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# Emergency Planning and Community Right-To-Know Act Section 313 Reporting Guidance for the Printing, Publishing, and Packaging Industry

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## OVERVIEW

This document supersedes the booklet entitled *Title III Section 313 Release Reporting Guidance, Estimating Chemical Releases from Printing Operations,* dated January 1988. It is intended to assist establishments and facilities performing printing operations in complying with the Emergency Planning and Community Right-To-Know Act (EPCRA) Section 313 and Pollution Prevention Act (PPA) Section 6607 reporting requirements, the preparation of Form R or the alternate certification statement, Form A. The EPCRA Section 313 program is commonly referred to as the Toxic Chemical Release Inventory (TRI).

The principal differences in this new document include:

- More detailed examples;
- New EPCRA Section 313 regulations and guidance developed since 1988;
- PPA Section 6607 reporting requirements;
- U.S. Environmental Protection Agency's (EPA's) interpretive guidance on various issues specific to printing operations; and
- EPCRA Section 313 issues regarding processes not discussed in the earlier documents.

This document is designed to be a supplement to the annual issue of the *Toxic Chemical Release Inventory Reporting Forms and Instructions,* (*TRI Forms and Instructions).* It is organized to provide a step-by-step guide to compliance with EPCRA Section 313 and PPA Section 6607, starting with how to determine if your facility must report and ending with guidance for estimating release and other waste management activity quantities.

The printing, publishing, and packaging industry includes firms whose business is dominated by printing operations, firms performing operations commonly associated with printing such as platemaking or bookbinding, and publishers, whether or not they actually print their own material. It is estimated that 97% of all printing activities can be categorized into five different printing processes:

1. Lithography.
2. Gravure.

3. Flexography.
4. Letterpress.
5. Screen Printing.

The equipment, applications, and ink formulations for each of these processes differ; however, they all print an image on a substrate (cardboard, paper, packaging, etc.) following the same basic sequence:

1. Imaging.
2. Pre-press.
3. Printing.
4. Post-press.

The primary sources of release and other waste management quantities of EPCRA Section 313 chemicals and chemical categories are from solvents found in the ink formulations and solvents used in cleanup operations.

Not all printing, publishing, and packaging establishments will have all unit operations described in this document; however, each of the unit operations discussed are common operations found in printing operations covered by EPCRA Section 313 reporting requirements. You should select the operation, or combination of operations, that most closely fits the activities at your establishment.

Chapter 1 introduces EPCRA Section 313 and PPA Section 6607 reporting and provides a brief background on Section 313 of EPCRA and Section 6607 of PPA.

Chapter 2 discusses reporting requirements and begins with how to determine whether your facility must report. This determination is based on your answers to a series of four questions:

- Is your facility's primary SIC Code on the EPCRA Section 313 list?
- Does your facility employ ten or more full-time employees or the equivalent?
- Does your facility manufacture, process, or otherwise use any EPCRA Section 313 chemicals or chemical categories?

- Does your facility exceed any of the activity thresholds for an EPCRA Section 313 chemical or chemical category?

If the answer to ANY ONE of the first three questions is "No" you are not required to submit an EPCRA Section 313 report for any chemical. If you answer "Yes" to the first three questions and "No" to the fourth, you are not required to submit an EPCRA Section 313 report for that chemical or chemical category. If you answer "Yes" to ALL four questions, the next step is to determine what kind of report you must prepare, a Form R or the alternate certification statement, Form A. Chapter 2 provides detailed information on the requirements for each kind of report. Chapter 2 concludes with a discussion on how to address trade secrets and the records that should be kept to support your reporting.

Chapter 3 discusses how to calculate the activity thresholds (manufacture, process, and otherwise use) for the EPCRA Section 313 chemicals or chemical categories. Information is provided on how to determine which EPCRA Section 313 chemicals or chemical categories your facility manufactures, processes, or otherwise uses and how to calculate the quantities of each. Detailed information is also provided on the various exemptions:

- *De minimis* exemption;
- Article exemption;
- Facility-related exemption; and
- Activity-related exemptions.

Chapter 3 concludes with a discussion of how to determine which EPCRA Section 313 chemicals or chemical categories exceed a reporting threshold.

Chapter 4 discusses how to estimate the release and other waste management activity amounts for those EPCRA Section 313 chemicals and chemical categories for which you must prepare a report. The first part of this chapter provides a step-by-step approach designed to minimize the risk of overlooking an activity involving an EPCRA Section 313 chemical or chemical category and any potential sources or types of release and other waste management activities. This procedure consists of:

- Preparation of a detailed **process flow diagram**;

- Identification of EPCRA Section 313 chemicals and chemical categories and potential **sources** of chemical release and other waste management activities;
- Identification of the potential **types** of release and other waste management activities from each source; and
- Determination of the most appropriate methods for **estimating the quantities** of listed EPCRA Section 313 chemical and chemical category release and other waste management activities.

The second part of Chapter 4 is organized by the four typical activities in printing operations where EPCRA Section 313 chemicals and chemical categories are used: imaging, pre-press (platemaking), printing, and post-press. The commonly used EPCRA Section 313 chemicals and chemical categories, process descriptions, release and other waste management estimates, example calculations, and common problems are presented.

This document includes examples and common errors applicable to printing operations. These examples are based on information identified during voluntary site surveys of facilities that have filed EPCRA Section 313 reports in the past, discussion with representatives of the Graphic Arts Technical Foundation, the Gravure Association of America, the Foundation of the Flexographic Technical Association, the Flexible Packaging Association, the Printing Industry of America, the Screen Printing and Graphic Imaging Association, and on questions received by the EPCRA Hotline.

# CHAPTER 1 - INTRODUCTION

## 1.0 PURPOSE

The purpose of this guidance manual is two-fold. The primary purpose is to assist facilities performing printing operations in complying with the reporting requirements of Section 313 of the Emergency Planning and Community Right-to-Know Act of 1986 (EPCRA) and of Section 6607 of the Pollution Prevention Act of 1990 (PPA). This manual explains the EPCRA Section 313 reporting requirements and discusses specific release and other waste management activities encountered at many facilities that conduct these operations. Since each plant is unique, the recommendations presented may have to be modified for your particular facility. The secondary purpose is to provide information to other interested parties (such as management, legal professionals, inspectors, consultants, teachers, students, and the general public) about the processes and some of the toxic chemicals used in this industry.

This manual is intended solely for guidance and does not alter any statutory or regulatory requirements. The document should be used in conjunction with the appropriate statutes and regulations but does not supersede them. Accordingly, the reader should consult other applicable documents (for example, the statute, the Code of Federal Regulations (CFR), relevant preamble language, and the current *Toxic Chemical Release Inventory Reporting Forms and Instructions* (*TRI Forms and Instructions*)).

This document supersedes the 1988 document entitled *Title III Section 313 Release Reporting Guidance, Estimating Chemical Releases from Printing Operations.* This new document includes:

- More detailed examples;
- New EPCRA Section 313 regulations and guidance developed since 1988;
- PPA Section 6607 reporting requirements;
- U.S. Environmental Protection Agency's (U.S. EPA's) interpretive guidance on various issues specific to printing operations; and
- EPCRA Section 313 issues regarding processes not discussed in the earlier document.

It is intended to supplement the *TRI Forms and Instructions* document that is updated and published annually by U.S. EPA. It is essential that you use the current version of the *TRI Forms and Instructions* to determine if (and how) you should report. Changes or modifications to EPCRA Section 313 reporting requirements are reflected in the annual *TRI Forms and Instructions* and should be reviewed before compiling information for the report.

The objectives of this manual are to:

- Reduce the level of effort expended by those facilities that prepare an EPCRA Section 313 report; and
- Increase the accuracy and completeness of the data being reported.

U.S. EPA cannot anticipate every potential issue or question that may apply to your facility. Therefore, this manual attempts to address those issues most prevalent or common for printing operations. Used in conjunction with the most current *TRI Forms and Instructions* and *Estimating Releases and Waste Treatment Efficiencies for the Toxic Chemical Release Inventory Form (2000 version)*, facilities should be able to provide complete and accurate information for EPCRA Section 313 reporting. Additional discussions on specific issues can be found in U.S. EPA's current edition of *EPCRA Section 313, Questions and Answers* (the 1998 edition is EPA 745-B-98-004), which is available on the U.S. EPA's TRI website (**http://www.epa.gov/tri**) or by contacting the **EPCRA Hotline at 1-800-424-9346**. In the Washington, DC metropolitan area, call 703-412-9810.

## 1.1 Background on EPCRA Section 313 and PPA Section 6607

The following overview of EPCRA Section 313 and Section 6607 of the PPA, will provide you with a basic understanding of the objectives and requirements of this program, and will help you in completing your forms.

One of the primary goals of EPCRA is to increase the public's knowledge of, and access to, information on both the presence of toxic chemicals in their communities and on releases into the environment and other waste management activities of those chemicals. EPCRA Section 313 requires certain designated businesses (see SIC Code discussion, Chapter 2,

Section 2.2) to submit annual reports (commonly referred to as Form R reports and Form A reports) on over 600 EPCRA Section 313 chemicals and chemical categories. Covered facilities report the amounts released or otherwise managed as waste. However, if a facility meets the reporting criteria for listed toxic chemicals, the facility must report even if there are no releases or other waste management quantities associated with these chemicals. Throughout this document, whenever EPCRA Section 313 chemicals are discussed, the discussion includes chemical categories, as appropriate. Chemicals or chemical categories may be added or deleted from the list. Therefore, before completing your annual report, be sure to check the most current list included with the *TRI Forms and Instructions* when evaluating the chemicals and chemical categories present at your facility. Copies of the reporting package can be requested from the EPCRA Hotline, 1-800-424-9346.

All facilities meeting the EPCRA Section 313 reporting criteria must report the annual release and other waste management activity quantities (routine and accidental) of EPCRA Section 313 chemicals and chemical categories to all environmental media. A separate report is required for each EPCRA Section 313 chemical or chemical category that is manufactured (including imported), processed, or otherwise used above the reporting threshold. The reports must be submitted to U.S. EPA and State or Tribal governments, on or before July 1, for activities in the previous calendar year. The owner/operator of the facility on July 1 is primarily responsible for the report, even if the owner/operator did not own the facility during the reporting year. However, property owners with no business interest in the operation of the facility, other than a lessor interest, are exempt from reporting requirements.

EPCRA also mandates U.S. EPA to establish and maintain a publicly available database system consisting of the information reported under Section 313 and under Section 6607 of the PPA. This database, known as the Toxic Chemical Release Inventory (TRI) database, can be accessed through the following sources:

- U.S. EPA Internet site, http://www.epa.gov/tri;
- Envirofacts Warehouse Internet site, http://www.epa.gov/enviro/; and
- Right-to-Know network, http://www.rtk.net/trisearch.html.

However, information qualifying as a trade secret, in accordance with the regulatory requirements, is protected from public release. In addition to being a resource for the public, TRI data are also used in the research and development of regulations related to EPCRA Section 313 chemicals and chemical categories.

To reduce the reporting burden for small businesses, U.S. EPA established an alternate activity threshold of one million pounds manufactured, processed, or otherwise used for facilities with total annual reportable amounts of 500 pounds or less for each EPCRA Section 313 chemical or chemical category. Provided the facility does not exceed either the reportable amount or the alternate threshold, the facility may file a certification form (Form A) rather than file a Form R. By filing the Form A the facility certifies that they do not exceed the reportable amount of 500 pounds or exceed the alternate threshold of one million pounds for the respective chemical or chemical category.

Note that the annual reportable amount includes the quantity of the EPCRA Section 313 chemical or chemical category in all production-related waste management activities, not just releases (see the discussion in Section 2.8 for more detail). Also note that either a Form A or a Form R, but not both, must be submitted for each EPCRA Section 313 chemical or chemical category above any reporting threshold, even if there are zero release and other waste management activity quantities.

Violation of EPCRA Section 313 reporting provisions may result in federal civil penalties of up to $27,500 per day for each violation (61 FR 69360). State enforcement provisions may also be applicable depending on the state's EPCRA Section 313 reporting regulations.

Members of the Graphic Arts Technical Foundation, the Foundation of the Flexographic Technical Association, the Gravure Association of America, the Flexible Packaging Association, the Printing Industry of America, and the Screenprinting and Graphic Imaging Association provided input on common problems, specific to printing operations, encountered by those completing the EPCRA Section 313 reports. U.S. EPA has combined this input with questions forwarded to the EPCRA Hotline and those identified during voluntary site

surveys of facilities that have filed EPCRA Section 313 reports in the past. Selected issues and guidance addressing these common problems are presented throughout this document as applicable.

The *TRI Forms and Instructions* contain discussions of common problems in completing the EPCRA Section 313 reports. You are encouraged to read this document before filling out the Form R (or Form A) for your facility.

If, after reading this manual, you still have questions about EPCRA Section 313 reporting, please contact the EPCRA Hotline at 1-800-424-9346 or refer to the U.S. EPA's TRI website, http://www.epa.gov/tri. Assistance is also available from the designated EPCRA Section 313 Coordinator in the U.S. EPA regional office and the EPCRA contact in your state (see the *TRI Forms and Instructions* for a current list of these contacts). Additional guidance is also available in the resources listed in Appendix A.

# CHAPTER 2 - REPORTING REQUIREMENTS

## 2.0 PURPOSE

The purpose of this chapter is to help you determine if you must prepare an EPCRA Section 313 report(s) and, if so, what kind of a report(s) should be prepared (Form R or the alternate certification statement, the Form A). This chapter presents the EPCRA Section 313 reporting requirements to help you determine if these requirements apply to your facility. It also discusses the reporting of trade secrets and the records that must be kept.

To understand the following discussion you must first understand how EPCRA defines a facility. The term "facility" is defined as, "all buildings, equipment, structures, and other stationary items which are located on a single site or on contiguous or adjacent sites and which are owned or operated by the same person (or by any person who controls, who is controlled by, or who is under common control with such person). A facility may contain more than one establishment" (40 CFR 372.3). An "establishment" is defined as, "an economic unit, generally at a single physical location, where business is conducted, or where services or industrial operations are performed" (40 CFR 372.3).

U.S. EPA recognizes that for business reasons it may be easier and more appropriate for establishments at one facility to report separately. However, the combined quantities of EPCRA Section 313 chemicals or chemical categories manufactured, processed, or otherwise used in all establishments making up that facility must be considered for threshold determinations. Also, the combined release and other waste management activity quantities reported singly for each establishment must total those for the facility as a whole.

Note that if a facility is comprised of more than one establishment, once an activity threshold is met by the facility, providing the facility meets the SIC Code and employee threshold criteria, release and other waste management activities from <u>all</u> establishments at the facility must be reported.

**Example - Multiple Establishments**

Your facility has a printing and a bookbinding establishment, both with SIC Codes covered under EPCRA Section 313. One establishment used 23,000 pounds of copper, an EPCRA Section 313 chemical, during the year to manufacture gravure cylinders. Another establishment purchased and used 4,000 pounds of copper during the year as a pigment in the coating of book covers. Both activities constitute processing of the EPCRA Section 313 chemical (as presented in Section 2.5 and described in detail in Chapter 3) and the total for the facility exceeded the 25,000-pound processing threshold for the year. Thus, if your facility meets the employee threshold, you must file one Form R for copper from your facility, or two Form Rs, one from each establishment. **Please note that you may be eligible to file one Form A for the facility but you cannot file a separate Form A for each establishment.**

## 2.1 Must You Report?

How do you determine if your facility must prepare an EPCRA Section 313 report? Your answers to the following four questions will help you decide (illustrated by Figure 2-1):

1) Is the primary SIC Code for your facility included in the list covered by EPCRA Section 313 reporting (see Section 2.2)?

2) Does your facility have 10 or more full-time employees or the equivalent (see Section 2.3)?

3) Does your facility manufacture (which includes importation), process, or otherwise use EPCRA Section 313 chemicals or chemical categories (see Section 2.4)?

4) Does your facility exceed any applicable thresholds of EPCRA Section 313 chemicals or chemical categories (for non-PBT chemicals: 25,000 pounds per year for manufacturing; 25,000 pounds per year for processing; or 10,000 pounds per year for otherwise use - see Section 2.5; for PBT chemicals - see Section 2.6 for applicable thresholds)?

If you answered "No" to any of the first three questions, you are not required to prepare any EPCRA Section 313 reports. If you answered "Yes" to ALL of the first three questions, you must complete a threshold calculation for each EPCRA Section 313 chemical at the facility, and submit an EPCRA Section 313 report for each chemical and chemical category exceeding the applicable threshold.

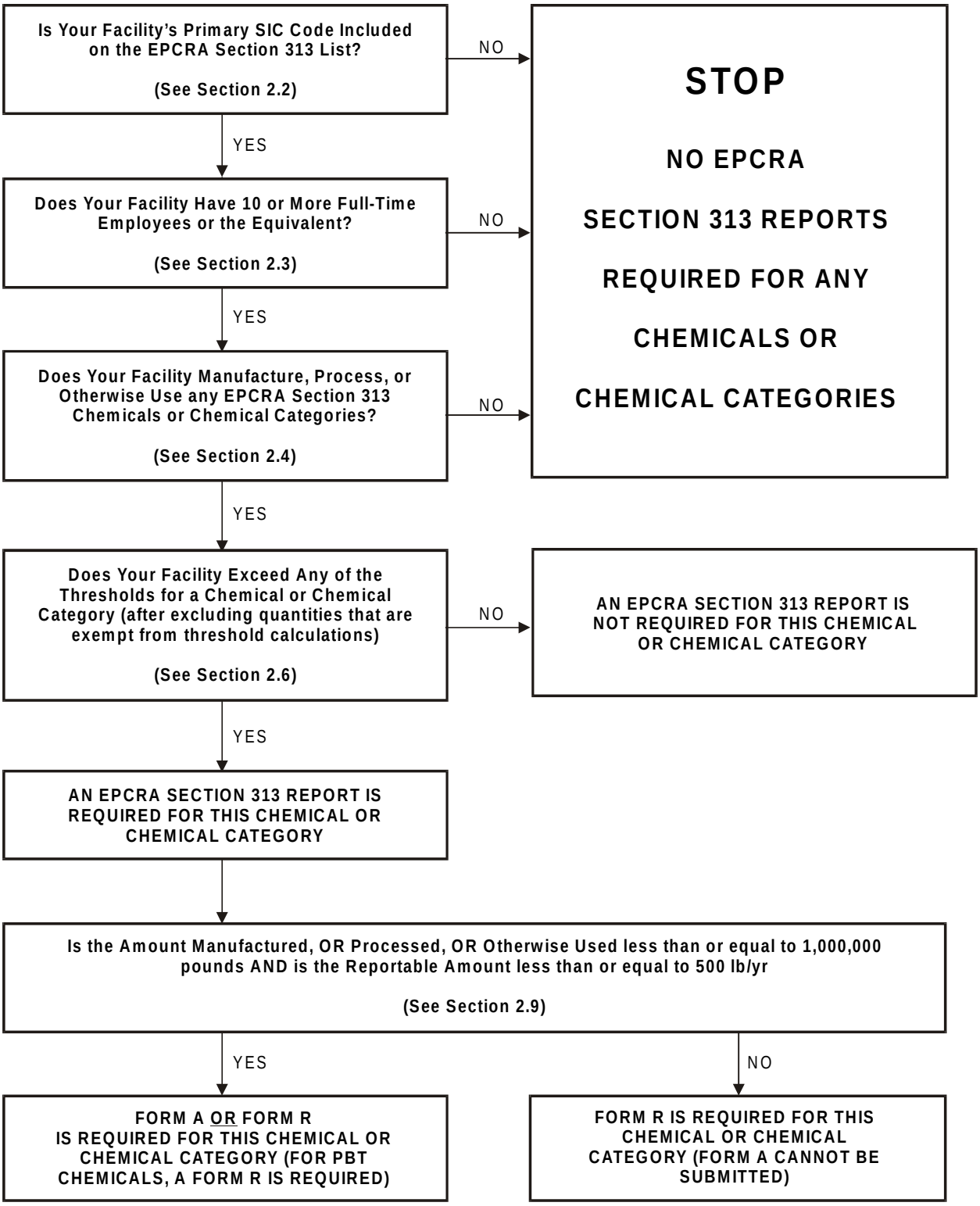


**Figure 2-1. EPCRA Section 313 Reporting Decision Diagram**

## 2.2 SIC Code Determination

Facilities with the SIC Codes presented in Table 2-1 are covered by the EPCRA Section 313 reporting requirements.

### Table 2-1

### SIC Codes Covered by EPCRA Section 313 Reporting

| SIC Codes | Industry | Qualifiers |
|---|---|---|
| 10 | Metal Mining | Except SIC Codes 1011, 1081, and 1094 |
| 12 | Coal Mining | Except SIC Code 1241 |
| 20 through 39 | Manufacturing | None |
| 4911, 4931, and 4939 | Electric and Other Services and Combination Utilities | Limited to facilities that combust coal and/or oil for the purpose of generating electricity for distribution in commerce |
| 4953 | Refuse Systems | Limited to facilities regulated under RCRA Subtitle C |
| 5169 | Chemicals and Allied Products | None |
| 5171 | Petroleum Bulk Stations and Terminals | None |
| 7389 | Business Services | Limited to facilities primarily engaged in solvent recovery services on a contract or fee basis |

Table 2-2 presents a listing of each SIC Code for facilities typically engaged in printing operations, with brief descriptions. You should determine the SIC Code(s) for your facility, based on the activities on site. For assistance in determining which SIC Code best suits your facility refer to *Standard Industrial Classification Manual, 1987* published by the Office of Management and Budget.

As an independent activity, printing operations would most likely be included under SIC Code 27 - Printing, Publishing, and Allied Industries. In addition, some printing operations may fall under SIC Code 26 - Paper and Allied Products.

## Table 2-2

## SIC Codes for Facilities That May Perform Printing Operations

| SIC Code | SIC Description |
|---|---|
| 2653 | Corrugated and solid fiber boxes |
| 2657 | Folding paperboard boxes, including sanitary |
| 2672 | Coated and laminated paper, n.e.c.* |
| 2673 | Plastics, foil, and coated paper bags |
| 2674 | Uncoated paper and multiwall bags |
| 2677 | Envelopes |
| 2678 | Stationary, tablets, and related products |
| 2679 | Converted paper and paperboard products, n.e.c.* |
| 2711 | Newspapers: publishing, or publishing and printing |
| 2721 | Periodicals: publishing, or publishing and printing |
| 2731 | Books: publishing, or publishing and printing |
| 2732 | Book printing |
| 2741 | Miscellaneous publishing |
| 2752 | Commercial printing, lithography |
| 2754 | Commercial printing, gravure |
| 2759 | Commercial printing, n.e.c.* |
| 2761 | Manifold business forms |
| 2771 | Greeting cards |
| 2782 | Blankbooks, looseleaf binders and devices |
| 2789 | Bookbinding and related work |
| 2791 | Typesetting |
| 2796 | Platemaking and related services |
| 3999 | Manufacturing Industries, n.e.c.* |

* n.e.c. - not elsewhere classified

Note that auxiliary facilities can assume the SIC Code of another covered establishment if the primary function is to support the covered establishment's operations. For the purpose of EPCRA Section 313, auxiliary facilities are defined as those that are primarily engaged in performing support services for another covered establishment or multiple establishments of a covered facility, and are in a different physical location from the primary facility. In addition, auxiliary facilities perform an integral role in the primary facility's

activities. In general, the auxiliary facility's basic administrative services (e.g., paperwork, payroll, employment) are performed by the primary facility. If an auxiliary facility's primary function is to support/service a facility with a covered SIC Code, the auxiliary facility assumes the covered SIC Code as its primary SIC code and must consider the other reporting requirements (40 CFR Section 372.22) to determine if it must comply with the EPCRA Section 313 reporting requirements. However, if the SIC Code for the primary facility is not covered by EPCRA Section 313, then neither the primary nor the auxiliary facility is required to submit a report.

If your facility has more than one SIC Code (i.e., several establishments with different SIC Codes are owned or operated by the same entity and are located at your facility), you are subject to reporting requirements if:

- All the establishments have SIC Codes covered by EPCRA Section 313; OR
- The total value of the products shipped or services provided at establishments with covered SIC Codes is greater than 50% of the value of the entire facility's products and services; OR
- Any one of the establishments with a covered SIC Code ships and/or produces products or provides services whose value exceeds the value of services provided, products produced and/or shipped by every other establishment within the facility.

A pilot plant within a covered SIC Code is considered a covered facility and is subject to reporting, provided it meets the employee and activity criteria (note that pilot plants are not eligible for the laboratory exemption, which is discussed in Section 3). Warehouses on the same site as facilities in a covered SIC Code, and warehouses that qualify as auxiliary facilities of covered facilities, are also subject to reporting, provided all applicable reporting requirements are met.

While you are currently required to determine your facility's reporting eligibility based on the SIC code system described above, it is important to be aware that the SIC code system will be replaced by a new system in the future. On April 9, 1997 (62 FR 17287), the Office of Management and Budget promulgated the North American Industrial Classification

System (NAICS). NAICS is a new economic classification system that replaces the SIC code system as a means of classifying economic activities for economic forecasting and statistical purposes. The transition to the new NAICS may require regulatory actions. As a result, the SIC code system is still required to be used as the mechanism to determine your facility's reporting eligibility. EPA will issue notice in the *Federal Register* to inform you and other EPCRA Section 313 facilities of its plans to adopt the NAICS and how facilities should make their NAICS code determination.

## 2.3 Number of Employees

If your facility meets SIC Code and activity threshold criteria, you are required to prepare an EPCRA Section 313 report if your facility has 10 or more full-time employees or the equivalent. A full-time employee equivalent is defined as a work year of 2,000 hours. If your facility's employees hours total 20,000 or more hours in a calendar year, you meet the 10 or more employee threshold criterion.

The following information should be included in your employee calculations:

- Owners;
- Operations/manufacturing staff;
- Clerical staff;
- Temporary employees;
- Sales personnel;
- Truck drivers (employed by the facility);
- Other non-manufacturing or off-site facility employees directly supporting the facility;
- Paid vacation and sick leave; and
- Contractor employees (maintenance, construction, etc. but excluding contracted truck drivers and minor intermittent service vendors (e.g., trash handlers)).

In general, if an individual is employed or hired to work at the facility, all the hours worked by that individual (including paid leave and overtime) for the facility should be counted in determining if the 20,000-hour criterion has been met.

**Example - Employee Equivalent Calculation**

Your facility has six full-time employees working 2,000 hours/year. You also employ two full-time sales people and a delivery truck driver (employed by the facility) who are assigned to the plant, each working 2,000 hours/year but predominantly on the road or from their homes. The wastewater treatment system (on site and owned by the facility) is operated by a contractor who spends an average of two hours per day and five days per week at the plant. Finally, you built an addition to the plant warehouse during the year, using four contractor personnel who were on site full time for six months (working on average of 1,000 hours each). You would calculate the number of full-time employee equivalents as follows:

- Hours for your nine full-time employees (six plant personnel, two salespeople, and one delivery truck driver) are:
  (9 employees) × (2,000 hours/year) = 18,000 hours/year

- Hours for the wastewater treatment system operator are:
  (2 hours/day) × (5 days/week) × (52 weeks/year) = 520 hours/year; and

- Hours for the construction crew are:
  (4 contractors) × (1,000 hours) = 4,000 hours/year.

Your facility has a total of 22,520 hours for the year, which is above the 20,000 hours/year threshold; therefore, you meet the employee criterion.

## 2.4 Manufacturing, Processing, and Otherwise Use of EPCRA Section 313 Chemicals or Chemical Categories

If you are in a covered SIC Code and have 10 or more full-time employee equivalents, you must determine which EPCRA Section 313 chemicals and chemical categories are manufactured, processed, or otherwise used at your facility. You should prepare a list which includes all chemicals and chemical categories found in mixtures and trade name products at all establishments at the facility. This list should then be compared to the CURRENT list of EPCRA Section 313 chemicals and chemical categories found in the *TRI Forms and Instructions* document for that reporting year (also available from the EPCRA Hotline, 1-800-424-9346). Once you identify the EPCRA Section 313 chemicals and chemical categories at your facility, you must evaluate the activities involving each chemical and chemical category and determine if any activity thresholds have been met.

The original list of chemicals or chemical categories subject to EPCRA Section 313 reporting was a combination of lists from New Jersey and Maryland. Refinements to the list have been made and changes are anticipated to continue. The list can be modified by U.S. EPA initiatives or industry or the public can petition U.S. EPA to modify the list. When evaluating a

chemical or chemical category for addition or deletion from the list, U.S. EPA must consider the chemical's or chemical category's potential acute human health effects, chronic human health effects, or its adverse environmental effects. U.S. EPA reviews these petitions and initiates a rulemaking to add or delete the chemical or chemical category from the list, or publishes an explanation why it denied the petition.

Note that chemicals and chemical categories are periodically added, delisted, or modified. Therefore, it is imperative that you refer to the appropriate reporting year's list. You can refer to the U.S. EPA's TRI website, http://www.epa.gov/tri, for updated guidance. Also, note that a list of synonyms for EPCRA Section 313 chemicals and chemical categories can be found in the U.S. EPA publication *Common Synonyms for Chemicals Listed Under Section 313 of the Emergency Planning and Community Right-To-Know Act*, (EPA 745-R-95-008). Table 2-3 lists the EPCRA Section 313 chemicals and chemical categories most frequently reported for printing operations. Some of the chemicals may be used both as a carrier solvent in ink formulations and for cleanup operations. This list is not intended to be all inclusive and should only be used as a guide.

## Table 2-3

## EPCRA Section 313 Chemicals and Chemical Categories Commonly Encountered in Printing Operations

| Process | Chemical |
|---|---|
| Ink solvent<br>Cleaning | Toluene, MEK, Methanol, Xylene, Ethylbenzene |
| Fountain solution<br>Cleaning | Certain Glycol Ethers |
| Cleaning | Xylene (mixed), MIBK |
| Acrylic coatings, gravure inks | Zinc Compounds |
| Copper plating | Copper |
| Red ink pigments | Barium Compounds |
| Green ink pigment | Copper Compounds |
| Adhesive solvent | n-Hexane |
| Ink solvent | n-Butyl Alcohol |
| Fountain solution cleaning | Ethylene Glycol |
| Plasticizer | Dibutyl Phthalate |

## Table 2-3 (Continued)

| Process | Chemical |
|---|---|
| Cleaning solvent | Ethylbenzene, 1,2,4-Trimethylbenzene, Hexane |
| Water-based inks and coatings | Ammonia |
| Cleaning<br>Etching | Nitric Acid |

## 2.5 Activity Categories

EPCRA Section 313 defines three activity categories for the listed chemicals and chemical categories: manufacturing (which includes importing), processing, and otherwise use. The activity thresholds are 25,000 pounds per year for manufacturing, 25,000 pounds per year for processing, and 10,000 pounds per year for otherwise use.[1] These thresholds apply to each chemical or chemical category individually. The quantity of chemicals or chemical categories stored on site or purchased is not relevant for threshold determinations. Rather, the determination is based solely on the annual quantity actually manufactured (including imported), processed, or otherwise used. Therefore, EPCRA Section 313 chemicals and chemical categories that are brought on site and stored, but are not prepared in the reporting year for distribution in that year or subsequent years or are not otherwise used on site during the reporting year, are not considered towards any activity threshold.

Expanded definitions, with examples, of each of the three activities are found in Chapter 3, Tables 3-2, 3-3, and 3-4. The terms are briefly defined in Table 2-4.

Relabeling or redistribution of an EPCRA Section 313 chemical or chemical category where no repackaging occurs does not constitute manufacturing, processing, or otherwise use of that chemical. This type of activity should not be included in threshold determinations.

[1]These activity thresholds are for non-PBT chemicals. See Section 2.6 for the activity thresholds applicable to PBT chemicals.

## Example - Relabeling

You buy a mixture in small containers that contains an EPCRA Section 313 chemical. When it arrives you put your own label on each container and put the containers in a larger box with several other items you manufacture, and sell the larger box as a kit. The quantity of the EPCRA Section 313 chemical in the small containers should not be counted toward the processing threshold (because you did not repackage the chemical) or the otherwise use threshold, nor should it be counted toward the manufacturing activity threshold unless the small containers were imported. However, you must consider other EPCRA Section 313 chemicals that you manufactured in the kit toward manufacturing and processing threshold determinations.

## Example - Treatment of Wastes from Off Site

A large printing facility receives a waste containing 12,000 pounds of Chemical A, an EPCRA Section 313 chemical, from off-site. The facility treats the waste, destroying Chemical A and in the treatment process manufactures 10,500 pounds of Chemical B, another EPCRA Section 313 chemical. Chemical B is disposed on site.

Since the waste was received from off site for the purpose of waste management, the amount of Chemical A must be included in the otherwise use threshold determination for Chemical A. The otherwise use threshold is 10,000 pounds and since the amount of Chemical A exceeds this threshold, all release and other waste management activities for Chemical A must be reported.

Chemical B was manufactured in the treatment of a waste received from off site. Accordingly, the quantity of chemical B should be counted towards the manufacturing threshold. However, the facility disposed of Chemical B on site and "otherwise use" of a toxic chemical includes disposal, stabilization (without subsequent distribution in commerce) or treatment for destruction if the toxic chemical that was disposed, stabilized, or treated for destruction was manufactured as a result of waste management activities on materials received from off site for the purpose of further waste management activities. Therefore, the amount of Chemical B must also be considered in the otherwise use threshold determination. Thus, at 10,0500 pounds, the otherwise use reporting threshold for Chemical B has been exceeded and all release and other waste management activities for Chemical B must be reported.

# Table 2-4

## Activity Categories

| Activity Category | Definition | Threshold[1] (lb/yr) |
|---|---|---|
| Manufacture | To produce, prepare, import, or compound an EPCRA Section 313 chemical. Manufacture also applies to an EPCRA Section 313 chemical that is produced coincidentally during the manufacture, processing, otherwise use, or disposal of another chemical or mixture of chemicals as a byproduct, and an EPCRA Section 313 chemical that remains in that other chemical or mixture of chemicals as an impurity during the manufacturing, processing, or otherwise use or disposal of any other chemical substance or mixture. An example would be the production of ammonia or nitrate compounds in a wastewater treatment system. | 25,000 |
| Process | To prepare an EPCRA Section 313 chemical, or a mixture or trade name product containing an EPCRA Section 313 chemical, for distribution in commerce. For example, the addition of EPCRA Section 313 listed pigments to ink should be reported if you exceeded the reporting threshold. Processing includes the preparation for sale to your customers (and transferring between facilities within your company) of a chemical or formulation that you manufacture. For example, if you manufacture an EPCRA Section 313 chemical or chemical category or product, package it, and then distribute it into commerce, this chemical has been manufactured AND processed by your facility. | 25,000 |
| Otherwise Use | Generally, use of an EPCRA Section 313 chemical category that does not fall under the manufacture or process definitions is classified as otherwise use. An EPCRA Section 313 chemical or chemical category that is otherwise used does not function by being incorporated into a product that is distributed in commerce, but may be used instead as a manufacturing or processing aid (e.g., catalyst), in waste processing, or as a fuel (including waste fuel). For example, xylene used as a carrier solvent for ink is classified as otherwise used.<br><br>On May 1, 1997 U.S. EPA revised the interpretation of otherwise use. The following new otherwise use definition became effective with the 1998 reporting year (62 FR 23834, May 1, 1997):<br><br>Otherwise use means "any use of a toxic chemical contained in a mixture or other trade name product or waste, that is not covered by the terms manufacture or process. Otherwise use of a toxic chemical does not include disposal, stabilization (without subsequent distribution in commerce), or treatment for destruction unless:<br><br>1) The toxic chemical that was disposed, stabilized, or treated for destruction was received from off site for the purposes of further waste management; OR<br><br>2) The toxic chemical that was disposed, stabilized, or treated for destruction was manufactured as a result of waste management activities on materials received from off site for the purposes of further waste management activities." | 10,000 |

[1]These activity thresholds are for non-PBT chemicals. See Section 2.6 for the activity thresholds applicable to PBT chemicals.

