal/year, the total loading releases would be:

$$\frac{1.76 \text{ lb}}{1000 \text{ gal}} \times 51{,}000{,}000 \text{ gal} = \sim 90{,}000 \text{ lb per year}$$

The use of vapor balance loading would greatly reduce these releases.

Leaks from valves, flanges, pumps, etc. can be estimated from factors developed for the synthetic organic manufacturing processes (see Appendix G). The number of fittings in the plant and the service (i.e., gas, liquid, etc.) of each fitting must be known to make this estimate. This example uses the following breakdown of equipment and the associated emission factors:

Equipment	Emission factor, lb/hr per fitting
25 pumps in light-liquid service	0.11
500 pipeline valves in light-liquid service	0.016
100 pipeline valves in gas-vapor service	0.012
50 safety-relief valves in gas-vapor service	0.23

The total AN releases are the sum of these separate leaks, or:

25 (0.11) + 500 (0.016) + 100 (0.012) + 50 (0.23) = 23.45 lb per hour

For 7000 hours of operation per year, annual releases would be:

$$\frac{7000 \text{ hr}}{\text{year}} \times \frac{23.45 \text{ lb}}{\text{hour}} = 164{,}150 \text{ lb per year}$$

A good maintenance and inspection program would greatly reduce these average releases. If you have data on your leak rates, these data should be used.

LAM 005638

Atmospheric Release Summary for AN

The following is a listing summarizing atmospheric releases of AN.

Process	Releases, lb/yr
Absorber	32,438
Recovery columns after flare	35,000
Storage (1635 + 6105)	7,740
Loading	90,000
Leaks	164,150
Estimated total annual release during normal operations	329,328 or 329,000

2.7.2 Wastewater Column Releases

Liquid discharge from the wastewater column contains small amounts of AN in addition to cyanide, sulfates, ammonia, and acetonitrile, which generally would go to wastewater treatment. Estimates of releases after treatment should be based on effluent measurements, if available. In the absence of such data, the amount of AN released can be estimated by calculating the amount of AN influent to treatment and then applying the efficiency of the treatment.

Problem: Estimate wastewater releases of AN

Approach: Measured flow data are available prior to treatment and will be used to calculate annual releases of AN. A treatment efficiency will then be applied to estimate actual plant releases.

- Average discharge flow = 500 gallons/min
- AN concentration = 150 parts per million by weight
- Annual operating hours = 7000

The AN releases to a wastewater treatment system are calculated by multiplying the flow by the concentration and the duration of release. Note that the density of water is 8.32 lb/gal at 70°F.

$$\frac{500\ \text{gal}}{\text{minute}} \times \frac{8.32\ \text{lb}}{\text{gallon}} \times \frac{150\ \text{parts}}{10^6\ \text{parts}} \times \frac{60\ \text{min}}{\text{hour}} \times \frac{7000\ \text{hr}}{\text{year}} = 262{,}000\ \text{lb per year}$$

The treatment efficiency can be estimated based on published data for similar treatment at the appropriate influent concentration. As shown in

Appendix D, AN can be reduced by 99.1 percent for an initial concentration of 110 mg/liter (ppm) by the use of activated sludge treatment. Releases to surface water would then be:

$$\frac{262{,}000 \text{ lb to treatment}}{\text{year}} \times \frac{(100 - 99.1)}{100} = 2400 \text{ lb per year}$$

APPENDIX A

TOXIC CHEMICAL RELEASE INVENTORY FORM AND LISTED COMPOUNDS

clipped portion

Form Approved OMB No.: _____

Important: Read instructions before completing form

Approval Expires: _____

U.S. Environmental Protection Agency

TOXIC CHEMICAL RELEASE INVENTORY

Section 313, Title III of The Superfund Amendments and Reauthorization Act of 1986

R EPA Form R

Report Number

Calendar Year

I. CERTIFICATION *(Read and sign after completing all sections)*

I certify under penalty of law that I have personally examined and am familiar with the information submitted in this and all attached documents, and that based on my inquiry of those individuals immediately responsible for obtaining the information, I believe that the submitted information is true, accurate, and complete.

Name and official title of owner/operator or senior management official

Signature

Date Signed

II. FACILITY IDENTIFICATION

A. Name and Location

Name

Street Address

City County

State Zip

B. Technical Contact

Name

Street Address

Telephone

C. Facility Identifiers

Facility Dun & Bradstreet Number ☐☐-☐☐☐-☐☐☐☐

EPA Identification Number

NPDES Permit Number

Name of Receiving Stream or Body of Water

UIC Identification Number

Facility Primary SIC Code

Other Manufacturing SIC Code

Other Manufacturing SIC Code

Dun & Bradstreet Number of Parent Company ☐☐-☐☐☐-☐☐☐☐

D. Parent Company Name

III. OFF-SITE LOCATIONS TO WHICH ANY TOXIC CHEMICAL IS TRANSFERRED

A. Publicly Owned Treatment Works (POTW)

Name

Address

B. 1. Other off-site location

Type of treatment/disposal (enter code) ☐☐☐☐

Name

Address

Is location under control of reporting facility or parent company? ☐ yes ☐ no

2. Other off-site location

Type of treatment/disposal (enter code) ☐☐☐☐

Name

Address

Is location under control of reporting facility or parent company? ☐ yes ☐ no

3. Other off-site location

Type of treatment/disposal (enter code) ☐☐☐☐

Name

Address

Is location under control of reporting facility or parent company? ☐ yes ☐ no

☐ Check if supplemental sheet is attached

LAM 005642

IV. CHEMICAL IDENTITY

A. CAS # ☐☐☐☐☐-☐☐-☐

B. Trade Secret ☐

(Provide the generic classification code and name in Section C below. Attach the required explanation to this submission.)

Chemical or Chemical Category Name

_____

C. Generic classification of the chemical or chemical category

(Complete if the chemical or chemical category identity is claimed a trade secret or you are reporting a mixture or tradename product under D, below, and the supplier has provided you with the generic classification.)

Code ☐☐☐ Generic Classification _____

D. Mixture or tradename product identification

(Complete this section only if you are reporting a mixture or tradename product and you do not know the specific toxic chemical component.)

_____
Name of product

Do you know the percentage composition of the toxic chemical in the product?

☐ yes – complete the remainder of this form

☐ no – complete only through section V of this form

V. ACTIVITIES AND USES OF THE TOXIC CHEMICAL AT THE FACILITY

(Check all that apply)

A. MANUFACTURE

- Produce ☐
- Import ☐
- For on-site use/processing ☐
- For sale/distribution ☐
- As a byproduct ☐
- As an impurity ☐

B. PROCESS

- As a reactant ☐
- As a formulation component ☐
- As an article component ☐
- Repackaging only ☐

C. OTHERWISE USED

- As a chemical processing aid ☐
- As a manufacturing aid ☐
- Ancillary or other use ☐

VI. MAXIMUM AMOUNT OF THE CHEMICAL ON-SITE AT ANY TIME DURING THE REPORTING PERIOD

Check the Reporting Range That Applies	Weight Range in Pounds From...	To...
☐	0	99
☐	100	999
☐	1000	9,999
☐	10,000	99,999
☐	100,000	999,999
☐	1,000,000	9,999,999
☐	10,000,000	49,999,999
☐	50,000,000	99,999,999
☐	100,000,000	499,999,999
☐	500,000,000	999,999,999
☐	1 billion	more than 1 billion

LAM 005643

DPMC-03234

Form R (continued)

VII. RELEASES TO THE ENVIRONMENT

	Total Release (lbs/yr)	Basis of Estimate (Enter Code)	Title III Sec. 304 Release? Yes	Title III Sec. 304 Release? No	Permit Applies to Release? Yes	Permit Applies to Release? No
A. Emission to the Air						
Fugitive or non-point air emissions						
Stack or point air emissions						
B. Discharges to Water						
Direct discharges						
C. Releases to Land						
1. Enter code						
2. Enter code						
3. Enter code						
4. Enter code						
D. Transfers to Off-Site Locations						
1. Discharge to POTW						
2. Other off-site location – Enter block number from section III.B.						
3. Other off-site location – Enter block number from section III.B.						
4. Other off-site location – Enter block number from section III.B.						

