EPCRA Section 313
Data Quality Inspection Manual

U. S. Environmental Protection Agency
Office of Compliance Monitoring

Printed on Recycled Paper

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Data Quality Inspection Manual

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Chapter One

Introduction

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1. Introduction

On October 17, 1986, the Federal Superfund Amendments and Reauthorization Act (SARA) was enacted into law. The Emergency Planning and Community Right-to-Know Act (EPCRA) is Title III of SARA. EPCRA is designed to help communities deal safely and effectively with the numerous toxic and hazardous chemicals used daily in our society. It contains provisions that improve emergency planning for toxic and hazardous chemicals and require facilities to identify hazardous chemicals present onsite and toxic chemicals released into the environment.

1.1 EPCRA Section 313

Specifically, Section 313 of EPCRA addresses reporting requirements for the release of toxic chemicals. This section has three primary requirements:

- Covered facilities must submit annual reports to the States and the Environmental Protection Agency (EPA) on the amounts of toxic chemicals released to the environment or transferred offsite. Toxic chemicals are defined as any chemical on the Toxic Chemical List.
- EPA must establish an inventory of data from the facility reports.
- States and EPA must make the release information available to the public and communities through a nationalized database and other means.

EPCRA stipulates that facilities that manufacture, process, or otherwise use certain toxic chemicals in excess of a specified amount, or threshold quantities, must submit annual reports on the amounts of those toxic chemicals released into the air, water, and land or transferred offsite. The original Section 313 Toxic Chemical List, comprising more than 300 chemicals and chemical categories, was based on lists already in use by the States of Maryland and New Jersey. Through a petition process, EPA can add or delete chemicals from the Section 313 Toxic Chemical List. Such additions or deletions occur frequently.

Currently, the reporting requirements apply to owners and/or operators of facilities that meet the following requirements:

- Have 10 or more full-time employees (or 20,000 paid personnel hours)
- Are in Standard Industrial Classification (SIC) Codes 20XX through 39XX (i.e., facilities in the manufacturing sector)
- Are a multi-establishment complex in which all establishments have a primary SIC code of 20 through 39 or meet other requirements as written in 40 CFR 372.22(3)(i) and (ii)

- Manufacture, process, or otherwise use a listed toxic chemical in excess of the specified threshold quantities.

For a list of SIC groups subject to Section 313, see Figure 1-1.

Threshold quantities have changed since the first year of reporting. Facilities manufacturing or processing any Section 313 chemicals in excess of the 75,000 pound threshold for 1987 should have submitted toxic chemical release forms (EPA Form R) by July 1, 1988. Facilities manufacturing or processing in excess of the 50,000 pound threshold for 1988 should have reported by July 1, 1989. Thereafter, facilities manufacturing or processing more than the 25,000 pound threshold in a year are required to submit the forms by July 1 of the following year. Likewise, facilities otherwise using listed toxic chemicals in quantities more than the 10,000 pound threshold in a calendar year are required to submit toxic chemical release forms by July 1 of the following year.

Facilities must provide the required information on the Toxic Chemical Release Form (EPA Form R) and are required to retain onsite copies of all forms submitted, along with the supporting materials used to develop information in the report, for three years from the date of submission. These materials must also be readily available for inspection by EPA or other authorized organizations. EPCRA Section 313 also requires EPA to enter the data from each Form R report into the Toxic Chemical Release Inventory System (TRIS), which is a database accessible to members of the public. The Pollution Prevention Act of 1990 (PPA) mandated that information on past or current year source reduction or recycling activities and future estimates be included in the Form R.

1.2 EPCRA Section 313 Enforcement and Data Quality

Numerous EPA offices use Toxic Release Inventory (TRI) data for:

- Developing regulations. TRI data can pinpoint chemicals of concern that may require more stringent regulation based on emission estimates.

- Program planning. TRI data can provide a wealth of information on specific chemical emissions for special initiative planning.

- Establishing benchmarks for pollution prevention/waste minimization initiatives. The emissions data from previous years can serve as the starting point for meeting reduction goals.

Because so many offices use TRI data for their programs, it is important that the data contained within TRIS be of the highest integrity. The Office of Compliance Monitoring (OCM) and EPA Regions,

Figure 1-1
Standard Industrial Classification Groups Subject to Section 313

SIC Code	Industry Group
20	Food and kindred products
21	Tobacco products
22	Textile mill products
23	Apparel and other finished products made from fabrics and other similar materials
24	Lumber and wood products, except furniture
25	Furniture and fixtures
26	Paper and allied products
27	Printing, publishing, and allied industries
28	Chemicals and allied products
29	Petroleum refining and related industries
30	Rubber and miscellaneous plastic products
31	Leather and leather products
32	Stone, clay, glass, and concrete products
33	Primary metal industries
34	Fabricated metal products, except machinery and transportation equipment
35	Industrial and commercial machinery and computer equipment
36	Electrical and other electronic equipment and components, except computer equipment
37	Transportation equipment
38	Measuring, analyzing, and controlling instruments; photographic, medical and optical goods; watches and clocks
39	Miscellaneous manufacturing industries

through the inspection process, are obligated to help ensure that all facilities in the regulated community are reporting and submitting accurate estimates.

Section 325(c) of EPCRA authorizes the EPA Administrator to assess administrative civil penalties for violations of EPCRA Section 313. In the program's first years, EPA's enforcement program focused primarily on identifying and taking action against facilities that failed to report. However, EPA is now taking steps to make data quality a priority in its enforcement program. This guidance manual is an essential element of that effort.

1.2.1 Headquarters-Regional Memorandum of Agreement Process and the Enforcement Response Policy

The intended purpose of the Office of Prevention, Pesticides, and Toxic Substances (OPPTS) Headquarters-Regional Memoranda of Agreement (MOAs) is to implement the pesticide and toxics programs to achieve National program objectives while recognizing the relevant circumstances or conditions in the different Regions. Both Regional and Headquarters management will agree on program goals, flexibility, or discretion. The goal is to use available resources fully to address Regional and National priorities for prevention, pesticides, and toxic substances.

The process is being implemented in the spirit of improving Headquarters-Regional teamwork and partnerships for OPPTS programs. Headquarters and Regions recognize that the growing demand on resources to meet an ever increasing array of priorities requires that agreements be reached on Regional and National priorities.

The OPPTS FY 1993 MOA asked Regions to increase EPCRA Section 313 inspections by 25 percent and target 10 percent of all Section 313 inspections on data quality. Data quality errors, as defined in the current EPCRA Section 313 Enforcement Response Policy, are errors that cause erroneous data to be submitted to EPA and States. Generally, these errors result from a failure to comply with the explicit requirements of EPCRA Section 313 and are not readily detectable during EPA's data entry process. The following list from the Enforcement Response Policy presents the range of actions that constitute data quality errors:

- Failure to identify all appropriate categories of chemical use, which causes an error in release or offsite transfer amounts
- Failure to identify for each wastestream the waste treatment or disposal methods employed and an estimate of the treatment efficiency typically achieved by such methods for that wastestream
- Failure to use all information necessary to calculate releases or offsite transfers
- Failure to perform release estimation or offsite transfer calculations

- Failure to provide the annual quantity of the toxic chemical that entered the environmental medium
- Failure to provide the annual quantity of the toxic chemical transferred offsite
- Failure to provide information required by regulations promulgated under Section 7 of the PPA[1]
- Failure to claim the correct source reduction or recycling activities (under the requirements of Section 7 of the PPA, past or current year source reduction or recycling activities planned, but not yet implemented by the facility, cannot be claimed)[1]
- Failure to correct previous errors or omissions resulting in Notices of Noncompliance (NON), as demonstrated by a facility's Form R reports.

It should be noted that an error made in determining a facility's toxic chemical threshold that results in the facility erroneously concluding that a Form R report for that chemical is not required is not a data quality error but a "failure to report in a timely manner" violation.

1.3 Purpose of This Manual

The purpose of this manual is to provide guidance to EPA inspectors who conduct data quality inspections under EPCRA Section 313. While there are other EPA guidance materials pertaining to inspections in general, this manual is intended to stand alone and provide specific guidance for Section 313 data quality inspections. This manual is not intended to replace previous documents, but rather, to serve as a supplement to them. Therefore, inspectors may and should refer to those other documents as necessary when performing inspections to determine data quality.

The following chapters of this manual provide information pertaining to the various components of an EPCRA data quality inspection. The remainder of the manual is comprised of the following chapters:

Chapter 2:	Data Quality and Nonreporters Targeting
Chapter 3:	Pre-Inspection Activities
Chapter 4:	Industrial Profiles for Section 313 Nonreporter and Data Quality Inspections
Chapter 5:	Entry to the Facility and the Opening Conference
Chapter 6:	Onsite Evaluation of Data Quality
Chapter 7:	Closing Conference
Chapter 8:	Post-Inspection Activities
Chapter 9:	Elements of a Good Data Quality Case

[1] PPA inspection guidance will be developed in cooperation with OPPT as the program develops.

Where appropriate, sections of the EPCRA data quality inspection checklist have been incorporated into the text. When a checklist section appears in the manual, a discussion of the guidelines for completing that section is also included. Additionally, at the end of this chapter, Guidelines for a Comprehensive EPCRA Section 313 Data Quality Inspection Process has been included. The guidelines will help the inspector who is unfamiliar with the data quality inspection process or who wants to establish a thorough chronology for her/his recordkeeping purposes to ensure that all inspection requirements have been met and that, if necessary, all materials are available to develop a strong case. If, at the end of the inspection process, questions arise concerning any phase of the process, the inspector will have documented evidence of her/his activities.

Guidelines for a Comprehensive EPCRA Section 313 Data Quality Inspection Process

Name of Facility	
Inspector Name	
Inspection Date	

Pre-Inspection Phase

	Yes	No	Date
Was inspection targeted?			
Were Form R reports reviewed?			
For SIC information?			
For relevant permits?			
For chemical-specific information?			
Were facility summary matrices created, if necessary?			
Were EPA records and databases reviewed?			
Has the pre-inspection checklist been completed?			
Has the inspection plan been developed?			

Describe the National/Regional priority

_____

_____

_____

_____

Inspection Phase

	Yes	No	Date
Has the data quality inspection checklist been completed?			
Facility tour?			
Review of Section 313 chemicals?			
Review of threshold determination?			
Review of release estimates?			
Have the suggested questions at the back of the industrial profiles (if applicable) been asked and recorded?			
Has the information on EPCRA Section 313 and data quality compliance been given to the facility?			

Post-Inspection Phase

	Yes	No	Date
Has any needed follow-up action been initiated?			
Has the inspection report been completed and filed with the case development officer?			

Chapter Two

EPCRA Data Quality and Nonreporters Targeting

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2. EPCRA Data Quality and Nonreporters Targeting

The purpose of this guide is to assist EPA Regional Office personnel with the targeting and conducting of SARA Title III, Section 313 inspections. This guide provides sources of general information for a wide variety of industries that may be used to target facilities for inspections. The sources may also be used to gather general information on an industry of interest such as typical sizes, throughputs, or chemical releases. This guide provides methods to identify facilities that are subject to the SARA Title III, Section 313 reporting but who have not submitted Form Rs for their releases and offsite transfers. The guide also provides methods to identify data quality problems for those facilities that have reported.

Industry-specific profiles have been prepared for the following industries (See Chapter Four for additional information on the industry-specific profiles):

- Electroplating
- Foundries
- Furniture manufacture
- Paint formulation
- Ink formulation
- Petroleum refineries
- Motor vehicle parts and accessories.

These industry-specific profiles provide targeting guidance for the six industries studied. This document provides guidance for targeting nonreporters and data quality problems in the TRI system as a whole. This guide presents information identified during the preparation of industry-specific profiles and information supplied by EPA Regional Office personnel. The guide is intended to provide EPA Regional personnel with sources of background information to target facilities for visits and to review prior to a SARA Title III, Section 313 inspection at a facility.

Section 2.1 of this chapter provides methods to identify nonreporting facilities. Section 2.2 provides methods that may be used to identify data quality errors and chemicals that were not reported at facilities that submitted some Form Rs. Both industry-wide and plant-specific data sources that may provide comparisons with TRI submitted data are

discussed. Section 2.3 discusses common errors in TRI submittals. Appendices 2-A through 2-D present listings of data sources that may be useful to Regional inspectors.

2.1 Identification of Possible Nonreporting Facilities

For the TRI database to be accurate, all facilities with over 10 employees that manufacture or process over 25,000 pounds (or otherwise use over 10,000 pounds) of listed chemicals in SIC codes 20 through 39 must submit Form Rs estimating releases and offsite transfers of these chemicals. Therefore, it is important to identify facilities who are required to report to TRI but who have not.

In the preparation of the six industry profiles, the number of facilities in the TRI database was compared with the number of establishments with 10 or more employees in County Business Patterns[1] and Dunn and Bradstreet (D&B).[2] Consistently, the number of establishments with 10 or more employees in the 4-digit SIC category reported in these published sources was about double that in the same 4-digit SIC category in the TRI database. Within the SIC codes selected for the industry profiles, almost all facilities manufacture, process, or otherwise use at least one Section 313 chemical in excess of threshold quantities. Part of this difference can be accounted for by offices of the manufacturing establishments that would not need to report to TRI. A number of facilities, however, apparently are subject to the reporting requirements of Section 313, but they are not reporting.

Identification of nonreporting facilities using public databases presents several problems including:

- Four-digit SIC codes in many industries are not clearly understood; therefore, many facilities are classified differently in different databases.

- Company names (corporate, subsidiary, and division names) and even addresses (P.O. Box versus street address) differ for the same facility in different databases.

- Offices of a company where no Section 313 chemicals are used are included as establishments on many lists.

- Some operations are embedded in a larger facility with a different SIC; and therefore, they are difficult to identify by SIC.

- Because the completion dates of the databases differ, company ownership changes are difficult to identify.

Based on International Technology's (IT's) experience from this project and discussions with Regional Office personnel, several sources emerged as the most useful in identifying nonreporting facilities. This assessment, however, should not exclude other sources from consideration. The methodology proposed for identifying nonreporting facilities consists of seven steps:

1) Select industries where nonreporting appears to be a problem and identify one or more 4-digit SIC codes that define this industry.

2) Compare the total number establishments in TRI in the region with the number reported with over 10 employees in County Business Patterns[1] and D&B[2].

3) Obtain D&B printout for geographic area of interest for those 4-digit SICs with large differences and in which most facilities with over 10 employees would manufacture, process, or otherwise use at least one Section 313 chemical in excess of threshold quantities.

4) Compare D&B printout with facilities that reported in the TRI database.

5) Recheck TRI by name and location to ensure a facility has not reported under a different SIC.

6) Gather data on sales, employment, Resource conservation and Recovery Act (RCRA), and other information.

7) Select candidate facilities.

The EPCRA Targeting System (ETS) provides automated support to the above methodology for identifying nonreporting facilities. This system was developed by the Office of Compliance Monitoring, with regional input, to provide Regional inspectors with a tool to manipulate the universe of facilities that are potential nonreporters. ETS is a hybrid PC/Mainframe computer system that provides local access to and manipulation of facility information for the creation of prioritized inspection targeting lists. It also supports tracking of facility contacts, tips/complaints, and can support outreach efforts.

The ETS national facility universe is created from Dun & Bradstreet (D&B) and TRIS, for facilities with a SIC range of 20-39 and 10 or more employees. The national universe is partitioned into ten regional universes. Each region can then download their own data to a PC for local use. Each Region's universe contains only facilities located in their Region.

The crossmatched information (between D&B and TRIS) provides the inspector with facility information, parent company corporate and demographic information and TRIS reporting status and dates. The inspector also has fields in ETS in which information on facility history, previous facility contact, comments, and tips/complaints can be manually inputted. Tip/complaints and facility contact information can be used as criteria in the development of new inspection targetting lists.

Please note that a brochure on the EPCRA Targeting System has been included in this manual (in the front pouch).

2.1.1 Select Industries

Perhaps the most important task in effectively identifying nonreporters is the selection of industries to be investigated. This selection should be based on the following types of criteria:

- Likelihood of otherwise using chemicals in significant quantities. This is important because the threshold is lower for otherwise used chemicals, releases are typically higher, and offsite transfers may be a RCRA waste. These industries would typically involve use of paints, inks, or degreasing solvents.

- Experience of the Regional Office with this industry. This can include things such as the record of other environmental violations and the sophistication of the industry in understanding environmental requirements.

- Existence of clearly defined 4-digit SICs. This is necessary because much of the data will be gathered using a 4-digit SIC. For example, vapor degreasing as a category would be difficult to identify by use of SIC codes.

2.1.2 Compare TRI and Other Databases

Using the 4-digit SICs, compare the total number of establishments in TRI with the number of establishments in County Business Patterns[1]. County Business Patterns

presents the number of establishments by employment size class: 1-4, 5-9, 10-19, 20-49, 50-99, 100-249, 250-499, 500-979, and 1,000 or more establishments. If, in the industry selected, it is likely that all facilities with 10 or more employees would use at least one Section 313 chemical in excess of the threshold, then the number of establishments with over 10 employees should be selected for comparison with the TRI database. If only larger facilities would be expected to exceed the threshold on a consistent basis, then over 20 employees or over 50 employees may be used. Also obtain the number of establishments in the same 4-digit SIC in D&B[2]. A current list of D&B is available in DIALOG D&B File 515. The total number of facilities in the SIC over a specified employment size may be printed out without listing the facilities. Compare the total number of establishments in County Business Patterns and D&B with the total number in the TRI database (by region, state, or other desired area).

2.1.3 Print Out D&B Listing of Establishments

For 4-digit SICs with at least twice as many establishments in the published databases (over specified employment size) as are in the TRI database, print out a list of these facilities from D&B. The printout may be done for the whole region or for a particular state or area of interest. Some Regional Offices also mentioned that geographic targeting at this stage helped to lower the ultimate costs when the sites are visited.

2.1.4 Compare D&B Listing With TRI

Remove those facilities that have reported in TRI from the D&B list. Use state manufacturing directories to resolve discrepancies on name, address, or SIC Code. Remove other establishments that are obviously (by name or address) not a manufacturing facility, such as headquarter facilities.

2.1.5 Recheck TRI by Name and Location

Because facilities may report to TRI and D&B using different SIC codes, recheck TRI to be sure that the facility has not submitted information under a different SIC code. Remove those facilities found.

2.1.6 Gather Sales, Employment, and RCRA Generator Information

For each facility, gather the number of employees and the sales numbers for the facility. This information can be obtained from the State Manufacturing Directories or from

DIALOG D&B Files 515 and 516. If available in the region, the quantity of RCRA-generated waste should also be added. Any other databases available to the Regional Office that help prioritize the remaining facilities on the list (such as information from states in the region) should also be added.

2.1.7 Select Candidate Facilities

Select facilities with high sales, employees, or RCRA volumes as the best candidate facilities. Also, confirm by telephone that this location is primarily a manufacturing facility and not an office or warehouse location.

2.2 Identification of Data Quality Problems

Section 2.0 discussed methods to identify nonreporting facilities. This section discusses methods to identify errors at facilities that have reported to TRI. This section presents methods to identify data quality errors in the TRI database. Data quality errors include overestimates as well as underestimates of chemical releases or offsite transfers. Data quality errors also include not reporting for chemicals because of calculation errors or not understanding the reporting requirements (e.g., threshold determination or de minimis).

This section also discusses methods that may be used to identify potential errors. Potential errors may be identified by comparison with other data sources, identifying common errors associated with different calculation methods, and other targeting methods.

2.2.1 Comparison of TRI Reported Releases With Other Data Sources

Sources of data that may be used to identify potential data quality problems in SARA Title III, Section 313 reporting can be divided into general industry data and plant-specific data.

2.2.1.1 General Industry Data

General information on industries comes from many sources. The following sources can be used to estimate typical process parameters, identify potential sources of release/offsite transfer, estimate typical releases, as sources of emission factors, and regulatory limits. Standard sources that present this type of information include:

- Industrial Process Profiles for Environmental Use (IPPEU). This source contains detailed process flow diagrams including input materials, process conditions, and release estimates for 29 broad industries. A separate volume addresses each industry, and some industries (e.g., plastics and resins) contain over 20 specific process flow sheets and 60 process descriptions. A listing of the IPPEUs is presented in Appendix 2-A.

- Kirk-Othmer Encyclopedia of Chemical Technology[3]. This source contains detailed, documented information on almost every type of chemical process. The bibliography after each section is an excellent source of additional information. The author of each section is an expert in the field who is typically knowledgeable of current trends in the industry.

- Compilation of Air Pollutant Emission Factors, AP-42[4]. This source contains process descriptions, emission factor estimates, and control information on more than 120 processes. Emissions factors are provided for criteria pollutants. Factors for total particulates or Volatile Organic Compounds (VOCs) can be used with composition information to prepare rough estimates of releases from similar processes. Sections on the storage and transfer of organic liquids are particularly useful in calculating releases.

- Air Pollution Engineering Manual, AP-40[5]. This source contains process descriptions and control information for a wide variety of industries located in the Los Angeles area. Some of the information (especially control information) is out of date since the date of the publication is 1973.

- Effluent Guideline Series. This source contains information on releases of many pollutants to wastewater for industries that represent major sources of wastewater releases.

- New Source Performance Standards (NSPS). This source contains air release limitations that apply to new sources in 58 industries. Many standards involve particulates or VOCs that may be useful in determining reasonable releases of Section 313 constituents of the release. Background documents prepared in support of the NSPS are most helpful. A listing of the NSPS is contained in Appendix 2-B.

- SARA Title III, Section 313, Release Reporting Guidance Documents. These reports contain brief descriptions of the industry, identify potential release points, and model calculations for estimating releases. A listing of these guidance documents is contained in Appendix 2-C.

- Office of Air Quality Planning and Standards (OAQPS) Reports. These sources provide process manufacturing descriptions and release estimates and some data on the use of specific chemicals. A listing of these reports is presented in Appendix 2-D.

- National Institute of Occupational Safety and Health (NIOSH) Health Hazard Evaluations (HHEs) and Industry-wide Surveys (IWSs). These sources contain well-documented occupational exposure measurements. They also contain general process descriptions.

Industry-specific regulatory limits may be used to identify chemicals of concern. The regulations may vary by plant size, water discharge volume, or other variables that can be used to identify parameters common to different plant sizes. Finally, regulatory limits may be used to calculate an upper limit of release for the regulated chemical. However, this is not meant to imply that any specific plant must have this release.

Regulatory limits for an industry as a whole may be used as a reality check for high release estimates or as an upper-bound estimate for lower release estimates. Because industry-wide regulatory limits are upper-bound release limits, they are generally not good indicators of actual releases at a specific facility. Also, these regulations may be for groups of chemicals such as VOCs or particulates that are difficult to relate to specific Section 313 chemical releases.

Probably the best source of industry-wide data is the TRI database. In the industry-specific profiles prepared by IT, an analysis of the TRI data was very important to identify specific chemicals used and expected typical releases and offsite transfers. Although too much time would be required for an inspector to do a similar analysis, the TRI database may be used to produce an industry overview. To produce meaningful results, however, any analysis must be performed at the 4-digit SIC level. The analysis may be done nation-wide or on a regional or state basis. The most useful information is data on the number of facilities that report use of a particular Section 313 chemical. For example, if 90 percent of the facilities report for xylene and the plant in question does not, this difference should be investigated. The analysis for the industry-specific profiles discussed any chemical used by more than 5 percent of the facilities; however, chemicals used by more than a third or half may be more useful for a quick analysis. Chemicals that are common substitutes for each other should be grouped into categories such as chlorinated solvents, organic solvents, and metals/metal compounds. For example, the TRI data may

indicate that chlorinated solvents are commonly used (rather than indications that 1,1,1-trichloroethane is commonly used).

To estimate probable releases during the development of the six industry-specific guides, a mean release/offsite transfer was calculated for the industry or industry segment. Again, this would require too much time for an inspector to perform. The best method, if possible, would be to identify similar facilities. Information in the TRI database (such as maximum quantity onsite) should not be used, however, because it often is not reliable and does not correlate well with releases. Similar facilities may be identified through inspector knowledge of the facilities or through comparison of sales or number of employees in State Manufacturer Directories. Comparisons may be made with only a few facilities. If any statistical analysis is attempted (such as calculation of a mean release), however, at least 10 or more facilities should be selected. Although there may be very good reasons for differences in releases or offsite transfers between identical facilities (such as better control or difference production rates in a given year), differences that are of an order of magnitude should be questioned.

2.2.1.2 Plant-Specific Data

Publicly available plant-specific data is the best source of information for which to review TRI data submittals. The types of plant-specific data that may be used to target potential errors include regulatory submittals [e.g., RCRA, National Pollutant Discharge Elimination System (NPDES)], TRI comparisons (e.g., year to year, Sections 6 to 8), and other public sources. The following sources are particularly useful:

- RCRA hazardous waste generator reports
- Stack tests
- Reported VOC releases
- Wastewater monitoring data
- Year-to-year TRI comparisons
- Section 8 of TRI submittals (beginning with the 1991 submittals) for otherwise-used chemicals.
- SRI Directory of Chemical Producers
- NIOSH HHEs.

2.2.1.2.1 Regulatory Submittals

RCRA manifest and hazardous waste generator reports are particularly useful to estimate offsite transfers for Section 313 chemicals because the facility that receives the waste must analyze it prior to recycling, treatment or disposal. Some of the analyses will be Toxic Characteristic Leachate Procedure (TCLP) measurements. TCLP measurements report leachable contaminants, not contaminant concentration. For standard wastes, however, the industry in question may have developed a conversion factor that is calculated based on a concentration/TCLP ratio. The concentrations may then be estimated using this ratio. Therefore, the facility typically will have all the information needed to accurately calculate most offsite transfers for these wastestreams, especially solvent streams sent offsite for fuel blending or reclamation. It should be remembered that SARA Title III, Section 313 chemicals may be present in wastestreams that are not RCRA wastes; however, the RCRA streams constitute a major source of data for checking TRI estimates. Reality checks based on total reported volumes can be used to identify potential reporting errors. For example, if offsite transfers of F001 or F002 RCRA wastes equal the reported quantities of chlorinated degreasing solvents sent offsite, the facility probably over reported offsite transfers and under reported air releases of chlorinated solvents. This is because a degreasing waste should contain a sizable percentage of the contaminants being cleaned in the waste solvent.

Stack tests performed on control equipment may be used to check the order of magnitude of air releases for major point sources at a facility. While these results may be applicable for particulates or VOCs, they can be used in conjunction with published chemical speciation data to estimate releases. For example, if the quantity sent offsite for disposal from a control device (e.g., a baghouse) and the control efficiency are known (i.e., a stack test), the air release reported in TRI can be easily estimated and compared with the TRI reported releases.

Some facilities must report VOC releases to state agencies as a condition of their permit. These reported releases may be used in conjunction with speciation data to estimate air releases of Section 313 chemicals.

Wastewater monitoring data on pH, metals, or other constituents may be used along with wastewater release quantities to estimate releases of SARA Title III, Section 313 chemicals to water or Publicly Owned Treatment Works (POTW).

2.2.1.2.2 TRI Comparisons

Year-to-year comparisons of reported releases and offsite transfers of Section 313 chemicals can detect calculation errors or errors in the methods used to calculate releases. While year-to-year fluctuations may be explained by changes in usage (e.g., changes in paints used), or the addition of control equipment, large changes can also indicate errors made in one or more of the reporting years. This is especially true if no changes were made in the type or efficiency of the reported controls for this chemical.

Discrepancies in year-to-year release estimates are not always an indication of a data quality error. This is especially true if release estimates are declining. This may be an indication of the use of a more sophisticated estimation methodology. For example, use of monitoring data will typically result in a lower emission estimate than the use of an emission factor or mass balance. Basing emission estimates on leak detection systems or stratified factors can also result in lower reported releases. In general, more sophisticated methodologies are more expensive and tend to be used by larger companies.

Comparison of release and offsite transfer reporting (on Form R, Sections 5 and 6) with Source Reduction and Recycling Activity Reporting (on Form R, Section 8) for 1991 and later reporting years can also be used to identify errors. Releases reported in Section 5 should equal the quantity released in Section 8 (adjusted for rounding). The Waste Treatment/Disposal/Recycling/Energy Recovery Codes in Section 6 and the associated offsite transfers should agree with the equivalent reported quantities in Section 8 (adjusted for rounding). In conclusion, inconsistencies in reporting within a TRI submittal may indicate errors in the calculation of releases and offsite transfers.

The value that is most useful in calculating releases and offsite transfers is the chemical throughput. This quantity, however, was specifically excluded from reporting to TRI. The new Form R submitted for reporting year 1991, however, contains all the information needed to directly calculate chemical throughput for otherwise-used chemicals that are not recycled onsite. The sum of the quantities listed in Sections 8.1 through 8.8 of Form R equals the throughput for otherwise-used chemicals unless the chemical is consumed or transformed within the manufacturing process. If onsite recycling is reported, the estimation of throughput can become more complicated because the recycled chemical may be reused in the same process or used for other purposes elsewhere at the facility. If the totals reported in Section 8.1 through 8.8 do not exceed 10,000 pounds, either the facility should not have reported the otherwise-used chemical because the threshold was

not exceeded, or the reported quantities are incorrect. If the throughput for otherwise-used chemicals is known, releases to various media can be estimated based on published emission factors or other estimation methods.

2.2.1.2.3 Other Public Sources

For chemical producers, the SRI Directory of Chemical Producers should be used to confirm that all Section 313 chemicals reported in SRI as manufactured at that site are reported in TRI. The directory contains information on over 1,500 facilities. The SRI Directory's lower limit for reporting in the Directory is 5,000 pounds or $5,000, which is below the 25,000 pounds TRI reporting threshold; however, almost all the Section 313 chemicals would be manufactured in quantities greater than the TRI reporting threshold.

If a NIOSH HHE was performed for the facility in question, the HHE should be reviewed to ascertain which chemicals were present at the facility. Because NIOSH measures for chemicals that are not necessarily present at the facility, the report, not just the results, must be reviewed.

2.2.2 Errors Associated With Calculation Methods

The quality of the release estimates is directly related to the method used by the facility to calculate the estimate. There are specific types of errors that should be looked for with each calculation method. One of four codes is reported on Form R as the basis of the estimate: M, monitoring data; C, mass balance; E, published emission factor; and O, other approaches.

Monitoring data is the best method for calculating releases or offsite transfer quantities for an individual wastestream. These estimates always boil down to a measured wastestream chemical concentration multiplied by the mass or volume of the wastestream. Several errors can occur in using this method. These errors tend to cause order of magnitude errors in the estimated releases or offsite transfers and can be identified by year-to-year or industry-wide comparisons. First, use of improper units caused calculational errors in the result. Second, an inappropriate measurement may be used. The use of TCLP measurement will underestimate releases because these tests measure leachable metals, not metal content, in the sample. Third, a measurement may be used of a sample that does not represent the average concentration in the wastestream for the entire year. For example, concentrations in wastewater will vary during low or high wastewater flow

periods and annual average concentration must have a sufficient number of measurements to account for this. Often the facility will have only one data point for a chemical in a wastestream. Nonrepresentative monitoring data should not be used to calculate releases; however, it is often the only reasonable method that the facility can use to calculate an estimate.

Mass balance provides a means of accounting for all the inputs and outputs of process chemicals. A mass balance is useful for estimating releases when measured release data are not available or when other inlet and output streams are quantified. The amounts entering or leaving a process are either measured or estimated. A mass balance can be performed on the process as a whole or on a subprocess. Individual operations within the process usually must be evaluated.

Mass balance calculations are the best overall method to use to account for the total usage of the chemical for otherwise-used chemicals. Because total throughput is accounted for, the only reporting error will be to which media the release represents. For manufactured or processed chemicals, mass balance calculations can again account for all releases or offsite transfers once the quantity that remains with the product is estimated. Mass balance calculations are not appropriate when releases and offsite transfers represent only a small percentage of the chemical throughput. If mass balance calculations are used to estimate very small releases or offsite transfers for manufactured or processed chemicals, the results should be questioned.

A third technique for estimating releases and offsite transfer from processes involves the use of emission factors. One type of emission factor relates a quantity of a pollutant to some process-related parameter or measurement. The amount of pollutant per quantity of product is frequently used. Many emission factors are expressed in terms of total VOC or particulates rather than a single chemical compound. Emission factors for VOCs are available in VOC Emission Factors for the National Acid Precipitation Assessment Program (NAPAP) Emission Inventory.[7] These data can be used with actual process vent measurements of volatile organics or particulates to estimate emissions of a specific compound. The Volatile Organic Compound (VOC) Species Data Manual[8] also provides information on many air emission sources. This allows the user to estimate releases of specific toxic compounds based on the total amount of VOCs emitted from a particular source. Similarly, the Receptor Model Source Composition Library[9] provides information relating metals emissions to total particulate emissions for different release sources.

Another good source of information is Toxic Air Pollutant Emissions Factors - A Compilation for Selected Air Toxic Compounds and Sources.[10]

Errors can result in the use of emission factors if inappropriate factors are used or if these factors are "adjusted" by the facility using questionable rationale. If the facility reports the use of an emission factor, the calculation should be reviewed using accepted EPA factors for comparison.

Engineering calculations or "other approaches" can be used when parameters related to emissions cannot be directly measured. Emissions can be estimated or inferred through engineering calculations or measurement of other secondary parameters (i.e., physical/chemical properties of the materials involved, design information on the unit operation for which the estimate is being made, or emission information from similar processes). Engineering calculations are generally used to "fill in" information needed for other emission estimation methods.

Physical/chemical information derived from the ideal gas law, vapor pressure, and equilibrium relationships can frequently be applied when gaseous concentrations of a particular compound are estimated. Some releases, such as VOC releases from storage tanks, can be estimated by use of a combination of emission factors and engineering calculations. For example, the EPA publication AP-42 provides equations for estimating air emissions from organic liquid storage and handling operations.[4] These equations contain factors that depend on tank parameters and service conditions. More specific information on storage tank emissions including example calculations for horizontal tanks and chemical mixtures can be found in Estimating Air Toxics Emissions From Organic Liquid Storage Tanks.[11] The only way to identify errors in engineering calculations is to check the rationale and the actual calculation, including units.

Finally, the methods and data presented in Estimating Releases and Waste Treatment Efficiencies For The Toxic Chemical Release Inventory Form are useful to check estimates of release or offsite transfer reported by the facility.[12]

2.2.3 Other Targeting Methods

In discussions with Regional Office personnel, several additional targeting methods were identified. They include:

- Targeting in conjunction with other cross-program multi-media inspections [e.g., RCRA, Clean Water Act (CWA)]

- Targeting using tips or complaints from other media programs on questionable submissions

- Targeting in conjunction with other Office of Compliance Monitoring (OCM) control program inspections [e.g., Toxic Substances Control Act Sections 5 and 8 or polychlorinated biphenyls (PCB)]

- Targeting as a follow-up or add-on to a nonreporter inspection

- Targeting a geographic area where there are a large number of facilities, thus reducing inspection costs

- Targeting by inspecting facilities that have violations of other regulations

- Targeting using newspaper or broadcast accounts of chemical usage or release

- Targeting facilities that have received Notices of Noncompliance (NONs)

- Targeting facilities that are large emitters or emitters of specific toxic chemicals.

It should be noted that Region VII has developed a basic formula which evaluates chemical emission by toxicity, carcinogenicity, chemical release amount, and media released to. This method allows a Region to focus data quality inspections on chemicals that pose the highest risk.

2.3 Common Errors

In targeting chemicals or processes at a facility, certain common errors should be investigated. Based on IT experience on this project and other Section 313 projects for Office of Pollution Prevention and Toxic (OPTS), the following general types of errors are common enough that checks for TRI reporting errors should include these topics when appropriate. This section also presents a list of general questions that may be helpful to determine if reporting errors were made.

General types of errors include:

- Many facilities do not understand the difference between manufactured, processed, or otherwise used chemicals. This can cause a facility not to report chemicals that were otherwise used because the wrong threshold was used.

- Many facilities do not understand that the weight of metal compound is used to determine if the threshold is exceeded while the weight of the metal only is used to calculate releases and offsite transfers. This can cause errors in both threshold determination and release estimation.

- The maximum quantity reported onsite is sometimes misunderstood to be the annual usage of the chemical.

- For metals/metal compounds, TCLP is sometimes used to estimate the metal concentration in wastes sent offsite. This does not measure metal content, but rather leachable metal content, and should not be used in calculations.

- Some small facilities do not understand that the threshold determination is based on throughput, not on release quantities. Some think that they need to release 10,000 pounds before the chemical is reportable.

- Some facilities think that the total quantity of chlorinated solvents, purge solvents, etc., sent offsite for reclamation is waste solvent and did not account for the other constituents of the waste. This mistake causes underestimation of air releases.

- Many smaller facilities are not familiar with SIC definitions, and therefore use incorrect SIC codes. This can cause difficulties in using TRI data to calculate mean release quantities or to identify nonreporting facilities.

- If Material Safety Data Sheet (MSDS) information is used to estimate the quantity of Section 313 chemical used at the facility, the supplier should be checked to see if the percentage represented an average or a maximum concentration. Many MSDSs report toxic materials on the high side for safety reasons.

The following questions can be helpful to determine if reporting errors were made for the following types of releases.

<u>Organic Solvents</u>

- For otherwise-used solvents (i.e., coatings, cleanups), did a mass balance for solvents account for total usage at the facility?

- Was the otherwise-used threshold of 10,000 pounds applied for all solvents used in coatings?

- How were releases of organic solvents other than to air estimated?

- If a paint booth and drying oven were vented to different control devices, how was the booth/oven split determined?

- For solvents sent offsite for fuel burning, recycling, or disposal, was a waste analysis used to determine the quantity of the 313 chemical? Most wastes should be RCRA wastes, which are analyzed by the waste receiver.

- How were releases of process solvents determined? What percentage of throughput was released to air?

- For manufactured or processed chemicals, were analyses of the products used to determine the quantity of the Section 313 chemical that remained in the product?

Chlorinated Solvents (degreasing)

- Was a mass balance accounting for all chlorinated solvent usage used to estimate releases and offsite transfers?

- Was the percentage of chlorinated solvent in the waste accounted for?

- For vapor degreasing with water separation, were releases to water or POTW estimated?

Metals/Metal Compounds

- Was TCLP used as a measure of metal concentration in any calculation? TCLP does not measure metal content, but rather leachable metal, and should not be used in calculations.

- Were wastewater monitoring data used to estimate releases to water or POTW? What was the frequency of the monitoring?

- Were thresholds for metal compounds determined using the weight of the compound and not just the metal portion of the compound?

- Were thresholds determined for all metals/metal compounds processed at the facility?

- Did the facility determine if it met the reporting thresholds from the amount released or transferred offsite instead of the amount processed or otherwise used?

- For metals/metal compounds in paints, how was a coating transfer efficiency determined?

Acids

- Was the pH of acid releases continuously measured to support any assumption of neutralization? If not, what was the frequency of the monitoring?

- Was the percentage of acid in the original acid or acid solution taken into account in the calculation of threshold?

Other Chemicals

- If chlorine releases to water or POTW were reported, the water pH should be checked. If pH is higher than 4, there is only a very small release to water.

- Were total ammonia (NH_3 + $NH4^+$) levels used to report ammonia releases to water?

References

1. U.S. Department of Commerce; Bureau of the Census. County Business Patterns, 1989. CBP-89-1, Washington, D.C. 1991.

2. Dunn & Bradstreet. Dunn's Electronic Business Directory in DIALOG Database File 515. 1992.

3. Kirk-Othmer. Encyclopedia of Chemical Technology, Third Edition. John Wiley and Sons. 1982.

4. U.S. Environmental Protection Agency. Compilation of Air Pollutant Emission Factors. Volume I: Stationary Point and Area Sources, AP-42. Research Triangle Park, NC. 1985.

5. U.S. Environmental Protection Agency. Air Pollution Engineering Manual. Second Edition, AP-40. May 1973.

6. SRI International. SRI Directory of Chemical Procedures, 1992. United States of America. 1982.

7. U.S. Environmental Protection Agency. VOC Emission Factors of a NAPAP Emission Inventory. EPA 600/7-86-052. Research Triangle Park, NC. 1986.

8. U.S. Environmental Protection Agency. Volatile Organic Compound (VOC) Species Data Manual. Second Edition. EPA-450/4-80-015. Research Triangle Park, NC. 1980.

9. Carl, J. F., et al. Receptor Model Composition Library. EPA-450/4-85-002. 1984.

10. U.S. Environmental Protection Agency. Toxic Air Pollutant Emission Factors - A Compilation of Selected Air Toxic Compounds and Sources, EPA 450/2-88-006a. Research Triangle Park, NC. 1988.

11. U.S. Environmental Protection Agency. Estimating Air Toxics Emissions From Organics Liquid Storage Tanks. EPA 450/4-88-004. Research Triangle Park, NC. 1988.

12. U.S. Environmental Protection Agency. Estimating Releases and Waste Treatment Efficiencies For the Toxic Chemical Release Inventory Form. EPA 560/4-88-002. Washington, DC. 1987.

Appendix 2-B: Listing of Background Documents for New Source Performance Standards

4. New Source Performance Standard (40 CFR 60)

Subpart	Standards of Performance for -
D	Fossil-Fuel Fired Steam Generators for Which Construction is Commenced After August 17, 1971
Da	Electric Utility Steam Generating Units for Which Construction is Commenced After September 18, 1978
Db	Industrial-Commerical-Institutional Steam Generating Units
Dc	Small Industrial-Commercial-Institutional Steam Generating Units
E	Incinerators
F	Portland Cement Plants
G	Nitric Acid Plants
H	Sulfuric Acid Plants
I	Asphalt Concrete Plants
J	Petroleum Refineries
K	Storage Vessels for Petroleum Liquids for Which Construction, Reconstruction, or Modification Commenced after June 11, 1973 and prior to May 19, 1978
Ka	Storage Vessels for Petroleum Liquids for Which Construction, Reconstruction, or Modification
Kb	Volatile Organic Liquid Storage Vessels (including Petroleum Liquid Storage Vessels) for which Construction, Reconstruction, or Modification Commenced after July 23, 1984
L	Secondary Lead Smelters
M	Secondary Brass and Bronze Ingot Production Plants
N	Primary Emissions from Basic Oyxgen Process Furnaces for Which Construction is Commenced After June 11, 1973
Na	Secondary Emissions From Basic Oxygen Process Steelmaking Facilities for Which Construction Commenced After January 20, 1983
O	Sewage Treatment Plants
P	Primary Copper Smelters
Q	Primary Zinc Smelters
R	Primary Lead Smelters
S	Primary Aluminium Reduction Plants
T	Phosphate Fertilizer Industry: Wet-Process Phosphoric Acid Plants
U	Phosphate Fertilizer Industry: Superphosphoric Acid Plants
V	Phosphate Fertilizer Industry: Diammonium Phosphate Plants
W	Phosphate Fertilizer Industry: Triple Superphosphate Plants
X	Phosphate Fertilizer Industry: Granular Triple Superphosphate Storage Facilities
Y	Coal Preparation Plants
Z	Ferroalloy Production Facilities
AA	Steel Plants: Electric Arc Furnaces

Appendix 2-A: Listing of Industrial Process Profiles for Environmental Use

AAa	Steel Plants: Electric Arc Furnaces and Argon-Oxygen Decarburization Vessels Constructed After August 17, 1983
BB	Kraft Pulp Mills
CC	Glass Manufacturing Plants
DD	Grain Elevators
EE	Surface Coating of Metal Furniture
FF	(Reserved)
GG	Stationary Gas Turbines
HH	Lime Manufacturing Plants
KK	Lead-Acid Battery Manufacturing Plants
LL	Metallic Mineral Processing Plants
MM	Automobile and Light-Duty Truck Surface Coating Operations
NN	Phosphate Rock Plants
PP	Ammonium Sulfate Manufacture
OO	(Reserved)
QQ	Graphic Arts Industry: Publication Rotogravure Printing
RR	Pressure Sensitive Tape and Label Surface Coating Operations
SS	Industrial Surface Coating: Large Applicances
TT	Metal Coil Surface Coating
UU	Asphalt Processing and Asphalt Roofing Manufacture
VV	Equipment Leaks of VOC in Synthetic Organic Chemicals Manufacturing Industry
WW	Beverage Can Surface Coating Industry
XX	Bulk Gasoline Terminals
AAA	New Residential Wood Heaters
BBB	Rubber Tire Manufacturing Industry
CCC	(Reserved)
DDD	(Reserved)
EEE	(Reserved)
FFF	Flexible Vinyl and Urethane Coating and Printing
GGG	Equipment Leaks of VOC in Petroleum Refineries
HHH	Synthetic Fiber Production Facilities
III	Volatile Organic Compound Emissions from the Synthetic Organic Chemical Manufacturing Industry (SOCMI) Air Oxidation Unit Processes
JJJ	Petroleum Dry Cleaners
KKK	Equipment Leaks of VOC From Onshore Natural Gas Processing Plants
LLL	Onshore Natural Gas Processing: SO_2 Emissions
MMM	(Revised)
NNN	Volatile Organic Compound Emissions from Synthetic Organic Chemical Manufacturing Industry Distillation Operations
OOO	Nonmetallic Mineral Processing Plants
PPP	Wool Fiberglass Insulation Manufacturing Plants
QQQ	VOC Emissions from Petroleum Refinery Wastewater Systems
RRR	(Reserved)

SSS	Magnetic Tape Coating Facilities
TTT	Industrial Surface Coating: Surface Coating of Plastic Parts for Business Machines
UUU	(Reserved)
VVV	Polymeric Coating of Supporting Substrates Facilities

Appendix 2-C: Listing of Section 313 Reporting Guidance Documents

Title III Section 313 Release Reporting Guidance Estimating Releases from:

Monofilament Fiber Manufacture	EPA 560/4-88-004a	Jan 1988
Printing Operations	EPA 560/4-88-004b	Jan 1988
Electrodeposition of Organic Coatings	EPA 560/4-88-004c	Jan 1988
Spray Application of Organic Coatings	EPA 560/4-88-004d	Jan 1988
Semiconductor Manufacture	EPA 560/4-88-004e	Jan 1988
Formulating Aqueous Solutions	EPA 560/4-88-004f	Mar 1988
Electroplating Operations	EPA 560/4-88-004g	Jan 1988
Textile Dyeing	EPA 560/4-88-004h	Feb 1988
Presswood and Laminated Wood Products	EPA 560/4-88-004i	Mar 1988
Roller, Knife, and Gravure Coating Operations	EPA 560/4-88-004j	Feb 1988
Paper and Paperboard Production	EPA 560/4-88-004k	Feb 1988
Leather Tanning and Finishing Processes	EPA 560/4-88-004l	Feb 1988
Wood Preserving	EPA 560/4-88-004p	Feb 1988
Rubber Production and Compounding	EPA 560/4-88-004q	Mar 1988
Food Processers	EPA 560/4-90-014	June 1990

These reports contain brief descriptions of the industry, identify potential release points, and model calcualtions for estimating releases.

Appendix 2-D: Listing of Selected Office of Air Quality Planning and Standards Chemical-Specific Reports for Section 313 Chemicals

Office of Air Quality Planning and Standards (OAQPS) Reports

These following reports may be useful for estimating releases for existing chemicals. They contain information concerning chemical/physical properties, overview of production and uses, amount consumed per end use, major industrial source categories, process descriptions and flow diagrams, potential emission points, emission factors, number of sites and facility names, and references for source sampling and analysis procedures. The following reports have been issued for Section 313 chemicals.

Locating and Estimating Air Emissions from Sources of:

Acrylonitrile	EPA 450/4-84-007a	Mar 1984
Carbon tetrachloride	EPA 450/4/84-007b	Mar 1984
Chloroform	EPA 450/4-84-007c	Mar 1984
Ethylene dichloride (1,2-Dichloroethane)	EPA 450/4/84-007d	Mar 1984
Formaldehyde	EPA 450/4-84-007e	Mar 1984
Nickel	EPA 450/4-84-007f	Mar 1984
Chromium	EPA 450/4-84-007g	July 1984
Manganese	EPA 450/4-84-007h	Sept 1985
Phosgene	EPA 450/4-84-007i	Sept 1985
Epichlorohydrin	EPA 450/4-84-007j	Sept 1985
Vinylidene chloride	EPA 450/4-84-007k	Sept 1985
Ethylene oxide	EPA 450/4-84-007l	Sept 1986
Chlorobenzenes	EPA 450/4-84-007m	Sept 1986
Polychlorinated Biphenyl's (PCBs)	EPA 450/4-84-007n	May 1987
Benzene	EPA 450/4-84-007q	Mar 1988
Perchloroethylene and trichloroethylene	EPA 450/2-89-013	Mar 1988
Chromium (supplement)	EPA 450/2-89-002	Aug 1989
1,3-Butadiene	EPA 450/2-89-021	Dec 1989

The following reports contain industry and process descriptions, process flow diagrams, emissions data, applicable control systems, and impact analysis. All chemicals, not just Section 313 chemicals are presented.

Organic Chemical Manufacturing Vol. 6 through 10: Selected Processes:

Organic Chemical Manufacturing Vol. 6: Selected Processes
PB 81-220550 EPA 450/3-80-028a Dec 1980

Cyclohexane
Chlorobenzenes
Styrene
Cyclohexanol
Cyclohexanone
Maleic anhydride
Ethylbenzene
Capralacton
Adipic acid

Organic Chemical Manufacturing Vol. 7: Selected Processes
PB 81-220568 EPA 450/3-80-028b Dec 1980

Nitrobenzene
Toluene diisocyanate
Dimethyl terephthalate
Phenol
Aniline
Cumene
Crude terephthalic acid
Purified terephthalic acid
Acetone
Linear alkylbenzenes

Organic Chemical Manufacturing Vol. 8: Selected Processes
PB 81-220576 EPA 450/3-80-028c Dec 1980

Ethylene dichloride
Perchloroethylene by hydrocarbon chlorinolysis process
Fluorocarbons

Trichloroethylene
Chloromethanes by methane chlorination process
Chloromethanes by methanol hydrochlorination and methyl chloride chlorination process
Carbon tetrachloride
1,1,1-Trichloroethane
Perchloroethylene
Vinylidene chloride

Organic Chemical Manufacturing Vol. 9: Selected Processes
PB 81-220584 EPA 450/3-80-028d Dec 1980

Formaldehyde
Ethylene
Acetaldehyde
Methanol
Ethanol amines
Ethylene oxide
Vinyl acetate
Ethylene glycol

Organic Chemical Manufacturing Vol. 10: Selected Processes
PB 81-220592 EPA 450/3-80-028e Dec 1980

Propylene oxide
Glycerin and intermediates (allyl chloride, epichlorohydrin, acrolein, allyl alcohol)
Chloroprene
Formic acid
Waste sulfuric acid treatment for acid recovery
Acrylonitrile
Acetic anhydride
Acetic acid
Ethyl acetate
Methyl ethyl ketone

Chapter Three

Pre-Inspection Preparation

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3. Pre-Inspection Preparation

3.1 Introduction

This chapter contains guidance on conducting pre-inspection activities pertaining to Section 313 of EPCRA. A good inspection begins with planning, which should commence well before the inspector visits the facility to be inspected. Planning is the means by which the inspector identifies all the required activities to be completed during the inspection process, from obtaining records before the inspection to writing reports and follow up.

Planning includes conducting a thorough review, prior to the inspection, of EPA records and data pertaining to the facility to be inspected (including data that may be obtained from the facility itself). This saves time in the long run because familiarity with the operations, history, and compliance status of the facility decreases the need for covering these areas during the limited time typically spent onsite. In addition, planning promotes a better relationship with the regulated community because the EPA inspector should be able to answer questions concerning the application of EPCRA requirements to a particular facility. It also enhances the facility's confidence in the EPA inspector and aids in establishing good relationships with facility representatives.

Another important benefit of planning is to enhance the inspector's ability to identify and document potential violations and thus provide more time to collect necessary data to assist Case Development Officers (CDOs) in their subsequent compliance and enforcement activities. Ultimately, planning an inspection may actually take more time than the inspection itself but will result in a more efficient and productive inspection overall.

The objectives of inspection planning are to:

- Understand the objectives of the inspection
- Understand EPCRA and applicable regulations
- Be familiar with the compliance history and physical site layout of the particular facility to be inspected
- Be well-versed in the policies and procedures governing EPCRA inspections
- Be prepared to collect and record documents taken from the facility

- Be familiar with the safety plan for protection from potential hazards at the facility.

This chapter describes the planning process that should take place prior to any routine EPCRA inspection. The basic elements of inspection planning are determining if an EPCRA inspection should be included in a multi-media inspection (Section 3.1); reviewing EPA and other records and data concerning the subject facility (Section 3.2); providing advance notification of the inspection to the facility (Section 3.3); completing the pre-visit section of the Inspection Checklist (Section 3.4); preparing a written inspection plan to be followed during the actual inspection (Section 3.5); and gathering inspection documents (Section 3.6).

3.2 EPCRA and Multimedia Inspections

To date, most of the data quality inspections conducted have been part of a larger multimedia inspection. Working with a team of inspectors on a strict schedule can pose problems for the EPCRA Section 313 data quality inspector because an onsite, thorough, data quality review may require up to 3 days. The logistics of conducting a multimedia inspection can also drain resources from the data quality inspection itself.

TIP

Many data quality inspectors feel there is not enough time to adequately review emissions data during a multimedia inspection, whether announced or unannounced. Inspectors in some Regions have eliminated this problem by scheduling data quality reviews after other members of the multimedia team have completed their inspection.

(Taken from *Study of Regional Experience Conducting EPCRA Data Quality Inspections*)

Given this problem and because Regional resources are scarce, it is important that inspectors and their managers determine when EPCRA Section 313 data quality inspections should be part of larger multimedia efforts. The following bullets are merely suggestions for situations in which an EPCRA data quality inspection might benefit from being part of a larger multimedia effort:

- Single chemical initiatives
- Geographic initiatives
- Enforcement Management Council/Office of Enforcement initiatives
- Facilities manufacturing/use of explosive or highly toxic chemicals.

TIP
Reporting Status
Many facilities are also cited for failure to submit a Form R during a data quality inspection. Inspectors should always examine the reporting status of a facility before conducting a data quality inspection.

If an inspector determines that an EPCRA inspection should not occur within a multi-media inspection, then s/he should follow the procedures outlined in the rest of this chapter.

3.3 Review of Facility and EPA Records

A thorough review of EPA records for the facility to be inspected is a critical component of pre-inspection preparation. This section focuses on the review of key facility and EPA written records and databases, which together will supply the inspector with crucial background information pertaining to the facility to be inspected. However, the inspector should also supplement record review activities by interviewing appropriate EPA personnel who may have additional information or knowledge of the subject facility. The appropriate persons to interview will be based on the inspector's need for clarifying issues or data discovered during the record review process and on the need for additional information. When reviewing the available information on a facility, the inspector should identify and focus on the information most relevant to the purpose of the inspection.

This section discusses the purpose of pre-inspection records review; types of information to be reviewed; sources of information; procedures for requesting information from EPA Headquarters; and CBI considerations for the records review process.

Proper review of EPA records prior to the inspection of a subject facility is essential to the overall success of compliance inspection efforts. The information obtained from reviews of specific regulatory requirements that apply to the facility, as well as site-specific background information on compliance history and facility operations, help the inspector to develop the written inspection plan (Section 3.5) and gather inspection documents (Section 3.6). In addition, facility representatives may be more responsive to an inspector who has a thorough understanding of the facility operations and structure.

In general, the objectives of the records review include the following:

- Become familiar with facility size, operations, and physical layout
- Learn about facility compliance history
- Discover inadequacies and inconsistencies in the information on the subject facility that the inspector may want to clarify during the inspection
- Minimize inconvenience to facility personnel by not having to ask for basic facility-specific information that may already be in EPA records and avoid having to spend on site time doing so
- Clarify technical and legal issues before conducting the inspection
- Make more efficient use of EPA personnel and funding by saving time once at the inspection site.

The following list highlights examples of the types of information the inspector should search for during the record review process. Obtaining all this information may not be possible; however, because of its value to the inspection process, the inspector should expend significant efforts to obtain these and other types of information on the facility.

- General Facility Information. Some of the general information on a facility the inspector should look for during the records review process includes:
  - Maps and/or aerial photographs showing the location of the facility and its relationship to the surrounding area
  - Names, titles, and telephone numbers of facility officials and/or representatives
  - Organizational structure

- Special facility entry requirements
- Past and present (and possibly future) operations and production levels
- Safety equipment and health and safety training requirements
- Water, air, and waste treatment pollution and control equipment
- Descriptions of the facility's (and/or the company's or parent company's) recordkeeping and filing systems
- Physical layout of facility
- Size of facility.

These types of information are particularly useful in helping the inspector plan the details of the inspection and allocate time and resources, as well as prepare necessary documents and equipment. For example, information on personnel and organizational structure can help the inspector determine who should be interviewed during the inspection. Data on facility-specific entry requirements may help the inspector determine whether it is necessary to obtain a warrant. Information not available from EPA Headquarters or from Regional EPCRA files may be available from other program offices in the Region. Water, air, and waste permit applications and inspection reports, for example, could have any or all of this information on a facility.

- Previous Enforcement Information. EPCRA inspectors should also review inspection records, compliance histories, and enforcement actions under other programs, including the water, air, and hazardous waste programs. This information can also be critical in planning an inspection and understanding the facility.

- Reports Prepared by the Facility. The inspector should review any reports prepared by the facility (e.g., self-monitoring reports) that may be found in EPA files. The inspector may review these reports to determine whether there are any discrepancies between the self-monitoring records and the EPA records. For example, a facility may submit a discharge monitoring report (under the NPDES permit program) indicating the presence of a Section 313 chemical in the discharge. However in the Form R report, the facility did not indicate any releases to receiving water. This is a discrepancy in the data and should be resolved during the inspection.

  The inspector may want to investigate further any discrepancies, either by requesting clarification from the facility during the advance notification or during the inspection. Therefore, the inspector should make note of these discrepancies, as well as the proposed method for addressing them.

TIP
The Toxic Release Inventory System (TRIS) 313 Edit Error Reports of questionable data for 1987-88 can be reviewed. This will help the inspector spot large discrepancies in emissions from one year to the next by facility and by State.

- Permits and Permit Applications. The inspector should review any facility operating permits or permit applications. Such documents may provide information on limitations and requirements applicable to discharges, emissions, and operations; compliance schedules; and monitoring, analytical, and reporting requirements. While the inspector is concerned only with documenting potential EPCRA violations, EPA is interested in encouraging comprehensive environmental compliance inspections focusing on compliance with more than one EPA-administered law (e.g., a combined EPCRA and Toxic Substances Control Act [TSCA] inspection).

  As noted above, programs, permits, and applications can also be useful for providing background information. In addition, monitoring and spill data could alert an inspector to the presence of an unexpected chemical of concern, while EPA staff in other programs who are knowledgeable about the facility may be able to provide insight into facility operations.

- Correspondence. Correspondence between the facility and EPA (or the State) may provide important information on compliance issues. In addition, EPA's response to correspondence from the facility can affect the requirements that are applicable to the facility. Once again, the inspector should review EPCRA-related correspondence but may also review EPA correspondence related to other program areas such as air, water, and RCRA.

- Laws and Regulations. Prior to the inspection, the inspector must review and identify the EPCRA regulations that apply to the facility to be inspected.

- Technical Reports. The inspector should review (and, if necessary, take to the inspection site) copies of EPA or other publications that provide generic information on industrial process operations. As noted elsewhere, the inspector's knowledge of the processes and associated control equipment at a facility can be instrumental in ensuring the success of an inspection.

- Form R Report. The primary sources of information the inspector needs to review are the Form R chemical reports submitted by a facility to EPA. Each Form R report contains eight types of information: facility identification data, offsite location data, chemical-specific data, manufacturing process data, release data, offsite transfer, waste treatment methods, and pollution prevention data. Appendix A contains a blank Form R report.

Table 3-1. Example of Facility Summary Matrix

Section 313 Chemical	Use	Fugitive	Stack	Receiving Stream	Under-ground Injection	Onsite Land	POTW	Other Offsite Locations	Maximum Amount Onsite
Toluene	U	10,000	10,000	0	0	0	0	500	5,000
Hydrochloric Acid	U	1-499	0	200	0	0	0	0	2,000
Lead Compounds	P	0	2,500	50	0	1,000	0	20,000	10,000

Inspectors should gather chemical-specific information that may be needed to make onsite calculations or to determine where releases may occur. This information includes the following chemical properties:

- Volatility/vapor pressure
- Solubility
- Henry's law constant (for dilute compounds)
- Specific gravity/density
- Molecular weight
- Fate of chemical in solution.

Many methods of estimating releases, such as those detailed in *Estimating Releases and Waste Treatment Efficiencies for the Toxic Chemical Release Inventory Form* (EPA 560/4-88-002), also known as the "Green Book," require the use of such parameters to complete release calculations. Some chemical properties may also dictate where an inspector should look for releases. For example, if a particular chemical is highly volatile, the inspector should look closely at air release estimates.

Understanding typical industrial uses and typical storage practices of a particular chemical is also helpful. This information is contained in standard chemical dictionaries, such as *The Condensed Chemical Dictionary,* published by the Van Nostrand Reinhold Company. Inspectors should learn the treatment technologies used in the industry, and, if time and resources allow, they should also investigate the efficiencies of different treatment units.

The inspector should then prepare a list of questions to discuss with the facility contact during the inspection. Such questions typically seek to clarify any discrepancies in reported information.

3.3.1 EPCRA Section 312 Tier I and II Forms

Under Section 312, facilities must report information about the amounts, location, and potential effects of hazardous chemicals to Local and State Emergency Planning Committees (LEPC and SERC). These reports consist of annual inventories of EPCRA chemicals kept onsite. A two-tier approach exists for annual inventory reporting: Tier I and Tier II reports. These inventory forms are due annually on March 1, since 1988.

Under Tier I, (See Appendix B) a facility must report the amounts and general location of chemicals in certain hazard categories. These forms are a generalized summary of the information collected to complete the Tier II form. Tier I forms require development of estimates for the amount of chemicals in each hazard category concerning the maximum combined amount of hazardous chemicals, average daily amount present, and general location of the chemicals in the facility.

A Tier II report (See Appendix B) contains basically the same information, but it must name the specific chemical. Tier II forms are more detailed and describe for each hazardous chemical, the common name listed on the MSDS, maximum and average amounts of the chemical present, storage conditions, location of the chemical, and confidential status of the location information. Companies have the flexibility to choose whether to file Tier I or Tier II forms, unless the SERC, LERC, or fire department request Tier II, but many companies voluntarily provide Tier II reports.

TIP
Some Regional inspectors have requested a copy of the Tier II Inventory Report for the facility from either the SEPC or LEPC. EPCRA Section 313 chemicals or mixtures reported at fairly high inventory levels can then be questioned during the inspection.

3.3.2 Federal Database Comparison

The inspector should search the Regional files for any information obtained through compliance monitoring activities of other Regional programs (e.g., NPDES permitting and RCRA) relating to the facility to be inspected. Some Regions may have a filing system or database from which the inspector can get information on the subject facility. In addition, the Federal Insecticide, Fungicide, and Rodenticide Act (FIFRA) and the FIFRA and TSCA Tracking System (FTTS) should be searched to determine if the company has been inspected previously.

The inspector should also check other EPA databases, such as those listed below, for information on the facility to be inspected.

- TRIS. This database contains information on facilities subject to EPCRA Section 313 reporting. The TRIS database contains information on the facility, identification of the toxic chemical, the amount of chemical released, and the media to which it was released. Information on accessing this database can be obtained from the EPCRA Section 313 Regional contact or by contacting TRI User Support at 202-260-9419.

- IDEA (Integrated Data for Enforcement Analysis) System. This is a new database developed by the Office of Enforcement to integrate information from various databases maintained by different program offices for enforcement targeting, case screening, and multimedia initiatives. It is recommended that inspectors run the facility through the IDEA database because it tracks an individual facility's compliance records for most of the EPA statutes. A facility that has failed to report under EPCRA may show up with a compliance record under a different statute. IDEA's information can be another tool to help an inspector determine whether EPCRA data appear to be consistent across program lines. *A User's Guide to the IDEA System*, dated August 2, 1991, provides instructions on how to access the system through the EPA National Computer Center IBM mainframe.

  Technical, rather than comprehensive, training for IDEA has been given in all 10 Regions to an average of about 10 people per Region. IDEA managers are currently modifying IDEA so it will suppress confidential information when the States access it.

- FACTS (Facility and Company Tracking System). This database provides detailed information on names, addresses, employment, sales, and SIC Codes. Facilities with SIC Codes 28xx and 2911 or that are within a particular geographic area can be specified. The database is available through on-line connection to the EPA National Computer Center.

- FINDS (Facility Index System). This database is designed to track facilities subject to various Federal environmental laws, including RCRA, NPDES, and the Clean Air Act. It is available through on-line access to the EPA National Computer Center.

3.3.3 Confidential Business Information Considerations

Section 322 of EPCRA and EPA regulations (40 CFR Part 350) protect EPCRA trade secret information from disclosure (as they apply to emergency planning, community right-to-know, and toxic chemcial release reporting). The uncontrolled disclosure of trade secrets including chemical identity, process, formulation, or production data could cause damage to a facility's competitive position. In general, disclosure of legitimately trade secret information is prohibited; however, there are certain specific and limited exceptions when

trade secret withholding is not allowed. (e.g., under EPCRA Section 304 no information may be declared trade secret).

Definition (40 CFR Part 350)
A trade secret may consist of any formula, pattern, device, or compilation of information that is used in one's business, and that gives [the employer] an opportunity to obtain an advantage over competitors who do not know or use it. Trade secret is not intended to provide protection for chemical identities that are readily determinable by reverse engineering.

Companies reporting under EPCRA can, under limited conditions, request that the identity of specific chemicals in their reports not be disclosed to the public. No other information required by this law in the reports filed under other Sections of EPCRA can be withheld from the public. To protect a chemical's identity from disclosure, the company must be able to prove among other things that the information has not been reported under other environmental regulation, and that it is a legitimate trade secret.

The inspector should keep in mind that information obtained from a facility during an EPCRA inspection can, for the most part, be disclosed in response to a request from the general public, or other requesting party, under the Freedom of Information Act (FOIA).

In addition, because the inspector is very likely to require access to Confidential Business Information (CBI) before (i.e., while preparing for an inspection), during, and after an inspection, the inspector must be knowledgeable of EPA procedures governing access to, handling of, and disclosure of CBI. The inspector and others who may use the information may need to have CBI access authorization under various statutes (e.g., TSCA, RCRA, and FIFRA), since only authorized individuals may have access to CBI. An inspector may need access to CBI data that a subject facility submitted to EPA or provides during the inspection as well as information that was collected during a prior inspection under other statutes.

3.4 Providing Advance Notification

EPA is not required by law to provide advance notice of inspection. In some cases, the Agency could be subject to criticism for checking compliance after providing advance warning and for allowing a facility the time to address any "issues" they may be aware of

before the inspector arrives. It is up to the discretion of Regional management to decide whether or not to provide advance notification. The inspector must abide by his/her Regional policy regarding advanced notification.

The potential advantages and disadvantages associated with providing advance notification are as follows:

- Potential advantages
  - The facility will have the necessary documents, records, or personnel accessible to the inspector, saving valuable time onsite and requiring less time during follow up stages of the inspection.
  - The subject facility appreciates being provided advance notification so that its regular operations are not interrupted, thereby fostering a cooperative relationship between EPA and the regulated industry.
- Potential disadvantages
  - The inspector may not have the opportunity to view the subject facility under normal operating conditions, because the facility, with advance notification, could tailor its operations to fit preconceived notions of what the inspector may want to see.
  - If a tip or complaint is involved, advanced notification could put an employee's/customer's/associate's relationship with the company in jeopardy (if, indeed, the company is suspicious of the timing of the inspection versus an incident).

3.4.1 Identification of Contact Person to Notify

If the decision is made to provide advance notification, the inspector must determine which individual at a particular facility is the appropriate one to arrange the inspection. This determination can be difficult. The inspector should contact the signer of the Form R report. A D&B report can also be used, which usually provides the name and telephone number of the senior person in charge of a listed facility. If all else fails, the inspector should call the general number or directory assistance for the company and ask to speak to the person in charge.

3.4.2 Items Addressed in Advance Notification

If advance notification is provided, the inspector should make note of this in the inspection report. Specific objectives of advance notification include the following:

- Scheduling the inspection.
- Determining the appropriate site(s) for the inspection, including identification of where the necessary records, as specified in the inspection plan, are located. Records the inspector needs to review should be described as specifically as possible.
- Ensuring that personnel are available to accompany EPA inspectors during the inspection.

If the facility representative contacted does not cooperate, the inspector's supervisor and the Compliance Branch Coordinator at EPA Headquarters should be consulted for instructions on how to proceed.

When providing advance notification by telephone to the appropriate contact person at the facility, the inspector should discuss the following items:

- Introduction. The inspector should begin the telephone contact by introducing her/himself as an EPA inspector or other person with the authority to conduct EPCRA Section 313 inspections. The inspector should discuss the nature and purpose of the inspection. If the inspection is routine, as opposed to "for cause" (i.e., based on a tip or complaint), this fact should be conveyed. If the inspection is being conducted "for cause," the inspector should obtain guidance from her/his supervisor and/or Regional Counsel as to the nature and amount of information that should be conveyed during the initial telephone conversation.
- Administrative details of the inspection. The inspector should discuss several administrative matters pertaining to the inspection. Specifically, the inspector should establish the following:

  - The location of and directions to the inspection site
  - The date and time of the intended inspection
  - The name and title of the facility employee or official who will serve as the designated contact person for the inspection, if such person will be different from the one contacted during this advance telephone notification

- The fact that the facility should have certain records and other data available for review during the inspection and that certain facility personnel should be available during the inspection for interviews

- The need to tour the manufacturing and other operational areas of the facility

- The types of safety equipment that may be needed to tour the facility

- The company's right to claim EPCRA trade secrets for any information collected at the facility

- A follow up letter that will be sent which includes: the purpose and scope of the inspection, the records that the facility should make available for review by the inspector during the inspection (discussed below), and the name of an EPA contact.

3.5 Pre-Visit Completion of the Inspection Checklist

Unless the intention of the inspection program is to conduct a "no-knock" inspection, the inspector should contact the technical representative of a facility prior to the inspection to complete Section 1.0 of the EPCRA Section 313 Data Quality Inspection Checklist. This checklist was derived from the OPPT Quality Assurance Audit Manual developed in cooperation with Radian Corporation.

Section 1.0 of the inspection checklist contains three major parts: technical review, supplier notification, and logistics. Each part has questions that should be completed during a telephone conversation with the facility representative prior to the inspection. Although the checklist is largely self-explanatory, this section provides brief descriptions of the information which the inspector should collect to assist in preparing for the inspection.

3.5.1 Technical Review

During the pre-inspection telephone interview, the inspector should ask the facility contact how many Form R chemical reports were submitted for the reporting year (Question 1.1). This will enable the inspector to verify the number of Form R reports received by EPA from the facility.

The inspector should ask the facility contact how many EPCRA Section 313 chemicals were identified as being at the facility during the reporting year (Question 1.2). This will help the inspector estimate the level of effort needed to complete the inspection for this facility.

The inspector should establish whether the facility submitted revised Form R reports (Question 1.3) and should list all chemicals for which chemical reports were revised (Question 1.4). If the facility submitted revised reports for the reporting year, the inspector should confirm whether EPA has the most updated version. If EPA does not, the inspector should either request the new information over the telephone or ask the facility to have the new data available at the time of the visit. The inspector should also review the amended Form R report(s) and determine the reason for the amendment.

The inspector should next ascertain the number of full-time equivalent employees at the facility during the reporting year (Question 1.5).

Definition (40 CFR 372.3)
Full-time equivalent employee means 2,000 hours per year of full-time equivalent employment. A facility would calculate the number of full-time employees by totaling the hours worked during the calendar year by all employees and dividing that total by 2,000 hours. Remember, if the facility had fewer than 10 full-time employees, it was not required to report.

Next, the inspector should inquire about the type of industrial processes performed at the facility, as well as any significant changes in processes and treatment technologies that have occurred since the reporting year (Questions 1.6, 1.7, 1.8, 1.9, and 1.10). The inspector should describe the operations and any changes thoroughly in the appropriate questions within the checklist. This information will 1) verify the data which the EPA currently has on the facility and operations and 2) focus the inspector on the specific changes which have occurred at the facility since they last reported.

Finally, the inspector should be sure to emphasize to the facility contact that all supporting materials used to develop information contained within the Form R chemical reports must be available for review. In addition, s/he should request that copies of process flow diagrams be available at the time of the visit.

3.5.2 Supplier Notification

In accordance with 40 CFR Section 372.45, suppliers and distributors of mixtures that include EPCRA Section 313 chemicals must notify their customers of the following:

- A statement that the mixture or trade name product or chemicals is subject to the reporting requirements of EPCRA Section 313.
- The name of each toxic chemical and associated Chemical Abstracts Service (CAS) registry number of each chemical if, applicable.
- The percentage, by weight, of each toxic chemical (or all toxic chemicals within a listed category) contained in the mixture or trade name product.

Notifications must be sent to facilities described in 40 CFR Section 372.22 or to persons who may in turn sell or otherwise distribute such mixtures or products to a facility described in 40 CFR Section 372.22(b). An example of a Supplier Notification form is found in Appendix C. Receipt of the Supplier Notification form means that users and/or processors have received information on all the purchased mixtures and trade name products containing EPCRA Section 313 chemicals.

A Supplier Notification form is a tool that facilities use to improve the accuracy and completeness of their Form R data. This general information on supplier notification is important because the accuracy and completeness of the data in the Supplier Notification form will affect a facility's ability to make threshold determinations and improve the accuracy of their data. According to Analysis of Compliance with the Supplier Notification Requirements under Section 313 of the Emergency Planning and Community Right-to-Know Act (EPCRA), 65 percent of users and/or processors reported that the availability of Supplier Notification data improved the accuracy of their estimates. In addition, inspectors can examine it to verify whether a facility had adequate information (as found in a complete and accurate Supplier Notification form) to correctly estimate their releases.

Supplier Notification Requirements (40 CFR 372.45)

Facilities must comply with supplier notification requirements if:

- Classified in SIC Codes 20 through 39
- Manufactures, imports, or processes a listed EPCRA Section 313 chemical
- Sells or distributes a mixture or trade name product containing the EPCRA Section 313 chemical to either a SIC Code 20-39 company or a company that subsequently sells the mixture or trade name product to another SIC Code 20-39 company.

The following section provides information for completing the Supplier Notification section of the checklist and contains information concerning supplier notification and data quality.

- General Supplier Notification. First the inspector should document whether the facility received the appropriate notification from its supplier(s) regarding mixtures containing EPCRA Section 313 chemicals (Question 1.11) and then list the names and addresses of any suppliers that did not provide notification to the facility (Question 1.12). The inspector should ascertain whether the facility distributed mixtures containing Section 313 chemicals during the reporting year (Question 1.13). If the facility distributed mixtures containing Section 313 chemicals, the inspector should record whether the facility developed and distributed the appropriate information to its customers (Question 1.14). During the inspection, the inspector should request a copy of the information distributed.

- Supplier Notification and Data Quality. The "percent by weight of the Section 313 chemical" is the critical piece of information contained in the Supplier Notification for the purpose of release determinations. Inspectors should do the following:

  - Examine the Supplier Notification form applicable to/received for each chemical
  - Quiz the company on its use of Supplier Notification information to determine release estimates
  - Take note of the formulas used (if any) to determine release estimates from Supplier Notification.