Also, note that the threshold determinations for the three activity categories (manufacturing, processing, and otherwise use) are mutually exclusive. That is, you must conduct a separate threshold determination for each activity category and if you exceed any threshold, all release and other waste management activities of that EPCRA Section 313 chemical at the facility must be considered for reporting.

## 2.6 Persistent, Bioaccumulative, and Toxic (PBT) Chemicals

U.S. EPA promulgated the final rule for Persistent, Bioaccumulative, and Toxic (PBT) chemicals in the October 29, 1999 Federal Register (64 FR 209). This rule applies for the reporting year beginning January 1, 2000 (for EPCRA Section 313 reports that must be filed by July 1, 2001).

In this rule, U.S. EPA has added seven chemicals and lowered the reporting thresholds for 18 chemicals and chemical categories that meet the EPCRA Section 313 criteria for persistence and bioaccumulation. The PBT chemicals and their final thresholds are listed in Table 2-5.

### Table 2-5

### Reporting Thresholds for EPCRA Section 313 Listed PBT Chemicals

| Chemical Name or Chemical Category | CASRN | Section 313 Reporting Threshold (in pounds unless noted other-wise) |
|---|---|---|
| Aldrin | 309-00-2 | 100 |
| Benzo(g,h,i)perylene | 191-24-2 | 10 |
| Chlordane | 57-74-9 | 10 |
| Dioxin and dioxin-like compounds category (manufacturing; and the processing or otherwise use of dioxin and dioxin-like compounds if the dioxin and dioxin-like compounds are present as contaminants in a chemical and if they were created during the manufacturing of that chemical) | NA | 0.1 grams |
| Heptachlor | 76-44-8 | 10 |
| Hexachlorobenzene | 118-74-1 | 10 |
| Isodrin | 465-73-6 | 10 |
| Methoxychlor | 72-43-5 | 100 |

## Table 2-5 (Continued)

| Chemical Name or Chemical Category | CASRN | Section 313 Reporting Threshold (in pounds unless noted other-wise) |
|---|---|---|
| Octachlorostyrene | 29082-74-4 | 10 |
| Pendimethalin | 40487-42-1 | 100 |
| Pentachlorobenzene | 608-93-5 | 10 |
| Polycyclic aromatic compounds category | NA | 100 |
| Polychlorinated biphenyl (PCBs) | 1336-36-3 | 10 |
| Tetrabromobisphenol A | 79-94-7 | 100 |
| Toxaphene | 8001-35-2 | 10 |
| Trifluralin | 1582-09-8 | 100 |
| Mercury | 7439-97-6 | 10 |
| Mercury compounds | NA | 10 |

U.S. EPA also added two chemicals to the polycyclic aromatic compounds (PACs) category that is listed above:

- Benzo(j,k)fluorene (fluoranthene)
- 3-methylchloanthrene

These two chemicals are not to be reported individually; rather, they should be included within the PACs compound category.

U.S. EPA finalized two thresholds based on the chemicals' potential to persist and bioaccumulate in the environment. The two levels include setting Section 313 manufacture, process, and otherwise use thresholds to 100 pounds for PBT chemicals and to 10 pounds for that subset of PBT chemicals that are highly persistent and highly bioaccumulative. One exception is the dioxin and dioxin-like compounds category. EPA set the threshold for the dioxin and dioxin-like compound category at 0.1 gram.

U.S. EPA eliminated the *de minimis* exemption for the PBT chemicals. However, this action does not affect the applicability of the *de minimis* exemption to the supplier notification requirements (40 CFR 372.45(d)(1)). U.S. EPA also excluded all PBT chemicals from eligibility for the alternate threshold of 1 million pounds (see Section 2.9) and eliminated

range reporting of PBT chemicals and chemical categories for on-site releases and transfers off-site for further waste management.

Concurrent with the additions and lowered thresholds discussed above, U.S. EPA added "vanadium, except when contained in an alloy" and "vanadium compounds" to the list of toxic chemicals subject to reporting under EPCRA Section 313. The corresponding thresholds for vanadium and vanadium compounds remain 10,000 pounds if otherwise used, 25,000 pounds if processed, and 25,000 pounds if manufactured. Please refer to the discussion on "Qualifiers" in Section 3.1 if vanadium is a concern at your facility.

Note that U.S. EPA is currently developing five guidance documents for chemicals modified in the PBT rule:

- Dioxins and dioxin-like compounds;
- Mercury and mercury compounds;
- Vanadium and vanadium compounds;
- Polycyclic aromatic compounds (PACs) category; and
- Other PBT chemicals.

Please refer to this guidance if applicable to your facility.

## 2.7 How Do You Report?

You must submit an EPCRA Section 313 report for each EPCRA Section 313 chemical or chemical category that exceeds a threshold for manufacturing, OR processing, OR otherwise use (providing you meet the employee and SIC Code criteria). Provided you do not exceed certain alternate activity thresholds and total annual reportable amounts, you may prepare a Form A (See Section 2.9) rather than a Form R. The *TRI Forms and Instructions* contain detailed directions for the preparation and submittal of EPCRA Section 313 reports for the reporting year. The *TRI Forms and Instructions* are sent to all facilities that submitted EPCRA Section 313 reports the preceding year. However, if you do not receive a courtesy copy, you may request copies of the *TRI Forms and Instructions* from the EPCRA Hotline (1-800-424-9346).

## 2.8 Form R

Form R is the report in which the information required by EPCRA Section 313 is reported. If you are submitting a Form R, it is essential that you use the *TRI Forms and Instructions* for the appropriate reporting year. U.S. EPA encourages the electronic submittal of the Form R, via the Automated Toxic Chemical Release Inventory Reporting Software (ATRS). Use of the ATRS will save preparation time in data entry and photocopying and reduce errors via on-line validation routines and use of pick lists. The ATRS can be found on the Internet at**:**

- **http://www.epa.gov/atrs**

The ATRS is available in both DOS and Windows versions. More information can be found in the *TRI Forms and Instructions* and by calling the ATRS User Support Hotline at (703) 816-4434.

The Form R consists of two parts:

Part I, Facility Identification Information. This part may be photocopied and re-used for each Form R you submit, except for the signature, which must be original for each submission.

Part II, Chemical Specific Information. You must complete this part separately for each EPCRA Section 313 chemical or chemical category; it cannot be reused year to year even if reporting has not changed.

Submission of incomplete EPCRA Section 313 reports may result in issuance of a Notice of Technical Error (NOTE), Notice of Significant Error (NOSE), or Notice of Non-compliance (NON). See the current *TRI Forms and Instructions* for more detailed information on completing the Form R and submitting the EPCRA Section 313 report.

## 2.9 Alternate Threshold and Form A

U.S. EPA developed the Form A, also referred to as the "Certification Statement," to reduce the annual reporting burden for facilities with minimal amounts of EPCRA

Section 313 chemicals or chemical categories released and otherwise managed as waste (59 FR 61488, November 1994; applicable beginning reporting year 1994 and beyond). On Form A you certify that you are not required to report the release and other waste management information required by EPCRA Section 313 and PPA Section 6607. A facility must meet the following two criteria to use a Form A:

- First, the total annual reportable amount of the EPCRA Section 313 chemical cannot exceed 500 pounds per year. The "reportable amount" is defined as the sum of the on-site amounts released (including disposal), treated, recycled, and combusted for energy recovery, combined with the sum of the amounts transferred off site for recycling, energy recovery, treatment, and/or release (including disposal). This total corresponds to the total of data elements 8.1 through 8.7 on the 1999 version of the Form R.

- Second, the amount of the EPCRA Section 313 chemical manufactured, processed, OR otherwise used cannot exceed one million pounds. It is important to note that the quantities for each activity are mutually exclusive and must be evaluated independently. If the quantity for any one of the activities exceeds 1,000,000 pounds a Form A cannot be used.

**Example - Form A Threshold**

If the combined annual reportable amounts from all activities do not exceed 500 pounds, a facility that manufactures 900,000 pounds of an EPCRA Section 313 chemical and processes 150,000 pounds of the same chemical is eligible to use the Form A because the facility did not exceed the one million pounds for either activity, even though the total usage exceeds one million pounds.

The Form A Certification Statement must be submitted for each eligible EPCRA Section 313 chemical or chemical category. The information on the Form A will be included in the publicly accessible TRI database; however, these data are marked to indicate that they represent certification statements rather than Form Rs. Note that separate establishments at a facility cannot submit separate Form As for the same chemical or chemical category; rather, only one Form A per EPCRA Section 313 chemical or chemical category can be submitted per facility.

While Form A requests facility identification and chemical identification information, no release and other waste management quantity estimations to any media are

required. You must simply certify that the total annual reportable amount did not exceed 500 pounds and that amounts manufactured, processed, or otherwise used did not exceed one million pounds. Once the facility has completed estimates to justify the submission of a Form A, there is a considerable time savings in using the Form A, especially in subsequent years, providing activities involving the chemical or chemical category did not change significantly. It is strongly recommended that you document your initial rationale and refer to it every year, to verify that you have not modified a part of the process that would invalidate the initial rationale supporting submission of Form A.

## 2.10 Trade Secrets

If you submit trade secret information, you must prepare two versions of the substantiation form as prescribed in 40 CFR Part 350 (see 53 FR 28801, July 29, 1988) as well as two versions of the EPCRA Section 313 report. One set of reports should be "sanitized" (i.e., it should provide a generic name for the EPCRA Section 313 chemical or chemical category identity). This version will be made available to the public. The second version, the "unsanitized" version, should provide the actual identity of the EPCRA Section 313 chemical and chemical category and have the trade secret claim clearly marked in Part I, Section 2.1 of the Form R or Form A. The trade secrets provision only applies to the EPCRA Section 313 chemical or chemical category identity. All other parts of the Form R or Form A must be filled out accordingly.

Individual states may have additional criteria for confidential business information and the submittal of both sanitized and unsanitized reports for EPCRA Section 313 chemicals and chemical categories. Facilities may jeopardize the trade secret status of an EPCRA Section 313 chemical by submitting an unsanitized version to a state agency or tribal government that does not require an unsanitized version.

More information on trade secret claims, including contacts for individual state's submission requirements, can be found in the *TRI Forms and Instructions*.

## 2.11 Recordkeeping

Complete and accurate records are absolutely essential to meaningful compliance with EPCRA Section 313 reporting requirements. Compiling and maintaining good records will help you to reduce the effort and cost in preparing future reports, and to document how you arrived at the reported data in the event of U.S. EPA compliance audits. U.S. EPA requires you to maintain records substantiating each EPCRA Section 313 report submission for a minimum of three years. Each facility must keep copies of every EPCRA Section 313 report along with all supporting documents, calculations, work sheets, and other forms that you used to prepare the EPCRA Section 313 report. U.S. EPA may request this supporting documentation during a regulatory audit.

Specifically, U.S. EPA requires the following records be maintained for a period of three years from the date of the submission of a report (summarized from 40 CFR 372.10):

1) A copy of each EPCRA Section 313 report that is submitted.

2) All supporting materials and documentation used to make the compliance determination that the facility or establishment is a covered facility.

3) Documentation supporting the report submitted, including:
   - Claimed allowable exemptions,
   - Threshold determinations,
   - Calculations for each quantity reported as being released, either on or off site, or otherwise managed as waste,
   - Activity determinations, including dates of manufacturing, processing, or use,
   - The basis of all estimates,
   - Receipts or manifests associated with transfers of each EPCRA Section 313 chemical or chemical category in waste to off-site locations, and
   - Waste treatment methods, treatment efficiencies, ranges of influent concentrations to treatment, sequential nature of treatment steps, and operating data to support efficiency claims.

4) For facilities submitting a Form A, all supporting materials used to make the compliance determination the facility or establishment is eligible to submit a Form A, including:
   - Data supporting the determination the alternate threshold applies,
   - Calculations of the annual reportable amounts,

- Receipts or manifests associated with the transfer of each EPCRA Section 313 chemical or chemical category in waste to off-site locations, and
- Waste treatment methods, treatment efficiencies, ranges of influent concentrations to treatment, sequential nature of treatment steps, and operating data to support efficiency claims.

Because EPCRA Section 313 reporting does not require additional testing or monitoring you must determine the best readily available source of information for all estimates. Some facilities may have detailed monitoring data and off-site transfer records that can be used for estimates while others may only have purchase and inventory records. Examples of records that you should keep, if applicable, might include:

- Each EPCRA Section 313 report submitted;
- EPCRA Section 313 Reporting Threshold Worksheets (sample worksheets can be found in Chapter 3 of this document as well as in the *TRI Forms and Instructions)*;
- EPCRA Section 313 Reporting Release and Other Waste Management Quantity Estimation Worksheets (sample worksheets can be found in Chapter 4 of this document);
- Engineering calculations and other notes;
- Purchase records from suppliers;
- Formulation sheets;
- Inventory data;
- Material Safety Data Sheets (MSDS);
- New Source Performance Standards;
- National Pollutant Discharge Elimination System (NPDES)/State Pollutant Discharge Elimination System (SPDES) permits and monitoring reports;
- EPCRA Section 312, Tier II reports;
- Monitoring records;
- Air permits;
- Flow measurement data;
- Resource Conservation Recovery Act (RCRA) hazardous waste generator's reports;
- Pretreatment reports filed with local governments;
- Invoices from waste management firms;
- Manufacturer's estimates of treatment efficiencies;
- Comprehensive Environmental Response, Conservation, and Liability Act of 1980 (CERCLA) Reportable Quantity (RQ) reports;
- RCRA manifests; and
- Process flow diagrams (including emissions, releases, and other waste management activities).

# CHAPTER 3 - EPCRA SECTION 313 CHEMICAL OR CHEMICAL CATEGORY ACTIVITY THRESHOLD DETERMINATIONS

## 3.0 PURPOSE

This chapter provides a step-by-step procedure for determining if any EPCRA Section 313 chemicals or chemical categories exceed a reporting threshold. Threshold determinations are essentially a three step process:

***Step 1)*** Identify any EPCRA Section 313 chemicals or chemical categories you manufacture/import, process, or otherwise use.

***Step 2)*** Identify the activity category and any exempt activities for each EPCRA Section 313 chemical or chemical category.

***Step 3)*** Calculate the quantity of each EPCRA Section 313 chemical or chemical category and determine which ones exceed an activity threshold.

## 3.1 Step 1 - Identify Which EPCRA Section 313 Chemicals or Chemical Categories are Manufactured (Including Imported), Processed, or Otherwise Used

Compile lists of all chemicals and mixtures at your facility. For facilities with many different chemicals and mixtures it is often helpful to prepare two lists: one with the pure (single ingredient) chemicals (including chemical compounds) and one with the mixtures and trade name products. On the second list, under the name of each mixture/trade name product, write the names of all chemicals in that product. Next, compare the chemicals or chemical categories on both lists to the current EPCRA Section 313 chemicals and chemical categories list found in the *TRI Forms and Instructions* (remember that chemicals and chemical categories may be periodically added and deleted and you should use the current reporting year's instructions). Highlight the EPCRA Section 313 chemicals and chemical categories that are on your lists.

Review the lists to be sure each chemical or chemical category is shown by its correct EPCRA Section 313 name. For example, a common EPCRA Section 313 chemical found in printing operations is toluene. Toluene (Chemical Abstracts Service (CAS) Registry

No. 108-88-3) has several synonyms including methylbenzene, methylbenzol, phenylmethane, and toluol. It must be reported on Form R (or Form A), Item 1.2, by its EPCRA Section 313 chemical name, toluene. Synonyms can be found in the U.S. EPA document *Common Synonyms for Chemicals Listed Under Section 313 of the Emergency Planning and Community Right-to-Know Act* (EPA 745-R-95-008).

While you must consider every chemical on the EPCRA Section 313 chemical or chemical category list, you should be aware of the chemicals or chemical categories typically used in printing operations. As a guide, the most frequently reported EPCRA Section 313 chemicals or chemical categories for reporting year 1995 in printing operations, and the processes they are typically used in, are listed in Table 2-3.

A computerized spreadsheet may be helpful in developing your facility's chemical or chemical category list and performing threshold calculations. The spreadsheet could show the chemical or chemical category mixture with corresponding component concentrations; the yearly quantity manufactured, processed, or otherwise used; and the CAS Registry number. The spreadsheet could also be designed to identify the total quantity by activity category (amounts manufactured, processed, and otherwise used) for each EPCRA Section 313 chemical or chemical category in every mixture, compound, and trade name product.

An initial investment of time will be required to develop this spreadsheet; however, the time and effort saved in threshold calculations in subsequent years will be significant. Such a system will also reduce the potential of inadvertently overlooking EPCRA Section 313 chemicals or chemical categories present in mixtures purchased from off-site sources.

To develop the chemical or chemical category list and the associated activity categories you may want to consult the following:

- Material Safety Data Sheets (MSDSs);
- Facility purchasing records;
- New Source Performance Standards;
- Inventory records;

- Air and water discharge permits;
- Individual manufacturing/operating functions; and
- Receipts or manifests associated with the transfer of each EPCRA Section 313 chemical or chemical category in waste to off-site locations.

The following is suggested useful information needed to prepare your EPCRA Section 313 reports and should be included for each chemical or chemical category on your spreadsheet:

- The mixture name and associated EPCRA Section 313 chemical or chemical category names;
- The associated Chemical Abstract Service (CAS) Registry numbers;
- The trade name for mixtures and compounds;
- The throughput quantities; and
- Whether the chemical or chemical category is manufactured, processed, or otherwise used at the facility (be sure to include quantities that are coincidentally manufactured and imported, as appropriate).

MSDSs provide important information for the type and composition of chemicals and chemical categories in mixtures, and for determining whether you have purchased raw materials that contain EPCRA Section 313 chemicals and chemical categories. As of 1989, chemical suppliers to facilities in SIC Major Group Codes 20 through 39 are required to notify manufacturing customers of any EPCRA Section 313 chemicals and chemical categories present in mixtures or trade name products distributed to facilities. The notice must be provided to the receiving facility and may be attached or incorporated into that product's MSDS. If no MSDS is required, the notification must be in a letter that accompanies the first shipment of the product to your facility each year. This letter must contain the chemical name, CAS Registry number, and the weight or volume percent (or a range) of the EPCRA Section 313 chemical or chemical category in mixtures or trade name products.

Carefully review the entire MSDS. Although new MSDSs must list whether EPCRA Section 313 chemicals or chemical categories are present, the language and location of this notification is not currently standardized. Depending on the supplier, this information could be found in different sections of the MSDS. The most likely sections of an MSDS to provide information on EPCRA Section 313 chemicals or chemical categories are:

- Physical properties/chemical composition section;
- Regulatory section;
- Hazardous components section;
- Labeling section; and
- Additional information section.

Also, many EPCRA Section 313 chemicals or chemical categories are present as impurities in mixtures. These quantities must also be considered in threshold determinations unless the concentration is below the *de minimis* value (see Section 3.2.2.1).

**COMMON ERROR - Mixture Components**

Facilities often overlook EPCRA Section 313 chemicals that are present in small quantities of bulk solutions. For example, a common chemical used in printing operations is xylene. Xylene is often purchased in large quantities for use as a solvent, among other things. Most facilities correctly report for xylene; however, ethylbenzene is typically present at up to 15% in solutions of xylene commercially available. Many facilities have historically overlooked the ethylbenzene in their bulk xylene purchases.

**Qualifiers**

Several chemicals on the EPCRA Section 313 chemical and chemical category list include qualifiers related to use or form. Some chemicals are reportable ONLY if manufactured by a specified process or classified in a specified activity category. For example, isopropyl alcohol is only reportable if it is manufactured using the strong acid process and saccharin is reportable only if it is manufactured. Some other chemicals are only reportable if present in certain forms. For example, only yellow or white phosphorus is reportable, while black or red phosphorus is not reportable.

The qualifiers and associated chemicals and chemical categories are presented below. Please make special note of the discussion pertaining to vanadium and vanadium compounds.

- **Aluminum oxide (fibrous) -** Aluminum oxide is only subject to threshold determination and release and other waste management calculations when it is handled in fibrous forms. U.S. EPA has characterized fibrous aluminum oxide for purposes of EPCRA Section 313 reporting as a man-

made fiber commonly used in high-temperature insulation applications such as furnace linings, filtration, gaskets, joints, and seals.

- **Ammonia** - (includes anhydrous ammonia and aqueous ammonia from water dissociable ammonium salts and other sources) On June 26, 1995, U.S. EPA qualified the listing for ammonia (CAS Registry No. 7664-41-7) and deleted ammonium sulfate (solution) (CAS Registry No. 7783-20-2) from the EPCRA Section 313 chemical list. Both the qualification and the deletion were effective as of reporting year 1994. The qualifier for ammonia means that anhydrous forms of ammonia are 100% reportable while only 10% of the total aqueous ammonia is reportable. Any evaporation of ammonia from aqueous ammonia solutions is considered anhydrous ammonia. This qualifier applies to both activity threshold determinations and release and other waste management calculations. Note that while ammonium sulfate is no longer an EPCRA Section 313 chemical, 10% of the aqueous ammonia formed from the dissociation of ammonium sulfate (and all other ammonium salts) is reportable, and must be included in both activity threshold determinations and release and other waste management calculations. Additionally, any ammonium nitrate must also be included in the threshold determination and the nitrate portion included in the release and other waste management calculations, for the nitrate compounds category. U.S. EPA has published guidance on reporting for ammonia and ammonium salts in *Emergency Planning and Community Right-to-Know, EPCRA Section 313, Guidance for Reporting Aqueous Ammonia,* EPA 745-R-95-012 (see Appendix C).

- **Asbestos (friable)** - Asbestos only needs to be considered when it is handled in the friable form. Friable refers to the physical characteristics of being able to crumble, pulverize, or reduce to a powder with hand pressure.

- **Fume or dust** - Two metals (aluminum and zinc) are qualified with "fume or dust." This definition excludes "wet" forms such as solutions or slurries, but includes powder, particulate, or gaseous forms of these metals. There is no particle size limitation for particulates. For example, use of zinc metal as a paint component is not subject to reporting unless the zinc is in the form of a fume or dust. However, even though elemental zinc is reportable only in the fume or dust form, all forms of zinc compounds are reportable. Note that the entire weight of all zinc compounds should be included in the threshold determination for zinc compounds, while only the metal portion of metal compounds is reported in the release and other waste management amounts. Prior to reporting year 2000, vanadium was also qualified with "fume or dust." As of reporting year 2000 this qualifier has been removed for vanadium such that all physical forms are now reportable unless the vanadium is contained in an alloy. Please see the discussion on vanadium and vanadium compounds below, if applicable.

- **Hydrochloric acid (acid aerosols)** - On July 25, 1996, U.S. EPA promulgated a final rule delisting non-aerosol forms of hydrochloric acid (CAS Registry No. 7647-01-0) from the EPCRA Section 313 chemical list (effective for the 1995 reporting year). Therefore, threshold determinations and release and other waste management estimates now apply only to the aerosol forms. Under EPCRA Section 313, the term aerosol covers any generation of airborne acid (including mists, vapors, gas, or fog) without any particle size limitation. Therefore, any process that intentionally sprays hydrochloric acid on an item for cleaning, etching, or other purposes constitutes manufacture and otherwise use of the hydrochloric acid aerosol. If the hydrochloric acid aerosol are used in a process in which any part of the hydrochloric acid becomes incorporated into a product which is then distributed in commerce, the aerosol is considered to be processed. U.S. EPA has published guidance for hydrochloric acid aerosols in *Guidance for Reporting Hydrochloric Acid (acid aerosols including mists, vapors, gas, fog, and other airborne forms of any particle size).* EPA 745-B-99-014. December, 1999.

- **Manufacturing qualifiers** - Two chemicals, saccharin and isopropyl alcohol, contain qualifiers relating to manufacture. The qualifier for saccharin means that only manufacturers of the chemical are subject to the reporting requirement. The qualifier for isopropyl alcohol means that only facilities that manufacture the chemical by the strong acid process are required to report. Facilities that only process or otherwise use these chemicals are not required to report. Thus, a facility that uses isopropyl alcohol as an ink solvent or in cleanup operations should not report for isopropyl alcohol.

- **Nitrate Compounds (water dissociable; reportable only in aqueous solution)** - A nitrate compound is covered by this listing only when in water and if water dissociable. Although the complete weight of the nitrate compound must be used for threshold determinations for the nitrate compounds category, only the nitrate portion of the compound must be considered for release and other waste management calculations. One issue recently raised by industry is how to report nitrate compounds in wastewater and sludge that is applied to farms as a nitrogen source (either on site or off site). Although during such use nitrate compounds may be taken up by plants and cycled back into the ecosystem, U.S. EPA considers that the nitrate compounds in wastewater/sludge to be managed as waste. In this scenario, nitrate compounds should be reported as being disposed to land (either on site or off site as appropriate). U.S. EPA has published guidance for these chemicals in *List of Toxic Chemicals Within the Water Dissociable Nitrate Compounds Category and Guidance for Reporting*, EPA 745-R-96-004.

- **Phosphorus (yellow or white)** - Only manufacturing, processing, or otherwise use of phosphorus in the yellow or white chemical forms require reporting. Black and red phosphorus are not subject to EPCRA Section 313 reporting.

- **Sulfuric acid (acid aerosols)** - On June 26, 1995, U.S. EPA promulgated a final rule delisting non-aerosol forms of sulfuric acid (CAS Registry No. 7664-93-9) from the EPCRA Section 313 toxic chemical list (effective for the 1994 reporting year). Therefore, threshold determinations and release and other waste management estimates now apply only to the aerosol forms. Under EPCRA Section 313, the term aerosol covers any generation of airborne acid (including mists, vapors, gas, or fog) without any particle size limitation. Therefore, any process that intentionally sprays sulfuric acid on an item for cleaning, etching, or other purposes constitutes manufacture and otherwise use of the sulfuric acid aerosol. If the sulfuric acid aerosol is used in a process in which any part of the sulfuric acid becomes incorporated into a product which is then distributed in commerce, the aerosol is considered to be processed. U.S. EPA has published guidance for sulfuric acid aerosols in *Guidance for Reporting Sulfuric Acid (acid aerosols including mists, vapors, gas, fog, and other airborne forms of any particle size).* EPA 745-R-97-007. March 3, 1998.

- **Vanadium and vanadium compounds** - Note that prior to reporting year 2000 (effective December 31, 1999 for EPCRA Section 313 reports that must be filed by July 1, 2001), the fume or dust qualifier also applied to vanadium. As of December 31, 1999, U.S. EPA removed this qualifier for vanadium for reporting year 2000 and beyond. Concurrently, U.S. EPA exempted all physical forms of metallic vanadium that are present in alloys. Therefore, vanadium that is present in any physical form of alloys should not be considered for EPCRA Section 313 reporting. However, if vanadium is separated from the alloy, all physical forms of the vanadium are considered to be manufactured and the quantity manufactured should be applied to the 25,000-pound manufacturing threshold. If the vanadium is subsequently processed or otherwise used, the applicable quantity should also be applied to the processing or otherwise use threshold(s). If a threshold is exceeded, all quantities released or otherwise managed as waste must be reported as appropriate.

  Concurrent with this rulemaking, U.S. EPA also added vanadium compounds to the list of toxic chemicals subject to reporting under EPCRA Section 313. U.S. EPA specifically excluded vanadium compounds from the fume or dust qualifier and from the alloy exemption. Therefore, all physical forms of vanadium compounds must be included in threshold determinations and release and other waste management activities estimates.

In addition to these qualifiers, EPCRA Section 313 chemicals in two compound categories often cause confusion for facilities performing printing operations. These are discussed below:

- **Copper Compounds** - The copper compounds category no longer includes copper phthalocyanine compounds substituted with only hydrogen and/or chlorine and/or bromine. This change was effective for the reporting year 1994 and beyond. Copper compounds may be found in some blue and green ink pigments - Pigment Blue 15, Pigment Green 7, and Pigment Green 36. For more information regarding this issue, refer to the EPA document *Toxics Release Inventory - Copper Phthalocyanine Compounds Excluded for the Reporting Requirements Under the Copper Compounds Category on the EPCRA Section 313 List* (EPA-745-R-95-007).

- **Certain Glycol Ethers** - The certain glycol ethers category includes glycol ethers derived from ethylene glycol, diethylene glycol, and triethylene glycol. It does not include glycol ethers derived from propylene glycol, dipropylene glycol, or tripropylene glycol. Refer to the EPA document *Toxics Release Inventory - List of Toxic Chemicals Within the Glycol Ethers Category* (EPA 745-R-95-006) for a complete discussion, definition, and examples of chemicals that should be included in the certain glycol ethers category. For printing operations, the following chemicals are commonly used and are included in the certain glycol ethers category:

  -- Ethylene glycol monobutyl ether (CAS Registry No. 111-76-2)
  - also known as butyl cellosolve or 2-butoxyethanol
  -- Ethylene glycol dimethyl ether (CAS Registry No. 110-71-4)
  - also known as 1,2-dimenthoxyethane
  -- Diethylene glycol mono-n-butyl ether (CAS Registry No. 112-34-5)
  - also known as butyl carbitol
  -- Diethylene glycol monomethyl ether (CAS Registry No. 111-77-3)
  - also known as 2-methoxyethoxy ethanol
  -- Diethylene glycol monoethyl ether (CAS Registry No. 110-90-0)
  - also known as 2-ethoxyethoxy ethanol
  -- Diethylene glycol dimethyl ether (CAS Registry No. 111-96-6)
  - also known as 2-methoxyethyl ether
  -- Diethylene glycol diethyl ether (CAS Registry No. 112-36-7)
  - also known as 2-ethyoxyethyl ether

  There are two glycol ethers, 2-methoxyethanol (CAS No. 109-86-4) and 2-ethoxyethanol (CAS No. 110-80-5) that are commonly used in printing operations and that are on the EPCRA Section 313 individual chemical

list. Threshold determinations should be made for each of these chemicals individually and separately from the certain glycol ethers category. The following chemicals are also commonly used in the printing, publishing, and packaging industry but are not included in the certain glycol ethers category:

-- Diethylene glycol (CAS Registry No. 111-46-6)
-- Propylene glycol methyl ether (CAS Registry No. 108-65-6)
-- Dipropylene glycol monomethyl ether (CAS Registry No. 3459-09-48)

## 3.2 Step 2 - Identify the Activity Category and Any Exempt Activities for Each EPCRA Section 313 Chemical and Chemical Category

The next step is to identify the activity category (or categories) and any exempt activities for each EPCRA Section 313 chemical and chemical category on your list. Table 3-1 lists the reporting thresholds for each of these activity categories (Tables 3-2 through 3-4 provide detailed definitions of subcategories for each activity category). Each threshold must be individually calculated; they are mutually exclusive and are not additive.

### Table 3-1

### Reporting Thresholds

| Activity Category | Threshold[1] |
|---|---|
| Manufacture (including import) | 25,000 pounds per year |
| Process | 25,000 pounds per year |
| Otherwise use | 10,000 pounds per year |

[1]These reporting thresholds are for non-PBT chemicals. See Section 2.6 for the reporting thresholds applicable to PBT chemicals.

**Example -Threshold Determination**

If your facility manufactures 22,000 pounds of an EPCRA Section 313 chemical or chemical category and you also otherwise use 8,000 pounds of the same chemical or chemical category, you have not exceeded either threshold, and an EPCRA Section 313 report for that chemical or chemical category is not required. However, if your facility manufactures 28,000 pounds per year of an EPCRA Section 313 chemical or chemical category and otherwise uses 8,000 pounds of the same chemical or chemical category, you have exceeded the manufacturing threshold and ALL release and other waste management quantities (except those specifically exempted) of that chemical or chemical category must be reported on the Form R, including those from the otherwise use activity.

**Example - Xylene Isomers**

Printing operations use the EPCRA Section 313 chemical xylene with the mixed isomers, CAS Registry No. 1330-20-7, being the most frequently reported type. Ortho-, meta-, and para-xylenes are listed on the EPCRA Section 313 chemicals and chemical categories list in addition to xylene (mixed isomers). The mixed isomers classification should be used when a mixture contains any combination of two or three of the isomers. The threshold determination for xylene should be calculated for each isomeric form individually unless the xylenes are manufactured, processed, or otherwise used as a mixture of xylene isomers. For example, a covered facility annually uses 8,000 pounds of para-xylene, 6,000 pounds of ortho-xylene, and 8,000 pounds of mixed isomers as carrier solvents in three separate processing lines. All three activities of xylene are classified as otherwise use as the carrier is intended to evaporate and not remain with the product. There are no other uses of any form of xylene in the facility. The otherwise use activity threshold of 10,000 pounds/year has not been reached for any of the xylenes and an EPCRA Section 313 report need not be prepared for xylene. However, should any two of the streams mix, the facility will exceed the otherwise use threshold for mixed isomers and an EPCRA Section 313 report must be prepared for the mixed isomer form of xylene.

**COMMON ERROR - Threshold Determination for Recirculation**

Facilities often incorrectly base threshold calculations on the amount of EPCRA Section 313 chemicals or chemical categories in a recirculation system rather than the amount actually used in the reporting year. The amount of the EPCRA Section 313 chemical or chemical category that is actually manufactured (including the quantity imported), processed, or otherwise used, not the amount in storage or in the system, should be the amount applied to the threshold determination. For example, a solvent containing an EPCRA Section 313 chemical or chemical category is used, recirculated on site, and reused as a solvent. The amount of EPCRA Section 313 chemical or chemical category recirculated in the on-site recycling process is not considered in the threshold determination because it is considered a "direct reuse" and is not reportable. Only the amount of new chemical added to the system should be included in the otherwise used threshold calculation. However, if you send a solvent containing an EPCRA Section 313 chemical or chemical category off site for distillation and subsequent recycling, it should be reported as a transfer to an off-site location for recycling (Part II, Sections 6.2 and 8.5 of the 1999 Form R) because the distillation is considered a waste management activity. The amount of solvent returned to you and subsequently used in the same reporting year must be included in the threshold determination. If the reporting threshold is exceeded, the total quantity recycled should be reported in Section 8.4, i.e., the amount recycled on site must be reported in Section 8.4 each time it is recycled.

Each of the activity categories is divided into subcategories. As discussed in the *TRI Forms and Instructions*, you are required to designate EACH category and subcategory that applies to your facility. Detailed definitions, including descriptions of subcategories for each activity and selected examples, are presented in Tables 3-2, 3-3, and 3-4.