Check if supplemental sheet is attached.

LAM 005644

DPMC-03235

VIII. WASTE TREATMENT METHODS AND EFFICIENCY

General Wastestream

Check the box corresponding to the general wastestream.

G = Gaseous
W = Wastewater
L = Liquid Waste (Non-Aqueous)
S = Solid Waste (including slurry/sludge)

	G	W	L	S	Treatment Method (Enter Code)	Range of Influent Concentration (Enter Code)	Treatment Efficiency Estimate	Based on Operating Data? yes	Based on Operating Data? no
1.	☐	☐	☐	☐	☐☐☐☐	☐	____ %	☐	☐
2.	☐	☐	☐	☐	☐☐☐☐	☐	____ %	☐	☐
3.	☐	☐	☐	☐	☐☐☐☐	☐	____ %	☐	☐
4.	☐	☐	☐	☐	☐☐☐☐	☐	____ %	☐	☐
5.	☐	☐	☐	☐	☐☐☐☐	☐	____ %	☐	☐
6.	☐	☐	☐	☐	☐☐☐☐	☐	____ %	☐	☐
7.	☐	☐	☐	☐	☐☐☐☐	☐	____ %	☐	☐
8.	☐	☐	☐	☐	☐☐☐☐	☐	____ %	☐	☐
9.	☐	☐	☐	☐	☐☐☐☐	☐	____ %	☐	☐
10.	☐	☐	☐	☐	☐☐☐☐	☐	____ %	☐	☐
11.	☐	☐	☐	☐	☐☐☐☐	☐	____ %	☐	☐
12	☐	☐	☐	☐	☐☐☐☐	☐	____ %	☐	☐
13.	☐	☐	☐	☐	☐☐☐☐	☐	____ %	☐	☐
14.	☐	☐	☐	☐	☐☐☐☐	☐	____ %	☐	☐

☐ Check if supplemental sheet is attached

IX. OPTIONAL INFORMATION ON WASTE MINIMIZATION

Describe actions taken since the last report to reduce the amount of toxic chemicals being released from the facility. See the instructions for coded items and explanation of what information to include, or provide a narrative explanation in the space provided.

Type of modification (Enter Code)	Quantity of chemical in the wastestream prior to treatment/disposal: Current reporting year (lb/yr)	Prior year (lb/yr)	OR Percent change	Index	Reason for Action (Enter Code)
☐☐	_____	_____	_____ %	☐☐	☐☐

Narrative Description

_____

_____

_____

_____

_____

_____

LAM 005645

☐ Check if supplemental sheet is attached.

X. SPACE FOR SUPPLEMENTAL INFORMATION

Enter Section No.

Where to send completed forms:

OTS Document Control Officer
U.S. Environmental Protection Agency
401 M Street SW
Washington, D.C. 20460
Attn: Toxic Chemical Release Inventory

LAM 005646

(a) Alphabetical listing.

Chemical Name	CAS Number	Generic Classification Code	Effective Date
Acetaldehyde	75-07-0	C07	01/01/87
Acetamide	60-35-5	C09	01/01/87
Acetone	67-64-1	C07	01/01/87
Acetonitrile	75-05-8	C11	01/01/87
2-Acetylaminofluorene	53-96-3	C10	01/01/87
Acrolein	107-02-8	C07	01/01/87
Acrylamide	79-06-1	C09	01/01/87
Acrylic acid	79-10-7	C08	01/01/87
Acrylonitrile	107-13-1	C11	01/01/87
Aldrin	309-00-2	C03	01/01/87
Allyl chloride	107-05-1	C03	01/01/87
Aluminum (fume or dust)	7429-90-5	C15	01/01/87
Aluminum oxide	1344-28-1	C15	01/01/87
2-Aminoanthraquinone	117-79-3	C10	01/01/87
4-Aminoazobenzene	60-09-3	C10	01/01/87
4-Aminobiphenyl	92-67-1	C10	01/01/87
1-Amino-2-methylanthraquinone	82-28-0	C10	01/01/87
Ammonia	7664-41-7	C16	01/01/87
Ammonium nitrate (solution)	6484-52-2	C16	01/01/87
Ammonium sulfate (solution)	7783-20-2	C16	01/01/87
Aniline	62-53-3	C10	01/01/87
o-Anisidine	90-04-0	C10	01/01/87
p-Anisidine	104-94-9	C10	01/01/87
o-Anisidine hydrochloride	134-29-2	C10	01/01/87
Anthracene	120-12-7	C01	01/01/87
Antimony	7440-36-0	C15	01/01/87

Chemical Name	CAS Number	Generic Classification Code	Effective Date
Arsenic	7440-38-2	C15	01/01/87
Asbestos (friable)	1332-21-4	C16	01/01/87
Auramine	492-80-8	C10	01/01/87
Barium	7440-39-3	C15	01/01/87
Benzal chloride	98-87-3	C02	01/01/87
Benzamide	55-21-0	C09	01/01/87
Benzene	71-43-2	C01	01/01/87
Benzidine	92-87-5	C10	01/01/87
Benzoic trichloride (Benzotrichloride)	98-07-7	C02	01/01/87
Benzoyl chloride	98-88-4	C09	01/01/87
Benzoyl peroxide	94-36-0	C09	01/01/87
Benzyl chloride	100-44-7	C02	01/01/87
Beryllium	7440-41-7	C15	01/01/87
Biphenyl	92-52-4	C01	01/01/87
Bis(2-chloroethyl) ether	111-44-4	C06	01/01/87
Bis(chloromethyl) ether	542-88-1	C06	01/01/87
Bis(2-chloro-1-methylethyl) ether	108-60-1	C06	01/01/87
Bis(2-ethylhexyl) adipate	103-23-1	C08	01/01/87
Bromoform (Tribromomethane)	75-25-2	C02	01/01/87
Bromomethane (Methyl bromide)	74-83-9	C02	01/01/87
1,3-Butadiene	106-99-0	C01	01/01/87
Butyl acrylate	141-32-2	C08	01/01/87
n-Butyl alcohol	71-36-3	C05	01/01/87
sec-Butyl alcohol	78-92-2	C05	01/01/87
tert-Butyl alcohol	75-65-0	C05	01/01/87

Chemical Name	CAS Number	Generic Classification Code	Effective Date
Butyl benzyl phthalate	85-68-7	C08	01/01/87
1,2-Butylene oxide	106-88-7	C06	01/01/87
Butyraldehyde	123-72-8	C07	01/01/87
C.I. Acid Blue 9, diammonium salt	2650-18-2	C13	01/01/87
C.I. Acid Blue 9, disodium salt	3844-45-9	C13	01/01/87
C.I. Acid Green 3	4680-78-8	C13	01/01/87
C.I. Basic Green 4	569-64-2	C10	01/01/87
C.I. Basic Red 1	989-38-8	C10	01/01/87
C.I. Disperse Yellow 3	2832-40-8	C14	01/01/87
C.I. Food Red 5	3761-53-3	C14	01/01/87
C.I. Food Red 15	81-88-9	C10	01/01/87
C.I. Solvent Orange 7	3118-97-6	C14	01/01/87
C.I. Solvent Yellow 3	97-56-3	C14	01/01/87
C.I. Solvent Yellow 14	842-07-9	C14	01/01/87
C.I. Vat Yellow 4	128-66-5	C07	01/01/87
Cadmium	7440-43-9	C15	01/01/87
Calcium cyanamide	156-62-7	C11	01/01/87
Captan	133-06-2	C13	01/01/87
Carbaryl	63-25-2	C09	01/01/87
Carbon disulfide	75-15-0	C13	01/01/87
Carbon tetrachloride	56-23-5	C02	01/01/87
Carbonyl sulfide	463-58-1	C13	01/01/87
Catechol	120-80-9	C05	01/01/87
Chloramben	133-90-4	C11	01/01/87
Chlordane	57-74-9	C03	01/01/87