3.5.3 Logistical Arrangements

The inspector should inquire as to the size of the facility, including the production or processing areas, storage facilities, and treatment areas (Question 1.15). In addition, the inspector should document the procedures used by the facility to collect and document information for EPCRA reporting and the number of personnel involved (Question 1.16). This will assist the inspector in planning the resources (both time and personnel) needed to complete the inspection. Finally, the inspector should request that the appropriate personnel are available during the inspection for interviews.

The inspector should clarify with the facility contact whether the facility will be operating under normal conditions (Question 1.17) and whether there will be any problems in arranging for a tour of the facility. In addition, the inspector should identify any personal protective equipment needed for a tour of the facility (Question 1.18).

3.6 Section 1.0 of the Inspection Checklist: Telephone Contact

Facility ID: _____

TECHNICAL REVIEW

1.1 How many Form R chemical reports were submitted for this facility for the reporting year?

|__|__|

1.2 How many 313 chemicals were identified by this facility, but not reported, for the reporting year?

|__|__|

1.3 Did the facility submit any revised Form R chemical reports for the reporting year?

YES ..... ☐ NO ..... ☐ *(If no, skip to Q. 1.5.)*

1.4 List the chemicals which had revised chemical reports here.

_____

_____

_____

_____

_____

1.5 How many full-time equivalent employees did the facility have during the reporting year?

|__|__|__|__|

NOTE: If there were fewer than 10 full-time equivalent employees, this facility was not required to report.

1.6 Briefly describe the number and type of industrial processes performed at this facility during the reporting year.

_____

_____

_____

_____

Facility ID: _____

1.7 Have the facility's process operations significantly changed since the reporting year (including equipment, chemicals, feedstock, etc.)?

YES ..... ☐ NO ..... ☐ *(If no, skip to Q. 1.9.)*

1.8 Briefly describe any process changes.

_____

_____

_____

_____

1.9 Has the facility implemented any new treatment technologies since the reporting year?

YES ..... ☐ NO ..... ☐ *(If no, skip to Q. 1.11.)*

1.10 Briefly describe any new treatment operations.

_____

_____

_____

_____

SUPPLIER NOTIFICATION

1.11 Did the facility receive notification from chemical/material suppliers of all Section 313 chemicals in their products supplied to the facility during the reporting year?

YES ..... ☐ NO ..... ☐ *(If yes, skip to Q. 1.13.)*

1.12 Record the name(s) and address(es) of suppliers that did not notify this facility of Section 313 chemicals in their products.

_____

_____

_____

_____

Facility ID: _____

1.13 Did the facility distribute chemicals listed under Section 313 in mixtures or as trade name products during the reporting year?

YES ..... ☐ NO ..... ☐ *(If no, skip to Q. 1.15.)*

1.14 Did the facility develop and distribute supplier notification information under Section 313 requirements?

YES ..... ☐ NO ..... ☐

Formulas used to determine release estimates from supplier notification. **(Add a question # here???)**

1.15 How large an area (# buildings, acres, etc.) do the production areas, storage facilities, and treatment areas of the facility occupy? _____

(Consider this when planning the type and duration of tour that would be most useful.)

1.16 Briefly describe the procedures used to collect and document information for EPCRA reporting, including the number of people involved at the facility and whether they will be available during the audit to answer questions.

LOGISTICS

1.17 Will the facility be operating under normal conditions at the time of the audit?

YES ..... ☐ NO ..... ☐

1.18 What personnel protective equipment will be needed to participate in a facility tour?

Hard Hat ☐

Safety Boots ☐

Safety Glasses ☐

Respirator ☐

Other ☐

_____

_____

_____

FOR THE INSPECTOR ONLY -- DO NOT ASK THIS OF FACILITY:

1.19 Coordination/logistics with other members of multimedia team, if applicable.

_____

_____

_____

_____

3.7 Development of an Inspection Plan

After completing Section 1.0 of the inspection checklist, the inspector should then develop the inspection plan. An inspection plan is designed to help the inspector focus on the important elements of the planned inspection and to provide the inspector with a pre-planned methodology for conducting the inspection. The inspector should ensure that key aspects of the inspection are not overlooked when developing this plan. Also, the inspector should use the plan to brief facility officials during the opening conference on the general approach to the inspection. However, the inspector should not provide facility officials with a copy of this plan, because the inspector may want to deviate from the plan during the course of inspection and will not want to feel locked into the details outlined in the plan. The worksheet presented in Figure 3-2 should provide information directly relevant to the development of the inspection plan.

3.7.1 Purpose

The main purpose of the inspection plan is to serve as a guide or blueprint to the entire inspection process at the subject facility. The inspector should keep in mind that one of the most important objectives of the inspection is to collect enough documentation of potential violations of EPCRA to determine compliance and take appropriate enforcement actions against subject facilities. Section 3.7.2 outlines the elements of a basic inspection plan.

The investment of time required to produce a quality inspection plan can save time for the inspector once at the inspection site. Also, the inspector can make better use of facility officials' time if a well-prepared plan guides the inspection.

A well-developed inspection plan will help the inspector accomplish the following:

- Know the facility's compliance status during the inspection
- Develop a plan for evidence collection techniques should the inspection lead to a case being issued.

3.7.2 Elements of the Inspection Plan

Written inspection plans may vary in length and subject matter, but should include at least the following components:

- Objective of the background data search and review and the inspection
- Scope and assessment topics of interest/concern
- Anticipated inspection activities and field techniques.

The following guidelines should assist the inspector in developing these components:

- Objective of Inspection and Background Data. This introductory section should provide a brief history of factors relevant to the particular facility (e.g., previous TRI reports, previous inspection dates and types of inspections, whether any potential compliance issues were identified and what they were). This section should also identify the objective or reason for the inspection. This will vary from inspection to inspection (e.g., "for cause," random, case development, or followup). More specific objectives may also be identified in addition to the overall objective.

- Scope and Assessment Topics. The inspection plan should clearly establish the scope of the inspection and the assessment topics. The scope of the inspection is a function of the overall objective of the inspection. For example, if the inspection is "for cause," then the scope of the inspection should include all records, operations, and areas of the facility that will need to be inspected to determine compliance with the provisions of EPCRA Section 313 suspected of being violated. Some discussion of the boundaries of the inspection should be included (i.e., if the inspection will include a tour of the facility, as well as records review and interviews with personnel, or will only focus on a records review).

  Once the scope has been identified, the inspection plan should designate the assessment topics. Assessment topics can be roughly defined as the major regulatory areas to be covered during the inspection. The assessment topics should be further broken down into specific questions to be asked of facility officials concerning the particular assessment topic and specific associated tasks.

- Inspection Activities. Once the assessment topics have been established, the inspector must determine the most appropriate inspection activity or method of assessing compliance and gathering evidence of potential violations (e.g., observation, records review, interviews, collection of samples) for each task.

  Compliance and assessment and evidence collecting techniques can be organized in an inspection plan as follows:

  - Facility Tour. List the activities, operations, and/or equipment to be observed (e.g., manufacturing processes and equipment).

- Records Review. List facility records that will be reviewed to determine statutory and regulatory compliance, along with the regulatory citation(s) applicable to each record that must be maintained, as well as a description of the required content of each record.

- Conduct of Interviews. List the titles, and names (if known) of key personnel with whom meetings should be held to determine compliance with specific regulatory provisions.

Figure 3-1
Worksheet for Developing a Written Inspection Plan

1.0 Components of the Written Inspection Plan

Does the written inspection plan include:	Yes	No
• Objective of the background data search/review and the inspection?		
• Scope and assessment topics of interest/concern?		
• Anticipated inspection activities and field techniques?		

1.1 Objective of the Background Data Search/Review and the Inspection

Does this component of the written inspection plan include:	Yes	No
• Brief history of factors relevant to the facility?		
• Objective or reason for the inspection?		

1.2 Scope and Assessment Topics of Interest/Concern

Does this component of the written inspection plan:	Yes	No
• Clearly establish the scope of the inspection and the assessment topics?		
• Discuss the boundaries of the inspection?		
• Designate the assessment topics?		

1.3 Anticipated Inspection Activities and Field Techniques

Does the written inspection plan consider the following activities:	Yes	No
• Facility Tour?		
• Records review?		
• Conduct of interviews?		

3.8 Collection of Inspection Documents

In addition to preparing the written inspection plan and reviewing EPA records prior to conducting the inspection, the inspector should also gather and prepare the necessary documents and equipment to be used during the inspection.

No single list of documents and equipment can be appropriate for all inspections. The list provided below is intended for guidance purposes only. The inspector's experience in the field and information obtained during pre-inspection planning should assist in preparing lists tailored to specific inspection sites and needs.

Specific needs will be determined by the requirements of the inspection, the availability of equipment, conditions at the facility, EPA policies, and whether or not advance notification of an inspection will be given. Documents necessary for the inspection should be prepared in advance of the inspection, whenever possible. The inspector should be familiar with these required documents.

Several documents that are used in facility inspections include:

- Notice of Inspection. Portions of this form can be filled out in advance, but the time of inspection and the names of facility officials must be entered at the time of inspection.

- Receipt for Samples and Documents (See Figure 5-4). All samples and documents taken during an inspection are listed on this form. Any documents and samples taken during an inspection that have been claimed as trade secret information should also be noted on this form.

- Copies of EPCRA and Specific Regulations. Some facility officials may not have copies of EPCRA or of applicable rules and regulations. Inspectors should have these available for distribution.

- EPA Outreach Materials. Inspectors should provide current, relevant educational information to facility officials relating to voluntary compliance efforts. EPA has established an EPCRA Hotline at 1-800-535-0202.

Chapter Four

Industrial Profiles for Section 313 Nonreporter and Data Quality Inspections

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4. Industrial Profiles for Section 313 Nonreporter and Data Quality Inspections

4.1 Introduction

At the end of this manual are seven profiles for industries that have been identified by the Regions as having a high potential for:

- Being nonreporters under EPCRA Section 313
- Having data quality problems on their Form R submissions

The industry categories that profiles have been developed for include:

- Foundries
- Electroplating
- Petroleum Refining
- Ink Formulation
- Motor Vehicle Parts and Supply Manufacturing
- Furniture Manufacturing
- Paint Formulation

It is believed that these profiles will assist inspectors with:

- Relevant permit information from other statutes
- Byproducts
- Major sources
- Throughput qualities
- Typical chemicals
- Process flow diagrams
- Common pollution prevention/control equipment

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Chapter Five

Entry to the Facility and the Opening Conference

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5. Entry to the Facility and the Opening Conference

5.1 Introduction

This chapter discusses the required procedures for entering a facility to conduct an EPCRA inspection. Guidance is provided to the EPCRA inspector on the preliminary aspects of an EPCRA inspection, ranging from a discussion of the importance of facility owner/operator consent to procedures for conducting an opening conference. Procedures for conducting the inspection to assess data quality are covered in Chapter 6.

5.2 Authority to Enter and to Inspect

EPCRA implicitly authorizes EPA to enter and to inspect any establishment or facility in which chemical substances are manufactured, processed, stored, held, or otherwise used before or after their distribution in commerce. This implicit authority is a function of the self-implementing Section 313 reporting requirement and EPA's authority to assess a civil penalty against individuals who fail to report.

An inspection under EPCRA may be conducted only after the inspector has presented the following items to the owner, operator, or agent in charge:

- Appropriate credentials
- Written Notice of Inspection.

The scope of a EPCRA inspection may include inspection of records, files, papers, processes, controls, and facilities. EPCRA does not prohibit inspection of any certain type of data.

EPCRA inspections must be completed with reasonable promptness and at reasonable times (i.e., normal working hours).

5.2.1 Arrival

The inspector must arrive at the facility during normal working hours and locate a facility official immediately. After locating the appropriate facility official(s), the inspector should:

- Identify her/himself as an EPA inspector and present EPA credentials
- Introduce the inspection team (if a team is present) in a courteous manner
- Present a Notice of Inspection (NOI).

5.2.2 Credentials

Upon arrival at the facility, the inspector should present her/his EPA credentials. These credentials indicate that the inspector is a lawful representative of the EPA Administrator authorized to perform inspections under EPCRA. Credentials must be presented whether or not identification is requested. Business cards may be used for introductory purposes, but they do not replace official credentials. Credentials should never leave the sight of the inspector, and the inspector should not permit photocopying of credentials.

Approximately 50 percent of EPCRA inspectors are members of the National Council of Senior Citizens (NCSC). NCSC inspectors are issued special EPCRA credentials. These credentials are provided by EPA Headquarters.

5.2.3 Notice of Inspection

After the inspector has presented her/his credentials, s/he should present the written NOI to corporate officials. The NOI form (Figure 5-1) should be filled out completely. This NOI informs the owner, operator, or agent in charge of the reason for an inspection and contains the inspector's address and signature. It should be dated and the time of inspection should be entered as proof that entry was requested at a reasonable hour. An NOI is not required for each entry made during the period covered by the inspection, only the initial entry.

The inspector presents the NOI after arrival at the facility to be inspected. EPCRA does not require the inspector to provide advance notification of the inspection to the facility, but some inspectors may choose to provide such notice (discussed in detail in Chapter 3).

The inspector should make a note in the inspection notebook that the NOI was presented and should keep a copy of the notice for the records.

To make certain that all steps are covered in conducting an EPCRA inspection, the inspector should refer to the Guidelines for a Comprehensive EPCRA Section 313 Data Quality Inspection Process found in Chapter 1.

5.3 Consent to Enter and Inspect

EPA has authority to enter a facility subject to EPCRA for the purposes of conducting an inspection by the U.S. Supreme Court's decision in *Marshall, Secretary of Labor v. Barlow's, Inc.* (1978), and may do so without obtaining consent. However, facility officials sometimes withhold consent or attempt to impose restrictions or conditions upon entry. EPA policy requires the inspector to obtain such consent for the inspection. Therefore, the inspector must do one of the following:

- Obtain consent prior to conducting the inspection
- Or, if unable to obtain consent, followed proper procedures for when entry to a facility is denied or when conditions or restrictions are imposed by facility officials.

Consent to enter must be given knowingly and freely. The inspector must not coerce or lie to facility officials in order to induce consent.

Express consent is not necessary and the absence of express denial constitutes consent. Entry remains voluntary and consensual unless there is a withdrawal of consent. Consent must be given by the person with authority to give consent at the time of the inspection. An owner does not always have authority to give consent. If someone with the necessary authority cannot be located, the inspector must make a good faith effort to determine who may otherwise consent to the entry (such as the agent in charge). The inspector should present her/his credentials to that individual and record the name and title of that person in the inspection record book.

In most instances, if the inspector follows proper procedures upon arrival at the facility (i.e., presentation of credentials and NOI), it will be simple to obtain consent to enter. However, special situations may arise, as follows:

- Owner/operator reluctance to give consent
- Withdrawal of consent.

These situations and the inspector's responsibilities in each situation are discussed below.

5.3.1 Consent

Consent is generally needed to inspect the nonpublic portions of a facility. Entry is considered voluntary and consensual, unless the inspector is expressly told to leave the premises. Expressed consent is not necessary for a credentialed inspector; however, expressed consent is necessary for uncredentialed persons accompanying an inspector.

Figure 5-1. Notice of Inspection

EPA

NOTICE OF INSPECTION

U.S. ENVIRONMENTAL PROTECTION AGENCY
Emergency Planning and Community Right-to-Know Act of 1986
(~~SARA Title~~ III) EPCRA

1. INVESTIGATION IDENTIFICATION			2. TIME	3. FIRM NAME
DATE	INSPECTOR NO	DAILY SEQ NO		
4 INSPECTOR ADDRESS				5 FIRM ADDRESS

REASON FOR INSPECTION: This inspection is for the purpose of determining compliance with the Emergency Planning and Community Right-to-Know Act of 1986, Section 313 toxic chemical release reporting requirements. The scope of this inspection may include, but is not limited to: reviewing and obtaining copies of documents and records; interviews and taking of statements; reviewing of chemical manufacturing, importing, processing, and/or use facilities, including waste handling and treatment operations; taking samples and photographs; and any other inspection activities necessary to determine compliance with the Act.

INSPECTOR SIGNATURE	RECIPIENT SIGNATURE
NAME	NAME
TITLE DATE SIGNED	TITLE DATE SIGNED

5.3.2 Reluctance to Give Consent

Receptiveness toward inspectors will vary from facility to facility. However, in most instances, inspectors will be able to proceed without difficulty. In some cases, officials may be reluctant to give entry consent because of misunderstandings of responsibilities, inconvenient scheduling, or other reasons that may be overcome by diplomacy and discussion. Whenever the inspector encounters resistance to enter, s/he should tactfully probe the reasons for the resistance and work with officials to overcome the obstacles. The inspector should also explain in detail the purpose of the inspection. Care should be taken to avoid threats of any kind, inflammatory discussions, or increased misunderstanding. The inspector should suggest that the officials seek advice from their attorneys on the scope of EPA's inspection authority under EPCRA and the U.S. Supreme Court's decision in *Marshall, Secretary of Labor v. Barlow's, Inc.* (1978). However, it is crucial during any negotiations or discussions that an inspector not agree to any restrictions on the scope of an inspection authorized under EPCRA. Types of restrictions that facility officials may attempt to impose on inspectors are described in Figure 5-2.

If consent to enter still is denied, the inspector should follow denial of entry procedures described in Section 5.3.4.

Under no circumstances should the inspector attempt to gain entry or consent to enter by coercive actions or by making statements that suggest that the facility representatives could be fined or otherwise "punished" unless entry is allowed.

Figure 5-2. Types of Inspection Restrictions

Types of Inspection Restrictions on Inspectors

- *Waivers and Other Restrictive Agreements*

  EPA inspectors have the right and the responsibility to refuse to sign any agreement or waiver that promises that records or other data obtained from the facility will not be released to any third party. Any attempt by a facility to restrict inspection activities by requiring inspectors to sign such restrictive agreements should be viewed as a denial of consent to inspect the facility and treated accordingly. However, during the opening conference, inspectors must advise the facility owner, operator, or agent-in-charge of her/his right to claim such data as CBI and of the procedures for making such claims.

- *Restrictions on Use of Photographic or Other Recording Equipment*

  EPCRA inspectors may document evidence of potential violations at the facility by means of tape recordings, photography, recording by electronic devices with a visual taped readout, or by other methods. Inspectors have the authority to use these recording devices, which include aerial overflights, LIDAR (a type of radar used to detect and measure distant air emissions of particulate matter), and other aerial or ground surveillance sense-enhancement devices. Facility officials often attempt to restrict the use of any or all such devices by EPA inspectors. Any attempt by a facility to restrict the use of such devices is considered a denial of consent and appropriate procedures governing such denials should be followed. Facility officials should be advised that photographs may be claimed as CBI.

- *Health and Safety Restrictions*

  The inspector should ascertain the facility safety and applicable OSHA requirements before the inspection, if possible. The inspector should be aware that s/he is subject to the applicable safety requirements of the facility. For example, if safety boots and glasses are required to walk through the manufacturing area, then the inspector must wear these items. However, EPA inspectors cannot be required to participate in the facility's safety training program as a condition of conducting an EPCRA inspection. If facility officials make such a demand, the inspector should refuse and should treat the situation as a denial of consent.

- *Refusal to Allow Access to Certain Areas of the Facility*

  If, during the course of the inspections, access is denied or restricted to certain areas of the facility, the inspector should make a notation describing such denial or restriction in her/his notebook and identify which portion of the inspection could not be completed due to the denied or restricted access. However, despite the access restriction, the inspector should proceed with the remainder of the inspection. After leaving the facility, the inspector should contact his/her supervisor to determine whether a warrant should be obtained to complete the inspection.

5.3.3 Withdrawal of Consent

Occasionally, facility officials may initially consent to an inspection and later withdraw the consent during the inspection. Consent to the inspection may be withdrawn at any time after entry has been made. EPA policy concerning withdrawal of consent is to view it as an outright denial of consent. In such cases, appropriate procedures should be followed. All activities and evidence obtained prior to the withdrawal of consent are valid. Therefore, evidence obtained by the inspector before consent was withdrawn would be usable in any subsequent enforcement actions and should be retained by the inspector. The inspector should not give any evidence that has been collected before the withdrawal of consent back to the facility if requested to do so by the facility official.

5.3.4 Procedures for Denial of Entry

As noted previously, the inspector should make certain that s/he has properly presented all credentials and notices to the facility owner/operator or agent in charge. If the inspector is denied entry, s/he should withdraw from the premises. Under no circumstances should the inspector discuss potential penalties under EPCRA or do anything that may be construed as coercive or threatening. The inspector should leave a copy of the written NOI with facility officials to show that proper procedures were followed. The inspector should carefully note all observations pertaining to the denial, including the following items, in her/his field notebook:

- Facility name and exact address
- Name and title of person(s) approached
- Time of denial and reason for denial
- Authority of person who refused entry
- Facility appearance
- Any reasonable suspicions that refusal was based on a desire to cover up regulatory violations.

If the inspector is denied access to some parts of the facility, s/he should note the circumstances surrounding the denial and the portion of the inspection that could not be completed and then proceed with the rest of the inspection. After leaving the facility, the inspector should contact her/his supervisor to determine whether a warrant should be obtained to complete the inspection.

5.3.5 Warrants

The inspector, after leaving the premises, should contact her/his supervisor immediately. Once contacted, the supervisor will confer with attorneys to discuss the desirability of obtaining an administrative warrant and will contact OCM.

Definition
A warrant is judicial authorization for an appropriate official (EPA inspector, U.S. Marshal, or other Federal officer) to enter a specifically described location and perform specifically described inspection functions.

If a decision is made to obtain a warrant, the designated official should contact the U.S. Attorney of the district in which the facility is located. EPA should assist the U.S. Attorney in the preparation of the warrant and necessary affidavits. The application for a warrant should identify the statutes and regulations under which EPA is seeking the warrant, as well as the name and location of the site or establishment to be inspected and, if possible, the names of the owner and/or operator. The application must be signed by the U.S. Attorney or her/his assistant.

An inspector may also obtain a warrant before s/he conducts an inspection. A pre-inspection warrant may be obtained at the discretion of the EPA Regional Office. Situations in which the inspector may want to obtain a pre-inspection warrant include the following:

- A suspected violation could be covered up during the time needed to secure a warrant
- Prior correspondence or other contact with the facility provides reason to believe that entry will be denied when the inspector arrives
- The facility is unusually remote from the EPA Regional Office or a U.S. District Court and obtaining a warrant would be inconvenient to the government.

5.4 Opening Conference

Once credentials and required notices have been presented, the inspector can hold the opening conference with facility officials. During this meeting, the inspector should present an overview of the inspection plan and attempt to gain a fuller understanding of the facility's organization, obtain current information regarding facility operations and processes, and clarify any key issues or ambiguities identified during the pre-inspection preparation phase (discussed in Chapter 3).

5.4.1 Purpose

The purpose of the opening conference is to establish a forum for the exchange of information between EPA inspection personnel and facility officials. To facilitate the inspection, the inspector should attempt to accomplish the following items during the opening conference:

- Develop a rapport with facility officials and start the inspection on a positive and professional note
- Present and discuss any supporting information (e.g., a copy of EPCRA, Form R and instructions booklet, or other resources)
- Acknowledge that the inspection may disrupt daily facility routines, but assert that reasonable efforts will be made to minimize such disruption
- Listen carefully and be willing to answer questions from the facility officials
- Avoid compromising EPA policies or procedures or overstepping her/his authority to accommodate facility representatives.

The opening conference is an appropriate time for the facility to claim any legitimate information as confidential. The inspector should have facility officials complete a Declaration of Confidential Business Information (Figure 5-3). The inspector should also be familiar with the fact that facilities tend to claim information under EPCRA as trade secret and CBI under statutes such as TSCA (See Section 3.2.5).

In addition, the inspector should present to facility officials a copy of a Receipt for Samples and Documents (Figure 5-4). This document provides EPA with a list of documents and samples of chemical substances and/or mixtures collected during the EPCRA inspection.

A cooperative working relationship developed during the opening conference can set the tone for the remainder of the inspection. If approached properly, the opening conference provides an ideal opportunity for the inspector to function as a public relations liaison and educator.

From the perspective of both EPA and the regulated community, the inspector is well-positioned to serve as a source of regulatory information. As such, the inspector should provide tactful assistance to the facility before, during, and after the inspection.

During the conference, inspectors may want to focus on the following topics:

- Overview of EPCRA
- Specific regulation requirements

- Importance of EPCRA Section 313 data quality
- Options for helping with facility-specific problems
- Agency outreach efforts.

In addition, the inspector is responsible for explaining inspection activities to facility officials, gaining and understanding of facility operations and practices by asking facility officials questions, and making logistical arrangements.

Figure 5-3. Declaration of Confidential Business Information

EPA

US ENVIRONMENTAL PROTECTION AGENCY
WASHINGTON, DC 20460

TOXIC SUBSTANCES CONTROL ACT

Form Approved
OMB No 2070-0007
Approval expires 8-31 85

DECLARATION OF CONFIDENTIAL BUSINESS INFORMATION

1 INVESTIGATION IDENTIFICATION			2. FIRM NAME
DATE	INSPECTOR NO	DAILY SEQ. NO	
3 INSPECTOR ADDRESS			4 FIRM ADDRESS

INFORMATION DESIGNATED AS CONFIDENTIAL BUSINESS INFORMATION

NO	DESCRIPTION

ACKNOWLEDGEMENT BY CLAIMANT

The undersigned acknowledges that the information described above is designated as Confidential Business Information under Section 14(c) of the Toxic Substances Control Act. The undersigned further acknowledges that he/she is authorized to make such claims for his/her firm.

The undersigned understands that challenges to confidentiality claims may be made, and that claims are not likely to be upheld unless the information meets the following guidelines (1) The company has taken measures to protect the confidentiality of the information and it intends to continue to take such measures, (2) The information is not, and has not been reasonably attainable without the company's consent by other persons (other than governmental bodies) by use of legitimate means (other than discovery based on a showing of special need in a judicial or quasi-judicial proceeding), (3) The information is not publicly available elsewhere, and (4) Disclosure of the information would cause substantial harm to the company's competitive position

INSPECTOR SIGNATURE		CLAIMANT SIGNATURE	
NAME		NAME	
TITLE	DATE SIGNED	TITLE	DATE SIGNED

EPA Form 7740-2 (12-82) WHITE - INSPECTION FILE YELLOW FACILITY PINK - REGIONAL OFFICE GOLD - INSPECTOR'S FILE

Figure 5-4. Receipt for Samples and Documents

EPA

RECEIPT FOR SAMPLES AND DOCUMENTS

U.S. ENVIRONMENTAL PROTECTION AGENCY

Emergency Planning and Community Right-to-Know Act of 1986

(S~~ARA Title~~ III) EPCRA

Page ___ of ___

1. INVESTIGATION IDENTIFICATION				3. FIRM NAME
DATE	INSPECTOR NO	DAILY SEQ. NO.		
4 INSPECTOR ADDRESS				5. FIRM ADDRESS

The documents and samples of chemical substances and/or mixtures described below were collected in connection with the administration and enforcement of the Emergency Planning and Community Right-to-Know Act of 1986

RECEIPT OF THE DOCUMENT(S) AND/OR SAMPLE(S) DESCRIBED IS HEREBY ACKNOWLEDGED:

NO	DESCRIPTION

INSPECTOR SIGNATURE	RECIPIENT SIGNATURE
NAME	NAME
TITLE DATE SIGNED	TITLE DATE SIGNED

5.4.1.1 Explaining Inspection Activities

An outline of inspection objectives will inform facility officials of the purpose and scope of the inspection, and may help avoid misunderstandings. The inspector should explain the anticipated inspection activities in general terms and avoid providing the facility representatives with the precise focus of the inspection for the following reasons:

- To avoid creating a situation in which facility officials use specific knowledge as advance notification and attempt to hide violations in areas they know will be subject to scrutiny.
- To minimize the likelihood that facility officials, once having consented to the inspection, will withdraw consent based on their perception that the inspection includes more than they understood and agreed to. Such perceptions could contribute to misunderstandings later during the inspection.
- To allow facility representatives to prepare the documents needed for a data quality inspection and minimize the possibility that facility officials will limit the number of documents for review.

5.4.1.2 Understanding Facility Operations and Practices

During the opening conference, the inspector should attempt to understand facility operations and practices thoroughly by asking facility representatives about current operations and practices, as well as organizational accountability and personnel, that may not have been included (or requires clarification) in EPA records. This is an opportunity for the inspector to follow up on outstanding issues raised during the pre-inspection preparation phase of the inspection (discussed in Chapter 3). The key areas are listed below:

- Nature of the Operations. The inspector should determine the facility activities from an operational standpoint, the materials used, and the management and/or disposal of wastes that are generated. The inspector should obtain copies of manufacturing or process diagrams to use during the inspection. The inspector should also obtain copies of plant diagrams showing emission, or release points, such as air exhausts and sewer discharge lines.
- Major Facility Environmental Programs. The inspector should ask which environmental programs are part of the facility's culture, such as effluent sampling, analysis, and reporting; inspection and maintenance of pollution control equipment; and emergency response.
- Applicability of Environmental Regulations. The inspector should verify that facility operations and programs have not changed in such a way as to alter the regulations or requirements that apply to the site. Such information will permit the inspector to review and revise the inspection plan, if necessary, by shifting the emphasis of planned activities,

deleting inappropriate activities, and/or adding new activities not initially considered relevant.

- Key Responsibilities, Authorities, and Accountabilities. The inspector should establish which facility officials are responsible for specific environmental activities, communicating the chain-of-command in case of emergencies, and developing environmental performance measures. In addition, it is important to clarify what authorities have been specifically delegated and how responsibilities are established and maintained. A telephone directory or an organizational chart can be requested. This information will assist the inspector in determining which individuals are knowledgeable about specific areas and who should be interviewed.

5.4.1.3 Logistical Arrangements

The inspector should determine logistical requirements and make arrangements in the opening conference to minimize delays and avoid misunderstandings. The following items should be addressed:

- Facility Support. It may be beneficial to identify the facility official(s) to accompany the inspector during the inspection (or selected parts of it) who will describe the facility and its principal operating characteristics and, where appropriate, who will indicate which processes, records, and other materials should be claimed as CBI.

- Safety Requirements. The inspector should determine what OSHA and facility safety regulations will be involved in the inspection and should be prepared to comply with them. EPA typically has its representatives use the same safety equipment that is actually used by employees. EPA has the right to and does decline to undergo the safety training that facilities require of their employees, with the exception of site-specific mine safety training required under EPA Order 1440.4. While onsite, the inspector should be aware of compliance with OSHA requirements and be prepared to make a referral to OSHA if violations are suspected.

- Order of Inspection. A discussion of the order in which operations will be inspected will help eliminate wasted time by giving facility officials time to gather the records needed for review.

- List of Records. A list of records to be inspected will permit facility officials to gather and make them available for the inspector. If, however, the inspector has any reason to believe that such advance notice will tempt facility representatives to sanitize, withhold portions of, or destroy records, such a list should be prepared for inspector use only, not for submission to facility officials.

- Meeting Schedule. Based on the planned inspection activities and the inspector's understanding of facility personnel responsible for key assessment topic areas, a schedule of meeting times can be developed for the duration of the inspection. This will allow key personnel to plan and schedule the time needed to meet with the inspector.

Once the inspector has gained entry to the facility and conducted the opening conference, s/he is ready to initiate the onsite phase of a data quality inspection, as discussed in Chapter Six.

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Chapter Six

Onsite Evaluation of Data Quality

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6. Onsite Evaluation of Data Quality

6.1 Introduction

An inspection may take up to 3 days onsite to complete depending on the size and complexity of a facility and the nature of the audit program. While onsite, inspectors should review all submitted data and supporting materials the facility has available from its EPCRA Section 313 reporting. Inspectors should document all calculations and assumptions on the audit checklist.

This chapter includes Sections 2.0 through 6.0 and brief guidelines for completing the sections. The inspector should note that Section 2.0 of the checklist is completed once for each facility, Section 3.0 is completed for every EPCRA Section 313 chemical identified at the facility by the auditor, and Sections 4.0 through 6.0 are completed for every EPCRA Section 313 chemical that meets the reporting requirements. The inspector should make an appropriate number of copies of Sections 3.0 through 6.0 prior to the audit.

The inspection checklist which is presented throughout this Chapter is intended to document pertinent factual information needed for preparation of the EPCRA Section 313 inspection report. All information pertaining to the facility, its processes, and the completion of its Form R chemical reports must be documented on the checklist or appended to the checklist as an attachment.

This chapter also discusses reasons for data discrepancies and reporting errors.

6.2 EPCRA Section 313 Chemicals

Before beginning the facility tour, the inspector should review all processes with the facility representative and discuss any changes that have occurred in the reporting year. The inspector should ask questions identified during the pre-inspection review of the facility's Form R reports. Detailed information on pre-inspection review is found in Chapter 3 of this manual.

First, the inspector should complete Section 2.0 of the audit checklist (i.e., Introduction and Facility Tour). To complete Section 2.0, the inspector must identify and list all the Section 313 chemicals both reported (on the Form R report) and not reported which are present at the facility. This will be done through: 1) review of the facility's Form R report and supporting documentation, 2) review of additional information and records available at the facility, 3) discussion with facility officials, and 4) facility tour.

- List of Section 313 Chemicals reported on the Form R report (Question 2.1). The inspector should record all the EPCRA Section 313 chemicals reported by the facility. This information can be taken directly from the facility's Form R report. If the facility reported a chemical category, such as "lead compounds," the inspector should enter NA in the first two boxes of the Chemical Abstract Service (CAS) number. Sections 3.0 through 6.0 of the checklist must be completed for each chemical listed here.

  If the facility reported a chemical that is not included in the Section 313 list of toxic chemicals, the inspector should check the box indicating the chemical is not a Section 313 chemical. This would include any reported chemical that is listed with a qualifier and that the facility does not use in the listed form. For example, isopropyl alcohol is a listed chemical with the qualifier "manufacturing-strong acid process." Only facilities that manufacture isopropyl alcohol by the strong acid process should report it as a Section 313 chemical.

- List of Chemicals not reported on the Form R but documented by the facility (Question 2.2). The inspector should record all chemicals documented by the facility for Section 313 reporting that did not have Form R chemical reports submitted. This information can be obtained from the supporting materials provided by the facility. If the chemical is not included in the Section 313 list, the inspector should check the box indicating the chemical is not a Section 313 chemical. The inspector should note that Section 3.0 of the checklist must be completed for each chemical listed here.

- List of Chemicals not reported or documented, but identified by the inspector (Question 2.3). The inspector should record all other Section 313 chemicals identified by the inspector during the inspection. This information is obtained through review of facility records, discussions with facility officials, and the facility tour. Section 3.0 of the checklist must be completed for each chemical listed here.

- List of mixtures identified during the facility tour which may contain Section 313 Chemicals (Question 2.4). Under EPCRA Section 313, toxic chemicals in mixtures, as well as trade name products, must be factored into threshold and release calculations. The inspector should record all mixtures identified during the inspection that may contain Section 313 chemicals in Column a. The inspector should then investigate whether the mixtures that are identified during the facility tour contain a Section 313 chemical. This is done by reviewing the MSDS to verify the constituents of the mixture (recorded in column b) and to record concentrations of any Section 313 chemical in the mixture (recorded in column c).

The inspector should note that the facility is not required to consider the quantity of toxic chemical present in a mixture if the mixture contains de minimis concentrations. De minimis concentrations means the toxic chemical is present at less than 1 percent of a mixture, or, if the toxic chemical is a carcinogen as defined in 29 CFR 1910.1200 (d)(4), less than 0.1 percent of the mixture.

Information on the amount of mixture and of Section 313 chemical (i.e., columns d and e) should be completed concurrently with the threshold determination in Section 3.0.

DEFINITION (40 CFR 372.3)
A mixture is any combination of two or more chemicals, if the combination is not, in whole or in part, the result of a chemical reaction. However, if the combination was produced by a chemical reaction but could have been produced without a chemical reaction, it is also treated as a mixture. A mixture also includes any combination which consists of a chemical and associated impurities.

6.3 Facility Tour Activities

During the tour of the facility, the inspector should focus on areas in which Section 313 chemicals are used in process lines and treatment areas. The inspector should sketch process diagram(s) in the designated Section 2.0 checklist areas if none are available from the facility. In particular, the inspector should identify areas where releases could occur in the facility (e.g., drains, exhaust fans, vents, and ducts), keeping in mind the following items:

- Housekeeping practices
- Method(s) of receiving and unloading chemicals
- Storage practices
- Disposal method(s)
- Use(s) of each Section 313 chemical
- Waste treatment and pollution control devices.

The inspector should record descriptions and document how each Section 313 chemical is used to determine its activity classification (i.e., manufactured, processed, and otherwise used). Finally, the inspector should document the types of control methods that are used at the facility and make a qualitative assessment of their efficiency by observing their operation and then record these observations in Section 2.0 of the inspection checklist. For example, a degreasing unit that is open to the atmosphere would release a greater amount of solvent to the air than a unit with a solvent recovery system.

Section 2.0 Introduction and Facility Tour Section 313 Chemicals Present Onsite

2.1 List all chemicals reported on the facility's Form R chemical reports.

Chemical Name	CAS Number	Not a Section 313 Chemical

2.2 List all chemicals not reported on the facility's Form R chemical reports, but documented by the facility.

None:_____

Chemical Name	CAS Number	Not a Section 313 Chemical

2.3 List other Section 313 chemicals not reported or documented, but identified by the inspector during the inspection.

None:_____

Chemical Name	CAS Number

2.4 List all mixtures identified during the facility tour that may contain Section 313 chemicals.

a. Mixture Name	b. Section 313 Chemical Present	c. Concentration of Chemical[1]	d. Amount of Mixture Used in Year[2]	e. Amount of Section 313 Chemical Used[2]

[1] If concentration of chemical is below *de minimis* (0.1 percent for carcinogens, 1.0 percent for all others), do not include mixture in threshold determinations.

[2] Complete Columns d and e during threshold determination.

Process Diagram(s):

Treatment Unit Operation(s):

Facility Tour Notes:

Facility Tour Notes (cont'd):

6.4 Review of EPCRA Section 313 Chemicals

The inspector should complete Sections 3.0 through 6.0 of the audit checklist for each EPCRA Section 313 chemical manufactured, processed, or otherwise used at the facility that meets the requirements for reporting. Section 3.0 of the checklist should be completed for every EPCRA Section 313 chemical used by the facility. The inspector should document all calculations and assumptions on the appropriate worksheets in Section 6.0. Calculations should be reproducible by a reviewer unfamiliar with the facility. In addition, the inspector should collect supporting documents for responses on the checklist for use as evidence in any potential enforcement actions.

6.4.1 Review of Threshold Determination

In completing Section 3.0 of the checklist, the inspector reviews the facility's decision to report a chemical, including the activities of the chemical and the amount used. The inspector should ensure that the name of the chemical being reviewed is recorded at the top of each page in Section 3.0.

- Ways the chemical is employed at the facility (Question 3.1). In this question, the inspector is documenting all the ways the chemical is being employed (1) based on the facility's documentation and (2) based on the inspector's own review of process diagrams, discussions with the facility personnel, and from the plant tour. The checklist contains three activity categories (i.e., manufacture, process, and otherwise use) as well as exempt uses. The inspector checks the appropriate activity category based on the facility's documentation in the left hand column, which is labeled facility.

  If the chemical was present as an impurity (under the manufacture category), the inspector must document the percent concentration. This is because the chemical is exempt from reporting if it is only present below the de minimis concentration (0.1 percent for carcinogens, 1.0 percent for all others). The de minimis exemption only applies to toxic chemicals in mixtures and products. It does not apply to wastestreams from manufacturing processes or to chemicals that undergo intentional beneficiation.

  The inspector must also indicate if the chemical is employed in one of the exempt uses (activities "n" through "s" in the checklist). These uses include the following:

  - Laboratories: Listed toxic chemicals that are manufactured, processed, or otherwise used in laboratory activities at a covered facility under the direct supervision of a technically qualified individual meet this exemption. Pilot plant scale and specialty chemical production are not included in the laboratory exemption.

  - Use exemption: The following uses are exempt - use as a structural component of the facility, use in routine janitorial or facility grounds maintenance, personal uses by employees or other persons, use for motor vehicle maintenance, and use of toxic chemicals contained in intake water (used for processing or noncontact

cooling water) or in the intake air (used either as compressed air or for combustion).

Article exemption: Quantities of toxic chemicals contained in an article which is processed or used at the facility meet this exemption.

DEFINITIONS

Manufacture means to produce, prepare, import, or compound one of the toxic chemicals on the list. For example, if you make a dye for clothing by taking raw materials and reacting them, you are manufacturing the dye. You also would be covered if you were a textile manufacturer who imported a dye on the list for purposes of applying it to fabric produced at your plant.

Process, in general, is the incorporation of the toxic chemical into a product and includes making mixtures, repackaging, or using a chemical as a feed-stock, raw material, or starting material for making another chemical.

Examples of *processing* include:

- Adding a solvent as a diluent when making a paint, coating, or other mixture
- Using a chemical as reactant in the manufacture of a pesticide (e.g., using chemical A to make chemical B).

Otherwise Use applies to any use of a toxic chemical at a covered facility that is not covered by the terms "manufacture" or "process" and includes use of a toxic chemical contained in a mixture or trade name product. A toxic chemical that is *otherwise used* by a facility is not intentionally incorporated into a product distributed in commerce.

Examples include:

- Using a metal cutting fluid that contains diethanolamine
- Using a heat transfer fluid containing biphenyl
- Using trichloroethylene to degrease tools
- Using chlorine in waste water treatment
- Using Freon 113 as a refrigerant to cool process streams.

The inspector should not include these activities (i.e., exemptions) in threshold or release calculations.

- Was the chemical reported by the facility? (Questions 3.2 and 3.2.1). In these questions, the inspector indicates whether the chemical was reported by the facility. If it was not, the inspector should then record why the facility felt this chemical was not reportable. The

inspector should obtain this information from the facility's documentation. If the documentation is not available, the inspector should ask the facility official why it was not reported and document the answer.

- Is the chemical exempt from reporting? (Question 3.3). The inspector should record whether the chemical is exempt from reporting. The chemical is exempt if it is employed in one of the uses or is manufactured, processed, or otherwise used at an exempt facility as described above under question 3.1.

- Is documentation supporting the threshold determination available for review? (Question 3.4). The inspector should determine if the facility has supporting documentation on the threshold calculation for this chemical and obtain copies if available. If not available, the inspector should record the most appropriate reason listed in Question 3.4.1 in the checklist why the facility does not have the documentation. This information should be obtained through discussion with the facility officials.

- What was the basis of the estimate of the amount of chemical manufactured, processed, or otherwise used during the reporting year? (Question 3.5). The inspector should determine by reviewing the facility documentation and/or discussions with facility officials, what method the facility used to estimate the amount of chemical manufactured, processed, or otherwise used. The inspector should record the method(s) used by the facility, keeping in mind that possibly more than one method or approach was used.

- How much chemical did the facility manufacture, process, or otherwise use during the reporting year? (Question 3.6). The inspector should review the facility's documentation of the threshold determination for the chemical and record the amount for each activity category. If the chemical was not used for a particular activity, the inspector should enter zero into that column. The inspector should document whether the facility did not estimate the quantities or whether there is not enough information available to estimate these quantities.

  In addition, the inspector must also do her/his own calculation of the amount of chemical manufactured, processed, or otherwise used during the reporting year. This is done using the threshold determination worksheet provided in Section 6.0 of the checklist.

At this point, the inspector should also complete Question 2.4 of the checklist discussed previously in this chapter. The concentration of toxic chemical in the mixture (i.e., column c) can be retrieved from the MSDS for the mixture. The amount of mixture used (i.e., column d) can be obtained from inventory or purchasing records. The inspector can then calculate the amount of Section 313 chemical used (i.e., column e) simply by multiplying the concentration of chemical in the mixture by the amount of mixture used.

- Was the reviewer's estimate of the amount of chemical manufactured, processed, or otherwise used recalculated using available documentation or recreated using other facility data? (Question 3.7). In this question, the inspector must either 1) recalculate the threshold determination using the available facility documentation or 2) recreate the threshold

determination if the facility has no documentation or if the inspector is aware of additional, more accurate information to use.

If the inspector recalculates the threshold value, s/he must appropriately record whether her/his value is within a factor of 2 (box a), within a factor of 10 (box b), or not within a factor of 10 (box c) of the facility value. Likewise, if the inspector recreates the threshold value, s/he must appropriately record whether her/his value is within a factor of 2 (box d), within a factor of 10 (box e), or not within a factor of 10 (box f) of the facility value.

The inspector should also record whether the facility overlooked this chemical, and therefore, did not estimate the threshold value (box g). Finally, if the inspector is unable to perform these calculations, s/he should document in detail the reason (box h).

- Was a threshold exceeded for this chemical in the reporting year? (Question 3.8). The inspector should document whether the threshold value has been exceeded for this chemical. This is done by comparing the amounts of chemicals in Question 3.6 to the threshold values for the activity categories. If either the "manufactured" or "processed" value is greater than 25,000 pounds, or if the "otherwise used" value is greater than 10,000 pounds, a threshold has been exceeded.

- What was the maximum amount of chemical onsite at any time? (Question 3.9). The inspector should review and document the maximum amount of the chemical onsite at any time during the reporting year as indicated in the Form R report and/or in facility documentation.

  In addition, the inspector must calculate the maximum amount onsite using the worksheet provided in Section 6.0 of the checklist. In calculating this value, the inspector should consider the amount of chemical in all storage areas, in use at any time, and in each wastestream. The inspector may need to review inventory records and tour the plant storage areas to complete these calculations.

- Was the chemical correctly reported or not reported? (Question 3.10). In this section, the inspector must record whether the chemical was correctly reported or not reported as follows:

  - Correctly included. The chemical was reported by the facility, is not exempt, and exceeded the applicable threshold limit. In this case, the inspector should proceed to complete Section 4.0 of the checklist for this chemical.

  - Correctly omitted. The chemical was not reported by the facility and is either exempt or did not exceed the applicable threshold limit. In this case, the inspector should now start to complete Section 3.0 of the checklist for the next chemical.

  - Incorrectly included. The chemical was reported by the facility, but is either exempt or did not exceed the applicable threshold limit. In this case, the inspector should proceed to Question 3.11 for this chemical.

Incorrectly omitted. The chemical was not reported, but was not exempt and exceeds the applicable threshold limit. In this case, the inspector should proceed to question 3.12 for this chemical.

- Why was the chemical incorrectly reported? (Question 3.11). In this question, the inspector should record the reason obtained from review of the facility's documentation and/or through discussions with the facility officials that most closely describes why this chemical was reported.

  - Although the facility was aware this chemical did not exceed the threshold limit, it was reported anyway "to be safe."
  - The facility incorrectly assumed a threshold limit was exceeded (i.e., did not complete a calculation).
  - The facility misclassified the chemical activity as "otherwise used," when it is really "processed" or "manufactured."
  - The facility made a calculation error while determining the threshold quantity, which resulted in the chemical exceeding a threshold limit.
  - The facility reported the chemical because a threshold limit was exceeded. However, all uses of the chemical are exempt, and therefore, are nonreportable.
  - Any other reason not previously described. Be thorough, but brief, in your description.

The inspector should start to complete Section 3.0 of the checklist for the next chemical.

- Why was the chemical incorrectly omitted? (Question 3.12). In this question, the inspector should record the reason as obtained through the facility's documentation, the facility tour, and/or discussions with facility officials that most closely describes why this chemical was not reported.

  - The facility overlooked the activity of a chemical as being "manufactured," "processed," or "otherwise used." Examples include:
    - Manufacturing byproducts
    - Wastewater treatment byproducts
    - Wastewater treatment chemicals
    - Cleaning chemicals.
  - The facility misclassified the chemical activity as "processed" or "manufactured," when it is really "otherwise used."
  - The facility made a calculation error while determining the threshold quantity, which did not exceed a threshold limit.
  - Any other reason not previously described. Be thorough, but brief, in your description.

The inspector should now proceed to complete Section 4.0 of the checklist for this chemical.

Section 3.0 Review Threshold Determination

Chemical Name:

3.1 How is this chemical employed at the facility? *(Check all that apply.)*

Manufacture

a. Import/produce for onsite use/processing . . . . . ☐

b. Import/produce for sale/distribution . . . . . ☐

c. Byproduct of process . . . . . ☐

d. Byproduct of waste treatment . . . . . ☐

e. Impurity[3] (% = ___) . . . . . ☐

Process *(incorporative activity)*

f. Chemical reactant (raw materials, intermediates, etc.) . . . . . ☐

g. Formulation component . . . . . ☐

h. Article component . . . . . ☐

i. Repackage . . . . . ☐

Other Use *(nonincorporative activity)*

j. Chemical processing aid (added to reaction mixture) . . . . . ☐

k. Manufacturing aid (process lubricants, coolants, etc.) . . . . . ☐

l. Ancillary use (cleaners, degreasers, lubricants) . . . . . ☐

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[3] If impurity is present below *de minimis* concentrations (0.1 percent for carcinogens, 1.0 percent for all others), it is exempt from reporting.

Exempt Uses

m. Laboratory chemical . . . . . ☐

n. Structural component . . . . . ☐

o. Routine janitorial/facility grounds maintenance . . . . . ☐

p. Personal employee use . . . . . ☐

q. Motor vehicle maintenance . . . . . ☐

r. Intake water component . . . . . ☐

s. Contained in an article . . . . . ☐

3.2 Was the chemical reported by the facility?

YES ..... ☐ NO ..... ☐ *(If yes, skip to Q. 3.3.)*

3.2.1 If no, why did the facility decide this chemical was not reportable?

a. Below threshold . . . . . ☐

b. Exempt use . . . . . ☐

c. Overlooked chemical altogether . . . . . ☐

(If checked, skip to Q. 3.6)

d. Other (specify) _____ . . . . . ☐

3.3 Is chemical exempt from reporting?

YES ..... ☐ NO ..... ☐ *(If yes, skip to Q. 3.10.)*

3.4 Is documentation supporting the threshold determination available for review?

YES ..... ☐ NO ..... ☐ *(If yes, skip to Q. 3.5.)*

3.4.1 If no, why not?

a. Documentation cannot be located . . . . . ☐

b. Documentation was not retained by facility . . . . . ☐

c. Facility unaware that documentation is required . . . . . ☐

3.5 What was the basis of estimate used by the facility for the amount manufactured, processed, or otherwise used during the reporting year? (*Check all that apply.*)

a. Purchase/inventory records . . . . . ☐

b. Emission factors . . . . . ☐

c. Mass balance . . . . . ☐

d. Assumed threshold exceeded (no calculations completed) . . . ☐

e. Process recipes . . . . . ☐

f. Monitoring data . . . . . ☐

g. Production data . . . . . ☐

h. Other (specify) . . . . . ☐

3.6 How much chemical did the facility manufacture, process, or otherwise use during the reporting year?[4]

a. Manufactured . . . . . lbs
b. Processed . . . . . lbs
c. Otherwise used . . . . . lbs
d. Facility did not estimate these quantities ☐
e. Reviewer unable to estimate quantities ☐

3.7 Was the reviewer's estimate of the amount of chemical manufactured, processed, or otherwise used recalculated using available documentation or recreated using other facility data?

a. Recalculated, within a factor of 2 . . . . . ☐
b. Recalculated, within a factor of 10 . . . . . ☐
c. Recalculated, greater than a factor of 10 . . . . . ☐
d. Recreated, within a factor of 2 . . . . . ☐
e. Recreated, within a factor of 10 . . . . . ☐
f. Recreated, greater than a factor of 10 . . . . . ☐
g. Facility did not estimate these quantities . . . . . ☐
h. Reviewer unable to estimate quantities[5] . . . . . ☐

[4] Record calculations and assumptions for the threshold determination on the worksheet in Section 6.0.

[5] Document why you are unable to estimate chemical quantities for the reporting year on the threshold determination worksheet in Section 6.0.

3.8 Was a threshold exceeded for this chemical in the reporting year?

YES . . . . . ☐ *(This chemical should have been reported. Continue.)*

NO . . . . . ☐ *(This chemical should not have been reported. Skip to Q.3.10.)*

Cannot be determined . . ☐ *(Skip to next chemical.)*

3.9 What is the maximum amount of this chemical onsite at any time?[6]

a. Maximum onsite . . . . lbs lbs

3.10 This chemical was:

a. Correctly included . . . ☐ *(If checked, skip to Section 4.0.)*

b. Correctly omitted . . . . ☐ *(If checked, skip to next chemical.)*

c. Incorrectly included . . ☐ *(If checked, skip to Q. 3.11.)*

d. Incorrectly omitted . . . ☐ *(If checked, skip to Q. 3.12.)*

[6] Record calculations and assumptions for the maximum onsite quantity on the worksheet in Section 6.0.

3.11 Why was this chemical incorrectly included?

a. Facility reported, although amount used was below threshold ☐

b. Facility incorrectly assumed threshold was exceeded . . . . . ☐

c. Chemical activity was misclassified . . . . . ☐

d. Threshold quantity was miscalculated . . . . . ☐

e. Chemical was exempt . . . . . ☐

f. Other (specify) ☐

(Skip to next chemical)

3.12 Why was this chemical incorrectly omitted?

a. Chemical activity was overlooked . . . . . ☐

b. Chemical activity was misclassified . . . . . ☐

c. Threshold quantity was miscalculated . . . . . ☐

d. Other (specify) . . . . . ☐

6.4.2 Review of Release Estimates

In completing Section 4.0 of the checklist, the inspector reviews the facility's methodology and support documentation for calculating the release estimates. This includes the review of the sources of releases to ensure that all sources have been accounted for.

- Is documentation on release estimate available for review? (Question 1). In this question, the inspector must obtain and review the facility's supporting documentation on each release estimate available for this chemical. If not available, the inspector must record the reason (as determined through discussions with facility officials) which most closely describes why the documentation is not available. If the facility overlooked this chemical, the inspector should proceed to Section 4.1 of the checklist for this chemical.

- If monitoring data were used, are data available for review? (Question 2). The inspector should obtain copies of any monitoring data used to develop the release estimates. The inspector should note that the facility must use all readily available data collected to meet other regulatory requirements or as part of routine plant operations for the toxic chemical. However, the facility is not required to conduct additional monitoring or measurements of the toxic chemical for the purposes of completing the Form R report.

  The inspector should also document the reason if such monitoring data was used but is not available for review.

- If a percent from stormwater estimate was reported, are the monitoring data on which the estimate was based available for review? (Question 3). The inspector should obtain copies of any monitoring data used by the facility to calculate the percent from stormwater estimate (if Question 5.C completed on the Form R report). The inspector should note that if the facility has monitoring data on the toxic chemical and the flow rate, such data must be used to calculate the percent from stormwater estimate. In addition, if the facility does not have periodic measurements of stormwater releases of the toxic chemical, but has submitted chemical-specific monitoring data in permit applications, then these data must be used to calculate the percent from stormwater estimate. In this case, the inspector should obtain copies of the data used in the permit application.

  The inspector should also document the reason if such monitoring data was used but is not available for review.

- If emission factors were used, what is the source of the factors? (Question 4). The inspector should record and document the source of any emission factors used by the facility to calculate the release estimate. Such factors could be facility-derived factors, EPA-published emission factors, trade association factors, etc. The inspector should indicate NA if emission factors were not used.

- Was each air or wastestream counted only once in the release estimate? (Question 5). The inspector should review the facility's documentation and record whether each air stream or wastestream that contributed to the release estimates was counted only once. Any streams that were double counted must be documented in the release calculation worksheet in Section

6.0. An example of double counting would be reporting releases that are vented from a spray paint booth as an air stack release as well as building fugitive emissions.

- Were all air or wastestreams containing < 1% of the chemical included in the release calculations? (Question 6). The inspector should review the facility's documentation and document whether any air or wastestreams containing less than 1 percent of the chemical were included in the release calculations. The de minimis exemption applies to ingredients of mixtures or to impurities present in products processed or used. However, it does not apply to wastes when chemicals in mixtures above the de minimis level are manufactured, processed, or otherwise used, and meet the applicable activity threshold. Wastes and releases must be reported regardless of the concentration. In addition, when the facility's operations create (manufacture) the chemical in waste treatment, the de minimis exemption does not apply.

  The inspector should record if the facility has misinterpreted the de minimis rule and not included wastestreams with less than 1 percent of the chemical, or the reason that most closely describes why such wastestreams were not included.

- Was onsite treatment of this chemical included in release estimates? (Question 4.7). The inspector should review the facility's documentation and record whether onsite treatment of the chemical is included in the facility's release calculations. All onsite treatment processes must be included in the release calculations. These processes would include:

  - Air Emissions Treatment
  - Biological Treatment
  - Chemical Treatment
  - Incineration/Thermal Treatment
  - Physical Treatment
  - Solidification/Stabilization.

  If the facility did not include onsite treatment in its estimate, the inspector should determine (through discussions with facility officials) and document the reason which explains most closely why such treatment was not included.

- If sequential treatment was reported, was the efficiency based on overall treatment? (Question 8). The inspector should document if the facility used overall treatment efficiency for any sequential treatment which was reported. Sequential treatment refers to several individual treatment steps used in a series to treat the toxic chemical. When the facility has sequential treatment, it should use the overall treatment efficiency in its release calculations.

TIPS
The treatment efficiency (expressed as percent removal) represents the mass or weight percentage of chemical destroyed or removed, not merely changes in volume or concentration of the chemical in the wastestream. The efficiency refers only to the percent destruction, degradation, conversion, or removal of the listed toxic chemical from the wastestream, not the percent conversion or removal of other wastewater constituents which may occur together with the listed chemical.

- Were treatment efficiencies used consistent with vendor specs or EPA-published efficiencies? (Question 9). The inspector should review and document whether treatment efficiencies used by the facility were consistent with vendor specifications or with EPA-published values. The efficiencies reported on the facility's Form R report should be compared to literature values before the inspection, if possible. The inspector should discuss any identified inconsistencies with facility officials during the inspection and document the reason for such discrepancies in Section 6.0 of the checklist. The inspector should record whether the facility did not use treatment efficiencies in the release determination.

6.4.3 Sources of Chemical Releases and Transfers

Section 4.1 of the checklist is designed to summarize information on the sources of chemical release or transfer considered by the facility for each release estimate. Under EPCRA Section 313, the facility is required to account for the total aggregate releases of the toxic chemical to the environment for the reporting year. The facility is not required to count as releases quantities of a toxic chemical lost due to natural weathering or corrosion, normal/natural degradation of a product, or normal migration of a chemical from a product.

Releases to media that must be included in release calculations are listed in Section 4.1 and are as follows:

- Fugitive or Nonpoint Air Emissions. This includes all releases to air that are not released through stacks, vents, ducts, pipes, or any other confined air stream.

- Stack or Point Air Emissions. This includes all releases to air that are released through stacks, vents, ducts, pipes, or any other confined air stream.

- Discharges to Receiving Streams or Water Bodies. This includes releases from the facility to each receiving stream or water body. It does not include discharges to POTWs or other offsite wastewater treatment systems.

- Underground Injection. This includes the injection of the toxic chemical into all wells.

- Releases to Land Onsite. There are four subcategories for reporting quantities of the chemical released to land within the boundaries of the facility. These categories include:

  - Landfill
  - Land treatment/application farming
  - Surface impoundment
  - Other disposal (such as spills or leaks of the chemical to land).

- Discharges to POTWs. This includes discharges to sewer lines which ultimately go to wastewater treatment plants.

- Offsite Transfers. The offsite transfer consists of the total quantity of chemical sent to any offsite disposal, treatment, or storage facilities.

For each release medium listed in Section 4.1, the inspector should indicate whether the source of release was:

- Y - Considered in the estimate
- N - Not considered in the estimate
- NA - Not present at the facility for the chemical and medium.

This section of the checklist will assist the inspector in completing Section 5.0 of the checklist. The inspector should note that the shaded areas in Section 4.1 should not be completed.

TIPS
Errors commonly made by facilities in the preparation of the release estimate include: • Reporting the materials being transferred offsite for recycling or reuse. Materials being sent offsite for recycling or reuse are not considered a release under Section 313. • Reporting zero air emissions for VOCs. VOCs are chemicals which readily evaporate at room temperature, and therefore, will evaporate when present in an open tank or painting or degreasing operation. • Reporting discharges of mineral acids after neutralization. A mineral acid stream neutralized to a pH of 6 or above is considered to be 100 percent neutralized. Such a discharge may be reported as zero acid released. • Incorrectly identifying/reporting fugitive and stack emissions. Fugitive and stack emissions must be reported separately as releases to air.

Section 4.0 Review of Release Calculations

Code List for Section 4.0

Q1	Y	=	Yes
	N1	=	Documentation cannot be located
	N2	=	Documentation was not retained by facility
	N3	=	Facility unaware that documentation required
	N4	=	Facility overlooked chemical
	N5	=	Other
	NA	=	Facility does not have a release for this medium
Q2	Y	=	Yes
	N1	=	Facility unable to locate data
	N2	=	Facility did not retain data
	NA	=	Monitoring data not used
Q3	Y	=	Yes
	N1	=	Facility unable to locate data
	N2	=	Facility did not retain data
	N3	=	Facility did not base estimate on monitoring data
	NA	=	Percent from stormwater estimate was not reported
Q4	1	=	Facility-derived factors
	2	=	EPA-published emission factors
	3	=	Trade association factors
	4	=	Other
	NA	=	Emission factors not used
Q5	Y	=	Yes
	N	=	No
	NA	=	Facility does not have a release for this medium
Q6	Y	=	Yes
	N1	=	Facility misinterpreted *de minimis* rule
	N2	=	Facility overlooked chemical
	N3	=	Other
	NA	=	Facility does not have a release from this medium
Q7	Y	=	Yes
	N	=	No, facility overlooked treatment
	NA	=	No treatment of this chemical for this release medium occurred
Q8	Y	=	Yes
	N	=	Facility incorrectly reported treatment efficiency
	NA	=	Sequential treatment uses not reported
Q9	Y	=	Yes
	N	=	No
	NA	=	No treatment efficiencies were used

Section 4.0 Review of Release Estimates

Chemical Name	Fugitive Air	Stack Air	Receiving Stream	Underground Injection	Land Onsite	POTW	Offsite Transfer
1. Is documentation on release estimate available for review?[1]							
2. If monitoring data were used, are data available for review?							
3. If a percent from stormwater estimate was reported, are the monitoring data estimate is based on available for review?							
4. If emission factors were used, what is the source of the factors?							
5. Was each air or waste stream counted only once in release estimates?[2]							
6. Were all air or waste streams containing <1% of the chemical included in release calculations?							
7. Was onsite treatment of this chemical included in release estimates?							
8. If sequential treatment was reported, was the efficiency based on the overall treatment?							
9. Were treatment efficiencies used consistent with vendor specs or EPA published efficiences?[3]							

[1] If the facility overlooked this chemical, enter N4 and skip to Section 4.1.
[2] If no, document all streams double counted in release calculation in Section 6.0.
[3] If no, document inconsistency of treatment efficiencies used in Section 6.0.

Section 4.1 Sources of Chemical Releases and Transfers

Document whether facility considered all releases from the following sources:[1]

Chemical Name	Fugitive Air	Stack Air	Receiving Stream	Underground Injection	Land Onsite	POTW	Offsite Transfer
SOURCE A Process vents/stacks							
B Pumps/valves/flanges							
C Volatilization from process areas							
D Volatilization from treatment areas							
E Indoor air releases							
F Storage tank/stockpile losses							
G Accidental spills/releases							
H Air or waste treatment discharge streams[2]							
I Stormwater runoff							
J Process discharge streams							
K Housekeeping practices/cleanup wastes							
L Container residue							
M Treatment sludges							
N Other							

[1] Y = Yes, release from this source was considered in estimate. N = No, release from this source was overlooked. NA = This source was not present at the facility for this chemical.

[2] Includes pollution control devices, pollution equipment bypass or malfunctions, land farming, or discharges to ponds, pits, and lagoons.

6.4.4 Summary of Release Estimates

Section 5.0 is designed to summarize both the facility and inspector release estimates for each medium and the methods used to estimate each. When entering the release estimate for a particular medium, the inspector should sum each occurrence of the release type. For example, the facility may release a chemical to two or more receiving streams. The amount in each stream should be added, and the total should be recorded in the appropriate column.

- Estimate facility's release. (Question 1). The inspector should document the facility's release estimates reported on Form R for each medium. If the facility did not report a release, the inspector should enter zero.

- What method(s) did the facility use to estimate their releases? (Question 2). The inspector should document the methods that were actually used by the facility to estimate each release using the appropriate code found in the list given prior to Section 5.0 in the checklist. This may not necessarily be what the facility reported on the Form R chemical report. The types of methods that can be used include:

  - Monitoring Data. Estimate is based on monitoring data or on measurements for the toxic chemical as released to the environment and/or offsite facility.
  - Mass Balance. Estimate is based on mass balance calculations, such as a calculation of the amount of the toxic chemical in streams entering and leaving process equipment.
  - Emission Factors. Estimate is based on published emission factors, such as those relating release quantity to throughput or equipment type (e.g., air emission factors).
  - Engineering Judgment. Estimate is based on engineering calculations (e.g., estimating volatilization using published mathematical formulas) or best engineering judgment. This includes applying an estimated removal efficiency to a wastestream, even if the composition of the stream before treatment was fully characterized by monitoring data.

- Based on data available to the facility, is this the best method? (Question 3). After reviewing the facility's documentation for this release estimate, the inspector should record whether the facility used the best method for determining the release, keeping in mind that the four primary methods are monitoring data, mass balance, emission factors, and engineering judgment. To decide whether one method is better than another, it is necessary to evaluate the type and quality of data available to the facility at the time of reporting. For example, if a facility used engineering judgment but had monitoring data for the toxic chemical, the facility should have used the monitoring data. If the facility used the best method based on available data, the inspector should proceed to Question 6.

- What method(s) could be used to calculate a more accurate release? (Question 4). The inspector should record the method that would be better based on data available to the facility. The inspector should document thoroughly in Section 6.0 of the checklist why this method is a more accurate one for this facility based on her/his evaluation.

- Enter the reviewer's release estimate using the preferred method(s). (Question 5). Using the preferred method stated in Question 3, the inspector should calculate a new release estimate for the facility on the release estimate worksheet provided in Section 6.0 and record her/his answer. The inspector should be sure to document all her/his calculations.

- Enter the reviewer's release estimate using the same method(s) as the facility. (Question 6). Using the same method as the facility, the inspector should recalculate the release estimates on the release estimate worksheet in Section 6.0 and record her/his answer. The inspector should be sure to calculate the estimates appropriately, avoiding the common problems noted in Section 6.3.3 of this manual. If the facility had no documentation and the inspector is unable to recreate the estimate, the inspector should enter "Unknown."

Section 5.0 Summary of Release Estimates

Code List for Section 5.0

1 M = Monitoring data or direct measurements
C = Mass balance calculations
E = Published emission factors
OC = Engineering calculations
OJ = Engineering judgement
OH = Hazardous waste manifests
O = Other_____
NA = Facility did not estimate release

2 Y = Yes
N = No
NA = Facility did not estimate release

3 Document why this method is more accurate in Section 6.0

4 Document release calculations in Section 6.0

Section 5.0 Summary of Release Estimates

Chemical Name	Fugitive Air	Stack Air	Receiving Stream	Underground Injection	Land On Site	POTW	Offsite Transfer
1. Enter facility's release estimate (in lbs). (Check range, if appropriate.)	1-499 500-999 |__||__| _____	1-499 500-999 |__| |__| _____	1-499 500-999 |__| |__| _____	1-499 500-999 |__| |__| _____	1-499500-999 |__| |__| _____	1-499 500-999 |__| |__| _____	1-499 500-999 |__| |__| _____
2. What method(s) did the facility use to estimate their release?							
3. Based on data available to the facility, is this the best method to determine a release estimate? IF YES, SKIP TO QUESTION 6.							
4. What method(s) could be used to calculate a more accurate release estimate?							
5. Enter the reviewer's release estimate using the preferred method(s). (Check range, if appropriate.)	1-499 500-999 |__| |__| _____	1-499 500-999 |__| |__| _____	1-499 500-999 |__| |__| _____	1-499 500-999 |__| |__| _____	1-499500-999 |__| |__| _____	1-499 500-999 |__| |__| _____	1-499 500-999 |__| |__| _____
6. Enter the reviewer's release estimate using the same method(s) as the facility. (Check range, if appropriate.)	1-499 500-999 |__| |__| _____	1-499 500-999 |__| |__| _____	1-499 500-999 |__| |__| _____	1-499 500-999 |__| |__| _____	1-499500-999 |__| |__| _____	1-499 500-999 |__| |__| _____	1-499 500-999 |__| |__| _____

6.4.5 Calculations

Section 6.0 contains worksheets for completing the following calculations:

- Threshold determination
- Maximum amount onsite
- Release estimates.

The completion of these worksheets has been discussed in previous sections of this chapter. In general, the inspector should document all assumptions made during calculations on the worksheets. In addition, the inspector should record and document the basis for any conclusions that the facility's reported release is accurate or inaccurate. A second reviewer, not necessarily familiar with the facility, should be able to recreate the calculations.

Section 6.0 Calculations

Threshold Determination Worksheet

Chemical Name:

Description of Use	Amount Manufactured	Amount Processed	Amount Otherwise Used
Totals			

Calculations:

Maximum Amount Onsite Worksheet

Chemical Name:

Instructions: *Calculate the maximum amount of the chemical onsite at any one time during the reporting year. Keep in mind the following:*

- All storage areas (raw materials and products) where this chemical may be kept
- The amount of chemical being used at any time
- The amount of chemical in each wastestream.

Storage Areas:

Total: [ ]

Chemical in Use:

Total: [ ]

Chemical in Wastestreams:

Total: [ ]

Total Onsite: [ ]

Release Estimate Worksheet

Chemical Name:

Instructions: *Record all calculations for release estimates below in the appropriate sections. Be sure to state whether calculations use the same method as the facility or a preferred method.*

Fugitive Air

Stack Air

Chemical Name:

Receiving Stream

Underground Injection

Land Onsite

Chemical Name:

Offsite Transfer to POTW

Offsite Transfer

6.5 Reasons for Reporting Errors/Data Discrepancies

A number of items contribute to differences in the amount of reported releases and transfers from one year to another. These changes can be attributed to: 1) reporting errors caused by a lack of understanding of the reporting requirements, calculation errors, and personnel changes, and 2) data discrepancies due to process modifications, production changes, product substitution, and product elimination. In some cases, the significant reductions in releases resulted from the implementation of pollution prevention activities.

Some reasons for potential data quality errors, which should be kept in mind as the inspector moves through the onsite phase of the data quality inspection, are described below.

- Technical Contact. Changes in technical contact personnel have led to errors or inconsistent reporting from year to year. Often, the new technical contact may not be familiar with the reporting requirements, and therefore, must go through an educational process.

- Administrative Errors. The most common errors involve entry of information on the Form R, calculation of releases, and threshold determination errors. Although data may have been collected by a facility correctly, the data were incorrectly transferred onto the form or entered in the wrong section of the form.

- Data/Calculation Errors. Some common errors in calculations occur when a facility includes the entire weight of a chemical in a mixture instead of just the weight of the chemical itself or includes the amount of a chemical purchased in a calendar year rather than the amount used. Threshold determination errors include incorrectly interpreting the threshold definitions for the manufactured, processed, or otherwise used activity categories.

Some reasons for significant changes in amounts of chemicals used or amounts of chemicals released are described below.

- Process Change. Several process changes were observed during the site visits. With the emphasis shifting from pollution control to pollution prevention, facilities are attempting to decrease the amount of Section 313 chemicals used in their processes.

- Housekeeping. Some facilities were able to decrease the amount of Section 313 chemicals used by incorporating simple housekeeping practices (e.g., adding cooling coils on a vapor degreaser and keeping the cover closed when it is not in use).

- Product Substitution/Elimination. The substitution of less toxic or hazardous chemicals for Section 313 chemicals, or total elimination of the Section 313 chemicals, can have many economic and environmental benefits, including:

  - Economic benefits
    - Reduction of raw material costs
    - Decrease in transport, treatment, and disposal costs
    - Reduction of insurance liability through a safer work environment.

- Environmental benefits
  - Reduction in potentially harmful effects to the environment and public health
  - Protection of worker health.

An example of such benefits would be a large manufacturing facility that installed a powder paint system, thus reducing its overall usage of common paint-carrying solvents, such as xylene, toluene, methyl ethyl ketone, and n-butyl alcohol.

- Production Changes. In the past few years, many facilities have been affected by the weakened economy, which in turn has led to decreased production and a reduction in raw material usage. Because of production slowdowns, some facilities did not meet the reporting thresholds.

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Chapter Seven

Closing Conference

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7. Closing Conference

7.1 Introduction

The closing conference with facility officials enables the inspector to "wrap up" an inspection. The inspector should prepare and present to the facility officials any remaining receipts for documents and should resolve information gaps by obtaining either the necessary information or an informal agreement that the information will be forthcoming. The inspector should clarify any final questions and provide the facility officials with the opportunity to ask any final questions. This chapter provides guidance for inspectors on several of the issues that may arise during the closing conference, such as the facility's compliance status, facility questions, confidentiality claims, and compliance outreach.

7.2 Inspection Findings

The inspector should summarize the inspection findings in an objective and factual manner. If facility officials ask if any violations were found, the inspector may point out various items that facility officials might want to address. However, EPA inspectors are never authorized to say that there are or are not violations. At most, an inspector may communicate that there were areas of possible concern or that no major problems were "readily apparent," but should always emphasize that the decision on whether a violation exists is not made by the inspector.

There are several reasons why the inspector should not offer conclusions, which appear to be complete and final, regarding the facility's compliance status:

- The inspector has not had time to reflect upon and correlate all that s/he has observed and a case development officer has not yet analyzed the inspection report. Any conclusion made by an inspector could compromise later decisions.

- The intricacies of EPA-administered statutes and regulations do not usually lend themselves to simple or quick assessments.

- The inspection findings may represent only a portion of a larger enforcement case.

Additionally, should the facility later be informed that the inspection did substantiate a finding of violation, facility officials are likely to insist that the EPA inspector stated there were no violations at the time s/he left the premises, and therefore, to question the final assessment.

During the closing conference, facility officials may assert that they have the right to see or copy notes made by EPA inspection personnel. Although they may submit a Freedom of Information Act (FOIA) request, to which EPA must respond within 10 days, EPA policy is that the inspector not permit facility representatives to see or copy inspection notes.

7.3 Confidentiality Claims

During the inspection, some information may have been declared confidential. These items should be reviewed and confirmed with facility officials, and confidentiality claims must be completed by a facility representative (see *TSCA Inspection Guidance Manual* for additional procedures). Senior Environmental Employment (SEE) enrollees should be aware that, pending congressional legislation, they are not allowed to see confidential business information.

Facility officials should then review the completed Receipt for Samples (if prepared) and make any further claims. Even when no receipt is required, inspectors should be sure that facility officials understand their right to make confidentiality claims.

7.4 Compliance Outreach

Since the inspector is often the only contact between EPA and the regulated industries, s/he should be aware of opportunities to promote compliance with EPA regulations. The closing conference provides an ideal opportunity to offer various kinds of help to facility officials. The inspector will have just completed an inspection and will have first-hand knowledge of questions, problems, and possible solutions.

However, in this role, the inspector should be careful to answer only those questions that are within her/his ability or authority. The inspector should never recommend that a particular step be taken to address a problem. Such advice may be wrong, and if the facility is later found to be in noncompliance, EPA's ability to pursue an enforcement action would be jeopardized. However, the inspector can offer or suggest resources that are available to facility officials to help solve problems (e.g., technical publications, special services). Inspectors should refer questions and problems to other EPA personnel as needed, and follow up with those personnel when practical to see that facility officials receive a response.