# Table 3-2

## Definitions and Examples of Manufacturing Subcategories

| Manufacturing Activity Subcategory | Definition | Examples in Printing Operations* |
|---|---|---|
| Produced or imported for on-site use/processing | A chemical that is produced or imported and then further processed or otherwise used at the same facility. | Facilities conducting silk screening or printing on T-shirts may import specialty chemicals (dyes) from other countries, which may contain EPCRA Section 313 chemicals and chemical categories. |
| Produced or imported for sale/distribution | A chemical that is produced or imported specifically for sale or distribution outside the manufacturing facility. | |
| Produced as a byproduct | A chemical that is produced coincidentally during the production, processing, or otherwise use of another chemical substance or a mixture and is separated from that substance or mixture. EPCRA Section 313 chemicals or chemical categories produced and released as a result of waste treatment or disposal are also considered byproducts. | |
| Produced as an impurity | A chemical that is produced coincidentally as a result of the manufacture, processing, or otherwise use of another chemical and remains primarily in the mixture or product with that other chemical. | |

* Printing operations do not typically manufacture EPCRA Section 313 chemicals or chemical categories.

# Table 3-3

## Definitions and Examples of Processing Subcategories

| Processing Activity Subcategory | Definition | Examples in Printings Operations* |
|---|---|---|
| Reactant | A natural or synthetic chemical used in chemical or chemical category reactions for the manufacture of another chemical substance or product. Examples include feedstocks, raw materials, intermediates, and initiators. | |
| Formulation component | A chemical that is added to a product or product mixture prior to further distribution of the product and acts as a performance enhancer during use of the product. Examples include additives, dyes, reaction diluents, initiators, solvents, inhibitors, emulsifiers, surfactants, lubricants, flame retardants, and rheological modifiers. | |
| Article component | A chemical that becomes an integral component of an article distributed for industrial, trade, or consumer use. | Zinc compounds, barium compounds, chromium compounds |
| Repackaging only | A chemical that is processed or prepared for distribution in commerce in a different form, state, or quantity. May include, but is not limited to, the transfer of material from a bulk container, such as a tank truck, to smaller containers such as cans or bottles. | Zinc compounds, barium compounds, chromium compounds |

* More complete discussions of the industry-specific examples can be found in Section 4 of this guidance manual.

## Table 3-4

## Definitions and Examples of Otherwise Use Subcategories

| Otherwise Use Activity Subcategory | Definition | Examples in Printings Operations* |
|---|---|---|
| Chemical processing aid | A chemical or chemical category that is added to a reaction mixture to aid in the manufacture or synthesis of another chemical or chemical category substance but is not intended to remain in or become part of the product or product mixture. Examples include process solvents, catalysts, inhibitors, initiators, reaction terminators, and solution buffers. | Xylene, methyl ethyl ketone, zinc compounds, glycol ethers, toluene, methyl isobutyl ketone |
| Manufacturing aid | A chemical or chemical category that aids the manufacturing process but does not become part of the resulting product and is not added to the reaction mixture during the manufacture or synthesis of another chemical substance. Examples include process lubricants, metalworking fluids, coolants, refrigerants, and hydraulic fluids. | Freon, hydraulic fluids |
| Ancillary or other use | A chemical or chemical category that is used for purposes other than aiding chemical processing or manufacturing. Examples include cleaners, degreasers, lubricants, fuels (including waste fuels), and chemicals used for treating wastes. | Toluene, methyl ethyl ketone, ethylbenzene |

* More complete discussions of the industry-specific examples can be found in Chapter 4 of this guidance manual.

**Example - Chemical Processing Aid**

A printing operation uses toluene as a carrier solvent. Ideally all the solvent would evaporate, however, studies have shown 1% of the applied solvent remains on the printed material. Since the function of the solvent is to improve the application of the ink and is a non-incorporative activity, the entire amount of toluene is considered otherwise used. If the solvent's function was such that it was intended to remain with the printed material, it would be considered processed, as is the case for pigments, binders, and other ink components intended to remain with the printed material.

### 3.2.1 Concentration Ranges for Threshold Determination

You should use the best readily available information or where such data are not available, reasonable estimates for all calculations in EPCRA Section 313 reporting; however, the exact concentration of an EPCRA Section 313 chemical or chemical category in a mixture or

trade name product may not be known. The supplier or MSDS may only list ranges, or upper or lower bound concentrations. U.S. EPA has developed guidance on how to use information in this situation for threshold determinations.

- If the concentration is provided as a lower and upper bound or as a range, you should use the mid-point in your calculations for the threshold determination. For example, the MSDS for the trade name product states methanol is present in a concentration of not less than 20% and not more than 40%, or it may be stated as present at a concentration between 20 to 40 percent. You should use the mid-point value of 30% methanol in your threshold calculations.

- If only the lower bound concentration of the EPCRA Section 313 chemical or chemical category is specified and the concentration of other components are given, subtract the other component values from 100 percent. The remainder should be considered the upper bound for the EPCRA Section 313 chemical or chemical category and you should use the given lower bound to calculate the mid-point as discussed above. For example, the MSDS states that a solvent contains at least 50% methyl ethyl ketone (MEK) and 20% non-hazardous surfactants. Subtracting the non-hazardous contents from 100% leaves 80% as the upper bound for MEK. The mid-point between upper (80%) and lower (50%) bounds is 65%, the value you should use in your threshold calculation.

- If only the lower bound is specified and no information on other components is given you should assume the upper bound is 100% and calculate the mid-point as above.

- If only the upper bound concentration is provided, you should use this value in your threshold calculation.

Special guidance for concentration ranges that straddle the *de minimis* value is presented in Section 3.2.2.1.

### 3.2.2 Evaluation of Exemptions

When determining thresholds, you can exclude quantities of any EPCRA Section 313 chemicals and chemical categories that are manufactured, processed, or otherwise used in exempt activities. Exemptions are divided into four classes:

1. *De minimis* exemption;
2. Article exemption;
3. Facility-related exemption; and
4. Activity-related exemptions.

**COMMON ERROR - Exempt Activities**

If an EPCRA Section 313 chemical or chemical category is used in exempt activities, the quantity used in these activities does not need to be included in your threshold determinations or release and other waste management calculations, even if the chemical is used in a reportable activity elsewhere in the facility.

### 3.2.2.1 *De Minimis* Exemption

If the amount of EPCRA Section 313 chemical(s) or chemical categories present in a mixture or trade name product processed or otherwise used is below its *de minimis* concentration level, that amount is considered to be exempt from threshold determinations and release and other waste management calculations. Note that this exemption does not apply to manufacturing, except for importation or as an impurity as discussed below. Also note that the *de minimis* exemption does not apply to the manufacturing, processing, or otherwise use of the PBT chemicals (refer to Section2.6). The *de minimis* concentration for EPCRA Section 313 chemicals and chemical categories is 1%, except for Occupational Safety and Health Administration (OSHA)-defined carcinogens, which have a 0.1% *de minimis* concentration. Note that if a mixture contains more than one member of an EPCRA Section 313 chemical category, the weight percent of all members must be summed. If the total meets or exceeds the category's *de minimis* level, the *de minimis* exemption does not apply. U.S. EPA has published several detailed questions and answers and a directive in the current edition of *EPCRA Section 313 Questions and Answers* (1998 edition is EPA 745-B-98-004; see Appendix A, Directive #2) that may be helpful if you have additional concerns about the *de minimis* exemption. The *TRI Forms and Instructions* list each EPCRA Section 313 chemical and chemical category with the associated *de minimis* value.

Once the *de minimis* level has been equaled or exceeded, the exemption no longer applies to that process stream, even if the EPCRA Section 313 chemical or chemical category later falls below the *de minimis* concentration. All release and other waste management activities that occur after the *de minimis* concentration has been equaled or exceeded are subject to

reporting. The facility does not have to report release and other waste management activities that took place before the *de minimis* concentration was equaled or exceeded.

**Example - *De Minimis***

Your facility processes a mixture containing 1.1% nitric acid and 0.6% manganese. The *de minimis* exemption would apply to manganese because the concentration is below 1% which is the *de minimis* level for manganese; however, it would not apply to nitric acid. All of the nitric acid must be included in threshold determinations, and release and other waste management calculations.

The *de minimis* exemption also applies to EPCRA Section 313 chemicals and chemical categories that are coincidentally manufactured below the *de minimis* level only if that chemical is manufactured as an impurity in a mixture and subsequently distributed in commerce. In addition, the exemption applies to EPCRA Section 313 chemicals and chemical categories below the *de minimis* concentration in an imported mixture or trade name product.

For some mixtures the concentration of EPCRA Section 313 chemicals and chemical categories may be available only as a range. U.S. EPA has developed guidance on how to determine quantities applicable to threshold determinations, and release and other waste management calculations when this range straddles the *de minimis* value. In general, only the quantity of the processed or otherwise used EPCRA Section 313 chemical or chemical categories whose concentration exceeds the *de minimis* must be considered. Therefore, U.S. EPA allows facilities to estimate the quantity below the *de minimis* and exclude it from further consideration. The following examples illustrate this point.

**Examples - *De Minimis* Concentration Ranges**

Example 1:

A facility processes 8,000,000 pounds of a mixture containing 0.25 to 1.25% manganese. Manganese is subject to a 1% *de minimis* concentration exemption. The amount of mixture subject to reporting is the quantity containing manganese above the *de minimis* concentration:

$$(8{,}000{,}000) \times (0.0125 - 0.0099) \div (0.0125 - 0.0025)$$

*(Continued on next page)*

*(Continued from previous page)*

The average concentration of manganese that is not exempt (above the *de minimis)* is:

$$(0.0125 + 0.01) \div (2)$$

Therefore, the amount of manganese that is subject to threshold determination and release and other waste management estimates is:

$$\left[\frac{(8{,}000{,}000) \times (0.0125 - 0.0099}{(0.0125 - 0.0025)}\right] \times \left[\frac{(0.0125 + 0.01)}{(2)}\right] = 23{,}400 \text{ pounds}$$

= 23,400 pounds manganese (which is below the processing threshold)

In this example, because your facility's information pertaining to manganese was available to two decimal places, 0.99 was used to determine the amount below the *de minimis* concentrations. If the information was available to one decimal place, 0.9 should be used, as in Example 2 below.

Example 2:

As in Example 1, manganese is present in a mixture, of which 8,000,000 pounds is processed. The MSDS states the mixture contains 0.2% to 1.2% manganese. The amount of mixture subject to reporting (above *de minimis*) is:

$$(8{,}000{,}000) \times (0.012 - 0.009) \div (0.012 - 0.002)$$

The average concentration of manganese that is not exempt (above *de minimis*) is:

$$(0.012 + 0.01) \div (2)$$

Therefore, the amount of manganese that is subject to threshold determinations and release and other waste management estimates is:

$$\left[\frac{(8{,}000{,}000) \times (0.012 - 0.009)}{(0.012 - 0.002)}\right] \times \left[\frac{(0.012 + 0.01)}{(2)}\right] = 26{,}400 \text{ pounds}$$

= 26,400 pounds manganese (which is above the processing threshold)

The exemption does not apply to EPCRA Section 313 chemicals or chemical categories coincidentally manufactured as byproducts and separated from the product, nor does it apply to EPCRA Section 313 chemicals and chemical categories coincidentally manufactured as a result of waste management activities, from either on site or off site. (Under EPCRA Section 313, U.S. EPA does not consider waste to be a mixture.) For example, many facilities treat waste solvents by incinerating them. If coal is used as the primary fuel source to incinerate these waste solvents, combustion can result in the coincidental manufacture of sulfuric and hydrochloric acid aerosols and metal compounds. Since the *de minimis* exemption does not apply to the

coincidental manufacture of EPCRA Section 313 chemicals or chemical categories as a byproduct or in a waste treatment process, the formation of these compounds must be considered for threshold determinations, and release and other waste management calculations.

#### 3.2.2.2 Articles Exemption

An article is defined as a manufactured item that:

- Is formed to a specific shape or design during manufacture;
- Has end-use functions dependent in whole or in part upon its shape or design; and
- Does not release an EPCRA Section 313 chemical or chemical category under normal conditions of processing or otherwise use of the item at the facility.

If you receive a manufactured article from another facility or you produce the article in your facility and process or otherwise use it without changing the shape or design, and your processing or otherwise use does not result in the release into the environment of more than 0.5 pound of the EPCRA Section 313 chemical or chemical category in a reporting year for all like articles, then the EPCRA Section 313 chemical or chemical category in that article is exempt from threshold determinations and release and other waste management calculations (U.S. EPA allows a release of 0.5 pound or less to be rounded to zero; the 0.5-pound limit does not apply to each individual article, but applies to the sum of all releases from processing or use of all like articles). Section 313 chemicals or chemical categories used to produce an article, however, do not qualify for the article exemption.

The shape and design can be changed somewhat during processing and otherwise use as long as part of the item retains the original dimensions. That is, as a result of processing or otherwise use, if an item retains its initial thickness or diameter, in whole or in part, then it still meets the article definition. If the item's original dimensional characteristics are totally altered during processing or otherwise use, the item would not meet the definition. As an example, items that do not meet the definition would be items that are cold extruded, such as lead ingots formed into wire or rods. However, cutting a manufactured item into pieces that are recognizable as the article would not change the exemption status as long as the diameter and the

thickness of the item remain unchanged. For instance, metal wire may be bent and sheet metal may be cut, punched, stamped, or pressed without losing the article status as long as no change is made in the diameter of the wire or tubing or the thickness of the sheet and no releases above 0.5 pound per year occur for all like articles.

Any processing or otherwise use of an article that results in a release above 0.5 pound per year for each EPCRA Section 313 chemical or chemical category for all like articles negates the exemption. Cutting, grinding, melting, or other processing of a manufactured item could result in a release of an EPCRA Section 313 chemical or chemical category during normal conditions of use and, therefore, could negate the article exemption if the total annual releases from all like articles exceed 0.5 pound in a year. However, if all of the resulting waste is recycled or reused, either on site or off site, so that the release of the EPCRA Section 313 chemical or chemical category does not exceed 0.5 pound for the calendar year, then the article's exemption status is maintained. If the processing or otherwise use of similar manufactured items results in a total release of less than or equal to 0.5 pound of any individual EPCRA Section 313 chemical or chemical category to any environmental media in a calendar year, U.S. EPA will allow this quantity to be rounded to zero and the manufactured items maintain their article status. The 0.5-pound limit does not apply to each individual article, but applies to the sum of all releases from processing or otherwise use of like articles for each EPCRA Section 313 chemical or chemical category. The current edition of *EPCRA Section 313 Questions and Answers* (1998 edition is EPA 745-B-98-004) presents several specific question and answers/discussions pertaining to the articles exemption.

#### 3.2.2.3 Facility-Related Exemption

##### Laboratory Activity Exemption

EPCRA Section 313 chemicals and chemical categories that are manufactured, processed, or otherwise used in laboratories under the supervision of a technically qualified individual are exempted from the threshold determination (and subsequent release and other waste management calculations). This exemption may be applicable in circumstances such as laboratory sampling and analysis, research and development, and quality assurance and quality

control activities. It does not include pilot plant scale or specialty chemical production. It also does not include laboratory support activities. For example, chemicals used to maintain laboratory equipment are not eligible for the laboratory exemption.

**Example - Laboratory Activity Exemption**

A printing facility at a separate research laboratory facility applies various formulations of inks containing EPCRA Section 313 chemicals and chemical categories to various products. The testing is under the supervision of a "technically qualified individual" in the laboratory. The EPCRA Section 313 chemicals and chemical categories used in this activity would be exempt from EPCRA Section 313 reporting and should not be included in any threshold determinations or release and other waste management calculations.

#### 3.2.2.4 Activity-Related Exemptions (Otherwise Use Exemptions)

Some exemptions apply to the otherwise use of an EPCRA Section 313 chemical and chemical category. The specific quantities of EPCRA Section 313 chemicals or chemical categories used in these activities do not need to be included in facility threshold determinations (nor the associated release and other waste management calculations). The following otherwise use activities are considered exempt:

- **EPCRA Section 313 chemicals and chemical categories used in routine janitorial or facility grounds maintenance**. Examples are bathroom cleaners, fertilizers, and garden pesticides similar in type or concentration to consumer products. Materials used to clean process equipment do not meet this exemption.

- **Personal use of items**. Examples are foods, drugs, cosmetics, and other personal items including those items within a facility-operated cafeteria, store, or infirmary. Office supplies such as correction fluid are also exempt.

- **Structural components of the facility**. Exemptions apply to EPCRA Section 313 chemicals and chemical categories present in materials used to construct, repair, or maintain structural components of a facility. An example common to all facilities would be the solvents and pigments used to paint buildings. Materials used to construct, repair, or maintain process equipment are not exempt.

- **EPCRA Section 313 chemicals and chemical categories used with facility motor vehicles**. This exemption includes the use of EPCRA Section 313 chemicals and chemical categories for the purpose of maintaining motor vehicles operated by the facility. Common examples include gasoline, radiator coolant, windshield wiper fluid, brake and transmission fluid, oils and lubricants, cleaning solutions, and solvents in paint used to touch up the vehicle. Motor vehicles include, but may not be limited to, cars, trucks, forklifts, locomotives, and aircraft. Note that this exemption applies to the OTHERWISE USE of the EPCRA Section 313 chemicals and chemical categories. The coincidental manufacture of EPCRA Section 313 chemicals and chemical categories resulting from combustion of gasoline is not exempt and should be considered toward the manufacturing threshold.

**Example - Motor Vehicle Exemption**

Methanol is purchased for use as a processing aid and as a windshield washer anti-freeze in company vehicles. Only the amount used as a processing aid would be used in facility threshold calculations. Even if the facility still exceeds the otherwise use threshold, the amount in the anti-freeze is exempt from release and other waste management calculations.

This exemption does NOT apply to stationary equipment. The use of lubricants and fuels for stationary process equipment (e.g., pumps and compressors) and stationary energy sources (e.g., furnaces, boilers, heaters), are NOT exempt.

**Example - Process Equipment Chemical Use**

Lubricants containing EPCRA Section 313 chemicals or chemical categories used on facility vehicles, or on-site structural maintenance activities that are not integral to the process, are exempt activities. However, lubricants used to maintain pumps and compressors that aid facility process operations are not exempt and the amount of the EPCRA Section 313 chemicals and chemical categories in the lubricant should be applied to the otherwise use threshold.

- **EPCRA Section 313 chemicals and chemical categories in certain air or water drawn from the environment or municipal sources**. Included are an exemption for EPCRA Section 313 chemicals and chemical categories present in process water and non-contact cooling water drawn from the environment or a municipal source, or chemicals and chemical categories present in air used either as compressed air or as an oxygen source for combustion.

**Example - Chemicals in Process Water**

A facility uses river water for one of its processes. This water contains approximately 100 pounds of an EPCRA Section 313 chemical or chemical category. The facility ultimately returns the water that contains the entire 100 pounds of the EPCRA Section 313 chemical or chemical category to the river. The EPCRA Section 313 chemical or chemical category in the water can be considered exempt because the EPCRA Section 313 chemical was present as it was drawn from the environment. The facility does not need to consider the EPCRA Section 313 chemical drawn with river water for threshold determinations or release and other waste management calculations.

### 3.2.3 Additional Guidance on Threshold Calculations for Certain Activities

This section covers three specific situations in which the threshold determination may vary from normal facility operations: reuse, remediation, and recycling activities of EPCRA Section 313 chemicals or chemical categories.

#### 3.2.3.1 Reuse Activities

Threshold determinations of EPCRA Section 313 chemicals or chemical categories that are reused at the facility are based only on the amount of the EPCRA Section 313 chemical or chemical category that is added to the system during the year, not the total volume in the system. For example, a facility operates a refrigeration unit that contains 15,000 pounds of anhydrous ammonia at the beginning of the year. The system is charged with 2,000 pounds of anhydrous ammonia during the year. The facility has therefore otherwise used only 2,000 pounds of the EPCRA Section 313 chemical or chemical category and is not required to report (unless the facility has additional otherwise use activities of ammonia that, when taken together, exceed the reporting threshold). If, however, the whole refrigeration unit was recharged with 15,000 pounds of new or fresh anhydrous ammonia during the year, the facility would exceed the otherwise use threshold, and be required to report.

### 3.2.3.2 Remediation Activities

EPCRA Section 313 chemicals and chemical categories undergoing remediation (e.g., Superfund remediation) are not being manufactured, processed, or otherwise used. Therefore, they are not included in the activity threshold determinations.

However, if you are conducting remediation of an EPCRA Section 313 chemical or chemical category that is also being manufactured, processed, or otherwise used by the facility above an activity threshold level, you must consider this activity for release and other waste management calculations. You must report any release or other waste management quantities of an EPCRA Section 313 chemical or chemical category due to remediation in Part II, Sections 5 through 8, accordingly, of the 1999 Form R. Those quantities would also be considered as part of the amount for determining Form A eligibility. EPCRA Section 313 chemicals or chemical categories used for remediation should be considered toward threshold determinations. If an EPCRA Section 313 chemical or chemical category exceeds one of the reporting thresholds elsewhere at the facility, all release and other waste management activity quantities of that chemical or chemical category must be reported, including release and other waste management activity quantities resulting from remediation.

Excavation (that is considered part of the remedial action) of material already landfilled does not constitute a manufacturing, processing, or other use activity. However, routine activities (e.g., dredging a lagoon), even if not performed every year, are not considered to be remedial actions and are always subject to reporting.

### 3.2.3.3 Recycling Activities

For on-site recycling and reuse systems, where the same EPCRA Section 313 chemical or chemical category is recycled and reused multiple times, the recycled quantity should be counted only once (at the time it is introduced into the system) for threshold calculations. (Please note that for reporting on-site waste management activities the quantity of the EPCRA Section 313 chemical or chemical category should be counted every time it exits the recycling unit in Section 8 of Form R.) EPCRA Section 313 chemicals or chemical categories recycled off

site and returned to the facility should be treated as newly purchased materials for purposes of EPCRA Section 313 threshold determinations.

## 3.3 Step 3 - Calculate the Quantity of Each EPCRA Section 313 Chemical and Chemical Category and Determine Which Ones Exceed an Activity Threshold

The final step is to determine the quantity and which EPCRA Section 313 chemicals and chemical categories exceed an activity threshold. At this point you should have:

1. Identified each EPCRA Section 313 chemical and chemical category at your facility.

2. Determined the activity category for each EPCRA Section 313 chemical and chemical category (manufactured, processed, or otherwise used).

Now, you must sum the amount for each EPCRA Section 313 chemical and chemical category by activity category, subtract all exempt quantities, and compare the totals to the applicable thresholds. Each EPCRA Section 313 chemical and chemical category exceeding **any one** of the activity thresholds requires the submission of an EPCRA Section 313 report. Provided you meet certain criteria you may prepare a Form A rather than a Form R (see Section 2.8).

**COMMON ERROR - Assuming a Threshold is Exceeded**

U.S. EPA recently published a report, *The 1994 and 1995 Toxic Release Inventory Data Quality Report,* EPA 745-R-98-002, with the site survey results of over 100 facilities to evaluate EPCRA Section 313 reporting quality. One of the findings of this survey was that facilities that simply assumed that chemical activity thresholds were exceeded were often in error. This resulted in many of these facilities filing EPCRA Section 313 reports when thresholds were actually not exceeded. Unless the facility has strong grounds to support such an assumption, the time spent in explicitly calculating the activity threshold is well spent.

**COMMON ERROR - Zero Release and Other Waste Management Quantities**

If you meet all reporting criteria and exceed any activity threshold for an EPCRA Section 313 chemical or chemical category, you must file an EPCRA Section 313 report for that chemical or chemical category, even if you have zero release and other waste management activity quantities. Exceeding the chemical activity threshold, not the quantity released or otherwise managed as waste determines whether you must report. Note that if the release and other waste management activity quantity is 500 pounds or less for each chemical or chemical category you may be eligible to use the alternate certification statement, Form A, rather than a Form R (see Section 2-9).

To determine if an EPCRA Section 313 chemical or chemical category exceeds a reporting threshold, you must calculate the annual activity amount of that chemical or chemical category. Start with the amount of chemical or chemical category at the facility as of January 1, add any amounts brought on site during the year and the amount manufactured (including imported), and subtract the amount left in the inventory on December 31. If necessary, adjust the total to account for exempt activities (see Section 3.2.2 for a discussion of exemptions). You should then compare the result to the appropriate threshold to determine if you are required to submit an EPCRA Section 313 report for that chemical or chemical category. Keep in mind that the threshold calculations are independent for each activity category: manufactured, processed, and otherwise used. If more than one activity category applies, the amount associated with each category is determined separately.

Table 3-5 presents a work sheet that may be helpful when conducting your threshold determinations. Table 3-6 illustrates how the work sheet can be used for the following example:

**Example - Threshold Worksheet**

Assume your facility purchases, in the applicable reporting year, two mixtures that contain xylene (mixed isomers). You purchased 25,000 pounds of Mixture A (which is 50% xylene, by weight, according to the MSDS) and 110,000 pounds of Mixture B (which contains 20% xylene, by weight). Further, you determine that you process the entire quantity of Mixture A, while you process only half of Mixture B and otherwise use the other half. You do not qualify for any exempt activities.

In this example, you would have processed a total of 23,500 pounds of xylene (12,500 pounds from activities associated with Mixture A and 11,000 pounds from activities associated with Mixture B). You would also have otherwise used a total of 11,000 pounds (all from Mixture B). Therefore, you would not have exceeded the 25,000-pound threshold for processing; however, you would have exceeded the 10,000-pound threshold for otherwise use and would be required to submit an EPCRA Section 313 report that includes releases and other waste management quantities from all activities (including processing).

## Table 3-5. EPCRA Section 313 Reporting Threshold Worksheet

**Facility Name:** _____
**EPCRA Section 313 Chemical or Chemical Category:** _____
**CAS Registry Number:** _____
**Reporting Year:** _____

**Date Worksheet Prepared:** _____
**Prepared By:** _____

**Amounts of chemical or chemical category manufactured, processed, or otherwise used.**

| Mixture Name or Other Identifier | Information Source | Total Weight (lb) | Percent EPCRA Section 313 Chemical or Chemical Category by Weight | EPCRA Section 313 Chemical or Chemical Category Weight (lb) | Amount of the EPCRA Section 313 Chemical or Chemical Category by Activity (lb): | | |
|---|---|---|---|---|---|---|---|
| | | | | | Manufactured | Processed | Otherwise Used |
| 1. | | | | | | | |
| 2. | | | | | | | |
| 3. | | | | | | | |
| 4. | | | | | | | |
| Subtotal: | | | | | (A)_____lb. | (B)_____lb. | (C)_____lb. |

**Exempt quantity of chemical or chemical category that should be excluded.**

| Mixture Name as Listed Above | Applicable Exemption (de minimis, article, facility, activity) | Fraction or Percent Exempt (if Applicable) | Amount of the EPCRA Section 313 Chemical or Chemical Category Exempt from Above (lb): | | |
|---|---|---|---|---|---|
| | | | Manufactured | Processed | Otherwise Used |
| 1. | | | | | |
| 2. | | | | | |
| 3. | | | | | |
| 4. | | | | | |
| Subtotal: | | | ($A_1$)_____lb. | ($B_1$)_____lb. | ($C_1$)_____lb. |
| | | Amount subject to threshold: | (A-$A_1$)_____ lb. | (B-$B_1$)_____ lb. | (C-$C_1$)_____ lb. |
| Compare to threshold for EPCRA Section 313 reporting. | | Activity threshold quantities[1]: | 25,000 lb. | 25,000 lb. | 10,000 lb. |

**If any one of the thresholds is exceeded, reporting is required for all activities. [Do not submit this worksheet with Form R, retain it for your records.]**

[1]These activity thresholds are for non-PBT chemicals. See Section 2.6 for the activity thresholds applicable to PBT chemicals.

## Table 3-6. Sample EPCRA Section 313 Reporting Threshold Worksheet

**Facility Name:** _____ **Date Worksheet Prepared:** May 1, 2000
**EPCRA Section 313 Chemical or Chemical Category:** Xylene (mixed isomers) **Prepared By:** _____
**CAS Registry Number:** 1330-20-7
**Reporting Year:** 1999

**Amounts of chemical or chemical category manufactured, processed, or otherwise used.**

| Mixture Name or Other Identifier | Information Source | Total Weight (lb) | Percent EPCRA Section 313 Chemical or Chemical Category by Weight | EPCRA Section 313 Chemical or Chemical Category Weight (lb) | Amount of the EPCRA Section 313 Chemical or Chemical Category by Activity (lb): | | |
|---|---|---|---|---|---|---|---|
| | | | | | Manufactured | Processed | Otherwise Used |
| 1. Mixture A | MSDS | 25,000 | 50% | 12,500 | --- | 12,500 | --- |
| 2. Mixture B | MSDS | 110,000 | 20% | 22,000 | --- | 11,000 | 11,000 |
| 3. | | | | | | | |
| 4. | | | | | | | |
| Subtotal: | | | | | (A) 0 lb. | (B) 23,500 lb. | (C) 11,000 lb. |

**Exempt quantity of chemical or chemical category that should be excluded.**

| Mixture Name as Listed Above | Applicable Exemption (de minimis, article, facility, activity) | Fraction or Percent Exempt (if Applicable) | Amount of the EPCRA Section 313 Chemical or Chemical Category Exempt from Above (lb): | | |
|---|---|---|---|---|---|
| | | | Manufactured | Processed | Otherwise Used |
| 1. Mixture A | none | | | | |
| 2. Mixture B | none | | | | |
| 3. | | | | | |
| 4. | | | | | |
| Subtotal: | | | ($A_1$) 0 lb. | ($B_1$) 0 lb. | ($C_1$) 0 lb. |
| | | Amount subject to threshold: | (A-$A_1$) 0 lb. | (B-$B_1$) 23,500 lb. | (C-$C_1$) 11,000 lb. |
| Compare to threshold for EPCRA Section 313 reporting. | | Activity threshold quantities[1]: | 25,000 lb. | 25,000 lb. | 10,000 lb. |

**If any one of three thresholds is exceeded, reporting is required for all activities. [Do not submit this worksheet with Form R, retain it for your records.]**

[1]These activity thresholds are for non-PBT chemicals. See Section 2.6 for the activity thresholds applicable to PBT chemicals.

# CHAPTER 4 - ESTIMATING RELEASE AND OTHER WASTE MANAGEMENT QUANTITIES

## 4.0 PURPOSE

This chapter is intended to guide the user in developing a systematic approach for estimating release and other waste management quantities of EPCRA Section 313 chemicals or chemical categories from printing operations. Figure 4-1 diagrams a recommended approach for estimating quantities of reportable EPCRA Section 313 chemicals or chemical categories.

This chapter also includes common EPCRA Section 313 reporting and compliance issues as they apply to the printing industry. The general discussion (Section 4.1) is followed by a presentation of specific examples and issues (Section 4.2).

## 4.1 General Steps for Determining Release and Other Waste Management Activity Quantities

Release and other waste management activity quantities can be determined by completing the following four steps, described in detail in the following sections.

| | |
|---|---|
| ***Step 1)*** | Prepare a **process flow diagram**. |
| ***Step 2)*** | Identify EPCRA Section 313 chemicals and chemical categories and potential **sources** of chemical release and other waste management activities. |
| ***Step 3)*** | Identify release and other waste management activity **types**. |
| ***Step 4)*** | Determine the most appropriate method(s) and **calculate the estimates** for release and other waste management activity quantities. |

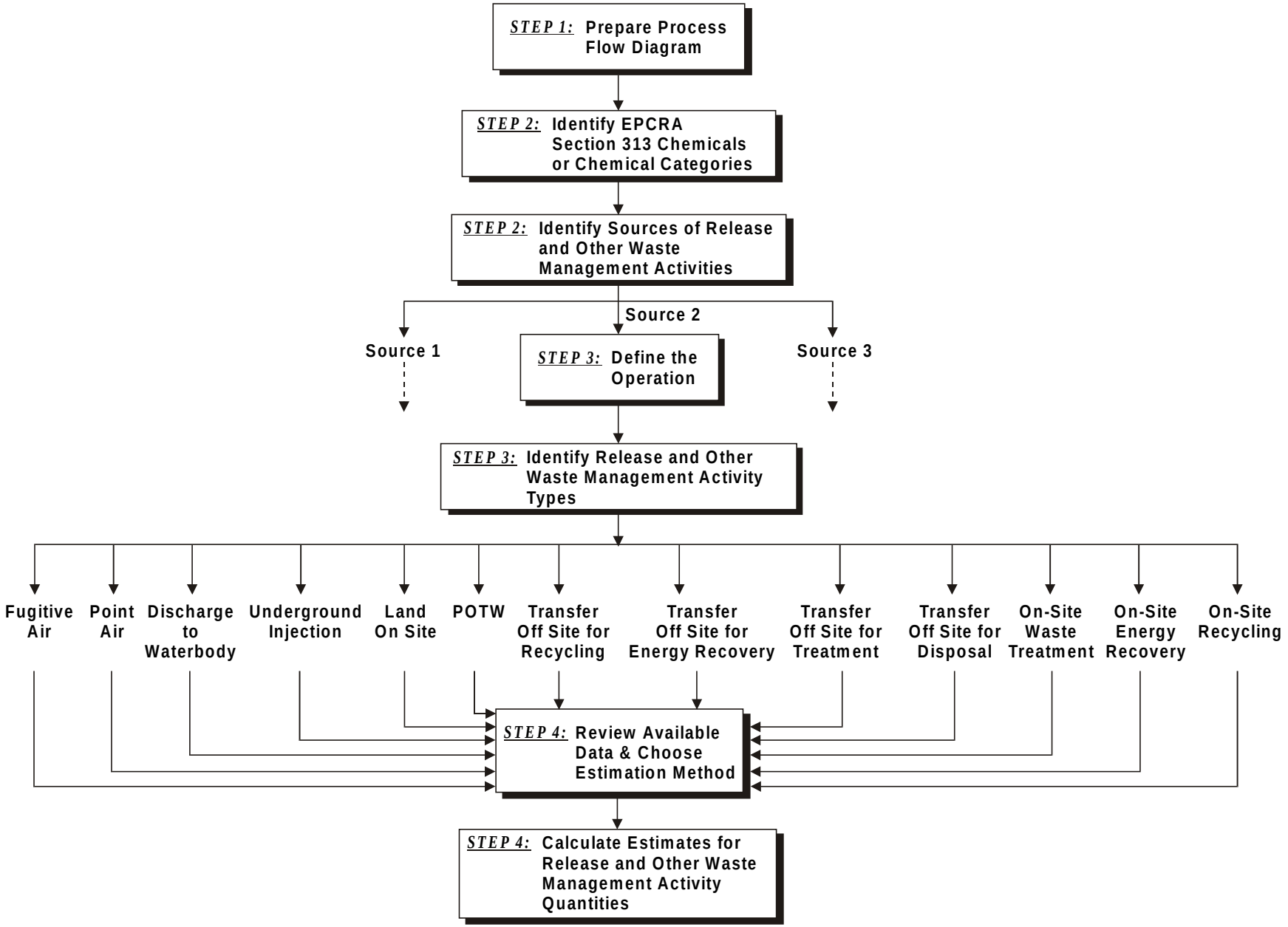


**Figure 4-1. Release and Other Waste Management Activity Calculation Approach**

For EPCRA Section 313 purposes, "sources" are defined as the streams or units that generate the release and other waste management activity (such as process vents, container residue, or spills) and "types" are defined as the environmental media corresponding to elements in Sections 5 through 8 of the 1999 Form R (for example, releases to fugitive air, releases to stack air, discharges to receiving streams or POTWs, or releases to land).