Chemical Name	CAS Number	Generic Classification Code	Effective Date
Chlorinated fluorocarbon (Freon 113)	76-13-1	C02	01/01/87
Chlorine	7782-50-5	C16	01/01/87
Chlorine dioxide	10049-04-4	C16	01/01/87
Chloroacetic acid	79-11-8	C08	01/01/87
2-Chloroacetophenone	532-27-4	C07	01/01/87
Chlorobenzene	108-90-7	C04	01/01/87
Chlorobenzilate	510-15-6	C08	01/01/87
Chloroethane (Ethyl chloride)	75-00-3	C02	01/01/87
Chloroform	67-66-3	C02	01/01/87
Chloromethane (Methyl chloride)	74-87-3	C02	01/01/87
Chloromethyl methyl ether	107-30-2	C06	01/01/87
Chloroprene	126-99-8	C03	01/01/87
Chlorothalonil	1897-45-6	C09	01/01/87
Chromium	7440-47-3	C15	01/01/87
Cobalt	7440-48-4	C15	01/01/87
Copper	7440-50-8	C15	01/01/87
p-Cresidine	120-71-8	C06	01/01/87
Cresol (mixed isomers)	1319-77-3	C05	01/01/87
m-Cresol	108-39-4	C05	01/01/87
o-Cresol	95-48-7	C05	01/01/87
p-Cresol	106-44-5	C05	01/01/87
Cumene	98-82-8	C01	01/01/87
Cumene hydroperoxide	80-15-9	C05	01/01/87
Cupferron	135-20-6	C12	01/01/87
Cyanide compounds	57-12-5	C16	01/01/87

Chemical Name	CAS Number	Generic Classification Code	Effective Date
Cyclohexane	110-82-7	C01	01/01/87
2,4-D	94-75-7	C08	01/01/87
Decabromodiphenyl oxide	1163-19-5	C04	01/01/87
Diallate	2303-16-4	C13	01/01/87
2,4-Diaminoanisole	615-05-4	C10	01/01/87
2,4-Diaminoanisole sulfate	39156-41-7	C10	01/01/87
4,4'-Diaminodiphenyl ether	101-80-4	C10	01/01/87
Diaminotoluene (mixed isomers)	25376-45-8	C10	01/01/87
2,4-Diaminotoluene	95-80-7	C10	01/01/87
Diazomethane	334-88-3	C11	01/01/87
Dibenzofuran	132-64-9	C06	01/01/87
1,2-Dibromo-3-chloropropane (DBCP)	96-12-8	C02	01/01/87
1,2-Dibromoethane (Ethylene dibromide)	106-93-4	C02	01/01/87
Dibutyl phthalate	84-74-2	C08	01/01/87
Dichlorobenzene (mixed isomers)	25321-22-6	C04	01/01/87
1,2-Dichlorobenzene	95-50-1	C04	01/01/87
1,3-Dichlorobenzene	541-73-1	C04	01/01/87
1,4-Dichlorobenzene	106-46-7	C04	01/01/87
3,3'-Dichlorobenzidine	91-94-1	C10	01/01/87
Dichlorobromomethane	75-27-4	C02	01/01/87
1,2-Dichloroethane (Ethylene dichloride)	107-06-2	C02	01/01/87
1,2-Dichloroethylene	540-59-0	C03	01/01/87

Chemical Name	CAS Number	Generic Classification Code	Effective Date
Dichloromethane (Methylene chloride)	75-09-2	C02	01/01/87
2,4-Dichlorophenol	120-83-2	C04	01/01/87
1,2-Dichloropropane	78-87-5	C02	01/01/87
1,3-Dichloropropylene	542-75-6	C03	01/01/87
Dichlorvos	62-73-7	C13	01/01/87
Dicofol	115-32-2	C04	01/01/87
Diepoxybutane	1464-53-5	C06	01/01/87
Diethanolamine	111-42-2	C10	01/01/87
Di-(2-ethylhexyl) phthalate (DEHP)	117-81-7	C08	01/01/87
Diethyl phthalate	84-66-2	C08	01/01/87
Diethyl sulfate	64-67-5	C13	01/01/87
3,3'-Dimethoxybenzidine	119-90-4	C10	01/01/87
4-Dimetnylaminoazobenzene	60-11-7	C10	01/01/87
3,3'-Dimethylbenzidine (o-Tolidine)	119-93-7	C10	01/01/87
Dimethylcarbamyl chloride	79-44-7	C09	01/01/87
1,1-Dimethyl hydrazine	57-14-7	C11	01/01/87
2,4-Dimethylphenol	105-67-9	C05	01/01/87
Dimethyl phthalate	131-11-3	C08	01/01/87
Dimethyl sulfate	77-78-1	C13	01/01/87
4,6-Dinitro-o-cresol	534-52-1	C12	01/01/87
2,4-Dinitrophenol	51-28-5	C12	01/01/87
2,4-Dinitrotoluene	121-14-2	C12	01/01/87
2,6-Dinitrotoluene	606-20-2	C12	01/01/87

Chemical Name	CAS Number	Generic Classification Code	Effective Date
n-Dioctyl phthalate	117-84-0	C08	01/01/87
1,4-Dioxane	123-91-1	C06	01/01/87
1,2-Diphenylhydrazine (Hydrazobenzene)	122-66-7	C11	01/01/87
Direct Black 38	1937-37-7	C14	01/01/87
Direct Blue 6	2602-46-2	C14	01/01/87
Direct Brown 95	16071-86-6	C14	01/01/87
Epichlorohydrin	106-89-8	C06	01/01/87
2-Ethoxyethanol	110-80-5	C06	01/01/87
Ethyl acrylate	140-88-5	C08	01/01/87
Ethylbenzene	100-41-4	C01	01/01/87
Ethyl chloroformate	541-41-3	C09	01/01/87
Ethylene	74-85-1	C01	01/01/87
Ethylene glycol	107-21-1	C05	01/01/87
Ethyleneimine (Aziridine)	151-56-4	C11	01/01/87
Ethylene oxide	75-21-8	C06	01/01/87
Ethylene thiourea	96-45-7	C13	01/01/87
Fluometuron	2164-17-2	C09	01/01/87
Formaldehyde	50-00-0	C07	01/01/87
Heptachlor	76-44-8	C03	01/01/87
Hexachlorobenzene	118-74-1	C04	01/01/87
Hexachloro-1,3-butadiene	87-68-3	C03	01/01/87
Hexachlorocyclopentadiene	77-47-4	C03	01/01/87
Hexachloroethane	67-72-1	C02	01/01/87
Hexachloronaphthalene	1335-87-1	C04	01/01/87
Hexamethylphosphoramide	680-31-9	C13	01/01/87