Since the purpose of the inspection process is to promote compliance, as well as to identify violations, it is important for the inspector to help raise the level of a facility's awareness of EPCRA Section 313. The closing conference is an ideal opportunity for the inspector to promote compliance by disseminating

EPA literature to the facility. The following publications may be recommended or given to the facility to increase their awareness of EPCRA Section 313 (especially data quality). The inspector should tell facility officials that any information or publications on data quality given to a facility should be tailored to their specific needs.

- General: Statute and Regulations
  - Toxic Chemical Release Reporting Regulations - 40 CFR Part 372
  - *Toxic Chemical Release Inventory Reporting Package for 1990* (EPA 560/4-91-001)
  - *Toxic Chemical Release Inventory Questions and Answers* (EPA 560/4-90-003)
  - *Common Synonyms for Section 313 Chemicals* (EPA 560/4-90-005)
  - Section 313 Interpretive Guidance System (ASKSAM Database)
  - Compilation of Air Pollution Emission Factors (AP-42, OAQPS, Sept.1985)
  - *Toxic Air Pollutant Emission Factors – A compilation for Selected Air Toxics Compounds and Sources* (EPA 450/2-88-006a)
  - *Estimating Releases and Waste Treatment Efficiencies for the Toxic Chemical Release Inventory Form* (EPA 560/4-88-002)
- Industry-Specific
  - *Toxic Chemical Release Inventory: Clarification and Guidance for the Metal Fabrication Industry* (EPA 560/4-90-012)
  - *Title III Section 313 Release Reporting Guidance* (EPA 560/4-88-004 a through l, p, and q), estimating chemical releases from :

    a. Monofilament Fiber Manufacturing
    b. Printing Operations
    c. Electrodeposition of Organic Coatings
    d. Spray Application of Organic Coatings
    e. Semiconductor Manufacture
    f. Formulating Aqueous Solutions
    g. Electroplating Operations
    h. Textile Dyeing
    i. Presswood and Laminated Wood Products Manufacturing
    j. Roller, Knife, and Gravure Coating Operations
    k. Paper and Paperboard Production
    l. Leather Tanning and Finishing Processes
    p. Wood Processing
    q. Rubber Production and Compounding

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Chapter Eight

Post-Inspection Activities

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8. Post-Inspection Activities

8.1 Introduction

The effectiveness of an EPCRA data quality inspection is dependent on many factors, including the thoroughness of the inspection, the evidence collected by the inspector, and the cooperation of the facility being inspected. Critical to the success of the inspection process are two steps that follow the inspection itself:

- Conducting followup activities, which help ensure that any outstanding questions or data discrepancies are answered and resolved and contribute to a more detailed, thorough inspection report
- Preparing the inspection report, which clearly outlines the elements for consideration prior to making an enforcement decision.

This chapter includes discussion of followup activities and report preparation, including guidance on what to do with the inspection report once it is completed. Followup activities are necessary to ensure that any outstanding data pertaining to the facility and the inspection are obtained as soon as possible following the inspection for inclusion in the inspection report. The primary function of the inspection report is to serve as the main document upon which EPA Case Development Officers (CDOs) will base enforcement decisions concerning the facility. These two post-inspection activities should be completed as soon as possible, but no later than 45 days after the inspection. Each of these two steps is discussed below.

8.2 Followup Activities

Before preparing the inspection report, the inspector should review the information documented during every phase of the EPCRA data quality inspection process, making note of data discrepancies or gaps in knowledge, inspection processes, or timelines. The inspector should be looking for these gaps and discrepancies when examining the following materials:

- Field notebooks
- Checklists
- Photographs
- Facility documents
- Notices of Inspection, Receipts for Samples and Documents, CBI forms
- Sketches of flow diagrams and process lines
- Statements by facility officials.

If an inspector discovers gaps or discrepancies that could affect the quality of the inspection report, the information needed may be requested from the facility via: 1) telephone call, 2) written request with a timeframe for return attached (usually 30 days), or 3) in unusual circumstances, a followup visit.

The inspector should conduct the necessary followup to answer outstanding questions and obtain relevant documents. The inspector should focus on obtaining information necessary to fill in gaps in material already obtained from EPA records and/or the facility pertaining to facility operations and data quality. The inspector should also collect information that clarifies the data already in the inspector's possession. This additional and clarifying information should be included in the inspection report.

The inspector should keep in mind that s/he should already have requested outstanding data at the closing conference. Therefore, the purpose of conducting followup activities is to ensure that facility representatives respond to requests by EPA to supply missing data identified during the inspection. Other followup can be through Headquarters (late reports, etc.), other contacts suggested on site, or other program offices, if warranted.

8.3 The Inspection Report

The inspection report is the final activity and one of the most critical components of the inspection process. It is the document that enables the CDOs to make correct enforcement decisions regarding a facility's compliance and, if necessary, develop a case. Therefore, it is imperative that the inspection report is complete and factual and accomplishes all of the following objectives:

- Contains all the components of the report, including copies of relevant forms and documents as appendices, as well as the narrative component of the report referencing forms and documents.
- Substantiates, with as much evidence as possible, each potential violation of EPCRA Section 313 cited in the report, ensuring that any documents and/or photographs are not only appended to the report but are referenced in the narrative component of the report. (This is necessary so that CDOs know how the data relate to the inspection.)
- Is written in clear and precise language.
- Presents factual and accurate information pertaining to all steps of the inspection process, from opening to closing conference and followup.
- Makes only those observations that are based on firsthand knowledge of the facility since enforcement personnel must be able to depend on the accuracy of all information.
- Includes only information that is relevant to the facility and its compliance with EPCRA Section 313. (Irrelevant facts can interfere with enforcement decisionmaking.)

A well-developed inspection report must include several key pieces of information. This information will enable the CDO to have all the information necessary to make the correct enforcement decision. Therefore, it is critical that all the components of the inspection report lead the reader, in a simple and logical progression, to the correct conclusion regarding a facility's compliance status.

The following components should be included in the inspection report:

- Title page
- Index
- Facility information
  - Company name, address, and telephone number
  - Parent company name and address
  - Primary SIC code and D&B number
  - Type of facility
  - Number of employees
  - Threshold quantities of listed EPCRA Section 313 chemicals
  - History of violations/receipt of Notices of Noncompliance
- Inspection information (narrative body of report)
  - Inspector name
  - Date of notification
  - Date, time, and type of EPCRA inspection
  - Responsible facility official's name, title, and phone number
  - Other contributing facility representatives
  - Reason for inspection
  - Physical and operational description of facility
  - Compliance with entry and inspection procedures
  - Chronology of actions during inspection
  - Factual observations
  - Deviations from inspection plan, if any
  - Claims of CBI, if any
- Evidence and exhibits (all evidence and exhibits must be referenced and explained in the narrative body of the report)
  - Notification letter, if used
  - NOI
  - Receipt for Samples and Documents
  - Declaration of CBI
  - Inspection plan and inspection checklist
  - Photographs
  - Facility documentation supporting an estimate of releases

- Summary
  - Type of inspection conducted
  - Inspection priorities identified
  - Preliminary identification of potential violations (this is exempted from release under FOIA)

While preparing the inspection report, the inspector should keep in mind that some or all of the data gathered during the inspection may be CBI. Otherwise, the report may be released to the public in response to a FOIA Request. Therefore, if the inspection report contains CBI, those portions of the inspection report must be treated in accordance with CBI procedures. In addition, if the inspector takes notes in the field logbook during the inspection and refers to CBI, s/he should treat such notes as CBI. However, the inspector may include a reference number in the notes (referring to CBI elsewhere) so that the notes will not have to be treated as CBI.

8.4 Submitting the Inspection Report

Once a thorough and complete inspection report has been developed, it should be reviewed by the EPCRA Section 313 Coordinator and forwarded to the CDO. The CDO will review the inspection report carefully, determine if a possible violation exists, draft a complaint, and begin to develop the case.

Even though the inspector's role in the investigation of a facility is technically completed once an inspection report has been filed, the inspector should be available to the CDO to provide clarification on technical and logistical issues and should be ready to testify if the case goes to court.

Chapter Nine

Elements of a Good Data Quality Case

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Industry Profiles

TRI FACILITY PROFILE
FOUNDRIES

by

IT Corporation
11499 Chester Road
Cincinnati, Ohio 45246

Contract No. 68-D0-0020
Work Assignment No. 2-27/2-65/3-18
JTN 830015-5-1

Prepared for

U.S. ENVIRONMENTAL PROTECTION AGENCY
OFFICE OF TOXIC SUBSTANCES
401 M Street, SW
Washington, D.C. 20460

July 1992

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TRI FACILITY PROFILE
FOUNDRIES

The purpose of this profile is to assist EPA Regional Office personnel with Section 313 inspections. The profile describes key toxic chemicals used in foundries, describes how these chemicals are used, and identifies key release sources. All Section 313 chemicals reported to TRI by over 5 percent of the foundries in each foundry type are presented in this profile.

Foundries are operations that melt metal to pour into molds to produce castings. The industry is primarily defined as SIC 332 - Iron and Steel Foundries and SIC 336 - Nonferrous Foundries (Castings). For purposes of this profile, the industry is further divided into five categories:

- Iron foundries defined as SIC 3321 - Gray and Ductile Iron Foundries and SIC 3322 - Malleable Iron Foundries.
- Steel foundries defined as SIC 3324 - Steel Investment Foundries and SIC 3325 - Steel Foundries Not Elsewhere Classified.
- Aluminum foundries defined as SIC 3363 - Aluminum Die Castings and SIC 3365 - Aluminum Foundries.
- Copper foundries defined as SIC 3366 - Copper Foundries.
- Other nonferrous foundries defined as SIC 3364 - Nonferrous Die Castings Except Aluminum and SIC 3369 - Nonferrous Foundries Except Aluminum and Copper.

Table 1 shows the various types of furnaces used to melt metal in a foundry operation.[1]

Foundries use similar processes, regardless of the raw material used.[1] Since iron and steel foundries account for the vast majority of tonnages produced by all foundries in

TABLE 1. TYPES OF FURNACES USED IN FOUNDRY OPERATIONS[1]

	Furnace type						
Metal	Crucible	Electric induction	Reverberatory	Cupola	Electric arc	Open hearth	Pot
Aluminum	X	X					
Brass/Bronze	X	X	X				
Gray Iron		X	X	X	X		
Steel		X			X	X	
Zinc	X	X					
Copper	X	X	X				
Lead							X

the United States, a brief description of the gray iron foundry operation is given here. After this description, each foundry type (iron, steel, aluminum, copper, and other non-ferrous) will be discussed separately with emphasis on differences from this overall description and with specific emphasis on the Section 313 chemicals used in each foundry type. As Explained in the section on nonreporting facilities, most foundries with more than 10 employees probably are processing or otherwise using at least one Section 313 chemical in excess of threshold values. Figure 1 presents a simplified process flow diagram showing major operations that occur in foundries. Figure 2 presents the emission points in a typical iron foundry.[2]

The four major production steps in foundry operations include raw materials handling and preparation, metal melting, mold and core production, and casting and finishing.[2]

Raw materials handling and preparation operations include receiving, unloading, storing and conveying of all raw materials for both furnace charging and mold and core preparation.[2] The major groups of raw materials required for furnace charging are metallics, fluxes, and fuels. Raw material preparation may include the cleaning of scrap metals before charging.

Metal melting is done in a variety of furnaces with the furnace charge consisting of metallics, fluxes and fuels. As presented in Table 1, seven general furnace types are used in foundries. The cupola, which is the major type of furnace used in iron foundries, is a vertical cylindrical steel shell with either a refractory-lined or water-cooled inner wall.[2] Refractory linings usually consist of silica brick, dolomite, or magnesium brick. Water cooled linings, which involve circulating water around the outer steel shell, are used to protect the furnace wall from interior temperatures. The cupola is charged at the top with alternate layers of coke metallics and fluxes. Cupola capacities typically range from 1 to 30 tons per hour, with a few larger units approaching 100 tons per hour.

Electric Arc Furnaces (EAF) are large, welded-steel cylindrical vessels equipped with a removable roof through which retractable carbon electrodes are inserted.[2] The electrodes are lowered through the roof of the furnace and are energized by three-phase alternating current, to create arcs that melt the metallic charge with their heat.

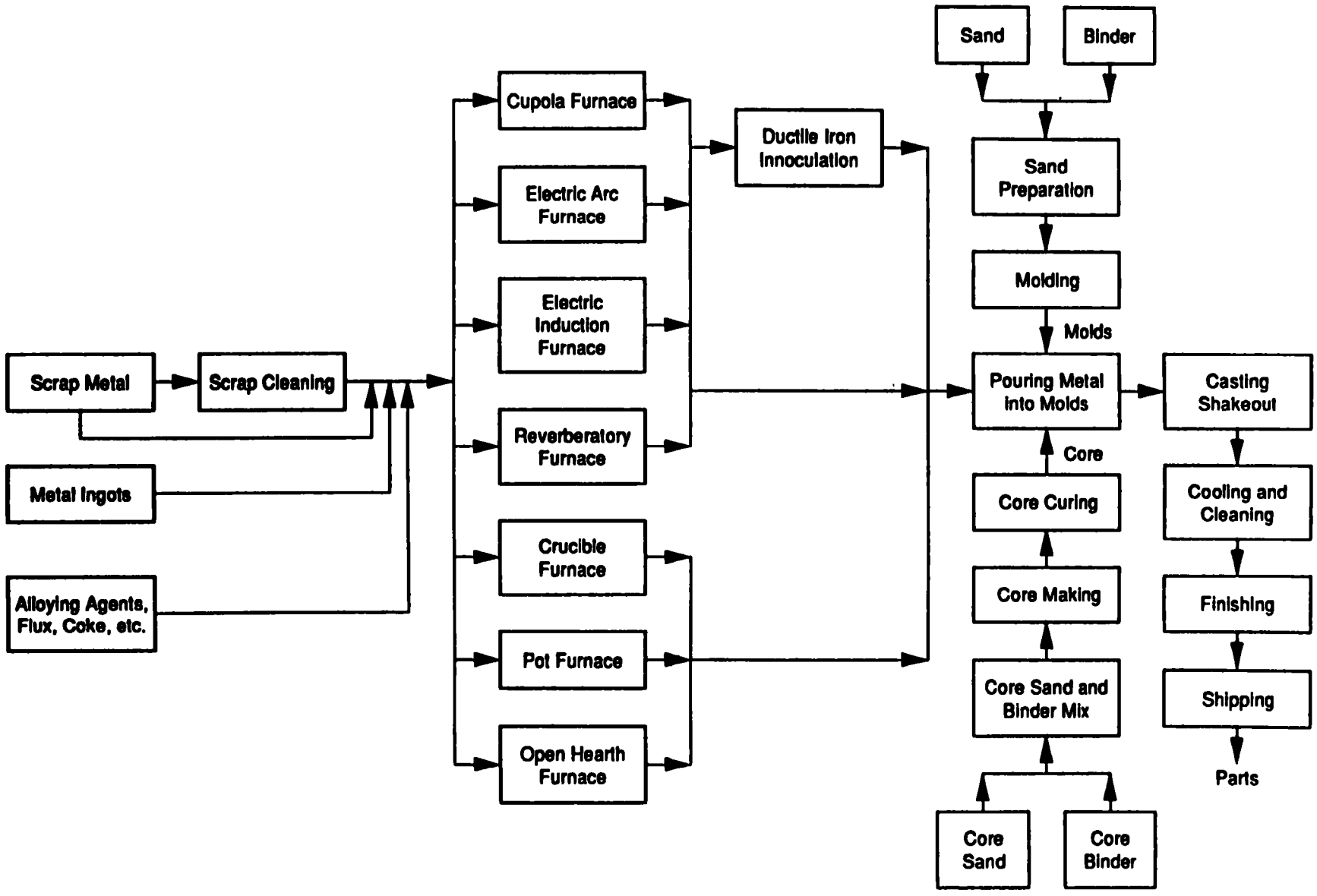

Figure 1.
Simplified process flow diagram for foundries.[1]

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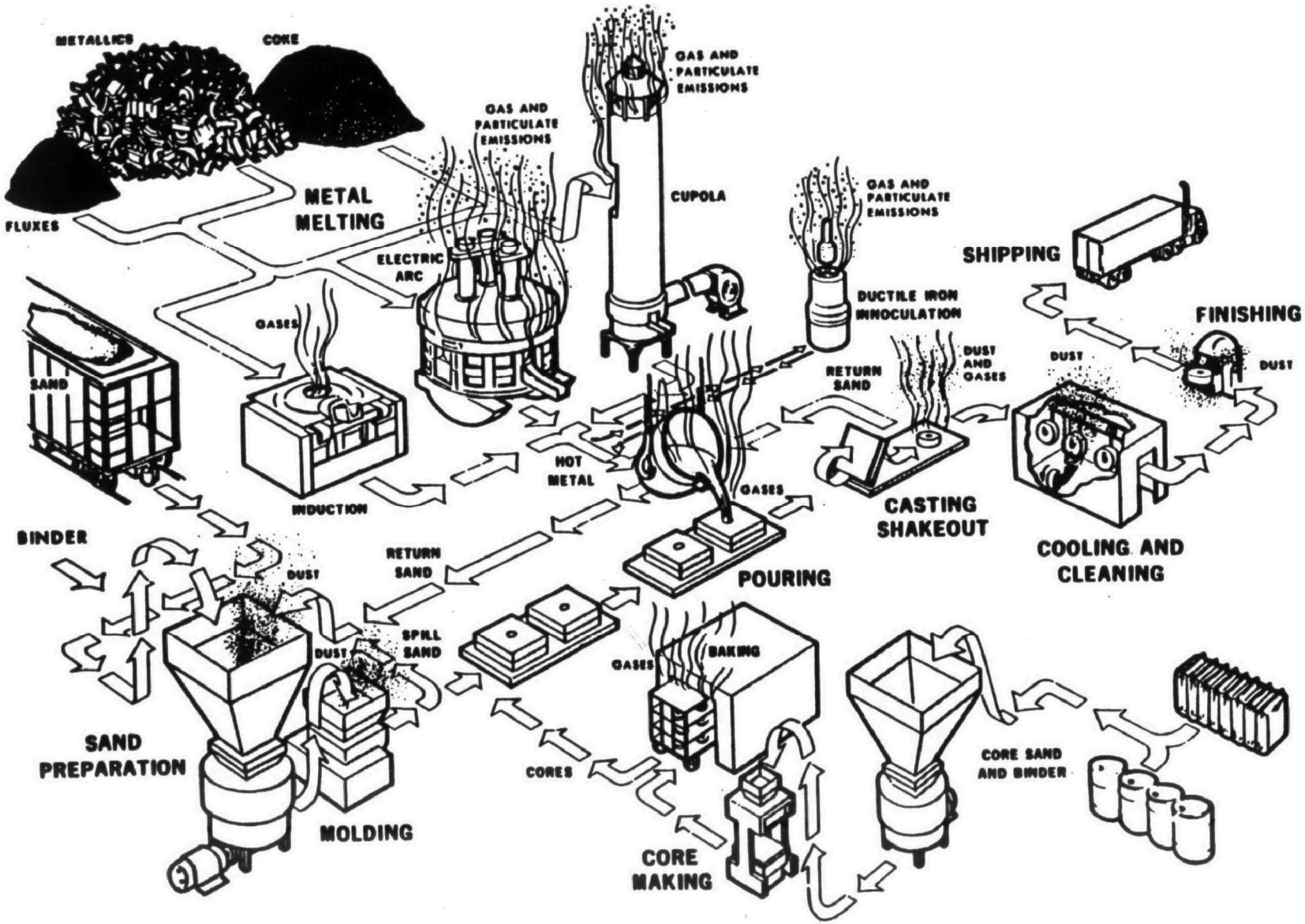

Figure 2. Emission points in a typical iron foundry.[2]

Additional heat is produced by the resistance of the metal between the arc paths. The most common method of charging an electric arc furnace is by removing the roof and introducing the raw materials directly. Alternative methods include introducing the charge through a chute cut in the roof or through a side charging door in the furnace shell. Once the melting cycle is complete, the carbon electrodes are raised, and the roof is removed. The vessel is tilted, and the molten iron is poured into a ladle. Electric arc furnace capacities range from 0.23 to 59 megagrams (0.25 to 65 tons). Nine to eleven pounds of electrode are consumed per ton of metal melted. Electric arc furnaces are becoming increasingly popular in the steel-making industry.

Electric induction furnaces are either cylindrical or cup-shaped refractory-lined vessels that are surrounded by electrical coils which, when energized with high frequency alternating current, produce a fluctuating electromagnetic field to heat the metal charge.[2] For safety reasons, the scrap metal added to the furnace charge is cleaned and heated before being introduced into the furnace. Any oil or moisture on the scrap could cause an explosion in the furnace. Induction furnaces are kept closed except during charging, skimming and tapping. The molten metal is tapped by tilting the vessel and pouring the metal through a hole in the vessel side. Induction furnaces also may be used for metal refining in conjunction with melting in other furnaces and for holding and superheating the molten metal before pouring (casting).

Reverberatory furnaces operate by radiating heat from a burner flame, furnace roof, and furnace walls onto the material heated.[3] The reverberatory furnace usually consists of a shallow, generally rectangular, refractory hearth for holding the metal charge. The furnace is enclosed by vertical side walls and covered with a low, arched, refractory-lined roof. Fuel is combusted directly above the molten bath; the walls and roof reserve radiant heat from the hot combustion products and, in turn, reradiate the heat to the surface of the bath surface.[3] Heat is transferred almost entirely by radiation.

Crucible furnaces used to melt metals with melting points below 2,500°F, are usually constructed with a shell of welded steel lined with refractory materials.[3] Their covers are constructed of materials similar to the inner shell lining; a small hole over the crucible is used for charging materials and exhausting combustion products. The

crucible, which rests on a pedestal in the center of the furnace, is commonly constructed of refractory materials such as clay-graphite mixtures or silicon carbide. Crucibles are made in several shapes and sizes for melting from 20 to 2,000 pounds.[3] Crucible furnaces are classified as tilting, pit, or stationary furnaces.

Pot furnaces are used to melt metals with a melting temperature below 1,400°F.[3] These furnaces may be cylindrical or rectangular and consist of an outer shell lined with refractory material, a combustion chamber, and a pot. The pots are made of pressed steel, cast steel, or cast iron with flanged tops.[3] The flange rests on the furnace wall, holds the pot above the furnace floor, and seals the contents of the pot from the combustion products of the fuel used.[3] The shape of the pot depends upon the operation to be conducted. Large rectangular furnaces, generally called kettles, are used to melt large amounts of metal for dipping operations, such as galvanizing.[3] For melting large castings, shallow, large-diameter pots are used. When ingots or other small pieces of metal are to be melted, deep pots are used to promote better heat transfer. Pot furnaces are usually emptied by tilting, dipping, or pumping. Combustion equipment ranges from simple atmospheric-type burners located directly below the pot to premix-type tangentially fired burners. The larger kettles are generally provided with many burners along both sides of the pot.

Open hearth furnaces may be charged with various types of iron-bearing materials 1) hot metal (pig iron) and molten steel, 2) cold steel scrap and cold pig iron, 3) all steel scrap, or 4) steel scrap and molten pig iron.[3] A luminous flame with excess air is passed over the charged materials to provide heat for the process. Combustion air is alternately preheated by regenerating units, which, in turn, are heated by the products of combustion discharging from the furnace.

Mold and core production requires the use of Section 313 chemicals. Molds are forms used to shape the exteriors of castings.[2] Cores are molded sand shapes used to make the internal voids in castings. Cores are made by mixing sand with organic binders, molding the sand into a core, and baking the core in an oven. Molds are prepared of a mixture of wet sand, clay, and organic additives to make the mold shapes, which are usually dried with hot air. Cold setting binders are being used more

frequently in both core and mold production. Used sand from castings shakeout (after metal pouring) is recycled to the sand preparation area and cleaned to remove any clay or carbonaceous buildup. The sand is then screened and reused to make new molds. Makeup sand is added to allow for process losses and discard of a certain amount of sand because of contamination.

Casting and finishing operations include molten metal pouring, mold removal and various other operations used to finish the casting. After the melting process, molten metal is tapped from the furnace. Molten iron produced in cupolas is tapped from the bottom of the furnace into a trough, into a ladle. Iron produced in electric arc and induction furnaces is poured directly into a ladle by tilting the furnace.

When castings have cooled, any unwanted appendages, such as spurs, gates, and risers, are removed. These appendages are removed with an oxygen torch, abrasive band saw, or friction cutting tools. In less-mechanized foundries, hand hammers may be used to knock off the appendages. After appendage removal the castings are subjected to abrasive blast cleaning and/or tumbling to remove any remaining mold sand or scale. The castings may also be finished for machining or grinding, and some products are degreased and painted before shipment.

SECTION 313 CHEMICALS USED IN FOUNDRIES

Section 313 chemicals commonly used in foundries can be classified into five distinct categories: metals/metal compounds, chlorinated solvents, acids, organic solvents, and other Section 313 chemicals. Each category is discussed separately in this report. Each section contains a description of how the Section 313 chemicals are used, a discussion of typical releases and off-site transfers, a table summarizing releases and off-site transfers that were reported to the Toxic Release Inventory (TRI) in 1990, a description of industry-specific and chemical-specific regulations, typical control practices, and common reporting errors. Methods for identifying nonreporting facilities and a list of questions are also presented. Appendix A presents selected information and published emission factors for iron foundries.

IRON FOUNDRIES

Each of the five categories of Section 313 chemicals will be discussed separately.

Metals and metal compounds are processed as constituents of the iron or added to form alloys to provide desired properties in the metal casting. Metal compounds may also be manufactured as byproducts in the melting process. The primary metals/metal compounds processed at iron foundries are manganese, copper, chromium, and nickel (and their compounds). Lead, zinc, aluminum (fume or dust), and cadmium (and their compounds) are processed to a lesser degree. The compounds of these metals may be manufactured as a byproduct of the process. Metal/metal compounds may also be released during finishing of the castings during grinding and other mechanical processes.

The metals/metal compounds are in the form of fume and dust and are controlled by a number of control devices. These controls vary so widely among foundries that specific controls at the foundry in question should be identified.

The metals/metal compounds may also be transferred off site for treatment or disposal or may be disposed of on site as a land release. Small quantities may be sent to water or Publicly Owned Treatment Works (POTW). Based on Section 313 reporting

for 1990, Table 2, presents a summary of Section 313 reported releases and off-site transfers of metals/metal compounds at iron foundries.

For metals/metal compounds processed in iron foundries, stack test results provide the best data for estimating air releases. If the stack tests are for total particulates, then the percentage of the metal/metal compound in the control device may be used to estimate releases of the metal/metal compound. Some plants test the captured particulates for metals for internal purposes or testing may be required if this waste is a RCRA waste. Where no stack test data are available, emission factors listed in AP-42 (Section 7.4 and 7.10) by furnace and control type[2] may be used. On-site land disposal or off-site transfers can be estimated by the volume of waste and the percentage of metal/metal compound in the waste. Releases to water or POTW may be estimated by using monitoring data or by comparison with monitoring data for a related metal/metal compound. For example, EPA Effluent Guidelines may require testing for copper, lead, or zinc for certain foundries.

Chlorinated solvents are otherwise used at iron foundries as a mold release carrier, in the degreasing of metal scrap, and in degreasing of the castings prior to or during finishing operations. Chlorinated solvents may also be present in metal cutting fluids used at iron foundries or in products used to detect cracks in castings.

The primary chlorinated solvent used at iron foundries is 1,1,1-trichloroethane. Dichloromethane, trichloroethylene, and Freon-113 are used to a much lesser degree.

When chlorinated solvents are used as a mold release carrier and in products used to detect cracks in castings, all emissions are released to air without pollution controls. Therefore, the air release is equal to solvent usage. For cutting fluids, some emissions are released to air during usage and some are transferred off site for treatment or disposal as waste cutting oil or in degreasing waste if the parts are cleaned with a chlorinated solvent.

Chlorinated solvents may also be used to degrease scrap or to clean castings prior to finishing. They may be used as a solvent wipe, in a cold degreaser, or in a vapor degreaser.

TABLE 2. SUMMARY OF REPORTED RELEASES OF METALS AND METAL COMPOUNDS FROM IRON FOUNDRIES

Section 313 Chemical	Number of facilities reporting usage[a] (% reporting usage)	Mean release, lb (% reporting to each media)[b]						
		Fugitive	Stack	Water	Land	POTW[c]	Off-site transfer	Total[d]
Manganese	96 (49)	685 (58)	6,567 (50)	303 (13)	116,972 (25)	587 (15)	47,410 (51)	63,173 (91)
Manganese compounds	23 (12)	571 (52)	2,199 (61)	729 (26)	385,550 (26)	100 (13)	182,395 (65)	242,454 (91)
Copper	76 (39)	1,996 (55)	184 (53)	48 (16)	4,181 (20)	162 (17)	3,026 (53)	4,024 (91)
Copper compounds	10 (5)	182 (60)	529 (70)	24 (40)	12,000 (10)	34 (40)	7,124 (80)	7,402 (100)
Chromium	58 (29)	1,053 (48)	267 (50)	77 (16)	19,893 (17)	150 (19)	30,599 (43)	20,885 (83)
Chromium compounds	19 (10)	1,113 (53)	593 (79)	69 (26)	280,000 (11)	49 (32)	46,878 (79)	71,324 (95)
Nickel	54 (27)	192 (52)	129 (50)	62 (9)	1,830 (15)	164 (15)	3,985 (44)	2,744 (81)
Nickel compounds	11 (6)	34 (45)	139 (63)	132 (18)	3,700 (9)	52 (27)	4,922 (73)	4,463 (91)
Lead	14 (7)	190 (50)	1197 (71)	96 (21)	e (50)	135 (14)	e (71)	e (100)
Lead compounds	13 (7)	473 (46)	860 (77)	70 (38)	34,700 (31)	93 (23)	44,678 (85)	49,410 (100)
Zinc (fume or dust)[f]	6 (3)	812 (67)	e (50)	0 (0)	e (50)	750 (17)	e (17)	e (100)
Zinc compounds	13 (7)	678 (46)	1,306 (69)	586 (31)	152,790 (23)	1,200 (8)	117,031 (69)	139,183 (85)
Aluminum (fume or dust)[f]	12 (6)	784 (33)	1,676 (67)	500 (8)	48,046 (25)	250 (17)	192,811 (8)	35,450 (83)
Cadmium	6 (3)	5 (50)	53 (83)	1 (17)	e (67)	250 (17)	67 (83)	e (100)
Molybdenum trioxide	3 (1)	250 (33)	0 (0)	250 (33)	0 (0)	0 (0)	0 (0)	250 (67)
Cobalt	2 (1)	5 (50)	5 (50)	0 (0)	0 (0)	250 (50)	1056 (50)	658 (100)
Cobalt compounds	1 (0.5)	21 (100)	58 (100)	0 (0)	0 (0)	29 (100)	9,418 (100)	9,526 (100)

[a] A total of 197 facilities in SICs 3321 and 3322 reported usage of at least one Section 313 chemical above the threshold limits.

[b] Mean release in pounds per year in 1990 for firms reporting releases of this chemical, and percentage of firms reporting usage of this chemical and releases to this media. Releases to other media were insignificant.

[c] POTW = Publicly owned treatment works.

[d] The total includes all releases and off-site transfers, not just categories summarized in this table.

[e] Mean value is not representative because of a very large value at one facility and the small number of facilities.

[f] These chemicals are produced as by-products.

In a solvent wipe, a rag or other wiper is dipped in the chlorinated solvent and wiped across the part to remove the contaminant from the casting. Cold degreasers usually consist of a tank, basket, and cover, and may employ spraying, brushing, agitation, flushing, or immersion. The solvent is usually kept near room temperature. Cold units vary greatly in size and design. The size of the degreaser is directly related to the size and number of the castings being cleaned.

A vapor degreaser consisting of a tank and heating system to boil the solvent, may be operated manually or it may be conveyorized. In this process, parts are lowered into a solvent vapor produced for cleaning. Vapors condense on the parts until the temperature of the part approaches that of the vapor, at which time the parts are removed. Most vapor degreasers are equipped with condenser coils located on the upper sidewalls of the degreaser to control the vapor level in the tank. They may also be equipped with water separators, which are simple containers in which solvent and water that condenses from the ambient air are separated. Lids are commonly closed when the degreaser is not in use.

Degreasing operations primarily produce fugitive and point-source air releases and off-site transfers for solvent recovery or disposal. In vapor degreasing, moisture from air condensing on the cooling coils of the degreaser may result in minimal releases to water or POTWs. Based on Section 313 reporting for 1990, Table 3 presents a summary of Section 313 reported releases and off-site transfers from use of chlorinated solvents at foundries.

Various controls may be used to reduce releases and off-site transfers of Section 313 chemicals from foundries. Air releases from the use of chlorinated solvents in vapor degreasing operations may be reduced by application of the following engineering controls and operation and maintenance (O&M) procedures:

Engineering controls

- Lowering the temperature of cooling water.
- Increasing freeboard height (distance between top of vapor phase and top of degreaser).
- Adding low-solvent-level detector.

TABLE 3. SUMMARY OF REPORTED RELEASES OF CHLORINATED SOLVENTS FROM IRON FOUNDRIES

Section 313 Chemical	Number of facilities reporting usage[a] (% reporting usage)	Mean release, lb (% reporting to each media)[b]				
		Fugitive	Stack	POTW[c]	Off-site transfer[d]	Total[e]
1,1,1-Trichloroethane	51 (26)	97,746 (92)	103,790 (37)	4,207 (12)	802 (20)	129,423 (100)
Dichloromethane	7 (4)	14,924 (100)	6,984 (14)	250 (29)	6,028 (14)	16,855 (100)
Trichloroethylene	6 (3)	39,553 (83)	39,076 (67)	19 (50)	7,866 (67)	64,265 (100)
Freon-113	5 (3)	1,312 (100)	36,168 (40)	414 (80)	1,077 (20)	16,326 (100)

[a] A total of 197 facilities in SICs 3321 and 3322 reported usage of at least one Section 313 chemical above the threshold limits.

[b] Mean release in pounds per year in 1990 for firms reporting releases of this chemical and percentage of firms reporting usage of this chemical and releases to this media. Releases to other media were insignificant.

[c] POTW = Publicly owned treatment works.

[d] Off-site transfer for recycling was not reportable in 1990; transfer for recycling would be significant for chlorinated solvents used in degreasing operations.

[e] The total includes all releases and off-site transfers, not just categories summarized in this table.

- Using optimum parts-handling speeds (automatic hoists).
- Adding automatic lid closure.
- Adding extra cooling coils on inlets and outlets.

O&M procedures

- Closing the cover when possible.
- Minimizing drafts.
- Positioning work to minimize dragout (solvent on part when removed from the degreaser).
- Spraying only below the vapor level.
- Avoiding excessively large loads.
- Maintaining equipment.

Waste solvent evaporation can be a major source of air release from cold cleaning. This release occurs when spent solvent is stored in open containers prior to disposal and/or from evaporation at the disposal site. This release can be minimized by covering spent solvent containers and by reclaiming solvent. Another release source, solvent bath evaporation, can be reduced through use of a cover whenever parts are not being cleaned and through adjustment of room and exhaust ventilation rates to minimize drafts. A third release source, solvent carryout, is dependent on the use of a drainage rack. Internal or external racks can be used, depending on the size of the cleaning unit. Also, drainage time must be of adequate duration to ensure that the racks are effective in reducing carryout.

Resource Conservation and Recovery Act (RCRA) wastes are those that are defined in § 261 of RCRA. Specific chlorinated solvents are identified in § 261.31 as wastes from non-specific sources or "F" wastes. F001 and F002 generic wastes as defined by the RCRA are spent solvent wastes that before use contained over 10 percent listed chlorinated solvents (including tetrachloroethylene, trichloroethylene, methylene chloride, 1,1,1-trichloroethane, carbon tetrachloride, chlorobenzene, orthodichlorobenzene, trichlorofluoromethane, and 1,1,2-trichloroethane). Off-site transfers of waste chlorinated solvents (RCRA F001 and F002 wastes) can be reduced through use of on-site solvent recovery.

For two of the chlorinated solvents used in foundries (1,1,1-trichloroethane and Freon-113), use is expected to drop significantly as a result of EPA environmental regulations to reduce ozone depletion. These regulations will eventually phase out the use of these solvents entirely and will result in increased control of air releases, substitution, and use of solvent recovery due to rising solvent costs. Although terpenes, aqueous cleaning and semi-aqueous cleaning are being substituted in may uses for chlorinated solvents, the probable substitutes in the foundry industry are not well defined.

For chlorinated solvents used in degreasing, a mass balance (addressing primarily air release and off-site transfer of waste solvent) that accounts for the total throughput of the solvent is the best methodology for estimating release and off-site transfer. Prior to the 1991 reporting year (to be submitted by July 1, 1992), this approach was difficult using the Section 313 reporting quantities because off-site transfer for recycling of the chlorinated solvents was not reportable. Beginning with the submittals for the 1991 reporting year, a mass balance will be possible for all reportable quantities once the throughput has been obtained from the facility as all releases and off-site transfers are now reportable. A common error in reporting has been the use of the total quantity of waste solvent sent off site (i.e., that reportable under RCRA as F001 and F002 wastes) as the quantity of chlorinated solvent sent off site. Since the chlorinated solvent represents only a portion of the waste, the mass balance underestimates the air release of the chlorinated solvent. Although Section 313 reporting does not require the facility to take any measurements, the facility usually can contact the solvent reclaimer to obtain the percentage of chlorinated solvent in the waste solvent. If the percentage of chlorinated solvent represents only a portion of the waste, it is the appropriate quantity to use in a mass balance.

Acids are otherwise used in a wide variety of ways at foundries. Sulfuric and phosphoric acids are the primary acids used at iron foundries with hydrochloric and nitric used to a much lesser extent. Sulfuric acid may be used in wastewater treatment and as a constituent of scrubber water. Phosphoric acid may be present in mold or refractory materials or used in phosphating of parts during finishing processes. Hydrochloric acid may be used to clean the cupola shell or in metal precipitation during wastewater

treatment. Acids are primarily released through off-site transfer of spent acid. Some of the more volatile acids are released to air and some are released to water if the stream is not neutralized. Table 4 presents a summary of reported releases and off-site transfers of acids from iron foundries. Acid releases are primarily controlled through neutralization. For acid use, a release to water is not reportable if the pH is 6 or higher; however, a facility cannot just assume neutralization. Typically, pH monitoring data for other regulations is (and should be) retained by the facility. This data can be used to calculate water releases if excursions below pH 6.

Organic solvents are primarily otherwise used as solvents in paints and coatings in the finishing of parts formed at iron foundries. For all organic solvents virtually all release occurs to air. Minor quantities may be transferred off site in paint wastes or to POTW if a water curtain is used as a control/collection measure for spray mist. A mass balance may be calculated with almost all of the usage released as an air waste. Table 5 presents a summary of reported releases and off-site transfers of organic solvents from iron foundries.

Other Section 313 chemicals have three primary uses at iron foundries.

Phenol, methylenebis (phenylisocyanate) formaldehyde, and ammonium nitrate (solution) are otherwise used in core making at iron foundries. They are constituents in the binder used to form the molds. Both organic binders and cross-linked organic polymers may be used as core binders.[4] The cross-linked organic polymers undergo thermal decomposition when exposed to the very high temperatures of casting (typically 1400°C for iron casting).[4] At these temperatures it is likely that pyrolysis of the chemical binder will produce a complex of free radicals which may recombine to form a wide range of chemical compounds.[4] Each chemical binder system gives rise to a number of different thermal decomposition products.[4]

Releases to air can occur during the core making process. Releases to land or off-site transfers can occur during disposal of molding materials. Minor quantities may be released to water or a POTW.

Ethylene glycol is otherwise used in hydraulic fluids in iron foundries. Releases and off-site transfers of this chemical can occur when the hydraulic fluid is changed or

TABLE 4. SUMMARY OF REPORTED RELEASES OF ACIDS FROM IRON FOUNDRIES

Section 313 Chemical	Number of facilities reporting usage[a] (% reporting usage)	Mean release, lb (% reporting to each media)[b]						
		Fugitive	Stack	Water	Land	POTW[c]	Off-site transfer	Total[d]
Sulfuric acid	30 (15)	e (28)	e (20)	0 (0)	0 (0)	5 (3)	34,034 (27)	17,290 (57)
Phosphoric acid	23 (12)	1,385 (35)	5 (9)	0 (0)	20,133 (13)	202 (22)	46,330 (22)	21,725 (61)
Hydrochloric acid	7 (4)	3,300 (4)	188 (57)	0 (0)	0 (0)	0 (0)	36,000 (14)	10,013 (57)
Nitric acid	1 (0.5)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	14,688 (100)	14,688 (100)

[a] A total of 197 facilities in SICs 3321 and 3322 reported usage of at least one Section 313 chemical above the threshold limits.

[b] Mean release in pounds per year in 1990 for firms reporting releases of this chemical, and percentage of firms reporting usage of this chemical and releases to this media. Releases to other media were insignificant.

[c] POTW = Publicly owned treatment works.

[d] The total includes all releases and off-site transfers, not just categories summarized in this table.

[e] Mean value is not representative because of one high value that may be in error. Air releases would be low because of low vapor pressure of sulfuric acid (VP <0.001 mmHg).

TABLE 5. SUMMARY OF REPORTED RELEASES OF ORGANIC SOLVENTS FROM IRON FOUNDRIES

Section 313 Chemical	Number of facilities reporting usage[a] (% reporting usage)	Mean release, lb (% reporting to each media)[b]					
		Fugitive	Stack	Water	POTW[c]	Off-site transfer[d]	Total[e]
Methanol	30 (15)	33,735 (90)	46,288 (30)	6 (13)	167 (10)	1,458 (30)	46,244 (97)
Xylene (mixed isomers)	25 (13)	35,843 (96)	22,422 (44)	0 (0)	17 (4)	2,397 (12)	44,563 (100)
Toluene	12 (6)	20,847 (100)	23,072 (42)	0 (0)	0 (0)	925 (25)	30,691 (100)
Glycol ethers	8 (4)	3,410 (63)	8,672 (63)	128 (50)	294 (50)	f (25)	f (100)
Methyl ethyl ketone	2 (1)	1,776 (100)	0 (0)	0 (0)	0 (0)	8,117 (50)	5,834 (100)

[a] A total of 197 facilities in SICs 3321 and 3322 reported usage of at least one Section 313 chemical above the threshold limits.

[b] Mean release in pounds per year in 1990 for firms reporting releases of this chemical and percentage of firms reporting usage of this chemical reporting releases to this media. Releases to other media were insignificant.

[c] POTW = Publicly owned treatment works.

[d] Off-site transfer for recycling or fuel blending was not reportable in 1990; transfer offsite of purge or cleanup solvent for these purposes will be reportable in 1991.

[e] The total includes all releases to and off-site transfers, not just categories summarized in this table.

[f] Mean value is not representative because of one high value.

when equipment leaks. If the leak is not cleaned up, then release may be to air. If leaks are flushed down the sewer, then releases may be to water or a POTW. Beginning in reporting year 1991, ethylene glycol in hydraulic fluid transferred offsite for fuel blending will be reportable under Section 313 and off-site transfers may increase from previous years.

Diethanolamine is otherwise used as a product constituent to detect cracks in castings at some iron foundries. Reported releases include fugitive air POTW and off-site transfers. No controls are typically used for any of these otherwise used chemicals.

Table 6 presents a summary of reported releases and off-site transfers of other chemicals at iron foundries. It should be noted that some foundries reported the use of isopropyl alcohol. Since this chemical is only reportable if it is manufactured at a facility using a strong acid process, it should not have been reported by the iron foundries and therefore is a mistake. Also, some facilities reported aluminum oxide (fibrous form). It is unlikely but possible that over 25,000 lb of aluminum oxide (fibrous form) would have been processed or otherwise used. Aluminum oxide is used on grinding wheels, sanding cones and in refractory bricks but not in the fibrous form.

TABLE 6. SUMMARY OF REPORTED RELEASES OF OTHER CHEMICALS FROM IRON FOUNDRIES

Section 313 Chemical	Use	Number of facilities reporting usage[a] (% reporting usage)	Mean release, lb (% reporting to each media)[b]						
			Fugitive	Stack	Water	Land	POTW[c]	Off-site transfer	Total[d]
Phenol	Core-making	60 (30)	20,064 (77)	5,912 (53)	136 (23)	5,762 (15)	172 (20)	5,914 (62)	23,505 (98)
Methylenebis (phenylisocyanate)	Core-making	32 (16)	3,931 (72)	5,530 (44)	15 (3)	36,046 (18)	1,503 (8)	14,456 (53)	20,416 (97)
Formaldehyde	Core-making	21 (11)	5,523 (95)	10,166 (38)	1 (5)	29,200 (10)	1,381 (24)	2,509 (48)	13,437 (100)
Ammonium nitrate (solution)	Core-making	6 (3)	e (33)	e (33)	34,000 (17)	24,000 (17)	1,780 (33)	16,967 (66)	26,339 (83)
Ethylene glycol	Hydraulic fluid	8 (4)	5,885 (50)	1,225 (25)	854 (25)	11,000 (13)	3,954 (38)	7,821 (50)	11,692 (88)
Diethanolamine	Casting finishing	4 (2)	300 (25)	0 (0)	0 (0)	0 (0)	5,971 (75)	41,019 (25)	14,808 (100)

[a] A total of 197 facilities in SICs 3321 and 3322 reported usage of at least one Section 313 chemical above the threshold limits.

[b] Mean release in pounds per year in 1990 for firms reporting releases of this chemical and percentage of firms reporting usage of this chemical and releases to this media. Releases to other media were insignificant.

[c] POTW = Publicly owned treatment works.

[d] The total includes all releases and off-site transfers, not just categories summarized in this table.

[e] Although two firms reported air releases of ammonium nitrate (solution), air releases for this chemical should be zero.

STEEL FOUNDRIES

Steel foundries produce steel castings through melting, alloying, and molding of pig iron and steel scrap. The process flow diagram of a typical steel foundry is presented in Figure 3. The major processing operations of a typical steel foundry are raw materials handling, metal melting, mold and core production, and casting and finishing.[2]

Raw materials used by steel foundries include pig iron, iron and steel scrap, foundry returns, metal turnings, alloys, carbon additives, fluxes (limestone, soda ash, fluorspar, calcium carbide), sand, sand additives, and binders. These raw materials are received in ships, railcars, trucks, and containers and are transferred by trucks, loaders, and conveyors to both open pile and enclosed storage areas.[2]

Generally, the first step in the metal melting operations is scrap preparation. Since scrap is normally purchased in the proper size for furnace feed, preparation primarily consists of scrap degreasing. This step is very important for electric induction furnaces, as organics on scrap can be explosive. Scrap may be degreased with solvents, by centrifugation, or by incinerator or preheater combustion. After preparation, the scrap, metal, alloy, and flux are weighed and charged to the furnace.[2]

Electric arc furnaces (EAF's) are used almost exclusively in the steel foundry for melting and formulating steel. EAF's are charged with raw materials by removal of the lid, through a chute opening in the lid, or through a door in the side. The molten metal is tapped by tilting the furnace and pouring the contents through a hole in the side. Melting capacity ranges up to 10 megagrams (11 tons) per hour.[2] EAF's generate a dust of metallic oxides containing the volatile metals present in the charge (e.g., Zn, Pb, Cd, Cr, and Mn).

A second, less common, furnace used in steel foundries is the open hearth furnace--a very large, shallow refractory-lined vessel operated in a batch manner. The open hearth furnace is fired at alternate ends by using heat from the waste combustion gases to heat incoming combustion air.[2] Aluminum oxide is used in refractory bricks but not in the fibrous form.

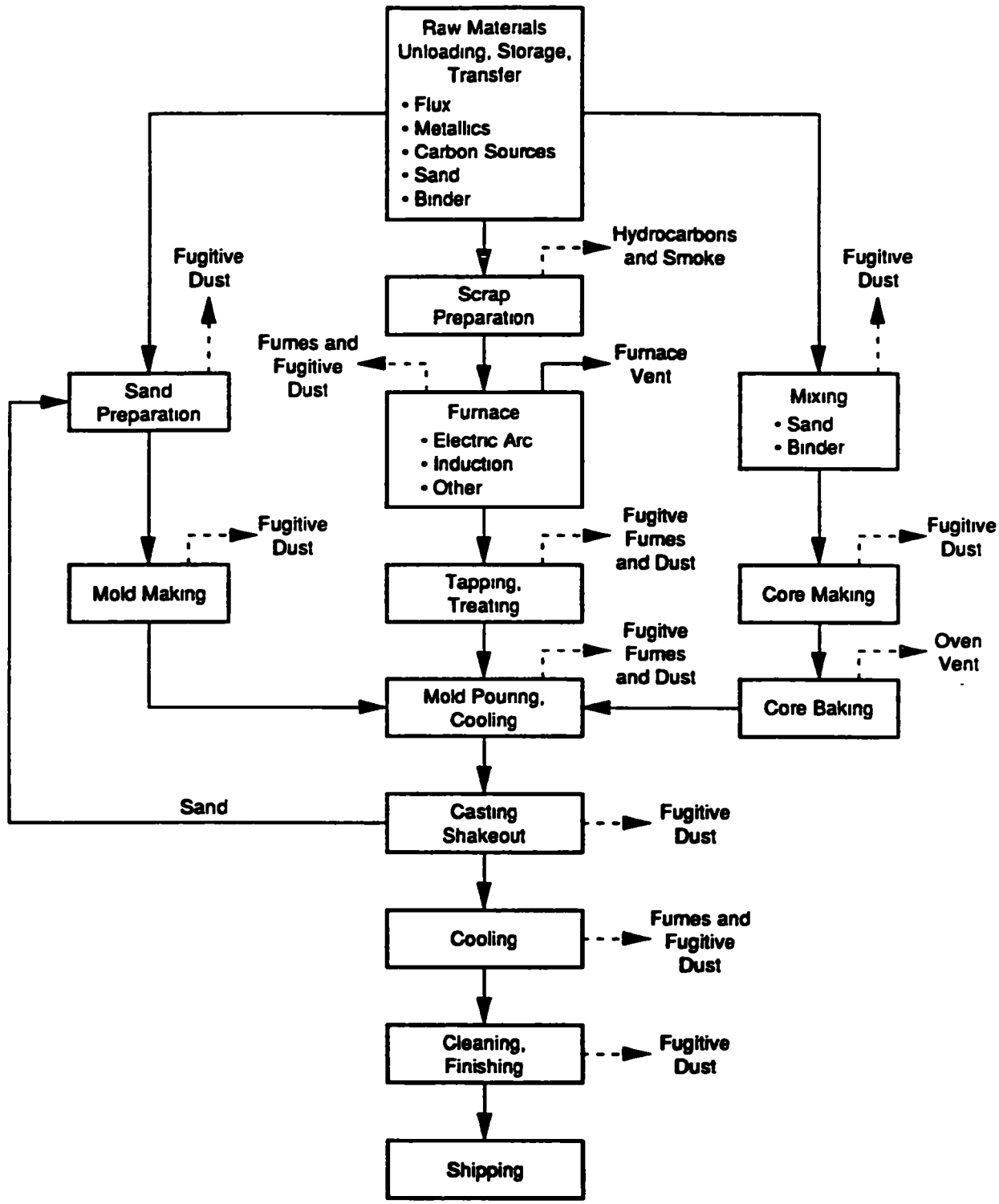

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Figure 3
Typical flow diagram of a steel foundry.[2]

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A third furnace used in the steel foundry is the induction furnace. Induction furnaces are vertical, refractory-lined cylinders surrounded by electrical coils energized with alternating current. The resulting fluctuating magnetic field heats the metal. Induction furnaces are kept closed except when charging, skimming, and tapping. The molten metal is tapped by tilting the container and pouring the metal through a hole in the side of the container.[2]

The basic melting process operations are 1) furnace charging, in which metal, scrap, alloys, carbon, and flux are added to the furnace; 2) melting, during which the furnace remains closed; 3) backcharging, which is the addition of more metal and possible alloys; 4) refining, during which the carbon content is adjusted; 5) oxygen lancing, which is the injection of oxygen into molten steel to dislodge slag and to adjust the chemistry of the metal; 6) slag removal; and 7) tapping the molten metal into a ladle or directly into molds.[2]

Sand containing organic binders is molded into a core and baked in an oven. When the melting process is complete, molten metal is tapped and poured into a ladle. At this time, molten metal may be treated by adding alloys and/or other chemicals. Treated metal is then poured into a mold and allowed to partially cool under carefully controlled conditions.[2] When partially cooled, the castings are placed on a vibrating grid, and the sand in the mold and core are shaken away from the casting.[2]

The same five categories of Section 313 chemicals are used as were used for iron foundries.

Metals and metal compounds are processed as constituents of the steel or added to form alloys to provide desired properties in the metal casting. Metal compounds may be manufactured as a byproduct of the process. The metal/metal compounds are processed in different proportions than for iron; chromium, nickel, manganese, and copper are processed most often, but cobalt and molybdenum trioxide also processed. Aluminum (fume or dust) is manufactured as a byproduct. Lead and zinc are processed at a few steel foundries.

Table 7 presents a summary of Section 313 reported releases and off-site transfers of metals/metal compounds at steel foundries. Releases may be calculated by similar

TABLE 7. SUMMARY OF REPORTED RELEASES OF METALS AND METAL COMPOUNDS FROM STEEL FOUNDRIES

Section 313 Chemical	Number of facilities reporting usage[a] (% reporting usage)	Mean release, lb (% reporting to each media)[b]						
		Fugitive	Stack	Water	Land	POTW[c]	Off-site transfer	Total[d]
Chromium	92 (69)	455 (93)	230 (68)	275 (10)	38,598 (14)	159 (16)	28,129 (64)	25,109 (96)
Chromium compounds	30 (22)	318 (63)	291 (63)	56 (17)	100,696 (20)	100 (20)	40,730 (53)	43,735 (97)
Nickel	77 (57)	224 (69)	171 (57)	66 (5)	3,219 (12)	122 (19)	8,018 (66)	6,293 (95)
Nickel compounds	19 (14)	62 (63)	126 (63)	88 (16)	0 (0)	22 (16)	3,721 (58)	2,418 (95)
Manganese	67 (50)	e (71)	575 (75)	155 (10)	403,969 (19)	100 (16)	82,297 (67)	114,852 (94)
Manganese compounds	18 (13)	1,021 (72)	254 (72)	360 (17)	90 (6)	39 (22)	200,754 (72)	164,231 (89)
Copper	30 (22)	131 (73)	87 (53)	176 (10)	260 (7)	91 (40)	6,329 (57)	3,931 (97)
Copper compounds	6 (4)	e (67)	e (67)	1 (17)	0 (0)	250 (17)	1,088 (50)	2,260 (100)
Cobalt	12 (9)	61 (75)	39 (58)	250 (8)	0 (0)	87 (67)	10,814 (83)	9,158 (100)
Cobalt compounds	8 (6)	48 (75)	196 (50)	0 (0)	0 (0)	29 (13)	3,488 (38)	1,652 (88)
Molybdenum trioxide	13 (10)	67 (62)	145 (8)	168 (23)	750 (8)	128 (15)	1,196 (71)	1,288 (92)
Aluminum (fume or dust)[f]	13 (10)	94 (46)	995 (54)	0 (0)	19,618 (15)	78 (31)	7,931 (62)	8,460 (100)
Lead	3 (2)	168 (100)	128 (67)	5 (33)	0 (0)	128 (67)	875 (67)	923 (100)
Lead compounds	4 (3)	1700 (25)	250 (25)	250 (25)	0 (0)	25 (50)	e (75)	e (75)
Zinc (fume or dust)[f]	4 (3)	87 (25)	103 (50)	0 (0)	0 (0)	250 (25)	2,947 (50)	1,609 (100)
Zinc compounds	2 (1)	1 (50)	0 (0)	0 (0)	0 (0)	1 (50)	0 (0)	2 (50)

[a] A total of 134 facilities in SICs 3324 and 3325 reported usage of at least one Section 313 chemical above the threshold limits.

[b] Mean release in pounds per year in 1990 for firms reporting releases of this chemical, and percentage of firms reporting usage of this chemical and releases to this media. Releases to other media were insignificant.

[c] POTW = Publicly owned treatment works.

[d] The total includes all releases and off-site transfers, not just categories summarized in this table.

[e] Mean value is not representative because of a very large value at one facility and the small number of facilities.

[f] These chemicals are produced as by-products.

methods described for iron foundries with the exception that AP-42 Section 7.13 should be used to determine emission factors.

Chlorinated solvents have the same uses as the ones described in iron foundries. Table 8 presents a summary of Section 313 reported releases and off-site transfers of chlorinated solvents at steel foundries.

Acids are otherwise used for the same uses described in iron foundries. Table 9 presents a summary of reported releases and off-site transfers of acids from steel foundries.

Organic solvents are otherwise used for the same uses described in iron foundries. Table 10 presents a summary of reported releases and off-site transfers of other solvents from steel foundries.

Other chemicals have two uses at steel foundries: core making and hydraulic fluid. These uses are described in the iron foundries section. Table 11 presents a summary of reported releases and off-site transfers of other chemicals from steel foundries. If heating is done with other than electric or natural gas, any TRI chemicals in the fuels should also be considered in threshold and release calculations.

TABLE 8. SUMMARY OF REPORTED RELEASES OF CHLORINATED SOLVENTS FROM STEEL FOUNDRIES

Section 313 Chemical	Number of facilities[a] reporting usage (% reporting usage)	Mean release, lb (% reporting to each media)[b]					
		Fugitive	Stack	Water	POTW[c]	Off-site transfer[d]	Total[e]
1,1,1-Trichloroethane	24 (18)	29,886 (96)	20,736 (29)	11 (6)	0 (0)	9,249 (25)	37,001 (100)
Freon-113	14 (10)	21,669 (86)	36,910 (29)	0 (0)	1,154 (7)	2,249 (29)	32,140 (93)
Dichloromethane	3 (2)	40,550 (100)	24,514 (33)	0 (0)	0 (0)	0 (0)	48,721 (100)
Trichloroethylene	2 (2)	39 (50)	113,335 (50)	0 (0)	7 (50)	29,179 (50)	127,947 (100)
Tetrachloroethylene	2 (2)	13,848 (100)	0 (0)	0 (0)	0 (0)	1,502 (50)	14,598 (100)

[a] A total of 134 facilities in SICs 3324 and 3325 reported usage of at least one Section 313 chemical above the threshold limits.

[b] Mean release in pounds per year in 1990 for firms reporting releases of this chemical, and percentage of firms reporting usage of this chemical and releases to this media. Releases to other media were insignificant.

[c] POTW = Publicly owned treatment works.

[d] Off-site transfer for recycling was not reportable in 1990; transfer for recycling would be significant for chlorinated solvents used in degreasing operations.

[e] The total includes all releases and off-site transfers, not just categories summarized in this table.

TABLE 9. SUMMARY OF REPORTED RELEASES OF ACIDS FROM STEEL FOUNDRIES

Section 313 Chemical	Number of facilities reporting usage[a] (% reporting usage)	Mean release, lb (% reporting to each media)[b]						
		Fugitive	Stack	Water	Land	POTW[c]	Off-site transfer	Total[d]
Sulfuric acid	12 (9)	128 (17)	128 (17)	0 (0)	0 (0)	0 (0)	21,865 (17)	7,373 (50)
Hydrochloric acid	6 (4)	87 (50)	128 (33)	0 (0)	0 (0)	0 (0)	72,751 (33)	36,505 (67)
Phosphoric acid	5 (4)	128 (40)	553 (40)	5 (25)	5 (20)	250 (20)	21,914 (60)	22,452 (60)
Nitric acid	2 (1)	5 (50)	5 (50)	0 (0)	0 (0)	5 (50)	16,844 (100)	16,852 (100)

[a] A total of 134 facilities in SICs 3324 and 3325 reported usage of at least one Section 313 chemical above the threshold limits.

[b] Mean release in pounds per year in 1990 for firms reporting releases of this chemical, and percentage of firms reporting usage of this chemical and releases to this media. Releases to other media were insignificant.

[c] POTW = Publicly owned treatment works.

[d] The total includes all releases and off-site transfers, not just categories summarized in this table.

TABLE 10. SUMMARY OF REPORTED RELEASES OF ORGANIC SOLVENTS FROM STEEL FOUNDRIES

Section 313 Chemical	Number of facilities[a] reporting usage (% reporting usage)	Mean release, lb (% reporting to each media)[b]					
		Fugitive	Stack	Water	POTW[c]	Off-site transfer[d]	Total[e]
Methanol	9 (7)	66,688 (100)	128 (22)	0 (0)	0 (0)	15,836 (11)	70,236 (100)
Xylene (mixed isomers)	4 (3)	67,277 (100)	15,230 (50)	250 (33)	250 (25)	250 (25)	75,142 (100)
Toluene	3 (2)	1,822 (100)	3,498 (67)	250 (50)	250 (33)	625 (67)	4,737 (100)
Methyl ethyl ketone	2 (1)	27,705 (100)	5,698 (50)	0 (0)	0 (0)	0 (0)	30,554 (100)

[a] A total of 134 facilities in SICs 3324 and 3325 reported usage of at least one Section 313 chemical above the threshold limits.

[b] Mean release in pounds per year in 1990 for firms reporting releases of this chemical, and percentage of firms reporting usage of this chemical releases to this media. Releases to other media were insignificant.

[c] POTW = Publicly owned treatment works.

[d] Off-site transfer for recycling or fuel blending was not reportable in 1990; transfer offsite of purge or cleaning solvent for these purposes will be reported in 1991.

[e] The total includes all releases and off-site transfers, not just categories summarized in this table.

TABLE 11. SUMMARY OF REPORTED RELEASES OF OTHER CHEMICALS FROM STEEL FOUNDRIES

Section 313 Chemical	Use	Number of facilities reporting usage (% reporting usage)[a]	Mean release, lb (% reporting to each media)[b]						
			Fugitive	Stack	Water	Land	POTW[c]	Off-site transfer	Total[d]
Phenol	Core-making	23 (17)	9,115 (91)	2,134 (52)	214 (18)	3,407 (22)	250 (9)	4,940 (91)	12,803 (100)
Methylenebis (phenyl isocyanate)	Core-making	7 (5)	10,185 (86)	250 (14)	0 (0)	0 (0)	0 (0)	963 (57)	19,868 (86)
Formaldehyde	Core-making	4 (3)	15,983 (75)	2,735 (75)	0 (0)	2,800 (25)	750 (25)	1,000 (25)	15,176 (100)
Ethylene glycol	Hydraulic fluid	7 (5)	9,703 (71)	0 (0)	0 (0)	0 (0)	60,000 (14)	19,000 (14)	21,553 (86)

[a] A total of 134 facilities in SICs 3324 and 3325 reported usage of at least one Section 313 chemical above the threshold limits.

[b] Mean release in pounds per year in 1990 for firms reporting releases of this chemical, and percentage of firms reporting usage of this chemical releases to this media. Releases to other media were insignificant.

[c] POTW = Publicly owned treatment works.

[d] The total includes all releases and off-site transfers, not just categories summarized in this table.

ALUMINUM FOUNDRIES

Secondary aluminum melting is essentially the process of remelting aluminum, but the term encompasses the following additional practices.[3]

- Fluxing. This term is applied to any process in which materials are added to the melt to aid in removal of gases, oxides, or other impurities, but which do not remain in the final product.

- Alloying. This term is applied to any process in which materials are added to give desired properties to the product and which become part of the final product.

- Degassing. This includes any process used to reduce or eliminate dissolved gases.

- "Demagging." This includes any process used to reduce the magnesium content of the alloy.

These terms are often used vaguely and overlap to a great extent. For example, degassing and demagging are usually accomplished by means of fluxes. The use of zinc chloride and zinc fluoride fluxes increases the zinc content of aluminum alloys.[3]

Aluminum for secondary melting comes from three main sources:

- Aluminum pigs. These may be primary metal but may also be secondary aluminum produced by a large secondary smelter to meet standard alloy specifications.

- Foundry returns. These include gates, risers, runners, spruces, and rejected castings. In foundries producing sand mold castings, foundry returns may amount to 40 to 60 percent of the metal poured.

- Scrap. This category includes aluminum contaminated with oil, grease, paint, rubber, plastics, and other metals such as iron, magnesium, zinc, and brass.

The melting of clean aluminum pigs and foundry returns without the use of fluxes does not result in the discharge of significant quantities of air contaminants. The melting of aluminum scrap, however, frequently requires air pollution control equipment to prevent the discharge of excessive air contaminants.[3]

Crucible or pot-type furnaces are used extensively to melt small quantities (up to 1,000 pounds) of aluminum. Almost all crucibles are made of silicon carbide or similar refractory material. Small crucibles are lifted out of the furnace and used as ladles to pour molds. The larger crucibles are usually used with tilting-type furnaces. For die casting, molten metal is ladled out with a small hand ladle or it can be fed automatically to the die-casting machine.[3]

The reverberatory furnace is commonly used for medium- and large-capacity heating operations. Small reverberatory furnaces up to approximately 3,000-pound capacity may be of the tilting type. Sometimes a double-hearth construction is employed in furnaces of 1,000- to 3,000-pound holding capacity.[3]

Reverberatory furnaces of 20- to 50-ton holding capacity are common. Usually one heat is produced in a 24-hour period; however, the time required per heat in different shops varies from 4 hours to as much as 72 hours.[3]

Electric induction furnaces are becoming increasingly common for both melting and holding aluminum in spite of higher installation and operating costs. Some of the advantages they offer over other furnaces are higher efficiency, closer temperature control, no contaminants from products of combustion, less oxidation, and improved homogeneity of metal. Electric resistance heating is sometimes used for holding but rarely for melting furnaces. Most electric furnaces for aluminum melting are relatively small, although some holding furnaces have capacities up to about 15 tons.[3]

The types of fluxing generally fall into four main categories:

- Cover fluxes. These fluxes are used to cover a metal surface to prevent further oxidation and are usually liquid at the melting point of aluminum. Some of these are also effective in preventing gas absorption.

- Solvent fluxes. These fluxes generally cause impurities and oxides to float on top of the melt in the form of a dross that can be easily skimmed off.

- Degassing fluxes. These fluxes are used to purge the melt of dissolvent gases. The dissolved gas is assumed to be hydrogen, but other gases are also highly soluble in aluminum. The solubility of gases in molten aluminum increases with temperature. The gases most soluble in molten aluminum, in decreasing order of solubility, are hydrogen, methane, carbon

dioxide, sulfur dioxide, oxygen, air, and carbon monoxide. The solubility of hydrogen is 6 to 7 times as great as that of methane and over 10 times that of carbon dioxide. Elimination of hydrogen gas in aluminum is a major problem.

- Magnesium-reducing fluxes. These fluxes are used to reduce magnesium content of the alloy (known as demagging).

The quantity and type of fluxing depend on the type of furnace, materials being melted, and specifications of the final product. Chlorine gas, used for reducing the magnesium content of the alloy (demagging) is easier to regulate than fluxes used for that purpose.[3]

Only four of the five categories of Section 313 chemicals that were used for iron foundries are used at aluminum foundries. No organic solvents are used at aluminum foundries because aluminum castings are not typically painted or coated.

Metals and metal compounds are processed as constituents of the aluminum or added to form alloys to provide desired properties in aluminum casting. Metal compounds and aluminum (fume or dust) may be formed as a by-product of the process. The metal/metal compounds processed are different than those at iron and steel foundries. Copper, zinc, and nickel are the primary metals processed with manganese, lead, and chromium processed to a lesser extent.

TRI reported releases to air are similar to those for iron and steel foundries; however, TRI reported releases to land and off-site transfers are lower for aluminum foundries than for iron and steel foundries. Table 12 presents a summary of Section 313 reported releases of metal/ metal compounds at aluminum foundries. Releases may be calculated by similar methods described for iron foundries with the exception that AP-42 Section 7.8 should be used for emission factors.

Chlorinated solvents are otherwise used for the same uses described in iron foundries. Table 13 presents a summary of Section 313 reported releases and off-site transfers of chlorinated solvents at aluminum foundries.

TABLE 12. SUMMARY OF REPORTED RELEASES OF METALS AND METAL COMPOUNDS FROM ALUMINUM FOUNDRIES

Section 313 Chemical	Number of facilities reporting usage[a] (% reporting usage)	Mean release, lb (% reporting to each media)[b]						
		Fugitive	Stack	Water	Land	POTW[c]	Off-site transfer	Total[d]
Copper	93 (62)	856 (56)	341 (59)	137 (6)	308 (8)	92 (18)	1,070 (38)	1.305 (87)
Copper compounds	15 (10)	162 (33)	722 (53)	5 (7)	5 (7)	569 (40)	899 (47)	1,165 (93)
Aluminum (fume or dust)[e]	46 (31)	4,462 (56)	9,403 (78)	1,226 (11)	7,306 (17)	254 (22)	59,542 (43)	38,921 (96)
Zinc (fume or dust)[e]	18 (12)	662 (56)	1,316 (78)	0 (0)	250 (6)	4 (17)	4,739 (28)	2,883 (94)
Zinc compounds	15 (10)	110 (47)	345 (67)	69 (27)	5 (7)	302 (60)	380 (73)	760 (100)
Nickel	20 (13)	171 (60)	228 (45)	250 (5)	250 (5)	64 (20)	825 (35)	591 (90)
Nickel compounds	3 (2)	5 (33)	168 (100)	250 (1)	0 (0)	0 (0)	750 (33)	503 (100)
Manganese	13 (9)	450 (62)	131 (62)	50 (8)	625 (15)	123 (15)	649 (38)	726 (100)
Manganese compounds	3 (2)	250 (33)	250 (67)	0 (0)	0 (0)	489 (33)	398 (67)	845 (100)
Lead	11 (7)	479 (64)	254 (73)	0 (0)	0 (0)	250 (9)	544 (45)	836 (91)
Chromium	5 (3)	18 (60)	128 (40)	26 (40)	0 (0)	7 (20)	135 (40)	127 (100)
Chromium compounds	3 (2)	1225 (66)	2,200 (33)	0 (0)	f (33)	126 (33)	45 (33)	f (100)

[a] A total of 149 facilities in SICs 3363 and 3365 reported usage of at least one Section 313 chemical above the threshold limits.

[b] Mean release in pounds per year in 1990 for firms reporting releases of this chemical, and percentage of firms reporting usage of this chemical and releases to this media. Releases to other media were insignificant.

[c] POTW = Publicly owned treatment works.

[d] The total includes all releases and off-site transfers, not just categories summarized in this table.

[e] These chemicals are produced as by-products.

[f] Mean value is not representative because of a very large value at one facility and the small number of facilities.

TABLE 13. SUMMARY OF REPORTED RELEASES OF CHLORINATED SOLVENTS FROM ALUMINUM FOUNDRIES

Section 313 Chemical	Number of facilities reporting usage[a] (% reporting usage)	Mean release, lb (% reporting to each media)[b]					
		Fugitive	Stack	Water	POTW[c]	Off-site transfer[d]	Total[e]
1,1,1-Trichloroethane	13 (9)	14,950 (92)	17,375 (31)	0 (0)	5 (8)	250 (8)	19,166 (100)
Trichloroethylene	6 (4)	9,431 (83)	35,782 (83)	223 (25)	5 (17)	7,976 (83)	44,362 (100)
Dichloromethane	5 (3)	9,611 (100)	16,680 (40)	0 (0)	0 (0)	3,775 (60)	18,548 (100)
Freon-113	4 (3)	13,559 (100)	16,142 (25)	0 (0)	0 (0)	1,680 (50)	18,435 (100)
Tetrachloroethylene	3 (2)	2,875 (67)	25,667 (100)	0 (0)	0 (0)	0 (0)	27,583 (100)

[a] A total of 149 facilities in SICs 3363 and 3365 reported usage of at least one Section 313 chemical above the threshold limits.

[b] Mean release in pounds per year in 1990 for firms reporting releases of this chemical, and percentage of firms reporting usage of this chemical and releases to this media. Releases to other media were insignificant.

[c] POTW = Publicly owned treatment works.

[d] Off-site transfer for recycling was not reportable in 1990; transfer for recycling would be significant for chlorinated solvents used in degreasing operations.

[e] The total includes all releases and off-site transfers, not just categories summarized in this table.

Acids are otherwise used for the uses described in iron foundries. Table 14 presents a summary of reported releases and off-site transfers of acids from aluminum foundries.

Other chemicals are also used at aluminum foundries. As in iron steel foundry use, phenol and methylenebis (phenylisocyanate) are used in core making, diethanolamine is used in a product to detect cracks in castings, and ethylene glycol is used as a hydraulic fluid. Unlike iron and steel, foundry use, chlorine is used in degassing at aluminum foundries. Table 15 presents a summary of reported releases and off-site transfers of other chemicals at aluminum foundries.

TABLE 14. SUMMARY OF REPORTED RELEASES OF ACIDS FROM ALUMINUM FOUNDRIES

Section 313 Chemical	Number of facilities reporting usage[a] (% reporting usage)	Mean release, lb (% reporting to each media)[b]						
		Fugitive	Stack	Water	Land	POTW[c]	Off-site transfer	Total[d]
Sulfuric acid	20 (13)	270 (50)	159 (40)	250 (8)	0 (0)	500 (10)	28,048 (10)	4,717 (65
Hydrochloric acid	11 (7)	314 (73)	8,500 (9)	5 (14)	750 (18)	0 (0)	0 (0)	1,391 (82)
Nitric acid	4 (3)	338 (75)	376 (75)	5 (33)	0 (0)	0 (0)	12,329 (25)	3,619 (100)

[a] A total of 149 facilities in SICs 3363 and 3365 reported usage of at least one Section 313 chemical above the threshold limits.

[b] Mean release in pounds per year in 1990 for firms reporting releases of this chemical, and percentage of firms reporting usage of this chemical and releases to this media. Releases to other media were insignificant. A pH release above 6 is not reportable under Section 313.

[c] POTW = Publicly owned treatment works.

[d] The total includes all releases and off-site transfers, not just categories summarized in this table.

TABLE 15. SUMMARY OF REPORTED RELEASES OF OTHER CHEMICALS FROM ALUMINUM FOUNDRIES

Section 313 Chemical	Use	Number of facilities reporting usage[a] (% reporting usage)	Mean release, lb (% reporting to each media)[b]						
			Fugitive	Stack	Water	Land	POTW[c]	Off-site transfer	Total[d]
Ethylene glycol	Hydraulic fluid	21 (4)	2,222 (38)	250 (5)	5,125 (10)	17,085 (15)	20,020 (38)	17,709 (57)	22,610 (95)
Chlorine	Degassing	14 (9)	327 (93)	394 (50)	385 (14)	0 (0)	250 (7)	e (14)	e (100)
Phenol	Core-making	6 (4)	1,827 (100)	2,213 (67)	250 (17)	1,052 (33)	5 (17)	2,096 (33)	4,394 (100)
Methylenebis (phenyl isocyante)	Core-making	5 (3)	625 (80)	750 (60)	0 (0)	0 (0)	0 (0)	61,467 (60)	47,288 (80)
Diethanolamine	Coating finisher	2 (1)	0 (0)	0 (0)	250 (50)	8,759 (50)	16,484 (50)	8,759 (50)	17,117 (100)

[a] A total of 149 facilities in SICs 3363 and 3365 reported usage of at least one Section 313 chemical above the threshold limits.

[b] Mean release in pounds per year in 1990 for firms reporting releases of this chemical, and percentage of firms reporting usage of this chemical and releases to this media. Releases to other media were insignificant.

[c] POTW = Publicly owned treatment works.

[d] The total includes all releases and off-site transfers, not just categories summarized in this table.

[e] Although two firms reported large off-site transfers of chlorine (mean 14,000 lb), this would not be typical and may be an error.