### 4.1.1 Step 1: Prepare a Process Flow Diagram

Preparing a process flow diagram will help you to identify potential sources and types of EPCRA Section 313 chemicals and chemical categories released and otherwise managed as waste at your facility. Depending on the complexity of your facility, you may want to diagram individual processes or operations rather than the entire facility. The diagram should show how materials flow through the processes and identify material input, generation, and output points. Looking at each operation separately, you can determine where EPCRA Section 313 chemicals and chemical categories are used and the medium to which they may be released or otherwise managed as waste.

### 4.1.2 Step 2: Identify EPCRA Section 313 Chemicals and Chemical Categories and Potential Sources of Chemical Release and Other Waste Management Activities

Once a process flow diagram has been developed, you must determine the potential sources and the EPCRA Section 313 chemicals and chemical categories that may be released and otherwise managed as waste from each unit operation and process. Remember to include upsets and routine maintenance activities. Potential sources include:

- Accidental spills and releases;
- Air pollution control devices (e.g., baghouses, electrostatic precipitators, and scrubbers)
- Clean up and housekeeping practices;
- Combustion byproducts;
- Container residues;
- Fittings;
- Flanges;
- Process discharge stream;
- Process vents;
- Pumps;
- Recycling and energy recovery byproducts;
- Relief valves;
- Stock pile losses;

- Storage tanks;
- Storm water runoff;
- Tower stacks;
- Transfer operations;
- Treatment sludge;
- Volatilization from process or treatment; and
- Waste treatment discharges.

Next, you must identify the EPCRA Section 313 chemicals and chemical categories that may be released or otherwise managed as waste from each source. A thorough knowledge of the facility operations and processes is required for this determination. You should also consider whether any of the EPCRA Section 313 chemicals and chemical categories are coincidentally manufactured at your facility. Table 2-3 identifies EPCRA Section 313 chemicals typically used in common printing operations. This table can be used as an aid in identifying which chemicals and chemical categories are found in your process. The list may not include all the EPCRA Section 313 chemicals and chemical categories your facility uses, and it may include many chemicals and chemical categories that you do not use.

### 4.1.3 Step 3: Identify Release and Other Waste Management Activity Types

For each identified source of an EPCRA Section 313 chemical or chemical category, you should examine all possible release and other waste management activity types. Figure 4-2 schematically represents the possible release and other waste management activity types as they correspond to individual data elements of the Form R. Remember to include both routine operations and accidents when identifying types. This diagram along with the following descriptions can be used as a checklist to make sure all possible types of release and other waste management activities have been considered.

**a. Fugitive or Non-Point Air Emissions (Part II, Section 5.1 of Form R)** - Includes all emissions to the air that are not released through stacks, vents, ducts, pipes, or any confined air stream. Examples include:

- Equipment leaks from valves, pump seals, flanges, compressors, sampling connections, open-ended lines, etc.;
- Releases from building ventilation systems, such as a roof fan in an open room;
- Evaporative losses from solvent cleaning tanks, surface impoundments, and spills; and
- Emissions from any other fugitive or non-point source.

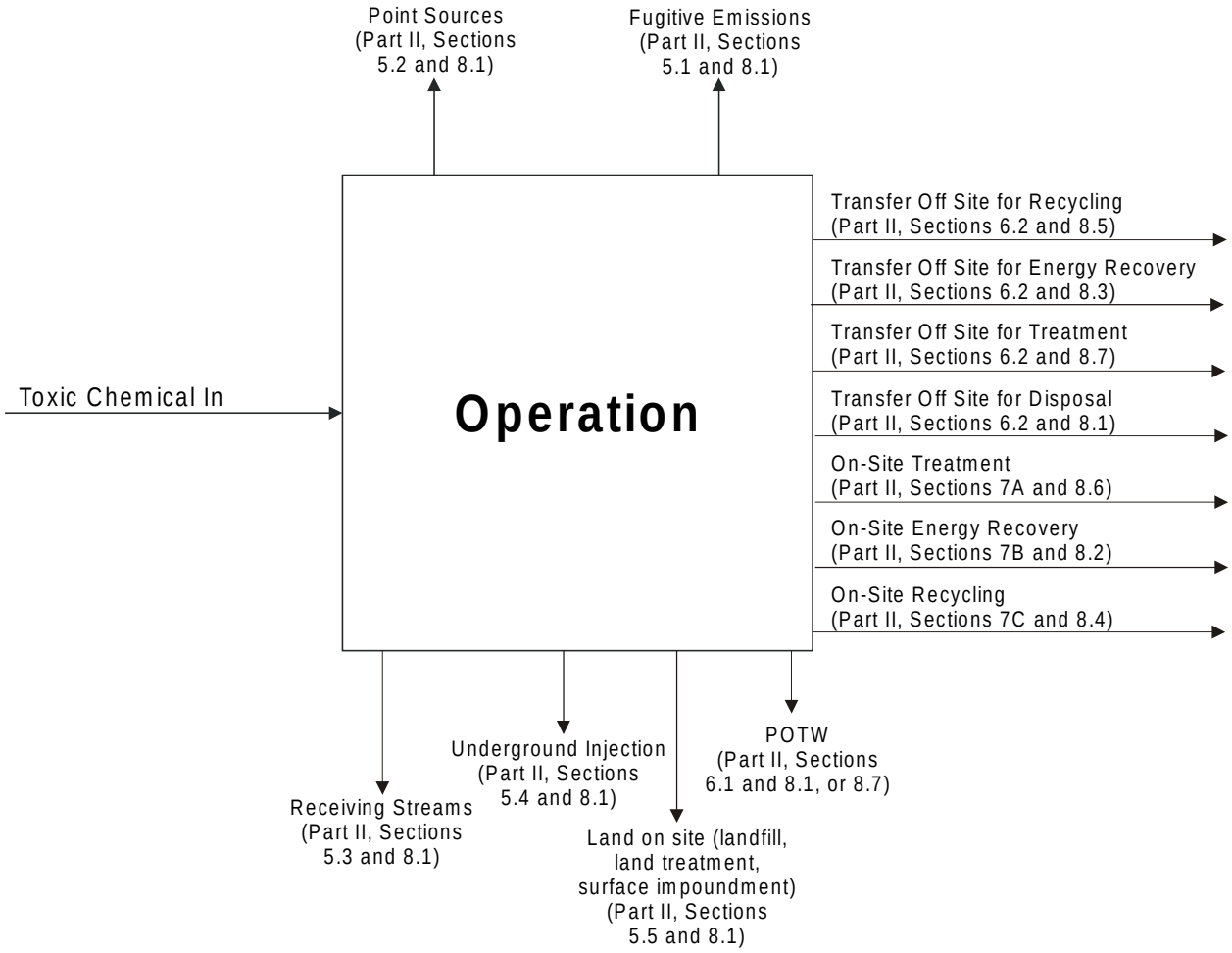


**Figure 4-2. Possible Release and Other Waste Management Types[1] for EPCRA Section 313 Chemicals and Chemical Categories**

[1]Sections refer to 1999 Form R. Quantities released to the environment as a result of remedial actions, catastrophic events, or one-time events should be reported in Part II, Section 8 as Subsection 8.8.

**b. Stack or Point Air Emissions (Part II, Section 5.2 of Form R)** - Includes all emissions to the air that occur through stacks, vents, ducts, pipes, or any confined air stream, including the emissions from storage tanks and air pollution control equipment. Air emissions from printing operations are often channeled through vapor recovery systems and/or air pollution control devices, and are considered stack emissions. Note that emissions released from general room air through a ventilation system are not considered stack or point releases for the purpose of EPCRA Section 313 reporting unless they are channeled through an air pollution control device. Instead, they are considered fugitive releases. However, you should note that for certain state reporting requirements not associated with EPCRA Section 313 reporting, some state air quality agencies consider ventilation systems to be a stack or point source.

**c.** **Discharges to Receiving Streams or Water Bodies (Part II, Section 5.3 of Form R)** - Includes direct wastewater discharges to a receiving stream or surface water body. Discharges usually occur under a NPDES or SPDES permit.

**d.** **Underground Injection On-Site to Class I Wells (Part II, Section 5.4.1 of Form R) and to Class II through V Wells (Part II, Section 5.4.2 of Form R)** - Includes releases into an underground well at the facility. These wells may be monitored under an Underground Injection Control (UIC) Program permit. RCRA Hazardous Waste Generator Reports may be a good source of information for wastes injected into a Class I well. Injection rate meters may provide information for all the well classes.

**e.** **Disposal to Land On-Site (Part II, Section 5.5 of Form R)** - Includes all releases to land on site, both planned (i.e., disposal) and unplanned (i.e., accidental release or spill). The four predefined subcategories for reporting quantities released to land within the boundaries of the facility are:

(1) **Landfill** - The landfill may be either a RCRA permitted (Part II, Section 5.5.1A) or a non-hazardous waste landfill (Part II, Section 5.5.1B). Both types are included if they are located on site. Leaks from landfills in the years subsequent to the disposal of the EPCRA Section 313 chemicals or chemical categories in the landfill do not need to be reported as a release.

(2) **Land treatment/application farming** - Land treatment is a disposal method in which a waste containing an EPCRA Section 313 chemical or chemical category is applied to or incorporated into soil. Volatilization of an EPCRA Section 313 chemical or chemical category because of the disposal operation must be included in the total fugitive air releases and should be excluded from land treatment/application farming to avoid double counting.

Sludge and/or aqueous solutions that contain biomass and other organic materials are often collected and applied to farm land. This procedure supplies a nitrogen source for plants and supplies metabolites for microorganisms. U.S. EPA considers this operation to be land treatment/farming if it occurs on site. If a facility sends this material off site for the same purpose, it is considered to be a “transfer to an off-site location, disposal” and should be reported under Sections 6.2 and 8.1 of the Form R.

The ultimate disposition of the chemical or chemical category after application to the land does not change the required reporting. For example, even if the chemical or chemical category is eventually

biodegraded by microorganisms or plants, it is not considered recycled, reused, or treated.

(3) **Surface impoundment** - A surface impoundment is a natural topographic depression, man-made excavation, or diked area formed primarily of earthen materials that is designed to hold an accumulation of wastes containing free liquids. Examples include: holding, settling, storage, and elevation pits; ponds; and lagoons. Quantities of the toxic chemical released to surface impoundments that are used merely as part of a wastewater treatment process generally must not be reported in this section. However, if the sludge from the surface impoundment contains the EPCRA Section 313 chemical or chemical category, then the EPCRA Section 313 chemicals or chemical categories in the sludge must be estimated in this section unless the sludge is removed and subjected to another waste management activity.

(4) **Other disposal** - Releases to land that do not fit the categories of landfills, land treatment, or surface impoundment are classified as other disposal. This disposal may include any spills or leaks of the EPCRA Section 313 chemical or chemical category to land.

**f. Discharges to Publicly Owned Treatment Works (POTW) (Part II, Section 6.1 of Form R)** - Includes the amount of EPCRA Section 313 chemical or chemical category in water transferred to an off-site POTW. Note that metals and metal compounds transferred to a POTW must also be reported in Section 8.1.

**g. Transfers to Other Off-Site Locations (Part II, Section 6.2 of Form R)** - Includes all off-site transfers containing the EPCRA Section 313 chemical or chemical category for the purposes of disposal, treatment, energy recovery, or recycling. Off-site transfer for disposal includes underground injection, landfill/surface impoundment, other land disposal and transfer to a waste broker for disposal. The amount transferred off site for disposal must also be reported in Section 8.1.

Be sure to consider metals and metal compounds that are present in inks used in printing operations. Waste containing these pigments may be present in spent filters or other waste generated from printing operations.

Also reported in Section 6.2 would be any residual EPCRA Section 313 chemicals or chemical categories in “empty” containers transferred off site. U.S. EPA expects that all containers (bags, totes, drums, tank trucks, etc.) will have a small amount of residual solids and/or liquid. On-site cleaning of containers must be considered for EPCRA Section 313 reporting. If the cleaning occurs with a solvent (organic or aqueous), you must report the disposition of the waste solvent as appropriate. If the

containers are sent off site for disposal or reclamation, you should report the EPCRA Section 313 chemical or chemical category in this section.

**COMMON ERROR - Shipping Container Residue**

Do not overlook residual chemicals in containers. U.S. EPA recently published *The 1994 and 1995 Toxic Release Inventory Data Quality Report,* EPA 745-R-98-002, presenting the site survey results of over 100 facilities to evaluate EPCRA Section 313 reporting quality. This survey found the largest source of overlooked release and other waste management activities was from container residue. So-called "empty" drums may contain an inch or more of liquid after draining and similarly "empty" bags may contain residues of dust and powder. Even though each individual drum or bag may only contain a small amount of an EPCRA Section 313 chemical or chemical category, for facilities that receive hundreds or thousands of drums or bags each year the annual cumulative amount of an EPCRA Section 313 chemical or chemical category can be substantial. The quantities should typically be reported in Section 6.2 (see Table 4-1 for estimates of liquid drum residual and the text of this section for estimates of residual from solids). Please note that unlike RCRA, EPCRA Section 313 does not define what constitutes an "empty" container. EPCRA Section 313 is merely trying to account for all the quantities of toxic chemicals released and otherwise managed as waste.

Actual data and a knowledge of the unloading methods at your facility can be used to estimate the quantity of residual EPCRA Section 313 chemicals or chemical categories in containers. However, U.S. EPA has developed guidance to assist facilities if no site-specific information is available. Table 4-1 provides results from experimentation on residue quantities left in drums and tanks when emptied. These results are presented as the mass percent of the vessel capacity, and are categorized based on unloading method, vessel material, and bulk fluid material properties such as viscosity and surface tension.

# Table 4-1

## Summary of Liquid Residue Quantities From Pilot-Scale Experimental Study[a,b] (weight percent of drum capacity)

| Unloading Method | Vessel Type | Value | Material | | | |
|---|---|---|---|---|---|---|
| | | | Kerosene[c] | Water[d] | Motor Oil[e] | Surfactant Solution[f] |
| Pumping | Steel drum | Range<br>Mean | 1.93 - 3.08<br>2.48 | 1.84 - 2.61<br>2.29 | 1.97 - 2.23<br>2.06 | 3.06<br>3.06 |
| Pumping | Plastic drum | Range<br>Mean | 1.69 - 4.08<br>2.61 | 2.54 - 4.67<br>3.28 | 1.70 - 3.48<br>2.30 | Not Available |
| Pouring | Bung-top steel drum | Range<br>Mean | 0.244 - 0.472<br>0.404 | 0.266 - 0.458<br>0.403 | 0.677 - 0.787<br>0.737 | 0.485<br>0.485 |
| Pouring | Open-top steel drum | Range<br>Mean | 0.032 - 0.080<br>0.054 | 0.026 - 0.039<br>0.034 | 0.328 - 0.368<br>0.350 | 0.089<br>0.089 |
| Gravity Drain | Slope-bottom steel tank | Range<br>Mean | 0.020 - 0.039<br>0.033 | 0.016 - 0.024<br>0.019 | 0.100 - 0.121<br>0.111 | 0.048<br>0.048 |
| Gravity Drain | Dish-bottom steel tank | Range<br>Mean | 0.031 - 0.042<br>0.038 | 0.033 - 0.034<br>0.034 | 0.133 - 0.191<br>0.161 | 0.058<br>0.058 |
| Gravity Drain | Dish-bottom glass-lined tank | Range<br>Mean | 0.024 - 0.049<br>0.040 | 0.020 - 0.040<br>0.033 | 0.112 - 0.134<br>0.127 | 0.040<br>0.040 |

[a]From "Releases During Cleaning of Equipment." Prepared by PEI Associates, Inc. for the U.S. Environmental Protection Agency, Office of Pesticides and Toxic Substances, Washington DC Contract No. 68-02-4248. June 30, 1986.

[b]The values listed in this table should only be applied to similar vessel types, unloading methods, and bulk fluid materials. At viscosities greater than 200 centipoise, the residue quantities can rise dramatically and the information on this table is not applicable.

[c]For kerosene, viscosity = 5 centipoise, surface tension = 29.3 dynes/cm$^2$

[d]For water, viscosity = 4 centipoise, surface tension = 77.3 dynes/cm$^2$

[e]For motor oil, viscosity = 97 centipoise, surface tension = 34.5 dynes/cm$^2$

[f]For surfactant solution viscosity = 3 centipoise, surface tension = 31.4 dynes/cm$^2$

The following example describes how the information in the table can be used to estimate the quantity of an EPCRA Section 313 chemical in water that was used to clean drums on site.

**Example - Container Residue**

You have determined that a Form R for an EPCRA Section 313 chemical must be submitted. The facility purchases and uses one thousand 55-gallon steel drums that contain a 10% aqueous solution of the chemical. Further, it is assumed that the physical properties of the solution are similar to water. The solution is pumped from the drums directly into a mixing vessel and the "empty" drums are triple-rinsed with water. The rinse water is indirectly discharged to a POTW and the cleaned drums are sent to a drum reclaimer.

From Table 4-1, the average drum residue quantity for this scenario is 2.29%. In this example, it can be assumed that all of the residual solution in the drums was transferred to the rinse water. Therefore, the quantity of the EPCRA Section 313 chemical transferred to the drum reclaimer should be reported as "zero."

The annual quantity of residual solution that is transferred to the rinse water can be estimated by multiplying the mean weight percent of residual solution remaining in a pumped steel drum by the total annual weight of solution in the drums. If the density is not known, it may be appropriate to use the density of water (8.34 pounds per gallon):

$$(0.0229) \times (55 \text{ gal/drum}) \times (1{,}000 \text{ drums}) \times (8.34 \text{ lb/gal}) = 10{,}504 \text{ pounds solution}$$

The concentration of the EPCRA Section 313 chemical in the solution is only 10%.

$$(10{,}504 \text{ lb solution}) \times (0.1) = 1{,}050 \text{ pounds of the EPCRA Section 313 chemical}$$

Therefore, 1,050 pounds of the EPCRA Section 313 chemical are transferred to the POTW, and should be reported in Part II, Sections 6.1 and 8.7 of the 1999 Form R. Because they cannot be destroyed, metals cannot be reported as being treated, and metals and metal portions of metal compounds should be reported in Part II, Section 6.1 and 8.1 of the 1999 Form R.

**h. On-Site Waste Treatment (Part II, Section 7A of Form R)** - Includes all on-site waste treatment of EPCRA Section 313 chemicals or chemical categories. The information reported in Section 7A focuses on the treatment of the entire waste stream, not the specific EPCRA Section 313 chemical or chemical category. The information includes type of waste stream (gaseous, aqueous or non-aqueous liquid, or solid); treatment methods or sequence; influent concentrations of the EPCRA Section 313 chemical or chemical category; treatment efficiency (combined removal and destruction) of the entire method or sequence; and whether efficiency data are based on actual operating data. Metals and metal portions of metal compounds treated in a combustion process are not destroyed but should still be reported as going through the treatment process, with a treatment efficiency of zero. Note that only the metal portion of metal compounds should be reported in the Form R. The following example illustrates how Section 7A should be completed for on-site treatment of a wastewater stream containing three EPCRA Section 313 chemicals or chemical categories.

## Example - On-Site Waste Treatment

A process at your facility generates a wastewater stream containing an EPCRA Section 313 chemical (chemical A). A second process generates a wastewater stream containing two EPCRA Section 313 chemicals, a metal (chemical B) and a mineral acid (chemical C). Thresholds for all three chemicals have been exceeded and you are in the process of completing separate Form Rs for each chemical.

The two wastewater streams are combined and sent to an on-site wastewater treatment system before being released to a POTW. This system consists of an oil/water separator that removes 99% of chemical A; a neutralization tank in which the pH is adjusted to 7.5, thereby destroying 100% of the mineral acid (chemical C); and a settling tank where 95% of the metal (chemical B) is removed from the water (and eventually land filled off site).

Section 7A should be completed slightly differently when you file the Form R for each of the chemicals or chemical categories. The table accompanying this example shows how Section 7A should be completed for each chemical or chemical category. First, on each Form R you should identify the type of waste stream in Section 7A.1a as wastewater (aqueous waste, code W). Next, on each Form R you should list the code for each of the treatment steps that is applied to the entire waste stream, regardless of whether the operation affects the chemical or chemical category for which you are completing the Form R (for instance, the first four blocks of Section 7A.1b of all three Form Rs should show: P19 (liquid phase separation), C11 (neutralization), P11 (settling/clarification), and N/A (to signify the end of the treatment system). Note that Section 7A.1b is the only section of the Form R that is not chemical or chemical category specific. It applies to the entire waste stream being treated. Section 7A.1c of each Form R should show the concentration of the specific chemical or chemical category in the influent to the first step of the process (oil/water separation). For this example, assume chemicals or chemical categories A, B, and C are all present at concentrations greater than 1%. Therefore, code "1" should be entered. Section 7A.1d is also chemical specific. It applies to the efficiency of the entire system in destroying and/or removing the chemical or chemical category for which you are preparing the Form R. You should enter 99% when filing for chemical A, 95% for chemical B, and 100% for chemical C. Finally, you should report whether the influent concentration and efficiency estimates are based on operating data for each chemical or chemical category, as appropriate.

Chemical A

| 7A.1a | 7A.1b | | | 7A.1c | 7A.1d | 7A.1e | |
|---|---|---|---|---|---|---|---|
| | 1. P19 | 2. C11 | | | | | |
| W | 3. P11 | 4. N/A | 5. | 1 | 99 % | Yes | No |
| | 6. | 7. | 8. | | | X | |

Chemical B

| 7A.1a | 7A.1b | | | 7A.1c | 7A.1d | 7A.1e | |
|---|---|---|---|---|---|---|---|
| | 1. P19 | 2. C11 | | | | | |
| W | 3. P11 | 4. N/A | 5. | 1 | 95 % | Yes | No |
| | 6. | 7. | 8. | | | X | |

Chemical C

| 7A.1a | 7A.1b | | | 7A.1c | 7A.1d | 7A.1e | |
|---|---|---|---|---|---|---|---|
| | 1. P19 | 2. C11 | | | | | |
| W | 3. P11 | 4. N/A | 5. | 1 | 100 % | Yes | No |
| | 6. | 7. | 8. | | | X | |

Note that the quantity removed and/or destroyed is not reported in Section 7 and that the efficiency reported in Section 7A.1d refers to the amount of EPCRA Section 313 chemical or chemical category destroyed and/or removed from the applicable waste stream. The amount actually destroyed should be reported in Section 8.6 (quantity treated on site). For example, when completing the Form R for chemical B you should report "0" pounds in Section 8.6 because the metal has been removed from the wastewater stream, but not actually destroyed. The quantity of chemical B that is ultimately land filled off site should be reported in Section 6.2 and 8.1. However, when completing the Form R for chemical C you should report the entire quantity in Section 8.6 because raising the pH to 7.5 will completely destroy the mineral acid.

**i.** **On-Site Energy Recovery (Part II, Section 7B of Form R)** - Includes all on-site energy recovery of reported EPCRA Section 313 chemicals and chemical categories. U.S. EPA's view is that EPCRA Section 313 chemicals or chemical categories that do not contribute significant heat energy during combustion processes should not be considered for energy recovery. Therefore, only EPCRA Section 313 chemicals or chemical categories with a significant heating value that are combusted in an energy recovery unit, such as an industrial furnace, kiln, or boiler can be reported for energy recovery. If an EPCRA Section 313 chemical or chemical category is incinerated on site but does not significantly contribute energy to the process, (e.g., chlorofluorocarbons (CFCs)) it must be considered on-site waste treatment (see 4.1.3, h. above). Metals and metal portions of metal compounds will never be combusted for energy recovery. Note that only the metal portion of metal compounds should be reported in the Form R.

**j.** **On-Site Recycling (Part II, Section 7C of Form R)** - Includes all on-site recycling methods used on EPCRA Section 313 chemicals or chemical categories.

**k.** **Source Reduction and Recycling Activities (Part II, Section 8 of Form R)**[1] - Provide information about source reduction and recycling activities related to the EPCRA Section 313 chemical or chemical category for which release and other waste management activities are being reported. Section 8 uses some data collected to complete Part II, Sections 5 through 7. For this reason, Section 8 should be completed last. The relationship between Sections 5, 6, and 8.8 to Sections 8.1, 8.3, 8.5, and 8.7 are provided in equation forms below.

(1) **Quantity Released (Part II, Section 8.1 of Form R)** - The quantity reported in Section 8.1 is the quantity reported in all of Section 5 plus the quantity of metals and metal compounds reported as discharged off site to POTWs in Section 6.1 plus the quantity reported as sent off site for disposal in Section 6.2 minus the quantity reported in Section 8.8 that was released on site or sent off site for disposal:

§8.1 = §5 + §6.1 (metals and metal compounds) + §6.2 (disposal) - §8.8 (on-site release or off-site disposal only)

(2) **Quantity Used for Energy Recovery On-Site (Part II, Section 8.2 of Form R)** - Estimate the quantity of the EPCRA Section 313 chemical or chemical category in wastes combusted for energy recovery on site. This estimate should be the quantity of the

[1]The Subsection 8.1 through 8.8 designations are for the 1999 Form R. Please refer to the current reporting year *TRI Forms and Instructions* for any changes.

chemical or chemical category combusted in the process for which codes were reported in Section 7B. Test data from trial burns or other monitoring data may be used to estimate the quantity of the EPCRA Section 313 chemical or chemical category combusted for energy recovery purposes. If monitoring data are not available, vendor specifications regarding combustion efficiency may be used as they relate to the EPCRA Section 313 chemical or chemical category. A quantity must be reported in Section 8.2 when a method of on-site energy recovery is reported in Section 7B and vice versa.

Two conditions need to be met to report the combustion of an EPCRA Section 313 chemical or chemical category in waste as energy recovery: the chemical or chemical category (1) must have a significant heating value and (2) must be combusted in an energy recovery unit, such as a waste heat boiler, an industrial furnace, or a kiln. If an EPCRA Section 313 chemical or chemical category that does not have a significant heating value (except metals and metal compounds) is combusted for energy recovery on site, it must be considered on-site waste treatment (see 4.1.3.h). Metals and metal compounds in a waste that are combusted on site will never be combusted for energy recovery or treated for destruction and are therefore normally disposed. Note that "NA" should be reported for EPCRA Section 313 chemicals or chemical categories that do not have a significant heating value. This includes metals, metal portions of metal compounds, halogens, hydrochlorofluorocarbons (HCFCs), and CFCs.

(3) **Quantity Used for Energy Recovery Off-Site (Part II, Section 8.3 of Form R)** - The quantity reported in Section 8.3 is the quantity reported in Section 6.2 for which energy recovery codes are reported. If a quantity is reported in Section 8.8, subtract any associated off-site transfers for energy recovery:

§8.3 = §6.2 (energy recovery) - §8.8 (off-site energy recovery)

Two conditions need to be met to report the combustion of an EPCRA Section 313 chemical or chemical category in waste as energy recovery: the chemical or chemical category (1) must have a significant heating value and (2) must be combusted in an energy recovery unit, such as a waste heat boiler, an industrial furnace, or a kiln. If an EPCRA Section 313 chemical or chemical category that does not have a significant heating value (except metals and metal compounds) is sent off site for energy recovery, it must be considered off-site waste treatment (see 4.1.3.g). However, this does not apply to metals and metal compounds. Metals and metal compounds sent off site for combustion in energy recovery units

must be considered as sent off site for disposal because typically they will ultimately be disposed. Metals and metal portions of metal compounds will never be treated or combusted for energy recovery. Note that only the metal portion of metal compounds should be reported in the Form R. Also note that "NA" should be reported for EPCRA Section 313 chemicals or chemical categories that do not have a significant heating value. This includes metals, metal portions of metal compounds, halogens, HCFCs, and CFCs.

(4) **Quantity Recycled On-Site (Part II, Section 8.4 of Form R)** - Estimate the quantity of the EPCRA Section 313 chemical or chemical category recycled in wastes on site. This estimate should be the quantity of the chemical or chemical category recycled in the process for which codes were reported in Section 7C. A quantity should be reported in Section 8.4 when a method of on-site recycling is reported in Section 7C and vice versa. To estimate this quantity, you should determine if operating data exist that indicate a recovery efficiency and use that efficiency value combined with throughput data to calculate an estimate. If operating data are unavailable, available vendor specifications may be appropriate.

(5) **Quantity Recycled Off-Site (Part II, Section 8.5 of Form R)** - The quantity reported in Section 8.5 must be the same as the quantity reported in Section 6.2 for which recycling codes are reported. If a quantity is reported in Section 8.8, subtract any associated off-site transfers for recycling:

If the facility has knowledge about metals being recovered, this quantity should be reported in Section 8.5.

§8.5 = §6.2 (recycling) - §8.8 (off-site recycling)

**COMMON ERROR - Direct Reuse vs. Recycling**

The direct reuse of an EPCRA Section 313 chemical does not need to be included in the amount reported in Part II, Section 8 of Form R. However, recycling of the chemical should be included.

(6) **Quantity Treated On-Site (Part II, Section 8.6 of Form R)** - Waste treatment in Section 8 is limited to the destruction or chemical conversion of the EPCRA Section 313 chemical or chemical category in wastes. The quantities reported in Section 8.6 will be those that have undergone processes that are a subset of the processes for which codes were reported in Section 7A, where treatment includes physical removal from a waste stream. To estimate the quantity treated, you should determine if operating

data exist that indicate a treatment efficiency (e.g., destruction or chemical conversion of the EPCRA Section 313 chemical or chemical category) and use that efficiency value combined with throughput data to calculate an estimate. Because metals cannot be destroyed or chemically converted into something other than the metal or metal compound, metals cannot be reported as treated in Section 8.6. Note that conversion of a metal from one oxidation state to another (e.g., Cr(VI) to Cr(III)) is not considered treatment for Section 8.6. If operating data are unavailable, available vendor specifications may be appropriate. Section 7A must be completed if a quantity is entered in Section 8.6.

(7) **Quantity Treated Off-Site (Part II, Section 8.7 of Form R)** - The quantity reported in Section 8.7 must be the same as the quantity reported in Section 6.2 for which treatment codes are reported plus quantities sent to a POTW as reported in Section 6.1 except for metals and metal compounds. If a quantity is reported in Section 8.8, subtract any associated off-site transfers for treatment:

§8.7 = §6.1 (except metals and metal compounds) + §6.2 (treatment) - §8.8 (off-site treatment)

Because metals cannot be destroyed or chemically converted into something other than the metal or metal compound, metals cannot be reported as treated in Section 8.7. Quantities of metals reported in Section 6.1 and 6.2 should be reported in Section 8.1 (Quantity Released) unless the facility has knowledge that the metal is being recovered.

(8) **Quantity Released to the Environment as a Result of Remedial Actions, Catastrophic Events, or One-Time Events Not Associated with Production Processes (Part II, Section 8.8 of Form R)** - The purpose of this section is to separate quantities recycled off site, used for energy recovery off site, treated off site, or released (including disposed) that are associated with normal or routine production from those quantities that are not. The quantity reported in Section 8.8 is the quantity of the EPCRA Section 313 chemical or chemical category released directly into the environment or sent off site for recycling, energy recovery, treatment, or disposal during the reporting year due to any of the following events:

- Remedial actions;
- Catastrophic events such as earthquakes, fires, or floods; or
- One-time events not associated with normal or routine production processes.

The quantity reported in Section 8.8 should not be included with quantities reported in Part II, Sections 8.1 through 8.7 of Form R, but should be included in Part II, Sections 5 and 6 of Form R as appropriate.

Spills that occur as a routine part of production operations and could be reduced or eliminated by improved handling, loading, or unloading procedures are included in the quantities reported in Section 8.1 through 8.7 as appropriate. This includes small drippings and spills that often occur during transfer operations and loading/unloading operations associated with many painting processes.

On-site releases and off-site transfers for further waste management from remediation of an EPCRA Section 313 chemical or chemical category or an unpreventable accident unrelated to production (such as a hurricane) are reportable in Section 8.8.

On-site treatment, energy recovery, or recycling of EPCRA Section 313 chemicals or chemical categories in wastes generated as a result of remedial actions, catastrophic events, or one-time events not associated with production processes are not reported in Part II, Section 8.8, nor in Sections 8.1 through 8.7 of Form R.

**COMMON ERROR - Double Counting**

Release and other waste management activities should not be "double counted." A single wastewater discharge should not be listed as both a release to water (on site) and a discharge to POTW (off site). Similarly, a release to land should not be listed as both a release to land (on site) and a transfer to an off-site landfill. Estimates of release and other waste management activities should be prepared for Sections 5 through 7 of the Form R. For the most part, Section 8 relies on the data collected to complete these previous sections. Therefore, Section 8 should be completed last. However, the data elements of Section 8 (8.1 through 8.7) are mutually exclusive and care should be taken to avoid double counting.

### 4.1.4 Step 4: Determine the Most Appropriate Method(s) and Calculate the Estimates for Release and Other Waste Management Activity Quantities

After you have identified all of the potential sources for release and other waste management activity types, you must estimate the quantities of each EPCRA Section 313 chemical and chemical category released and otherwise managed as waste. U.S. EPA has identified four basic methods that may be used to develop estimates (each method has been

assigned a code that must be included when reporting). The methods and corresponding codes are:

- Monitoring Data or Direct Measurement (M);
- Mass Balance (C);
- Emission Factors (E); and,
- Engineering Calculations (O).

Descriptions of these techniques are provided in the U.S. EPA publication, *Estimating Releases and Waste Treatment Efficiencies for the Toxic Chemical Release Inventory Forms* (1999 edition). They are also briefly described below. A more detailed discussion including examples of selected calculation techniques is presented in Appendix B. U.S. EPA does not require you to conduct additional sampling or testing for EPCRA Section 313 reporting; however, you are required to use the best, readily available information to determine the method that will result in the most accurate estimate. For example, it may not be appropriate to use emission factors or engineering calculations if more accurate data, such as stack testing results, are available. You are required to identify the primary method used for each estimation.

Many potential sources of data exist for these (and other) methods of developing estimates. Table 4-2 presents potential data sources and the estimation methodology in which they are most likely to be used. Based on site-specific knowledge and potential data sources available, you should be able to determine the best method for calculating each release and other waste management activity quantity.

Once all potential release and other waste management activity sources, types, and estimation methods have been determined, an estimate for each EPCRA Section 313 chemical and chemical category can be developed corresponding to the elements on Form R.

## Table 4-2

## Potential Data Sources for Release and Other Waste Management Calculations

| DATA SOURCES | |
|---|---|
| **Monitoring Data** | **Mass Balance** |
| • Air permits<br>• Continuous emission monitoring<br>• Effluent limitations<br>• Hazardous waste analysis<br>• Industrial hygiene monitoring data<br>• NPDES permits<br>• Outfall monitoring data<br>• pH for acids and bases<br>• POTW pretreatment standards<br>• RCRA permit<br>• Stack monitoring data<br>• New Source Performance Standards<br>• Title V Permit Data | • Air emissions inventory<br>• Hazardous material inventory<br>• Hazardous waste manifests<br>• MSDSs<br>• Pollution prevention reports<br>• Spill event records<br>• Supply and purchasing records |
| **Emission Factors** | **Engineering Calculations** |
| • AP-42 chemical specific emission factors<br>• Facility or trade association derived chemical-specific emission factors | • Facility non-chemical specific emission factors.<br>• Henry's Law<br>• Raoult's Law<br>• SOCMI* or trade association non-chemical specific emission factors<br>• Solubilities<br>• Volatilization rates |

*Synthetic Organic Chemicals Manufacturing Industry.

