

Sunshine Act Meetings

Federal Register

Vol. 57, No. 102

Wednesday, May 27, 1992

This section of the FEDERAL REGISTER contains notices of meetings published under the "Government in the Sunshine Act" (Pub. L. 94-409) 5 U.S.C. 552b(e)(3).

COMMODITY FUTURES TRADING COMMISSION

TIME AND DATE: 11:30 a.m., Friday, May 29, 1992.

PLACE: 2033 K St., NW., Washington, DC, 8th Floor Conference Room.

STATUS: Closed.

MATTERS TO BE CONSIDERED:

Enforcement Matters.

CONTACT PERSON FOR MORE

INFORMATION: Jean A. Webb, 254-6314.

Lynn K. Gilbert,

Deputy Secretary of the Commission.

[FR Doc. 92-12406 Filed 5-22-92; 11:19 am]

BILLING CODE 6351-01-M

DEPARTMENT OF ENERGY

Federal Energy Regulatory Commission Notice

(May 20, 1992)

The following notice of meeting is published pursuant to Section 3(a) of the Government in the Sunshine Act (Pub. L. No. 94-409), 5 U.S.C. 552b:

DATE AND TIME: May 27, 1992, 10:00 a.m.

PLACE: 825 North Capitol Street, NE., room 9306, Washington, DC 20426.

STATUS: Open.

MATTERS TO BE CONSIDERED:

Agenda

*Note.—Items listed on the agenda may be deleted without further notice.

CONTACT PERSON FOR MORE

INFORMATION: Lois D. Cashell, Secretary, Telephone (202) 208-0400. For a recording listing items stricken from or added to the meeting, call (202) 208-1627.

This is a list of matters to be considered by the Commission. It does not include a listing of all papers relevant to the items on the agenda; however, all public documents may be examined in the Reference and Information Center.

Consent Agenda—Hydro, 959th Meeting—May 27, 1992, Regular Meeting (10:00 a.m.)

CAH-1.

Project No. 1417-037, Central Nebraska Public Power and Irrigation District
Project No. 1835-069, Nebraska Public Power District

CAH-2.

Project No. 2698-008, Nantahala Power and Light Company

CAH-3.

Project No. 8263-005, Summit Hydropower

CAH-4.

Project No. 10047-002, Northern Hydro Consultants, Inc.

Project No. 10514-001, C&A Wallcoverings, Inc.

CAH-5.

Project No. UL89-15-006, T.A. Keck

CAH-6.

Project No. 8974-002, Southern New Hampshire Hydroelectric Development Corporation

CAH-7.

Project No. 2205-011, Central Vermont Public Service Corporation

CAH-8.

Omitted

CAH-9.

Omitted

CAH-10.

Omitted

CAH-11.

Omitted

CAH-12.

Docket No. HB-20-85-1-003, Louisville Gas and Electric Company

CAH-13.

Project No. 7664-008, East Bench Irrigation District

CAH-14.

Project No. 6433-003, Warren B. Nelson

Project No. 6434-006, Thomas A. Nelson

Project No. 6435-001, Joseph B. Nelson

Consent Agenda—Electric

CAE-1.

Docket No. ER92-417-000, Niagara Mohawk Power Corporation

CAE-2.

Docket Nos. ER92-436-000 and EL92-29-000, Florida Power Corporation

CAE-3.

Docket No. ER92-286-000, New England Power Company

CAE-4.

Docket No. ER92-316-000, Southern Company Services, Inc.

CAE-5.

Docket Nos. ER92-361-000 and ER92-362-000, Green Mountain Power Corporation

CAE-6.

Docket No. EL92-12-000, Wisconsin Public Service Corporation

CAE-7.

Docket No. ER92-115-001, Portland General Electric Company

CAE-8.

Docket No. ER92-198-003, Consumers Power Company

CAE-9.

Docket No. EL88-1-003, Indiana & Michigan Municipal Distributors Association and City of Auburn, Indiana v. Indiana Michigan Power Company
Docket Nos. ER88-31-001 and ER88-32-001, Indiana Michigan Power Company

CAE-10.

Docket No. EL87-51-002, Cajun Electric Power Cooperative, Inc. v. Gulf States Utilities Company
Docket No. ER88-477-002, Gulf States Utilities Company

Consent Agenda—Oil and Gas

CAG-1.

Docket Nos. RP91-143-013 and RP92-159-000, Great Lakes Gas Transmission Limited Partnership

CAG-2.

Docket No. RP91-157-000, Pacific Offshore Pipeline Company

CAG-3.

Docket No. RP92-160-000, Tennessee Gas Pipeline Company

CAG-4.

Docket No. RP92-161-000, Penn-York Energy Corporation

CAG-5.

Docket Nos. RP92-163-000 and RP92-170-000, Williston Basin Interstate Pipeline Company

CAG-6.

Docket No. RP92-164-000, Tarpon Transmission Company

CAG-7.

Docket No. RP92-165-000, Trunkline Gas Company

CAG-8.

Docket No. RP92-166-000, Panhandle Eastern Pipe Line Company

CAG-9.

Docket Nos. RP91-161-008 and RP92-3-004, Columbia Gas Transmission Corporation

CAG-10.

Docket No. RP92-74-002, South Georgia Natural Gas Company

CAG-11.

Docket Nos. RP91-204-000 and RP90-111-000, East Tennessee Natural Gas Company

CAG-12.

Docket No. RP92-168-000, Florida Gas Transmission Company

CAG-13.

Docket Nos. RP92-156-000 and RS92-45-001, Natural Gas Pipeline Company of America

CAG-14.

Docket No. RP92-167-000, Natural Gas Pipeline Company of America

CAG-15.

Docket Nos. TA92-1-56-000 and TM92-2-56-000, Valero Interstate Transmission Company

CAG-16.

Docket No. TA92-1-55-000, Questar Pipeline Company

CAG-17.

Omitted

CAG-18.

Omitted

CAG-19.

Docket No. TQ92-10-25-000, Mississippi River Transmission Corporation

CAG-20.

- Docket No. TQ92-4-46-000, Kentucky West Virginia Gas Company
- CAG-21.
Docket Nos. TQ92-3-21-000 and TM92-8-21-001, Columbia Gas Transmission Corporation
- CAG-22.
Docket No. TQ92-4-18-000, Texas Gas Transmission Corporation
- CAG-23.
Docket Nos. TQ92-4-63-000 and TM92-2-63-000, Carnegie Natural Gas Company,
- CAG-24.
Docket No. TQ92-4-23-000, Eastern Shore Natural Gas Company
- CAG-25.
Docket Nos. TQ92-7-59-000 and 001, Northern Natural Gas Company
- CAG-26.
Docket Nos. TQ92-3-20-000 and TM92-16-20-000, Algonquin Gas Transmission Company
- CAG-27.
Omitted
- CAG-28.
Docket No. RP92-158-000, South Georgia Natural Gas Company
- CAG-29.
Docket No. TA92-1-7-000, Southern Natural Gas Company
- CAG-30.
Docket No. TA91-1-48-003, ANR Pipeline Company
- CAG-31.
Docket No. RP91-143-014, Great Lakes Gas Transmission Limited Partnership
- CAG-32.
Docket Nos. RP92-104-001 and RP92-131-001, K N Energy, Inc.
- CAG-33.
Docket No. RP92-118-002, Panhandle Eastern Pipe Line Company
- CAG-34.
Docket No. RP92-102-002, Panhandle Eastern Pipe Line Company
- CAG-35.
Docket No. RP92-123-001, Trunkline Gas Company
- CAG-36.
Docket No. RP91-203-012, Tennessee Gas Pipeline Company
- CAG-37.
Docket Nos. TM92-9-21-001 and RP91-41-012, Columbia Gas Transmission Corporation
- CAG-38.
Docket No. TA92-1-37-001, Northwest Pipeline Corporation
- CAG-39.
Docket No. TA92-1-7-001, Southern Natural Gas Company
- CAG-40.
Docket No. ST90-267-002, Transok Gas Transmission Company
- CAG-41.
Omitted
- CAG-42.
Docket Nos. RP84-82-012 and RP92-97-002, Tarpon Transmission Company
- CAG-43.
Omitted
- CAG-44.
Docket Nos. RP92-51-001, 004 and RP91-98-003, CNG Transmission Corporation
- CAG-45.
Omitted
- CAG-46.
Docket Nos. RP92-109-001 and 002, Northern Natural Gas Company
- CAG-47.
Omitted
- CAG-48.
Omitted
- CAG-49.
Docket No. RP87-15-032, Trunkline Gas Company
- Docket No. RP92-128-001, Panhandle Eastern Pipe Line Company
- CAG-50.
Docket No. RP92-122-001, Trunkline LNG Company
- Docket No. RP92-124-001, Trunkline Gas Company
- Docket No. RP92-125-001, Panhandle Eastern Pipe Line Company
- CAG-51.
Docket No. RP92-126-001, Trunkline Gas Company
- Docket No. RP92-127-001, Panhandle Eastern Pipe Line Company
- CAG-52.
Docket Nos. CP88-391-009, RP73-3-012, CP91-2819-001, RP82-55-051, RP85-148-012, CP72-255-004, CP89-759-010, CP90-2228-003, CP90-2229-003, RP87-7-075, CP90-2230-004, CP89-728-003, CP89-790-003, CP88-273-002, CP88-328-007, CP89-1916-004, RP90-8-009, RP90-51-002, CP90-499-002, CP84-146-009, CP84-336-007, G-12503-002, G-12059-002, RP82-55-051 and RP88-187-004, Transcontinental Gas Pipe Line Corporation
- CAG-53.
Docket No. CP88-391-010, Transcontinental Gas Pipe Line Corporation
- CAG-54.
Docket Nos. RP91-161-000, RP92-3-000 and RS92-5-000, Columbia Gas Transmission Corporation
- Docket Nos. RP91-160-000, RP92-2-000 and RS92-6-000, Columbia Gulf Transmission Company
- CAG-55.
Docket Nos. RP91-116-000 and 002, Raton Gas Transmission Company
- CAG-56.
Docket No. RP92-52-000, Nora Transmission Company
- CAG-57.
Docket No. PR92-7-000, Louisiana Intrastate Gas Corporation
- CAG-58.
Docket No. PR92-6-000, Delhi Gas Pipeline Corporation
- CAG-59.
Docket No. PR91-23-000, Midcoast Ventures I
- CAG-60.
Docket No. RM84-6-037, Refunds Resulting from Btu Measurement Adjustments
- CAG-61.
Omitted
- CAG-62.
Docket No. CP92-9-000, Arkansas Oil and Gas Commission, Tight Formation Determination, Arkansas-2, FERC No. JD92-01180T
- CAG-63.
Docket No. CP88-433-005, El Paso Natural Gas Company
- Docket Nos. RP89-48-018, CP89-1126-003, RP89-222-007, RP89-254-006, CP88-133-005, and CP89-886-004, Transwestern Pipeline Company
- Docket No. TA91-1-86-002, Pacific Gas Transmission Company
- Docket No. CP91-2468-001, Windward Energy & Marketing Company v. Pacific Gas Transmission Company and Pacific Gas & Electric Company
- CAG-64.
Docket No. CP92-260-001, Transcontinental Gas Pipe Line Corporation
- CAG-65.
Docket No. CP91-2394-001, Questar Pipeline Company
- CAG-66.
Docket Nos. CP92-71-000 and CP88-435-005, Northern Natural Gas Company
- Docket No. CP91-1031-001, Pacific Gas Transmission Company
- Docket No. CP88-138-025, Texas Eastern Transmission Corporation
- Docket No. CP88-686-002, Texas Gas Transmission Corporation
- Docket Nos. CP88-328-005, CP89-1916-005 and CP92-378-000, Transcontinental Gas Pipe Line Corporation
- Docket No. CP90-1777-000, TransColorado Gas Transmission Company
- Docket No. CP88-133-004, Transwestern Pipeline Company
- Docket No. CP86-586-002, Trunkline Gas Company
- CAG-67.
Docket Nos. CP91-1110-00 and 001, Colorado Interstate Gas Company
- CAG-68.
Docket No. CP92-479-000, New York State Electric and Gas Corporation
- CAG-69.
Docket Nos. CP91-780-000, 001, 002 and 003, Northwest Pipeline Corporation
- CAG-70.
Docket No. CP91-500-000, El Paso Natural Gas Company and Western Gas Interstate Company
- CAG-71.
Docket Nos. CP91-2322-000, 001, 002 and CP90-767-000, Paiute Pipeline Company
- CAG-72.
Docket Nos. CP89-362-002 and CP89-363-002, North Country Gas Pipeline Corporation
- CAG-73.
Docket Nos. RS92-86-000, RP92-137-000, RP92-108-000 and CP92-378-000, Transcontinental Gas Pipe Line Corporation
- CAG-74.
Docket No. RM88-13-000, Brokering of Interstate Natural Gas Pipeline Capacity
- CAG-75.
Docket Nos. RP91-111-004, 002, 003, RS92-68-000, CP91-2649-001, SA91-8-001, RP88-190-004, RP88-57-007, RP88-110-004, TM89-2-27-005, TA88-1-27-006 and TM89-2-27-004, North Penn Gas Company
- Docket Nos. RP85-178-072, 068, 067, 070, RP88-191-020, 028 and RP90-122-003, Tennessee Gas Pipeline Company
- Docket Nos. RP88-68-036 and RP87-7-073, Transcontinental Gas Pipe Line Corporation
- Docket No. RP88-217-016, CNG Transmission Corporation

CAG-76.

Docket No. CP90-134-003, Algonquin Gas Transmission Company
 Docket No. RP88-45-022, Arkla Energy Resources
 Docket No. CP88-311-010, CNL Transmission Corporation
 Docket No. RP88-186-001, *et al.*, Columbia Gas Transmission Corporation
 Docket No. CP90-1292-004, East Tennessee Natural Gas Company
 Docket No. RP89-50-022, Florida Gas Transmission Company
 Docket No. CP90-406-006, High Island Offshore System
 Docket No. CP89-2047-007, Kern River Gas Transmission Company
 Docket No. CP89-174-002, Midwestern Gas Transmission Company
 Docket No. CP89-1-015, Mojave Pipeline Corporation
 Docket No. CP89-1580-004, Northwest Pipeline Corporation
 Docket No. CP90-187-004, Oklahoma-Arkansas Pipeline Company
 Docket No. RP89-73-010, Pelican Interstate Gas System
 Docket No. CP88-136-031, Texas Eastern Transmission Corporation
 Docket No. CP88-686-008, Texas Gas Transmission Corporation
 Docket No. CP88-328-010, Transcontinental Gas Pipeline Corporation
 Docket No. RP91-197-003, United Gas Pipeline Company
 Docket No. CP90-1874-005, U-T Offshore System
 Docket No. CP90-273-008, Viking Gas Transmission Company
 Docket No. CP90-706-004, Wyoming Interstate Company, Ltd.

CAG-77.

(A) Docket No. CP91-1983-000, Algonquin Gas Transmission Company
 (B) Docket No. CP91-1111-001, Algonquin Gas Transmission Company
 Docket No. CP91-3236-001, Distrigas of Massachusetts Corporation

Hydro Agenda

H-1.
 Reserved

Electric Agenda

E-1.
 Omitted
 E-2.
 Docket No. ER91-195-004, Western System Power Pool. Order on rehearing.
 E-3.
 Docket No. RM92-10-000, Streamlining Electric Power Regulation. Notice of Proposed Rulemaking.
 E-4.
 Docket No. ER91-313-001, Pennsylvania Electric Company. Order on rehearing.

Oil and Gas Agenda

I. Pipeline Rate Matters

PR-1.

(A) Docket Nos. RP88-262-018, CP89-917-007, TA89-1-28-007, TA90-1-28-005, RP88-88-011 and RP91-229-002, Panhandle Eastern Pipe Line Company. Opinion No. 369-A and order on rehearing.

(B) Docket Nos. RP91-229-003, 004 and 005, Panhandle Eastern Pipe Line Company. Order on rates.

(C) Docket Nos. RP91-229-000 and 001, Panhandle Eastern Pipe Line Company. Order on rehearing.

(D) Docket Nos. RP87-103-012 and CP90-1050-000, Panhandle Eastern Pipe Line Company. Order on rehearing.

II. Producer Matters

PF-1.

Reserved

III. Pipeline Certificate Matters

PC-1.

Docket No. CP92-285-000, Richfield Gas Storage System. Order on application for construction.

PC-2.

Omitted

Lois D. Cashell,

Secretary.

[FR Doc. 92-12355 Filed 5-21-92; 4:20 pm]

BILLING CODE 5717-01-M

FEDERAL RESERVE SYSTEM BOARD OF GOVERNORS

TIME AND DATE: 11:00 a.m., Monday, June 1, 1992.

PLACE: Marriner S. Eccles Federal Reserve Board Building, C Street entrance between 20th and 21st Streets, NW., Washington, DC 20551.

STATUS: Closed.

MATTERS TO BE CONSIDERED:

1. Personnel actions (appointments, promotions, assignments, reassignments, and salary actions) involving individual Federal Reserve System employees.
3. Any items carried forward from a previously announced meeting.

CONTACT PERSON FOR MORE INFORMATION:

Mr. Joseph R. Coyne, Assistant to the Board; (202) 452-3204. You may call (202) 452-3207, beginning at approximately 5 p.m. two business days before this meeting, for a recorded announcement of bank and bank holding company applications scheduled for the meeting.

Dated: May 22, 1992.

Jennifer J. Johnson,

Associate Secretary of the Board.

[FR Doc. 92-12493 Filed 5-22-92; 3:14 pm]

BILLING CODE 6210-01-M

NUCLEAR REGULATORY COMMISSION

DATE: Weeks of May 25, June 1, 8, and 15, 1992.

PLACE: Commissioners' Conference Room, 11555 Rockville Pike, Rockville, Maryland.

STATUS: Open and Closed.

MATTERS TO BE CONSIDERED:

Week of May 25

Wednesday, May 27

11:30 a.m.

Affirmation/Discussion and Vote (Public Meeting) (if needed)

Week of June 1—Tentative

Monday, June 1

10:00 a.m.

Annual Briefing on Medical Use of Byproduct Material (Public Meeting)

1:30 p.m.

Briefing on Rulemaking Procedures for Design Certification Under Part 52 (Public Meeting)

3:00 p.m.

Status Report on Enhanced Participatory Rulemaking (Public Meeting)

Tuesday, June 2

10:30 a.m.

Briefing on Status of Licensed Operator Requalification Program and Complex Simulator Scenarios (Public Meeting)

Wednesday, June 3

10:00 a.m.

Briefing by INPO on National Academy for Nuclear Training (Public Meeting)

11:30 a.m.

Affirmation/Discussion and Vote (Public Meeting) (if needed)

2:00 p.m.

Briefing by GE on Status of ABWR Application for Design Certification (Public Meeting)

Week of June 8—Tentative

Thursday, June 11

4:30 p.m.

Affirmation/Discussion and Vote (Public Meeting) (if needed)

Week of June 15—Tentative

Friday, June 19

10:00

Briefing on Requests to DOE for Technology Transfers under 10 CFR Part 810 (Closed—Ex. 1 & 4)

11:30 a.m.

Affirmation/Discussion and Vote (Public Meeting) (if needed)

Note.—Affirmation sessions are initially scheduled and announced to the public on a time-reserved basis. Supplementary notice is provided in accordance with the Sunshine Act as specific items are identified and added to the meeting agenda. If there is no specific subject listed for affirmation, this means that no item has as yet been identified as requiring any Commission vote on this date.

TO VERIFY THE STATUS OF MEETING CALL (RECORDING): (301) 504-1292.

CONTACT PERSON FOR MORE INFORMATION:

William Hill (301) 504-1661.

Dated: May 22, 1992.

Andrew L. Bates,

Office of the Secretary

[FR Doc. 92-12464 Filed 5-22-92; 2:15 pm]

BILLING CODE 7590-01-M

Corrections

Federal Register

Vol. 57, No. 102

Wednesday, May 27, 1992

This section of the FEDERAL REGISTER contains editorial corrections of previously published Presidential, Rule, Proposed Rule, and Notice documents. These corrections are prepared by the Office of the Federal Register. Agency prepared corrections are issued as signed documents and appear in the appropriate document categories elsewhere in the issue.

DEPARTMENT OF AGRICULTURE

Forest Service

Newspapers To Be Used for Publication of Legal Notice of Appealable Decisions for Southern Region; Alabama, Kentucky, Georgia, Tennessee, Florida, Louisiana, Mississippi, Virginia, West Virginia, Arkansas, Oklahoma, North Carolina, South Carolina, Texas, Puerto Rico

Correction

In notice document 92-9970 beginning on page 18124 in the issue of Wednesday, April 29, 1992, make the following correction:

On page 18126, in the third column, just before the FR Doc. line insert the following:

Marvin C. Meier,
Deputy Regional Forester.

BILLING CODE 1505-01-D

DEPARTMENT OF EDUCATION

Pell Grant Program; 1992-93 Award Year Zero Pell Grant Index (PGI) Charts

Correction

In notice document 92-10343 beginning on page 19216 in the issue of Monday, May 4, 1992, make the following correction:

On page 19217, in the first column, under the *Zero PGI - Chart A* table, the 17 lines below the table should be a part of footnote 5 and should read as follows:

- * Use chart A if—
For a dependent student:
(1) The parents of the student are married and both parents earned income of \$3,000 or more; or
(2) The parent of the student qualified as a head of household for Federal income tax

purposes and the parent earned income of \$3,000 or more.

For an independent student with dependents:

- (1) Both the student and the spouse combined earned income of \$3,000 or more; or
(2) The student qualified as a head of household for Federal income tax purposes and the student earned income of \$3,000 or more.

BILLING CODE 1505-01-D

DEPARTMENT OF ENERGY

Invitation for Proposals From Northeastern Organizations for Projects Designed To Foster the Expanded Adoption of Energy-Efficient Industrialized Housing

Correction

In notice document 92-11764 beginning on page 21237 in the issue of Tuesday, May 19, 1992, make the following correction:

On page 21239, in the first column, under *E. Eligible Applicants*, in the second line from the bottom, "Northwestern" should read "Northeastern".

BILLING CODE 1505-01-D

federal register

**Wednesday
May 27, 1992**

Part II

Department of Labor

**Occupational Safety and Health
Administration**

**29 CFR Part 1910
Occupational Exposure to Formaldehyde;
Final Rule**

DEPARTMENT OF LABOR

Occupational Safety and Health Administration

29 CFR Part 1910

[Docket No. H-225D]

Occupational Exposure to Formaldehyde

AGENCY: Occupational Safety and Health Administration (OSHA), Labor.

ACTION: Response to Court remand; final rule.

SUMMARY: By this action, the Occupational Safety and Health Administration (OSHA) hereby amends its existing regulation for occupational exposure to formaldehyde, 29 CFR 1910.1048, in response primarily to a remand by the U.S. Court of Appeals for the D.C. Circuit in *UAW v. Pendergrass*, 878 F.2d 389 (D.C. Cir. 1989). The final amendments lower the permissible exposure level for formaldehyde from 1 ppm (part per million) as an 8-hour time-weighted average (TWA) to an 8-hour time-weighted average of 0.75 ppm. The amendments also add medical removal protection provisions to supplement the existing medical surveillance requirements for those employees suffering significant eye, nose or throat irritation and for those suffering from dermal irritation or sensitization from occupational exposure to formaldehyde. In addition, certain changes have been made to the standard's hazard communication and employee training requirements. These amendments establish specific hazard labeling requirements for all forms of formaldehyde, including mixtures and solutions composed of 0.1% or greater of formaldehyde in excess of 0.1 ppm. Additional hazard labeling, including a warning that formaldehyde presents a potential cancer hazard, is required where formaldehyde levels, under reasonably foreseeable conditions of use, may potentially exceed 0.5 ppm. The final amendments also provide for annual training of all employees exposed to formaldehyde at levels of 0.1 ppm or higher.

DATES: Effective date: This amendment shall take effect on June 26, 1992. Certain provisions of the amended standard have delayed start-up dates which are detailed in paragraph (p) of § 1910.1048.

FOR FURTHER INFORMATION CONTACT: Mr. James Foster, Office of Information and Consumer Affairs, Occupational Safety and Health Administration, U.S. Department of Labor, room N-3647, 200

Constitution Avenue, NW., Washington, DC 20210. Telephone: (202) 523-8151.

SUPPLEMENTARY INFORMATION:**Background and History of the Regulation**

On December 4, 1987, after an extensive rulemaking proceeding, detailed in the preamble to the final rule (52 FR at 46169-46171), OSHA issued a comprehensive regulation covering occupational exposure to formaldehyde at 29 CFR 1910.1048. This rule reduced the permissible exposure limits (PELs) to 1 part formaldehyde per million parts of air (ppm) as an 8-hour time-weighted average (TWA), and established a 2 ppm 15-minute short term exposure limit (STEL). The comprehensive standard also included an "action level" of 0.5 ppm, measured as an 8-hour TWA, and provisions for employee exposure monitoring, medical surveillance, recordkeeping, regulated areas, emergency procedures, preferred methods to control exposure, maintenance and selection of personal protective equipment, and hazard communication. OSHA's rule was based on the consideration of a wide range of new evidence including animal bioassays and epidemiological evidence. It was based in part on OSHA's recognition of formaldehyde as a potential occupational carcinogen as well as its irritating and sensitizing effects.

The standard was challenged in the United States Court of Appeals for the District of Columbia Circuit, pursuant to section 6(f) of the Act, 29 U.S.C. 655(f), by both industry and labor. Four unions, the International Union, United Automobile, Aerospace and Agricultural Implement Workers of America (UAW), the Amalgamated Clothing and Textile Workers Union (ACTWU), the International Ladies' Garment Workers Union (ILGWU) and the International Molders and Allied Workers Union, and Public Citizen, a public interest group, challenged the standard as being insufficiently protective. They contended that the PEL was not set low enough to eliminate all significant risk of harm from both cancer and from formaldehyde's irritant effects. They also objected to OSHA's decision not to include a medical removal protection (MRP) provision in the standard, and to a number of other aspects of the standard, including the setting of the action level, the lack of a requirement for annual medical examinations, and the provisions regarding labeling and training.

The Formaldehyde Institute (FI), on the other hand, sought review of the

hazard communication provisions in paragraph (m) of the standard. While challenging these provisions in court, the FI, along with others, petitioned OSHA for an administrative stay of the hazard communication provisions and reconsideration of these provisions. On December 13, 1988, after giving the public an opportunity to comment on this petition, OSHA stayed the hazard communication provisions, paragraphs (m)(1)(i) through (m)(4)(ii), and announced its intention to consider further regulatory action on these provisions (53 FR 50198). The effect of the stay was to continue the implementation of OSHA's generic Hazard Communication Standard (29 CFR 1910.1200) in effect with respect of formaldehyde. The administrative stay was subsequently continued to allow the Agency more time to resolve the issue (54 FR 35639, 8/29/89; 55 FR 24070, 6/13/90; 55 FR 32616, 8/10/90; 55 FR 51698, 12/17/90; 56 FR 10377, 3/12/91; 56 FR 26909, 6/12/91; 56 FR 37651, 8/8/91; 56 FR 57593, 11/13/91; 57 FR 2681, 1/23/92).

The Court of Appeals affirmed the final standard in most respects but concluded that OSHA had failed adequately to explain its cancer risk estimates and why it had not included medical removal protection (MRP) provisions in the standard. *UAW v. Pendergrass*, 878 F.2d 389 (D.C. Cir. 1989). The Court's decision required OSHA to better explain or reevaluate the risk assessment that led it to choose a PEL of 1 ppm. According to the Court, should OSHA conclude that a significant risk remains at 1 ppm, the Agency could then adjust the standard accordingly. The Court's decision also required OSHA to better explain or reevaluate its decision not to include an MRP provision in the standard.

The Court did not review the hazard communication provisions of the standard because they had been administratively stayed for reconsideration at the time. Because all of the provisions of the standard are interconnected, OSHA determined that the hazard communication provisions should be reconsidered together with the remand issues.

The Parties' Recommendation

Following the remand, parties to the litigation developed recommendations for revisions to the standard that they believed represented a reasonable resolution of all outstanding issues. Their recommendation, presented to OSHA on June 27, 1990, proposed to (1) lower the PEL to 0.75 ppm TWA; (2) include in the standard certain

provisions for MRP benefits; and (3) modify the standard's hazard communication provisions by revising labeling requirements for materials capable of releasing small amounts of formaldehyde and providing annual training in formaldehyde hazards for all employees exposed at or above 0.1 ppm (Ex. 278).

OSHA gave these recommendations careful consideration in developing the proposed amendments. On July 15, 1991, the Agency issued a proposed rule in response to the Court's remand (56 FR 32302). The proposal incorporated the substance of the recommendations of the parties to the litigation and requested public comment.

Properties, Manufacture, and Uses of Formaldehyde

The chemical "formaldehyde" is a colorless, pungent gas at room temperature with an approximate odor threshold of about 1 ppm [Ex. 73-120]. While the term "formaldehyde" is also used to describe various mixtures of formaldehyde, water, and alcohol, the term "formalin" more precisely describes aqueous solutions, particularly those containing 37 to 50 percent formaldehyde and 6 to 15 percent alcohol stabilizer. Most formaldehyde enters commerce as formalin. Alcoholic solutions of formaldehyde are available for processes that require low water content [Ex. 73-53]. Paraformaldehyde, a solid, also serves as a source of formaldehyde gas. Formaldehyde gas *per se* is not available commercially. The Chemical Abstracts Service (CAS) has assigned the number "50-00-0" to formaldehyde. This number applies to both formaldehyde gas and its aqueous or alcohol stabilized solutions.

Formaldehyde is a major industrial chemical, ranked 24th in production volume in the United States [Ex. 138-F]. In 1985, 5.7 billion pounds of 37 percent formaldehyde (by weight) was produced. Formaldehyde has four basic uses: As an intermediate in the production of resins; as an intermediate in the production of industrial chemicals; as a bactericide or fungicide; and as a component in the formulation of end-use consumer items. The manufacture of three types of resins: urea-formaldehyde, phenolformaldehyde, and melamine formaldehyde, accounts for about 59 percent of total consumption [Exs. 70-2; 73-52]. An additional seven percent is consumed in the production of thermoplastic acetal resins [Ex. 8]. About one-third is used in the synthesis of high volume chemical derivatives, including pentaerythritol,

hexamethylenetetramine, and butanediol [Ex. 8]. Two percent is used in textile treating and small amounts of formaldehyde are present as preservatives or bactericides in consumer and industrial products, such as cosmetics, shampoos and glues.

Some products prepared from formaldehyde contain unreacted formaldehyde residues which may be released from the product over its useful life. One example is urea-formaldehyde resin. Urea-formaldehyde resin is a generic name that actually represents an entire class of related formulations. Over 60 percent of ureaformaldehyde resin production in 1977 was consumed by particleboard and plywood manufacturing, where the resin is used as a glue. Urea-formaldehyde resins are also used in decorative laminates, textiles, paper, and foundry sand molds [Ex. 73-53].

Formaldehyde resins are used to treat textiles to impart wrinkle-resistance to clothing. About 60-85 percent of all apparel fabric is finished with formaldehyde-containing resins. As apparel manufacture is the sixth largest industry sector in the United States [Exs. 70-2; 70-14], this use is the major source of widespread exposure to formaldehyde because of the large number of workers potentially exposed.

Formaldehyde destroys bacteria, fungi, molds, and yeast. Its commercial importance as a fungicide is probably its greatest use as a disinfectant [Ex. 70-2]. Because of its bactericidal properties, formaldehyde is used in numerous cosmetic preparations.

Formaldehyde's uses can lead to widespread exposure in downstream industries. For example, when formaldehyde is present in disinfectants, preservatives, and embalming fluid, worker exposure can occur. Although formaldehyde changes into other chemicals when urea-formaldehyde resins and concentrates are produced, decay may occur, causing workers in numerous industries including wood products and apparel manufacture to be exposed to airborne formaldehyde when it offgasses from products manufactured with these resins.

Summary and Explanation of the Final Amendments

The final amendments to the formaldehyde standard in response to the Court remand and related issues are generally unchanged from OSHA's proposal published July 15, 1991, with only a few exceptions. As explained below, the most significant change is in the hazard communication provisions, paragraph (m).

A total of 34 comments were received. Most comments supported the amendments as proposed.

This preamble describes the specific points raised by commenters and the resolution of the issues involved.

Paragraph (c)—Permissible Exposure Limit (PEL)

This amendment to the final rule reduces the permissible exposure limit to 0.75 parts formaldehyde per million parts of air as an 8-hour time weighted average (0.75 ppm TWA). The basis for this change is the reexamination of the formaldehyde risk assessment that was undertaken in response to the Court remand. In its risk assessment accompanying the promulgation of the standard in 1987, OSHA calculated both the maximum likelihood estimate (MLE) and the upper confidence limit (UCL) for several mathematical models that it concluded best represented the carcinogenic action of formaldehyde. The MLE calculations, which statistically represent the most likely estimate of the risk, indicated that no significant risk remained at the PEL of 1 ppm. However, the UCL figures, which have only a 5% probability of understating the risk, indicated that a significant risk remained at 1 ppm.

OSHA did not accept either the MLE or the UCL as the single best prediction of risk for formaldehyde, but concluded that they defined a range in which the degree of risk was highly uncertain and effectively indeterminable based on the present state of scientific evidence. Since it was uncertain whether a significant risk remained below 1 ppm, OSHA included ancillary provisions in the standard with the expectation that they would further reduce any residual risk that remained at a PEL of 1 ppm (see discussion at 52 FR 46223-46224).

As instructed by the Court, the Agency reconsidered the record evidence applicable to its original finding that a 1 ppm PEL and ancillary provisions would prevent a significant risk of cancer in workers who are exposed to formaldehyde. OSHA continues to believe that neither the UCL nor the MLE can be used to establish a precise estimate of the remaining risk, but rather believes that they define a continuum within which the risk falls. In choosing where in the continuum to establish the PEL, OSHA reevaluated its conclusion that the ancillary provisions promulgated on December 4, 1987 would reduce the residual risk that remained at a PEL of 1 ppm. The court criticized OSHA's reliance on the ancillary provisions to reduce risk because OSHA could not

quantify the extent of exposure reduction, and hence risk reduction, these provisions would produce. 878 F.2d at 396. Although OSHA is convinced that the ancillary provisions contribute to risk reduction (52 FR 46253, 46275, 46285, 46287), the Agency is still unable to quantify that reduction. OSHA therefore believes it cannot rely on the ancillary provisions to reduce risk and that it is appropriate to reduce the PEL further in order to increase the certainty that workers are adequately protected. The Agency has determined that the PEL should be reduced to 0.75 ppm TWA, a point within the continuum defined by the MLE and UCL risk estimates. This PEL represents OSHA's best judgment of the exposure limit, along with the ancillary provisions, necessary to eliminate a significant risk of harm to employees.

Of the commenters who responded to the proposed amendments, only six addressed this issue specifically. Of these comments, five (Ex. 304-3, 304-14, 304-15, 304-24, and 304-27) ranged from expressing positive or conditional support to providing recommendations that would, in the commenters' estimation, strengthen the evidence for adopting the 0.75 ppm level.

The comment submitted by the Society of the Plastics Industry (Ex. 304-3) expressed unconditional support for the lower PEL. However, the National Electrical Manufacturers Association (Ex. 304-14), while supporting the lower PEL, cautioned against further reduction. Similarly, Monsanto (Ex. 304-15) supported the proposed PEL.

While not disagreeing with a PEL of 0.75 ppm, Du Pont (Ex. 304-24) suggested that OSHA supplement the cancer incidence information by incorporating risk data compiled by Casanova and Heck, and published by the Chemical Industry Institute of Toxicology (CIIT), which utilized pharmacokinetic modeling. OSHA considered these types of studies in preparing the risk assessment for the 1987 final standard for formaldehyde. The Agency's reasons for not including these types of studies are discussed in the preamble to the 1987 final standard (52 FR 46225) and remain the same. Moreover, since Du Pont does not claim that these data would justify a different PEL than 0.75 ppm, OSHA does not believe it is necessary or appropriate to reopen the rulemaking record at this stage of the proceedings to include them.

In a related comment, Duke Power (Ex. 304-24) suggested that factors other than carcinogenicity, e.g. irritant properties, should be used to justify the reduction of the PEL. OSHA agrees that irritant effects are involved and that

lowering the PEL will reduce incidences of these effects. Reducing the PEL below 1 ppm will reduce the residual irritant risk that remains at 1 ppm.

Only one comment, submitted by an individual worker, (Ex. 304-1) opposed the proposed action to lower the PEL, but offered no substantive information to support its opposition.

OSHA believes that the comments support the reduction in the PEL effected by this amendment. OSHA further concludes that this reduction in the PEL is economically and technologically feasible. See the discussion under Regulatory Impact and Regulatory Flexibility Assessment later in this preamble.

Paragraph (d)—Exposure Monitoring

Exposure monitoring informs the employer of the levels of formaldehyde to which employees are exposed. Such information is essential to determining whether the employer meets the obligation to keep employee exposures below the PEL and STEL and the obligations imposed by the standard when exposures exceed the action level. It permits the employer to evaluate the effectiveness of engineering and work practice controls, and identifies the need for additional controls. Exposure monitoring data are part of the information that must be supplied to the physician under the standard's medical surveillance provisions.

The monitoring provisions of the formaldehyde standard contain many of the same elements as the monitoring requirements in other OSHA health standards, including provisions for initial and periodic monitoring; the use of objective data in lieu of initial monitoring; use of representative sampling strategies; termination of monitoring; precision and accuracy of monitoring methods; and employee observation of monitoring and notification of the results. The final amendments do not affect these major components, which are described more fully in the preamble to the final standard (52 FR at 46254-46261). The general requirement that the employer monitor employees to determine their exposure to formaldehyde is unchanged, as is the exemption which allows the employer to utilize objective data to determine that measurements are not required for employees exposed below the action level or STEL.

A technical amendment was proposed for the monitoring provisions of the formaldehyde standard which is implemented in the final amendments. Specifically, paragraph (d)(1)(ii)(A), which contained an exception to the general exposure monitoring

requirement, is deleted, since it related to the definition of formaldehyde health hazard which had been included in paragraph (m)(1)(i) but which is also being deleted in this final rule. The intent of this section, however, is not changed.

The other exception in paragraph (d)(1)(ii)(A) which made reference to the need to monitor if there are employee health complaints, i.e., reports of signs and symptoms of formaldehyde exposures, has been removed from paragraph (d)(1)(ii)(A) and added as a new paragraph (d)(2)(iii). This has the effect of stating the requirement positively rather than indirectly as was originally done in paragraph (d)(1)(ii)(A). It is felt that this change clarifies the employer's obligation.

The new paragraph requires employee monitoring if there are reports of signs or symptoms due to formaldehyde exposure, and additionally specifies that monitoring of employees reporting signs of symptoms be done promptly. While the time period represented by "promptly" is not specified in order to provide employers some flexibility, OSHA intends that no more than a few days elapse between the report and the exposure monitoring, unless there are extenuating circumstances.

Duke Power (Ex. 304-24) suggested that "a few days" may not allow sufficient time for some employers to conduct monitoring, particularly those who would need to hire outside consultants to conduct the monitoring. OSHA believes that in the event this situation arises it would constitute extenuating circumstances and would be permissible, provided the employer can prove his or her diligence in attempting to meet the requirement.

Under existing paragraph (d)(1)(ii)(B), which is not being changed, objective data may be used to determine that the employee's exposure cannot exceed the action level or STEL. However, the data used must accurately reflect the affected employee's exposure (see discussion of objective data below.).

A related comment submitted by Owens Corning Fiberglas (Ex. L304-31) pointed out that sampling methods were not specified relative to determining if concentrations exceed levels which would require labeling and training. Neither the proposal nor the final amendments require sampling in such cases but allow the use of objective data which would indicate the potential formaldehyde release under reasonably foreseeable conditions of use. Thus, the standard does not actually pose the difficulty which is perceived by this commenter.

Paragraph (g)—Respiratory Protection

Issues related to respiratory protection were not part of the proposed amendments. However, two comments were submitted that were a logical outgrowth of the proposal to reduce the PEL. Wilson Safety Products (Ex. 304-12) pointed out that Table 1 of the 1987 standard (52 FR 46293), "Minimum Requirements for Respiratory Protection Against Formaldehyde," should be corrected to reflect the change in the PEL from 1 ppm to 0.75 ppm. OSHA agrees and has accordingly reproduced the table with the necessary corrections in paragraph (g). Footnote "2" regarding the use of half-mask respirators is retained. In addition, a technical correction has been made to paragraph (g)(3)(iv) to reflect the change in the PEL. This paragraph addresses the required frequency of replacement for canisters in atmospheres up to 10 times the PEL and 100 times the PEL, respectively. The allowable concentrations are changed from 10 ppm to 7.5 ppm and from 100 ppm to 75 ppm to reflect the 0.75 permissible exposure limit.

ISEA (Ex. 304-21) observed that the proposed amendments did not discuss the relative merits of engineering controls and respirators to protect against airborne formaldehyde. ISEA suggested that before OSHA prescribes engineering controls in lieu of respirators as the primary means of complying with the new PEL for formaldehyde, it should complete its ongoing rulemaking on Methods of Compliance. (See 54 FR 23991, 6/5/89.)

The methods of compliance section of the formaldehyde standard was not challenged before the D.C. Circuit and OSHA did not propose to reconsider it when it proposed the amendments now under consideration. The formaldehyde record was reopened only to resolve the remand issues and the outstanding issues related to the hazard communication provisions. Moreover, the Methods of Compliance rulemaking proposed to amend only the Air Contaminants standard (29 CFR 1910.1000) and the Respiratory Protection standard (29 CFR 1910.134). Since that rulemaking does not propose to amend substance-specific standards such as the formaldehyde standard, it provides no basis to defer action on these proposed amendments.

Paragraph (l)—Medical Surveillance (8)—Medical Removal

The final formaldehyde standard promulgated on December 4, 1987 did not include medical removal protection (MRP) provisions. In response to the Court remand on this issue, OSHA has

reexamined its reasoning, and carefully reviewed the record. On reconsideration, the Agency has concluded that MRP provisions can contribute to the success of the medical surveillance programs prescribed in the formaldehyde standard. Unlike some other substance-specific standards, the formaldehyde standard does not provide for periodic medical examinations for employees exposed at or above the action level. Instead, medical surveillance is accomplished in the final rule through the completion of annual medical questionnaires, coupled with affected employees' reports of signs and symptoms and medical examinations where necessary. This alternative depends on a high degree of employee participation and cooperation to determine if employee health is being impaired by formaldehyde exposure. OSHA believes these new MRP provisions will encourage employee participation in the standard's medical surveillance program and avoid the problems associated with nonspecificity and quick resolution of signs and symptoms that originally concerned the agency (see 52 FR 46282).

The final amendments specify those conditions covered by MRP. Conditions which are potentially covered by MRP are limited to significant irritation of the mucosa of the eyes and of the upper airway, respiratory sensitization, dermal irritation, or dermal sensitization (Ex. 42-87, p.175). In the case of dermal irritation and dermal sensitization, and these conditions alone, the medical removal provisions do not apply when the percent of formaldehyde content in the product suspected of causing the dermal condition is below 0.05%. This is because, on the basis of evidence in the record, only those products with higher concentrations have clearly been associated with dermal irritation or dermal sensitization (Ex. 85-56, p.5).

The existing formaldehyde standard requires that employers institute medical surveillance programs for employees exposed to formaldehyde. The purpose of such programs is to identify employees adversely affected by formaldehyde exposure, even if the exposure is below the PEL. In this way, the employee can be treated if necessary, potential causes can be identified, and remedial measures taken.

The medical surveillance program, and all procedures conducted under it, must be supervised by a licensed physician, and provided at no cost to employees. The program consists of screening formaldehyde-exposed employees, with follow-up medical examinations in those instances when the physician feels it necessary. As a

minimum, the screening consist of the administration of a questionnaire, which must include a work history, a smoking history, and elicit information on a variety of medical conditions associated with formaldehyde exposure. These conditions include eye, nose, or throat irritation, chronic airway problems or hyperactive airway disease, allergic skin conditions or dermatitis, and upper and lower respiratory problems.

All employees exposed to formaldehyde at or above the action level or STEL must be screened annually, by means of a medical questionnaire. In addition, employees exposed to formaldehyde must be screened with the questionnaire if they develop signs or symptoms of possible formaldehyde-related illness. If the responsible physician, upon evaluating the questionnaire, determines that a medical examination is necessary, the employee must be examined, and given any tests which the physician feels are appropriate.

When the physician has determined that a medical examination is necessary, it must be conducted promptly (as soon as possible, but within a few days at most) and the employer shall promptly comply with any subsequent recommendations for removal or restriction. If an employee reports signs or symptoms, and the physician determines that a medical examination is not immediately necessary, a two-week observation period begins. The purpose of this two-week observation period begins. The purpose of this two-week period is to provide an opportunity for evaluation of the problem and for possible remediation of the condition or causative factors. This provision is supported by information in the record that many formaldehyde-induced signs and symptoms often resolve themselves within a few hours or days (52 FR 46282). It will permit the employer to see whether signs or symptoms subside spontaneously or with minimal treatment, or to improve working conditions to alleviate the exposure, and the resulting condition, without unnecessary expenditure. If the signs or symptoms have not subsided or been remedied by the end of the two week period, the employee must be examined by the physician. If the signs and symptoms worsen during the two week period, the employee must be examined by the physician as soon as this fact is determined.

Any examination conducted in response to an employee report of signs or symptoms must include a medical and work history and any other element, including tests, which the examining

physician deems necessary. The standard does not specify any particular tests. This is due to the variety of conditions associated with formaldehyde exposure which are covered by these provisions.

Accordingly, the physician is given broad discretion in selecting any tests appropriate and useful under the circumstances.

If, in the examining physician's professional judgment, restrictions or removal are needed to alleviate the employee's symptoms of formaldehyde exposure, the physician's recommendations must be followed as soon as possible (a day or two at most). In the case of removal, transfer alternatives must be considered first. The employee must be moved to a job location with significantly less formaldehyde exposure (about twenty-five percent or greater reduction), which cannot exceed the action level. Transfer alternatives include possible job transfers that could be accomplished if the employee were to receive training for a short period of time. OSHA views a short period of time in this context as any period up to 6 months, the maximum period that MRP is available to employees under any circumstance. While the provisions require transfer, if possible, the type of training to be provided by the employer is not specified. OSHA does not intend that special job training programs be established. Job training opportunities such as the employer has afforded employees in the past should be sufficient to meet this requirement.

If there are no transfer alternatives, the employee must still be removed from the formaldehyde exposure for a period of up to six months or until a physician determines either that the employee is able to return to work or that the employee will not ever be able to return to work.

In addition to effecting actual physical removal, MRP assures that employees are provided with temporary economic protection. When an employee is removed from formaldehyde exposure, through transfer or other means, the employer must maintain the employee's earnings, seniority and benefits. This includes overtime, bonuses, increases and production rate payments the employee would normally receive. This must be continued until the employee is determined to be able to return to the original job, or is determined to be unable to return to any workplace formaldehyde exposure, or for six months, whichever occurs first. If the employee receives any compensation through workers' compensation or other

programs, MRP payments can be reduced by that amount. If the employee's removal permits the employee to obtain other employment, the employer's obligation is similarly reduced.

The determination as to whether the employee can return to the original job or is permanently unable to return to formaldehyde exposure is a medical decision, which must be based on a follow-up exam conducted by the employer's chosen physician. When the employee is returned to the original job, any subsequent signs or symptoms that may be reported are subject to another initial evaluation and determination as to whether an exam is necessary. If there is a determination that no exam is immediately necessary, a two-week period for evaluation and remediation is again initiated, and the employer proceeds from that point as described above.

When medical removal protection is part of a standard, OSHA usually provides a multiple physician review mechanism to assure successful operation of such programs. Multiple physician review provides an employee with an opportunity for a second medical opinion in a situation where a worker questions the recommendations resulting from a medical exam or consultation performed by a physician chosen by the employer. By doing so, it assures employee confidence in the soundness of medical determinations which may impact them significantly. As employee confidence is necessary to assure that employees will cooperate with the standard's medical surveillance provisions, multiple physician review is an integral component of the standard. A full discussion of multiple physician review is contained in the preamble to the lead standard (43 FR 52972, 52998) which is applicable here since the multiple physician review mechanism provided by these final amendments is similar to that in the lead standard in all respects.

The initial choice of the examining physician is made by the employer. After any examination or consultation concerning medical removal or restriction is made by the employer's chosen physician, the employee must receive a copy of the physician's written opinion within 15 days from the time the employer receives it. The employer must also inform the employee of the right to seek a second medical opinion if the employee does not agree with the employer's physician's opinion. The employee must act within fifteen days from these notifications, or the employer may decline to participate in, or to pay

for, any ensuing medical reviews. Otherwise, the multiple physician review mechanism must be provided by the employer without cost to the employee, including lost work time.

In seeking a second opinion, the employee may choose a physician to conduct appropriate examinations and tests and issue a written opinion concerning the employee's ability to work with formaldehyde. If the two physicians arrive at different conclusions, and quick (a few days at most) resolution is not possible, a third physician, jointly designated by the two physicians or by the employer and employee (or the employee's authorized representative) must be consulted. This third physician must be a specialist in the area of the body affected or the condition in question (e.g., dermatologist, allergist, pulmonary physician) or must be an occupational physician. The recommendation of the third physician shall be promptly (a few days at most) followed, unless the employer and employee agree to follow any one of the three physicians' recommendations.

The MRP provisions are in many respects similar to and consistent with the MRP mechanism of the lead standard, and a more detailed discussion of how the similar provisions work appears in the lead preamble (43 FR at 52972). For example, both MRP programs base removal decisions on the recommendation of a physician (although removal under the lead standard is also required if an employee's blood lead level exceeds a certain value), both programs include wage retention provisions, and both programs include a multiple physician review mechanism. To the extent the provisions of the formaldehyde MRP program are similar to those of the lead MRP program, OSHA adopts the legal justification supporting the lead standard, particularly the goal of encouraging employee participation in medical surveillance, in support of the MRP provisions of the formaldehyde standard. OSHA also intends that the provisions of the formaldehyde MRP program which are similar to those in the lead standard will operate and be enforced in a like manner.

Of course, OSHA recognizes that there are important differences between the lead MRP program and the MRP provisions of this standard. For example, formaldehyde MRP is limited to those employees exhibiting signs or symptoms of specified ailments; the formaldehyde MRP program includes a two-week remediation period for those employees not immediately referred to a

physician and formaldehyde MRP is not automatically triggered by a laboratory result, such as the blood lead measurements, relied upon in the lead standard. On the issues where the provisions of the formaldehyde MRP program are not consistent with those of the lead MRP program, OSHA expects that the lead standard will offer little enforcement guidance.

The Agency received a number of comments in connection with various aspects of the proposed MRP provision. Three commenters, Honeywell, Amoco Corporation, and Duke Power (Exs. 304-2, 304-18 and 304-24, respectively) raised the question as to whether the provision was intended to apply to office environments where employees may potentially be adversely affected by the off-gassing of formaldehyde from building materials and furnishings. OSHA believes that paragraph (a), scope and application, of the final standard indicates the Agency's intent to include all occupational exposures to formaldehyde under the standard, without regard to workplace environment. In particular, the standard's application to materials that release formaldehyde is relevant to offices and similar workplaces where formaldehyde exposures primarily result from off-gassing of building materials and furnishings. OSHA believes that to the extent that an employee in any occupational setting is exposed to formaldehyde at concentrations high enough to induce signs and symptoms of formaldehyde-related illness, that person should be protected by the MRP provisions of this standard. However, since formaldehyde exposures in offices are low, OSHA would expect MRP to affect employees in such environments only in exceptional cases.

MRP is directed toward employees suffering significant irritant effects attributable to formaldehyde exposures who, in the examining physician's judgment, will benefit from restriction or removal from work areas where formaldehyde is present. The MRP provisions are not designed to cover employees who have been determined to be permanently sensitized to formaldehyde. However, while that determination is being made, OSHA would expect that such employees receive MRP benefits. Sensitized employees often can resume work in areas with lower formaldehyde exposure without suffering adverse effects. The provision exempts from coverage dermal conditions (irritation or sensitization) caused by exposure to products containing less than 0.05 percent formaldehyde.

The commenters identified above also recommended that OSHA provide a cut-off level for airborne concentrations of formaldehyde below which the MRP provisions would not apply, e.g. 0.1 or 0.5 ppm. Because of the nature of the hazard presented by formaldehyde and the variation in individual susceptibility to its effects, OSHA does not believe that there is sufficient justification in the record to establish such a level. Moreover, OSHA does not feel that such a level is necessary, given the checks and balances built into the MRP provisions. For example, administration of the medical questionnaire precedes any action connected with MRP. On the basis of the employee's responses, the examining physician can make a determination regarding the need for medical examinations. If the physician decides that medical examinations are not immediately necessary, the employee begins a 2-week observation period. During this time the medical condition may be resolved either spontaneously or through remedial action such as removal of the formaldehyde source, a reduction in the exposure level or the intervention of minimal medical treatment. OSHA believes that this approach will allow employers an opportunity to resolve many employee medical problems associated with exposure to formaldehyde before medical removal would become necessary.

A comment submitted by ARCO Alaska, Inc. (Ex. 304-4) suggested that medical removal be triggered by "objective clinical evidence" rather than an employee's complaint of signs or symptoms of sensory irritation. ARCO Alaska requested that the standard permit the examining physician leeway to rely on evidence derived from a physical exam. OSHA believes that the proposed amendments already accommodate the concern expressed by the commenter. The MRP provisions do not preclude the examining physician from performing any type of medical exam that he or she feels is appropriate in reaching a decision as to whether the signs and symptoms presented by an employee are related to that employee's exposure to formaldehyde. The physician must first administer the medical questionnaire to employees exhibiting signs and symptoms of formaldehyde exposure. Following this, the physician is given broad discretion in selecting appropriate and useful medical tests.

In a related comment, the Amoco Corporation (Ex. 304-18) recommended that OSHA require the examining physician to be one who specializes in

occupational medicine. OSHA notes that the initial choice of an examining physician rests with the employer, and the standard does not preclude the employer from choosing a physician licensed in occupational medicine. However, as in previous rulemakings, the Agency does not feel that requiring physicians to be specialists in occupational medicine is practical or feasible, given the limited number of such physicians. (The number of occupational physicians is estimated to be around 5,000 according to the Institute of Occupational Medicine.) Also, OSHA believes that many licensed physicians who are not specialists in occupational medicine are fully qualified to make the medical determinations required under the MRP provisions. The final amendment does require that if a third physician is consulted with respect to the MRP provisions, this physician must be specialized in the area of the body affected or condition (e.g. dermatologist, allergist) or be an occupational physician. OSHA believes that this will not overly tax the number of occupational physicians available and will reserve the requirement to use one to those instances where there is a difference in professional opinion, the resolution of which might benefit from a physician trained in occupational medicine.

Additional comments were received regarding the economic protection clause of the MRP provisions. For example, the Amoco Corporation (Ex. 304-18) stated: "Worker protections such as these have traditionally been considered the province of labor relations and, in our opinion should remain so." OSHA notes that MRP is not a labor-relations provision but a mechanism to protect worker health. In promulgating the lead standard, (see 43 FR 52973, November 14, 1978), convincing evidence was presented that pointed out the painful dilemma confronting many lead-exposed workers. For examples, a worker could participate in the medical surveillance program and risk losing his or her job if abnormal medical findings were revealed that could be linked to occupational exposure to lead. On the other hand, a worker could resist participation in the medical surveillance program and thus lose the benefits that medical surveillance is designed to provide. To obviate the need for employees to have to make such decisions, OSHA required employers to protect employee benefits in the event a job transfer or removal became necessary. OSHA is not aware of

evidence in the formaldehyde record that suggests that the situation is different regarding formaldehyde workers. OSHA believes that formaldehyde workers need similar assurance that wages, seniority and other attendant benefits will be retained to secure their participation in medical surveillance.