COPPER FOUNDRIES

This section discusses copper foundries (SIC 3366). Brass and bronze foundries should also report under SIC 3366. However, it is clear from many company names that many brass and bronze foundries report to TRI under SIC 3669 and processes such as the lost wax process used at these foundries are discussed in the next section on Other Foundries. Copper die casting is contained in SIC 3364. Only three of the five categories of Section 313 chemicals used at iron foundries are used at copper foundries. Although coatings may be applied to copper, brass, or bronze to prevent oxidation, only 2 facilities of the 80 facilities (2.5%) who reported to TRI in SIC 3366 reported use of methyl ethyl ketone and toluene. No other solvents were reported in TRI in SIC 3366. If coatings are applied, then it is probable that the threshold limit for otherwise used chemicals (10,000 lb) would be exceeded for at least one solvent. Also no "other chemicals" including core making chemicals, were reported under SIC 3366 in the TRI database.

Brass and bronze may be cast at precision investment foundries. This process is discussed in the next section on Other Foundries.

Metals and metal compounds are processed as constituents of the copper or are added to form alloys. Because of the high boiling temperature of copper (2567°C), lower boiling metals (BP Mn 1,962°C, Pb 1,740°C, Zn 907°C) will be released in greater percentages than their concentration in the melt. The metal/metal compounds processed in copper foundries are different from those in iron and steel; copper, lead, nickel, and manganese are the primary metals/metal compounds, but zinc (fume or dust) and zinc compounds are also processed.

Releases to air are similar to those for iron and steel foundries; however, off-site transfers are much lower for copper foundries than for iron and steel foundries. Table 16 presents a summary of Section 313 reported releases of metals/metal compounds at copper foundries. Releases may be calculated by similar methods described for iron foundries with the exception that AP-42 Section 7.9 should be used for emission factors.

TABLE 16. SUMMARY OF REPORTED RELEASES OF METALS AND METAL COMPOUNDS FROM COPPER FOUNDRIES

Section 313 Chemical	Number of facilities reporting usage[a] (% reporting usage)	Mean release, lb (% reporting to each media)[b]						
		Fugitive	Stack	Water	Land	POTW[c]	Off-site transfer	Total[d]
Copper	75 (94)	1,311 (67)	649 (56)	250 (4)	17,231 (12)	161 (17)	3,565 (49)	5,627 (91)
Copper compounds	6 (7)	1,567 (50)	10,321 (83)	250 (17)	0 (0)	625 (50)	e (67)	e (83)
Lead	26 (33)	282 (77)	1,290 (65)	250 (12)	38,165 (4)	250 (8)	3,376 (50)	4,435 (96)
Lead compounds	4 (5)	0 (0)	765 (50)	0 (0)	0 (0)	67 (75)	e (75)	e (75)
Nickel	18 (23)	145 (61)	180 (39)	5 (6)	128 (11)	65 (22)	513 (56)	567 (83)
Nickel compounds	3 (4)	0 (0)	183 (67)	250 (33)	0 (0)	620 (33)	27,754 (67)	28,372 (67)
Manganese	9 (11)	271 (67)	152 (56)	250 (11)	5 (11)	84 (33)	11 (44)	367 (89)
Manganese compounds	3 (4)	250 (33)	5 (67)	250 (33)	0 (0)	0 (0)	875 (67)	753 (100)
Zinc (fume or dust)[f]	7 (9)	152 (86)	984 (71)	750 (14)	114,494 (14)	0 (0)	6,878 (28)	e (100)
Zinc compounds	5 (6)	500 (40)	2,681 (100)	250 (20)	1,400 (20)	225 (60)	81,167 (100)	84,514 (100)

[a] A total of 80 facilities in SICs 3366 reported usage of at least one Section 313 chemical above the threshold limits.

[b] Mean release in pounds per year in 1990 for firms reporting releases of this chemical, and percentage of firms reporting usage of this chemical and releases to this media. Releases to other media were insignificant.

[c] POTW = Publicly owned treatment works.

[d] The total includes all releases and off-site transfers, not just categories summarized in this table.

[e] Mean value is not representative because of a very large value at one facility and the small number of facilities.

[f] These chemicals are produced as by-products.

Chlorinated solvents are used for some of the same purposes as in iron foundries, but to a much lower degree. Most copper foundries do not use chlorinated solvents above the threshold quantities. Table 17 presents a summary of reported releases and off-site transfers of chlorinated solvents from copper foundries.

Acids are otherwise used for the uses described in iron foundries. In addition, bronze that will not be exposed to extremes of weather can be protected from corrosion by warming it to slightly over 212°F (100°C) in an oxygen atmosphere. A thin layer of oxide or patina forms to prevent further oxidation. A patina may be formed on art objects by exposure first to acid fumes and then drying as above. While still warm, the object can be further protected by a spray of wax in a solvent. Table 18 presents a summary of releases and off-site transfer of acids at copper foundries.

TABLE 17. SUMMARY OF REPORTED RELEASES OF CHLORINATED SOLVENTS FROM COPPER FOUNDRIES

Section 313 Chemical	Number of facilities reporting usage (% reporting usage)[a]	Mean release, lb (% reporting to each media)[b]					
		Fugitive	Stack	Water	POTW[c]	Off-site transfer[d]	Total[e]
1,1,1-Trichloroethane	6 (8)	153,447 (100)	19,238 (33)	5 (13)	108 (33)	400 (33)	160,029 (100)
Freon-113	2 (3)	15,319 (100)	0 (0)	0 (0)	0 (0)	16,20 (100)	16,99 (100)

[a] A total of 80 facilities in SIC 3366 reported usage of at least one Section 313 chemical above the threshold limits.

[b] Mean release in pounds per year in 1990 for firms reporting releases of this chemical, and percentage of firms reporting usage of this chemical and releases to this media. Releases to other media were insignificant.

[c] POTW = Publicly owned treatment works.

[d] Off-site transfer for recycling was not reportable in 1990; transfer for recycling would be significant for chlorinated solvents used in degreasing operations.

[e] The total includes all releases and off-site transfers, not just categories summarized in this table.

TABLE 18. SUMMARY OF REPORTED RELEASES OF ACIDS FROM COPPER FOUNDRIES

Section 313 Chemical	Number of facilities reporting usage (% reporting usage)	Mean release, lb (% reporting to each media)[b]						
		Fugitive	Stack	Water	Land	POTW[c]	Off-site transfer	Total[d]
Sulfuric acid	7 (9)	351 (57)	250 (14)	11,920 (11)	42,750 (14)	11,920 (14)	21,693 (57)	28,619 (71)
Phosphoric acid	3 (4)	87 (100)	168 (100)	5 (50)	5 (33)	0 (0)	40,366 (67)	27,167 (100)
Hydrochloric acid	1 (1)	0 (0)	0 (0)	0 (0)	0 (0)	28,000 (100)	0 (0)	28,000 (100)
Nitric acid	1 (1)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)

[a] A total of 80 facilities in SIC 3366 reported usage of at least one Section 313 chemical above the threshold limits.

[b] Mean release in pounds per year in 1990 for firms reporting releases of this chemical, and percentage of firms reporting usage of this chemical and releases to this media. Releases to other media were insignificant. pH release above 6 is not reportable under Section 313.

[c] POTW = Publicly owned treatment works; sulfuric acid release is to water.

[d] The total includes all releases and off-site transfers, not just categories summarized in this table.

OTHER FOUNDRIES

This category includes nonferrous foundries except copper, aluminum, and all die-castings. It's clear from company name, however, that many brass and bronze foundries report using SIC 3369. Four of the five categories of Section 313 chemicals used for iron foundries are used for other foundries. Although coatings may be applied to silver, brass or bronze castings to prevent oxidation, only one facility per solvent of the 128 facilities, who, reported to TRI in the other foundries category reported the use of MEK, MIBK, toluene or xylene. If coatings are applied then it is probable that the threshold limit for otherwise used chemicals (10,000 lb) would be exceeded for at least one solvent.

Investment foundries may cast bronze, stainless steel and precious metals such as silver using the lost wax process. Products include sculptures, commemorative medals, trophies and plaques. Precision investment casting, also known as the *cire perdue* or *lost wax* process, is a special process for making castings to very close dimensional tolerances. The process consists of making a pattern of such materials as wax, plastics, fusible alloy or frozen mercury. A Suitable molding or investment compound such as ethyl silicate is cast around the pattern, cured, and the invested pattern melted out to form the finished mold. After the metal is cast, usually under pressure, the mold is broken and removed to free the castings, which usually only require the removal of gates for finishing. The investment casting method has been used to mass produce parts weighing between 5 and 4500 g.

An older but similar process used in statuary founding involves modeling in wax over a core, and then covering with plaster. The wax is removed by melting, and a metal shell is cast in its place between the core and the plaster mold. The main advantage of this procedure is the ability to make intricate shapes without machining while attaining close dimensional tolerances. Size is a limitation and may range up to 8 cm maximum dimension with a maximum 4 cm section in thickness.

<u>Metals and metal compounds</u> are processed as constituents of the metal castings or are added to form alloys. The metals/metal compounds reported in TRI in

descending order of reporting are copper, zinc (fume or dust), lead, nickel, chromium, aluminum (fume or dust), cobalt, and manganese. The metal compounds, zinc (fume or dust), and aluminum (fume or dust) may be manufactured as a by-product in the process.

Releases to air are difficult to estimate unless process specifics are known. Releases are similar to those for aluminum and copper foundries in that off-site transfers are lower than for iron and steel foundries. Table 19 presents a summary of Section 313 reported releases of metal/metal compounds at other foundries.

Chlorinated solvents are used for the same purposes as in iron foundries. Table 20 presents a summary of Section 313 reported releases of chlorinated solvents at other foundries.

Acids are otherwise used for the uses described in iron foundries except phosphoric acid is not used. Table 21 presents a summary of releases and off-site transfer of acids at other foundries.

Other chemicals are otherwise used at other foundries. Phenol and formaldehyde are otherwise used as binders in core making, ethylene glycol is otherwise used in hydraulic fluid, and chlorine is otherwise used in degassing. Table 22 presents a summary of releases and off-site transfers of other chemicals at other foundries.

TABLE 19. SUMMARY OF REPORTED RELEASES OF METALS AND METAL COMPOUNDS FROM OTHER FOUNDRIES

Section 313 Chemical	Number of facilities reporting usage[a] (% reporting usage)	Mean release, lb (% reporting to each media)[b]						
		Fugitive	Stack	Water	Land	POTW[c]	Off-site transfer	Total[d]
Copper	74 (58)	349 (65)	1,172 (64)	209 (8)	12,450 (7)	152 (26)	9,512 (34)	5,372 (95)
Copper compounds	13 (10)	230 (62)	472 (100)	152 (38)	250 (8)	86 (46)	5,211 (54)	3,536 (100)
Zinc (fume or dust)[e]	25 (20)	1,217 (52)	f (76)	87 (12)	0 (0)	250 (16)	10,072 (28)	f (92)
Zinc compounds	16 (13)	346 (69)	2,750 (75)	297 (43)	250 (13)	116 (38)	12,208 (50)	8,594 (100)
Lead	31 (24)	137 (61)	510 (61)	87 (10)	11,000 (3)	136 (19)	1,242 (32)	1,472 (81)
Lead compounds	4 (3)	500 (50)	176 (75)	1 (25)	5 (25)	5 (25)	269 (50)	519 (100)
Nickel	26 (20)	187 (69)	135 (57)	8 (8)	2,162 (4)	173 (38)	3,016 (65)	2,524 (92)
Nickel compounds	5 (4)	168 (60)	127 (80)	188 (80)	0 (0)	5 (20)	14,537 (80)	11,983 (100)
Chromium	15 (12)	224 (67)	142 (67)	1 (7)	854 (13)	149 (40)	3,220 (67)	2,747 (93)
Chromium compounds	4 (3)	107 (75)	265 (75)	5 (25)	0 (0)	148 (50)	7,337 (100)	7,691 (100)
Aluminum (fume or dust)[e]	18 (14)	1,168 (56)	2,006 (78)	128 (11)	18,845 (11)	201 (28)	5,841 (33)	6,320 (100)
Cobalt	10 (8)	343 (60)	183 (50)	1 (10)	1,785 (10)	78 (40)	4,909 (80)	4,927 (90)
Manganese	8 (6)	145 (88)	75 (88)	0 (0)	375 (25)	128 (25)	449 (50)	542 (100)
Manganese compounds	1 (1)	5 (100)	250 (100)	0 (0)	0 (0)	250 (100)	255 (100)	760 (100)

[a] A total of 128 facilities in SICs 3364 and 3369 reported usage of at least one Section 313 chemical above the threshold limits.

[b] Mean release in pounds per year in 1990 for firms reporting releases of this chemical, and percentage of firms reporting usage of this chemical and releases to this media. Releases to other media were insignificant.

[c] POTW = Publicly owned treatment works.

[d] The total includes all releases and off-site transfers not just categories summarized in this table.

[e] These chemicals are produced as by-products.

[f] Mean value is not representative because of a very large value at one facility and the small number of facilities.

TABLE 20. SUMMARY OF REPORTED RELEASES OF CHLORINATED SOLVENTS FROM OTHER FOUNDRIES

Section 313 Chemical	Number of facilities[a] reporting usage (% reporting usage)	Mean release, lb (% reporting to each media)[b]					
		Fugitive	Stack	Water	POTW[c]	Off-site transfer[d]	Total[e]
1,1,1-Trichloroethane	16 (13)	17,280 (81)	28,137 (69)	0 (0)	87 (19)	2,317 (25)	33,979 (100)
Freon-113	8 (6)	20,435 (100)	4,783 (25)	0 (0)	0 (0)	1,680 (25)	22,051 (100)
Trichloroethylene	8 (6)	11,848 (75)	25,903 (75)	0 (0)	0 (0)	7,908 (25)	30,290 (100)
Tetrachloroethylene	6 (5)	f (50)	28,672 (83)	0 (0)	44 (17)	1,903 (17)	51,932 (100)
Dichloromethane	2 (2)	753 (100)	8,700 (100)	0 (0)	0 (0)	9,400 (50)	14,153 (100)

[a] A total of 128 facilities in SICs 3364 and 3369 reported usage of at least one Section 313 chemical above the threshold limits.

[b] Mean release in pounds per year in 1990 for firms reporting releases of this chemical, and percentage of firms reporting usage of this chemical and releases to this media. Releases to other media were insignificant.

[c] POTW = Publicly owned treatment works.

[d] Off-site transfer for recycling was not reportable in 1990; transfer for recycling would be significant for chlorinated solvents used in degreasing operations.

[e] The total includes all releases and off-site transfers, not just categories summarized in this table.

[f] Mean value is not representative because of a very large value at one facility and the small number of facilities.

TABLE 21. SUMMARY OF REPORTED RELEASES OF ACIDS FROM OTHER FOUNDRIES

Section 313 Chemical	Number of facilities reporting usage (% reporting usage)[a]	Mean release, lb (% reporting to each media)[b]						
		Fugitive	Stack	Water	Land	POTW[c]	Off-site transfer	Total[d]
Sulfuric acid	19 (15)	145 (74)	118 (63)	0 (0)	0 (0)	5 (5)	21,574 (16)	4,010 (89)
Hydrochloric acid	13 (10)	133 (77)	316 (85)	5 (10)	0 (0)	1,937 (23)	13,000 (8)	1,968 (92)
Nitric acid	12 (9)	530 (75)	1,030 (58)	0 (0)	4,200 (8)	378 (16)	15,098 (42)	7,702 (100)
Phosphoric acid	1 (1)	250 (100)	250 (100)	0 (0)	0 (0)	5 (100)	7,600 (100)	8,105 (100)

[a] A total of 128 facilities in SICs 3364 and 3369 reported usage of at least one Section 313 chemical above the threshold limits.

[b] Mean release in pounds per year in 1990 for firms reporting releases of this chemical, and percentage of firms reporting usage of this chemical and releases to this media. Releases to other media were insignificant.

[c] POTW = Publicly owned treatment works.

[d] The total includes all releases and off-site transfers, not just categories summarized in this table.

TABLE 22. SUMMARY OF REPORTED RELEASES OF OTHER CHEMICALS FROM OTHER FOUNDRIES

Section 313 Chemical	Use	Number of facilities reporting usage[a] (% reporting usage)	Mean release, lb (% reporting to each media)[b]						
			Fugitive	Stack	Water	Land	POTW[c]	Off-site transfer	Total[d]
Ethylene glycol	Hydraulic fluid	9 (7)	1,301 (44)	168 (33)	0 (0)	0 (0)	18,921 (67)	12,590 (56)	21,274 (89)
Chlorine	Degassing	5 (4)	4,337 (100)	557 (60)	5 (20)	0 (0)	0 (0)	750 (20)	4,822 (100)
Phenol	Core-making	2 (2)	945 (100)	0 (0)	0 (0)	250 (50)	5 (50)	0 (0)	1,073 (100)
Formaldehyde	Core-making	1 (1)	2,350 (100)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	2,350 (100)

[a] A total of 128 facilities in SICs 3364 and 3369 reported usage of at least one Section 313 chemical above the threshold limits.

[b] Mean release in pounds per year in 1990 for firms reporting releases of this chemical and percentage of firms reporting usage of this chemical and releases to this media. Releases to other media were insignificant.

[c] POTW = Publicly owned treatment works.

[d] The total includes all releases and off-site transfers, not just categories summarized in this table.

USE OF REGULATIONS TO ESTIMATE RELEASE OF SECTION 313 CHEMICALS

Two regulations that may assist in emission estimations of Section 313 chemicals are the effluent guidelines and standards governing water releases and the particulate emission standards governing air releases. Because the Section 313 chemical concentration is highly variable between facilities, neither set of regulations is directly applicable. The regulations may require monitoring or other testing, however, that may be used to estimate releases of the Section 313 chemicals.

Water Releases

The EPA Effluent Guidelines and Standards for Metal Molding and Casting (40 CFR 464; 50 FR 45247, October 30, 1985; corrected by 51 FR 21760, June 16, 1986) provide effluent limits for foundries. The guidelines are detailed and specific to the type and size of foundry, process, and type of discharge. The specific guideline for the foundry type in question should be consulted to estimate the maximum allowable discharge. The guidelines are applicable to aluminum casting, copper casting, ferrous casting, and zinc casting. There are limits for discharged copper, lead, zinc, total phenols, oil and grease, total suspended solids, and pH. The limits are separately applied by process including 1) casting cleaning operations, 2) casting quench operations, 3) dust collection scrubber operations, 4) grinding scrubber operations, 5) investment casting, 6) melting furnace scrubber operations, 7) mold cooling operations, 8) slag quench operations and 9) wet sand reclamation operations. Separate standards are established for best available technology economically achievable, best practicable control technology currently available, new source performance standards, and pretreatment standards for new sources. Standards are also different based on the size of the foundry (based on tons of metal poured) and the type of discharge (continuous or noncontinuous).

Although these standards cannot be used directly to estimate releases of Section 313 chemicals, they can be used as a pointer as to what to look for in permit or monitoring records. The pH of the wastewater discharge can be used to determine releases for acids used at the facility if only one acid is present in the discharge. Also, regulatory

standards for copper, lead, and zinc can be used as the upper limits of the waste discharge. Measurements of these metals in the wastewater made by the facility to comply with the standards can be used along with the discharge quantities to calculate water releases of metals/metal compounds.

Air Releases

State and local air regulations requiring installation and operation of pollution controls on ferrous foundries vary widely both from state to state and within states. The enactment of an emission limit at a foundry is influenced by factors such as foundry location, type of process, foundry size, date of startup, available legal structure, and previous experience with the public, the foundry industry, and the court systems.[6]

The four general types of air regulations enacted to control foundry process emissions are mass emission, visible emission, fugitive emission, and nuisance-related regulations. Other important regulations are the malfunction regulation operation and maintenance (O&M) regulations, and operating permit regulations. These regulations may be used individually or in combination to ensure appropriate control of foundry emissions.[6]

Three major types of mass emissions regulations are: process weight regulation which limits the total mass of hourly emissions based on the hourly raw material input; concentration regulation, which limits the mass of particulate in a specified volume of undiluted gas; and removal efficiency regulation which specifies the efficiency that must be attained by the control device on a foundry process.[6]

Visible emissions (VE) regulations generally limit the opacity of the emissions plume. (Opacity is the degree to which the plume limits an observer's view of the background.) Unlike mass emissions regulations, VE regulations cannot be used to limit precisely the quantities of particulate emitted to the atmosphere.[6]

Fugitive emissions regulations involve no specific, quantitative standards; rather, they invite the discretion of the responsible agency official to determine the levels of

Nuisance-related regulations include: a general proscription against emissions that harm persons or property; a proscription against air pollution that causes a nuisance; and regulations that proscribe air-pollution-causing odors.[6]

Although air regulations may be used in conjunction with a particulate concentration estimate of a Section 313 metal/metal compound in order to estimate releases, this approach may not necessarily provide the best estimate. The amount of particulates captured by control devices and control efficiency may also be used to estimate particulate release. Concentration of Section 313 chemicals in captured particulate must be adjusted, however, to account for low-boiling metals that may be released in higher concentrations.

NONREPORTING FACILITIES

Nonreporting facilities may be identified by comparing lists of facilities in the following Standard Industrial Classifications (SICs) having more than 10 employees with those facilities that have reported under Section 313.

Iron foundries - SICs 3321 and 3322
Steel foundries - SICs 3324 and 3325
Aluminum foundries - SICs 3363 and 3365
Copper foundries - SIC 3366
Other foundries - SICs 3364 and 3369

Most foundries with more than 10 employees probably are processing or otherwise using at least one Section 313 chemical in excess of threshold values. For example, iron and steel foundries likely are processing a Section 313 metal in iron or steel that is in excess of 25,000 lb per year. Most nonferrous foundries probably are also processing more than 25,000 lb per year of a Section 313 metal. Foundries may also otherwise use an acid or core binder in excess of the 10,000-lb threshold.

Sources of information on facilities in the various foundry SIC's presented by employment class are included in County Business Patterns (for number of facilities), published by the U.S. Department of Commerce.[7] Another source of information is Dunn and Bradstreet (D&B), which provides lists of companies by SIC and employment size category.[8] Table 22 presents data on the number of facilities employing more than 10 employees, as reported in County Business Patterns, D&B, and TRI database in 1990.

TABLE 23. NUMBER OF FACILITIES WITH MORE THAN TEN EMPLOYEES

Foundry type	SICs	TRI 1990	County Business Patterns[7] (1989)	D&B 1992
Iron	3321, 3322	197	584	464
Steel	3324, 3325	134	326	252
Aluminum	3363, 3365	149	612	617
Copper	3366	80	203	196
Other	3364, 3369	128	243	397

A review of TRI data in 1990 pointed out apparent errors in reporting of whether the chemical was manufactured, processed, or otherwise used. All metals are processed at foundries with the exception of aluminum (fume or dust) and zinc (fume or dust). The fume or dust is manufactured at the foundry. Foundries manufacture or process metals/metal compounds by changing the metal to a metal compound or visa versa (i.e., oxide of the metal). All metals/metal compounds are subject to the 25,000-lb threshold. All chlorinated solvents, acids, organic solvents, and other chemicals are otherwise used and subject to the 10,000-lb threshold.

Another error made by a number of foundries was to report the use of isopropyl alcohol (IPA) and aluminum oxide. IPA is reportable only for facilities who manufacture IPA by the strong acid process, and aluminum oxide is reportable only if it is in the fibrous form. No foundries should report either of these Section 313 chemicals.

LIST OF QUESTIONS

The following questions may be helpful in determining if errors were made in Section 313 reporting for foundries.

Metal/Metal Compounds

- Were threshold determinations made for all metals/metal compounds processed at the facility?
- Did the facility determine if it met the reporting thresholds from the amount released or transferred instead of the amount processed or otherwise used?
- Were threshold determinations for metal compounds made using the weight of the compound and not just the metal portion of the compound?
- How was air release calculated? Were emission factors or monitoring data used? What were these factors?
- Was Toxicity Characteristic Leaching Procedure (TCLP) used as a measure of metal concentration in any of the calculations? TCLP measures leachable metal, not metal content, and thereby should not be used in calculations.

Chlorinated Solvents

- Was a mass balance accounting for all chlorinated solvent usage used to estimate releases and off-site transfers? (Mass balance is especially useful for chlorinated solvents because total usage is usually released or transferred off-site.)
- Was the percentage of chlorinated solvent in the waste solvent accounted for?
- For vapor degreasing with water separation, was release to water or POTW estimated?

Acids

- Was the pH of the release continuously measured as a means of verifying neutralization? (Monitoring of pH may be required by EPA Effluent Guidelines)

- Was the percentage of acid in the original acid or solution taken into account in the threshold calculations?

- For brass and bronze foundries, were any acids used to form patinas counted in threshold and release calculations.

Organic Solvents

- How were solvents otherwise used?

- How were releases for solvents other than to air estimated?

- Did mass balance for solvents account for total usage calculated?

- For brass and bronze foundries, was any coating applied to the casting? Did these coatings contain TRI solvents in excess of 10,000 lbs?

Other Chemicals

- Was a threshold determination made for Section 313 chemicals in core binders such as phenol, methylenebis (phenylisocyanate), formaldehyde, or ammonium nitrate (solution).

- Was a threshold determination made for usage of ethylene glycol in hydraulic fluid.

- Was a threshold determination made for Section 313 chemicals used for mold-making, shelling?

BIBLIOGRAPHY

1. U.S. Environmental Protection Agency. Technical Guidance for Control of Industrial Process Fugitive Particulate Emissions. EPA-450/3-77-010, Research Triangle Park, N.C. March 1979.

2. U.S. Environmental Protection Agency. Compilation of Air Pollutant Emission Factors. AP-42. Volume 1 Stationary and Point Source. September 1985 plus supplements.

3. U.S. Environmental Protection Agency. Air Pollution Engineering Manual, Second Edition. AP-40. May 1983.

4. U.S. Environmental Protection Agency, Control Technology Center. Emissions for Iron Foundries - Criteria and Toxic Pollutants. EPA 600/2-90-044. Research Triangle Park, N.C. August 1990.

5. Kirk Othmer Encyclopedia of Chemical Technology. Third edition. Volume 7 Copper Alloys. John Wiley and Sons. 1979

6. U.S. Environmental Protection Agency. Summary of Factors Affecting Compliance by Ferrous Foundries, Volume I. EPA 340/1-80-020. January 1981.

7. U.S. Department of Commerce, Bureau of Census, County Business Patterns 1989, CBP-89-1 Washington, D.C. 1991.

8. Dunn & Bradstreet. International Dunn's Market Identifier in DIALOG data base File 518. 1992.

9. U.S. Environmental Protection Agency. Electric Arc Furnaces in Ferrous Foundries - Background Information for Proposed Standards - Draft EIS. EPA-450/3-88-020a. May 1980.

10. U.S. Environmental Protection Agency. Development Document for Effluent Limitations Guidelines and Standards for the Metal Molding and Casting (Foundries) Point Source Category, Volumes I and II, EPA 440/1-82/070b. November 1982.

11. 40 CFR 464. U.S. Environmental Protection Agency Effluent Guidelines and Standards for Metal Molding and Casting. Revised June 16, 1986.

12. United States Steel. The Making, Shaping and Treating of Steel. Tenth Edition. 1985.

13. PEDCo Environmental, Inc. International Technology for the Nonferrous Smelting Industry. Noyes Data Corporation. 1982.

14. U.S. Environmental Protection Agency. Emission Factors for Iron and Steel Jouries - Criteria and Toxic Pollutants. EPA 600/2-90-024. Research Triangle Park, N.C. June 1990.

15. U.S. Environmental Protection Agency. Organic Emissions form Ferrous Metallurgical Industries: Compilation of Emission Factors and Control Technologies. EPA 600/2-84-003. Research Triangle Park, N.C. January 1984.

16. Baldwin V.H. Jr. Environmental Assessment of Iron Casting. EPA 600/2-80-021. U.S. Environmental Protection Agency. 1980.

17. Baldwin V.H. Environmental Assessment of Melting, Inoculation, and Pouring. American Foundrymen's Society. 153: 65-72, 1982.

18. Ambidge, P.F. and P.D.E. Biggins. Environmental Problems Arising From the Use of Chemicals in Molding Materials. BCIRA Report, 1984.

APPENDIX A

SELECTED INFORMATION AND EMISSION FACTORS FOR IRON FOUNDRIES[a]

[a] All information in this section is from Reference 4. Original sources of data are provided in this reference.

TABLE A1. SOME FOUNDRY-ATOMOSPHERE CONTAMINANTS EVOLVED DURING MOLD AND CORE MAKING, CASTING, AND COOLING AT IRON FOUNDRIES[4]

PROCESS	BINDER INGREDIENTS	POTENTIAL EMISSIONS
Shell	Ammonia Phenol Hexamethylene tetramine Stearates Fatty acids	Ammonia Aromatic hydrocarbons (benzene, toluene, xylene, etc.) Phenol and homologues (phenol, cresol, xylenol, etc.) Hexamethylene tetramine Other amines (e.g. trimethylamine) Hydrogen cyanide
Hot-box	Formaldehyde Phenol Urea Furfuryl alcohol	Aromatic hydrocarbons Phenol and homologues Ammonia Chlorinated hydrocarbons Hydrogen cyanide
Cold-set	Formaldehyde Furfuryl alcohol Phenol Benzene) Toluene) depends on catalyst Xylene)	Sulphur dioxide Hydrogen sulphide Mercaptans (e.g. methyl, ethyl mercaptan) Aromatic hydrocarbons Phenol and homologues Furan and homologues (furan, methyl furan, etc.) Carbonyl sulphide Carbon disulphide Aromatic sulphur compounds (Methyl ethyl ketone) (Acetone - from SO2 - gassed system only)
Cold-box (amine-gassed)	Carbon dioxide Triethyl amine Dimethyl ethyl amine MDI Phenol Resin solvents (e.g. trimethyl benzene, isophorone) Naphthalene and homologues	Hydrogen cynide Phenol and homologues Aromatic hydrocarbons Aniline and homologues (aniline, toluidine, etc.) Aliphatic amines Resin solvents (e.g. trimethyl benzene, isophorone) Isocyanates (e.g. methyl, phenyl isocyanate) Benzoquinolines

TABLE A2. INTRODUCTION FURNACE EMISSIONS AT IRON FOUNDRIES[4]

	Malleable Iron mg/Mg	Ductile Iron mg/Mg
ZnO	5.2×10^4	7.8×10^3
Al_2O_3	2.6×10^4	5.2×10^4
Cr_2O_3	1.3×10^3	2.0×10^3
MnO	1.3×10^3	1.3×10^3
NiO	1.3×10^2	1.3×10^2
PbO	1.3×10^1	1.3×10^1
CuO	1.3	2.6
CoO	2.6	2.6
BaO	2.6	2.6

TABLE A3. ORGANIC EMISSIONS FROM IRON FOUNDRIES, mg/Mg IRON PRODUCED[4]

	Electric Arc Furnaces	Cupola	Inoculation	Pouring	Green Sand Shakeout
Aliphatic Hydrocarbons	4.94	1.92	0.08	0.78	0.39
Halogenated Hydrocarbons	4.94	1.92	0.08	0.78	
Aromatic Hydrocarbons	3.41	1.70	0.19	0.56	1.34
Fused Aromatics (>216 MW)					
Halogenated Aromatics	3.41	1.70	0.05	0.56	0.13
Heterocyclic N Compounds	0.12	0.16	0.01	0.14	0.56
Heterocyclic S Compounds	0.12	0.16	0.01	0.14	0.05
Alcohols	0.40	0.14	0.01	0.26	0.31
Phenols	0.12	0.14	0.06	0.05	0.31
Ketones	0.84	1.51	0.01	0.42	0.05
Amines	0.40	0.14	0.01	0.31	0.31
Silicones	0.37	0.43	0.18	0.07	
Heterocyclic O Compounds	1.63	1.01	0.00	0.47	0.05
Nitroaromatics	0.00	0.11	0.05	0.03	0.01
Ethers	0.02	1.10	0.01	0.20	0.05
Aldehydes	0.00	0.11	0.01	0.03	0.05
Phosphates	0.82	0.16	0.00	0.06	
Nitriles	0.00	0.11	0.01	0.03	0.01
Alkyl S Compounds	0.12	0.14	0.01	0.08	0.03
Sulfonic Acids	0.12	0.14	0.01	0.06	0.03
Sulfoxides	0.12	0.14	0.01	0.05	
Amides	0.12	0.14	0.01	0.09	0.23
Carboxylic Acids	0.40	0.14	0.01	0.26	0.25
Esters	0.12	0.89	0.02	0.22	0.15
Haloaliphatics					0.12

TABLE A4. INORGANIC EMISSIONS FROM IRON FOUNDRIES, mg/Mg IRON PRODUCED[4]

Element	Cupola	Electric Arc Furnaces	Inoculation	Pouring
Ag			8.7	1.0
Al			55	>66
As	26.1		7.3 - 26.8	0.1
Ba			55	65
Be			0.02	0.04
Cd		1,654	1.5	0.8
Co			0.1	0.35
Cr		97	4.0	>66
Cu	850		11.7	14.7
Hg		36	22	11
Mg			56	>66
Mn	125,000	65	35	>66
Ni			0.31	25
Pb	5×10^4 - 5.5×10^5 2.6×10^5	323	56	11
Se			5.8	0.1
Th				1.1
Zn			56	>66

TABLE A5. TOXIC POLLUTANT EMISSION FACTORS FOR IRON FOUNDRIES[4]

Type of Furnace	Pollutant	Emission Factor, mg/Mg
Cupola	halogenated hydrocarbons	1.92
	aromatic hydrocarbons	1.70
	halogenated aromatics	1.70
	silicones	0.43
	heterocyclic N compounds	0.16
	amines	0.14
	arsenic	26.1
	lead	5×10^4 - 5.5×10^5
	manganese	1.25×10^5
	copper	8.5×10^2
Electirc Arc Furnace	halogenated hydrocarbons	4.94
	aromatic hydrocarbons	3.41
	halogenated aromatics	3.41
	amines	0.40
	tin	1,654
	antimony	3
	silver	36
	lead	323
	mercury	35
	boron	81
	flourine	6,614
	chromium	97
	maganese	65

TRI FACILITY PROFILE, ELECTROPLATING

by

IT Corporation
11499 Chester Road
Cincinnati, Ohio 45246

Contract No. 68-DO-0020
Work Assignment No. 2-27/2-65/3-18
JTN 830015-5-1

Prepared for

U.S. ENVIRONMENTAL PROTECTION AGENCY
OFFICE OF TOXIC SUBSTANCES
401 M Street, SW
Washington, D.C. 20460

June 1992

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TRI FACILITY PROFILE, ELECTROPLATING

The purpose of this profile is to assist U.S. Environmental Protection Agency (EPA) personnel with Section 313 inspections. The profile describes key toxic chemicals used in electroplating, describes how these chemicals are used, and identifies key release sources. All Section 313 chemicals reported to TRI by more than 5 percent of the electroplating facilities are presented in this profile.

Electroplating is the electrodeposition of an adherent metallic coating on an electrode in order to form a surface with properties or dimensions different from those of the base metal.[1] The Section 313 metals that are commonly electroplated include nickel, copper, chromium, and zinc, and to a lesser degree, cadmium and lead. The electroplating process includes cleaning, rinsing, plating, and postplating treatments: such operations can be performed manually or with varying degrees of automation.[1] The primary cleaning processes performed prior to electroplating include solvent cleaning, alkaline cleaning, and acid cleaning. Alkaline cleaners do not typically contain Section 313 chemicals in high enough concentrations such that use would be above the threshold limits. Parts to be plated may be hung in the plating tank on wires or racks, contained in wire baskets, or, more commonly placed in barrels that rotate in the plating tank.[1] Movement from one operation to the next may be by hand or by machine. Figure 1 presents a process flow diagram showing chromium plating of decorative zinc die castings in a plating operation of several Section 313 metals.

SECTION 313 ELECTROPLATING CHEMICALS

Section 313 chemicals commonly used in electroplating can be classified into four distinct categories: chlorinated solvents, acids, metals/metal compounds, and other Section 313 chemicals. Each category is discussed separately in this report.

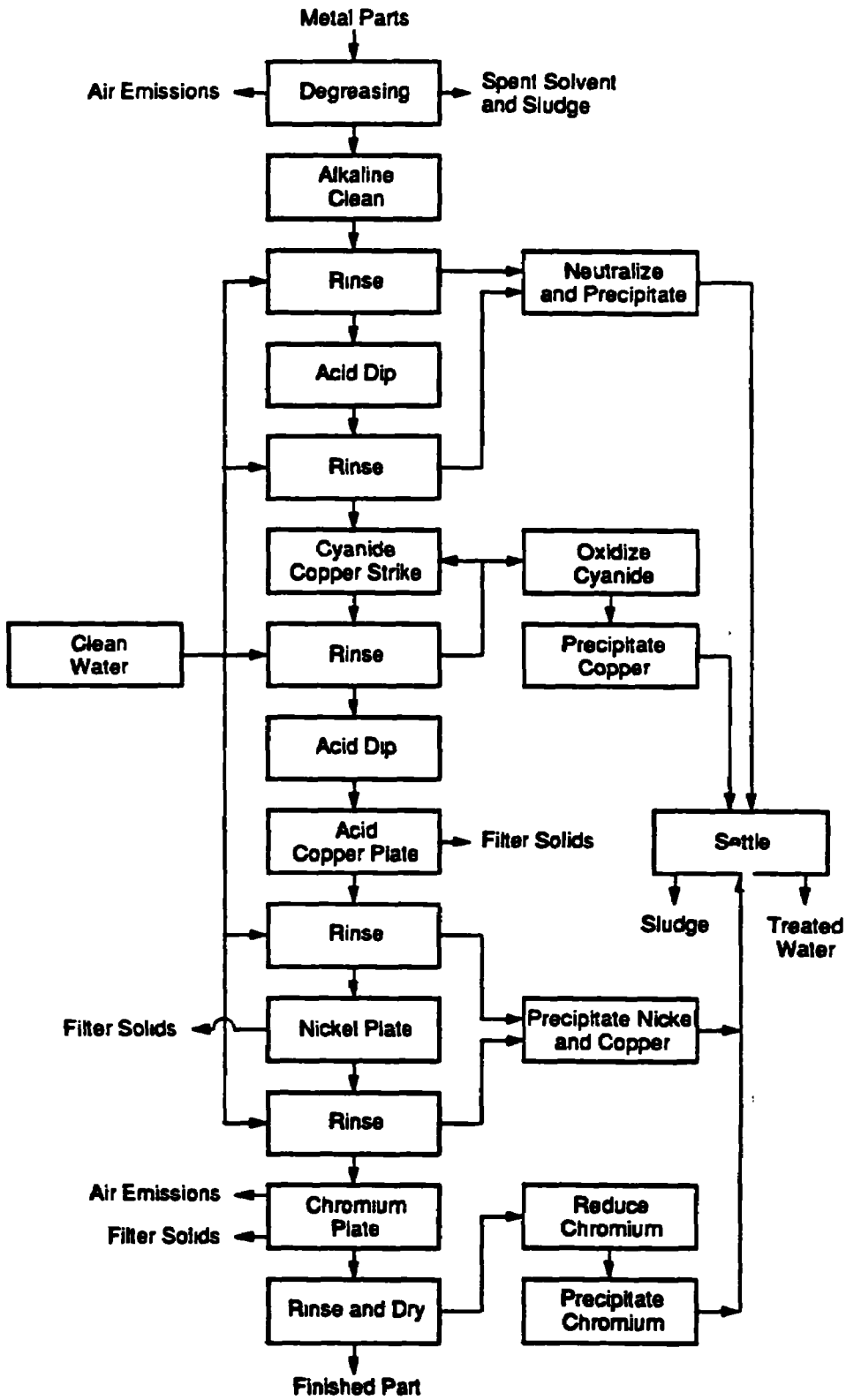

Figure 1. Process flow diagram of chromium plating of decorative zinc die castings.

INTERNATIONAL TECHNOLOGY CORPORATION

Each section contains a description of how the Section 313 chemicals are used, a discussion of typical releases and off-site transfers, a table summarizing releases and off-site transfers that were reported to TRI in 1990, a description of industry-specific and chemical-specific regulations, typical control practices, and common reporting errors. Methods for identifying nonreporting facilities and a list of questions are also presented.

CHLORINATED SOLVENTS

The primary chlorinated solvents used in degreasing prior to electroplating are 1,1,1-trichloroethane and trichloroethylene; CFC-113, tetrachloroethylene, and dichloromethane (methylene chloride) are used to a lesser degree. No Section 313 byproducts are formed during the use of chlorinated solvents in degreasing.

Chlorinated solvents are otherwise used in electroplating to remove unpigmented oil/grease and metal chips/cutting fluid. They may be used as a solvent wipe, in a cold degreaser, or in a vapor degreaser.

In a solvent wipe, a rag or other wiper is dipped in the chlorinated solvent and wiped across the part to remove the contaminant. Cold degreasers usually consist of a tank, basket, and cover, and may employ spraying, brushing, agitation, flushing, or immersion. The solvent is usually kept near room temperature. Cold units vary greatly in size and design.

A vapor degreaser which consists of a tank and heating system to boil the solvent, may be operated manually or it may be conveyorized. In this process, a solvent vapor phase is produced and parts to be cleaned are lowered into the vapor phase. Vapors condense on the parts until the temperature of the part approaches that of the vapor, at which time the parts are removed. Most vapor degreasers are equipped with condenser coils located on the upper sidewalls of the degreaser to control the vapor level in the tank. They may also be equipped with water separators, which are simple containers in which solvent and water that condenses from the ambient air are separated. Lids are commonly closed when the degreaser is not in use.

Degreasing operations primarily produce fugitive and point-source air releases and off-site transfers for solvent recovery or disposal. In vapor degreasing, moisture from air condensing on the cooling coils of the degreaser may result in minimal releases to water or publicly owned treatment works (POTWs). Based on Section 313 reporting for 1990, Table 1 presents a summary of Section 313 reported releases and off-site transfers from solvent degreasing at electroplating facilities.

Various controls may be used to reduce releases and off-site transfers of Section 313 chemicals from electroplating operations. Air releases from the use of

TABLE 1. SUMMARY OF REPORTED RELEASES OF CHLORINATED SOLVENTS FROM ELECTROPLATING FACILITIES

Section 313 chemical	Number of facilities reporting usage[a] (% reporting usage)	Mean release, lb (% reporting to each media)[b]				
		Fugitive	Stack	POTW[c]	Off-site transfer[d]	Total[e]
1,1,1-Trichloroethane	184 (19)	19,159 (85)	33,550 (50)	125 (18)	7,401 (34)	35,877 (99)
Trichloroethylene	97 (10)	21,430 (82)	35,316 (61)	69 (20)	5,652 (49)	42,946 (98)
CFC-113	55 (5)	23,767 (96)	16,704 (25)	4 (5)	3,711 (40)	28,639 (100)
Tetrachloroethylene	35 (4)	24,180 (86)	31,444 (57)	110 (14)	12,465 (31)	43,881 (97)
Dichloromethane	29 (3)	8,127 (93)	39,187 (69)	177 (28)	8,367 (45)	38,515 (100)

[a] A total of 994 facilities in SIC 3471 reported usage of at least one Section 313 chemical above threshold limits in 1990.

[b] Mean release in pounds per year in 1990 for firms reporting release of this chemical and percentage of firms reporting usage of this chemical that reported release to this media. Releases to other media were insignificant.

[c] POTW = Publicly owned treatment works.

[d] Off-site transfer for recycling was not reportable in 1990; transfer for recycling would be significant for chlorinated solvents. The mean release to off-site transfer would be expected to increase significantly in the 1991 reporting year.

[e] The total includes all releases and off-site transfers not just categories summarized in this table.

chlorinated solvents in vapor degreasing may be reduced by application of the following engineering controls and operation and maintenance (O&M) procedures:

Engineering controls

- Lowering the temperature of cooling water.
- Increasing freeboard height (distance between top of vapor phase and top of degreaser).
- Adding low-solvent-level detector.
- Using optimum parts-handling speeds (automatic hoists).
- Adding automatic lid closure.
- Adding extra cooling coils on inlets and outlets.

O&M procedures

- Closing the cover when possible.
- Minimizing drafts.
- Positioning work to minimize dragout (solvent on part when removed from the degreaser).
- Spraying only below the vapor level.
- Avoiding excessively large loads.
- Maintaining equipment.

Waste solvent evaporation can be a major source of air release from cold cleaning. This release occurs when spent solvent is stored in open containers prior to disposal and/or from evaporation at the disposal site. This release can be minimized by covering spent solvent containers and by reclaiming solvent. Another release source, solvent bath evaporation, can be reduced through use of a cover whenever parts are not being cleaned and through adjustment of room and exhaust ventilation rates to minimize drafts. A third release source, solvent carryout, is dependent on the use of a drainage rack. Internal or external racks can be used, depending on the size of the cleaning unit. Also, drainage time must be of adequate duration to ensure that the racks are effective in reducing carryout.

F001 and F002 Generic RCRA* wastes are spent solvent wastes that before use contained over 10 percent listed chlorinated solvents. Off-site transfers of waste chlorinated solvents (RCRA F001 and F002 wastes) can be reduced through use of

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* Resource Conservation and Recovery Act.

on-site solvent recovery. For two of the chlorinated solvents used in degreasing (1,1,1-trichloroethane and CFC-113), use is expected to drop significantly because of environmental regulation by EPA to reduce ozone depletion. These regulations will eventually phase out the use of these solvents entirely and will cause increased control of air releases, substitution, and use of solvent recovery as a result of rising costs solvent costs.

For chlorinated solvents used in degreasing, a mass balance (addressing primarily air release and off-site transfer of waste solvent) which accounts for the total throughput of the solvent (at least 10,000 pounds) is the best methodology to estimate release and off-site transfer. Prior to the 1991 reporting year, this approach is difficult using the Section 313 reported quantities because off-site transfer for recycling of the chlorinated solvents is common and this quantity was not reportable. Beginning with the submittals for the 1991 reporting year, the new pollution prevention reportable quantities will enable a mass balance to be performed if the throughput has been obtained from the facility. A common error in reporting has been the use of the total quantity of waste solvent sent off site (i.e., that reportable under RCRA as F001 and F002 wastes) as the quantity of chlorinated solvent sent off site. Since this overestimates the quantity of chlorinated solvent sent off site, use of this amount in mass balance calculations underestimates the air release of the chlorinated solvent. Although Section 313 reporting does not require the facility to take any measurements, the facility usually can contact the solvent reclaimer to obtain the percentage of chlorinated solvent in the waste solvent.

ACIDS

Sulfuric and hydrochloric acids are the primary acids used as components in electroplating solutions, with nitric and phosphoric acids used to a lesser degree. Acids are otherwise used in electroplating to control the pH of the plating baths, to clean surfaces before and between plating steps, and as postplating treatments (e.g., phosphate treatments). Although acids in electroplating solutions are used to control the pH of the solution to promote the formation of desired ionic metal compounds, there is no net formation of Section 313 byproducts during the use of acids in electroplating. Because hydrogen cyanide gas can form if acid and cyanide solutions are mixed, great care is taken when cyanide is used in the plating bath to avoid mixing the cyanide solution with acids either through dragout or disposal. The primary release of acids is through off-site transfer of spent acid or plating solution and release to water or POTW through dragout to the rinse water. As described in the Metals/Metal Compounds section of this profile, a mist is formed over plating baths as a result of the evolution of gases during the electroplating process. This mist will contain acids from the plating bath. Controls designed to capture metals and cyanides in the bath will also capture the acids in the mist. Although these systems will be pH controlled to limit corrosion problems and to eliminate the possible formation of hydrogen cyanide gas, the pH of any discharges (e.g., scrubber water) should be checked to determine if any acids are released. Based on Section 313 reporting for 1990, Table 2 presents a summary of the reported releases and off-site transfers of acids from the electroplating process.

Neutralization is the primary control used for acid releases. For acid use, a release to surface waters is not reportable under TRI if the pH is 6 or higher. The pH value of wastewater discharged should not be assumed by the facility, but should be verified. Typically, pH monitoring for other regulations is (and should be) retained by the facility. Most electroplating facilities are required to monitor the pH of discharges continuously. These data can be used to calculate water releases if excursions below pH 6 occurred and only one acid is present in the wastewater. The U.S. EPA Pretreatment Standards for Electroplating Facilities[2] requires that facilities with a discharge of

TABLE 2. SUMMARY OF REPORTED RELEASES OF ACIDS FROM ELECTROPLATING FACILITIES

Section 313 chemical	Number of facilities reporting usage[a] (% reporting usage)	Mean release, lb (% reporting to each media)[b]					
		Fugitive	Stack	Water	POTW[c]	Off-site transfer	Total[d]
Sulfuric acid	676 (68)	496 (55)	605 (45)	1386 (5)	7,557 (26)	56,987 (14)	14,127 (74)
Hydrochloric acid	514 (52)	670 (67)	911 (48)	211 (4)	15,006 (26)	34,884 (12)	11,102 (82)
Nitric acid	372 (37)	357 (63)	1469 (58)	2779 (3)	3,984 (28)	13,425 (19)	5,726 (84)
Phosphoric acid	123 (12)	277 (57)	1055 (50)	750 (1)	9,714 (24)	9,765 (14)	5,645 (78)

[a] A total of 994 facilities in SIC 3471 reported usage of at least one Section 313 chemical above threshold limits.

[b] Mean release in pounds per year in 1990 for firms reporting release of this chemical and percentage of firms reporting usage of this chemical reporting release to this media. Releases to other media were insignificant. pH release above 6 is not reportable under Section 313.

[c] POTW = Publicly owned treatment works.

[d] The total includes all releases and off-site transfers not just categories summarized in this table.

more than 38,000 L/day to maintain the pH of the discharge between 7.5 and 10. The U.S. EPA Effluent Limitations for Metal Finishing Facilities[3] requires certain facilities to maintain the pH of the discharges between 6 and 9.

METALS/METAL COMPOUNDS

Metals/metal compounds are processed in electroplating operations. While conversions between metal and metal compounds do occur there are no Section 313 byproducts formed during the use of the metal/metal compounds in electroplating. The purpose of electroplating is to deposit the metal on the surface of the part being plated. Plating baths for the Section 313 chemicals are almost always aqueous solutions.[1] The part being plated is made the cathode, and the metal salts in the aqueous solution are reduced and electroplated onto the part. The thickness of the metal deposit applied by electroplating can vary from 0.025 μm to 1 mm or more in electroforming, with a standard nickel-chromium plate on exterior automotive hardware from 25 to 50 μm.[1]

The major types of electroplating include immersion plating, barrel plating, and brush plating. In immersion plating, the metallic coating is deposited on the base metal from a solution containing the coating metal.[4] Immersion baths are usually inexpensive and permit plating on different surfaces, such as the insides of tubing.[4] In barrel plating, a bulk workload is tumbled in a rotating vessel incorporating electrical contacts to attract metals out of solution onto the parts.[4] The major advantage of barrel plating is high efficiency.[4] Available barrel-plating equipment varies widely, but generally conforms to two major configurations: horizontal and oblique barrels.[4] Brush plating is a process performed with a hand-held or portable plating tool, rather than a tank of solution; it is also called contact plating, selective plating, or swab plating.[4] Half of the time brush plating is used because it is a better way to apply an electroplate and the other half because it is a better repair method for work on mismachined parts.[4]

The anode is the positive electrode in a plating bath; it conducts the current into the solution and, by its shape and position relative to the cathode, influences the distribution of current over the cathode surface. Anodes may be soluble or insoluble, or both may be used in combination.[5] In most plating operations, a soluble anode supplies the metal that is deposited on the cathode; the solution is merely the means by which the metal is carried from anode to cathode. Insoluble electrodes are used

either as cathodes or anodes in electrocleaning, as cathodes in electropolishing, and as anodes in certain plating operations, the most important of which is chromium plating.[5]

An ideal soluble anode has the following desirable characteristics:[5]

1) Corrodes smoothly and evenly under the influence of the current.
2) Produces, in corroding, a minimum quantity of sludge and metallic particles.
3) Corrodes with a high anode efficiency under normal operating conditions.
4) Has a high limiting current density.
5) Has a low rate of solution in the bath (without current).
6) Introduces no objectionable amount of impurities into the bath.

The sole function of an insoluble electrode is to complete the electrical circuit to the solution; hence, it is merely necessary for it to be a good conductor and to be unattacked by the bath with or without current flowing.[5] Insoluble electrodes are used as anodes in plating, as cathodes in electropolishing and anodizing, and as either anodes or cathodes in electrolytic treatments in acid or alkaline solutions, In all such operations there will be strong gassing at the electrode, usually liberating hydrogen at the cathode and oxygen at the anode; however, an insoluble anode in a chloride-bearing electrolyte will release chlorine.[5] In this case, chloride should be reported as manufactured as a byproduct of the process. An insoluble anode will tend to oxidize certain bath constituents as organic addition agents and cyanide. The irreversible reactions occurring at insoluble anodes will materially increase the cell voltage over that required for soluble anodes operating under the same conditions.

Steel, nickel, alloyed lead, and carbon (graphite) serve as insoluble anodes.[5]

Release of metals and metal compounds from electroplating is primarily through off-site transfer of spent plating bath solutions. Significant quantities of metals and metal compounds are also released to water and POTW through dragout from the plating bath to the rinse water and from release of scrubber water used to control air release. Finally, small quantities of metals and metal compounds are released to air (both fugitive and stack) through misting during electroplating. Based on Section 313

reporting for 1990, Table 3 presents a summary of the reported releases and off-site transfers of metals and metal compounds from the electroplating baths.

Releases of several chemicals are strictly regulated for electroplating operations. A summary of the U.S. EPA Pretreatment Standards for the Electroplating Point Source Category is presented in Table 4. For full explanation of these guidelines, see 40 CFR 413. The Pretreatment Standards presented in Table 4 are basically the standards for those facilities discharging into POTWs. A summary of the U.S. EPA Effluent Limitations for the Metal Finishing Point Source Category are presented in Table 5. For full explanation of these guidelines, see 40 CFR 433. The Effluent Limitations presented in Table 5 are the standards for direct discharges to navigable waterways or rivers. The concentrations in Tables 4 and 5 may be used as a guideline to estimate releases; however, local regulations may be more stringent and actual concentrations may be below the allowable levels. The facility would likely be required to monitor for these pollutants. These monitoring data represent the best release estimates, and releases reported should be checked on Form R as calculated using monitoring data.

Releases and off-site transfers of metals and metal compounds are strictly regulated. Because of the effluent guidelines summarized in Table 4 limiting release of cyanide and metals to water, pretreatment of the wastewater may generate a RCRA F006 waste (wastewater treatment sludges from electroplating operations). F006 wastes result primarily from wastewater treatment operations in the electroplating or metal-finishing operations.[6] The leading technology used to remove metals from plating wastewaters include 1) a chromium reduction step to treat hexavalent chromium, 2) a chemical precipitation step to precipitate metals out of solution (using lime or sulfides), and 3) a sludge dewatering step to remove the precipitated residues from solution.[6]

Waste volumes determined from RCRA reporting and estimates or measurement of the concentrations of metals or metal compounds may be used to estimate off-site transfers.

Individual states may have regulations that are more stringent than RCRA. For example, California regulates any spent plating bath that does not fit into one of the other RCRA categories as a hazardous waste under the generic category of spent

TABLE 3. SUMMARY OF REPORTED RELEASES OF METALS AND METAL COMPOUNDS FROM ELECTROPLATING FACILITIES

Section 313 chemical	Number of facilities reporting usage[a] (% reporting usage)	Mean release, lb (% reporting to each media)[b]					
		Fugitive	Stack	Water	POTW[c]	Off-site transfer	Total[d]
Nickel	118 (12)	113 (48)	122 (31)	351 (14)	273 (77)	12,477 (64)	8,969 (92)
Nickel compounds	105 (11)	129 (50)	133 (41)	264 (11)	402 (87)	32,571 (69)	23,754 (96)
Copper	125 (13)	133 (36)	210 (39)	263 (19)	208 (68)	8,885 (66)	6,488 (96)
Copper compounds	61 (6)	97 (39)	633 (48)	205 (21)	295 (80)	19,161 (72)	15,192 (95)
Chromium	76 (8)	169 (63)	187 (72)	104 (14)	239 (62)	14,242 (75)	11,936 (95)
Chromium compounds	96 (10)	106 (57)	197 (59)	136 (8)	272 (79)	16,054 (83)	13,928 (99)
Zinc (fume or dust)	37 (4)	347 (54)	655 (35)	72 (22)	278 (73)	12,402 (70)	9,887 (95)
Zinc compounds	108 (11)	168 (46)	664 (40)	203 (16)	285 (81)	32,019 (84)	28,655 (96)
Lead	35 (4)	127 (43)	535 (40)	259 (11)	117 (60)	8,494 (74)	6,875 (97)
Lead compounds	8 (1)	4 (50)	5 (50)	5 (13)	102 (63)	52,423 (38)	22,550 (88)
Cadmium	23 (2)	128 (43)	152 (43)	260 (4)	166 (91)	8,057 (74)	6,848 (91)
Cadmium compounds	15 (2)	66 (27)	128 (27)	0 (0)	184 (93)	7,162 (87)	6,431 (100)

[a] A total of 994 facilities in SIC 3471 reported usage of at least one Section 313 chemical above threshold limits.

[b] Mean release in pounds per year in 1990 for firms reporting release of this chemical and percentage of firms reporting usage of this chemical reporting release to this media. Releases to other media were insignificant.

[c] POTW = Publicly owned treatment works.

[d] The total includes all releases and off-site trnasfers not just categories summarized in this table.

TABLE 4. SUMMARY OF PRETREATMENT STANDARDS FOR THE ELECTROPLATING POINTSOURCE CATEGORY
[Daily average in mg/L (mg/m² operation)[a,b]

Pollutant	Less than 38,000-L (10,000-gal/day) discharge			More than 38,000-L (10,000-gal/day) discharge		
	Electro-plating common metals	Electro-plating precious metals	Anodizing	Electro-plating common metals	Electro-plating precious metals	Anodizing
Cyanide[c]	2.7	2.7	2.7			
Cyanide, total				1.0 (39)	1.0 (39)	1.0 (39)
Copper				2.7 (105)	2.7 (105)	2.7 (105)
Nickel				2.6 (100)	2.6 (100)	2.6 (100)
Chromium				4.0 (156)	4.0 (156)	4.0 (156)
Zinc				2.6 (102)	2.6 (102)	2.6 (102)
Lead	0.4	0.4	0.4	0.4 (16)	0.4 (16)	0.4 (16)
Cadmium	0.7	0.7	0.7	0.7 (29)	0.7 (29)	0.7 (29)
Total metals[d]				6.8 (267)	6.8 (267)	6.8 (267)
pH				7.5-10	7.5-10	7.5-10
TTO[e]	4.57	4.57	4.57	2.13	2.13	2.13
TSS[f]				13.4	13.4	13.4
Ag					0.7 (29)	

[a] 40 CFR 413 (Electroplating Point Source Category also presents pretreatment standards Subpart E - Coatings Subcategory, Subpart F - Chemical Etching and Milling Subcategory, Subpart G - Electroless Plating Subcategory, and Subpart H - Printed Circuit Board Subcategory.

[b] Values presented are average daily values for 4 consecutive monitoring days. Daily maximum limitations are also presented in 40 CFR 413.

[a] Cyanide amenable to chlorination.

[b] Total copper, nickel, zinc, and chromium.

[c] Total toxic organics listed in 40 CFR 413.02(i).

[d] Total suspended solids. Value presented is a 1-day maximum.

TABLE 5. SUMMARY OF EFFLUENT LIMITATION FOR METAL FINISHING (Monthly average in mg/L)[a]

Pollutant	BPT[b]	BAT[c]	PSES[d]	NSPS[e]	PSNS[f]
Cadmium, total	0.26	0.26	0.26	0.26	0.26
Chromium, total	1.71	1.71	1.71	1.71	1.71
Copper, total	2.07	2.07	2.07	2.07	2.07
Lead, total	0.43	0.43	0.43	0.43	0.43
Nickel, total	2.38	2.38	2.38	2.38	2.38
Silver, total	0.24	0.24	0.24	0.24	0.24
Zinc, total	1.48	1.48	1.48	1.48	1.48
Cyanide[g]	0.32	0.32	0.32	0.32	0.32
Cyanide, total	0.65	0.65	0.65	0.65	0.65
TTO[h]	2.13	2.13	2.13	2.13	2.13
Oil and grease	26			26	
TSS[i]	31			31	
pH	6-9			6-9	

[a] 40 CFR 433 Metal Finishing Point Source Subcategory. Maximums for any one day are also presented.

[b] BPT = Best practicable control technology currently available.

[c] BAT = Best available control technology economically achievable.

[d] PSES = Pretreatment standards for existing sources (except job shops and independent printed circuit board manufacturers.

[e] NSPS = New source performance standards.

[f] PSNS = Pretreatment standards for new sources.

[g] Cyanide amenable to chlorination.

[h] Total toxic organics listed in 40 CFR 433.11(e). Value presented is a 1-day maximum.

[i] TSS = Total suspended solids.

plating bath. Plating solutions containing nickel, for example, are not regulated as hazardous wastes under RCRA (if the pH is greater than 2.0) but are regulated in California. Therefore, records maintained for manifests and reporting requirements could be used as a source for estimating off-site transfers of nickel compounds.

A mist is formed over plating baths due to the evolution of gases during the electroplating process. For example, in a hexavalent chromium plating process only about 10 to 20 percent of the current applied is used to deposit chromium on the item plated. Eighty to ninety percent of the current is consumed by the evolution of hydrogen gas at the cathode with the resultant liberation of gas bubbles. Additional bubbles are formed at the anode due to the evolution of oxygen. As the bubbles burst at the surface of the plating solution, a fine mist of plating bath droplets is formed.

Releases to air from the mist generated from plating baths depend on the surface area of the bath, the applied current, the hours of operation of the bath, the concentration of the metal in the solution, and the controls on the system. Table 6 presents emission factors from the Crosswalk/Air Toxic Emission Factor (XATEF) Database.[7]

Mist generated during electroplating operations can cause threshold limit values (TLVs) for cyanide and some metals to be exceeded in the workplace air. Local exhaust ventilation (LEV) may be used to reduce potential worker exposures. Because LEV creates a point-source release for these toxics, controls may be used such as mist eliminators (usually using impaction of droplets onto a stationary set of blades or mesh pad) or wet scrubbers (typically single and double packed-bed) that are operated at a relatively low pressure drop.[8] Because of the corrosive properties of many of the electroplating baths, the control devices may be constructed of polyvinyl chloride (PVC) or fiberglass.[8]

Since metal discharges are regulated under Effluent Limitations and Pretreatment Standards, most facilities should have monitoring data as required by their permits. Regulatory limits and the wastewater flow rates may be used to estimate maximum release. The metal content of the pretreatment sludge is typically not

TABLE 6. SUMMARY OF EMISSION FACTORS FROM XATEF DATABASE

Process	Metal	Emission factor	Conditions
Cadmium electroplating	Cadmium	0.00005 g/h/amp	Entire process, uncontrolled
Chrome plating, hard	Chromium VI	0.00191 lb/h/ft^2 tank area	Chromic acid anodizing tank, uncontrolled
Chrome plating, hard	Chromium	1.64×10^{-4} lb/h/ft^2 tank area	Plating tank, uncontrolled
Nickel electrodeposition	Nickel	4.95×10^{-7} lb/h/amp	Value is for striking, can be used for plating
Chrome plating, decorative	Chromium VI	1.0×10^{-8} lb/amp hour	Plating tank controlled by foam blanket fume suppressant with wetting agent
Chrome plating, hard	Chromium VI	3.08×10^{-7} lb/amp hour	Plating bath controlled by double packed-bed scrubber followed by chevron blades
Chrome plating, hard	Chromium VI	3.08×10^{-7} lb/amp hour	Plating tank controlled by single packed-bed scrubber
Chrome plating, hard	Chromium VI	1.23×10^{-6} lb/amp hour	Plating tank controlled by double packed-bed scrubber
Chrome plating, hard	Chromium VI	1.76×10^{-7} lb/amp hour	Plating tank controlled by mesh pad mist eliminator with two sets of chevron blades followed by two pads
Chrome plating, hard	Chromium VI	3.96×10^{-7} lb/amp hour	Plating tank controlled by one mesh pad mist eliminator
Chrome plating, hard	Chromium VI	5.9×10^{-7} to 1.2×10^{-6} lb/amp hour	Plating tank controlled by chevron-blade mist eliminators
Chrome plating, decorative	Chromium VI	3.6×10^{-6} lb/amp hour	Plating tank, uncontrolled
Chrome plating, hard	Chromium VI	2.02×10^{-5} lb/amp hour	Plating tank, uncontrolled
Chrome plating, decorative	Chromium	0.00012 lb/h/ft^2 surface area	Chromic acid anodizing tank, uncontrolled
Chrome plating, anodizing	Chromium	6 mg/amp hour	Plating tank controlled by foam additives
Chrome plating, decorative	Chromium	20 mg/amp hour	Plating tank, uncontrolled
Chrome plating, hard	Chromium	0.7 mg/amp hour	Plating tank controlled by scrubber
Chrome plating, hard	Chromium	0.04 mg/amp hour	Plating tank controlled by polyball
Chrome plating, decorative	Chromium	12 mg/amp hour	Plating tank, uncontrolled
Chrome plating, decorative	Chromium	0.001 mg/amp hour	Plating tank controlled by foam additives

available and may be difficult to relate to F006 disposal quantities. The best method to use to estimate this quantity is to estimate the quantity based on the quantity released to water and the control efficiency of the pretreatment. Mass balance calculations for total metal usage are not useful, as most of the metal and metal compounds are deposited on the product. However, a mass balance using measured values of influent and effluent to the wastewater treatment plant may be used when available. The quantities of metal and metal compounds in the spent plating bath may be estimated from disposal quantities and the concentration maintained in the baths during operation.

OTHER SECTION 313 CHEMICALS

Six other Section 313 chemicals are otherwise used at electroplating facilities. The use of these chemicals does not typically form any Section 313 byproducts during use in electroplating. Three are solvents: methyl ethyl ketone (MEK), toluene, and xylene (mixed isomers). These solvents are widely used, and although they may be used at some facilities for cleaning, they are probably used in coatings that are applied elsewhere in the facility and are not directly related to the electroplating process. The other three Section 313 chemicals used at electroplating facilities are ammonia, chlorine, and cyanide compounds. Ammonia may be used to adjust the pH of the plating bath or wastewater treatment operations. Chlorine is used in wastewater treatment and for cyanide destruction. Chlorine gas or hypochlorites are used to break down cyanides in the following reaction:[1]

$$CN^- + Cl_2 \rightarrow CNCl + Cl^-$$
$$CNCl + 2OH^- \rightarrow CNO^- + Cl^- + H_2O$$
$$2CNO^- + 4OH^- + 3Cl_2 \rightarrow 6Cl^- + 2CO_2 + 2H_2O + N_2$$

Cyanide compounds are otherwise used in alkaline plating baths. Cyanide compounds consist of both compounds of the metals being plated (e.g., Cu, Zn, Cd) and compounds of alkali metals (e.g., Na, K). Solutions of these compounds are always basic. When the compound consists of a Section 313 metal and cyanide, two Form Rs are required. One Form R is required to report the metal portion of the metal compound, and a separate Form R is required to report the cyanide portion of the cyanide compound. While the weight of the entire compound is used for the threshold evaluation, only the cyanide portion is used to estimate releases and off-site transfers. While the metal compound is subject to the 25,000-pound threshold because it is processed, the cyanide compound is subject to the 10,000-pound threshold because it is otherwise used.

Great care is taken to avoid mixing the cyanide compounds with any acids because this would cause formation of cyanide gas. The primary release of cyanide compounds results from the off-site transfer of spent plating bath solutions. The plat-

ing baths containing cyanides are RCRA hazardous wastes. Spent cyanide plating bath solutions from electroplating operations are classified as F007 wastes. F008 wastes are plating sludges from the bottom of plating baths in electroplating operations using cyanide. F009 wastes are spent stripping and cleaning bath solutions from electroplating operations using cyanides. Waste volumes determined from RCRA reporting and estimates or measurement of the concentrations of cyanide may be used to estimate off-site transfers. Cyanide releases to water, POTW, or off-site transfer may be estimated by using cyanide measurements made for other regulations and the volume of the waste stream.

Cyanide compounds are also released to water or POTW from dragout to rinsing operations and from scrubber water used to control air releases. Minor releases of cyanide compounds to air (both stack and fugitive) also result from misting during plating operations. The Best Demonstrated Available Technology (BDAT) for treatment for cyanides in F006 wastewaters is alkaline chlorination.[6] Based on Section 313 reporting for 1990, Table 7 presents a summary of the reported releases and off-site transfers for six "other chemicals" used at electroplating facilities.

Chlorine and ammonia releases are minimal. Chlorine reacts with water to form HOCl, Cl^-, and H^+. Although this is an equilibrium reaction, at pH above 4, the equilibrium is shifted almost completely to the right. Therefore, essentially zero releases of chlorine to water will occur under normal circumstances. Small fugitive releases of chlorine to air from tank changeover should be reported.

Because ammonia is a listed Section 313 chemical, all gaseous and aqueous forms must be considered for reporting. Aqueous solutions of ammonia contain both nonionized ammonia (NH_3) and ionized ammonia (NH_4^+). As the following chemical equation shows, an equilibrium exists between the two forms of ammonia in the presence of water.

$$NH_3 + 2H_2O \longleftrightarrow NH_4^+ + OH^- + H_2O$$

The term "total ammonia" refers to the sum of these species (i.e., $NH_3 + NH_4^+$). The relative amounts of NH_3 and NH_4^+ depend upon several factors (e.g.,

TABLE 7. SUMMARY OF REPORTED RELEASES OF OTHER CHEMICALS FROM ELECTROPLATING FACILITIES

Section 313 chemical	Use	Number of facilities reporting usage[a] (% reporting usage)	Mean release, lb (% reporting to each media)[b]					
			Fugitive	Stack	Water	POTW[c]	Off-site transfer	Total[d]
MEK	Solvent	69 (7)	7984 (86)	35,465 (74)	5 (3)	8 (6)	8,334 (46)	36,906 (100)
Toluene	Solvent	51 (5)	7166 (88)	35,585 (92)	5 (6)	7 (4)	13,963 (39)	44,593 (100)
Xylene	Solvent	47 (5)	2891 (85)	20,603 (89)	87 (6)	110 (4)	11,638 (40)	25,587 (100)
Ammonia	Wastewater/ bath pH	54 (5)	1137 (74)	3,621 (46)	151 (4)	7774 (35)	6,756 (15)	7,044 (89)
Chlorine	Wastewater/ cyanide treatment	57 (6)	184 (61)	518 (42)	265 (19)	1710 (49)	253 (5)	1,409 (87)
Cyanide compounds	Plating bath	137 (14)	178 (54)	527 (41)	181 (11)	198 (85)	1,951 (78)	2,089 (97)

[a] A total of 994 facilities in SIC 3471 reported usage of at least one Section 313 chemical above threshold limits.

[b] Mean release in pounds per year in 1990 for firms reporting release of this chemical and percentage of firms reporting usage of this chemical that reported release to this media. Releases to other media were insignificant.

[c] POTW = Publicly owned treatment works.

[d] The total includes all releases and off-site transfers not just categories summarized in this table.

temperature, pH, ionic strength, and other chemical reactions). To account for all forms that are present, estimates of releases for Section 313 should be made for total ammonia.

Ammonia hydroxide solutions should also be considered ammonia because ammonium hydroxide is aqueous ammonia. The commercial products "aqua ammonia" and "ammonium hydroxide" are approximately equivalent to 30 percent solutions of ammonia in water. These products are mixtures of ammonia and water, and therefore should be reported as ammonia.

NONREPORTING FACILITIES

Nonreporting facilities may be identified by comparing lists of facilities in Standard Industrial Classification (SIC) 3471 having more than 10 employees with those facilities that have reported under Section 313. Most facilities that perform electroplating operations and have more than 10 employees should be using at least one Section 313 chemical in excess of the threshold value. Exceptions include facilities that only polish, anodize, or color the products or who electroplate metals that are not reportable under Section 313 [primarily tin, precious metals (gold or platinum), or rare metals (e.g., rhodium)]. Frequently, these cases can be identified by the name of the company. For some facilities, the electroplating operation may be a very small part of a large operation, and SIC 3471 may not be used to identify the facility. Sources of information on facilities in SIC 3471 by employment size class include County Business Patterns (for number of facilities), published by the U.S. Department of Commerce.[9] Another source is Dunn and Bradstreet (D&B), which provides lists of companies by SIC and employment size category.[10] D&B reported 2181 facilities with more than 10 employees in SIC 3471 in 1992.[10] County Business Patterns reported 1760 facilities with more than 10 employees as SIC 3471 in 1989.[9] In 1990, 944 facilities reported under Section 313 using SIC 3471.

A review of the facilities in SIC 3471 in 1990 seemed to indicate some misreporting of whether a chemical was manufactured, processed or otherwise used. This misinterpretation for otherwise used chemicals could cause the facility to use the wrong threshold and not report for some of the otherwise used chemicals.

LIST OF QUESTIONS

The following questions can be helpful to determine if errors were made in Section 313 reporting for electroplating facilities.

Chlorinated Solvents

- Was a mass balance accounting for all chlorinated solvent usage used to estimate releases and off-site transfers?
- Was the percentage of chlorinated solvent in the waste solvent accounted for?
- For vapor degreasing with water separation, was release to water or POTW accounted for?

Acids

- Was pH of releases continuously measured to support any assumption of neutralization?
- Was the percentage of acid in the original acid or solution taken into account in the calculations of threshold?

Metals/Metal Compounds

- Was TCLP used as a measure of metal concentration in any of the calculations? TCLP does not measure metal content but rather leachable metal and should not be used in calculations.
- Were wastewater monitoring data used to estimate release to water or POTW? What was frequency of monitoring?
- Were emission factors used to calculate air releases from plating baths? What is the source of these emission factors?

Other Section 313 Chemicals

- How were other solvents used?
- How were releases for other solvents other than to air estimated?
- Was mass balance for other solvents accounting for total usage calculated?

- If chlorine release to water or POTW was reported, check pH of water. If pH is higher than 4, there is only a very small release to water.
- Was total ammonia used to report ammonia release to water?
- Was cyanide compound release estimated using RCRA reported release quantities?

BIBLIOGRAPHY

1. Kirk-Othmer Encyclopedia of Chemical Technology. Volume 8, Electroplating, pp. 826-868.

2. U.S. Environmental Protection Agency. Effluent Guidelines and Standards for Electroplating. 40 CFR 413 - Electroplating Point Source Category.

3. U.S. Environmental Protection Agency. Effluent Guidelines and Standards for Metal Finishing. 40 CFR 433 - Metal Finishing Point Source Category.

4. Metal Finishing Guidebook and Directory Issue '92, Plating Procedures, pp. 289-371. 1992.

5. Durney, L. J. (ed). Electroplating Engineering Handbook. 4th Edition. 1984. Van Nostrand Reinhold Co.

6. U.S. Environmental Protection Agency. Proposed Best Demonstrated Available Technology (BDAT) Background Document for F006 (Addendum). Volume 12. PB90-166232. Washington, D.C. November 1989.

7. U.S. Environmental Protection Agency. Crosswalk/Air Toxic Emission Factor (XATEF) Database Management System and User's Manual, Version 1.2. U.S. EPA Office of Air Quality Planning and Standards. October 1991. EPA 450/4-91-028.

8. U.S. Environmental Protection Agency. Locating and Estimating Air Emissions From Sources of Chromium (Supplement). EPA/450-2-89-002. PB90-103243. Research Triangle Park, North Carolina. August 1989.