### 4.1.4.1 Monitoring Data or Direct Measurement (code M)

Using monitoring data or direct measurements is usually the best method for developing chemical release and other waste management activity quantity estimates. Your facility may be required to perform monitoring under provisions of the Clean Air Act (CAA), Clean Water Act (CWA), RCRA, or other statutory or regulatory requirements. If so, data should be available for developing estimates. Data may have also been collected for your facility through an occupational health and safety assessment. If only a small amount of direct measurement data are available or if you believe the monitoring data are not representative, you must decide if another estimation method would give a more accurate result.

**Example - Monitoring Data**

Data from the on-site wastewater treatment facility indicate that the annual average concentration of copper in the discharge is 2 mg/L. The wastewater treatment facility processed 1.5 million gallons of water. The treated wastewater is discharged to an off-site POTW. The amount of copper transferred off site to the POTW (for Sections 6.1 and 8.1 of the Form R) is estimated as follows:

Amount of copper transferred

$$= (2\ \text{mg/L}) \times \left(\frac{\text{g}}{1{,}000\ \text{mg}}\right) \times \left(\frac{\text{lb}}{453.59\ \text{g}}\right) \times \left(\frac{\text{L}}{0.2642\ \text{gal}}\right) \times (1{,}500{,}000\ \text{gal/yr})$$

$$= 25\ \text{lb/yr}$$

**COMMON ERROR - Treatment Efficiencies**

Vendor data on treatment efficiencies often represent ideal operating conditions. You should adjust such data to account for downtime and process upsets during the year that would result in lower efficiencies. Remember that efficiencies reported by vendors are often general and may not apply to specific chemicals. For example, an incinerator or flare may be 99.99% efficient in destroying certain organic chemicals, but will have a 0% efficiency in destroying metals.

#### 4.1.4.2 Mass Balance (code C)

A mass balance involves determining the amount of an EPCRA Section 313 chemical or chemical category entering and leaving an operation. The mass balance is written as follows:

Input + Generation = Output + Consumption

where:

- Input refers to the materials (chemicals) entering an operation. For example, chlorine added to process water as a disinfectant would be considered an input to the water treatment operation.

- Generation identifies those chemicals created during an operation (manufactured, including coincidental manufacturing). For example,

when nitrogen sources are used in biological wastewater treatment systems, nitrate compounds and additional ammonia may be coincidentally manufactured.

- Output refers to the materials (chemicals) leaving an operation by various avenues. Output avenues may include on-site release and other on-site waste management activities; transfers off site for recycling, energy recovery, treatment, storage, or disposal; or the amount of chemical that leaves with the final product. In a printing operation, for example, pigments in the ink may leave the operation as part of the product.

- Consumption refers to the amount of chemical converted to another substance during the operation (i.e., reacted).

The mass balance technique may be applied toward manufactured, processed, or otherwise used chemicals. It is typically most useful for otherwise used chemicals that do not become part of the final product, such as catalysts. For large inputs and outputs, a mass balance may not be the best estimation method, because slight uncertainties in mass calculations can yield significant errors in the release and other waste management estimates.

The gravure printing industry often uses a liquid-liquid mass balance approach to calculate emissions of carrier solvents and/or diluents found in inks. Using this approach, fugitive air emissions are assumed equal to the amount of the EPCRA Section 313 chemical used minus the amount sold back to the vendor, the amount shipped off site as hazardous waste, and the amount remaining in the product.

**Example - Mass Balance**

A facility otherwise uses a volatile EPCRA Section 313 chemical as an ink solvent and adds 20,000 pounds to the system over the course of a year (to make up for system losses). The chemical is released to the air from hood vents, during system filling operations and from leaks in valves and fittings. Monitoring data of the hazardous waste collected from this system indicate that 1,200 pounds of the chemical were sent off site for treatment and/or recovery. The remaining losses are assumed to be fugitive air releases and are estimated as follows:

Fugitive air releases of the EPCRA Section 313 chemical

= Amount input (lb/yr) - Amount sent off site as hazardous waste (lb/yr)

= 20,000 lb/yr - 1,200 lb/yr

= 18,800 lb/yr

**COMMON ERROR - Mass Balances for Otherwise Used Chemicals**

Facilities often do not account for the entire quantity of EPCRA Section 313 chemicals or chemical categories that are otherwise used. Many EPCRA Section 313 chemicals and chemical categories used in printing operations are classified as otherwise used. These may include ink solvents, diluents, and fountain solutions or fountain solution additives. Such chemicals and chemical categories may or may not leave the facility with the product. For those instances where the EPCRA Section 313 chemical or chemical category does not leave the facility in the product, all throughput may be lost during processing through on-site releases to air, water, or land, or it may be shipped off site for further waste management activities. Thus, the entire throughput is often reportable on Form R as release and other waste management activities to various media. Be sure to consider the entire throughput in these circumstances and partition it as appropriate. A mass balance may be the best starting point to estimate the release and other waste management quantities.

#### 4.1.4.3 Emission Factors (code E)

An emission factor is a representative value that attempts to relate the quantity of a chemical or chemical category released with an associated activity. These factors are usually expressed as the weight of chemical or chemical category released divided by a unit weight, volume, distance, or duration of the activity releasing the chemical (e.g., pounds of chemical released per pounds of product produced). Emission factors, commonly used to estimate air emissions, have been developed for many different industries and activities. You should carefully evaluate the source of the emission factor and the conditions for its use to determine if it is applicable to the situation at your facility. If there are more than one EPA published emission factor, you should determine which is most appropriate for your operations and document your rationale.

The most widely known and used source for emission factors is U.S. EPA's publication *Compilation of Air Pollutant Emission Factors (AP-42)*. Volume I of AP-42 contains information on over 200 stationary source categories, including process descriptions and potential sources of air emissions from these processes. Methodologies for estimating the quantity of air pollutant emissions from these sources are presented as Emission Factors. For EPCRA Section 313 purposes only CHEMICAL-SPECIFIC emission factors can be reported as Code "E" - Emission Factor in Part II, Section 5, Column B, Basis for estimate, of the Form R. AP-42 contains emission factors for individual chemicals and for the chemical group Volatile Organic Compounds (VOCs). The VOC emission factors are NOT chemical specific and when

used must be reported in Column B as Code "O" - Engineering Calculations. Each chapter in Volume I covers a major industry or source category. Of special interest to printing operations would be Chapter 4: Evaporation Loss Sources, in particular Sections 4.9.1, General Graphical Printing; and 4.9.2, Publication Gravure Printing.

AP-42 can be accessed at the following Internet site:

- **http://www.epa.gov/ttn/chief/ap42.html**

In an effort to provide current emissions data in an easy-to-access format, U.S. EPA has prepared a CD-ROM entitled Air CHIEF (Air ClearingHouse for Inventories and Emission Factors). The Air CHIEF CD-ROM is updated annually and is available from the Government Printing Office and can be ordered from their Web site. In addition to AP-42, the Air CHIEF CD-ROM contains the Factor Information Retrieval (FIRE) data system, a database management system containing U.S. EPA's recommended emission estimation factors for criteria and hazardous air pollutants. The CD-ROM also contains installable copies of software programs for air emission estimation models such as "TANKS" for VOC emission from storage tanks; "WATER8" for air emissions from wastewater systems; and "CHEMDAT8" for VOC emissions from Treatment, Storage, and Disposal Facility (TSDF) processes. Additional information on Air CHIEF and the CD-ROM is available at:

- **http://www.epa.gov/ttn/chief/airchief.html**

Your facility may have developed non-chemical specific emission factors for fugitive or stack emissions from printing operations based on stack tests for various air permits. Be sure to consider these emission factors if appropriate. However, if such factors are used, they are considered "engineering calculations" for the purposes of EPCRA Section 313 reporting.

**Example - Emission Factors**

Emission factors have been developed for air releases of fuel constituents and combustion products from boiler operations. AP-42 lists a range of formaldehyde emission factors when distillate (No. 2) fuel oil is consumed:

0.035 to 0.061 lb formaldehyde generated/$10^3$ gal No. 2 fuel oil fired.

Assuming a facility met reporting requirements for formaldehyde, the facility operating a boiler using No. 2 fuel oil could use the above emission factor to determine the amount of formaldehyde generated and subsequently released to the air. If 1,000,000 gallons of No. 2 fuel oil is used during a reporting year, the amount of formaldehyde generated would be between:

($0.035$ lb/$10^3$ gal) × (1,000,000 gal) and ($0.061$ lb/$10^3$ gal) × (1,000,000 gal)

= 35 and 61 lb of formaldehyde generated

If there are no engineering controls or air pollution control devices that would destroy or remove the formaldehyde, this quantity should be reported in Part II, Sections 5.2 and 8.1 of the 1999 Form R.

NOTE: No. 2 fuel oil contains other EPCRA Section 313 chemicals and chemical categories and EPCRA Section 313 chemicals and chemical categories may also be coincidentally manufactured during combustion. All should be considered for EPCRA Section 313 reporting.

#### 4.1.4.4 Engineering Calculations (code O)

Engineering calculations are assumptions and/or judgments used to estimate quantities of EPCRA Section 313 chemicals or chemical categories released or otherwise managed as waste. The quantities are estimated by using physical and chemical properties and relationships (e.g., Ideal Gas law, Raoult's law) or by modifying an emission factor to reflect the chemical properties of the chemical in question. Engineering calculations rely on the process parameters; you must have a thorough knowledge of your facility operations to complete these calculations.

## Examples - Engineering Calculations

Example 1:
Stack monitoring data are available for xylene but you are required to report for toluene. Toluene is used in the same application as xylene at your facility and the concentrations of the chemicals in the liquid feedstock are approximately the same. You can estimate the emissions of toluene by adjusting the monitoring data of xylene by a ratio of the vapor pressure for xylene to toluene. This example is an engineering calculation based on physical properties and process operation information:

From facility stack monitoring data, you determine that an estimated 200 lb of xylene are released as air emissions during the reporting year. Toluene is also present in the air emissions, but not monitored. The stack operates at approximately 20°C. Based on literature data, the vapor pressure at 20°C for toluene is 22 millimeters of mercury (mmHg) and for xylene is 6 mmHg. Using a ratio of the vapor pressures, the amount of toluene released as air emissions from the stack can be calculated:

$$\frac{\text{X lb/yr toluene}}{\text{200 lb/yr xylene}} = \frac{\text{22 mmHg (vapor pressure of toluene)}}{\text{6 mmHg (vapor pressure of xylene)}}$$

$$\text{X lb/yr toluene} = \frac{\text{(200 lb/yr xylene) (22 mmHg toluene)}}{\text{(6 mmHg xylene)}}$$

Completing the calculation, you determine that 730 lbs of toluene were released as stack air emissions during the reporting year. The quantity of toluene released should be reported in Section 5.2 of the 1999 Form R.

Example 2:
A printing process uses 10,000 gallons per year of an ink that is 3% xylene by volume. All of the xylene in the ink is assumed to evaporate during the printing operation. The printing process is equipped with a fume collection hood that captures 80% of the ink vapors. The remaining 20% of the ink vapors are assumed to be released as fugitive air emissions. The collection hood routes the ink vapors to an incinerator that is vented to the atmosphere and has a destruction efficiency of 99% for xylene. The specific gravity of xylene is 0.86 and the density of water is 8.34 lb/gal. Fugitive air emissions and stack air emissions may be estimated as follows:

1. The total amount of xylene volatilized to air (assumed to be the total amount of xylene in ink)

   = (10,000 gal/yr ink) × (0.03, three percent xylene) × (0.86 xylene specific gravity) × (8.34 lb/gal, density of water)

   = 2,152 lb/yr xylene evaporated from printing operations

2. The amount of xylene released as fugitive air emissions

   = (2,152 lb/yr) × (0.2; twenty percent released as fugitive air emissions)
   = 430 lb/yr

3. The amount of xylene released as stack air emissions

   = (2,152 lb/yr) × (0.8, eighty percent capture efficiency) × (1-0.99, percent not incinerated)
   = 17 lb/yr

   This should be reported in Part II, Section 5.2 and 8.1 of the 1999 Form R.

Engineering calculations can also include computer models. Several computer models are available for estimating emissions from landfills, wastewater treatment, water treatment, and other processes.

Non-chemical-specific emission factors, Synthetic Organic Chemicals Manufacturing Industry (SOCMI) emission factors, industry-determined emission factors for processes or equipment, and site-specific emission factors also can be used, but must be classified as "Engineering Calculations" for EPCRA Section 313 reporting.

#### 4.1.4.5 Estimating Release and Other Waste Management Quantities

Once all sources, types, and appropriate estimation methodologies have been identified, you can estimate the release and other waste management activity quantities of EPCRA Section 313 chemicals or chemical categories for each element of the Form R. The recommended approach is that you estimate amounts from all sources at your facility to each type as identified by the elements of Form R. Table 4-3 presents a work sheet that may be helpful in compiling this information.

If you prepare a Form R, you must also enter on-site treatment information in Section 7A, including the code for each treatment method used, the destruction and removal efficiency for the EPCRA Section 313 chemical in the treated waste stream, and the concentration of the EPCRA Section 313 chemical in the influent to treatment. You should report treatment methods that do not actually destroy or remove the chemical by entering "zero (0)" for removal efficiency. Similarly, on-site energy recovery methods and on-site recycling methods must be reported in Sections 7B and 7C, respectively.

# Table 4-3. Release and Other Waste Management Quantity Estimation Worksheet

Facility Name: _____ Date Worksheet Prepared: _____
EPCRA Section 313 Chemical or Chemical Category: _____ Prepared by: _____
CAS Registry Number: _____
Reporting Year: _____

| **ON SITE** | | | |
|---|---|---|---|
| **Release or Other Waste Management Activity Type** | **Amount (lb)** | **Basis of Estimate** | **Form R Element* (1999 version)** |
| FUGITIVE AIR | | | |
| Equipment Leaks | | | 5.1 and 8.1 or 8.8 |
| Process Areas | | | 5.1 and 8.1 or 8.8 |
| Evaporative Losses, Spills, Surface Impoundments | | | 5.1 and 8.1 or 8.8 |
| Total = | | | 5.1 and 8.1 or 8.8 |
| STACK AIR | | | |
| Process Vents | | | 5.2 and 8.1 or 8.8 |
| Storage Tanks | | | 5.2 and 8.1 or 8.8 |
| Control Device Stacks | | | 5.2 and 8.1 or 8.8 |
| Other | | | 5.2 and 8.1 or 8.8 |
| Total = | | | 5.2 and 8.1 or 8.8 |
| RECEIVING STREAM/WATER BODY DISCHARGE | | | |
| Stormwater Discharge | | | 5.3 and 8.1 or 8.8 |
| On-Site Treatment Plant Discharge | | | 5.3 and 8.1 or 8.8 |
| Total = | | | 5.3 and 8.1 or 8.8 |
| ON-SITE UNDERGROUND INJECTION | | | |
| Underground Injection to Class I Wells | | | 5.4 and 8.1 or 8.8 |
| Underground Injection to Class II - V Wells | | | 5.4 and 8.1 or 8.8 |
| Total = | | | 5.4 and 8.1 or 8.8 |

*Entries for Section 8.8 only if release is result of remedial action, catastrophic event, or one-time event not associated with production process.

## Table 4-3 (Continued)

| ON SITE | | | |
|---|---|---|---|
| **Release or Other Waste Management Activity Type** | **Amount (lb)** | **Basis of Estimate** | **Form R Element* (1999 version)** |
| ON-SITE LAND | | | |
| RCRA Subtitle C Landfill | | | 5.5 and 8.1 or 8.8 |
| Other Landfill | | | 5.5 and 8.1 or 8.8 |
| Land Treatment/Application Farming | | | 5.5 and 8.1, or 8.8 |
| Surface Impoundment | | | 5.5 and 8.1 or 8.8 |
| Other Disposal | | | 5.5 and 8.1 or 8.8 |
| Total = | | | 5.5 and 8.1 or 8.8 |
| ON-SITE ENERGY RECOVERY | | | |
| Industrial Kiln | | | 8.2 |
| Industrial Furnace | | | 8.2 |
| Industrial Boiler | | | 8.2 |
| Other Energy Recovery Methods | | | 8.2 |
| Total = | | | 8.2 |
| ON-SITE RECYCLING | | | |
| Solvents/Organics Recovery | | | 8.4 |
| Metals Recovery | | | 8.4 |
| Acid Regeneration | | | 8.4 |
| Other Reuse or Recovery | | | 8.4 |
| Total = | | | 8.4 |
| ON-SITE TREATMENT | | | |
| Air Emissions Treatment | | | 8.6 |
| Biological Treatment | | | 8.6 |
| Chemical Treatment | | | 8.6 |
| Incineration/Thermal Treatment | | | 8.6 |
| Physical Treatment | | | 8.6 |
| Solidification/Stabilization | | | 8.6 |
| Total = | | | 8.6 |

*Entries for Section 8.8 only if release is result of remedial action, catastrophic event, or one-time event not associated with production process.

## Table 4-3 (Continued)

| **OFF SITE** | | | | |
|---|---|---|---|---|
| **Release or Other Waste Management Activity Type** | **Amount (lb)** | **Basis of Estimate** | **Form R Element* (1999 version)** | **Off-Site Location (name)** |
| OFF-SITE DISPOSAL | | | | |
| Solidification/Stabilization (metals and metal compounds only) | | | 6.2 and 8.1 or 8.8 | |
| Amount of metal and metal compounds to POTW | | | 6.1 and 8.1 or 8.8 | |
| Wastewater Treatment (excluding POTWs) metals and metal compounds only | | | 6.2 and 8.1 or 8.8 | |
| Underground Injection | | | 6.2 and 8.1 or 8.8 | |
| Landfill/Surface Impoundment | | | 6.2 and 8.1 or 8.8 | |
| Land Treatment | | | 6.2 and 8.1 or 8.8 | |
| Other Land Disposal | | | 6.2 and 8.1 or 8.8 | |
| Other Off-Site Management | | | 6.2 and 8.1 or 8.8 | |
| Total = | | | 6.2 and 8.1 or 8.8 | |
| OTHER AMOUNTS SENT OFF SITE | | | | |
| Amounts sent for storage | | | 6.2 and 8.1 or 8.8 | |
| Amounts sent for unknown waste management practice | | | 6.2 and 8.1 or 8.8 | |
| Total = | | | 6.2 and 8.1 or 8.8 | |
| OFF-SITE TREATMENT | | | | |
| Solidification/Stabilization | | | 6.2 and 8.7 or 8.8 | |
| Incineration/Thermal Treatment | | | 6.2 and 8.7 or 8.8 | |
| Incineration/Insignificant Fuel Value | | | 6.2 and 8.7 or 8.8 | |
| Wastewater Treatment (to POTW excluding metals and metal compounds) | | | 6.1 and 8.7 or 8.8 | |
| Wastewater Treatment (excluding POTW and metal and metal compounds) | | | 6.2 and 8.7 or 8.8 | |
| Sent to Waste Treatment Broker | | | 6.2 and 8.7 or 8.8 | |
| Total = | | | 6.2 and 8.7 or 8.8 | |

*Entries for Section 8.8 only if release is result of remedial action, catastrophic event, or one-time event not associated with production process.

## Table 4-3 (Continued)

| OFF SITE | | | | |
|---|---|---|---|---|
| **Release or Other Waste Management Activity Type** | **Amount (lb)** | **Basis of Estimate** | **Form R Element* (1999 version)** | **Off-Site Location (name)** |
| OFF-SITE ENERGY RECOVERY | | | | |
| Off-Site Energy Recovery | | | 6.2 and 8.3 or 8.8 | |
| Sent to Energy Recovery Broker | | | 6.2 and 8.3 or 8.8 | |
| Total = | | | 6.2 and 8.3 or 8.8 | |
| OFF-SITE RECYCLING | | | | |
| Solvents/Organics Recovery | | | 6.2 and 8.5 or 8.8 | |
| Metals Recovery | | | 6.2 and 8.5 or 8.8 | |
| Other Reuse or Recovery | | | 6.2 and 8.5 or 8.8 | |
| Acid Regeneration | | | 6.2 and 8.5 or 8.8 | |
| Sent to Recycling Waste Broker | | | 6.2 and 8.5 or 8.8 | |
| Total = | | | 6.2 and 8.5 or 8.8 | |

*Entries for Section 8.8 only if release is result of remedial action, catastrophic event, or one-time event not associated with production process.

## 4.2 Determination of Release and Other Waste Management Activity Quantities from Printing Operations

This section discusses the five basic printing technologies (lithography, (roto)gravure, flexography, screen, and letterpress) and the specific issues associated with each that apply to EPCRA Section 313 reporting. A general description of each technique is followed by more detailed discussions of the four fundamental steps that are common to each technique. The suggested method to determine release and other waste management activity quantities from each step are then presented in Sections 4.2.1 through 4.2.4 as follows:

- Imaging/Film Processing (Section 4.2.1);
- Image Carrier Preparation (Section 4.2.2);
- Printing (Section 4.2.3); and
- Post-press (Section 4.2.4).

The printing and publishing industry, defined most broadly, includes firms whose business is dominated by printing operations, firms performing operations commonly associated with printing such as platemaking or bookbinding, and publishers, whether or not they actually print their own material. The printing industry produces a wide array of printed products as well as materials used in the printing process. Some of the products produced within the industry include newspapers, books, greeting cards, checks, annual reports, magazines, and packaging.

From the printing industry's perspective, the industry is organized by the type of printing technology used: lithography, roto-gravure, flexography, screen, letterpress, and digital. Facilities tend to employ one type of printing process exclusively, although some of the larger facilities may use two or more types. Based on the estimated value of shipments from the U.S. printing industry in 1990, lithography dominates the market with a 46% market share; gravure, 18%; flexography, 18%; letterpress, 10%; digital, 15%, and screen printing, 3 percent.[2] The six basic printing processes are described in the following paragraphs.

[2]Variation in facility counts occur across data sources due to many factors such as reporting and definitional differences. This document does not attempt to reconcile these differences, but rather reports the data as they are maintained by each source.

**Lithography.** Lithography is a planographic method of printing (in contrast to gravure, in which the image is etched or engraved below the surface of a plate or cylinder, or flexography, in which the image is raised above the surface of the plate). Where the image area and non-image area are in the same plane, the image area is ink receptive (water repellant) and the non-image area is water receptive (ink repellant). In offset lithographic printing, ink is transferred from the plate to a rubber blanket cylinder. The blanket cylinder is used to print the substrate.

The lithographic printing industry is divided on the basis of press equipment between sheet-fed (where individual sheets of paper are used), non-heatset web (where a continuous roll of paper is used without the application of heat), and heatset web printing (where a continuous roll of paper or other substrate material is used with the application of heat). Lithographic inks do not typically contain EPCRA Section 313 chemicals or chemical categories, but fountain solutions used in the process and cleanup solvents may contain these chemicals.

**Gravure.** Gravure printing is a printing process in which an image (type and art) is etched or engraved below the surface of a plate or cylinder (rotogravure). On a gravure plate or cylinder, the printing image consists of millions of minute cells etched or engraved into copper cylinders that is subsequently plated with chrome. Gravure requires very fluid inks that flow from the cells to the substrate at high press speeds. In addition to inks, other materials including adhesives, primers, coatings, and varnishes may be applied with gravure cylinders. These materials dry by evaporation as the substrate passes through hot air dryers. Solvent-borne or waterborne ink systems can be used but these ink systems are not interchangeable. Both the printing cylinders and the drying systems are specific to the solvent system in use.

The evaporated components of the ink and other materials may contain EPCRA Section 313 chemicals or chemical categories to varying extents. Additional EPCRA Section 313 chemicals and chemical categories may be present in solvents used to clean presses and press components. Rotogravure can be divided into the publication and product/packaging segments. Because of the expense and complexity of rotogravure cylinder engraving, it is particularly suited to long run printing jobs.

**Flexography.** Flexographic printing is an example of relief printing where the image area is raised relative to its non-image area. The pattern to be applied is raised above the printing plate and the image carrier is made of rubber or other elastomeric materials. The major applications of flexographic printing are flexible and rigid packaging; tags and labels; newspapers, magazines, and directories; and consumer paper products such as paper towels and tissues. Because of the ease of plate making and press set up, flexographic printing is more suited to short production runs than gravure and accounts for about 85% of package printing.

Flexographic inks must be very fluid to print properly and include both waterborne and solvent-based systems (solvent-based systems may include EPCRA Section 313 chemicals or chemical categories). The solvents must be compatible with the rubber or polymeric plates; thus, aromatic solvents are not used. Some of the components of solvent-based flexographic ink include alcohols (like ethyl alcohol); glycol ethers; aliphatic hydrocarbons; acetates; and esters.

Flexographic printing can be divided between publication and packaging/product printing. Additional distinctions can be made on the basis of web versus sheetfed press equipment.

**Digital.** Digital printing is any printing completed via digital files, not restricted to short runs and is able to provide variable printing such as incorporating data directly for a compact database and printing to a digital press not using traditional methods of film or printing plates.

**Screen.** In screen printing, ink is forced through a stencil placed over a porous screen. The screens are generally made of silk, nylon, or metal mesh. Screen printing is used for signs, displays, electronics, wall paper, greeting cards, ceramics, decals, banners, and textiles.

Ink systems used in screen printing include ultraviolet cure, waterborne (which may contain ammonia), solvent borne, and plastisol (polyvinyl chloride). Plastisol is mainly used in textile printing. Solvent-based ink systems (which may include EPCRA Section 313 chemicals or chemical categories) contain aliphatic, aromatic, and oxygenated organic solvents.

Both sheetfed and web presses are used. Depending on the substrate printed, the substrate can be dried after each station or, for absorbent substrates, after all colors are printed. Solvent and waterborne inks are dried in hot air or infrared drying ovens. Dryer gasses are typically partially recycled and partially vented (either to the atmosphere or to an air pollution control system).

**Letterpress.** Letterpress printing uses a relief printing plate, as does flexography, and viscous inks similar to lithographic inks. Various types of letterpress plates are available. These plates differ from flexographic plates in that they have a metal backing. The industry currently uses both sheetfed and web presses. The industry currently uses both sheet fed, heatset web, and non-heatset web presses. Newspapers were traditionally printed by web non-heatset letterpress; however, flexographic and lithographic presses are gradually replacing this process. Letterpress is used to print newspapers, magazines, books, stationery, and advertising.

The equipment, applications, and chemicals for each of these printing technologies differ; however, they all print an image on a substrate following the same basic sequence and the associated EPCRA Section 313 reporting issues are similar. The fundamental steps in printing are referred to as imaging/film processing, image carrier preparation, printing, and post-press operations (see Figure 4-3). Process flow diagrams presenting typical sources for EPCRA Section 313 chemical and chemical category release and other waste managed quantities are presented in Sections 4.2.1 through 4.2.4. The type of printing technology that is used depends on a variety of factors, including the substrate used (e.g., paper, plastic, metal, ceramic, etc.), the length and speed of the print run, the required print image quality, and the end product.

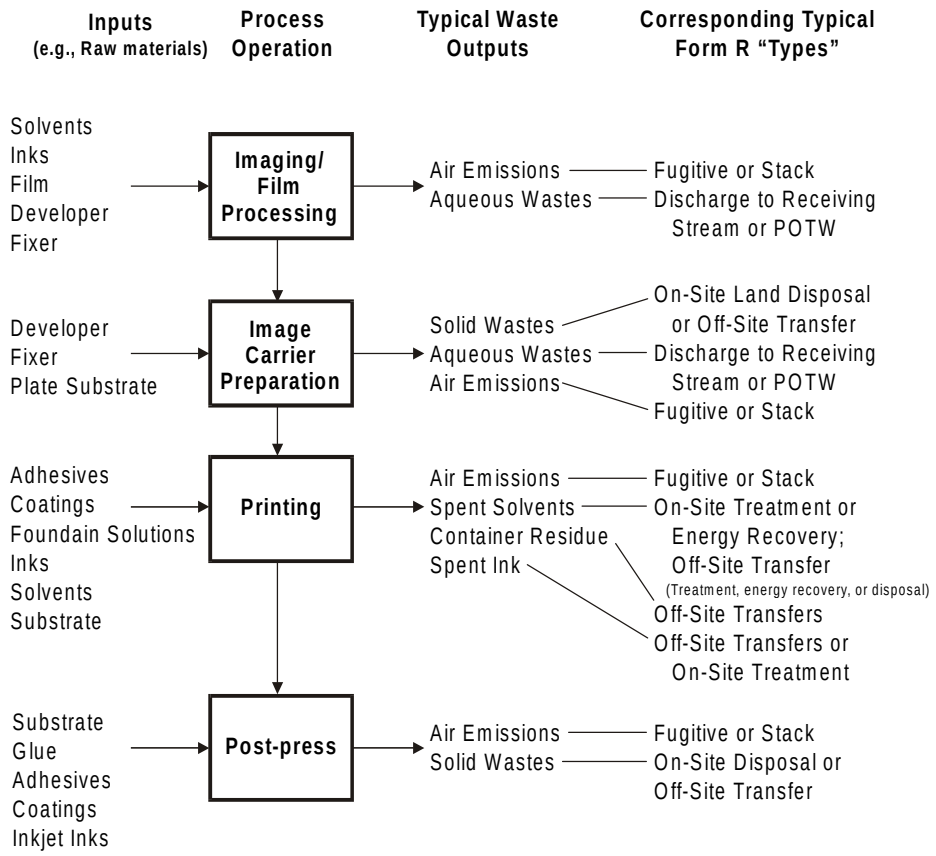


**Figure 4-3. Overall Process Flow Diagram**

The first step in the printing process, imaging/film processing, produces an image of the material to be printed. Traditionally, this image is produced photographically, but with increasing frequency the image is produced electronically. The production of a photographic image involves a variety of chemicals similar to the ones used in other fields of photography, especially black and white film chemistry, which is the most common. In the image carrier preparation step, the image on the film is transferred to either an image carrier or plate. During printing, ink is applied to the plate and the image is transferred to the substrate. In the post-press step, the printed material may be subject to any one of numerous finishing operations, depending on the desired form of the final product.

Each of the six predominant printing technologies differ significantly in how the image is transferred from the image carrier to the substrate in the printing step. In general, the imaging and post-press operations are fairly similar for all printing technologies and the platemaking and press operations are specific to each technology.

Each of the four printing steps is addressed in the following sections. Issues and guidance specific to one of the five traditional printing technologies are included where appropriate. While there are many steps involved prior to actual printing, there are only two where Section 313 chemicals are used most commonly and released in appreciable quantities. These are film processing and image carrier preparation.

### 4.2.1 Imaging/Film Processing

Imaging/film processing operations begin with composition and typesetting, followed by the production of a photographic negative or positive. During composition, art and text are arranged into the desired format, usually through the use of computer systems. Computers can be equipped with both optical character recognition and photographic image scanners and digitizers so that pre-typed material and images can be incorporated into the document being composed.

Once the desired format and images are assembled, they are photographed to produce transparencies. The purpose of this step is to produce a photographic negative (for lithography and letterpress) or a positive (for gravure, screen printing, and other lithographic processes). The printing industry photographic process uses input materials very similar to the ones used in other fields of photography. The process uses paper, plastic film, or a glass base covered with a light-sensitive coating called a photographic emulsion, usually composed of silver halide salts and gelatin. The desired image is projected onto the film to produce a film negative or a film positive. When the exposed photographic emulsion is developed, the silver halide in the emulsion is converted to metallic silver, in proportion to the amount of exposure it has received. The developing action is stopped by immersing the film in a fixing bath, which is mainly composed of sodium thiosulfate ("hypo"). The fixed photographic emulsion is then rinsed. If an image is to be printed as a color reproduction, negatives are made for each of the colors to be used on the press. Multi-color printing is done by passing the same substrate through several color-printing operations. Three or four basic colors are combined on the final product to yield any color desired.

#### 4.2.1.1 Step 1: Prepare Process Flow Diagram

You should prepare a site-specific process flow diagram to help identify all potential sources and types of chemical releases and waste management activities. A typical flow diagram is presented in Figure 4-4.

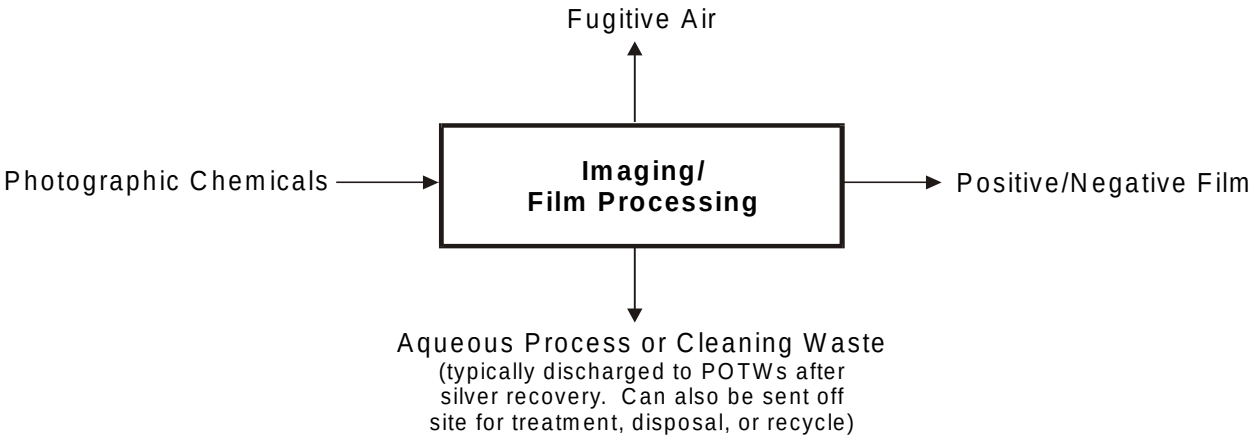


**Figure 4-4. Process Flow Diagram - Imaging/Film Processing**

#### 4.2.1.2 Step 2: Identify EPCRA Section 313 Chemicals and Chemical Categories and Potential Sources of Chemical Release and Other Waste Management Activities

As mentioned above, imaging/film processing operations are similar for each of the five printing technologies and are essentially photographic processes. As such, the most common potential source of EPCRA Section 313 chemicals or chemical categories is from the use of film, glass., and other equipment cleaners, and film developers.

#### 4.2.1.3 Step 3: Identify Release and Other Waste Management Activity Types

The primary source of release is the film processing unit itself. Release and other waste management activity types include fugitive emissions to the air from the volatilization of EPCRA Section 313 chemicals found in cleaning solutions, discharging of Section 313

chemicals to POTWs from film processes and aqueous wastes sent off site for treatment, disposal, or recycling. Typical release and other waste management activities and typical EPCRA Section 313 chemicals or chemical categories found in imaging are presented in Table 4-4.

## Table 4-4

## Typical Release and Other Waste Management Activity Types and Associated EPCRA Section 313 Chemicals and Chemical Categories Found in Imaging/Film Processing

| Type | Typical EPCRA Section 313 Chemicals |
|---|---|
| Fugitive Air | Ammonia, hexane, ethyl benzene, toluene, xylene |
| Off-Site Transfer (typically treatment, disposal, or energy recovery) | Ammonia, hydroquinone, diethanolamine, zinc compounds |

EPCRA Section 313 chemicals and chemical categories used in these processes are often used as ink solvents or cleaners in the application of inks to the printed material. The combination of these various uses may exceed an activity threshold. If so, all release and other waste management quantities must be estimated and reported as appropriate.