Chemical Name	CAS Number	Generic Classification Code	Effective Date
Hydrazine	302-01-2	C11	01/01/87
Hydrazine sulfate	10034-93-2	C11	01/01/87
Hydrochloric acid	7647-01-0	C16	01/01/87
Hydrogen cyanide	74-90-8	C16	01/01/87
Hydrogen fluoride	7664-39-3	C16	01/01/87
Hydroquinone	123-31-9	C07	01/01/87
Isobutyraldehyde	78-84-2	C07	01/01/87
Isopropyl alcohol (mfg.--strong acid processes)	67-63-0	C05	01/01/87
4,4'-Isopropylidenediphenol	80-05-7	C05	01/01/87
Lead	7439-92-1	C15	01/01/87
Lindane	58-89-9	C02	01/01/87
Maleic anhydride	108-31-6	C08	01/01/87
Maneb	12427-38-2	C16	01/01/87
Manganese	7439-96-5	C15	01/01/87
Melamine	108-78-1	C10	01/01/87
Mercury	7439-97-6	C15	01/01/87
Methanol	67-56-1	C05	01/01/87
Methoxychlor	72-43-5	C03	01/01/87
2-Methoxyethanol	109-86-4	C06	01/01/87
Methyl acrylate	96-33-3	C08	01/01/87
Methyl tert-butyl ether	1634-04-4	C06	01/01/87
4,4'-Methylenebis(2-chloro aniline) (MOCA)	101-14-4	C10	01/01/87
4,4'-Methylenebis(N,N-dimethyl) benzenamine	101-61-1	C10	01/01/87

Chemical Name	CAS Number	Generic Classification Code	Effective Date
Methylenebis(phenylisocyanate) (MBI)	101-68-8	C11	01/01/87
Methylene bromide	74-95-3	C02	01/01/87
4,4'-Methylenedianiline	101-77-9	C10	01/01/87
Methyl ethyl ketone	78-93-3	C07	01/01/87
Methyl hydrazine	60-34-4	C11	01/01/87
Methyl iodide	74-88-4	C02	01/01/87
Methyl isobutyl ketone	108-10-1	C07	01/01/87
Methyl isocyanate	624-83-9	C11	01/01/87
Methyl methacrylate	80-62-6	C08	01/01/87
Michler's ketone	90-94-8	C07	01/01/87
Molybdenum trioxide	1313-27-5	C15	01/01/87
Mustard gas	505-60-2	C13	01/01/87
Naphthalene	91-20-3	C01	01/01/87
alpha-Naphthylamine	134-32-7	C10	01/01/87
beta-Naphthylamine	91-59-8	C10	01/01/87
Nickel	7440-02-0	C15	01/01/87
Nitric acid	7697-37-2	C16	01/01/87
Nitrilotriacetic acid	139-13-9	C08	01/01/87
5-Nitro-o-anisidine	99-59-2	C12	01/01/87
Nitrobenzene	98-95-3	C12	01/01/87
4-Nitrobiphenyl	92-93-3	C12	01/01/87
Nitrofen	1836-75-5	C15	01/01/87
Nitrogen mustard	51-75-2	C10	01/01/87
Nitroglycerin	55-63-0	C12	01/01/87
2-Nitrophenol	88-75-5	C12	01/01/87

Chemical Name	CAS Number	Generic Classification Code	Effective Date
4-Nitrophenol	100-02-7	C12	01/01/87
2-Nitropropane	79-46-9	C12	01/01/87
p-Nitrosodiphenylamine	156-10-5	C12	01/01/87
N,N-Dimethylaniline	121-69-7	C10	01/01/87
N-Nitrosodi-n-butylamine	924-16-3	C12	01/01/87
N-Nitrosodiethylamine	55-18-5	C12	01/01/87
N-Nitrosodimethylamine	62-75-9	C12	01/01/87
N-Nitrosodiphenylamine	86-30-6	C12	01/01/87
N-Nitrosodi-n-propylamine	621-64-7	C12	01/01/87
N-Nitrosomethylvinylamine	4549-40-0	C12	01/01/87
N-Nitrosomorpholine	59-89-2	C12	01/01/87
N-Nitroso-N-ethylurea	759-73-9	C12	01/01/87
N-Nitroso-N-methylurea	684-93-5	C12	01/01/87
N-Nitrosonornicotine	16543-55-8	C12	01/01/87
N-Nitrosopiperdine	100-75-4	C12	01/01/87
Octachloronaphthalene	2234-13-1	C04	01/01/87
Osmium tetroxide	20816-12-0	C15	01/01/87
Parathion	56-38-2	C13	01/01/87
Pentachlorophenol (PCP)	87-86-5	C04	01/01/87
Peracetic acid	79-21-0	C09	01/01/87
Phenol	108-95-2	C05	01/01/87
p-Phenylenediamine	106-50-3	C10	01/01/87
2-Phenylphenol	90-43-7	C05	01/01/87
Phosgene	75-44-5	C09	01/01/87
Phosphoric acid	7664-38-2	C16	01/01/87
Phosphorus (yellow or white)	7723-14-0	C16	01/01/87

Chemical Name	CAS Number	Generic Classification Code	Effective Date
Phthalic anhydride	85-44-9	C08	01/01/87
Picric acid	88-89-1	C08	01/01/87
Polychlorinated biphenyls (PCBs)	1336-36-3	C04	01/01/87
Propane sultone	1120-71-4	C13	01/01/87
beta-Propiolactone	57-57-8	C08	01/01/87
Propionaldehyde	123-38-6	C07	01/01/87
Propoxur	114-26-1	C09	01/01/87
Propylene (Propene)	115-07-1	C01	01/01/87
Propyleneimine	75-55-8	C11	01/01/87
Propylene oxide	75-56-9	C06	01/01/87
Pyridine	110-86-1	C11	01/01/87
Quinoline	91-22-5	C11	01/01/87
Quinone	106-51-4	C07	01/01/87
Quintozene (Pentachloronitro-benzene)	82-68-8	C12	01/01/87
Saccharin (manufacturing)	81-07-2	C09	01/01/87
Safrole	94-59-7	C06	01/01/87
Selenium	7782-49-2	C16	01/01/87
Silver and compounds	7440-22-4	C15	01/01/87
Sodium hydroxide (solution)	1310-73-2	C16	01/01/87
Sodium sulfate (solution)	7757-82-6	C16	01/01/87
Styrene	100-42-5	C01	01/01/87
Styrene oxide	96-09-3	C06	01/01/87
Sulfuric acid	7664-93-9	C16	01/01/87
Terephthalic acid	100-21-0	C08	01/01/87
1,1,2,2-Tetrachloroethane	79-34-5	C02	01/01/87

Chemical Name	CAS Number	Generic Classification Code	Effective Date
Tetrachloroethylene (Perchloroethylene)	127-18-4	C03	01/01/87
Tetrachlorvinphos	961-11-5	C13	01/01/87
Thallium	7440-28-0	C15	01/01/87
Thioacetamide	62-55-5	C13	01/01/87
4,4'-Thiodianiline	139-65-1	C13	01/01/87
Thiourea	62-56-6	C13	01/01/87
Thorium dioxide	1314-20-1	C15	01/01/87
Titanium dioxide	13463-67-7	C15	01/01/87
Titanium tetrachloride	7550-45-0	C15	01/01/87
Toluene	108-88-3	C01	01/01/87
Toluene-2,4-diisocyanate	584-84-9	C11	01/01/87
Toluene-2,6-diisocyanate	91-08-7	C11	01/01/87
o-Toluidine	95-53-4	C10	01/01/87
o-Toluidine hydrochloride	636-21-5	C10	01/01/87
Toxaphene	8001-35-2	C02	01/01/87
Triaziquone	68-76-8	C11	01/01/87
Trichlorfon	52-68-6	C13	01/01/87
1,2,4-Trichlorobenzene	120-82-1	C04	01/01/87
1,1,1-Trichloroethane (Methyl chloroform)	71-55-6	C02	01/01/87
1,1,2-Trichloroethane	79-00-5	C02	01/01/87
Trichloroethylene	79-01-6	C03	01/01/87
2,4,5-Trichlorophenol	95-95-4	C04	01/01/87
2,4,6-Trichlorophenol	88-06-2	C04	01/01/87
Trifluralin	1582-09-8	C12	01/01/87