9. U.S. Department of Commerce, Bureau of the Census. County Business Patterns 1989. CBP-89-1. Washington, D.C. 1991.

10. Dunn & Bradstreet. International Dunn's Market Identifier in DIALOG data base File 518, 1992.

11. The Hazardous Waste Consultant. Volume 10, Issue 1. RDB Memos - EPA's Unpublished Regulatory Interpretations, Part II - Electroplating Wastes p 4.6-4.7. McCoy and Associates Inc. January/February 1992.

12. U.S. Environmental Protection Agency. Development Document for Effluent Limitations Guidelines and New Source Performances Standards for the Copper, Nickel, Chromium, and Zinc Segment of the Electroplating Point Source Category. EPA 440/1-74-003A. Washington DC. March 1974.

13. U.S. Environmental Protection Agency. Locating and Estimating Air Emissions From Sources of Chromium. EPA/450-2-89-002. August 1989.

14. U.S. Environmental Protection Agency. Development Document for Effluent Limitations Guidelines and Standards for the Metal Finishing Point Source Category. June 1983. EPA 440/1-83-091.

15. U.S. Environmental Protection Agency. Estimating Releases for Mineral Acid Discharges Using pH Measurements. June 1991. U.S. EPA Office of Toxic Substances, Economics Technology Division.

16. U.S. Environmental Protection Agency. Waste Minimization in Metal Parts Cleaning. August 1989. U.S. EPA Office of Solid Waste and Emergency Response. EPA/530-SW-89-049.

17. U.S. Environmental Protection Agency. Guides to Pollution Prevention - The Fabricated Metal Products Industry. July 1990. EPA 625/7-90-006.

18. U.S. Environmental Protection Agency. Locating and Estimating Air Emissions From Sources of Nickel. EPA 450/4-84-007F. March 1984.

19. U.S. Environmental Protection Agency. Chromium Emissions From Chromium Electroplating and Chromic Acid Anodizing Operations - Background Information for Proposed Standards for NESHAP (National Emission Standards for Hazardous Air Pollutants). December 1990. Preliminary Draft. Vol. I and II.

TRI FACILITY PROFILE, PETROLEUM REFINERIES

by

IT Corporation
11499 Chester Road
Cincinnati, Ohio 45246

Contract No. 68-DO-0020
Work Assignment No. 2-27/2-65/3-18
JTN 830015-5-1

Prepared for

U.S. ENVIRONMENTAL PROTECTION AGENCY
OFFICE OF TOXIC SUBSTANCES
401 M Street, SW
Washington, D.C. 20460

September 1992

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TRI FACILITY PROFILE, PETROLEUM REFINERIES

The purpose of this profile is to assist U.S. Environmental Protection Agency (EPA) Regional Office personnel in conducting SARA Title III, Section 313, inspections. The profile describes key toxic chemicals manufactured, processed, or otherwise used in petroleum refining, describes how these chemicals are used, and identifies key release sources. All Section 313 chemicals reported to the Toxic Release Inventory (TRI) by more than 5 percent of the petroleum refineries are presented in this profile.

For the purposes of this profile, the petroleum refining industry is defined as:

- SIC 2911 - Petroleum Refining

This Standard Industrial Classification (SIC) includes establishments primarily engaged in producing gasoline, kerosene, distillate fuel oils, residual fuel oils, and lubricants through fractionation or straight distillation of crude oil, redistillation of unfinished petroleum derivatives, cracking, or other processes. Establishments in this industry also produce aliphatic and aromatic chemicals as by-products.[1] Major products are aromatic chemicals (including benzene), asphalt, butadiene, butylene, coke, diesel fuel, ethylene, gasoline, greases, jet fuels, kerosene, mineral oils/waxes, naphtha, oils (fuel and lubricating), propylene, solvents, and tar.[1]

Petroleum refineries convert crude oil into products such as liquified petroleum gas, gasoline, kerosene, jet fuel, diesel fuel, fuel oils (home heating oils, etc.), and feedstocks for the petrochemical industry. The petroleum refining industry begins with the storage of crude oil and terminates with the storage of refined products. Crude oil production, distribution of refined products, and production of petrochemicals are generally considered part of other industries.[2]

Crude oil typically contains a wide range of hydrocarbons: paraffins, cyclo-paraffins (naphthenes), and aromatic compounds. Crude oil also contains some sulfur

compounds, a small amount of nitrogen compounds, and small amounts of oxygen compounds or olefins.[3]

Because of the wide range of hydrocarbons found in crude oil, many processes are used at petroleum refineries to yield the desired type and quantity of products. These processes can be grouped into the following classes: separation, conversion, treatment, feedstock and product handling, and auxiliary facilities.

Crude oil is transported to the refinery by either pipeline or tanker and stored in large tanks. The crude oil is washed with water to remove salt and suspended particles before being introduced into the process system.

Figure 1 illustrates a simplified process flow diagram used by refineries in the United States. A more detailed process flow diagram is presented in Appendix A. Distillation is the first process that the crude oil is subjected to at a typical refinery. The distillation process takes place at atmospheric pressure and is used typically to separate numerous fractions boiling below approximately 370°C.

The distillate fractions are then further processed to upgrade the quality of, and remove sulfur and other contaminants from, the distillate to produce a salable product. The following are examples of these processes:

- Naphtha is typically upgraded to increase its octane number and aromatic content by noble-metal catalysts in a fixed-bed reactor;
- Light gas oil is subjected to hydroprocessing, which removes sulfur, nitrogen, oxygen, and metals. Also, hydroprocessing converts unsaturated compounds to saturated compounds to improve burning properties;
- Heavier gas oil is usually processed further by catalytic cracking to yield high-octane gasoline.

The bottoms from the atmospheric distillation are further distilled under vacuum. These distillate fractions are fed to the process stream of heavier gas above and subjected to catalytic cracking.

Vacuum distillation bottoms can be used as fuel or road asphalt or processed further in coking. Coking is a thermal process that cracks heavy oil into a range of lighter products and a solid coke product. The lighter products produced are hydrotreated to yield a salable fuel oil.

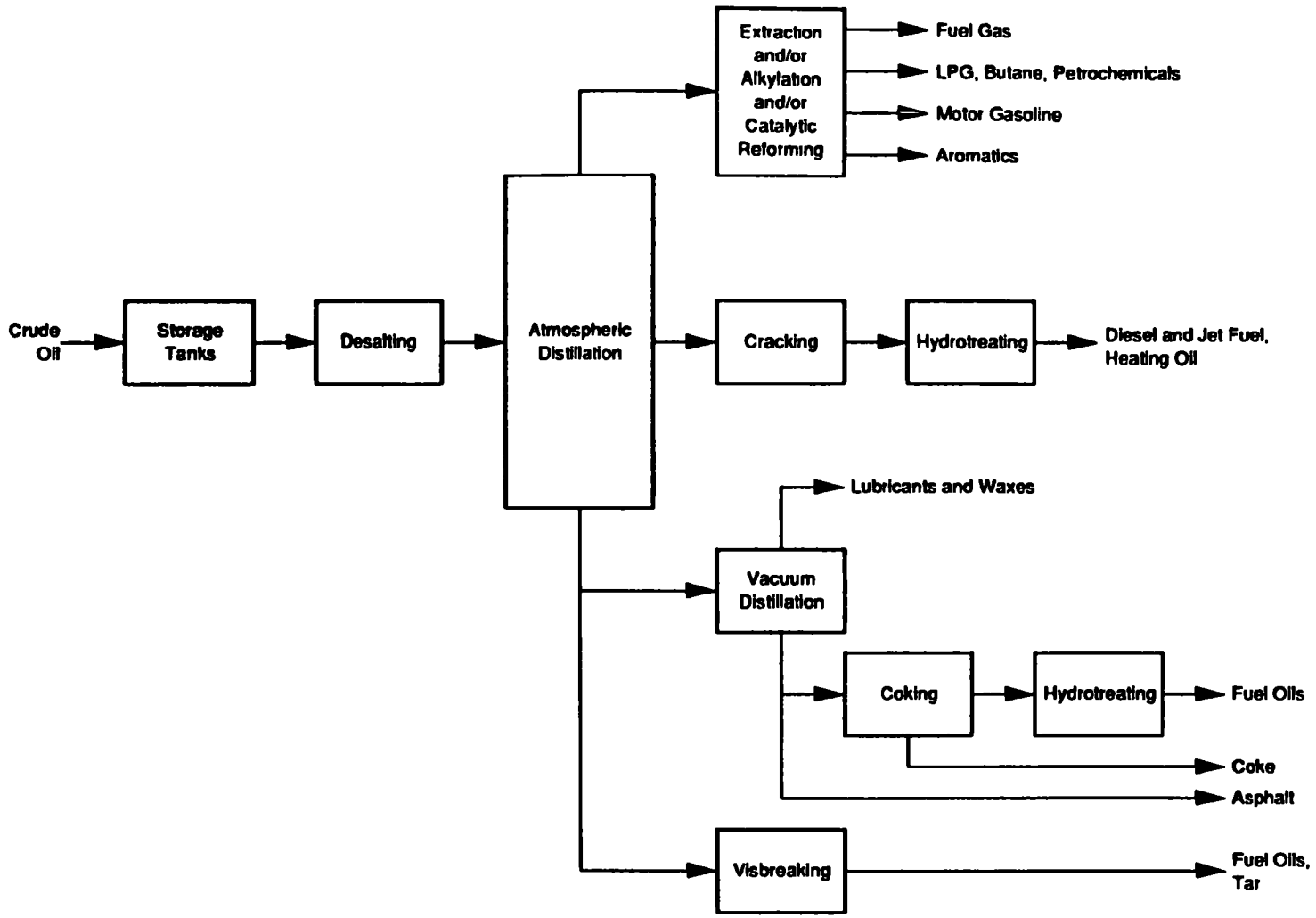

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Figure 1.
Petroleum Refinery Process Flow Diagram.

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TYPICAL REFINERY PROCESSES

Refineries will differ from facility to facility; however, the following categories of processes and associated operations will typically be found at a refinery:

- Separation
- Conversion
- Treatment
- Feedstock and product handling
- Auxiliary facilities

These operations are described in the following sections. The arrangement of the processes varies among refineries, and few will contain all of the processes described in this report.

SEPARATION PROCESSES

The first step in petroleum refining is the separation of crude oil into its major constituents by two separation processes:

- Distillation
- Extraction

Distillation is a unit operation that is used to separate the components of a liquid solution based on the distribution of these various components between a vapor and liquid phase. All components are present in both phases. The liquid mixture is fed to a point along the length of the distillation column. The column contains packing or trays to promote vapor-liquid contact. The liquid at the bottom is heated. As the vapor rises up the column, the vapor is washed of the heavier components by the liquid feed and returned to the liquid phase. This washed vapor fraction is a product stream taken from the process. The fraction may be taken from a variety of heights in the column depending upon the weight of the fraction required. The typical locations are top, middle, and bottom. This type of distillation is called continuous fractionation plate distillation.

The initial distillation of the raw crude oil, also known as primary distillation or atmospheric distillation, is performed under atmospheric pressure and at a bottom

temperature of 370°C to 400°C. The main products of primary distillation are naphtha, light and heavy gas oil, and a bottoms fraction that is usually further processed. The lightest fraction, naphtha, is taken from the top of the tower. The middle fraction contains diesel, jet fuel, and home heating oil. The bottom fraction containing the heaviest components of crude oil is usually processed further by vacuum distillation to yield several valuable products.[3]

Vacuum distillation is the same type of process as the primary distillation, with one distinct change: the column is operated under vacuum pressure instead of at atmospheric pressure. Primary distillation bottoms are subjected to vacuum distillation to increase the yield of high-value distillate oil.

Extraction is a separation process that separates by chemical type in the liquid phase rather than by boiling point differences as is done in distillation. An extraction solvent is introduced to the oil and the chemical species separate from the oil into the solvent. Because of the high cost of extraction compared with distillation, extraction is used only when distillation is not suitable. Extraction is primarily used to remove aromatic compounds, including recovery of benzene, toluene, and xylene from naphtha fractions. Extraction is also used to upgrade the middle distillates: kerosene, diesel, and jet fuel, and to prepare high-quality lubricating oils from the light fraction from vacuum distillation.[3]

CONVERSION PROCESSES

Conversion processes transform crude oil components such as residual oil, fuel oil, and light ends to highly demanded high-octane gasoline. The conversion processes used at refineries are:

- Hydrocracking
- Catalytic cracking
- Coking
- Visbreaking
- Stream cracking
- Alkylation

Hydrocracking is a high-severity process in which high molecular weight compounds are cracked to lower molecular weight, lower boiling compounds. The process operates at high hydrogen pressure of approximately 1500 psig inside the reactor and uses over 1000 cubic feet of hydrogen per barrel of crude oil. This process is typically applied to high-quality kerosene, diesel, and jet fuels low in sulfur and nitrogen in order to produce a naphtha product.[3]

Catalytic cracking was initially in use as a cyclic fixed-bed process; however, current use is almost exclusively as a fluidized process. In the fluidized process, small particles (20 to 200 micron) of catalyst are suspended in upflowing gas and circulated through pipes and valves between reaction and regeneration vessels.[3] This allows for a continuous process and a transfer of heat from the regeneration to the reactor vessel where the heat is needed by the recirculation of the catalyst. The coke burned in the regenerator produces and releases this large amount of heat. The recirculating catalyst is stripped with steam before regeneration to recover hydrocarbons. Temperatures range from 480°C to 510°C in the reactor to 620°C in the regeneration vessel.[3]

The catalysts typically used are a synthetic silica gel activated with 15% to 60% Al_2O_3 or a more active zeolite catalyst. The zeolite catalyst can withstand higher temperatures and is usually regenerated at 700°C to allow for more complete oxidation of carbon monoxide to carbon dioxide. To assure complete combustion of carbon monoxide, a noble metal or other combustion catalyst is added at a parts-per-million level in the regeneration vessel.[3]

The conversion of the fresh feed ranges from 50% to 90% with the use of the zeolite catalyst yielding the higher percent conversion. Part of the feed to the process is refractory and recycled. The typical range of the recycle flow rate is 20% to 50% of the fresh feed.[3]

Catalytic cracking is used at refineries to convert heavy distillates to compounds of lower molecular weight in the boiling range of gasoline and middle distillates. The main objective of catalytic cracking is to increase the yield of gasoline and raise the octane number.

Coking is a high-severity thermal cracking distillation. Two types of coking operations are typically used: delayed coking and fluid coking.

Delayed coking is a cyclic batch operation in which several drums of hot vacuum distillation bottoms are held at approximately 450°C and 5 to 10 psi to deposit coke, while cracked vapors are taken in an overhead stream. Once the coking process is complete in the drum, the drum must be steamed out and the coke removed by a hydraulic cutter nozzle using water at 2030 psi.[3]

Fluid coking is a continuous process in which the hot vacuum distillation bottoms are sprayed into a fluidized bed of hot coke particles. The process is operated at 22 to 36 psi and 510°C or higher by recirculating the coke particles to a burner vessel. The feed vaporizes in the reactor and cracks, which forms a liquid film on the coke particle surfaces. This deposition of the liquid film on the coke particles avoids deposition on the reactor walls and thus avoids high-maintenance costs of delayed coking. Product coke, however, still must be removed from the system in order to keep the average particle size in the range of 100 to 600 microns.[3] Part of the product coke removed from the system is ground and recycled to maintain the desired particle size range in the system.

Gas, naphtha, gas oils, and coke are products from either delayed or fluid coking. The naphtha fraction is hydrotreated and the other light olefins are used in alkylation, both to obtain motor gasoline. The coke produced can be utilized as fuel if SO_x controls are provided in the combustion system, since the coke usually contains as much as 50% higher sulfur content than the feed. Other special coke produced is used in graphite production.[3]

Visbreaking is a thermal cracking process used to decrease the viscosity of the heavy fuel oil to permit handling at lower temperatures. In visbreaking, the primary distillation bottoms are heated in a furnace to approximately 480°C and held at that temperature for sufficient time to yield the desired amount of cracking.[3] Visbreaking yields typically 1% to 2% gas, 5% to 10% naphtha, and 20% to 30% distillate gas oil. The bottoms of the process are usually vacuum distilled to yield a pitch that can be used in asphalt or roofing tar.[3]

Steam cracking is a thermal cracking process operated at 800°C to 850°C and slightly above atmospheric pressure. The hydrocarbon partial pressure is reduced by adding the steam with the feed, thus yielding more olefins. The quantity of steam is usually equal to the weight of the oil feed.[3] This process is typically used to produce olefinic raw materials for petrochemicals manufacture from feed stocks ranging from ethane to vacuum gas oil. The typical feeds are ethane, butane, and naphtha.

Alkylation is a process that reacts olefins of 3, 4, and 5 carbon atoms with isobutane in the presence of a catalyst to yield higher molecular weight products of high octane. Sulfuric acid or hydrofluoric acid is used as the catalyst.

Sulfuric acid alkylation is typically operated at a temperature range of 4°C to 15°C and at a pressure slightly greater than atmospheric. Isobutane is allowed to boil from the reactor to control the heat of reaction; however, chilling of the reactor is required. The feed consisting of olefins and isobutane is injected into the reaction emulsion via high-velocity nozzles. The mixture in the reactor is agitated with mechanical stirrers. The vapor is compressed, condensed, and recycled to the reactor. A large amount of the isobutane is also recycled to the reactor to minimize the undesirable side reactions that produce products of lower octane. Recycled isobutane is obtained by fractionation of the hydrocarbon phase withdrawn from the reactor. Acid is settled out of the liquid hydrocarbon and recycled to the reactor. Some of the acid is replaced with fresh acid on a continuous basis. Fresh acid requirements typically are 90 grams per kilogram of alkylation product.[3]

The hydrofluoric acid alkylation is operated in the same fashion as the sulfuric system with the exception of the operation temperature and pressure. The process temperature ranges from 25°C to 45°C, while the pressure ranges from 101 to 145 psi to keep the hydrofluoric acid in the liquid phase.[3]

TREATMENT PROCESSES

Treatment processes separate petroleum products from less-desirable products and remove objectionable elements such as sulfur, nitrogen, and oxygen. The four upgrading treatment processes used at refineries are:

- Desalting
- Hydroprocessing
- Catalytic reforming
- Chemical sweetening

Desalting is used to remove salt, clay, and other suspended solids that are introduced into the crude oil as a result of contamination in the ground or in the tanker during transportation. Crude oil salt concentration averages approximately 280 grams per 100 cubic meters of crude oil. These contaminants are removed from the crude oil by washing the crude oil with water at a temperature range of 65°C to 90°C to decrease viscosity. Electrostatic precipitation is used to separate the wash water from the crude oil. The desalting process may remove 95% or more of these contaminants with no significant amount of crude oil lost.[3]

Hydrotreating improves oil quality by removing contaminants such as sulfur, nitrogen, oxygen, and metals. Also, unsaturated hydrocarbons are converted to saturated hydrocarbons. The operating conditions depend on the severity of the contamination. Under mild conditions, a fixed bed is used and operated at 200 to 300 psi and 350°C to 400°C without catalyst regeneration. On the other hand, severe conditions require 1000 to 3000 psi and 350°C to 500°C with catalyst regeneration. The typical catalysts used are cobalt/molybdenum or nickel/tungsten of 3- to 6-millimeter size.[3]

During operation, hydrogen gas is recirculated at a high rate to hold the hydrogen sulfide content to only a few percent within the reactor. The recycle stream typically contains 65% hydrogen. The hydrogen sulfide is removed from the gas stream by scrubbing with a solution. Nitrogen compounds are removed from the gas by forming ammonia, and oxygen is removed by forming water.[3]

Net consumption of hydrogen can range from 100 to 1000 cubic feet of hydrogen per barrel of feed.[3] The lower end of the range is the typical range for hydrotreating. The hydrogen needed historically was provided as a by-product from catalytic reforming, but recently the demand for hydrogen has significantly increased

because of its use in sulfur controls and upgrading of heavier stocks. Therefore, hydrogen manufacture has become an essential part of the refinery.

Mild hydrotreating removes sulfur, nitrogen, oxygen, and metals and converts olefins to saturated compounds. Moderate-severity hydrotreating is applied to lube stocks to remove wax or to jet and diesel fuel to saturate the aromatic compounds. Hydrotreating is typically applied to the feed or products of catalytic cracking or on the products of coking or thermal cracking.

Catalytic reforming is a fixed-bed process typically operated at 430°C to 520°C and 145 to 870 psi. A number of fixed-bed reactors typically are used in series and the reactant streams are heated, since the reactions are endothermic. The reactions that occur within the reactors are: dehydrogenation of cycloparaffins, hydrocracking of paraffins, and removal of sulfur, olefins, nitrogen, and oxygen (if present). The reactions yield hydrogen, typically 140 to 180 cubic meters per cubic meter of feed, and C_5 and greater hydrocarbons at approximately 80 to 85% by volume. The hydrogen produced is recycled to minimize carbon deposits within the reactors.[3]

The catalyst typically used may be 0.5% platinum on alumina, which may also contain rhenium or another metal. Chlorine is also added to the catalyst as a promoter and to keep the platinum well dispersed over the catalyst surface. The catalyst is typically replenished at a rate of 25 to 50 kilograms of feed per gram of catalyst. Once spent, the catalyst is regenerated by burning in a low-oxygen atmosphere.[3]

Catalytic reforming is applied to naphtha fractions boiling in the range of 80°C to 230°C to increase the octane for use in motor gasoline. Octane rating is improved in catalytic reforming by removal of low-octane paraffins from the gasoline boiling range. Catalytic reforming is also a source of isobutane for use in gasoline blending or alkylation and a source of benzene, toluene, and xylene for chemicals manufacture.

Chemical sweetening processes remove mercaptans, hydrogen sulfide, and elementary sulfur from light distillates.[3] Sweetening is accomplished in three major ways: oxidation of mercaptans to disulfides, removal of mercaptans, and destruction and removal of elemental sulfur and sulfur compounds (desulfurization).

Oxidation processes use copper chloride solutions with a low pH and air or oxygen to wash the light distillate, typically gasoline. The process involves the oxidation of mercaptans to disulfides and the reduction of cupric chloride to cuprous chloride. The cuprous chloride is then oxidized in the presence of hydrochloric acid and oxygen or air back to the cupric state. Hydrogen sulfide and other sulfur compounds are removed by a preliminary caustic wash.[4]

Mercaptan removal processes typically employ a caustic solution to wash the product. The product is contacted with sodium, calcium, or magnesium hydroxide solution of 5% to 15%. An organic agent may also be used to increase the solubility of mercaptans in the caustic solution.[4]

Desulfurization is obtained by two processes: hydrotreating and solvent extraction. Hydrotreating was previously described. Solvent extraction typically uses sulfuric or hydrofluoric acids.[4]

FEEDSTOCK AND PRODUCT HANDLING

These operations include storage tanks and loading/unloading of transportation vessels. Storage tanks come in five basic designs for feedstock and product storage: fixed roof, external floating roof, internal floating roof, variable vapor space, and pressure (low and high).[4] Transportation vessels include tankers, barges, rail tank cars, tank trucks, and pipelines.

AUXILIARY FACILITIES

Several processes and equipment not directly involved in the refining of crude oil are used at a refinery. Examples of these are boilers, wastewater treatment facilities, hydrogen plants, cooling towers, and sulfur recovery units. Products from these are required by several process units throughout the refinery.

SECTION 313 PETROLEUM REFINING CHEMICALS

Section 313 chemicals commonly used in petroleum refining can be classified into five general categories: constituents of crude oil, manufactured products, processed and otherwise used chemicals, metals/metal compounds, and acids. Each category is discussed separately in this report. Each section contains a description of how the Section 313 chemicals are used, a table summarizing releases and off-site releases that were reported to TRI in 1990, a discussion of typical releases and off-site transfers, and typical control practices. Also presented are methods for identifying nonreporting facilities, a description of industry-specific and chemical-specific regulations, common reporting errors, and a list of questions.

CONSTITUENTS OF CRUDE OIL

Crude oil contains a wide range of saturated and unsaturated hydrocarbons, sulfur compounds, nitrogen compounds, oxygen compounds, and metals/metal compounds. The metals/metal compounds are described in a later section. This section discusses the releases of hydrocarbons and ammonia--constituents of crude oil and Section 313 listed chemicals. Table 1 presents a summary of Section 313 reported releases and off-site transfers of crude oil constituents from petroleum refineries.

The type of crude used at a refinery will determine which of the chemicals listed in Table 1 will be reported. In most crude oils, ammonia will be below de minimis concentrations. These levels may be concentrated during processing or formed during hydrotreating, however, and therefore surpass the de minimis concentration; therefore, reporting would be required.

Crude oil is the main feed stock to a petroleum refinery. Releases of Section 313 listed constituents from crude oil can occur in the following areas.

- Loading/unloading transportation vessels
- Storage tanks
- Leaking compressors, pumps, valves, and flanges
- Flares
- Catalyst regeneration
- Process drains/wastewater
- Tank bottoms/sludges
- Wastewater treatment

These releases are primarily fugitive and point-source air releases with smaller releases to water, land, publicly owned treatment works (POTW), and off-site transfers.

Fugitive emission sources include valves, flanges, pump seals, compressor seals, process drains, pressure vessel relief valves, cooling towers, and oil/water separators. Controls to minimize fugitive releases of crude oil constituents include good operation and maintenance (O&M) procedures for the facility. Some of these O&M procedures include: 1) regular inspection of storage tanks, process vessels, piping, pumps, and valves to maintain structural integrity and proper operation,

TABLE 1. SUMMARY OF REPORTED RELEASES OF CONSTITUENTS OF CRUDE OIL FROM PETROLEUM REFINERIES

Section 313 chemical	Number of facilities reporting usage[a] (% reporting usage)	Mean release, lb (% reporting to each media)[b]						
		Fugitive	Stack	Water	Land	POTW[c]	Off-site transfer	Total[d]
Benzene	196 (100)	19,636 (98)	13,825 (94)	118 (41)	10,657 (34)	4,865 (19)	1,548 (50)	38,501 (100)
Toluene	189 (96)	38,552 (98)	23,739 (93)	142 (39)	2,383 (34)	5,548 (19)	2,778 (49)	63,874 (99)
Xylene (mixed isomer)	169 (86)	26,119 (98)	14,263 (93)	142 (36)	6,433 (33)	3,513 (17)	5,646 (51)	44,803 (100)
Ethylbenzene	163 (83)	6,588 (98)	3,543 (94)	102 (40)	1,092 (31)	774 (19)	1,251 (51)	11,021 (100)
Cyclohexane	149 (76)	8,985 (98)	5,861 (92)	68 (33)	436 (22)	1,621 (10)	974 (30)	14,787 (100)
1,2,4-Trimethylbenzene	125 (64)	9,208 (94)	3,373 (95)	85 (34)	294 (22)	703 (10)	4,318 (34)	13,738 (100)
Ammonia	116 (59)	26,899 (73)	106,548 (44)	40,444 (72)	17,069 (16)	82,746 (16)	2,841 (16)	426,024 (98)
o-Xylene	25 (13)	13,375 (100)	8,743 (96)	69 (40)	292 (28)	896 (16)	1,215 (48)	22,604 (100)
p-Xylene	23 (12)	22,868 (100)	20,717 (96)	67 (43)	228 (30)	85 (13)	773 (48)	43,164 (100)
m-Xylene	22 (11)	20,135 (100)	10,398 (95)	83 (45)	196 (32)	253 (14)	1,732 (45)	30,981 (100)

[a] A total of 196 facilities in SIC 2911 reported usage of at least one Section 313 chemical above threshold limits in 1990.

[b] Mean release in pounds per year in 1990 for firms reporting releases of this chemical and percentage of firms reporting usage of this chemical that reported release to this media. Releases to other media were insignificant.

[c] POTW = Publicly owned treatment works.

[d] The total includes all releases and off-site transfers, not just categories summarized in this table.

2) regular equipment changes to prevent leaks, 3) off-loading of crude oil from, and loading of products onto, transportation vessels in a manner that minimizes spills and releases, 4) proper maintenance of heat exchangers and condensers to minimize contamination of cooling water (thus minimizing emissions from cooling towers), and 5) covering wastewater systems such as oil/water separators and settling basins. These fugitive releases can be estimated by utilizing established emissions factors such as those presented in Appendix A.

Releases from storage tanks depend upon the tank type. Five basic tank designs are used for material storage at refineries: fixed roof, external floating roof, internal floating roof, variable vapor space, and pressure (low and high).[5]

Fixed roof tanks, the minimum acceptable equipment for storage of organic liquids, are typically equipped with a pressure/vacuum vent that allows for operation at a slight internal pressure/vacuum to prevent the release of vapors during slight changes in temperature, pressure, and/or liquid level. This vent is the emission point of the vapors to the atmosphere. These emissions can be controlled by the installation of an internal floating roof and seals to minimize vaporization of the contained product, use of a vapor recovery system to collect vapors and convert them to liquids, or thermal oxidation (incineration) of the vapors.[5]

External and internal floating roof tanks consist of a cylindrical steel shell with a movable roof that floats on the surface of the contained liquid. The internal floating roof tank, however, has a permanent fixed roof outside of the floating roof. The liquid surface is completely covered with the exception of a small annular space between the floating roof and the tank wall. A seal attached to the roof fills this annular space and contacts the tank wall. This seal is the release point of emissions from external and internal floating roof tanks. These emissions can be controlled by regular replacement of the seals and use of multiple seals to minimize emissions.[5]

Variable vapor space tanks have expandable vapor reservoirs to accommodate vapor volume fluctuations caused by temperature and barometric changes. The two common types of variable vapor space tanks are: lifter roof and flexible diaphragm tanks. Lifter roof tanks have a telescoping roof with a space between the roof and

tank wall that is a trough filled with liquid or filled with a flexible coated fabric. Flexible diaphragm tanks have flexible membranes that provide the expandable volume. Emissions occur when the vapor storage capacity is displaced with liquid during filling operations. These emissions can be controlled by regular replacement of the seals and by not surpassing tank vapor capacity.

Pressure tanks are typically used for storing organic liquids and gases with high vapor pressures. There are high and low operating pressure classes of tanks. Both classes have a pressure/vacuum vent set to release pressure only as a safety feature. High-pressure tanks can be operated with virtually no emissions. On the other hand, low-pressure tanks can produce emissions by atmospheric venting during filling operations. Typical controls on low-pressure tanks are vapor recovery systems to contain releases.

Flares can be an emission source at a refinery. Typically, flares are considered to be 98% efficient.[5] Thus, some estimation or monitoring data is required to estimate flare releases. The refinery's process control equipment usually records process upsets. Temperature and pressure data recorded at the time of the upset can be used to perform mass balances to estimate the quantity of material sent to the flare.

Oil/water separators and process drains/wastewater are sources of air emissions. Typically, emissions factors are used to estimate total VOC emissions from these operations. These emissions factors are presented in Appendix A.

Catalyst regeneration can be a source of air emissions. Emissions can include hydrocarbons, ammonia, and acids. Catalyst regeneration processes are described in the Section titled "Metals/Metal Compounds." Controls used to minimize these emissions are incineration of flue gases and use of high-efficiency cyclones.

Process wastewater and oil/water separators are a source of releases to water or POTWs. Plant effluent monitoring can supply data needed to calculate these releases. Typical controls to minimize releases include high-efficiency oil/water separators.

Off-site transfers of crude oil constituents typically include tank bottoms and other unusable sludges from processing and cleaning of process equipment. These transfers are typically sent to recyclers, fuel blenders, or landfills.

MANUFACTURED PRODUCTS

Several Section 313 chemicals are manufactured at petroleum refineries. These chemicals are hydrocarbons produced for use as chemical feedstocks or blended into petroleum products. Table 2 presents a summary of Section 313 reported releases and off-site transfers of manufactured products from petroleum refineries.

The chemicals listed in Table 2 are typically manufactured in cracking processes, in coking, and in catalytic reforming. Once the feed is cracked in hydrocracking, steam cracking, and/or catalytic cracking, chemicals are formed into product streams that are fed directly to storage tanks or to other processes, including chemical sweetening and catalytic reforming. The products are then fed to storage tanks prior to use in gasoline blending or petrochemical refining.

Releases of the products manufactured thus can occur from the conversion processes on through product storage. These releases can occur from the following:

- Loading products into transportation vessels
- Product storage tanks
- Leaking compressors, pumps, valves, and flanges
- Flares
- Catalyst regeneration
- Process drains/wastewater
- Tank bottoms/sludges
- Wastewater treatment

These release sources are discussed in the previous section on releases of constituents of crude oil. The difference between this section and the previous one, however, is that the chemicals in this section are manufactured during the process and are not present in the feedstock crude oil. Therefore, these chemicals pass through fewer pumps, valves, flanges, etc., than do the chemicals present in the crude oil.

TABLE 2. SUMMARY OF REPORTED RELEASES OF MANUFACTURED PRODUCTS FROM PETROLEUM REFINERIES

Section 313 chemical	Number of facilities reporting usage[a] (% reporting usage)	Mean release, lb (% reporting to each media)[b]						
		Fugitive	Stack	Water	Land	POTW[c]	Off-site transfer	Total[d]
Propylene	123 (63)	34,598 (76)	38,555 (61)	192 (3)	41 (1)	0 (0)	33 (2)	56,708 (100)
Ethylene	108 (55)	16,222 (93)	30,522 (51)	271 (3)	5 (1)	0 (0)	62 (2)	31,149 (98)
Naphthalene	92 (47)	4,658 (86)	1,316 (77)	96 (37)	3,997 (29)	154 (8)	3,231 (55)	8,505 (96)
1,3-butadiene	74 (38)	3,412 (96)	3,171 (49)	87 (9)	1 (1)	0 (0)	89 (4)	4,985 (97)
Phenol	60 (31)	9,838 (48)	16,748 (35)	3,161 (77)	474 (23)	89,481 (30)	e	79,622 (98)
Cumene	54 (28)	15,382 (89)	15,163 (76)	59 (30)	272 (13)	128 (4)	766 (26)	26,073 (98)
Cresol (mixed isomer)	28 (14)	2,522 (61)	35 (39)	166 (36)	310 (25)	6,814 (14)	1,321 (25)	3,483 (86)
Methyl tert-butyl ether [MTBE]	23 (12)[f]	6,213 (91)	24,813 (96)	1,561 (17)	430 (4)	35,470 (9)	191 (9)	38,834 (96)
Styrene	12 (6)	910 (92)	323 (67)	65 (58)	14 (17)	10 (8)	8 (25)	1,092 (100)
Biphenyl	10 (5)	2,281 (80)	635 (50)	19 (40)	0 (0)	0 (0)	2,134 (50)	3,574 (90)
Methanol	7 (4)[f,g]	4,355 (100)	12,971 (71)	5 (14)	0 (0)	236,342 (29)	36 (14)	81,152 (100)

[a] A total of 196 facilities in SIC 2911 reported usage of at least one Section 313 chemical above threshold limits in 1990.

[b] Mean release in pounds per year in 1990 for firms reporting releases of this chemical and percentage of firms reporting usage of this chemical that reported release to this media. Releases to other media were insignificant.

[c] POTW = Publicly owned treatment works.

[d] The total includes all releases and off-site transfers, not just categories summarized in this table.

[e] Mean value is not representative because of a very large value at one facility and the small number of facilities.

[f] The number of facilities reporting usage as manufactured. Facilities that do not report as manufactured are not included.

[g] The total reported usage of manufactured, processed, and otherwise used is greater than 5% of the number of facilities reporting usage.

PROCESSED AND OTHERWISE USED CHEMICALS

Several chemicals are processed and/or otherwise used at petroleum refineries. Chemicals that are processed are typically blending additives added to a product. On the other hand, otherwise used chemicals are used at refineries in a variety of ways including to clean and maintain process equipment. Metals/metal compounds or acids that are processed or otherwise used are discussed in separate sections. Table 3 presents a summary of processed and otherwise used chemical releases from petroleum refineries.

Processed chemicals are hydrocarbon compounds added as an aid in product formulation. The following are chemical additives and their uses:

- Methanol is blended with gasoline as a gas-line antifreeze.
- Methyl tert-butyl ether, 1,2-dichloroethane, and 1,2-dibromoethane are blended with gasoline as anti-knock agents or to increase octane levels.
- 2-methoxyethanol is blended with military jet fuel as a deicer component.

These chemicals are typically introduced in storage tanks and blended within the tank. Thus, releases can occur from tanks, product loading/unloading of transportation vessels, and process fittings (valves, flanges, etc.). Process controls are discussed in the previous section titled "Constituents of Crude Oil."

Otherwise used chemicals aid in the operation and maintenance of the petroleum refinery. Chlorine is added to process cooling water systems to control biological fouling in the system. Chlorine is also added to maintain the platinum dispersion over the catalyst surface of platinum-based catalysts used in catalytic reforming. Chlorine may be released to air as a result of the handling and storage of chlorine gas. Diethanolamine, 1,1,1-trichloroethylene, carbon tetrachloride, methyl ethyl ketone, acetone, and glycol ethers are used as refinery cleaners. These cleaners are used to clean tanks, reactors, and other process equipment of sludges and other fouling materials. Diethanol amine (DEA) is also otherwise used as a scrubbing agent in the refinery's light-ends recovery system. Uncondensed gases of five carbon

TABLE 3. SUMMARY OF REPORTED RELEASES OF PROCESSED AND OTHERWISE USED CHEMICALS FROM PETROLEUM REFINERIES

Section 313 chemical	Number of facilities reporting usage[a] (% reporting usage)	Mean release, lb (% reporting to each media)[b]						
		Fugitive	Stack	Water	Land	POTW[c]	Off-site transfer	Total[d]
Chlorine	109 (56)	1,018 (69)	4,881 (35)	1,292 (14)	393 (2)	841 (4)	0 (0)	3,135 (83)
Methanol	68 (35)[e]	5,375 (84)	2,323 (65)	56,610 (18)	5,440 (7)	124,673 (9)	160 (7)	33,308 (96)
Diethanolamine	54 (28)	2,378 (44)	103 (9)	f	47 (11)	f	117 (13)	63,263 (72)
Methyl tert-butyl ether	47 (24)[e]	9,744 (77)	14,810 (91)	1,037 (28)	266 (9)	f	5 (2)	22,600 (100)
1,1,1-Trichloroethylene	37 (19)	6,226 (84)	90 (19)	72 (24)	250 (3)	7,219 (8)	2,781 (14)	6,574 (95)
Carbon tetrachloride	31 (16)	1,605 (94)	226 (29)	49 (13)	128 (6)	0 (0)	1,133 (10)	1,808 (94)
1,2-Dichloroethane	25 (13)	513 (64)	126 (16)	87 (4)	100 (4)	167 (12)	53 (8)	570 (68)
Ethylene glycol	25 (13)	2,635 (48)	f	f	f	22,732 (8)	175 (8)	20,020 (68)
1,2-Dibromoethane	23 (12)	120 (65)	201 (22)	0 (0)	63 (7)	250 (4)	45 (7)	206 (74)
2-Methoxyethanol	23 (12)	644 (78)	350 (57)	27 (13)	66 (17)	5 (4)	0 (0)	825 (87)
Methyl ethyl ketone	21 (11)	185,803 (90)	25,388 (48)	591 (38)	344 (14)	0 (0)	1,533 (14)	189,725 (95)
Acetone	11 (6)	43,011 (100)	58,880 (55)	4,400 (18)	1,767 (18)	87,875 (18)	928 (18)	98,349 (100)
Glycol ethers	11 (6)	f	129 (45)	0 (0)	331 (18)	34,000 (9)	0 (0)	6,843 (64)

[a] A total of 196 facilities in SIC 2911 reported usage of at least one Section 313 chemical above threshold limits.

[b] Mean release in pounds per year in 1990 for firms reporting releases of this chemical and percentage of firms reporting usage of this chemical that reported release to this media. Releases to other media were insignificant.

[c] POTW = Publicly owned treatment works.

[d] The total includes all releases and off-site transfers, not just categories summarized in this table.

[e] The number of facilities reporting usage as processed and/or otherwise used. Facilities that have reported as manufactured are not included.

[f] Mean value is not representative because of a very large value at one facility and the small number of facilities.

atoms or less are compressed, scrubbed with an amine to remove H_2S, and then used for liquified petroleum gas (LPG) or as fuel in refinery furnaces. Air releases of DEA may occur through scrubber stacks or from material handling and storage. Wastestreams containing DEA from the scrubber may be released to water or transferred off site to a POTW. Methyl ethyl ketone (MEK) is otherwise used in solvent separation extractions. Many refineries use MEK in azeotrophic distillation processes to produce high quality toluene. MEK is also used to purify lubricating oils by removing wax from waxy distillates. MEK releases to air occur during distillation and from the filtration process to remove waxes from lubricating oils.

Glycol ethers are processed as detergent additives in gasoline. Ethylene glycol is typically used in closed refrigeration systems with a lesser amount used in fire foam systems.

Releases of these otherwise used chemicals can occur from many pathways. Releases of chlorine may occur from storage tanks, process water, and cooling towers. Process water typically is discharged to water and/or POTWs, and cooling tower emissions are released directly to the air. Releases from process equipment cleaning chemicals are mostly fugitive emissions from evaporation of the solvents during cleaning operations. The cleaners may also be mixed into the sludge material cleaned from the equipment that is transferred off site. Some of the higher boiling solvents may remain in the rinse water and be released to water and/or POTWs through process drains and wastewater treatment activities.

Controls typically used to minimize the releases of otherwise used chemicals include: using solvent cleaners in an enclosed environment and venting of the hydrocarbon vapors from cleaning to a vapor collection system.

METALS/METAL COMPOUNDS

Metals/metal compounds are processed and otherwise used in petroleum refinery operations. Metals/metal compounds are introduced into the refinery by metal contamination in the crude oil, as a metal catalyst used in catalytic processes, from catalyst regeneration on site, as metal compound additives to the petroleum products, and as metal compound additives to other process streams. Table 4 presents a summary of reported releases of metal/metal compounds from petroleum refineries.

Metal contamination in crude oil is typically from nickel and nickel compounds. When crude oil is introduced to the refinery, the typical concentration of the nickel is a few hundred parts per million (ppm)--well below the de minimis level. The nickel tends to concentrate in the residuum and other heavy bottoms, however, and may become concentrated enough to exceed the de minimis level.

Several metal/metal compound catalysts are used at a refinery. Section 313 metal catalysts include cobalt/molybdenum, nickel/tungsten, and copper chloride solution. Cobalt/molybdenum and nickel/tungsten catalysts are used in hydrotreating. These catalysts are regenerated by burning deposits off the surface in a low-oxygen atmosphere at 500°C to 600°C.[3] This regeneration process can be a source of air emissions. The regeneration off-gases typically pass through a CO boiler and particulate control system before being emitted. The copper chloride solution catalyst is used in chemical sweetening to remove sulfur compounds. The off-gases from this process typically pass through a sulfur scrubber, thus removing any entrained copper compound. This scrubber solution, however, can be released to water and/or POTW.

Several metal compound additives are used at petroleum refineries. These additives include barium compounds, lead/lead compounds, and manganese compounds. Barium compounds (barium sulfonates or phenates) are typically detergent additives added to lubricant products.[4] Lead/lead compounds (tetraethyllead) and manganese compounds are octane-boosting additives that may be added to motor gasoline. These additives are typically blended with the products after the main

TABLE 4. SUMMARY OF REPORTED RELEASES OF METALS AND METAL COMPOUNDS FROM PETROLEUM REFINERIES

Section 313 chemical	Number of facilities reporting usage[a] (% reporting usage)	Mean release, lb (% reporting to each media)[b]						
		Fugitive	Stack	Water	Land	POTW[c]	Off-site transfer	Total[d]
Lead	17 (9)	152 (47)	223 (24)	152 (29)	115 (24)	153 (12)	286 (76)	432 (100)
Lead compounds	58 (30)	197 (43)	168 (31)	390 (36)	4,715 (40)	629 (14)	8,434 (59)	7,861 (91)
Chromium	17 (9)	250 (18)	3,437 (29)	252 (76)	e	2,232 (18)	6,849 (71)	20,604 (100)
Chromium compounds	44 (22)	2,214 (39)	6,332 (50)	780 (68)	5,281 (55)	2,217 (20)	7,224 (75)	13,306 (100)
Nickel	22 (11)	110 (45)	1,221 (54)	191 (50)	7,045 (27)	338 (9)	17,641 (77)	16,395 (100)
Nickel compounds	33 (17)	1,044 (12)	415 (36)	555 (52)	4,409 (39)	189 (15)	8,292 (70)	9,331 (88)
Zinc compounds	38 (19)	1,068 (21)	1,319 (39)	1,205 (55)	3,722 (39)	3,725 (21)	11,695 (55)	11,319 (89)
Molybdenum trioxide	36 (18)	115 (17)	86 (8)	1,078 (8)	1,128 (17)	0 (0)	20,880 (22)	9,888 (50)
Manganese compounds	23 (12)	137 (35)	953 (26)	772 (35)	e	0 (0)	605 (17)	5,239 (78)
Cobalt compounds	17 (9)	87 (18)	23 (12)	395 (24)	6 (35)	0 (0)	883 (53)	947 (76)
Copper compounds	13 (7)	e	67 (8)	373 (62)	1,819 (38)	500 (15)	2,400 (46)	5,069 (85)
Barium compounds	9 (5)	0 (0)	e	2,146 (56)	6,433 (33)	0 (0)	1,473 (56)	12,335 (78)

[a] A total of 196 facilities in SIC 2911 reported usage of at least one Section 313 chemical above threshold limits in 1990.

[b] Mean release in pounds per year in 1990 for firms reporting releases of this chemical and percentage of firms reporting usage of this chemical that reported release to this media. Releases to other media were insignificant.

[c] POTW = Publicly owned treatment works.

[d] The total includes all releases and off-site transfers, not just categories summarized in this table.

[e] Mean value is not representative because of a very large value at one facility and the small number of facilities.

petroleum processing units and before product storage. Thus, releases are limited to blending tanks through product storage tanks and transportation vessels. Controls typically used are those discussed previously for storage tank controls. Off-site transfers are usually limited to off-spec products and spills/leaks of liquid materials.

Several metal compound additives are added to other process streams including chromium/chromium compounds and zinc compounds. These compounds are added to cooling water to inhibit corrosion within the system. These metals can be released by the cooling tower and as discharges to water or POTWs. Controls used to minimize these releases include ion exchange and precipitation processes. These control processes can result in off-site transfers of regeneration liquids and precipitate sludges.

ACIDS

Several acids are used at petroleum refineries. These acids are used as catalysts or for pH control, desulfurization, and resin regeneration. The four acids reported to TRI in 1990 are: sulfuric, hydrofluoric, phosphoric, and hydrochloric acids. Table 5 presents a summary of reported releases of acids from petroleum refineries.

Sulfuric acid may be used in many processes. Sulfuric acid is used as a catalyst in alkylation, for pH control in cooling towers, and to regenerate resin beds in boiler feed water systems. Releases can occur from these processes by leaks in process piping, pumps, valves, etc. Spent acid streams typically are treated in the wastewater treatment system and/or transferred off site.

Hydrofluoric acid can be used as an alternative catalyst in alkylation. Releases and off-site transfers of hydrofluoric acid can occur in the same pathways as sulfuric acid in alkylation.

Phosphoric acid is used in the wastewater treatment facilities. The acid is used to adjust the pH of the water and to supply phosphorus to the biological organisms within the system. Air releases can occur from open-top tanks, and liquid releases can occur in the piping, valves, etc. and from spills. Off-site transfers are typically from spills and spent acid.

Hydrochloric acid is used in chemical sweetening processes to keep the pH of the copper chloride solution low so that the cuprous chloride will oxidize back to the cupric state in the presence of air/oxygen. These releases are typically limited to the sweetening process and wastewater treatment areas with potential releases to water and POTWs. Neutralization is used to control water and POTW releases and off-site transfers.

TABLE 5. SUMMARY OF REPORTED RELEASES OF ACIDS FROM PETROLEUM REFINERIES

Section 313 chemical	Number of facilities reporting usage[a] (% reporting usage)	Mean release, lb (% reporting to each media)[b]						
		Fugitive	Stack	Water	Land	POTW[c]	Off-site transfer	Total[d]
Sulfuric acid	127 (65)	207 (32)	6,059 (22)	164 (4)	1,065 (9)	940 (3)	1,171 (6)	3,415 (47)
Hydrofluoric acid	60 (31)	3,929 (90)	7,495 (40)	5 (2)	697 (2)	84 (2)	1,264 (8)	7,257 (92)
Phosphoric acid	57 (29)	148 (19)	103 (9)	383 (4)	e	0 (0)	e	44,227 (39)
Hydrochloric acid	38 (19)	2,650 (37)	17,155 (39)	5 (3)	2,336 (5)	0 (0)	1,825 (5)	12,664 (66)

[a] A total of 196 facilities in SIC 2911 reported usage of at least one Section 313 chemical above threshold limits in 1990.

[b] Mean release in pounds per year in 1990 for firms reporting releases of this chemical and percentage of firms reporting usage of this chemical that reported release to this media. Releases to other media were insignificant.

[c] POTW = Publicly owned treatment works.

[d] The total includes all releases and off-site transfers, not just categories summarized in this table.

[e] Mean value is not representative because of a very large value at one facility and the small number of facilities.

USE OF REGULATIONS TO ESTIMATE RELEASE OF SECTION 313 CHEMICALS

Two regulations that may provide assistance in estimating emissions of Section 313 chemicals are the effluent guidelines and standards governing water releases and the standards of performance for new stationary air sources. Because the Section 313 chemical concentration is highly variable between facilities, neither set of regulations is directly applicable. The regulations may require monitoring or other testing, however, and may be used to estimate releases of the Section 313 chemicals.

WATER RELEASES

The EPA Effluent Guidelines and Standards for Petroleum and Petroleum Refining (40 CFR 419; 47 FR 46446, October 18, 1982) provide effluent limits for petroleum refineries. The guidelines are detailed and specific to the refinery process, size, and type of discharge. The specific guideline for the refinery process should be consulted to estimate the maximum allowable discharge. The guidelines are applicable to topping/catalytic reforming processes, cracking processes, petrochemical operations, and lube oil operations. These guidelines apply individually and as a separate subcategory for an integrated facility containing part or all of the above processes. Limits have been established for discharged biological oxygen demand (BOD), total suspended solids (TSS), chemical oxygen demand (COD), oil and grease, phenolic compounds, ammonia as nitrogen, sulfide, total chromium, hexavalent chromium, and pH. Separate standards are established for best practicable control technology currently available (BPT), best available technology economically achievable (BAT), best conventional pollutant control technology (BCT), pretreatment standards for existing sources (PSES), standards of performance for new sources (NSPS), and pretreatment standards for new sources (PSNS). The standards are also different based on the size of the refinery (based on 1,000 bbl of feedstock processed).

Although these standards cannot be used directly to estimate releases of Section 313 chemicals, they can be used as a guide in permit or monitoring records. The pH of the wastewater discharge can be used to determine releases for acids used

at the facility if only one acid is present in the discharge. Also, oil and grease, phenolic compounds, ammonia, and chromium regulatory standards can be used to estimate the upper limits of the wastewater discharge. Measurements of the chemicals in the wastewater made by the facility to comply with the standards can be used along with the discharge quantities to calculate water releases of these chemicals.

AIR RELEASES

State and local air regulations requiring installation and operation of pollution controls on petroleum refineries vary widely both from state to state and within states. Thus, the plant-specific regulation should be consulted.

The EPA Regulations on Standards of Performance for New Stationary Sources (40 CFR 60; 57 FR 24550, June 10, 1992) provide emission limits for petroleum refineries. The guidelines are detailed and specific to the refinery process. The specific guideline for the refinery process may be consulted to estimate the maximum allowable emission. The guidelines are applicable to the fluid catalytic cracking unit, catalyst regenerators, fuel gas combustion devices, all Claus sulfur recovery plants (except Claus plants of 20 long tons per day or less), petroleum liquids storage vessels (larger than 40,000 gallons), equipment (valves, pumps, pressure relief device, sampling connection system, open-ended valve or line, compressors, flange, or other connector in VOC service), and wastewater systems (process drains, oil-water separators, and wastewater treatment facilities). There are limits for emitted particulate matter, carbon monoxide, sulfur oxides, and VOCs. VOC standards are established for petroleum liquid storage vessels, equipment, and wastewater systems only.

As with the effluent standards, the emission standards cannot be used directly to estimate releases of Section 313 chemicals. Both standards, however, can be used as a guide to indicate possible permit or monitoring records. Also, regulatory emission monitoring for particulate matter and VOCs can be used as the upper limits of the waste discharge and can aid in the calculation of quantities released to the air.

NONREPORTING FACILITIES

Nonreporting facilities may be identified by comparing lists of facilities in the Standard Industrial Classification (SIC) 2911 having more than 10 employees with those facilities that have reported under Section 313. Most petroleum refineries with more than 10 employees probably are manufacturing, processing, or otherwise using at least one Section 313 chemical in excess of threshold values. For example, benzene, toluene, or xylene is likely manufactured or processed in excess of 25,000 pounds per year. Refineries may also otherwise use an acid in excess of the 10,000-pound-per-year threshold.

A source of information on the number of facilities in SIC 2911 presented by employment class is County Business Patterns published by the U.S. Department of Commerce.[6] Another source of information is Dunn and Bradstreet (D&B), which provides lists of companies by SIC and employment size category.[7] The 1990 TRI database indicates 196 facilities reported, while County Business Patterns - 1989 reports 326 facilities in SIC 2911 employing more than 10 employees and D&B - 1992 reports 688 facilities in SIC 2911 employing more than 10 employees.

LIST OF QUESTIONS

The following questions may be helpful in determining if errors were made in Section 313 reporting for petroleum refineries.

Constituents of Crude oil

- What were the constituents of the crude oil processed at the facility? (Compare with Table 1)
- How were the concentrations of these constituents determined?

Manufactured Chemicals

- What Section 313 chemicals were produced at the facility? (Compare with the SRI Directory of Chemical Products List)
- Are any analyses of the products available?
- What type of storage tanks and controls were in place on the storage tanks at the facility?

Processed and Otherwise Used Chemicals

- How is biological fouling controlled in the cooling towers?
- How are these chemicals processed or otherwise used?
- Does the facility add de-icer or anti-knock agents to the products?
- How are releases determined for these chemicals?

Metals/Metal Compounds

- What metals/metal compounds were added to petroleum products?
- What metals/metal compounds were used as process catalysts at the facility?
- Were metals included in the threshold analysis that were not added to the system (i.e., fixed-bed catalysts)?

Acids

- Were acid releases to POTW and/or off-site transfers determined by pH measurements?
- How were air releases determined for acids?

General Facility

- How were the total number of process fittings determined?
- Which emission factors were used to estimate releases?
- How were the percent leakers of process fittings determined if SOCMI emission factors were used?
- What constituents are measured in wastewater discharged to POTW?
- What chemicals does the facility manufacture, process, or otherwise use that the facility calculated to be exempt from reporting to TRI?
- What process units or storage tanks have air permit limits and what is the total allowable VOC releases from them?
- How were chemical analysis of effluents determined? (TCLP cannot be used to determine chemical composition.)
- Was monitoring data used to calculate emissions when possible?
- Were hazardous and nonhazardous wastes reviewed for Section 313 chemicals?
- Was the current definition of de minimis applied? (1991 and after).
- Were air releases estimated from wastewater treatment? (oil/water separators, biological treatments, etc.)
- Were air releases estimated for flares?
- Were vapors from storage tanks vented to flares accounted for?
- Were all accidents reported?
- Were any materials (hazardous or nonhazardous) transferred off site for treatment, recycling, or disposal?

BIBLIOGRAPHY

1. Office of Management and Budget. Standard Industrial Classification Manual. Washington, DC. 1987.

2. U.S. Department of Commerce. Industrial Process Profiles for Environmental Use. Industrial Environmental Research Lab, Research Triangle Park, NC. January 1977.

3. Kirk-Othmer Encyclopedia of Chemical Technology. Third Edition. Volume 17. Petroleum (Refinery Processes, Survey. Wiley & Sons. 1982.

4. Nelson, W. L. Petroleum Refinery Engineering. Fourth Edition. McGraw-Hill. 1958.

5. U.S. Environmental Protection Agency. Compilation of Air Pollutant Emission Factors. AP-42. Volume 1 Stationary and Point Source. September 1985 plus supplements.

6. U.S. Department of Commerce, Bureau of Census, County Business Patterns 1989, CBP-89-1 Washington, DC. 1991.

7. Dunn & Bradstreet. Dunn's Electronic Business Directory in DIALOG database File 515. 1992.

8. Lafargue, E. and C. Barker. Effect of Water Washing on Crude Oil Compositions. The American Association of Petroleum Geologists Bulletin. Volume 72. Number 3. March 1988. Pages 263-276.

9. Park, S. J. and G. A. Mansoori. Aggregation and Deposition of Heavy Organics in Petroleum Crudes. Energy Sources. Volume 10. Pages 109-125.

APPENDIX A

SELECTED INFORMATION AND EMISSION FACTORS

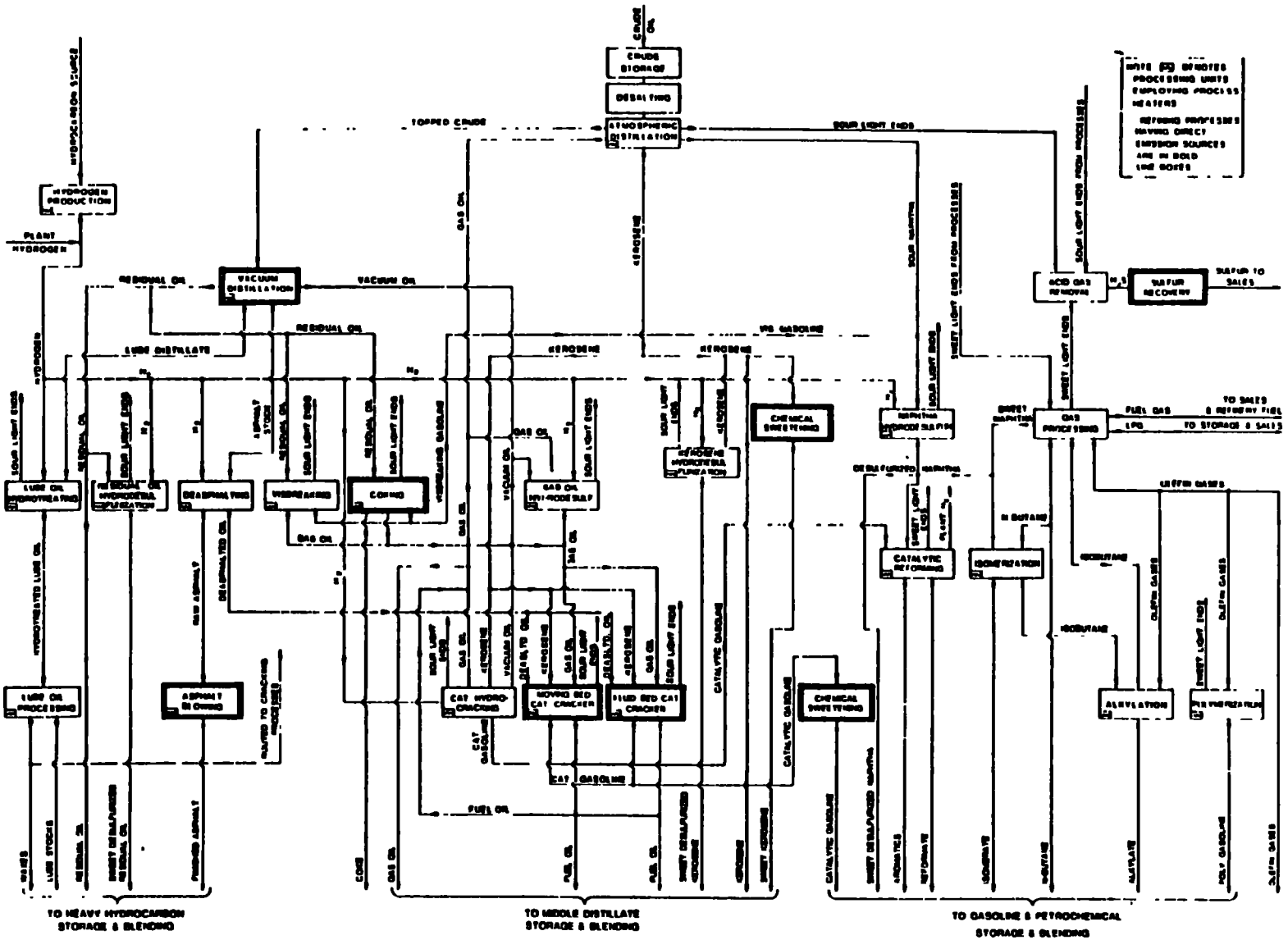

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Figure A-1.
Detailed Petroleum Refinery
Schematic from AP-42.[5]

DRAWING BY	JEH 9/14/92	CHECKED BY	EAP	9/14/92	DRAWING NO M-830015-5-1 9/92-2
		APPROVED BY			

Process	Particulates	Sulfur oxides (as SO_2)	Carbon monoxide	Total hydro-carbons [a]	Nitrogen oxides (as NO_2)	Aldehydes	Ammonia	Emission factor rating
Boilers and process heaters,								
Fuel Oil	See Section 1 3 - Fuel Oil Combustion							
Natural Gas	See Section 1 4 - Natural Gas Combustion							
Fluid catalytic cracking units [b]								
Uncontrolled								
lb/10³bbl fresh feed	242 (93 to 340) [c]	493 (100 to 525)	13,700	220	71 0 (37 1 to 145 0)	19	54	B
kg/10³ liters fresh feed	0 695 (0 267 to 0 976)	1 413 (0 288 to 1 505)	39 2	0 630	0 204 (0 107 to 0 416)	0 054	0 155	B
Electrostatic precipitator and CO boiler								
lb/10³ bbl fresh fed	45 [d] (7 to 150)	493 (100 to 525)	Neg [e]	Neg	71 0 [f] (37 1 to 145 0)	Neg	Neg	B
kg/10³ liters fresh feed	0 128 (0 020 to 0 428)	1 413 (0 288 to 1 505)	Neg	Neg	0 204 (0 107 to 0 416)	Neg	Neg	B
Moving-bed catalytic cracking units [g]								
lb/10³ bbl fresh feed	17	60	3,600	87	5	12	6	B
kg/10³ liters fresh feed	0 049	0 171	10 8	0 250	0 014	0 034	0 017	B
Fluid coking units [h]								
Uncontrolled								
lb/10³ bbl fresh feed	523	NA [i]	NA	NA	NA	NA	NA	C
kg/10³ liters fresh feed	1 50	NA	NA	NA	NA	NA	NA	C
Electrostatic precipitator and CO boiler								
lb/10³ bbl fresh feed	6 85	NA	Neg	Neg	NA	Neg	Neg	C
kg/10³ liters fresh feed	0 0196	NA	Neg	Neg	NA	Neg	Neg	C
Delayed coking units	NA	NA	NA	NA	NA	NA	NA	
Compressor engines [j]								
Reciprocating engines								
lb/10³ ft³ gas burned	Neg	2s [k]	0 43	1 4	3 4	0 1	0 2	B
kg/10³ m³ gas burned	Neg	32s	7 02	21 8	55 4	1 61	3 2	B
Gas turbines								
lb/10³ ft³ gas burned	Neg	2s	0 12	0 02	0 3	NA	NA	B
kg/10³ m³ gas burned	Neg	32s	1 94	0 28	4 7	NA	NA	B

INTERNATIONAL TECHNOLOGY CORPORATION

Table A-1.
Emission Factors for Petroleum Refineries from Section 9.1 of AP-42.[5]

DRAWING BY	JEA	CHECKED BY	PAP	9/14/92	DRAWING NO M 830 Y92-3
		APPROVED BY			

Process	Particulates	Sulfur oxides (as SO_2)	Carbon monoxide	Total hydro-carbons	Nitrogen oxides (as NO_2)	Aldehydes	Ammonia	Emission factor rating
Blowdown systems[l]								
Uncontrolled								
lb/10³ bbl refinery feed	Neg	Neg	Neg	580	Neg	Neg	Neg	C
kg/10³ liters refinery feed	Neg	Neg	Neg	1 662	Neg	Neg	Neg	C
Vapor recovery system and flaring								
lb/10³ bbl refinery feed	Neg	26 9	4 3	0 8	18 9	Neg	Neg	C
kg/10³ liters refinery feed	Neg	0 077	0 012	0 002	0 054	Neg	Neg	C
Vacuum distillation[m] column condensers								
Uncontrolled								
lb/10³ bbl refinery feed	Neg	Neg	Neg	18	Neg	Neg	Neg	C
kg/10³ liters refinery feed	Neg	Neg	Neg	0 052	Neg	Neg	Neg	C
lb/10³ bbl vacuum feed	Neg	Neg	Neg	50 (0-130)	Neg	Neg	Neg	C
kg/10³ liters vacuum feed	Neg	Neg	Neg	0 144	Neg	Neg	Neg	C
Controlled	Neg	Neg	Neg	Neg	Neg	Neg	Neg	C
Claus plant and tail gas treatment		See section 5 18						

[a] Overall, less than 1 percent by weight of the total hydrocarbon emissions are methane
[b] References 2 through 8
[c] Numbers in parenthesis indicate range of values observed
[d] Under the New Source Performance Standards controlled FCC regenerators will have particulate emissions lower than 19 lb/10³ bbl fresh feed
[e] Negligible emission
[f] May be higher due to the combustion of ammonia
[g] Reference 2
[h] Reference 5
[i] NA Not Available
[j] References 9 10
[k] s = Refinery gas sulfur content (lb/1000 ft³) Factors based on 100 percent combustion of sulfur to SO_2
[l] References 2 11
[m] References 2 12, 13

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Table A-1 (Continued).
Emission Factors for Petroleum Refineries from Section 9.1 of AP-42.[5]

DRAWING BY	JEA 9/14/92	CHECKED BY	TAP	9/14/92	DRAWING NO M-830015-5-1-9/92-4
		APPROVED BY			

Emission Source	Process Stream Type[b]	Emission Factor Units	Emission Factors: Uncontrolled Emissions[c]		Controlled Emissions	Applicable Control Technology	Emission Factor Rating
Pipeline valves[d]	II gas	lb/hr-source	0.059	(0.030 - 0.110)	NA	Monitoring and maintenance programs	A
		kg/day-source	0.64	(0.32 - 1.19)			
	III	"	0.024	(0.017 - 0.036)	NA		A
		"	0.26	(0.18 - 0.39)			
	IV	"	0.0005	(0.0002- 0.0015)	NA		A
		"	0.005	(0.002 - 0.016)			
	V	"	0.018	(0.007 - 0.045)	NA		A
		"	0.20	(0.08 - 0.49)			
Open ended valves[d,e]	I	"	0.005	(0.0016- 0.016)	NA	Installation of cap or plug on open end of valve/line	A
		"	0.05	(0.017 - 0.17)			
Flanges[d]	I	"	0.00056	(0.0002- 0.0025)	NA	Monitoring and maintenance programs	A
			0.0061	(0.002 - 0.027)			
Pump seals[d]	III	"	0.25	(0.16 - 0.37)	NA	Mechanical seals, dual seals, purged seals, monitoring and maintenance programs, controlled degassing vents	A
		"	2.7	(1.7 - 4.0)			
	IV	"	0.046	(0.019 - 0.11)	NA		A
		"	0.50	(0.21 - 1.2)			
Compressor seals[d]	II	"	1.4	(0.66 - 2.9)	NA	Mechanical seals, dual seals, purged seals, monitoring and maintenance programs, controlled degassing vents	A
		"	15	(7.1 - 31)			
	V	"	0.11	(0.05 - 0.23)	NA		A
		"	1.2	(0.5 - 2.5)			
Process drains[d]	I	"	0.070	(0.023 - 0.20)	NA	Traps and covers	A
		"	0.76	(0.25 - 2.2)			
Pressure vessel relief valves (gas service)[d,f]	II	"	0.36	(0.10 - 1.3)	Negligible	Rupture disks upstream of relief valves and/or venting to a flare	A
		"	3.9	(1.1 - 14)			
Cooling towers	-	$lb/10^6$ gal cooling water	6		0.70	Minimization of hydrocarbon leaks into cooling water system. Monitoring of cooling water for hydrocarbons	D
		$kg/10^6$ liters cooling water	0.7		0.083		
		$lb/10^3$ bbl refinery feed[g]	10		1.2		
		$kg/10^3$ liters refinery feed	0.03		0.004		
Oil/water separators	-	$lb/10^3$ gal wastewater	5		0.2	Covered separators and/or vapor recovery systems	D
		$kg/10^3$ liter waste water	0.6		0.024		
		$lb/10^3$ bbl refinery feed	200		10		
		$kg/10^3$ liters refinery feed	0.6		0.03		
Storage	See Section 4.3						
Loading	See Section 4.4						

[a] Data from References 2, 4, 12 and 13 except as noted. Overall, less than 1% by weight of the total VOC emissions are methane.
NA = Not Available.
[b] The volatility and hydrogen content of the process streams have a substantial effect on the emission rate of some fugitive emission sources. The stream identification numerals and group names and descriptions are

Stream Identification Numeral	Stream Name	Stream Group Description
I	All streams	All streams
II	Gas streams	Hydrocarbon gas/vapor at process conditions (containing less than 50% hydrogen, by volume)
III	Light liquid and gas/liquid streams	Liquid or gas/liquid stream with a vapor pressure greater than that of kerosene (> 0.1 psia @ 100°F or 689 Pa @ 38°C), based on the most volatile class present at > 20% by volume
IV	Heavy liquid streams	Liquid stream with a vapor pressure equal to or less than that of kerosene (≤ 0.1 psia @ 100°F or 689 Pa @ 38°C), based on the most volatile class present at > 20% by volume
V	Hydrogen streams	Gas streams containing more than 50% hydrogen by volume

[c] Numbers in parentheses are the upper and lower bounds of the 95% confidence interval for the emission factor
[d] Data from Reference 17.
[e] The downstream side of these valves is open to the atmosphere. Emissions are through the valve seat of the closed valve.
[f] Emission factor for relief valves in gas service is for leakage, not for emissions caused by vessel pressure relief
[g] Refinery rate is defined as the crude oil feed rate to the atmospheric distillation column

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Table A-2.
Fugitive Emission Factors for Petroleum Refineries[9] from Section 9.1 of AP-42.[5]

DRAWING NO 30015-5-1-002-5
9/14/91
CHECKED BY
APPROVED BY
DRAWING

TRI FACILITY PROFILE
INK FORMULATION

by

IT Corporation
11499 Chester Road
Cincinnati, Ohio 45246

Contract No. 68-D0-0020
Work Assignment No. 2-27/2-65/3-18
JTN 830015-5-1

Prepared for

U.S. ENVIRONMENTAL PROTECTION AGENCY
OFFICE OF TOXIC SUBSTANCES
401 M Street, SW
Washington, D.C. 20460

August 1992

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TRI FACILITY PROFILE, INK FORMULATION

The purpose of this profile is to assist U.S. Environmental Protection Agency (EPA) Regional Office personnel with Section 313 inspections. The profile describes key toxic chemicals processed or otherwise used in ink formulation, describes how the chemicals are used, and identifies key release sources. All Section 313 chemicals reported to the Toxic Release Inventory (TRI) by more than 5 percent of the paint formulators are presented in this profile.

For the purposes of this profile, the ink formulation industry is defined as:

- SIC 2893 - Printing Ink

This Standard Industrial Classification (SIC) includes establishments primarily engaged in manufacturing printing ink, including gravure ink, screen process ink, and lithographic ink.[1] Establishments primarily engaged in manufacturing writing ink and drawing ink are not included. The following types of ink are specifically included:

- Bronze and gold
- Flexographic
- Gravure
- Duplicating
- Letterpress
- Lithographic
- Offset
- Printing
- Screen process

The U.S. printing ink industry services two much larger industries: graphic arts (printing and publishing) and packaging.[2] The complexity and size of the graphics arts and packaging industries have a strong bearing on the makeup and structure of the

ink formulation industry.[2] Thus, the size and distribution of printing ink formulators follow the industry it serves. The ink formulation industry consists of about 500 establishments. This does not include about 170 blending stations operated by larger producers at facilities of major customers or about 100 captive ink formulation operations owned by printing companies.[2] Ink formulators are as geographically dispersed as their customers, with packets of concentration around major metropolitan areas.[2]

The diversity of end-use markets has created a need for inks with a wide variety of characteristics. More than 1 million individual ink formulations are developed each year to satisfy the specific needs of the U.S. printing and packaging industries.[2] An estimated 5 million formulations are in active use at any given time, with the majority being customized inks for specific needs.[2]

Printing ink is a mixture of coloring matter dispersed or dissolved in a vehicle or carrier that forms a fluid or paste which can be printed on a substrate and dried.[3] Printing inks can generally be described as mixtures of pigments dispersed in various oils, resins, organic solvents, water, and chemical additives.[2] Ingredients in inks fall into three main categories: fluid ingredients or vehicles (also known as varnishes), solid ingredients or pigments, and additives.[2] Most inks reportedly contain at least 10 or more ingredients.[2] Table 1 presents estimated raw material consumption in ink formulation in 1981.

In the formulation of printing inks, solvents dissolve vehicle components, control vehicle viscosity, and aid in the blending of vehicles and pigment.[2] In addition, solvents are used in printing to reduce the viscosity of flexographic and gravure inks. The concentration of solvents in gravure flexographic and screen printing inks is much higher than that used in letterpress and lithographic inks.[2]

Ink solvents fall into two general categories: hydrocarbon and oxygenated types. Hydrocarbon solvents are aliphatic, naphthenic, or aromatic. Oxygenated solvents include monohydric alcohols, glycols, glycol ethers, ketones, and esters. Solvents are selected based on drying speed, printability, cost, odor, color, flammability, and toxicity. Table 2 presents the estimated amounts of different solvents

TABLE 1. ESTIMATED RAW MATERIAL CONSUMPTION IN PRINTING INK FORMULATION, 1981[2]

Type	Millions of pounds	Percent of total
Solvents, total	489	35[b]
Hydrocarbon[a]	298	
Oxygenated[a]	120	
Water	68	
Resins	325	23[b]
Oils (mineral, drying)	295	21[b]
Pigments[c]	255	18
Additives	35	3
Total	1399	100

[a] These estimates represent the use of solvents in ink manufacture only. Inks employing hydrocarbon solvents (except ink oils) and oxygenated solvents (i.e., flexographic and gravure inks) are sold in concentrated form and require dilution (thinning) at press side. For the combined total of solvent dilution at press side, an additional 75-100% of solvent is required.

[b] Components of the vehicle.

[c] Includes carbon black, organic and inorganic pigments, and extenders.

TABLE 2. ESTIMATED SOLVENT CONSUMPTION IN PRINTING INK FORMULATION, 1981[2]

	Millions of pounds	Percent of total
Oxygenated solvents (alcohols, acetates, ketones, glycols, and glycol ethers)	120	24
Hydrocarbon solvents, total	301	62
Ink oils	115	24
Mineral spirits (lacteal spirits)	130	27
Aromatics[a]	51	10
Aliphatics[b]	5	1
Water	68	14
Total	489	100

[a] Almost exclusively toluene; only minor amounts of xylene are used. Toluene is used mostly in publication gravure inks.