The Photo Marketing Association International (L304-29) asserted: "[T]o the extent the allergic reaction prevents the employee from working or causes other injury, the employee has a remedy through the state worker's compensation laws." As noted earlier in this preamble discussion, where an employee has been determined to be unable to work in areas where formaldehyde is present due to permanent sensitization to the substance, the MRP provisions cease to apply. MRP is designed to bridge the short period while a symptomatic employee is waiting to recover or is being trained to do another job with lower formaldehyde exposure. Where an employee cannot work with formaldehyde and there is no other job available, the employee will need to rely on worker's compensation. In cases where employees are covered by MRP, if the employee receives any compensation through worker's compensation or other programs, the MRP payments can be reduced by that amount. However, in cases where the medical condition is reversible, OSHA believes that MRP is an appropriate measure for the reasons discussed above. The comment submitted by the Photo Marketing Association International goes on to urge OSHA to either delete the requirement of maintaining the affected employee's benefits or to exempt small businesses from these requirements. OSHA does not feel there is justification for an exemption for small businesses; the harm that may be inflicted on an employee will not differ with the size of the business and there is no evidence in the record to show that the MRP provisions would cause an unacceptable or infeasible burden on small businesses. The costs and benefits of MRP are addressed in the Regulatory Impact Analysis.

Organization Resources Counselors, Inc. (Ex. L304-19) raised objection to the requirement for a second medical opinion if the first medical opinion recommended that the employee be restricted rather than removed. ORC believed that a second opinion was not necessary in such a situation because the employee's compensation and benefits would not be at risk. This comment misconceives the purpose of

multiple physician review. That purpose is to assure that a second medical opinion can be sought by an employee who is dissatisfied with the recommendations of the physician chosen by the employer. OSHA believes that this provision is essential to assure that employees have confidence in the soundness of medical determinations that affect them. If an employee is suffering sensory irritation from formaldehyde and the employer's physician recommends restriction rather than removal, the employee may believe that this recommendation will not adequately address his or her symptoms and seek a second medical opinion, which might recommend removal. Thus, even if the first physician recommends restriction, the outcome of the multiple physician review process may be removal.

The Department of Veterans Affairs (Ex. 304-23) asked that OSHA specify the frequency and duration of the symptoms reported by the employee before medical removal would apply. OSHA believes this approach to be unrealistic. As the provision is written, restriction or removal of an employee is based on the physician's professional judgment. While frequency of symptoms may enter into the physician's decision with respect to determining the appropriate course of action, other factors such as the severity of symptoms as well as the employee's general state of health will also enter into this decision. Therefore OSHA does not feel that frequency should be mandated by this amendment.

Paragraph (m)—Hazard Communication

Generally, hazard communication requirements are governed by OSHA's generic Hazard Communication Standard (HCS), 29 CFR 1910.1200. The HCS requires the use of labels on containers of the hazardous substance, material safety data sheets (MSDSs) and employee information and training. The labels must include the identity of the hazardous chemicals, appropriate hazard warnings and the name and address of the chemical manufacturer, importer or other responsible party. The employer must retain MSDSs received from the manufacturer or distributor and make them available to employees working with the substance. The material safety data sheets include more extensive information than that on the label, such as the physical and chemical characteristics of the chemicals, the health hazards, the primary routes of entry, the PEL or other recommended exposure limit, whether the substance is listed in the NTP Annual Report on Carcinogens or has been found to be a

potential carcinogen by IARC, precautions for safe use and handling, control measures, and emergency and first aid procedures. In addition, the employer must make sure that employees are informed of any operations in their workplace where hazardous chemicals are present, and the location and availability of a written hazard communication program with supporting materials, such as MSDSs. Employees must be trained in methods that may be used to detect the presence or the release of a hazardous chemical in their work area, the physical and health hazards of the chemicals in the work area and measures employees can take to protect themselves from these hazards.

The formaldehyde standard contained specific hazard communications provisions in paragraph (m) that supplemented the requirements of the generic HCS in an attempt to accommodate the unique properties of formaldehyde. Those provisions have been the subject of much of the controversy surrounding the formaldehyde standard. In brief, the hazard communication provisions of the formaldehyde standard applied to formaldehyde gas, all mixtures or solutions composed of greater than 0.1 percent formaldehyde and materials capable of releasing formaldehyde into the air at concentrations reaching or exceeding 0.1 ppm. Employers were required, as a minimum, to address the following hazards: cancer, irritation, and sensitization of the skin and respiratory system, eye and throat irritation and acute toxicity. Manufacturers and importers of formaldehyde were required to provide downstream employers with an objective determination through labels and material safety data sheets if the items were considered to constitute a health hazard in accordance with the HCS under normal conditions of use. The labels were to comply with the requirements of the HCS, 29 CFR 1910.1200(f). As a minimum, the labels were required to identify the hazardous material; identify the responsible party; contain the language, "Potential Cancer Hazard;" and warn of all other hazards as defined in Appendices A and B of 29 CFR 1910.1200. Material safety data sheets were to be developed in accordance with paragraph (g) of the HCS.

The "de minimis exemption," which exempted materials capable of releasing formaldehyde in concentrations less than 0.1 ppm from hazard communication requirements, was an attempt to address the problem of

products which emit or "offgas" formaldehyde, and because of this fact do not fall under the "articles" exemption of the generic HCS. The de minimis exemption, contained in paragraph (m)(1)(i), proved confusing and controversial, because it implied, contrary to other provisions, of the standard, that any exposure above 0.1 ppm constituted a health hazard. The provision prompted a petition from the Formaldehyde Institute, which OSHA granted, to stay paragraphs (m)(1)(i) through (m)(4)(ii) (53 FR 50198). Having decided that its attempt to provide a workable de minimis exemption was not successful, the Agency desired to investigate means of clarifying the requirement and improving compliance. Upon reconsideration, OSHA proposed to amend paragraph (m). The proposed amendments were designed to provide hazard communication provisions that accommodate the unusual properties of formaldehyde and provide appropriate worker protection without undue burden on employers.

In order to clarify the intent of the standard, the text has been simplified. Wood products continue to be covered by the hazard communication requirements of this section. Although the language specifying wood products industry coverage no longer appears in the regulatory language, that industry continues to be covered by the hazard communication requirements of this section, because the exemption in paragraph (b)(6)(ii) of the generic hazard communication standard, 29 CFR 1910.1200, is not referenced and does not apply to this standard. (56 FR at 3207, 7/15/91.)

The following summarizes the changes in brief: Wood products continue to be covered under the hazard communication provisions of the formaldehyde standard; references to the generic Hazard Communication Standard in the stayed paragraphs of the formaldehyde standard (m)(1)(i) through (m)(4) were deleted; the definition of "health hazard" was deleted but trigger levels for action (0.1% or 0.1 ppm) were retained.

In developing the proposed amendments the Agency gave a great deal of consideration to finding acceptable means to apply hazard communication provisions in the formaldehyde standard given the known unique properties of the chemical. In particular, formaldehyde's ability to "offgas," that is, to release formaldehyde gas from solid materials such as wood products and textiles distinguishes it from other chemicals for which the generic Hazard

Communication Standard can readily apply. Solid materials capable of emitting formaldehyde do not neatly fall within the "article" exemption of the generic standard. An "article" as defined at 29 CFR 1910.1200 (c) means a manufactured item (i) which is formed to a specific shape or design during manufacture; (ii) which has an end function(s) dependent in whole or in part upon its shape or design during end use; and (iii) which does not release, or otherwise result in exposure to, a hazardous chemical, under normal conditions of use. An article is not considered to release a hazardous chemical if only a few molecules or a trace amount are emitted. (See 52 FR at 31865, August 24, 1987.) With regard to formaldehyde, the amount of the chemical that is emitted is highly variable, depending on the amount of the chemical bound up in the material and the rate of decay or release which decreases over time. The rate of release is influenced by environmental factors such as temperature and humidity. Therefore to apply the generic hazard communication provisions without qualification would, in effect, require comprehensive labeling for all products capable of emitting more than a few molecules of formaldehyde without due consideration to other relevant factors.

To address this problem, OSHA proposed that, where the potential exposure is under 0.5 ppm, the label needs to indicate that formaldehyde may be present, give the name and address of a responsible party and indicate that physical and health hazard information is available from the employer and from MSDSs. Specific hazard information need not appear on the label, only the indication that such information exists, and directions and the location for obtaining such information. Where it cannot be documented that the concentration of formaldehyde will always remain at or below 0.5 ppm under reasonably foreseeable circumstances, the label information would be required to detail all appropriate hazards, including the information that formaldehyde is a potential cancer hazard.

The Agency felt that this "low potential exposure" labeling for solid materials which may offgas formaldehyde struck a balance, eliminating unnecessary hazard warnings where the potential may not be realized, and giving employees the appropriate warnings, via the label, MSDSs and training where there are low level emissions from products which may represent a health risk.

A considerable number of comments were received that questioned the Agency's proposed approach which, according to the commenters, established an artificial distinction between formaldehyde exposures from solid materials and other physical forms of formaldehyde. For example, in its comment the Association of Nonwoven Fabrics Industry stated:

To the best of our knowledge, OSHA has provided no evidence documenting that the health hazard of exposure to 0.1–0.5 ppm of formaldehyde from a solid material can be distinguished by the exposed individual to an equal exposure of 0.1–0.5 ppm of formaldehyde from another source. (Ex. 304–9).

A similar comment was submitted by the Industrial Coatings Group, Inc. With respect to labeling, the comment stated:

A distinction is drawn between solids and other materials for no apparent reason. Since the issue is the potential emission of a chemical, and since the property under discussion is the amount of formaldehyde capable of being released (not what form it is in) it seems peculiar to make a distinction based on the phase of the emission source. (Ex. 304–22).

Several other commenters supported the above view. (Exs. 304–8, 304–8, L304–19, L304–25, 304–27, and L304–34).

OSHA has therefore reevaluated the options with respect to hazard communication and agrees that the distinction between solids and other forms of formaldehyde is not appropriate. OSHA has concluded that labeling requirements should apply uniformly to all forms of formaldehyde. Specifically, where it is determined through monitoring or the use of objective data that employee exposures will not exceed levels above 0.5 ppm, the hazard warning label shall include the following information: The material or mixture contains formaldehyde; the name and address of the responsible party; and a statement that physical and health hazard information is readily available from the employer and from material safety data sheets. Where it cannot be documented that the concentration will always remain at or below 0.5 ppm under reasonable foreseeable conditions, the label information must detail all appropriate hazards, including information that formaldehyde is a potential cancer hazard. Formaldehyde-containing products incapable of causing exposures at or above 0.1 ppm or mixtures and solutions containing less than 0.1% formaldehyde will not be subject to any hazard communication requirements.

This provision should not be construed as precedential for other

rulemakings. Formaldehyde has unique properties and uses which make it necessary to distinguish its handling from that of the generic labeling requirements of the Hazard Communication Standard. The importance and effectiveness of the Hazard Communication Standard itself should in no way be diminished by the approach taken in these final amendments concerning formaldehyde.

OSHA notes that the foregoing should resolve other questions concerning the labeling requirements as proposed. For example, the BF Goodrich Company (Ex. 304-17) asked for a definition of "materials" and "solid materials" if OSHA continued to make such distinctions in the context of labeling requirements. OSHA believes that the final amendments clarify the fact that all physical forms of formaldehyde will be subject to identical labeling requirements as prescribed in paragraph (m)(1)(ii) and (m)(1)(iii) and therefore such definitions are unnecessary.

The Shipbuilders Council of America (Ex. 304-7) and Newport News Shipbuilding (Ex. 304-33) recommended that OSHA allow employers the option of posting signs in work areas affected by formaldehyde off-gassing in lieu of labeling, where such conditions are transient and short-lived. The source of the off-gassing or conditions of use of formaldehyde were not apparent from the comment. However, paragraph (f) of the Hazard Communication Standard, referenced in this section, provides for the use of signs in situations where it is impractical to affix labels. Specifically, paragraph (f)(6) of the Hazard Communication Standard allows employers to use signs, placards, process sheets, etc. in lieu of affixing labels to individual process containers as long as the alternative method conveys the identity of the hazardous chemical and appropriate hazard warning. OSHA believes that it is reasonable to allow the use of signs in work areas where employees may be incidentally exposed to formaldehyde for brief periods of time as long as the appropriate hazard warning is noted and employees are trained regarding the significance of information on the sign.

Updike, Kelly & Spellacy (Ex. 304-5) suggested that the labeling provisions should apply only to products produced 6 months or more after the effective date to eliminate the need for employers to repackage and relabel any existing inventory to meet the requirements of the provision. OSHA notes that labeling has already been an ongoing obligation under the generic Hazard Communication standard. Consequently,

the labels prepared in order to comply with the generic HCS will automatically be in compliance with this standard and therefore there is no need for repackaging or relabeling products by manufacturers, importers or employers.

The Amoco Corporation (Ex. 304-18) questioned whether manufacturers could anticipate a product's reasonably foreseeable conditions of use for labeling purposes. The comment asked for guidance on a number of points with respect to how the manufacturer or importer should calculate the rate of emission for labeling purposes.

The labeling requirement is intended to apply to the maximum potential emission under foreseeable conditions of use. It is the responsibility of the manufacturer and/or importer to establish what that value is and label accordingly. OSHA noted in the original rulemaking that it could be difficult for the manufacturer or importer to make this determination (52 FR at 46285), but OSHA nevertheless believes that this approach best provides for employees to have comprehensive hazard information without unnecessary burden to employers. If manufacturers or importers are uncertain over whether labeling is required under certain circumstances, they can assure compliance by labeling in accordance with conservative assumptions as to emission levels. OSHA therefore does not believe it is necessary or appropriate to give specific guidance on calculating emission rates beyond the "reasonably foreseeable conditions of use" language in the standard.

Finally, a considerable number of commenters (See Exs. 304-3, 304-7, 304-9, 304-11, 304-15, 304-17, L304-19, 304-24, L304-25, 304-27, L304-28 and 304-32) asked for clarification on whether the levels that trigger the labeling and training provisions are intended to be based on instantaneous exposures, short term exposures, or 8-hour time-weighted averages. OSHA intends for these levels to mean 8-hour time-weighted averages.

The proposed amendments to the formaldehyde standard specified that objective data could be used by the employer in determining anticipated levels of formaldehyde release. This provision remains unchanged in the final amendments and is consistent with paragraph (d)(1)(ii)(B), which is discussed above. Objective data consists of information which demonstrates that a particular product or material cannot release formaldehyde in concentrations exceeding the two labeling triggers of 0.1 ppm or above 0.5 ppm under reasonably foreseeable conditions. Examples of information

which might be used as objective data include representative personal samples, area samples, historical monitoring data, industry-wide studies, lab test results, and manufacturer's data. A full discussion of objective data is contained in the preamble to the 1987 final standard (see 52 FR at 46255-46256).

Paragraph (n)—Employee Information and Training

The final amendments require that employee training be conducted on an annual basis for all employees exposed to formaldehyde concentrations of 0.1 ppm or greater. The 1987 final standard requires initial training for persons exposed at 0.1 ppm or above the action level or STEL. The content of the training is not affected by this final amendment.

OSHA has determined that training for employees exposed to lower concentrations of formaldehyde is necessary for a number of reasons. Training is one of the three main elements of hazard communication. The success of risk management programs requires that employees be aware of hazard, work practice and other information essential to understanding the risks associated with their exposure, and the means of reducing that risk. The continued awareness on the part of the employee depends on constant reminders, such as hazard warning labels. Periodic training becomes especially important for formaldehyde, given the importance of the ancillary provisions in reducing risk, and the exemptions to the labeling requirements, which are discussed above. Although employees will have access to material safety data sheets, MSDSs are a passive source of information. It is anticipated that training will play a more essential role in employees' awareness of the specific hazards in their workplace and control measures employed. This is particularly true for illiterate or non-English speaking workers.

Annual training is also important for successful medical surveillance and MRP. These provisions will only be effective if employees know what signs or symptoms are related to the health effects of formaldehyde, if they know how to properly report them to the employer, and if they are periodically encouraged to do so. The record indicates that signs or symptoms are not uncommon in employees exposed to levels of formaldehyde below the action level and the STEL (52 FR at 46280). It is felt that annual training for employees exposed to lower concentrations of formaldehyde will help assure the

continued effectiveness of the ancillary provisions in reducing the risks of formaldehyde exposure. It will also help identify and assist those employees actually suffering health effects, through improving employee corporation and participation in medical surveillance programs.

Several comments were submitted concerning the employee information and training provision. The Food and Allied Service Trades (304-6) suggested that OSHA strengthen the training program for workers exposed to formaldehyde and recommended several subject areas that should be included. This was not an issue for consideration in the proposed amendments, and OSHA has no evidence that the training provisions of the final formaldehyde standard issued in 1987 are not sufficient. The intent of paragraph (n) as contained in the proposed amendments was to clarify when training is to be conducted for employees exposed to formaldehyde and the frequency of such training. The final amendment requires annual training for all formaldehyde-exposed workers at levels at or above 0.1 ppm.

The Shipbuilders Council of America (Ex. 304-7) and Newport News Shipbuilding (Ex. 304-33) asked OSHA to extend to the start-up date for training by an additional four months beyond the proposed effective date to coincide with the 6 months allowed for the labeling provisions. The commenters' reasoning was that much of the requirement for training would be based on the presence of the manufacturer's label. OSHA agrees that warning labels must be covered under training. However, labeling is broadly required under the HCS and there is no need to delay training simply because the content of the labels may change. In other words, labels conforming to the Hazard Communication Standard will also comply with those required by this amended standard. As labels or other information change, the training, which must be conducted annually, can be modified as needed. Therefore, OSHA feels that the time allocated for the implementation of initial training is appropriate.

The other concerns regarding the training provisions dealt with requests that the 0.1 ppm trigger level that initiates training be specified as an 8-hour TWA. As discussed earlier in this preamble, OSHA interprets the 0.1 ppm trigger to be an 8-hour TWA.

Paragraph (p)—Dates

The final amendments become effective 30 days following publication in the Federal Register. This period

enables employers to familiarize themselves with these new provisions. In addition, individual provisions, where appropriate, have delayed start-up dates.

Employers will be given one year to install any additional engineering controls necessary to achieve the new PEL of 0.75 ppm TWA. Many employers will be able to meet this new PEL presently and will not need any more time; with this in mind, this start-up date section requires that compliance be accomplished as quickly as possible, but no later than a year from the effective date of the amendment.

In those cases where respiratory protection is required, such protection must be provided to employees in compliance with paragraph (g) as quickly as possible but no later than 3 months after the effective date of the amendment. It is felt that this extra time may be needed because some employers may have situations where no respiratory protection was needed to meet the PEL of 1 ppm, while the new PEL of 0.75 ppm may require implementation of respiratory protection programs, at least temporarily until they can achieve compliance with the PEL through the use of engineering controls. Therefore a period of three months is considered necessary for these employers to properly select the appropriate respirator to protect their employees and complete fit testing and other necessary elements of an effective respiratory protection program.

The standard's medical surveillance provisions have been in effect for over two years. Employers have already implemented these provisions, including the administration of medical questionnaires to employees reporting signs or symptoms of formaldehyde exposure or employees exposed above the action level or STEL, medical examinations where appropriate and the receipt of physician's written opinions. Employers may need some additional time to implement the medical removal provisions and to ascertain how to adapt them to their particular workplace. The Agency believes that a six month period is appropriate under the circumstances.

Paragraph (m) of the formaldehyde standard as well as the hazard communication standard already impose general hazard communication requirements on employers handling formaldehyde-containing products in their workplaces. The final amendments would alter somewhat the labeling requirements for containers of certain products capable of releasing small amounts of formaldehyde. The Agency believes that employers handling

formaldehyde products such as those described above may need some additional time to formulate the new labels. Six months is believed to be an appropriate amount of time to accomplish this task in view of the substantial amount of inventory that may be on hand. Moreover, this delayed start-up date would not adversely affect employee health since formaldehyde products would still need to be labeled in the interim in compliance with OSHA's generic hazard communication standard.

The amendments to the final standard increase the frequency with which employees exposed to formaldehyde between 0.1 ppm and 0.5 ppm must receive training. Following initial training, such employees must receive training annually. OSHA has concluded that a two month start-up period for this provision is appropriate to allow the employer to determine which employees must be trained more frequently.

Republication of Standard

In addition to the revisions and amendments discussed above, OSHA is republishing at the end of this document the revised formaldehyde standard in toto. The Agency determined that the republication would be a helpful tool for the public to ascertain information and compliance obligations based on the entire standard as revised. The preamble to the 1987 final rule is not reprinted herein; interested persons are encouraged to refer to the preamble to the original rule for explanations of provisions not changed in this promulgation (see 52 FR 46168, 12/4/87).

Regulatory Impact and Regulatory Flexibility Assessment

Executive Order 12291 (46 FR 13197, February 19, 1981) requires that a regulatory analysis be prepared for any proposed regulation that meets the criteria for a "major rule"; likely to result in an annual impact on the economy of \$100 million or more; have a major increase on cost or prices for consumers, individual industries, federal, state, or local government agencies, or geographic regions; or, have significant adverse effects on competition, employment, investment, productivity, innovation, or on the ability of United States-based enterprises to compete with foreign-based enterprises in domestic or export markets. In addition, the Regulatory Flexibility Act (5 U.S.C. 601, et seq.) requires an analysis of whether a regulation will have a significant economic impact on a substantial number of small entities. Finally, the

Occupational Safety and Health Act requires proof of economic and technological feasibility.

Consistent with these requirements, OSHA has prepared a Regulatory Impact and Regulatory Flexibility Assessment. This regulatory assessment is a supplement to the final Regulatory Impact Analysis (RIA) currently in the docket [Ex. 206].

Industry Profile

As described in the 1987 RIA [Ex. 206], OSHA estimates that approximately 2.2 million workers are exposed to formaldehyde at levels of 0.1 ppm or greater. As a result of the introduction of the 1.0 ppm PEL, no workers should currently be exposed at levels above 1.0 ppm. An estimated 83,818 workers are exposed at levels between 0.75 ppm and 1.0 ppm. The balance of about 2.1 million workers are estimated to be exposed at levels between 0.1 and 0.75 ppm. The largest number of exposures

currently is in the apparel industry, with an estimated 941,300 exposed workers, 58,831 of which have exposures between 0.75 and 1.0 ppm.

For the purpose of this analysis, it is assumed that (1) establishments are in compliance with the existing OSHA standard and (2) exposure levels have responded as projected in the 1987 RIA.

OSHA's estimates of employee exposures to formaldehyde in 1991 are based upon the exposure estimates in the 1987 RIA with two modifying assumptions:

(1) As projected in the 1987 RIA, all employees previously exposed above 1.0 ppm are now exposed at 0.75 ppm;

(2) Exposure levels in textile finishing, laboratories and formaldehyde production are now below 0.75 ppm due to improved work practices for complying with the 1.0 ppm rule as well as other rules which have been implemented since the 1987 formaldehyde rule. Therefore, of the

2,156,801 employees currently exposed to formaldehyde, 1,950,429 employees are exposed between 0.1 ppm and 0.5 ppm.

the remaining employees, 60% (122,554) have exposure levels between 0.5 ppm and 0.75 ppm and 40% (83,818) are exposed between 0.75 ppm and 1.0 ppm.

Only establishments with exposures between the new PEL of 0.75 ppm and the existing PEL of 1.0 ppm would be affected by the new PEL. These establishments are expected to target average exposures at 75% of the new PEL, or 0.56 ppm¹. The number of establishments and exposed employees in affected industries are displayed by exposure level in Table I.

¹ This targeting strategy is consistent with the assumption made in the RIA of the 1987 Standard, in which it was assumed employers would reduce exposures to 75% of the required PEL [Ex. 206, p. V-3].

TABLE I.—NUMBER OF AFFECTED ESTABLISHMENTS AND EMPLOYEES BY FORMALDEHYDE EXPOSURE LEVEL

SIC	Industry	Establishments				Exposed employees			
		0.75–1.0 ppm	0.5–0.75 ppm	0.1–0.5 ppm	Total	0.75–1.0 ppm	0.5–0.75 ppm	0.1–0.5 ppm	Total
2435	Hardwood Plywood.....	33	73	94	200	787	1,242	8,699	10,728
2492	Particleboard.....	8	22	16	46	720	1,021	2,836	4,577
2499	Fiberboard.....	3	12	0	14	294	524	335	1,153
25	Furniture.....	1,323	1,507	2,645	5,475	11,612	12,643	235,095	259,349
2821	Resins.....	0	51	46	97	490	875	8,335	9,700
332, 336	Foundries.....	718	1,765	520	3,002	6,085	10,594	43,322	60,000
806, 807	Laboratories.....	0	3,998	8,167	12,165	0	12,220	24,441	36,661
7261	Funeral Services.....	0	0	15,000	15,000	0	0	30,000	30,000
226	Textile Finishing.....	0	685	0	685	0	19,125	10,298	29,423
23	Apparel.....	2,869	2,869	17,211	22,948	58,831	58,831	823,637	941,300
2869	Formaldehyde Production.....	0	16	33	49	0	480	3,401	3,881
3079	Plastic Molding.....	500	500	4,000	5,000	5,000	5,000	90,000	100,000
2436	Softwood Plywood.....	0	0	250	250	0	0	31,100	31,100
2611	Pulp Mills.....	0	0	43	43	0	0	12,800	12,800
2621	Paper Mills.....	0	0	299	299	0	0	100,100	100,100
2631	Paperboard Mills.....	0	0	222	222	0	0	43,000	43,000
2642	Envelopes.....	0	0	296	296	0	0	19,000	19,000
2653	Corrugated & Solid Fiber Boxes.....	0	0	1,491	1,491	0	0	67,400	67,400
2851	Paints, Pigments.....	0	0	1,441	1,441	0	0	27,600	27,600
2865	Cyclic Crudes, Cyclic Intermediates, Dyes & Organic Pigments.....	0	0	189	189	0	0	16,000	16,000
2879	Agricultural Chemicals, NEC.....	0	0	330	330	0	0	9,700	9,700
2891	Adhesives & Sealants.....	0	0	683	683	0	0	10,900	10,900
2899	Chemicals & Chemical Preparations, NEC.....	0	0	1,439	1,439	0	0	23,100	23,100
3291	Abrasive Products.....	0	0	374	374	0	0	17,000	17,000
3293	Gaskets, Packaging & Sealing Devices.....	0	0	474	474	0	0	21,800	21,800
3296	Mineral Wool Insulation.....	0	0	179	179	0	0	15,500	15,500
3634	Electric Housewares & Fans.....	0	0	263	263	0	0	29,300	29,300
3643	Current-carrying Wiring Devices.....	0	0	415	415	0	0	31,900	31,900
3644	Noncurrent-carrying Wiring Devices.....	0	0	226	226	0	0	18,100	18,100
3694	Electrical Equip. For I.C. Engines.....	0	0	433	433	0	0	32,300	32,300
3792	Mobile Homes Manufacturing.....	0	0	1,655	1,655	0	0	11,200	11,200
7395	Photofinishing Labs.....	0	0	3,589	3,589	0	0	71,742	71,742
806	Hemodialysis.....	0	0	10,500	10,500	0	0	31,500	31,500
822	Biology Instructors.....	0	0	22,575	22,575	0	0	28,950	28,950
822	Veterinary Anatomy.....	0	0	19	19	0	0	38	38
	Total.....	5,453	11,496	95,117	112,066	83,818	122,554	1,950,429	2,156,801

**Totals may not add due to rounding.

Source: U.S. Department of Labor, OSHA, Office of Regulatory Analysis.

Nonregulatory Alternatives

As elaborated in the 1987 RIA [Ex. 206, p. VII-1-14], market mechanisms and actions by other governmental bodies have been inadequate in eliminating significant risk to workers from formaldehyde exposure. For this reason, both a lower PEL and annual training for all workers exposed at 0.1 ppm and above are being instituted. In the case of workers leaving employment for medical reasons, workers compensation or unemployment insurance systems can provide income to workers. These systems, however, vary from state to state and do not provide for complete substitution of wages and benefits. Without medical removal and wage protection safeguards, workers may continue to suffer acute formaldehyde-related symptoms out of fear of job loss.

Technological Feasibility

The feasibility of a 0.75 ppm PEL was not explicitly addressed in the previous record. However, based upon previous contractors' reports and consistent with OSHA's analysis of compliance with the 1.0 ppm PEL, OSHA believes a 0.75 ppm PEL is technologically feasible.

In the 1987 RIA, OSHA judged that it was technologically feasible to achieve compliance with a 1.0 ppm PEL [Ex. 206, p. III-2]. To assure compliance with a 1.0 ppm PEL, OSHA estimated that those establishments with exposures above 1.0 ppm would lower average personal exposures to 75% of the required PEL, or 0.75 ppm². Those establishments with

exposures below 1.0 ppm were judged to be unaffected by the new PEL [Ex. 206, IV-1]. This analysis is consistent with the methodology in the 1986 Heiden report [Ex. 133], which assigned no costs of engineering controls to establishments with exposures below 1.0 ppm.

In this analysis, those establishments with pre-1987 exposures between 1.0 ppm and 0.75 ppm are assumed to lower their exposures to 75% of the new PEL, or 0.56 ppm. These establishments generally had fewer structural or process-inherent exposure problems than those establishments which had exposures above 1.0 ppm in 1987 [Ex. 206, p. IV-19, 20, 30, 32, 46, 51, 52, 58, 59, 61]. Feasibility is not expected to be a problem for these establishments.

Four of the industries—textile finishing, apparel manufacturing, formaldehyde production and plastic molding—are estimated to have potential exposures in excess of 0.5 ppm, but below 1.0 ppm. Both the 1985 Heiden report [Ex. 77-19] and the 1981 Ashford report [Ex. 70-1], identified feasible strategies for reaching exposure levels below 1.0 ppm for these industry sectors.

In the preliminary Regulatory Impact Analysis of July 1991, OSHA estimated 152 nitrogen fertilizer plants have exposures between 0.5 and 1.0 ppm. Since then, OSHA had obtained new data from both the Fertilizer Institute [Ex. L304-35] as well as from OSHA's IMIS database. These data indicate that current work practices have reduced employee exposure to below 0.1 ppm. Thus, the final standard should have no affect upon the nitrogenous fertilizer industry (SIC 2873).

Costs of Compliance

Engineering Controls

Sources available in the record for analyzing the incremental cost of moving from the current 1.0 ppm PEL to a PEL of 0.75 ppm are limited. While a shift to a new technology would be the only means of achieving compliance with a 0.5 ppm PEL in some industries, this is not necessarily the case with respect to a 0.75 ppm PEL. For the purposes of this analysis, OSHA concludes that the technology necessary to comply with a 0.75 ppm PEL would be

exposed to formaldehyde levels of 0.5 ppm or less [Ex. 206, p. II-13, IV-55]. The introduction of engineering controls since the 1987 rule should have moved more employees below 0.75 ppm. OSHA has conducted 101 inspections and 94 exposure readings within the foundry industry since the standard took effect. These data indicate that the majority of foundries inspected had exposures below 0.75 ppm and therefore support the conclusion that a PEL of 0.75 ppm is technologically feasible [Ex. 301-1].

generally the same as that used to bring those plants with exposures above 1.0 ppm prior to 1987 into compliance with a 1.0 ppm PEL.

Unit price assumptions and revenue data within this analysis are based upon the 1987 Producer Price index, as they were for the 1987 Regulatory Impact Analysis.

Foundries

In the 1987 RIA [Ex. 206, p. IV-54], it was estimated that 1,047 foundries had exposures above 1.0 ppm and an additional 1,435 had exposures between 0.5 ppm and 1.0 ppm. It was projected that as a result of the 1.0 ppm PEL, average exposures in the first group would be lowered to 0.75 ppm, and that the second group would remain unchanged. OSHA estimates that half of the second group, or 718 foundries, would need to respond to the new PEL of 0.75 ppm.

As discussed in the 1987 RIA [Ex. 206, p. IV-53], OSHA found that this group is comprised largely of foundries using the shell core process. To comply with the standard, firms would incur capital costs for local exhaust ventilation of \$10,000, with an annual operating cost of \$900 per machine, and would have an average of 3 affected machines per plant [Ex. 206, p. IV-52], for a total capital cost of \$21,540,000 ($718 \times 3 \times \$10,000$) and annual operating costs of \$1,938,600 ($718 \times 3 \times \900). Annualizing the capital cost at 10% over a 10 year expected equipment lifetime results in an annualized cost of \$3,505,536.³ Total annual costs therefore, are projected to be \$5,444,136 (annualized costs plus annual recurring operating costs). It is possible that providing controls for only a portion of the machines would reduce exposures sufficiently to achieve compliance with the proposed PEL, but OSHA conservatively assumes that controls on all three would be necessary.

Hardwood Plywood

In the 1987 RIA [Ex. 206, p. IV-36] it was estimated that forty hardwood plywood establishments had exposures above 1.0 ppm and would lower exposures to 0.75 ppm as a result of the 1.0 ppm PEL. Sixty-six establishments unaffected by the 1.0 ppm PEL were estimated to have exposures between 0.5 ppm and 1.0 ppm. OSHA estimates that half of these establishments, or 33, would be affected by a 0.75 ppm PEL.

³ The annualized cost is derived by applying a cost recovery factor (of 0.163 based on an equipment life expectancy of 10 years and a 10% cost of capital) to total capital costs.

² The assumption within the 1987 Regulatory Impact Analysis that establishments previously above 1.0 ppm would be reduced to 0.75 ppm in response to the 1.0 ppm PEL was a conservative assumption in two respects. First, as a technological matter, in a number of industries, the engineering controls described were shown to be capable of lowering exposures by a factor of 10 or more, in many cases to below 0.5 ppm [Ex. 128, p. 6, 15; 1, Chap III]. However, due to difficulties encountered in lowering exposures in some establishments within certain industries [Ex. 206, Chap III], OSHA employed a generic assumption of 0.75 ppm as the exposure level attainable by establishments after implementing engineering controls.

All exposures above 1.0 ppm were projected to drop to 0.75 ppm. Targeting controls to achieve an effective 0.75 ppm limit provided a critical buffer for unforeseen exposure problems that may arise. Thus, in order to insure compliance with the 1.0 ppm PEL, exposures were projected to drop to 0.75 ppm or lower.

In the 1987 RIA, OSHA indicated that for some foundries, complying with a PEL of 0.5 ppm would not be feasible [Ex. 206, p. III-2]. The Agency's position was summarized in the Foundry section of the technological feasibility analysis: "OSHA therefore concludes that achieving a 0.5 ppm is not feasible by the use of engineering controls." However, OSHA believes that achieving a 0.75 ppm TWA in the foundry industry is technologically feasible. Evidence in the existing record indicates that the majority of foundry employees were

OSHA assumes that plants with exposures between 0.75 ppm and 1.0 ppm have exposure problems similar to those plants which were out of compliance with the 1.0 ppm PEL. These plants were estimated to require fan replacement at an incremental capital cost of \$2,000 and an incremental annual operating cost of \$100 per plant [Ex. 206, p. IV-34]. The costs to come into compliance with a 0.75 ppm PEL in this industry are therefore estimated to be \$66,000 in capital costs and \$3,300 in annual operating costs.

In the 1987 RIA, OSHA stated that some plants could comply with a 1.0 ppm PEL with ventilation alone, others would also need to convert to low-emitting ureaformaldehyde (LEUF) resins [Ex. 206, p. IV-30-35]. While it is possible that some or all of the plants discussed in the previous paragraph could achieve compliance with a 0.75 ppm PEL through increased ventilation alone, OSHA conservatively assumes that these plants would also need to convert to LEUF resins to assure compliance. The 1987 RIA noted a gradual shift to LEUF resins in the hardwood plywood industry [Ex. 206, p. IV-32, 35]. However, establishments with the highest formaldehyde exposures currently are also the least likely to have converted. Due to uncertainty regarding these plants, OSHA is employing the conservative assumption that LEUF resins would be introduced directly as a result of this rule. Using the same method of estimating cost as was used in the 1987 RIA [Ex. 206, p. IV-35], it is estimated that an additional 235 million square feet (MMSF) of board production would need to be converted to LEUF at a cost of \$2,750 per MMSF, or an annual operating cost of \$646,250 ($\$2,750 \times 235$). The total costs associated with complying with a 0.75 ppm in the hardwood plywood industry are therefore estimated to be \$66,000 in capital costs and \$649,550 in annual operating costs for the 33 plants affected within this industry. Annualizing the capital cost at 10% over a 10 year expected equipment lifetime results in an annualized cost of \$10,741. The total annual costs, therefore, are projected to be \$660,291.

Particleboard

In the 1987 RIA [Ex. 206, p. IV-24, 26] it was estimated that 14 out of 46 plants had exposures above 1.0 ppm, and would lower exposures to 0.75 ppm as a result of the standard. An additional 16 plants were estimated to have exposures between 0.5 and 1.0 ppm, 8 of which are estimated to have exposures between 0.75 and 1.0 ppm. Assuming

these plants would need to employ ventilation similar to those with exposures previously above 1.0 ppm, these plants would need additional ventilation at a capital cost of \$215,320 per plant and annual operating costs of \$53,830 per plant [Ex. 206, p. IV-21], or a total capital cost of \$1,722,560 and a total annual operating cost of \$430,640. Based upon the annualized capital cost of \$280,339 and the recurring annual operating cost, total annual costs are \$710,979.

Medium Density Fiberboard (MDF)

The 1987 RIA [Ex. 206, p. IV-27, 29, 31] projected that 9 MDF establishments would lower exposures to 0.75 ppm as a result of the 1.0 ppm PEL. It is estimated that 5 additional establishments have exposures between 0.5 and 1.0 ppm. It is estimated that approximately half, or 3 of these establishments would be affected by a 0.75 ppm PEL.

In the 1987 RIA it was estimated that the capital costs of lowering exposures to 0.75 ppm through additional ventilation would be \$105,534 per plant, with annual operating costs of \$63,486. Applying these costs to the 3 affected plants, OSHA estimates that cost of additional ventilation in this industry would be \$316,602 in capital costs, and \$190,458 in annual operating costs. The annualized cost of capital is equal to \$51,526 using the 10%, 10 year expected equipment lifetime cost recovery value. Thus, the total annualized costs for this industry is projected to be \$241,984.

Furniture

In the 1987 RIA, it was estimated that 184 plants had exposures above 1.0 ppm and would lower exposures to 0.75 ppm in response to the 1.0 ppm PEL. These were all facilities producing both furniture and board ("integrated" plants), with hazardous exposures in board production operations rather than furniture operations. There were an additional 2,649 establishments that had exposures estimated between 0.5 and 1.0 ppm, mostly furniture assembly plants with relatively isolated exposures above 0.5 ppm [Ex. 206, p. IV-43-44].

It was assumed that one-half of these, or 1,323 plants, have exposures between 0.75 ppm and 1.0 ppm. However, as noted in the 1987 RIA [Ex. 206, p. IV-44], in many of these plants, the exposure problems were due to improper use of non-use of existing ventilation systems. Poor work practices may also be responsible. In this regard, more training, not additional engineering controls, would remedy the exposure problems.

To the extent that available ventilation is utilized, there would be an

increase in operating costs for these furniture plants. One basis for estimating these costs is the cost of annual exhaust ventilation employed by Ashford [Ex. 70-1]. The annual operating cost related to increased usage was estimated to be approximately \$864 per establishment. However, OSHA assumes that this additional per plant cost would apply to only half of annual work days, or \$432 annually. This cost would be incurred at 1,323 plants and the estimated cost of compliance at these plants would be \$571,536 annually.

In approximately 214 plants (one half the integrated plants unaffected by the 1.0 ppm PEL) additional ventilation would likely be necessary to comply with a 0.75 ppm PEL. Based upon the analysis in the 1987 RIA [Ex. 206, p. IV-42], OSHA estimates that capital costs would be \$52,000 per plant, or \$11,128,000 for all furniture plants. The annual operating costs would be \$13,000 per plant, or \$2,782,000 for all "integrated" plants, or a total for the industry of \$3,353,536. Annualizing the capital cost at 10% over a 10-year expected equipment lifetime results in an annualized cost of \$1,811,031; total annual costs, therefore, are projected to be \$5,164,567.

Laboratories

In the 1987 RIA analysis of formaldehyde exposures in laboratories [Ex. 206, p. IV-58-59, 61], a clear dichotomy was found between laboratories with functioning fume hoods and good work practices and those without them. High exposure levels were believed to exist in "problem" histology and pathology labs as a result of malfunctioning or misused fume hoods or poor work practices. Engineering controls and good work practices implemented in response to the existing standard, should have largely eliminated exposures above 0.5 ppm [Ex. 128, p. 4, 6, 9]. Exposures in some laboratories also show significant peak periods or episodes [Ex. 128, p. 5]. To the extent that laboratories are in compliance with the existing 2.0 ppm STEL, they should also be in compliance with a 0.75 ppm PEL [Ex. 128, p. 9]. Therefore, no engineering controls are thought to be necessary.

Funeral Services

The 1987 RIA indicated, based upon a study of 44 Iowa funeral homes, that TWA exposures were less of a problem than short-term exposures in this industry sector. TWA exposures were estimated to be below 0.5 ppm for all establishments in compliance with the

present standard [Ex. 206, p. IV-66]. Annual training for employees exposed between 0.1 and 0.5 ppm should improve work practices and help reduce short term exposures. No engineering controls are thought to be necessary for this.

Resins

OSHA's 1987 RIA indicated that 35 of 97 plants had partially open production processes and would need to install engineering controls, lowering exposures to 0.75 ppm. The other 62 plants had a closed production process and were not believed to have exposures above 0.5 ppm [Ex. 206, p. IV-70]. No additional engineering control costs are estimated for this industry.

Textile Finishing

At the time of the 1987 rulemaking, OSHA estimated that there were 685 textile finishing plants with formaldehyde exposures between 0.5 and 1.0 ppm [Ex. 206, p. 78, 80]. Approximately half, or 343, were estimated to have exposures between 0.75 and 1.0 ppm.

The Ashford report examined methods [Ex. 70-1] which would be expected to lower exposures in many areas of textile plants. However, the textile industry indicated that as of 1986, they were using the most chemically advanced resins available, and a further reduction of formaldehyde content in cloth would come only at the expense of a significant decrease in fabric quality [Ex. 159].

However, in 1989 OSHA lowered permissible exposure limits (PELs) on about 200 chemicals and instituted first time PELs for about 160 others. Since the textile finishing industry uses a large number of regulated chemicals, OSHA believes that improved ventilation is being introduced in order to limit chemical exposure generally [54 FR 2816, 1/19/89]. Recent OSHA inspection data have indicated no personal exposures to formaldehyde above 0.5 ppm in this industry [Ex. 301-1]. OSHA therefore believes that all textile

finishing plants are currently in compliance with a 0.75 ppm PEL.

Apparel

In the 1987 RIA, OSHA estimated that 5,737 establishments had exposures between 0.5 and 1.0 ppm. OSHA estimates that approximately half of these, or 2,869 establishments, may have exposures between 0.75 and 1.0 ppm.

The record indicates that exposure problems in the apparel industry are due to the lack of appropriate exhaust ventilation. That is, the workplace is treated like an office or store and air is recirculated rather than exhausted and replaced, allowing formaldehyde concentrations to build [Ex. 78-24, 78-48]. A relatively simple solution to this problem of air stagnation is to install roof exhaust fans. These fans will also provide the additional benefit of exhausting the excess heat and formaldehyde present within the air. Ashford cited the cost of installing a 2,000 cubic feet per minute (cfm) roof exhaust fan at \$1,000, with an annual operating cost of \$720 [Ex. 70-1, p. 4-19]. Factoring in inflation, the capital cost is now estimated to be approximately \$1,200, and the incremental annual operating cost \$864. OSHA, therefore, estimates the cost of compliance with the lower PEL in the apparel industry to be \$3,442,800 for capital and \$2,478,816 for annual operating costs. Annualizing the capital cost at 10% over a 10 year expected equipment lifetime results in an annualized cost of \$560,300; total annual costs, therefore, are projected to be \$3,039,116.

Formaldehyde Production

The 1987 RIA estimated that approximately 16 out of 49 establishments would have exposures above 0.5 ppm after promulgation of the standard; the 1987 RIA indicated no exposures above 0.7 ppm [Ex. 206, p. IV-78].

Ashford [Ex. 70-1] developed formaldehyde production engineering control cost estimates in 1981 and

indicated costs of compliance to meet all potential exposure limits. (However, Ashford actually had very little information on formaldehyde production operations and based his cost estimates on vinyl chloride monomer production operations.) In 1985 Heiden indicated that such plants were already in compliance with a 1.0 ppm PEL [Ex. 77-19]. Consistent with the above analysis and data, OSHA believes no additional controls would be necessary to achieve compliance with a 0.75 ppm PEL.

Plastic Molding Laminates

In its 1987 RIA, OSHA estimated that approximately 1,000 plants have exposures between 0.5 and 1.0 ppm [Ex. 206, p. IV-75, 76]. OSHA estimates that approximately half, or 500 plants, have exposures between 0.75 and 1.0 ppm. Ashford [Ex. 70-1] estimated that there was one molding machine for every four workers, the capital cost for local ventilation was \$425 per machine and the annual operating cost was approximately \$133 per machine. Given the estimated 5,000 workers exposed between 0.75 and 1.0 ppm, ventilation would be required for 1,250 machines. OSHA estimates the capital cost would be \$510 per machine and the annual operating cost \$160. Based upon these unit costs, OSHA estimates \$637,500 in capital costs and \$200,000 in annual operating costs. The annualized capital cost amounts to \$103,750. Therefore, total annual cost of compliance for this industry is expected to be \$303,750.

Summary of Engineering Control Costs

OSHA estimates the total capital costs of instituting engineering controls which would be sufficient to comply with a 0.75 ppm PEL to be \$38.9 million, with annual operating costs of \$9.2 million. The annualized cost of the engineering control capital costs is estimated to be \$6.4 million, for a total annual cost of \$15.6 million. An annual cost summary for each industry is provided in Table II.

TABLE II.—ANNUAL COSTS OF ENGINEERING CONTROLS IN COMPLIANCE WITH THE REVISED FORMALDEHYDE STANDARD

(1987 dollars)

SIC	Industry	Capital cost	Annualized capital cost	Annual operating cost	Total annual cost
332,336	Foundries	\$21,540,000	\$3,505,536	\$1,938,600	\$5,444,136
2435	Hardwood Plywood	66,000	10,741	649,550	660,291
2492	Particleboard	1,722,560	280,339	430,640	710,979
2499	Fiberboard	316,602	51,526	190,458	241,984
25	Furniture	11,128,000	1,811,031	3,353,536	5,164,567
23	Apparel	3,442,800	560,300	2,478,816	3,039,116
3079	Plastic Molding	637,500	103,750	200,000	303,750
Total		38,853,462	6,323,222	9,241,600	15,564,822

Source: U.S. Department of Labor, OSHA, Office of Regulatory Analysis.

Medical Removal Protection

The medical removal process begins when an employee reports signs and symptoms of possible overexposure to formaldehyde. OSHA previously estimated that 10 percent of workers exposed between 0.1 and 0.5 ppm would report signs and symptoms [Ex. 206, p. IV-11]. These workers would fill out a medical questionnaire, after which a two week evaluation and remediation period would begin. If the symptoms have not subsided after two weeks, the employee would be immediately referred to a physician. The physician might, in turn recommend transferring the employee to a job with significantly less formaldehyde exposure.

OSHA's medical removal provision is a codified version of plans that already exist in a number of companies [Ex. 159]. Companies with current removal programs have noted that placement in another job because of formaldehyde exposure, is rare. The former medical director of Burlington Industries reported that "clearly less than ten percent" of employees completing medical questionnaires required further medical evaluation. He added that among all exposed employees, only about one percent had symptoms that were clearly "chemically related" [Tr. 160, May 12, 1986]. The American Textile Manufacturers Institute stated that " * * * most companies have a complaint mechanism in place to discover individuals with problems * * *. Corporate medical surveillance programs show absolutely no evidence that contact dermatitis or allergic reaction from formaldehyde is a frequent problem [Ex. 159]." The medical director for the Dan River Clinic, indicated that over a 10 year period he received "no complaints about formaldehyde irritation or formaldehyde induced dermatological problems" [Ex. 159]. This clinic provides medical examinations for 6,000-12,000 company employees, 25 percent of whom are exposed to formaldehyde at levels between 0.15 and 1.0 ppm in textile operations.

There are, however, additional safeguards in the final provision that may increase the frequency of medical removal. The amended standard provides for additional training, which

should increase employee awareness of the signs and symptoms of formaldehyde exposure, as well as an understanding of their rights under medical removal protection (MRP) and the proper channels to follow in using it. Additionally, under the final rule, an employee is allowed to appeal the company doctor's decision. Therefore, it is reasonable to expect some increase in the amount of transfer and removal over what is currently reported.

Based upon the discussion above, OSHA estimates that one percent, or 22,000 of all employees exposed to formaldehyde may require medical removal protection as provided for in the final rule. These employees are already provided medical surveillance under the present standard and a large number of employers presently provide for medical removal in one form or another. Thus, the additional burden imposed by this amendment is expected to be small. It is estimated that most sensitized employees will be transferred out of higher exposure areas into other jobs.

However, a potentially significant cost of this provision would be the requirement to provide 6 months compensation to employees for whom alternate jobs would not be available. Although the record on medical removal programs in larger companies suggests that alternate jobs are usually available [Ex. 159], the effect of universal medical removal protection on small firms is uncertain. For the purposes of estimating the impact of this provision, OSHA assumes that 30 percent of 2,200 sensitized employees in smaller establishments, or 660 employees will not be provided alternate positions by their employer and therefore must be provided six months compensation. By this assumption, the cost would be \$6.0 million annually.

The existence of current medical removal plans in industry points to the fact that it makes economic sense to have a medical removal program. Workers who suffer adverse health effects from formaldehyde exposure can be moved to positions where they can contribute productively to a firm's operation. OSHA anticipates offsetting cost savings from this provision in the

form of reduced absenteeism and reduced medical care costs.

Hazard Communication

In an expansion of the existing standard, workers exposed between 0.1 and 0.5 ppm are now required to receive annual training on the hazards of formaldehyde and ways to avoid them. OSHA estimates the cost of this to be \$13.5 million per year.

Based upon the 1987 RIA [Ex. 206, p. I-3], OSHA estimates that there are currently approximately 2 million employees exposed to formaldehyde between 0.1 and 0.5 ppm. OSHA estimates that when current compliance is accounted for, it would take an additional half an hour annually, on average, to provide training specific to formaldehyde for these employees⁴. Employing the data and methodology used in the RIA [Ex. 206, p. 15], OSHA estimates the cost of training as follows:

Employee Training Cost: # of employees between 0.1 and 0.5 ppm $\times$ (1 + $\frac{1}{2}$ turnover rate⁵) $\times$ (wage $\times$ 1.3 fringe rate) $\times$ $\frac{1}{2}$ hour

Trainer cost in establishments with 20 employees or more: # of employees exposed between 0.1 and 0.5 ppm $\times$ (1 + $\frac{1}{2}$ turnover rate) / 20 $\times$ \$26⁶ $\times$ $\frac{1}{2}$ hour

Trainer cost in establishments with 20 or fewer employees: # of affected establishments $\times$ \$26 $\times$ $\frac{1}{2}$ hour

A summary of the compliance costs of these revisions to the standard for each industry are provided in Table III.

⁴ In the 1987 RIA, OSHA estimated that one hour training would be a reasonable estimate of the amount of time required for the annual training in the average establishment [Ex. 206, p. IV-15]. However, the original RIA training costs did not factor in current compliance. In the apparel industry, with almost half of the affected employees, little time would be needed to train employees on these provisions. Moreover, in addition to whatever baseline existed before, the current standard has likely spurred additional training for employees with exposure below 0.5 ppm, in part because some establishments may have chosen to establish training programs for all employees, not just new employees or those exposed above 0.5 ppm.

⁵ While the exact turnover rate varies by industry, OSHA has assumed that $\frac{1}{2}$ each industry's turnover rate reflects the percent of employees leaving a job who were already trained in that year. [Ex. 206, p. IV-4]

⁶ Trainer hourly compensation [Ex. 206, p. IV-15].

TABLE III.—ANNUAL COSTS OF COMPLYING WITH THE REVISED FORMALDEHYDE STANDARD

[1987 Dollars]

SIC	Industry	Engineering controls	Medical removal protection	Training	Total
2435	Hardwood Plywood	\$660,291	\$28,451	\$50,720	\$739,461
2492	Particleboard	710,979	12,834	17,634	741,447
2499	Fiberboard	241,984	3,233	2,011	247,227
25	Furniture	5,164,567	752,527	1,498,668	7,415,761
2821	Resins	0	49,860	81,433	131,293
332,336	Foundries	5,444,136	279,162	397,961	6,121,259
806,807	Laboratories	0	133,827	321,714	455,541
7261	Funeral Services	0	91,962	363,597	455,559
226	Textile Finishing	0	83,423	62,996	146,419
23	Apparel	3,039,116	2,132,891	4,367,703	9,539,710
2869	Formaldehyde Production	0	11,594	25,461	37,055
3079	Plastic Molding	303,750	317,460	630,934	1,252,144
2436	Softwood Plywood	0	100,903	193,398	294,301
2611	Pulp Mills	0	41,529	90,578	132,107
2621	Paper Mills	0	324,772	708,344	1,033,116
2631	Paperboard Mills	0	139,512	304,284	443,796
2642	Envelopes	0	61,645	142,735	204,380
2653	Corrugated & Solid Fiber Boxes	0	218,678	492,770	711,448
2865	Cyclic Crudes, Cyclic Intermediates, Dyes & Organic Pigment	0	51,912	112,685	164,597
2851	Paints, Pigments	0	89,548	203,638	293,186
2879	Agricultural Chemicals, NEC	0	31,471	70,593	102,064
2891	Adhesives & Sealants	0	35,365	79,691	115,056
2899	Chemicals & Chemical Preparations, NEC	0	74,947	168,887	243,834
3291	Abrasive Products	0	55,156	123,149	178,305
3293	Gaskets, Packaging & Sealing Devices	0	70,730	157,920	228,650
3296	Mineral Wool Insulation	0	50,289	112,283	162,572
3634	Electric Housewares & Fans	0	95,063	218,147	313,210
3643	Current-carrying Wiring Devices	0	103,499	235,365	338,863
3644	Noncurrent-carrying Wiring Devices	0	58,725	133,545	192,270
3694	Electrical Equip. For I.C. Engines	0	104,797	231,816	336,613
3792	Mobile Homes Manufacturing	0	36,338	91,275	127,613
7395	Photofinishing Labs	0	232,765	520,050	752,815
806	Hemodialysis	0	102,201	460,368	562,569
822	Biology Instructors	0	93,928	759,151	853,078
822	Veterinary Anatomy	0	123	494	617
Total		15,564,822	6,071,119	13,431,998	35,067,940

Source: U.S. Department of Labor, OSHA, Office of Regulatory Analysis

Benefits

OSHA expects these final revisions to the standard to produce quantifiable benefits in the form of reduced cancer incidence due to the lowered PEL and increased training, and reduced acute respiratory irritation due to the institution of medical removal protection. In addition, OSHA expects that the lower PEL and increased training would improve worker productivity through a lessening of irritation and an improved understanding of workplace processes.

Cancers Avoided

An estimated 83,818 workers are currently exposed above 0.75 ppm, at an average formaldehyde concentration of 0.875 ppm. This exposure is expected to be reduced to an average of 0.5625 ppm after implementation of the 0.75 ppm PEL. The 1987 RIA employed a cancer risk model developed by the Consumer Product Safety Commission based upon rat studies [Ex. 206, p. V-1-5]. Based upon this model, OSHA estimates that from 0.2 to 72 cancers would be avoided

over the next 45 years by lowering the PEL from 1 to 0.75 ppm, depending on whether the Maximum Likelihood Estimate (MLE) or the Upper Confidence Limit (UCL) is used in the risk assessment⁷. Lowering exposure levels should also bring some decrease in respiratory distress and may result in greater worker productivity, as described further below.

OSHA believes that the additional training would also provide health benefits. Annual training ensures that the knowledge and appreciation of the hazard and ways to limit exposure through good work practices are reinforced continually.

⁷ Based upon the CPSC five-stage model, the Maximum Likelihood Estimate of Risk (MLE) is expressed as:

$$EP(d) = 0.3954783163 \times 10^{-5} \times (\text{dose in ppm})^4 + 0.1597258396 \times 10^{-5} \times (\text{dose in ppm})^5$$

where
EP(d) = the excess probability of cancer attributable to formaldehyde

The Upper Confidence Limit (UCL) is approximately linear at low doses and, for the purposes of this analysis, could be expressed as:
 $EP(d) = 264 \times 10^{-5} \times (\text{dose in ppm})$

The projected benefits of the hazard communication rule were a 20% reduction in all chemically related worker illnesses as the result of labeling, MSDSs and initial training. With the specific exposure reductions noted in the industry discussion, OSHA expects an additional 5% reduction in formaldehyde-related illnesses among the workers exposed between 0.1 and 0.5 ppm. Using the same risk model used to project benefits from lowering the PEL, OSHA estimates that, given a 5% risk reduction from annual training, an additional .004 to 79 cancers would be avoided over the next 45 years as a result of annual training⁸.