Chemical Name	CAS Number	Generic Classification Code	Effective Date
1,2,4-Trimethylbenzene	95-63-6	C01	01/01/87
Tris(2,3-dibromopropyl) phosphate	126-72-7	C13	01/01/87
Urethane (Ethyl carbamate)	51-79-6	C09	01/01/87
Vanadium (fume or dust)	7440-62-2	C15	01/01/87
Vinyl acetate	108-05-4	C08	01/01/87
Vinyl bromide	593-60-2	C03	01/01/87
Vinyl chloride	75-01-4	C03	01/01/87
Vinylidene chloride	75-35-4	C03	01/01/87
Xylene (mixed isomers)	1330-20-7	C01	01/01/87
m-Xylene	108-38-3	C01	01/01/87
o-Xylene	95-47-6	C01	01/01/87
p-Xylene	106-42-3	C01	01/01/87
2,6-Xylidine	87-62-7	C10	01/01/87
Zinc (fume or dust)	7440-66-6	C15	01/01/87
Zineb	12122-67-7	C15	01/01/87

(b) CAS number listing

CAS Number	Chemical Name	Generic Classification Code	Effective Date
50-00-0	Formaldehyde	C07	01/01/87
51-28-5	2,4-Dinitrophenol	C12	01/01/87
51-75-2	Nitrogen mustard	C10	01/01/87
51-79-6	Urethane (Ethyl carbamate)	C09	01/01/87
52-68-6	Trichlorfon	C13	01/01/87
53-96-3	2-Acetylaminofluorene	C10	01/01/87
55-18-5	N-Nitrosodiethylamine	C12	01/01/87
55-21-0	Benzamide	C09	01/01/87
55-63-0	Nitroglycerin	C12	01/01/87
56-23-5	Carbon tetrachloride	C02	01/01/87
56-38-2	Parathion	C13	01/01/87
57-12-5	Cyanide compounds	C16	01/01/87
57-14-7	1,1-Dimethyl hydrazine	C11	01/01/87
57-57-8	beta-Propiolactone	C08	01/01/87
57-74-9	Chlordane	C03	01/01/87
58-89-9	Lindane	C02	01/01/87
59-89-2	N-Nitrosomorpholine	C12	01/01/87
60-09-3	4-Aminoazobenzene	C10	01/01/87
60-11-7	4-Dimethylaminoazobenzene	C10	01/01/87
60-34-4	Methyl hydrazine	C11	01/01/87
60-35-5	Acetamide	C09	01/01/87
62-53-3	Aniline	C10	01/01/87
62-55-5	Thioacetamide	C13	01/01/87
62-56-6	Thiourea	C13	01/01/87
62-73-7	Dichlorvos	C13	01/01/87

CAS Number	Chemical Name	Generic Classification Code	Effective Date
62-75-9	N-Nitrosodimethylamine	C12	01/01/87
63-25-2	Carbaryl	C09	01/01/87
64-67-5	Diethyl sulfate	C13	01/01/87
67-56-1	Methanol	C05	01/01/87
67-63-0	Isopropyl alcohol (mfg.-- strong acid processes)	C05	01/01/87
67-64-1	Acetone	C07	01/01/87
67-66-3	Chloroform	C02	01/01/87
67-72-1	Hexachloroethane	C02	01/01/87
68-76-8	Triaziquone	C11	01/01/87
71-36-3	n-Butyl alcohol	C05	01/01/87
71-43-2	Benzene	C01	01/01/87
71-55-6	1,1,1-Trichloroethane (Methyl chloroform)	C02	01/01/87
72-43-5	Methoxychlor	C03	01/01/87
74-83-9	Bromomethane (Methyl bromide)	C02	01/01/87
74-85-1	Ethylene	C01	01/01/87
74-87-3	Chloromethane (Methyl chloride)	C02	01/01/87
74-88-4	Methyl iodide	C02	01/01/87
74-90-8	Hydrogen cyanide	C16	01/01/87
74-95-3	Methylene bromide	C02	01/01/87
75-00-3	Chloroethane (Ethyl chloride)	C02	01/01/87
75-01-4	Vinyl chloride	C03	01/01/87
75-05-8	Acetonitrile	C11	01/01/87
75-07-0	Acetaldehyde	C07	01/01/87

CAS Number	Chemical Name	Generic Classification Code	Effective Date
75-09-2	Dichloromethane (Methylene chloride)	C02	01/01/87
75-15-0	Carbon disulfide	C13	01/01/87
75-21-8	Ethylene oxide	C06	01/01/87
75-25-2	Bromoform (Tribromomethane)	C02	01/01/87
75-27-4	Dichlorobromomethane	C02	01/01/87
75-35-4	Vinylidene chloride	C03	01/01/87
75-44-5	Phosgene	C09	01/01/87
75-55-8	Propyleneimine	C11	01/01/87
75-56-9	Propylene oxide	C06	01/01/87
75-65-0	tert-Butyl alcohol	C05	01/01/87
76-13-1	Chlorinated fluorocarbon (Freon 113)	C02	01/01/87
76-44-8	Heptachlor	C03	01/01/87
77-47-4	Hexachlorocyclopentadiene	C03	01/01/87
77-78-1	Dimethyl sulfate	C13	01/01/87
78-84-2	Isobutyraldehyde	C07	01/01/87
78-87-5	1,2-Dichloropropane	C02	01/01/87
78-92-2	sec-Butyl alcohol	C05	01/01/87
78-93-3	Methyl ethyl ketone	C07	01/01/87
79-00-5	1,1,2-Trichloroethane	C02	01/01/87
79-01-6	Trichloroethylene	C03	01/01/87
79-06-1	Acrylamide	C09	01/01/87
79-10-7	Acrylic acid	C08	01/01/87
79-11-8	Chloroacetic acid	C08	01/01/87
79-21-0	Peracetic acid	C09	01/01/87

CAS Number	Chemical Name	Generic Classification Code	Effective Date
79-34-5	1,1,2,2-Tetrachloroethane	C02	01/01/87
79-44-7	Dimethylcarbamyl chloride	C09	01/01/87
79-46-9	2-Nitropropane	C12	01/01/87
80-05-7	4,4'-Isopropylidenediphenol	C05	01/01/87
80-15-9	Cumene hydroperoxide	C05	01/01/87
80-62-6	Methyl methacrylate	C08	01/01/87
81-07-2	Saccharin (manufacturing)	C09	01/01/87
81-88-9	C.I. Food Red 15	C10	01/01/87
82-28-0	1-Amino-2-methylanthraquinone	C10	01/01/87
82-68-8	Quintozene (Pentachloro nitrobenzene)	C12	01/01/87
84-66-2	Diethyl phthalate	C08	01/01/87
84-74-2	Dibutyl phthalate	C08	01/01/87
85-44-9	Phthalic anhydride	C08	01/01/87
85-68-7	Butyl benzyl phthalate	C08	01/01/87
86-30-6	N-Nitrosodiphenylamine	C12	01/01/87
87-62-7	2,6-Xylidine	C10	01/01/87
87-68-3	Hexachloro-1,3-butadiene	C03	01/01/87
87-86-5	Pentachlorophenol (PCP)	C04	01/01/87
88-06-2	2,4,6-Trichlorophenol	C04	01/01/87
88-75-5	2-Nitrophenol	C12	01/01/87
88-89-1	Picric acid	C08	01/01/87
90-04-0	o-Anisidine	C10	01/01/87
90-43-7	2-Phenylphenol	C05	01/01/87
90-94-8	Michler's ketone	C07	01/01/87
91-08-7	Toluene-2,6-diisocyanate	C11	01/01/87