[b] Mainly n-heptane.

processed in the formulation of printing inks. These estimates do not include solvents used at press side for thinning.[2]

An additional 75 to 100 percent of hydrocarbon and oxygenated solvents are used in press side to dilute flexographic and gravure inks concentrates prior to use. Of the oxygenated solvents, alcohols account for the greatest share followed by acetates, ketones, and then glycols and glycol ethers. Ethyl, n-propyl and isopropyl acetates are the main esters used in inks. MEK is the predominant ketone with acetone, MIBK, and isophorone used to lesser extents. Ethanol is the major alcohol, but n-propanol and isopropanol are also used.[2]

Resins used in printing inks influence hardness, gloss, adhesion, and flexibility. Both natural and synthetic resins are used in ink vehicles and varnishes. Table 3 presents the estimated amounts of resins processed in the formulation of printing inks.[2]

Pigments are used not only for color but also to produce other physical properties such as bulk, opacity, specific gravity, and viscosity.[3] The most common pigments used in ink formulation are:[3]

- Black pigments - primarily carbon black.
- White pigments - including titanium dioxide, zinc sulfide, and zinc oxide (extenders).
- Transparent pigments (extenders) - including alumina hydrate, magnesium carbonate, calcium carbonate, barium sulfate, and clay.
- Inorganic color pigments - including lead chromate, chrome orange, molybdate orange, cadmium yellow/orange/red, cadmium-mercury red, and iron blue (a complex cyanide).
- Organic color pigments - including yellow Lakes (dyes deposited on alumina hydrate), Hansa yellows (from ozo dyes), orange pigments (dianisidine orange, benzidine orange, and Persian orange), and red pigments.
- Blue pigments - including peacock blue, victoria blue, alkali blues.

TABLE 3. ESTIMATED RESIN CONSUMPTION IN PRINTING INK FORMULATION, 1981[2]

General type	Millions of pounds	Percent of total
Rosin ester adducts[a]	90	27
Metallized rosins[b] (metal resinates)	55	17
Hydrocarbon resins[c]	47	15
Alkyds	37	11
Acrylics	28	9
Nitrocellulose	10	3
Polyamides	10	3
Miscellaneous	48	15
Total	325	100

[a] In general, rosin esters are important components of rapidly drying heatset inks.

[b] Zinc and calcium resinates are mainly used in gravure inks for publication printing.

[c] In news inks, hydrocarbon resins are replacing rosin-based compounds. Hydrocarbon resins are used extensively in lithographic and letterpress vehicles and a little in publication gravure inks.

- Purple pigments - including methyl violet.
- Green pigments - including phythalocyanine and green lake.

Additives such as driers, waxes, lubricants, reducing oils, antioxidants, gums, starches, and surface-active agents are used in printing inks to impart special characteristics.[2] Driers are soaps of cobalt, manganese, and lead formed with organic acids such as linolenic, naphthenic, and octanoic acids.[3] Some additives are incorporated directly into the vehicle during cooking, some may be added during compounding in the ink, while others can be added to the finished ink in the pressroom.[2]

Figure 1 presents a simplified process flow diagram of ink formulation. The basic raw materials, such as mineral oil and solvents, are supplied in tanker loads and are unloaded into bulk storage tanks adjacent to the ink manufacturing facility.[2] The oils or solvents are then pumped and metered into mixing tanks where other liquid ingredients are added in a similar manner.[2] Resins may also be added. Vehicle preparation can involve polymerization of resins or involve only cold dissolving of vehicle solids in appropriate solvents.[3] Therefore, vehicle preparation equipment may include autoclaves for polymerization reactions or high-speed mixers for simple dissolving.[3]

Varnish or vehicle preparation by heating is by far the largest source of ink manufacturing VOC emissions.[4] The ink "varnish" or vehicle is generally cooked in large kettles at 200° to 600°F for 8 to 12 hours in much the same way that regular varnish is made.[4] Cooling the varnish components (resins, drying oils, petroleum oils, and solvents) produces odorous emissions. At about 350°F, the products begin to decompose, resulting in the emission of decomposition products from the cooking vessel.[4] Emissions continue throughout the cooking process with maximum emissions occurring just after maximum temperature is reached.[4] Emissions of VOCs from vehicle cooking can be reduced by more than 90 percent with the use of scrubbers or condensers followed by afterburners.[4] Compounds emitted from the cooking of oleoresinous varnish (resin plus varnish) include water vapor, fatty acids, glycerine, acrolein, phenols, aldehydes, ketones, terpene oils, terpenes, and carbon dioxide.[4]

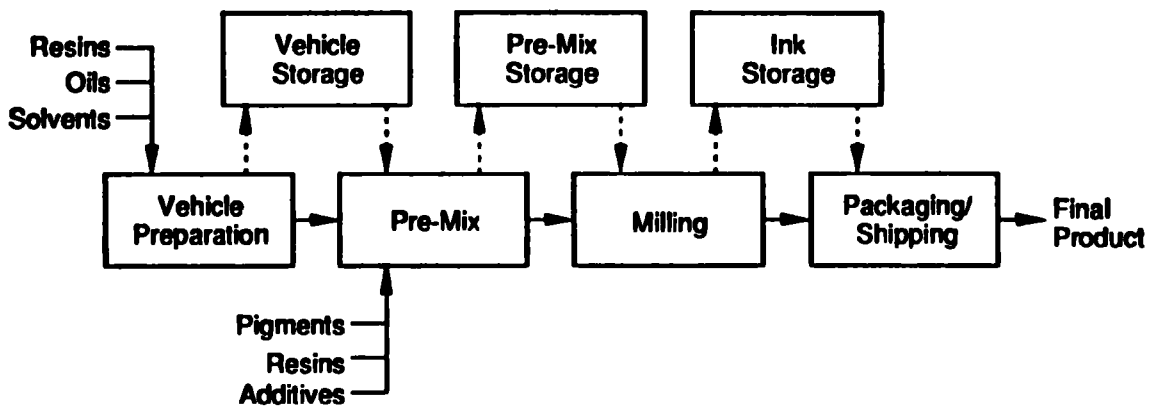

Figure 1. Simplified process flow diagram for ink formulation.

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Emissions of thinning solvents used in flexographic and rotogravure inks may also occur.[4] The quantity, composition, and rate of emissions from ink manufacturing depend upon cooking temperature and time, ingredients, method of introducing additives, degree of stirring, and extent of air or inert gas blowing.[4]

Once these operations are complete, the vehicle may be pumped to a premix tank where solid materials such as pigments or resins are added. The solid materials are generally purchased in bags or other containers, and formulations correspond to a number of full bags to avoid problems with solids weighing and handling.[2]

The unground ink is then pumped or gravity fed into the mixture or milling equipment. During the transfer, the premix may be filtered. Although printing inks vary greatly in composition and properties, only two mechanical means produce dispersions--mixing and milling. Mixing is a mechanical blending of pigment and vehicle that is continued until no dry pigment is visible.[2] Milling is a mechanical process that reduces particle size by cleavage or fracture of the particle.

The process of dispersion occurs in three stages, but in practice these stages may overlap.[2] The primary stage is the wetting of the pigment by the vehicle. The efficiency of this operation depends on the nature of the pigment and vehicle and the mechanical equipment used. During the second stage, the easily broken aggregates are reduced. Thus, stage two requires the application of considerable mechanical force. A notable increase in viscosity occurs during stage two because the breakdown of pigment agglomerates leads to an increase in pigment surface area that absorbs more vehicle. The third stage is the completion of wetting and separation of particles so that no flocculation or reassemblage occurs.[2]

Table 4 presents a simplified relationship between ink type, premixer characteristics, and mill type. Dispersion equipment is classified as follows:

- Low-shear equipment including pug mill, planetary mixers, and two-blade mixers.
- High-shear dispersers including cavitation mixers, Kady mill, and high-tip-speed impellers or rotors.

- Ball mills - including sand mills, Perle mills, and attritors.
- Roll mills - including single or multiple roll mills.

TABLE 4. RELATIONSHIP BETWEEN INK TYPE, PREMIXER, AND MILL TYPE[2]

Ink product characteristic	Premixer characteristic	Mill type
Viscous paste ink	Low shear	Roll mill
Medium-viscous paste ink	High shear	Roll mill, bead mill
Low-viscous paste ink	High shear	Bead mill
Liquid inks		
Pigmented	High-shear	Ball mill
Dye-based	High-speed stirrer	Bead mill, micromill

Pigment aggregates are broken down by three types of mechanical forces: impact, pressure, or shearing. Application of pressure crushes aggregates, while impact shatters them on collision. Shearing action results when parallel layers of material are flowing at different speeds. Each of these effects is strongly dependent on viscosity.

The various types of mixers and mills used in ink production include:[2]

Premixer--The use of lower viscosity inks and more easily dispersed pigments has lead to the increased use of the vertical mixer over the horizontal blade mixer.

Low-Viscosity-Mixer--Low-viscosity inks, such as those for the high-speed web process and pre-mixes for liquid inks for shot mills, are generally handled by mixers that consist of an impeller in a cylindrical mixing tank. The ratio of impeller to tank diameter and to depth of the tank are important to ensure optimum results. The design of the impellers varies from the simplest form, which is a disk, to the most widely used impeller, which is the saw tooth design. These mixers cannot handle hard aggregates and are most efficient with medium-viscosity systems using easy dispersing pigments. Most of the energy is applied by forming viscous shear between fluid near the impeller and fluid in the outer areas of the tank.[2]

Medium viscosity mixer--Medium-viscosity mixers rely on high shear produced by a rapid stirring action. The same basic machines used for low-viscosity mixing may be used with some modifications. The low flow properties of the medium-viscosity products may result in dead zones in regions of the mixing vessel. In a twin-shaft disperser, a slow-speed agitator clears the sides and bottom and feeds the mix into one or more high-speed rotors operating off center. Other types of medium viscosity mixers have two counter-rotating shafts with projections mounted down their length to provide shearing action.[2]

High-Viscosity-Mixer--Twin-blade Z-arm mixers are the most common premixers in the paste ink industry. In operation, two gear-driven Z-shaped blades rotate in opposite directions, usually at different speeds, and almost scrape the bottom and sides of the mixer. This type of mixer is capable of mixing extremely viscous materials and relies on high viscosity for its shearing action. The mix is kneaded as the blades rotate resulting in strong internal shear forces. A buss kneader is another example of heavy-duty mixing equipment. These machines work on the same principle as the worm drive. A series of projections along the chamber provide a kneading action as the mix is forced along the chamber length. Machines with twin screws running parallel are also available.[2]

Ball Mills--The ball mill was the principal machine for dispersing pigment in the news inks, photogravure inks, flexographic inks, and roller coatings. With the development of easy-disperse pigments and advances in the dispersion machine, however, ball mills have declined in use. A ball mill is a hollow cylinder that rotates on a horizontal axis. This cylinder is partly filled with the material to be mixed and steel or ceramic balls. The balls roll and cascade over each other during cylinder rotation, thereby crushing and shearing the ink components. Several advantages of ball mills are the simplicity of design and operation, easy loading of raw materials in a single charge, low labor requirements, easy discharge, and uniformity of product. These mills are often noisy, large and difficult to clean, however, and have low production rates.

The pigment/vehicle mixture significantly affects the performance of the ball mill because milling efficiency is strongly dependent on the mixture viscosity. Several modifications have been made to deal with the slow dispersing speed of the ball mill. These modified ball mills use a stationary vessel and move the mixture and balls, pebbles, or sand by agitation. These mills are advantageous because the smaller size grinding media lead to better dispersing efficiency. Also, these mills can operate continuously. The high-speed agitator bead mill is the predominant method for manufacturing newspaper ink, which is generally a dispersion of carbon black in a mineral oil vehicle system.

Roller Mills--The main function of the roll mill is to complete and refine the total dispersion process begun at the premix stage. Roller mill dispersion is produced by the differential speeds of the roller surfaces, together with the pressure exerted between the rolls. Multiroll mills are more effective with viscous products because the shearing forces increase proportionally with an increase in viscosity. Modern roll mills use three rollers. The three-roll mill is the basic machine for letterpress and offset ink production.

When the milling operation is complete, inks of moderate to low viscosity may undergo a finer filtration step. The finished ink is then pumped or gravity fed into storage tanks for transfer to tanker truck or rail car for delivery. Small batches of ink may be transferred to totes, drums, pails, or smaller containers for labeling and shipment.

SECTION 313 CHEMICALS USED IN INK FORMULATION

Section 313 chemicals commonly processed or otherwise used in ink formulation can be classified into three distinct categories: solvents (chlorinated and organic), metals and metal compounds, and other constituents. Each category is discussed separately in this report. Each contains a description of how the Section 313 chemicals are used, a discussion of typical releases and off-site transfers, a table summarizing releases and off-site transfers that were reported to the Toxic Release Inventory (TRI) in 1990, a description of industry-specific and chemical-specific regulations, typical control practices, and common reporting errors. Methods for identifying nonreporting facilities and a list of questions are also presented.

SOLVENTS

Solvents are both processed and otherwise used by ink formulators. Solvents are primarily processed as a constituent of the ink. Solvents are also otherwise used as cleanup solvents throughout the formulation process. Solvents may be organic or chlorinated and are received by drum, tote, tanker truck, or rail car.

For solvents processed in ink formulation, solvents may be released during vehicle preparation or during mixing/milling/packaging operations. For those ink formulators that have vehicle cooking, AP-42 presents the following uncontrolled VOC emission factors for vehicle cooking: general (6%), oils (2%), oleoresinous (7.5%), and alkyds (8%).[4] The uncontrolled emission factors are a percent of vehicle produced. The VOC emissions from vehicle cooking are a mix of volatilized vehicle components, cooking decomposition products and ink solvent.[4] No breakdown was found to indicate that emissions other than solvent emissions are Section 313 chemicals.

No emission factor was found to estimate the solvent releases from mixing, milling, or packaging operations. Because the process is similar to paint formulation, however, AP-42 was used to estimate a 1 to 2 percent release to air even under well-controlled conditions.[4] The primary factors affecting solvent air emissions from ink formulation are the vapor pressure of the solvent, care in handling, enclosure of the formulation equipment, mixing temperature, and air movement near open tanks or packaging equipment. Air releases may be either fugitive or stack depending if local exhaust ventilation is used to reduce potential worker exposure to solvents. Fugitive air releases can also occur from spills that are allowed to evaporate. The manufacture of water-based inks containing solvents (e.g., glycol ethers, methanol) may result in releases to water or POTW when equipment is washed with water and then sewered. Off-site transfers occur from ink residues in cleaning solvent and disposal of off-spec ink. Land releases are not common, but can occur through spills. Small quantities of solvents may also be contained in dirty filters or ink sludge generated during cleaning operations.

Some of the solvent otherwise used to clean equipment is lost to air during cleaning while the remainder is typically transferred off site for recycling, use as a fuel, or for treatment and disposal. Releases of solvents otherwise used as a cleaning solvent may be best determined through mass balance calculations with almost all of the usage either released to air or transferred off site. The quantity transferred off site for recycling or fuel burning was not reportable under Section 313 until 1991 (estimates due July 1, 1992).

When solvent-based cleaning solvents are transferred off site, they may be classified as a RCRA waste based upon one of the following criteria:

K086 - Contain solvent washes and sludges, caustic washes and sludges, or water washes and sludges from cleaning tubs and equipment used in the formulation of ink from pigments, driers, soaps, and stabilizers containing chromium and lead.

F002 - Contain a total of 10 percent or more (by volume) prior to use of one or more of the following solvents: tetrachloroethylene, methylene chloride, trichloroethylene, 1,1,1-trichloroethane, chlorobenzene, 1,1,2-trichloro-1,2,2-trifluoroethane, orthodichlorobenzene, trichlorofluoromethane, and 1,1,2-trichloroethane.

F003 - Contain a total of 10 percent or more (by volume) prior to use of one or more of the following solvents: xylene, acetone, ethyl acetate, ethylbenzene, ethyl ether, MIBK, n-butyl alcohol, cyclohexanone, and methanol.

F005 - Contain a total of 10 percent or more (by volume) prior to use of one or more of the following solvents: toluene, MEK, carbon disulfide, isobutanol, pyridine, benzene, 2-ethoxyethanol, and 2-nitropropane.

Off-site transfers of RCRA-classified waste can best be calculated from RCRA manifests and analysis by the company receiving the waste.

K086 wastes include solvent washes and sludges, caustic washes and sludges, or water washes and sludges from cleaning tubs and equipment used in the formulation of ink from pigments, driers, soaps, and stabilizers containing chromium and lead.[5,6] Best Demonstrated Available Technology (BDAT) is defined for two sub-

categories: wastewater (caustic/water washes) and nonwastewater (solvent washes). BDAT standards for the regulated organics and cyanides in K086 nonwastewaters are based on incineration.[5,6] BDAT treatment standards for the regulated metals in all K086 wastes are based on hexavalent chromium reduction to trivalent chromium followed by lime precipitation and sludge filtration with sludge stabilization.

BDAT standards for cyanide in wastewaters is based on cyanide oxidation. BDAT for organic wastewater K086 wastes is incineration, wet air oxidation, or chemical oxidation followed by carbon adsorption, biological treatment, or steam stripping.[5,6]

Table 5 presents a summary of Section 313 reported releases and off-site transfers of solvents at ink formulators, based on Section 313 reporting for 1990. As expected, solvents such as toluene, MEK, and xylene that are both processed as paint solvents and otherwise used in cleaning solvents are the most widely reported solvents.

Table 6 presents a description of the specific uses of ink solvents in ink formulation.[2] The solvents are presented in order of their reported usage in the TRI database in 1990.

Air releases of solvents can be reduced by enclosure of the mixing, packaging, and cleaning operations and through management practices that minimize spills or the quantity of cleanup solvent necessary.

Equipment cleaning wastes can be reduced through source reduction by reducing the frequency of required cleaning or reducing the quantity of cleaning solvent. Scheduling for long production runs, use of dedicated equipment, or scheduling batches from light color inks to dark color inks can also reduce the need for cleaning.

Recycling and reuse of cleaning waste can substantially reduce waste volumes. Cleaning wastes may be: 1) collected and used in the next compatible batch as part of the formulation, 2) collected and recycled on or off site, or 3) collected and reused as a cleaning solvent by filtering or other means of solids removal.

TABLE 5. SUMMARY OF REPORTED RELEASES OF SOLVENTS FROM INK FORMULATION

Section 313 chemical	Number of facilities reporting usage[a] (% reporting usage)	Mean release, lb (% reporting to each media)[b]						
		Fugitive	Stack	Water	Land	POTW[c]	Off-site transfer	Total[d]
Toluene	74 (94)	10,547 (92)	14,780 (82)	0 (0)	33 (4)	148 (3)	14,957	30,370 (100)
Glycol ethers	49 (62)	509 (80)	952 (67)	15 (2)	13 (4)	286 (24)	1809 (65)	2347 (98)
Methyl ethyl ketone	30 (38)	e	13,902 (80)	0 (0)	20 (3)	0 (0)	11,658 (70)	e
Methanol	29 (37)	1071 (90)	1681 (90)	0 (0)	20 (3)	875 (7)	1871 (62)	3690 (100)
Xylene (mixed isomer)	27 (34)	675 (96)	1452 (85)	15 (4)	20 (4)	5 (7)	2802 (44)	3135 (100)
Acetone	13 (16)	e	e	0 (0)	20 (8)	0 (0)	6442 (23)	14,892 (92)
1,1,1-Trichloroethylene	13 (16)	e	e	0 (0)	20 (8)	0 (0)	e	22,907 (100)
Ethylene glycol	10 (13)	114 (90)	87 (30)	0 (0)	0 (0)	370 (20)	417 (30)	364 (90)
Dichloromethane	6 (8)	1556 (100)	2748 (67)	0 (0)	0 (0)	0 (0)	393 (33)	3519 (100)
Methyl isobutyl ketone	5 (6)	24,215 (100)	e	0 (0)	0 (0)	0 (0)	9,020 (60)	38,971 (100)

[a] A total of 79 facilities in SIC 2893 reported usage of at least one Section 313 chemical above threshold limits.

[b] Mean release in pounds per year in 1990 for firms reporting releases of this chemical and percentage of firms reporting usage of this chemical that release to this media. Releases to other media were insignificant.

[c] POTW = Publicly owned treatment works.

[d] The total includes all releases and off-site transfers, not just categories summarized in this table.

[e] Mean value is not representative because of a very large value at one facility and the small number of facilities.

TABLE 6. USES OF TYPICAL INK SOLVENTS[2]

Solvent	Main resin types for which solvent is useful	Other remarks
Toluene	Rubber, chlorinated rubber melamine, urea formaldehyde, phenolics, ethyl cellulose, resinates, ester gum, polyvinyl acetate, and polystyrene.	Used extensively in gravure inks (for which special low-odor grades are available).
Glycol Ethers		
Ethylene Glycol Monomethyl Ether (Methyl Glycol, Methyl Cellosolve)	Nitrocellulose, cellulose, acetate, vinyl acetate, CAP, shellac, zein, spirit soluble maleic resins and various rosin derivatives.	Miscible with water, aromatic hydrocarbons, and some aliphatic hydrocarbons. Viewed as a slow evaporating solvent for flexographic and gravure inks, but as fast solvent for air-drying screen inks.
Ethylene Glycol Monoethyl Ether (Ethyl Glycol, Cellosolve)	Same as for methyl cellosolve except for cellulose acetate and propionate.	Miscible with water, hydrocarbons, and castor oil. Used as a main solvent in screen inks and as a retarder in liquid inks.
Ethylene Glycol Monobutyl Ether (Butyl Glycol, Butyl Cellosolve)	Nitrocellulose, ethyl cellulose, epoxy resins, alkyds, phenolics, maleics, shellac, ester gum, and chlorinated rubber.	Miscible with water, linseed oil, and hydrocarbons. Used in screen and letterset inks.
Diethylene Glycol Monoethyl Ether (Hydroxyethoxyethyl Ether, Carbitol).	Shellac, nitrocellulose, epoxy resins, and PVAC.	Miscible with water. Used in letterpress, dry off-set, and screen inks. Also used in textile printing.
Diethylene Glycol Monobutyl Ether (Butyl Digol, Butyl Carbitol)	Nitrocellulose, PVAC. Only partly dissolves shellac and ester gum.	Miscible with water and hydrocarbons. Inks containing this solvent are slower setting but have better press stability than those based on carbitol.
Methyl Ethyl Ketone (MEK)	Similar to acetone except for cellulose acetate for which MEK is not a very good solvent.	Completely miscible with linseed and castor oils, and with most organic solvents. Main use is in gravure inks. Often used as a substitute for ethyl acetate in nitrocellulose lacquers.
Methanol	No information found but probably water-based inks.	Miscible with water.

(continued)

TABLE 6 (CONTINUED)

Solvent	Main resin types for which solvent is useful	Other remarks
Xylene	Solvency is similar to toluene, except that it is a poor solvent for polyvinyl acetate. It will penetrate treated polythene and PVC.	A mixture of the ortho- mea- and para-isomers. Its slow evaporation rate (half that of toluene) limits its use to gravure proofing and sheet-fed gravure inks. Its excellent solubilizing ability for many resins makes it a useful solvent for the removal of dried ink films.
Acetone	Cellulose acetate, nitrocellulose, ethyl cellulose, CAB, CAP, PVAC, PVC, ester gum, and many other natural and synthetic resins. (It also penetrates methyl methacryate and polythene.)	Miscible with water, hydrocarbons, and natural oils. Occasionally used in flexographic and gravure inks as a rapid evaporating solvent. Can also be used in lacquers. Too volatile for most applications, though.
1,1,1-Trichloroethylene	No information found.	May be in ink formulation but primarily used in products for ink cleanups.
Ethylene glycol	Gelatin, dextrin, zein, and maleic or fumaric resins of high acid value.	Very hygroscopic; is miscible with water, alcohol and some ketone solvents. Used in moisture-set inks and water-reducible letterpress inks. (The relatively rapid evaporation rate leads to poor press stability.)
Dichloromethane	No information found.	May be used in inks formulation, but primarily used in products for ink cleanup (e.g., blanket wash sold to printers.)
Methyl Isobutyl Ketone (MIBK)	Nitrocellulose, ethyl cellulose, CAB, PVC, PVAC, vinyl copolymers, acrylics, chlorinated rubber, polyurethane, phenolic, and epoxy resins.	Miscible with most solvents and oils (not water). Used in gravure and screen inks.

METALS AND METAL COMPOUNDS

Metals and metal compounds are processed by ink formulators as solid constituents in inks. The metal/metal compounds are primarily processed as pigments but may also be part of metallized rosins (e.g., zinc resinate). Metal/metal compounds reported by more than 5 percent of ink formulators in 1990 include barium, copper, lead, chromium, and zinc. Table 7 presents a summary of Section 313 reported releases and off-site transfers of metals/metal compounds at ink formulators, based on Section 313 reporting for 1990.

Metals and metal compounds are typically received in dry form. According to AP-42 estimates, 1 percent of pigments handled in dry form during uncontrolled operations will be lost to air during transfer. Air releases may be easily controlled with a baghouse when local exhaust ventilation is used to reduce worker exposure to the pigments.

The primary releases are off-site transfers of pigments in the cleanup solvent, filter disposal, and disposal of off-spec ink.

The next largest release is to POTW. Most of this release is comprised of pigments contained in wash water from cleaning equipment used to make water-based inks. Some POTW releases could also result from spills that are sewered. The use of dedicated equipment and reuse of wash solvent in the next ink batch can all reduce the POTW release of pigments during cleaning.

Air releases during the transfer of dry pigments can be fugitive or stack, based on whether local exhaust ventilation is used to reduce worker exposure to the pigments.

TABLE 7. SUMMARY OF REPORTED RELEASES OF METALS AND METAL COMPOUNDS FROM INK FORMULATION

Section 313 chemical	Number of facilities reporting usage[a] (% reporting usage)	Mean release, lb (% reporting to each media)[b]						
		Fugitive	Stack	Water	Land	POTW[c]	Off-site transfer	Total[d]
Barium compounds	52 (66)	103 (31)	31 (35)	0 (0)	378 (4)	56 (15)	633 (52)	554 (71)
Barium	7 (9)	82 (57)	3 (57)	250 (14)	0 (0)	2280 (14)	2153 (86)	2255 (100)
Copper compounds	33 (42)	5 (30)	68 (24)	0 (0)	5 (3)	128 (21)	407 (30)	372 (45)
Copper	7 (9)	250 (14)	26 (86)	250 (14)	0 (0)	1850 (14)	730 (71)	1026 (86)
Lead compounds	17 (22)	432 (35)	304 (47)	0 (0)	0 (0)	5 (6)	870 (76)	1021 (94)
Lead	3 (4)	145 (67)	250 (33)	0 (0)	0 (0)	0 (0)	255 (67)	350 (100)
Chromium compounds	14 (18)	155 (36)	64 (29)	0 (0)	0 (0)	0 (0)	547 (79)	542 (93)
Chromium	3 (4)	180 (100)	250 (33)	0 (0)	0 (0)	0 (0)	380 (67)	517 (100)
Zinc compounds	13 (16)	167 (23)	65 (31)	0 (0)	0 (0)	0 (0)	1029 (85)	1006 (92)
Zinc (fume or dust)	5 (6)	250 (20)	64 (100)	0 (0)	0 (0)	0 (0)	603 (80)	597 (100)

[a] A total of 79 facilities in SIC 2893 reported usage of at least one Section 313 chemical above threshold limits.

[b] Mean release in pounds per year in 1990 for firms reporting releases of this chemical and percentage of firms reporting usage of this chemical that release to this media. Releases to other media were insignificant.

[c] POTW = Publicly owned treatment works.

[d] The total includes all releases and off-site transfers, not just categories summarized in this table.

OTHER CHEMICALS

Table 8 presents a summary of Section 313 reported releases and off-site transfers of other chemicals, based on Section 313 reporting for 1990. Dibutyl phthalate is used as a plasticizer in liquid inks and lacquers.[2] The purpose of the plasticizer is to make the dried print more flexible and pliable.[2] Release or off-site transfer of dibutyl phthalate was reported by 13 percent of ink formulators; off-site transfer was most commonly reported. Air releases, both fugitive and stack, were also commonly reported.

Although no information was found on the use of ammonia in ink formulation, ammonia likely is an additive in water-based inks. Use was reported by 13 percent of ink formulators.

If ammonia is received in gaseous form, air releases can result from storage and transfer. Ammonia in aqueous form or in water-based ink is released to air from open tanks and packaging. Off-site transfers and releases to water, POTW, or land result from cleaning or spills. These releases/transfers can be determined by the percentage of ammonia listed on the MSDS for the ink.

Because ammonia is a listed Section 313 chemical, all gaseous and aqueous forms must be considered for reporting. Aqueous solutions of ammonia contain both nonionized ammonia (NH_3) and ionized ammonia (NH_4+). As the following chemical equation shows, the two forms of ammonia are in equilibrium in the presence of water.

$$NH_3 + 2H_2O \leftrightarrow NH_4^+ + OH^- + H_2O$$

The term "total ammonia" refers to the sum of these species (i.e., $NH_3 + NH_4^+$). The relative amounts of NH_3 and NH_4^+ depend upon several factors (e.g., temperature, pH, ionic strength, and other chemical reactions). To account for all forms that are present, Section 313 releases should be estimated for total ammonia.

TABLE 8. SUMMARY OF REPORTED RELEASES OF OTHER CHEMICALS FROM INK FORMULATION

Section 313 chemical	Number of facilities reporting usage[a] (% reporting usage)	Mean release, lb (% reporting to each media)[b]						
		Fugitive	Stack	Water	Land	POTW[c]	Off-site transfer	Total[d]
Dibutyl phthalate	10 (13)	138 (60)	390 (30)	0 (0)	0 (0)	0 (0)	586 (90)	727 (100)
Ammonia	10 (13)	594 (100)	940 (90)	0 (0)	0 (0)	280 (50)	462 (50)	1811 (100)

[a] A total of 79 facilities in SIC 2893 reported usage of at least one Section 313 chemical above threshold limits.

[b] Mean release in pounds per year in 1990 for firms reporting releases of this chemical and percentage of firms reporting usage of this chemical that release to this media. Releases to other media were insignificant.

[c] POTW = Publicly owned treatment works.

[d] The total includes all releases and off-site transfers, not just categories summarized in this table.

USE OF REGULATIONS TO ESTIMATE RELEASE OF SECTION 313 CHEMICALS

Regulations pertaining to ink formulators do not provide direct assistance in estimating emissions of Section 313 chemicals.

WATER RELEASES

The EPA Effluent Limitations Guidelines for Ink Formulation (40 CFR 447) define the best available technology economically achievable for oil-based solvent wash as no discharge of process wastewater pollutants to navigable waters. New source performance standards are the same. Pretreatment standards for the same source are no discharge of process water pollutants to a POTW. These standards apply only to facilities in which tanks are used to formulate oil-based inks. These regulations are not particularly useful for estimating water releases because the most likely water/POTW discharge of solvents and metal/metal compounds is from water washing of equipment used to make water-based inks and most ink formulators formulate both solvent-based and water-based inks. Monitoring of discharges may be required by the POTW for TTO (total organics listed in 40 CFR 413.02(i)) or metals.

AIR RELEASES

No national regulations directly limit air releases of VOCs or other pollutants from ink formulation. The State Implementation Plans for some noncompliance areas may have plant-specific VOC limits that apply to large facilities. Regulations governing the printing industry have caused some ink formulators to reformulate coatings to reduce the VOC content in the ink they produce. Because VOC regulations are not particularly useful in helping to predict releases of Section 313 chemicals from ink formulators, each plant must be assessed individually based on the products they produce.

NONREPORTING FACILITIES

Nonreporting facilities may be identified by comparing lists of facilities in Standard Industrial Classification (SIC) 2893 having more than 10 employees with those facilities that have reported under Section 313. Most if not all ink formulators with more than 10 employees would process in excess of 25,000 pounds of at least one solvent or metal/metal compound (approximately 55-60 drums of the chemical). This would be true even for water-based ink formulators.

Sources of information on number of establishments in SIC 2893 presented by employment class include County Business Patterns, published by the U.S. Department of Commerce,[7] and Dunn and Bradstreet (D&B).[8]

Table 9 presents a comparison of the number of facilities listed in various sources with the number of facilities reporting to TRI in 1990.

TABLE 9. NUMBER OF ESTABLISHMENTS IN SIC 2893

Source	Basis	Number of establishments reported
TRI, 1990	SIC 2893	79
County Business Patterns 1989[7]	SIC 2893, >10 employees	332
D&B 1992[8]	SIC 2893, >10 employees	379

There apparently are a number of nonreporting facilities, based on the number of facilities reported in County Business Patterns and D&B and the probability that almost all ink formulators with over 10 employees would process at least one Section 313 chemical in excess of 25,000 pounds.

A review of the TRI data in 1990 pointed out few apparent errors. There did appear to be a possible underreporting of solvents that are typically used as cleanup solvents as otherwise used. Because of the lower threshold for these uses, this could also cause nonreporting for some cleanup solvents if the higher processed threshold (25,000) were used. There was also one Section 313 chemical (n-butyl alcohol) that in

the literature appeared to be used in sufficient quantities that more than 5 percent of the ink formulators should have reported. However, only 3 percent of the ink formulators reported releases or off-site transfers of this solvent.

LIST OF QUESTIONS

The following list of questions may be helpful in determining if errors were made in Section 313 reporting for ink formulators:

Solvents

- Which solvents were processed (just formulated into inks) and which were also otherwise used (also used as a cleanup solvent)?
- Was vehicle cooking performed at the facility? Were any Section 313 solvents used in the process?
- For processed solvents, how was air release calculated?
- For otherwise used solvents, was a mass balance performed on the total quantity used?
- For solvents sent off site for fuel burning, recycling, or disposal, was waste analysis used to determine the quality of the 313 chemical? Most wastes should be RCRA wastes which are analyzed by the waste receiver.
- Was a 10,000-pound threshold used for all otherwise used solvents (cleanup solvents)?
- How was the quantity of solvent in water-based inks released to water determined (e.g., glycol ethers, methanol)?

Metals/Metal Compounds

- Were thresholds for metal compounds determined using the weight of the compound and not just the weight of the metal portion of the compound?
- Was Toxicity Characteristic Leaching Procedure (TCLP) used as a measure of metal concentration in any of the calculations? TCLP measures leachable metal, not metal content, and therefore should not be used in any release calculations.

Other Chemicals

- Was total ammonia used to report ammonia releases to water?

BIBLIOGRAPHY

1. Office of Management and Budget. Standard Industrial Classification Manual. 1987. Washington, D.C. 1987.

2. U.S. Environmental Protection Agency. Industrial Process Profiles to Support PMN Review: Printing Inks. Office of Pesticides and Toxic Substances, Washington, D.C. February 1983.

3. Kirk-Othmer. Encyclopedia of Chemical Technology. 3rd Edition, Volume 13. Inks. John Wiley and Sons, 1981.

4. U.S. Environmental Protection Agency. Compilation of Air Pollution Emission Factors, 3rd Edition, AP-42. Research Triangle Park, N.C. 1983.

5. U.S. Environmental Protection Agency. Best Demonstrated Available Technology (BDAT) Background Document for K086 (Ink Formulation Equipment Cleaning Wastes.) Washington, D.C., May 1990.

6. U.S. Environmental Protection Agency. Proposed Best Demonstrated Available Technology (BDAT) Background Document for K086 (Ink Formulation Equipment Cleaning Wastes) (Addendum) Volume 6. Washington, D.C., November 1989.

7. U.S. Department of Commerce, Bureau of Census, County Business Patterns, 1989, CBP-89-1, Washington, D.C. 1991.

8. Dunn & Bradstreet, Dunn's Electronic Business Directory in DIALOG database file 515.1992.

TRI FACILITY PROFILE, MOTOR VEHICLE PARTS AND ACCESSORIES

by

IT Corporation
11499 Chester Road
Cincinnati, Ohio

Contract No. 68-D0-0020
Work Assignment No. 2-27/2-65/3-18
JTN 830015-5-1

Prepared for

U.S. ENVIRONMENTAL PROTECTION AGENCY
OFFICE OF TOXIC SUBSTANCES
401 M Street, S.W.
Washington, D.C. 20460

September 1992

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TRI FACILITY PROFILE,
MOTOR VEHICLE PARTS AND ACCESSORIES

The purpose of this profile is to assist U.S. Environmental Protection Agency (EPA) Regional Office personnel in conducting Superfund Amendments and Reauthorization Act (SARA) Title III, Section 313, inspections. The profile describes key toxic chemicals manufactured, processed, or otherwise used in the manufacture of motor vehicle parts and accessories, describes how these chemicals are used, and identifies key release sources. All Section 313 chemicals reported to the Toxic Release Inventory (TRI) by more than 5 percent of the motor vehicle parts and accessories manufacturers are presented in this profile.

For the purposes of this profile, the motor vehicle parts and accessories industry is defined as:

- SIC 3714 - Motor Vehicle Parts and Accessories

This Standard Industrial Classification (SIC) includes establishments primarily engaged in manufacturing motor vehicle parts and accessories, but not engaged in manufacturing complete motor vehicles or passenger car bodies. Establishments primarily engaged in manufacturing or assembling complete automobiles and trucks are classified in SIC 3711; those manufacturing tires and tubes are in SIC 3011; those manufacturing automobile glass are in Major Group 32; those manufacturing automobile stampings are classified in SIC 3465; those manufacturing vehicular lighting equipment are classified in SIC 3647; those manufacturing ignition systems are classified in SIC 3694; those manufacturing storage batteries are classified in SIC 3691; and those manufacturing carburetors, pistons, piston rings, and engine intake and exhaust valves are classified in SIC 3592.[1]

SIC 3714 does include the manufacture of brakes and brake parts, wiring harnesses (except ignition), axles, axle housings and shafts, ball joints, bearings,

bumpers, bumperettes, camshafts, air cleaners, connecting rods, control equipment, crankshaft assemblies, cylinder heads, defrosters, differentials, directional signals, drive shafts, dump truck lifting mechanisms, engines and engine parts, exhaust systems, fifth wheels, filters (oil, fuel, and air), frames, fuel pumps, fuel systems, gas tanks, gears, heaters, horns, power steering pumps, instrument board assemblies, lubrication systems, manifolds, engine rebuilding, mufflers, PVC valves, transmissions, pumps (oil, water, and fuel), radiators, wheel rims, shock absorbers, steering mechanisms, thermostats, suspension parts, universal joints, and windshield frames and wiper systems.[1] While this list contains most of the parts and accessories in SIC 3714, it is not an all-inclusive list.

The manufacture of motor vehicle parts and accessories utilizes the following types of operations:

- Foundries
- Metal fabrication
- Plastics processing
- Parts coating
- Electroplating
- Electronics manufacturing

The first three operations (foundries, metal fabrication, and plastics forming) are the initial processes for parts such as engines, suspension parts, body parts, interior parts, and other metal and plastic parts. Foundries are operations that melt metal to pour into molds to produce castings. Metal fabrication includes operations such as stamping, welding, or soldering. Plastics forming operations utilize resins or liquid organic compounds to produce a solid polymerized chemical in the desired shape. Once the basic part is formed, it is usually further processed by one or more of the finishing processes.

Parts coating and electroplating operations are finishing processes that apply a decorative and/or protective layer on the metal and plastic parts such as trim parts, bumpers, exterior parts, and wheel rims. Parts coating operations deposit a coating on the part, typically by either dipping, spray coating, or electrodeposition. Electroplating operations deposit metal on the surface of the part by electrochemical reaction.

Electronics manufacture utilizes similar operations to produce finished accessory products such as radios, electronic instrument panels, and other electronic accessories.

TYPICAL OPERATIONS USED

Motor vehicle parts and accessories manufacturing facilities differ widely from facility to facility. The following operations are typically used to manufacture motor vehicle parts and accessories:

- Foundries
- Metal fabrication
- Plastics processing
- Parts coating
- Electroplating
- Electronics manufacturing

Each of these operations is described separately. Few of the motor vehicle parts and accessories manufacturing facilities will contain all of these operations.

FOUNDRY PROCESSES

This section summarizes information presented in the TRI Facility Profile, Foundries.[2] For more detailed information on foundry operations, please consult this profile. Five metals/metal alloys are utilized in motor vehicle parts and accessories manufacturing. These include iron, steel, aluminum, magnesium, and lead. Typical iron castings include engine blocks, crank shafts, and other engine components. Steel castings are used in chassis components, suspension components, and wheel rims. Aluminum castings include engine heads, blocks, and intake parts. Magnesium is typically alloyed with other metals for use in wheel rims. Lead castings are typically limited to ingots used for balancing purposes on parts and in applications bearings.

The four major production steps in foundry operations include raw materials handling and preparation, metal melting, mold and core production, and casting and finishing.[2]

Raw materials handling and preparation operations include receiving, unloading, storing, and conveying of all raw materials for both furnace charging and mold and core preparation. The major groups of raw materials required for furnace charging are metallics, fluxes, and fuels. Raw material preparation may include the cleaning of scrap metals before charging.

Metal melting is performed in a variety of furnaces with the furnace charge consisting of metallics, fluxes, and fuels. Seven general furnace types are used in foundries.

- Cupola
- Electric arc furnace
- Electric induction furnaces
- Reverberatory furnaces
- Crucible furnaces
- Pot furnaces
- Open hearth furnaces

The cupola, which is the major type of furnace used in iron foundries, is a vertical cylindrical steel shell with either a refractory-lined or water-cooled inner wall.[2] Refractory linings usually consist of silica brick, dolomite, or magnesium brick. Water-cooled linings, which involve circulating water around the outer steel shell, are used to protect the furnace wall from interior temperatures. The cupola is charged at the top with alternate layers of coke metallics and fluxes. Cupola capacities typically range from 1 to 30 tons per hour, with a few larger units approaching 100 tons per hour.

Electric Arc Furnaces (EAF) are large, welded-steel cylindrical vessels equipped with a removable roof through which retractable carbon electrodes are inserted. The electrodes are lowered through the roof of the furnace and are energized by three-phase alternating current to create arcs that melt the metallic charge with their heat.[2] Additional heat is produced by the resistance of the metal between the arc paths. The most common method of charging an electric arc furnace is by removing the roof and introducing the raw materials directly. Alternative methods include introducing the charge through a chute cut in the roof or through a side charging door in the furnace shell. Once the melting cycle is complete, the carbon electrodes are raised, and the roof is removed. The vessel is tilted, and the molten iron is poured into a ladle. Electric arc furnace capacities range from 0.23 to 59 megagrams (0.25 to 65 tons). Nine to eleven pounds of electrode are consumed per ton of metal melted. Electric arc furnaces are becoming increasingly popular in the steel-making industry.

Electric induction furnaces are either cylindrical or cup-shaped refractory-lined vessels that are surrounded by electrical coils that, when energized with high-frequency alternating current, produce a fluctuating electromagnetic field to heat the metal charge.[2] For safety reasons, the scrap metal added to the furnace charge is cleaned and heated before being introduced into the furnace. Induction furnaces are kept closed except during charging, skimming, and tapping. The molten metal is tapped by tilting the vessel and pouring the metal through a hole in the vessel side. Induction furnaces also may be used for metal refining in conjunction with melting in other furnaces and for holding and superheating the molten metal before pouring (casting).

Reverberatory furnaces operate by radiating heat from a burner flame, furnace roof, and furnace walls onto the material heated. The reverberatory furnace usually consists of a shallow, generally rectangular, refractory hearth for holding the metal charge. The furnace is enclosed by vertical side walls and covered with a low, arched, refractory-lined roof. Fuel is combusted directly above the molten bath; the walls and roof reserve radiant heat from the hot combustion products and, in turn, reradiate the heat to the surface of the bath surface. Heat is transferred almost entirely by radiation.[2]

Crucible furnaces used to melt metals with melting points below 2,500°F are usually constructed with a shell of welded steel lined with refractory materials. Their covers are constructed of materials similar to the inner shell lining; a small hole over the crucible is used for charging materials and exhausting combustion products. The crucible, which rests on a pedestal in the center of the furnace, is commonly constructed of refractory materials such as clay-graphite mixtures or silicon carbide. Crucibles are made in several shapes and sizes for melting from 20 to 2,000 pounds. Crucible furnaces are classified as tilting, pit, or stationary furnaces.[2]

Pot furnaces are used to melt metals with a melting temperature below 1,400°F.[3] These furnaces may be cylindrical or rectangular and consist of an outer shell lined with refractory material, a combustion chamber, and a pot. The pots are made of pressed steel, cast steel, or cast iron with flanged tops. The flange rests on the furnace wall, holds the pot above the furnace floor, and seals the contents of the

pot from the combustion products of the fuel used. The shape of the pot depends upon the operation to be conducted. Large rectangular furnaces, generally called kettles, are used to melt large amounts of metal for dipping operations, such as galvanizing. For melting large castings, shallow, large-diameter pots are used. When ingots or other small pieces of metal are to be melted, deep pots are used to promote better heat transfer. Pot furnaces are usually emptied by tilting, dipping, or pumping. Combustion equipment ranges from simple atmospheric-type burners located directly below the pot to premix-type tangentially fired burners. The larger kettles are generally provided with many burners along both sides of the pot.[2]

Open hearth furnaces may be charged with various types of iron-bearing materials 1) hot metal (pig iron) and molten steel, 2) cold steel scrap and cold pig iron, 3) all steel scrap, or 4) steel scrap and molten pig iron. A luminous flame with excess air is passed over the charged materials to provide heat for the process. Combustion air is alternately preheated by regenerating units, which, in turn, are heated by the products of combustion discharging from the furnace.[2]

Mold and core production requires the use of Section 313 chemicals. Molds are forms used to shape the exteriors of castings. Cores are molded sand shapes used to make the internal voids in castings. Cores are made by mixing sand with organic binders, molding the sand into a core, and baking the core in an oven. Molds are prepared of a mixture of wet sand, clay, and organic additives to make the mold shapes, which are usually dried with hot air. Cold setting binders are being used more frequently in both core and mold production. Used sand from castings shakeout (after metal pouring) is recycled to the sand preparation area and cleaned to remove any clay or carbonaceous buildup. The sand is then screened and reused to make new molds. Makeup sand is added to allow for process losses and discard of a certain amount of sand because of contamination.[2]

Casting and finishing operations include molten metal pouring, mold removal, and various other operations used to finish the casting. After the melting process, molten metal is tapped from the furnace. Molten iron produced in cupolas is tapped

from the bottom of the furnace into a trough, into a ladle. Iron produced in electric arc and induction furnaces is poured directly into a ladle by tilting the furnace.

When castings have cooled, any unwanted appendages, such as spurs, gates, and risers, are removed. These appendages are removed with an oxygen torch, abrasive band saw, or friction cutting tools. In less-mechanized foundries, hand hammers may be used to knock off the appendages. After appendage removal, the castings are subjected to abrasive blast cleaning and/or tumbling to remove any remaining mold sand or scale. The castings may also be finished for machining or grinding, and some products are degreased and coated or electroplated before shipment.

METAL FABRICATION

Body parts, frame parts, and system parts such as radiators or air conditioners may be fabricated from purchased metal at motor vehicle parts and accessory manufacturers. These processes can use operations such as stamping, welding, cutting, grinding, or soldering. Releases can include releases of metal from cutting or grinding or metal vapors from welding or soldering. The fabricated parts may then be coated prior to shipment. Coating operations are described later in the section called Parts Coating.

PLASTIC PROCESSING

At least 17 types of plastic resins and compounds are used in the manufacture of motor vehicle parts and accessories. These materials include:

- Acetals
- Acrylics
- Cellulosics
- Ketone-based resins
- Nylon
- Polyamide-imide
- Polyarylate
- Polycarbonate
- Polybutylene terephthalate
- Polyetherimides
- Ionomer
- Thermoplastic polyimides
- Polyphenylene ethers
- Polypropylene
- Styrenic resins
- Thermoplastic elastomers
- Polyurethane

These materials are used to make a wide variety of plastic parts and accessories. A description of each of these plastics follows.

Acetals are engineering thermoplastics that are characterized by their high load-bearing capabilities and low coefficient of friction. Acetals, also known technically as polyoxymethylenes (POM), are polymers of formaldehyde with the linear polymer structure of (-CH20-) units repeating in their backbone. Typical applications of POM are molded window lift mechanisms; ball sockets for track rod ends; fasteners for interior and exterior trim, cables, etc.; functional parts in heating, ventilation, and air conditioning systems; steering column/gear shift mechanisms; and door handles.[3]

Acrylics are used by the motor vehicle parts and accessory industry for their sparkling crystal clarity, outstanding surface hardness, superior weatherability, and good chemical resistance. Acrylic is used as a monomer for coating resins and casting sheet, rods, and tubes and as polymer beads or pellets for extrusion or injection molding. Acrylics typically start with methyl methacrylate (MMA) monomer. MMA is polymerized by a free radical process in the presence of peroxides to form poly-MMA (PMMA). Typical PMMA applications are taillights, side markers, escutcheons, pillar posts, instrument covers, nameplates, trim, and dials.[3]

Cellulosics are plastics produced by the chemical modification of cellulose. Cellulose is the cell wall substance of many trees and plants that is produced by photosynthesis. Cellulosics are characterized by their toughness, surface gloss, clarity, and ability to be processed by a variety of methods. Typical cellulosics applications include steering wheels in luxury and special-purpose vehicles and coated-over foil strips for trim parts.[3]

Ketone-based resins are characterized by their chemical resistance, toughness, strength, rigidity, radiation resistance, and easy melting process. These resins are partially crystalline aromatic materials composed of aryl repeating units linked by oxygen and carbonyl groups. Typical application of these resins are bearing cages, seals, housings, and printed circuit boards.[3]

Nylons are notable for their resistance to oils and greases, repeated impacts, fatigue, and abrasion. Nylons contain an amide group (-CONH-) as the recurring

part of the chain. Typical applications of nylons are electrical connectors, wire jackets, emission canisters, light-duty gears for windshield wipers and speedometers, trim clips, engine fans, radiator headers, brake and power steering reservoirs, valve covers, mirror housings, and fender extensions.[3]

Polyamide-imides (PAI) are amorphous, high-temperature engineering thermoplastics. PAI is produced by the reaction of trimellitic anhydride and aromatic diamines followed by condensation to form the imide group. After molding, the parts must be thermally treated by a program of increasing temperatures that increases the molecular weight and improves the properties of the material. Typical applications of PAIs are thrust washers and seal rings in transmissions, universal joints, and power-assisted devices.[3]

Polyarylates are noted for their tough, durable, and heat-resistance properties. These polymers are aromatic polymers with an amorphous molecular structure. Polyarylate parts provide excellent surfaces for painting, plating, hot stamping, and printing. Typical applications of polyarylates are headlight housings, brakelight reflectors, door handles, mirror housings, window trim, brackets, fasteners, and windshield wipers.[3]

Polycarbonates (PC) are characterized by high clarity, heat- and flame-resistance, dimensional stability, and exceptional high impact strength over a wide range of temperatures. PC is a polyester of carbonic acid generally produced by using a reaction between di- or polyhydric phenols and a suitable carbonate precursor such as dichlorocarbonate. Typical applications of PCs are instrument panels, light pipes, glazing, seat backs, headlights, taillight lenses, and side markers.[3]

Polybutylene terephthalates (PBT) are thermoplastic polyesters that are characterized by good chemical resistance and good electrical properties. PBTs are produced by the transesterification of dimethyl terephthalate with butanediol. Typical applications of PBT are grilles, body panels, fenders, bumper covers, wheel covers, distributor caps, rotors, head lamp system parts, windshield wiper assemblies, water pump parts, brake system parts, and components for doors, windows, and mirrors.[3]

Polyetherimides are thermoplastics characterized by high strength and rigidity at elevated temperatures, long-term heat resistance, highly stable dimensional and electrical properties, and broad chemical resistance. Polyetherimide has an amorphous chemical structure with recurring aromatic imide and ether units. Typical applications of polyetherimides are under-the-hood temperature sensors, fuel system components, lamp sockets, and metallized reflectors; and high-strength transmission components.[3]

Ionomers are noted for their UV resistance, transparency, colorability, low-temperature toughness, and adhesion to other materials. Ionomers, a generic term for polymers containing interchain ionic bonding, are based on metal salts (usually sodium or zinc) of ethylene/methacrylic acid copolymers. Typical applications of ionomers are air dams, exterior trim parts, bumper pads, and bumper guards.[3]

Thermoplastic polyimides are linear polymers with the imide group (-CONCO-) incorporated in the polymer main chain. The key properties include outstanding high-temperature resistance, toughness, and high resistance to deformation under load at elevated temperatures. Thermoplastic polyimides are typically used for the manufacture of rotary seal rings in heavy-duty transmissions.[3]

Polyphenylene ethers (PPE) are produced by the oxidative coupling of substituted phenols. The two main materials are the homopolymer based on 2,6 dimethyl phenol and the copolymer, which contains primarily 2,6 dimethyl phenol and a lower concentration of 2,3,6 trimethyl phenol. PPE is typically alloyed with polystyrene to provide excellent melt flow characteristics. Polyblends are typically applied to instrument panels, seat backs, rear spoilers, wheel covers, mirror housings, electrical connectors, and fuse blocks.[3]

Polypropylenes (PP) are noted for their low specific gravity and good resistance to chemicals and fatigue. Typical PP is a stereo-specific polymer with propylene units attached in a head-to-tail fashion and with methyl groups aligned on the same side of the backbone. PP is produced by the polymerization of polypropylene with organometallic stereo-specific catalysts. Typical applications of PP are interior trim parts and air ducts.[3]

Styrenic resins are a family of thermoplastics that include acrylonitrile-butadiene-styrene (ABS), acrylic-styrene-acrylonitrile (ASA), styrene-acrylonitrile (SAN), and styrene-maleic anhydride (SMA). These listed are the typically used thermoplastics in motor vehicle parts and accessories manufacturing. ABS is a mixture of SAN co-polymer with SAN-grafted polybutadiene typically used in interior moldings, consoles, quarter trim panels, map pockets, grilles, mirror housings, wheelcovers, and headlamp bezels. ASA is an outdoor weatherable and UV-resistant material that is produced by a terpolymer system. ASA is typically used in body side moldings and trim, mirror housings, bumper parts, and interior trim parts. SAN is a copolymer system that possesses transparency, high gloss, and chemical resistance and is typically applied to instrument lenses and dash board components. SMA is a thermoplastic produced by the copolymerization of styrene and maleic anhydride that are typically used in electrical connectors, consoles, top pads, instrument panels and supports, interior trim parts, headliners, heater ducts, and consoles.[3]

Thermoplastic elastomers (TPE) are a category of polymers that are a combination of the mechanical properties of thermoset rubber with the processing ease of thermoplastics. TPEs are resistant to high loads and chemicals and have a broad service temperature range. Applications of TPEs include hose jacketing, seals, grommets, air ducts, convoluted boots, weatherstripping, o-rings, bumper covers, air dams, and gear shift knobs.[3]

Polyurethanes (PUR) are produced by combining two primary ingredients, a polyisocyanate and a polyol, during processing. Two types of foams are typically produced by motor vehicle parts and accessories manufacturers: integral skin foams and semi-rigid foams. Integral skin foams have a thin tough skin on a lightweight foam core that are typically used to produce armrests and steering wheels. Semi-rigid foams are open-celled foams that are harder and do not form a skin during forming as integral skin foams. Semi-rigid foams have a moderate amount of resiliency and excellent sound and energy absorbency properties that are used in armrests, door panels, and instruments panels.[3]

Four major processes typically are used by motor vehicle parts and accessories manufacturing facilities to process these plastics into useable parts. These processes are:

- Blow molding
- Extrusion
- Injection molding
- Thermoforming

Blow molding may be used on several thermoplastic materials. The materials typically used by motor vehicle parts and accessory manufacturers are polyarylates, polycarbonates, ionomers, styrenic resins, and polyurethanes. Blow molding follows a six-step process that is typically totally automated. The first step is extrusion from the molten plastic of a round hollow tube, called a parison. This parison is then entrapped between two halves of the mold. The parison within the mold is expanded by air pressure (usually 100 psi) against the cavity of the mold to form the part. The part is allowed to cool within the mold. Once cooled, the part is removed from the mold and the excess is trimmed.[3]

Extrusion may be used for the following thermoplastic materials typically used by motor vehicle parts and accessory manufacturers: acetals, cellulosics, nylons, polyarylates, polycarbonates, ionomers, and styrenic resins. Extrusion follows a four-step process. First, the plastic powder or granules are heated to a continuous uniform melt. This melt is then forced through a die of the desired part shape. The part is held in the desired shape until it cools back into a solid state. Extruded parts can be in the form of custom profiles, flat sheets, piping and tubing, and fibers.

Injection molding involves a three-step process to manufacture a molded part. Pelletized granular or powdered plastic is fed to a heating cylinder where heat and pressure are applied to the plastic to obtain a melt. The melt is then injected under high pressure into a metal mold. The pressure is maintained in the mold until the plastic is hard enough to be removed from the mold. Typical materials processed by injection molding by motor vehicle parts and accessory manufacturers are acetals, acrylics, ketone-based resins, nylons, polyamide-imides, polyarylates, polycarbonates,

polybutylene terephthalates, polyetherimides, ionomers, polyimides, polyphenylene ethers, polypropylenes, styrenic resins, and thermoplastic elastomers.

Thermoforming involves a simple two-step process of elevating the temperature of a thermoplastic material to a workable level and forming the material into the desired shape by one of nine techniques: straight vacuum forming, drape forming, matched mold forming, pressure bubble-plug assist vacuum forming, plug assist forming, vacuum snapback forming, pressure bubble vacuum snapback forming, trapped sheet contact heat pressure forming, and air-slip forming. Typical materials processed by thermoforming are cellulosics, polyarylates, polyetherimides, and styrenic resins.

PARTS COATING

Coatings are applied to motor vehicle parts and accessories for appearance, durability, and corrosion protection. Typically three steps are used in coating parts: pretreatment, primer coat, and top coat.

The coating process begins with a pretreatment process. Pretreatment can consist of phosphate coating or degreasing. For phosphate coating, metal parts are bathed or sprayed with a hot phosphoric acid solution containing dissolved zinc and other metals. The part is then rinsed with dilute chromic acid and water. Once dried, the surface of the part will contain a conversion coating of zinc or iron phosphate.

An alternate pretreatment is to degrease the part using a chlorinated solvent or other cleaning solution. In a solvent wipe, a rag or other wiper is dipped in the chlorinated solvent and wiped across the part to remove the contaminant from the part. Cold degreasers usually consist of a tank, basket, and cover, and may employ spraying, brushing, agitation, flushing, or immersion. The solvent is usually kept near room temperature. Cold units vary greatly in size and design. The size of the degreaser is directly related to the size and number of the parts being cleaned.

A vapor degreaser consisting of a tank and heating system to boil the solvent may be operated manually or it may be conveyorized. In this process, parts are lowered into a solvent vapor produced for cleaning. Vapors condense on the parts

until the temperature of the part approaches that of the vapor, at which time the parts are removed. Most vapor degreasers are equipped with condenser coils located on the upper sidewalls of the degreaser to control the vapor level in the tank. They may also be equipped with water separators, which are simple containers in which solvent and water that condenses from the ambient air are separated. Lids are commonly closed when the degreaser is not in use.

Once the surface of the part is pretreated, a primer coating is applied. The main function of the primer is corrosion protection and, to a lesser degree, to smooth out small imperfections in the surface. Primer is usually applied to auto parts by one of three methods: dipping, spray coating, or electrodeposition. Dipping and spray coating primers may use a binder of alkyd and epoxy resins dissolved in an organic solvent. Electrodeposition coating may be used to provide an adequate coating to recessed areas where dipping and spraying coatings do not. Electrodeposition typically uses polybutadiene- or epoxy-based binders. The typical range of thickness of the primer coating is 7.5 to 25 microns. The primer coating may be air dried or baked dried.

The topcoat is the final coating and is placed on top of the primer coating. Typical topcoats used by motor vehicle parts and accessories manufacturers for visible exterior body parts are lacquers and enamels. Lacquer binders consist mainly of poly(methyl methacrylate) and also contain cellulose acetate butyrate, a small amount of alkyd plasticizer, and a copolymer of methyl methacrylate with an acrylate dispersed in an organic solvent. Enamel topcoats are composed of a mixture of an acrylic resin and a melamine-formaldehyde resin usually dispersed in an organic solvent. To achieve a metallic finish for exterior visible parts, a concentration of aluminum pigment of about 2 percent is added to the coating material before application.

Plastic parts may also be coated. They are typically coated with a lacquer-type primer consisting of a polyether urethane. Topcoats are typically enamels made with binders of hydroxy-functional polyester urethanes that are cross-linked with a melamine-formaldehyde resin, while other topcoats are acrylic resins cross-linked with

melamine-formaldehyde resin and contain a plasticizer. No conversion coating is applied; however, the parts may be degreased prior to coating.

ELECTROPLATING

This section summarizes information presented in the TRI Facility Profile, Electroplating.[5] For more detailed information on electroplating operations, please consult this profile.

Electroplating is the electrodeposition of an adherent metallic coating on an electrode in order to form a surface with properties or dimensions different from those of the base metal. The Section 313 metals that are commonly electroplated in auto parts manufacture include chromium, nickel, and zinc. The electroplating process includes cleaning, rinsing, plating, and postplating treatments; such operations can be performed manually or with varying degrees of automation. The primary cleaning processes performed prior to electroplating include solvent cleaning, alkaline cleaning, and acid cleaning. The processes associated with chlorinated solvent degreasing were previously described in the section on parts coating. Alkaline cleaners do not typically contain Section 313 chemicals in high enough concentrations such that use would be above the threshold limits. Parts to be plated may be hung in the plating tank on wires or racks, contained in wire baskets, or, more commonly placed in barrels that rotate in the plating tank. Movement from one operation to the next may be by hand or by machine.[5]

ELECTRONICS

Electronic parts manufacturing includes printed circuit board assembly and wiring, enclosure fabrication, and entire part assembly. Electronics manufacturing may also include integrated circuit silicon chip fabrication; however, it is assumed that this part of the electronic component is fabricated at another facility.

Printed circuit board assembly involves the degreasing of the printed circuit boards, application of solder flux, wiring and soldering connections, and removal of the solder flux. Chlorinated solvents are used for the degreasing and flux removal

operations because of the extreme requirements for cleanliness and purity of the products. Solvent degreasing in the electronics manufacturing process consists of seven steps: degreasing with a chlorinated solvent, cleaning with an abrasive, soaking in alkaline or acid, rinsing, dipping in hydrochloric acid, final rinsing, and drying. Once dry, the flux is applied to the components to be joined to clean the surfaces and promote the fusion of the solder with the surfaces. Typical solder used is tin-lead solder to join the connections and wiring components.

The flux that remains on the circuit board after soldering is removed by either chlorinated solvent or aqueous-based systems. The choice of flux removal system is determined by the type of flux used. There are three types of solder flux: rosin, organic acid, and synthetic-activated resin. Both systems may be used to remove rosin fluxes, organic acids fluxes are removed exclusively with aqueous systems, and synthetic-activated resin fluxes require halogenated solvent removal.

Enclosure fabrication and product assembly include some of the processes discussed previously such as electroplating, plastics forming, and parts coating. Examples of these include electroplating metal contacts with gold or other conductive metal, plastic forming enclosure shells, and coating metal or plastic parts and enclosures.

SECTION 313 CHEMICALS USED IN THE MANUFACTURE OF MOTOR VEHICLE PARTS AND ACCESSORIES

Section 313 chemicals commonly used in the manufacture of motor vehicle parts and accessories can be classified into six general categories: organic solvents, chlorinated solvents, polymer chemicals, metals/metal compounds, acids, and other chemicals. Each category is discussed separately in this report. Each section contains a description of how the Section 313 chemicals are used, a table summarizing the releases and off-site transfers that were reported to TRI in 1990, and a discussion of typical releases, off-site transfers, and typical control practices. Also presented are methods for identifying nonreporting facilities and a list of questions.

ORGANIC SOLVENTS

Eight organic solvents are otherwise used at motor vehicle parts and accessory facilities. The use of these chemicals does not typically form any Section 313 chemical by-products during use. These solvents are widely used, and although they may be used at some facilities for cleaning, they are typically used in coatings that are applied to the parts. For all organic solvents, virtually all releases occur to air. Minor quantities may be transferred off site in paint wastes or to POTWs if a water curtain is used as a control/collection measure for spray mist. Because glycol ethers are soluble in water, significant release to water or POTW is to be expected for this chemical.

Organic solvents that are used as purge solvents such as xylene, toluene, or MEK can be expected to be transferred off site for recycling, fuel blending, or disposal. Because off-site transfer for recycling or fuel blending was not reportable prior to the 1991 reporting year, significant increases in the off-site transfers of these organic solvents can be expected in 1991 and subsequent years. These quantities will also be reported in Sections 8.3 and 8.5 of the Form R. Table 1 presents a summary of reported releases and off-site transfers of organic solvents from the manufacture of motor vehicle parts and accessories.

Controls of organic solvent releases include add-on pollution control equipment such as thermal or catalytic incinerators or carbon adsorbers. The most prevalent control to reduce Volatile Organic Compound (VOC) emissions involves process changes such as use of high solids paint, powder coatings, and water-borne coatings. Process changes such as new spray guns are also used to increase transfer efficiencies and therefore reduce solvent consumption.

TABLE 1. SUMMARY OF REPORTED RELEASES OF ORGANIC SOLVENTS FROM MOTOR VEHICLE PARTS AND ACCESSORY MANUFACTURING

Section 313 chemical	Number of facilities reporting usage[a] (% reporting usage)	Mean release, lb (% reporting to each media)[b]						
		Fugitive	Stack	Water	Land	POTW[c]	Off-site Transfer	Total[d]
Xylene (mixed isomer)	94 (28)	13,561 (79)	84,067 (91)	66 (4)	0 (0)	265 (15)	5,233 (49)	90,191 (100)
Toluene	86 (26)	16,084 (74)	52,219 (88)	10 (2)	135 (2)	241 (17)	9,425 (48)	82,655 (100)
Methyl ethyl ketone	73 (22)	9,953 (89)	68,590 (84)	87 (4)	0 (0)	1,201 (10)	14,603 (58)	74,698 (100)
Glycol ethers	62 (19)	6,071 (76)	44,327 (84)	e	0 (0)	23,710 (50)	7,168 (47)	59,139 (97)
Methanol	50 (15)	3,923 (84)	27,423 (64)	0 (0)	0 (0)	e	3,603 (26)	24,943 (90)
Acetone	49 (15)	28,874 (86)	67,938 (61)	0 (0)	0 (0)	500 (12)	1,977 (37)	68,530 (98)
n-Butyl alcohol	35 (11)	4,080 (86)	37,785 (86)	5 (3)	0 (0)	973 (11)	1,232 (51)	36,629 (100)
Methyl isobutyl ketone	27 (8)	7,764 (89)	39,580 (89)	0 (0)	0 (0)	551 (19)	4,297 (56)	44,573 (100)

[a] A total of 331 facilities in SIC 3714 reported usage of at least one Section 313 chemical above threshold limits.

[b] Mean releases in pounds per year in 1990 for facilities reporting releases of this chemical and percentage of facilities reporting usage of this chemical that release to this media. Releases to other media were insignificant.

[c] POTW = Publicly Owned Treatment Works.

[d] The total includes all releases and off-site transfers, not just categories summarized in this table.

[e] Mean value is not representative because of a very large value at one facility and the small number of facilities.

CHLORINATED SOLVENTS

Chlorinated solvents are otherwise used at auto parts and accessory manufacturing facilities in foundry, parts coating, electroplating, and electronics operations. These solvents are typically used as cleaning and degreasing agents at all of the above-listed operations. At foundry operations, however, chlorinated solvents may also be contained in metal cutting fluids, used as mold release carriers, and contained in products used to detect cracks in casting. Table 2 presents a summary of 1990 reported releases and off-site transfers of chlorinated solvents from motor vehicle parts and accessories manufacturing.

During use of chlorinated solvents contained in mold release carriers and in products used to detect cracks in castings at foundry operations, all emissions are released to air and no pollution controls are typically used. Therefore, the air release is equal to the solvent usage. For cutting fluids, some emissions are released to air during usage and some are transferred off site for treatment or disposal as waste cutting oil.

Chlorinated solvents may also be used to degrease or clean metal castings, metal parts before electroplating, or parts coating. Chlorinated solvents are also used to clean electronic circuit boards. The solvents may be used in a solvent wipe, cold degreaser, or vapor degreaser, all of which have been previously described.

Degreasing operations primarily produce fugitive and point-source air releases and off-site transfers for solvent recovery or disposal. In vapor degreasing, moisture from air condensing on the cooling coils of the degreaser may result in minimal releases to water or POTWs.

Numerous controls may be used to reduce releases and off-site transfers of chlorinated solvents from motor vehicle parts and accessories manufacturing. Air releases from vapor degreasing operations may be reduced by application of the following engineering controls and operation and maintenance (O&M) procedures:

TABLE 2. SUMMARY OF REPORTED RELEASES OF CHLORINATED SOLVENTS FROM MOTOR VEHICLE PARTS AND ACCESSORY MANUFACTURING

Section 313 chemical	Number of facilities reporting usage[a] (% reporting usage)	Mean release, lb (% reporting to each media)[b]						
		Fugitive	Stack	Water	Land	POTW[c]	Off-site Transfer	Total[d]
1,1,1-Trichloroethane	129 (39)	27,929 (91)	42,673 (70)	8 (2)	20 (1)	100 (13)	12,816 (39)	60,084 (100)
Freon 113	56 (17)	36,352 (100)	35,372 (41)	250 (2)	0 (0)	128 (4)	4,021 (29)	52,038 (100)
Trichloroethylene	34 (10)	49,655 (91)	60,791 (74)	98 (9)	0 (0)	204 (18)	12,698 (44)	95,619 (100)
Dichloromethane	27 (8)	16,920 (89)	27,858 (63)	0 (0)	0 (0)	189 (15)	9,533 (52)	37,551 (100)
Tetrachloroethylene	18 (5)	45,413 (83)	32,774 (83)	111 (11)	0 (0)	29 (17)	5,175 (28)	66,610 (100)

[a] A total of 331 facilities in SIC 3714 reported usage of at least one Section 313 chemical above threshold limits.

[b] Mean releases in pounds per year in 1990 for facilities reporting releases of this chemical and percentage of facilities reporting usage of this chemical that release to this media. Releases to other media were insignificant.

[c] POTW = Publicly Owned Treatment Works.

[d] The total includes all releases and off-site transfers, not just categories summarized in this table.

Engineering controls

- Lowering the temperature of cooling water
- Increasing freeboard height (distance between top of vapor phase and top of degreaser)
- Adding low-solvent detector
- Using optimum part-handling speeds (automatic hoists)
- Adding automatic lid closure
- Adding extra cooling coils on inlets and outlets

O&M procedures

- Closing the cover when possible
- Minimizing drafts
- Positioning work to minimize dragout
- Spraying only below the vapor level
- Avoiding excessively large loads
- Maintaining equipment

Waste solvent evaporation can be a major source of air releases from cold cleaning. This release occurs when spent solvent is stored in open containers prior to disposal and/or from evaporation at the disposal site. This release can be minimized by covering spent solvent containers and by reclaiming solvent. Another release source, solvent bath evaporation, can be reduced through use of a cover whenever parts are not being cleaned and through adjustment of room and exhaust ventilation rates to minimize drafts. A third release source, solvent carryout, is dependent on the use of a drainage rack. Internal or external racks can be used, depending on the size of the cleaning unit. Also, drainage time must be of adequate duration to ensure that the racks are effective in reducing carryout.

A common error in reporting has been the use of the total quantity of waste solvent sent off site (i.e., that reportable under the Resource Conservation and Recovery Act as F001 and F002 waste mixtures) as the quantity of chlorinated solvent sent off site. Using this overestimation of the quantity of chlorinated solvent sent off site in mass balance calculations underestimates the air releases of the solvent. The facility usually may contact the solvent reclaimer to obtain the percentage of chlorinated solvent in the waste mixture.

POLYMER CHEMICALS

Polymer chemicals are processed in plastics forming operations. Two polymer chemicals were reported to TRI in 1990: methylenebis(phenyl isocyanate) and styrene. Table 3 presents a summary of reported releases and off-site transfers of polymer chemicals from motor vehicle parts and accessories manufacturing. Many other Section 313 chemicals may be used as polymer chemicals; however, they may be present at below the de minimis levels. These other polymer chemicals include formaldehyde, methyl acrylate, ethylene, acrylonitrile, butadiene, and maleic anhydride.

The majority of the Section 313 listed polymer chemicals are released to air. Solvent recovery systems, vessel washings, and condensate may produce water or POTW releases. Off-site transfers are typically waste polymer and off-spec product and parts. Controls of polymer chemical releases include add-on pollution control equipment such as thermal or catalytic incinerators or carbon adsorbers.

TABLE 3. SUMMARY OF REPORTED RELEASES OF POLYMER CHEMICALS FROM MOTOR VEHICLE PARTS AND ACCESSORY MANUFACTURING

Section 313 chemical	Number of facilities reporting usage[a] (% reporting usage)	Mean release, lb (% reporting to each media)[b]						
		Fugitive	Stack	Water	Land	POTW[c]	Off-site Transfer	Total[d]
Methylenebis (phenyl isocyanate)	29 (9)	2,435 (48)	1,346 (38)	0 (0)	0 (0)	128 (7)	e	14,423 (69)
Styrene	24 (7)	e	20,176 (54)	0 (0)	0 (0)	0 (0)	10,556 (29)	95,783 (96)

[a] A total of 331 facilities in SIC 3714 reported usage of at least one Section 313 chemical above threshold limits.

[b] Mean releases in pounds per year in 1990 for facilities reporting releases of this chemical and percentage of facilities reporting usage of this chemical that release to this media. Releases to other media were insignificant.

[c] POTW = Publicly Owned Treatment Works.

[d] The total includes all releases and off-site transfers, not just categories summarized in this table.

[e] Mean value is not representative because of a very large value at one facility and the small number of facilities.

METALS AND METAL COMPOUNDS

Metals and metal compounds are processed at motor vehicle parts and accessories manufacturing facilities that utilize foundry, coating, electroplating, and electronic manufacturing operations. While conversions between metal and metal compounds may occur, there are no Section 313 metal by-products formed during the use of metal/metal compounds in coating, electroplating, and electronics operations. However, metal compounds may be manufactured as by-products in the melting process in foundry operations. Table 4 presents a summary of reported releases and off-site transfers of metals and metal compounds from the manufacture of motor vehicle parts and accessories.

The primary metals/metal compounds processed at foundry operations are aluminum (fume or dust), chromium, copper, lead, manganese, nickel, and zinc (and their compounds). The compounds of these metals may be manufactured as a by-product of the process. Metal/metal compounds may also be released during finishing of the castings during grinding and other mechanical processes.

The metals/metal compound releases to air at foundries are in the form of fume or dust and are controlled by a number of control devices. These controls vary so widely among foundry operations that specific controls at the foundry in question should be identified.

The metal/metal compounds may also be transferred off site at foundries for treatment or disposal or may be disposed of on site as a land release from foundry operations. Small quantities may be sent to water or Publicly Owned Treatment Works (POTWs).