In sum, OSHA estimates that lowering the PEL and providing additional training could prevent as many as 151 cancers over the next 45 years based upon the upper confidence limit risk assessment model. However, the

⁸ This was estimated by using the MLE and the UCL applied to all employees exposed to formaldehyde between 0.5 and 0.1 ppm, assuming an average exposure of 0.3 ppm, and a 5% reduction in risk.

maximum likelihood estimate of risk, produces only negligible benefits related to the final revisions.

Non-Carcinogenic Benefits

In the 1987 RIA, OSHA estimated that 5,911 cases of respiratory distress would be eased by lowering the PEL to 1.0 ppm [Ex. 206, p. V-9-11]. These same symptoms persist at very low exposure levels for a small percentage of the population. These employees would be directly aided by medical removal protection.

There are approximately 2,156,801 employees exposed to formaldehyde at 0.1 ppm or greater. As discussed in the 1987 RIA, employee exposure to formaldehyde can cause eye, nose, and throat irritation, coughing, headaches, chest discomfort, changes in lung function, impaired physical performance and exacerbation of asthma. OSHA estimates that as many as 1%, or 21,568 workers may be removed annually for respiratory distress. This represents a potential cost savings to society since the protected worker will be more

productive when not experiencing health problems.

Economic Impact and Regulatory Flexibility

An analysis of revenue and profit data provided in the 1987 RIA indicates that the costs to comply (without consideration of cost savings) with these amendments would not have a significant adverse impact on a substantial number of small entities nor on the economy as a whole. In only the fiberboard industry are costs expected to be as much as 0.1% of revenue, and costs are expected to be less than 1% of profits in all but a few industries. The greatest potential impact on profits would be in the hardwood plywood industry, where compliance costs are estimated to be 5.4% of profits.

Smaller establishments should not be disproportionately impacted. Although it is possible that a small number of marginal firms may have to cease operations, OSHA estimates that most of these firms should be able to absorb the costs of this standard. Most of the costs in the hardwood plywood industry

are attributed to the capital and operating costs associated with the introduction of LEUF resins, and these costs are directly proportional to sales. In the furniture industry, most of the engineering control costs would be absorbed by a minority of larger plants. Human resource costs, such as removal protection and training are generally proportional to the number of employees, and therefore would not have a disproportionate impact on small businesses. The requirement to give employees six month removal compensation might be more burdensome to small businesses due to limited availability of alternate jobs, but this should be a particularly rare event. Since the likelihood of encountering such formaldehyde-sensitive employees is directly related to the number of employees in a business, this provision is not expected to impact a substantial number of small entities. Estimates of average compliance costs per establishment, as a percentage of revenues and profits are provided for all affected industries in Table IV.

TABLE IV.—COST OF PROPOSED AMENDMENTS TO FORMALDEHYDE STANDARD AS A PERCENTAGE OF REVENUES AND PROFIT

SIC	Industry	Annual costs (\$)	Cost per establishment	Costs as % of revenue	Cost as % of profits
2435	Hardwood Plywood	739,461	3,697	0.075	5.35
2492	Particleboard	741,447	16,118	0.089	1.78
2499	Fiberboard	247,227	17,659	0.102	2.04
25	Furniture	7,415,761	1,355	0.080	3.09
2821	Resins	131,293	1,354	0.003	0.08
332, 336	Foundries	6,121,259	2,039	0.049	1.63
806, 807	Laboratories	455,541	37	0.000	NA
7261	Funeral Services	455,559	30	0.009	0.10
226	Textile Finishing	146,419	214	0.003	0.16
23	Apparel	9,539,710	416	0.018	0.57
2869	Formaldehyde Production	37,055	756	0.002	0.03
3079	Plastic Molding	1,252,144	250	0.006	NA
2436	Softwood Plywood	294,301	1,177	0.004	0.09
2611	Pulp Mills	132,107	3,072	0.004	0.09
2621	Paper Mills	1,033,116	3,455	0.004	0.09
2631	Paperboard Mills	443,796	1,999	0.004	0.09
2642	Envelopes	204,380	690	0.010	0.26
2653	Corrugated & Solid Fiber Boxes	711,448	477	0.005	0.14
2865	Cyclic Crudes, Cyclic Intermediates, Dyes	164,597	871	0.002	0.04
2851	Paints, Pigments	293,186	203	0.003	0.07
2879	Agricultural Chemicals, NEC	102,064	309	0.002	0.05
2891	Adhesives & Sealants	115,056	168	0.003	0.07
2899	Chemicals & Chemical Preparations, NEC	243,834	169	0.003	0.08
3291	Abrasive Products	178,305	477	0.005	0.27
3293	Gaskets, Packaging & Sealing Devices	228,650	482	0.010	NA
3296	Mineral Wool Insulation	162,572	908	0.005	NA
3634	Electric Houseware & Fans	313,210	1,191	0.010	0.19
3643	Current-carrying Wiring Devices	338,863	817	0.010	0.20
3644	Noncurrent-carrying Wiring Devices	192,270	851	0.008	0.18
3694	Electrical Equip. For I.C. Engines	336,613	777	0.006	0.12
3792	Mobile Homes Manufacturing	127,613	77	0.009	0.32
7395	Photofinishing Labs	752,815	210	0.026	0.60
806	Hemodialysis	562,569	54	0.000	NA
822	Biology Instructors	853,078	38	0.001	NA
822	Veterinary Anatomy	617	32	0.000	NA

Source: U.S. Department of Labor, OSHA, Office of Regulatory Analysis

Environmental Impact Analysis

The National Environmental Policy Act of 1969, 42 U.S.C. 4321 *et. seq.*, requires OSHA to determine whether this regulatory action would have a significant impact on the environment. These amendments would not increase the amount of formaldehyde found in the general environment and may decrease it as some establishments switch to low-emitting resins. Therefore, the Agency believes that these provisions would not have a significant impact on the environment. No comments made at the public hearing or submitted to the record contradict this conclusion.

Paperwork Reduction

The amended paragraphs of the formaldehyde standard do not have information collection requirements subject to OMB review under the Paperwork Reduction Act. The existing paperwork requirements were approved by OMB under control number 1218-0145.

Federalism and State Plan Applicability

This final standard has been reviewed in accordance with Executive Order 12612, 52 FR 41685 (October 30, 1987), regarding Federalism. This Order requires that agencies, to the extent possible, refrain from limiting state policy options, consult with States prior to taking any actions that would restrict State policy options, and take such actions only when there is clear constitutional authority and the presence of a problem of national scope. The Order provides for preemption of State law only if there is a clear Congressional intent for the agency to do so. Any such preemption is to be limited to the extent possible.

Section 18 of the Occupational Safety and Health Act (OSH Act), expresses Congress' clear intent to preempt State laws with respect to which Federal OSHA has promulgated occupational safety or health standards. Under the OSH Act, a State can avoid preemption only if it submits, and obtains Federal approval of, a plan for the development of such standards and their enforcement. Occupational safety and health standards developed by such Plan-States must, among other things, be at least as effective as the Federal standards in providing safe and healthful employment and places of employment.

Those States which have elected to participate under Section 18 of the OSH Act would not be preempted by this regulation and would be able to deal with special, local conditions within the framework provided by this performance-oriented standard while ensuring that their standards are at least as effective as the Federal standard.

The 25 States with their own OSHA-approved occupational safety and health plans must adopt a comparable standard within six months of publication of a final rule. The States are: Alaska, Arizona, California, Connecticut, Hawaii, Indiana, Iowa, Kentucky, Maryland, Michigan, Minnesota, Nevada, New Mexico, New York, North Carolina, Oregon, Puerto Rico, South Carolina, Tennessee, Utah, Vermont, Virginia, Virgin Islands, Washington, Wyoming. For New York and Connecticut, plans cover only State and local government employees. Until such time as a State standard is promulgated, Federal OSHA will provide interim enforcement assistance, as appropriate, in these States.

Authority and Signature

This document was prepared under the direction of Dorothy L. Strunk, Acting Assistant Secretary of Labor for Occupational Safety and Health, 200 Constitution Avenue, NW., Washington DC 20210. Pursuant to the authority of section 4(b)(2), 6(b), and 8(c) of the Occupational Safety and Health Act of 1970 (the Act) (29 U.S.C. 653, 655, 657), the Construction Safety Act (40 U.S.C. 333), the Longshore and Harbor Workers' Compensation Act (33 U.S.C. 941), the Secretary of Labor's Order 1-90 (55 FR 9033), 29 CFR part 1911, 29 CFR part 1910 is amended as set forth below. As with the original standard covering occupational exposure to formaldehyde, this final amendment of that standard would also apply to the maritime and construction industries.

List of Subjects in 29 CFR Part 1910

Formaldehyde, Occupational Safety and Health, Chemicals, Cancer.

Signed at Washington, DC this 15th day of May, 1992.

Dorothy L. Strunk,
Acting Assistant Secretary of Labor.

PART 1910—[AMENDED]

Part 1910 of title 29 of the Code of Federal Regulations is therefore amended as follows:

1. The authority citation for subpart Z of part 1910 continues to read in part as follows:

Authority: Secs. 6, 8, Occupational Safety and Health Act, 29 U.S.C. 655, 657; Secretary of Labor's Orders 12-71 (36 FR 8754), 8-76 (41 FR 25059), 9-83 (48 FR 35736) or 1-90 (55 FR 9033) as applicable; and 29 CFR part 1911.

Section 1910.1048 also issued under 29 U.S.C. 653.

2. In § 1910.1048, Table 1 is removed from paragraph (g)(3)(ii), and paragraphs (c)(1), (d)(1)(ii), (g)(2)(i) (including Table 1), (g)(3)(iv), (m)(1) introductory text, (m)(1)(i), (m)(3), (m)(4), (n)(1) and (n)(2) are revised; and paragraphs (d)(2)(iii), (1)(8), (1)(9), (m)(5) and (p)(3) are added to read as follows:

§ 1910.1048 Formaldehyde.

(c) *Permissible Exposure Limit (PEL)*—(1) TWA: The employer shall assure that no employee is exposed to an airborne concentration of formaldehyde which exceeds 0.75 parts per million (ppm) as an 8-hour TWA.

(d) *Exposure monitoring*—(1) *General*.

(ii) *Exception*. Where the employer documents, using objective data, that the presence of formaldehyde or formaldehyde-releasing products in the workplace cannot result in airborne concentrations of formaldehyde that would cause any employee to be exposed at or above the action level or the STEL under foreseeable conditions of use, the employer will not be required to measure employee exposure to formaldehyde.

(2) *Initial monitoring*.

(iii) If the employer receives reports of signs or symptoms of respiratory or dermal conditions associated with formaldehyde exposure, the employer shall promptly monitor the affected employee's exposure.

(g) *Respiratory protection*.

(2) *Respiratory selection*. (i) The appropriate respirators as specified in Table 1 shall be selected from those approved by the Mine Safety and Health Administration (MSHA) and by the National Institute for Occupational Safety and Health (NIOSH) under the provisions of 30 CFR part 11.

TABLE 1.—MINIMUM REQUIREMENTS FOR RESPIRATORY PROTECTION AGAINST FORMALDEHYDE

Condition of use or formaldehyde concentration (ppm)	Minimum respirator required ¹
Up to 7.5 ppm. (10 × PEL).	Full facepiece with cartridges or canisters specifically approved for protection against formaldehyde. ²
Up to 75 ppm. (100 × PEL).	Full-face mask with chin style or chest or back mounted type with industrial size canister specifically approved for protection against formaldehyde. Type C supplied-air respirator, pressure demand or continuous flow type, with full facepiece, hood, or helmet.
Above 75 ppm. or unknown (emergencies). (100 × PEL).	Self-contained breathing apparatus (SCBA) with positive pressure full facepiece.
22	Combination supplied-air, full facepiece positive pressure respirator with auxiliary self-contained air supply.
Firefighting.....	SCBA with positive pressure in full facepiece.
Escape.....	SCBA in demand or pressure demand mode. Full-face mask with chin style or front or back mounted type industrial size canister specifically approved for protection against formaldehyde.

¹ Respirators specified for use at higher concentrations may be used at lower concentrations.

² A half-mask respirator with cartridges specifically approved for protection against formaldehyde can be substituted for the full facepiece respirator providing that effective gas-proof goggles are provided and used in combination with the half-mask respirator.

(3) Respirator usage. ***

(iv) Unless the canister contains a NIOSH-approved end-of-service-life indicator to show when breakthrough occurs, canisters used in atmospheres up to 7.5 ppm (10 × PEL) shall be replaced every 4 hours and industrial sized canisters used in atmospheres up to 75 ppm (100 × PEL) shall be replaced every two hours or at the end of the workshift, whichever is sooner.

(1) Medical surveillance. ***

(8) Medical removal. (i) The provisions of paragraph (1)(8) apply when an employee reports significant irritation of the mucosa of the eyes or of the upper airways, respiratory sensitization, dermal irritation, or dermal sensitization attributed to workplace formaldehyde exposure. Medical removal provisions do not apply in the case of dermal irritation or dermal sensitization when the product suspected of causing the dermal condition contains less than 0.05% formaldehyde.

(ii) An employee's report of signs or symptoms of possible overexposure to formaldehyde shall be evaluated by a physician selected by the employer pursuant to paragraph (1)(3). If the physician determines that a medical examination is not necessary under paragraph (1)(3)(ii), there shall be a two-week evaluation and remediation period to permit the employer to ascertain whether the signs or symptoms subside untreated or with the use of creams, gloves, first aid treatment or personal protective equipment. Industrial hygiene measures that limit the employee's exposure to formaldehyde may also be implemented during this period. The employee shall be referred immediately to a physician prior to expiration of the two-week period if the signs or

symptoms worsen. Earnings, seniority and benefits may not be altered during the two-week period by virtue of the report.

(iii) If the signs or symptoms have not subsided or been remedied by the end of the two-week period, or earlier if signs or symptoms warrant, the employee shall be examined by a physician selected by the employer. The physician shall presume, absent contrary evidence, that observed dermal irritation or dermal sensitization are not attributable to formaldehyde when products to which the affected employee is exposed contain less than 0.1% formaldehyde.

(iv) Medical examinations shall be conducted in compliance with the requirements of paragraph (1)(5)(i) and (ii). Additional guidelines for conducting medical exams are contained in appendix C.

(v) If the physician finds that significant irritation of the mucosa of the eyes or of the upper airways, respiratory sensitization, dermal irritation, or dermal sensitization result from workplace formaldehyde exposure and recommends restrictions or removal, the employer shall promptly comply with the restrictions or recommendation of removal. In the event of a recommendation of removal, the employer shall remove the affected employee from the current formaldehyde exposure and if possible, transfer the employee to work having no or significantly less exposure to formaldehyde.

(vi) When an employee is removed pursuant to paragraph (1)(8)(v), the employer shall transfer the employee to comparable work for which the employee is qualified or can be trained in a short period (up to 6 months), where the formaldehyde exposures are as low as possible, but not higher than the action level. The employer shall

maintain the employee's current earnings, seniority, and other benefits. If there is no such work available, the employer shall maintain the employee's current earnings, seniority and other benefits until such work becomes available, until the employee is determined to be unable to return to workplace formaldehyde exposure, until the employee is determined to be able to return to the original job status, or for six months, whichever comes first.

(vii) The employer shall arrange for a follow-up medical examination to take place within six months after the employee is removed pursuant to this paragraph. This examination shall determine if the employee can return to the original job status, or if the removal is to be permanent. The physician shall make a decision within six months of the date the employee was removed as to whether the employee can be returned to the original job status, or if the removal is to be permanent.

(viii) An employer's obligation to provide earnings, seniority and other benefits to a removed employee may be reduced to the extent that the employee receives compensation for earnings lost during the period of removal either from a publicly or employer-funded compensation program or from employment with another employer made possible by virtue of the employee's removal.

(ix) In making determinations of the formaldehyde content of materials under this paragraph the employer may rely on objective data.

(9) Multiple physician review. (i) After the employer selects the initial physician who conducts any medical examination or consultation to determine whether medical removal or restriction is appropriate, the employee may designate a second physician to review any findings, determinations or

recommendations of the initial physician and to conduct such examinations, consultations, and laboratory tests as the second physician deems necessary and appropriate to evaluate the effects of formaldehyde exposure and to facilitate this review.

(ii) The employer shall promptly notify an employee of the right to seek a second medical opinion after each occasion that an initial physician conducts a medical or consultation for the purpose of medical removal or restriction.

(iii) The employer may condition its participation in, and payment for, the multiple physician review mechanism upon the employee doing the following within fifteen (15) days after receipt of the notification of the right to seek a medical opinion, or receipt of the initial physician's written opinion, whichever is later:

(A) The employee informs the employer of the intention to seek a second medical opinion, and

(B) The employee initiates steps to make an appointment with a second physician.

(iv) If the findings, determinations or recommendations of the second physician differ from those of the initial physician, then the employer and the employee shall assure that efforts are made for the two physicians to resolve the disagreement. If the two physicians are unable to quickly resolve their disagreement, then the employer and the employee through their respective physicians shall designate a third physician who shall be a specialist in the field at issue:

(A) To review the findings, determinations or recommendations of the prior physicians; and

(B) To conduct such examinations, consultations, laboratory tests and discussions with the prior physicians as the third physician deems necessary to resolve the disagreement of the prior physicians.

(v) In the alternative, the employer and the employee or authorized employee representative may jointly designate such third physician.

(vi) The employer shall act consistent with the findings, determinations and recommendations of the third physician, unless the employer and the employee reach an agreement which is otherwise consistent with the recommendations of at least one of the three physicians.

(m) *Hazard communication*—(1) *General*. Communication of the hazards associated with formaldehyde in the workplace shall be governed by the requirements of paragraph (m). The definitions of 29 CFR 1910.1200(c) shall apply under this paragraph.

(i) The following shall be subject to the hazard communication requirements of this paragraph: formaldehyde gas, all mixtures or solutions composed of greater than 0.1 percent formaldehyde, and materials capable of releasing formaldehyde into the air, under reasonably foreseeable conditions of use, at concentrations reaching or exceeding 0.1 ppm.

(3) *Labels*. (i) The employer shall assure that hazard warning labels complying with the requirements of 29 CFR 1910.1200(f) are affixed to all containers of materials listed in paragraph (m)(1)(i), except to the extent that 29 CFR 1910.1200(f) is inconsistent with this paragraph.

(ii) *Information on labels*. As a minimum, for all materials listed in paragraph (m)(1)(i) capable of releasing formaldehyde at levels of 0.1 ppm to 0.5 ppm, labels shall identify that the product contains formaldehyde; list the name and address of the responsible party; and state that physical and health hazard information is readily available from the employer and from material safety data sheets.

(iii) For materials listed in paragraph (m)(1)(i) capable of releasing formaldehyde at levels above 0.5 ppm, labels shall appropriately address all hazards as defined in 29 CFR 1910.1200(d) and 29 CFR 1910.1200 appendices A and B, including respiratory sensitization, and shall contain the words "Potential Cancer Hazard."

(iv) In making the determinations of anticipated levels of formaldehyde release, the employer may rely on objective data indicating the extent of potential formaldehyde release under reasonably foreseeable conditions of use.

(v) *Substitute warning labels*. The employer may use warning labels required by other statutes, regulations, or ordinances which impart the same information as the warning statements required by this paragraph.

(4) *Material safety data sheets*. (i) Any employer who uses formaldehyde-containing materials listed in paragraph (m)(1)(i) shall comply with the requirements of 29 CFR 1910.1200(g) with regard to the development and updating of material safety data sheets.

(ii) *Manufacturers, importers, and distributors* of formaldehyde-containing materials listed in paragraph (m)(1)(i) shall assure that material safety data sheets and updated information are provided to all employers purchasing such materials at the time of the initial shipment and at the time of the first

shipment after a material safety data sheet is updated.

(5) *Written hazard communication program*. The employer shall develop, implement, and maintain at the workplace, a written hazard communication program for formaldehyde exposures in the workplace, which at a minimum describes how the requirements specified in this paragraph for labels and other forms of warning and material safety data sheets, and paragraph (n) for employee information and training, will be met. Employers in multi-employer workplaces shall comply with the requirements of 29 CFR 1910.1200(e)(2).

(n) *Employee information and training*—(1) *Participation*. The employer shall assure that all employees who are assigned to workplaces where there is exposure to formaldehyde participate in a training program, except that where the employer can show, using objective data, that employees are not exposed to formaldehyde at or above 0.1 ppm, the employer is not required to provide training.

(2) *Frequency*. Employers shall provide such information and training to employees at the time of initial assignment, and whenever a new exposure to formaldehyde is introduced into the work area. The training shall be repeated at least annually.

(p) *Dates*. * * *

(3) *Start-up dates of amended paragraphs*—(i) *Respiratory protection*. Respiratory protection required to meet the amended PEL of 0.75 ppm TWA shall be provided as soon as possible but no later than September 24, 1992.

(ii) *Engineering and work practice controls*. Engineering and work practice controls required to meet the amended PEL of 0.75 ppm TWA shall be implemented as soon as possible, but no later than June 26, 1993.

(iii) *Medical removal protection*. The medical removal protection provisions including the multiple physician review mechanism shall be implemented no later than December 28, 1992.

(iv) *Hazard communication*. The labeling provisions contained in amended paragraph (m) of this standard shall be implemented no later than December 28, 1992. Labeling of containers of formaldehyde products shall continue to comply with the provisions of 29 CFR 1910.1200 (e)-(j) until that time.

(v) *Training*. The periodic training mandated for all employees exposed to formaldehyde between 0.1 ppm and 0.5 ppm shall begin no later than August 25, 1992.

For the convenience of the public, the Formaldehyde Standard, 29 CFR 1910.1048 as revised is set forth below.

§ 1910.1048 Formaldehyde.

(a) *Scope and application.* This standard applies to all occupational exposures to formaldehyde, i.e. from formaldehyde gas, its solutions, and materials that release formaldehyde.

(b) *Definitions.* For purposes of this standard, the following definitions shall apply:

Action level means a concentration of 0.5 part formaldehyde per million parts of air (0.5 ppm) calculated as an eight (8)-hour time-weighted average (TWA) concentration.

Assistant Secretary means the Assistant Secretary of Labor for the Occupational Safety and Health Administration, U.S. Department of Labor, or designee.

Authorized person means any person required by work duties to be present in regulated areas, or authorized to do so by the employer, by this section, or by the OSH Act of 1970.

Director means the Director of the National Institute for Occupational Safety and Health, U.S. Department of Health and Human Services, or designee.

Emergency is any occurrence, such as but not limited to equipment failure, rupture of containers, or failure of control equipment that results in an uncontrolled release of a significant amount of formaldehyde.

Employee exposure means the exposure to airborne formaldehyde which would occur without corrections for protection provided by any respirator that is in use.

Formaldehyde means the chemical substance, HCHO, Chemical Abstracts Service Registry No. 50-00-0.

(c) *Permissible Exposure Limit (PEL)*—(1) *TWA*: The employer shall assure that no employee is exposed to an airborne concentration of formaldehyde which exceeds 0.75 parts formaldehyde per million parts of air (0.75 ppm) as an 8-hour TWA.

(2) *Short Term Exposure Limit (STEL)*: The employer shall assure that no employee is exposed to an airborne concentration of formaldehyde which exceeds two parts formaldehyde per million parts of air (2 ppm) as a 15-minute STEL.

(d) *Exposure monitoring*—(1) *General*. (i) Each employer who has a workplace covered by this standard shall monitor employees to determine their exposure to formaldehyde.

(ii) *Exception.* Where the employer

documents, using objective data, that the presence of formaldehyde or formaldehyde-releasing products in the workplace cannot result in airborne concentrations of formaldehyde that would cause any employee to be exposed at or above the action level or the STEL under foreseeable conditions of use, the employer will not be required to measure employee exposure to formaldehyde.

(iii) When an employee's exposure is determined from representative sampling, the measurements used shall be representative of the employee's full shift or short-term exposure to formaldehyde, as appropriate.

(iv) Representative samples for each job classification in each work area shall be taken for each shift unless the employer can document with objective data that exposure levels for a given job classification are equivalent for different work shifts.

(2) *Initial monitoring.* The employer shall identify all employees who may be exposed at or above the action level or at or above the STEL and accurately determine the exposure of each employee so identified.

(i) Unless the employer chooses to measure the exposure of each employee potentially exposed to formaldehyde, the employer shall develop a representative sampling strategy and measure sufficient exposures within each job classification for each workshift to correctly characterize and not underestimate the exposure of any employee within each exposure group.

(ii) The initial monitoring process shall be repeated each time there is a change in production, equipment, process, personnel, or control measures which may result in new or additional exposure to formaldehyde.

(iii) If the employer receives reports of signs or symptoms of respiratory or dermal conditions associated with formaldehyde exposure, the employer shall promptly monitor the affected employee's exposure.

(3) *Periodic monitoring.* (i) The employer shall periodically measure and accurately determine exposure to formaldehyde for employees shown by the initial monitoring to be exposed at or above the action level or at or above the STEL.

(ii) If the last monitoring results reveal employee exposure at or above the action level, the employer shall repeat monitoring of the employees at least every 6 months.

(iii) If the last monitoring results reveal employee exposure at or above the STEL, the employer shall repeat monitoring of the employees at least

once a year under worst conditions.

(4) *Termination of monitoring.* The employer may discontinue periodic monitoring for employees if results from two consecutive sampling periods taken at least 7 days apart show that employee exposure is below the action level and the STEL. The results must be statistically representative and consistent with the employer's knowledge of the job and work operation.

(5) *Accuracy of monitoring.* Monitoring shall be accurate, at the 95 percent confidence level, to within plus or minus 25 percent for airborne concentrations of formaldehyde at the TWA and the STEL and to within plus or minus 35 percent for airborne concentrations of formaldehyde at the action level.

(6) *Employee notification of monitoring results.* Within 15 days of receiving the results of exposure monitoring conducted under this standard, the employer shall notify the affected employees of these results. Notification shall be in writing, either by distributing copies of the results to the employees or by posting the results. If the employee exposure is over either PEL, the employer shall develop and implement a written plan to reduce employee exposure to or below both PELs, and give written notice to employees. The written notice shall contain a description of the corrective action being taken by the employer to decrease exposure.

(7) *Observation of monitoring.* (i) The employer shall provide affected employees or their designated representatives an opportunity to observe any monitoring of employee exposure to formaldehyde required by this standard.

(ii) When observation of the monitoring of employee exposure to formaldehyde requires entry into an area where the use of protective clothing or equipment is required, the employer shall provide the clothing and equipment to the observer, require the observer to use such clothing and equipment, and assure that the observer complies with all other applicable safety and health procedures.

(e) *Regulated areas.* (1) The employer shall establish regulated areas where the concentration of airborne formaldehyde exceeds either the TWA or the STEL and post all entrances and accessways with signs bearing the following information:

DANGER

FORMALDEHYDE

IRRITANT AND POTENTIAL CANCER
HAZARD

AUTHORIZED PERSONNEL ONLY

(2) The employer shall limit access to regulated areas to authorized persons who have been trained to recognize the hazards of formaldehyde.

(3) An employer at a multiemployer worksite who establishes a regulated area shall communicate the access restrictions and locations of these areas to other employers with work operations at that worksite.

(f) *Methods of compliance*—(1) *Engineering controls and work practices.* The employer shall institute engineering and work practice controls to reduce and maintain employee

exposures to formaldehyde at or below the TWA and the STEL.

(2) *Exception.* Whenever the employer has established that feasible engineering and work practice controls cannot reduce employee exposure to or below either of the PELs, the employer shall apply these controls to reduce employee exposures to the extent feasible and shall supplement them with respirators which satisfy this standard.

(g) *Respiratory protection*—(1) *General.* Where respiratory protection is required, the employer shall provide the respirators at no cost to the employee and shall assure that they are properly used. The respirators shall comply with the requirements of this standard and shall reduce the concentration of formaldehyde inhaled by the employee to at or below both the TWA and the STEL. Respirators shall be used in the following circumstances:

(i) During the interval necessary to install or implement feasible engineering and work practice controls;

(ii) In work operations, such as maintenance and repair activities or vessel cleaning, for which the employer establishes that engineering and work practice controls are not feasible;

(iii) In work situations where feasible engineering and work practice controls are not yet sufficient to reduce exposure to or below the PELs; and

(iv) In emergencies.

(2) *Respirator selection.* (i) The appropriate respirators as specified in Table 1 shall be selected from those approved by the Mine Safety and Health Administration (MSHA) and by the National Institute for Occupational Safety and Health (NIOSH) under the provisions of 30 CFR part 11.

TABLE 1.—MINIMUM REQUIREMENTS FOR RESPIRATORY PROTECTION AGAINST FORMALDEHYDE

Condition of use or formaldehyde concentration (ppm)	Minimum respirator required ¹
Up to 7.5 ppm (10 x PEL).	Full facepiece with cartridges or canisters specifically approved for protection against formaldehyde. ²
Up to 75 ppm (100 x PEL).	Full-face mask with chin style or chest or back mounted type with industrial size canister specifically approved for protection against formaldehyde. Type C supplied-air respirator, pressure demand or continuous flow type, with full facepiece, hood, or helmet.
Above 75 ppm or unknown (emergencies). (100 x PEL).	Self-contained breathing apparatus (SCBA) with positive pressure full facepiece. Combination supplied-air, full facepiece positive pressure respirator with auxiliary self-contained air supply.
Firefighting.....	SCBA with positive pressure in full facepiece.
Escape.....	SCBA in demand or pressure demand mode. Full-face mask with chin style or front or back mounted type industrial size canister specifically approved for protection against formaldehyde.

¹ Respirators specified for use at higher concentrations may be used at lower concentrations.

² A half-mask respirator with cartridges specifically approved for protection against formaldehyde can be substituted for the full facepiece respirator providing that effective gas-proof goggles are provided and used in combination with the half-mask respirator.

(ii) The employer shall make available a powered air-purifying respirator adequate to protect against formaldehyde exposure to any employee who experiences difficulty wearing a negative pressure respirator to reduce exposure to formaldehyde.

(3) *Respirator usage.* (i) whenever respirator use is required by this standard, the employer shall institute a respiratory protection program in accordance with 20 CFR 1910.134(b), (d), (e), and (f).

(ii) The employer shall perform either quantitative or qualitative face fit tests in accordance with the procedures outlined in Appendix E at the time of initial fitting and at least annually thereafter for all employees required by this standard to wear negative pressure respirators.

(A) Respirators selected shall be from those exhibiting the best facepiece fit.

(B) No respirator shall be chosen that would potentially permit the employee

to inhale formaldehyde at concentrations in excess of either the TWA or the STEL.

(iii) Where air purifying chemical cartridge respirators are used, the cartridges shall be replaced after three hours of use or at the end of the workshift, whichever is sooner unless the cartridge contains a NIOSH-approved end-of-service indicator to show when breakthrough occurs.

(iv) Unless the canister contains a NIOSH-approved end-of-service-life indicator to show when breakthrough occurs, canisters used in atmospheres up to 7.5 ppm (10xPEL) shall be replaced every 4 hours and industrial sized canisters used in atmospheres up to 75 ppm (100xPEL) shall be replaced every two hours or at the end of the workshift, whichever is sooner.

(v) Employers shall permit employees to leave the work area to wash their faces and respirator facepieces as

needed to prevent skin irritation from respirator use.

(h) *Protective equipment and clothing.* Employers shall comply with the provisions of 29 CFR 1910.132 and 29 CFR 1910.133. When protective equipment or clothing is provided under these provisions, the employer shall provide these protective devices at no cost to the employee and assure that the employee wears them.

(1) *Selection.* The employer shall select protective clothing and equipment based upon the form of formaldehyde to be encountered, the conditions of use, and the hazard to be prevented.

(i) All contact of the eyes and skin with liquids containing 1 percent or more formaldehyde shall be prevented by the use of chemical protective clothing made of material impervious to formaldehyde and the use of other personal protective equipment, such as goggles and face shields, as appropriate to the operation.

(ii) Contact with irritating or sensitizing materials shall be prevented to the extent necessary to eliminate the hazard.

(iii) Where a face shield is worn, chemical safety goggles are also required if there is a danger of formaldehyde reaching the area of the eye.

(iv) Full body protection shall be worn for entry into areas where concentrations exceed 100 ppm and for emergency reentry into areas of unknown concentration.

(2) *Maintenance of protective equipment and clothing.* (i) The employer shall assure that protective equipment and clothing that has become contaminated with formaldehyde is cleaned or laundered before its reuse.

(ii) When ventilating formaldehyde-contaminated clothing and equipment, the employer shall establish a storage area so that employee exposure is minimized. Containers for contaminated clothing and equipment and storage areas shall have labels and signs containing the following information:

DANGER

**FORMALDEHYDE-CONTAMINATED
[CLOTHING] EQUIPMENT**

**AVOID INHALATION AND SKIN
CONTACT**

(iii) The employer shall assure that only persons trained to recognize the hazards of formaldehyde remove the contaminated material from the storage area for purposes of cleaning, laundering, or disposal.

(iv) The employer shall assure that no employee takes home equipment or clothing that is contaminated with formaldehyde.

(v) The employer shall repair or replace all required protective clothing and equipment for each affected employee as necessary to assure its effectiveness.

(vi) The employer shall inform any person who launders, cleans, or repairs such clothing or equipment of formaldehyde's potentially harmful effects and of procedures to safely handle the clothing and equipment.

(i) *Hygiene protection.* (1) The employer shall provide change rooms, as described in 29 CFR 1910.141 for employees who are required to change from work clothing into protective clothing to prevent skin contact with formaldehyde.

(2) If employees' skin may become splashed with solutions containing 1 percent or greater formaldehyde, for example, because of equipment failure or improper work practices, the employer shall provide conveniently

located quick drench showers and assure that affected employees use these facilities immediately.

(3) If there is any possibility that an employee's eyes may be splashed with solutions containing 0.1 percent or greater formaldehyde, the employer shall provide acceptable eyewash facilities within the immediate work area for emergency use.

(j) *Housekeeping.* For operations involving formaldehyde liquids or gas, the employer shall conduct a program to detect leaks and spills, including regular visual inspections.

(1) Preventative maintenance of equipment, including surveys for leaks, shall be undertaken at regular intervals.

(2) In work areas where spillage may occur, the employer shall make provisions to contain the spill, to decontaminate the work area, and to dispose of the waste.

(3) The employer shall assure that all leaks are repaired and spills are cleaned promptly by employees wearing suitable protective equipment and trained in proper methods for cleanup and decontamination.

(4) Formaldehyde-contaminated waste and debris resulting from leaks or spills shall be placed for disposal in sealed containers bearing a label warning of formaldehyde's presence and of the hazards associated with formaldehyde.

(k) *Emergencies.* For each workplace where there is the possibility of an emergency involving formaldehyde, the employer shall assure appropriate procedures are adopted to minimize injury and loss of life. Appropriate procedures shall be implemented in the event of an emergency.

(l) *Medical surveillance—(1) Employees covered.* (i) The employer shall institute medical surveillance programs for all employees exposed to formaldehyde at concentrations at or exceeding the action level or exceeding the STEL.

(ii) The employer shall make medical surveillance available for employees who develop signs and symptoms of overexposure to formaldehyde and for all employees exposed to formaldehyde in emergencies. When determining whether an employee may be experiencing signs and symptoms of possible overexposure to formaldehyde, the employer may rely on the evidence that signs and symptoms associated with formaldehyde exposure will occur only in exceptional circumstances when airborne exposure is less than 0.1 ppm and when formaldehyde is present in material in concentrations less than 0.1 percent.

(2) *Examination by a physician.* All medical procedures, including

administration of medical disease questionnaires, shall be performed by or under the supervision of a licensed physician and shall be provided without cost to the employee, without loss of pay, and at a reasonable time and place.

(3) *Medical disease questionnaire.* The employer shall make the following medical surveillance available to employees prior to assignment to a job where formaldehyde exposure is at or above the action level or above the STEL and annually thereafter. The employer shall also make the following medical surveillance available promptly upon determining that an employee is experiencing signs and symptoms indicative of possible overexposure to formaldehyde.

(i) Administration of a medical disease questionnaire, such as in appendix D, which is designed to elicit information on work history, smoking history, any evidence of eye, nose, or throat irritation; chronic airway problems or hyperreactive airway disease; allergic skin conditions or dermatitis; and upper or lower respiratory problems.

(ii) A determination by the physician, based on evaluation of the medical disease questionnaire, of whether a medical examination is necessary for employees not required to wear respirators to reduce exposure to formaldehyde.

(4) *Medical examinations.* Medical examinations shall be given to any employee who the physician feels, based on information in the medical disease questionnaire, may be at increased risk from exposure to formaldehyde and at the time of initial assignment and at least annually thereafter to all employees required to wear a respirator to reduce exposure to formaldehyde. The medical examination shall include:

(i) A physical examination with emphasis on evidence of irritation or sensitization of the skin and respiratory system, shortness of breath, or irritation of the eyes.

(ii) Laboratory examinations for respirator wearers consisting of baseline and annual pulmonary function tests. As a minimum, these tests shall consist of forced vital capacity (FVC), forced expiratory volume in one second (FEV₁), and forced expiratory flow (FEF).

(iii) Any other test which the examining physician deems necessary to complete the written opinion.

(iv) Counseling of employees having medical conditions that would be directly or indirectly aggravated by exposure to formaldehyde on the

increased risk of impairment of their health.

(5) *Examinations for employees exposed in an emergency.* The employer shall make medical examinations available as soon as possible to all employees who have been exposed to formaldehyde in an emergency.

(i) The examination shall include a medical and work history with emphasis on any evidence of upper or lower respiratory problems, allergic conditions, skin reaction or hypersensitivity, and any evidence of eye, nose, or throat irritation.

(ii) Other examinations shall consist of those elements considered appropriate by the examining physician.

(6) *Information provided to the physician.* The employer shall provide the following information to the examining physician:

(i) A copy of this standard and appendix A, C, D, and E;

(ii) A description of the affected employee's job duties as they relate to the employee's exposure to formaldehyde;

(iii) The representative exposure level for the employee's job assignment;

(iv) Information concerning any personal protective equipment and respiratory protection used or to be used by the employee; and

(v) Information from previous medical examinations of the affected employee within the control of the employer.

(vi) In the event of a nonroutine examination because of an emergency, the employer shall provide to the physician as soon as possible: A description of how the emergency occurred and the exposure the victim may have received.

(7) *Physician's written opinion.* (i) For each examination required under this standard, the employer shall obtain a written opinion from the examining physician. This written opinion shall contain the results of the medical examination except that it shall not reveal specific findings or diagnoses unrelated to occupational exposure to formaldehyde. The written opinion shall include:

(A) The physician's opinion as to whether the employee has any medical condition that would place the employee at an increased risk of material impairment of health from exposure to formaldehyde;

(B) Any recommended limitations on the employee's exposure or changes in the use of personal protective equipment, including respirators;

(C) A statement that the employee has been informed by the physician of any medical conditions which would be aggravated by exposure to

formaldehyde, whether these conditions may have resulted from past formaldehyde exposure or from exposure in an emergency, and whether there is a need for further examination or treatment.

(ii) The employer shall provide for retention of the results of the medical examination and tests conducted by the physician.

(iii) The employer shall provide a copy of the physician's written opinion to the affected employee within 15 days of its receipt.

(8) *Medical removal.* (i) The provisions of paragraph (1)(8) apply when an employee reports significant irritation of the mucosa of the eyes or the upper airways, respiratory sensitization, dermal irritation, or dermal sensitization attributed to workplace formaldehyde exposure. Medical removal provisions do not apply in the case of dermal irritation or dermal sensitization when the product suspected of causing the dermal condition contains less than 0.05% formaldehyde.

(ii) An employee's report of signs or symptoms of possible overexposure to formaldehyde shall be evaluated by a physician selected by the employer pursuant to paragraph (1)(3). If the physician determines that a medical examination is not necessary under paragraph (1)(3)(ii), there shall be a two-week evaluation and remediation period to permit the employer to ascertain whether the signs or symptoms subside untreated or with the use of creams, gloves, first aid treatment or personal protective equipment. Industrial hygiene measures that limit the employee's exposure to formaldehyde may also be implemented during this period. The employee shall be referred immediately to a physician prior to expiration of the two-week period if the signs or symptoms worsen. Earnings, seniority and benefits may not be altered during the two-week period by virtue of the report.

(iii) If the signs or symptoms have not subsided or been remedied by the end of the two-week period, or earlier if signs or symptoms warrant, the employee shall be examined by a physician selected by the employer. The physician shall presume, absent contrary evidence, that observed dermal irritation or dermal sensitization are not attributable to formaldehyde when products to which the affected employee is exposed contain less than 0.1% formaldehyde.

(iv) Medical examinations shall be conducted in compliance with the requirements of paragraph (1)(5) (i) and (ii). Additional guidelines for conducting

medical exams are contained in Appendix C.

(v) If the physician finds that significant irritation of the mucosa of the eyes or of the upper airways, respiratory sensitization, dermal irritation, or dermal sensitization result from workplace formaldehyde exposure and recommends restrictions or removal, the employer shall promptly comply with the restrictions or recommendation of removal. In the event of a recommendation of removal, the employer shall remove the effected employee from the current formaldehyde exposure and if possible, transfer the employee to work having no or significantly less exposure to formaldehyde.

(vi) When an employee is removed pursuant to paragraph (1)(8)(v), the employer shall transfer the employee to comparable work for which the employee is qualified or can be trained in a short period (up to 6 months), where the formaldehyde exposures are as low as possible, but not higher than the action level. The employee shall maintain the employee's current earnings, seniority, and other benefits. If there is no such work available, the employer shall maintain the employee's current earnings, seniority and other benefits until such work becomes available, until the employee is determined to be unable to return to workplace formaldehyde exposure, until the employee is determined to be able to return to the original job status, or for six months, whichever comes first.

(vii) The employer shall arrange for a follow-up medical examination to take place within six months after the employee is removed pursuant to this paragraph. This examination shall determine if the employee can return to the original job status, or if the removal is to be permanent. The physician shall make a decision within six months of the date the employee was removed as to whether the employee can be returned to the original job status, or if the removal is to be permanent.

(viii) An employer's obligation to provide earnings, seniority and other benefits to a removed employee may be reduced to the extent that the employee receives compensation for earnings lost during the period of removal either from a publicly or employer-funded compensation program or from employment with another employer made possible by virtue of the employee's removal.

(ix) In making determinations of the formaldehyde content of materials under this paragraph the employer may rely on objective data.

(9) *Multiple physician review.* (i) After the employer selects the initial physician who conducts any medical examination or consultation to determine whether medical removal or restriction is appropriate, the employee may designate a second physician to review any findings, determinations or recommendations of the initial physician and to conduct such examinations, consultations, and laboratory tests as the second physician deems necessary and appropriate to evaluate the effects of formaldehyde exposure and to facilitate this review.

(ii) The employer shall promptly notify an employee of the right to seek a second medical opinion after each occasion that an initial physician conducts a medical examination or consultation for the purpose of medical removal or restriction.

(iii) The employer may condition its participation in, and payment for, the multiple physician review mechanism upon the employee doing the following within fifteen (15) days after receipt of the notification of the right to seek a second medical opinion, or receipt of the initial physician's written opinion, whichever is later:

(A) The employee informs the employer of the intention to seek a second medical opinion, and

(B) The employee initiates steps to make an appointment with a second physician.

(iv) If the findings, determinations or recommendations of the second physician differ from those of the initial physician, then the employer and the employee shall assure that efforts are made for the two physicians to resolve the disagreement. If the two physicians are unable to quickly resolve their disagreement, then the employer and the employee through their respective physicians shall designate a third physician who shall be a specialist in the field at issue:

(A) To review the findings, determinations or recommendations of the prior physicians; and

(B) To conduct such examinations, consultations, laboratory tests and discussions with the prior physicians as the third physician deems necessary to resolve the disagreement of the prior physicians.

(v) In the alternative, the employer and the employee or authorized employee representative may jointly designate such third physician.

(vi) The employer shall act consistent with the findings, determinations and recommendations of the third physician, unless the employer and the employee reach an agreement which is otherwise

consistent with the recommendations of at least one of the three physicians.

(m) *Hazard communication.*—(1) *General.* Communication of the hazards associated with formaldehyde in the workplace shall be governed by the requirements of paragraph (m). The definitions of 29 CFR 1910.1200(c) shall apply under this paragraph.

(i) The following shall be subject to the hazard communication requirements of this paragraph: Formaldehyde gas, all mixtures or solutions composed of greater than 0.1 percent formaldehyde, and materials capable of releasing formaldehyde into the air, under reasonably foreseeable conditions of use, at concentrations reaching or exceeding 0.1 ppm.

(ii) As a minimum, specific health hazards that the employer shall address are: Cancer, irritation and sensitization of the skin and respiratory system, eye and throat irritation, and acute toxicity.

(2) Manufacturers and importers who produce or import formaldehyde or formaldehyde-containing products shall provide downstream employers using or handling these products with an objective determination through the required labels and MSDSs if these items may constitute a health hazard within the meaning of 29 CFR 1910.1200(d) under normal conditions of use.

(3) *Labels.* (i) The employer shall assure that hazard warning labels complying with the requirements of 29 CFR 1910.1200(f) are affixed to all containers of materials listed in paragraph (m)(1)(i), except to the extent that 29 CFR 1910.1200(f) is inconsistent with this paragraph.

(ii) *Information on labels.* As a minimum, for all materials listed in paragraph (m)(1)(i) capable of releasing formaldehyde at levels of 0.1 ppm to 0.5 ppm, labels shall identify that the product contains formaldehyde; list the name and address of the responsible party; and state that physical and health hazard information is readily available from the employer and from material safety data sheets.

(iii) For materials listed in paragraph (m)(1)(i) capable of releasing formaldehyde at levels above 0.5 ppm, labels shall appropriately address all hazards as defined in 29 CFR 1910.1200(d) and 29 CFR 1910.1200 appendices A and B, including respiratory sensitization, and shall contain the words "Potential Cancer Hazard."

(iv) In making the determinations of anticipated levels of formaldehyde release, the employer may rely on objective data indicating the extent of potential formaldehyde release under

reasonably foreseeable conditions of use.

(v) *Substitute warning labels.* The employer may use warning labels required by other statutes, regulations, or ordinances which impart the same information as the warning statements required by this paragraph.

(4) *Material safety data sheets.* (i) Any employer who uses formaldehyde-containing materials listed in paragraph (m)(1)(i) shall comply with the requirements of 29 CFR 1910.1200(g) with regard to the development and updating of material safety data sheets.

(ii) Manufacturers, importers, and distributors of formaldehyde-containing materials listed in paragraph (m)(1)(i) shall assure that material safety data sheets and updated information are provided to all employers purchasing such materials at the time of the initial shipment and at the time of the first shipment after a material safety data sheet is updated.

(5) *Written hazard communication program.* The employer shall develop, implement, and maintain at the workplace, a written hazard communication program for formaldehyde exposures in the workplace, which at a minimum describes how the requirements specified in this paragraph for labels and other forms of warning and material safety data sheets, and paragraph (n) for employee information and training, will be met. Employers in multi-employer workplaces shall comply with the requirements of 29 CFR 1910.1200(e)(2).

(n) *Employee information and training.*—(1) *Participation.* The employer shall assure that all employees who are assigned to workplaces where there is exposure to formaldehyde participate in a training program, except that where the employer can show, using objective data, that employees are not exposed to formaldehyde at or above 0.1 ppm, the employer is not required to provide training.

(2) *Frequency.* Employers shall provide such information and training to employees at the time of initial assignment, and whenever a new exposure to formaldehyde is introduced into the work area. The training shall be repeated at least annually.

(3) *Training program.* The training program shall be conducted in a manner which the employee is able to understand and shall include:

(i) A discussion of the contents of this regulation and the contents of the Material Safety Data Sheet.

(ii) The purpose for and a description of the medical surveillance program required by this standard, including:

(A) A description of the potential health hazards associated with exposure to formaldehyde and a description of the signs and symptoms of exposure to formaldehyde.

(B) Instructions to immediately report to the employer the development of any adverse signs or symptoms that the employee suspects is attributable to formaldehyde exposure.

(iii) Description of operations in the work area where formaldehyde is present and an explanation of the safe work practices appropriate for limiting exposure to formaldehyde in each job;

(iv) The purpose for, proper use of, and limitations of personal protective clothing and equipment;

(v) Instructions for the handling of spills, emergencies, and clean-up procedures;

(vi) An explanation of the importance of engineering and work practice controls for employee protection and any necessary instruction in the use of these controls; and

(vii) A review of emergency procedures including the specific duties or assignments of each employee in the event of an emergency.

(4) *Access to training materials.* (i) The employer shall inform all affected employees of the location of written training materials and shall make these materials readily available, without cost, to the affected employees.

(ii) The employer shall provide, upon request, all training materials relating to the employee training program to the Assistant Secretary and the Director.

(o) *Recordkeeping—(1) Exposure measurements.* The employer shall establish and maintain an accurate record of all measurements taken to monitor employee exposure to formaldehyde. This record shall include:

(i) The date of measurement;

(ii) The operation being monitored;

(iii) The methods of sampling and analysis and evidence of their accuracy and precision;

(iv) The number, durations, time, and results of samples taken;

(v) The types of protective devices worn; and

(vi) The names, job classifications, social security numbers, and exposure estimates of the employees whose exposures are represented by the actual monitoring results.

(2) *Exposure determinations.* Where the employer has determined that no monitoring is required under this standard, the employer shall maintain a record of the objective data relied upon to support the determination that no employee is exposed to formaldehyde at or above the action level.

(3) *Medical surveillance.* The employer shall establish and maintain an accurate record for each employee subject to medical surveillance under this standard. This record shall include:

(i) The name and social security number of the employee;

(ii) The physician's written opinion;

(iii) A list of any employee health complaints that may be related to exposure to formaldehyde; and

(iv) A copy of the medical examination results, including medical disease questionnaires and results of any medical tests required by the standard or mandated by the examining physician.

(4) *Respirator fit testing.* (i) The employer shall establish and maintain accurate records for employees subject to negative pressure respirator fit testing required by this standard.

(ii) This record shall include:

(A) A copy of the protocol selected for respirator fit testing.

(B) A copy of the results of any fit testing performed.

(C) The size and manufacturer of the types of respirators available for selection.

(D) The date of the most recent fit testing, the name and social security number of each tested employee, and the respirator type and facepiece selected.

(5) *Record retention.* The employer shall retain records required by this standard for at least the following periods:

(i) Exposure records and determinations shall be kept for at least 30 years.

(ii) Medical records shall be kept for the duration of employment plus 30 years.

(iii) Respirator fit testing records shall be kept until replaced by a more recent record.

(6) *Availability of records.* (i) Upon request, the employer shall make all records maintained as a requirement of this standard available for examination and copying to the Assistant Secretary and the Director.

(ii) The employer shall make employee exposure records, including estimates made from representative monitoring and available upon request for examination, and copying to the subject employee, or former employee, and employee representatives in accordance with 29 CFR 1910.20 (a)-(e) and (g)-(i).

(iii) Employee medical records required by this standard shall be provided upon request for examination and copying, to the subject employee or former employee or to anyone having the specific written consent of the

subject employee or former employee in accordance with 29 CFR 1910.20 (a)-(e) and (g)-(i).

(p) *Dates—(1) Effective dates—(i) General.* This section shall become effective February 2, 1988, except as noted below.

(ii) *Laboratories.* This standard shall become effective for anatomy, histology, and pathology laboratories February 2, 1988, except as noted in the start-up date section. For all other laboratories, paragraphs (a) and (c) of this standard shall become effective February 2, 1988, and paragraphs (b) and (d)-(o) of this standard shall become effective on September 1, 1988 except as noted in the start-up date section.

(2) *Start-up dates—(i) Exposure determinations.* Initial monitoring or objective determinations that no monitoring is required by the standard shall be completed by 6 months after the effective date of the standard.

(ii) *Medical surveillance.* The initial medical surveillance of all eligible employees shall be completed by 6 months after the effective date of the standard.

(iii) *Emergencies.* The emergency procedures required by this standard shall be implemented by 6 months after the effective date of the standard.

(iv) *Respiratory protection.* Respiratory protection as required in this standard shall be provided as soon as possible and no later than 9 months after the effective date of the standard.

(v) *Engineering and work practice controls.* Engineering and work practice controls required by this standard shall be implemented as soon as possible, but no later than one year after the effective date of the standard.

(vi) *Employee training.* Written materials for employee training shall be updated as soon as possible, but no later than 2 months after the effective date of the standard.

(3) *Start-up dates of amended paragraphs—(i) Respiratory protection.* Respiratory protection required to meet the amended PEL of 0.75 ppm TWA shall be provided as soon as possible but no later than September 24, 1992.

(ii) *Engineering and work practice controls.* Engineering and work practice controls required to meet the amended PEL of 0.75 ppm TWA shall be implemented as soon as possible, but no later than June 26, 1993.

(iii) *Medical removal protection.* The medical removal protection provisions including the multiple physician review mechanism shall be implemented no later than December 28, 1992.

(iv) *Hazard communication.* The labeling provisions contained in

amended paragraph (m) of this standard shall be implemented no later than December 28, 1992. Labeling of containers of formaldehyde products shall continue to comply with the provisions of 29 CFR 1910.1200 (e)-(j) until that time.

(v) **Training.** The periodic training mandated for all employees exposed to formaldehyde between 0.1 ppm and 0.5 ppm shall begin no later than August 25, 1992.

Appendix A to § 1910.1048—Substance Technical Guidelines for Formalin

The following Substance Technical Guideline for Formalin provides information on uninhibited formalin solution (37% formaldehyde, no methanol stabilizer). It is designed to inform employees at the production level of their rights and duties under the formaldehyde standard whether their job title defines them as workers or supervisors. Much of the information provided is general; however, some information is specific for formalin. When employee exposure to formaldehyde is from resins capable of releasing formaldehyde, the resin itself and other impurities or decomposition products may also be toxic, and employers should include this information as well when informing employees of the hazards associated with the materials they handle. The precise hazards associated with exposure to formaldehyde depend both on the form (solid, liquid, or gas) of the material and the concentration of formaldehyde present. For example, 37–50 percent solutions of formaldehyde present a much greater hazard to the skin and eyes from spills or splashes than solutions containing less than 1 percent formaldehyde. Individual Substance Technical Guidelines used by the employer for training employees should be modified to properly give information on the material actually being used.

Substance Identification

Chemical Name: Formaldehyde

Chemical Family: Aldehyde

Chemical Formula: HCHO

Molecular Weight: 30.03

Chemical Abstracts Service Number (CAS Number): 50-00-0

Synonyms: Formalin; Formic Aldehyde; Paraform; Formol; Formalin (Methanol-free); Fyde; Formalith; Methanal; Methyl Aldehyde; Methylene Glycol; Methylene Oxide; Tetraoxymethalene; Oxomethane; Oxymethylene

Components and Contaminants

Percent: 37.0 Formaldehyde

Percent: 63.0 Water

(Note.—Inhibited solutions contain methanol.)

Other Contaminants: Formic acid (alcohol free)

Exposure Limits:

OSHA TWA—1 ppm

OSHA STEL—2 ppm

Physical Data

Description: Colorless liquid, pungent odor

Boiling point: 214 °F (101 °C)

Specific Gravity: 1.08 (H₂O=1 @ 20 °C)

pH: 2.8–4.0

Solubility in Water: Miscible

Solvent Solubility: Soluble in alcohol and acetone

Vapor Density: 1.04 (Air=1 @ 20 °C)

Odor Threshold: 0.8–1 ppm

Fire and Explosion Hazard

Moderate fire and explosion hazard when exposed to heat or flame.

The flash point of 37% formaldehyde solutions is above normal room temperature, but the explosion range is very wide, from 7 to 73% by volume in air.

Reaction of formaldehyde with nitrogen dioxide, nitromethane, perchloric acid and aniline, or peroxyformic acid yields explosive compounds.

Flash Point: 185 °F (85 °C) closed cup

Lower Explosion Limit: 7%

Upper Explosion Limit: 73%

Autoignition Temperature: 808 °F (430 °C)

Flammability Class (OSHA): III A

Extinguishing Media: Use dry chemical, "alcohol foam", carbon dioxide, or water in flooding amounts as fog. Solid streams may not be effective. Cool fire-exposed containers with water from side until well after fire is out.

Use of water spray to flush spills can also dilute the spill to produce nonflammable mixtures. Water runoff, however, should be contained for treatment.