CAS Number	Chemical Name	Generic Classification Code	Effective Date
91-20-3	Naphthalene	C01	01/01/87
91-22-5	Quinoline	C11	01/01/87
91-59-8	beta-Naphthylamine	C10	01/01/87
91-94-1	3,3'-Dichlorobenzidine	C10	01/01/87
92-52-4	Biphenyl	C01	01/01/87
92-67-1	4-Aminobiphenyl	C10	01/01/87
92-87-5	Benzidine	C10	01/01/87
92-93-3	4-Nitrobiphenyl	C12	01/01/87
94-36-0	Benzoyl peroxide	C09	01/01/87
94-59-7	Safrole	C06	01/01/87
94-75-7	2,4-D	C08	01/01/87
95-47-6	o-Xylene	C01	01/01/87
95-48-7	o-Cresol	C05	01/01/87
95-50-1	1,2-Dichlorobenzene	C04	01/01/87
95-53-4	o-Toluidine	C10	01/01/87
95-63-6	1,2,4-Trimethylbenzene	C01	01/01/87
95-80-7	2,4-Diaminotoluene	C10	01/01/87
95-95-4	2,4,5-Trichlorophenol	C04	01/01/87
96-09-3	Styrene oxide	C06	01/01/87
96-12-8	1,2-Dibromo-3-chloropropane (DBCP)	C02	01/01/87
96-33-3	Methyl acrylate	C08	01/01/87
96-45-7	Ethylene thiourea	C13	01/01/87
97-56-3	C.I. Solvent Yellow 3	C14	01/01/87
98-07-7	Benzoic trichloride (Benzotrichloride)	C02	01/01/87

CAS Number	Chemical Name	Generic Classification Code	Effective Date
98-82-8	Cumene	C01	01/01/87
98-87-3	Benzal chloride	C02	01/01/87
98-88-4	Benzoyl chloride	C09	01/01/87
98-95-3	Nitrobenzene	C12	01/01/87
99-59-2	5-Nitro-o-anisidine	C12	01/01/87
100-02-7	4-Nitrophenol	C12	01/01/87
100-21-0	Terephthalic acid	C08	01/01/87
100-41-4	Ethylbenzene	C01	01/01/87
100-42-5	Styrene	C01	01/01/87
100-44-7	Benzyl chloride	C02	01/01/87
100-75-4	N-Nitrosopiperidine	C12	01/01/87
101-14-4	4,4'-Methylenebis(2-chloroaniline) (MOCA)	C10	01/01/87
101-61-1	4,4'-Methylenebis(N,N-dimethyl)benzenamine	C10	01/01/87
101-68-8	Methylenebis(phenyliso cyanate) (MBI)	C11	01/01/87
101-77-9	4,4'-Methylenedianiline	C10	01/01/87
101-80-4	4,4'-Diaminodiphenyl ether	C10	01/01/87
103-23-1	Bis(2-ethylhexyl) adipate	C08	01/01/87
104-94-9	p-Anisidine	C10	01/01/87
105-67-9	2,4-Dimethylphenol	C05	01/01/87
106-42-3	p-Xylene	C01	01/01/87
106-44-5	p-Cresol	C05	01/01/87
106-46-7	1,4-Dichlorobenzene	C04	01/01/87
106-50-3	p-Phenylenediamine	C10	01/01/87

CAS Number	Chemical Name	Generic Classification Code	Effective Date
106-51-4	Quinone	C07	01/01/87
106-88-7	1,2-Butylene oxide	C06	01/01/87
106-89-8	Epichlorohydrin	C06	01/01/87
106-93-4	1,2-Dibromoethane (Ethylene dibromide)	C02	01/01/87
106-99-0	1,3-Butadiene	C01	01/01/87
107-02-8	Acrolein	C07	01/01/87
107-05-1	Allyl chloride	C03	01/01/87
107-06-2	1,2-Dichloroethane (Ethylene dichloride)	C02	01/01/87
107-13-1	Acrylonitrile	C11	01/01/87
107-21-1	Ethylene glycol	C05	01/01/87
107-30-2	Chloromethyl methyl ether	C06	01/01/87
108-05-4	Vinyl acetate	C08	01/01/87
108-10-1	Methyl isobutyl ketone	C07	01/01/87
108-31-6	Maleic anhydride	C08	01/01/87
108-38-3	m-Xylene	C01	01/01/87
108-39-4	m-Cresol	C05	01/01/87
108-60-1	Bis(2-chloro-1-methylethyl) ether	C06	01/01/87
108-78-1	Melamine	C10	01/01/87
108-88-3	Toluene	C01	01/01/87
108-90-7	Chlorobenzene	C04	01/01/87
108-95-2	Phenol	C05	01/01/87
109-86-4	2-Methoxyethanol	C06	01/01/87
110-80-5	2-Ethoxyethanol	C06	01/01/87

CAS Number	Chemical Name	Generic Classification Code	Effective Date
110-82-7	Cyclohexane	C01	01/01/87
110-86-1	Pyridine	C11	01/01/87
111-42-2	Diethanolamine	C10	01/01/87
111-44-4	Bis(2-chloroethyl) ether	C06	01/01/87
114-26-1	Propoxur	C09	01/01/87
115-07-1	Propylene (Propene)	C01	01/01/87
115-32-2	Dicofol	C04	01/01/87
117-79-3	2-Aminoanthraquinone	C10	01/01/87
117-81-7	Di(2-ethylhexyl) phthalate (DEHP)	C08	01/01/87
117-84-0	n-Dioctyl phthalate	C08	01/01/87
118-74-1	Hexachlorobenzene	C04	01/01/87
119-90-4	3,3'-Dimethoxybenzidine	C10	01/01/87
119-93-7	3,3'-Dimethylbenzidine (o-Tolidine)	C10	01/01/87
120-12-7	Anthracene	C01	01/01/87
120-71-8	p-Cresidine	C06	01/01/87
120-80-9	Catechol	C05	01/01/87
120-82-1	1,2,4-Trichlorobenzene	C04	01/01/87
120-83-2	2,4-Dichlorophenol	C04	01/01/87
121-14-2	2,4-Dinitrotoluene	C12	01/01/87
121-69-7	N,N-Dimethylaniline	C10	01/01/87
122-66-7	1,2-Diphenylhydrazine (Hydrazobenzene)	C11	01/01/87
123-31-9	Hydroquinone	C07	01/01/87
123-38-6	Propionaldehyde	C07	01/01/87

CAS Number	Chemical Name	Generic Classification Code	Effective Date
123-72-8	Butyraldehyde	C07	01/01/87
123-91-1	1,4-Dioxane	C06	01/01/87
126-72-7	Tris-2,3-dibromopropyl) phosphate	C13	01/01/87
126-99-8	Chloroprene	C03	01/01/87
127-18-4	Tetrachloroethylene (Perchloroethylene)	C03	01/01/87
128-66-5	C.I. Vat Yellow 4	C07	01/01/87
131-11-3	Dimethyl phthalate	C08	01/01/87
132-64-9	Dibenzofuran	C06	01/01/87
133-06-2	Captan	C13	01/01/87
133-90-4	Chloramben	C11	01/01/87
134-29-2	o-Anisidine hydrochloride	C10	01/01/87
134-32-7	alpha-Naphthylamine	C10	01/01/87
135-20-6	Cupferron	C12	01/01/87
139-13-9	Nitrilotriacetic acid	C08	01/01/87
139-65-1	4,4'-Thiodianiline	C13	01/01/87
140-88-5	Ethyl acrylate	C08	01/01/87
141-32-2	Butyl acrylate	C08	01/01/87
151-56-4	Ethyleneimine (Aziridine)	C11	01/01/87
156-10-5	p-Nitrosodiphenylamine	C12	01/01/87
156-62-7	Calcium cyanamide	C11	01/01/87
302-01-2	Hydrazine	C11	01/01/87
309-00-2	Aldrin	C03	01/01/87
334-88-3	Diazomethane	C11	01/01/87
463-58-1	Carbonyl sulfide	C13	01/01/87