#### 4.2.1.4 Step 4: Determine the Most Appropriate Method(s) and Calculate the Estimates for Release and Other Waste Management Activity Quantities

Fugitive emissions from imaging/film processing operations can be estimated using engineering calculations and mass balance approaches based on purchasing records. Aqueous waste disposal can be estimated using hazardous waste manifest data, or other records of shipment.

**EXAMPLE CALCULATION 4.1 - Imaging/Film Processing Operations**

N-Hexane is used at a rotogravure printing facility in a variety of cleanup operations, including the film processing area where it is used as a glass and equipment cleaner. You have determined that your facility is over the reporting threshold for n-hexane, so a Form R is required.

The film shop used 100 pounds of n-hexane over the course of the year, and records indicate that 80 pounds were collected as waste solvent or in cleanup rags and sent off site to an energy recovery facility. This quantity should be reported in Part II, Section 8.3 (quantity used for energy recovery off site). The difference is assumed to be released as fugitive air emissions:

Fugitive air emissions = 100 (lbs/year) - 80 (lbs/year)
= 20 (lbs/year)

This quantity should be reported as fugitive air releases in Part II, Section 5.1 (fugitive or non-point air emissions). Note that if the cleaning operations were done in an enclosed area (such as under a hooded vent), the emissions would be reported as stack air emissions in Part II, Section 5.2 (stack or point air emissions).

### 4.2.2 Image Carrier Preparation

Image carrier preparation operations include those operations used to create a "plate" which is used in each printing process to carry or transfer ink in the form of the image to the substrate. The following paragraphs contain a brief description of the platemaking process for each of the five printing technologies.

**Lithography**. In lithography, a planographic plate is used where the image areas and the non-image areas are on the same plane (they are neither raised nor depressed) and are defined by differences in their physiochemical properties. The industry performs several types of lithographic printing, but all types use a planographic plate and rely on the fundamental property that oil and water do not mix. As a result, lithographic inks are traditionally oil-based derived from petroleum. A metal or paper or plastic printing plate is coated with a light-sensitive chemical which becomes ink receptive when exposed to light. Through the photographic negative, the coating is exposed to light, chemically changing the exposed areas and making the image areas ink-receptive. The non-image areas remain water-receptive. Water-based mixtures, referred to as fountain solution, are applied to enhance the non-image area's ability to repel ink. Fountain solutions may contain 5 to 10% isopropyl alcohol or they may contain alcohol substitutes that meet the same needs but with a lower VOC content. It should be noted that while isopropyl alcohol is considered a VOC, it is not subject to EPCRA Section 313 reporting

requirements, unless being manufactured by the strong acid process. Therefore, isopropyl alcohol processed or used in these operations should not be considered in threshold determination. Through the use of inking rollers, ink is applied to the plate, adhering only to the image areas. The image is transferred or offset from the plate to a rubber roller (the blanket), which then transfers the image to the substrate being printed.

**Gravure**. Gravure printing uses almost exclusively electro-mechanically engraved copper image carriers (plates) to separate the image area from the non-image area. Typically, the gravure image carrier is a cylinder consisting of a steel or plastic base plated with copper or a special alloy. Electronic impulses drive a diamond stylus which engraves minute cells at the rate of over 3,000 per second. Today, most of the gravure cylinders are engraved directly from digital files. Chemical etching, which is a dominant technology for the gravure cylinder imaging in the past, represents a very small percentage of the total engravings done today. It is used for special applications only.

**Flexography and Letterpress**. The traditional method of making flexography and letterpress plates begins with exposing a metal plate through a negative then processing the exposed plate using an acid bath. The resulting metal engraving may be used directly for letterpress (flatbed), or alternatively used to mold a master using a bakelite board. The board, under pressure and heat, fills the engraving and, when cooled, becomes a master for molding a rubber plate with a raised area that will transfer the graphics. The second method of making plates employs photopolymers in either a solid or liquid state. The photopolymer sheet (consisting of monomers) is exposed to light through a negative and the unexposed areas are washed out by means of a solvent or water wash. The result is the relief plate.

**Screen Printing**. Unlike the impervious plates used in the other four printing techniques, the screen printing process uses a porous polyester mesh. The mesh is stretched tightly over a frame, and a stencil, which defines the image to be printed, is applied to the mesh. A squeegee applies pressure to the ink thereby forcing the ink through the open areas of the screen. The thread count and diameter determine the amount of ink deposited onto the substrate below.

#### 4.2.2.1 Step 1: Prepare Process Flow Diagram

As discussed above, image carrier preparation operations will differ significantly depending on the printing technology employed; however, the general process streams and the associated EPCRA Section 313 chemical and chemical category release and other waste management activities are expected to be similar for each technology. You should prepare a site-specific process flow diagram to help identify all potential sources and types of EPCRA Section 313 chemical and chemical category release and other waste management activities. A typical flow diagram is presented in Figure 4-5.

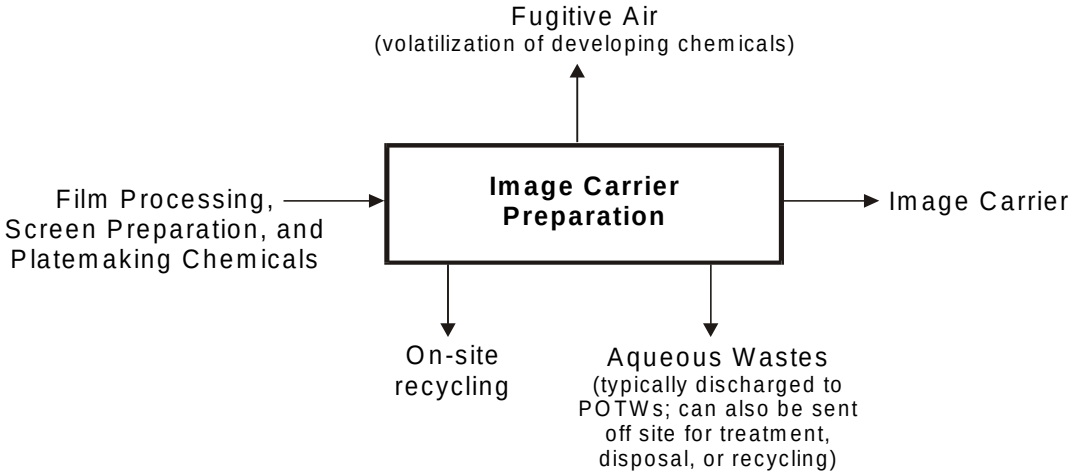


**Figure 4-5. Process Flow Diagram - Image Carrier Preparation**

#### 4.2.2.2 Step 2: Identify EPCRA Section 313 Chemicals and Chemical Categories and Potential Sources of Chemical Release and Other Waste Management Activities

As described above, image carrier preparation or platemaking operations are unique for each of the five printing processes. Typical sources of EPCRA Section 313 chemicals and chemical categories are flexographic plate developers, etching chemicals (typically nitric acid) for metallic plates, and copper and chromium electroplating solutions.

#### 4.2.2.3 Step 3: Identify Release and Other Waste Management Activity Types

Release sources from image carrier preparation or platemaking processes include process units and spent electroplating solutions. Release types include fugitive emissions to the air from the volatilization of developing chemicals, and aqueous wastes sent off site for treatment, disposal, or energy recovery. Acids used in image carrier preparation operations (typically nitric acid used in etching of metal plates) and neutralized on site before being discharged to a POTW should be identified as being treated on site if the pH of the effluent remains between 6 and 9 (See *Estimating Releases for Mineral Acid Dischargers Using pH Measurement*, U.S. Environmental Protection Agency, June 1991). Typical release and other waste management activities and typical EPCRA Section 313 chemicals or chemical categories found in image carrier preparation operations are presented in Table 4-5.

## Table 4-5

## Typical Release and Other Waste Management Activity Types and Associated EPCRA Section 313 Chemicals and Chemical Categories Found in Image Carrier Preparation Operations

| Type | Typical EPCRA Section 313 Chemicals and Chemical Categories |
|---|---|
| Fugitive Air | Ethylene glycol, certain glycol ethers, methanol |
| POTW | Ethylene glycol, certain glycol ethers, methanol, nitric acid |
| Off-Site Treatment | Nitric acid, copper and chromium compounds |
| Off-Site Energy Recovery | Ethylene glycol, certain glycol ethers, methanol |

#### 4.2.2.4 Step 4: Determine the Most Appropriate Method(s) and Calculate the Estimates for Release and Other Waste Management Activity Quantities

Fugitive emissions from image carrier preparation operations can be estimated using engineering calculations and mass balance approaches based on purchasing records. Aqueous waste disposal can be estimated using hazardous waste manifest data.

Wastewater volumes are normally metered or may be estimated based on make-up quantities required. Monitoring data for on-site wastewater treatment plant permits and NPDES permit requirements can generally provide wastewater concentrations of EPCRA Section 313 chemicals and chemical categories that are directly or indirectly discharged in your facility's wastewater. The following example provides an example using NPDES data for estimating the quantity of an EPCRA Section 313 chemical discharged in wastewater.

**EXAMPLE CALCULATION 4.2 - Image Carrier Preparation**

Your facility collects spent electroplating solution from gravure cylinder making operations for shipment to an off-site treatment facility. The solution contains copper compounds at a concentration of 200 (mg/L). Over the course of a year you send 100,000 gallons of spent solution to an off-site facility for treatment.

Off-site transfers = 200 (mg/L) * (1 g/$10^3$ mg) * (1 lb/454 g) * 3.785 (L/gal) * 100,000 (gal/year)
= 167 (lb./year)

This quantity should be reported in Part II, Section 6.2 (off-site transfers).

### 4.2.3 Printing

The majority of releases in the printing industry occur during the actual printing step. For purposes of this discussion, printing also includes cleanup operations, that may occur continuously during the print run or between runs. The EPCRA Section 313 chemicals and chemical categories used in each printing technology differ; therefore, typical chemicals and chemical categories specific to each technology are highlighted in the general discussion below, which is followed by the suggested steps to identify and calculate release and otherwise managed quantities.

The inks used in **lithography** are oil-based and traditionally do not contain EPCRA Section 313 chemicals as solvents, but may contain reportable metals or metal compounds. A metal or paper or plastic printing plate is coated with an ink-receptive image area. The non-image areas remain water-receptive. Water-based mixtures, referred to as fountain solution, are applied to enhance the non-image area's ability to repel ink. Fountain solutions may contain isopropyl alcohol (which is not reportable if processed or otherwise used; see "Manufacturing Qualifiers," Section 3.1) or certain glycol ethers (which may be reportable; see *Toxic Release Inventory; List of Toxic Chemicals Within the Glycol Ethers Category*, U.S.

Environmental Protection Agency, May 1995. EPA-745-R-95-006). Through the use of inking rollers, ink is applied to the plate, adhering only to the image areas. The image is transferred or offset from the plate to a rubber roller (the blanket), which then transfers the image to the substrate being printed. Some lithographic inks are curable using ultraviolet energy or electron beam, and do not contain solvents.

In **gravure printing**, ink is applied to the engraved cylinder, then wiped from the surface by the doctor blade, leaving ink only on the engraved image area. The printing substrate is brought into contact with the cylinder with sufficient pressure so that it picks up the ink left in the depressions on the cylinder. Gravure printing requires low viscosity inks (with solvents containing EPCRA Section 313 chemicals such as toluene, xylene, and methyl ethyl ketone (MEK)) that fill the tiny depressions on the plate. To dry the ink and drive off the solvents, the paper travels through drying ovens. The solvent-laden air can be passed through carbon beds to trap and condense the solvent. Most of the ink solvents, and associated EPCRA Section 313 chemicals and chemical categories, are recaptured using this process, and can either be recycled for reuse, reused directly in printing processes, sold back to the ink vendor, or destroyed by thermal or catalytic oxidation.

In the typical **flexographic printing** sequence, the substrate is fed into the press from a roll. The image is printed as the substrate travels through a series of stations with each station printing a single color. Each station is made up of four rollers where the first roller transfers the ink from an ink pan to the second roller, the meter roller (also known as an Anilox Roll). Most Anilox rollers are equipped with a doctor blade system which shears excess ink from the surface of the roller, allowing for better control of ink transfer to the actual printing plate. Chambered doctor blades, a relatively new development, consist of an enclosed chamber that holds a controlled amount of ink and two doctor blades. Since the ink is within an enclosed system, solvent evaporation (and thus air emissions) is minimized.

The meter roller meters the ink to a uniform thickness onto the third roller, the plate cylinder. The substrate moves between the plate cylinder and the fourth roller. The plate is attached to the third roller (the plate cylinder) and the fourth roller (the impression cylinder) applies pressure to the plate cylinder, thereby forming the image on the substrate. The printed

web proceeds through an overhead dryer section to dry the ink before the next station. Upon completion of the printing of the last color, the web may then move through an overhead tunnel dryer to remove all residual solvents. The ink tray used on larger flexographic presses is very long, allowing for significant evaporation of ink solvents (which typically contain EPCRA Section 313 chemicals such as toluene or xylene). Printers with the more narrow presses (for tags, labels, and tapes) generally use water-based inks (which may contain ammonia; see Appendix C for guidance in reporting ammonia if applicable) and ultraviolet (UV) coatings. As in gravure coating operations, fast-drying low-viscosity inks are used. These inks lie on the surface of nonabsorbent substrates and solidify when solvents evaporate or are cured, making flexography ideal for printing on impervious materials such as polyethylene, cellophane, and other plastics and metallized surfaces. The soft plates allow quality printing on compressible surfaces such as cardboard packaging.

**Letterpress**, like flexography, uses a plate with a raised image on a metal or plastic plate. The three types of letterpresses in use today are the platen, flat-bed, and rotary. On the platen press, the raised plate is locked on a flat surface. The substrate is placed on another flat surface and pressed against the inked plate. The flat-bed cylinder press prints as the substrate passes around an impression cylinder on its way from the feed stack to the delivery stack. These presses are often very slow as compared to lithographic, flexographic, or gravure presses. The most popular letterpress is the web-fed rotary letterpress. Designed to print both sides of the web simultaneously, these presses are used primarily for printing newspapers.

**Digital printing**, or electronic printing, is primarily xerographic and laser printing. In both processes, an image is recorded on a drum in the form of an electrostatic charge. The electrostatic charge is then transferred to a sheet of material, generally paper. Toner, a conductive fine dry powder, is then spread on the paper and attracted to the electrostatically charged areas of the paper. The paper is then heat treated to melt and affix the toner to the paper.

The **screen printing** process uses a porous polyester mesh as a plate, unlike the impervious plates used in the other four printing processes, . The mesh is stretched tightly over a frame, and a stencil, which defines the image to be printed, is applied to the mesh. A squeegee

applies pressure to the ink thereby forcing the ink through the open areas of the screen. A thread count and porosity of the mesh determine the amount of ink deposited onto the substrate below. The primary EPCRA Section 313 chemicals used in screen printing include organic solvents found in ink, such as toluene. The chemical composition of the ink used varies depending on the substrate printed and the end product produced. The screen printing process uses five main categories of inks: UV-curable, solvent-based, water-based for graphic applications, plastisols for textile applications, and water-based for textile applications. Depending on the ink category, a wide variety of EPCRA Section 313 chemicals and chemical categories could be present; including but not limited to:

#### 4.2.3.1 Step 1: Prepare Process Flow Diagram

Again, the specific operations and associated EPCRA Section 313 chemicals and chemical categories used in the printing step can vary tremendously depending on the specific printing techniques employed. However, the general process streams, sources, and types of EPCRA Section 313 chemicals and chemical categories are expected to be similar for each technology.

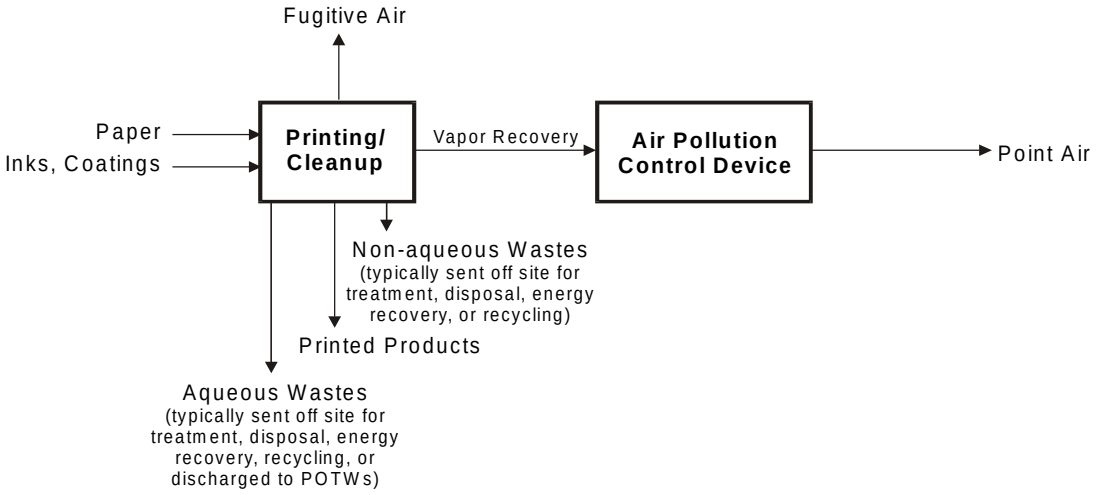


**Figure 4-6. Process Flow Diagram - Printing Step**

A site-specific process flow diagram should be prepared to help identify all potential sources and types of chemical release and waste management activities. A typical flow diagram is presented in Figure 4-6.

**COMMON ERROR**

Metals may be present in waste inks and solvents sent off-site for energy recovery, treatment, or disposal. In cases where the waste is sent off-site for energy recovery, the metals should not be reported as "Off-Site Energy Recovery", but may be reported as "Off-Site Disposal" or if the ink is to be recycled, then "Off-Site Recycling."

#### 4.2.3.2 Step 2: Identify EPCRA Section 313 Chemicals and Chemical Categories and Potential Sources of Chemical Release and Other Waste Management Activities

The majority of release and other waste management activities from printing operations occur during the cleanup process of the printing step. Sources of EPCRA Section 313 chemicals and chemical categories include ink solvents, cleanup solvents, fountain solution, fountain solution additives, and solvents found in coatings.

#### 4.2.3.3 Step 3: Identify Release and Other Waste Management Activity Types

Releases from printing and cleanup operations usually occur in the form of fugitive air and stack air emissions. Other waste management activity types associated directly with the cleanup process of the printing step include on-site treatment (through the use of air pollution control devices such as thermal oxidizers); on-site recycling (condensers or carbon adsorption/absorption where the solvent is recovered and recycled); and off-site treatment, disposal, or energy recovery or recycle. As discussed earlier, on-site and off-site waste management activity (including treatment, disposal, recycling, energy recovery, etc.,) quantities should be reported in Part II, Sections 7 and 8 of the Form R as appropriate. Please refer back to Section 4.1.3 of this manual for a detailed discussion of how these quantities should be reported.

Non-heatset lithography and letterpress printing operations rarely use air pollution control devices, so air releases from these operations are expected to be in the form of fugitive emissions. However, depending on location and ambient air quality attainment status, heatset

lithographers and heatset letterpress operations may utilize air pollution control devices (oxidizers or carbon adsorption systems) and virtually all gravure shops and wide web flexographic printers using solvent based ink coating systems are expected to have control devices (oxidizers). Although flexo printers using solvent inks are required to have oxidizers in most states, this is not true for all situations. Water ink users and small emitters nay not be required to have oxidizers. In those instances where control devices (or drying ovens vented to the atmosphere without the use of control devices) are employed, air emissions will occur in the form of both fugitive (uncontrolled) and stack releases from the control stack.

Note that any EPCRA Section 313 chemical or chemical category sent through an air pollution control device is considered to have been treated for destruction if it is converted to another chemical or it is HC1 or $H_2SO_4$ acid aerosols. The treatment efficiency of the unit should be reported in Section 7A and the quantity treated for destruction should be reported in Section 8.6. Also, note that any EPCRA Section 313 chemical or chemical category sent through an air pollution control device is considered to have been captured for further waste management activities if it is not converted to another chemical or it is not HC1 or $H_2SO_4$ acid aerosols. The capture efficiency of the unit should be reported in Section 7A and the quantity captured should be reported in Sections 6 and/or 8 depending on the final disposition of the chemical or chemical category.

Typical release and other waste management activities and corresponding EPCRA Section 313 chemicals are presented in Table 4-6.

## Table 4-6

## Typical Release and Other Waste Management Activity Types and Associated EPCRA Section 313 Chemicals and Chemical Categories Found in Printing Operations

| Type | Typical EPCRA Section 313 Chemicals |
|---|---|
| Fugitive Air | Toluene, xylene, certain glycol ethers, MEK, methanol, ammonia |
| Stack Air | Toluene, xylene, certain glycol ethers, MEK, ethanol, MIBK |
| Off-Site Transfer From Container Residue (off-site treatment, disposal, energy recovery, or recycle) | Zinc, toluene, xylene, MEK, MIBK, barium, cadmium, manganese |
| On-Site Treatment | Toluene, xylene, certain glycol ethers, MEK, methanol, ammonia |
| Off-Site Transfer From Liquid Cleaning Waste (off-site treatment, disposal, energy recovery, or recycle) | Zinc, toluene, xylene, MEK, MIBK, barium, cadmium, manganese |

While the release and other waste management activity types identified above are typical across the printing industry, not every operation is expected to have all release and other waste management activity types. Release and other waste management activity types expected from different technologies are as follows:

Lithography (non-heatset), Letterpress, Screen Printing: Fugitive air, Container Residue, Off-Site Transfer

Heatset Lithography, Gravure, Flexography: Fugitive Air, Stack Air, Container Residue, On-Site Treatment, Off-Site Transfer

#### 4.2.3.4 Step 4: Determine the Most Appropriate Method(s) and Calculate the Estimates for Release and Other Waste Management Activity Quantities

Many of the solvents and other EPCRA Section 313 chemicals and chemical categories processed and otherwise used in certain printing operations are very volatile. It may be appropriate to assume that most or all of the chemical or chemical category will evaporate and

be released to the air, either as a fugitive emission, or as a stack emission if vapors are isolated or channeled through an air pollution control device. Do not forget to account for any potential container residue before estimating the quantity that may be volatilized during processing or otherwise use. Potential container residue quantities can be estimated as discussed in Section 4.1.3(g).

Mass balance techniques may be the most appropriate method of estimating air releases. The total amount released can be estimated based on purchasing records combined with beginning and end-of-year facility inventory amounts. If air pollution control equipment is used, stack test data (which may be obtained from compliance tests, performance tests, etc.) can be used to determine control efficiencies. Alternatively, short term stack test data are often used to develop site-specific emission factors in terms of pounds of pollutant per unit time, or pounds of pollutant per pounds of chemical used. These emission factors may be used to estimate annual emissions based on operating parameters such as the amount of chemical used over the course of a year or the number of hours of operation. See Section 4.1.4.3 for a complete discussion of emission factors, including references for identifying factors associated with the printing industry and corresponding examples. Remember that air pollution control devises are considered on-site treatment systems. Therefore, Part II, Section 7A and 8.6 of the 1999 Form R should be completed as appropriate for any EPCRA Section 313 chemical or chemical category entering the devise. Note that any EPCRA Section 313 chemical or chemical category sent through an air pollution control device is considered to have been treated for destruction if it is converted to another chemical or it is HCl or $H_2SO_4$ acid aerosols. The treatment efficiency of the unit should be reported in Section 7A and the quantity treated for destruction should be reported in Section 8.6. Also, note that any EPCRA Section 313 chemical or chemical category sent through an air pollution control device is considered to have been captured for further waste management activities if it is not converted to another chemical or it is not HCl or $H_2SO_4$ acid aerosols. The capture efficiency of the unit should be reported in Section 7A and the quantity captured should be reported in Sections 6 and/or 8, depending on the final disposition of the chemical or chemical category. Section 4.1.3(h) presents an example for on-site treatment.

EPCRA Section 313 chemicals and chemical categories sent off site for disposal, treatment, energy recovery, or recycling can be estimated based on analytical data from

hazardous waste manifests. Alternatively, if the amount of an EPCRA Section 313 chemical or chemical category released in the form of air emissions (and the amount destroyed and removed through the use of on-site control equipment, if applicable) is known, a mass balance approach can be used with this information to determine the amount of the chemical sent off site.

**EXAMPLE - Printing Operations (Fugitive Releases of Ethylene Glycol)**

Ethylene glycol is used in a sheetfed offset lithographic printing process as a component in fountain solution concentrate and is also found in the fountain solution additive.

You must determine whether a threshold is exceeded for this chemical. For these applications, the ethylene glycol is not intended to remain in a product sold in commerce and is considered otherwise used. It is subject to a 10,000 pound per year reporting threshold. The relevant data are the amount of fountain solution concentrate and fountain solution additive used, and the concentration of ethylene glycol found in each material. In the calendar year, 10,000 gallons of fountain solution concentrate containing 0.717 pounds of ethylene glycol per gallon and 3,000 gallons of fountain solution additive containing 1.2 pounds per gallon ethylene glycol are added to the fountain solution. Each solution is purchased in 55-gallon drums. It is assumed that after emptying the drums into the process equipment, they are left open in a designated, outdoor drum storage area and allowed to completely dry.

Threshold determination:

Amount otherwise used = (fountain solution concentrate) × (ethylene glycol concentration in fountain solution concentrate) + (fountain solution additive) × (ethylene glycol concentration in fountain solution additive)

= (10,000 gallons/year) × (0.717 lb ethylene glycol/gallon) + (3,000 gallons/year) × (1.2 lb ethylene glycol/gallon)

= 7,170 lb ethylene glycol/year + 3,600 lb ethylene glycol/year
= 10,770 lb ethylene glycol/year

Because the otherwise use reporting threshold is exceeded, you must estimate and report all release and other waste management activities of ethylene glycol.

Fugitive Air Release:

In this example, it is assumed that all ethylene glycol used at the facility evaporates during the printing operations (none remains with the product). Further, since the drums were allowed to completely dry before being disposed, no ethylene glycol is expected in container residue. Therefore, it can be assumed that the entire quantity of this EPCRA Section 313 chemical volatizes and is released as a fugitive air emission.

Fugitive air release = 10,770 lb ethylene glycol

This quantity should be reported in Part II, Section 5.1 and added to the total quantity reported in Part II, Section 8.1. Note that if a vapor collection system and/or an air pollution control device were used, Part II, Sections 7A and 8.6 (on-site treatment) should be completed as appropriate; and any release from the device after treatment should be reported in Part II, Section 5.2 (stack releases) as appropriate.

## EXAMPLE - Printing Operations (reporting for toluene)

Toluene is used in a gravure coating and printing operation as both an ink solvent as well as a cleanup solvent. In this example, mass balances and other engineering calculations are used to estimate the associated release and other waste management quantities.

Toluene is a highly volatile chemical and all of the toluene contained in the ink is assumed to volatilize during the printing process. The printing press is controlled by a thermal oxidizer with an estimated destruction efficiency of 95% (based on compliance test results). It is operated under negative pressure (relative to the room) so that all of the toluene from the ink is assumed to be routed through the control device.

Based on your facility's purchase records and hazardous wastes manifests, you estimate that 80% of the toluene used in cleanup operations volatilizes, and the remainder is collected as waste solvent or in shop towels (from hand wiping operations). The collected waste solvent and towels are sent to an off-site incinerator for energy recovery purposes. Further, you estimate that 30% of the volatilized portion of the cleaning solvent is entrained in the airflow into the control device, and the remainder is emitted as fugitive air releases.

Threshold Determination:

Your first step is to determine if you have exceeded an activity threshold for toluene. In both of the applications presented in this example, toluene is not intended to remain in a product sold into commerce and it is considered otherwise used. It is subject to the 10,000 lb/year reporting threshold.

The relevant data for this calculation are the amount of ink used, the concentration of toluene in the ink, the amount of cleanup solvent used, and the concentration of toluene in the cleanup solvent. This information was determined from purchase records and MSDSs as follows:

Total amount of ink used = 4,000 gallons/year
Toluene concentration in the ink = 0.94 (lb/gal)
Total amount of cleanup solvent used = 1,000 gallons/year
Toluene density in the cleanup solvent = 7.22 (lb/gal)

Total amount of toluene otherwise used = 4,000 (gallons/year) × 0.94 (lb/gal) + 1,000 (gallons/year) × 7.22 (lb/gal)
= 10,980 (lb/year)

This amount exceeds the otherwise use reporting threshold so you must estimate and report all release and other waste management activities for toluene.

Fugitive Air Emissions:

Your next step is to estimate the amount of toluene released as fugitive emissions. As in the previous example, each solution is purchased in 55-gallon drums, and it is assumed that after emptying the drums into the process equipment, they are left open in a designated, outdoor drum storage area and allowed to completely dry.

Fugitive emissions = Amount of toluene used in cleanup operations × 80% (amount of toluene assumed to volatilize in cleanup) × 70% (amount of volatilized toluene assumed to be emitted as fugitive air releases; 30% is captured and sent to the control device)
= 1,000 (gallons/year) × 7.22 (lb toluene/gal) × 0.8 × 0.7
= 4,043 (lb toluene/year)

This value should be reported in Part II, Section 5.1 (fugitive or non-point air emissions) and added to the total releases reported in Part II, Section 8.1 (quantity released).

Stack Releases:

Now you must determine stack releases from the air pollution control device:

Stack releases = (amount of toluene used in ink + amount of toluene used in cleanup operations and vented to the control device) × (1 - destruction and removal efficiency)
= [ (4,000 (gal/yr) × (0.94 lb/gal) + (1,000 gal/yr) × (7.22 lb/gal) × (0.8) × (0.3) ]
× (1 - 0.95)
= 275 (lb toluene/yr)

This value should be reported in Part II, Section 5.2 (stack or point air emissions) and added to the total releases reported in Part II, Section 8.1 (quantity released).

On-Site Treatment:

The next step is to determine the amount of toluene treated on site in the control device:

On-site treatment = (amount of toluene used in ink + amount of toluene used in cleanup operations and vented to the control device) × (destruction or removal efficiency)
= [ (4,000 (gal/yr) × (0.94 lb/gal) + (1,000 gal/yr) × (7.22 lb/gal) × (0.8) × (0.3) ]
× (0.95)
= 5,218 (lb toluene/year)

This value should be reported in Part II, Section 8.6 (quantity treated on site). Additionally, Part II, Section 7A should be reported, as appropriate.

Off-Site Energy Recovery:

Your final step is to determine the amount of toluene sent off site for energy recovery:

Off-site energy recovery = amount of toluene used in cleanup operations × 20% (amount collected as waste solvent and in shop rags)
= (1,000 gal/yr) × (7.22 lb toluene/gal) × (0.2)
= 1,444 (lb toluene/year)

This value should be reported in Part II, Section 8.3 (quantity used for energy recovery off site).

**Special Note:** Air emissions rules have recently been promulgated for printing operations. As a result of these initiatives, U.S. EPA and other interested parties have developed methodologies for estimating air emissions from this industry. While it is beyond the scope of this document to present an in-depth analysis of all the work done to date, Appendix A contains a listing of other sources of information which you may find useful in estimating air emissions from printing operations. The majority of these documents deal with criteria pollutant emissions, specifically VOCs; however, the estimation approaches may also be applied to calculate air releases of EPCRA Section 313 chemicals and chemical categories.

### 4.2.4 Post-Press

Post-press processes include, but are not limited to cutting, folding, collating, binding, perforating, drilling, embossing, foil stamping, laminating, trimming, and ink jetting. Inkjet inks can be solvent-based or water-based. Typical solvents for solvent-based inkjets include methanol, MEK, and MIBK. Cold glues are used for binding in typically water-based latex that becomes impervious to water when it dries. Hot melts glues can also be used and are very common in perfect binding operations.

#### 4.2.4.1 Step 1: Prepare Process Flow Diagram

You should prepare a site-specific process flow diagram to help identify all potential sources and types of EPCRA Section 313 chemical and chemical category release and other waste management activities. A typical flow diagram is presented in Figure 4-7.

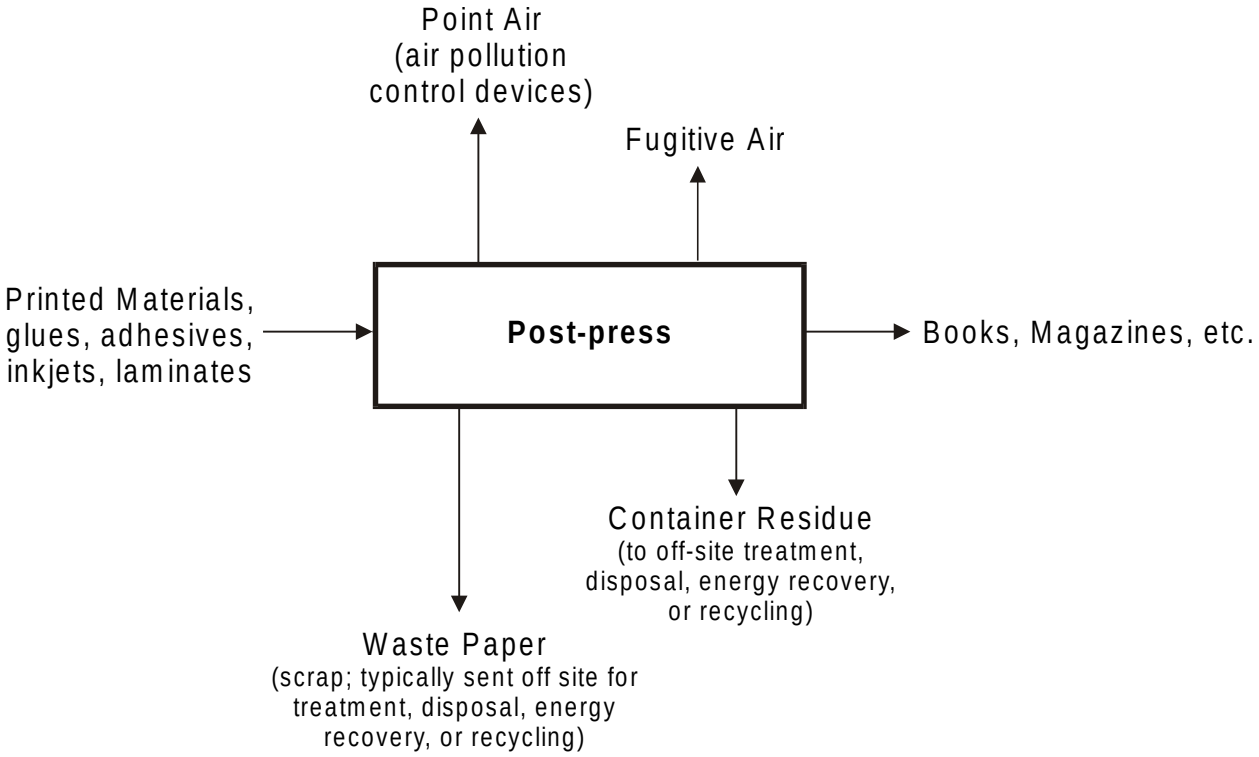


**Figure 4-7. Process Flow Diagram - Post-Press**

#### 4.2.4.2 Step 2: Identify EPCRA Section 313 Chemicals and Chemical Categories and Potential Sources of Chemical Release and Other Waste Management Activities

The primary source of EPCRA Section 313 chemicals and chemical categories used in post-press operations are air emissions and clean-up operations associated with binding and other finishing processes. Empty containers containing residual chemicals are a second potential source.