National Fire Protection Association Section 325M Designation:

Health: 2—Materials hazardous to health, but areas may be entered with full-faced mask self-contained breathing apparatus which provides eye protection.

Flammability: 2—Materials which must be moderately heated before ignition will occur. Water spray may be used to extinguish the fire because the material can be cooled below its flash point.

Reactivity: D—Materials which (in themselves) are normally stable even under fire exposure conditions and which are not reactive with water. Normal fire fighting procedures may be used.

Reactivity

Stability: Formaldehyde solutions may self-polymerize to form paraformaldehyde which precipitates.

Incompatibility (Materials to Avoid):

Strong oxidizing agents, caustics, strong alkalies, isocyanates, anhydrides, oxides, and inorganic acids. Formaldehyde reacts with hydrochloric acid to form the potent carcinogen, bis-chloromethyl ether. Formaldehyde reacts with nitrogen dioxide, nitromethane, perchloric acid and aniline, or peroxyformic acid to yield explosive compounds. A violent reaction occurs when formaldehyde is mixed with strong oxidizers.

Hazardous Combustion or Decomposition Products: Oxygen from the air can oxidize formaldehyde to formic acid, especially when heated. Formic acid is corrosive.

Health Hazard Data

Acute Effects of Exposure

Ingestion (Swallowing): Liquids containing 10 to 40% formaldehyde cause severe irritation and inflammation of the mouth, throat, and stomach. Severe stomach pains will follow ingestion with possible loss of consciousness and death. Ingestion of dilute formaldehyde solutions (0.03–0.04%) may cause discomfort in the stomach and pharynx.

Inhalation (Breathing): Formaldehyde is highly irritating to the upper respiratory tract and eyes. Concentrations of 0.5 to 2.0 ppm may irritate the eyes, nose, and throat of some individuals. Concentrations of 3 to 5 ppm also cause tearing of the eyes and are intolerable to some persons. Concentrations of 10 to 20 ppm cause difficulty in breathing, burning of the nose and throat, cough, and heavy tearing of the eyes, and 25 to 30 ppm causes severe respiratory tract injury leading to pulmonary edema and pneumonitis. A concentration of 100 ppm is immediately dangerous to life and health. Deaths from accidental exposure to high concentrations of formaldehyde have been reported.

Skin (Dermal): Formalin is a severe skin irritant and a sensitizer. Contact with formalin causes white discoloration, smarting, drying, cracking, and scaling. Prolonged and repeated contact can cause numbness and a hardening or tanning of the skin. Previously exposed persons may react to future exposure with an allergic eczematous dermatitis or hives.

Eye Contact: Formaldehyde solutions splashed in the eye can cause injuries ranging from transient discomfort to severe, permanent corneal clouding and loss of vision. The severity of the effect depends on the concentration of formaldehyde in the solution and whether or not the eyes are flushed with water immediately after the accident.

Note.—The perception of formaldehyde by odor and eye irritation becomes less sensitive with time as one adapts to formaldehyde. This can lead to overexposure if a worker is relying on formaldehyde's warning properties to alert him or her to the potential for exposure.

Acute Animal Toxicity:

Oral, rats: LD50=800 mg/kg

Oral, mouse: LD50=42 mg/kg

Inhalation, rats: LCLo=250 mg/kg

Inhalation, mouse: LCLo=900 mg/kg

Inhalation, rats: LC50=590 mg/kg

Chronic Effects of Exposure

Carcinogenicity: Formaldehyde has the potential to cause cancer in humans. Repeated and prolonged exposure increases the risk. Various animal experiments have conclusively shown formaldehyde to be a carcinogen in rats. In humans, formaldehyde exposure has been associated with cancers of the lung, nasopharynx and oropharynx, and nasal passages.

Mutagenicity: Formaldehyde is genotoxic in several *in vitro* test systems showing properties of both an initiator and a promoter.

Toxicity: Prolonged or repeated exposure to formaldehyde may result in respiratory impairment. Rats exposed to formaldehyde at 2 ppm developed benign nasal tumors and changes of the cell structure in the nose as well as inflamed mucous membranes of the nose. Structural changes in the epithelial cells in the human nose have also been observed. Some persons have developed asthma or bronchitis following exposure to formaldehyde, most often as the result of an accidental spill involving a single exposure to a high concentration of formaldehyde.

Emergency and First Aid Procedures

Ingestion (Swallowing): If the victim is conscious, dilute, inactivate, or absorb the ingested formaldehyde by giving milk, activated charcoal, or water. Any organic material will inactivate formaldehyde. Keep affected person warm and at rest. Get medical attention immediately. If vomiting occurs, keep head lower than hips.

Inhalation (Breathing): Remove the victim from the exposure area to fresh air immediately. Where the formaldehyde concentration may be very high, each rescuer must put on a self-contained breathing apparatus before attempting to remove the victim, and medical personnel should be informed of the formaldehyde exposure immediately. If breathing has stopped, give artificial respiration. Keep the affected person warm and at rest. Qualified first-aid or medical personnel should administer oxygen, if available, and maintain the patient's airways and blood pressure until the victim can be transported to a medical facility. If exposure results in a highly irritated upper respiratory tract and coughing continues for more than 10 minutes, the worker should be hospitalized for observation and treatment.

Skin Contact: Remove contaminated clothing (including shoes) immediately. Wash the affected area of your body with soap or mild detergent and large amounts of water until no evidence of the chemical remains (at least 15 to 20 minutes). If there are chemical burns, get first aid to cover the area with sterile, dry dressing, and bandages. Get medical attention if you experience appreciable eye or respiratory irritation.

Eye Contact: Wash the eyes immediately with large amounts of water occasionally lifting lower and upper lids, until no evidence of chemical remains (at least 15 to 20 minutes). In case of burns, apply sterile bandages loosely without medication. Get medical attention immediately. If you have experienced appreciable eye irritation from a splash or excessive exposure, you should be referred promptly to an ophthalmologist for evaluation.

Emergency Procedures

Emergencies: If you work in an area where a large amount of formaldehyde could be released in an accident or from equipment failure, your employer must develop procedures to be followed in event of an emergency. You should be trained in your specific duties in the event of an emergency, and it is important that you clearly understand these duties. Emergency equipment must be accessible and you should

be trained to use any equipment that you might need. Formaldehyde contaminated equipment must be cleaned before reuse.

If a spill of appreciable quantity occurs, leave the area quickly unless you have specific emergency duties. Do not touch spilled material. Designated persons may stop the leak and shut off ignition sources if these procedures can be done without risk. Designated persons should isolate the hazard area and deny entry except for necessary people protected by suitable protective clothing and respirators adequate for the exposure. Use water spray to reduce vapors. Do not smoke, and prohibit all flames or flares in the hazard area.

Special Firefighting Procedures: Learn procedures and responsibilities in the event of a fire in your workplace. Become familiar with the appropriate equipment and supplies and their location. In firefighting, withdraw immediately in case of rising sound from venting safety device or any discoloration of storage tank due to fire.

Spill, Leak, and Disposal Procedures

Occupational Spill: For small containers, place the leaking container in a well ventilated area. Take up small spills with absorbent material and place the waste into properly labeled containers for later disposal. For larger spills, dike the spill to minimize contamination and facilitate salvage or disposal. You may be able to neutralize the spill with sodium hydroxide or sodium sulfite. Your employer must comply with EPA rules regarding the clean-up of toxic waste and notify state and local authorities, if required. If the spill is greater than 1,000 lb/day, it is reportable under EPA's Superfund legislation.

Waste Disposal: Your employer must dispose of waste containing formaldehyde in accordance with applicable local, state, and Federal law and in a manner that minimizes exposure of employees at the site and of the clean-up crew.

Monitoring and Measurement Procedures

Monitoring Requirements: If your exposure to formaldehyde exceeds the 0.5 ppm action level or the 2 ppm STEL, your employer must monitor your exposure. Your employer need not measure every exposure if a "high exposure" employee can be identified. This person usually spends the greatest amount of time nearest the process equipment. If you are a "representative employee", you will be asked to wear a sampling device to collect formaldehyde. This device may be a passive badge, a sorbent tube attached to a pump, or an impinger containing liquid. You should perform your work as usual, but inform the person who is conducting the monitoring of any difficulties you are having wearing the device.

Evaluation of 8-hour Exposure: Measurements taken for the purpose of determining time-weighted average (TWA) exposures are best taken with samples covering the full shift. Samples collected must be taken from the employee's breathing zone air.

Short-term Exposure Evaluation: If there are tasks that involve brief but intense exposure to formaldehyde, employee exposure must be measured to assure

compliance with the STEL. Sample collections are for brief periods, only 15 minutes, but several samples may be needed to identify the peak exposure.

Monitoring Techniques: OSHA's only requirement for selecting a method for sampling and analysis is that the methods used accurately evaluate the concentration of formaldehyde in employees' breathing zones. Sampling and analysis may be performed by collection of formaldehyde on liquid or solid sorbents with subsequent chemical analysis. Sampling and analysis may also be performed by passive diffusion monitors and short-term exposure may be measured by instruments such as real-time continuous monitoring systems and portable direct reading instruments.

Notification of Results: Your employer must inform you of the results of exposure monitoring representative of your job. You may be informed in writing, but posting the results where you have ready access to them constitutes compliance with the standard.

Protective Equipment and Clothing

[Material impervious to formaldehyde is needed if the employee handles formaldehyde solutions of 1% or more. Other employees may also require protective clothing or equipment to prevent dermatitis.]

Respiratory Protection: Use NIOSH-approved full facepiece negative pressure respirators equipped with approved cartridges or canisters within the use limitations of these devices. (Present restrictions on cartridges and canisters do not permit them to be used for a full workshift.) In all other situations, use positive pressure respirators such as the positive-pressure air purifying respirator or the self-contained breathing apparatus (SCBA). If you use a negative pressure respirator, your employer must provide you with fit testing of the respirator at least once a year in accordance with the procedures outlined in Appendix E.

Protective Gloves: Wear protective (impervious) gloves provided by your employer, at no cost, to prevent contact with formalin. Your employer should select these gloves based on the results of permeation testing and in accordance with the ACGIH Guidelines for Selection of Chemical Protective Clothing.

Eye Protection: If you might be splashed in the eyes with formalin, it is essential that you wear goggles or some other type of complete protection for the eye. You may also need a face shield if your face is likely to be splashed with formalin, but you must not substitute face shields for eye protection. (This section pertains to formaldehyde solutions of 1% or more.)

Other Protective Equipment: You must wear protective (impervious) clothing and equipment provided by your employer at no cost to prevent repeated or prolonged contact with formaldehyde liquids. If you are required to change into whole-body chemical protective clothing, your employer must provide a change room for your privacy and for storage of your normal clothing.

If you are splashed with formaldehyde, use the emergency showers and eyewash fountains provided by your employer

immediately to prevent serious injury. Report the incident to your supervisor and obtain necessary medical support.

Entry Into an IDLH Atmosphere

Enter areas where the formaldehyde concentration might be 100 ppm or more only with complete body protection including a self-contained breathing apparatus with a full facepiece operated in a positive pressure mode or a supplied air respirator with full facepiece and operated in a positive pressure mode. This equipment is essential to protect your life and health under such extreme conditions.

Engineering Controls

Ventilation is the most widely applied engineering control method for reducing the concentration of airborne substances in the breathing zones of workers. There are two distinct types of ventilation.

Local Exhaust: Local exhaust ventilation is designed to capture airborne contaminants as near to the point of generation as possible. To protect you, the direction of contaminant flow must always be toward the local exhaust system inlet and away from you.

General (Mechanical): General dilution ventilation involves continuous introduction of fresh air into the workroom to mix with the contaminated air and lower your breathing zone concentration of formaldehyde. Effectiveness depends on the number of air changes per hour. Where devices emitting formaldehyde are spread out over a large area, general dilution ventilation may be the only practical method of control.

Work Practices: Work practices and administrative procedures are an important part of a control system. If you are asked to perform a task in a certain manner to limit your exposure to formaldehyde, it is extremely important that you follow these procedures.

Medical Surveillance

Medical surveillance helps to protect employees' health. You are encouraged strongly to participate in the medical surveillance program.

Your employer must make a medical surveillance program available at no expense to you and at a reasonable time and place if you are exposed to formaldehyde at concentrations above 0.5 ppm as an 8-hour average or 2 ppm over any 15-minute period. You will be offered medical surveillance at the time of your initial assignment and once a year afterward as long as your exposure is at least 0.5 ppm (TWA) or 2 ppm (STEL). Even if your exposure is below these levels, you should inform your employer if you have signs and symptoms that you suspect, through your training, are related to your formaldehyde exposure because you may need medical surveillance to determine if your health is being impaired by your exposure.

The surveillance plan includes:

- (a) A medical disease questionnaire.
- (b) A physical examination if the physician determines this is necessary.

If you are required to wear a respirator, your employer must offer you a physical examination and a pulmonary function test every year.

The physician must collect all information needed to determine if you are at increased risk from your exposure to formaldehyde. At the physician's discretion, the medical examination may include other tests, such as a chest x-ray, to make this determination.

After a medical examination the physician will provide your employer with a written opinion which includes any special protective measures recommended and any restrictions on your exposure. The physician must inform you of any medical conditions you have which would be aggravated by exposure to formaldehyde.

All records from your medical examinations, including disease surveys, must be retained at your employer's expense.

Emergencies

If you are exposed to formaldehyde in an emergency and develop signs or symptoms associated with acute toxicity from formaldehyde exposure, your employer must provide you with a medical examination as soon as possible. This medical examination will include all steps necessary to stabilize your health. You may be kept in the hospital for observation if your symptoms are severe to ensure that any delayed effects are recognized and treated.

Appendix B to § 1910.1048—Sampling Strategy and Analytical Methods for Formaldehyde

To protect the health of employees, exposure measurements must be unbiased and representative of employee exposure. The proper measurement of employee exposure requires more than a token commitment on the part of the employer. OSHA's mandatory requirements establish a baseline; under the best of circumstances all questions regarding employee exposure will be answered. Many employers, however, will wish to conduct more extensive monitoring before undertaking expensive commitments, such as engineering controls, to assure that the modifications are truly necessary. The following sampling strategy, which was developed at NIOSH by Nelson A. Leidel, Kenneth A. Busch, and Jeremiah R. Lynch and described in NIOSH publication No. 77-173 (Occupational Exposure Sampling Strategy Manual) will assist the employer in developing a strategy for determining the exposure of his or her employees.

There is no one correct way to determine employee exposure. Obviously, measuring the exposure of every employee exposed to formaldehyde will provide the most information on any given day. Where few employees are exposed, this may be a practical solution. For most employers, however, use of the following strategy will give just as much information at less cost.

Exposure data collected on a single day will not automatically guarantee the employer that his or her workplace is always in compliance with the formaldehyde standard. This does not imply, however, that it is impossible for an employer to be sure that his or her worksite is in compliance with the standard. Indeed, a properly designed sampling strategy showing that all employees are exposed below the PELs, at least with a 95 percent certainty, is compelling evidence that the exposure limits are being achieved

provided that measurements are conducted using valid sampling strategy and approved analytical methods.

There are two PELs, the TWA concentration and the STEL. Most employers will find that one of these two limits is more critical in the control of their operations, and OSHA expects that the employer will concentrate monitoring efforts on the critical component. If the more difficult exposure is controlled, this information, along with calculations to support the assumptions, should be adequate to show that the other exposure limit is also being achieved.

Sampling Strategy

Determination of the Need for Exposure Measurements

The employer must determine whether employees may be exposed to concentrations in excess of the action level. This determination becomes the first step in an employee exposure monitoring program that minimizes employer sampling burdens while providing adequate employee protection. If employees may be exposed above the action level, the employer must measure exposure. Otherwise, an objective determination that employee exposure is low provides adequate evidence that exposure potential has been examined.

The employer should examine all available relevant information, eg. insurance company and trade association data and information from suppliers or exposure data collected from similar operations. The employer may also use previously-conducted sampling including area monitoring. The employer must make a determination relevant to each operation although this need not be on a separate piece of paper. If the employer can demonstrate conclusively that no employee is exposed above the action level or the STEL through the use of objective data, the employer need proceed no further on employee exposure monitoring until such time that conditions have changed and the determination is no longer valid.

If the employer cannot determine that employee exposure is less than the action level and the STEL, employee exposure monitoring will have to be conducted.

Workplace Material Survey

The primary purpose of a survey of raw material is to determine if formaldehyde is being used in the work environment and if so, the conditions under which formaldehyde is being used.

The first step is to tabulate all situations where formaldehyde is used in a manner such that it may be released into the workplace atmosphere or contaminate the skin. This information should be available through analysis of company records and information on the MSDSs available through provisions of this standard and the Hazard Communication standard.

If there is an indication from materials handling records and accompanying MSDSs that formaldehyde is being used in the following types of processes or work operations, there may be a potential for releasing formaldehyde into the workplace atmosphere:

(1) Any operation that involves grinding, sanding, sawing, cutting, crushing, screening, sieving, or any other manipulation of material that generates formaldehyde-bearing dust

(2) Any processes where there have been employee complaints or symptoms indicative of exposure to formaldehyde

(3) Any liquid or spray process involving formaldehyde

(4) Any process that uses formaldehyde in preserved tissue

(5) Any process that involves the heating of a formaldehyde-bearing resin.

Processes and work operations that use formaldehyde in these manners will probably require further investigation at the worksite to determine the extent of employee monitoring that should be conducted.

Workplace Observations

To this point, the only intention has been to provide an indication as to the existence of potentially exposed employees. With this information, a visit to the workplace is needed to observe work operations, to identify potential health hazards, and to determine whether any employees may be exposed to hazardous concentrations of formaldehyde.

In many circumstances, sources of formaldehyde can be identified through the sense of smell. However, this method of detection should be used with caution because of olfactory fatigue.

Employee location in relation to source of formaldehyde is important in determining if an employee may be significantly exposed to formaldehyde. In most instances, the closer a worker is to the source, the higher the probability that a significant exposure will occur.

Other characteristics should be considered. Certain high temperature operations give rise to higher evaporation rates. Locations of open doors and windows provide natural ventilation that tend to dilute formaldehyde emissions. General room ventilation also provides a measure of control.

Calculation of Potential Exposure Concentrations

By knowing the ventilation rate in a workplace and the quantity of formaldehyde generated, the employer may be able to determine by calculation if the PELs might be exceeded. To account for poor mixing of formaldehyde into the entire room, locations of fans and proximity of employees to the work operation, the employer must include a safety factor. If an employee is relatively close to a source, particularly if he or she is located downwind, a safety factor of 100 may be necessary. For other situations, a factor of 10 may be acceptable. If the employer can demonstrate through such calculations that employee exposure does not exceed the action level or the STEL, the employer may use this information as objective data to demonstrate compliance with the standard.

Sampling Strategy

Once the employer determines that there is a possibility of substantial employee exposure to formaldehyde, the employer is obligated to measure employee exposure.

The next step is selection of a maximum risk employee. When there are different

processes where employees may be exposed to formaldehyde, a maximum risk employee should be selected for each work operation.

Selection of the maximum risk employee requires professional judgment. The best procedure for selecting the maximum risk employee is to observe employees and select the person closest to the source of formaldehyde. Employee mobility may affect this selection; e.g. if the closest employee is mobile in his tasks, he may not be the maximum risk employee. Air movement patterns and differences in work habits will also affect selection of the maximum risk employee.

When many employees perform essentially the same task, a maximum risk employee cannot be selected. In this circumstance, it is necessary to resort to random sampling of the group of workers. The objective is to select a subgroup of adequate size so that there is a high probability that the random sample will contain at least one worker with high exposure if one exists. The number of persons in the group influences the number that need to be sampled to ensure that at least one individual from the highest 10 percent exposure group is contained in the sample. For example, to have 90 percent confidence in the results, if the group size is 10, nine should be sampled; for 50, only 18 need to be sampled.

If measurement shows exposure to formaldehyde at or above the action level or the STEL, the employer needs to identify all other employees who may be exposed at or above the action level or STEL and measure or otherwise accurately characterize the exposure of these employees.

Whether representative monitoring or random sampling are conducted, the purpose remains the same—to determine if the exposure of any employee is above the action level. If the exposure of the most exposed employee is less than the action level and the STEL, regardless of how the employee is identified, then it is reasonable to assume that measurements of exposure of the other employees in that operation would be below the action level and the STEL.

Exposure Measurements

There is no "best" measurement strategy for all situations. Some elements to consider in developing a strategy are:

- (1) Availability and cost of sampling equipment
- (2) Availability and cost of analytic facilities
- (3) Availability and cost of personnel to take samples
- (4) Location of employees and work operations
- (5) Intraday and interday variations in the process
- (6) Precision and accuracy of sampling and analytic methods, and
- (7) Number of samples needed.

Samples taken for determining compliance with the STEL differ from those that measure the TWA concentration in important ways. STEL samples are best taken in a nonrandom fashion using all available knowledge relating to the area, the individual, and the process to obtain samples during periods of maximum expected concentrations. At least three measurements on a shift are generally

needed to spot gross errors or mistakes; however, only the highest value represents the STEL.

If an operation remains constant throughout the workshift, a much greater number of samples would need to be taken over the 32 discrete nonoverlapping periods in an 8-hour workshift to verify compliance with a STEL. If employee exposure is truly uniform throughout the workshift, however, an employer in compliance with the 1 ppm TWA would be in compliance with the 2 ppm STEL, and this determination can probably be made using objective data.

Need to Repeat the Monitoring Strategy

Interday and intraday fluctuations in employee exposure are mostly influenced by the physical processes that generate formaldehyde and the work habits of the employee. Hence, in-plant process variations influence the employer's determination of whether or not additional controls need to be imposed. Measurements that employee exposure is low on a day that is not representative of worst conditions may not provide sufficient information to determine whether or not additional engineering controls should be installed to achieve the PELs.

The person responsible for conducting sampling must be aware of systematic changes which will negate the validity of the sampling results. Systematic changes in formaldehyde exposure concentration for an employee can occur due to:

- (1) The employee changing patterns of movement in the workplace
- (2) Closing of plant doors and windows
- (3) Changes in ventilation from season to season
- (4) Decreases in ventilation efficiency or abrupt failure of engineering control equipment
- (5) Changes in the production process or work habits of the employee.

Any of these changes, if they may result in additional exposure that reaches the next level of action (i.e. 0.5 or 1.0 ppm as an 8-hr average or 2 ppm over 15 minutes) require the employer to perform additional monitoring to reassess employee exposure.

A number of methods are suitable for measuring employee exposure to formaldehyde or for characterizing emissions within the worksite. The preamble to this standard describes some methods that have been widely used or subjected to validation testing. A detailed analytical procedure derived from the OSHA Method 52 for acrolein and formaldehyde is presented below for informational purposes.

Inclusion of OSHA's method in this appendix in no way implies that it is the only acceptable way to measure employee exposure to formaldehyde. Other methods that are free from significant interferences and that can determine formaldehyde at the permissible exposure limits within ± 25 percent of the "true" value at the 95 percent confidence level are also acceptable. Where applicable, the method should also be capable of measuring formaldehyde at the action level to ± 35 percent of the "true" value with a 95 percent confidence level.

OSHA encourages employers to choose methods that will be best for their individual needs. The employer must exercise caution, however, in choosing an appropriate method since some techniques suffer from interferences that are likely to be present in workplaces of certain industry sectors where formaldehyde is used.

OSHA's Analytical Laboratory Method

Method No: 52

Matrix: Air

Target Concentration: 1 ppm (1.2 mg/m³)

Procedures: Air samples are collected by drawing known volumes of air through sampling tubes containing XAD-2 adsorbent which have been coated with 2-(hydroxymethyl) piperidine. The samples are desorbed with toluene and then analyzed by gas chromatography using a nitrogen selective detector.

Recommended Sampling Rate and Air

Volumes: 0.1 L/min and 24 L

Reliable Quantitation Limit: 16 ppb (20 µg/m³)

Standard Error of Estimate at the Target Concentration: 7.3%

Status of the Method: A sampling and analytical method that has been subjected to the established evaluation procedures of the Organic Methods Evaluation Branch.

Date: March 1985

1. General Discussion

1.1 Background: The current OSHA method for collecting acrolein vapor recommends the use of activated 13X molecular sieves. The samples must be stored in an ice bath during and after sampling and also they must be analyzed within 48 hours of collection. The current OSHA method for collecting formaldehyde vapor recommends the use of bubblers containing 10% methanol in water as the trapping solution.

This work was undertaken to resolve the sample stability problems associated with acrolein and also to eliminate the need to use bubblers to sample formaldehyde. A goal of this work was to develop and/or to evaluate a common sampling and analytical procedure for acrolein and formaldehyde.

NIOSH has developed independent methodologies for acrolein and formaldehyde which recommend the use of reagent-coated adsorbent tubes to collect the aldehydes as stable derivatives. The formaldehyde sampling tubes contain Chromosorb 102 adsorbent coated with N-benzylethanolamine (BEA) which reacts with formaldehyde vapor to form a stable oxazolidine compound. The acrolein sampling tubes contain XAD-2 adsorbent coated with 2-(hydroxymethyl)piperidine (2-HMP) which reacts with acrolein vapor to form a different, stable oxazolidine derivative. Acrolein does not appear to react with BEA to give a suitable reaction product. Therefore, the formaldehyde procedure cannot provide a common method for both aldehydes. However, formaldehyde does react with 2-HMP to form a very suitable reaction product. It is the quantitative reaction of acrolein and formaldehyde with 2-HMP that provides the basis for this evaluation.

This sampling and analytical procedure is very similar to the method recommended by NIOSH for acrolein. Some changes in the

NIOSH methodology were necessary to permit the simultaneous determination of both aldehydes and also to accommodate OSHA laboratory equipment and analytical techniques.

1.2 Limit-defining parameters: The analyte air concentrations reported in this method are based on the recommended air volume for each analyte collected separately and a desorption volume of 1 mL. The amounts are presented as acrolein and/or formaldehyde, even though the derivatives are the actual species analyzed.

1.2.1 Detection limits of the analytical procedure: The detection limit of the analytical procedure was 386 pg per injection for formaldehyde. This was the amount of analyte which gave a peak whose height was about five times the height of the peak given by the residual formaldehyde derivative in a typical blank front section of the recommended sampling tube.

1.2.2 Detection limits of the overall procedure: The detection limits of the overall procedure were 482 ng per sample (16 ppb or 20 µg/m³ for formaldehyde). This was the amount of analyte spiked on the sampling device which allowed recoveries approximately equal to the detection limit of the analytical procedure.

1.2.3 Reliable quantitation limits: The reliable quantitation limit was 482 ng per sample (16 ppb or 20 µg/m³) for formaldehyde. These were the smallest amounts of analyte which could be quantitated within the limits of a recovery of at least 75% and a precision (± 1.96 SD) of $\pm 25\%$ or better.

The reliable quantitation limit and detection limits reported in the method are based upon optimization of the instrument for the smallest possible amount of analyte. When the target concentration of an analyte is exceptionally higher than these limits, they may not be attainable at the routine operating parameters.

1.2.4 Sensitivity: The sensitivity of the analytical procedure over concentration ranges representing 0.4 to 2 times the target concentration, based on the recommended air volumes, was 7,589 area units per µg/mL for formaldehyde. This value was determined from the slope of the calibration curve. The sensitivity may vary with the particular instrument used in the analysis.

1.2.5 Recovery: The recovery of formaldehyde from samples used in an 18-day storage test remained above 92% when the samples were stored at ambient temperature. These values were determined from regression lines which were calculated from the storage data. The recovery of the analyte from the collection device must be at least 75% following storage.

1.2.6 Precision (analytical method only): The pooled coefficient of variation obtained from replicate determinations of analytical standards over the range of 0.4 to 2 times the target concentration was 0.0052 for formaldehyde (Section 4.3).

1.2.7 Precision (overall procedure): The precision at the 95% confidence level for the ambient temperature storage tests was $\pm 14.3\%$ for formaldehyde. These values each

include an additional $\pm 5\%$ for sampling error. The overall procedure must provide results at the target concentrations that are $\pm 25\%$ at the 95% confidence level.

1.2.8 Reproducibility: Samples collected from controlled test atmospheres and a draft copy of this procedure were given to a chemist unassociated with this evaluation. The formaldehyde samples were analyzed following 15 days storage. The average recovery was 96.3% and the standard deviation was 1.7%.

1.3 Advantages:

1.3.1 The sampling and analytical procedures permit the simultaneous determination of acrolein and formaldehyde.

1.3.2 Samples are stable following storage at ambient temperature for at least 18 days.

1.4 Disadvantages: None.

2. Sampling Procedure

2.1 Apparatus:

2.1.1 Samples are collected by use of a personal sampling pump that can be calibrated to within $\pm 5\%$ of the recommended 0.1 L/min sampling rate with the sampling tube in line.

2.1.2 Samples are collected with laboratory prepared sampling tubes. The sampling tube is constructed of silane treated glass and is about 8-cm long. The ID is 4 mm and the OD is 6 mm. One end of the tube is tapered so that a glass wool end plug will hold the contents of the tube in place during sampling. The other end of the sampling tube is open to its full 4-mm ID to facilitate packing of the tube. Both ends of the tube are fire-polished for safety. The tube is packed with a 75-mg backup section, located nearest the tapered end and a 150-mg sampling section of pretreated XAD-2 adsorbent which has been coated with 2-HMP. The two sections of coated adsorbent are separated and retained with small plugs of silanized glass wool. Following packing, the sampling tubes are sealed with two 7/8 inch OD plastic end caps. Instructions for the pretreatment and the coating of XAD-2 adsorbent are presented in Section 4 of this method.

2.1.3 Sampling tubes, similar to those recommended in this method, are marketed by Supelco, Inc. These tubes were not available when this work was initiated; therefore, they were not evaluated.

2.2 Reagents: None required.

2.3 Technique:

2.3.1 Properly label the sampling tube before sampling and then remove the plastic end caps.

2.3.2 Attach the sampling tube to the pump using a section of flexible plastic tubing such that the large, front section of the sampling tube is exposed directly to the atmosphere. Do not place any tubing ahead of the sampling tube. The sampling tube should be attached in the worker's breathing zone in a vertical manner such that it does not impede work performance.

2.3.3 After sampling for the appropriate time, remove the sampling tube from the pump and then seal the tube with plastic end caps.

2.3.4 Include at least one blank for each sampling set. The blank should be handled in the same manner as the samples with the exception that air is not drawn through it.

2.3.5 List any potential interferences on the sample data sheet.

2.4 Breakthrough:

2.4.1 Breakthrough was defined as the relative amount of analyte found on a backup sample in relation to the total amount of analyte collected on the sampling train.

2.4.2 For formaldehyde collected from test atmospheres containing 6 times the PEL, the average 5% breakthrough air volume was 41 L. The sampling rate was 0.1 L/min and the average mass of formaldehyde collected was 250 µg.

2.5 *Desorption Efficiency*: No desorption efficiency corrections are necessary to compute air sample results because analytical standards are prepared using coated adsorbent. Desorption efficiencies were determined, however, to investigate the recoveries of the analytes from the sampling device. The average recovery over the range of 0.4 to 2 times the target concentration, based on the recommended air volumes, was 96.2% for formaldehyde. Desorption efficiencies were essentially constant over the ranges studied.

2.6 Recommended Air Volume and Sampling Rate:

2.6.1 The recommended air volume for formaldehyde is 24 L.

2.6.2 The recommended sampling rate is 0.1 L/min.

2.7 Interferences:

2.7.1 Any collected substance that is capable of reacting 2-HMP and thereby depleting the derivatizing agent is a potential interference. Chemicals which contain a carbonyl group, such as acetone, may be capable of reacting with 2-HMP.

2.7.2 There are no other known interferences to the sampling method.

2.8 Safety Precautions:

2.8.1 Attach the sampling equipment to the worker in such a manner that it will not interfere with work performance or safety.

2.8.2 Follow all safety practices that apply to the work area being sampled.

3. Analytical Procedure

3.1 Apparatus:

3.1.1 A gas chromatograph (GC), equipped with a nitrogen selective detector. A Hewlett-Packard Model 5840A GC fitted with a nitrogen-phosphorus flame ionization detector (NPD) was used for this evaluation. Injections were performed using a Hewlett-Packard Model 7671A automatic sampler.

3.1.2 A GC column capable of resolving the analytes from any interference. A 6 ft x 1/4 in OD (2 mm ID) glass GC column containing 10% UCON 50-HB-5100 + 2% KOH on 80/100 mesh Chromosorb W-AW was used for the evaluation. Injections were performed on-column.

3.1.3 Vials, glass 2-mL with Teflon-lined caps.

3.1.4 Volumetric flasks, pipets, and syringes for preparing standards, making dilutions, and performing injections.

3.2 Reagents:

3.2.1 Toluene and dimethylformamide. Burdick and Jackson solvents were used in this evaluation.

3.2.2 Helium, hydrogen, and air, GC grade.

3.2.3 Formaldehyde, 37%, by weight, in water. Aldrich Chemical, ACS Reagent Grade formaldehyde was used in this evaluation.

3.2.4 Amberlite XAD-2 adsorbent coated with 2-(hydroxymethyl)-piperidine (2-HMP), 10% by weight (Section 4).

3.2.5 Desorbing solution with internal standard. This solution was prepared by adding 20 µL of dimethylformamide to 100 mL of toluene.

3.3 Standard preparation:

3.3.1 *Formaldehyde*: Prepare stock standards by diluting known volumes of 37% formaldehyde solution with methanol. A procedure to determine the formaldehyde content of these standards is presented in Section 4. A standard containing 7.7 mg/mL formaldehyde was prepared by diluting 1 mL of the 37% reagent to 50 mL with methanol.

3.3.2 It is recommended that analytical standards be prepared about 16 hours before the air samples are to be analyzed in order to ensure the complete reaction of the analytes with 2-HMP. However, rate studies have shown the reaction to be greater than 95% complete after 4 hours. Therefore, one or two standards can be analyzed after this reduced time if sample results are outside the concentration range of the prepared standards.

3.3.3 Place 150-mg portions of coated XAD-2 adsorbent, from the same lot number as used to collect the air samples, into each of several glass 2-mL vials. Seal each vial with a Teflon-lined cap.

3.3.4 Prepare fresh analytical standards each day by injecting appropriate amounts of the diluted analyte directly onto 150-mg portions of coated adsorbent. It is permissible to inject both acrolein and formaldehyde on the same adsorbent portion. Allow the standards to stand at room temperature. A standard, approximately the target levels, was prepared by injecting 11 µL of the acrolein and 12 µL of the formaldehyde stock standards onto a single coated XAD-2 adsorbent portion.

3.3.5 Prepare a sufficient number of standards to generate the calibration curves. Analytical standard concentrations should bracket sample concentrations. Thus, if samples are not in the concentration range of the prepared standards, additional standards must be prepared to determine detector response.

3.3.7 Desorb the standards in the same manner as the samples following the 16-hour reaction time.

3.4 Sample preparation:

3.4.1 Transfer the 150-mg section of the sampling tube to a 2-mL vial. Place the 75-mg section in a separate vial. If the glass wool plugs contain a significant number of adsorbent beads, place them with the appropriate sampling tube section. Discard the glass wool plugs if they do not contain a significant number of adsorbent beads.

3.4.2 Add 1 mL of desorbing solution to each vial.

3.4.3 Seal the vials with Teflon-lined caps and then allow them to desorb for one hour. Shake the vials by hand with vigorous force several times during the desorption time.

3.4.4 Save the used sampling tubes to be cleaned and recycled.

3.5 Analysis:

3.5.1 GC Conditions

Column Temperature:

Bi-level temperature program—First level: 100 to 140 °C at 4 °C/min following completion of the first level.

Second level: 140 to 180 °C at 20 °C/min following completion of the first level.

Isothermal period: Hold column at 180 °C until the recorder pen returns to baseline (usually about 25 min after injection).

Injector temperature: 180 °C

Helium flow rate: 30 mL/min (detector response will be reduced if nitrogen is substituted for helium carrier gas).

Injection volume: 0.8 µL

GC column: Six-ft x 1/4-in OD (2 mm ID) glass

GC column containing 10% UCON 50-HB-5100 + 2% KOH on 80/100 Chromosorb W-AW.

NPD conditions:

Hydrogen flow rate: 3 mL/min

Air flow rate: 50 mL/min

Detector temperature: 275 °C

3.5.2 *Chromatogram*: For an example of a typical chromatogram, see Figure 4.11 in OSHA Method 52.

3.5.3 Use a suitable method, such as electronic integration, to measure detector response.

3.5.4 Use an internal standard method to prepare the calibration curve with several standard solutions of different concentrations. Prepare the calibration curve daily. Program the integrator to report results in µg/mL.

3.5.5 Bracket sample concentrations with standards.

3.6 Interferences (Analytical)

3.6.1 Any compound with the same general retention time as the analytes and which also gives a detector response is a potential interference. Possible interferences should be reported to the laboratory with submitted samples by the industrial hygienist.

3.6.2 GC parameters (temperature, column, etc.) may be changed to circumvent interferences.

3.6.3 A useful means of structure designation is GC/MS. It is recommended this procedure be used to confirm samples whenever possible.

3.6.4 The coated adsorbent usually contains a very small amount of residual formaldehyde derivative (Section 4.8).

3.7 Calculations:

3.7.1 Results are obtained by use of calibration curves. Calibration curves are prepared by plotting detector response against concentration for each standard. The best line through the data points is determined by curve fitting.

3.7.2 The concentration, in µg/mL, for a particular sample is determined by comparing its detector response to the calibration curve. If either of the analytes is found on the backup section, it is added to the amount found on the front section. Blank corrections should be performed before adding the results together.

3.7.3 The acrolein and/or formaldehyde air concentration can be expressed using the following equation:

$$\text{mg/m}^3 = (A)(B)/C$$

where A = µg/mL from 3.7.2, B = desorption volume, and C = L of air sampled.

No desorption efficiency corrections are required.

3.7.4 The following equation can be used to convert results in mg/m^3 to ppm.

$$\text{ppm} = (\text{mg}/\text{m}^3)(24.45)/\text{MW}$$

where mg/m^3 = result from 3.7.3, 24.45 = molar volume of an ideal gas at 760 mm Hg and 25 °C, MW = molecular weight (30.0).

4. Backup Data

4.1 Backup data on detection limits, reliable quantitation limits, sensitivity and precision of the analytical method, breakthrough, desorption efficiency, storage, reproducibility, and generation of test atmospheres are available in OSHA Method 52, developed by the Organics Methods Evaluation Branch, OSHA Analytical Laboratory, Salt Lake City, Utah.

4.2 Procedure to Coat XAD-2 Adsorbent with 2-HMP

4.2.1 Apparatus: Soxhlet extraction apparatus, rotary evaporation apparatus, vacuum desiccator, 1-L vacuum flask, 1-L round-bottomed evaporative flask, 1-L Erlenmeyer flask, 250-mL Buchner funnel with a coarse fritted disc, etc.

4.2.2 Reagents:

4.2.2.1 Methanol, isooctane, and toluene.
4.2.2.2 2-(Hydroxymethyl)piperidine.
4.2.2.3 Amberlite XAD-2 non-ionic polymeric adsorbent, 20 to 60 mesh, Aldrich Chemical XAD-2 was used in this evaluation.

4.2.3 Procedure: Weigh 125 g of crude XAD-2 adsorbent into a 1-L Erlenmeyer flask. Add about 200 mL of water to the flask and then swirl the mixture to wash the adsorbent. Discard any adsorbent that floats to the top of the water and then filter the mixture using a fritted Buchner funnel. Air dry the adsorbent for 2 minutes. Transfer the adsorbent back to the Erlenmeyer flask and then add about 200 mL of methanol to the flask. Swirl and then filter the mixture as before. Transfer the washed adsorbent back to the Erlenmeyer flask and then add about 200 mL of methanol to the flask. Swirl and then filter the mixture as before. Transfer the washed adsorbent to a 1-L round-bottomed evaporative flask, add 13 g of 2-HMP and then 200 mL of methanol, swirl the mixture and then allow it to stand for one hour. Remove the methanol at about 40 °C and reduced pressure using a rotary evaporation apparatus. Transfer the coated adsorbent to a suitable container and store it in a vacuum desiccator at room temperature overnight. Transfer the coated adsorbent to a Soxhlet extractor and then extract the material with toluene for about 24 hours. Discard the contaminated toluene, add methanol in its place and then continue the Soxhlet extraction for an additional 4 hours. Transfer the adsorbent to a weighted 1-L round-bottom evaporative flask and remove the methanol using the rotary evaporation apparatus. Determine the weight of the adsorbent and then add an amount of 2-HMP, which is 10% by weight of the adsorbent. Add 200 mL of methanol and then swirl the

mixture. Allow the mixture to stand for one hour. Remove the methanol by rotary evaporation. Transfer the coated adsorbent to a suitable container and store it in a vacuum desiccator until all traces of solvents are gone. Typically, this will take 2-3 days. The coated adsorbent should be protected from contamination. XAD-2 adsorbent treated in this manner will probably not contain residual acrolein derivative. However, this adsorbent will often contain residual formaldehyde derivative levels of about 0.1 μg per 150 mg of adsorbent. If the blank values for a batch of coated adsorbent are too high, then the batch should be returned to the Soxhlet extractor, extracted with toluene again and then re-coated. This process can be repeated until the desired blank levels are attained.

The coated adsorbent is now ready to be packed into sampling tubes. The sampling tubes should be stored in a sealed container to prevent contamination. Sampling tubes should be stored in the dark at room temperature. The sampling tubes should be segregated by coated adsorbent lot number. A sufficient amount of each lot number of coated adsorbent should be retained to prepare analytical standards for use with air samples from that lot number.

4.3 A Procedure to Determine Formaldehyde by Acid Titration: Standardize the 0.1 N HCl solution using sodium carbonate and methyl orange indicator.

Place 50 mL of 0.1 M sodium sulfite and three drops of thymolphthalein indicator into a 250-mL Erlenmeyer flask. Titrate the contents of the flask to a colorless endpoint with 0.1 N HCl (usually one or two drops is sufficient). Transfer 10 mL of the formaldehyde/methanol solution (prepared in 3.3.1) into the same flask and titrate the mixture with 0.1 N HCl, again, to a colorless endpoint. The formaldehyde concentration of the standard may be calculated by the following equation:

$$\frac{\text{Formaldehyde, mg/ mL}}{\text{acid titer} \times \text{acid normality} \times 30.0} = \text{mL of sample}$$

This method is based on the quantitative liberation of sodium hydroxide when formaldehyde reacts with sodium sulfite to form the formaldehyde-bisulfite addition product. The volume of sample may be varied depending on the formaldehyde content but the solution to be titrated must contain excess sodium sulfite. Formaldehyde solutions containing substantial amounts of acid or base must be neutralized before analysis.

Appendix C to § 1910.1048—Medical Surveillance—Formaldehyde

1. Health Hazards

The occupational health hazards of

formaldehyde are primarily due to its toxic effects after inhalation, after direct contact with the skin or eyes by formaldehyde in liquid or vapor form, and after ingestion.

II. Toxicology

A. Acute Effects of Exposure

1. *Inhalation (breathing):* Formaldehyde is highly irritating to the upper airways. The concentration of formaldehyde that is immediately dangerous to life and health is 100 ppm. Concentrations above 50 ppm can cause severe pulmonary reactions within minutes. These include pulmonary edema, pneumonia, and bronchial irritation which can result in death. Concentrations above 5 ppm readily cause lower airway irritation characterized by cough, chest tightness and wheezing. There is some controversy regarding whether formaldehyde gas is a pulmonary sensitizer which can cause occupational asthma in a previously normal individual. Formaldehyde can produce symptoms of bronchial asthma in humans. The mechanism may be either sensitization of the individual by exposure to formaldehyde or direct irritation by formaldehyde in persons with pre-existing asthma. Upper airway irritation is the most common respiratory effect reported by workers and can occur over a wide range of concentrations, most frequently above 1 ppm. However, airway irritation has occurred in some workers with exposures to formaldehyde as low as 0.1 ppm. Symptoms of upper airway irritation include dry or sore throat, itching and burning sensations of the nose, and nasal congestion. Tolerance to this level of exposure may develop within 1-2 hours. This tolerance can permit workers remaining in an environment of gradually increasing formaldehyde concentrations to be unaware of their increasingly hazardous exposure.

2. *Eye contact:* Concentrations of formaldehyde between 0.05 ppm and 0.5 ppm produce a sensation of irritation in the eyes with burning, itching, redness, and tearing. Increased rate of blinking and eye closure generally protects the eye from damage at these low levels, but these protective mechanisms may interfere with some workers' work abilities. Tolerance can occur in workers continuously exposed to concentrations of formaldehyde in this range. Accidental splash injuries of human eyes to aqueous solutions of formaldehyde (formalin) have resulted in a wide range of ocular injuries including corneal opacities and blindness. The severity of the reactions have been directly dependent on the concentration of formaldehyde in solution and the amount of time lapsed before emergency and medical intervention.

3. *Skin contact:* Exposure to formaldehyde solutions can cause irritation of the skin and allergic contact dermatitis. These skin

diseases and disorders can occur at levels well below those encountered by many formaldehyde workers. Symptoms include erythema, edema, and vesiculation or hives. Exposure to liquid formalin or formaldehyde vapor can provoke skin reactions in sensitized individuals even when airborne concentrations of formaldehyde are well below 1 ppm.

4. Ingestion: Ingestion of as little as 30 ml of a 37 percent solution of formaldehyde (formalin) can result in death. Gastrointestinal toxicity after ingestion is most severe in the stomach and results in symptoms which can include nausea, vomiting, and severe abdominal pain. Diverse damage to other organ systems including the liver, kidney, spleen, pancreas, brain, and central nervous systems can occur from the acute response to ingestion of formaldehyde.

B. Chronic Effects of Exposure

Long term exposure to formaldehyde has been shown to be associated with an increased risk of cancer of the nose and accessory sinuses, nasopharyngeal and oropharyngeal cancer, and lung cancer in humans. Animal experiments provide conclusive evidence of a causal relationship between nasal cancer in rats and formaldehyde exposure. Concordant evidence of carcinogenicity includes DNA binding, genotoxicity in short-term tests, and cytotoxic changes in the cells of the target organ suggesting both preneoplastic changes and a dose-rate effect. Formaldehyde is a complete carcinogen and appears to exert an effect on at least two stages of the carcinogenic process.

III. Surveillance considerations

A. History

1. Medical and occupational history: Along with its acute irritative effects, formaldehyde can cause allergic sensitization and cancer. One of the goals of the work history should be to elicit information on any prior or additional exposure to formaldehyde in either the occupational or the non-occupational setting.

2. Respiratory history: As noted above, formaldehyde has recognized properties as an airway irritant and has been reported by some authors as a cause of occupational asthma. In addition, formaldehyde has been associated with cancer of the entire respiratory system of humans. For these reasons, it is appropriate to include a comprehensive review of the respiratory system in the medical history. Components of this history might include questions regarding dyspnea on exertion, shortness of breath, chronic airway complaints, hyperreactive airway disease, rhinitis, bronchitis, bronchiolitis, asthma, emphysema, respiratory allergic reaction, or other preexisting pulmonary disease.

In addition, generalized airway hypersensitivity can result from exposures to a single sensitizing agent. The examiner should, therefore, elicit any prior history of exposure to pulmonary irritants, and any short- or long-term effects of that exposure.

Smoking is known to decrease mucociliary clearance of materials deposited during

respiration in the nose and upper airways. This may increase a worker's exposure to inhaled materials such as formaldehyde vapor. In addition, smoking is a potential confounding factor in the investigation of any chronic respiratory disease, including cancer. For these reasons, a complete smoking history should be obtained.

3. Skin Disorders: Because of the dermal irritant and sensitizing effects of formaldehyde, a history of skin disorders should be obtained. Such a history might include the existence of skin irritation, previously documented skin sensitivity, and other dermatologic disorders. Previous exposure to formaldehyde and other dermal sensitizers should be recorded.

4. History of atopic or allergic diseases: Since formaldehyde can cause allergic sensitization of the skin and airways, it might be useful to identify individuals with prior allergen sensitization. A history of atopic disease and allergies to formaldehyde or any other substances should also be obtained. It is not definitely known at this time whether atopic diseases and allergies to formaldehyde or any other substances should also be obtained. Also it is not definitely known at this time whether atopic individuals have a greater propensity to develop formaldehyde sensitivity than the general population, but identification of these individuals may be useful for ongoing surveillance.

5. Use of disease questionnaires: Comparison of the results from previous years with present results provides the best method for detecting a general deterioration in health when toxic signs and symptoms are measured subjectively. In this way recall bias does not affect the results of the analysis. Consequently, OSHA has determined that the findings of the medical and work histories should be kept in a standardized form for comparison of the year-to-year results.

B. Physical Examination

1. Mucosa of eyes and airways: Because of the irritant effects of formaldehyde, the examining physician should be alert to evidence of this irritation. A speculum examination of the nasal mucosa may be helpful in assessing possible irritation and cytotoxic changes, as may be indirect inspection of the posterior pharynx by mirror.

2. Pulmonary system: A conventional respiratory examination, including inspection of the thorax and auscultation and percussion of the lung fields should be performed as part of the periodic medical examination. Although routine pulmonary function testing is only required by the standard once every year for persons who are exposed over the TWA concentration limit, these tests have an obvious value in investigating possible respiratory dysfunction and should be used wherever deemed appropriate by the physician. In cases of alleged formaldehyde-induced airway disease, other possible causes of pulmonary dysfunction (including exposures to other substances) should be ruled out. A chest radiograph may be useful in these circumstances. In cases of suspected airway hypersensitivity or allergy, it may be appropriate to use bronchial challenge testing with formaldehyde or methacholine to determine the nature of the disorder. Such testing should be performed by or under the

supervision of a physician experienced in the procedures involved.

3. Skin: The physician should be alert to evidence of dermal irritation of sensitization, including reddening and inflammation, urticaria, blistering, scaling, formation of skin fissures, or other symptoms. Since the integrity of the skin barrier is compromised by other dermal diseases, the presence of such disease should be noted. Skin sensitivity testing carries with it some risk of inducing sensitivity, and therefore, skin testing for formaldehyde sensitivity should not be used as a routine screening test. Sensitivity testing may be indicated in the investigation of a suspected existing sensitivity. Guidelines for such testing have been prepared by the North American Contact Dermatitis Group.

C. Additional Examinations or Tests

The physician may deem it necessary to perform other medical examinations or tests as indicated. The standard provides a mechanism whereby these additional investigations are covered under the standard for occupational exposure to formaldehyde.

D. Emergencies

The examination of workers exposed in an emergency should be directed at the organ systems most likely to be affected. Much of the content of the examination will be similar to the periodic examination unless the patient has received a severe acute exposure requiring immediate attention to prevent serious consequences. If a severe overexposure requiring medical intervention or hospitalization has occurred, the physician must be alert to the possibility of delayed symptoms. Followup nonroutine examinations may be necessary to assure the patient's well-being.

E. Employer Obligations

The employer is required to provide the physician with the following information: A copy of this standard and appendices A, C, D, and E; a description of the affected employee's duties as they relate to his or her exposure concentration; an estimate of the employee's exposure including duration (e.g., 15 hr/wk, three 8-hour shifts, full-time); a description of any personal protective equipment, including respirators, used by the employee; and the results of any previous medical determinations for the affected employee related to formaldehyde exposure to the extent that this information is within the employer's control.

F. Physician's Obligations

The standard requires the employer to obtain a written statement from the physician. This statement must contain the physician's opinion as to whether the employee has any medical condition which would place him or her at increased risk of impaired health from exposure to formaldehyde or use of respirators, as appropriate. The physician must also state his opinion regarding any restrictions that should be placed on the employee's exposure to formaldehyde or upon the use of protective clothing or equipment such as respirators. If the employee wears a respirator as a result of his or her exposure to formaldehyde, the

physician's opinion must also contain a statement regarding the suitability of the employee to wear the type of respirator assigned. Finally, the physician must inform the employer that the employee has been told the results of the medical examination and of any medical conditions which require further explanation or treatment. This written opinion is not to contain any information on specific findings or diagnoses unrelated to occupational exposure to formaldehyde.

The purpose in requiring the examining physician to supply the employer with a written opinion is to provide the employer with a medical basis to assist the employer in placing employees initially, in assuring that their health is not being impaired by formaldehyde, and to assess the employee's ability to use any required protective equipment.

Appendix D to § 1910.1048—Nonmandatory Medical Disease Questionnaire

A. Identification

Plant Name _____
 Date _____
 Employee Name _____
 S.S. # _____
 Job Title _____
 Birthdate: _____
 Age: _____
 Sex: _____
 Height: _____
 Weight: _____

B. Medical History

1. Have you ever been in the hospital as a patient?
 Yes ☐ No ☐
 If yes, what kind of problem were you having? _____
2. Have you ever had any kind of operation?
 Yes ☐ No ☐
 If yes, what kind? _____
3. Do you take any kind of medicine regularly?
 Yes ☐ No ☐
 If yes, what kind? _____
4. Are you allergic to any drugs, foods, or chemicals?
 Yes ☐ No ☐
 If yes, what kind of allergy is it? _____
 What causes the allergy? _____
5. Have you ever been told that you have asthma, hayfever, or sinusitis?
 Yes ☐ No ☐
6. Have you ever been told that you have emphysema, bronchitis, or any other respiratory problems?
 Yes ☐ No ☐
7. Have you ever been told you had hepatitis?
 Yes ☐ No ☐
8. Have you ever been told that you had cirrhosis?
 Yes ☐ No ☐
9. Have you ever been told that you had cancer?
 Yes ☐ No ☐
10. Have you ever had arthritis or joint pain?
 Yes ☐ No ☐

11. Have you ever been told that you had high blood pressure?
 Yes ☐ No ☐
12. Have you ever had a heart attack or heart trouble?
 Yes ☐ No ☐

B-1. Medical History Update

1. Have you been in the hospital as a patient any time within the past year?
 Yes ☐ No ☐
 If so, for what condition? _____
2. Have you been under the care of a physician during the past year?
 Yes ☐ No ☐
 If so, for what condition? _____
3. Is there any change in your breathing since last year?
 Yes ☐ No ☐
 Better? _____
 Worse? _____
 No change? _____
 If change, do you know why? _____
4. Is your general health different this year from last year?
 Yes ☐ No ☐
 If different, in what way? _____
5. Have you in the past year or are you now taking any medication on a regular basis?
 Yes ☐ No ☐
 Name Rx _____
 Condition being treated _____

C. Occupational History

1. How long have you worked for your present employer? _____
2. What jobs have you held with this employer? Include job title and length of time in each job.

3. In each of these jobs, how many hours a day were you exposed to chemicals? _____
4. What chemicals have you worked with most of the time?

5. Have you ever noticed any type of skin rash you feel was related to your work?
 Yes ☐ No ☐
6. Have you ever noticed that any kind of chemical makes you cough?
 Yes ☐ No ☐
 Wheeze?
 Yes ☐ No ☐
 Become short of breath or cause your chest to become tight?
 Yes ☐ No ☐
7. Are you exposed to any dust or chemicals at home?
 Yes ☐ No ☐
 If yes, explain: _____
8. In other jobs, have you ever had exposure to:
 Wood dust? _____
 Yes ☐ No ☐
 Nickel or chromium?
 Yes ☐ No ☐
 Silica (foundry, sand blasting)?
 Yes ☐ No ☐

Arsenic or asbestos?

Yes ☐ No ☐

Organic solvents?

Yes ☐ No ☐

Urethane foams?

Yes ☐ No ☐

C-1. Occupational History Update

1. Are you working on the same job this year as you were last year?
 Yes ☐ No ☐
 If not, how has your job changed? _____
2. What chemicals are you exposed to on your job?

3. How many hours a day are you exposed to chemicals?

4. Have you noticed any skin rash within the past year you feel was related to your work?
 Yes ☐ No ☐
 If so, explain circumstances: _____
5. Have you noticed that any chemical makes you cough, be short of breath, or wheeze?
 Yes ☐ No ☐
 If so, can you identify it? _____

D. Miscellaneous

1. Do you smoke?
 Yes ☐ No ☐
 If so, how much and for how long? _____
 Pipe _____
 Cigars _____
 Cigarettes _____
2. Do you drink alcohol in any form?
 Yes ☐ No ☐
 If so, how much, how long, and how often? _____
3. Do you wear glasses or contact lenses?
 Yes ☐ No ☐
4. Do you get any physical exercise other than that required to do your job?
 Yes ☐ No ☐
 If so, explain: _____
5. Do you have any hobbies or "side jobs" that require you to use chemicals, such as furniture stripping, sand blasting, insulation or manufacture of urethane foam, furniture, etc?
 Yes ☐ No ☐
 If so, please describe, giving type of business or hobby, chemicals used and length of exposures.