Metals/metal compounds are solid constituents of coatings processed by coating operations. The metals/metal compounds are primarily processed as pigments, but may also be constituents of other additives. Major pigments that are Section 313 chemicals include barium compounds, zinc oxide and other zinc compounds, and chromium compounds. Lead and lead compounds are still used, but their use is on the decline due to toxicity concerns. Most of the metal/metal

TABLE 4. SUMMARY OF REPORTED RELEASES OF METALS AND METAL COMPOUNDS FROM MOTOR VEHICLE PARTS AND ACCESSORY MANUFACTURING

Section 313 chemical	Number of facilities reporting usage[a] (% reporting usage)	Mean release, lb (% reporting to each media)[b]						
		Fugitive	Stack	Water	Land	POTW[c]	Off-site Transfer	Total[d]
Copper	116 (35)	128 (42)	608 (42)	91 (12)	250 (1)	159 (44)	e	26,101 (85)
Copper compounds	20 (6)	145 (35)	329 (70)	125 (30)	250 (1)	369 (60)	19,421 (65)	16,470 (80)
Nickel	70 (21)	181 (33)	224 (30)	85 (10)	1,675 (3)	341 (40)	10,357 (69)	7,992 (93)
Nickel compounds	28 (8)	148 (43)	118 (43)	203 (18)	0 (0)	2,219 (79)	e	75,442 (100)
Manganese	69 (21)	217 (39)	209 (43)	220 (4)	3,183 (4)	144 (20)	4,631 (58)	3,275 (93)
Manganese compounds	24 (7)	244 (50)	203 (42)	155 (13)	0 (0)	8,101 (54)	14,503 (75)	15,492 (100)
Zinc compounds	65 (20)	e	1,223 (51)	352 (25)	10,072 (5)	820 (77)	33,462 (82)	30,349 (97)
Chromium	64 (19)	326 (36)	178 (38)	117 (8)	378 (3)	283 (39)	6,021 (73)	5,053 (94)
Chromium compounds	36 (11)	175 (36)	223 (47)	104 (17)	0 (0)	1,635 (56)	e	65,923 (97)
Lead	48 (15)	113 (44)	359 (75)	226 (10)	0 (0)	93 (50)	3,282 (63)	2,546 (96)
Lead compounds	30 (9)	211 (50)	166 (50)	118 (33)	11 (3)	177 (60)	12,009 (77)	10,601 (90)
Barium compounds	36 (11)	1,791 (25)	484 (36)	98 (11)	e	e	39,967 (81)	140,554 (89)
Aluminum (fume or dust)	18 (5)	339 (72)	e	83 (11)	0 (0)	6,143 (28)	4,560 (28)	6,173 (83)

[a] A total of 331 facilities in SIC 3714 reported usage of at least one Section 313 chemical above threshold limits.

[b] Mean releases in pounds per year in 1990 for facilities reporting releases of this chemical and percentage of facilities reporting usage of this chemical that release to this media. Releases to other media were insignificant.

[c] POTW = Publicly Owned Treatment Works.

[d] The total includes all releases and off-site transfers, not just categories summarized in this table.

[e] Mean value is not representative because of a very large value at one facility and the small number of facilities.

compound pigment typically is applied to the manufactured part; however, some metals/metal compounds may be transferred off site in coating wastes or to POTWs if a water curtain is used as a control/collection measure for spray mist.

Releases of metals/metal compounds from electroplating operations are primarily through off-site transfer of spent plating solutions. Also, significant quantities of metals/metal compounds are released to water and POTW through dragout from the plating bath to the rinse water and from releases of scrubber water used to control air releases. Other small quantities of metal/metal compounds are released to air through misting during electroplating.

A mist is formed over plating baths due to the evolution of gases during the electroplating process. As the bubbles burst at the surface of the plating solution, a fine mist of plating solution droplets is formed. Emission factors from the Crosswalk/Air Toxic Emission Factor (XATEF) Database may be used to determine the air releases from the plating bath.

Metals/metal compounds released during electronic manufacturing processes may be minimal. Solder is the main metal/metal compound used in electronic manufacturing and almost all of the material is applied to the parts. Some solid metal/metal compound material may be generated and transferred off site or released to land on site.

Fumes of metals contained in the solder, welding rod, or metal being joined will be released to air as metal/metal compounds if these operations are present at the facility.

Stack test results provide the best data for estimating air releases from these operations. Where no stack test data is available, emissions factors listed in AP-42 may be used. On-site land disposal or off-site transfers can be estimated by using the volume of the waste and the percentage of metal/metal compound contained in the waste. Releases to water or POTW may be estimated by using monitoring data as required by EPA Effluent Guidelines.

ACIDS

Acids are otherwise used in a wide variety of ways in foundry, coating, electroplating, and electronics operations. Sulfuric, hydrochloric, nitric, and phosphoric acids were reported to TRI in 1990 for motor vehicle parts and accessories manufacturing. Table 5 presents a summary of reported releases and off-site transfers of acids from motor vehicle parts and accessories manufacturing.

Foundry operations use acids as cleaners, in finishing processes, and as a constituent of scrubber water. Hydrochloric acid may be used to clean the cupola shell. Phosphoric acid may be used in the phosphating of parts during finishing processes. Sulfuric acid may be used as a constituent of scrubber water.

Coating operations utilize phosphoric acid in a pretreatment process. A hot phosphoric acid bath is used to apply a conversion coating of zinc or iron phosphate onto metal parts.

Electroplating operations utilize acids to control pH of plating baths, to clean surfaces before and between plating steps, and as post-plating treatments (e.g., phosphate treatments). As described in the Metals and Metal Compounds section of this profile, a mist is formed over the plating baths as a result of evolution of gases during the electroplating process. This mist may contain acids from the plating bath and subsequently released to the air.

Electronic operations utilize acids in a solvent degreasing process. Hydrochloric acid dip is used in the process before final rinsing and drying.

These acids from all of the operations are primarily released through off-site transfer of spent acid. Some of the more volatile acids are released to air and some are released to water if the stream is not neutralized to a pH greater than 6. Neutralization is the primary control used for acid releases. For acid use, releases to surface waters and POTWs are not reportable under TRI if the pH is 6 or higher. Typically, pH monitoring for other regulations, such as EPA Pretreatment Standards and Effluent Limitations, is retained by the facility. These data may be used to calculate water or POTW releases if excursions below pH of 6 occurred and only one acid is present in the water.

TABLE 5. SUMMARY OF REPORTED RELEASES OF ACIDS FROM MOTOR VEHICLE PARTS AND ACCESSORY MANUFACTURING

Section 313 chemical	Number of facilities reporting usage[a] (% reporting usage)	Mean release, lb (% reporting to each media)[b]						
		Fugitive	Stack	Water	Land	POTW[c]	Off-site Transfer	Total[d]
Sulfuric acid	155 (47)	154 (31)	614 (40)	e	0 (0)	e	e	36,442 (54)
Hydrochloric acid	64 (19)	525 (58)	1,479 (52)	5 (2)	0 (0)	e	e	23,804 (78)
Nitric acid	58 (18)	321 (43)	987 (50)	5 (3)	0 (0)	e	6,360 (19)	3,339 (60)
Phosphoric acid	57 (17)	149 (30)	418 (37)	5 (2)	0 (0)	e	11,753 (23)	7,993 (54)

[a] A total of 331 facilities in SIC 3714 reported usage of at least one Section 313 chemical above threshold limits.

[b] Mean releases in pounds per year in 1990 for facilities reporting releases of this chemical and percentage of facilities reporting usage of this chemical that release to this media. Releases to other media were insignificant.

[c] POTW = Publicly Owned Treatment Works.

[d] The total includes all releases and off-site transfers, not just categories summarized in this table.

[e] Mean value is not representative because of a very large value at one facility and the small number of facilities.

OTHER CHEMICALS

Three other chemicals are used in electroplating and coating operations. These other chemicals are ammonia, ethylene glycol, and diethanolamine. All three of these chemicals are used by only a small percentage of motor vehicle parts and accessories manufacturers: ammonia, 13 percent; ethylene glycol, 9 percent; and diethanolamine 6 percent. Table 6 presents a summary of reported releases and off-site transfers of other chemicals from motor vehicle parts and accessories manufacturing.

Because of the wide variety of uses of these chemicals and the small percentage of the facilities that use them, IT could not determine specific uses at motor vehicle parts and accessories manufacturers. The following are probable uses of these chemicals.

Ammonia may be used in wastewater treatment or for pH adjustment of electroplating baths. Ammonia is also used as a constituent of some coatings. Because ammonia is a listed Section 313 chemical, all gaseous and aqueous forms must be considered for reporting. Aqueous solutions of ammonia contain both nonionized ammonia (NH_3) and ionized ammonia (NH_4^+). As the following chemical equation shows, an equilibrium exists between the two forms of ammonia in the presence of water.

$$NH_3 + 2H_2O \leftrightarrow NH_4^+ + OH^- + H_2O$$

The term "total ammonia" refers to the sum of these species (i.e., $NH_3 + NH_4^+$). The relative amounts of NH_3 and NH_4^+ depend upon several factors (e.g., temperature, pH, ionic strength, and other chemical reactions). To account for all forms that are present, estimates of releases for Section 313 should be made for total ammonia.

Ammonia hydroxide solutions should also be considered ammonia because ammonium hydroxide is aqueous ammonia. The commercial products "aqua ammonia" and "ammonium hydroxide" are approximately equivalent to 30 percent solutions

TABLE 6. SUMMARY OF REPORTED RELEASES OF OTHER CHEMICALS FROM MOTOR VEHICLE PARTS AND ACCESSORY MANUFACTURING

Section 313 chemical	Number of facilities reporting usage[a] (% reporting usage)	Mean release, lb (% reporting to each media)[b]						
		Fugitive	Stack	Water	Land	POTW[c]	Off-site Transfer	Total[d]
Ammonia	42 (13)	836 (62)	2,643 (57)	942 (7)	0 (0)	e	775 (5)	7,032 (79)
Ethylene glycol	30 (9)	382 (57)	7,820 (33)	6,400 (3)	5 (7)	17,628 (53)	e	26,609 (100)
Diethanolamine	21 (6)	2,395 (52)	1,148 (33)	8,183 (10)	0 (0)	40,092 (57)	5,490 (29)	33,223 (81)

[a] A total of 331 facilities in SIC 3714 reported usage of at least one Section 313 chemical above threshold limits.

[b] Mean releases in pounds per year in 1990 for facilities reporting releases of this chemical and percentage of facilities reporting usage of this chemical that release to this media. Releases to other media were insignificant.

[c] POTW = Publicly Owned Treatment Works.

[d] The total includes all releases and off-site transfers, not just categories summarized in this table.

[e] Mean value is not representative because of a very large value at one facility and the small number of facilities.

of ammonia in water. These products are mixtures of ammonia and water, and therefore should be reported as ammonia. Ammonia is released to air and to water.

Ethylene glycol may be used in hydraulic fluid, as antifreeze, and as a residual constituent in some resins. Release is primarily to water or POTW, probably through leaks or spills.

No information was found on how diethanolamine is used in motor vehicle parts and accessories manufacture. The largest release is to water or POTW with some release to air or off-site transfer. Diethanolamine may be used as a corrosion inhibiter, as a polyurethane crosslinker, or in coatings.

REGULATIONS USEFUL FOR ESTIMATING RELEASES OF SECTION 313 CHEMICALS

No regulations are directly applicable to motor vehicle parts and accessory manufacture. This is because SIC 3714 covers such a broad range of processes that where regulations are applicable they are specific to a process type that is represented by only a small portion of the facilities in these industry categories. The EPA Effluent Guidelines and Pretreatment Standards for Foundries and Electroplating are the primary examples. The regulations for these categories are explained in the individual Industry Profiles for these industries.[2,5] For even these regulatory limits to be useful, however, the inspector must have considerable knowledge of the processes at the facility. This detailed knowledge of the plant processes is unlikely to be easily available from public sources. Therefore, the more efficient way to determine the air and water release regulatory limits for the plant in question is to go directly to the Regional, State, or local files for the individual facility in question.

RCRA* reported wastes at motor vehicle parts and accessory manufacturers can be extremely useful in estimating off-site transfers of Section 313 chemicals at these facilities. The following RCRA generic wastes can be used to determine what processes are at a facility and what quantities of these wastes are generated.

Waste No.	Description
F001	Specified halogenated solvents used in degreasing
F002	Specified halogenated solvents
F003	Specified nonhalogenated solvents
F004	Specified nonhalogenated solvents
F005	Specified nonhalogenated solvents
F006	Wastewater treatment sludges from electroplating
F007	Spent cyanide plating bath sludges
F008	Spent cyanide plating bath sludges

* Resource Conservation and Recovery Act.

Waste No.	Description
F009	Spent stripping and cleaning bath solutions at electroplating operations where cyanides are used
F010	Quenching bath residues from oil baths from heat treating metals where cyanides are used
F011	Spent cyanide solutions from salt bath pot cleaning from metal heat treating operations
F012	Quenching wastewater treatment sludges from metal heat treating where cyanides are used

NONREPORTING FACILITIES

Nonreporting facilities may be identified by comparing lists of facilities in the Standard Industrial Classification (SIC) 3714 having more than 10 employees with those facilities that have reported under Section 313. Most motor vehicle parts and accessories manufacturers with more than 10 employees probably are manufacturing, processing, or otherwise using at least one Section 313 chemical in excess of threshold values.

A source of information on the number of facilities in SIC 3714 presented by employment class is County Business Patterns published by the U.S. Department of Commerce.[6] Another source of information is Dunn and Bradstreet (D&B), which provides lists of companies by SIC and employment size category.[7] The 1990 TRI database indicates 331 facilities reported, while County Business Patterns - 1989 reports 1,817 facilities in SIC 3714 employing more than 10 employees and D&B - 1992 reports 2,384 facilities in SIC 3714 employing more than 10 employees.

LIST OF QUESTIONS

The following questions may be helpful in determining if errors were made in Section 313 reporting for motor vehicle parts and accessory manufacturers. Since this industry category is composed of a wide variety of facilities, general facility questions to determine what the facility does are presented first.

General Facility

- What products are produced at this facility?
- Are foundry electroplating or electronics manufacturing operations done at this facility?
- Are metal or plastic products produced?
- What metals are processed?
- Are coatings applied to any parts?

Organic Solvents

- Was a mass balance for organic solvents calculated that accounted for total usage?
- How were releases of organic solvents other than to air calculated?
- If a solvent is reported as processed on Form R, what threshold was used for all other organic solvents? The 10,000-pound threshold for otherwise-used chemicals should be used.

Chlorinated Solvents

- How were chlorinated solvents used?
- Was the percentage of chlorinated solvent in any waste solvent accounted for?
- Was a mass balance accounting for all chlorinated solvent usage used to estimate releases and off-site transfers?
- For vapor degreasing with water separation, was release to water or POTW estimated?

Polymer Chemicals

- Was MSDS information used to estimate the quantity of unreacted monomer in polymers used at the facility?

- Were any polymers manufactured (polymerized) at the facility? What were the reactants?

Metals/Metal Compounds

- Were threshold determinations made for all metals/metal compounds processed at the facility?

- Did the facility determine if it met the reporting thresholds from the amount released or transferred instead of the amount processed or otherwise used?

- Were threshold determinations for metal compounds made using the weight of the compound and not just the metal portion of the compound?

- How was air release calculated? Were emission factors or monitoring data used? What were these factors?

- Was Toxicity Characteristic Leaching Procedure (TCLP) used as a measure of metal concentration in any of the calculations? TCLP measures leachable metal, not metal content, and thereby should not be used in calculations.

Acids

- Was the pH of the release measured or was neutralization just assumed? What was the frequency of monitoring?

- Was the percentage of acid in the original acid or solution taken into account in the threshold calculations?

Other Chemicals

- How were other chemicals used at the facility?

- Was total ammonia used to report ammonia release to water?

BIBLIOGRAPHY

1. Office of Management and Budget. Standard Industrial Classification Manual. Washington, DC. 1987.

2. IT Corporation. TRI Facility Profile, Foundries. Prepared for U.S. Environmental Protection Agency under Contract No. 68-DO-0020. Cincinnati, Ohio. July 1992.

3. Modern Plastics Encyclopedia. Vol. 65, No. 11. McGraw-Hill. October 1988.

4. Kirk-Othmer Encyclopedia of Chemical Technology. Third Edition. Volume 6. Coatings, Industrial. Wiley & Sons. 1982.

5. IT Corporation. TRI Facility Profile, Electroplating. Prepared for U.S. Environmental Protection Agency under Contract 68-DO-0020. Cincinnati, Ohio. June 1992.

6. U.S. Department of Commerce, Bureau of Census, County Business Patterns 1989, CBP-89-1 Washington, DC. 1991.

7. Dunn & Bradstreet. International Dunn's Electronic Business Directory in DIALOG Database File 515. 1992.

TRI FACILITY PROFILE
FURNITURE MANUFACTURE

by

IT Corporation
11499 Chester Road
Cincinnati, Ohio

Contract No. 68-D0-0020
Work Assignment No. 2-27/2-65/3-18
JTN 830015-5-1

Prepared for

U.S. ENVIRONMENTAL PROTECTION AGENCY
OFFICE OF TOXIC SUBSTANCES
401 M Street, S.W.
Washington, D.C. 20460

September 1992

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TRI FACILITY PROFILE
FURNITURE MANUFACTURE

The purpose of this profile is to assist U.S. Environmental Protection Agency (EPA) Regional Office personnel in conducting Superfund Amendments and Reauthorization Act (SARA) Title III, Section 313, inspections. The profile describes key toxic chemicals manufactured, processed, or otherwise used in furniture manufacture, describes how these chemicals are used, and identifies key release sources. All Section 313 chemicals reported to the Toxic Release Inventory (TRI) by more than 5 percent of the furniture manufacturers are presented in this profile.

The furniture manufacturing industry is defined by SIC 25, Furniture and Fixtures. For purposes of this profile, the industry is divided into four categories:

- Wood Furniture With Coatings defined under SIC 2511 - Wood Household Furniture, Except Upholstered; SIC 2517 - Wood Television, Radio, Phonograph, and Sewing Machine Cabinets; and SIC 2521 - Wood Office Furniture.

- Wood Furniture, Lower Coatings Use, defined under SIC 2512 - Wood Household Furniture, Upholstered, and SIC 2541-Wood Office and Store Fixtures, Partitions, Shelving, and Lockers.

- Metal Furniture defined under SIC 2514 - Metal Household Furniture.

- Other Furniture defined under SIC 2515 - Mattresses, Formulations, and Convertible Beds; SIC 2519 - Household Furniture, not Elsewhere Classified; SIC 2525 - Office Furniture, Except Wood; SIC 2531 - Public Building and Related Furniture; SIC 2542 - Office and Store Fixtures, Partitions, Shelving, and Lockers, except Wood; SIC 2591 - Drapery Hardware and Window Blinds and Shades; and SIC 2599 - Furniture and Fixtures, Not Elsewhere Classified.

Figure 1 presents a simplified process flow diagram of the furniture manufacturing process. The flow diagram includes both wood and metal furniture manufacture.

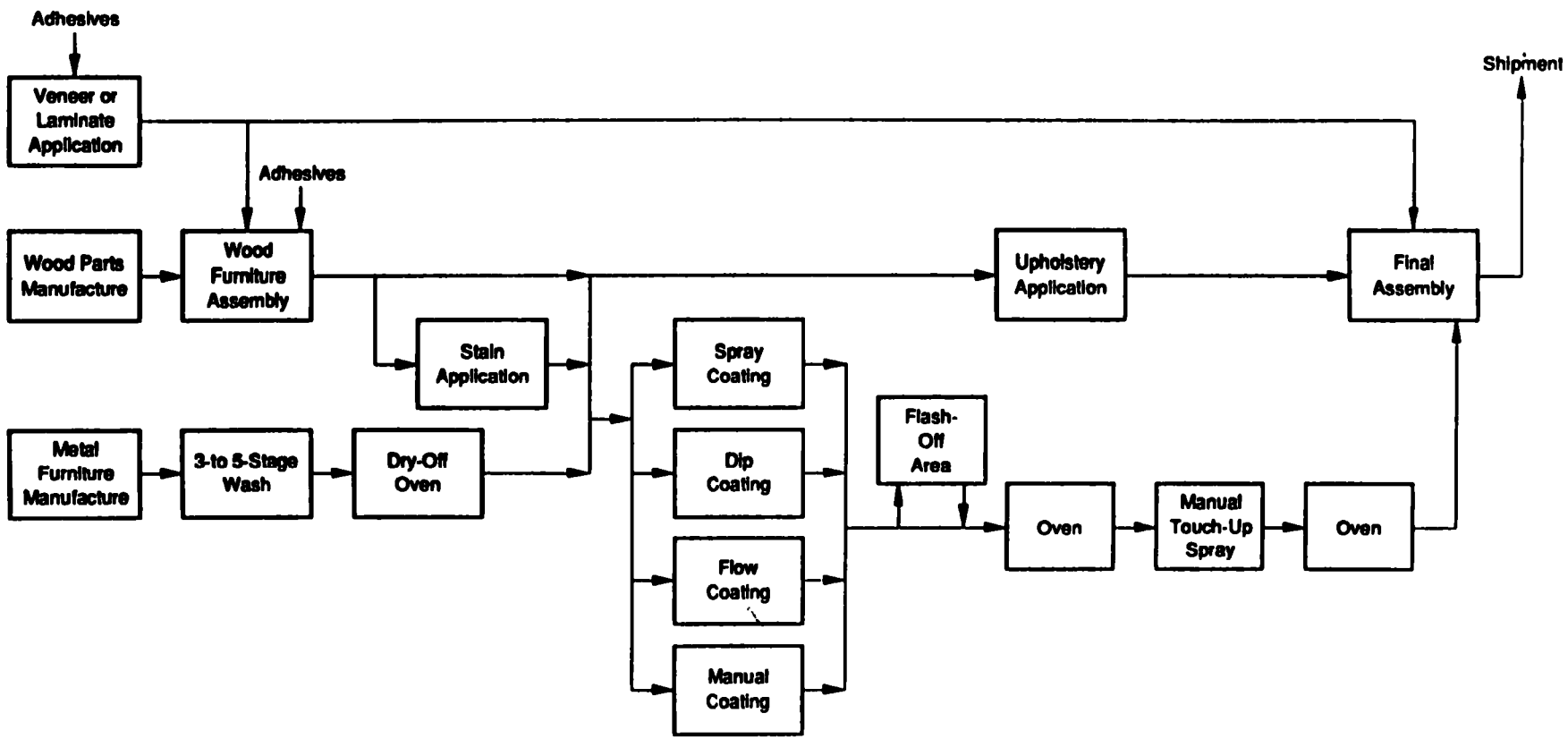
Woodworking associated with the manufacture of wood furniture parts can include mechanical manipulations of wood or wood by-products including sawing, planing, chipping, shaping, lathing, and sanding. Although these operations generate wood waste particles such as shavings, sanderdust, or sawdust, they do not generally release Section 313 chemicals.

The fabrication of metal furniture consists of cutting, bending, and possibly grinding of the metal. Section 313 metals (e.g. Cr, Mn) may be present in the metal used, however, in most cases the quantity processed will be below the 25,000 pound threshold.

Adhesives may be used for several purposes in furniture manufacture. They may be used to glue wood veneer on wood furniture products, to glue laminatés on wood or metal furniture products, or to glue wood furniture parts together. Some adhesives contain chlorinated solvents or organic solvents that are released to air upon application.

The furniture coating application (including stains) uses the largest quantity of Section 313 chemicals in both wood and metal furniture manufacture. A wide variety of solvents are otherwise used to apply the coatings. Metals/metal compounds and polymers are processed as part of the coatings. The coatings are applied by a variety of methods including spray coating, dip coating, flow coating and manual coating. Table 1 presents selected information on both wood and metal furniture spray coating operations. After the coating dries a manual touch-up repairs any imperfections.

Other operations that do not involve use of Section 313 chemicals include upholstery application, mounting of metal hardware, and final assembly.



INTERNATIONAL TECHNOLOGY CORPORATION

Figure 1.
Simplified Process Flow Diagram of Furniture Manufacture.

DRAWING BY	JEA	CHECKED BY	E.A.P.	6/11/92	DRAW	NO
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TABLE 1. SELECTED INFORMATION ON FURNITURE SPRAY COATING[1]

	Wood	Metal
Coating components	Resins: Urea formaldehyde, catalyzed urethane, nitrocellulose, acrylic, oil-based.	Resins: acrylics, amines, vinyls, cellulosics.
	Solvents: Acetates, acetone, alcohols, aromatic hydrocarbons, ethers, glycol ethers, ketones, mineral spirits.	Solvents: Aliphatics, xylene, toluene, other aromatics.
	Pigments: Silica, calcium carbonate, iron oxide, titanium dioxide, talc.	Pigments: Titanium dioxide, iron, barium compounds, talc, calcium carbonate, chromium compounds.
Coating classifications	Mostly low-solids, solvent-based.	Waterborne; solvent-borne (conventional and high solids).
Coating compositions (% Weight as applied)	Body stain: 1% solids.	Solvent-based (conventional): 15 to 25% solids.
	Washcoat: 8 to 10% solids.	Solvent-based (high-solids): 40 to 60% solids.
	Filler: 40% solids.	Waterborne (15 to 25% solids).
	Sealed (barrier coat): 14 to 23% solids.	
	Glaze: 21 to 24% solids.	
	Clear lacquer (topcoat): 14 to 15% percent solids	
Overspray	Air atomized: More than 50%.	Air-atomized: 50% to 75%.
	Airless: Less than 50%.	Airless: 75%

(continued)

TABLE 1 (continued)

	Wood	Metal
Overspray (continued)		Electrostatic: Manual - 40% Nonrotational automatic - 30% Rotational (manual/automatic) - 5 to 20%.
Solvent discharge	Application/Flash-off - 80 to 90%.	Application/Flash-off - 80% (air-atomized), 65 to 70% (electrostatic.
	Oven drying 10 to 20%.	Oven drying: 20% (air-atomized), 30 to 35% (electrostatic).
Exposure/release controls	Spray booths with disposable filters and turning vanes. Filters are changed at the end of a shift. Makeup air is provided.[2]	Filter bank with makeup air supplied from opposite the exhaust filter bank, and fram-filtered-air inlets in each conveyor exit. Water-washed spray booths are also used. Thick mesh prefilters are sometimes fitted over the water curtains (side draft) to reduce booth cleanup time/frequency.[1]
	Particle removal efficiencies could range from 94 to 96%.	These prefilters are changed periodically (some shifts may not apply enough paint to clog filters).
		Particle-removal efficiencies of water-washed booths could range from 95 to 99%.

(continued)

SECTION 313 CHEMICALS USED IN FURNITURE MANUFACTURE

Section 313 chemicals commonly used in furniture manufacture can be classified into four distinct categories: organic solvents, chlorinated solvents, metals/metal compounds, and other Section 313 chemicals. Each category is discussed separately in this report. Each section includes a description of how the Section 313 chemicals are used, a discussion of typical releases and off-site transfers, a table summarizing releases and off-site transfers that were reported to TRI in 1990, a description of pertinent regulations, typical control practices, and common reporting errors. Methods for identifying nonreporting facilities and a list of questions are also presented.

WOOD FURNITURE, WITH COATINGS

This category includes wood furniture that would likely have stains and coatings applied to the finished product. Most of the releases and off-site transfers of Section 313 chemicals are associated with the application of these coatings or with the use of adhesives. Wood furniture coating is characterized by many manual operations. A great variety of procedures and formulas are used in furniture coating. The decorative effect of finishes often relies on the appearance of the fibrous structure of the wood itself. This appearance is enhanced by the addition of transparent coatings that penetrate pores and the addition of pigments that fill the pores and also improve the color uniformity of the wood. Nitrocellulose has advantages over other treatments in its ease of application and drying and in the degree to which it highlights natural wood patterns.[2]

In general, the wood is stained to a uniform desired color (bleaching may be a necessary first step); stains may be applied using water or solvent. A typical stain would contain about 1% of a dye mixture in methanol and might contain a small amount of less-volatile solvent.[2]

A sealer coat is then applied and sanded. The sealer might be a 15% nitrocellulose-based vehicle ; 1% colloidal silica (for filling, flatting, and transparency); 1% zinc stearate (for easy sanding); and mixtures of alcohol, ester, and hydrocarbon solvents appropriate for the spray system and ambient temperature in the factory.[2]

A wiping stain may be applied instead of the separate stain and sealer. When this stain is applied, the excess must be wiped off.

Shellac-type sealers may contain 10% binder (50% shellac and 50% other film formers such as nitrocellulose or poly(vinyl butyryl) and 90% solvent. Transparent pigments such as silica or zinc stearate can be added to improve sanding properties.[2]

The finish coat is usually nitrocellulose based. The binder may contain about 35% nitrocellulose and 65% of a mixture of nitrocellulose and plasticizers, which may include simple esters, polyesters, and esters of rosin.[2]

Urea-formaldehyde resins, acid catalyzed to permit low-temperature drying, are second to nitrocellulose in the furniture market. A typical formulation would consist of 45% butylated urea-formaldehyde resin and 55% plasticizers dissolved in aromatic hydrocarbon, alcohol, and ketone solvents.

Table 2 presents a process schedule for a typical wood furniture finishing operation.[1]

Each of the four categories of Section 313 chemicals will be discussed separately.

Organic solvents are otherwise used as constituents of stains, coatings, or adhesives applied at the facilities. SARA, Section 313 organic solvents used in coatings include toluene, methanol, xylene, glycol ethers and ethylbenzene. SARA, Section 313 organic solvents used in adhesives include MEK, MIBK, xylene, and toluene. Most of the organic solvent emissions are released to the air when the coating is dried. If a water curtain is used to capture particulate releases during spray coating operations, some organic solvents may be transferred to water to public owned treatment works (POTW).

Organic purge solvents for cleaning spray equipment or for other cleanup purposes may be transferred off site for recycling, fuel burning, or disposal. SARA, Section 313 organic solvents used in purge and cleanup solvents include acetone, toluene, and methanol.

Two major sources of spent solvent in wood furniture finishing are from furniture stripping or "wash-off" and from finishing equipment and spray booth cleanup. In the

TABLE 2. TYPICAL WOOD FURNITURE FINISHING SCHEDULE[1]

Operation No.	Operation name	Operation time allowed, minutes	No. of persons per operation
1	Load	5	1
2	Spray uniform stain	1.5	2
3	Dry	15	
4	Spray stain	1.5	2
5	Dry	20	
6	Spray wash coat	1.5	2
7	Dry	20	
8	Sand lightly	1.5	4
9	Spray filler	1.5	2
10	Flash-off filler	2	
11	Wipe filler	4	8
12	Dry	45	
13	Spray sealer	1.5	2
14	Dry	30	
15	Sand	3	7
16	Spray sealer	1.5	2
17	Dry	30	
18	Sand	3	7
19	Spray glaze	1.5	2
20	Wipe and brush	5	13
21	Dry	60	
22	Distress	2	4
23	Spray lacquer	1.5	2
24	Dry	45	
25	Spray lacquer	1.5	2
26	Dry	75	
27	Unload	5	1
28	Return to load	15	
	TOTAL	399	63

"wash-off" process, improperly finished furniture is stripped of the defective finish by means of a lacquer thinner or "stripper" which is reused until too dirty for further use. Spray guns, feed lines, and spray booths are regularly cleaned with lacquer thinner which goes into the waste stream after being used for cleanup. Some spent solvent also comes from an occasional batch of defective finishing materials. Virgin stripper is usually a mixture of toluene, xylene, acetone, ethanol, butanol, isopropyl alcohol, naphtha, methyl ethyl ketone and esters.[3]

Spent solvents from wash-off and spray booth cleanup are usually contaminated with stains, fillers, glazes and nitrocellulose. Since the solvents used are normally non-halogenated and have high BTU values, spent solvents from the furniture industry are much easier to dispose of than from industries which use halogenated solvents or produce low BTU wastes. Because of the high BTU value and the absence of halogens in their waste streams, some companies have been incinerating their spent solvents or burning them for fuel. As the price of petroleum products and solvents increases, more and more furniture plants are recycling their spent solvents either in-house or through an outside recycler.[3]

Transfers off site for recycling or fuel burning were not reportable under Section 313 until 1991 (estimates due July 1, 1992). Table A-1 in Appendix A presents more information on wastes generated in the furniture industry.

Particulate control equipment may consist of fabric filters or a water wash. Releases of volatile organic carbon (VOC) at large facilities may be controlled by incineration or other pollution equipment.

The best method of verifying release estimates is to calculate a mass balance based on total usage of organic solvents with almost all of the emission released to air or sent to an air control device (e.g., an incinerator).

Table 3 presents a summary of reported releases and off-site transfers of organic solvents resulting from wood furniture manufacture with coatings.

Chlorinated solvents are otherwise used in wood furniture manufacture as a solvent in adhesives and as a coating stripper. Adhesives are used in wood furniture manufacture to apply veneer or laminates to a wood or wood composite base or to glue

TABLE 3. SUMMARY OF REPORTED RELEASES OF ORGANIC SOLVENTS FROM THE MANUFACTURE OF WOOD FURNITURE WITH COATINGS

Section 313 chemical[a]	No. of facilities reporting usage[b] (% reporting usage)	Mean release, lb (% reporting to each media)[c]				
		Fugitive	Stack	POTW[d]	Off-site transfer[e]	Total[f]
Toluene	257 (100)	8,391 (70)	4,913 (96)	1,231 (5)	4,757 (30)	52,608 (100)
Methanol	196 (76)	6,256 (67)	44,831 (96)	291 (6)	3,719 (27)	48,433 (100)
Xylene (mixed isomers)	195 (76)	8,180 (66)	32,219 (96)	1,067 (6)	2,961 (30)	37,796 (100)
MEK	151 (59)	3,529 (69)	28,380 (97)	292 (6)	6,644 (28)	32,406 (99)
Acetone	125 (49)	6,648 (69)	28,825 (96)	251 (6)	5,754 (26)	33,787 (100)
n-Butyl alcohol	96 (37)	1,955 (66)	23,423 (99)	922 (8)	1,545 (33)	25,054 (100)
MIBK	59 (23)	5,906 (78)	28,901 (98)	521 (5)	4,235 (39)	35,307 (98)
Glycol ethers	31 (12)	3,344 (54)	22,836 (94)	g	5,770 (35)	26,992 (100)
Ethylbenzene	8 (3)	1,781 (100)	19,860 (100)	325 (25)	1,969 (25)	23,078 (100)

[a] Isopropyl alcohol (IPA) was reported by 20 facilities. Since IPA is only reportable by manufacturers of IPA, IPA is not reportable in the furniture manufacture industry.

[b] A total of 257 facilities in SICs 2511, 2517, and 2521 reported usage of at least one Section 313 chemical above the threshold limits.

[c] Mean release in pounds per year in 1990 for firms reporting release of this chemical and percentage of firms reporting usage of this chemical and release to this media. Releases to other media were insignificant.

[d] POTW = Publicly Owned Treatment Works.

[e] Off-site transfer for recycling or fuel blending was not reportable in 1990; transfer off site of purge or cleanup solvent for these purposes will be reportable in 1991.

[f] The total includes all releases and off-site transfers, not just categories summarized in this table.

[g] Mean value is not representative because of one high value.

wood parts together. 1,1,1-Trichloroethane is the primary chlorinated solvent used in adhesives at furniture manufacturers. If plastic parts are used as part of the furniture, chlorinated solvents can be used as a plastic adhesive or as a mold release carrier in the process.

Methylene chloride may be used to strip coatings from defective products, from the walls of the spray booth, from brushes, spray guns, or from other equipment. Methylene chloride may also be used to refinish furniture.

Chlorinated solvent used by wood furniture manufacturers is primarily released to air. Some dichloromethane used to strip furniture, spray booths, or equipment may be transferred off site for disposal.

No controls are typically used to reduce the release or off-site transfer of chlorinated solvents at furniture manufacturing facilities. Also, off-site transfers would not typically be recycled. Therefore, the best method for estimating releases is a mass balance based on total usage of chlorinated solvent. The quantity of chlorinated solvent transferred off site may be estimated by determining the quantity and concentration of waste generated at the facility under guidelines established by the Resource Conservation and Recovery Act (RCRA).

RCRA wastes are defined in § 261 of RCRA. Specific chlorinated solvents are identified in § 261.31 as wastes from nonspecific sources or "F" waste. F002 generic RCRA wastes are spent solvent wastes that prior to use contained over 10 percent of the listed chlorinated solvents. Table A-1 in Appendix A presents more information on wastes generated in the furniture industry. Use of 1,1,1-trichloroethane is expected to drop significantly because of EPA environmental regulation to reduce ozone depletion. These regulations will eventually phase out the use of this solvent entirely.

Table 4 presents a summary of Section 313 reported releases and off-site transfers from use of chlorinated solvents at wood furniture manufacturers applying coatings.

Metals/metal compounds are processed at wood furniture manufacturers as constituents of coatings because they remain as part of the furniture and are therefore subject to the 25,000-pound threshold. Very few furniture manufacturers will exceed this threshold for any individual metal or metal compound. Even if the threshold is

TABLE 4. SUMMARY OF REPORTED RELEASES OF CHLORINATED SOLVENT FROM THE MANUFACTURE OF WOOD FURNITURE WITH COATINGS

Section 313 chemical	No. of facilities reporting usage[a] (% reporting usage)	Mean release, lb (% reporting to each media)[b]					
		Fugitive	Stack	Land	Water or POTW[c]	Off-site transfer[d]	Total[e]
1,1,1-Tri-chloroethane	36 (14)	15,967 (78)	36,042 (81)	13,300 (3)	250 (6)	5,965 (17)	42,830 (100)
Dichloro-methane	9 (4)	13,804 (100)	18,340 (44)	-	-	12,095 (78)	31,362 (100)

a A total of 257 of facilities in SICs 2511, 2517, and 2521 reported usage of at least one Section 313 chemical above the threshold limits.

b Mean release in pounds per year in 1990 for firms reporting release of this chemical and percentage of firms reporting usage of this chemical and release to this media. Releases to other media were insignificant.

c POTW = Publicly Owned Treatment Works.

d Off-site transfer for recycling was not reportable in 1990.

e The total includes all releases and off-site transfers, not just categories summarized in this table.

exceeded, releases and off-site transfers will be small. Table 5 presents a summary of Section 313 reported releases and off-site transfers of metals/metal compounds at wood furniture manufacturers applying coatings.

If a facility is large enough to exceed the threshold for metals/metal compounds, it is likely that the spray booth will be controlled with a water wash to capture particulates and send them to a settling basin. Most of the metals/metal compounds are removed from the settling basin periodically and transferred off site for disposal. Some of the metals/metal compounds will be released to water or POTW. A small quantity of metals/metal compounds not captured in the water wash will be released to air through a stack.

Other Section 313 chemicals are processed at wood furniture manufacturers as constituents of the coatings. Di-(2-ethylhexyl)phthalate (DEHP), formaldehyde, and styrene may be present in resins used as coatings on wood furniture. Formaldehyde may also be present in glues used during furniture manufacture. Although most of these Section 313 chemicals are reacted to form the resin, some will remain unreacted and therefore will be released on site or transferred off site. The percentage of unreacted chemical should be available on the Material Safety Data Sheet (MSDS) pertaining to a specific coating.

Table 6 presents a summary of reported releases and off-site transfers of these other Section 313 chemicals from wood furniture manufacture with coatings. The primary release is to air with some off-site transfer possible if waste resin or coating is sent off site for disposal. Releases and off-site transfers are best estimated based on information contained on the MSDS specifying the quantity of unreacted chemical in the coating.

TABLE 5. SUMMARY OF REPORTED RELEASES OF METALS AND METALS COMPOUNDS FROM THE MANUFACTURE OF WOOD FURNITURE WITH COATINGS

Section 313 chemical	No. of facilities reporting usage[a] (% reporting usage)	Mean release, lb (% reporting to each media)[b]				
		Fugitive	Stack	POTW[c]	Off-site transfer[e]	Total[d]
Barium	1 (0.4)	250 (100)	5,933 (100)	-		6,183 (100)
Barium compounds	7 (3)	250 (14)	635 (43)	375 (29)	5,741 (100)	6,156 (100)
Zinc (fume or dust)	1 (0.4)	1 (100)	10 (100)	-	-	11 (100)
Zinc compounds	4 (2)	378 (50)	250 (50)	2,560 (25)	1,983 (75)	3,254 (75)
Chromium	2 (1)	250 (50)	1 (50)	-	-	126 (1a)
Chromium compounds	3 (1)	-	-	-	418 (100)	418 (100)
Nickel	2 (1)	250 (50)	250 (50)	250 (50)	4,945 (50)	2,848 (100)
Nickel compounds	2 (1)	-	-	250 (50)	383 (100)	508 (100)
Manganese	2 (1)	126 (100)	32 (50)	-	-	142 (100)
Manganese compounds	1 (0.4)	-	-	-	2 (100)	2 (100)
Copper	1 (0.4)	3 (100)	54 (100)	-	-	57 (100)
Copper compounds	2 (1)	-	-	-	500 (100)	500 (100)
Cobalt compounds	1 (0.4)	-	-	-	6 (100)	6 (100)

(continued)

TABLE 5 (continued)

Section 313 chemical	No. of facilities reporting usage[a] (% reporting usage)	Mean release, lb (% reporting to each media)[b]				
		Fugitive	Stack	POTW[c]	Off-site transfer[a]	Total[d]
Lead compounds	1 (0.4)	-	-	-	750 (100)	750 (100)
Antimony compounds	1 (0.4)	-	-	-	750 (100)	750 (100)

[a] A total of 257 facilities in SICs 2511, 2517, and 2521 reported usage of at least one Section 313 chemical above the threshold limits.

[b] Mean release in pounds per year in 1990 for firms reporting release of this chemical and percentage of firms reporting usage of this chemical and release to this media. Releases to other media were insignificant.

[c] POTW = Publicly Owned Treatment Works.

[d] The total includes all releases and off-site transfers, not just categories summarized in this table.

TABLE 6. SUMMARY OF REPORTED RELEASES OF OTHER CHEMICALS FROM THE MANUFACTURE OF WOOD FURNITURE WITH COATINGS

Section 313 chemical	No. of facilities reporting usage[a] (% reporting usage)	Mean release, lb (% reporting to each media)[b]				
		Fugitive	Stack	POTW[c]	Off-site transfer	Total[d]
DEHP	22 (9)	2,103 (59)	12,714 (86)	-	8,434 (23)	15,553 (91)
Formaldehyde	13 (5)	2,633 (77)	2,870 (77)	250 (15)	622 (38)	4,549 (100)
Styrene	5 (2)	833 (40)	14,363 (100)	-	-	14,969 (100)

a A total of 257 facilities in SICs 2511, 2517, and 2521 reported usage of at least one Section 313 chemical above the threshold limits.

b Mean release in pounds per year in 1990 for firms reporting release of this chemical and percentage of firms reporting usage of this chemical and release to this media. Releases to other media were insignificant.

c POTW = Publicly Owned Treatment Works.

d The total includes all releases and off-site transfers, not just categories summarized in this table.

WOOD FURNITURE, LOWER COATING USE

This category includes wood furniture that would tend to use less coatings. Coating use would be lower because either upholstery covers a wood frame or laminates are used to cover the wood. Although, parts of the furniture may be stained or coated, coating use generally would be lower than for the wood furniture with coatings category.

Only two of the four categories described in wood furniture with coatings would typically be used in this category. These categories are organic solvents and chlorinated solvents. Metals/metal compounds and other chemicals (containing the constituents of resins) typically are not used above threshold limits.

Organic solvents are otherwise used as constituents of stains, coatings, or adhesives. The percentage of facilities reporting use of organic solvents above threshold limits is lower than for wood furniture with coatings, and the releases and off-site transfers reported are lower for those facilities that do report usage of organic solvents. The same organic solvents are reported as were reported for wood furniture with coatings, and the same controls would be used.

The best method for checking release estimates is to calculate a mass balance based on total usage of the organic solvents with almost all of the usage released to air or sent to an air control device (e.g., incinerator).

Table 7 presents a summary of reported releases and off-site transfers of organic solvents from wood furniture manufacture, lower coating use.

Chlorinated solvents are otherwise used in wood furniture manufacture as a solvent in adhesives and to a lesser extent as a coating stripper. Adhesives are used in wood furniture manufacture to apply veneer or laminates to a wood or wood component base or to glue wood parts together. If plastic parts are used as part of the furniture, chlorinated solvents can be used as a plastic adhesive or as a mold release carrier in the process. Dichloromethane may be used to strip coatings from defective products, from the walls of the spray booth, or from other equipment. Usage of 1,1,1-trichloroethane is higher in this category than for wood furniture with coatings, and reported releases for those facilities that did report usage is also higher. Dichloromethane use is similar to

TABLE 7. SUMMARY OF REPORTED RELEASES OF ORGANIC SOLVENTS FROM THE MANUFACTURE OF WOOD FURNITURE, LOWER COATING USE

Section 313 chemical[a]	No. of facilities reporting usage[a] (% reporting usage)	Mean release, lb (% reporting to each media)[c]			
		Fugitive	Stack	Off-site transfer[d]	Total[e]
Toluene	58 (88)	7,359 (62)	22,660 (90)	2,624 (38)	25,918 (100)
Methanol	23 (35)	3,653 (70)	16,351 (87)	1,945 (35)	17,435 (100)
Xylene (mixed isomers)	23 (35)	2,162 (61)	50,980 (100)	4,552 (39)	54,007 (100)
MEK	23 (35)	5,069 (57)	16,016 (87)	1,518 (26)	17,188 (100)
Acetone	19 (29)	6,174 (74)	11,028 (89)	12,394 (26)	17,678 (100)
n-Butyl alcohol	10 (15)	993 (90)	18,612 (100)	2,156 (40)	20,368 (100)
MIBK	10 (15)	2,188 (60)	10,043 (90)	2,785 (40)	11,465 (100)
Glycol ethers	5 (8)	1,733 (80)	41,925 (60)	800 (20)	26,701 (100)

[a] Isopropyl alcohol (IPA) was reported by three facilities. Since IPA is only reportable by manufacturers of IPA, this is not reportable in the furniture manufacture industry.

[b] A total of 66 facilities in SICs 2512 and 2541 reported usage of at least one Section 313 chemical above the threshold limits.

[c] Mean release in pounds per year in 1990 for firms reporting release of this chemical and percentage of firms reporting usage of this chemical and percentage of firms regulating usage of this chemical and release to this media. Releases to other media were insignificant.

[d] Off-site transfer for recycling or fuel blending was not reportable in 1990; transfer offsite of purge or cleanup solvent for these purposes will be reportable in 1991.

[e] The total includes for all releases and off-site transfers, not just categories summarized in this table.

that for wood furniture manufacture with coatings. No controls are typically used and off-site transfer would typically not be for recycling. Therefore, the best method for estimating releases is a mass balance based on total usage of the chlorinated solvent. The quantity of chlorinated solvent transferred off site may be estimated based on the quantity and concentration of RCRA waste (F002) generated as described previously.

Table 8 presents a summary of Section 313 reported releases and off-site transfers from use of chlorinated solvents at wood furniture manufacturers with lower coating use.

TABLE 8. SUMMARY OF REPORTED RELEASES OF CHLORINATED SOLVENTS FROM THE MANUFACTURE OF WOOD FURNITURE, LOWER COATING USE

Section 313 chemical	No. of facilities reporting usage[a] (% reporting usage)	Mean release, lb (% reporting to each media)[b]				
		Fugitive	Stack	POTW[c]	Off-site transfer[d]	Total[e]
1,1,1-Trichloroethane	15 (23)	22,054 (60)	54,321 (80)	5 (7)	1,634 (27)	57,125 (100)
Dichloromethane	4 (6)	11,203 (100)	12,342 (75)	-	5,042 (25)	21,720 (100)
Trichloroethylene	1 (2)	-	6,645 (100)	-	-	6,645 (100)

a A total of 66 facilities in SICs 2512 and 2541 reported usage of at least one Section 313 chemical above the threshold limits.

b Mean release in pounds per year in 1990 for firms reporting release of this chemical and percentage of firms reporting usage of this chemical and percentage of firms regulating usage of this chemical and release to this media. Releases to other media were insignificant.

c POTW = Publicly Owned Treatment Works.

d Offsite transfer for recycling was not reportable in 1990.

e The total includes all releases and off-site transfers, not just categories summarized in this table.

METAL FURNITURE

This category includes metal household furniture. Some metal furniture is also produced in some of the SICs classified in this report as "other furniture." The definitions of these other categories were redefined from "metal" to "except wood" in the SIC categories. To avoid confusion, therefore, the metal furniture category will include SICs that remain exclusively metal.

Table 9 presents typical operating parameters for metal furniture coating for three plant sizes.[4] Metal furniture pieces are loaded onto an overhead conveyor moving at speeds of 2.5 to 7 meters per minute.[5] Coating of metal furniture is usually preceded by a three or five stage washer. A five-stage cleaning process contains the following steps:

1. Alkaline cleaner wash
2. Iron phosphate
3. Hot-water rinse
4. Chromic wash
5. Cold-water rinse

TABLE 9. TYPICAL OPERATING PARAMETERS FOR COATING OPERATIONS[4]

Plant size	Operating schedule h/yr	No. of lines	Line speed[a] m/min	Surface area coated m^2/yr	Coating used, l[b]
Small	2,000	1 (spray booth)	2.5	45,000	5,000
Medium	2,000	2 (3 booths/line)	2.4	780,000	87,100
Large	2,000	10 (3 booths/line)	4.6	4,000,000	446,600

[a] Line speed is not used to calculate emissions, only to characterize plant operations.

[b] Based on 35 volume percent solids coating, applied by electrostatic spray at 65 percent transfer efficiency.

Alkaline cleaning removes oil and grease, and phosphate treatment improves the adhesion characteristics of the surface.[5] Most metal furniture coating operations only use a 3-stage cleaning process (Steps 1, 2, and 3). After washing, the furniture or furniture parts pass through a dry-off oven and then into the coating operation. Coating application methods include spray coating, dip coating, and flow coating. Electrostatic spray coating is the most common application method.[5] After coating, the solvent is allowed to flash-off and the paint is then dried in an oven.

Transfer efficiency for paint solids varies from 60 to 95% depending on the type of application equipment and the configuration of the item being painted. Because of the length of time that the item is in the booth and flash-off area, approximately 70% of the solvent evaporates prior to the oven.[5]

Dip coating is the second most commonly used method of paint application.[1] Items to be coated are loaded onto an overhead conveyor that lowers them (manually or automatically) into the paint dip tank.[6] They are then raised from the tank and suspended in the flash-off area over a drain board. Approximately 40 percent of the solvent emissions are released during application and flash-off. Transfer efficiency is approximately 90%.[6]

Flow coating is the least-used application method.[6] For topcoat application, furniture items are carried by an overhead conveyor into a flow-coating chamber.[4] In the chamber, paint is directed at the object from many angles through as many as 100 nozzles.[6] The nozzles effectively form a curtain of paint through which the furniture items must pass.

After application, the coated objects are held over a drain board in a flash-off area and then are moved to a curing oven. Approximately 80% of all solvent emissions are released in the application and flash-off areas.[6] Transfer efficiency is estimated at 90 percent with no significant differences with varying object shapes.[6]

Three of the four categories described in wood furniture with coatings would typically be used in the metal furniture category. The "other chemicals" categories containing constituents of resins are not typically used.

Organic solvents are otherwise used as constituents of paints for coating metal furniture. Solvent emissions in the metal furniture coating industry are directly related to the types of coating materials used and the technique used to apply the coating.[1] Controls of organic solvent release include add-on air pollution control equipment such as thermal or catalytic incinerators or carbon adsorbers. The most prevalent control involves process changes such as the use of high solids paint, powder coatings, water-borne coatings, or increased transfer efficiencies. Additional information on methods that may be used to control VOCs from metal furniture coating is found in the EPA Control Techniques Guideline (CTG) document[6] or AP-42.[4]

Table 10 presents AP-42 emission factors for determining total VOC releases from metal furniture coating operations.[4] The best method for calculating releases and off-site transfers of VOC in metal furniture coating is a mass balance taking into account using total annual chemical usage. Most releases are to air with some transfer offsite for disposal of purge solvent or waste paint.

Table 11 presents a summary of Section 313 reported releases and off-site transfer of organic solvents from the manufacture of metal furniture.

Chlorinated solvents are otherwise used in adhesives and as a coating stripper in metal furniture manufacture. Adhesives may be used in metal furniture manufacture to apply laminates. Chlorinated solvents may also be used as a metal degreasing solvent at some facilities. Dichloromethane may be used to strip coatings from defective products, from the walls of the spray booth, or from other equipment.

For all chlorinated solvent usage, the primary release is to air. Dichloromethane used to strip furniture, spray booths, or equipment, may be transferred offsite for disposal. No controls are typically used to reduce releases or off-site transfers of chlorinated solvents at metal furniture manufacturing facilities. Off-site transfers may be F002 RCRA wastes.

Table 12 presents a summary of Section 313 reported releases and off-site transfers from use of chlorinated solvents by metal furniture manufacturers.

TABLE 10. VOC EMISSION FACTORS FOR VOC SURFACE COATING OPERATIONS[4]

Plant size and control technique	VOC emissions[a]		
	kg/m^2 coated	kg/yr	kg/h
Small			
Uncontrolled emissions	0.064	2,875	1.44
65 Volume % high solids coating	0.019	835	0.42
Waterborne coating	0.012	520	0.26
Medium			
Uncontrolled emissions	0.064	49,815	24.90
65 volume % high solids coating	0.019	14,445	7.22
Waterborne coating	0.012	8,970	4.48
Large			
Uncontrolled emissions	0.064	255,450	127.74
65 volume % high solids coating	0.019	74,080	37.04
Waterborne coating	0.012	46,000	23.00

[a] Calculated using the parameters given in Table 9 and the following equation. Values have been rounded off.

$$E = \frac{0.0254\ A\ T\ V\ D}{S\ Te}$$

where E = Mass of VOC emitted per hour (kg)
A = Surface area coated per hour (m^2)
T = Dry film thickness of coating applied (mils)
V = VOC content of coating; including dilution solvents added at the plant (fraction by volume)
D = VOC density (assumed to be 0.88 kg/L)
S = Solids content of coating (fraction by volume)
Te = Transfer efficiency (fraction)

The constant 0.0254 converts the volume of dry film applied per m^2 to liters.

Nominal values of T, V, S, and Te are:

T = 1 mil (for all cases)
V = 0.65 (uncontrolled), 0.35 (65 volume % solids), 0.117 (waterborne)
S = 0.35 (uncontrolled), 0.65 (65 volume % solids), 0.35 (waterborne)
Te = 0.65 (for all cases)

TABLE 11. SUMMARY OF REPORTED RELEASES OF ORGANIC SOLVENTS FROM THE MANUFACTURE OF METAL FURNITURE

Section 313 chemical	No. of facilities reporting usage[a] (% reporting usage)	Mean release, lb (% reporting to each media)[b]			
		Fugitive	Stack	Off-site transfer[c]	Total[d]
Xylene (mixed isomers)	11 (65)	4,688 (91)	26,651 (91)	7,756 (45)	32,016 (100)
Toluene	6 (35)	2,635 (100)	40,030 (100)	3,333 (50)	44,332 (100)
Glycol ethers	3 (18)	2,292 (100)	18,835 (100)	-	21,127 (100)
Acetone	3 (18)	606 (100)	26,248 (100)	6,926 (33)	29,166 (100)
n-Butyl alcohol	2 (12)	9,820 (100)	7,933 (50)	2,273 (50)	14,923 (100)
MEK	2 (12)	7,567 (100)	31,738 (100)	1,000 (50)	39,805 (100)

a A total of 17 facilities in SIC 2514 reported usage of at least one Section 313 chemical above the threshold limits.

b Mean release in pounds per year in 1990 for firms reporting release of this chemical and percentage of firms reporting usage of this chemical and percentage of firms regulating usage of this chemical and release to this media. Releases to other media were insignificant.

c Off-site transfer for recycling or fuel blending was not reportable in 1990; transfer off site of purge or cleanup solvent for these purposes will be reportable in 1991.

d The Total includes all releases and off-site transfers, not just categories summarized in this table.

TABLE 12. SUMMARY OF REPORTED RELEASES OF CHLORINATED SOLVENTS FROM THE MANUFACTURE OF METAL FURNITURE

Section 313 chemical	No. of facilities reporting usage[a] (% reporting usage)	Mean release, lb (% reporting to each media)[b]			
		Fugitive	Stack	Off-site transfer[c]	Total[d]
1,1,1-Trichloroethane	4 (24)	28,645 (75)	27,392 (75)	750 (25)	42,216 (100)
Dichloromethane	2 (12)	53,333 (100)	8,341 (100)	4,446 (100)	66,126 (100)

a A total of 17 facilities in SIC 2514 reported usage of at least one Section 313 chemical above the threshold limits.

b Mean release in pounds per year in 1990 for firms reporting release of this chemical and percentage of firms reporting usage of this chemical and release to this media. Releases to other media were insignificant.

c Off-site transfer for recycling was not reportable in 1990; transfer for recycling could be significant for chlorinated solvents used in degreasing operations.

d The total includes all releases and off-site transfers, not just categories summarized in this table.

Metals/metal compounds are processed at metal furniture manufacturers as constituents of the metal or as constituents of the coating. Table 13 presents typical transfer efficiencies for various methods of coating application. The best method for estimating releases of metals/metal compounds is to multiply the total quantity of metals/metal compound times (1 - transfer efficiency). This quantity will be released or transferred off site for disposal. Depending on the particulate controls present, a small quantity may be released to air. If a water wash is used, a small release to water is also likely. The remaining metals/metal compounds in the overspray are typically transferred off site for disposal.

If grinding operations are performed on the metal, a small quantity of alloy metal in the steel may be released to air or transferred offsite for disposal. Table 14 presents a summary of Section 313 reported releases and off-site transfers of metals/metal compounds at metal furniture manufacturers. Fewer metals/metal compounds and lower air releases than expected were reported. It is not known if this is due to high transfer efficiency through use of dip tanks or flow coats, the use of water walls to control air releases, under-reporting of these compounds, or a combination of these reasons.

TABLE 13. TRANSFER EFFICIENCIES FOR METAL FURNITURE COATING[4]

Application method	Transfer efficiency
Air-atomized spray	0.25
Airless spray	0.25
Manual electrostatic spray	0.60
Nonrotational automatic electrostatic spray	0.70
Rotating head electrostatic spray (manual and automatic)	0.80
Dip coat and flow coat	0.90
Electrodeposition	0.95

TABLE 14. SUMMARY OF REPORTED RELEASES OF METALS AND METAL COMPOUNDS FROM THE MANUFACTURE OF METAL FURNITURE

Section 313 chemical	No. of facilities reporting usage[a] (% reporting usage)	Mean release, lb (% reporting to each media)[b]			
		Stack	POTW[c]	Off-site transfer	Total[d]
Nickel	2 (12)	250 (50)	250 (50)	5,548 (100)	5,798 (100)
Nickel compounds	3/19)	-	250 (67)	1,720 (100)	1,887 (100)
Copper	2 (12)	5 (100)	-	128 (100)	133 (100)

[a] A total of 17 facilities in SIC 2514 reported usage of at least one Section 313 chemical above the threshold limits.

[b] Mean release in pounds per year in 1990 for firms reporting release of this chemical and percentage of firms reporting usage of this chemical and release to this media. Releases to other media were insignificant.

[c] POTW = Publicly Owned Treatment Works.

[d] The total includes all releases and off-site transfers, not just categories summarized in this table.

OTHER FURNITURE

This category includes all furniture not included in the categories previously discussed. It includes the types of facilities previously discussed as well as furniture made from polymers. Releases and off-site transfers for all four categories of Section 313 chemicals were reported in 1990. Each category will be discussed separately.

Organic solvents are otherwise used as constituents of stains, coatings, adhesives, and polymers. Most solvents are released to air, but some are released to water if a water curtain is used. Organic purge solvents used to clean spray equipment or for other cleaning purposes may be transferred offsite for recycling, fuel burning, or disposal.

The best method for calculating releases is a mass balance based on total usage of organic solvents with almost all of the emissions released to air or sent to an air control device.

Table 15 presents a summary of reported releases and off-site transfers of organic solvents from the manufacture of other furniture.

Chlorinated solvents are otherwise used in other furniture manufacture as a solvent in adhesives and as a coating stripper. Adhesives may be used to apply laminates. Chlorinated solvents may also be used as a metal degreasing solvent at some facilities. Dichloromethane may be used to strip coatings from defective products, from the walls of the spray booth, or from other equipment.

Chlorinated solvents are primarily released to air. A significant amount of dichloromethane used as a stripper as well as and other chlorinated solvents used as a degreaser may be transferred offsite. No controls are typically used to reduce releases or off-site transfers of chlorinated solvents at other furniture manufacturing facilities. Off-site transfers may be F002 RCRA wastes.

Table 16 presents a summary of Section 313 reported releases and off-site transfers from otherwise uses of chlorinated solvents in other furniture manufacture.

Metals/metal compounds are processed at other furniture manufacturers as constituents of the coatings. The best method for estimating releases of metals/metal

TABLE 15. SUMMARY OF REPORTED RELEASES OF ORGANIC SOLVENTS FROM THE MANUFACTURE OF OTHER FURNITURE

Section 313 chemical[a]	No. of facilities reporting usage[b] (% reporting usage)	Mean release, lb (% reporting to each media)[c]				
		Fugitive	Stack	POTW[d]	Off-site transfer[e]	Total[f]
Xylene (mixed isomers)	92 (54)	8,387 (72)	39,886 (96)	169 (7)	18,728 (34)	51,697 (99)
Toluene	83 (49)	4,892 (67)	27,481 (89)	78 (5)	23,486 (45)	38,745 (99)
Acetone	40 (24)	8,224 (83)	14,788 (83)	3,753 (5)	10,761 (38)	23,209 (100)
MEK	29 (17)	5,398 (79)	20,484 (86)	5,252 (10)	11,434 (41)	27,215 (100)
n-Butyl alcohol	23 (14)	2,782 (70)	14,839 (100)	5 (9)	1,192 (43)	17,295 (100)
Methanol	18 (11)	5,940 (50)	16,047 (83)	-	14,936 (22)	20,820 (94)
MIBK	18 (11)	2,629 (61)	12,691 (100)	-	7,291 (44)	17,539 (100)
Glycol ethers	7 (4)	10,648 (67)	47,018 (87)	12,067 (40)	9,040 (27)	55,174 (100)
Ethylbenzene	7 (4)	4,772 (71)	21,246 (100)	-	7,643 (43)	27,932 (100)

[a] Isopropyl alcohol was reported by five facilities. Since IPA is only reportable by manufacturers of IPA, this is not reportable in the furniture manufacture industry.

[b] A total of 169 facilities in SICs 2515, 2519, 2522, 2531, 2542, 2591, and 2599 reported usage of at least one Section 313 chemical above the threshold limits.

[c] Mean release in pounds per year in 1990 for firms reporting release of this chemical and percentage of firms reporting usage of this chemical and release to this media. Releases to other media were insignificant.

[d] POTW = Publicly Owned Treatment Works.

[e] Off-site transfer for recycling or fuel blending was not reportable in 1990; transfer off site of purge or cleanup solvent for these purposes will be reportable in 1991.

[f] The total includes all releases and off-site transfers, not just categories summarized in this table.

TABLE 16. SUMMARY OF REPORTED RELEASES OF CHLORINATED SOLVENTS FROM THE MANUFACTURE OF OTHER FURNITURE

Section 313 chemical	No. of facilities reporting usage[a] (% reporting usage)	Mean release, lb (% reporting to each media)[b]			
		Fugitive	Stack	Off-site transfer[c]	Total[d]
1,1,1-Trichloroethane	45 (27)	16,775 (76)	37,067 (78)	6,639 (24)	43,139 (100)
Dichloromethane	7 (4)	1,755 (71)	2,633 (86)	32,582 (71)	53,560 (100)
Trichloroethylene	3 (2)	38,154 (100)	12,499 (33)	37,211 (33)	54,724 (100)

[a] A total of 169 facilities in SICs 2515, 2519, 2522, 2531, 2542, 2591, and 2599 reported usage of at least one Section 313 chemical above the threshold limits.

[b] Mean release in pounds per year in 1990 for firms reporting release of this chemical and percentage of firms reporting usage of this chemical and release to this media. Releases to other media were insignificant.

[c] Off-site transfer for recycling was not reportable in 1990.

[d] The total includes all releases and off-site transfers, not just categories summarized in this table.

compounds is to multiply the total quantity of metal/metal compound times (1 - transfer efficiency). This quantity will be released or transferred off site for disposal. Depending on the particulate controls present, a small quantity may be released to air. If a water wash is used, a small release to water is also likely. The remaining metal/metal compounds in the overspray are typically transferred off site for disposal.

Table 17 presents a summary of Section 313 reported releases and off-site transfers of metals/metal compounds at other furniture manufacturers.

Other chemicals are both processed and otherwise used above the threshold limits by a small number of facilities in other furniture manufacture. Sulfuric and hydrochloric acids may be otherwise used in wastewater treatment or in metal cleaning. For these uses, releases to POTW is typically between pH 6 to 9 and therefore not reportable under Section 313. A facility cannot just assume a neutral pH, however, and should have monitoring data to support this assumption. If pH is below 6, then releases to POTW can be calculated based on the pH and volume of water if only one acid is present. Small air releases of more volatile acids can also be expected from transfer loses. Neutralization is the primary method used to control acids.

Phosphoric acid may be processed at some facilities in the 3- or 5-step wash of metal furniture or furniture parts. Phosphate treatment improves the adhesion characteristics of the metal surface for subsequent coating application. Neutralization is the primary method used to control phosphoric acid.

Methylenebis (phenylisocyanate) (MBI) is processed as a constituent of urethane and other resins. Although most of the MBI is reacted to form the resin, some small quantity of unreacted MBI may be released to air or transferred off site in waste resin.

Table 18 presents a summary of Section 313 reported releases and off-site transfers of other chemicals at other furniture manufacturers.

TABLE 17. SUMMARY OF REPORTED RELEASES OF METALS AND METAL COMPOUNDS FROM THE MANUFACTURE OF OTHER FURNITURE

Section 313 chemical	No. of facilities reporting usage[a] (% reporting usage)	Mean release, lb (% reporting to each media)[b]				
		Fugitive	Stack	POTW[c]	Off-site transfer[e]	Total[d]
Nickel	12 (7)	451 (42)	250 (25)	146 (58)	1,459 (83)	1,697 (92)
Nickel compounds	4 (2)	87 (75)	5 (50)	128 (50)	7,854 (100)	8,035 (100)
Manganese	9 (5)	209 (67)	250 (33)	5 (11)	160 (22)	333 (78)
Chromium	4 (2)	250 (50)	250 (25)	-	250 (50)	417 (75)
Chromium compounds	2 (1)	5 (50)	-	236 (50)	6,658 (100)	6,818 (100)
Zinc compounds	4 (2)	253 (100)	189 (100)	1,405 (50)	2,945 (50)	2,616 (100)

a A total of 169 facilities in SICs 2515, 2519, 2522, 2531, 2542, 2591, and 2599 reported usage of at least one Section 313 chemical above the threshold limits.

b Mean release in pounds per year in 1990 for firms reporting release of this chemical and percentage of firms reporting usage of this chemical and release to this media. Releases to other media were insignificant.

c POTW = Publicly Owned Treatment Works.

d The total includes all releases and off-site transfers, not just categories summarized in this table.

TABLE 18. SUMMARY OF REPORTED RELEASES OF OTHER CHEMICALS FROM THE MANUFACTURE OF OTHER FURNITURE

Section 313 chemical	No. of facilities reporting usage[a] (% reporting usage)	Mean release, lb (% reporting to each media)[b]				
		Fugitive	Stack	POTW[c]	Off-site transfer	Total[d]
Sulfuric acid	21 (12)	154 (48)	406 (24)	e	-	e
Hydrochloric acid	14 (8)	459 (43)	578 (29	e	-	e
Phosphoric acid	9 (5)	714 (56)	599 (44)	13,921	21,941 (22)	15,079 (78)
Methylene bis (phenyl isocyanate)	9 (5)	478 (56)	1,984 (44)	-	1,953 (33)	2,698 (67)

[a] A total of 169 facilities in SIC 2514 reported usage of at least one Section 313 chemical above the threshold limits.

[b] Mean release in pounds per year in 1990 for firms reporting release of this chemical and percentage of firms reporting usage of this chemical and reporting release to this media. Releases to other media were insignificant.

[c] POTW - Publicly Operated Treatment Works.

[d] The total includes all releases and off-site transfers, not just categories summarized in this table.

[e] Most releases to POTW are zero; however, two facilities reported very large releases to POTW. Therefore, mean releases are not representative of the industry.

REGULATIONS USEFUL FOR ESTIMATING RELEASES OF SECTION 313 CHEMICALS

Two regulations that may provide assistance in estimating emissions of Section 313 chemicals are effluent guidelines and standards governing water releases and VOC standards governing air releases. Because the concentration of Section 313 chemicals varies greatly between facilities, neither set of regulations is directly applicable. The regulations may require monitoring or other testing, however, that may be used to estimate releases of Section 313 chemicals.

Water Releases

Effluent limitations pertaining to Wood Furniture and Fixture Production are presented in Code of Federal Regulations (CFR) §429 Subparts O and P. Subpart O presents the standards applicable to for Wood Furniture Production Without Water Wash Spray Booth(s) or Without Laundry Facilities. Best practicable control technology for this subcategory currently available (BPT) and Best Available Technology (BAT) economically available for this subcategory is no discharge of process wastewater into navigable waterways.

Subpart P presents the standards for Wood Furniture and Fixture Production With Water Wash Spray Booth(s) or With Laundry Facilities. Best practicable control technology currently available (BPT) for this subcategory is settleable solids less than or equal to 0.2 ml/l with a pH between 6.0 and 9.0 at all times. Best Available Technology (BAT) economically available calls for no discharge of process wastewater pollutants into navigable waterways. The New Source Performance Standard (NSPS) governing new sources calls for no discharge of process wastewater pollutants.

Metal furniture manufacturers which use electroplating, electroless plating, anodizing, or coating (chromating, phosphating, and coloring) are subject to the effluent limitations pertaining to the Metal Finishing Subcategory (433.10 Subpart A). These limitations are summarized in Table 19.

Discharges into a POTW must comply with 40 CFR 403 General Pretreatment Regulations for Existing and New Sources of Pollution. The general Pretreatment

TABLE 19. SUMMARY OF EFFLUENT LIMITATION FOR METAL FINISHING (Monthly average in mg/L)[a]

Pollutant	BPT[b]	BAT[c]	PSES[d]	NSPS[e]	PSNS[f]
Cadmium, total	0.26	0.26	0.26	0.26	0.26
Chromium, total	1.71	1.71	1.71	1.71	1.71
Copper, total	2.07	2.07	2.07	2.07	2.07
Lead, total	0.43	0.43	0.43	0.43	0.43
Nickel, total	2.38	2.38	2.38	2.38	2.38
Silver, total	0.24	0.24	0.24	0.24	0.24
Zinc, total	1.48	1.48	1.48	1.48	1.48
Cyanide[g]	0.32	0.32	0.32	0.32	0.32
Cyanide, total	0.65	0.65	0.65	0.65	0.65
TTO[h]	2.13	2.13	2.13	2.13	2.13
Oil and grease	26			26	
TSS[i]	31			31	
pH	6-9			6-9	

[a] 40 CFR 433 Metal Finishing Point Source Subcategory. Maximums for any one day are also presented.

[b] BPT = Best practicable control technology currently available.

[c] BAT = Best available control technology economically achievable.

[d] PSES = Pretreatment standards for existing sources (except job shops and independent printed circuit board manufacturers.

[e] NSPS = New source performance standards.

[f] PSNS = Pretreatment standards for new sources.

[g] Cyanide amenable to chlorination.

[h] Total toxic organics listed in 40 CFR 433.11(e). Value presented is a 1-day maximum.

[i] TSS = Total suspended solids.

Regulations establish discharge standards and categorical pretreatment standards to control pollutant discharges into the POTW. Discharge standards apply to all industrial and commercial discharges connected to POTW's. Categorical pretreatment standards apply to industrial and commercial discharges in 25 specific industrial categories. The furniture industry is not among these 25 industries.

Discharge standards applicable to the furniture industry prohibits discharge of pollutants that:

- Create a fire or explosion hazard in sewers or treatment works;
- Are corrosive (with a pH lower than 5.0);
- Obstruct flow in the sewer system or interfere with operation;
- Upset the treatment process or cause a violations of the POTW's permit; or
- Increase the temperature of wastewater entering the treatment plant above 104°F (40°C).

The furniture industry is subject to the above discharge standards as well as any permit requirements of the local POTW.

Air Releases

Air releases of VOCs in metal furniture coating are regulated in 19 states. The regulations are based on pounds of VOC content as applied (less water) (i.e., 3.0 lb VOC/gallon), specified transfer efficiencies, or other means used to reduce VOC releases. Permit conditions applicable to the specific plant should be consulted.

Two states (Indiana and New Jersey) regulate VOC releases from wood furniture surface coating operations. The standards are dependent on the type of operation and are stated in lb VOC/gallon.

New Source Performance Standards (NSPS) governing Surface Coating of Metal Furniture are presented in Subpart EE (§ 60.310 to § 60.315). The NSPS exempt sources that use less than 3,842 liters of coating per year. Sources subject to NSPS must limit VOC emissions to 0.90 kg VOC per liter of coating solids applied. Procedures are

provided to calculate VOC releases by month. Recordkeeping of coatings used is required as are estimates of the proportion of VOC that enters a control device. Although these data do not present information on Section 313 chemicals, the usage reports, collection efficiencies, and control efficiencies can be used to calculate releases of Section 313 solvents that are used in the coatings.

Off-Site Transfers

RCRA wastes reported by generators can be a good source of information on off-site transfers from furniture manufacturers. A waste solvent may be determined hazardous by two methods.[3] Either the waste is "listed" or the solvent exhibits a hazardous "characteristic."

A waste is "listed" in the regulations because it has already been determined to exhibit a hazardous characteristic or it has been determined to be toxic to humans. There are over 700 chemicals listed in the regulations. Most waste solvents used in the furniture industry are solvent blends containing methyl ethyl ketone, acetone, toluene, etc. which are usually toxic or ignitible and have the EPA Waste Numbers F001 through F005.

If a waste exhibits one or more of the following characteristics, it is considered a hazardous waste.

- Ignitibility
- Corrosivity
- Reactivity, and
- EP Toxic.

Results from standard tests specified by the EPA will determine if the waste is deemed hazardous by the characteristic test. The furniture industry works with solvent blends that frequently will exhibit the ignitibility characteristic. If the waste solvent is not listed in the F001-F005 wastes and is "ignitible" it has the EPA Hazardous Waste Number D001.

NONREPORTING FACILITIES

Nonreporting facilities may be identified by comparing lists of facilities in the following Standard Industrial Classifications (SICs) having more than 10 employees with those facilities that have reported under Section 313.

Wood furniture with coatings - SICs 2511 and 2517
Wood furniture, lower coating use - SICs 2512 and 2541
Metal furniture - SIC 2514
Other furniture - SICs 2515, 2519, 2522, 2531, 2542, 2591, and 2599

Most larger furniture manufacturers that coat furniture probably are using at least one Section 313 chemical in excess of threshold values. A significant number of medium to large facilities that apply coatings most likely otherwise use more than 10,000 pounds of at least one organic solvent.

Sources of information on furniture manufacture facilities presented by SIC and employment size class include County Business Patterns (for number of facilities), published by the U.S. Department of Commerce.[7] Another source is Dunn and Bradstreet (D&B), which provides lists of companies by SIC and employment size category.[8]

Table 20 presents the number of facilities with over 10 employees as reported in County Business Patterns (1989) and D&B compared with the number of facilities in the TRI database in 1990. Because most small furniture manufacturers would not exceed the threshold for any Section 313 chemical, facilities with more than 50 (or 100) employees are the most likely to be required to report.

Significant nonreporting may be occurring in the furniture manufacturing industry, based on the number of facilities reporting in the TRI database and the number of facilities listed in County Business Patterns with over 50 employees (Table 20). Some of the difference may be accounted for by facilities manufacturing furniture that is not coated or which use high solids coatings; however, larger facilities that do perform coating should be checked to determine if they exceed the threshold for any of the coating solvents.