CAS Number	Chemical Name	Generic Classification Code	Effective Date
492-80-8	Auramine	C10	01/01/87
505-60-2	Mustard gas	C13	01/01/87
510-15-6	Chlorobenzilate	C08	01/01/87
532-27-4	2-Chloroacetophenone	C07	01/01/87
534-52-1	4,6-Dinitro-o-cresol	C12	01/01/87
540-59-0	1,2-Dichloroethylene	C03	01/01/87
541-41-3	Ethyl chloroformate	C09	01/01/87
541-73-1	1,3-Dichlorobenzene	C04	01/01/87
542-75-6	1,3-Dichloropropylene	C03	01/01/87
542-88-1	Bis(chloromethyl) ether	C06	01/01/87
569-64-2	C.I. Basic Green 4	C10	01/01/87
584-84-9	Toluene-2,4-diisocyanate	C11	01/01/87
593-60-2	Vinyl bromide	C03	01/01/87
606-20-2	2,6-Dinitrotoluene	C12	01/01/87
615-05-4	2,4-Diaminoanisole	C10	01/01/87
621-64-7	N-Nitrosodi-n-propylamine	C12	01/01/87
624-83-9	Metnyl isocyanate	C11	01/01/87
636-21-5	o-Toluidine hydrochloride	C10	01/01/87
680-31-9	Hexamethylphosphoramide	C13	01/01/87
684-93-5	N-Nitroso-N-methylurea	C12	01/01/87
759-73-9	N-Nitroso-N-ethylurea	C12	01/01/87
842-07-9	C.I. Solvent Yellow 14	C14	01/01/87
924-16-3	N-Nitrosodi-n-butylamine	C12	01/01/87
961-11-5	Tetrachlorvinphos	C13	01/01/87
989-38-8	C.I. Basic Red 1	C10	01/01/87
1120-71-4	Propane sultone	C13	01/01/87

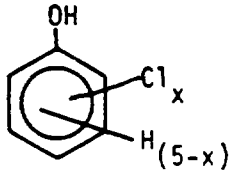
CAS Number	Chemical Name	Generic Classification Code	Effective Date
1163-19-5	Decabromodiphenyl oxide	C04	01/01/87
1310-73-2	Sodium hydroxide (solution)	C16	01/01/87
1313-27-5	Molybdenum trioxide	C15	01/01/87
1314-20-1	Thorium dioxide	C15	01/01/87
1319-77-3	Cresol (mixed isomers)	C05	01/01/87
1330-20-7	Xylene (mixed isomers)	C01	01/01/87
1332-21-4	Asbestos (friable)	C16	01/01/87
1335-87-1	Hexachloronaphthalene	C04	01/01/87
1336-36-3	Polychlorinated biphenyls (PCBs)	C04	01/01/87
1344-28-1	Aluminum oxide	C15	01/01/87
1464-53-5	Diepoxybutane	C06	01/01/87
1582-09-8	Trifluralin	C12	01/01/87
1634-04-4	Methyl tert-butyl ether	C06	01/01/87
1836-75-5	Nitrofen	C15	01/01/87
1897-45-6	Chlorothalonil	C09	01/01/87
1937-37-7	Direct Black 38	C14	01/01/87
2164-17-2	Fluometuron	C09	01/01/87
2234-13-1	Octachloronaphthalene	C04	01/01/87
2303-16-4	Diallate	C13	01/01/87
2602-46-2	Direct Blue 6	C14	01/01/87
2650-18-2	C.I. Acid Blue 9, diammonium salt	C13	01/01/87
2832-40-8	C.I. Disperse Yellow 3	C14	01/01/87
3118-97-6	C.I. Solvent Orange 7	C14	01/01/87
3761-53-3	C.I. Food Red 5	C14	01/01/87

CAS Number	Chemical Name	Generic Classification Code	Effective Date
3844-45-9	C.I. Acid Blue 9, disodium salt	C13	01/01/87
4549-40-0	N-Nitrosomethylvinylamine	C12	01/01/87
4680-78-8	C.I. Acid Green 3	C13	01/01/87
6484-52-2	Ammonium nitrate (solution)	C16	01/01/87
7429-90-5	Aluminum (fume or dust)	C15	01/01/87
7439-92-1	Lead	C15	01/01/87
7439-96-5	Manganese	C15	01/01/87
7439-97-6	Mercury	C15	01/01/87
7440-02-0	Nickel	C15	01/01/87
7440-22-4	Silver	C15	01/01/87
7440-28-0	Thallium	C15	01/01/87
7440-36-0	Antimony	C15	01/01/87
7440-38-2	Arsenic	C15	01/01/87
7440-39-3	Barium	C15	01/01/87
7440-41-7	Beryllium	C15	01/01/87
7440-43-9	Cadmium	C15	01/01/87
7440-47-3	Chromium	C15	01/01/87
7440-48-4	Cobalt	C15	01/01/87
7440-50-8	Copper	C15	01/01/87
7440-62-2	Vanadium (fume or dust)	C15	01/01/87
7440-66-6	Zinc (fume or dust)	C15	01/01/87
7550-45-0	Titanium tetrachloride	C15	01/01/87
7647-01-0	Hydrochloric acid	C16	01/01/87
7664-38-2	Phosphoric acid	C16	01/01/87
7664-39-3	Hydrogen fluoride	C16	01/01/87

CAS Number	Chemical Name	Generic Classification Code	Effective Date
7664-41-7	Ammonia	C16	01/01/87
7664-93-9	Sulfuric acid	C16	01/01/87
7697-37-2	Nitric acid	C16	01/01/87
7723-14-0	Phosphorus (yellow or white)	C16	01/01/87
7757-82-6	Sodium sulfate (solution)	C16	01/01/87
7782-49-2	Selenium	C16	01/01/87
7782-50-5	Chlorine	C16	01/01/87
7783-20-2	Ammonium sulfate (solution)	C16	01/01/87
8001-35-2	Toxaphene	C02	01/01/87
10034-93-2	Hydrazine sulfate	C11	01/01/87
10049-04-4	Chlorine dioxide	C16	01/01/87
12122-67-7	Zineb	C15	01/01/87
12427-38-2	Maneb	C16	01/01/87
13463-67-7	Titanium dioxide	C15	01/01/87
16071-86-6	Direct Brown 95	C14	01/01/87
16543-55-8	N-Nitrosonornicotine	C12	01/01/87
20816-12-0	Osmium tetroxide	C15	01/01/87
25321-22-6	Dichlorobenzene (mixed isomers)	C04	01/01/87
25376-45-8	Diaminotoluene (mixed isomers)	C10	01/01/87
39156-41-7	2,4-Diaminoanisole sulfate	C10	01/01/87

(c) Chemical categories in alphabetical order.