E. Symptoms Questionnaire

1. Do you ever have any shortness of breath?
 Yes ☐ No ☐
 If yes, do you have to rest after climbing several flights of stairs?
 Yes ☐ No ☐
 If yes, if you walk on the level with people your own age, do you walk slower than they do?
 Yes ☐ No ☐
 If yes, if you walk slower than a normal pace, do you have to limit the distance that you walk?
 Yes ☐ No ☐
 If yes, do you have to stop and rest while bathing or dressing?

- Yes ☐ No ☐
2. Do you cough as much as three months out of the year?
Yes ☐ No ☐
If yes, have you had this cough for more than two years?
Yes ☐ No ☐
If yes, do you ever cough anything up from chest?
Yes ☐ No ☐
3. Do you ever have a feeling of smothering, unable to take a deep breath, or tightness in your chest?
Yes ☐ No ☐
If yes, do you notice that this on any particular day of the week?
Yes ☐ No ☐
If yes, what day or the week?
Yes ☐ No ☐
If yes, do you notice that this occurs at any particular place?
Yes ☐ No ☐
If yes, do you notice that this is worse after you have returned to work after being off for several days?
Yes ☐ No ☐
4. Have you ever noticed any wheezing in your chest?
Yes ☐ No ☐
If yes, is this only with colds or other infections?
Yes ☐ No ☐
Is this caused by exposure to any kind of dust or other material?
Yes ☐ No ☐
If yes, what kind? _____
5. Have you noticed any burning, tearing, or redness of your eyes when you are at work?
Yes ☐ No ☐
If so, explain circumstances: _____
6. Have you noticed any sore or burning throat or itchy or burning nose when you are at work?
Yes ☐ No ☐
If so, explain circumstances: _____
7. Have you noticed any stuffiness or dryness of your nose?
Yes ☐ No ☐
8. Do you ever have swelling of the eyelids or face?
Yes ☐ No ☐
9. Have you ever been jaundiced?
Yes ☐ No ☐
If yes, was this accompanied by any pain?
Yes ☐ No ☐
10. Have you ever had a tendency to bruise easily or bleed excessively?
Yes ☐ No ☐
11. Do you have frequent headaches that are not relieved by aspirin or tylenol?
Yes ☐ No ☐
If yes, do they occur at any particular time of the day or week?
Yes ☐ No ☐
If yes, when do they occur? _____
12. Do you have frequent episodes of nervousness or irritability?
Yes ☐ No ☐
13. Do you tend to have trouble concentrating or remembering?
Yes ☐ No ☐

14. Do you ever feel dizzy, light-headed, excessively drowsy or like you have been drugged?
Yes ☐ No ☐
15. Does your vision ever become blurred?
Yes ☐ No ☐
16. Do you have numbness or tingling of the hands or feet or other parts of your body?
Yes ☐ No ☐
17. Have you ever had chronic weakness or fatigue?
Yes ☐ No ☐
18. Have you ever had any swelling of your feet or ankles to the point where you could not wear your shoes?
Yes ☐ No ☐
19. Are you bothered by heartburn or indigestion?
Yes ☐ No ☐
20. Do you ever have itching, dryness, or peeling and scaling of the hands?
Yes ☐ No ☐
21. Do you ever have a burning sensation in the hands, or reddening of the skin?
Yes ☐ No ☐
22. Do you ever have cracking or bleeding of the skin on your hands?
Yes ☐ No ☐
23. Are you under a physician's care?
Yes ☐ No ☐
If yes, for what are you being treated? _____
24. Do you have any physical complaints today?
Yes ☐ No ☐
If yes, explain: _____
25. Do you have other health conditions not covered by these questions?
Yes ☐ No ☐
If yes, explain: _____

Appendix E to § 1910.1048—Qualitative and Quantitative Fit Testing Procedures

1. FIT Test Protocols

Because exposure to formaldehyde can affect the employee's ability to detect common odorants, fit test results from the isoamyl acetate test must be augmented by results from either the saccharin or irritant smoke test.

A. The employer shall include the following provisions in the fit test procedures. These provisions apply to both qualitative fit testing (QLFT) and quantitative fit testing (QNFT).

1. The test subject shall be allowed to pick the most comfortable respirator from a selection including respirators of various sizes from different manufacturers. The selection shall include at least three sizes of elastomeric facepieces of the type of respirator that is to be tested, i.e., three sizes of half mask; or three sizes of full facepiece; and units from at least two manufacturers.

2. Prior to the selection process, the test subject shall be shown how to put on a respirator, how it should be positioned on the face, how to set strap tension and how to determine a comfortable fit. A mirror shall be available to assist the subject in evaluating the fit and positioning the respirator. This instruction may not constitute the subject's formal training on respirator use, as it is only a review.

3. The test subject shall be informed that he/she is being asked to select the respirator

which provides the most comfortable fit. Each respirator represents a different size and shape, and if fitted and used properly, will provide adequate protection.

4. The test subject shall be instructed to hold each facepiece up to the face and eliminate those which obviously do not give a comfortable fit.

5. The more comfortable facepieces are noted; the most comfortable mask is donned and worn at least five minutes to assess comfort. Assistance in assessing comfort can be given by discussing the points in item 6 below. If the test subject is not familiar with using a particular respirator, the test subject shall be directed to don the mask several times and to adjust the straps each time to become adept at setting proper tension on the straps.

6. Assessment of comfort shall include reviewing the following points with the test subject and allowing the test subject adequate time to determine the comfort of the respirator:

- (a) position of the mask on the nose.
- (b) room for eye protection.
- (c) room to talk.
- (d) position of mask on face and cheeks.

7. The following criteria shall be used to help determine the adequacy of the respirator fit:

- (a) chin properly placed;
- (b) adequate strap tension, not overly tightened;
- (c) fit across nose bridge;
- (d) respirator of proper size to span distance from nose to chin;
- (e) tendency of respirator to slip;
- (f) self-observation in mirror to evaluate fit and respirator position.

8. The test subject shall conduct the negative and positive pressure fit checks as described below or ANSI Z88.2-1980. Before conducting the negative or positive pressure test, the subject shall be told to seat the mask on the face by moving the head from side-to-side and up and down slowly while taking in a few slow deep breaths. Another facepiece shall be selected and retested if the test subject fails the fit check tests.

(a) *Positive pressure test.* Close off the exhalation valve and exhale gently onto the facepiece. The face fit is considered satisfactory if a slight positive pressure can be built up inside the facepiece without any evidence of outward leakage of air at the seal. For most respirators this method of leak testing requires the wearer to first remove the exhalation valve cover before closing off the exhalation valve and then carefully replacing it after the test.

(b) *Negative pressure test.* Close off the inlet opening of the canister or cartridge(s) by covering with the palm of the hand(s) or by replacing the filter seal(s), inhale gently so that the facepiece collapses slightly, and hold the breath for ten seconds. If the facepiece remains in its slightly collapsed condition and no inward leakage of air is detected, the tightness of the respirator is considered satisfactory.

9. The test shall not be conducted if there is any hair growth between the skin and the facepiece sealing surface, such as stubble beard growth, beard, or long sideburns which

cross the respirator sealing surface. Any type of apparel which interferes with a satisfactory fit shall be altered or removed.

10. If a test subject exhibits difficulty in breathing during the tests, she or he shall be referred to a physician trained in respiratory disease or pulmonary medicine to determine whether the test subject can wear a respirator while performing her or his duties.

11. The test subject shall be given the opportunity to wear the successfully fitted respirator for a period of two weeks. If at any time during this period the respirator becomes uncomfortable, the test subject shall be given the opportunity to select a different facepiece and to be retested.

12. The employer shall certify that a successful fit test has been administered to the employee. The certification shall include the following information:

- (a) Name of employee;
- (b) Type, brand and size of respirator; and
- (c) Date of test;

Where QNFT is used, the fit factor, strip chart, or other recording of the results of the test, shall be retained with the certification. The certification shall be maintained until the next fit test is administered.

13. Exercise regimen. Prior to the commencement of the fit test, the test subject shall be given a description of the fit test and the test subject's responsibilities during the test procedure.

The description of the process shall include a description of the test exercises that the subject will be performing. The respirator to be tested shall be worn for at least 5 minutes before the start of the fit test.

14. Test Exercises. The test subject shall perform exercises, in the test environment, in the manner described below:

(a) *Normal breathing.* In a normal standing position, without talking, the subject shall breathe normally.

(b) *Deep breathing.* In a normal standing position, the subject shall breathe slowly and deeply, taking caution so as to not hyperventilate.

(c) *Turning head side to side.* Standing in place, the subject shall slowly turn his/her head from side to side between the extreme positions on each side. The head shall be held at each extreme momentarily so the subject can inhale at each side.

(d) *Moving head up and down.* Standing in place, the subject shall slowly move his/her head up and down. The subject shall be instructed to inhale in the up position (i.e., when looking toward the ceiling).

(e) *Talking.* The subject shall talk out loud slowly and loud enough so as to be heard clearly by the test conductor. The subject can read from a prepared text such as the Rainbow Passage, count backward from 100, or recite a memorized poem or song.

(f) *Grimace.* The test subject shall grimace by smiling or frowning.

(g) *Bending over.* The test subject shall bend at the waist as if he/she were to touch his/her toes. Jogging in place shall be substituted for this exercise in those test environments such as shroud type QNFT units which prohibit bending at the waist.

(h) *Normal breathing.* Same as exercise 1.

Each test exercise shall be performed for one minute except for the grimace exercise which shall be performed for 15 seconds.

The test subject shall be questioned by the test conductor regarding the comfort of the respirator upon completion of the protocol. If it has become uncomfortable, another model of respirator shall be tried.

B. Qualitative Fit Test (QLFT) Protocols

1. *General.* (a) The employer shall assign specific individuals who shall assume full responsibility for implementing the respirator qualitative fit test program.

(b) The employer shall ensure that persons administering QLFT are able to prepare test solutions, calibrate equipment and perform tests properly, recognize invalid tests, and assure that test equipment is in proper working order.

(c) The employer shall assure the QLFT equipment is kept clean and well maintained so as to operate at the parameters for which it was designed.

2. *Isoamyl Acetate Protocol*—(a) *Odor threshold screening.* The odor threshold screening test, performed without wearing a respirator, is intended to determine if the individual tested can detect the odor of isoamyl acetate.

(1) Three 1-liter glass jars with metal lids are required.

(2) Odor free water (e.g., distilled or spring water) at approximately 25 degrees C shall be used for the solutions.

(3) The isoamyl acetate (IAA) (also known as isopentyl acetate) stock solution is prepared by adding 1 cc of pure IAA to 800 cc of odor free water in a 1 liter jar and shaking for 30 seconds. A new solution shall be prepared at least weekly.

(4) The screening test shall be conducted in a room separate from the room used for actual fit testing. The two rooms shall be well ventilated but shall not be connected to the same recirculating ventilation system.

(5) The odor test solution is prepared in a second jar by placing 0.4 cc of the stock solution into 500 cc of odor free water using a clear dropper or pipette. The solution shall be shaken for 30 seconds and allowed to stand for two to three minutes so that the IAA concentration above the liquid may reach equilibrium. This solution shall be used for only one day.

(6) A test blank shall be prepared in a third jar by adding 500 cc of odor free water.

(7) The odor test and test blank jars shall be labeled 1 and 2 for jar identification. Labels shall be placed on the lids so they can be periodically peeled, dried off and switched to maintain the integrity of the test.

(8) The following instruction shall be typed on a card and placed on the table in front of the two jars (i.e., 1 and 2): "The purpose of this test is to determine if you can smell banana oil at a low concentration. The two bottles in front of you contain water. One of these bottles also contain a small amount of banana oil. Be sure the covers are on tight, then shake each bottle for two seconds. Unscrew the lid of each bottle, one at a time, and sniff at the mouth of the bottle. Indicate to the test conductor which bottle contains banana oil."

(9) The mixtures used in the IAA odor detection test shall be prepared in an area separate from where the test is performed, in order to prevent olfactory fatigue in the subject.

(10) If the test subject is unable to correctly identify the jar containing the odor test solution, the IAA qualitative fit test shall not be performed.

(11) If the test subject correctly identifies the jar containing the odor test solution, the test subject may proceed to respirator selection and fit testing.

(b) *Isoamyl acetate fit test.* (1) The fit test chamber shall be similar to a clear 55-gallon drum liner suspended inverted over a 2-foot diameter frame so that the top of the chamber is about 6 inches above the test subject's head. The inside top center of the chamber shall have a small hook attached.

(2) Each respirator used for the fitting and fit testing shall be equipped with organic vapor cartridges or offer protection against organic vapors. The cartridges or masks shall be changed at least weekly.

(3) After selecting, donning, and properly adjusting a respirator, the test subject shall wear it to the fit testing room. This room shall be separate from the room used for odor threshold screening and respirator selection, and shall be well ventilated, as by an exhaust fan or lab hood, to prevent general room contamination.

(4) A copy of the test exercises and any prepared text from which the subject is to read shall be taped to the inside of the test chamber.

(5) Upon entering the test chamber, the test subject shall be given a 6-inch by 5-inch piece of paper towel, or other porous, absorbent, single-ply material, folded in half and wetted with 0.75 cc of pure IAA. The test subject shall hang the wet towel on the hook at the top of the chamber.

(6) Allow two minutes for the IAA test concentration to stabilize before starting the fit test exercises. This would be an appropriate time to talk with the test subject; to explain the fit test, the importance of his/her cooperation, and the purpose for the head exercises; or to demonstrate some of the exercises.

(7) If at any time during the test, the subject detects the banana like odor of IAA, the test has failed. The subject shall quickly exit from the test chamber and leave the test area to avoid olfactory fatigue.

(8) If the test has failed, the subject shall return to the selection room and remove the respirator, repeat the odor sensitivity test, select and put on another respirator, return to the test chamber and again begin the procedure described in (1) through (7) above. The process continues until a respirator that fits well has been found. Should the odor sensitivity test be failed, the subject shall wait about 5 minutes before retesting. Odor sensitivity will usually have returned by this time.

(9) When a respirator is found that passes the test, its efficiency shall be demonstrated for the subject by having the subject break the face seal and take a breath before exiting the chamber.

(10) When the test subject leaves the chamber, the subject shall remove the saturated towel and return it to the person conducting the test. To keep the test area from becoming contaminated, the used towels shall be kept in a self sealing bag so

there is no significant IAA concentration build-up in the test chamber during subsequent tests.

3. *Saccharin Solution Aerosol Protocol.* The saccharin solution aerosol QLFT protocol is the only currently available, validated test protocol for use with particulate disposable dust respirators not equipped with high-efficiency filters. The entire screening and testing procedure shall be explained to the test subject prior to the conduct of the screening test.

(a) *Taste threshold screening.* The saccharin taste threshold screening, performed without wearing a respirator, is intended to determine whether the individual being tested can detect the taste of saccharin.

(1) Threshold screening as well as fit testing subjects shall wear an enclosure about the head and shoulders that is approximately 12 inches in diameter by 14 inches tall with at least the front portion clear and that allows free movements of the head when a respirator is worn. An enclosure substantially similar to the 3M hood assembly, parts # FT 14 and # FT 15 combined, is adequate.

(2) The test enclosure shall have a 3/4-inch hole in front of the test subject's nose and mouth area to accommodate the nebulizer nozzle.

(3) The test subject shall don the test enclosure. Throughout the threshold screening test, the test subject shall breathe through his/her wide open mouth with tongue extended.

(4) Using a DeVilbiss Model 40 Inhalation Medication Nebulizer the test conductor shall spray the *threshold check solution* into the enclosure. This nebulizer shall be clearly marked to distinguish it from the fit test solution nebulizer.

(5) The *threshold check solution* consists of 0.83 grams of sodium saccharin USP in 1 cc of warm water. It can be prepared by putting 1 cc of the fit test solution (see (b)(5) below) in 100 cc of distilled water.

(6) To produce the aerosol, the nebulizer bulb is firmly squeezed so that it collapses completely, then released and allowed to fully expand.

(7) Ten squeezes are repeated rapidly and then the test subject is asked whether the saccharin can be tasted.

(8) If the first response is negative, ten more squeezes are repeated rapidly and the test subject is again asked whether the saccharin is tasted.

(9) If the second response is negative, ten more squeezes are repeated rapidly and the test subject is again asked whether the saccharin is tasted.

(10) The test conductor will take note of the number of squeezes required to solicit a taste response.

(11) If the saccharin is not tasted after 30 squeezes (step 10), the test subject may not perform the saccharin fit test.

(12) If a taste response is elicited, the test subject shall be asked to take note of the taste for reference in the fit test.

(13) Correct use of the nebulizer means that approximately 1 cc of liquid is used at a time in the nebulizer body.

(14) The nebulizer shall be thoroughly rinsed in water, shaken dry, and refilled at

least each morning and afternoon or at least every four hours.

(b) *Saccharin solution aerosol fit test procedure.* (1) The test subject may not eat, drink (except plain water), or chew gum for 15 minutes before the test.

(2) The fit test uses the same enclosure described in (a) above.

(3) The test subject shall don the enclosure while wearing the respirator selected in section (a) above. The respirator shall be properly adjusted and equipped with a particular filter(s).

(4) A second DeVilbiss Model 40 Inhalation Medication Nebulizer is used to spray the fit test solution into the enclosure. This nebulizer shall be clearly marked to distinguish it from the screening test solution nebulizer.

(5) The fit test solution is prepared by adding 83 grams of sodium saccharin to 100 cc of warm water.

(6) As before, the test subject shall breathe through the open mouth with tongue extended.

(7) The nebulizer is inserted into the hole in the front of the enclosure and the fit test solution is sprayed into the enclosure using the same number of squeezes required to elicit a taste response in the screening test.

(8) After generating the aerosol the test subject shall be instructed to perform the exercises in section I. A. 14 above.

(9) Every 30 seconds the aerosol concentration shall be replenished using one half the number of squeezes as initially.

(10) The test subject shall indicate to the test conductor if any time during the fit test the taste of saccharin is detected.

(11) If the taste of saccharin is detected, the fit is deemed unsatisfactory and a different respirator shall be tried.

4. *Irritant Fume Protocol.* (a) The respirator to be tested shall be equipped with high-efficiency particulate air (HEPA) filters.

(b) The test subject shall be allowed to smell a weak concentration of the irritant smoke before the respirator is donned to become familiar with its characteristic odor.

(c) Break both ends of a ventilation smoke tube containing stannic oxychloride, such as the MSA part No. 5645, or equivalent. Attach one end of the smoke tube to a low flow air pump set to deliver 200 milliliters per minute.

(d) If a half-mask is being fitted, advise the test subject that the smoke can be irritating to the eyes and instruct the subject to keep his/her eyes closed while the test is performed.

(e) The test conductor shall direct the stream of irritant smoke from the smoke tube towards the face seal area of the test subject. He/She shall begin at least 12 inches from the facepiece and gradually move to within one inch, moving around the whole perimeter of the mask.

(f) The exercises identified in section I. A. 14 above shall be performed by the test subject while the respirator seal is being challenged by the smoke.

(g) Each test subject passing the smoke test without evidence of a response shall be given a sensitivity check of the smoke from the same tube once the respirator has been removed to determine whether he/she reacts to the smoke. Failure to evoke a response shall void the fit test.

(h) The fit test shall be performed in a location with exhaust ventilation sufficient to prevent general contamination of the testing area by the test agent.

C. *Quantitative Fit Test (QNFT) Protocol*

1. *General.* (a) The employer shall assign specific individuals who shall assume full responsibility for implementing the respirator quantitative fit test program.

(b) The employer shall ensure that persons administering QNFT are able to calibrate equipment and perform tests properly, recognize invalid tests, calculate fit factors properly and assure that test equipment is in proper working order.

(c) The employer shall assure that QNFT equipment is kept clean and well maintained so as to operate at the parameters for which it was designed.

2. *Definitions.* (a) Quantitative fit test. The test is performed in a test chamber. The normal air-purifying element of the respirator is replaced by a high-efficiency particulate air (HEPA) filter in the case of particulate QNFT aerosols or a sorbent offering contaminant penetration protection equivalent to high-efficiency filters where the QNFT test agency is a gas or vapor.

(b) Challenge agent means the aerosol, gas or vapor introduced into a test chamber so that its concentration inside and outside the respirator may be measured.

(c) Test subject means the person wearing the respirator for quantitative fit testing.

(d) Normal standing position means standing erect and straight with arms down along the sides and looking straight ahead.

(e) Maximum peak penetration method means the method of determining test agent penetration in the respirator as determined by strip chart recordings of the test. The highest peak penetration for a given exercise is taken to be representative of average penetration into the respirator for that exercise.

(f) Average peak penetration method means the method of determining test agent penetration into the respirator utilizing a strip chart recorder, integrator, or computer. The agent penetration is determined by an average of the peak heights on the graph or by computer integration, for each exercise except the grimace exercise. Integrators or computers which calculate the actual test agent penetration into the respirator for each exercise will also be considered to meet the requirements of the average peak penetration method.

(g) "Fit Factor" means the ratio of challenge agent concentration outside with respect to the inside of a respirator inlet covering (facepiece or enclosure).

3. *Apparatus.* (a) Instrumentation. Aerosol generation, dilution, and measurement systems using corn oil or sodium chloride as test aerosols shall be used for quantitative fit testing.

(b) Test chamber. The test chamber shall be large enough to permit all test subjects to perform freely all required exercises without disturbing the challenge agent concentration or the measurement apparatus. The test chamber shall be equipped and constructed so that the challenge agent is effectively

isolated from the ambient air, yet uniform in concentration throughout the chamber.

(c) When testing air-purifying respirators, the normal filter or cartridge element shall be replaced with a high-efficiency particulate filter supplied by the same manufacturer.

(d) The sampling instrument shall be selected so that a strip chart record may be made of the test showing the rise and fall of the challenge agent concentration with each inspiration and expiration at fit factors of at least 2,000. Integrators or computers which integrate the amount of test agent penetration leakage into the respirator for each exercise may be used provided a record of the readings is made.

(e) The combination of substitute air-purifying elements, challenge agent and challenge agent concentration in the test chamber shall be such that the test subject is not exposed in excess of an established exposure limit for the challenge agent at any time during the testing process.

(f) The sampling port on the test specimen respirator shall be placed and constructed so that no leakage occurs around the port (e.g., where the respirator is probed), a free air flow is allowed into the sampling line at all times and so that there is no interference with the fit or performance of the respirator.

(g) The test chamber and test set up shall permit the person administering the test to observe the test subject inside the chamber during the test.

(h) The equipment generating the challenge atmosphere shall maintain the concentration of challenge agent inside the test chamber constant to within a 10 percent variation for the duration of the test.

(i) The time lag (interval between an event and the recording of the event on the strip chart or computer or integrator) shall be kept to a minimum. There shall be a clear association between the occurrence of an event inside the test chamber and its being recorded.

(j) The sampling line tubing for the test chamber atmosphere and for the respirator sampling port shall be of equal diameter and of the same material. The length of the two lines shall be equal.

(k) The exhaust flow from the test chamber shall pass through a high-efficiency filter before release.

(l) When sodium chloride aerosol is used, the relative humidity inside the test chamber shall not exceed 50 percent.

(m) The limitations of instrument detection shall be taken into account when determining the fit factor.

(n) Test respirators shall be maintained in proper working order and inspected for deficiencies such as cracks, missing valves and gaskets, etc.

4. *Procedural Requirements.* (a) When performing the initial positive or negative pressure test the sampling line shall be crimped closed in order to avoid air pressure leakage during either of these tests.

(b) An abbreviated screening isoamyl acetate test or irritant fume test may be utilized in order to quickly identify poor fitting respirators which passed the positive and/or negative pressure test and thus reduce the amount of QNFT time. When performing a screening isoamyl acetate test, combination high-efficiency organic vapor cartridges/canisters shall be used.

(c) A reasonably stable challenge agent concentration shall be measured in the test chamber prior to testing. For canopy or shower curtain type of test units the determination of the challenge agent stability may be established after the test subject has entered the test environment.

(d) Immediately after the subject enters the test chamber, the challenge agent concentration inside the respirator shall be measured to ensure that the peak penetration does not exceed 5 percent for a half mask or 1 percent for a full facepiece respirator.

(e) A stable challenge concentration shall be obtained prior to the actual start of testing.

(f) Respirator restraining straps shall not be overtightened for testing. The straps shall be adjusted by the wearer without assistance from other persons to give a reasonable comfortable fit typical of normal use.

(g) The test shall be terminated whenever any single peak penetration exceeds 5 percent for half masks and 1 percent for full

facepiece respirators. The test subject shall be refitted and retested. If two of the three required tests are terminated, the fit shall be deemed inadequate.

(h) In order to successfully complete a QNFT, three successful fit tests are required. The results of each of the three independent fit tests must exceed the minimum fit factor needed for the class of respirator (e.g., half mask respirator, full facepiece respirator).

(i) Calculation of fit factors.

(1) The fit factor shall be determined for the quantitative fit test by taking the ratio of the average chamber concentration to the concentration inside the respirator.

(2) The average test chamber concentration is the arithmetic average of the test chamber concentration at the beginning and of the end of the test.

(3) The concentration of the challenge agent inside the respirator shall be determined by one of the following methods:

(i) Average peak concentration

(ii) Maximum peak concentration

(iii) Integration by calculation of the area under the individual peak for each exercise. This includes computerized integration.

(j) Interpretation of test results. The fit factor established by the quantitative fit testing shall be the lowest of the three fit factor values calculated from the three required fit tests.

(k) The test subject shall not be permitted to wear a half mask, or full facepiece respirator unless a minimum fit factor equivalent to at least 10 times the hazardous exposure level is obtained.

(l) Filters used for quantitative fit testing shall be replaced at least weekly, or whenever increased breathing resistance is encountered, or when the test agent has altered the integrity of the filter media. Organic vapor cartridges/canisters shall be replaced daily (when used) or sooner if there is any indication of breakthrough by a test agent.

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Part III

Environmental Protection Agency

OMB Response to Agency Paperwork
Reduction Act Clearance Request; Notice

ENVIRONMENTAL PROTECTION AGENCY

[OPPTS-400054B; FRL-4069-8]

OMB Response to Agency Paperwork Reduction Act Clearance Request**AGENCY:** Environmental Protection Agency (EPA).**ACTION:** Approval of 1991 Form R and Instructions.

SUMMARY: The Office of Management and Budget (OMB) has approved the revised Form R and instructions which are to be used to comply with the reporting requirements of section 313 of the Emergency Planning and Community Right-to-Know Act of 1986 (EPCRA) and section 6607 of the Pollution Prevention Act of 1990 (PPA) for the 1991 calendar (reporting) year.

DATES: The form and instructions were approved on May 19, 1992, and are effective through November 30, 1992.

FOR FURTHER INFORMATION CONTACT: The Emergency Planning and Community Right-to-Know Hotline, Environmental Protection Agency, Mail Stop OS-120, 401 M St., SW., Washington, DC 20460, Toll free: 800/535-0202.

SUPPLEMENTARY INFORMATION: EPA Information Collection Request (ICR) No. 1363.04; Toxic Release Inventory Reporting Form Pollution Prevention Information was approved May 19, 1992, under OMB No. 2070-0093 which expires November 30, 1992. This ICR covers modifications to the Toxic Chemical Release Inventory (TRI) reporting Form R to include additional reporting elements required by the Pollution Prevention Act of 1990 (42 U.S.C. 11071 to 11079).

The modifications require that facilities that must currently comply with the requirements of section 313 of EPCRA also provide quantities: released; used for energy recovery onsite and off-site; recycled on-site and off-site; treated on-site and off-site; and released due to remedial actions, catastrophic events, or one-time events not associated with production processes. Respondent facilities must also provide: a production ratio or activity index; information on source reduction activities and the methods used to identify the opportunity for those activities; and an indication if additional optional information is included with the Form R submission. The following table provides the previous burden on respondent facilities for complying with EPCRA section 313 and the new additional burden on those facilities for complying with the reporting modifications as required by the PPA.

Table 1.—Effect on Total Annual Burden

	Existing Form R	PPA Requirements	Combined Total
Number of Respondents.....	28,000	28,000	28,000
Responses per Respondent.....	4	4	4
Total Hours.....	3,728,908	1,214,772	4,943,680

Because of delays in finalizing and distributing the OMB-approved 1991 Form R and accompanying instructions, facilities subject to EPCRA and PPA reporting may not have sufficient time to prepare and submit their reports by July 1, 1992. EPA is aware that delay in the distribution of the reporting package is creating concern regarding potential enforcement actions, including civil penalties, for those facilities reporting after the July 1, 1992 deadline.

In recognition of legitimate concerns and the importance to the public that facilities submit complete and accurate Form R reports, EPA will not initiate

enforcement proceedings against facilities that file accurate Form R reports between July 1, 1992 and September 1, 1992. Reports for the 1991 reporting year that are filed after September 1, 1992 and/or contain inaccurate or missing information, including errors or omissions, may be subject to EPA enforcement action, including, but not limited to, civil penalties.

This determination applies only to violations of the EPCRA section 313 and PPA section 6607 reporting obligations for Form R reports due on July 1, 1992, covering calendar year 1991. Nothing in

this determination shall be construed to apply to any other EPCRA reporting obligations of facilities for Form R reports for past or future reporting years. This action does not represent an administrative suspension of the statutory deadline established by Congress. Rather, this decision recognizes the inability of the government to provide approved Form R reporting forms and the Administrator's discretion to determine the appropriate EPA enforcement response for violations of EPCRA section 313.

The form and instructions follow.

BILLING CODE 6550-50-F

Important Changes in the Section 313 Requirements for Reporting Year 1991

Reporting requirements for calendar year 1991 (reports due July 1, 1992) differ from previous years: (4)

- (1) The following chemicals have been specifically delisted and are not covered for the 1991 reporting year:

Chemical Name	CAS Number
Terephthalic acid	100-21-0
Melamine	108-78-1
*C.I. Pigment Blue 15	147-14-8
Sodium hydroxide (solution)	1310-73-2
*C.I. Pigment Green 7	1328-53-6
Aluminum oxide (non-fibrous forms)	1344-28-1
C.I. Acid Blue 9 diammonium salt	2650-18-2
C.I. Acid Blue 9 disodium salt	3844-45-9
Sodium sulfate (solution)	7757-82-6
Titanium dioxide	13463-67-7
*C.I. Pigment Green 36	14302-13-7

*These substances were delisted from the "Copper Compounds" category.

- (2) The following chemicals have been added to the toxic chemical list and are covered for the 1991 reporting year: (6)

Chemical Name	CAS Number
Bromotrifluoromethane (Halon 1301)	75-63-8
Trichlorofluoromethane (CFC-11)	75-69-4
Dichlorodifluoromethane (CFC-12)	75-71-8
Dichlorotetrafluoroethane (CFC-114)	76-14-2
Monochloropentafluoroethane (CFC-115)	76-15-3
Dibromotetrafluoroethane (Halon 2402)	124-73-2
Bromochlorodifluoromethane (Halon 1211)	353-59-3

- (3) Reporting in Part II, Section 8, "Source Reduction and Recycling Activities," is now mandatory under the Pollution Prevention Act of 1990. All facilities required to file Form R are now required to report any source reduction and recycling activity engaged in during the reporting year. See the instructions for Part II, Section 8 for information about the new requirements. (7)

Toxic chemicals that are used for energy recovery purposes now have a separate reporting data element. If the reported toxic chemical is actually used for energy recovery and has a significant heat of combustion value, that activity will be reported as energy recovery. If the toxic chemical is incinerated with no recovery of energy, or if the heat of combustion value of the toxic chemical is too low to contribute significantly to energy recovery, the activity will be considered waste treatment.

The de minimis exemption has been revised; beneficiation activities are no longer excluded from this exemption. Under any circumstances, toxic chemicals received in mixtures or trade name products under the de minimis value of one percent, or 0.1 percent if carcinogenic, are exempted from threshold determinations and release calculations.

Once a listed toxic chemical exceeds its de minimis level, however, all releases occurring after that point are subject to reporting.

A TRI facility identification number has been assigned to each facility that previously submitted Form R reports. This identification number is designed to simplify locating facility reports. All facilities which submitted a Form R previously will receive a section 313 compliance package that includes a self-adhesive mailing label with the TRI facility identification number. If this package does not contain a mailing label or you have misplaced it, contact the Emergency Planning and Community Right-to-Know Information Hotline for help in determining your TRI facility identification number.

The toll-free telephone number for the Emergency Planning and Community Right-to-Know Information Hotline, 1-800-535-0202, is now accessible throughout the U.S., including Washington, D.C., and Alaska. The toll telephone number has been changed to 703-920-9877.

Important Changes to Form R for 1991

The Form R for reporting year 1991 contains many changes. The changes were made to consolidate related data elements and clarify reporting requirements. The following changes have been made for the 1991 reporting year (reports due on or before July 1, 1992):

- The format of Form R has been changed to make the data readable by the Optical Character Recognition (OCR) Scanner.
- Part II, Section 8 of Form R, "Source Reduction and Recycling Activities," contains data elements mandated by the Pollution Prevention Act of 1990 (PPA).
- Form R now consists of two parts:
 - Part I. Facility Identification Information (pages 1-2); and
 - Part II. Chemical-Specific Information (pages 3-9).

Part II of previous Form Rs, "Off-Site Locations to which Toxic Chemicals are Transferred in Wastes," has been incorporated into Part II, Section 6 of this year's form, "Transfers of the Toxic Chemical in Wastes to Off-Site Locations." This change allows location information and transfer amounts to be reported together. Part III of previous Form Rs, "Chemical-Specific Information," is now Part II. Part IV of previous Form Rs, "Supplemental Information," has been eliminated.

- A space was added to page 1 for indicating if the form being submitted is a revision.
- Space has been made available to enter the toxic chemical name and TRI facility identification number on every page of Form R (minimum of 9 pages per Form R). These spaces are designed to help ensure correct reporting by facilities and correct data entry by EPA. They are not required data elements.

● On page 1, Part I, Section 4.1, space has been added for including the reporting facility's mailing address if it differs from the street address.

● The data elements for entering the names of receiving streams and water bodies have been incorporated into Part II, Section 5, "Releases of the Toxic Chemical to the Environment On-Site." As a result, the amount released will appear next to the name of the receiving stream or water body.

● In Part II, Section 5, "Releases of the Toxic Chemical to the Environment On-Site," and Part II, Section 6, "Transfers of the Toxic Chemical in Wastes to Off-Site Locations," the range reporting columns have been removed. Space has been added to enter either an estimate or a code representing one of the three reporting ranges.

● Information on off-site transfers for recycling and energy recovery is included in Part II, Section 6, "Transfers of the Toxic Chemical in Wastes to Off-Site Locations." Section 6 has been modified to allow for more than one operation code (i.e., waste treatment, disposal, recycling, or energy recovery) and more than one amount to be entered per location.

● Section 6.1, "Discharges to Publicly Owned Treatment Works" now contains two parts: 6.1.A, "Total Quantity Transferred to POTWs and Basis of Estimate," and 6.1.B, "POTW Name and Location Information." If you transfer a toxic chemical in wastes to more than one POTW, enter the total transfers to all POTWs in section 6.1.A.1, and in section 6.1.A.2 enter the basis of estimate for the total amount transferred. In section 6.1.B., list the name and location of all POTWs that received the toxic chemical in wastes.

- If additional space is needed for completing Sections 5.3, "Discharges to Receiving Stream or Water Body" and Section 6, "Transfers of the Toxic Chemical in Wastes to Off-Site Locations," pages 5 and 6 should be photocopied, and the extra pages submitted.
- Part II, Section 7A, "On-Site Waste Treatment Methods and Efficiency," has been expanded and now is the only data element on page 7 of Form R. If additional space is needed for Section 7A (On-Site Waste Treatment Methods and Efficiency), this page may be photocopied, and the extra pages submitted. Page 8 contains two new required data elements: Section 7B, "On-Site Energy Recovery Processes," and Section 7C, "On-Site Recycling Processes."
- Page 9 consists of the required PPA data elements. Section 8, "Source Reduction and Recycling Activities," is now a required section of Form R. See Part II, Section 8 for the data elements.

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Reporting Form R Submission Checklist

1. Complete a separate Form R for each toxic chemical or chemical category you are reporting.
 - ☐ 1.a Enter CAS number and toxic chemical name in Part II, Sections 1.1 and 1.2 (or the toxic chemical category name and category code in the CAS number section);
 - ☐ 1.b Enter the toxic chemical, chemical category, or generic chemical name and the TRI facility identification number in the appropriate space on every page of Form R (optional); and
 - ☐ 1.c Enter information that applies only to the toxic chemical or chemical category being reported.
2. Complete the report with information from the previous calendar year.
 - ☐ 2.a Complete all sections, if applicable, or enter NA;
 - ☐ 2.b Include both Parts I and II (minimum of 9 pages); and
 - ☐ 2.c Sign the report certification (Part I, Section 3).
3. Submit by July 1, 1992, to:
 - ☐ 3.a EPA Headquarters (original signature on Part I, Section 3 is required for each form submitted to EPA) at the following address:

EPCRA Reporting Center
P.O. Box 23779
Washington, D.C. 20026-3779
Attn: Toxic Chemical Release Inventory

and
 - ☐ 3.b State-designated section 313 contact (see Appendix F) or the designated official of an Indian tribe.
4. Keep a copy of each Form R and all supporting documentation for your files. (All such information must be kept for three years.)
 - Additional requirements if claiming a toxic chemical identity a trade secret (see Section A.2: Trade Secret Claims):
 1. Submit two complete Form R reports (minimum of 9 pages);
 - ☐ 1.a One that identifies the toxic chemical ("unsanitized");
 - ☐ 1.b One that provides a generic chemical identity ("sanitized"); and
 - ☐ 1.c Certify both with an original signature and date.
 2. Provide two complete trade secret substantiation forms:
 - ☐ 2.a One that identifies the toxic chemical ("unsanitized");
 - ☐ 2.b One that provides a generic chemical identity ("sanitized"); and
 - ☐ 2.c Certify both with an original signature and date.
 3. Check that the sanitized and unsanitized versions are correctly identified in Part I, Section 2.2.
 4. Originals of both Form Rs and both trade secret substantiation forms should be submitted to EPA Headquarters (see address above).
 5. Verify if submission requirements in your state differ from EPA's by contacting your state-designated section 313 contact (see Appendix F), and submit the correct version(s).

A. General Information

Submission of EPA Form R, the Toxic Chemical Release Inventory (TRI) Reporting Form, is required by section 313 of the Emergency Planning and Community Right-to-Know Act (EPCRA, or Title III of the Superfund Amendments and Reauthorization Act of 1986), Public Law 99-499. The information contained in Form R constitutes a "report," and the submission of a report to the appropriate authorities constitutes "reporting."

Reporting is required to provide the public with information on the releases of listed toxic chemicals in their communities and to provide EPA with release information to assist the Agency in determining the need for future regulations. Facilities must report the quantities of both routine and accidental releases of listed toxic chemicals, as well as the maximum amount of the listed toxic chemical on-site during the calendar year and the amount contained in wastes transferred off-site.

The Pollution Prevention Act, passed into law in October, 1990 (Pub. L. 101-508), added reporting requirements to Form R. These new requirements will affect all facilities required to submit Form R under section 313 of EPCRA. The new data, which is described in the preceding section, "Important Changes to Form R for 1991," will be required beginning with reports for calendar year 1991 (first reports due to EPA and States by July 1, 1992).

A completed Form R must be submitted for each toxic chemical manufactured, processed, or otherwise used at each covered facility as described in the reporting rule in 40 CFR Part 372 (originally published February 16, 1988, in the Federal Register). These instructions supplement and elaborate on the requirements in the reporting rule. Together with the reporting rule, they constitute the reporting requirements. All references in these instructions are to sections in the reporting rule unless otherwise indicated.

A.1 How to Assemble a Complete Report

The Toxic Chemical Release Reporting Form, EPA Form R, consists of two parts:

- Part I, Facility Identification Information (pages 1 and 2); and
- Part II Chemical-Specific Information (pages 3-9).

Most of the information required in Part I of Form R can be completed, photocopied, and attached to each chemical-specific report. However, Part I of each Form R submitted must have an original signature on the certification statement and the trade secret designation must be entered as appropriate. Part II must be completed separately for each toxic chemical or chemical category. Because a complete Form R consists of at least 9 unique pages, any submissions containing less than 9 unique pages is not a valid submission.

A complete report for any listed toxic chemical that is not claimed as a trade secret consists of the following completed parts:

- Part I with an original signature on the certification statement (Section 2); and
- Part II (Section 8 is now mandatory).

Staple all 9 pages of each report together. If you check yes on Part II, Section 8.12, you may attach additional information on pollution prevention activities at your facility.

A.2 Trade Secret Claims

For any toxic chemical whose identity is claimed as a trade secret, you must submit to EPA two versions of the substantiation form as prescribed in 40 CFR Part 350, published July 29, 1988, in the Federal Register (53 FR 28772) as well as two versions of Form R. One set of forms, the "unsanitized" version, should provide the actual identity of the toxic chemical. The other set of forms, the "sanitized" version, should provide only a generic identity of the toxic chemical. If EPA deems the trade secret substantiation form valid, only the sanitized set of forms will be made available to the public.

Use the order form in this document to obtain copies of the rule and substantiation form. Further explanation of the trade secret provisions is provided in Part I, Sections 2.1 and 2.2, and Part II, Section 1.3, of the instructions.

In summary, a complete report to EPA for a toxic chemical claimed as a trade secret must include all of the following:

- A completed "unsanitized" version of a Form R report including the toxic chemical identity (staple the pages together);

- A "sanitized" version of a completed Form R report in which the toxic chemical identity items (Part II, Sections 1.1 and 1.2) have been left blank but in which a generic chemical name has been supplied (Part II, Section 1.3) (staple the pages together);
- A completed "unsanitized" version of a trade secret substantiation form (staple the pages together); and
- A "sanitized" version of a completed trade secret substantiation form (staple the pages together).

Securely fasten all four reports together.

Some states also require submission of both sanitized and unsanitized reports for toxic chemicals whose identity is claimed as a trade secret. Others require only a sanitized version. Facilities may jeopardize the trade secret status of a toxic chemical by submitting an unsanitized version of Form R to a state agency or Indian tribe that does not require unsanitized forms. You may identify an individual State's submission requirements by contacting the appropriate state-designated Section 313 contact (see Appendix F).

A.3 Recordkeeping

Sound recordkeeping practices are essential for accurate and efficient TRI reporting. It is in the facility's interest, as well as EPA's, to maintain records properly.

Facilities must keep a copy of each Form R report filed for at least three years from the date of submission. These reports will be of use in subsequent years when completing future Form R reports.

Facilities must also maintain those documents, calculations, worksheets, and other forms upon which they relied to gather information for prior Form R reports. In the event of a problem with data elements on a facility's Form R, EPA may request documentation from the facility that supports the information reported. In the future, EPA may conduct data quality reviews of past Form R submissions. An essential component of this process would be to review a facility's records for accuracy and reliability.

A partial list of records, organized by year, that a facility should maintain include:

- Previous years' Form Rs;
- Section 313 Reporting Threshold Worksheets;
- Engineering calculations and other notes;
- Purchase records from suppliers;
- Inventory data;
- EPA (NPDES) permits;
- EPCRA Section 312, Tier II Reports;
- Monitoring records;
- Flowmeter data;
- RCRA Hazardous Waste Generator's Report;
- Pretreatment reports filed by the facility with the local government;
- Invoices from waste management companies;
- Manufacturer's estimates of treatment efficiencies;
- RCRA Manifests; and
- Process diagrams that indicate emissions and releases.

A.4 When the Report Must be Submitted

The report for any calendar year must be submitted on or before July 1 of the following year (e.g., the report for calendar year 1991, January-December, must be submitted on or before July 1, 1992).

Voluntary Revision of a Previous Submission

Voluntary revisions must be submitted on a Form R identical to the version originally submitted to EPA for that reporting year. The Emergency Planning and Community Right-to-Know Information Hotline can help you identify the version of Form R used for each reporting year.

For the 1991 reporting year only, enter "X" in the space marked "Enter 'X' here if this is a revision" on page 1 of the form if you are making a voluntary revision to a previous Form R submission. If you have obtained the Document Control Number (DCN) of the original submission from EPA, enter that number in red ink in any available space on page 1 of the form. Enter the revised data to the Form R and circle all changes from the original submission in red ink. Sign the certification statement and provide a current date.

For reporting years prior to 1991, there are two options for making voluntary revisions. The first is to submit a photocopy of the original Form R submission (from your file), with corrections made in red ink. Write the words "VOLUNTARY REVISION", and the Document Control Number (DCN), if available, on page 1 of the Form R, and re-sign and re-date the certification statement on page 1.

The second is to obtain a blank Form R for the reporting year affected by the correction(s). Complete all data elements on this Form, but circle with red ink those data elements that you have changed. A cover letter should be included to clarify exactly which voluntary revisions you have made.

Send the entire completed or revised Form R report to EPA and the appropriate state agency (or the designated official of an Indian tribe). Submissions for the next calendar year are not considered revisions of a previous year's data.

A.5 Where to Send the Form R

Form R submissions must be sent to both EPA and the State (or the designated official of an Indian tribe). If a Form R is not received by both EPA and the State (or the designated official of an Indian tribe), the submitter is considered out of compliance and subject to enforcement action.

Send reports to EPA by mail to:

EPCRA Reporting Center
P.O. Box 23779
Washington, D.C. 20026-3779
Attn: Toxic Chemical Release Inventory

To submit a Form R via hand delivery or certified mail, please call the Emergency Planning and Community Right-to-Know Information Hotline to obtain the street address of the EPCRA Reporting Center.

In addition, you must also send a copy of the report to the State in which the facility is located. ("State" also includes: the District of Columbia, the Commonwealth of Puerto Rico, Guam, American Samoa, the U.S. Virgin Islands, the Northern Mariana Islands, and any other territory or possession over which the U.S. has jurisdiction.) Refer to Appendix F for the appropriate State submission addresses.

Facilities located on Indian land should send a copy to the Chief Executive Officer of the applicable Indian tribe. Some tribes have entered into a cooperative agreement with States; in this case, Form R submissions should be sent to the entity designated in the cooperative agreement.

Submission of section 313 reports in magnetic media and computer-generated facsimile formats has been approved by EPA. EPA has developed a package called the "Toxic Chemical Release Inventory Reporting System." The easy-to-use diskette comes with complete instructions for its use. It also provides prompts and messages to help you report according to EPA instructions. For copies of the diskette you may call the EPCRA Hotline.

Many firms are offering computer software to assist facilities in producing magnetic media submissions or computer-generated facsimiles of Form R reports. To ensure accuracy, EPA will only accept magnetic media submissions and computer-generated facsimiles that meet basic specifications established by EPA. To determine if software offered by a firm meets these specifications, EPA reviews and approves all software upon request. Call the Emergency Planning and Community Right-to-Know Information Hotline to identify the software that has been approved by EPA for the current reporting year.

It should be noted, however, that some States may accept only hard copies of Form R. If this is the case, a magnetic media or computer-generated facsimile may be unacceptable.

A.6 How to Obtain Forms and Other Information

A copy of Form R is included in this booklet. Remove this form and produce as many photocopies as needed. Related guidance documents may be obtained from:

Section 313 Document Distribution Center
P.O. Box 12505
Cincinnati, OH 45212

See Appendix I for the document request form and more information on available documents.

Questions about completing Form R may be directed to the Emergency Planning and Community Right-to-Know Information Hotline at the following address or telephone numbers.

Emergency Planning and Community
Right-to-Know Information Hotline
U.S. Environmental Protection Agency
401 M Street, S.W. (OS-120)
Washington, DC 20460

(800) 535-0202 or (703) 920-9877
from 8:30 am - 7:30 pm Eastern Time
(Mon-Fri, except Federal Holidays.)

EPA Regional Staff may also be of assistance. Refer to
Appendix G for a list of EPA Regional Offices.

A.7 Who Must Submit this Form

Section 313 of EPCRA requires that reports be filed by
owners and operators of facilities that meet all three of
the following criteria:

- The facility has 10 or more full-time employees;
and
- The facility is included in Standard Industrial
Classification (SIC) Codes 20 through 39; and
- The facility manufactures (defined to include
importing), processes, or otherwise uses any
listed toxic chemical in quantities equal to or
greater than the established threshold in the
course of a calendar year.

B. How to Determine if Your Facility Must Submit EPA Form R

(See Figure 1 for more information.)

B.1 Full-Time Employee Determination

A "full-time employee," for purposes of section 313 reporting, is defined as 2,000 work hours per year. This definition is dependent only upon the number of hours worked by all employees for the facility during the calendar year and not the number of persons working. To determine the number of full-time employees working for your facility, add up the hours worked by all employees during the calendar year, including contract employees and sales and support staff working for the facility, and divide the total by 2,000 hours. In other words, if the total number of hours worked by all employees is 20,000 hours or more, your facility meets the ten employee threshold.

Examples include:

- A facility consists of 11 employees who each worked 1500 hours for the facility in a calendar year. Consequently, the total number of hours worked by all employees for the facility during the calendar year is 16,500 hours. The number of full-time employees for this facility is equal to 16,500 hours divided by 2,000 hours per full-time employee, or 8.3 full-time employees. Therefore, even though 11 persons worked for this facility during the calendar year, the number of hours worked is equivalent to 8.3 full-time employees. This facility does not meet the employee criteria and is not subject to section 313 reporting.
- Another facility consists of 6 workers and 3 sales staff. The 6 workers each worked 2,000 hours for the facility in the calendar year. The sales staff also each worked 2,000 hours in the calendar year although they may have been on the road half of the year. In addition, 5 contract employees were hired for a period during which each worked 400 hours for the facility. The total number of hours is equal to the time worked by the workers at the facility (12,000 hours), plus the time worked by the sales staff for the facility (6,000 hours), plus the time worked by the contract employees at the facility (2,000 hours), or 20,000 hours. Dividing the 20,000 hours by 2,000 yields 10 full-time employees. This facility has

met the full-time employee criteria and may be subject to reporting if the other criteria are met.

B.2 Primary SIC Code Determination

Standard Industrial Classification (SIC) codes 20-39 are covered by the rule and are listed in Table I. The first two digits of a 4-digit SIC code define a major business sector, while the last two digits denote a facility's specialty within the major sector. If you are not familiar with the SIC codes that apply to your facility, contact your trade association, Chamber of Commerce, or legal counsel. For a detailed description of 4-digit SIC codes, refer to the "Standard Industrial Classification Manual 1987." Clothbound editions are available in most major libraries or may be ordered through the National Technical Information Service, 5285 Port Royal Road, Springfield, VA, 22161, (703) 487-4650. The access number for the clothbound manual is PB87-100012, and the price is \$30.00.

Section 313 requires that reports be filed by "facilities," which are defined as "all buildings, equipment, structures, and other stationary items which are located on a single site or on contiguous or adjacent sites and which are owned or operated by the same person." The SIC code system, however, classifies businesses not as "facilities," but as "establishments," which are defined as "distinct and separate economic activities [that] are performed at a single physical location."

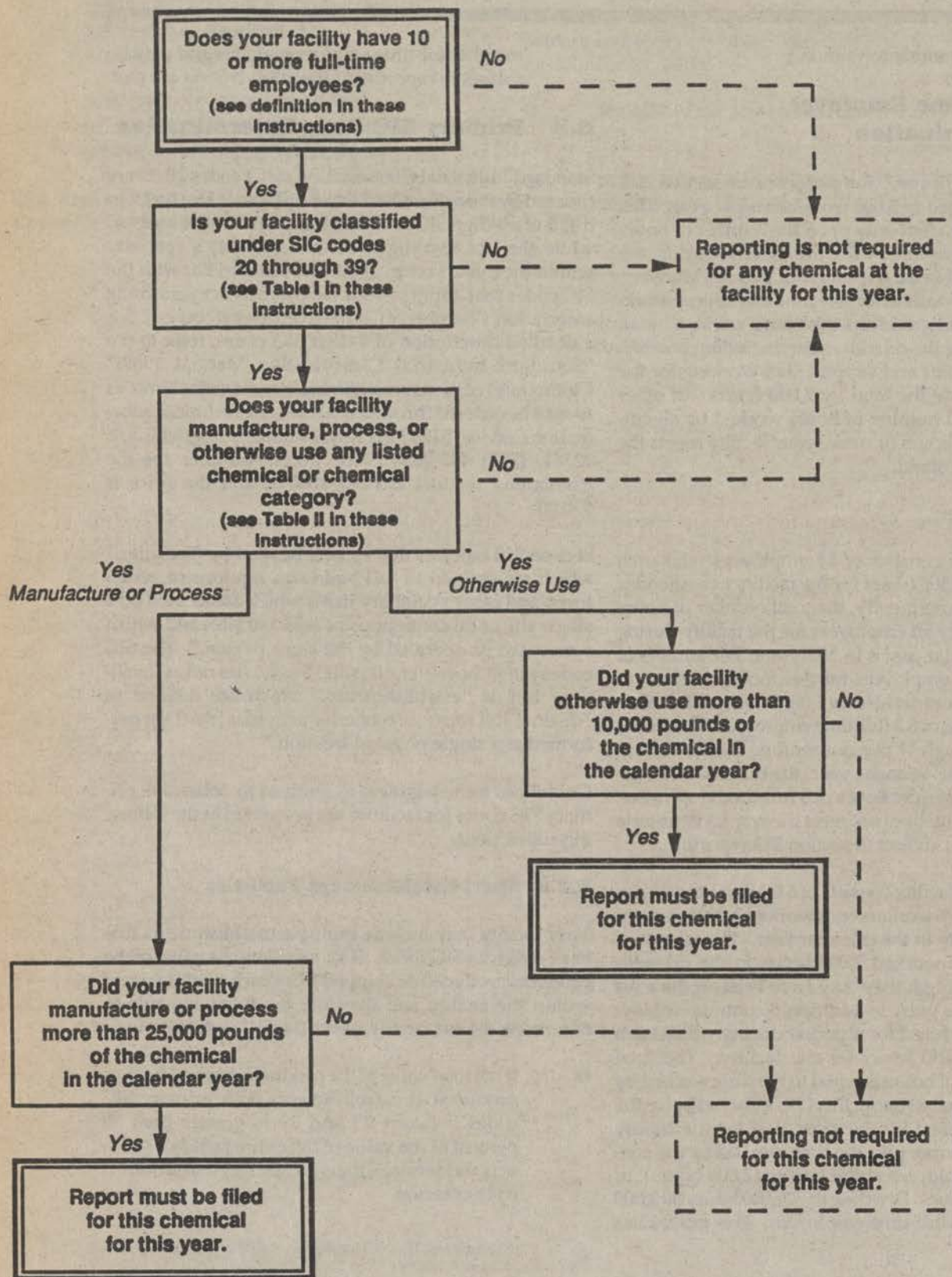
Guidelines for using these definitions to determine primary SIC codes for facilities are presented in the following subsections.

B.2.a Multi-Establishment Facilities

Your facility may include multiple establishments that have different SIC codes. If so, calculate the value of the products produced or shipped from each establishment within the facility and then use the following rule to determine if your facility meets the SIC code criterion:

- If the total value of the products shipped from or produced at establishments with primary SIC codes between 20 and 39 is greater than 50 percent of the value of the entire facility's products and services, the entire facility meets the SIC code criterion.

Figure 1

Determining Applicability of Section 313 Requirements

- If any one establishment with a primary SIC code between 20 and 39 produces or ships products whose value exceeds the value of products and services produced or shipped by any other establishment within the facility, the facility also meets the SIC code criterion.

The value of production attributable to a particular establishment may be isolated by subtracting the value of products obtained from other establishments within the same facility that are incorporated into its final products. This procedure eliminates the potential for "double counting" production in situations where establishments are engaged in sequential production activities at a single facility.