#### 4.2.4.3 Step 3: Identify Release and Other Waste Management Activity Types

Release and other waste management activity types from this operation include fugitive emissions from the evaporation of solvents found in binding and finishing materials. Typical release and other waste management activities and typical EPCRA Section 313 chemicals and chemical categories from post-press operations are presented in Table 4-7.

## Table 4-7

## Typical Release and Other Waste Management Activity Types and Associated EPCRA Section 313 Chemicals and Chemical Categories Found in Post-Press Operations

| Type | Typical EPCRA Section 313 Chemicals and Chemical Categories |
|---|---|
| Fugitive Air | n-Hexane, methanol, MEK, and MIBK |
| Off-Site Disposal (of waste paper) | Zinc, barium, cadmium and associated compounds |
| Off-Site Transfer from Container Residue (disposal, treatment, energy recovery, or recycle) | n-Hexane, methanol, 1,1,1-trichloroethane |

#### 4.2.4.4 Step 4: Determine the Most Appropriate Method(s) and Calculate the Estimates for Release and Other Waste Management Activity Quantities

Fugitive emissions from evaporative losses can be estimated using engineering calculations and mass balances based on purchasing records as discussed in previous sections.

Container residue can be estimated as discussed in Section 4.1.3(g).

**EXAMPLE - Post-Press Operations (fugitive air releases of methanol)**

Your facility uses methanol in a variety of applications, including as an ink solvent (80-90%) and also as the solvent component in adhesives (50-60%) used in the binding process. Based on purchase records, you determined that you have exceeded the reporting threshold of 10,000 pounds for operations classified as otherwise used. Therefore, you must report methanol release and other waste management quantities for all processes occurring at your facility.

For the binding process, methanol is released as fugitive air emissions and should be reported in Part II, Section 5.1 (fugitive or non-point air emissions) and added to the total releases reported in Part II, Section 8.1 (quantity released).

The relevant data used to estimate releases are the amount of adhesive used and the concentration of methanol in the adhesive. A mass balance approach will yield the amount of methanol released as a result of these operations.

# Appendix A

# EPCRA SECTION 313 GUIDANCE RESOURCES

# Appendix A

# TRI GUIDANCE RESOURCES

## A.1 EPCRA Section 313 RELATED REFERENCES

40 CFR 372, Toxic Chemical Release Reporting; Community Right-to-Know; Final Rule
See 53 FR 4500, February 16, 1988.

Toxic Chemical Release Inventory Reporting Forms and Instructions for the Current Reporting Year - See also Automated Toxic Chemical Release Inventory Reporting Software (ATRS) under Section A.2, Internet Sites.
U.S. EPA publishes this document each year to provide current guidance for preparing the Form R and Form A reports. This document contains the most up-to-date list of chemicals for which reports are required. It includes a blank Form R and Form A and provides step-by-step instructions for completing each report. It also has a list of U.S. EPA regional and state contacts for EPCRA Section 313 reporting. The current version of this document should always be consulted in preparing the EPCRA Section 313 report.

Common Synonyms for Chemicals Listed Under EPCRA Section 313 of the Emergency Planning and Community Right-to-Know Act (EPA 745-R-95-008)
This glossary contains chemical names and their synonyms for substances covered by the reporting requirements of EPCRA Section 313. The glossary was developed to aid in determining whether a facility manufactures, processes, or uses a chemical subject to EPCRA Section 313 reporting.

Consolidated List of Chemicals Subject to the Emergency Planning and Community Right-to-Know Act (EPCRA) and Section 112(r) of the Clean Air Act (as amended) (EPA 740-R-95-001)
List of chemicals covered by EPCRA Sections 302 and 313, CERCLA Hazardous Substances, and CAA 112(r). The list contains the chemical name, CAS Registry Number, and reporting requirement(s) to which the chemical is subject.

The Emergency Planning and Community Right-to-Know Act: EPCRA Section 313 Release Reporting Requirements, August, 1995 (EPA 745/K-95-052)
This brochure alerts businesses to their reporting obligations under EPCRA Section 313 and assists in determining whether their facility is required to report. The brochure contains U.S. EPA Regional contacts, the list of EPCRA Section 313 toxic chemicals and a description of the Standard Industrial Classification (SIC) codes subject to EPCRA Section 313.

EPCRA Section 313 Questions and Answers: 1998 Version, (EPA 745-B-97-004).

Executive Order 12856 - Federal Compliance with Right-to-Know Laws and Pollution Prevention Requirements: Questions and Answers (EPA 745-R-95-011)
This document assists federal facilities in complying with Executive Order 12856. This information has been compiled by U.S. EPA from questions received from federal facilities. This document is intended for the exclusive use of federal facilities in complying with Sections 302,

303, 304, 311, 312, and 313 of the Emergency Planning and Community Right-to-Know Act (EPCRA) of 1986 and the Pollution Prevention Act of 1990, as directed by the Executive Order.

Supplier Notification Requirements (EPA 560/4-91-006)
This pamphlet assists chemical suppliers who may be subject to the supplier notification requirements under EPCRA Section 313. The pamphlet explains the supplier notification requirements, gives examples of situations which require notification, describes the trade secret provision, and contains a sample notification.

Toxic Chemical Release Inventory - Data Quality Checks to Prevent Common Reporting Errors on Form R/Form A (EPA 745-R-98-012)
This is a compilation of Notices of Data Change, Significant Error, Noncompliance, or Technical Error. It provides a listing of common errors found on the Form R reports submitted to U.S. EPA. It also provides a discussion of the types of errors which result in each of the above Notices as well as a list of Notice of Technical Error codes and descriptions.

Trade Secrets Rule and Form
See 53 FR 28772, July 29, 1988. This rule implements the trade secrets provision of the EPCRA (Section 322) and includes a copy of the trade secret substantiation form.

## A.2 INFORMATION SOURCES

Most of the materials included as reference in this manual are available from the following sources:

National Center for Environmental Publications and Information (NCEPI)
P.O. Box 42419
Cincinnati, OH 45242-2419
(800) 490-9198
Fax: (513)489-8695
Internet: *http://www.epa.gov/ncepihom/index.html*

Emergency Planning and Community Right-to-Know (EPCRA) Information Hotline
U.S. Environmental Protection Agency
(800) 424-9346 or (703) 412-9810 (for the Washington, D.C. metropolitan area)
TDD: (800) 553-7672

### Internet Sites

- TRI homepage: *http://www.epa.gov/tri*
  This site contains information on the Toxic Release Inventory and provides links to a variety of data and documents related to the TRI program.

- Automated Toxic Chemical Release Inventory Reporting Software (ATRS): *http://www.epa.gov/atrs*
  This site provides access to the automated EPCRA Section 313 reporting forms for electronic submittal of required data to U.S. EPA.

- Air CHIEF CD-ROM
  *http://www.epa.gov/ttn/chief/airchief.html*
  This site provides information on the Air CHIEF CD-ROM, contents, ordering information, system requirements, and sources for additional information.

- Clearinghouse for Inventories and Emission Factors (CHIEF):
  *http://www.epa.gov/ttn/chief/*
  This site provides access to the latest information and tools for estimating emissions of air pollutants and performing emission inventories.

- Code of Federal Regulations, 40 CFR: *http://www.epa.gov/epacfr40*
  This site was created by U.S. EPA to expand access to Title 40 - Environmental Protections of the Code of Federal Regulations.

- Compilation of Air Pollutant Emission Factors (AP-42):
  *http://www.epa.gov/ttn/chief/ap42etc.html*
  This site provides access to files containing guidance for estimating emissions from specific sources and emission factors.

- Federal Register Notice: *http://www.epa.gov/EPA-TRI*
  This site provides access to all Federal Register notices related to the TRI program from 1994 to current.

- Material Safety Data Sheets (MSDSs):
  *http://msds.pdc.cornell.edu/issearch/msdssrch.htm*
  A key word searchable database of 325,000 MSDSs.

- TANKS: *http://www.epa.gov/ttn/chief/tanks.html*
  This site contains information on TANKS, a DOS-based computer software program that computes estimates of VOC emissions from fixed and floating-roof storage tanks.

- WATER8/CHEMDAT8: *http://www.epa.gov/ttn/chief/software.html#water8*
  WATER8 is an analytical model for estimating compound-specific air emissions from wastewater collection and treatment systems. CHEMDAT8 is a Lotus 1-2-3 spreadsheet for estimating VOC emissions from TSDF processes.

## A.3 INDUSTRY-SPECIFIC TECHNICAL GUIDANCE DOCUMENTS

In 1988 and 1990, U.S. EPA developed a group of individual guidance documents for industries or activities in industries who primarily manufacture, process, or otherwise use EPCRA Section 313 chemicals. See list of industries/activities below. U.S. EPA is currently revising some of these documents and preparing additional documents. The newer versions will be available beginning in the Fall of 1998.

Chemical Distribution Facilities, January 1999 (EPA 745-B-99-005)

Coal Mining Facilities, January 1999 (EPA 745-B-99-002)

Coincidental Manufacture/Byproducts (EPA 745-B-00-014)

Electricity Generating Facilities, January 1999 (EPA 745-B-99-003)

RCRA Subtitle C TSD Facilities and Solvent Recovery Facilities, January 1999 (EPA 745-B-99-004)

Estimating Releases and Waste Treatment Efficiencies

Food Processors, September 1998 (EPA 745-R-98-011)

Formulation of Aqueous Solutions

Foundry Operations (EPA 745-B-00-016)

Leather Tanning and Finishing Processes, April 2000 (EPA 745-B-00-012)

Metal Mining Facilities, January 1999 (EPA 745-B-99-001)

Metal Working and Electroplating Operations, April 2000 (EPA 745-B-00-015)

Monofilament Fiber Manufacture (EPA 745-B-00-013)

Petroleum Bulk Storage Facilities, January 1999 (EPA 745-B-99-006)

Presswood & Laminated Wood Products Manufacturing

Printing Operations, April 2000 (EPA 745-B-00-005)

Pulp, Paper, and Paperboard Production (EPA 745-B-00-010)

Rubber Production and Compounding, April 2000 (EPA 745-B-00-017)

Semiconductor Manufacture (EPA 745-R-99-007)

Smelting Operations (EPA 745-B-00-009)

Spray Application and Electrodeposition of Organic Coatings, December 1998 (EPA 745-B-99-014)

Textile Processing Industry, April 2000 (EPA 745-B-00-008)

Welding Operations (EPA 745-B-00-011)

Wood Preserving (EPA 745-B-00-007)

U.S. EPA, Office of Compliance, published a series of documents in 1995 called Sector Notebooks. These documents provide information of general interest regarding environmental issues associated with specific industrial sectors. The Document Control Numbers (DCN) range from EPA/310-R-95-001 through EPA/310-R-95-018.

## A.4 CHEMICAL-SPECIFIC GUIDANCE DOCUMENTS

U.S. EPA has also developed a group of guidance documents specific to individual chemicals and chemical categories. These are presented below.

"Air Pollution Engineering Guide for the Graphic Arts Industry," May 1993, Graphic Arts Technical Foundation.

Alternative Control Techniques (ACT) Document Offset Lithographic Printing, June 1994, U.S. EPA.

Draft CTG Control of Volatile Organic Compound Emissions from Offset Lithographic Printing, September 1993, U.S. EPA.

Emergency Planning and Community Right-to-Know EPCRA Section 313: Guidance for Reporting Aqueous Ammonia, July 1995 (EPA 745-R-95-012)

Emergency Planning and Community Right-to-Know EPCRA Section 313: List of Toxic Chemicals within the Chlorophenols Category, November 1995 (EPA 745-B-95-004)

Estimating Releases for Mineral Acid Discharges Using pH Measurements, U.S. Environmental Protection Agency, June 1991.

Guidance for Reporting Sulfuric Acid (acid aerosols including mists, vapors, gas, fog, and other airborne forms of any particle size), November 1997 (EPA-745-R-97-007)

Toxic Release Inventory List of Toxic Chemicals within the Glycol Ethers Category and Guidance for Reporting, May 1995 (EPA 745-R-95-006)

Toxic Release Inventory List of Toxic Chemicals within the Nicotine and Salts Category and Guidance for Reporting, February 1995 (EPA 745-R-95-004)

Toxic Release Inventory List of Toxic Chemicals within the Polychlorinated Alkanes Category and Guidance for Reporting, February 1995 (EPA 745-R-95-001)

Toxic Release Inventory List of Toxic of Chemicals within the Polycyclic Aromatic Compounds Category, February 1995 (EPA 745-R-95-003)

Toxic Release Inventory List of Toxic Chemicals within the Strychnine and Salts Category and Guidance for Reporting, February 1995 (EPA 745-R-95-005)

Toxic Release Inventory List of Toxic of Chemicals within the Water Dissociable Nitrate Compounds Category and Guidance for Reporting, May, 1996 (EPA 745-R-96-004)

Toxics Release Inventory - List of Toxic Chemicals Within Ethylenebisdithiocarbamic Acid Category, November 1994, EPA 745-B-94-003.

Toxics Release Inventory - Copper Phthalocyanine Compounds Excluded for the Reporting Requirements Under the Copper Compounds Category on the EPCRA Section 313 List, April 1995, EPA 745-R-95-007.

Toxics Release Inventory - List of Toxic Chemicals Within Warfarin Category, November 1994, EPA 745-B-94-004.

## A.5 OTHER USEFUL REFERENCES

Air Pollution Engineering Guide for the Graphic Arts Industry. May 1993. Graphic Arts Technical Foundation.

Alternative Control Techniques (ACT) Document Offset Lithographic Printing. June 1994. U.S. EPA

Burgess, W.A. Recognition of Health Hazards in Industry. Harvard School of Public Health. Boston, Massachusetts, John-Wiley & Sons.

CRC Handbook of Chemistry and Physics. Latest Edition, Robert C. Weast, Editor, CRC Press, Inc., Florida.

Draft CTG Control of Volatile Organic Compound Emissions from Offset Lithographic Printing. September 1993. U.S. EPA.

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# Appendix B

# BASIC CALCULATION TECHNIQUES

## Appendix B

## BASIC CALCULATION TECHNIQUES

This section will provide the basic techniques needed to use specific types of data or engineering calculations. Examples are provided for:

(1) Stack monitoring data;

(2) Industrial hygiene data;

(3) Raoult's Law;

(4) Air emission factors;

(5) RCRA hazardous waste analysis data;

(6) NPDES monitoring data.

### (1) Stack Monitoring Data

The following is an example of a release calculation using monitoring data.

**Example:** Stack monitoring data are available for a paint booth. The measured average concentration of toluene is 0.1 ppmv (dry gas basis). The moisture content in the stack is typically 10%, and stack conditions are maintained at 80°C and atmospheric pressure. The stack gas velocity is 8 m/s. The diameter of the stack is 0.3 m. Calculate the point air release of toluene.

Step 1. Calculate volumetric flow of stack gas stream.

| |
|---|
| Volumetric flow = (gas velocity) × [(π) × (internal stack diameter)$^2$/4)] |

Volumetric flow = (8.0 m/s) × [(π) × (0.3 m)$^2$/4] = 0.6 m$^3$/s

Step 2. Correct for moisture content in stack gas stream.

Stack exhausts may contain large amounts of water vapor. The concentration of the chemical in the exhaust is often presented on a dry basis. For an accurate release rate, correct the vent gas flow rate for the moisture content by multiplying by the term (1 - fraction water vapor). The dry gas rate can then by multiplied by the chemical concentration.

(Note: If the toluene concentration is on a wet gas basis, no correction is necessary for moisture content.)

Dry volumetric flow = (Volumetric flow) × (1-fraction water vapor)

Dry volumetric flow = (0.6 $m^3/s$) × (1-0.10) = 0.5 $m^3/s$

Step 3. Convert ppmv to $mg/m^3$.

- ppmv is defined as one part of a chemical in $10^6$ parts of gas (1.0 $m^3/10^6$ $m^3$).
- Use the molar volume of a gas, corrected for stack temperature and pressure conditions, calculated by the ideal gas law (PV = nRT). Note that the molar volume of an ideal gas at 237 K and 1 atm is 22.4 L/mole.
- Molecular weight of toluene (MW) = 92.14 g/mole.
- R = the Ideal Gas Constant (0.082057 L - atm per mole-Kelvin)

To calculate the molar volume of stack gas, use the ideal gas equation.

$$\text{Molar volume} = \frac{V}{n} = \frac{RT}{P}$$

For the example, the stack conditions are 80° C (353 K) and atmospheric pressure (1 atm).

$$\text{Molar volume} = \left(0.082057\ \frac{\text{L}-\text{atm}}{\text{mole}-\text{K}}\right) \times (353\ \text{K})/(1\text{atm})$$

$$= 29.0\ \text{L/mole}$$

The conversion of ppmv to $mg/m^3$ can now be calculated.

$$\left(\frac{\text{mg}}{\text{m}^3}\right) = (\text{concentration of chemical, ppmv}) \times \left(\frac{1}{\text{molar volume of gas}}\right) \times (\text{MW})$$

Using the example, the concentration of toluene is calculated as follows:

$$\left(\frac{0.1\ m^3}{10^6\ m^3}\right) \times \left(\frac{mole}{29.0\ L}\right) \times \left(\frac{92.14\ g}{mole}\right) \times \left(\frac{L}{10^{-3}\ m^3}\right) \times \left(\frac{1{,}000\ mg}{1\ g}\right) = 0.3\ mg/m^3$$

Step 4. Calculate air releases.

Air releases are calculated as follows:

| Air Release=(volumetric flow, $m^3/s$) × (concentration, $mg/m^3$) × (operating time, s/yr) |
|---|

The paint booth is used 8 hours per day, 5 days per week, 52 weeks per year.

$$\text{Operating time} = \left(8\ \frac{hr}{day}\right) \times \left(5\ \frac{day}{week}\right) \times \left(52\ \frac{week}{yr}\right) = 2{,}080\ hr/yr$$

$$\text{Air Release} = (0.5\ m^3/s) \times (0.3\ mg/m^3) \times \left(\frac{3{,}600\ s}{hr}\right) \times \left(\frac{2{,}080\ hr}{yr}\right) \times \left(\frac{lb}{454\ g}\right) \times \left(\frac{g}{1{,}000\ mg}\right)$$

$$= 2.5\ lb/yr\ of\ toluene$$

It is important to note that this calculation assumes the measured emissions are representative of actual emissions at all times; however, this is not always the case. Ideally, a continuous emissions monitor provides the most representative data.

Also note that monitoring and stack data may have units that are different than those used in the example. Modify conversion factors and constants to reflect your data when calculating air releases.

**(2) Industrial Hygiene Data**

The following is an example of a release calculation using industrial hygiene data.

**Example:** Occupational industrial hygiene data shows that workers are exposed to an average of 0.1 ppmv benzene (wet gas basis). The density of benzene vapor is 0.2 $lb/ft^3$. The ventilation system exhausts 20,000 acfm of room air at 70°F. The plant operates 24 hours per day, 330 days per year.

The benzene concentration is on a wet gas basis, therefore a moisture correction of the ventilation flow rate is not necessary. The industrial hygiene data is collected at the same ambient conditions as the ventilation system, therefore no

adjustment for temperature or pressure needs to be performed. A conservative estimation of benzene fugitive releases could be calculated as follows:

| | | |
|---|---|---|
| Air Release | = | (ventilation flow rate, $ft^3$/min) × (operating time, min/yr) × (concentration of chemical, ppmv) × (vapor density of chemical, lb/$ft^3$) |

Benzene releases per year would be calculated as follows:

$$\left(\frac{20{,}000\ ft^3}{min}\right) \times \left(\frac{60\ min}{hr}\right) \times \left(\frac{24\ hr}{day}\right) \times \left(\frac{330\ day}{yr}\right) \times \left(\frac{0.1\ ft^3\ benzene}{10^6\ ft^3\ air}\right) \times \left(\frac{0.2\ lb}{ft^3}\right)$$

$$= 190\ lb/yr\ of\ benzene$$

**(3) Raoult's Law**

The following is an example of a release calculation using Raoult's Law. Raoult's Law states that the partial pressure of a compound in the vapor phase over a solution may be estimated by multiplying its mole fraction in the liquid solution by the vapor pressure of the pure chemical.

$$P_A = X_{A,L}P^o = X_{A,G}P_T$$

where:

| | | |
|---|---|---|
| $P^\circ$ | = | Vapor pressure of pure liquid chemical A; |
| $X_{A,L}$ | = | Mole fraction of chemical A in solution; |
| $X_{A,G}$ | = | Mole fraction of chemical A in the gas phase; |
| $P_A$ | = | Partial pressure of chemical A in the gas phase; and |
| $P_T$ | = | Total pressure. |

**Example:** A wash tank holds a solution containing 10% by weight of o-xylene (A) and 90% by weight of toluene (B). The tank is vented to the atmosphere; the process vent flow rate is estimated as 100 acfm (2.83$m^3$/min) based on a minimum fresh air ventilation rate. The molecular weight of o-xylene is 106.17 g/mole and toluene is 92.14 g/mole. The vapor pressure of o-xylene is 10 mm of Hg (0.19 psia). The total pressure of the system is 14.7 psia (atmospheric conditions). The process tank is in service 250 days/yr. Calculate the air release of o-xylene.

Step 1: Calculate the mole fraction of o-xylene in the liquid solution.

$$X_{A,L} = \frac{\frac{\text{wt fraction A}}{MW_A}}{\frac{\text{wt fraction A}}{MW_A} + \frac{\text{wt fraction B}}{MW_B}}$$

Where:

| | | |
|---|---|---|
| $X_{A,L}$ | = | Mole fraction of chemical A in liquid solution; |
| MW | = | Molecular weight of chemical, g/mole; and |
| wt fraction | = | Weight fraction of chemical in material. |

$$X_{A,L} = \frac{\left[\frac{0.1}{106.17}\right]}{\left[\frac{0.1}{106.17} + \frac{0.9}{92.14}\right]}$$

$$X_{A,L} = 0.09$$

Step 2: Calculate the mole fraction of o-xylene in the gas phase.

$$X_{A,G} = \frac{X_{A,L}P^\circ}{P_T}$$

where:

| | | |
|---|---|---|
| $X_{A,G}$ | = | Mole fraction of chemical A in gas phase; |
| $X_{A,L}$ | = | Mole fraction of chemical A in liquid solution; |
| $P^\circ$ | = | Vapor pressure of pure liquid chemical A, psia; and |
| $P_T$ | = | Total pressure of system, psia. |

$$X_{A,G} = [0.09] \times \left[\frac{0.19 \text{ psia}}{14.7 \text{ psia}}\right] = 0.001$$

Step 3: Calculate releases using Raoult's Law.

$$\text{Emissions} = (X_{A,G}) \times (\text{AFR}) \times (t) \times (MW_A) \times \left(\frac{1}{MV}\right)$$

where:

| | | |
|---|---|---|
| Emissions | = | Air release of pollutant A, g-A/yr; |
| $X_{A,G}$ | = | Mole fraction of chemical A in gas phase; |
| AFR | = | Air flow rate of room, $m^3$/min; |
| t | = | Operating time of wash tank, min/yr; |
| MW | = | Molecular weight of chemical, g/g-mole; and |
| MV | = | Gas molar volume (22.4 L/mole at standard temperature and pressure). |

If conditions vary from standard temperature and pressure the gas molar volume can be calculated using the ideal gas law and tank conditions as presented in Example 1.

Emissions = (0.001) ×

$$\left(\frac{2.83\,m^3}{min}\right)\times\left(\frac{250\ day}{yr}\right)\times\left(\frac{24\ hr}{day}\right)\times\left(\frac{60\ min}{hr}\right)\times\left(\frac{mole}{22.4\,L}\right)\times\left(\frac{106.17\,g}{mole}\right)\times\left(\frac{L}{10^{-3}\,m^3}\right)$$

$= 4.8 \times 10^6$ g/yr

The emission of o-xylene is calculated as shown below.

$$\text{Emissions} = \left(4.8 \times 10^6\ \text{g/yr}\right) \times \left(\frac{\text{lb}}{454\ \text{g}}\right) = 10{,}570\ \text{lb/yr of o-xylene}$$

Air releases for toluene can be calculated in a similar manner.

**(4) <u>Air Emission Factor</u>**

The following is an example of a release calculation using air emission factors.

**Example:** An industrial boiler uses 300 gallons per hour of No. 2 fuel oil. The boiler operates 2,000 hours per year. Calculate emissions of formaldehyde using the AP-42 emission factors.

$$AE = (EF) \times (AU) \times (OT)$$

where:

| | | |
|---|---|---|
| AE | = | Annual emissions of pollutant, lb/yr |
| EF | = | Emission factor of pollutant, lb/$10^3$ gallon of fuel. EF for formaldehyde for an industrial boiler burning No. 2 fuel oil is 0.035 to 0.061 lb/$10^3$ gallons. |
| AU | = | Quantity of fuel used, gal/yr. |
| OT | = | Operating time, hr/yr. |

Using an emission factor of 0.061 pounds of formaldehyde per gallon of fuel, the air releases are calculated as follows:

$$AE = \left(\frac{0.061\ lb}{10^3\ gal}\right) \times \left(\frac{300\ gal}{hr}\right) \times \left(\frac{2{,}000\ hr}{yr}\right) = 36.6\ lb/yr\ of\ formaldehyde$$

**(5) RCRA Waste Analysis**

The following is an example of a calculation using RCRA waste analysis data.

**Example:** Spent paint wastes were disposed at an off-site waste treatment facility. The quantity of paint waste shipped was five 55-gallon drums per year. Analysis of the waste showed 5% cadmium by weight. Estimating the density of the paint waste to be 9.5 lb/gallon, the amount of cadmium to off-site disposal is calculated as follows:

Amount of cadmium = (amount of paint waste disposed, gal/yr) × (concentration of cadmium, lb/lb) × (density of paint waste, lb/gal)

$$\left(\frac{5\ drums}{yr}\right) \times \left(\frac{55\ gal}{drum}\right) \times \left(\frac{9.5\ lb}{gal}\right) \times \left(\frac{5\,lb\ Cd}{100\,lb\ waste}\right) = 131\ lb/yr\ of\ cadmium$$

**(6) NPDES Data**

The following is an example of a calculation using NPDES data.

NPDES permits require periodic monitoring of the effluent stream. In this example, quarterly samples were taken to be analyzed for silver content. Each sample was an hourly, flowrate-based composite taken for one day to be representative of the discharge for that day. The total effluent volume for that day was also recorded. The following data were collected on each sample day.

| Yearly Quarter Sample Number | Discharge Flow Rate ($10^6$ gal/day) | Total Silver (µg/L) |
|---|---|---|
| 1 | 0.5 | 10 |
| 2 | 0.6 | 10 |
| 3 | 0.4 | 6 |
| 4 | 0.2 | <3 |

To calculate the amount of silver in pounds discharged on each sample day, the concentration of silver in the discharge is multiplied by the discharge flow rate for that day, as shown below for the first quarter sample.

Amount of silver = (daily flow rate) × (silver concentration)

$$\text{First Quarter: } \left(\frac{10\,\mu g}{L}\right) \times \left(\frac{1\,g}{10^6\,\mu g}\right) \times \left(\frac{1\,lb}{454\,g}\right) \times \left(\frac{3.785\,L}{gal}\right) \left(\frac{0.5 \times 10^6\,gal}{day}\right)$$

= 0.04 lb/day of silver

The amount of silver discharged during each of the other three monitoring events was similarly determined to be:

0.05 lb/day; 0.02 lb/day, and 0.005 lb/day.

For the last data point the concentration of silver was reported by the laboratory to be less than the detection limit of 3 µg/L. For this calculation the detection limit was used to calculate the daily discharge, a conservative assumption.

The average daily discharge was calculated to be:

$$\left(\frac{0.04 + 0.05 + 0.02 + 0.005}{4}\right) \text{lb/day} = 0.03\,\text{lb/day}$$

The plant operates 350 days/year (plant shuts down for two weeks in July).

The estimated annual discharge of silver is calculated as follows:

Annual discharge = (350 day/yr) (0.03 lb/day) = 10.5 lb of silver/yr

# Appendix C

# GUIDANCE FOR REPORTING AQUEOUS AMMONIA

United States Environmental Protection Agency | Office of Pollution Prevention and Toxics Washington, DC 20460 | July 1995 EPA 745-R-95-012

# EMERGENCY PLANNING AND COMMUNITY RIGHT-TO-KNOW EPCRA Section 313

## Guidance for Reporting Aqueous Ammonia

EPCRA Section 313 of the Emergency Planning and Community Right-to-Know Act of 1986 (EPCRA) requires certain facilities manufacturing, processing, or otherwise using listed toxic chemicals to report their environmental releases of such chemicals annually. Beginning with the 1991 reporting year, such facilities also must report pollution prevention and recycling data for such chemicals, pursuant to section 6607 of the Pollution Prevention Act, 42 U.S.C. 13106. When enacted, EPCRA Section 313 established an initial list of toxic chemicals that was comprised of more than 300 chemicals and 20 chemical categories. EPCRA Section 313(d) authorizes EPA to add chemicals to or delete chemicals from the list, and sets forth criteria for these actions.

CONTENTS

## Section 1. Introduction

On June 30, 1995 EPA finalized four actions in response to a petition received in 1989 to delete ammonium sulfate (solution) from the list of toxic chemicals subject to reporting under EPCRA Section 313 of the Emergency Planning and Community Right-to-Know Act of 1986 (EPCRA), 42 U.S.C. 11001. The four actions taken are summarized as follows: (1) deleted ammonium sulfate (solution) from the EPCRA Section 313 list of toxic chemicals, (2) required that threshold and release determinations for aqueous ammonia be based on 10 percent of the total aqueous ammonia present in aqueous solutions of ammonia, (3) modified the ammonia listing by adding the following qualifier: ammonia (includes anhydrous ammonia and aqueous ammonia from water dissociable ammonium salts and other sources; 10 percent of total aqueous ammonia is reportable under this listing), and (4) deleted ammonium nitrate (solution) as a separately listed chemical on the EPCRA Section 313 list of toxic chemicals. All actions are effective for the 1994 reporting year for reports due July 1, 1995, with the exception of the deletion of ammonium nitrate (solution) as a separately listed chemical, which is effective for the 1995 reporting year for reports due July 1, 1996. At the time that these actions were finalized, EPA indicated that the Agency would develop, as appropriate, interpretations and guidance that the Agency determines are necessary to facilitate accurate reporting for aqueous ammonia. This document constitutes such guidance for reporting under the ammonia listing.

### Section 1.1 Who Must Report

A plant, factory, or other facility is subject to the provisions of EPCRA Section 313, if it meets all three of the following criteria:

- It conducts manufacturing operations (is included in Standard Industrial Classification (SIC) codes 20 through 39); and
- It has 10 or more full-time employees (or the equivalent 20,000 hours per year); and
- It manufactures, imports, processes, or otherwise uses any of the toxic chemicals listed on the EPCRA Section 313 list in amounts greater than the "threshold" quantities specified below.

### Section 1.2 Thresholds

Thresholds are specified amounts of toxic chemicals used during the calendar year that trigger reporting requirements.

If a facility *manufactures* or *imports* any of the listed toxic chemicals, the threshold quantity will be:

- 25,000 pounds per toxic chemical or category over the calendar year.

If a facility *processes* any of the listed toxic chemicals, the threshold quantity will be:

- 25,000 pounds per toxic chemical or category over the calendar year.

If a facility *otherwise uses* any of the listed toxic chemicals (without incorporating it into any product or producing it at the facility), the threshold quantity is:

- 10,000 pounds per toxic chemical or category over the calendar year.

**Section 1.3 Chemical Sources of Aqueous Ammonia**

If a facility manufactures, processes, or otherwise uses anhydrous ammonia or aqueous ammonia, they must report under the ammonia listing. EPA is providing a table of Chemical Abstract Service (CAS) numbers and chemical names to aid the regulated community in determining whether they need to report under the ammonia listing for aqueous ammonia. This table includes a list of water dissociable ammonium salts which, when placed in water, are a source of aqueous ammonia. The table contains only commonly used ammonium salts and therefore is not exhaustive. If a facility manufactures, processes, or otherwise uses aqueous ammonia, regardless of its source, it must report under the ammonia listing, even if the source of the aqueous ammonia is not listed in the table provided in this document.

**Section 1.4 *De Minimis* Concentrations**

The ammonia listing is subject to the one percent *de minimis* concentration. Thus, solutions containing aqueous ammonia at a concentration in excess of *one percent of the 10 percent reportable under this listing* should be factored into threshold and release determinations.

## Section 2. Guidance for Reporting Aqueous Ammonia

Note: for the purposes of reporting under the ammonia listing for aqueous ammonia, water dissociable ammonium salts means that the ammonium ion dissociates from its counterion when in solution.

### Section 2.1 Determining Threshold and Release Quantities for Ammonia

If a facility manufactures, processes, or otherwise uses *anhydrous ammonia*, the quantity applied towards threshold determinations for the ammonia listing is the total quantity of the anhydrous ammonia manufactured, processed, or otherwise used. The quantity reported when calculating the amount of ammonia that is released, transferred, or otherwise managed is the total quantity of *anhydrous ammonia* released or transferred.

If the facility manufactures, processes, or otherwise uses *anhydrous ammonia* in quantities that exceed the appropriate threshold and subsequently dissolves some or all of the *anhydrous ammonia* in *water*, then the following applies: 1) threshold determinations are based on 100 percent of the *anhydrous ammonia* (simply 10 percent of *aqueous ammonia*); 2) release, transfer, and other waste management quantities for the *aqueous ammonia* are calculated as 10 percent of total ammonia; 3) release, transfer, and other waste management quantities for the *anhydrous ammonia* are calculated as 100 percent of the *anhydrous ammonia*.

If a facility manufactures, processes, or otherwise uses *aqueous ammonia*, the quantity applied toward threshold determinations for the ammonia listing is 10 percent of the total quantity of the *aqueous ammonia* manufactured, processed, or otherwise used. The quantity reported when calculating the amount of ammonia that is released, transferred, or otherwise managed is 10 percent of the total quantity of *aqueous ammonia* released or transferred.

If a facility dissolves a water dissociable ammonium salt in water that facility has manufactured *aqueous ammonia* and 10 percent of the total *aqueous ammonia* manufactured from these salts is to be included in manufacturing threshold determinations under the ammonia listing.

If *aqueous ammonia* from water dissociable ammonium salts is processed or otherwise used, then 10 percent of the total *aqueous ammonia* is to be included in all processing and otherwise use threshold determinations under the ammonia listing.

Example 1: In a calendar year, a facility places 25,000 lbs of anhydrous ammonia in water for processing and processes 25,000 lbs of aqueous ammonia from an ammonium salt. The facility must include all of the 25,000 lbs of anhydrous ammonia in the determination of the processing threshold, but only 10 percent (or 2,500 lbs) of the aqueous ammonia from the ammonium salt in the processing threshold determination.