TABLE 20. NUMBER OF FACILITIES WITH MORE THAN 10 EMPLOYEES

Furniture type	SICs	TRI 1990	County Business Patterns[a]	D&B 1992
Wood, coatings	2511, 2517	257	1,199 (491)	1,824
Wood, lower coatings	2512, 2541	66	1,630 (562)	2,433
Metal	2514	17	248 (117)	376
Other	2515, 2519, 2522, 2531, 2542, 2591, 2599	169	2,269 (883)	3,681

[a] The numbers in parentheses are the number of facilities with over 50 employees.

A review of the 1990 TRI data seems to indicate some errors in reporting whether a chemical was manufactured, processed, or otherwise used. All organic solvents, chlorinated solvents, and some other chemicals are otherwise used at furniture manufacturers and are therefore subject to the 10,000-pound threshold. All metals/ metal compounds and some other chemicals are processed at furniture manufacturers. No chemicals are manufactured or manufactured as a by-product. Many firms reported that organic solvents were processed. This misunderstanding of the definitions of processed and otherwise used may cause nonreporting if the wrong threshold is used for the threshold determination.

Another error made by a number of furniture manufacturers was to report the use of isopropyl alcohol (IPA). IPA is reportable only for facilities who manufacture IPA by the strong acid process. No IPA should be reported by furniture manufacturers.

LIST OF QUESTIONS

The following questions may be helpful in determining whether furniture manufacturers made errors in Section 313 reporting.

Organic solvents

- If a solvent is reported as processed on Form R, ask what threshold was used for all organic solvents. The 10,000-pound threshold for otherwise used chemicals should be used.

- How were releases of organic solvents other than to air estimated?

- Was a mass balance for organic solvents that accounted for total usage calculated?

- If a control such as incineration was used on the drying oven, how were releases in the booth versus releases in the oven estimated?

Chlorinated solvents

- How were chlorinated solvents otherwise used (adhesives, cleaning, stripping)?

- Was the percentage of chlorinated solvent in any waste solvent accounted for?

- Was a mass balance accounting for all chlorinated solvent usage used to estimate releases and off-site transfers.

Metals/metal compounds

- Were threshold determinations made for all metals/metal compounds processed at the facility?

- Were threshold determinations made using the total quantity of Section 313 metal/metal compound processed and not the quantity of metal/metal compound released or transferred off site?

- Were threshold determinations for metal compounds made using the weight of the compound and not just the metal portion of the compound?

- Was TCLP used as a measure of metal concentration in any of the calculations? TCLP measures leachable metal (not metal content) and should not be used in calculations.

Other Chemicals

- How was the release of chemicals that are present in resins such as formaldehyde or styrene estimated?

- How were any acids estimated that were reported otherwise used at the facility? Is there monitoring data to support any neutralization assumptions?

BIBLIOGRAPHY

1. U.S. Environmental Protection Agency. Summary of Technical Information for Selected Volatile Organic Compound Source Categories. EPA 450/3-81-007. 1981 (Original source technical paper, Society of Manufacturing Engineers, MS-75-251).

2. Kirk-Othmer Encyclopedia of Chemical Technology. Volume 6, Coatings Industrial. pp. 443, 444.

3. North Carolina State University. Managing and Recycling Solvents in the Furniture Industry. Raleigh, NC. May 1986.

4. U.S. Environmental Protection Agency. Compilation of Air Pollutant Emission Factors. AP-42. Volume 1. Stationary and Point Source. Section 4.2.2.2 Other Metal Coating. September 1985 plus supplements.

5. U.S. Environmental Protection Agency. Surface Coating of Metal Furniture - Background Information for Proposed Standards. EPA-450/3-80-007a. September 1980.

6. U.S. Environmental Protection Agency. Control of Volatile Organic Emissions from Existing Stationary Sources, Volume III Surface Coating of Metal Furniture. EPA-450/2-77-032. December 1977.

7. U.S. Department of Commerce, Bureau of Census, County Business Patterns. 1989. CBP-89-1. Washington, D.C. 1991.

8. Dunn & Bradstreet. Dunn's Electronic Business Directory in DIALOG data base File 515. 1992.

9. U.S. Environmental Protection Agency. Pollution Prevention Options In Wood Furniture Manufacture, A Bibliographic Report. EPA/560/8-92/001c. February 1992.

10. U.S. Environmental Protection Agency. Summary of State VOC Regulations. EPA-450/2-85-003. April 1985.

11. U.S. Environmental Protection Agency. Air Pollution Engineering Manual, Second Edition AP-40. May 1973.

12. U.S. Environmental Protection Agency. Generic Engineering Assessment, Spray Coating, Occupational Exposure and Environmental Release. Chemical Engineering Branch, October 1987 (unpublished).

13. U.S. Environmental Protection Agency. Title III Section 313 Release Reporting Guidance, Estimating Chemical Releases From Electrodeposition of Organic Coatings. EPA/560/4-88-004c. January 1988.

14. U.S. Environmental Protection Agency. Title III Section 313 Release Reporting Guidance, Estimating Chemical Releases From Spray Application of Organic Coatings. EPA/560/4-88/004d. January 1988.

APPENDIX A

SELECTED INFORMATION OF THE FURNITURE INDUSTRY

TABLE A-1. TYPICAL FURNITURE MANUFACTURING OPERATIONS USING MATERIALS WHICH MAY GENERATE HAZARDOUS WASTES

Typical process/operation	Typical materials used	Typical material ingredients	General types of wastes generated
Wood cleaning and wax removal	petroleum distillates, white spirits	petroleum distillates, mineral spirits	ignitable wastes, spent solvents, volatile emissions
Refinishing/stripping	paint removers, varnish removers, enamel removers, shellac removers, paint solvents, turpentine	acetone, toluene, petroleum distillates, methanol, methylene chloride, alcohols, ketones, oxygenated solvents	ignitable wastes, ignitable paint wastes, solvent still bottoms, volatile emissions
Staining	stains	mineral spirits, alcohol pigments	ignitable wastes, spent solvents, solvent still bottoms, volatile emissions
Painting	enamels, lacquers, epoxy, alkyds, acrylics	toluene, pigments, titanium dioxide, epoxyester resins, aromatic hydrocarbons, glycol ether, halogenated hydrocarbons, vinylacetate acrylic	ignitable paint wastes, ignitable wastes, solvent still bottoms, paint waste containing heavy metals, volatile emissions
Finishing	varnish, shellac, polyurethane, lacquers with residues	denatured alcohols, resins, shellac, petroleum distillates, toluene, diisocyanate	ignitable wastes, spent solvents, solvent still bottoms, volatile emissions
Cleaning brushes, spray gun and spray equipment, and overspray from spray booths	paint thinners, enamel reducers, varnish removers, shellac removers, white spirits	acetone, toluene, petroleum distillates, methanol, methylene chloride, isopropanol, mineral spirits, alcohols	ignitable paint wastes, ignitable wastes, spent solvents, solvent still bottoms, volatile emissions
Gluing, cleaning adhesive application equipment	adhesives	methyl isobutyl ketone, methyl ethyl ketone, xylene, toluene, 1,1,1-trichloroethane	volatile emissions

Source: Tennessee Hazardous Waste Minimization Program as cited in Reference 9.

TABLE A-2. PHYSICAL CHARACTERISTICS OF SOLVENTS USED IN THE FURNITURE INDUSTRY[3]

PRODUCT	LB./GAL. 20°C	SP. GR. 20°/20°C	BOILING RANGE °C	BOILING RANGE °F	FL. PT[c] °F TCC	EVAP[d] RATE
Alcohols						
Methanol (L)	6.60	0.792	64-65	147-149	54	5.2
Ethanol, Prop. Anhy. (C)	6.75	0.809	74-80	165-176	51	6.8
Ethanol, Spec. Ind. Anhydrous (C)	6.59	0.790	75-81	167-178	50	6.8
Isopropanol, Anhydrous (C)	6.55	0.786	82-83	180-182	53	7.7
Isobutanol (L)	6.68	0.803	107-109	225-228	86	16.3
n-Butanol (L)	6.75	0.811	116-118	241-245	96	20.0
Ketones						
Acetone (L)	6.59	0.792	55.5-56.5	131-133	-4	1.9
Methyl Ethyl Ketone (L)	6.71	0.806	78-80	172-176	24	2.7
Methyl Isobutyl Ketone (L)	6.67	0.802	114-117	237-243	61	5.6
Methyl Isoamyl Ketone (C)	6.78	0.812	141-148	286-298	96	17.0
Diacetone Alcohol, F. (C)	7.82	0.937	145-172	293-342	120	60.0
Methyl Amyl Ketone (C)	6.81	0.818	147-154	297-309	102	22.0
Ester Solvents						
Ethyl Acetate 99% (L)	7.51	0.900	75.5-78	168-172	26	2.7
Isopropyl Acetate 99% (C)	7.27	0.871	86-90	187-194	47	3.0
n-Propyl Acetate (C)	7.40	0.887	99-103	210-217	55	4.8
Isobutyl Acetate (C)	7.24	0.870	112-119	234-246	63	5.8
n-Butyl Acetate 99% (C)	7.34	0.879	118-128	244-262	81	8.2
Isobutyl Isobutyrate (C)	7.13	0.855	144-151	291-304	101	15.0
Glycol Ether EE Acetate (C)	8.10	0.973	150-160	302-320	130	32.0
Glycol Ether EB Acetate (NH)	7.83	0.938	186-194	367-381	160	137.0

PRODUCT	LB./GAL. 20°C	SP. GR. 20°/20°C	BOILING RANGE °C	BOILING RANGE °F	FL. PT[b] °F COC
Glycols					
Propylene Glycol (NH)	8.64	1.038	186-190	367-374	225
Ethylene Glycol (NH)	9.28	1.115	193-202	379-396	240
Diethylene Glycol (NH)	9.31	1.119	242-250	468-482	290
Glycol Ethers					
Glycol Ether EM (C)	8.04	0.966	123-125	253-257	97
Glycol Ether EE (C)	7.74	0.930	134-136	273-277	110
Glycol Ether Eb (C)	7.51	0.903	169-173	336-343	140

TABLE A-2 (continued)

PRODUCT	LB./GAL. 20°C	SP. GR. 20°/20°C	BOILING RANGE °C	BOILING RANGE °F	FL. PT. °F TCC	KB[e]	ANILINE PT °F	% ARO[f]	EVAP[d] RATE
Aliphatic Solvents									
Hexane (C)	5.61	0.675	65-70	150-158	<0	28	151	0.1	1.9
Heptane (C)	5.76	0.704	94-98	202-209	25	32	146	0 1	2 9
Mineral Spirits (C)	6.55	0.787	157-196	315-385	105	31	155	<1	70.0

PRODUCT	LB./GAL. 20°C	SP. GR. 20°/20°C	BOILING RANGE °C	BOILING RANGE °F	FL. PT. °F TCC	KB	MAP	EVAP[d] RATE
Aromatic Solvents								
Toluene (L)	7.26	0.870	110-111	230-233	45	105	50	4.5
Xylene (L)	7.23	0.866	138-142	280-288	80	98	52	9.5

PRODUCT	LB./GAL. 20°C	SP. GR. 20°/20°C	BOILING RANGE °C	BOILING RANGE °F	FL. PT. °F TCC	FREEZING POINT °C
Amines						
Monoethanolamine (NH)	8.48	1.016	166-174	331-345	200	10
Triethanolamine (NH)	9.37	1.126	App 360	App 680	375	21

PRODUCT	LB.GAL. 25°/25°C	SP. GR. 25°/25°C	BOILING RANGE °C	BOILING RANGE °F	EVAP[d] RATE
Chlorinated Solvents					
Methylene Chloride (L)	11.0	1.320	39.4-40.4	103-105	1.8
1,1,1-Trichloroethane (L)	10.8	1.300	72-88	162-191	2.6
Trichloroethylene (L)	12.1	1.449	86-88	187-190	3.9
Perchloroethylene (L)	13.5	1.618	120-122	248-252	6 0

(C) - Characteristic
(L) - Listed
(NH) - Nonhazardous

[a] Selected solvents from a chart provided by Industrial Chemicals & Solvents Division, Ashland Chemical Company, Box 2219, Columbus, OH 43216.

[b] Cleveland Open-Cup Test (flashpoint).

[c] TAG Closed Cup Test (flashpoint).

[d] Ethyl Ether = 1.

[e] Kauri-Butanol Value (relative solvent power).

[f] Aromaticity

TRI FACILITY PROFILE, PAINT FORMULATION

by

IT Corporation
11499 Chester Road
Cincinnati, Ohio 45246

Contract No. 68-D0-0020
Work Assignment No. 2-27/2-65/3-18
JTN 830015-5-1

Prepared for

U.S. ENVIRONMENTAL PROTECTION AGENCY
OFFICE OF TOXIC SUBSTANCES
401 M Street, SW
Washington, D.C. 20460

August 1992

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TRI FACILITY PROFILE, PAINT FORMULATION

The purpose of this profile is to assist U.S. Environmental Protection Agency (EPA) Regional Office personnel with Section 313 inspections. The profile describes key toxic chemicals processed or otherwise used in paint formulation, describes how these chemicals are used, and identifies key release sources. All Section 313 chemicals reported to the Toxic Release Inventory (TRI) by more than 5 percent of the paint formulators are presented in this profile.

For purposes of this profile, the paint formulation industry is defined as:

- SIC 2851 - Paints, Varnishes, Lacquers, Enamels, and Allied Products

This Standard Industrial Classification (SIC) includes establishments primarily engaged in the manufacture of paints (in paste and ready mixed form), varnishes, lacquers, enamels, shellers, putties, wood fillers and sealers, paint and varnish removers, paint brush cleaners, and allied paint products.[1] Establishments engaged in the manufacture of pigments, resins, printing inks, adhesives and sealants, or artist materials are not included.[1]

The industry is comprised of roughly 1,375 establishments nationwide.[2] Approximately 44 percent of all paint manufacturing plant sites are located in five states (California, New Jersey, New York, Illinois, and Ohio).[2] Most of the plants are located near major population centers.[2]

Most small plants produce paint in 10- to 500-gallon batches.[2] Plants with more than 20 employees produce paint in 200- to 3000-gallon batches.[2] For an average paint plant located in the United States, 60 percent of its total annual production would be solvent-based paint, 35 percent would be water-based paint, and 5 percent would be allied products.[2] Although more than 70 percent of architectural coatings are water-based, solvent-based paint is still predominantly used for product and special-

purpose coatings.[2] Table 1 presents the volumes and distribution of products formulated by the paint industry in 1986.

The major raw materials used to formulate paint include resins, solvents, pigments, extenders, and drying oils.[2] Table 2 presents annual consumption of these materials in the paint formulation industry in 1982.

Paint is a mixture of pigments or combination of pigments and a liquid vehicle that is composed of binders and thinner. The formulation of paint is a highly developed combination of science, art, and technology.[7] Since paints are required to meet a wide diversity of end uses, the formulations vary widely. The type and relative quantities of vehicles, pigments, extenders, additives, and volatile thinners determine the final film properties.[7]

In paint manufacture, pigment is mixed with a portion of the vehicle to form a paste that is then milled to disperse the pigment into the vehicle. After the pigment is dispersed into finely divided particles, the balance of the vehicle and additives are added to produce the paint product. Tinting may be required to produce the proper color, and the paint may be filtered to remove foreign material or large particles. Paint formulation facilities usually take advantage of gravity flow.[7]

In paint formulation, only physical processes such as weighing, mixing, grinding, dispersion, thinning, filtering, and packaging take place. No chemical reactions are involved. The processes take place in large mixing tanks at room temperature.[8] At a typical plant, both solvent-based and water-based paints are formulated.[2]

Figure 1 presents a simplified process flow diagram of solvent-based paint formulation. The production of solvent-based paint begins by weighing and then mixing resins, dry pigment, and pigment extenders in a high-speed mixer. Solvents and plasticizers are also added during this operation. Following the mixing operation, the batch frequently is transferred to a mill for additional grinding and mixing.[2]

The type of mill is dependent on the types of pigments being handled; no one style is universal.[2] Mills break up the agglomerates by "smashing," "smearing," or a combination of the two actions.[7] The types of mills include:

TABLE 1. PAINT PRODUCTS AND USE DISTRIBUTIONS IN 1986[2-5]

Product	Volume, million gallons	Use and distribution (%)
Architectural coatings	525	Interior solvent-based (11) Interior water-based (43) Exterior solvent-based (16) Exterior water-based (23) Lacquers (2) Other and not specified (5)
Product coatings	371	Metal containers (19) Automotive (16) Machinery (6) Sheet, strip & coil (6) Metal furniture (5) Other (48)
Special-purpose coatings	250	High-performance maintenance (31) Automotive and machinery refinishing (29) Traffic paint (14) Other (26)

TABLE 2. RAW MATERIALS USED BY THE PAINT FORMATION INDUSTRY IN 1982[2,6]

Material	Usage, million lb/yr	Type and distribution (%)
Resins	1844	Alkyd (33) Acrylic (19) Vinyl (19) Other (29)
Solvents	3774	Aromatic (30) Aliphatic (27) Ketones (17) Alcohols (12) Other (14)
Pigments	1062	Titanium dioxide (65) Inorganic[a] (33) Organic (2)
Extenders	1162	Calcium carbonate (31) Talc (25) Clay (23) Other (21)
Miscellaneous	220	Drying oils (41) Plasticizers (18) Other (41)

[a] Approximately 60 percent of inorganic pigments used consisted of iron oxide, zinc oxide, zinc dust, and aluminum paste; 27 percent consisted of lead and chrome compounds; and 13 percent consisted of other compounds.

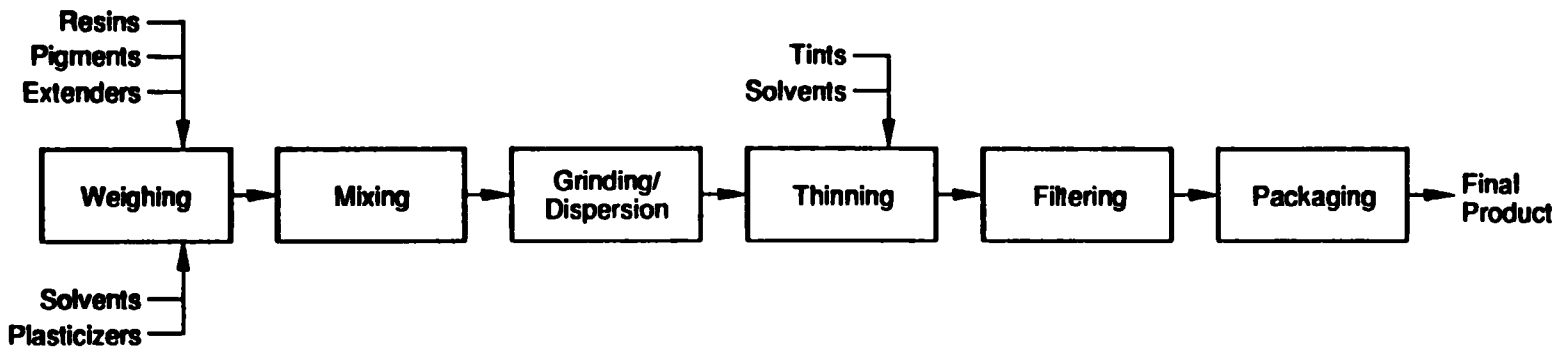

Figure 1. Simplified process flow diagram for solvent-based paint formulation.

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- Stone and colloid mills
- Roller mills
- Ball and pebble mills
- Sand mills
- High-speed dispersers
- Horizontal mills
- Kinetic dispersion mills

Stone and colloid mills contain a rotor (rotates) and stator (stationary) that can be made of stone or metal. A premix is fed by gravity into the mill, and residence time is short. Vehicle solids can be as low as 20 percent or as high as 75 percent.[7] As the paste reaches the rapidly revolving rotor, it is impelled to the outer edge by centrifugal force through a narrow adjustable gap. The material is subjected to high stress (smearing) as it passes between the rotor and the stator. Stone and colloid mills are usually used for architectural paints, but are not good for pigments that are difficult to disperse.

Roller mills in the paint industry typically consist of three rollers, but one, two, four, and five roller mills are also used.[7] The mills are of the smearer type with each roll rotating in the opposite direction at increasing revolutions per minute. The paste must be tacky so it adheres to the surface of the rotating rolls. The vehicle portion must be high in resin solids.[7] Clearances between the rolls are adjustable. Roller mills can be used for difficult-to-disperse pigments.[7]

Ball and pebble mills are hardened steel shells with closed ends that use steel balls as the grinding medium. Pebble mills have steel shells, but are lined with stone and use natural or porcelain balls as the grinding media.[7] The cascading action of the grinding media causes the pigment to be both impacted and sheared by the tumbling balls.

Sand mills consist of a water-jacketed cylindrical shell containing discs mounted on a centrally located shaft. A screen allows the paste to flow through the mill while retaining the media in the mill. The mill is typically operated in the temperature range of 120 to 150°F, but may be as high as 300°F. In addition to sand, many media such as glass beads, ceramics, Al_2O_3, and steel may be used; therefore, the sand mill may

be considered a small media mill.[7] Sand mills disperse by shearing and some impingement.[7]

High-speed dispersers consist of a disc that rotates at high speed in the center of a vertical tank. The disc (impeller), the key feature of a high-speed disperser, typically consists of a saw tooth disc. The teeth are formed by bending the edges of the disc alternately up and down.[7] With a high-speed disperser, a batch can be formulated and milled in the same tank.[7]

Horizontal mills have a horizontal grinding chamber. Suitable types of media include glass, ceramic, or steel. Unlike the sand mill, the horizontal mill does not work against gravity. The premix is subjected to both impact and shear by the grinding media.[7] A cooling system allows use of heat-sensitive products.

Kinetic dispersion mills use a high-speed impeller. The paste is of low viscosity, and the mill gives little or no shearing action and depends primarily on impact for dispersion. No premix is needed, and the time required varies from 15 to 45 minutes.[7]

After milling, the paint base or concentrate is transferred to an agitated tank where tints and thinner (usually volatile naphtha or a blend of solvents) and the balance of the resin are added. Upon reaching the proper consistency, the paint is filtered to remove any nondispersed pigment and then transferred to a loading hopper. From the hopper, the paint is poured into cans, drums, or totes. The product is then labeled/packed and moved to storage.

Figure 2 presents a simplified process flow diagram of water-based paint formulation. The water-based paint process is very similar to the solvent-based process previously described. The major difference is the substitution of water for solvent and the sequencing of material additions.[2] Water-based paint is prepared by first mixing water, ammonia, and a dispersant in a mixer. Dry pigment and pigment extender are then added. After mixing, the material is ground in a mill and then transferred to an agitated mix tank.[2]

Next, plasticizers and resin are added to the agitated mix tank. The polymer in a latex should be of high molecular weight. The viscosity of a high molecular weight

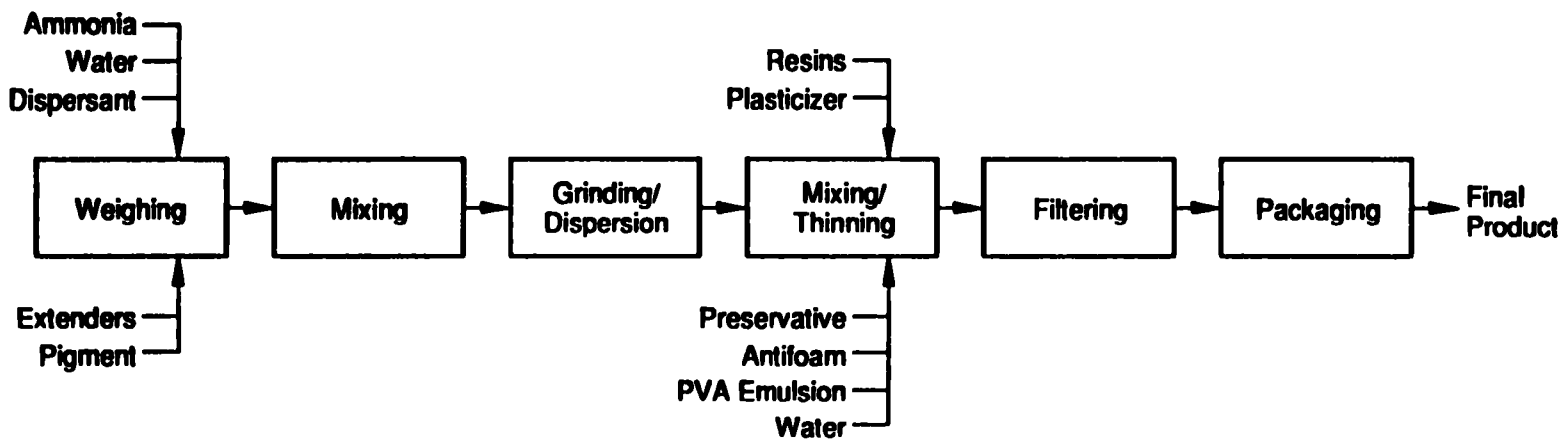

Figure 2. Simplified process flow diagram for water-based paint formulation.

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polymer is such, however, that coalescence at ambient temperatures is difficult. Therefore, temporary plasticizers are used to facilitate coalescence. They are usually water-miscible solvents (e.g., ethers or mixed ether esters of ethylene glycol) that are adsorbed by the latex particles, which soften the polymer.[8]

The next step is the addition of preservatives and an antifoaming agent. Then, a polyvinyl acetate emulsion is added followed by water to thin the paint. At many facilities, the grinding and mixing operations may all be carried out in a single high-speed mixer. Finally, the paint is filtered and sent for packaging.

Unlike paint formulation, varnish manufacture involves chemical reactions that are initiated by heating.[9] Figure 3 presents a simplified process flow diagram of varnish manufacture. Varnish is cooked in both portable kettles and large reactors. Kettles are used primarily by smaller manufacturers. The manufacture of varnish consists of heating oil and resins together to make them compatible, dissolving the mixture in solvent, and forming high molecular weight polymers.[10] Varnishes are cooked for periods of 4 to 16 hours at temperatures of 200° to 650°F.[9] A large variety of synthetic resins are produced for use in surface coatings, and operating variables differ with each resin. Viscosity adjustment (thinning), or the addition of dryers or unreacted monomers, usually does not take place in the reaction kettle.[11] Instead, the contents are pumped to other vessels designed for these purposes. These thinning vessels are typically closed and equipped with agitators.[11] After the thinning, the varnish is packaged for shipment.

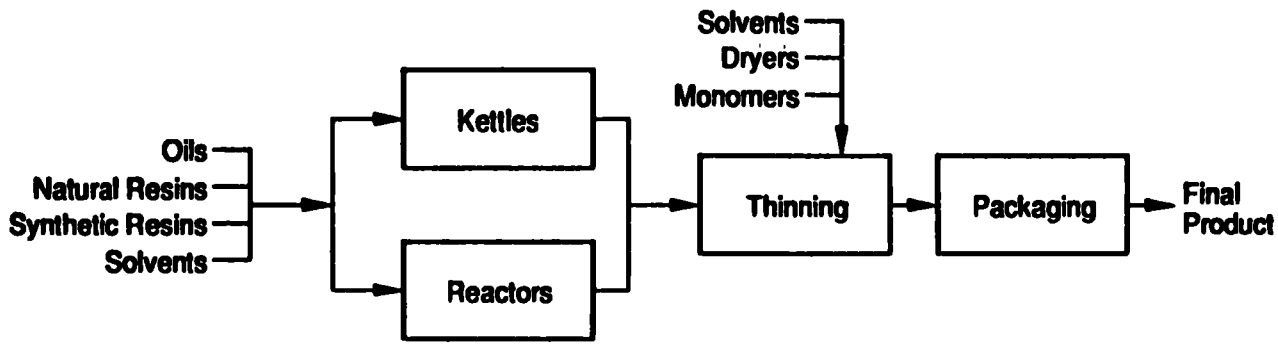

Figure 3. Simplified process flow diagram for varnish manufacture.

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SECTION 313 CHEMICALS USED IN PAINT FORMULATION

Section 313 chemicals commonly used in paint formulation can be classified into four distinct categories: solvents (chlorinated and organic), metals and metal compounds, resin constituents, and other chemicals. Each category is discussed separately in this report. Each contains a description of how the Section 313 chemicals are used, a discussion of typical releases and off-site transfers, a table summarizing releases and off-site transfers that were reported to the Toxic Release Inventory (TRI) in 1990, a description of industry-specific and chemical-specific regulations, typical control practices, and common reporting errors. Methods for identifying nonreporting facilities and a list of questions are also presented.

SOLVENTS

Solvents are both processed and otherwise used by paint formulators. Solvents are primarily processed as a constituent of the paint or varnish. Solvents are also otherwise used as cleanup solvents throughout the formulation process. Solvents may be organic or chlorinated and are received by drum, tote, tanker truck or rail car.

Even under well-controlled conditions, about 1 to 2 percent of solvents processed in paint formulation are lost to the air (per AP-42 estimates).[9] The primary factors affecting air emissions from paint manufacture are the vapor pressure of the solvent, care in handling, enclosure of formulation equipment, mixing temperature, and air movement near open tanks or packaging equipment. Air releases may be either fugitive or stack, depending if local exhaust ventilation is used to reduce potential worker exposure to the solvents. Fugitive air releases can also occur from spills that are allowed to evaporate. Releases to water or POTW can occur when equipment used in the preparation of water-based paints containing solvents (e.g., glycol ethers) is washed with water and then sewered. Off-site transfers occur from paint residues in cleaning solvent and the disposal of off-spec paint. Land release is not common, but can occur through spills. Dirty filters or paint sludge generated during cleaning operations may also contain small quantities of solvents.

Some of the solvent otherwise used to clean equipment is lost to air during cleaning while the remainder is typically transferred off site for recycling, fuel use, or treatment prior to disposal. Releases may be best determined through mass balance calculations; all releases are either released to air or transferred off site. The quantity transferred off site for recycling or fuel burning was not reportable under Section 313 until 1991 (estimates due July 1, 1992).

When solvent-based cleaning solvents are transferred off site, they may be classified as a RCRA waste based upon one of the following waste criteria:

F002 Contain a total of 10 percent or more (by volume) prior to use of one or more of the following solvents: tetrachloroethylene, methylene chloride, trichloroethylene, 1,1,1-trichloroethane, chlorobenzene, 1,1,2-trichloro-

1,2,2-trifluoroethane, orthodichlorobenzene, trichlorofluoromethane, and 1,1,2-trichloroethane.

F003 Contain a total of 10 percent or more (by volume) prior to use of one or more of the following solvents: xylene, acetone, ethyl acetate, ethylbenzene, ethyl ether, MIBK, n-butyl alcohol, cyclohexanone, and methanol.

F005 Contain a total of 10 percent or more (by volume) prior to use of one or more of the following solvents: toluene, MEK, carbon disulfide, isobutanol, pyridine, benzene, 2-ethoxyethanol, and 2-nitropropane.

Off-site transfers of RCRA-classified waste can best be determined from RCRA manifests and analysis by the company receiving the waste.

Table 3 presents a summary of Section 313 reported releases and off-site transfers of solvents at paint formulators, based on Section 313 reporting for 1990. As expected, the most widely reported solvents include xylene, toluene, and MEK, which are both processed as paint solvents and otherwise used in cleaning solvents.

Air releases of solvents can be reduced by enclosing the mixing, packaging, and cleaning operations and through management practices that minimize spills or the quantity of cleanup solvent necessary.

Equipment cleaning waste accounts for over 80 percent of the paint industry's waste.[5] Equipment cleaning wastes can be reduced through source reduction by reducing the frequency of required cleaning or reducing the quantity of cleaning solvent. Scheduling for long production runs, use of dedicated equipment, or scheduling batches from light colors to dark colors can also reduce the need for cleaning.

Recycling and reuse of cleaning waste can substantially reduce waste volumes. Cleaning wastes may be: 1) collected and used in the next compatible batch as part of the formulation, 2) collected and recycled on or off site, or 3) collected and reused as a cleaning solvent by filtering or other means of solids removal.

TABLE 3. SUMMARY OF REPORTED RELEASES OF SOLVENTS (CHLORINATED AND ORGANIC) FROM PAINT FORMULATION

Section 313 chemical	Number of facilities reporting usage[a] (% reporting usage)	Mean release, lb (% reporting to each media)[b]						
		Fugitive	Stack	Water	Land	POTW[c]	Off-site transfer	Total[d]
Xylene (mixed isomer)	485 (90)	4042 (92)	11,443 (74)	83 (2)	188 (3)	777 (11)	26,071 (48)	25,107 (99)
Toluene	465 (84)	3555 (92)	13,981 (76)	108 (2)	3648 (4)	749 (10)	22,710 (42)	23,768 (99)
Methyl ethyl ketone	348 (64)	3867 (91)	10,883 (78)	27 (2)	163 (3)	9242 (9)	15,135 (45)	19,730 (99)
Glycol ethers	262 (49)	1813 (92)	3519 (77)	195 (2)	2966 (4)	2169 (19)	6914 (58)	9006 (99)
Methyl isobutyl ketone	249 (46)	1635 (90)	2465 (81)	50 (1)	63 (2)	7612 (9)	8906 (48)	8429 (100)
n-butyl alcohol	237 (44)	1693 (92)	7171 (79)	455 (1)	109 (3)	2223 (11)	7499 (49)	11,303 (99)
Acetone	214 (40)	5098 (94)	14,124 (73)	133 (1)	98 (2)	162 (9)	15,069 (43)	21,683 (99)
Ethylene glycol	194 (36)	624 (78)	856 (70)	103 (4)	1925 (4)	4922 (34)	4403 (42)	4909 (95)
Methanol	171 (32)	1987 (94)	1727 (74)	572 (2)	90 (4)	e	15,508 (42)	13,713 (99)
Ethylbenzene	145 (27)	1267 (96)	5804 (89)	4 (1)	103 (3)	265 (21)	4691 (52)	8895 (100)
1,1,1-Trichloroethylene	116 (21)	3600 (94)	3520 (60)	0 (0)	20 (1)	4 (5)	7523 (28)	7715 (98)
Dichloromethane	79 (15)	4344 (92)	5144 (67)	255 (5)	18 (4)	236 (14)	5380 (34)	9470 (99)
Naphthalene	25 (5)	807 (96)	2378 (72)	0 (0)	0 (0)	19 (12)	2314 (28)	3136 (100)
Sec-butyl alcohol	18 (3)	472 (94)	200 (89)	0 (0)	0 (0)	5 (6)	984 (61)	1225 (100)

[a] A total of 540 facilities in SIC 2851 reported usage of at least one Section 313 chemical above threshold limits.

[b] Mean release in pounds per year in 1990 for firms reporting releases of this chemical and percentage of firms reporting usage of this chemical that release to this media. Releases to other media were insignificant.

[c] POTW = Publicly owned treatment works.

[d] The total includes all releases and off-site transfers, not just categories summarized in this table.

[e] Mean value is not representative because of a very large value at one facility and the small number of facilities.

METALS AND METAL COMPOUNDS

Metals and metal compounds are processed by paint formulators as solid constituents in the paints. The metal/metal compounds are primarily processed as pigments, but may also be constituents of other additives. A pigment is "a finely divided, insoluble powder which imparts color, including black or white, to the paint. Pigments also can impart flatness, rheology, corrosion resistance, hardness, etc."[8] Major pigments that are Section 313 chemicals include barium compounds, zinc oxide and other zinc compounds, and chromium compounds.[8,10] Lead and lead compounds are still used, but their use is declining because of toxicity concerns. Use of copper compounds, cobalt compounds, and antimony were also reported in the TRI database.

Metals and metal compounds may be received dry, as a paste, or in slurry form. Because most pigments are produced by precipitation in water or are washed with water at the pigment manufacturer, shipment in slurry form may reduce the cost of the pigment if it is to be used in a water-based paint. Shipment in paste or slurry form also reduces losses to air during transfer of dry pigment as well as reducing disposal costs associated with bags or other packages.[5] Empty containers of liquid raw materials may be cleaned or returned to the supplier to be recycled.[5]

According to AP-42 estimates, 0.5 to 1 percent of pigments handled in dry form during uncontrolled operations will be lost to air during transfer.[9] Air releases may be easily controlled with a baghouse when local exhaust is used to reduce worker exposure to the pigments.

Table 4 presents a summary of Section 313 reported releases and off-site transfers of metals/metal compounds at paint formulators, based on Section 313 reporting for 1990. The primary releases are off-site transfers of pigments in the cleanup solvent, filter disposal, and disposal of off-spec paint. Air releases are also reported for transfer of dry pigments. The air release is fugitive or stack depending on whether local exhaust ventilation is used to reduce worker exposure to the pigments.

TABLE 4. SUMMARY OF REPORTED RELEASES OF METALS AND METAL COMPOUNDS FROM PAINT FORMULATION

Section 313 chemical	Number of facilities reporting usage[a] (% reporting usage)	Mean release, lb (% reporting to each media)[b]						
		Fugitive	Stack	Water	Land	POTW[c]	Off-site transfer	Total[d]
Barium compounds	152 (28)	460 (61)	1310 (57)	140 (2)	640 (5)	822 (27)	3649 (71)	4124 (94)
Zinc (fume or dust)	36 (7)	451 (53)	896 (56)	115 (3)	250 (3)	113 (11)	1161 (56)	1486 (94)
Zinc compounds	131 (24)	244 (64)	298 (53)	10 (3)	385 (6)	169 (26)	1945 (74)	1926 (95)
Chromium compounds	111 (21)	247 (55)	123 (57)	7 (5)	60 (5)	73 (23)	1154 (72)	1161 (91)
Lead	17 (3)	196 (53)	557 (29)	0 (0)	0 (0)	5 (6)	521 (35)	512 (88)
Lead compounds	102 (19)	286 (55)	235 (66)	30 (4)	135 (5)	267 (23)	1853 (72)	1812 (94)
Copper compounds	39 (7)	225 (44)	106 (49)	5 (8)	126 (5)	121 (33)	2110 (87)	2089 (97)
Cobalt compounds	26 (5)	188 (35)	85 (42)	0 (0)	5 (8)	107 (27)	289 (92)	398 (100)
Antimony	25 (5)	281 (52)	82 (52)	250 (4)	1 (4)	109 (32)	436 (66)	600 (100)

[a] A total of 540 facilities in SIC 2851 reported usage of at least one Section 313 chemical above threshold limits.

[b] Mean release in pounds per year in 1990 for firms reporting releases of this chemical and percentage of firms reporting usage of this chemical that release to this media. Releases to other media were insignificant.

[c] POTW = Publicly owned treatment works.

[d] The total includes all releases and off-site transfers, not just categories summarized in this table.

The next largest release is to water or POTW. This release primarily involves pigments contained in wash water from cleaning equipment used to make water-based paints. Some water/POTW releases could also result from spills that are sewered. The water/POTW release of pigments during cleaning can also be reduced by the use of dedicated equipment, manual cleaning with spatulas or rubber wipers, or use of tanks with nonstick surfaces such as Teflon.®

RESIN CONSTITUENTS

Resin constituents that are Section 313 reportable chemicals are processed in paints as unreacted monomers in resin systems, as monomers added to the paint that react when the paint dries, as plasticizers added to the paint, or as two-part systems that react when paint is applied. These chemicals may be present in alkyd, polyester, urea-formaldehyde, acrylic, phenolic, or other resin systems. The best way to determine their presence is by reviewing MSDSs for the resins as received and the paints as shipped by the formulator.

Table 5 presents a summary of Section 313 reported releases and off-site transfers of resin constituents at paint formulators, based on Section 313 reporting for 1990. Air releases of these chemicals are difficult to determine as some are solids and some are liquids. The chemicals mainly are present in a complicated resin system that does not easily permit engineering calculations to predict volatilization. Off-site transfers and releases to water, POTW, or land may be estimated the same way as for solvents and pigments by using the chemical percentage from the MSDS.

TABLE 5. SUMMARY OF REPORTED RELEASES OF RESIN CONSTITUENTS FROM PAINT FORMULATION

Section 313 chemical	Number of facilities reporting usage[a] (% reporting usage)	Mean release, lb (% reporting to each media)[b]						
		Fugitive	Stack	Water	Land	POTW[c]	Off-site transfer	Total[d]
Styrene	79 (15)	9093 (89)	4368 (82)	1065 (1)	5 (1)	118 (19)	3720 (47)	13,778 (97)
1,2,4-Trimethylbenzene	60 (11)	1160 (95)	1039 (88)	5 (2)	134 (3)	1794 (12)	2451 (43)	3352 (98)
Phthalic anhydride	55 (10)	1499 (67)	1212 (69)	135 (4)	5700 (2)	4962 (15)	3171 (62)	4812 (96)
Methyl methacrylate	51 (9)	1235 (92)	2154 (90)	1 (2)	5 (2)	614 (20)	1749 (37)	3853 (100)
Butyl acrylate	44 (8)	312 (89)	402 (89)	e	5 (2)	338 (14)	844 (27)	1505 (100)
Butyl benzyl phthalate	29 (5)	313 (72)	289 (72)	0 (0)	1900 (3)	978 (21)	7356 (52)	4844 (93)
Di-(2-ethylhexyl)phthalate (DEHP)	29 (5)	408 (72)	211 (66)	0 (0)	250 (3)	84 (10)	1174 (38)	1057 (83)
Formaldehyde	28 (5)	797 (86)	464 (86)	167 (11)	42 (4)	591 (32)	1166 (43)	1927 (93)
4,4'-Isopropylidenediphenol	28 (5)	216 (50)	372 (71)	0 (0)	0 (0)	470 (7)	2348 (75)	2168 (100)
Maleic anhydride	25 (5)	129 (56)	116 (56)	0 (0)	0 (0)	87 (12)	590 (68)	623 (88)
Ethyl acrylate	23 (4)	179 (78)	361 (91)	0 (0)	5 (4)	353 (22)	691 (48)	877 (100)
Vinyl acetate	22 (4)	1208 (100)	2328 (77)	0 (0)	5 (5)	168 (14)	775 (9)	3100 (100)
Acrylic acid	21 (4)	45 (62)	192 (71)	0 (0)	0 (0)	22 (10)	616 (67)	607 (95)
Dibutyl phthalate	21 (4)	1295 (62)	302 (52)	0 (0)	0 (0)	1865 (10)	379 (43)	1365 (95)
Methyenebis (phenylisocyante) [MBI]	21 (4)	94 (52)	86 (43)	0 (0)	5 (5)	1 (5)	339 (33)	262 (76)
Cumene	20 (4)	547 (95)	426 (100)	0 (0)	0 (0)	1204 (15)	309 (50)	1281 (100)
Phenol	16 (3)	1134 (75)	458 (81)	1500 (6)	0 (0)	752 (19)	13,137 (44)	7685 (94)
Toluene diisocyante	15 (3)	64 (87)	52 (73)	0 (0)	0 (0)	1 (7)	74 (2)	109 (100)

[a] A total of 540 facilities in SIC 2851 reported usage of at least one Section 313 chemical above threshold limits.

[b] Mean release in pounds per year in 1990 for firms reporting releases of this chemical and percentage of firms reporting usage of this chemical that release to this media. Releases to other media were insignificant.

[c] POTW = Publicly owned treatment works.

[d] The total includes all releases and off-site transfers, not just categories summarized in this table.

[e] Mean value is not representative because of a very large value at one facility and the small number of facilities.

OTHER CHEMICALS

Table 6 presents a summary of Section 313 reported releases and off-site transfers of other chemicals based on Section 313 reporting for 1990. Ammonia is processed as a constituent of water-based paints.[5] If the ammonia is received in gaseous form, air releases can result during storage and transfer. When in aqueous form or when in water-based paint, air releases result from open tanks and packaging. Off-site transfers and releases to water, POTW, or land can result during cleaning or from spills. These releases/transfers can be determined in the same way as for solvents and pigments, based on the percentage of ammonia from the MSDS.

Because ammonia is a listed Section 313 chemical, all gaseous and aqueous forms must be considered for reporting. Aqueous solutions of ammonia contain both nonionized ammonia (NH_3) and ionized ammonia (NH_4+). As the following chemical equation shows, the two forms of ammonia are in equilibrium in the presence of water.

$$NH_3 + 2H_2O \leftrightarrow NH_4^+ + OH^- + H_2O$$

The term "total ammonia" refers to the sum of these species (i.e., NH_3 + NH_4^+). The relative amounts of NH_3 and NH_4^+ depend upon several factors (e.g., temperature, pH, ionic strength, and other chemical reactions). To account for all forms that are present, estimates of Section 313 releases should be made for total ammonia.

Acids (hydrochloric, sulfuric, and phosphoric) are used by a small percentage (5% or less) of paint formulators. No information was obtained on the use of these acids. Phosphoric acid may be processed as a phosphate coating product to treat metal prior to painting. Acids may also be processed as part of a pH adjustment in some electrocoated paints.

Hydrochloric acid or sulfuric acid may be used to regenerate water deionizers at water-based paint manufacturers. Sulfuric acid may also be used as a water treatment chemical at some facilities. Acids may also be otherwise used to neutralize caustic solutions from clean equipment used to make water-based paints.

TABLE 6. SUMMARY OF REPORTED RELEASES OF OTHER CHEMICALS FROM PAINT FORMULATION

Section 313 chemical	Number of facilities reporting usage[a] (% reporting usage)	Mean release, lb (% reporting to each media)[b]						
		Fugitive	Stack	Water	Land	POTW[c]	Off-site transfer	Total[d]
Ammonia	34 (6)	540 (82)	588 (62)	e	375 (6)	e	1361 (41)	7499 (100)
Hydrochloric acid	27 (5)	392 (81)	615 (56)	0 (0)	5 (4)	1579 (15)	e	13,966 (89)
Sulfuric acid	18 (3)	280 (61)	209 (33)	0 (0)	250 (6)	168 (17)	5 (6)	424 (67)
Phosphoric acid	15 (3)	254 (6)	168 (2)	0 (0)	0 (0)	0 (0)	507 (13)	345 (73)

[a] A total of 540 facilities in SIC 2851 reported usage of at least one Section 313 chemical above threshold limits.

[b] Mean release in pounds per year in 1990 for firms reporting releases of this chemical and percentage of firms reporting usage of this chemical that release to this media. Releases to other media were insignificant.

[c] POTW = Publicly owned treatment works.

[d] The total includes all releases and off-site transfers, not just categories summarized in this table.

[e] Mean value is not representative because of a very large value at one facility and the small number of facilities.

Acids may be released to air during storage and transfer and released to water or POTW during water treatment or equipment cleanup of paint products that could contain acids. Acid releases are primarily controlled through neutralization. For acid use, a release to water or POTW is not reportable if the pH is 6 or higher; however, a facility cannot just assume neutralization.

USE OF REGULATIONS TO ESTIMATE RELEASES OF SECTION 313 CHEMICALS

Regulations pertaining to paint formulators do not provide direct assistance in estimating emissions of Section 313 chemicals.

WATER RELEASES

The EPA Effluent Limitations Guidelines for Paint Formulation (40 CFR 466) define the best available technology economically achievable for oil-based solvent wash (tank cleaning performed with solvents) as no discharge of process wastewater pollutants to navigable waters. New source performance standards are the same. Pretreatment standards for the same source are no discharge of process water pollutants to a POTW. These standards apply only to facilities in which tanks used to formulate oil-based paint are cleaned by solvents. These regulations are not particularly useful for estimating water releases because the most likely water/POTW discharge of solvents, metal/metal compounds, and resin constituents is from water washing of equipment used to make water-based paints. Some facilities may be required by the POTW to monitor for TTO (total organics listed in 40 CFR 413.02(i)) or metals.

AIR RELEASES

No national regulations directly limit air releases of VOCs or other pollutants from paint formulation. The State Implementation Plans for some noncompliance areas may have plant-specific VOC limits that apply to large facilities. Numerous regulations governing the industries that apply the paints and coatings, however, have caused paint formulators to reformulate coatings to reduce the VOC content in the paint they produce. One source reported that the production of conventional solvent-based coatings has dropped from about 100 million dry gallons in 1983 to 65 million dry gallons in 1987 and is expected to drop to 40 million dry gallons by 1993.[5] The same source reported the production of high-solids solvent-based coatings increasing from 18 million dry gallons in 1983 to 35 million gallons in 1987.[9]

State regulations, especially those in California, may require that the VOC content of paint sold in the state be below a specified level (e.g., 250 g VOC per liter of paint). These regulations have also forced paint formulators to reduce the VOC content in the paints they produce.

These regulations are not particularly useful for predicting releases of Section 313 chemicals from paint formulators. Each plant must be assessed individually based on the products it produces.

NONREPORTING FACILITIES

Nonreporting facilities may be identified by comparing lists of facilities in Standard Industrial Classification (SIC) 2851 having more than 10 employees with those facilities that have reported under Section 313. In addition, an annual publication--The Paint Red Book--by the publishers of Modern Paint and Coatings lists paint formulators.[12] Dealers and repackagers are not listed, however. In 1989, The Paint Red Book contained listings of 1,202 plants representing 764 companies. The listing provides the name, location, phone number, total company employees, type of coatings formulated, and other information. Almost all the companies listed employ more than 10 employees.

Most if not all paint formulators with more than 10 employees would process in excess of 25,000 pounds of at least one solvent or metal/metal compound (approximately 55-60 drums of the chemical). This would be true even for water-based paint formulators.

In addition to the Paint Red Book, sources of information on SIC 2851 presented by employment class include County Business Patterns published by the U.S. Department of Commerce,[13] and Dunn and Bradstreet (D&B).[14]

Table 7 presents a comparison of the number of facilities listed in various sources with the number of facilities reporting to TRI in 1990.

TABLE 7. NUMBER OF ESTABLISHMENTS IN SIC 2851

Source	Basis	Number of establishments reported
TRI, 1990	SIC 2851	540
County Business Patterns 1989[13]	SIC 2851, >10 employees	899
D&B 1992	SIC 2851 >10 employees	984
Paint Red Book, 1989	Number of formulation plants[a]	1209

[a] Total list, but very few listed were below 10 employees.

There apparently are a number of nonreporting facilities, based on the number of facilities reported in County Business Patterns, D&B, and the Paint Red Book and the probability that almost all paint formulators would process at least one Section 313 chemical in excess of 25,000 pounds.

A review of the TRI data in 1990 pointed out apparent errors in reporting whether a chemical was manufactured, processed, or otherwise used. Many facilities reported chemicals as manufactured when they were clearly processed or otherwise used (e.g., solvents). There also appeared to be a possible underreporting of solvents that are typically used as cleanup solvents as otherwise used. Because of the lower threshold for these uses, this could also cause nonreporting for some cleanup solvents if the higher processed threshold (25,000 pounds) were used.

LIST OF QUESTIONS

The following list of questions may be helpful in determining if errors were made in Section 313 reporting for paint formulators:

Solvents

- Which solvents were processed (just formulated into paint) and which were also otherwise used (also used as a cleanup solvent)?
- For processed solvents, how was air release calculated? Air release should equal about 1 to 2 percent of throughput for most formulators (AP-42).
- For otherwise used solvents, was a mass balance performed on the total quantity used?
- For solvents sent off site for fuel burning, recycling, or disposal, was waste analysis used to determine the quality of the 313 chemical? Most wastes should be RCRA wastes, which are analyzed.
- Was a 10,000-pound threshold used for all otherwise used solvents (cleanup solvents)?
- How was the quantity of solvent in water-based paints released to water determined (e.g., glycol ethers)?

Metals/Metal Compounds

- Were thresholds for metal compounds determined using the weight of the compound and not just the weight of the metal portion of the compound?
- Was Toxicity Characteristic Leaching Procedure (TCLP) used as a measure of metal concentration in any of the calculations? TCLP measures leachable metal, not metal content, and therefore should not be used in any release calculations.

Resin Constituents

- Were the resin constituents received as an unreacted portion of a resin? Was the percentage of the 313 chemical on the MSDS as received used as the basis for release estimates?

- Were any monomers purchased and added to the formulations?
- Were any resins manufactured (polymerized) at the facility? What were the reactants?

Other Chemicals

- Was total ammonia used to report ammonia releases to water?
- Was the pH of the water or POTW release used to determine acid releases? (pH above 6 is not reportable.)

BIBLIOGRAPHY

1. Office of Management and Budget. Standard Industrial Classification Manual. 1987. Washington, D.C. 1987.

2. U.S. Environmental Protection Agency. Guides to Pollution Prevention. The Paint Manufacturing Industry. EPA/625/7-90/005. June 1990.

3. Webber, D. Coating Industry Heading for Record Year. Chem. Eng. News 61(4):51. 1984.

4. Winton, J. M. Coatings 1987. Chemical Week. 141 (15):30. 1987.

5. Lorton, G. A. Waste Minimization in the Paint and Allied Products Industry. Journal of the Air Pollution Control Association, 38(4)422. April 1988.

6. SRI Chemical Economics Handbook, 1981, as cited in Reference 2.

7. American Chemical Society. Applied Polymer Science. ACS Symposium Series 285, Second Edition. Paint Manufacture, Washington, D.C. 1985. p. 1297-1314.

8. Kirk-Othmer. Encyclopedia of Chemical Technology. 3rd Edition, Vol. 16. Paint. John Wiley & Sons, 1981.

9. U.S. Environmental Protection Agency. Compilation of Air Pollution Emission Factors, 3rd Edition, AP-42. Research Triangle Park, N.C. 1983.

10. U.S. Environmental Protection Agency. Air Pollution Control Engineering and Cost Study of the Paint and Varnish Industry. EPA 450/3-74-031, June 1974.

11. U.S. Environmental Protection Agency. Air Pollution Engineering Manual. AP-40, 2nd Edition. Research Triangle Park, N.C. May 1973.

12. Communication Channels Inc. 1989 Paint Red Book, 21st Edition, Atlanta, GA. 1989.

13. U.S. Department of Commerce, Bureau of Census, County Business Patterns 1989, CBP-89-1, Washington, D.C. 1991.

14. Dunn & Bradstreet, Dunn's Electronic Business Directory in DIALOG database file 515. 1992.

Appendix A

EPA
United States Environmental Protection Agency

FORM R TOXIC CHEMICAL RELEASE INVENTORY REPORTING FORM

Section 313 of the Emergency Planning and Community Right-to-Know Act of 1986, also known as Title III of the Superfund Amendments and Reauthorization Act

TRI FACILITY ID NUMBER

Toxic Chemical Category, or Generic Name

WHERE TO SEND COMPLETED FORMS:

1. EPCRA Reporting Center
   P.O. Box 23779
   Washington, DC 20026-3779
   ATTN: TOXIC CHEMICAL RELEASE INVENTORY
2. APPROPRIATE STATE OFFICE (See instructions in Appendix F)

Enter "X" here if this is a revision

For EPA use only

IMPORTANT: See instructions to determine when "Not Applicable (NA)" boxes should be checked.

PART I. FACILITY IDENTIFICATION INFORMATION

SECTION 1. REPORTING YEAR

19 ____

SECTION 2. TRADE SECRET INFORMATION

2.1	Are you claiming the toxic chemical identified on page 3 trade secret? ☐ Yes (Answer question 2.2; Attach substantiation forms) ☐ No (Do not answer 2.2; Go to Section 3)
2.2	If yes in 2.1, is this copy: ☐ Sanitized ☐ Unsanitized

SECTION 3. CERTIFICATION (Important: Read and sign after completing all form sections.)

I hereby certify that I have reviewed the attached documents and that, to the best of my knowledge and belief, the submitted information is true and complete and that the amounts and values in this report are accurate based on reasonable estimates using data available to the preparers of this report.

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

Signature

Date Signed

SECTION 4. FACILITY IDENTIFICATION

4.1

Facility or Establishment Name

TRI Facility ID Number

Street Address

City

County

State

Zip Code

Mailing Address (if different from street address)

City

State

Zip Code

PUT LABEL HERE

EPA
United States Environmental Protection Agency

EPA FORM R

PART I. FACILITY IDENTIFICATION INFORMATION (CONTINUED)

TRI FACILITY ID NUMBER

Toxic Chemical, Category, or Generic Name

SECTION 4. FACILITY IDENTIFICATION (Continued)

4.2	This report contains information for: (Important: check only one)	a. ☐ An entire facility		b. ☐ Part of a facility			
4.3	Technical Contact	Name			Telephone Number (include area code)		
4.4	Public Contact	Name			Telephone Number (include area code)		
4.5	SIC Code (4-digit)	a.	b.	c.	d.	e.	f.
4.6	Latitude and Longitude	Latitude			Longitude		
		Degrees	Minutes	Seconds	Degrees	Minutes	Seconds
4.7	Dun & Bradstreet Number(s) (9 digits)	a.					
		b.					
4.8	EPA Identification Number(s) (RCRA I.D. No.) (12 characters)	a.					
		b.					
4.9	Facility NPDES Permit Number(s) (9 characters)	a.					
		b.					
4.10	Underground Injection Well Code (UIC) I.D. Number(s) (12 digits)	a.					
		b.					

SECTION 5. PARENT COMPANY INFORMATION

5.1	Name of Parent Company	
	☐ NA	
5.2	Parent Company's Dun & Bradstreet Number	
	☐ NA	(9 digits)

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PART II. CHEMICAL-SPECIFIC INFORMATION

TRI FACILITY ID NUMBER

Toxic Chemical Category or Generic Name

SECTION 1. TOXIC CHEMICAL IDENTITY

(Important: DO NOT complete this section if you complete Section 2 below.)

1.1	CAS Number (Important: Enter only one number exactly as it appears on the Section 313 list. Enter category code if reporting a chemical category.)
1.2	Toxic Chemical or Chemical Category Name (Important: Enter only one name exactly as it appears on the Section 313 list.)
1.3	Generic Chemical Name (Important: Complete only if Part I, Section 2.1 is checked "yes." Generic Name must be structurally descriptive.)

SECTION 2. MIXTURE COMPONENT IDENTITY

(Important: DO NOT complete this section if you complete Section 1 above.)

2.1	Generic Chemical Name Provided by Supplier (Important: Maximum of 70 characters, including numbers, letters, spaces, and punctuation.)

SECTION 3. ACTIVITIES AND USES OF THE TOXIC CHEMICAL AT THE FACILITY

(Important: Check all that apply.)

3.1	Manufacture the toxic chemical:	a. ☐ Produce b. ☐ Import	If produce or import: c. ☐ For on-site use/processing d. ☐ For sale/distribution e. ☐ As a byproduct f. ☐ As an impurity
3.2	Process the toxic chemical:	a. ☐ As a reactant b. ☐ As a formulation component	c. ☐ As an article component d. ☐ Repackaging
3.3	Otherwise use the toxic chemical:	a. ☐ As a chemical processing aid b. ☐ As a manufacturing aid	c. ☐ Ancillary or other use

SECTION 4. MAXIMUM AMOUNT OF THE TOXIC CHEMICAL ON-SITE AT ANY TIME DURING THE CALENDAR YEAR

4.1	☐ (Enter two-digit code from instruction package.)

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PART II. CHEMICAL-SPECIFIC INFORMATION (CONTINUED)

TRI FACILITY ID NUMBER

Toxic Chemical, Category or Generic Name

SECTION 5. RELEASES OF THE TOXIC CHEMICAL TO THE ENVIRONMENT ON-SITE

			A. Total Release (pounds/year) (enter range code from instructions or estimate)	B. Basis of Estimate (enter code)	C. % From Stormwater
5.1	Fugitive or non-point air emissions	☐ NA			
5.2	Stack or point air emissions	☐ NA			
5.3	Discharges to receiving streams or water bodies (enter one name per box)				
5.3.1	Stream or Water Body Name				
5.3.2	Stream or Water Body Name				
5.3.3	Stream or Water Body Name				
5.4	Underground injections on-site	☐ NA			
5.5	Releases to land on-site				
5.5.1	Landfill	☐ NA			
5.5.2	Land treatment/ application farming	☐ NA			
5.5.3	Surface impoundment	☐ NA			
5.5.4	Other disposal	☐ NA			

☐ Check here only if additional Section 5.3 information is provided on page 5 of this form.

Range Codes. A = 1 - 10 pounds; B = 11 - 499 pounds; C = 500 - 999 pounds.

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PART II. CHEMICAL-SPECIFIC INFORMATION (CONTINUED)

TRI FACILITY ID NUMBER
Toxic Chemical, Category or Generic Name

SECTION 5.3 ADDITIONAL INFORMATION ON RELEASES OF THE TOXIC CHEMICAL TO THE ENVIRONMENT ON-SITE

5.3	Discharges to receiving streams or water bodies (enter one name per box)	A. Total Release (pounds/year) (enter range code from instructions or estimate)	B. Basis of Estimate (enter code)	C. % From Stormwater
5.3.__	Stream or Water Body Name			
5.3.__	Stream or Water Body Name			
5.3.__	Stream or Water Body Name			

SECTION 6. TRANSFERS OF THE TOXIC CHEMICAL IN WASTES TO OFF-SITE LOCATIONS

6.1 DISCHARGES TO PUBLICLY OWNED TREATMENT WORKS (POTW)

6.1.A Total Quantity Transferred to POTWs and Basis of Estimate

6.1.A.1 Total Transfers (pounds/year) (enter range code or estimate)	6.1.A.2 Basis of Estimate (enter code)

6.1.B POTW Name and Location Information

6.1.B.__ POTW Name	6.1.B.__ POTW Name
Street Address	Street Address
City / County	City / County
State / Zip Code	State / Zip Code

If additional pages of Part II, Sections 5.3 and/or 6.1 are attached, indicate the total number of pages in this box [ ] and indicate which Part II, Sections 5.3/6.1 page this is, here. [ ]
(example: 1, 2, 3, etc.)

Range Codes: A = 1 - 10 pounds; B = 11 - 499 pounds; C = 500 - 999 pounds

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PART II. CHEMICAL-SPECIFIC INFORMATION (CONTINUED)

TRI FACILITY ID NUMBER

Toxic Chemical Category or Generic Name

SECTION 6.2 TRANSFERS TO OTHER OFF-SITE LOCATIONS

6.2.__ Off-site EPA Identification Number (RCRA ID No.)

Off-Site Location Name

Street Address

City | County

State | Zip Code | Is location under control of reporting facility or parent company? ☐ Yes ☐ No

A. Total Transfers (pounds/year) (enter range code or estimate)	B. Basis of Estimate (enter code)	C. Type of Waste Treatment/Disposal/ Recycling/Energy Recovery (enter code)
1.	1.	1. M
2.	2.	2. M
3.	3.	3. M
4.	4.	4. M

SECTION 6.2 TRANSFERS TO OTHER OFF-SITE LOCATIONS

6.2.__ Off-site EPA Identification Number (RCRA ID No.)

Off-Site Location Name

Street Address

City | County

State | Zip Code | Is location under control of reporting facility or parent company? ☐ Yes ☐ No

A. Total Transfers (pounds/year) (enter range code or estimate)	B. Basis of Estimate (enter code)	C. Type of Waste Treatment/Disposal/ Recycling/Energy Recovery (enter code)
1.	1.	1. M
2.	2.	2. M
3.	3.	3. M
4.	4.	4. M

If additional pages of Part II, Section 6.2 are attached, indicate the total number of pages in this box ☐ and indicate which Part II, Section 6.2 page this is, here. ☐ (example: 1, 2, 3, etc.)

Range Codes: A = 1 - 10 pounds; B = 11 - 499 pounds; C = 500 - 999 pounds

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PART II. CHEMICAL-SPECIFIC INFORMATION (CONTINUED)

TRI FACILITY ID NUMBER

Toxic Chemical, Category, or Generic Name

SECTION 7A. ON-SITE WASTE TREATMENT METHODS AND EFFICIENCY

☐ Not Applicable (NA) - Check here if no on-site waste treatment is applied to any waste stream containing the toxic chemical or chemical category.

a. General Waste Stream (enter code)	b. Waste Treatment Method(s) Sequence [enter 3-character code(s)]	c. Range of Influent Concentration	d. Waste Treatment Efficiency Estimate	e. Based on Operating Data?
7A.1a	7A.1b 1 2 3 4 5 6 7 8	7A.1c	7A.1d %	7A.1e Yes ☐ No ☐
7A.2a	7A.2b 1 2 3 4 5 6 7 8	7A.2c	7A.2d %	7A.2e Yes ☐ No ☐
7A.3a	7A.3b 1 2 3 4 5 6 7 8	7A.3c	7A.3d %	7A.3e Yes ☐ No ☐
7A.4a	7A.4b 1 2 3 4 5 6 7 8	7A.4c	7A.4d %	7A.4e Yes ☐ No ☐
7A.5a	7A.5b 1 2 3 4 5 6 7 8	7A.5c	7A.5d %	7A.5e Yes ☐ No ☐

If additional copies of page 7 are attached, indicate the total number of pages in this box ☐ and indicate which page 7 this is, here. ☐ (example: 1, 2, 3, etc.)

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PART II. CHEMICAL-SPECIFIC INFORMATION (CONTINUED)

TRI FACILITY ID NUMBER

Toxic Chemical, Category, or Generic Name

SECTION 7B. ON-SITE ENERGY RECOVERY PROCESSES

☐ **Not Applicable (NA) - Check here if no on-site energy recovery is applied to any waste stream containing the toxic chemical or chemical category.**

Energy Recovery Methods [enter 3-character code(s)]

1 ☐ 2 ☐ 3 ☐ 4 ☐

SECTION 7C. ON-SITE RECYCLING PROCESSES

☐ **Not Applicable (NA) - Check here if no on-site recycling is applied to any waste stream containing the toxic chemical or chemical category.**

Recycling Methods [enter 3-character code(s)]

1 ☐ 2 ☐ 3 ☐ 4 ☐ 5 ☐

6 ☐ 7 ☐ 8 ☐ 9 ☐ 10 ☐

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PART II. CHEMICAL-SPECIFIC INFORMATION (CONTINUED)

TRI FACILITY ID NUMBER
Chemical Category, or Generic Name

SECTION 8. SOURCE REDUCTION AND RECYCLING ACTIVITIES

All quantity estimates can be reported using up to two significant figures.		Column A 1990 (pounds/year)	Column B 1991 (pounds/year)	Column C 1992 (pounds/year)	Column D 1993 (pounds/year)
8.1	Quantity released*				
8.2	Quantity used for energy recovery on-site				
8.3	Quantity used for energy recovery off-site				
8.4	Quantity recycled on-site				
8.5	Quantity recycled off-site				
8.6	Quantity treated on-site				
8.7	Quantity treated off-site				
8.8	Quantity released to the environment as a result of remedial actions, catastrophic events, or one-time events not associated with production processes (pounds/year)				
8.9	Production ratio or activity index				

8.10	Did your facility engage in any source reduction activities for this chemical during the reporting year? If not, enter "NA" in Section 8.10.1 and answer Section 8.11.			
	Source Reduction Activities [enter code(s)]	Methods to Identify Activity (enter codes)		
8.10.1		a.	b.	c.
8.10.2		a.	b.	c.
8.10.3		a.	b.	c.
8.10.4		a.	b.	c.

8.11	Is additional optional information on source reduction, recycling, or pollution control activities included with this report? (Check one box)	YES ☐	NO ☐

Report releases pursuant to EPCRA Section 329(8) including "any spilling, leaking, pumping, pouring, emitting, emptying, discharging, injecting, escaping, leaching, dumping, or disposing into the environment." Do not include any quantity treated on-site or off-site.

Appendix B

Revised June 1990

Page ____ of ____

Form Approved OMB No. [illegible]

Tier One

EMERGENCY AND HAZARDOUS CHEMICAL INVENTORY

Aggregate Information by Hazard Type

FOR OFFICIAL USE ONLY

Date Received

Important: Read instructions before completing form

Reporting Period From January 1 to December 31, '9____

Facility Identification

Name _____

Street _____

City _____ County _____ State _____ Zip _____

SIC Code [ ][ ][ ][ ] Dun & Bradstreet Number [ ][ ]-[ ][ ][ ]-[ ][ ][ ][ ]

Emergency Contacts

Name _____

Title _____

Phone ( ) _____

24 Hour Phone ( ) _____

Name _____

Title _____

Phone ( ) _____

24 Hour Phone ( ) _____

Owner/Operator

Name _____

Mail Address _____

Phone ( ) _____

☐ Check if information below is identical to the information submitted last year.

☐ Check if site plan is attached

Physical Hazards

Hazard Type	Max Amount*	Average Daily Amount*	Number of Days On-Site	General Location
Fire	[ ][ ]	[ ][ ]	[ ][ ][ ]	
Sudden Release of Pressure	[ ][ ]	[ ][ ]	[ ][ ][ ]	
Reactivity	[ ][ ]	[ ][ ]	[ ][ ][ ]	

Health Hazards

Immediate (acute)	[ ][ ]	[ ][ ]	[ ][ ][ ]	
Delayed (Chronic)	[ ][ ]	[ ][ ]	[ ][ ][ ]	

Certification *(Read and sign after completing all sections)*

I certify under penalty of law that I have personally examined and am familiar with the information submitted in pages one through _____ and that based on my inquiry of those individuals responsible for obtaining the information, I believe that the submitted information is true, accurate and complete.

_____

Name and official title of owner/operator OR owner/operator's authorized representative

Signature _____ Date signed _____

* Reporting Ranges

Range Code	Weight Range in Pounds From...	To...
01	0	99
02	100	999
03	1000	9,999
04	10,000	99,999
05	100,000	999,999
06	1,000,000	9,999,999
07	10,000,000	49,999,999
08	50,000,000	99,999,999
09	100,000,000	499 999 999
10	500,000,000	999 999 999
11	1 billion	higher than 1 billion

Revised November 1990

Form Approved (IMB No 2050-0072

Tier Two

EMERGENCY AND HAZARDOUS CHEMICAL INVENTORY

Specific Information by Chemical

Facility Identification

Name _____

Street _____

City _____ County _____ State _____ Zip _____

SIC Code ☐☐☐☐ Dun & Bradstreet Number ☐☐-☐☐☐-☐☐☐☐

FOR OFFICIAL USE ONLY: ID # _____ Date Received _____

Owner/Operator Name

Name _____ Phone ( )

Mail Address _____

Emergency Contact

Name _____ Title _____

Phone ( ) 24 Hr. Phone ( )

Name _____ Title _____

Phone ( ) 24 Hr. Phone ( )

Important: Read all instructions before completing form

Reporting Period From January 1 to December 31, 19____

☐ Check if information below is attached to the information attached last year.

Chemical Description	Physical and Health Hazards (check all that apply)	Inventory	Container Type / Pressure / Temperature	Storage Codes and Locations (Non-Confidential) *Storage Locations*	Optional
CAS ☐☐☐☐☐☐-☐☐-☐ Trade Secret ☐ Chem. Name _____ Check all that apply: ☐ Pure ☐ Mix ☐ Solid ☐ Liquid ☐ Gas ☐ EHS EHS Name _____	☐ Fire ☐ Sudden Release of Pressure ☐ Reactivity ☐ Immediate (acute) ☐ Delayed (chronic)	☐☐ Max. Daily Amount (code) ☐☐ Avg. Daily Amount (code) ☐☐☐ No. of Days On-site (days)	☐☐☐	_____	☐
CAS ☐☐☐☐☐☐-☐☐-☐ Trade Secret ☐ Chem. Name _____ Check all that apply: ☐ Pure ☐ Mix ☐ Solid ☐ Liquid ☐ Gas ☐ EHS EHS Name _____	☐ Fire ☐ Sudden Release of Pressure ☐ Reactivity ☐ Immediate (acute) ☐ Delayed (chronic)	☐☐ Max. Daily Amount (code) ☐☐ Avg. Daily Amount (code) ☐☐☐ No. of Days On-site (days)	☐☐☐	_____	☐
CAS ☐☐☐☐☐☐-☐☐-☐ Trade Secret ☐ Chem. Name _____ Check all that apply: ☐ Pure ☐ Mix ☐ Solid ☐ Liquid ☐ Gas ☐ EHS EHS Name _____	☐ Fire ☐ Sudden Release of Pressure ☐ Reactivity ☐ Immediate (acute) ☐ Delayed (chronic)	☐☐ Max. Daily Amount (code) ☐☐ Avg. Daily Amount (code) ☐☐☐ No. of Days On-site (days)	☐☐☐	_____	☐

Certification *(Read and sign after completing all sections)*

I certify under penalty of law that I have personally examined and am familiar with the information submitted in pages one through ____ and that based on my inquiry of those individuals responsible for obtaining the information, I believe that the submitted information is true, accurate, and complete.

Name and official title of owner/operator OR owner/operator's authorized representative _____ Signature _____ Date signed _____

Optional Attachments

☐ I have attached a site plan

☐ I have attached a list of site coordinate abbreviations

☐ I have attached a description of dikes and other safeguard measures

Form Approved OMB No. 2050-0072

Tier Two
EMERGENCY AND HAZARDOUS CHEMICAL INVENTORY
Specific Information by Chemical

Facility Identification
Name _____
Street _____
City _____ County _____ State _____ Zip _____
SIC Code ☐☐☐☐ Dun & Brad Number ☐☐-☐☐☐-☐☐☐☐

FOR OFFICIAL USE ONLY
ID # _____
Date Received _____

Owner/Operator Name
Name _____ Phone ( ) _____
Mail Address _____

Emergency Contact
Name _____ Title _____
Phone ( ) _____ 24 Hr Phone ( ) _____
Name _____ Title _____
Phone ( ) _____ 24 Hr Phone ( ) _____

Important: Read all instructions before completing form

Reporting Period From January 1 to December 31, 19____

☐ Check if information below is identical to the information submitted last year.

Confidential Location Information Sheet

	Container Type	Pressure	Temperature	Storage Codes and Locations (Confidential) *Storage Locations*	Optional
CAS # ☐☐☐☐☐☐ ☐☐ ☐ Chem. Name	☐	☐	☐	_____	☐
CAS # ☐☐☐☐☐☐ ☐☐ ☐ Chem. Name	☐	☐	☐	_____	☐
CAS # ☐☐☐☐☐☐ ☐☐ ☐ Chem. Name	☐	☐	☐	_____	☐

Certification *(Read and sign after completing all sections)*

I certify under penalty of law that I have personally examined and am familiar with the information submitted in pages one through _____, and that based on my inquiry of those individuals responsible for obtaining the information, I believe that the submitted information is true, accurate, and complete.

_____ Name and official title of owner/operator OR owner/operator's authorized representative
_____ Signature
_____ Date signed

Optional Attachments
☐ I have attached a site plan
☐ I have attached a list of site coordinate abbreviations
☐ I have attached a description of [illegible] and other safeguard measures

Appendix C

Sample Notification Letter

Mr. Edward Burke
Furniture Company of Ruritania
1000 Main Street
Sellers, Ruritania

Dear Mr. Burke:

The purpose of this letter is to inform you that a product that we sell to you, Furniture Lacquer KXZ-1390, contains 20 percent toluene (Chemical Abstracts Service (CAS) number 108-88-3). We are required to notify you of the presence of toluene in the product under Section 313 of the Emergency Planning and Community Right-to-Know Act of 1986. This law requires certain manuafcturers to report on annual emissions of specified toxic chemicals and chemical categories.

If you are unsure if you are subject to the reporting requirements of Section 313, or need more information, call the EPA Emergency Planning and Community Right-to-Know Information Hotline: (800) 535-0202 or (202) 479-2449 (in Washington, DC or Alaska). Your other suppliers should also be notifying you if Section 313 chemicals are in the mixtures and trade name products they sell to you.

Please also note that if they repackage or otherwise redistribute this product to industrial customers, a notice similar to this one should be sent to those customers.

Sincerely,

Axel Leaf
Sales Manager
Furniture Products

Sample Notification on an MSDS

Section 313 Supplier Notification

This product contains the following toxic chemicals subject to the reporting requirements of Section 313 of the Emergency Planning and Community Right-to-Know Act of 1986 (40 CFR 372):

CAS#	Chemical Name	Percent by Weight
108-88-3	Toluene	20%
NA	Copper Compounds	15%

This information must be included in all MSDSs that are copied and distributed for this material.