Examples include:

- One establishment in a gold mining facility is engaged primarily in the exploration of gold deposits, developing mines, and mining gold. This establishment deploys several means to mine the gold, including crushing, grinding, gravity concentration, froth flotation, amalgamation, cyanidation, and the production of bullion at the mine and mill sites (these processes are classified under SIC code 1041). All of the ore discovered through this establishment is delivered to a second establishment which is primarily engaged in rolling, drawing, and extruding the gold for sale and distribution. The smelting establishment in the facility is classified under SIC code 3339. The facility could calculate the value of production for each establishment separately (both SIC code 1041 and 3339 having separate values). Alternatively, the facility could determine the value of the smelter operation by subtracting the value of the ore produced from the value of entire facility's production (Gross value of facility - SIC code 1041 value = Value for SIC code 3339).
- A food processing establishment in a facility processes crops grown at the facility in a separate establishment. The facility could base the value of the products of each establishment on the total production value of each establishment. Alternatively, the facility could first determine the value of the crops grown at the agricultural establishment, and then calculate the contribution of the food processing establishment by subtracting the crop value from the total value of

the product shipped from the processing establishment. (Value of product shipped from processing - crop value = value of processing establishment)

A covered multi-establishment facility must make toxic chemical threshold determinations and, if required, must report all relevant information about releases, source reduction, recycling, and waste treatment associated with a listed toxic chemical for the entire facility, even from establishments that are not in SIC codes 20-39. EPA realizes, however, that certain establishments in a multi-establishment facility can be, for all practical purposes, separate business units. Therefore, individual establishments may report releases separately, provided that the total releases for the whole facility is represented by the sum of releases reported by the separate establishments.

B.2.b Auxiliary Facilities

An auxiliary facility is one that supports another facility's activities (e.g., research and development laboratories, warehouses, storage facilities, and waste-treatment facilities). An auxiliary facility can assume the SIC code of another covered facility if its primary function is to service that other covered facility's operations. Thus, a separate warehouse facility (i.e., one not located within the physical boundaries of a covered facility) may become a covered facility because it services a facility in SIC codes 20-39. Auxiliary facilities that are in SIC codes 20-39 are required to report if they meet the employee criterion and reporting thresholds for manufacture, process, or otherwise use. Auxiliary establishments that are part of a multi-establishment facility must be factored into threshold determinations for the facility as a whole.

B.2.c Facility-Related Exemptions

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 do not have to be considered for threshold and release calculations. However, pilot plant scale and specialty chemical production do not qualify for this laboratory activities exemption.

Property Owners: You are not required to report if you merely own real estate on which a facility covered by this rule is located; that is, you have no other business interest in the operation of that facility (e.g., your company owns an industrial park). The operator of that facility, however, is subject to reporting requirements.

B.3 Activity Determination

B.3.a Definitions of "Manufacture," "Process," and "Otherwise Use"

Manufacture: The term "manufacture" means to produce, prepare, compound, or import a listed toxic chemical. (See Part II, Section 3.1 of these instructions for further clarification.)

Import is defined as causing the toxic chemical to be imported into the customs territory of the United States. If you order a listed toxic chemical (or a mixture containing the chemical) from a foreign supplier, then you have imported the chemical when that shipment arrives at your facility directly from a source outside of the United States. By ordering the chemical, you have "caused it to be imported," even though you may have used an import brokerage firm as an agent to obtain the toxic chemical.

The term manufacture also includes coincidental production of a toxic chemical (e.g., as a byproduct or impurity) as a result of the manufacture, processing, otherwise use, or treatment of other chemical substances. In the case of coincidental production of an impurity (i.e., a toxic chemical that remains in the product that is distributed in commerce), the de minimis limitation, discussed in Section B.4.b of these instructions, applies. The de minimis limitation does not apply to byproducts (e.g., a toxic chemical that is separated from a process stream and further processed or disposed). Certain listed toxic chemicals may be manufactured as a result of wastewater treatment or other treatment processes. For example, neutralization of acid wastewater can result in the coincidental manufacture of ammonium nitrate (solution).

Example 1: Coincidental Manufacture

Your company, a nitric acid manufacturer, uses ammonia in a waste treatment system to neutralize an acidic wastewater stream containing nitric acid. The reaction of the ammonia and nitric acid produces an ammonium nitrate solution. Ammonium nitrate solution is a listed toxic chemical, as are nitric acid and ammonia. Your facility thus otherwise uses ammonia as a reactant and manufactures ammonium nitrate solution as a byproduct. If the ammonium nitrate solution is produced in a quantity that exceeds the threshold (e.g., 25,000 pounds for the reporting year), the facility must report for the ammonium nitrate solution. If more than 10,000 pounds of ammonia is added to the wastewater treatment system, then the facility must report for ammonia.

Process: The term "process" means the preparation of a listed toxic chemical, after its manufacture, for distribution in commerce. Processing is usually the intentional incorporation of a toxic chemical into a product (see Part II, Section 3.2 of these instructions for further clarification). Processing includes preparation of the toxic chemical in the same physical state or chemical form as that received by your facility, or preparation that produces a change in physical state or chemical form. The term also applies to the processing of a mixture or other trade name product (see Section B.4.b of these instructions) that contains a listed toxic chemical as one component.

Otherwise Use: The term "otherwise use" encompasses any activity involving a listed toxic chemical at a facility that does not fall under the definitions of "manufacture" or "process." A chemical that is otherwise used by a

Example 2: Typical Process and Manufacture Activities

- Your company receives toluene, a listed toxic chemical, from another facility, and reacts the toluene with air to form benzoic acid. Your company processes toluene and manufactures benzoic acid. Benzoic acid, however, is not a listed toxic chemical and thus does not trigger reporting requirements.
- Your facility combines toluene purchased from a supplier with various materials to form paint. Your facility processes toluene.
- Your company receives a nickel compound (nickel compound is a listed toxic chemical category) as a bulk solid and performs various size-reduction operations (e.g., grinding) before packaging the compound in 50 pound bags. Your company processes the nickel compound.
- Your company receives a prepared mixture of resin and chopped fiber to be used in the injection molding of plastic products. The resin contains a listed toxic chemical that becomes incorporated into the plastic. Your facility processes the toxic chemical.

Example 3: Otherwise Use

When your facility cleans equipment with toluene, you are otherwise using toluene. Your facility also separates two components of a mixture by dissolving one component in toluene, and subsequently recovers the toluene from the process for reuse or disposal. Your facility otherwise uses toluene.

facility is not intentionally incorporated into a product distributed in commerce (see Part II, Section 3.3 of these Instructions for further clarification).

B.3.b Activity Exemptions

Use Exemptions. Certain uses of listed toxic chemicals are specifically exempted:

- use as a structural component of the facility;
- use in routine janitorial or facility grounds maintenance;
- personal uses by employees or other persons;
- use of products containing toxic chemicals for the purpose of maintaining motor vehicles operated by the facility; or
- use of toxic chemicals contained in intake water (used for processing or non-contact cooling) or in intake air (used either as compressed air or for combustion).

Article Exemptions. Quantities of a listed toxic chemical contained in an article do not have to be factored into threshold or release determinations when that article is

processed or otherwise used at your facility. An article is defined as a manufactured item that is formed to a specific shape or design during manufacture, that has end-use functions dependent in whole or in part upon its shape or design during end-use, and that does not release a toxic chemical under normal conditions of the processing or otherwise use of that item at the facility.

If the processing or otherwise use of similar articles results in a total release of less than 0.5 pounds of a toxic chemical in a calendar year to any environmental media, EPA will allow this release quantity to be rounded to zero, and the manufactured items remain exempt as articles. EPA requires facilities to round off and report all estimates to the nearest whole number. The 0.5-pound limit does not apply to each individual article, but applies to the sum of all releases from processing or otherwise use of like articles.

The article exemption applies to the normal processing or otherwise use of an article. It does not apply to the manufacture of an article. Toxic chemicals processed into articles produced at a facility must be factored into threshold and release determinations.

A closed item containing toxic chemicals (e.g., a transformer containing PCBs) that does not release the toxic chemicals during normal use is considered an article if a facility uses the item as intended and the toxic chemicals are not released. If a facility services the closed item (e.g., a transformer) by replacing the toxic chemicals, the toxic chemicals added during the reporting year must be counted in threshold and release calculations.

Example 4: Article Exemption

- Lead that is incorporated into a lead acid battery is processed to manufacture the battery, and therefore must be counted toward threshold and release determinations. However, the use of the lead acid battery elsewhere in the facility does not have to be counted. Disposal of the battery after its use does not constitute a "release"; thus, the battery remains an article.
- Metal rods that are extruded into wire are not articles because their form changes during processing.
- If an item used in the facility is fragmented, the item is still an article if those fragments being discarded remain identifiable as the article (e.g., recognizable pieces of a cylinder, pieces of wire). For instance, an 8-foot piece of wire is broken into two 4-foot pieces of wire, without releasing any toxic chemicals. Each 4-foot piece is identifiable as a piece of wire; therefore, the article status for these pieces of wire remains intact.
- Toxic chemicals received in the form of pellets are not articles because the pellet form is simply a convenient form for further processing of the material.

When the processing or otherwise use of an item generates fumes, dust, filings, or grindings, the article exemption is not applicable. The toxic chemical(s) in the item must be counted toward the appropriate threshold determination, and the fumes, dust, filings, and grindings must be reported as releases or wastes. Scrap pieces that are recognizable as an article do not constitute a release.

B.3.c Activity Qualifiers

Table II contains the list of individual toxic chemicals and categories of chemicals subject to 1991 calendar year reporting. Some of the toxic chemicals listed in Table II have parenthetical qualifiers listed next to them. A toxic chemical that is listed without a qualifier is subject to reporting in all forms in which it is manufactured, processed, and otherwise used.

Fume or dust. Three of the metals on the list (aluminum, vanadium, and zinc) contain the qualifier "fume or dust." Fume or dust refers to dry forms of these metals but does not refer to "wet" forms such as solutions or slurries. As explained in Section B.3a of these instructions, the term manufacture includes the generation of a toxic chemical as a byproduct or impurity. In such cases, a facility should determine if, for example, it generated more than 25,000 pounds of aluminum fume or dust in 1991 as a result of its activities. If so, the facility must report that it manufactures "aluminum (fume or dust)." Similarly, there may be certain technologies in which one of these metals is processed in the form of a fume or dust to make other toxic chemicals or other products for distribution in commerce. In reporting releases, the facility would only report releases of the fume or dust.

EPA considers dusts to consist of solid particles generated by any mechanical processing of materials including crushing, grinding, rapid impact, handling, detonation, and decrepitation of organic and inorganic materials such as rock, ore, and metal. Dusts do not tend to flocculate, except under electrostatic forces. A fume is an airborne dispersion consisting of small solid particles created by condensation from a gaseous state, in distinction to a gas or vapor. Fumes arise from the heating of solids such as lead. The condensation is often accompanied by a chemical reaction, such as oxidation. Fumes flocculate and sometimes coalesce.

Manufacturing qualifiers. Two of the entries to the section 313 toxic chemical list contain a qualifier relating to manufacture. For isopropyl alcohol, the qualifier is "manufacturing -- strong acid process." For saccharin,

the qualifier simply is "manufacturing." For isopropyl alcohol, the qualifier means that only facilities manufacturing isopropyl alcohol by the strong acid process are required to report. In the case of saccharin, only manufacturers of the toxic chemical are subject to the reporting requirements. A facility that processes or otherwise uses either toxic chemical would not be required to report for those toxic chemicals. In both cases, supplier notification does not apply because only manufacturers, not users, of the toxic chemical must report.

Solutions. Two substances on the list, ammonium nitrate and ammonium sulfate, are qualified by the term "solution," which refers to the physical state of these toxic chemicals. Solid, molten, and pelletized forms of these toxic chemicals are exempt from threshold and release determinations. Only facilities that manufacture, process, or otherwise use these toxic chemicals in the form of a solution are required to report. Supplier notification applies only if the toxic chemical is distributed as a solution.

Phosphorus (yellow or white). The listing for phosphorus is qualified by the term "yellow or white." This means that only manufacturing, processing, or otherwise use of phosphorus in the yellow or white chemical form triggers reporting. Conversely, manufacturing, processing, or otherwise use of "black" or "red" phosphorus does not trigger reporting. Supplier notification also applies only to distribution of yellow or white phosphorus.

Asbestos (friable). The listing for asbestos is qualified by the term "friable," referring to the physical characteristic of being able to be crumbled, pulverized, or reducible to a powder with hand pressure. Only manufacturing, processing, or otherwise use of asbestos in the friable form triggers reporting. Supplier notification applies only to distribution of mixtures or trade name products containing friable asbestos.

Aluminum Oxide (fibrous forms). The listing for aluminum oxide is qualified by the term "fibrous forms." Fibrous refers to a man-made form of aluminum oxide that is processed to produce strands or filaments which can be cut to various lengths depending on the application. Only manufacturing, processing, or otherwise use of aluminum oxide in the fibrous form triggers reporting. Supplier notification applies only to distribution of mixtures or trade name products containing fibrous forms of aluminum oxide.

B.4 Threshold Determination

Section 313 reporting is required if threshold quantities are exceeded. Separate thresholds apply to the amount of the toxic chemical that is manufactured, processed, or otherwise used.

You must submit a report for any listed toxic chemical that is manufactured or processed at your facility in excess of the following threshold:

- 25,000 pounds during the course of a calendar year.

You must submit a report if the quantity of a listed toxic chemical that is otherwise used at your facility exceeds:

- 10,000 pounds during the course of a calendar year.

B.4.a How to Determine If Your Facility Has Exceeded Thresholds

To determine whether your facility has exceeded a section 313 reporting threshold, compare quantities of listed toxic chemicals that you manufacture, process, or otherwise use to the respective thresholds for those activities. A worksheet is provided in Figure 2 to assist facilities in determining whether they exceed any of the reporting thresholds. This worksheet also provides a format for maintaining reporting facility records. Use of this worksheet is not required and the completed worksheet(s) should not accompany Form R reports submitted to EPA and the State.

Complete a separate worksheet for each section 313 toxic chemical or chemical category. Base your threshold determination for listed toxic chemicals with qualifiers only on the quantity of the toxic chemical satisfying the qualifier.

Use of the worksheet is divided into three steps:

Step 1 allows you to record the gross amount of the toxic chemical or chemical category involved in activities throughout the facility. Pure forms as well as the amounts of the toxic chemical or chemical category present in mixtures or trade name products must be considered. The types of activity (i.e., manufacturing, processing, or otherwise using) for which the toxic chemical is used must be identified because separate thresholds apply to each of these activities. A record of the information source(s) used should be kept. Possible information

sources include purchase records, inventory data, and calculations by a process engineer. The data collected in Step 1 will be totalled for each activity to identify the overall amount of the toxic chemical or chemical category manufactured (including imported), processed, or otherwise used.

Step 2 allows you to identify uses of the toxic chemical or chemical category that were included in Step 1 but are exempt under section 313. Do not include in Step 2 exempt forms of the toxic chemical not included in the calculations in Step 1. For example, if freon contained in the building's air conditioners was not reported in Step 1, you would not include the amount as exempt in Step 2. Step 2 is intended for use when one form or use of the toxic chemical is exempt while other forms require reporting. Note the type of exemption for future reference. Also identify, if applicable, the fraction or percentage of the toxic chemical present that is exempt. Add the amounts in each activity to obtain a subtotal for exempted amounts of the toxic chemical or chemical categories at the facility.

Step 3 involves subtracting the result of Step 2 from the results of Step 1 for each activity. Compare this net sum to the applicable activity threshold. If the threshold is met or exceeded for any of the three activities, a facility must submit a Form R for that toxic chemical or chemical category. This worksheet should be retained in either case to document your determination for reporting or not reporting, but should not be submitted with the report. Do not sum quantities of the toxic chemical that are manufactured, processed, and otherwise used at your facility, because each of these activities requires a separate threshold determination. For example, if in a calendar year you processed 20,000 pounds of a chemical and you otherwise used 6,000 pounds of that same toxic chemical, your facility has not met or exceeded any applicable threshold and thus is not required to report for that chemical.

You must submit a report if you exceed any threshold for any listed toxic chemical or chemical category. For example, if your facility processes 22,000 pounds of a listed toxic chemical and also otherwise uses 16,000 pounds of that same toxic chemical, it has exceeded the otherwise used threshold (10,000 pounds) and your facility must report even though it did not exceed the process threshold. However, in preparing your reports, you must consider all non-exempted activities and all releases of the toxic chemical from your facility, not just releases from the otherwise use activity.

Figure 2
OPTIONAL SECTION 313 REPORTING THRESHOLD WORKSHEET

Facility Name: _____ Date Worksheet Prepared: _____
 Toxic Chemical or Chemical Category: _____ Prepared By: _____
 Reporting Year: _____

Step 1. Identify amounts of the toxic chemical manufactured, processed, or otherwise used.

Mixture Name or Other Identifier	Information Source	Percent by Weight	Total Weight (in lbs)	Amount of the Listed Toxic Chemical by Activity (in lbs.):		
				Manufactured	Processed	Otherwise Used
1.						
2.						
3.						
4.						
5.						
6.						
7.						
Subtotal:				(A) _____ lbs.	(B) _____ lbs.	(C) _____ lbs.

Step 2. Identify exempt forms of the toxic chemical that have been included in Step 1.

Mixture Name as Listed Above	Applicable Exemption	Note Fraction or Percent Exempt (if Applicable)	Exempt Amount of the Toxic Chemical from Above (in lbs.):		
			Manufactured	Processed	Otherwise Used
1.					
2.					
3.					
4.					
5.					
6.					
7.					
Subtotal:			(A) _____ lbs.	(B) _____ lbs.	(C) _____ lbs.

Step 3. Calculate the amount subject to threshold:

(A - A₁) _____ lbs. (B - B₁) _____ lbs. (C - C₁) _____ lbs.
 Compare to thresholds for section 313 reporting.
 25,000 lbs. 25,000 lbs. 10,000 lbs.

If any threshold is met, reporting is required for all activities. Do not submit this worksheet with Form R. Retain for your records.

Also note that threshold determinations are based upon the actual amounts of a toxic chemical manufactured, processed, or otherwise used over the course of the calendar year. The threshold determination may not relate to the amount of a toxic chemical brought on-site during the calendar year. For example, if a stockpile of 100,000 pounds of a toxic chemical is present on-site but only 20,000 pounds is applied to a process, only the 20,000 pounds processed is counted toward a threshold determination, not the entire 100,000 pounds of the stockpile.

Threshold Determinations for On-Site Reuse/Recycle Operations.

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

This exemption does not apply to toxic chemicals "recycled" off-site and returned to a facility. Such toxic chemicals returned to a facility are treated as the equivalent of newly purchased material for purposes of section 313 threshold determinations.

Threshold Determinations for Chemical Categories.

A number of chemical compound categories are subject to reporting. See Table II for a listing of these toxic chemical categories. When reporting for one of these toxic chemical categories, all individual members of a category that are manufactured, processed, or otherwise used must be counted. However, threshold determinations must be made separately for each of the three activities. Do not include in these threshold determinations for a category any chemicals that are also specifically listed section 313 toxic chemicals (see Table II) or specific toxic chemicals that have been deleted from the category (e.g., three compounds deleted from copper compound category -- see the introduction to these instructions). Specifically listed toxic chemicals are subject to their own, individual threshold determination.

Threshold determinations for metal-containing compounds present a special case. If, for example, your facility processes several different lead compounds, base your threshold determination on the total weight of all lead compounds processed. However, if your facility processes both the "parent" metal (lead) as well as one or more lead compounds, you must make threshold determinations for both because they are separately listed toxic chemicals. If your facility exceeds thresholds for both the parent metal and compounds of that same metal, EPA allows you to file one combined report (e.g., one report for lead compounds, including lead) because the release information you will report in connection with metal compounds will be the total pounds of the parent metal released.

One other case involving metal compounds should be noted. Some metal compounds may contain more than one listed metal. For example, lead chromate is both a lead compound and a chromium compound. In such cases, if applicable thresholds are exceeded, you are required to file two separate reports, one for lead compounds and one for chromium compounds. Apply the total weight of the lead chromate to the threshold determinations for both lead compounds and chromium compounds. However, only the amount of each parent metal released (not the amount of the compound) would be reported on the appropriate sections of both Form Rs.

B.4.b Mixtures and Trade Name Products

Toxic chemicals contained in mixtures and trade name products must be factored into threshold and release determinations.

If your facility processed or otherwise used mixtures or trade name products during the calendar year, you are required to use the best information available to determine whether the components of a mixture are above the de minimis concentration and, therefore, must be included in threshold and release determinations. If you know that a mixture or trade name product contains a specific toxic chemical, combine the amount of the toxic chemical in the mixture or trade name product with other amounts of the same toxic chemical processed or otherwise used at your facility for threshold and release determinations. If you know that a mixture contains a toxic chemical but no concentration information is provided by the supplier, you do not have to consider the amount of the toxic chemical present in that mixture for purposes of threshold and release determinations.

Example 5: Mixture and Trade Name Products

Scenario #1: Your facility uses 12,000 pounds of an industrial solvent (Solvent X) for equipment cleaning. The Material Safety Data Sheet (MSDS) for the solvent indicates that it contains at least 50 percent methyl ethyl ketone (MEK), a listed toxic chemical; however, it also states that the solvent contains 20 percent non-hazardous surfactants. This is the only MEK-containing chemical used at the facility.

Follow these steps to determine if the quantity of the toxic chemical in solvent x exceeds the threshold for otherwise use.

- 1) Determine a reasonable maximum concentration for the toxic chemical by subtracting out the non-hazardous surfactants (i.e., $100\% - 20\% = 80\%$).
- 2) Determine the midpoint between the known minimum (50%) and the reasonable maximum calculated above (i.e., $(80\% - 50\%) / 2 + 50 = 65\%$).
- 3) Multiply total weight of Solvent X otherwise used by 65 percent.
 $12,000 \text{ pounds} \times 0.65 = 7,800 \text{ pounds}$
- 4) Because the total amount of MEK otherwise used at the facility was less than the 10,000 pound otherwise use threshold, the facility is not required to file a Form R for MEK.

Scenario #2: Your facility otherwise used 15,000 pounds of Solvent Y to clean printed circuit boards. The MSDS for the solvent lists only that Solvent Y contains at least 80% of a listed toxic chemical which is only identified as chlorinated hydrocarbons.

Follow these steps to determine if the quantity of the toxic chemical in solvent exceeds the threshold for otherwise use.

- 1) Because the specific chemical is unknown, the Form R will be filed for "chlorinated hydrocarbons." This name will be entered into Part II, Section 2.1, "Mixture Component Identity." (Note: Because your supplier is claiming the toxic chemical identity a trade secret, you do not have to file substantiation forms.)
- 2) The upper bound limit is assumed to be 100 percent and the lower bound limit is known to be 80 percent. Using this information, the specific concentration is estimated to be 90 percent (i.e., the mid-point between upper and lower limits).
 $(1.0 + 0.80) / 2 = 0.90$
- 3) The total weight of Solvent Y is multiplied by 90 percent when calculating for thresholds.
 $15,000 \times 0.90 = 13,500$
- 4) Because the total amount of chlorinated hydrocarbons exceeds the 10,000 pound otherwise used threshold, you must file a Form R for this chemical.

Observe the following guidelines in estimating concentrations of toxic chemicals in mixtures when only limited information is available:

- If you know the lower and upper bound concentrations of a toxic chemical in a mixture, use the midpoint of these two concentrations for threshold determinations.
- If you know only the lower bound concentration, you should subtract out the percentages of any other known components to determine a reasonable upper bound concentration, and then determine a midpoint.
- If you have no information other than the lower bound concentration, calculate a midpoint assuming an upper bound concentration of 100%.
- If you only know the upper bound concentration, you must use it for threshold determinations.
- In cases where you only have a concentration range available, you should use the midpoint of the range extremes.

De Minimis Exemption. A listed toxic chemical does not have to be considered if it is present in a mixture at a concentration below a specified de minimis level. The de minimis level is 1.0%, or 0.1% if the toxic chemical meets the OSHA carcinogen standard. See Table II for the de minimis value associated with each listed toxic chemical. For mixtures that contain more than one member of a listed toxic chemical category, the de minimis level applies to the aggregate concentration of all such members and not to each individually. EPA included the de minimis exemption in the rule as a burden-reducing step, primarily because facilities are not likely to have information on the presence of a toxic chemical in a mixture or trade name product beyond that available in the product's MSDS. The de minimis levels are consistent with OSHA requirements for development of MSDS information concerning composition.

For threshold determinations, the de minimis exemption applies to:

- A listed toxic chemical in a mixture or trade name product received by the facility.

- A listed toxic chemical manufactured during a process where the toxic chemical remains in a mixture or trade name product distributed by the facility.

The de minimis exemption does not apply to:

- A toxic chemical manufactured at the facility that does not remain in a product distributed by the facility. A threshold determination must be made on the annual quantity of the toxic chemical manufactured regardless of the concentration. For example, quantities of formaldehyde created as a result of waste treatment must be applied toward the threshold for "manufacture" of this toxic chemical, regardless of the concentration of this toxic chemical in the waste.

In general, when the de minimis exemption applies to threshold determinations and the concentration of the toxic chemical in the mixture is below the de minimis limitation, then you are not required to report releases associated with the processing or otherwise use of the toxic chemical in that mixture. Note that it is possible to meet the threshold for a toxic chemical on a facility-wide basis, but not be required to calculate releases from a particular process because that process involves only mixtures containing the toxic chemical below the de minimis level.

Application of the de minimis exemption to process streams must also be reviewed. Mixtures containing toxic chemicals can be added to a process or generated within a process. A facility is required to consider and report releases from the process once the de minimis concentration level has been exceeded. All releases of the toxic chemical from the process which occur after the de minimis exemption has been exceeded are then subject to reporting, regardless of whether or not the toxic chemical concentration later falls to a level below the de minimis exemption.

Supplier Notification. Beginning in 1989, suppliers of facilities in SIC codes 20-39 are required to develop and distribute a notice if the mixtures or trade name products they manufacture or process, and subsequently distribute, contain listed toxic chemicals. These notices are distributed to other companies in SIC codes 20-39 or to companies that sell or otherwise distribute the product to facilities in SIC codes 20-39. If a MSDS is not required for

the mixture or trade name product, the notification must be in written form (i.e., letter). Otherwise, the notice must be incorporated into or attached to the MSDS for that product. The supplier notification requirement began with the first shipment of a product in 1989 and must accompany the first shipment each year thereafter. In addition, a new or revised notice must be sent if a change occurs in the product which affects the weight percent of a listed toxic chemical or if it is discovered that a previous notice did not properly identify the toxic chemicals or the percentage by weight. For more information on supplier notification, see Appendix D.

If listed toxic chemical concentrations are equal to or above the de minimis cut-off level, your supplier must identify the specific components as they appear in Table

II and provide their percentage composition by weight in the mixture or product. If your supplier maintains that the identity of a toxic chemical is a trade secret, a generic identity that is structurally descriptive must be supplied on the notice. A maximum concentration level must be provided if your supplier contends that chemical composition information is a trade secret. In either case, you do not need to make a trade secret claim on behalf of your supplier (unless you consider your use of the proprietary mixture a trade secret). On Form R, identify the toxic chemical you are reporting according to its generic name provided in the notification. (See the instructions for Part II, Section 2 for more information.) If the listed toxic chemical is present below the de minimis level, no notification is required.

C. Instructions for Completing EPA Form R

The following are specific instructions for completing each part of EPA Form R. The number designations of the parts and sections of these instructions correspond to those in Form R unless otherwise indicated.

For all parts of Form R:

1. Type or print information on the form in the units and format requested. Use black ink. (Using blue ink for the certification signature is suggested as a means of indicating its originality.)
2. All information on Form R is required.
3. Do not leave items in Parts I and II on Form R blank unless specifically directed to do so; if an item does not apply to you, enter not applicable, NA, in the space provided. If your information does not fill all the spaces provided for a type of information, enter NA, in the next blank space in the sequence.
4. Report releases, off-site transfers, and recycling activities to the nearest pound. Do not report fractions of pounds.
5. Do not submit an incomplete form. The certification statement (Part I) specifies that the report is complete as submitted. See page 1 of these instructions for the definition of a complete submission.
6. When completing additional pages for Part II of the form, number the additional information sequentially from the prior sections of the form.
7. Indicate your TRI Facility Identification Number and the toxic chemical, toxic chemical category, or generically named toxic chemical on which you are reporting in the space provided in the top right corner of each page of Form R. Completion of this non-mandatory data element will greatly aid your internal recordkeeping and the quality of EPA's data entry process.

Part I. Facility Identification Information

Section 1. Reporting Year

This is the calendar year to which the reported information applies, not the year in which you are submitting the report. Information for the 1991 reporting year must be submitted on or before July 1, 1992.

Section 2. Trade Secret Information

2.1 Are you claiming the chemical identity on page 3 trade secret?

Answer this question only after you have completed the rest of the report. The specific identity of the toxic chemical being reported in Part II, Section 1, may be designated as a trade secret. If you are making a trade secret claim, mark "yes" and proceed to Section 2.2. Only check "yes" if it is your manufacturing, processing, or otherwise use of the toxic chemical whose identity is a trade secret. (See page 1 of these instructions for specific information on trade secrecy claims.) If you checked "no," proceed to Section 3; do not answer Section 2.2.

2.2 If "yes" in 2.1, is this copy sanitized or unsanitized?

Answer this question only after you have completed the rest of the report. Check "sanitized" if this copy of the report is the public version which does not contain the toxic chemical identity but does contain a generic name in its place, and you have claimed the toxic chemical identity trade secret in Part I, Section 2.1. Otherwise, check "unsanitized."

Section 3. Certification

The certification statement must be signed by the owner or operator or a senior official with management responsibility for the person (or persons) completing the form. The owner, operator, or official must certify the accuracy and completeness of the information reported on the form by signing and dating the certification statement. Each report must contain an original signature. Print or type in the space provided the name and title of the person who signs the statement. This certification statement applies to all the information supplied on the form and should be signed only after the form has been completed.

Section 4. Facility Identification

4.1 Facility Name and Location

Enter the name of your facility (plant site name or appropriate facility designation), street address, mailing address, city, county, state, and zip code in the space provided. Do not use a post office box number as the street address. The street address provided should be the location where the toxic chemicals are manufactured, processed, or otherwise used. If your mailing address and street address are the same, enter NA in the space for the mailing address.

If you have submitted a Form R for previous reporting years, a TRI Facility Identification Number has been assigned to your facility. The TRI Facility Identification Number appears (with other facility-specific information) on the peel-off mailing label on the cover of this Toxic Chemical Release Inventory Instructions for 1991 (EPA 700-K-92-002). Remove the mailing label from the back of this document and apply it to the space marked "place label here" in Part I, Section 4.1 of the blank Form R.

If your mailing label is missing information required on Form R, insert that information in the appropriate box in Part I, Section 4.1. For example, if your label contains your street address and not your mailing address, enter your mailing address in the space provided.

If you do not have a mailing label or cannot locate your TRI Facility Identification Number, please contact the Emergency Planning and Community Right-to-Know Information Hotline.

Enter "NA" in the space for the TRI Facility Identification number if this is your first submission of a Form R.

4.2 Full or Partial Facility Indication

A covered facility must report all releases and source reduction and recycling activities of a listed toxic chemical if it meets a reporting threshold for that toxic chemical. However, if the facility is composed of several distinct establishments, EPA allows these establishments to submit separate reports for the toxic chemical as long as all releases of the toxic chemical from the entire facility are accounted for. Indicate in Section 4.2 whether your report is for the entire covered facility as a whole or for part of a covered facility. Check box (a) if the toxic

chemical information applies to the entire covered facility. Check box (b) if the toxic chemical information applies only to part of a covered facility.

Section 313 requires reports by "facilities," which are defined as "all buildings, equipment, structures, and other stationary items which are located on a single site or on contiguous or adjacent sites and which are owned or operated by the same person."

The SIC code system defines business "establishments" as "distinct and separate economic activities [that] are performed at a single physical location." Under section 372.30(c) of the reporting rule, you may submit a separate Form R for each establishment, or for groups of establishments in your facility, provided all releases and source reduction and recycling activities involving the toxic chemical from the entire facility are reported. This allows you the option of reporting separately on the activities involving a toxic chemical at each establishment, or group of establishments (e.g., part of a covered facility), rather than submitting a single Form R for that toxic chemical for the entire facility. However, if an establishment or group of establishments does not manufacture, process, or otherwise use or release a toxic chemical, you do not have to submit a report for that establishment or group of establishments. (See also Section B.2.a of these instructions.)

4.3 Technical Contact

Enter the name and telephone number (including area code) of a technical representative whom EPA or State officials may contact for clarification of the information reported on Form R. This contact person does not have to be the same person who prepares the report or signs the certification statement and does not necessarily need to be someone at the location of the reporting facility; however, this person must be familiar with the details of the report so that he or she can answer questions about the information provided.

4.4 Public Contact

Enter the name and telephone number (including area code) of a person who can respond to questions from the public about the report. If you choose to designate the same person as both the technical and the public contact, you may enter "Same as Section 4.3" in this space. This contact person does not have to be the same person who prepares the report or signs the certification statement

and does not necessarily need to be someone at the location of the reporting facility. If this space is left blank, the technical contact will be listed as the public contact in the TRI database.

4.5 Standard Industrial Classification (SIC) Code

Enter the appropriate 4-digit primary Standard Industrial Classification (SIC) code for your facility (Table I lists the SIC codes within the 20-39 range). If the report covers more than one establishment, enter the primary 4-digit SIC code for each establishment starting with the primary SIC code for the entire facility. You are required to enter SIC codes only for those establishments within the facility that fall within SIC codes 20 to 39. If you do not know your SIC code, check with your financial office or contact your local Chamber of Commerce or State Department of Labor.

4.6 Latitude and Longitude

Enter the latitudinal and longitudinal coordinates of your facility. Sources of these data include EPA permits (e.g., NPDES permits), county property records, facility blueprints, and site plans. Instructions on how to determine these coordinates can be found in Appendix E. Enter only numerical data. Do not preface numbers with letters such as N or W to denote the hemisphere.

Latitude and longitude coordinates of your facility are very important for pinpointing the location of reporting facilities and are required elements on the Form R. EPA encourages facilities to make the best possible measurements when determining latitude and longitude. As with any other data field, missing, suspect, or incorrect data may generate a Notice of Technical Error to be issued to the facility. (See Appendix C: Common Errors in Completing Form R Reports).

4.7 Dun and Bradstreet Number

Enter the 9-digit number assigned by Dun and Bradstreet (D & B) for your facility or each establishment within your facility. These numbers code the facility for financial purposes. This number may be available from your facility's treasurer or financial officer. You can also obtain the numbers from your local Dun and Bradstreet office (check the telephone book White Pages). If a facility does not subscribe to the D & B service, a "support number" can be obtained from the Dun & Bradstreet center located in Allentown, Pennsylvania, at (215) 882-

7748 (8:30 am to 8:00 pm, Eastern Time). If none of your establishments has been assigned a D & B number, enter not applicable, NA, in box (a). If only some of your establishments have been assigned Dun and Bradstreet numbers, enter those numbers in Part I, Section 4.7.

4.8 EPA Identification Number

The EPA I.D. Number is a 12-character number assigned to facilities covered by hazardous waste regulations under the Resource Conservation and Recovery Act (RCRA). Facilities not covered by RCRA are not likely to have an assigned I.D. Number. If your facility is not required to have an I.D. Number, enter not applicable, NA, in box (a). If your facility has been assigned EPA Identification Numbers, you must enter those numbers in the spaces provided in Section 4.8.

4.9 NPDES Permit Number

Enter the numbers of any permits your facility holds under the National Pollutant Discharge Elimination System (NPDES) even if the permit(s) do not pertain to the toxic chemical being reported. This 9-character permit number is assigned to your facility by EPA or the State under the authority of the Clean Water Act. If your facility does not have a permit, enter not applicable, NA, in Section 4.9a.

4.10 Underground Injection Well Code (UIC) Identification Number

If your facility has a permit to inject a waste containing the toxic chemical into Class 1 deep wells, enter the 12-digit Underground Injection Well Code (UIC) identification number assigned by EPA or by the State under the authority of the Safe Drinking Water Act. If your facility does not hold such a permit(s), enter not applicable, NA, in Section 4.10a. You are only required to provide the UIC number for wells that receive the toxic chemical being reported.

Section 5. Parent Company Information

You must provide information on your parent company. For purposes of Form R, a parent company is defined as the highest level company, located in the United States, that directly owns at least 50 percent of the voting stock of your company. If your facility is owned by a foreign entity, enter not applicable, NA, in this space. Corporate names should be treated as parent company names for companies with multiple facility sites. For example, the

Bestchem Corporation is not owned or controlled by any other corporation but has sites throughout the country whose names begin with Bestchem. In this case, Bestchem Corporation would be listed as the "parent" company.

5.1 Name of Parent Company

Enter the name of the corporation or other business entity that is your ultimate US parent company. If your facility has no parent company, check the NA box.

5.2 Parent Company's Dun & Bradstreet Number

Enter the Dun and Bradstreet Number for your ultimate US parent company, if applicable. The number may be obtained from the treasurer or financial officer of the company. If your parent company does not have a Dun and Bradstreet number, check the NA box.

Part II Chemical Specific Information

In Part II, you are to report on:

- The toxic chemical being reported;
- The general uses and activities involving the toxic chemical at your facility;
- Releases of the toxic chemical from the facility to air, water, and land;
- Quantities of the toxic chemical transferred to off-site locations;
- Information for on-site waste treatment, energy recovery, and recycling of the toxic chemical; and
- Source reduction activities.

Section 1. Toxic Chemical Identity

1.1 CAS Number

Enter the Chemical Abstracts Service (CAS) registry number in Section 1.1 exactly as it appears in Table II for the chemical being reported. CAS numbers are cross-referenced with an alphabetical list of chemical names in Table II of these instructions. If you are reporting one of the toxic chemical categories in Table II (e.g., chromium compounds), enter the applicable category code in the CAS number space. Toxic chemical category codes are listed below and can also be found in Table II.

Toxic Chemical Category Codes

N010	Antimony compounds
N020	Arsenic compounds
N040	Barium compounds
N050	Beryllium compounds
N078	Cadmium compounds
N084	Chlorophenols
N090	Chromium compounds
N096	Cobalt compounds
N100	Copper compounds
N106	Cyanide compounds
N230	Glycol ethers
N420	Lead compounds
N450	Manganese compounds
N458	Mercury compounds
N495	Nickel compounds
N575	Polybrominated biphenyls (PBBs)
N725	Selenium compounds
N740	Silver compounds
N760	Thallium compounds
N982	Zinc compounds

If you are making a trade secret claim, you must report the CAS number or category code on your unsanitized Form R and unsanitized substantiation form. Do not include the CAS number or category code on your sanitized Form R or sanitized substantiation form.

1.2 Toxic Chemical or Chemical Category Name

Enter the name of the toxic chemical or chemical category exactly as it appears in Table II. If the toxic chemical name is followed by a synonym in parentheses, report the chemical by the name that directly follows the CAS number (i.e., not the synonym). If the listed toxic chemical identity is actually a product trade name (e.g., dicofol), the 9th *Collective Index* name is listed below it in brackets. You may report either name in this case.

Do not list the name of a chemical that does not appear in Table II, such as individual members of a reportable toxic chemical category. For example, if you use silver nitrate, do not report silver nitrate with its CAS number. Report this chemical as "silver compounds" with its category code, N740.

If you are making a trade secret claim, you must report the specific toxic chemical identity on your unsanitized Form R and unsanitized substantiation form. Do not report the name of the toxic chemical on your sanitized Form R or sanitized substantiation form. Include a generic name in Part II, Section 1.3 of your sanitized Form R report.

EPA requests that the toxic chemical, chemical category, or generic name also be placed in the box marked "Chemical, Category, or Generic Name" in the upper right-hand corner on all pages of Form R. While this space is not a required data element, providing this information will help you in preparing a complete Form R report.

1.3 Generic Chemical Name

Complete Section 1.3 only if you are claiming the specific toxic chemical identity of the toxic chemical as a trade secret and have marked the trade secret block in Part I, Section 2.1 on page 1 of Form R. Enter a generic chemical name that is descriptive of the chemical structure. You must limit the generic name to seventy characters (e.g., numbers, letters, spaces, punctuation) or less. Do not enter mixture names in Section 1.3; see Section 2 below.

In-house plant codes and other substitute names that are not structurally descriptive of the toxic chemical identity being withheld as a trade secret are not acceptable as a generic name. The generic name must appear on both sanitized and unsanitized Form R's, and the name must be the same as that used on your substantiation forms.

Section 2. Mixture Component Identity

Do not complete this section if you have completed Section 1 of Part II. Report the generic name provided to you by your supplier in this section if your supplier is claiming the chemical identity proprietary or trade secret. Do not answer "yes" in Part I, Section 2.1 on page 1 of the form if you complete this section. You do not need to supply trade secret substantiation forms for this toxic chemical because it is your supplier who is claiming the chemical identity a trade secret.

2.1 Generic Chemical Name Provided by Supplier

Enter the generic chemical name in this section only if the following three conditions apply:

1. You determine that the mixture contains a listed toxic chemical but the only identity you have for that chemical is a generic name;
2. You know either the specific concentration of that toxic chemical component or a maximum or average concentration level; and
3. You multiply the concentration level by the total annual amount of the whole mixture processed or otherwise used and determine that you meet the process or otherwise use threshold for that single, generically identified mixture component.

Example 6: Mixture Containing Unidentified Toxic Chemical

Your facility uses 20,000 pounds of a solvent that your supplier has told you contains 80 percent "chlorinated aromatic," their generic name for a toxic chemical subject to reporting under section 313. You therefore know that you have used 16,000 pounds of some listed toxic chemical which exceeds the "otherwise use" threshold. You would file a Form R and enter the name "chlorinated aromatic" in the space provided in Part II, Section 2.

Section 3. Activities and Uses of the Toxic Chemical at the Facility

Indicate whether the toxic chemical is manufactured (including imported), processed, or otherwise used at the facility and the general nature of such activities and uses at the facility during the calendar year. Report activities that take place only at your facility, not activities that take place at other facilities involving your products. You must check all the boxes in this section that apply. If you are a manufacturer of the toxic chemical, you must check (a) and/or (b), and at least one of (c), (d), (e), or (f) in Section 3.1. Refer to the definitions of "manufacture," "process," and "otherwise use" in the general information section of these instructions or Part 40, Section 372.3 of the *Code of Federal Regulations* for additional explanations.

3.1 Manufacture the Toxic Chemical

Persons who manufacture (including import) the toxic chemical must check at least one of the following:

- a. *Produce* - the toxic chemical is produced at the facility.
- b. *Import* - the toxic chemical is imported by the facility into the Customs Territory of the United States. (See Section B.3.a of these instructions for further clarification of import.)

And check at least one of the following:

- c. *For on-site use/processing* - the toxic chemical is produced or imported and then further processed or otherwise used at the same facility. If you check this block, you must also check at least one item in Part II, Section 3.2 or 3.3.
- d. *For sale/distribution* - the toxic chemical is produced or imported specifically for sale or distribution outside the manufacturing facility.
- e. *As a byproduct* - the toxic chemical is produced coincidentally during the production, processing, otherwise use, or disposal of another chemical substance or mixture and, following its production, is separated from that other chemical substance or mixture. Toxic chemicals produced and released as a result of waste treatment or disposal are also considered byproducts.

- f. *As an impurity* - the toxic chemical is produced coincidentally as a result of the manufacture, processing, or otherwise use of another chemical but is not separated and remains primarily in the mixture or product with that other chemical.

3.2 Process the Toxic Chemical (incorporative activities)

- a. *As a reactant* - A natural or synthetic toxic chemical used in chemical reactions for the manufacture of another chemical substance or of a product. Includes, but is not limited to, feedstocks, raw materials, intermediates, and initiators.
- b. *As a formulation component* - A toxic chemical added to a product (or product mixture) prior to further distribution of the product that acts as a performance enhancer during use of the product. Examples of toxic chemicals used in this capacity include, but are not limited to, additives, dyes, reaction diluents, initiators, solvents, inhibitors, emulsifiers, surfactants, lubricants, flame retardants, and rheological modifiers.
- c. *As an article component* - A toxic chemical that becomes an integral component of an article distributed for industrial, trade, or consumer use. One example is the pigment components of paint applied to a chair that is sold.
- d. *Repackaging* - Processing or preparation of a toxic chemical (or product mixture) for distribution in commerce in a different form, state, or quantity.

This includes, but is not limited to, the transfer of material from a bulk container, such as a tank truck to smaller containers such as cans or bottles.

3.3 Otherwise Use the Toxic Chemical (non-incorporative activities)

- a. *As a chemical processing aid* - A toxic chemical that is added to a reaction mixture to aid in the manufacture or synthesis of another chemical substance but is not intended to remain in or become part of the product or product mixture. Examples of such toxic chemicals include, but are not limited to, process solvents, catalysts, inhibitors, initiators, reaction terminators, and solution buffers.
- b. *As a manufacturing aid* - A toxic chemical that aids the manufacturing process but does not become part of the resulting product and is not added to the reaction mixture during the manufacture or synthesis of another chemical substance. Examples include, but are not limited to, process lubricants, metalworking fluids, coolants, refrigerants, and hydraulic fluids.
- c. *Ancillary or other use* - A toxic chemical that is used at a facility for purposes other than aiding chemical processing or manufacturing as described above. Examples include, but are not limited to, cleaners, degreasers, lubricants, fuels, and toxic chemicals used for treating wastes.

Example 7: Activities and Uses of Toxic Chemicals

In the example below, it is assumed that the threshold quantities for manufacture, process, or otherwise use (25,000 pounds, 25,000 pounds, and 10,000 pounds, respectively, for calendar year 1991) have been exceeded and the reporting of listed toxic chemicals is therefore required.

Your facility manufactures sulfuric acid. Fifty percent is sold as a product. The remaining 50 percent is reacted with naphthalene, forming phthalic acid and also producing sulfur dioxide fumes.

- Your company manufactures sulfuric acid, a listed toxic chemical, both for sale/distribution as a commercial product and for on-site use/processing as a feedstock in the phthalic acid production process. Because the sulfuric acid is a reactant, it is also processed. See Figure 3 for how this information would be reported in Part II, Section 3 of Form R.
- Your facility also processes naphthalene, as a reactant to produce phthalic acid, a chemical not on the section 313 list.

Figure 3

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.)	7664-93-9	
1.2	Toxic Chemical or Chemical Category Name (Important: Enter only one name exactly as it appears on the Section 313 list.)	Sulfuric Acid	
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	<u>If produce or import:</u> 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

For data element 4.1 of Part II, insert the code (see below) that indicates the maximum quantity of the toxic chemical (e.g., in storage tanks, process vessels, on-site shipping containers) at your facility at any time during the calendar year. If the toxic chemical was present at several locations within your facility, use the maximum total amount present at the entire facility at any one time.

Weight Range in Pounds

Range Code	From...	To...
01	0	99
02	100	999
03	1,000	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	more than 1 billion

If the toxic chemical present at your facility was part of a mixture or trade name product, determine the maximum quantity of the toxic chemical present at the facility by calculating the weight percent of the toxic chemical only.

Do not include the weight of the entire mixture or trade name product. This data may be found in the Tier II form your facility may have prepared under Section 312 of EPCRA. See Part 40, Section 372.30(b) of the *Code of Federal Regulations* for further information on how to calculate the weight of the toxic chemical in the mixture or trade name product. For toxic chemical categories (e.g., nickel compounds), include all chemical compounds in the category when calculating the maximum amount, using the entire weight of each compound.

Section 5. Releases of the Toxic Chemical to the Environment On-Site

In Section 5, you must account for the total aggregate releases of the toxic chemical to the environment from your facility for the calendar year.

Do not enter the values in Section 5 in gallons, tons, liters, or any measure other than pounds. You must also enter the values as whole numbers. Numbers following a decimal point are not acceptable.

Releases to the environment include emissions to the air, discharges to surface waters, and on-site releases to land and underground injection wells. If you have no releases to a particular media (e.g., stack air), you must check the "NA" box or enter zero; do not leave any part of Section 5 blank. Check the box on the last line of this section if you use the additional space for Section 5.3 on page 5 of the Form.

You are not required to count, as a release, quantities of a toxic chemical that are lost due to natural weathering or corrosion, normal/natural degradation of a product, or normal migration of a toxic chemical from a product. For example, amounts of a listed toxic chemical that migrate from plastic products in storage do not have to be counted in estimates of releases of that toxic chemical from the facility. Also, amounts of listed metal compounds (e.g., copper compounds) that are lost due to normal corrosion of process equipment do not have to be considered as releases of copper compounds from the facility.

All releases of the toxic chemical to the air must be classified as either a point or non-point emission, and included in the total quantity reported for these releases in Sections 5.1 and 5.2. Instructions for columns A, B, and C follow the discussions of Sections 5.1 through 5.5.

5.1 Fugitive or Non-Point Air Emissions

Report the total of all releases of the toxic chemical to the air that are not released through stacks, vents, ducts, pipes, or any other confined airstream. You must include (1) fugitive equipment leaks from valves, pump seals, flanges, compressors, sampling connections, open-ended lines, etc.; (2) evaporative losses from surface impoundments and spills; (3) releases from building ventilation systems; and (4) any other fugitive or non-point air emissions. Engineering estimates and mass balance calculations (using purchase records, inventories, engineering knowledge or process specifications of the quantity of the toxic chemical entering product, hazardous waste manifests, or monitoring records) may be useful in estimating fugitive emissions.

5.2 Stack or Point Air Emissions

Report the total of all releases of the toxic chemical to the air that occur through stacks, vents, ducts, pipes, or other confined air streams. You must include storage tank emissions. Air releases from air pollution control equipment would generally fall in this category. Monitoring data, engineering estimates, and mass balance calculations may help you to complete this section.

5.3 Discharges to Receiving Streams or Water Bodies

In Section 5.3 you are to enter the name(s) of the stream(s) or water body(ies) to which your facility directly discharges the toxic chemical on which you are reporting. A total of three spaces are provided; however, other streams or water bodies to which the toxic chemical is discharged can be reported in the additional spaces for Section 5.3 found on page 5 of Form R. Enter the name of each receiving stream or surface water body to which the toxic chemical being reported is directly discharged. Report the name of the receiving stream or water body as it appears on the NPDES permit for the facility. If the stream is not covered by a permit, enter the name of the off-site stream or water body by which it is publicly known. Do not list a series of streams through which the toxic chemical flows. Be sure to include the receiving stream(s) or water body(ies) that receive stormwater runoff from your facility. Do not enter names of streams to which off-site treatment plants discharge. Enter "NA" in Section 5.3.1 if you do not discharge the listed toxic chemical to surface water bodies.

Enter the total annual amount of the toxic chemical released from all discharge points at the facility to each receiving stream or water body. Include process outfalls such as pipes and open trenches, releases from on-site wastewater treatment systems, and the contribution from stormwater runoff, if applicable (see instructions for column C below). Do not include discharges to a POTW or other off-site wastewater treatment facilities in this section. These off-site transfers must be reported in Part II, Section 6 of Form R.

Wastewater analyses and flowmeter data may provide the quantities you will need to complete this section.

Discharges of listed acids (e.g., hydrogen fluoride; hydrogen chloride; nitric acid; phosphoric acid; and sulfuric acid) may be reported as zero if the discharges have been neutralized to pH 6 or above. If wastewater containing a listed mineral acid is discharged below pH 6, then

releases of the mineral acid must be reported. In this case, pH measurements may be used to estimate the amount of mineral acid released.

If you must report more than three discharges to receiving streams or water bodies, check the box at the bottom of page 4 and enter the additional information on the following page, in Section 5.3, Additional Information on Releases of the Toxic Chemical to the Environment On-Site. In Section 5.3 on page 5, blanks in the data elements are provided so you may continue the numeration you began on page 4.

5.4 Underground Injection On-Site

Enter the total annual amount of the toxic chemical that was injected into all wells, including Class I wells, at the facility. Chemical analyses, injection rate meters, and RCRA Hazardous Waste Generators Reports are good sources for obtaining data that will be useful in completing this section. Check the Not Applicable "NA" box in Section 5.4 if you do not inject the reported toxic chemical into underground wells.

5.5 Releases to Land On-Site

Four predefined subcategories for reporting quantities released to land within the boundaries of the facility are provided. Do not report land disposal at off-site locations in this section. Accident histories and spill records may be useful (e.g., release notification reports required under Section 304 of EPCRA and accident histories required under Section 112(r)(7)(B)(ii) of the Clean Air Act).

5.5.1 Landfill—Typically, the ultimate disposal method for solid wastes is landfilling. Leaks from landfills need not be reported as a release because the amount of the toxic chemical in the landfill has already been reported as a release.

5.5.2 Land treatment/application farming—Land treatment is a disposal method in which a waste containing a listed toxic chemical is applied onto or incorporated into soil. While this disposal method is considered a release to land, any volatilization of listed toxic chemicals into the air occurring during the disposal operation must be included in the total fugitive air releases reported in Part II, Section 5.1 of Form R.

5.5.3 Surface impoundment—A surface impoundment is a natural topographic depression, man-made excavation, or diked area formed primarily of earthen materials

(although some may be lined with man-made materials), which is designed to hold an accumulation of liquid wastes or wastes containing free liquids. Examples of surface impoundments are holding, settling, storage, and elevation pits; ponds; and lagoons. If the pit, pond, or lagoon is intended for storage or holding without discharge, it would be considered to be a surface impoundment used as a final disposal method.

Quantities of the toxic chemical released to surface impoundments that are used merely as part of a wastewater treatment process generally must not be reported in this section. However, if the impoundment accumulates sludges containing the toxic chemical, you must include an estimate in this section unless the sludges are removed and otherwise disposed (in which case they should be reported under the appropriate section of the form). For the purposes of this reporting, storage tanks are not considered to be a type of disposal and are not to be reported in this section of Form R.

5.5.4 Other disposal — Includes any amount of a listed toxic chemical released to land that does not fit the categories of landfills, land treatment, or surface impoundment. This other disposal would include any spills or leaks of listed toxic chemicals to land. For example, 2,000 pounds of benzene leaks from a underground pipeline into the land at a facility. Because the pipe was only a few feet from the surface at the erupt point, 30 percent of the benzene evaporates into the air. The 600 pounds released to the air would be reported as a fugitive air release (Part II, Section 5.1) and the remaining 1,400 pounds would be reported as a release to land, other disposal (Part II, Section 5.5.4).

5. Column A Total Release

Only on-site releases of the toxic chemical to the environment for the calendar year are to be reported in this section of Form R. The total releases from your facility do not include transfers or shipments of the toxic chemical from your facility for sale or distribution in commerce, or of wastes to other facilities for waste treatment, recycling, disposal, or energy recovery (see Part II, Section 6 of these Instructions). Both routine releases, such as fugitive air emissions, and accidental or non-routine releases, such as chemical spills, must be included in your estimate of the quantity released. EPA requires no more than two significant digits when reporting releases (e.g., 7,521 pounds would be reported as 7,500 pounds).

Releases of Less Than 1,000 Pounds. For total annual releases or off-site transfers of a toxic chemical from the

facility of less than 1,000 pounds, the amount may be reported either as an estimate or by using the range codes that have been developed. The reporting range codes to be used are:

Code	Range (pounds)
A	1-10
B	11-499
C	500-999

Do not enter a range code and an estimate in the same box in column A. Total annual releases or off-site transfers of a toxic chemical from the facility of less than 1 pound may be reported in one of several ways. You should round the value to the nearest pound. If the estimate is 0.5 pounds or greater, you should either enter the range code "A" for "1-10" or enter "1" in column A. If the release is less than 0.5 pounds, you may round to zero and enter "0" in column A.

Note that total annual releases of less than 0.5 pounds from the processing or otherwise use of an article maintain the article status of that item. Thus, if the only releases you have are from processing an article, and such releases are less than 0.5 pounds per year, you are not required to submit a report for that toxic chemical. The 0.5-pound release determination does not apply to just a single article. It applies to the cumulative releases from the processing or otherwise use of the same type of article (e.g., sheet metal or plastic film) that occurs over the course of the calendar year.

Zero Releases. If you have no releases of a toxic chemical to a particular medium, report either NA, not applicable, or 0, as appropriate. Report NA only when there is no possibility a release could have occurred to a specific media or off-site location. If a release to a specific media or off-site location could have occurred, but either did not occur or the annual aggregate release was less than 0.5 pounds, report zero. However, if you report zero releases, a basis of estimate must be provided in column B.

For example, if hydrochloric acid is involved in the facility's processing activities but the facility neutralizes the wastes to a pH of 6 or above, then the facility reports a 0 release for the toxic chemical. If the facility has no underground injection well, "NA" would be written in Part I, Section 4.10 and checked in Part II, Section 5.4 of Form R. Also, if the facility does not landfill the acidic waste, NA would be checked in Part II, Section 5.5.1 of Form R.

Releases of 1,000 Pounds or More. For releases to any medium that amount to 1,000 pounds or more for the year, you must provide an estimate in pounds per year in column A. Any estimate provided in column A should be reported to no more than two significant figures. This estimate should be in whole numbers. Do not use decimal points.