Category Name	Generic Classification Code	Effective Date
Antimony Compounds Includes any unique chemical substance that contains antimony as part of that chemical's infrastructure.	C15	01/01/87
Arsenic Compounds Includes any unique chemical substance that contains arsenic as part of that chemical's infrastructure.	C15	01/01/87
Barium Compounds Includes any unique chemical substance that contains barium as part of that chemical's infrastructure.	C15	01/01/87
Beryllium Compounds Includes any unique chemical substance that contains beryllium as part of that chemical's infrastructure.	C15	01/01/87
Cadmium Compounds Includes any unique chemical substance that contains cadmium as part of that chemical's infrastructure.	C15	01/01/87
Chlorophenols	C04	01/01/87



Where x = 1 to 5

LAM 005673

DPMC-03264

Category Name	Generic Classification Code	Effective Date
Chromium Compounds Includes any unique chemical substance that contains chromium as part of that chemical's infrastructure.	C15	01/01/87
Cobalt Compounds Includes any unique chemical substance that contains cobalt as part of that chemical's infrastructure.	C15	01/01/87
Copper Compounds Includes any unique chemical substance that contains copper as part of that chemical's infrastructure.	C15	01/01/87
Cyanide Compounds $X^+ CN^-$ where X = H^+ or any other group where a formal dissociation can be made. For example KCN, or $Ca(CN)_2$.	C16	01/01/87
Glycol Ethers Includes mono- and di- ethers of ethylene glycol, diethylene glycol, and triethylene glycol. $R-(OCH_2CH_2)_n-OR'$ Where n = 1, 2, or 3 R = alkyl or aryl groups. R' = R, H, or groups which, when removed, yield glycol ethers with the structure: $R-(OCH_2CH)_n-OH$ Polymers are excluded from this category.	C06	01/01/87
Lead Compounds Includes any unique chemical substance that contains lead as part of that chemical's infrastructure.	C15	01/01/87

Category Name	Generic Classification Code	Effective Date
Manganese Compounds Includes any unique chemical substance that contains manganese as part of that chemical's infrastructure.	C15	01/01/87
Mercury Compounds Includes any unique chemical substance that contains mercury as part of that chemical's infrastructure.	C15	01/01/87
Nickel Compounds Includes any unique chemical substance that contains nickel as part of that chemical's infrastructure.	C15	01/01/87
Polybrominated Biphenyls (PBBs)	C04	01/01/87
 Where x = 1 to 10		
Selenium Compounds Includes any unique chemical substance that contains selenium as part of that chemical's infrastructure.	C15	01/01/87
Silver Compounds Includes any unique chemical substance that contains silver as part of that chemical's infrastructure.	C15	01/01/87

Category Name	Generic Classification Code	Effective Date
Thallium Compounds Includes any unique chemical substance that contains thallium as part of that chemical's infrastructure.	C15	01/01/87
Zinc Compounds Includes any unique chemical substance that contains zinc as part of that chemical's infrastructure.	C15	01/01/87

APPENDIX II

INDEX OF APPLICABLE SARA TITLE I SECTIONS

TITLE I: PROVISIONS RELATING PRIMARILY TO RESPONSE AND LIABILITY

Clepped porter

SECTION 101. AMENDMENTS TO DEFINITION
SECTION 102. REPORTABLE QUANTITIES
SECTION 103. NOTICES; PENALTIES
SECTION 104. RESPONSE AUTHORITIES
SECTION 105. NATIONAL CONTINGENCY PLAN
SECTION 106. REIMBURSEMENT
SECTION 107. LIABILITY
SECTION 108. FINANCIAL RESPONSIBILITY
SECTION 109. PENALTIES
SECTION 110. HEALTH-RELATED ACTIVITIES
SECTION 111. USES OF FUND
SECTION 114. RELATIONSHIP TO OTHER LAW
SECTION 116. SCHEDULES
SECTION 117. PUBLIC PARTICIPATION
SECTION 118. HIGH PRIORITY FOR DRINKING WATER SUPPLIES
SECTION 119. RESPONSE ACTION CONTRACTORS
SECTION 120. FEDERAL FACILITIES
SECTION 121. CLEANUP STANDARDS
SECTION 122. SETTLEMENTS
SECTION 126. WORKER PROTECTION STANDARDS

TITLE II: MISCELLANEOUS PROVISIONS

SECTION 202. HAZARDOUS MATERIALS TRANSPORTATION
SECTION 203. STATE PROCEDURAL REFORM
SECTION 204. CONFORMING AMENDMENT TO FUNDING PROVISIONS
SECTION 205. CLEANUP OF PETROLEUM FROM LEAKING UG STORAGE TANK
SECTION 206. CITIZENS SUITS

TITLE I. PROVISIONS RELATING PRIMARILY TO RESPONSE AND LIABILITY

SECTION 101. AMENDMENTS TO DEFINITION

Significant Amendments to Definitions:

- "RELEASE" is amended to include abandonment and discarding of drums containing hazardous substances.

- "REMEDIAL ACTION" is amended to include offsite transport and storage, treatment, destruction, or secure disposition.

- "POLLUTANT OR CONTAMINANT" is added to Section 101 and retains "petroleum exclusion," including "crude oil or any fraction thereof which is not otherwise specifically listed or designated as a hazardous substance ..."

  COMMENT: As an example, H_2S is a fraction of crude oil, but is a specifically listed hazardous substance. Therefore, the release of the compound H_2S in amounts exceeding the reportable quantity of 100 lb. is subject to the Act.

- "CONTRACTUAL RELATIONSHIP"; for the purpose of establishing a third party defense this term is amended to provide a better defense for property owners provided they can demonstrate they had no knowledge and had no reason to know of disposal of hazardous substances prior to taking title to the property. The burden of proof in making such a demonstration is substantial.

  COMMENT: Environmental Affairs will advise Corporate Real Estate of SARA implications under separate cover.

SECTION 102. REPORTABLE QUANTITIES

EPA must publish final rules by 12/31/86 establishing "Reportable Quantities" for all hazardous substances whose RQ's were proposed prior to 3/1/86. RQs not proposed for hazardous substance prior to 3/1/86 must be proposed by 12/31/86 and finalized by 4/30/88.

SECTION 104. RESPONSE AUTHORITIES

RESPONSES:

Allows responsible parties to carry out cleanup activity and conduct the RI/FS in accordance with Title I, Section 122 ("Settlements") if

they are qualified to do so. Such activity will be subject to oversight by EPA, the cost of which is reimbursable to Superfund by the responsible party/parties.

REMOVAL ACTIONS:

Removal action under this Section should, to the extent EPA deems practicable, contribute to long term remedial action of the release of hazardous substances.

> COMMENT: This subsection addresses concerns that previous remedial activities on occasion were for short term correction of a release and counter-productive to a permanent long-term site solution. It is one of the factors (among many in Section 104) that will increase both the cost and resource commitment for potentially responsible parties (PRPs) in future Superfund activity.

LIMITATIONS ON RESPONSE:

No removal or remedial action is authorized for releases that are naturally occurring, result from products that are part of a building structure (i.e., asbestos), or result in contamination of drinking water supplies due to the ordinary deterioration of the supply system unless the release constitutes a public health or environmental emergency. Under exceptions to these limitations, releases which can potentially damage natural resources must be reported to the appropriate Federal and State natural resource trustees, and remedial action for such releases under Superfund will be coordinated with the trustees.

MAINTENANCE AND REMEDIAL ACTION ACTIVITIES:

In the case of ground or surface water contamination, completed remedial action will include the completion of systems necessary to restore the surface or ground water to a level that assures protection of human health and the environment. The operation and maintenance of such systems for a period of up to 10 years after construction and installation shall be considered remedial action. Activities to maintain system effectiveness after this period will be considered operations or maintenance. The Federal share of funds for maintaining and operating these systems will be from funds recovered on behalf of Superfund.

SITING:

After October 17,1989, EPA will not provide any Superfund remedial action unless a State enters into an agreement to assure the availability of RCRA permitted hazardous waste treatment and disposal