Total aqueous ammonia is the sum of the two forms of ammonia (un-ionized, $NH_3$, and ionized, $NH_4^+$) present in aqueous solutions. A precise calculation of the weight of total aqueous ammonia would require determining the ratio of the two forms of ammonia present

using the pH and temperature of the solution. The weight of total aqueous ammonia can be more easily calculated by assuming that aqueous ammonia is comprised entirely of the $NH_4^+$ form or the $NH_3$ form. For the purpose of determining threshold and release quantities under EPCRA Section 313, EPA recommends that total aqueous ammonia be calculated in terms of $NH_3$ equivalents (i.e., for determining weights, assume total ammonia is comprised entirely of the $NH_3$ form). This method is simpler than using pH and temperature data to determine the ratio of the two forms present and is consistent with the presentation of total ammonia toxicity in a separate EPA document, *Ambient Water Quality Criteria for Ammonia* (EPA document #440/5-85-001, January 1985).

## Section 2.2 Chemical Sources of Aqueous Ammonia

Aqueous ammonia may be generated in solution from a variety of sources that include the release of anhydrous ammonia to water and the dissociation of ammonium salts in water. Water dissociable ammonium salts are not reportable in their entirety under the ammonia listing; these salts are reportable to the extent that they dissociate in water, and only 10 percent of the total aqueous ammonia that results when these salts dissociate is reportable. If these salts are not placed in water, they are not reportable.

If these salts are purchased neat or as solids by a facility, then placed in water by that facility, the facility is *manufacturing* aqueous ammonia.

### Section 2.2.1 Reporting Aqueous Ammonia Generated from Anhydrous Ammonia in Water

If the source of aqueous ammonia is anhydrous ammonia in water, total aqueous ammonia (calculated in terms of $NH_3$ equivalents) is equal to the quantity of anhydrous ammonia manufactured, processed, or otherwise used. A hypothetical scenario demonstrating the calculations involved in reporting aqueous ammonia generated from anhydrous ammonia in water is given in Example 2.

> Example 2: In a calendar year, a facility uses 30,000 pounds of anhydrous ammonia to neutralize acids in a wastewater stream. The neutralized waste stream (containing aqueous ammonia from dissociated ammonium salts) is then transferred to a POTW. The quantity to be applied toward threshold determinations is the total quantity of anhydrous ammonia used in the waste stream neutralization, or 30,000 pounds. The quantity of ammonia reported as transferred is 10 percent of the total quantity of aqueous ammonia transferred, or 3,000 pounds.

### Section 2.2.2 Reporting Aqueous Ammonia Generated from the Dissociation of Ammonium Salts (Other Than Ammonium Nitrate)

If the source of aqueous ammonia is the dissociation of ammonium salts in water, total aqueous ammonia (calculated in terms of $NH_3$ equivalents) is calculated from the weight percent (wt%) of the $NH_3$ equivalents of the ammonium salt. The $NH_3$ equivalent wt% of an ammonium salt is calculated using the following equation:

$NH_3$ equivalent wt% = ($NH_3$ equivalent weight)/(MW ammonium salt) × 100

If the source of aqueous ammonia is a monovalent compound (such as ammonium chloride, $NH_4Cl$, ammonium nitrate, $NH_4NO_3$, or ammonium bicarbonate ($NH_4HCO_3$), the $NH_3$ equivalent weight is equal to the MW of $NH_3$ (17.03 kg/kmol). If divalent compounds are involved (such as ammonium carbonate, $(NH_4)_2CO_3$), then the $NH_3$ equivalent weight is equal to the MW of $NH_3$ multiplied by two. Similarly, if trivalent compound are involved, then the $NH_3$ equivalent weight is equal to the MW of $NH_3$ multiplied by three.

Example 3:

The $NH_3$ equivalent wt% of ammonium chloride is calculated as follows:

$NH_3$ equivalent wt% = ($NH_3$ equivalent weight)/(MW ammonium chloride) × 100
$NH_3$ equivalent wt% = (17.03)/(53.49) × 100
$NH_3$ equivalent wt% = 31.84%

The $NH_3$ equivalent wt% of ammonium carbonate is calculated as follows:

$NH_3$ equivalent wt% = 2 × ($NH_3$ equivalent weight)/(MW ammonium chloride) × 100
$NH_3$ equivalent wt% = 2 × (17.03)/(96.09) × 100
$NH_3$ equivalent wt% = 35.45%

To aid the regulated community in reporting under the ammonia listing for aqueous ammonia, the table of chemical sources of aqueous ammonium provided in Section 3 of this document includes, in addition to CAS number, chemical name, and molecular weight, the $NH_3$ equivalent wt% of the commonly used, water dissociable ammonium salts listed in this table.

Example 4: In a calendar year, a facility uses 100,000 pounds of ammonium chloride, $NH_4Cl$, *in aqueous solution* which is released to wastewater streams, then transferred to a POTW. The $NH_3$ equivalent wt% of ammonium chloride is 31.84% (taken from Table 1 in Section 3 below or calculated as in Example 3 above). The total quantity of aqueous ammonia present in solution is 31.84% of the 100,000 pounds of ammonia chloride used, or 31,840 pounds. The quantity applied towards threshold determinations for the ammonia listing is 10 percent of the total quantity of aqueous ammonia present in solution, or 3,184 pounds. The quantity of ammonia reported as released or transferred is 10 percent of the total quantity of aqueous ammonia released or transferred, or 3,184 pounds.

Example 5: In a calendar year, a facility uses 500,000 pounds of ammonium carbonate, $(NH_4)_2CO_3$, and 400,000 pounds of ammonium bicarbonate, $NH_4HCO_3$, *in aqueous solution* which is released to wastewater streams, then transferred to a POTW. The $NH_3$ equivalent wt% of ammonium carbonate is 35.45%, and the $NH_3$ equivalent wt% of ammonium bicarbonate is 21.54% (taken from Table 1 in Section 3 below or calculated as in Example 3 above). The quantity of aqueous ammonia present in solution from ammonium carbonate is 35.45% of the 500,000 pounds of ammonia carbonate used, or 177,250 pounds. The quantity of aqueous ammonia present in solution from ammonium bicarbonate is 21.54% of the 400,000 pounds of ammonia bicarbonate used or 86,160 pounds. The total quantity of aqueous ammonia present in solution is 263,410 pounds. The quantity applied towards threshold determinations for the ammonia listing is 10 percent of the total quantity of aqueous ammonia present in solution, or 26,341 pounds. The quantity of ammonia reported as released or transferred is 10 percent of the total quantity of aqueous ammonia released or transferred, or 26,341 pounds.

### Section 2.2.3 Reporting Aqueous Ammonia Generated from the Dissociation of Ammonium Nitrate

Some sources of aqueous ammonia may be reportable under other EPCRA Section 313 category listings. Ammonium nitrate (solution) is relevant to reporting under the ammonia listing to the extent that 10 percent of the total aqueous ammonia that results when ammonium nitrate dissociates is reported when determining thresholds and calculating releases. However, under the nitrate compound category listing, ammonium nitrate (and other mixed salts containing ammonium and nitrate) must be reported in its entirety. When reporting ammonium nitrate under this category listing, the total nitrate compound, including both the nitrate ion portion and the ammonium counterion, is included when determining threshold quantities. However, only the nitrate ion portion is included when determining the amount of ammonium nitrate that is released, transferred, or otherwise managed in wastes. The calculations involved in determining threshold and release quantities for reporting under the nitrate compound category listing are described in a separate directive, *List of Toxic Chemicals within the Water Dissociable Nitrate Compounds Category and Guidance for Reporting* (EPA document #745-R-95-002, February 1995). Note: reporting ammonium nitrate under the ammonia listing and nitrate compounds category listing is effective for the 1995 reporting year for reports due July 1, 1996.

Example 6: In a calendar year, a facility uses 1,250,000 pounds of ammonium nitrate, $NH_4NO_3$, *in aqueous solution* which is released to wastewater streams, then transferred to a POTW. The $NH_3$ equivalent wt% of ammonium nitrate is 21.28% (taken from Table 1 in Section 3 below or calculated as in Example 3 above). The total quantity of aqueous ammonia present in solution is 21.28% of the 1,250,000 pounds of ammonia chloride used, or 266,000 pounds. The quantity applied towards threshold determinations for the ammonia listing is 10 percent of the total quantity of aqueous ammonia present in solution, or 26,600 pounds. The quantity of ammonia reported as released or transferred is 10 percent of the total quantity of aqueous ammonia released or transferred, or 26,600 pounds. For determining thresholds and calculating releases under the nitrate compound category listing, see the separate directive, *List of Toxic Chemicals within the Water Dissociable Nitrate Compounds Category and Guidance for Reporting* (EPA document #745-R-95-002, February, 1995).

Example 7: In a calendar year, a facility transfers 100,000 pounds of nitric acid ($HNO_3$) to an on-site treatment facility. The nitric acid is neutralized with anhydrous ammonia, and treatment efficiency is 95 percent (the nitrate compound formed as a result of the treatment is ammonium nitrate, $NH_4NO_3$). The neutralized waste stream (containing aqueous ammonia from dissociated ammonium nitrate) is then transferred to a POTW. The quantity of nitric acid neutralized is 95 percent of 100,000 pounds or 95,000 pounds. The quantity of nitric acid neutralized is converted first to kilograms then to kilomoles using the following equations:

Kilograms $HNO_3$ neutralized = (lbs $HNO_3$ neutralized) × (0.4536 kg/lb)
Kilomoles $HNO_3$ neutralized = (kg $HNO_3$) ÷ (MW of $HNO_3$ in kg/kmol)

Substituting the appropriate values into the above equations yields:

Kilograms $HNO_3$ neutralized = 95,000 lbs × 0.4536 kg/lb = 43,092 kg
Kilomoles $HNO_3$ neutralized = 43,092 kg ÷ 63.01 kg/kmol = 683.9 kmol

The quantity of anhydrous ammonia used in kilomoles in the acid neutralization and the quantity of ammonium nitrate generated in kilomoles from the neutralization are equal to the quantity of nitric acid neutralized (683.9 kmol). The quantity of anhydrous ammonia used in kilograms and pounds in the acid neutralization is calculated as follows:

Kilograms $NH_3$ used = (kmol $NH_3$) × (MW of $NH_3$ in kg/kmol)
Pounds $NH_3$ used = (kg $NH_3$) × (2.205 lbs/kg)

Substituting the appropriate values into the above equation yields:

Kilograms $NH_3$ used = (683.9 kmol) × (17.03 kg/kmol) = 11,647 kmol
Pounds $NH_3$ used = (11,647 $NH_3$) × (2,205 lbs/kg) = 25,682 pounds

The quantity reported applied towards threshold determinations for the ammonia listing is the total quantity of anhydrous ammonia used in the acid neutralization, or 25,682 pounds. The quantity of ammonia reported as released or transferred is 10 percent of the total quantity of aqueous ammonia released or transferred, or 2,568 pounds. For determining thresholds and calculating releases under the nitrate compound category listing, see the separate directive, *List of Toxic Chemicals within the Water Dissociable Nitrate Compounds Category and Guidance for Reporting* (EPA document #745-R-95-002, February 1995).

## Section 3. CAS Number and List of Some Chemical Sources of Aqueous Ammonia

EPA is providing the following table of CAS numbers and chemical names to aid the regulated community in determining whether they need to report under the ammonia listing for aqueous ammonia. If a facility manufactures, processes, or otherwise uses, *in aqueous solution*, a chemical which is listed below, they must report 10 percent of the total aqueous ammonia that is the result of the dissociation of this chemical. However, this list is not exhaustive. If a facility manufactures, processes, or otherwise uses, *in aqueous solution*, a water dissociable ammonium compound, they must report 10 percent of the total aqueous ammonia that is the result of the dissociation of the compound, even if the compound does not appear in the following table.

### Table C-1
### Listing by CAS Number and Molecular Weight of Some Chemical Sources of Aqueous Ammonia

| Chemical Name | Molecular Weight* | $NH_3$ Equivalent Wt% | CAS Number |
|---|---|---|---|
| Ammonium acetate | 77.08 | 22.09 | 631-61-8 |
| Ammonium aluminum sulfate<br>(Ammonium aluminum disulfate) | 237.14 | 7.181 | 7784-25-0 |
| Ammonium antimony fluoride<br>(Diammonium pentafluoroantimonate) | 252.82 | 13.47 | 32516-50-0 |
| Ammonium arsenate<br>(Ammonium arsenate, hydrogen)<br>(Ammonium arsenate, dihydrogen) | 158.97 | 10.71 | 13462-93-6 |
| Ammonium arsenate<br>(Diammonium arsenate)<br>(Diammonium arsenate, hydrogen)<br>(Diammonium arsenate, monohydrogen) | 176.00 | 19.35 | 7784-44-3 |
| Ammonium arsenite | 124.96 | 13.63 | 13462-94-7 |
| Ammonium azide | 60.06 | 28.35 | 12164-94-2 |
| Ammonium benzenesulfonate | 175.20 | 9.720 | 19402-64-3 |
| Ammonium benzoate | 139.15 | 12.24 | 1863-63-4 |
| Ammonium bromate | 145.94 | 11.67 | 13843-59-9 |
| Ammonium bromide | 97.94 | 17.39 | 12124-97-9 |
| Ammonium cadmium chloride<br>(Ammonium cadmium trichloride) | 236.81 | 7.191 | 18532-52-0 |
| Ammonium carbamate | 78.07 | 21.81 | 1111-78-0 |
| Ammonium carbonate carbamate | 157.13 | 21.68 | 8000-73-5 |
| Ammonium carbonate<br>(Diammonium carbonate) | 96.09 | 35.45 | 506-87-3 |

## Table C-1 (Continued)

| Chemical Name | Molecular Weight* | $NH_3$ Equivalent Wt% | CAS Number |
|---|---|---|---|
| Ammonium carbonate, hydrogen<br>(Ammonium bicarbonate) | 79.06 | 21.54 | 1066-33-7 |
| Ammonium cerium nitrate<br>(Ammonium hexanitratocerate)<br>(Ammonium hexanitratocerate (IV))<br>(Diammonium cerium hexanitrate) | 548.23 | 6.213 | 16774-21-3 |
| Ammonium cerous nitrate<br>(Ammonium cerous nitrate, tetrahydrate) | 486.22 | 7.005 | 13083-04-0 |
| Ammonium chlorate | 101.49 | 16.78 | 10192-29-7 |
| Ammonium perchlorate | 117.49 | 14.49 | 7790-98-9 |
| Ammonium chloride | 53.49 | 31.84 | 12125-02-9 |
| Ammonium chromate<br>(Ammonium chromate (VI))<br>(Diammonium chromate) | 152.07 | 22.40 | 7788-98-9 |
| Ammonium chromate<br>(Ammonium dichromate)<br>(Ammonium dichromate (VI))<br>(Ammonium bichromate)<br>(Diammonium dichromate) | 252.06 | 13.51 | 7789-09-5 |
| Ammonium chromium sulfate<br>(Ammonium chromic sulfate) | 265.17 | 6.422 | 13548-43-1 |
| Ammonium citrate<br>(Ammonium citrate, monohydrogen)<br>(Ammonium citrate, dibasic)<br>(Diammonium citrate)<br>(Diammonium citrate, hydrogen) | 226.19 | 15.06 | 3012-65-5 |
| Ammonium citrate<br>(Ammonium citrate, tribasic)<br>(Triammonium citrate) | 243.22 | 21.01 | 3458-72-8 |
| Ammonium cobalt sulfate<br>(Ammonium cobaltous sulfate) | 289.14 | 11.78 | 13596-46-8 |
| Ammonium cupric chloride<br>(Ammonium chlorocuprate (II))<br>(Diammonium copper tetrachloride)<br>(Diammonium tetrachlorocuprate) | 241.43 | 14.11 | 15610-76-1 |
| Ammonium cyanate<br>(Ammonium isocyanate) | 60.06 | 28.35 | 22981-32-4 |
| Ammonium cyanide | 44.06 | 38.65 | 12211-52-8 |

## Table C-1 (Continued)

| Chemical Name | Molecular Weight* | $NH_3$ Equivalent Wt% | CAS Number |
|---|---|---|---|
| Ammonium cyanoaurate, monohydrate<br>(Ammonium tetracyanoaurate, monohydrate) | 319.07 | 5.337 | 14323-26-3 |
| Ammonium cyanoaurate<br>(Ammonium dicyanoaurate) | 267.04 | 6.377 | 31096-40-9 |
| Ammonium ferricyanide<br>(Ammonium hexacyanoferrate (III))<br>(Triammonium hexacyanoferrate) | 266.07 | 19.20 | 14221-48-8 |
| Ammonium ferrocyanide<br>(Ammonium hexacyanoferrate (II))<br>(Tetraammonium ferrocyanide)<br>(Tetraammonium hexacyanoferrate) | 284.11 | 23.98 | 14481-29-9 |
| Ammonium fluoride | 37.04 | 45.98 | 12125-01-8 |
| Ammonium fluoride<br>(Ammonium difluoride)<br>(Ammonium bifluoride)<br>(Ammonium fluoride, hydrogen)<br>(Ammonium difluoride, hydrogen)<br>(Ammonium bifluoride, hydrogen) | 57.04 | 29.86 | 1341-49-7 |
| Ammonium fluoroborate<br>(Ammonium tetrafluoroborate) | 104.84 | 16.24 | 13826-83-0 |
| Ammonium fluorogermanate (IV)<br>(Ammonium hexafluorogermanate (IV))<br>(Diammonium hexafluorogermanate) | 222.66 | 15.30 | 16962-47-3 |
| Ammonium fluorophosphate<br>(Ammonium hexafluorophosphate) | 163.00 | 10.45 | 16941-11-0 |
| Ammonium fluorosulfate<br>(Ammonium fluorosulfonate) | 117.10 | 14.54 | 13446-08-7 |
| Ammonium formate | 63.06 | 27.01 | 540-69-2 |
| Ammonium gallium sulfate | 282.90 | 6.020 | 15335-98-5 |
| Ammonium hydroxide | 35.05 | 48.59 | 1336-21-6 |
| Ammonium iodide | 144.94 | 11.75 | 12027-06-4 |
| Ammonium iridium chloride<br>(Ammonium chloroiridate (III))<br>(Ammonium hexachloroiridate)<br>(Triammonium hexachloroiridate) | 459.05 | 11.13 | 15752-05-3 |
| Ammonium iron sulfate<br>(Ammonium ferric sulfate)<br>(Ammonium iron disulfate) | 269.02 | 6.330 | 10138-04-2 |

## Table C-1 (Continued)

| Chemical Name | Molecular Weight* | $NH_3$ Equivalent Wt% | CAS Number |
|---|---|---|---|
| Ammonium iron sulfate<br>(Ammonium ferrous sulfate)<br>(Diammonium iron disulfate)<br>(Diammonium ferrous disulfate) | 286.05 | 11.91 | 10045-89-3 |
| Ammonium lactate<br>(Ammonium 2-hydroxypropionate) | 107.11 | 15.90 | 515-98-0 |
| Ammonium laurate<br>(Ammonium dodecanoate) | 217.35 | 7.835 | 2437-23-2 |
| Ammonium magnesium sulfate | 252.50 | 13.49 | 14727-95-8 |
| Ammonium malate | 168.15 | 20.26 | 6283-27-8 |
| Ammonium malate, hydrogen<br>(Ammonium bimalate) | 151.12 | 11.27 | 5972-71-4 |
| Ammonium molybdate<br>(Diammonium molybdate) | 196.01 | 17.38 | 13106-76-8 |
| Ammonium molybdate<br>(Ammonium heptamolybdate)<br>(Ammonium molybdate, hydrate)<br>(Ammonium molybdate, tetrahydrate)<br>(Ammonium *para*molybdate, tetrahydrate) | 1,163.8 | 8.780 | 12054-85-2 |
| Ammonium nickel chloride, hexahydrate | 183.09 | 9.301 | 16122-03-5 |
| Ammonium nickel sulfate<br>(Ammonium nickel sulfate, hexahydrate)<br>(Ammonium nickel disulfate, hexahydrate)<br>(Diammonium nickel disulfate, hexahydrate) | 286.88 | 11.87 | 7785-20-8 |
| Ammonium nitrate | 80.04 | 21.28 | 6484-52-2 |
| Ammonium nitrate sulfate | 212.18 | 24.08 | 12436-94-1 |
| Ammonium nitrite | 64.04 | 26.59 | 13446-48-5 |
| Ammonium oleate | 299.50 | 5.686 | 544-60-5 |
| Ammonium oxalate | 124.10 | 27.45 | 1113-38-8 |
| Ammonium palladium chloride<br>(Ammonium chloropalladate (II))<br>(Ammonium tetrachloropalladte (II))<br>(Diammonium tetrachloropalladate) | 284.31 | 11.98 | 13820-40-1 |
| Ammonium phosphate<br>(Ammonium orthophosphate) | 149.09 | 34.27 | 10124-31-9 |

## Table C-1 (Continued)

| Chemical Name | Molecular Weight* | $NH_3$ Equivalent Wt% | CAS Number |
|---|---|---|---|
| Ammonium phosphate<br>(Ammonium biphosphate)<br>(Ammonium phosphate, hydrogen)<br>(Ammonium phosphate, dihydrogen)<br>(Ammonium orthophosphate, dihydrogen)<br>(Ammonium phosphate, monobasic) | 115.03 | 14.80 | 7722-76-1 |
| Ammonium phosphate<br>(Ammonium phosphate, hydrogen)<br>(Ammonium orthophosphate, monohydrogen)<br>(Ammonium phosphate, dibasic)<br>(Ammonium orthophosphate, dibasic)<br>(Diammonium phosphate)<br>(Diammonium orthophosphate)<br>(Diammonium phosphate, hydrogen)<br>(Diammonium phosphate, monohydrogen)<br>(Diammonium orthophosphate, hydrogen) | 132.06 | 25.79 | 7783-28-0 |
| Ammonium phosphinate<br>(Ammonium hypophosphite) | 83.03 | 20.51 | 7803-65-8 |
| Ammonium phosphite<br>(Ammonium biphosphite)<br>(Ammonium phosphite, dihydrogen) | 99.03 | 17.20 | 13446-12-3 |
| Ammonium picramate | 216.15 | 7.879 | 1134-85-6 |
| Ammonium propionate | 91.11 | 18.69 | 17496-08-1 |
| Ammonium rhodium chloride<br>(Ammonium chlororhodate (III))<br>(Ammonium hexachlororhodate (III))<br>(Triammonium rhodium hexachloride)<br>(Triammonium hexachlororhodate) | 369.74 | 13.82 | 15336-18-2 |
| Ammonium salicylate<br>(Ammonium 2-hydroxybenzoate) | 155.15 | 10.98 | 528-94-9 |
| Ammonium selenide | 115.04 | 29.61 | 66455-76-3 |
| Ammonium silicon fluoride<br>(Ammonium fluorosilicate)<br>(Ammonium hexafluorosilicate)<br>(Diammonium silicon hexafluoride)<br>(Diammonium fluorosilicate)<br>(Diammonium hexafluorosilicate) | 178.15 | 19.12 | 16919-19-0 |
| Ammonium stearate<br>(Ammonium octadecanoate) | 301.51 | 5.648 | 1002-89-7 |
| Ammonium succinate<br>(Diammonium succinate) | 152.15 | 22.39 | 2226-88-2 |

## Table C-1 (Continued)

| Chemical Name | Molecular Weight* | $NH_3$ Equivalent Wt% | CAS Number |
|---|---|---|---|
| Ammonium sulfamate<br>(Ammonium amidosulfate)<br>(Ammonium amidosulfonate) | 114.12 | 14.92 | 7773-06-0 |
| Ammonium sulfate<br>(Diammonium sulfate) | 132.13 | 25.78 | 7783-20-2 |
| Ammonium sulfate<br>(Ammonium bisulfate)<br>(Ammonium sulfate, hydrogen)<br>(Ammonium sulfate, monohydrogen) | 115.10 | 14.80 | 7803-63-6 |
| Ammonium *per*sulfate<br>(Ammonium peroxysulfate)<br>(Ammonium peroxydisulfate)<br>(Diammonium persulfate)<br>(Diammonium peroxydifulsite) | 228.19 | 14.93 | 7727-54-0 |
| Ammonium sulfide<br>(Ammonium bisulfide)<br>(Ammonium sulfide, hydrogen) | 51.11 | 33.32 | 12124-99-1 |
| Ammonium sulfide<br>(Ammonium monosulfide)<br>(Diammonium sulfide) | 68.14 | 49.99 | 12135-76-1 |
| Ammonium sulfide<br>(Diammonium pentasulfide) | 196.39 | 17.34 | 12135-77-2 |
| Ammonium sulfite, monohydrate<br>(Diammonium sulfite, monohydrate) | 116.13 | 29.33 | 7783-11-1 |
| Ammonium sulfite<br>(Ammonium bisulfite)<br>(Ammonium sulfite, hydrogen) | 99.10 | 17.18 | 10192-30-0 |
| Ammonium tetrachloroaurate (III), hydrate | 356.82 | 4.772 | 13874-04-9 |
| Ammonium thiocarbamate | 94.13 | 18.09 | 16687-42-6 |
| Ammonium thiocarbonate<br>(Diammonium trithiocarbonate) | 144.27 | 23.61 | 13453-08-2 |
| Ammonium thiocyanate<br>(Ammonium isothiocyanate)<br>(Ammonium sulfocyanate)<br>(Ammonium rhodanate)<br>(Rhodanid) | 76.12 | 22.37 | 1762-95-4 |
| Ammonium dithionate | 196.19 | 17.36 | 60816-52-6 |
| Ammonium thiosulfate<br>(Ammonium hyposulfite)<br>(Diammonium thiosulfate) | 148.20 | 22.98 | 7783-18-8 |

| Chemical Name | Molecular Weight* | $NH_3$ Equivalent Wt% | CAS Number |
|---|---|---|---|
| Ammonium tin bromide<br>(Ammonium bromostannate (IV))<br>(Ammonium hexabromostannate (IV))<br>(Diammonium hexabromostannate) | 634.19 | 5.371 | 16925-34-1 |
| Ammonium tin chloride<br>(Ammonium chlorostannate (IV))<br>(Ammonium hexachlorostannate (IV))<br>(Diammonium tin hexachloride)<br>(Diammonium hexachlorostannate) | 367.48 | 9.269 | 16960-53-5 |
| Ammonium titanium fluoride<br>(Ammonium fluorotitanate (IV))<br>(Ammonium hexafluorotitanate (IV))<br>(Diammonium titanium hexafluoride)<br>(Diammonium hexafluorotitanate) | 197.95 | 17.21 | 16962-40-6 |
| Ammonium titanium oxalate, monohydrate<br>(Diammonium dioxalatooxotitanate, monohydrate) | 276.00 | 12.34 | 10580-03-7 |
| Ammonium tungstate<br>(Ammonium tungstate (VI))<br>(Ammonium *para*tungstate)<br>(Hexaammonium tungstate) | 1,779.2 | 5.743 | 12028-06-7 |
| Ammonium tungstate<br>(Ammonium tungstate (VI))<br>(Ammonium *para*tungstate)<br>(Decaammonium tungstate) | 3,058.6 | 5.568 | 11120-25-5 |
| Ammonium valerate<br>(Ammonium pentoate) | 119.16 | 14.29 | 42739-38-8 |
| Ammonium zinc chloride<br>(Ammonium chlorozincate)<br>(Ammonium tetrachlorozincate)<br>(Diammonium tetrachlorozincate) | 243.27 | 14.00 | 14639-97-5 |

*For hydrated compounds, e.g., ammonium sulfite, monohydrate, the molecular weight excludes the weight of the hydrate portion.

# Appendix D

## UNIT CONVERSION FACTORS

## (From U.S. Coast Guard Commandant Instruction M.16465.12A)

# CONVERSION FACTORS

| To Convert | To | Multiply By |
|---|---|---|
| **Length** | | |
| inches | millimeters | 25.4 |
| inches | feet | 0.0833 |
| feet | inches | 12 |
| feet | meters | 0.3048 |
| feet | yards | 0.3333 |
| feet | miles (U.S. statute) | 0.0001894 |
| yards | feet | 3 |
| yards | miles (U.S. statute) | 0.0005682 |
| miles (U.S. statute) | feet | 5280 |
| miles (U.S. statute) | yards | 1760 |
| miles (U.S. statute) | meters | 1609 |
| miles (U.S. statute) | nautical miles | 0.868 |
| meters | feet | 3.271 |
| meters | yards | 1.094 |
| meters | miles (U.S. statute) | 0.0006214 |
| nautical miles | miles (U.S. statute) | 1.152 |
| **Area** | | |
| square inches | square centimeters | 6.452 |
| square inches | square feet | 0.006944 |
| square feet | square inches | 144 |
| square feet | square meters | 0.09290 |
| square meters | square feet | 10.76 |
| square miles | square yards | 3,097,600 |
| square yards | square feet | 9 |
| Volume | | |
| cubic inches | cubic centimeters | 16.39 |
| cubic inches | cubic feet | 0.0005787 |
| cubic feet | cubic inches | 1728 |
| cubic feet | cubic meters | 0.02832 |
| cubic feet | U.S. gallons | 7.481 |
| cubic meters | cubic feet | 35.31 |
| liters | quarts (U.S. liquid) | 1.057 |
| quarts (U.S. liquid) | liters | 0.9463 |
| U.S. gallons | barrels (petroleum) | 0.02381 |
| U.S. gallons | cubic feet | 0.1337 |
| U.S. gallons | Imperial gallons | 0.8327 |
| barrels (petroleum) | U.S. gallons | 42 |
| Imperial gallons | U.S. gallons | 1.201 |
| milliliters | cubic centimeters | 1 |

## CONVERSION FACTORS (Continued)

| To Convert | To | Multiply By |
|---|---|---|
| **Time** | | |
| seconds | minutes | 0.01667 |
| seconds | hours | 0.0002778 |
| seconds | days | 0.00001157 |
| minutes | seconds | 60 |
| minutes | hours | 0.01667 |
| minutes | days | 0.0006944 |
| hours | seconds | 3600 |
| hours | minutes | 60 |
| hours | days | 0.04167 |
| **Mass or Weight** | | |
| pounds | kilograms | 0.4536 |
| pounds | short tons | 0.0005 |
| pounds | long tons | 0.000464 |
| pounds | metric tons | 0.0004536 |
| tons (short) | pounds | 2000 |
| tons (metric) | pounds | 2205 |
| tons (long) | pounds | 2240 |
| kilograms | pounds | 2.205 |
| tonnes (metric tons) | kilograms | 1000 |
| **Energy** | | |
| calories | Btu | 0.003968 |
| calories | joules | 4.187 |
| Btu (British thermal units) | calories | 252.0 |
| Btu | joules | 1055 |
| joules | calories | 0.2388 |
| joules | Btu | 0.0009479 |
| **Velocity** | | |
| feet per second | meters per second | 0.3048 |
| feet per second | miles per hour | 0.6818 |
| feet per second | knots | 0.5921 |
| meters per second | feet per second | 3.281 |
| meters per second | miles per hour | 2.237 |
| miles per hour | meters per second | 0.4470 |
| miles per hour | feet per second | 1.467 |
| knots | meters per second | 0.5148 |
| knots | miles per hour | 1.151 |
| knots | feet per second | 1.689 |
| pounds per cubic foot | grams per cubic centimeter | 0.01602 |
| grams per cubic centimeter | pounds per cubic foot | 62.42 |
| grams er cubic centimeter | kilograms per cubic meter | 1000 |
| kilograms per cubic meter | grams per cubic centimeter | 0.001 |

## CONVERSION FACTORS (Continued)

| To Convert | To | Multiply By |
|---|---|---|
| **Pressure** | | |
| ponds per square inch (absolute) (psia) | kilonewtons per square meter ($kN/m^2$) | 6.895 |
| psia | atmospheres | 0.0680 |
| psia | inches of water | 27.67 |
| psia | millimeters of mercury (torr) | 51.72 |
| pounds per square inch (gauge) (psig) | psia | add 14.70 |
| millimeters of mercury (torr) | psia | 0.01934 |
| millimeters of mercury (torr) | $kN/m^2$ | 0.1333 |
| inches of water | psia | 0.03614 |
| kilograms per square centimeter | millimeters of mercury (torr) | 735.6 |
| inches of water | $kN/m^2$ | 0.2491 |
| kilograms per square centimeter | atmospheres | 0.9678 |
| atmospheres | $kN/m^2$ | 101.3 |
| kilograms per square centimeter | psia | 14.22 |
| atmospheres | psia | 14.70 |
| bars | $kN/m^2$ | 100 |
| kilonewtons per square meter ($kN/m^2$) | psia | 0.1450 |
| bars | atmospheres | 0.9869 |
| kilonewtons per square meter ($kN/m^2$) | atmospheres | 0.009869 |
| bars | kilograms per square centimeter | 1.020 |
| **Viscosity** | | |
| centipoises | pounds per foot per second | 0.0006720 |
| pounds per foot per second | centipoises | 1488 |
| centipoises | poises | 0.01 |
| centipoises | Newton seconds per square meter | 0.001 |
| poises | grams per centimeter per second | 1 |
| grams per centimeter per second | poises | 1 |
| Newton seconds per square meter | centipoises | 1000 |
| **Thermal Conductivity** | | |
| Btu per hour per foot per °F | watts per meter-kelvin | 1.731 |
| Btu per hour per foot per °F | kilocalories per hour per meter per °C | 1.488 |
| watts per meter-kelvin | Btu per hour per foot per °F | 0.5778 |
| kilocalories per hour per meter per °C | watts per meter-kelvin | 1.163 |
| kilocalories per hour per meter per °C | Btu per hour per foot per °F | 0.6720 |
| **Heat Capacity** | | |
| Btu per pound per °F | calories per gram per °C | 1 |
| Btu per pound per °F | joules per kilogram-kelvin | 4187 |
| joules per kilogram-kelvin | Btu per pound per °F | 0.0002388 |
| calories per gram per °C | Btu per pound per °F | 1 |

## CONVERSION FACTORS (Continued)

| To Convert | To | Multiply By |
|---|---|---|
| **Concentration (in water solution)** | | |
| parts per million (ppm) | milligrams per liter | 1 |
| milligrams per liter | ppm | 1 |
| milligrams per cubic meter | grams per cubic centimeter | $1\times10^{-9}$ |
| grams per cubic centimeter | milligrams per cubic meter | $1\times10^{9}$ |
| grams per cubic centimeter | pounds per cubic foot | 62.42 |
| pounds per cubic foot | grams per cubic centimeter | 0.01602 |
| **Temperature** | | |
| degrees Kelvin (°K) | degrees Rankine (°R) | 1.8 |
| degrees Rankine (°R) | degrees Kelvin (°K) | 0.5556 |
| degrees centigrade (°C) | degrees Fahrenheit (°F) | first multiply by 1.8, then add 32 |
| degrees Fahrenheit (°F) | degrees centigrade (°C) | first subtract 32, then multiply by 0.5556 |
| degrees centigrade (°C) | degrees Kelvin (°K) | add 273.2 |
| degrees Fahrenheit (°F) | degrees Kelvin (°K) | add 459.7 |
| **Flow** | | |
| cubic feet per second | U.S. gallons per minute | 448.9 |
| U.S. gallons per minute | cubic feet per second | 0.002228 |

**Universal Gas Constant (R)**

8.314 joules per gram mole-kelvin
1.987 calories per gram mole-kelvin
1.987 Btu per pound mole per °F
10.73 psia-cubic feet per pound mole per °F
82.057 atm-cubic centimeters per gram mole-kelvin
62.361 millimeters mercury liter per gram mole-kelvin

## INDEX

The pages listed in bold text in the index correspond to the primary uses or definitions of the associated term. Additionally, this index includes a list of primary purposes for examples and common errors that are presented throughout the document.

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