Calculating Releases. To provide the release information required in column A in this section, you must use all readily available data (including relevant monitoring data and emissions measurements) collected at your facility to meet other regulatory requirements or as part of routine plant operations, to the extent you have such data for the toxic chemical.

When relevant monitoring data or emission measurements are not readily available, reasonable estimates of the amounts released must be made using published emission factors, material balance calculations, or engineering calculations. You may not use emission factors or calculations to estimate releases if more accurate data are available.

No additional monitoring or measurement of the quantities or concentrations of any toxic chemical released into the environment, or of the frequency of such releases, beyond that which is required under other provisions of law or regulation or as part of routine plant operations, is required for the purpose of completing Form R.

You must estimate, as accurately as possible, the quantity (in pounds) of the toxic chemical or chemical category that is released annually to each environmental medium. Include only the quantity of the toxic chemical in this estimate. If the toxic chemical present at your facility was part of a mixture or trade name product, calculate only the releases of the toxic chemical, not the other components of the mixture or trade name product. If you are only able to estimate the releases of the mixture or trade name product as a whole, you must assume that the release of the toxic chemical is proportional to its concentration in the mixture or trade name product. See Part 40, Section 372.30(b) of the *Code of Federal Regulations* for further information on how to calculate the concentration and weight of the toxic chemical in the mixture or trade name product.

If you are reporting a toxic chemical category listed in Table II of these instructions rather than a specific toxic chemical, you must combine the release data for all chemicals in the listed toxic chemical category (e.g., all

glycol ethers or all chlorophenols) and report the aggregate amount for that toxic chemical category. Do not report releases of each individual toxic chemical in that category separately. For example, if your facility releases 3,000 pounds per year of 2-chlorophenol, 4,000 pounds per year of 3-chlorophenol, and 4,000 pounds per year of 4-chlorophenol to air as fugitive emissions, you should report that your facility releases 11,000 pounds per year of chlorophenols to air as fugitive emissions in Part II, Section 5.1.

For listed toxic chemicals with the qualifier "solution," such as ammonium nitrate, at concentrations of 1 percent (or 0.1 percent in the case of a carcinogen) or greater, the chemical concentrations must be factored into threshold and release calculations because threshold and release amounts relate to the amount of toxic chemical in solution, not the amount of solution.

For metal compound categories (e.g., chromium compounds), report releases of only the parent metal. For example, a user of various inorganic chromium salts would report the total chromium released regardless of the chemical form (e.g., as the original salts, chromium ion, oxide) and exclude any contribution to mass made by other species in the molecule.

5. Column B Basis of Estimate

For each release estimate, you are required to indicate the principal method used to determine the amount of release reported. You will enter a letter code that identifies the method that applies to the largest portion of the total estimated release quantity.

The codes are as follows:

- M- Estimate is based on monitoring data or measurements for the toxic chemical as transferred to an off-site facility.
- C- Estimate is based on mass balance calculations, such as calculation of the amount of the toxic chemical in wastes entering and leaving process equipment.
- E- Estimate is based on published emission factors, such as those relating release quantity to throughput or equipment type (e.g., air emission factors).

Example 8: Calculating Releases

Your facility disposes of 14,000 pounds of lead chromate ($\text{PbCrO}_4 \cdot \text{PbO}$) in an on-site landfill and transfers 16,000 pounds of lead selenite (PbSeO_4) to an off-site land disposal facility. You would therefore be submitting three separate reports on the following: lead compounds, selenium compounds, and chromium compounds. However, the quantities you would be reporting would be the pounds of "parent" metal being released or transferred off-site. All quantities are based on mass balance calculations (See Section 5.B for information on Basis of Estimate and Section 6.C for waste treatment or disposal codes and information on transfers of toxic chemicals in wastes). You would calculate releases of lead, chromium, and selenium by first determining the percentage by weight of these metals in the materials you use as follows:

Lead Chromate ($\text{PbCrO}_4 \cdot \text{PbO}$) -	Molecular weight = 546.37
Lead 2 Pb -	Molecular weight = $207.2 \times 2 = 414.4$
Chromate 1 Cr -	Molecular weight = 51.996
Lead chromate is therefore (% by weight)	

$$(414.4/546.37) = 75.85\% \text{ lead and}$$

$$(51.996/546.37) = 9.52\% \text{ chromium}$$

Lead Selenite (PbSeO_4)	Molecular weight = 350.17
Lead 1 Pb	Molecular weight = 207.2
Selenium 1 Se	Molecular weight = 78.96
Lead selenite is therefore (% by weight)	

$$(207.2/350.17) = 59.17\% \text{ lead and}$$

$$(78.96/350.17) = 22.55\% \text{ selenium.}$$

The total pounds of lead, chromium, and selenium released or transferred from your facility are as follows:

Lead

Release: $0.7585 \times 14,000 = 10,619$ pounds from lead chromate (round to 11,000 pounds)

Transfer: $0.5917 \times 16,000 = 9,467$ pounds from lead selenite (round to 9,500 pounds)

Chromium

Release: $0.0952 \times 14,000 = 1,333$ pounds from lead chromate (round to 1,300 pounds)

Selenium

Transfer: $0.2255 \times 16,000 = 3,608$ pounds of selenium from lead round to 3,600 pounds)

- O- Estimate is based on other approaches such as engineering calculations (e.g., estimating volatilization using published mathematical formulas) or best engineering judgment. This would include applying an estimated removal efficiency to a treatment, even if the composition of the waste before treatment was fully identified through monitoring data.

For example, if 40 percent of stack emissions of the reported toxic chemical were derived using monitoring data, 30 percent by mass balance, and 30 percent by emission factors, you would enter the code letter "M" for monitoring.

If the monitoring data, mass balance, or emission factor used to estimate the release is not specific to the toxic chemical being reported, the form should identify the estimate as based on engineering calculations or best engineering judgment.

If a mass balance calculation yields the flow rate of a waste, but the quantity of reported toxic chemical in the waste is based on solubility data, report "O" because "engineering calculations" were used as the basis of estimate of the quantity of the toxic chemical in the waste.

If the concentration of the toxic chemical in the waste was measured by monitoring equipment and the flow rate of the waste was determined by mass balance, then the primary basis of the estimate is "monitoring" (M). Even though a mass balance calculation also contributed to the estimate, "monitoring" should be indicated because monitoring data was used to estimate the concentration of the waste.

Mass balance (C) should only be indicated if it is directly used to calculate the mass (weight) of toxic chemical released. Monitoring data should be indicated as the basis of estimate only if the toxic chemical concentration is measured in the waste being released into the environment. Monitoring data should not be indicated, for example, if the monitoring data relates to a concentration of the toxic chemical in other process streams within the facility.

It is important to realize that the accuracy and proficiency of release estimation will improve over time. However, submitters are not required to use new emission factors or estimation techniques to revise previous Form R submissions.

5. Column C Percent From Stormwater

This column relates only to Section 5.3 — discharges to receiving streams or water bodies. If your facility has monitoring data on the amount of the toxic chemical in stormwater runoff (including unchanneled runoff), you must include that quantity of the toxic chemical in your water release in column A and indicate the percentage of the total quantity (by weight) of the toxic chemical contributed by stormwater in column C (Section 5.3C).

If your facility has monitoring data on the toxic chemical and an estimate of flow rate, you must use this data to determine the percent stormwater.

If you have monitored stormwater but did not detect the toxic chemical, enter zero (0) in column C. If your facility has no stormwater monitoring data for the chemical, enter not applicable, "NA," in this space on the form.

If your 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 contribution from stormwater. Rates of flow can be estimated by multiplying the annual amount of rainfall by the land area of the facility and then multiplying that figure by the runoff coefficient. The runoff coefficient represents the fraction of rainfall that does not seep into the ground but runs off as stormwater. The runoff coefficient is directly related to how the land in the drainage area is used. (See table below.)

Description of Land Area	Runoff Coefficient
Business	
Downtown areas	0.70-0.95
Neighborhood areas	0.50-0.70
Industrial	
Light areas	0.50-0.80
Heavy areas	0.60-0.90
Railroad yard areas	0.20-0.40
Unimproved areas	0.10-0.30
Streets	
Asphaltic	0.70-0.95
Concrete	0.80-0.95
Brick	0.70-0.85
Drives and walks	0.70-0.85
Roofs	0.75-0.95
Lawns: Sandy Soil	
Flat, 2%	0.05-0.10
Average, 2-7%	0.10-0.15
Steep, 7%	0.15-0.20

Example 9: Releases from Stormwater

Your stormwater monitoring data shows that the average concentration of zinc in the stormwater runoff from your facility from a biocide containing a zinc compound is 1.4 milligrams per liter, and the total annual stormwater discharge from the facility is 7.527 million gallons. The total amount of zinc discharged to surface water through the plant wastewater discharge (non-stormwater) is 250 pounds per year. The total amount of zinc discharged with stormwater is:

$$(7,527,000 \text{ gallons stormwater}) \times (3.785 \text{ liters/gallon}) = 28,489,695 \text{ liters stormwater}$$

$$(28,489,695 \text{ liters stormwater}) \times (1.4 \text{ mg. zinc/liter}) = 39,885.6 \text{ grams zinc} = 88 \text{ pounds zinc}$$

The total amount of zinc discharged from all sources of your facility is:

$$\begin{array}{r} 250 \text{ pounds zinc from wastewater discharge} \\ + 88 \text{ pounds zinc from stormwater runoff} \\ \hline 338 \text{ pounds zinc total water discharge} \end{array}$$

Round to 340 pounds of zinc on Form R.

The percentage of zinc discharged through stormwater is:

$$88/338 \times 100 = 26\%$$

Lawns: Heavy Soil

Flat, 2%	0.13-0.17
Average, 2-7%	0.18-0.22
Steep, 7%	0.25-0.35

Choose the most appropriate runoff coefficient for your site or calculate a weighted-average coefficient, which takes into account different types of land use at your facility:

$$\text{Weighted-average runoff coefficient} = (\text{Area 1 \% of total})(C1) + (\text{Area 2 \% of total})(C2) + (\text{Area 3 \% of total})(C3) + \dots + (\text{Area i \% of total})(Ci)$$

where C_i = runoff coefficient for a specific land use of Area i .

Section 6 Transfers of the Toxic Chemical in Wastes to Off-Site Locations

You must report in this section the total annual quantity of the toxic chemical in wastes sent to any off-site facility for the purposes of waste treatment, disposal, recycling, or energy recovery. Note that beginning with reporting year 1991, off-site transfers for the purposes of recycling and energy recovery are required to be reported. Report the total amount of the toxic chemical transferred off-site after any on-site waste treatment, recycling, or

removal is completed. Do not report transfers of listed mineral acids if they have been neutralized to a pH of 6 or above prior to discharge to a Publicly Owned Treatment Works (POTW).

If you do not discharge wastewater containing the reported toxic chemical to a POTW, enter not applicable, NA, in the box for the POTW's name in Section 6.1.B. If you do not ship or transfer wastes containing the reported toxic chemical to other off-site locations, enter not applicable, NA, in the box for the off-site location's EPA Identification Number in Section 6.2.

Important: Beginning with the 1991 reporting year, you must number the boxes for reporting the information for each POTW or other off-site location in Sections 6.1 and 6.2. In the upper left hand corner of each box, the section number is either 6.1.B. or 6.2.

If you report a transfer of the listed toxic chemical to one or more POTW, number the boxes in Section 6.1.B as 6.1.B.1, 6.1.B.2, etc. If you transfer the listed toxic chemical to more than two POTWs, photocopy page 5 of Form R as many times as necessary and then number the boxes consecutively for each POTW. At the bottom of page 5 you will find instructions for indicating the total number of page 5s that you are submitting as part of Form R, as well as indicating the sequence of those pages. For

Example 10: Stormwater Runoff

Your facility is located in a semi-arid region of the United States which has an annual precipitation (including snowfall) of 12 inches of rain. (Snowfall should be converted to the equivalent inches of rain; assume one foot of snow is equivalent to one inch of rain.) The total area covered by your facility is 42 acres (about 170,000 square meters or 1,829,520 square feet). The area of your facility is 50 percent unimproved area, 10 percent asphaltic streets, and 40 percent concrete pavement.

The total stormwater runoff from your facility is therefore calculated as follows:

Land Use	% Total Area	Runoff Coefficient
Unimproved area	50	0.20
Asphaltic streets	10	0.85
Concrete pavement	40	0.90

Weighted-average runoff coefficient = $(50\%) \times (0.20) + (10\%) \times (0.85) + (40\%) \times (0.90) = 0.545$

(Rainfall) $\times$ (land area) $\times$ (conversion factor) $\times$ (runoff coefficient) = stormwater runoff

$(1 \text{ foot}) \times (1,829,520 \text{ ft}^2) \times (7.48 \text{ gal/ft}^3) \times (0.545) = 7,458,221 \text{ gallons/year}$

Total stormwater runoff = 7.45 million gallons/year

example, your facility transfers the reported toxic chemical in wastewaters to three POTWs. You would photocopy page 5 once, indicate at the bottom of each page 5 that there are a total of two page 5s and then indicate the first and second page 5. The boxes for the two POTWs on the first page 5 would be numbered 6.1.B.1 and 6.1.B.2, while the box for the third POTW on the second page 5 would be numbered 6.1.B.3.

If you report a transfer of the listed toxic chemical to one or more other off-site locations, number the boxes in Section 6.2 as 6.2.1, 6.2.2, etc. If you transfer the listed toxic chemical to more than two other off-site locations, photocopy page 6 of Form R as many times as necessary and then number the boxes consecutively for each off-site location. At the bottom of page 6 you will find instructions for indicating the total number of page 6s that you are submitting as part of Form R as well as indicating the sequence of those pages. For example, your facility transfers the reported toxic chemical to three other off-site locations. You would photocopy page 6 once, indicate at the bottom of each page 6 that there are a total of two page 6s and then indicate the first and second page 6. The boxes for the two off-site locations on the first page 6 would be numbered 6.2.1 and 6.2.2, while the box for the third off-site location on the second page 6 would be numbered 6.2.3.

6.1 Discharges to Publicly Owned Treatment Works (POTW)

In Section 6.1.A, estimate the quantity of the reported toxic chemical transferred to all POTWs and the basis upon which the estimate was made. In Section 6.1.B, enter the name and address for each POTW to which your facility discharges wastewater containing the reported toxic chemical.

If you do not discharge wastewater containing the reported toxic chemical to a POTW, enter not applicable, NA, in the box for the POTW's name in Section 6.1.B.

6.1.A.1 Total Transfers

Enter the total amount, in pounds, of the reported toxic chemical that is contained in the wastewaters transferred to all POTWs. Do not enter the total poundage of the wastewaters. If the total amount transferred is less than 1,000 pounds, you may report a range by entering the appropriate range code. The following reporting range codes are to be used:

Code	Reporting Range (in pounds)
A	1-10
B	11-499
C	500-99

6.1.A.2 Basis of Estimate

You must identify the basis for your estimate of the total quantity of the reported toxic chemical in the wastewaters transferred to all POTWs. Enter one of the following letter codes that applies to the method by which the largest percentage of the estimate was derived.

- M- Estimate is based on monitoring data or measurements for the toxic chemical as transferred to an off-site facility.
- C- Estimate is based on mass balance calculations, such as calculation of the amount of the toxic chemical in streams entering and leaving process equipment.
- E- Estimate is based on published emission factors, such as those relating release quantity to throughput or equipment type (e.g., air emission factors).
- O- Estimate is based on other approaches such as engineering calculations (e.g., estimating volatilization using published mathematical formulas) or best engineering judgment. This would include applying an estimated removal efficiency to a waste stream, even if the composition of the stream before treatment was fully identified through monitoring data.

If you transfer a toxic chemical to more than one POTW, you should report the basis of estimate that was used to determine the largest percentage of the toxic chemical that was transferred.

6.2 Transfers to Other Off-Site Locations

In Section 6.2, enter the EPA Identification Number, name, and address for each off-site location to which your facility ships or transfers wastes containing the reported toxic chemical for the purposes of waste treatment, disposal, recycling, or energy recovery. Also estimate the quantity of the reported toxic chemical transferred and the basis upon which the estimate was made. If appropriate, you must report multiple activities (up to four) for each off-site location. For example, if your facility sends a reported toxic chemical in wastes to an

off-site location where some of the toxic chemical is to be recycled while the remainder of the quantity transferred is to be treated, you must report both the waste treatment and recycle activities, along with the quantity associated with each activity.

If you do not ship or transfer wastes containing the reported toxic chemical to other off-site locations, enter not applicable, NA, in the box for the off-site location's EPA Identification Number in Section 6.2. The EPA Identification Number (defined in 40 CFR 260.10 and therefore commonly referred to as the RCRA ID Number) may be found on the Uniform Hazardous Waste Manifest, which is required by RCRA regulations. If you ship or transfer wastes containing a toxic chemical and the off-site location does not have an EPA Identification Number (e.g., it does not accept RCRA hazardous wastes or the wastes in question are not classified as hazardous), enter NA in the box for the off-site location EPA Identification Number. If you ship or transfer the reported toxic chemical in wastes to another country, enter the Federal Information Processing Standards (FIPS) code for that country in the country field of the address for the off-site facility. The most commonly used FIPS codes are listed below.

The following is an abridged list of countries to which a U.S. facility might ship a listed toxic chemical. For a complete listing of FIPS codes, consult your local library.

Country	Code
Argentina	AR
Belgium	BE
Bolivia	BL
Brazil	BR
Canada	CA
Chile	CI
Columbia	CO
Costa Rica	CS
Cuba	CU
Ecuador	EC
El Salvador	ES
France	FR
Guatemala	GT
Honduras	HO
Ireland	EI
Italy	IT
Mexico	MX
Nicaragua	NU
Panama	PM
Paraguay	PA
Peru	PE

Country	Code
Portugal	PO
Puerto Rico	RQ
Spain	SP
Switzerland	SZ
United Kingdom	UK
Uruguay	UY
Venezuela	VE

You must distinguish between incineration, which is always considered waste treatment, and combustion where energy is actually recovered. When the reported toxic chemical has a significant heat of combustion value, and is transferred to an off-site location for combustion in an industrial kiln, furnace, or boiler, report the quantity as used for the purposes of energy recovery. However, toxic chemicals with little or no heat of combustion value (e.g., metals, chlorofluorocarbons) must be reported as treated.

6.2 column A Total Transfers

For each off-site location, enter the total amount, in pounds, of the toxic chemical that is contained in the waste transferred to that location. Do not enter the total poundage of the waste. If the total amount transferred is less than 1,000 pounds, you may report a range by entering the appropriate range code. The following reporting range codes are to be used:

Code	Reporting Range (in pounds)
A	1-10
B	11-499
C	500-999

If you transfer the toxic chemical in wastes to an off-site facility for distinct and multiple purposes, you must report those activities (up to four) for each off-site location, along with the quantity of the reported toxic chemical associated with each activity. For example, your facility transfers a total of 15,000 pounds of toluene to an off-site location that will use 5,000 pounds for the purposes of energy recovery, enter 7,500 pounds into a recovery process, and dispose of the remaining 2,500 pounds. These quantities and the associated activity codes must be reported separately in Section 6.2. (See Figure 4 for a hypothetical Section 6.2 completed for two off-site locations, one of which receives the transfer of 15,000 pounds of toluene as detailed.) If more than four activities are performed on distinct quantities at the off-site location, list the predominant four activities but still report all quantities sent to the off-site location.

Do not double or multiple count amounts transferred off-site. For example, when a reported toxic chemical is sent to an off-site facility for sequential activities and the specific quantities associated with each activity are unknown, report only a single quantity (the total quantity transferred to the off-site location) along with a single activity code. In such a case, report the activity applied to the majority of the reported toxic chemical sent off-site, not the ultimate disposition of the toxic chemical. For example, when a toxic chemical is first treated and then recovered with the majority of the toxic chemical being treated and only a fraction subsequently recovered, report the appropriate waste treatment activity along with the quantity.

6.2 column B Basis of Estimate

You must identify the basis for your estimates of the quantities of the reported toxic chemical in wastes transferred to each off-site location. Enter one of the following letter codes that applies to the method by which the largest percentage of the estimate was derived.

- M - Estimate is based on monitoring data or measurements for the toxic chemical as transferred to an off-site facility.
- C - Estimate is based on mass balance calculations, such as calculation of the amount of the toxic chemical in wastes entering and leaving process equipment.
- E - Estimate is based on published emission factors, such as those relating release quantity to throughput or equipment type (e.g., air emission factors).
- O - Estimate is based on other approaches such as engineering calculations (e.g., estimating volatilization using published mathematical formulas) or best engineering judgment. This would include applying an estimated removal efficiency to a treatment, even if the composition of the waste before treatment was fully identified through monitoring data.

6.2 column C Type of Waste Treatment/Disposal/Recycling/Energy Recovery

Enter one of the following codes to identify the type of waste treatment, disposal, recycling or energy recovery methods used by the off-site location for the reported toxic chemical. You must use more than one line and

Figure 4
Hypothetical Section 6.2 Completed for Two Off-site Locations

SECTION 6.2 TRANSFERS TO OTHER OFF-SITE LOCATIONS			
6.2.1 Off-site EPA Identification Number (RCRA ID No.)		COD 5666162461	
Off-Site Location Name Acme Waste Services			
Street Address 5 Market Street			
City Releaseville		County Hill	
State CO	Zip Code 80461	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. 5,000	1. O	1. M 56	
2. 7,500	2. C	2. M 20	
3. 2,500	3. O	3. M 72	
4. NA	4.	4. M	

This off-site location receives a transfer of 15,000 pounds of toluene (as discussed earlier) and will combust 5,000 pounds for the purposes of energy recovery, enter 7,500 pounds into a recovery process, and dispose of the remaining 2,500 pounds.

SECTION 6.2 TRANSFERS TO OTHER OFF-SITE LOCATIONS			
6.2.2 Off-site EPA Identification Number (RCRA ID No.)		COD 61772543	
Off-Site Location Name Combustion, Inc.			
Street Address 25 Facility Road			
City Dumfry		County Burns	
State CO	Zip Code 80500	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. 12,500	1. O	1. M 54	
2. NA	2.	2. M	
3.	3.	3. M	
4.	4.	4. M	

This off-site location receives a transfer of 12,500 pounds of tetrachloroethylene (perchloroethylene) that is part of a waste that is combusted for the purposes of energy recovery in an industrial furnace. Note that the perchloroethylene is reported using code M54 to indicate that it is combusted in an energy recovery unit but it does not contribute to the heating value of the waste.

code for a single location when distinct quantities of the reported toxic chemical are subject to different waste treatment, disposal, recycling, or energy recovery methods. You may have this information in your copy of EPA Form SO, Item S of the Annual/Biennial Hazardous Waste Treatment, Storage, and Disposal Report (RCRA), or in your invoices from the waste service(s) or broker(s) receiving your wastes for the purposes of waste treatment, disposal, recycling, or energy recovery.

You must distinguish between incineration, which is waste treatment, and legitimate energy recovery. In order for you to claim that a reported toxic chemical sent off-site is used for the purposes of energy recovery and not for waste treatment, the toxic chemical must have a heating value high enough to sustain combustion and must be combusted in an energy recovery unit such as an industrial boiler, furnace, or kiln. In a situation where the reported toxic chemical is in a waste that is combusted in an energy recovery unit, but the toxic chemical does not have a heating value high enough to sustain combustion, use code M54, Incineration/Insignificant Fuel Value, to indicate that the toxic chemical was incinerated in an energy recovery unit but did not contribute to the heating value of the waste (see Figure 4 for an example).

Applicable codes for Part II, Section 6.2, column C are:

Disposal

M10	Storage Only
M71	Underground Injection
M72	Landfill/Disposal Surface Impoundment
M73	Land Treatment
M79	Other Land Disposal
M94	Transfer to Waste Broker—Disposal

Recycling

M20	Solvents/Organics Recovery
M24	Metals Recovery
M26	Other Reuse or Recovery
M28	Acid Regeneration
M93	Transfer to Waste Broker—Recycling

Waste Treatment

M40	Solidification/Stabilization
M50	Incineration/Thermal Treatment
M54	Incineration/Insignificant Fuel Value
M61	Wastewater Treatment (Excluding POTW)
M69	Other Waste Treatment
M95	Transfer to Waste Broker—Waste Treatment

Energy Recovery

M56	Energy Recovery
M92	Transfer to Waste Broker—Energy Recovery

Section 7 On-Site Waste Treatment, Energy Recovery and Recycling Methods

You must report in this section the methods of waste treatment, energy recovery, and recycling applied to the reported toxic chemical in wastes on-site. There are three separate sections for reporting such activities.

Section 7A On-Site Waste Treatment Methods and Efficiency

In Section 7A, you must provide the following information if you treat the reported toxic chemical on-site:

- the general waste stream types containing the toxic chemical being reported;
- the waste treatment method(s) or sequence used on all waste streams containing the toxic chemical;
- the range of concentration of the toxic chemical in the influent to the waste treatment method;
- the efficiency of each waste treatment method or waste treatment sequence in removing the toxic chemical; and
- whether the waste treatment efficiency figure was based on actual operating data.

Use a separate line in Section 7A for each general waste stream type. Report only information about treatment of waste streams at your facility, not information about off-site waste treatment.

If you do not perform on-site treatment of waste streams containing the reported toxic chemical, check the Not Applicable (NA) box at the top of Section 7A.

7A column a General Waste Stream

For each waste treatment method, indicate the type of waste stream containing the toxic chemical that is treated. Enter the letter code that corresponds to the general waste stream type:

A	Gaseous (gases, vapors, airborne particulates)
W	Wastewater (aqueous waste)
L	Liquid waste streams (non-aqueous waste)
S	Solid waste streams (including sludges and slurries)

If a waste is a mixture of water and organic liquid and the organic content is less than 50 percent, report it as a wastewater (W). Slurries and sludges containing water must be reported as solid waste if they contain appreciable amounts of dissolved solids, or solids that may settle, such that the viscosity or density of the waste is considerably different from that of process wastewater.

7A column b Waste Treatment Method(s) Sequence

Enter the appropriate code from the list below for each on-site waste treatment method used on a waste stream containing the toxic chemical, regardless of whether the waste treatment method actually removes the specific toxic chemical being reported. Waste treatment methods must be reported for each type of waste stream being treated (i.e., gaseous waste streams, aqueous waste streams, liquid non-aqueous waste streams, and solids). Except for the air emission treatment codes, the waste treatment codes are not restricted to any medium.

Waste streams containing the toxic chemical may have a single source or may be aggregates of many sources. For example, process water from several pieces of equipment at your facility may be combined prior to waste treatment. Report waste treatment methods that apply to the aggregate waste stream, as well as waste treatment methods that apply to individual waste streams. If your facility treats various wastewater streams containing the toxic chemical in different ways, the different waste treatment methods must be listed separately.

If your facility has several pieces of equipment performing a similar service in a waste treatment sequence, you may combine the reporting for such equipment. It is not necessary to enter four codes to cover four scrubber units, for example, if all four are treating waste streams of similar character (e.g., sulfuric acid mist emissions), have similar influent concentrations, and have similar removal efficiencies. If, however, any of these parameters differs from one unit to the next, each scrubber must be listed separately.

If your facility performs more than eight sequential waste treatment methods on a single general waste stream, continue listing the methods in the next row and renumber appropriately those waste treatment method code boxes you used to continue the sequence. For example, if the general waste stream in box 7A.1a had nine treatment methods applied to it, the ninth method would be indicated in the first method box for row 7A.2a. The numeral "1" would be crossed out, and a "9" would be inserted.

Treatment applied to any other general waste stream types would then be listed in the next empty row. In the scenario above, for instance, the second general waste stream would be reported in row 7A.3a. See Figure 5 below for an example of a hypothetical Section 7A completed for a nine-step waste treatment process and a single waste treatment method.

If you need additional space to report under Section 7A, photocopy page 7 of Form R as many times as necessary. At the bottom of page 7 you will find instructions for indicating the total number of page 7s that you are submitting as part of Form R, as well as instructions for indicating the sequence of those pages.

Waste Treatment Codes

Air Emissions Treatment (applicable to gaseous waste streams only)

- A01 Flare
- A02 Condenser
- A03 Scrubber
- A04 Absorber
- A05 Electrostatic Precipitator
- A06 Mechanical Separation
- A07 Other Air Emission Treatment

Biological Treatment

- B11 Biological Treatment — Aerobic
- B21 Biological Treatment — Anaerobic
- B31 Biological Treatment — Facultative
- B99 Biological Treatment — Other

Chemical Treatment

- C01 Chemical Precipitation — Lime or Sodium Hydroxide
- C02 Chemical Precipitation — Sulfide
- C09 Chemical Precipitation — Other
- C11 Neutralization
- C21 Chromium Reduction
- C31 Complexed Metals Treatment (other than pH Adjustment)
- C41 Cyanide Oxidation — Alkaline Chlorination
- C42 Cyanide Oxidation — Electrochemical
- C43 Cyanide Oxidation — Other
- C44 General Oxidation (including Disinfection) — Chlorination
- C45 General Oxidation (including Disinfection) — Ozonation

Figure 5
Hypothetical Section 7A

SECTION 7A. ON-SITE WASTE TREATMENT METHODS AND EFFICIENCY										
☐ Not Applicable (NA) - Check here if <u>no</u> 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	P12	2	P18	7A.1c	7A.1d	7A.1e		
W	3	P17	4	P61	5	P42	A	%	Yes	No
	6	P21	7	B21	8	P11			☐	☐
7A.2a	7A.2b	9	C44	2		7A.2c	7A.2d	7A.2e		
	3		4		5		99 %	Yes	No	
	6		7		8			☒	☐	
7A.3a	7A.3b	1	A01	2		7A.3c	7A.3d	7A.3e		
A	3		4		5	A	91 %	Yes	No	
	6		7		8			☒	☐	

C46 General Oxidation (including Disinfection) —
Other

C99 Other Chemical Treatment

Incineration/Thermal Treatment

F01 Liquid Injection
F11 Rotary Kiln with Liquid Injection Unit
F19 Other Rotary Kiln
F31 Two Stage
F41 Fixed Hearth
F42 Multiple Hearth
F51 Fluidized Bed
F61 Infra-Red
F71 Fume/Vapor
F81 Pyrolytic Destructor
F82 Wet Air Oxidation
F83 Thermal Drying/Dewatering
F99 Other Incineration/Thermal Treatment

Physical Treatment

P01 Equalization
P09 Other Blending
P11 Settling/Clarification
P12 Filtration
P13 Sludge Dewatering (non-thermal)
P14 Air Flotation
P15 Oil Skimming
P16 Emulsion Breaking — Thermal
P17 Emulsion Breaking — Chemical
P18 Emulsion Breaking — Other
P19 Other Liquid Phase Separation
P21 Adsorption — Carbon
P22 Adsorption — Ion Exchange (other than for recovery/reuse)
P23 Adsorption — Resin
P29 Adsorption — Other
P31 Reverse Osmosis (other than for recovery/reuse)
P41 Stripping — Air
P42 Stripping — Steam
P49 Stripping — Other
P51 Acid Leaching (other than for recovery/reuse)
P61 Solvent Extraction (other than recovery/reuse)
P99 Other Physical Treatment

Solidification/Stabilization

G01 Cement Processes (including Silicates)
G09 Other Pozzolonic Processes (including Silicates)
G11 Asphaltic Processes
G21 Thermoplastic Techniques
G99 Other Solidification Processes

7A column c Range of Influent Concentration

The form requires an indication of the range of concentration of the toxic chemical in the waste stream (i.e., the influent) as it typically enters the waste treatment step or sequence. The concentration is based on the amount or mass of the toxic chemical in the waste stream as compared to the total amount or mass of the waste stream. Enter in the space provided one of the following code numbers corresponding to the concentration of the toxic chemical in the influent:

- 1 = Greater than 1 percent
- 2 = 100 parts per million (0.01 percent) to 1 percent (10,000 parts per million)
- 3 = 1 part per million to 100 parts per million
- 4 = 1 part per billion to 1 part per million
- 5 = Less than 1 part per billion

Note: Parts per million (ppm) is:

- o milligrams/kilogram (mass/mass) for solids and liquids;
- o cubic centimeters/cubic meter (volume/volume) for gases;
- o milligrams/liter for solutions or dispersions of the chemical in water; and
- o milligrams of chemical/kilogram of air for particulates in air.

If you have particulate concentrations (at standard temperature and pressure) as grains/cubic foot of air, multiply by 1766.6 to convert to parts per million; if in milligrams/cubic meter, multiply by 0.773 to obtain parts per million. These conversion factors are for standard conditions of 0°C (32°F) and 760 mmHg atmospheric pressure.

7A column d Waste Treatment Efficiency Estimate

In the space provided, enter the number indicating the percentage of the toxic chemical removed from the waste stream through destruction, biological degradation, chemical conversion, or physical removal. The waste treatment efficiency (expressed as percent removal) represents the percentage of the toxic chemical destroyed or removed (based on amount or mass), not merely changes in volume or concentration of the toxic chemical in the waste stream. The efficiency, which can reflect the overall removal from sequential treatment methods applied to the general waste stream, refers only to the percent destruction, degradation, conversion, or removal of the listed toxic chemical from the waste stream, not the percent conversion or removal of other constituents in the waste stream. The efficiency also does not refer to the general efficiency of the treatment method for any waste stream. For some waste treatment methods, the percent removal will represent removal by several mechanisms, as in an aeration basin, where a toxic chemical may evaporate, be biodegraded, or be physically removed from the sludge.

Percent removal can be calculated as follows:

$$\frac{(I - E)}{I} \times 100, \text{ where}$$

I = amount of the toxic chemical in the influent waste stream (entering the waste treatment step or sequence) and

E = amount of the toxic chemical in the effluent waste stream (exiting the waste treatment step or sequence).

Calculate the amount of the toxic chemical in the influent waste stream by multiplying the concentration (by weight) of the toxic chemical in the waste stream by the total amount or weight of the waste stream. In most cases, the percent removal compares the treated effluent to the influent for the particular type of waste stream. For solidification of wastewater, the waste treatment efficiency can be reported as 100 percent if no volatile toxic chemicals were removed with the water or evaporated into the air. Percent removal does not apply to incineration because the waste stream, such as wastewater or liquids, may not exist in a comparable form after waste treatment and the purpose of incineration as a waste treatment is to destroy the toxic chemical by converting it to carbon dioxide and water. In cases where the toxic chemical is incinerated, the percent efficiency must be based on the amount of the toxic chemical destroyed or

combusted, except for metals or metal compounds. In the cases where a metal or metal compound is incinerated, the efficiency is always zero for the parent metal.

Similarly, an efficiency of zero must be reported for any waste treatment method(s) (e.g., evaporation) that does not destroy, chemically convert, or physically remove the toxic chemical from the waste stream.

For metal compounds, the calculation of the reportable concentration and waste treatment efficiency must be based on the weight of the parent metal, not on the weight of the metal compounds. Metals are not destroyed, only physically removed or chemically converted from one form into another. The waste treatment efficiency reported must represent only physical removal of the parent metal from the waste stream (except for incineration), not the percent chemical conversion of the metal compound. If a listed waste treatment method converts but does not remove a metal (e.g., chromium reduction), the method must be reported with a waste treatment efficiency of zero.

Listed toxic chemicals that are strong mineral acids neutralized to a pH of 6 or above are considered treated at a 100 percent efficiency.

All data available at your facility must be used to calculate waste treatment efficiency and influent toxic chemical concentration. If data are lacking, estimates must be made using best engineering judgment or other methods.

7A column e Based on Operating Data?

This column requires you to indicate "Yes" or "No" to whether the waste treatment efficiency estimate is based on actual operating data. For example, you would check "Yes" if the estimate is based on monitoring of influent and effluent wastes under typical operating conditions.

If the efficiency estimate is based on published data for similar processes or on equipment supplier's literature, or if you otherwise estimated either the influent or effluent waste comparison or the flow rate, check "No."

Section 7B On-Site Energy Recovery Processes

In Section 7B, you must indicate the on-site energy recovery methods used on the reported toxic chemical. If you do not perform on-site energy recovery for the reported toxic chemical, check the Not Applicable (NA) box at the top of Section 7B.

Example 11: Reporting On-Site Energy Recovery

One waste stream generated by your facility contains, among other chemicals, toluene and cadmium. Threshold quantities are exceeded for both of these toxic chemicals, and you would, therefore, submit two separate Form R reports. This waste stream is sent to an on-site industrial furnace which uses the heat generated in a thermal hydrocarbon cracking process at your facility. Because toluene has a significant heat value (17,440 BTU/pound) and the energy is recovered in an industrial furnace, the code "U02" would be reported in Section 7B for the Form R submitted for toluene.

However, as cadmium is a non-combustible metal and therefore does not contribute any heat value for energy recovery purposes, the combustion of cadmium in the industrial furnace is considered waste treatment, not energy recovery. You would report cadmium as entering a waste treatment step (i.e., incineration), in Section 7A, column b.

Only listed toxic chemicals that have a significant heating value and are combusted in an energy recovery unit such as an industrial furnace, kiln, or boiler, can be reported as combusted for energy recovery in this section. If a reported toxic chemical is incinerated on-site but does not contribute energy to the process (e.g., metals and chlorofluorocarbons), it must be considered waste treated on-site and reported in Section 7A. Energy recovery may take place only in one of the types of energy recovery equipment listed below.

Energy Recovery Codes

- U01 Industrial Kiln
- U02 Industrial Furnace
- U03 Industrial Boiler
- U09 Other Energy Recovery Methods

If your facility uses more than one on-site energy recovery method for the reported toxic chemical, list the methods used in descending order (greatest to least) based on the amount of the toxic chemical entering such methods.

Section 7C On-Site Recycling Processes

In Section 7C, you must report the recycling methods used on the listed toxic chemical. If you do not conduct any on-site recycling of the reported toxic chemical, check the Not Applicable (NA) box at the top of Section 7C.

In this section, use the codes below to report only the recycling methods in place at your facility that are applied to the listed toxic chemical. Do not list any off-site recycling activities (Information about off-site recycling must be reported in Part II, Section 6, "Transfers of the Toxic Chemical in Wastes to Off-Site Locations,").

On-Site Recycling Codes

- R11 Solvents/Organics Recovery — Batch Still Distillation
- R12 Solvents/Organics Recovery — Thin-Film Evaporation
- R13 Solvents/Organics Recovery — Fractionation
- R14 Solvents/Organics Recovery — Solvent Extraction
- R19 Solvents/Organics Recovery — Other
- R21 Metals Recovery — Electrolytic
- R22 Metals Recovery — Ion Exchange
- R23 Metals Recovery — Acid Leaching
- R24 Metals Recovery — Reverse Osmosis
- R26 Metals Recovery — Solvent Extraction
- R27 Metals Recovery — High Temperature
- R28 Metals Recovery — Retorting
- R29 Metals Recovery — Secondary Smelting
- R30 Metals Recovery — Other
- R40 Acid Regeneration
- R99 Other Reuse or Recovery

If your facility uses more than one on-site recycling method for a toxic chemical, enter the codes in the space provided in descending order (greatest to least) of the volume of the reported toxic chemical recovered by each process. If your facility uses more than ten separate methods for recycling the reported toxic chemical on-site, then list the ten activities that recover the greatest amount of the toxic chemical (again, in descending order).

Section 8 Source Reduction and Recycling Activities

This Section includes the new data elements mandated by section 6607 of the Pollution Prevention Act of 1990 (PPA). Section 8 is now a required section of Form R and must be completed. This is the first reporting year these data are being collected. They are included in the Form R for reports due on or before July 1, 1992, covering source reduction and recycling activities in calendar year 1991. You are not required to amend previous year's submissions to include this information.

In Section 8, you must provide information about source reduction and recycling activities related to the toxic chemical for which releases are being reported. For all appropriate questions, report only the quantity, in pounds, of the reported toxic chemical. Do not include the weight of water, soil, or other waste constituents. When reporting on a metal compound, report only the amount of the parent metal as you do when estimating release amounts. All amounts must be reported in whole numbers and up to two significant figures can be provided.

Section 8.1 through 8.9 must be completed for each toxic chemical. Section 8.10 must be completed only if a source reduction activity was newly implemented specifically (in whole or in part) for the reported toxic chemical during the reporting year. Section 8.11 allows you to indicate if you have attached additional optional information on source reduction, recycling, or pollution control activities implemented at any time at your facility.

Sections 8.1 through 8.7 require reporting of quantities for the current reporting year, the prior year, and quantities anticipated in both the first year immediately following the reporting year and the second year following the reporting year (future estimates).

Column A: 1990 (Prior Year)

Quantities for Sections 8.1 through 8.7 must be reported for the year immediately preceding the reporting year in column A. For reports due July 1, 1992, the prior year is 1990. Information available at the facility that may be used to estimate the prior year's quantities include the prior year's Form R submission, supporting documentation, and recycling, energy recovery, or treatment operating logs or invoices.

EPA believes that such data should be available, especially in those cases where the facility has filed a Form R for the reported toxic chemical in the prior year. However, for the first year of reporting these data elements, 1991, prior year quantities are required only to the extent such information is available. In the event that sufficient data are not available, enter not applicable, "NA."

Column B: 1991 (Reporting Year)

Quantities for Sections 8.1 through 8.7 must be reported for the current reporting year in column B.

Columns C and D: 1992 and 1993 (Following Year and Second Year)

Quantities for Sections 8.1 through 8.7 must be estimated for 1992 and 1993. EPA expects reasonable future quantity estimates using a logical basis. Information available at the facility to estimate quantities of the chemical expected during these years include planned source reduction activities, market projections, expected contracts, anticipated new product lines, company growth projections, and production capacity figures. Not applicable, "NA", may not be entered for these data elements. Respondents should take into account protections available for trade secrets as provided in EPCRA Section 322 (42 USC 11042).

Example 12: Reporting Future Estimates

A pharmaceutical manufacturing facility uses a listed toxic chemical in the manufacture of a prescription drug. During the reporting year (1991), the company received approval from the Food and Drug Administration to begin marketing their product as an over-the-counter drug beginning in 1992. This approval is publicly known and does not constitute confidential business information. As a result of this expanded market, the company estimates that sales and subsequent production of this drug will increase their use of the reported toxic chemical by 30 percent per year for the two years following the reporting year. The facility treats the toxic chemical on-site and the quantity treated is directly proportional to production activity. The facility thus estimates the total quantity of the reported toxic chemical treated for the following year (1992) by adding 30 percent to the amount in column B (the amount for the current reporting year). The second year (1993) figure can be calculated by adding an additional 30 percent to the amount reported in Column C (the amount for the following year (1992) projection).

Relationship to Other Laws

The reporting categories for quantities recycled, treated, used for energy recovery, and disposed apply to completing Section 8 of Form R as well as to the rest of Form R. These categories are to be used only for TRI reporting. They are not intended for use in determining, under the Resource Conservation and Recovery Act (RCRA) Subtitle C regulations, whether a secondary material is a waste when recycled. These definitions also do not apply to the information that may be submitted in the Biennial Report required under RCRA. In addition, these definitions do not imply any future redefinition of RCRA terms and do not affect EPA's RCRA authority or authority under any other statute administered by EPA.

Differences in terminology and reporting requirements for toxic chemicals reported on Form R and for hazardous wastes regulated under RCRA occur because EPCRA and the PPA focus on specific chemicals, while the RCRA regulations and the Biennial Report focus on wastes, including mixtures. For example, a RCRA hazardous waste containing a section 313 toxic chemical is recycled to recover certain constituents of that waste, but not the toxic chemical reported under EPCRA section 313. The toxic chemical simply passes through the recycling process and remains in the residual from the recycling process. While the waste may be considered recycled under RCRA, the toxic chemical constituent would be considered to be treated for TRI purposes.

Quantities Reportable in Sections 8.1 - 8.7

8.1 Report releases pursuant to EPCRA Section 329(8) including "any spilling, leaking, pumping, pouring, emitting, emptying, discharging, injecting, escaping, leaching, dumping, or disposing [on-site or off-site] into the environment (including the abandonment of barrels, containers, and other closed receptacles)." Do not include any quantity treated on-site or off-site.

8.2 - 8.3 A toxic chemical or a mixture containing a toxic chemical that is used for energy recovery on-site or is sent off-site for energy recovery, unless it is a commercially available fuel. For the purposes of reporting on Form R, reportable on-site and off-site energy recovery is the combustion of a residual material containing a TRI toxic chemical when:

- (a) The combustion unit is integrated into an energy recovery system (i.e., industrial furnaces, industrial kilns, and boilers); and

- (b) The toxic chemical is combustible and has a heating value high enough to sustain combustion.

8.4 - 8.5 A toxic chemical or a mixture containing a toxic chemical that is recycled on-site or is sent off-site for recycling.

8.6 - 8.7 A toxic chemical or a mixture containing a toxic chemical that is treated on-site or is sent to a POTW or other off-site location for waste treatment.

A toxic chemical or a mixture identified as a waste under RCRA must be reported in Sections 8.1 through 8.7.

Avoid Double-Counting in Sections 8.1 Through 8.8

Section 8 of Form R uses data collected to complete Part II, Sections 5 through 7. For this reason, Section 8 should be completed last.

Do not double- or multiple-count quantities in Sections 8.1 through 8.7. The quantities reported in each of those sections must be mutually exclusive. Do not multiple-count quantities entering sequential reportable activities. For example, 5,000 pounds of toxic chemical enters a treatment operation. Three thousand pounds of the toxic chemical exits the treatment operation and then enters a recycling operation. Five hundred pounds of the toxic chemical is in residues from the recycling operation which is subsequently sent off-site for disposal. These quantities would be reported as follows in Section 8:

Section 8.1:	500 pounds disposed
Section 8.4:	2,500 pounds recycled
Section 8.6:	2,000 pounds treated (5,000 that initially entered - 3,000 that subsequently entered recycling)

To report that 5,000 pounds were treated, 3,000 pounds were recycled, and that 500 pounds were sent off-site for disposal would result in over-counting the quantities of toxic chemical recycled, treated, and disposed by 3,500 pounds.

Do not include in Sections 8.1 through 8.7 any quantities of the toxic chemical released into the environment due to remedial actions; catastrophic events such as earthquakes, fires, or floods; or unanticipated one-time events not associated with the production process such as tank ruptures or reactor explosions. These quantities should be reported in Section 8.8 only. For example, 10,000 pounds of diaminoaniline sulfate is released due to a catastrophic event and is subsequently treated on-site.

The 10,000 pounds is reported in Section 8.8, but the amount subsequently treated on-site is not reported in Section 8.6.

8.8 Quantity Released to the Environment as a Result of Remedial Actions, Catastrophic Events, or One-Time Events Not Associated with Production Processes.

In Section 8.8, enter the total quantity of toxic chemical released directly into the environment or sent off-site for recycling, waste treatment, energy recovery, or disposal during the reporting year due to any of the following events:

- (1) remedial actions,
- (2) catastrophic events such as earthquakes, fires, or floods; or
- (3) one-time events not associated with normal or routine production processes.

These quantities should not be included in Sections 8.1 through 8.7. The amount of toxic chemical released into the environment during remediation or transferred off-site is to be reported in Part II, Sections 5 and 6 as appropriate.

The purpose of this section is to separate quantities recycled, used for energy recovery, treated, or disposed that are associated with normal or routine production operations from those that are not. While all quantities released, recycled, treated, or disposed may ultimately be preventable, this section separates the quantities that

are more likely to be reduced or eliminated by process-oriented source reduction activities from those releases that are largely unpredictable and are less amenable to such source reduction activities. For example, spills that occur as a routine part of production operations and could be reduced or eliminated by improved handling, loading, or unloading procedures are included in the quantities reported in Section 8.1 through 8.7 as appropriate. A total loss of containment resulting from a tank rupture caused by a tornado would be included in the quantity reported in Section 8.8.

Similarly, the amount of a toxic chemical spilled or cleaned up from normal operations during the reporting year would be included in the quantities reported in Sections 8.1 through 8.7. However, the quantity of the reported toxic chemical generated from a remedial action (e.g., RCRA corrective action) to clean up the environmental contamination resulting from past practices should be reported in Section 8.8 because they cannot currently be addressed by source reduction methods. A remedial action for purposes of Section 8.8 is a waste cleanup (including RCRA and CERCLA operations) within the facility boundary. Most remedial activities involve collecting and treating contaminated material.

Also, releases caused by catastrophic events are to be incorporated into the quantity reported in Section 8.8. Such releases may be caused by natural disasters (e.g., hurricanes and earthquakes) or by large scale accidents (e.g., fires and explosions). These amounts are not included in the quantity reported in Sections 8.1 through 8.7 because such releases are generally unanticipated and

Example 13: Quantity Released to the Environment as a Result of Remedial Actions, Catastrophic Events, or One-Time Events Not Associated with Production Processes.

A chemical manufacturer produces a toxic chemical in a reactor that operates at low pressure. The reactants and the toxic chemical product are piped in and out of the reactor at monitored and controlled temperatures. During normal operations, small amounts of fugitive emissions occur from the valves and flanges in the pipelines.

Due to a malfunction in the control panel (which is state-of-the-art and undergoes routine inspection and maintenance), the temperature and pressure in the reactor increase, the reactor ruptures, and the toxic chemical is released. Because the malfunction could not be anticipated and, therefore, could not be reasonably addressed by specific source reduction activities, the amount released is included in Section 8.8. In this case, much of the toxic chemical is released as a liquid and pools on the ground. It is estimated that 1,000 pounds of the toxic chemical pooled on the ground and was subsequently collected and sent off-site for treatment. In addition, it is estimated that another 200 pounds of the toxic chemical vaporized directly to the air from the rupture. The total amount reported in Section 8.8 is the 1,000 pounds that pooled on the ground (and subsequently sent off-site), plus the 200 pounds that vaporized into the air, a total of 1,200 pounds. The quantity sent off-site must also be reported in Section 6 (but not in Section 8.7) and the quantity that vaporized must be reported as a fugitive emission in Section 5 (but not in Section 8.1).

cannot be addressed by routine process-oriented accident prevention techniques.

By checking your documentation for calculating estimates made for Part II, Section 5, "Releases of the Toxic Chemical to the Environment," you may be able to identify release amounts from the above sources. Emergency notifications under CERCLA and EPCRA as well as accident histories required under the Clean Air Act may provide useful information. You should also check facility incident reports and maintenance records to identify one-time or catastrophic events.

Note that while the information reported in Section 8.8 represents only remedial, catastrophic, or one-time events not associated with production processes, Section 5 of Form R (releases to the environment) and Section 6 (off-site transfers), must include all releases and transfers as appropriate, regardless of whether they arise from catastrophic, remedial, or routine process operations.

8.9 Production Ratio or Activity Index

For Section 8.9, you must provide a ratio of reporting year production to prior year production, or provide an "activity index" based on a variable other than production that is the primary influence on the quantity of the reported toxic chemical recycled, used for energy recovery, treated, or disposed. The ratio or index must be reported to the nearest tenths or hundredths place (e.g., one or two digits to the right of the decimal point). If the manufacture or use of the reported toxic chemical began during the current reporting year, enter not applicable, "NA," as the production ratio or activity index.

It is important to realize that if your facility reports more than one reported toxic chemical, the production ratio or activity index may vary for different chemicals. For facilities that manufacture reported toxic chemicals, the quantities of the toxic chemical(s) produced in the current and prior years provide a good basis for the ratio because that is the primary business activity associated with the reported toxic chemical(s). In most cases, the production ratio or activity index must be based on some variable of production or activity rather than on toxic

Example 14: Determining a Production Ratio

Your facility's only use of toluene is as a paint carrier for a painting operation. You painted 12,000 refrigerators in the current reporting year and 10,000 refrigerators during the preceding year. The production ratio for toluene in this case is 1.2 (12,000/10,000) because the number of refrigerators produced is the primary factor determining the quantity of toluene to be reported in Sections 8.1 through 8.7.

A facility manufactures inorganic pigments, including titanium dioxide. Hydrochloric acid is produced as a waste byproduct during the production process. An appropriate production ratio for hydrochloric acid is the annual titanium dioxide production, not the amount of byproduct generated. If the facility produced 20,000 pounds of titanium dioxide during the reporting year and 26,000 pounds in the preceding year, the production ratio would be 0.77 (20,000/26,000).

chemical or material usage. Indices based on toxic chemical or material usage may reflect the effect of source reduction activities rather than changes in business activity. Toxic chemical or material usage is therefore not a basis to be used for the production ratio or activity index where the toxic chemical is "otherwise-used" (i.e., non-incorporative activities such as extraction solvents, metal degreasers, etc.).

While several methods are available to the facility for determining this data element, the production ratio or activity index must be based on the variable that most directly affects the quantities of the toxic chemical recycled, used for energy recovery, treated, or disposed. Examples of methods available include:

- (1) Amount of toxic chemical manufactured in 1991 divided by the amount of toxic chemical manufactured in 1990; or
- (2) Amount of product produced in 1991 divided by the amount of product produced in 1990.

Example 15: Determining an Activity Index

Your facility manufactures organic dyes in a batch process. Different colors of dyes are manufactured, and between color changes, all equipment must be thoroughly cleaned with solvent containing glycol ethers to reduce color carryover. During the preceding year, the facility produced 2,000 pounds of yellow dye in January, 9,000 pounds of green dye for February through September, 2,000 pounds of red dye in November, and another 2,000 pounds of yellow dye in December. This adds up to a total of 15,000 pounds and four color changeovers. During the reporting year, the facility produced 10,000 pounds of green dye during the first half of the year and 10,000 pounds of red dye in the second half. If your facility uses glycol ethers in this cleaning process only, an activity index of 0.5 (based on two color changeovers for the reporting year divided by four changeovers for the preceding year) is more appropriate than a production ratio of 1.33 (based on 20,000 pounds of dye produced in the current year divided by 15,000 pounds in the preceding year). In this case, an activity index, rather than a production ratio, better reflects the factors that influence the amount of solvent recycled, used for energy recovery, treated, or disposed.

A facility that manufactures thermoplastic composite parts for aircraft uses acetone as a wipe solvent to clean molds. The solvent is stored in 55-gallon drums and is transferred to 1-gallon dispensers. The molds are cleaned on an as-needed basis that is not necessarily a function of the parts production rate. Operators cleaned 5,200 molds during the reporting year, but only cleaned 2,000 molds in the previous year. An activity index of 2.6 ($5,200/2,000$) represents the activities involving acetone usage in the facility. If the molds were cleaned after 1,000 parts were manufactured, a production ratio would equal the activity index and either could be used as the basis for the index.

A facility manufactures surgical instruments and cleans the metal parts with 1,1,1-trichloroethane in a vapor degreaser. The degreasing unit is operated in a batch mode and the metal parts are cleaned according to an irregular schedule. The activity index can be based upon the total time the metal parts are in the degreasing operation. If the degreasing unit operated 3,900 hours during the reporting year and 3,000 hours the prior year, the activity index is 1.3 ($3,900/3,000$).

A pharmaceutical plant uses hydrochloric acid to regenerate deionization units that supply deionized water to several operations in the facility. During the reporting year, the facility noted that the units were recharged once per week. Records for the prior year indicate that the units were recharged four times per week. Provided that the reduction in recharges per week is not part of a planned source reduction program, an index of 0.25 ($1/4$) represents the activities that were the primary influence on the amount of hydrochloric acid recycled, used for energy recovery, treated, or disposed.

Example 16: "NA" is Entered as the Production Ratio or Activity Index

Your facility began production of a microwidget during this reporting year. Perchloroethylene is used as a cleaning solvent for this operation and this is the only use of the toxic chemical in your facility. You would enter not applicable, "NA," in Section 8.9 because you have no basis of comparison in the prior year for the purposes of developing the activity index.

Example 17: Determining the Production Ratio Based on a Weighted Average

At many facilities, a reported toxic chemical is used in more than one production process. In these cases, a production ratio or activity index can be estimated by weighting the production ratio for each process based on the respective contribution of each process to the quantity of the reported toxic chemical recycled, used for energy recovery, treated, or disposed.

Your facility paints bicycles with paint containing toluene. Sixteen thousand bicycles were produced in the reporting year and 14,500 were produced in the prior year. There were no significant design modifications that changed the total surface area to be painted for each bike. The bicycle production ratio is 1.1 (16,000/14,500). You estimate 12,500 pounds of toluene treated, recycled, used for energy recovery, or disposed as a result of bicycle production. Your facility also uses toluene as a solvent in a glue that is used to make components and add-on equipment for the bicycles. Thirteen thousand components were manufactured in the reporting year as compared to 15,000 during the prior year. The production ratio for the components using toluene is 0.87 (13,000/15,000). You estimate 1,000 pounds of toluene treated, recycled, used for energy recovery, or disposed as a result of components production. A production ratio can be calculated by weighting each of the production ratios based on the relative contribution each has to the quantities of toluene treated, recycled, used for energy recovery, or disposed during the reporting year (13,500 pounds). The production ratio is calculated as follows:

$$\text{Production ratio} = (12,500/13,500 \times 1.1) + (1,000/13,500 \times 0.87) = 1.08$$

8.10 Did Your Facility Engage in any Source Reduction Activities for this Chemical during the Reporting Year?

If your facility engaged in any source reduction activity for the reported toxic chemical during the reporting year, report the activity that was implemented and the method used to identify the opportunity for the activity implemented. If your facility did not engage in any source reduction activity for the reported toxic chemical, enter not applicable, "NA," in Section 8.10.1 and answer Section 8.11.

Source reduction means any practice which:

- Reduces the amount of any hazardous substance, pollutant, or contaminant entering any waste stream or otherwise released into the environment (including fugitive emissions) prior to recycling, treatment, or disposal; and
- Reduces the hazards to public health and the environment associated with the release of such substances, pollutants, or contaminants.

The term includes equipment or technology modifications, process or procedure modifications, reformulation or redesign of products, substitution of raw materials, and improvements in housekeeping, maintenance, training, or inventory control.

The term source reduction does not include any practice which alters the physical, chemical, or biological characteristics or the volume of a hazardous substance, pollutant, or contaminant through a process or activity which itself is not integral to and necessary for the production of a product or the providing of a service.

Source reduction activities do not include recycling, treating, using for energy recovery, or disposing of a toxic chemical. Report in this section only the source reduction activities implemented to reduce or eliminate the quantities reported in Sections 8.1 through 8.7—the focus of the section is only those activities that are applied to reduce routine or reasonably anticipated releases and quantities of the reported toxic chemical recycled, treated, used for energy recovery, or disposed. Do not report in this section any activities taken to reduce or eliminate the quantities reported in Section 8.8.

Example 18: Source Reduction

A facility assembles and paints furniture. Both the glue used to assemble the furniture and the paints contain listed toxic chemicals. By examining the gluing process, the facility discovered that a new drum of glue is opened at the beginning of each shift, whether the old drum is empty or not. By adding a mechanism that prevents the drum from being changed before it is empty, the need for disposal of the glue is eliminated at the source. As a result, this activity is considered source reduction. The painting process at this facility generates a solvent waste which is collected and recovered. The recovered solvent is used to clean the painting equipment. The recycling activity does not reduce the amount of toxic chemical recycled, and therefore is not considered a source reduction activity.

Source Reduction Activities

You must enter in the first column of Section 8.10, "Source Reduction Activities," the appropriate code(s) indicating the type of actions taken to reduce the amount of the reported toxic chemical released (as reported in Section 8.1), used for energy recovery (as reported in Section 8.2), recycled (as reported in Section 8.4-8.5), or treated (as reported in Section 8.6-8.7). The list of codes below includes many, but not all, of the codes provided in the RCRA biennial report. Remember that source reduction activities include only those actions or techniques that reduce or eliminate the amounts of the toxic chemical reported in Section 8.1 through 8.7. Actions taken to recycle, treat, or dispose of the toxic chemical are not considered source reduction activities.

Source Reduction Activity Codes:**Good Operating Practices**

- W13 Improved maintenance scheduling, recordkeeping, or procedures
- W14 Changed production schedule to minimize equipment and feedstock changeovers
- W19 Other changes in operating practices

Inventory Control

- W21 Instituted procedures to ensure that materials do not stay in inventory beyond shelf-life
- W22 Began to test outdated material — continue to use if still effective
- W23 Eliminated shelf-life requirements for stable materials
- W24 Instituted better labelling procedures
- W25 Instituted clearinghouse to exchange materials that would otherwise be discarded
- W29 Other changes in inventory control

Spill and Leak Prevention

- W31 Improved storage or stacking procedures
- W32 Improved procedures for loading, unloading, and transfer operations
- W33 Installed overflow alarms or automatic shut-off valves
- W35 Installed vapor recovery systems
- W36 Implemented inspection or monitoring program of potential spill or leak sources
- W39 Other spill and leak prevention

Raw Material Modifications

- W41 Increased purity of raw materials
- W42 Substituted raw materials
- W49 Other raw material modifications

Process Modifications

- W51 Instituted recirculation within a process
- W52 Modified equipment, layout, or piping
- W53 Use of a different process catalyst
- W54 Instituted better controls on operating bulk containers to minimize discarding of empty containers
- W55 Changed from small volume containers to bulk containers to minimize discarding of empty containers
- W58 Other process modifications

Cleaning and Degreasing

- W59 Modified stripping/cleaning equipment
- W60 Changed to mechanical stripping/cleaning devices (from solvents or other materials)
- W61 Changed to aqueous cleaners (from solvents or other materials)

- W63 Modified containment procedures for cleaning units
- W64 Improved draining procedures
- W65 Redesigned parts racks to reduce dragout
- W66 Modified or installed rinse systems
- W67 Improved rinse equipment design
- W68 Improved rinse equipment operation
- W71 Other cleaning and degreasing modifications

Surface Preparation and Finishing

- W72 Modified spray systems or equipment
- W73 Substituted coating materials used
- W74 Improved application techniques
- W75 Changed from spray to other system
- W78 Other surface preparation and finishing modifications

Product Modifications

- W81 Changed product specifications
- W82 Modified design or composition of product
- W83 Modified packaging
- W89 Other product modifications

In columns a through c of Section 8.10, the "Methods to Identify Activity", you must enter one or more of the following code(s) that correspond to those internal and external method(s) or information sources you used to identify the possibility for a source reduction activity implementation at your facility. If more than three methods were used to identify the source reduction activity, enter only the three codes that contributed most to the decision to implement the activity.

Methods to Identify Activity

- T01 Internal pollution prevention opportunity audit(s)
- T02 External pollution prevention opportunity audit(s)
- T03 Materials balance audits
- T04 Participative team management
- T05 Employee recommendation (independent of a formal company program)
- T06 Employee recommendation (under a formal company program)
- T07 State government technical assistance program
- T08 Federal government technical assistance program
- T09 Trade association/industry technical assistance program
- T10 Vendor assistance
- T11 Other

8.11 Is Additional Information on Source Reduction, Recycling, or Pollution Control Activities Included with this Report?

Check "Yes" for this data element if you have attached to this report any additional optional information on source reduction, recycling, or pollution control activities you have implemented in the reporting year or in prior years for the reported toxic chemical. If you are not including additional information, check "No."

If you submit additional optional information, try to limit this information to one page that summarizes the source reduction, recycling, or pollution control activities. If there is a contact person at the facility, other than the technical or public contact provided in Part I, Section 4, the summary page should include that person's name and telephone number for individuals who wish to obtain further information about those activities. Also submit a copy of this additional information to the appropriate state agency as part of the Form R submittal to that agency.

TABLE II. SECTION 313 TOXIC CHEMICAL LIST FOR REPORTING YEAR 1991 (including Toxic Chemical Categories)

Specific toxic chemicals with CAS Number are listed in alphabetical order on this page. A list of the same chemicals in CAS Number order begins at the end of the alphabetical list of toxic chemicals. Covered toxic chemical categories follow.

Certain toxic chemicals listed in Table II have parenthetical "qualifiers." These qualifiers indicate that these toxic chemicals are subject to the section 313 reporting requirements if manufactured, processed, or otherwise used in a specific form. The following chemicals are reportable only if they are manufactured, processed, or otherwise used in the specific form(s) listed below:

<u>Chemical</u>	<u>CAS Number</u>	<u>Qualifier</u>
Aluminum (fume or dust)	7429-90-5	<u>Only</u> if it is in a fume or dust form.
Aluminum oxide (fibrous forms)	1344-28-1	<u>Only</u> if it is a fibrous form.
Ammonium nitrate (solution)	6484-52-2	<u>Only</u> if it is in a solution.
Ammonium sulfate (solution)	7783-20-2	<u>Only</u> if it is in a solution.
Asbestos (friable)	1332-21-4	<u>Only</u> if it is a friable form.
Isopropyl alcohol (manufacturing - strong acid process, no supplier notification)	67-63-0	<u>Only</u> if it is being manufactured by the strong acid process.
Phosphorus (yellow or white)	7723-14-0	<u>Only</u> if it is a yellow or white form.
Saccharin (manufacturing, no supplier notification).	81-07-2	<u>Only</u> if it is being manufactured.
Vanadium (fume or dust)	7440-62-2	<u>Only</u> if it is in a fume or dust form.
Zinc (fume or dust)	7440-66-6	<u>Only</u> if it is in a fume or dust form.

[Note: Chemicals may be added to or deleted from the list. The Emergency Planning and Community Right-to-Know Information Hotline, (800) 535-0202 or (703) 920-9877, will provide up-to-date information on the status of these changes. See Section B.4.b of the instructions for more information on the de minimis values listed below.]

a. Alphabetical Chemical List

			De Minimis		
CAS Number	Toxic Chemical Name	Concentration	CAS Number	Toxic Chemical Name	Concentration
			92-52-4	Biphenyl	1.0
			111-44-4	Bis(2-chloroethyl) ether	1.0
75-07-0	Acetaldehyde	0.1	542-88-1	Bis(chloromethyl) ether	
60-35-5	Acetamide	0.1	0.1108-60-1	Bis(2-chloro-1-methylethyl) ether	1.0
67-64-1	Acetone	1.0			
75-05-8	Acetonitrile	1.0	103-23-1	Bis(2-ethylhexyl) adipate	1.0
53-96-3	2-Acetylaminofluorene	0.1	353-59-3	Bromochlorodifluoromethane (Halon 1211)	1.0
107-02-8	Acrolein	1.0			
79-06-1	Acrylamide	0.1	75-25-2	Bromoform	1.0
79-10-7	Acrylic acid	1.0		(Tribromomethane)	
107-13-1	Acrylonitrile	0.1	74-83-9	Bromomethane	1.0
309-00-2	Aldrin	1.0		(Methyl bromide)	
	(1,4:5,8-Dimethanonaphthalene, 1,2,3,4,10,10-hexachloro-1,4,4a, 5,8,8a-hexahydro-(1.alpha., 4.alpha., 4a.beta., 5.alpha., 8.alpha., 8a.beta.)-)		75-63-8	Bromotrifluoromethane (Halon 1301)	1.0
			106-99-0	1,3-Butadiene	0.1
			141-32-2	Butyl acrylate	1.0
107-18-6	Allyl alcohol	1.0	71-36-3	n-Butyl alcohol	1.0
107-05-1	Allyl chloride	1.0	78-92-2	sec-Butyl alcohol	1.0
7429-90-5	Aluminum (fume or dust)	1.0	75-65-0	tert-Butyl alcohol	1.0
1344-28-1	Aluminum oxide (fibrous forms)	0.1	85-68-7	Butyl benzyl phthalate	1.0
			106-88-7	1,2-Butylene oxide	1.0
117-79-3	2-Aminoanthraquinone	0.1	123-72-8	Butyraldehyde	1.0
60-09-3	4-Aminoazobenzene	0.1	4680-78-8	C.I. Acid Green 3*	1.0
92-67-1	4-Aminobiphenyl	0.1	569-64-2	C.I. Basic Green 4*	1.0
82-28-0	1-Amino-2-methylantraquinone	0.1	989-38-8	C.I. Basic Red 1*	0.1
			1937-37-7	C.I. Direct Black 38*	0.1
			2602-46-2	C.I. Direct Blue 6*	0.1
7664-41-7	Ammonia	1.0	16071-86-6	C.I. Direct Brown 95*	0.1
6484-52-2	Ammonium nitrate (solution)	1.0	2832-40-8	C.I. Disperse Yellow 3*	1.0
7783-20-2	Ammonium sulfate (solution)	1.0	3761-53-3	C.I. Food Red 5*	0.1
62-53-3	Aniline	1.0	81-88-9	C.I. Food Red 15*	0.1
90-04-0	o-Anisidine	0.1	3118-97-6	C.I. Solvent Orange 7*	1.0
104-94-9	p-Anisidine	1.0	97-56-3	C.I. Solvent Yellow 3*	0.1
134-29-2	o-Anisidine hydrochloride	0.1	842-07-9	C.I. Solvent Yellow 14*	0.1
120-12-7	Anthracene	1.0	492-80-8	C.I. Solvent Yellow 34*	0.1
7440-36-0	Antimony	1.0		(Aurimine)	
7440-38-2	Arsenic	0.1	128-66-5	C.I. Vat Yellow 4*	1.0
1332-21-4	Asbestos (friable)	0.1	7440-43-9	Cadmium	0.1
7440-39-3	Barium	1.0	156-62-7	Calcium cyanamide	1.0
98-87-3	Benzal chloride	1.0	133-06-2	Captan	1.0
55-21-0	Benzamide	1.0		[1H-Isoindole-1,3(2H)-dione, 3a,4,7,7a-tetrahydro-2-[(trichloromethyl)thio]-]	
71-43-2	Benzene	0.1			
92-87-5	Benzidine	0.1	63-25-2	Carbaryl	1.0
98-07-7	Benzoic trichloride (Benzotrichloride)	0.1		(1-Naphthalenol, methylcarbamate)	
98-88-4	Benzoyl chloride	1.0			
94-36-0	Benzoyl peroxide	1.0	75-15-0	Carbon disulfide	1.0
100-44-7	Benzyl chloride	1.0	56-23-5	Carbon tetrachloride	0.1
7440-41-7	Beryllium	0.1	463-58-1	Carbonyl sulfide	1.0

CAS Number	Toxic Chemical Name	De Minimis Concentration	CAS Number	Toxic Chemical Name	De Minimis Concentration
120-80-9	Catechol	1.0	615-05-4	2,4-Diaminoanisole	0.1
133-90-4	Chloramben	1.0	39156-41-7	2,4-Diaminoanisole sulfate	0.1
	{Benzoic acid, 3-amino-2,5-dichloro-}		101-80-4	4,4'-Diaminodiphenyl ether	0.1
57-74-9	Chlordane	1.0	25376-45-8	Diaminotoluene (mixed isomers)	0.1
	{4,7-Methanoindan, 1,2,4,5,6,7,8,8-octachloro-2,3,3a,4,7,7a-hexahydro-}		95-80-7	2,4-Diaminotoluene	0.1
7782-50-5	Chlorine	1.0	334-88-3	Diazomethane	1.0
10049-04-4	Chlorine dioxide	1.0	132-64-9	Dibenzofuran	1.0
79-11-8	Chloroacetic acid	1.0	96-12-8	1,2-Dibromo-3-chloropropane (DBCP)	0.1
532-27-4	2-Chloroacetophenone	1.0	106-93-4	1,2-Dibromoethane (Ethylene dibromide)	0.1
108-90-7	Chlorobenzene	1.0	124-73-2	Dibromotetrafluoroethane (Halon 2402)	1.0
510-15-6	Chlorobenzilate	1.0	84-74-2	Dibutyl phthalate	1.0
	{Benzeneacetic acid, 4-chloro- α -(4-chlorophenyl)- α -hydroxy-ethyl ester}		25321-22-6	Dichlorobenzene (mixed isomers)	0.1
75-00-3	Chloroethane (Ethyl chloride)	1.0	95-50-1	1,2-Dichlorobenzene	1.0
67-66-3	Chloroform	0.1	541-73-1	1,3-Dichlorobenzene	1.0
74-87-3	Chloromethane (Methyl chloride)	1.0	106-46-7	1,4-Dichlorobenzene	0.1
107-30-2	Chloromethyl methyl ether	0.1	91-94-1	3,3'-Dichlorobenzidine	0.1
126-99-8	Chloroprene	1.0	75-27-4	Dichlorobromomethane	1.0
1897-45-6	Chlorothalonil (1,3-Benzenedicarbonitrile, 2,4,5,6-tetrachloro-}	1.0	75-71-8	Dichlorodifluoromethane (CFC-12)	1.0
			107-06-2	1,2-Dichloroethane (Ethylene dichloride)	0.1
7440-47-3	Chromium	0.1	540-59-0	1,2-Dichloroethylene	1.0
7440-48-4	Cobalt	1.0	75-09-2	Dichloromethane (Methylene chloride)	0.1
7440-50-8	Copper	1.0	120-83-2	2,4-Dichlorophenol	1.0
8001-58-9	Creosote	0.1	78-87-5	1,2-Dichloropropane	1.0
120-71-8	p-Cresidine	0.1	78-88-6	2,3-Dichloropropene	1.0
1319-77-3	Cresol (mixed isomers)	1.0	542-75-6	1,3-Dichloropropylene	0.1
108-39-4	m-Cresol	1.0	76-14-2	Dichlorotetrafluoroethane (CFC-114)	1.0
95-48-7	o-Cresol	1.0	62-73-7	Dichlorvos	1.0
106-44-5	p-Cresol	1.0		{Phosphoric acid, 2,2-dichloroethenyl dimethyl ester}	
98-82-8	Cumene	1.0	115-32-2	Dicofol (Benzenemethanol, 4-chloro- α -(4-chlorophenyl)- α -(trichloromethyl)-}	1.0
80-15-9	Cumene hydroperoxide	1.0			
135-20-6	Cupferron {Benzeneamine, N-hydroxy-N-nitroso, ammonium salt}	0.1	1464-53-5	Diepoxybutane	0.1
110-82-7	Cyclohexane	1.0	111-42-2	Diethanolamine	1.0
94-75-7	2,4-D {Acetic acid, (2,4-dichlorophenoxy)-}	1.0	177-81-7	Di-(2-ethylhexyl) phthalate (DEHP)	0.1
1163-19-5	Decabromodiphenyl oxide	1.0	84-66-2	Diethyl phthalate	1.0
2303-16-4	Diallate {Carbamothioic acid, bis(1-methylethyl)-, S-(2,3-dichloro-2-propenyl) ester}	1.0	64-67-5	Diethyl sulfate	0.1
			119-90-4	3,3'-Dimethoxybenzidine	0.1
			60-11-7	4-Dimethylaminoazobenzene	0.1

*C.I. means "Color Index"

Table II II-3

CAS Number	Toxic Chemical Name	De Minimis		CAS Number	Toxic Chemical Name	De Minimis	
		Concentration				Concentration	
119-93-7	3,3'-Dimethylbenzidine {o-Tolidine}	0.1		7647-01-0	Hydrochloric acid	1.0	
79-44-7	Dimethylcarbaryl chloride	0.1		74-90-8	Hydrogen cyanide	1.0	
57-14-7	1,1-Dimethyl hydrazine	0.1		7664-39-3	Hydrogen fluoride	1.0	
105-67-9	2,4-Dimethylphenol	1.0		123-31-9	Hydroquinone	1.0	
131-11-3	Dimethyl phthalate	1.0		78-84-2	Isobutyraldehyde	1.0	
77-78-1	Dimethyl sulfate	0.1		67-63-0	Isopropyl alcohol	0.1	
99-65-0	m-Dinitrobenzene	1.0			(manufacturing-strong acid process, no supplier notification)		
528-29-0	o-Dinitrobenzene	1.0		80-05-7	4,4'-Isopropylidenediphenol	1.0	
100-25-4	p-Dinitrobenzene	1.0		120-58-1	Isosafrole	1.0	
534-52-1	4,6-Dinitro-o-cresol	1.0		7439-92-1	Lead	0.1	
51-28-5	2,4-Dinitrophenol	1.0		58-89-9	Lindane	0.1	
121-14-2	2,4-Dinitrotoluene	1.0			[Cyclohexane,1,2,3,4,5,6- hexachloro-(1.alpha.,2.alpha., 3.beta.,4.alpha.,5.alpha.,6.beta.)-]		
606-20-2	2,6-Dinitrotoluene	1.0		108-31-6	Maleic anhydride	1.0	
25321-14-6	Dinitrotoluene (mixed isomers)	1.0		12427-38-2	Maneb	1.0	
117-84-0	n-Dioctyl phthalate	1.0			[Carbamodithioic acid, 1,2- ethanediylbis-, manganese complex]		
123-91-1	1,4-Dioxane	0.1		7439-96-5	Manganese	1.0	
122-66-7	1,2-Diphenylhydrazine (Hydrazobenzene)	0.1		7439-97-6	Mercury	1.0	
106-89-8	Epichlorohydrin	0.1		67-56-1	Methanol	1.0	
110-80-5	2-Ethoxyethanol	1.0		72-43-5	Methoxychlor	1.0	
140-88-5	Ethyl acrylate	0.1			[Benzene, 1,1'-(2,2,2- trichloroethylidene)bis {4-methoxy-}]		
100-41-4	Ethylbenzene	1.0		109-86-4	2-Methoxyethanol	1.0	
541-41-3	Ethyl chloroformate	1.0		96-33-3	Methyl acrylate	1.0	
74-85-1	Ethylene	1.0		1634-04-4	Methyl tert-butyl ether	1.0	
107-21-1	Ethylene glycol	1.0		101-14-4	4,4'-Methylenebis (2- chloroaniline)	0.1	
151-56-4	Ethyleneimine {Aziridine}	0.1			{MBOCA}		
75-21-8	Ethylene oxide	0.1		101-61-1	4,4'-Methylenebis (N,N-dimethyl)	0.1	
96-45-7	Ethylene thiourea	0.1			benzenamine		
2164-17-2	Fluometuron {Urea, N,N-dimethyl-N'- [3-(trifluoromethyl)phenyl]-}	1.0		101-68-8	Methylenebis (phenylisocyanate) [MBI]	1.0	
50-00-0	Formaldehyde	0.1		74-95-3	Methylene bromide	1.0	
76-13-1	Freon 113 {Ethane, 1,1,2-trichloro-1,2,2- trifluoro-}	1.0		101-77-9	4,4'-Methylenedianiline	0.1	
76-44-8	Heptachlor {1,4,5,6,7,8,8-Heptachloro- 3a,4,7,7a-tetrahydro- 4,7-methano-1H-indene}	1.0		78-93-3	Methyl ethyl ketone	1.0	
118-74-1	Hexachlorobenzene	0.1		60-34-4	Methyl hydrazine	1.0	
87-68-3	Hexachloro-1,3-butadiene	1.0		74-88-4	Methyl iodide	0.1	
77-47-4	Hexachlorocyclopentadiene	1.0		108-10-1	Methyl isobutyl ketone	1.0	
67-72-1	Hexachloroethane	1.0		624-83-9	Methyl isocyanate	1.0	
1335-87-1	Hexachloronaphthalene	1.0		80-62-6	Methyl methacrylate	1.0	
680-31-9	Hexamethylphosphoramide	0.1		90-94-8	Michler's ketone	0.1	
302-01-2	Hydrazine	0.1		1313-27-5	Molybdenum trioxide	1.0	
10034-93-2	Hydrazine sulfate	0.1		76-15-3	(Mono)chloropentafluoroethane	1.0	
					{CFC-115}		

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*C.I. means "Color Index"

De Minimis			De Minimis		
CAS Number	Toxic Chemical Name	Concentration	CAS Number	Toxic Chemical Name	Concentration
505-60-2	Mustard gas {Ethane, 1,1'-thiobis[2-chloro-]}	0.1	1336-36-3	Polychlorinated biphenyls {PCBs}	0.1
91-20-3	Naphthalene	1.0	1120-71-4	Propane sultone	0.1
134-32-7	alpha-Naphthylamine	0.1	57-57-8	beta-Propiolactone	0.1
91-59-8	beta-Naphthylamine	0.1	123-38-6	Propionaldehyde	1.0
7440-02-0	Nickel	0.1	114-26-1	Propoxur {Phenol, 2-(1-methylethoxy)-, methylcarbamate}	1.0
7697-37-2	Nitric acid	1.0			
139-13-9	Nitrilotriacetic acid	0.1	115-07-1	Propylene {Propene}	1.0
99-59-2	5-Nitro-o-anisidine	0.1	75-55-8	Propyleneimine	0.1
98-95-3	Nitrobenzene	1.0	75-56-9	Propylene oxide	0.1
92-93-3	4-Nitrobiphenyl	0.1	110-86-1	Pyridine	1.0
1836-75-5	Nitrofen {Benzene, 2,4-dichloro-1- (4-nitrophenoxy)-}	0.1	91-22-5	Quinoline	1.0
51-75-2	Nitrogen mustard {2-Chloro-N-(2-chloroethyl)-N- methylethanamine}	0.1	106-51-4	Quinone	1.0
			82-68-8	Quintozone	1.0
55-63-0	Nitroglycerin	1.0	81-07-2	{Pentachloronitrobenzene}	
88-75-5	2-Nitrophenol	1.0		Saccharin (manufacturing, no supplier notification)	0.1
100-02-7	4-Nitrophenol	1.0		{1,2-Benzisothiazol-3(2H)-one, 1,1-dioxide}	
79-46-9	2-Nitropropane	0.1	94-59-7	Safrole	0.1
156-10-5	p-Nitrosodiphenylamine	0.1	7782-49-2	Selenium	1.0
121-69-7	N,N-Dimethylaniline	1.0	7440-22-4	Silver	1.0
924-16-3	N-Nitrosodi-n-butylamine	0.1	100-42-5	Styrene	0.1
55-18-5	N-Nitrosodiethylamine	0.1	96-09-3	Styrene oxide	0.1
62-75-9	N-Nitrosodimethylamine	0.1	7664-93-9	Sulfuric acid	1.0
86-30-6	N-Nitrosodiphenylamine	1.0	79-34-5	1,1,2,2-Tetrachloroethane	0.1
621-64-7	N-Nitrosodi-n-propylamine	0.1	127-18-4	Tetrachloroethylene {Perchloroethylene}	0.1
4549-40-0	N-Nitrosomethylvinylamine	0.1			
59-89-2	N-Nitrosomorpholine	0.1	961-11-5	Tetrachlorvinphos {Phosphoric acid, 2-chloro-1- (2,4,5-trichlorophenyl) ethenyl dimethyl ester}	1.0
759-73-9	N-Nitroso-N-ethylurea	0.1			
684-93-5	N-Nitroso-N-methylurea	0.1	7440-28-0	Thallium	1.0
16543-55-8	N-Nitrosomorpholine	0.1	62-55-5	Thioacetamide	0.1
100-75-4	N-Nitrosopiperidine	0.1	139-65-1	4,4'-Thiodianiline	0.1
2234-13-1	Octachloronaphthalene	1.0	62-56-6	Thiourea	0.1
20816-12-0	Osmium tetroxide	1.0	1314-20-1	Thorium dioxide	1.0
56-38-2	Parathion {Phosphorothioic acid, O, O- diethyl-O-(4-nitrophenyl) ester}	1.0	7550-45-0	Titanium tetrachloride	1.0
87-86-5	Pentachlorophenol {PCP}	1.0	108-88-3	Toluene	1.0
79-21-0	Peracetic acid	1.0	584-84-9	Toluene-2,4-diisocyanate	0.1
108-95-2	Phenol	1.0	91-08-7	Toluene-2,6-diisocyanate	0.1
106-50-3	p-Phenylenediamine	1.0	26471-62-5	Toluenediisocyanate (mixed isomers)	0.1
90-43-7	2-Phenylphenol	1.0			
75-44-5	Phosgene	1.0	95-53-4	o-Toluidine	0.1
7664-38-2	Phosphoric acid	1.0	636-21-5	o-Toluidine hydrochloride	0.1
7723-14-0	Phosphorus (yellow or white)	1.0	8001-35-2	Toxaphene	0.1
85-44-9	Phthalic anhydride	1.0			
88-89-1	Picric acid	1.0			

*C.I. means "Color Index"

Table II II-5

CAS Number	Toxic Chemical Name	De Minimis Concentration	CAS Number	Toxic Chemical Name	De Minimis Concentration
68-76-8	Triaziquone	0.1	126-72-7	Tris (2,3-dibromopropyl) phosphate	0.1
	[2,5-Cyclohexadiene-1,4-dione, 2,3,5-tris(1-aziridinyl)-]		51-79-6	Urethane (Ethyl carbamate)	0.1
52-68-6	Trichlorfon	1.0	7440-62-2	Vanadium (fume or dust)	1.0
	{Phosphonic acid, (2,2,2-trichloro-1-hydroxyethyl)-, dimethyl ester}		108-05-4	Vinyl acetate	1.0
120-82-1	1,2,4-Trichlorobenzene	1.0	593-60-2	Vinyl bromide	0.1
71-55-6	1,1,1-Trichloroethane	1.0	75-01-4	Vinyl chloride	0.1
	{Methyl chloroform}		75-35-4	Vinylidene chloride	1.0
79-00-5	1,1,2-Trichloroethane	1.0	1330-20-7	Xylene (mixed isomers)	1.0
79-01-6	Trichloroethylene	1.0	108-38-3	m-Xylene	1.0
75-69-4	Trichlorofluoromethane (CFC-11)	1.0	95-47-6	o-Xylene	1.0
95-95-4	2,4,5-Trichlorophenol	1.0	106-42-3	p-Xylene	1.0
88-06-2	2,4,6-Trichlorophenol	0.1	87-62-7	2,6-Xylidine	1.0
1582-09-8	Trifluralin	1.0	7440-66-6	Zinc (fume or dust)	1.0
	{Benzenamine, 2,6-dinitro-N,N-dipropyl-4-(trifluoromethyl)-1}		12122-67-7	Zineb	1.0
95-63-6	1,2,4-Trimethylbenzene	1.0		{Carbamodithioic acid, 1,2-ethanediyldis-, zinc complex}	

b. List By CAS Number

			De Minimis	
CAS Number	Toxic Chemical Name	Concentration	CAS Number	Toxic Chemical Name Concentration
			67-64-1	Acetone 1.0
			67-66-3	Chloroform 0.1
50-00-0	Formaldehyde	0.1	67-72-1	Hexachloroethane 1.0
51-28-5	2,4-Dinitrophenol	1.0	68-76-8	Triaziquone 0.1
51-75-2	Nitrogen mustard	0.1		{2,5-Cyclohexadiene-1,4-dione, 2,3,5-tris(1-aziridinyl)-}
	{2-Chloro-N-(2-chloroethyl)-N-methylethanamine}		71-36-3	n-Butyl alcohol 1.0
51-79-6	Urethane	0.1	71-43-2	Benzene 0.1
	{Ethyl carbamate}		71-55-6	1,1,1-Trichloroethane 1.0
52-68-6	Trichlorfon	1.0		{Methyl chloroform}
	{Phosphonic acid, (2,2,2-trichloro-1-hydroxyethyl)-, dimethyl ester}		72-43-5	Methoxychlor 1.0
53-96-3	2-Acetylaminofluorene	0.1		{Benzene, 1,1'-(2,2,2-trichloroethylidene)bis [4-methoxy-]}
55-18-5	N-Nitrosodiethylamine	0.1	74-83-9	Bromomethane 1.0
55-21-0	Benzamide	1.0		{Methyl bromide}
55-63-0	Nitroglycerin	1.0	74-85-1	Ethylene 1.0
56-23-5	Carbon tetrachloride	0.1	74-87-3	Chloromethane 1.0
56-38-2	Parathion	1.0		{Methyl chloride}
	{Phosphorothioic acid, O,O-diethyl-O-(4-nitrophenyl)ester}		74-88-4	Methyl iodide 0.1
57-14-7	1,1-Dimethyl hydrazine	0.1	74-90-8	Hydrogen cyanide 1.0
57-57-8	beta-Propiolactone	0.1	74-95-3	Methylene bromide 1.0
57-74-9	Chlordane	1.0	75-00-3	Chloroethane 1.0
	{4,7-Methanoindan, 1,2,4,5,6,7, 8,8-octachloro-2,3,3a,4,7,7a-hexahydro-}		75-01-4	Vinyl chloride 0.1
			75-05-8	Acetonitrile 1.0
58-89-9	Lindane	0.1	75-07-0	Acetaldehyde 0.1
	{Cyclohexane, 1,2,3,4,5,6-hexachloro-, (1.alpha., 2.alpha., 3.beta., 4.alpha., 5.alpha., 6.beta.)-}		75-09-2	Dichloromethane 0.1
				{Methylene chloride}
59-89-2	N-Nitrosomorpholine	0.1	75-15-0	Carbon disulfide 1.0
60-09-3	4-Aminoazobenzene	0.1	75-21-8	Ethylene oxide 0.1
60-11-7	4-Dimethylaminoazobenzene	0.1	75-25-2	Bromoform 1.0
60-34-4	Methyl hydrazine	1.0		{Tribromomethane}
60-35-5	Acetamide	0.1	75-27-4	Dichlorobromomethane 1.0
62-53-3	Aniline	1.0	75-35-4	Vinylidene chloride 1.0
62-55-5	Thioacetamide	0.1	75-44-5	Phosgene 1.0
62-56-6	Thiourea	0.1	75-55-8	Propyleneimine 0.1
62-73-7	Dichlorvos	1.0	75-56-9	Propylene oxide 0.1
	{Phosphoric acid, 2,2-dichloroethenyl dimethyl ester}		75-63-8	Bromotrifluoromethane 1.0
62-75-9	N-Nitrosodimethylamine	0.1	75-65-0	{Halon 1301}
63-25-2	Carbaryl	1.0	75-69-4	tert-Butyl alcohol 1.0
	{1-Naphthalenol, methylcarbamate}			Trichlorofluoromethane 1.0
64-67-5	Diethyl sulfate	0.1	75-71-8	{CFC-11}
67-56-1	Methanol	1.0		Dichlorodifluoromethane 1.0
67-63-0	Isopropyl alcohol	0.1	76-14-2	{CFC-12}
	{manufacturing-strong acid process, no supplier notification}			Dichlorotetrafluoroethane 1.0
			76-15-3	{CFC-114}
				Monochloropentafluoroethane 1.0
				{CFC-115}

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Table II II-7

De Minimis			De Minimis		
CAS Number	Toxic Chemical Name	Concentration	CAS Number	Toxic Chemical Name	Concentration
76-44-8	Heptachlor (1,4,5,6,7,8,8-Heptachloro- 3a,4,7,7a-tetrahydro- 4,7-methano-1H-indene)	1.0	91-08-7	Toluene-2,6- Diisocyanate	0.1
77-13-1	Freon 113 (Ethane, 1,1,2-trichloro-1,2,2- trifluoro-)	1.0	91-20-3	Naphthalene	1.0
77-47-4	Hexachlorocyclopentadiene	1.0	91-22-5	Quinoline	1.0
77-78-1	Dimethyl sulfate	0.1	91-59-8	beta-Naphthylamine	0.1
78-84-2	Isobutyraldehyde	1.0	91-94-1	3,3'-Dichlorobenzidine	0.1
78-87-5	1,2-Dichloropropane	1.0	92-52-4	Biphenyl	1.0
78-88-6	2,3-Dichloropropene	1.0	92-67-1	4-Aminobiphenyl	0.1
78-92-2	sec-Butyl alcohol	1.0	92-87-5	Benzidine	0.1
78-93-3	Methyl ethyl ketone	1.0	92-93-3	4-Nitrobiphenyl	0.1
79-00-5	1,1,2-Trichloroethane	1.0	94-36-0	Benzoyl Peroxide	1.0
79-01-6	Trichloroethylene	1.0	94-59-7	Safrole	0.1
79-06-1	Acrylamide	0.1	94-75-7	2,4-D {Acetic acid, (2,4 dichlorophenoxy)-}	1.0
79-10-7	Acrylic acid	1.0	95-47-6	o-Xylene	1.0
79-11-8	Chloroacetic acid	1.0	95-48-7	o-Cresol	1.0
79-21-0	Peracetic acid	1.0	95-50-1	1,2 Dichlorobenzene	1.0
79-34-5	1,1,2,2-Tetrachloroethane	0.1	95-53-4	o-Toluidine	0.1
79-44-7	Dimethylcarbaryl chloride	0.1	95-63-6	1,2,4 Trimethylbenzene	1.0
79-46-9	2-Nitropropane	0.1	95-80-7	2,4-Diaminotoluene	0.1
80-05-7	4,4'-Isopropylidenediphenol	1.0	95-95-4	2,4,5-Trichlorophenol	1.0
80-15-9	Cumene hydroperoxide	1.0	96-09-3	Styrene oxide	0.1
80-62-6	Methyl methacrylate	1.0	96-12-8	1,2-Dibromo-3-chloropropane (DBCP)	0.1
81-07-2	Saccharin (manufacturing, no supplier notification) (1,2-Benzisothiazol-3(2H)-one, 1,1-dioxide)	0.1	96-33-3	Methyl acrylate	1.0
81-88-9	C.I. Food Red 15*	0.1	96-45-7	Ethylene thiourea	0.1
82-28-0	1-Amino-2-methyl- anthraquinone	0.1	97-56-3	C.I. Solvent Yellow 3*	0.1
82-68-8	Quintozene (Pentachloronitrobenzene)	1.0	98-07-7	Benzoic trichloride (Benzotrichloride)	0.1
84-66-2	Diethyl phthalate	1.0	98-82-8	Cumene	1.0
84-74-2	Dibutyl phthalate	1.0	98-87-3	Benzal chloride	1.0
85-44-9	Phthalic anhydride	1.0	98-88-4	Benzoyl chloride	1.0
85-68-7	Butyl benzyl phthalate	1.0	98-95-3	Nitrobenzene	1.0
86-30-6	N-Nitrosodiphenylamine	1.0	99-59-2	5-Nitro-o-anisidine	0.1
87-62-7	2,6-Xylidine	1.0	99-65-0	m-Dinitrobenzene	1.0
87-68-3	Hexachloro-1,3-butadiene	1.0	100-02-7	4-Nitrophenol	1.0
87-86-5	Pentachlorophenol (PCP)	1.0	100-25-4	p-Dinitrobenzene	1.0
88-06-2	2,4,6-Trichlorophenol	0.1	100-41-4	Ethylbenzene	1.0
88-75-5	2-Nitrophenol	1.0	100-42-5	Styrene	0.1
88-89-1	Picric acid	1.0	100-44-7	Benzyl chloride	1.0
90-04-0	o-Anisidine	0.1	100-75-4	N-Nitrosopiperidine	0.1
90-43-7	2-Phenylphenol	1.0	101-14-4	4,4'-Methylenebis (2- chloroaniline) (MBOCA)	0.1
90-94-8	Michler's Ketone	0.1	101-61-1	4,4'-Methylenebis(N,N- dimethyl) benzenamine	0.1
			101-68-8	Methylenebis (phenylisocyanate) (MBI)	1.0
			101-77-9	4,4'-Methylenedianiline	0.1

II-8 Table II

*C.I. means "Color Index"

De Minimis			De Minimis		
CAS Number	Toxic Chemical Name	Concentration	CAS Number	Toxic Chemical Name	Concentration
101-80-4	4,4'-Diaminodiphenyl ether	0.1	117-84-0	n-Dioctyl phthalate	1.0
103-23-1	Bis(2-ethylhexyl) adipate	1.0	118-74-1	Hexachlorobenzene	0.1
104-94-9	p-Anisidine	1.0	119-90-4	3,3'-Dimethoxybenzidine	0.1
105-67-9	2,4-Dimethylphenol	1.0	119-93-7	3,3'-Dimethylbenzidine	0.1
106-42-3	p-Xylene	1.0		{o-Tolidine}	
106-44-5	p-Cresol	1.0	120-12-7	Anthracene	1.0
106-46-7	1,4-Dichlorobenzene	0.1	120-58-1	Isosafrole	1.0
106-50-3	p-Phenylenediamine	1.0	120-71-8	p-Cresidine	0.1
106-51-4	Quinone	1.0	120-80-9	Catechol	1.0
106-88-7	1,2-Butylene oxide	1.0	120-82-1	1,2,4-Trichlorobenzene	1.0
106-89-8	Epichlorohydrin	0.1	120-83-2	2,4-Dichlorophenol	1.0
106-93-4	1,2-Dibromoethane	0.1	121-14-2	2,4-Dinitrotoluene	1.0
	{Ethylene dibromide}		121-69-7	N,N-Dimethylaniline	1.0
106-99-0	1,3-Butadiene	0.1	122-66-7	1,2-Diphenylhydrazine	0.1
107-02-8	Acrolein	1.0		{Hydrazobenzene}	
107-05-1	Allyl chloride	1.0	123-31-9	Hydroquinone	1.0
107-06-2	1,2-Dichloroethane	0.1	123-38-6	Propionaldehyde	1.0
	{Ethylene dichloride}		123-72-8	Butyraldehyde	1.0
107-13-1	Acrylonitrile	0.1	123-91-1	1,4-Dioxane	0.1
107-18-6	Allyl alcohol	1.0	124-73-2	Dibromotetrafluoroethane	1.0
107-21-1	Ethylene glycol	1.0		{Halon 2402}	
107-30-2	Chloromethyl methyl ether	0.1	126-72-7	Tris(2,3-dibromopropyl)	0.1
108-05-4	Vinyl acetate	1.0		phosphate	
108-10-1	Methyl isobutyl ketone	1.0	126-99-8	Chloroprene	1.0
108-31-6	Maleic anhydride	1.0	127-18-4	Tetrachloroethylene	0.1
108-38-3	m-Xylene	1.0		{Perchloroethylene}	
108-39-4	m-Cresol	1.0	128-66-5	C.I. Vat Yellow 4*	1.0
108-60-1	Bis(2-chloro-1-methylethyl)	1.0	131-11-3	Dimethyl phthalate	1.0
	ether		132-64-9	Dibenzofuran	1.0
108-88-3	Toluene	1.0	133-06-2	Captan	1.0
108-90-7	Chlorobenzene	1.0		{1H-Isoindole-1,3(2H)-dione,	
108-95-2	Phenol	1.0		3a,4,7,7a-tetrahydro-	
109-86-4	2-Methoxyethanol	1.0		2-[(trichloromethyl)thio]-}	
110-80-5	2-Ethoxyethanol	1.0	133-90-4	Chloramben	1.0
110-82-7	Cyclohexane	1.0		{Benzoic acid, 3-amino-	
110-86-1	Pyridine	1.0		2,5-dichloro-}	
111-42-2	Diethanolamine	1.0	134-29-2	o-Anisidine hydrochloride	0.1
111-44-4	Bis(2-chloroethyl) ether	1.0	134-32-7	alpha-Naphthylamine	0.1
114-26-1	Propoxur	1.0	135-20-6	Cupferron	0.1
	{Phenol, 2-(1-methylethoxy)-,			{Benzeneamine, N-hydroxy-	
	methylcarbamate}			N-nitroso, ammonium salt}	
115-07-1	Propylene (Propene)	1.0	139-13-9	Nitrilotriacetic acid	0.1
115-32-2	Dicofol	1.0	139-65-1	4,4'-Thiodianiline	0.1
	{Benzenemethanol, 4-chloro-		140-88-5	Ethyl acrylate	0.1
	alpha-(4-chlorophenyl)-		141-32-2	Butyl acrylate	1.0
	alpha-(trichloromethyl)-}		151-56-4	Ethyleneimine (Aziridine)	0.1
117-79-3	2-Aminoanthraquinone	0.1	156-10-5	p-Nitrosodiphenylamine	0.1
117-81-7	Di(2-ethylhexyl) phthalate	0.1	156-62-7	Calcium cyanamide	1.0
	{DEHP}		302-01-2	Hydrazine	0.1

*C.I. means "Color Index"

Table II II-9

CAS Number	Toxic Chemical Name	De Minimis Concentration	CAS Number	Toxic Chemical Name	De Minimis Concentration
309-00-2	Aldrin	1.0	1332-21-4	Asbestos (friable)	0.1
	{1,4:5,8-Dimethanonaphthalene,		1335-87-1	Hexachloronaphthalene	1.0
	1,2,3,4,10,10-hexachloro-1,4,4a,		1336-36-3	Polychlorinated biphenyls	0.1
	5,8,8a-hexahydro-(1.alpha.,			{PCBs}	
	4.alpha.,4a.beta.,5.alpha.,		1344-28-1	Aluminum oxide	0.1
	8.alpha.,8a.beta.)-}			(fibrous forms)	
334-88-3	Diazomethane	1.0	1464-53-5	Diepoxybutane	0.1
353-59-3	Bromochlorodifluoromethane	1.0	1582-09-8	Trifluralin	1.0
	{Halon 1211}			{Benzenamine, 2,6-dinitro-N,N-	
463-58-1	Carbonyl sulfide	1.0		dipropyl-4-(trifluoromethyl)-}	
492-80-8	C.I. Solvent Yellow 34*	0.1	1634-04-4	Methyl tert-butyl ether	1.0
	{Aurimine}		1836-75-5	Nitrofen	0.1
505-60-2	Mustard gas	0.1		{Benzene, 2,4-dichloro-1-	
	{Ethane,1,1'-thiobis[2-chloro-}			(4-nitrophenoxy)-}	
510-15-6	Chlorobenzilate	1.0	1897-45-6	Chlorothalonil	1.0
	{Benzeneacetic acid,4-chloro-			{1,3-Benzenedicarbonitrile,	
	.alpha.-(4-chlorophenyl)-			2,4,5,6-tetrachloro-}	
	.alpha.-hydroxy-ethyl ester}		1937-37-7	C.I. Direct Black 38*	0.1
528-29-0	o-Dinitrobenzene	1.0	2164-17-2	Fluometuron	1.0
532-27-4	2-Chloroacetophenone	1.0		{Urea, N,N-dimethyl-N'-	
534-52-1	4,6-Dinitro-o-cresol	1.0		[3-(trifluoromethyl)phenyl]-}	
540-59-0	1,2-Dichloroethylene	1.0	2234-13-1	Octachloronaphthalene	1.0
541-41-3	Ethyl chloroformate	1.0	2303-16-4	Diallate	1.0
541-73-1	1,3-Dichlorobenzene	1.0		{Carbamothioic acid,	
542-75-6	1,3-Dichloropropylene	0.1		bis (1-methylethyl)-, S-(2,3-	
542-88-1	Bis(chloromethyl) ether	0.1		dichloro-2-propenyl) ester}	
569-64-2	C.I. Basic Green 4*	1.0	2602-46-2	C.I. Direct Blue 6*	0.1
584-84-9	Toluene-2,4-diisocyanate	0.1	2832-40-8	C.I. Disperse Yellow 3*	1.0
593-60-2	Vinyl bromide	0.1	3118-97-6	C.I. Solvent Orange 7*	1.0
606-20-2	2,6-Dinitrotoluene	1.0	3761-53-3	C.I. Food Red 5*	0.1
615-05-4	2,4-Diaminoanisole	0.1	4549-40-0	N-Nitrosomethylvinylamine	0.1
621-64-7	N-Nitrosodi-n-propylamine	0.1	4680-78-8	C.I. Acid Green 3*	1.0
624-83-9	Methyl isocyanate	1.0	6484-52-2	Ammonium nitrate (solution)	1.0
636-21-5	o-Toluidine hydrochloride	0.1	7429-90-5	Aluminum (fume or dust)	1.0
680-31-9	Hexamethylphosphoramide	0.1	7439-92-1	Lead	0.1
684-93-5	N-Nitroso-N-methylurea	0.1	7439-96-5	Manganese	1.0
759-73-9	N-Nitroso-N-ethylurea	0.1	7439-97-6	Mercury	1.0
842-07-9	C.I. Solvent Yellow 14*	0.1	7440-02-0	Nickel	0.1
924-16-3	N-Nitrosodi-n-butylamine	0.1	7440-22-4	Silver	1.0
961-11-5	Tetrachlorvinphos	1.0	7440-28-0	Thallium	1.0
	{Phosphoric acid, 2-chloro-1-		7440-36-0	Antimony	1.0
	(2,4,5-trichlorophenyl)ethenyl		7440-38-2	Arsenic	0.1
	dimethyl ester}		7440-39-3	Barium	1.0
989-38-8	C.I. Basic Red 1*	0.1	7440-41-7	Beryllium	0.1
1120-71-4	Propane sultone	0.1	7440-43-9	Cadmium	0.1
1163-19-5	Decabromodiphenyl oxide	1.0	7440-47-3	Chromium	0.1
1313-27-5	Molybdenum trioxide	1.0	7440-48-4	Cobalt	1.0
1314-20-1	Thorium dioxide	1.0	7440-50-8	Copper	1.0
1319-77-3	Cresol (mixed isomers)	1.0	7440-62-2	Vanadium (fume or dust)	1.0
1330-20-7	Xylene (mixed isomers)	1.0	7440-66-6	Zinc (fume or dust)	1.0

CAS Number	Toxic Chemical Name	De Minimis Concentration
7550-45-0	Titanium tetrachloride	1.0
7647-01-0	Hydrochloric acid	1.0
7664-38-2	Phosphoric acid	1.0
7664-39-3	Hydrogen fluoride	1.0
7664-41-7	Ammonia	1.0
7664-93-9	Sulfuric acid	1.0
7697-37-2	Nitric acid	1.0
7723-14-0	Phosphorus (yellow or white)	1.0
7782-49-2	Selenium	1.0
7782-50-5	Chlorine	1.0
7783-20-2	Ammonium sulfate (solution)	1.0
8001-35-2	Toxaphene	0.1
8001-58-9	Creosote	0.1
10034-93-2	Hydrazine sulfate	0.1
10049-04-4	Chlorine dioxide	1.0
12122-67-7	Zineb	1.0
	(Carbamodithioic acid, 1,2-ethanedithiolbis-, zinc complex)	
12427-38-2	Maneb	1.0
	(Carbamodithioic acid, 1,2-ethanedithiolbis-, manganese complex)	
16071-86-6	C.I. Direct Brown 95*	0.1
16543-55-8	N-Nitrosomornicotine	0.1
20816-12-0	Osmium tetroxide	1.0
25321-14-6	Dinitrotoluene (mixed isomers)	1.0
25321-22-6	Dichlorobenzene (mixed isomers)	0.1
25376-45-8	Diaminotoluene (mixed isomers)	0.1
26471-62-5	Toluenediisocyanate (mixed isomers)	0.1
39156-41-7	2,4-Diaminoanisole sulfate	0.1

SECTION 313 TOXIC CHEMICAL CATEGORIES

Section 313 requires reporting on the toxic chemical categories listed below, in addition to the specific toxic chemicals listed above.

The metal compounds listed below, unless otherwise specified, are defined as including any unique chemical substance that contains the named metal (i.e., antimony, copper, etc.) as part of that chemical's structure.

Toxic chemical categories are subject to the 1 percent de minimis concentration unless the substance involved meets the definition of an OSHA carcinogen, which are subject to the 0.1 percent de minimis concentration. The de minimis concentration for each compound is provided in parenthesis.

Antimony Compounds - (Category Code N010) -
Includes any unique chemical substance that contains antimony as part of that chemical's infrastructure. (1.0)

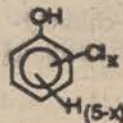
Arsenic Compounds - (Category Code N020) -
Includes any unique chemical substance that contains arsenic as part of that chemical's infrastructure. (Inorganic compounds: 0.1; organic compounds: 1.0)

Barium Compounds - (Category Code N040) -
Includes any unique chemical substance that contains barium as part of that chemical's infrastructure. (1.0)

Beryllium Compounds - (Category Code N050) -
Includes any unique chemical substance that contains beryllium as part of that chemical's infrastructure. (Inorganic compounds: 0.1; organic compounds: 1.0)

Cadmium Compounds - (Category Code N078) -
Includes any unique chemical substance that contains cadmium as part of that chemical's infrastructure. (Inorganic compounds: 0.1; organic compounds: 1.0)

Chlorophenols - (Category Code N084) - (0.1)



where x = 1 to 5

*C.I. means "Color Index"

Chromium Compounds - (Category Code N090) - Includes any unique chemical substance that contains chromium as part of that chemical's infrastructure. (chromium VI compounds: 0.1; chromium III compounds: 1.0)

Cobalt Compounds - (Category Code N096) - Includes any unique chemical substance that contains cobalt as part of that chemical's infrastructure. (1.0)

Copper Compounds - (Category Code N100) - Includes any unique chemical substance that contains copper as part of that chemical's infrastructure. (1.0)

This category does not include:

Chemical	CAS Number
C.I. Pigment Blue 15	147-14-8
C.I. Pigment Green 7	1328-53-6
C.I. Pigment Green 36	14302-13-7

Cyanide Compounds - (Category Code N106) - X^+CN^- where $X = H^+$ or any other group where a formal dissociation may occur. For example, KCN or $Ca(CN)_2$. (1.0)

Glycol Ethers - (Category Code N230) - Includes mono- and di-ethers of ethylene glycol, diethylene glycol, and triethylene glycol. (1.0)

$R-(OCH_2CH_2)_n-OR'$
Where $n = 1, 2, \text{ or } 3$

$R =$ alkyl or aryl groups

$R' = R, H,$ or groups which, when removed, yield glycol ethers with the structure:

$R-(OCH_2CH_2)_n-OH$

Polymers are excluded from this category.

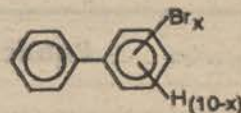
Lead Compounds - (Category Code N420) - Includes any unique chemical substance that contains lead as part of that chemical's infrastructure. (Inorganic compounds: 0.1; organic compounds: 1.0)

Manganese Compounds - (Category Code N450) - Includes any unique chemical substance that contains manganese as part of that chemical's infrastructure. (1.0)

Mercury Compounds - (Category Code N458) - Includes any unique chemical substance that contains mercury as part of that chemical's infrastructure. (1.0)

Nickel Compounds - (Category Code N495) - Includes any unique chemical substance that contains nickel as part of that chemical's infrastructure. (0.1)

Polybrominated Biphenyls (PBBs) - (Category Code N575) - (0.1)



where $x = 1$ to 10

Selenium Compounds - (Category Code N725) - Includes any unique chemical substance that contains selenium as part of that chemical's infrastructure. (1.0)

Silver Compounds - (Category Code N740) - Includes any unique chemical substance that contains silver as part of that chemical's infrastructure. (1.0)

Thallium Compounds - (Category Code N760) - Includes any unique chemical substance that contains thallium as part of that chemical's infrastructure. (1.0)

Zinc Compounds - (Category Code N982) - Includes any unique chemical substance that contains zinc as part of that chemical's infrastructure. (1.0)

APPENDIX A. BLANK TOXIC CHEMICAL RELEASE INVENTORY REPORTING FORM R

Public Reporting Burden

Public reporting burden for this collection of information is estimated to average 43 hours per response, including time for reviewing instructions, searching existing data sources, gathering and maintaining the data needed, and completing and reviewing the collection of information. Send comments regarding this burden estimate or any other aspect of this collection of information, including suggestions for reducing this burden, to Chief, Information Policy Branch (PM-223), U.S. EPA, 401 M Street, SW, Washington, D.C. 20460, Attention: TRI Burden, and to the Office of Information and Regulatory Affairs, Office of Management and Budget Paperwork Reduction Project (2070-0093), Washington, D.C. 20603.

(IMPORTANT: Type or print; read instructions before completing form)

Form Approved OMB Number: 2070-0093

Approval Expires: 11/92

Page 1 of 9



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

**IMPORTANT: See instructions to determine when "Not
Applicable (NA)" boxes should be checked.**

For EPA use only

PART I. FACILITY IDENTIFICATION INFORMATION

SECTION 1.

REPORTING YEAR

19 ____

SECTION 2. TRADE SECRET INFORMATION

Are you claiming the toxic chemical identified on page 3 trade secret?

2.1

☐ 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

Facility or Establishment Name

TRI Facility ID Number

Street Address

City

County

4.1

State

Zip Code

Mailing Address (if different from street address)

City

State

Zip Code

PUT LABEL HERE



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.	
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)



EPA FORM R

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	<u>If produce or import:</u> 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.					



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**PART II. CHEMICAL-SPECIFIC
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**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	City
County	County
State	State
Zip Code	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.)



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PART II. CHEMICAL-SPECIFIC
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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.)



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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	7A.1c	7A.1d	7A.1e
	1 2			
	3 4 5			Yes No
	6 7 8		%	☐ ☐
7A.2a	7A.2b	7A.2c	7A.2d	7A.2e
	1 2			
	3 4 5			Yes No
	6 7 8		%	☐ ☐
7A.3a	7A.3b	7A.3c	7A.3d	7A.3e
	1 2			
	3 4 5			Yes No
	6 7 8		%	☐ ☐
7A.4a	7A.4b	7A.4c	7A.4d	7A.4e
	1 2			
	3 4 5			Yes No
	6 7 8		%	☐ ☐
7A.5a	7A.5b	7A.5c	7A.5d	7A.5e
	1 2			
	3 4 5			Yes No
	6 7 8		%	☐ ☐

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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EPA FORM R**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(b) 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.

Dated: May 22, 1992.

Linda J. Fisher,

*Assistant Administrator for Prevention,
Pesticides and Toxic Substances.*

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